GREEN VOLT

Chapter 12

Offshore and Intertidal Ornithology

Offshore EIA Report: Volume 1

Revision history

Revision	Date	Description	Prepared	Checked	Approved
1	26/08/2022	First draft	RC (APEM Ltd)	SS (APEM Ltd)	VC (Flotation Energy)
2	05/09/2022	Second draft	RC (APEM Ltd)	SS (APEM Ltd)	VC (Flotation Energy)
3	21/10/2022	Third draft	RC (APEM Ltd)	SS (APEM Ltd)	VC (Flotation Energy)
4	23/12/2022	Fourth draft	RC (APEM Ltd)	SS (APEM Ltd)	VC (Flotation Energy)
5	18/01/2023	Final for submission	RC (APEM Ltd)	SS (APEM Ltd) HF (Royal HaskoningDHV)	VC (Flotation Energy)

Table of Contents

Table of Tables

Table of Figures

Appendices (Volume 2)

Appendix 12.1: Offshore and intertidal ornithology baseline technical report;

Appendix 12.2: Offshore ornithology displacement analysis;

Appendix 12.3: Offshore ornithology collision risk modelling;

Appendix 12.4: Comparative analysis of the design-based method and MRSea modelling using Green Volt survey data

Appendix 12.5: Colony counts and derived breeding populations used in assessments;

Appendix 12.6: Offshore ornithology population viability analysisand;

Appendix 12.7: Method Review Paper – Applicability of SeabORD for Green Volt

Acronyms

Acronym	Description
AON	Apparently Occupied Nest
BDMPS	Biologically Defined Minimum Population Scales
BO1 / 2 / 3	Band Option 1 / 2 / 3
BoCC5	Birds of Conservation Concern 5
BTO	The British Trust for Ornithology
C	Construction
CEA	Cumulative Effects Assessment
CIA	Cumulative Impact Assessment
CIEEM	Chartered Institute of Ecology and Environmental Management
CRM	Collision Risk Model
D	Decommissioning
DCO	Development Consent Order
Disp.	Displacement
EC	European Commission
EEA	European Economic Area
EIA	Environmental Impact Assessment
ESPG	European Petroleum Survey Group
ETG	Expert Topic Group
EU	European Union
FAD	Fish Aggregation Device
FOWT	Floating Offshore Wind Turbine
HDD	Horizontal Directional Drilling
HRA	Habitats Regulations Appraisal
HVDC	High Voltage Direct Current
IA	Inter-array
JNCC	Joint Nature Conservation Committee
km	Kilometre/s
km^2	Kilometre/s squared
LAT	Lowest Astronomical Tide
m	Metre/s
worst case scenario	Maximum Design Scenario
MHWS	Mean High Water Springs
MLWS	Mean Low Water Springs
MPS	Marine Policy Statement
MRSea	Marine Renewables Strategic Environmental Assessment
MSL	Mean Seal Level
MS-LOT	Marine Scotland Licensing Operations Team
MSS	Marine Scotland Science
MW	Megawatt
N/A	Not Applicable
NMP	National Marine Plan
no.	Number
NPS	National Policy Statement
NS	NatureScot
NSIP	Nationally Significant Infrastructure Project
O&M	Operation and Maintenance
O/M	Operation and Maintenance
OCP	Offshore Converter Project

ODPM	Office of the Deputy Prime Minister
ORJIP	Offshore Renewables Joint Industry Programme
OSP	Offshore Substation Platform
OSPAR	Oslo/Paris Convention
OWF	Offshore Windfarm
PCH	Potential Collision Height
PEMP	Project Environmental Monitoring Programme
PVA	Population Viability Analysis
PINS	Planning Inspectorate
RSPB	The Royal Society for the Protection of Birds
SAC	Special Area of Conservation
sCRM	Stochastic Collision Risk Model
SD	Standard Deviation
SNCB	Statutory Nature Conservation Body
SNH	Scottish Natural Heritage
SOSS	Strategic Ornithological Support Services
Sp.	Species
SPA	Special Protection Area
Spp.	Species (plural)
SSSI	Site of Special Scientific Interest
TLP	Tension-leg Platform
UK	United Kingdom
UN	United Nations
VOR	Valued Ornithological Receptors
WeBS	Wetland Bird Survey
WTG	Wind Turbine Generator
ZoI	Zone of Influence

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Glossary

Term	Description
Applicant	Green Volt Offshore Windfarm Ltd.
Buzzard	Buzzard Platform Complex.
Buzzard Export Cable Corridor	The area in which the export cables will be laid, from the perimeter of the Windfarm Site to Buzzard Platform Complex.
Green Volt Offshore Windfarm	Offshore windfarm including associated onshore and offshore infrastructure development (Combined On and Offshore Green Volt Projects).
Horizontal Directional Drilling	Mechanism for installation of export cable at landfall.
Inter-array cables	Cables which link the wind turbines to each other and the offshore substation platform.
Landfall Export Cable Corridor	The area in which the export cables will be laid, from the perimeter of the Windfarm Site to landfall.
Mean High Water Springs	At its highest and 'Neaps' or 'Neap tides' when the tidal range is at its lowest. The height of Mean High Water Springs (MHWS) is the average throughout the year, of two successive high waters, during a 24-hour period in each month when the range of the tide is at its greatest (Spring tides).
Moorings	Mechanism by which wind turbine generators are fixed to the seabed.
NorthConnect Parallel Export Cable Corridor Option	Landfall Export Cable Corridor between NorthConnect Parallel Landfall and point of separation from St Fergus South Export Cable Corridor Option.
NorthConnect Parallel Landfall	Southern landfall option where the offshore export cables come ashore.
Offshore Development Area	Encompasses i) Windfarm Site, including offshore substation platform ii) Offshore Export Cable Corridor to Landfall, iii) Export Cable Corridor to Buzzard Platform Complex.
Offshore export cables	The cables which would bring electricity from the offshore substation platform to the Landfall or to the Buzzard Platform Complex.
Offshore Export Cable Corridor	The proposed offshore area in which the export cables will be laid, from offshore substation to landfall or to the Buzzard Platform Complex
Offshore infrastructure	All of the offshore infrastructure, including wind turbine generators, offshore substation platform and all inter-array and export cables.
Offshore substation platform	A fixed structure located within the Windfarm Site, containing electrical equipment to aggregate the power from the wind turbine generators and convert it into a more suitable form for export to shore.
Onshore Export Cable Corridor	The proposed onshore area in which the export cables will be laid, from landfall to the onshore substation.
Project	Green Volt Offshore Windfarm project as a whole, including associated

	onshore and offshore infrastructure development.
Safety zones	An area around a structure or vessel which must be avoided.
St Fergus South Export Cable Corridor Option	Landfall Export Cable Corridor between St Fergus South Landfall and point of separation from NorthConnect Parallel Export Cable Corridor Option.
St Fergus South Landfall	Northern landfall option where the offshore export cables come ashore.
Windfarm Site	The area within which the wind turbine generators, offshore substation platform and inter-array cables will be present.

CHAPTER 12: OFFSHORE AND INTERTIDAL ORNITHOLOGY

12.1 Introduction

1. This chapter of the **Offshore Environmental Impact Assessment (EIA) Report** presents the assessment of the potential impacts of the Project (in this instance the Project refers to the offshore elements of the Green Volt Offshore Windfarm only, up to Mean High Water Springs (MHWS)) on ornithology receptors from construction, operation and maintenance and decommissioning of the Project. Specifically, this chapter considers the potential impact of the Project within the Windfarm Site (plus a 4 km buffer), the Offshore Export Cable Corridors, and the landfall onshore/offshore interface for the Offshore Export Cables. These areas are shown in **Figure 12.1.**

2. This chapter describes:

   - The planning policy, legislation and other types of documentation that has informed this assessment (**Section 12.2**).
   - The outcome of engagement and consultation that has been handled to date, including how issues in relation to offshore ornithology within the Formal Consultation period between 10/02/2022 to 21/09/2022 have been addressed (**Section 12.3**).
   - The methods used when collecting baseline data (**Section 12.4**).
   - The baseline conditions (**Section 12.5**).
   - Embedded environmental measures relevant to offshore and intertidal ornithology and the relevant maximum design scenario (**Section 12.7**).
   - The assessment methods and reference parameters used for the **Offshore EIA Report** (**Sections 12.8-12.9**).
   - The assessment of offshore and intertidal ornithology effects (**Sections 12.10**-**12.12**).
   - Inter-related effects (**Section 12.15**)
   - The assessment of offshore and intertidal ornithology cumulative impacts (**Section 12.13**)
   - Consideration of transboundary effects (**Section 12.14**).
   - A summary of residual effects for offshore and intertidal ornithology (**Section 12.15**).

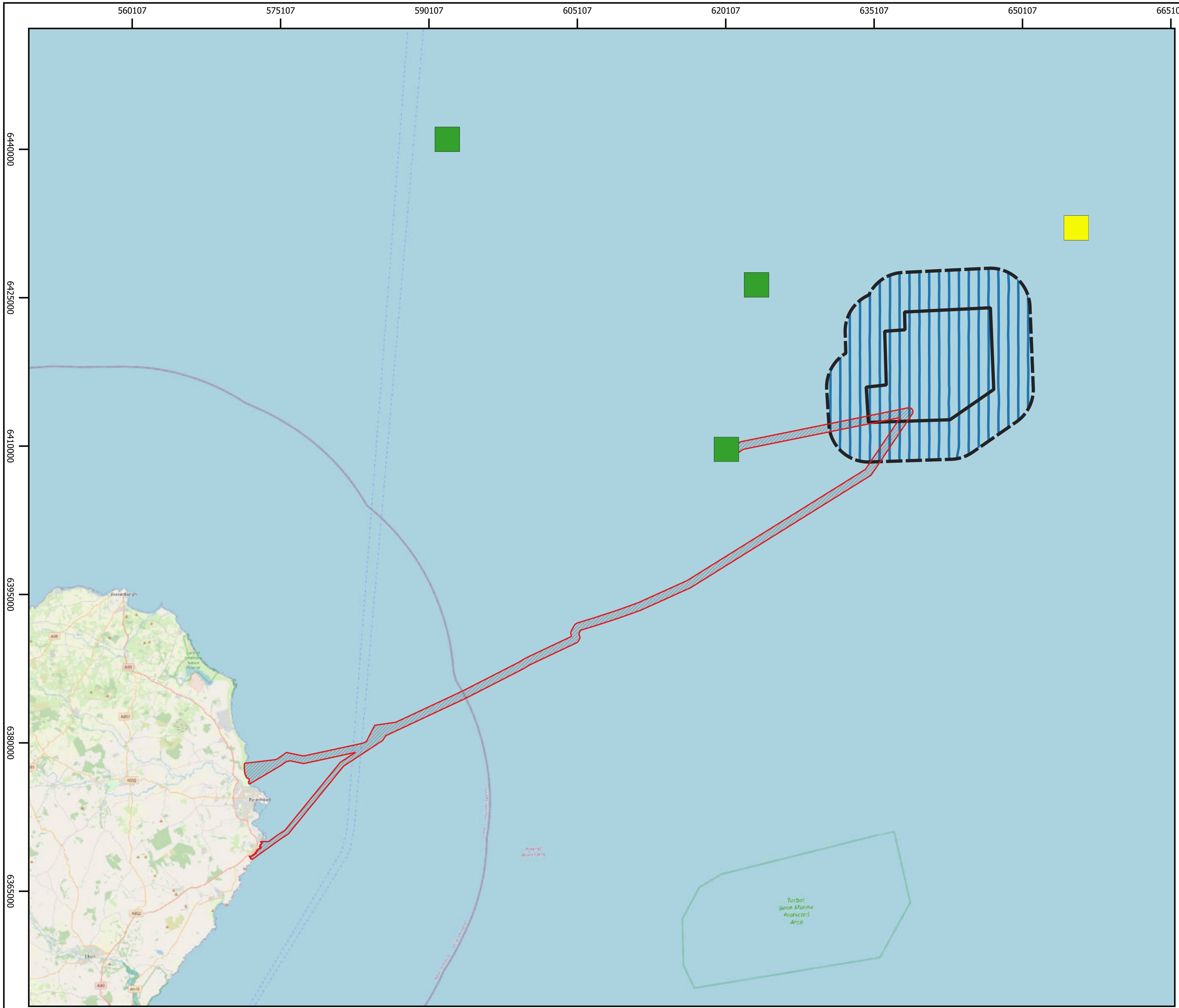
3. This chapter should be read in conjunction with the project description which can be found in **Chapter 5: Project Description**, and the relevant parts of the following chapters and appendices:

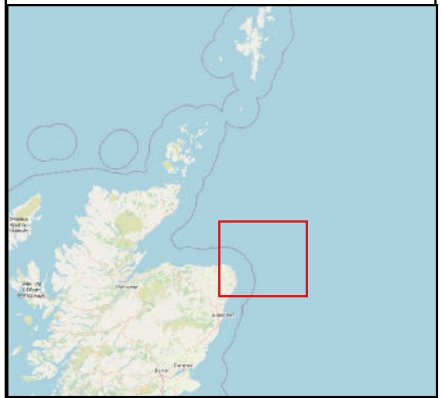
   - **Chapter 9: Benthic Ecology** (due to habitat intersections at MHWS).
   - **Chapter 10: Fish and Shellfish Ecology** (due to the potential indirect effects from potential changes in distribution and abundance of forage fish species).

4. This chapter is also supported by the following appendices:

   - **Appendix 12.1: Offshore and intertidal ornithology baseline technical report**;
   - **Appendix 12.2: Offshore ornithology displacement analysis**;
   - **Appendix 12.3: Offshore ornithology collision risk modelling**;

- **Appendix 12.4: Comparative analysis of the design-based method and MRSea modelling using Green Volt survey data** (appendix includes report of comparison between MRSea modelling and design-based methods for estimating guillemot abundances);
- **Appendix 12.5: Colony counts and derived breeding populations used in assessments and;**
- **Appendix 12.6: Offshore ornithology population viability analysis; and**
- **Appendix 12.7: Method Review Paper – Applicability of SeabORD for Green Volt** (appendix includes a review of the SeabORD model; its current capabilities and limitations in the context of applying it for assessment of Project data).





Legend

- Green Volt Windfarm Site
- Green Volt Windfarm Site plus 4 km buffer
- Transect Flight Path
- Export Cable Corridor
- Oil and Gas Platforms
- Decommissioned Oil and Gas Platforms
- Maritime Boundary

0 2 4 6 8 Kilometres

APEM	Client: Green Volt Seawind Ltd
Project: P00008351 Green Volt Ornithology EIAr	
Title: Figure 12.1 Green Volt Development Area	

Scale	Drawn	Auth	Date
1:250,000	AW	RC	16.01.23
Coordinates: EPSG:32630			

Map Reference: P8351_GreenVolt_Windfarm_Site_ArrayArea

12.2 Legislation, Guidance and Policy

12.2.1 Introduction

5. This section identifies the legislation, policy and other documentation that has informed the assessment of effects with respect to offshore and intertidal ornithology. Further information on policies relevant to the EIA and their status is provided in **Chapter 3: Policy and Legislative Context** of this **Offshore EIA Report**.

12.2.2 Legislation and national planning policy

6. There are a number of national (UK and Scottish) laws that need to be considered by the assessment, specifically those regarding the protection of wildlife and the marine environment.

7. **Table 12.1** lists the legislation relevant to the assessment of the effects on offshore ornithology receptors and the aims of national government policy and strategy documents, particularly Scotland's National Marine Plan (NMP) policy 'Renewables 5' (discussed further below).

Table 12.1 Legislation relevant to offshore ornithology

Legislation description	Relevance to assessment
Conservation (Natural Habitats, &c.) Regulations 1994 (as amended in Scotland) [Conservation of **Habitats and Species (Amendment) (EU Exit) Regulations 2019 in relation to certain specific activities]** *Part IV* The 2019 Habitats Regulations transfer functions from the European Commission to the appropriate authorities in Scotland, with all the processes or terms unchanged. The 2019 Habitats Regulations transpose aspects of the Birds Directive and the Habitats Directive into national law. Part IV of the 2019 Regulations implements Article 6(3) and 6(4) of the European Parliament Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (the 'Habitats Directive') in Scotland and within 12 nm (terrestrial and inshore habitats).	A competent authority – before deciding to undertake, or give any consent, permission or other authorisation for a plan or project which is likely to have a significant effect on a European site in Great Britain or a European offshore marine site (either alone or in combination with other plans or projects) and that is not directly connected with or necessary to the management of the site – shall make an appropriate assessment of the implications for the site in view of that site's conservation objectives. A person applying for any such consent, permission or other authorisation shall provide such information as the competent authority may reasonably require for the purposes of the assessment.
The **Conservation of Offshore Marine Habitats and Species Regulations 2017** *Part 2* Known as the 'Offshore Marine Regulations', they provide similar provisions to the 2017 Habitats Regulations in the offshore environment throughout the UK by implementing the species protection requirements of the Habitats and Birds Directives offshore. Part 2 of the 2017 Regulations implements Article 6(3) and 6(4) of the Habitats Directive beyond 12 nm (offshore habitats).	A competent authority before deciding to undertake, or give any consent, permission or other authorisation for a relevant plan or project must make an appropriate assessment of the implications for the site in view of that site's conservation objectives. A relevant plan or project plan is one which is likely to have a significant effect on a European offshore marine site or a European site (either alone or in combination with other plans or projects) and is not directly connected with or necessary to the management of the site. A person applying for any such consent, permission or other authorisation shall provide such information as the competent authority may reasonably require for the purposes of the assessment.
Wildlife and Countryside Act 1981 (as amended in Scotland) *Part 1* These Regulations ensure compliance with Council Directive on the Conservation of Wild Birds as amended by Commission Directive 91/244/EEC, Council Directive 94/24/EC and Commission Directive 97/49/EC. The 1981 Act applies to the Scottish terrestrial environment and inshore waters up to 12 nm. Part 1 of the 1981 Act details a large number of offences in relation to the killing and taking of wild birds, other animals and plants.	Implements Article 1 and 5 of the European Parliament Council Directive 2009/147/EC on the conservation of wild birds (the 'Birds Directive) making it an offence to intentionally or recklessly: Kill, injure or take any wild bird; Take, damage, destroy or otherwise interfere with the nest of any wild bird which that nest is in use or being built; At any other time take, damage, destroy or otherwise interfere with any nest habitually used by any wild bird included in Schedule 1A; Harass any wild bird included in Schedule 1A; Obstruct or prevent any wild bird from using its nest; and Take or destroy an egg of any wild bird.

Legislation description	Relevance to assessment
Nature Conservation (Scotland) Act 2004 (as amended) *Part 2* The Act sets out a series of measures which are designed to conserve biodiversity and to protect and enhance the biological and geological natural heritage of Scotland, requiring public bodies and office-holders to consider the effect of their actions at a local, regional, national and international level. Measures relating to the protection of species and habitats also recognise the importance of the wider international context. Part 2 of the Act sets out a system for conserving and enhancing particular areas of Scotland which are considered to be of particularly high quality in terms of their natural heritage. The provisions within this Part significantly extend and develop the SSSI system which was brought into being by Part II of the 1981 Act.	The Act makes it an offence for a public body or office-holder to carry out or cause or permit to carry out any operation which is likely to damage any natural feature specified in a SSSI notification except, *inter alia*, with the written consent of NS given on an application. Public body includes a statutory undertaker.

8. There are a number of international laws that form the basis of UK national laws regarding the protection of wildlife and the marine environment. In undertaking the assessment, the following overarching international legislation has been taken into account:

    - European Commission ('EC') Directive 2009/147/EC (codified version of 79/409/EC) on the Conservation of Wild Birds (the 'Birds Directive');
    - EC Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (known as the 'Habitats Directive'); and
    - Ramsar Convention on Wetlands of International Importance 1971.

9. The challenges of climate change, energy supply and security of supply are driving policy on renewable energy developments. There are now a significant number of national and international policies, strategies and regulations relating to climate change and the development of renewable energy in Europe, the UK and Scotland.

10. National government policy and strategy documents ensure that the functions of all public bodies comply with national legislation and the international commitments undertaken by the UK and Scottish governments; this includes those government bodies that determine planning permissions or license applications.

11. In Scotland, biodiversity related policy and strategy documents implement international commitments to biodiversity, including birds in the marine environment. These international biodiversity commitments are included in:

    - The European Biodiversity Strategy for 2020 – setting out six targets and 20 actions to halt the loss of biodiversity and ecosystem services in the EU;
    - The United Nations' (UN) Convention on Biological Diversity (1992); including the 'Aichi' biodiversity targets;
    - The Convention for the Protection of the Marine Environment of the North-East Atlantic (the OSPAR Convention 1992); and
    - The Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar Convention 1971).

12. The Bonn Convention (1979) provides for contracting parties to work together to conserve migratory species and their habitats by providing strict protection for endangered migratory species (listed in

Appendix I of the Convention), by concluding multilateral agreements for the conservation and management of migratory species which require or would benefit from international cooperation (listed in Appendix II of the Convention), and by undertaking cooperative research activities.

13. The Bern Convention (1979) aims to ensure conservation and protection of wild plant and animal species and their natural habitats (listed in Appendices I and II of the Convention). It also aims to increase cooperation between contracting parties and regulate the exploitation of those species (including migratory species) listed in Appendix III of the Convention.

14. 'Scotland's Biodiversity: It's in Your Hands' (Scottish Executive, 2004) together with '2020 Challenge for Scotland's Biodiversity' (The Scottish Government, 2013) together comprise the Scottish Biodiversity Strategy. The strategy, by implementing international biodiversity commitments, seeks to:

- Halt the loss of biodiversity and continue to reverse previous losses; and
- Protect, restore and enhance biodiversity.

15. Scottish Planning Policy (February 2010) determines that sites designated under the Ramsar Convention (1971) are also European sites and/or Sites of Special Scientific Interest (SSSI) and are protected under the relevant statutory regimes. Therefore, where the qualifying interest features of Ramsar sites correspond with those of overlapping European sites, "there is no need to consider them separately" (Scottish Government, 2011).

16. The Scottish Biodiversity Strategy aims are subsequently included in the NMP. 'The Marine (Scotland) Act 2010' required Scottish Ministers to prepare and adopt an NMP for the Scottish marine area. Scotland's NMP provides a framework for managing all developments, activities, and interests in or affecting Scotland's marine area (territorial and offshore waters). Adopted in March 2015, the NMP sets out high-level objectives, general policies, and sectoral policies.

17. The NMP (2015) sets out strategic policies for the sustainable development of Scotland's marine resources out to 200 nm. It is required to be compatible with the UK Marine Policy Statement and existing marine plans across the UK.

18. Planning policy on offshore renewable energy Nationally Significant Infrastructure Projects (NSIPs), specifically in relation to offshore ornithology, is contained in the Overarching National Policy Statement (NPS) for Energy (EN-1; Sep 2011a), and the Draft NPS for Renewable Energy Infrastructure (EN-3, Sep 2011b). NPS EN-1 and NPS EN-3 include guidance on what matters are to be considered in the assessment (i.e., scope provisions). NPS EN-3 also highlights several factors relating to the determination of an application and in relation to mitigation.

19. The key policies relevant to sustainable wind energy developments and offshore ornithology receptors are presented in **Table 12.2**.

Table 12.2 National planning policy relevant to offshore ornithology

Policy description	Relevance to assessment
Renewables 5	Renewable energy projects must demonstrate compliance with Environmental Impact Assessment and Habitat Regulations Appraisal legislative requirements.
Renewables 6	Cable and network owners and marine users should ensure a co-ordinated and strategic approach to development and activities to minimise impacts on the marine natural environment.
Renewables 9	Marine planners and decision makers should support the development of joint research and monitoring programmes for offshore wind and marine renewables energy development.

12.2.3 Other relevant information and guidance

20. This chapter has been compiled with reference to the following relevant guidance for conducting EIA:

- Chartered Institute of Ecology and Environmental Management (CIEEM) (2022) Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine;
- Institute of Environmental Management and Assessment ('IEMA') (2017) Delivering Proportionate Environmental Impact Assessment ('EIA'): A Collaborative Strategy for Enhancing UK Environmental Impact Assessment Practice; and
- Planning Inspectorate (PINS) (2019) - Advice Note Seventeen: Cumulative Effects Assessment.

21. Consideration has also been given to the latest guidance notes relating to displacement analysis and collision risk modelling, which are detailed in **Appendix 12.2** and **Appendix 12.3**, respectively.

12.3 Consultation and Engagement

12.3.1 Overview

22. This section describes the Project's early engagement, the outcome of, and response to the **Scoping Opinion** (**Appendix 1.1**) in relation to the offshore ornithology assessment and issues/ concerns raised during the Project's statutory consultation (hereafter referred to as the 'formal consultation') undertaken as part of the EIA process and how these have been addressed in the preparation of this **Offshore EIA Report**. An overview of engagement undertaken for the Project as a whole can be found in **Appendix 6.2: Pre-Application Consultation Report**

23. Given the social distancing restrictions which have been in place due to the COVID-19 pandemic, all technical consultation relating to offshore ornithology has taken place online, primarily in the form of conference calls using Microsoft Teams.

12.3.2 Scoping Opinion

24. The Applicant submitted an **Offshore Scoping Report** (**Appendix 1.2**) and request for **Scoping Opinion** to the Scottish Ministers' (administered by Marine Scotland - Licensing Operations Team (MS-LOT) on 15th November 2021. The **Scoping Opinion** (**Appendix 1.1**) was received on 20th April 2022. The **Offshore Scoping Report** sets out the proposed approach to assessment of offshore ornithology receptors, an outline of the baseline data collected to date, a programme of further surveys and the scope of the proposed impact assessments. A summary of the scoping opinion and consultee responses received in relation to offshore ornithology, the Applicant's response to comments received and where they have been addressed within this chapter is summarised in **Table 12.3.**

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Table 12.3 Scoping Opinion and Consultee responses to Scoping Report – Offshore and intertidal ornithology

Consultee	Date / Document	Comment	Response / where addressed in the EIA Report
Marine Scotland Licensing Operations Team (MS-LOT)	April 2022, Marine Scotland - Licensing Operations Team: Scoping Opinion for Green Volt Offshore Windfarm	The Scottish Ministers confirm that a minimum of two years of survey data must be gathered across the proposed Study Area, covering two full breeding and non-breeding seasons. This is a view supported by the NatureScot and RSPB representations and the MSS advice.	Two consecutive years of aerial digital survey data from May 2020 to April 2022 has been gathered across the Study Area, including two full breeding and non-breeding seasons. Survey details are presented in **Section 12.4**. A query was later raised regarding the survey periods in that they might not capture the whole of the breeding season for 2020, as the surveys were conducted between March 2020 and May 2022. Given that season mean peak counts are used for assessment, the same period in subsequent breeding seasons are also representative.
MS-LOT	April 2022, Marine Scotland - Licensing Operations Team: Scoping Opinion for Green Volt Offshore Windfarm	The Scottish Ministers advise that modelled abundance as produced by MRSea should be provided, to offer greater facility in understanding the variation in distribution in response to environmental variables. If this is not possible, then design-based estimates must be used, but this should be checked and agreed with MSS via MS-LOT and NatureScot in advance.	As requested by MS-LOT, The Applicant has provided a comparison between design-based and MRSea abundance estimates for guillemot (the species recorded in highest numbers during the Green Volt surveys) for the months where there was sufficient data. Results and discussion is provided in the updated MRSea paper in **Appendix 12.4**. The MRSea paper shows that the MRSea modelling outputs are similar to the design-based estimates where data is sufficient and that the conclusion of the impact assessment remains the same using either method. For EIA purposes, both methods are appropriate for the Project, where there is sufficient data.
MS-LOT	April 2022, Marine Scotland - Licensing Operations Team: Scoping Opinion for Green Volt Offshore Windfarm	In line with the NatureScot representation, the Scottish Ministers advise that where quantitative assessments will be undertaken there is still a requirement to fully assess the remaining impacts.	NatureScot, RSPB and MSS advice in relation to disturbance and displacement, collision risk and population consequences have been considered and incorporated in this chapter. Impacts remaining following quantitative assessment such as noise and vessel disturbance are considered under sections that cover disturbance and displacement, however as recognised in NatureScot's written responses, construction phase impacts (of a floating wind farm) are likely to be reduced compared to a piled wind farm. Impacts from lighting on wind turbine generators (WTGs) and vessels are considered in **Section 12.11.9**.
MS-LOT	April 2022, Marine Scotland - Licensing Operations Team: Scoping Opinion for Green Volt Offshore Windfarm	The Scottish Ministers broadly agree with the impacts proposed to be scoped in to the EIA Report and advise the Developer to address the representations from NatureScot and the RSPB along with the MSS advice in full.	Impacts to be scoped in are provided in **Table 12.15**, representations from NatureScot, MSS and the RSPB are addressed below.

Consultee	Date / Document	Comment	Response / where addressed in the EIA Report
MS-LOT	April 2022, Marine Scotland - Licensing Operations Team: Scoping Opinion for Green Volt Offshore Windfarm	In regard to key species, the Scottish Ministers advise that in addition to the six scoped in for assessment in the EIA Report, Leach's storm petrel should also be scoped in. This is in line with the representation received from the RSPB. The Scottish Ministers also advise that the RSPB advice in relation to a qualitative narrative of species presence and behaviour must be addressed in full and included within the EIA Report.	Leach's storm petrel was not recorded during the full two years of surveys and has been scoped out. European storm petrel was recorded during surveys, and a qualitative narrative has been included on this species in **Section 12.8.2**.
MS-LOT	April 2022, Marine Scotland - Licensing Operations Team: Scoping Opinion for Green Volt Offshore Windfarm	With regards to cumulative assessment, the Scottish Ministers advise that this should focus on the Proposed Development in combination with other consented projects in the Moray Firth including those granted lease agreements through ScotWind and sites identified in the draft Sectoral Marine Plan round for Offshore Wind for INTOG.	Cumulative assessment approach is given in **Table 12.44** and follows written advice by NatureScot (13th June 2022) on projects and plans to be considered for assessment.
MS-LOT	April 2022, Marine Scotland - Licensing Operations Team: Scoping Opinion for Green Volt Offshore Windfarm	The Scottish Ministers advise the Developer to address the points raised in the RSPB response in full including the recommendation that site-specific data should be examined and where maximum foraging range from colonies exceeds its generic value, the site-specific value should be used.	Advice from NatureScot and the RSPB on this issue has been taken forward, see **Section 12.9** for approach to population estimates for the breeding season.
NatureScot	27th January 2022 Representation to MS-LOT during consultation on Offshore Scoping Opinion	We query that Section 6.4 is entitled 'Offshore Ornithology', which is not wholly inclusive of the ornithological interests, as the assessment will include populations and assemblages of marine birds present at coastal designated sites and a cable corridor option that makes landfall within an SPA.	This chapter of the **Offshore EIA Report** presents the assessment of the potential impacts to offshore and intertidal ornithology defined as the environment seaward of MHWS. The assessment includes the cable corridor to landfall via HDD around the seabed exit and coastal/intertidal species were considered, for example see **Section 12.10.2** and **Appendix 12.1 Offshore and intertidal ornithology baseline technical report**. The Applicant is submitting a separate EIA Report for the onshore infrastructure of the project.
NatureScot	27th January 2022 Representation to MS-LOT during consultation on Offshore Scoping Opinion	Regarding site-specific surveys, Section 6.4.1.1, we are broadly content with the survey programme, noting that additional survey work is planned should the cable option within the SPA be chosen, although the duration of these surveys is not outlined.	Two consecutive years of aerial digital survey data from May 2020 to April 2022 has been gathered across the Study Area. Survey details are presented in **Section 12.5**. The Applicant is submitting a separate EIA Report for the onshore infrastructure of the project.
NatureScot	27th January 2022 Representation to MS-LOT during consultation on Offshore Scoping Opinion	We wish to see modelled abundance as produced by MRSea provided, as it would offer greater facility in understanding the variation in distribution in response to environmental variables. If this is not possible then design-based estimates will need to be used, but this should be checked and agreed with NatureScot and Marine Scotland in advance.	As requested by MS-LOT, The Applicant has provided a comparison between design-based and MRSea abundance estimates for guillemot (the species recorded in highest numbers during the Green Volt surveys) for the months where there was sufficient data. Results and discussion is provided in the updated MRSea paper in **Appendix 12.4**. The MRSea paper shows that the MRSea modelling outputs are similar to the design-based estimates where data is sufficient and that the conclusion of the

Consultee	Date / Document	Comment	Response / where addressed in the EIA Report
			impact assessment remains the same using either method. For EIA purposes, both methods are appropriate for the Project, where there is sufficient data.
NatureScot	27th January 2022 Representation to MS-LOT during consultation on Offshore Scoping Opinion	We note the impacts for which a quantitative assessment will be undertaken and confirm there is still a need to assess fully the remaining impacts e.g. disturbance effects from noisy construction / decommissioning activities, vessel activities etc.	Impacts remaining following quantitative assessment such as noise and vessel disturbance are considered under sections that cover disturbance and displacement, however as recognised in NatureScot's written responses construction phase impacts (of a floating wind farm) to be reduced compared to a piled wind farm. Impacts from lighting on WTGs and vessels are considered in **Section 12.11.9.**
NatureScot	27th January 2022 Representation to MS-LOT during consultation on Offshore Scoping Opinion	We note that the detailed methodology and scope of the impact assessment, and reference population sizes for each species, will be based on the best available information at the time of undertaking the assessment and will be subject to consultation with key stakeholders.	See **Table 12.4**: Formal Consultation Feedback for stakeholder engagement on these issues.
Royal Society for the Protection of Birds (RSPB)	27th January 2022 Representation to MS-LOT during consultation on Offshore Scoping Opinion	We welcome the two-year programme of monthly aerial digital surveys of the windfarm sites. We note these started in May 2020 and are due to be completed in April 2022. It would be helpful if the surveys could be extended over the full 2022 breeding season and ended at the start of the non-breeding season (1st September). This way analysis can be taken for two complete breeding and nonbreeding seasons.	Extending the survey period to September as recommended is suggestive that only complete seasons should be included in comparative analyses and the rationale for this assumption is unclear. Given that season mean peak counts are used for assessment, if peak counts for a species over the Study Area occurs in March or April and therefore potentially missed if surveys begin in May the same period in subsequent breeding seasons are also representative. See **Appendix 12.1** for further details.
RSPB	27th January 2022 Representation to MS-LOT during consultation on Offshore Scoping Opinion	We are concerned with the scoping out of Leach's storm-petrel. Although a relatively old resource, "An Atlas of seabird distribution from north-west European waters shows there have been recordings of Leach's Storm Petrel in this area. As however current evidence suggests that birds from the nearest colonies are likely to forage at the continental shelf, we believe it more likely these are sighting of non-breeding birds. This, combined with the birds being very small size and dark in colour may explain why they have not been picked up in an aerial digital survey to date. A qualitative narrative relating to the species present in the area and their behaviour throughout the year should be presented.	European storm petrel was recorded during surveys demonstrating that the presence of this species over the Study Area can be detected by the aerial digital surveys. Leach's storm petrel was not recorded during the full two years of surveys and has been scoped out. A qualitative narrative has been included on European storm petrel in **Section 12.8.2** as requested.

Consultee	Date / Document	Comment	Response / where addressed in the EIA Report
RSPB	27th January 2022 Representation to MS-LOT during consultation on Offshore Scoping Opinion	We encourage the adoption of a precautionary approach to the identification of relevant sites for seabirds with clear methodology on the exclusion of sites and species. We welcome using foraging ranges as published in Woodward et al. (2019) to derive connectivity with SPA colonies. We would also recommend that site specific data are examined and where the maximum foraging range from the colony exceeds the generic value, that the site-specific value is used.	Advice from NatureScot and the RSPB on this issue has been taken forward in **Section 12.9** which describes the approach to population estimates for the breeding season.
RSPB	27th January 2022 Representation to MS-LOT during consultation on Offshore Scoping Opinion	The exceptions to this are for common guillemot and razorbill. Tracking on Fair Isle showed foraging for both common guillemot and razorbill distances are greater than those of all other colonies. This may relate to poor prey availability during the study. However, trends for seabirds in the Northern Isles indicate this may be becoming a more frequent occurrence. For all designated sites south of the Pentland Firth (i.e. excluding the Northern Isles), we advise use of mean max +1SD discounting Fair Isle values. For clarity, North Caithness Cliffs SPA is considered to lie south of the Pentland Firth.	Advice from NatureScot and the RSPB on this issue has been taken forward in **Section 12.9** which describes the approach to population estimates for the breeding season.
RSPB	27th January 2022 Representation to MS-LOT during consultation on Offshore Scoping Opinion	We advise use of the SeaBORD modelling tool, supported by a matrix approach where SeaBORD is not applicable. We welcome further discussion around displacement and mortality values to be used in the model.	The Applicant issued a position paper on the applicability of the SeabORD modelling tool for the Project. The conclusions were that SeabORD would be unsuitable when applied outside the Forth and Tay region for which it was developed. Running a highly simplified model with data from the Project Study Area using homogenous prey distribution and with a distance decay function would not add any value to the assessment and pose further uncertainties compared to using a matrix approach. Agreement is pending on the use of a matrix approach with MS-LOT / MSS / NatureScot. Further details are provided in **Appendix 12.7**.
RSPB	27th January 2022 Representation to MS-LOT during consultation on Offshore Scoping Opinion	In relation to the Band model, Option 2 and Option 3 of which should use flight height distribution from Johnson *et al.* (2014) with corrigendum. In relation to use of the stochastic CRM shiny app developed by Marine Scotland Science, we recommend the full output reports are provided.	This approach has been utilised see **Section 12.11.5**, In relation to the full audit files produced from the modelling of the sCRM, the Applicant has provided a succinct version of the inputs and outputs produced from the sCRM within **Appendix 12.3**. In relation to the full audit files the Applicant is able to provide these should they be requested by any party not satisfied with the level of detail provided in **Appendix 12.3**, but due to the large file sizes of each output from the sCRM these are not included within the application.

Consultee	Date / Document	Comment	Response / where addressed in the EIA Report
RSPB	27th January 2022 Representation to MS-LOT during consultation on Offshore Scoping Opinion	We welcome use of avoidance rates based on Cook *et al.*, (2014) with the exception of breeding season gannet.	The avoidance rates for all species follows the guidance from Cook *et al.* (2014) and the JNCC led UK SNCBs review of avoidance rates to be applied in the Band models (JNCC *et al.*, 2014) in response to Cook *et al.*, (2014). Full details of the parameters used are given in **Appendix 12.3: Offshore ornithology collision risk modelling** and **Section 12.11.5** of the **Offshore EIA Report**.
RSPB	27th January 2022 Representation to MS-LOT during consultation on Offshore Scoping Opinion	We have serious concerns over the potential risks offshore wind projects pose to seabird populations both individually and cumulatively. We also have serious concerns about the potential for in-combination impacts with other offshore proposals. We believe the consented projects in the Moray Forth, those granted lease agreements under Scotwind, and sites identified in the draft Sectoral Marine Plan round for Offshore Wind for Innovation and Targeted Oil and Gas Decarbonisation (INTOG) are all of relevance to be considered with this project.	Cumulative impacts on offshore birds have been considered in the environmental impact assessment. The Applicant has followed written advice by NatureScot (13th June 2022) on projects and plans to be considered for assessment. Any project with a public scoping report or more in the planning process up to the 18th October 2022 has been included in the EIA and RIAA.
Marine Scotland Science (MSS)	4th February 2022 Representation to MS-LOT during consultation on Offshore Scoping Opinion	With respect to species screened out, MSS agree with NS and RSPB comments that both two full years of survey data should be considered in accordance with other data sources (examples given in RSPB and NS responses) to ensure evidence and context is provided to justify any exclusion of certain species such as storm petrels and skuas, and to enable full understanding of the rationale beyond no or few detections from aerial digital surveys.	Two consecutive years of aerial digital survey data from May 2020 to April 2022 has been gathered across the Study Area to inform which species were screened in. The surveys were able to detect European storm petrel, a small and more challenging species to detect, suggesting that other such species such as Leach's storm petrel would have been detected by the surveys if present.
MSS	4th February 2022 Representation to MS-LOT during consultation on Offshore Scoping Opinion	With respect to Ornithology, MSS agree with the list of impact pathways to be scoped into the EIA.	See **Table 12.6** for agreed impact pathways to be scoped in.
MSS	4th February 2022 Representation to MS-LOT during consultation on Offshore Scoping Opinion	MSS also note that the current minimum blade clearance is proposed to be 22 m above MSL. MSS would support an increased air gap as this will reduce collision risk by reducing the expected proportion of seabirds at collision risk height.	Although floating wind is a novel technology, the project expects to be able to deploy commercially available offshore wind turbines without substantial modification. The minimum blade clearance of 22 m above MSL has been used for assessment however, the Project is currently reviewing a number of designs which may have increased blade clearance.
MSS	4th February 2022 Representation to MS-LOT during consultation on Offshore Scoping Opinion	MSS consider that entanglement risks associated with mooring lines should also be scoped in for ornithological features.	Potential risk to birds resulting from entanglement with mooring cables are scoped in, see **Section 12.11.4**.

12.3.3 Formal Consultation

25. Three Formal consultation meetings in relation to offshore ornithology have taken place to date. The purpose of these meetings was to discuss key issues raised in relation to the Scoping Opinion and issues/clarifications as part of the EIA process. A summary of topics discussed in each meeting, along with how those discussions have been taken into consideration for this chapter are set out in **Table 12.4.** The Green Volt Offshore Windfarm Ornithology Working Group consisted of consultees from Marine Science Scotland, NatureScot and the RSPB.

Table 12.4 Formal Consultation feedback

Consultee	Date	Issue Raised	How this is addressed in this EIA Report
RSPB	16th February 2022 Stakeholder engagement meeting	Aonghais Cook's report was mentioned, which contains information on general avoidance rates, which is currently in review by JNCC. However, it recommended not to wait for the conclusive output of a review to be carried out before using the information contained within the report, with respect to considering how to account for gannet displacement ahead of inputting seabird density data for collision risk modelling	Shortly after being published, the paper was found to have included datasets which were concluded as being unreliable and skewing the avoidance rates advocated. The paper was shortly withdrawn from publication and as far as we are aware there is no news on the paper being republished. Therefore this paper has not been included within assessments.
RSPB	16th February 2022 Stakeholder engagement meeting	The SeaBORD update as part of the cumulative effects framework was mentioned. There are ongoing discussions about the use of SeaBORD and how useful it can be, involving the model authors, particularly Francis Daunt (from CEH). These discussions involve Marine Scotland Science and NatureScot. However, at this stage SeaBORD is not available for use for this region.	The Applicant issued a series of consultation papers on the applicability of the SeabORD modelling tool for the Project. The conclusions were that SeabORD would be unsuitable when applied outside the Forth and Tay region for which it was developed. Running a highly simplified model with data from the Project Study Area using homogenous prey distribution and with a distance decay function would not add any value to the assessment and pose further uncertainties compared to using a matrix approach. Agreement is pending on the use of a matrix approach with MS-LOT / MSS / NatureScot. Further details are provided **in Appendix 12.7.**
RSPB	16th February 2022 Stakeholder engagement meeting	The preference is for use the CRM both stochastically and deterministically, with the stochastic modelling approach providing great value in understanding variability and uncertainty around collision risk. It was also stated that there is merit for presenting the variability of the output mortality. The variability around the mortality estimates will inform the case-specific decision.	This approach has been used as advised. In relation to the full audit files produced from the modelling of the sCRM, the Applicant has provided a succinct version of the inputs and outputs produced from the sCRM within EIA Report Appendix 12.3. In relation to the full audit files the Applicant is able to provide these should they be requested by any party not satisfied with the level of detail provided in EIA Report Appendix 12.3, but due to the large file sizes of each output from the sCRM these are not included within the application.
MS-LOT	Written responses to proposed list of projects for Green Volt to consider as part of the cumulative and in combination assessment 13th June 2022.	Consideration of proposed list of projects for Green Volt to consider as part of the cumulative assessment following comment by NatureScot: 'We would advise that offshore wind projects should be ranked as follows for consideration: Operational wind farms – Beatrice, Moray East, HyWind, European Offshore Wind Deployment Centre and Kincardine. (There may also be a need to consider wind farms either in English waters or in other non-UK parts of the North Sea.) The consideration of which wind farms to be included will depend on species and their foraging ranges / management units. Under construction – SeaGreen, Neart na Gaoithe	Full consideration has been made to this advice, approach to projects and plans to be considered in the cumulative assessment is shown in **Table 12.44** and listed in **Table 12.45**.

Consultee	Date	Issue Raised	How this is addressed in this EIA Report
		Consented, but not yet under construction – Moray West, Inch Cape In planning / ScotWind lease sites – will depend on their timescales who needs to take account of who first'.	
NatureScot	Written responses to meeting on the 27th April 2022 issued on 26th May 2022	Advice on how to calculate mean peaks considering the algal bloom event in autumn 2021; 'We would advise that aerial digital surveys in 2021 may be depressed, in particular for auk species, due to the wreck(s) that occurred. When events such as these occur, if it's considered to be a one off then the maximum density for the other year could be used. Therefore, at this point in time we would advise that developers could consider additional survey or use the max density from the other year of survey for the months over which the wrecks occurred. If more information / evidence on the causes of these wrecks becomes known, our advice may be updated'.	Algal blooms are not one-off events in the North Sea and their occurrence are likely to be under-reported. Their impacts will vary considerably depending on their location, duration and timing. Peak densities during the post-breeding dispersal period for guillemot in the Windfarm Site was 155 birds/km^2 in 2020 and 31 birds/km^2 in 2021. Comparable inter-annual variation in peak densities were also observed at Hywind Scotland Pilot Park, 157 birds/km^2 in 2013 and 51 birds/km^2 in 2014. Given the distance of the Project from the shore peak densities are likely to vary considerably during this period due to timing of colony departure and vary levels of convergence of birds from different colonies out at sea. It is unknown whether the algal bloom suppressed auk numbers in the Project area, but the observed densities are in line with the inter-annual variation that can occur. Therefore, assessments have used the mean peak abundance.
NatureScot	Written responses to meeting on the 27th April 2022 issued on 26th May 2022	Additional guidance on how to assess the impact on storm petrels: We consider the key impact for storm petrels to be around lighting on turbines and construction/maintenance vessels. Given the initial survey results, we consider that there may be particular risks associated with this development for species such as storm petrels and shearwaters that may be attracted to and/or disorientated by artificial light sources. As well as turbine lighting, these include lighting on servicing or construction vessels, in particular if construction will be a 24/7 operation. Such effects could impact assessment of collision and/or displacement. We recommend further consultation with NatureScot and MS with respect to this aspect of the assessment, considering findings from current Marine Scotland commissioned review to inform the assessment of the risk of collision and displacement in petrels and shearwaters from offshore wind developments in Scotland, which is due for publication by autumn 2022. We recommend additional data are considered such as the MERP maps (Waggitt *et al*., 2020) and any relevant tracking data. We recommend that protocols built into construction and operation phases for monitoring and handling of any birds attracted by lighting on vessels as well as associated recording of any such incidents including context (e.g., weather) to help build that understanding	Construction of the WTGs and floating substructure occurs onshore and anchor embedment is carried out by one vessel and completed in one day for each WTG, the potential for lighting impacts is therefore likely to be from lighting on turbines during the operational phase than during construction and decommissioning. The full two years of surveys recorded only European storm petrel therefore a qualitative narrative has been included on this species in **Section 12.8.2** as requested.
NatureScot	Written responses to meeting on the 27th April 2022 issued on 26th May	"The issue with great black-backed gull estimates from Horswill and Robinson, has not arisen recently. Impacts to this species were last assessed in Scottish casework for the Moray Firth applications. APEM state that 'data on this species from Horswill	Recommendations from NatureScot on the mortality and productivity rates for great black-backed gull species have been followed.

<table>
<tr><th>Consultee</th><th>Date</th><th>Issue Raised</th><th>How this is addressed in this EIA Report</th></tr>
<tr><td></td><td>2022</td><td>and Robinson is stated as not deemed sufficiently robust enough to use’. That is paraphrasing the report, which actually says ‘local survival rates are largely unknown…..Juvenile and immature survival rates are also unknown. Population models should be constructed based on the demographic estimates reported for other large gull species.’

So the recommendation in Horswill and Robinson is that juvenile and immature survival rates are taken from other large gulls. Although they recommend ‘further matching of local population trends …to assess suitability of these estimates.’ So here APEM used the herring gull juvenile survival rate for juvenile great black backed gull as recommended in Horswill and Robinson, and then an ‘average’ survival for juvenile and adult herring gull for immature great black-backed gull. It may have been more suitable to use juvenile herring gull and adult great black-backed gull to calculate that value, but in any case no immature survival value is available in Horswill and Robinson. Instead a UK average productivity was calculated from SMP - Horswill and Robinson did provide a UK productivity estimate, although they stated that it may be more appropriate to use a local estimate if that could be obtained. The productivity estimate used by APEM is lower than the estimate in Horswill and Robinson (0.890 cf. 1.139 (sd 0.533))."</td><td></td></tr>
<tr><td>NatureScot</td><td>Written responses to meeting on the 27th April 2022 issued on 26th May 2022</td><td>We recommend (for the long list) using foraging ranges as published in Woodward et al. (2019) to derive connectivity with SPA colonies. We advise mean max + 1SD should be used to screen in connectivity to SPAs with the following exceptions:
For guillemot and razorbill use of mean max +1SD, including data from Fair Isle for all Northern Isles designated sites. For all designated sites south of the Pentland Firth (i.e., excluding the Northern Isles), use of mean max +1SD discounting Fair Isle values. North Caithness Cliffs SPA is considered to lie south of the Pentland Firth.
For gannet we recommend using mean max +1SD for all colonies without site specific maximum values. However, the site-specific maximum should be used for the following SPA colonies:
• Forth Islands,
• Grassholm and
• St Kilda</td><td>Advice from NatureScot and the RSPB on this issue has been taken forward, see Section 12.9 for approach to population estimates for the breeding season.</td></tr>
<tr><td>NatureScot</td><td>Written responses to meeting on the 27th April 2022 issued on 26th May 2022</td><td>Advice on mortality rate ranges for the matrix approach; ‘we are aware from discussions at this meeting that there may be issues in use of SeabORD for Green Volt related to the distance to shore. Our understanding is that APEM will consider its use and any potential issues and provide a detailed commentary on this for discussion with NatureScot and Marine Scotland. In line with our current advice for offshore wind farms we advise the following rates to be considered for the displacement matrix approach.
<table><tr><td></td><td>Displacement</td><td>Mortality – Breeding</td><td>Mortality – Non-Breeding</td></tr></table></td><td>The Applicant issued a series of consultation papers on the applicability of the SeabORD modelling tool for the Project. The conclusions were that SeabORD would be unsuitable when applied outside the Forth and Tay region for which it was developed. Running a highly simplified model with data from the Project Study Area using homogenous prey distribution and with a distance decay function would not add any value to the assessment and pose further uncertainties compared to using a matrix approach. Agreement is pending on the use of a matrix approach with MS-LOT / MSS / NatureScot. Further details are provided in Appendix 12.7.</td></tr>
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<table>
<tr><th>Consultee</th><th>Date</th><th>Issue Raised</th><th>How this is addressed in this EIA Report</th></tr>
<tr><td></td><td></td><td><table>
<tr><td></td><td></td><td></td><td>Season</td></tr>
<tr><td>Auks (GU, RZ, PU)</td><td>60%</td><td>3% and 5%</td><td>1% and 3%</td></tr>
<tr><td>Gannet</td><td>70%</td><td>1% and 3%</td><td>1% and 3%</td></tr>
<tr><td>Kittiwake</td><td>30%</td><td>1% and 3%</td><td>1% and 3%</td></tr>
</table></td><td>Advice on displacement and mortality rates has been incorporated into the assessment see Sections 12.10 and 12.11.</td></tr>
<tr><td>NatureScot</td><td>Written responses to meeting on the 27th April 2022 issued on 26th May 2022</td><td>"The following comments are based on the 12 month period that were collated and reported. We also received the initial survey results for the individual month surveys, but it is difficult to compare across the years, as the reporting metrics are different. The second year surveys will need processing to enable more useful comparisons.

There are a few interesting observations.
• Considering how far offshore this site is the numbers of large gulls recorded (in non-breeding season) is high.
• High numbers of large auks (here guillemot) in September is similar to the pattern we have seen at other east coast sites. August numbers were not elevated.
• The 2 red-throated diver at a location so far offshore in June is unexpected. They are not likely to be linked with a breeding site.
• 6 European storm petrel is a high number and probably pre-breeding. Foraging birds from northern colonies could forage in this area. ESP rarely recorded on DAS that we have seen to date in Scotland.
• Gannet numbers are significant although not huge. The most likely origin is Troup Head colony, but the location is easily within foraging range of several colonies.
• The 31 Arctic/common tern in July is noted.
• Interesting that nearly as many kittiwake are recorded as ‘unknown’ age as adult, yet they were identified as kittiwake. Proportion of adult Kittiwake at other East coast developments was usually much higher, between 57 and 99% and values below 70% were rare.

The autumn high densities of Guillemot (formed from adults dispersing with young) at Hywind tended to be earlier than September (mainly August), although in the second year of characterisation surveys at Hywind September densities were elevated, but still lower than August. The September density at Green Volt of 119 birds /km2 was comparable with the peak densities at Hywind (157 birds/km2 in August 2013). However Guillemot densities are moderate to high in all months (5 – 20 birds / km2) at the Green Volt survey area. This is clearly a valuable area for the local colonies, at least in this year of survey."</td><td>Noted. 2 years of baseline survey data is provided</td></tr>
<tr><td>NatureScot</td><td>Written responses to meeting on the 27th April 2022 issued on 26th May 2022</td><td>"We note that the Bird Surveys Annual Report does not specify any close gannet colonies. However, we note they are not far from Troup, Pennan and Lion’s Head SPA – although gannet are not a named SPA feature here. The report mentions 1 Arctic tern, but not the 31 Sterna terns recorded.</td><td>Noted. 2 years of baseline survey data is provided</td></tr>
</table>

Consultee	Date	Issue Raised	How this is addressed in this EIA Report
		Data tables indicate the Confidence Values (CVs) for most of the common species or species groups are reasonable (<25%) in most months. Guillemot is typically in the region of 10% which is pretty good (razorbill variable but never lower than 20%). We are slightly intrigued by the category 'gannet species' as opposed to gannet, although it doesn't contribute much over the gannet estimates (as expected)."	
NatureScot	Written responses to meeting on the 27th April 2022 issued on 26th May 2022	The CRM approach being used in Scottish casework currently is to provide a deterministic output for options 2 and 3, with avoidance rates based on the 2014 SNCB guidance. (0.989 (Kitt), 0.995 (gull), 0.989 (gannet).	The CRM approach advised has been used together with avoidance rates based on the 2014 SNCB guidance, see **Appendix 12.3 Offshore Ornithology: Collision Risk Modelling**, although the Applicant evidence that suggest these avoidance rates incorporate a high degree of precaution, see **Section 12.11.5.**
NatureScot	Written responses to meeting on the 27th April 2022 issued on 26th May 2022	For the non-breeding season impacts should be assessed against the relevant Furness BDMPS population, however this is not what we advise for guillemot. Guillemot should be assessed against a regional population based on foraging range.	The Applicant has followed the advice given for guillemot and assessed non-breeding season impacts against a regional population, see **Table 12.31..**
NatureScot	Written responses to meeting on the 27th April 2022 issued on 26th May 2022	We consider that the selected area for assessment for auks as array + buffer and for gannet as array only, while gannet is known to have high displacement rate and react at distance from the wind farm.	The recommend areas for auks and gannet have been used in the assessment see for example **Table 12.29, Table 12.31** and **Table 12.33** for the operation phase assessment.
NatureScot	Written responses to meeting on the 7th June 2022 issued on the 20th June 2022	Advice to inform on auk availability correction factor; 'There is no expectation by NatureScot to change existing guidance, however we are happy to consider changes. If APEM are proposing a change in approach, then we need this to be provided in writing. This would need to include justification as to why it should be considered (based on breeding and non-breeding data) and whether it's been peer reviewed and by whom.'	The Applicant has not proposed any refinement in auk availability correction factors and has used the current approach for abundance estimates, see **Appendix 12.1 Offshore and Intertidal Ornithology Baseline Technical Report**.
NatureScot	Written responses to meeting on the 7th June 2022 issued on the 20th June 2022	Advice to provide more information on the Scottish approach to guillemot assessment 'information can be found in both the Berwick Bank and West of Orkney NatureScot scoping advice and Marine Scotland scoping opinion'.	This advice has been followed and a regional approach to the non-breeding assessment for guillemot has been undertaken (see **Section 12.9.2**).
NatureScot	Written responses to meeting on the 7th June 2022 issued on the 20th June 2022	Response on approach of using tracking data as well as generic foraging range distances from Woodward *et al* (2019) to demonstrate and understand connectivity of different seabird colonies to the Green Volt area for the purpose of deriving population estimates to assess against.' We are currently considering this point and we will provide advice towards the end of July or early August'.	Advice on Applicant's approach presented in **Section 12.9.2** and **Appendix 12.5** is pending response from NatureScot.
NatureScot, Marine Scotland Science and	Green Volt Offshore Windfarm Ornithology Working Group - 27th April 2022	The issue of the autumn 2021 algal bloom incident in the North Sea was discussed and how to calculate mean peak abundances if the event had suppressed numbers over the survey area.	The Applicant has followed the advice of NatureScot received on the 26th May 2022.

Consultee	Date	Issue Raised	How this is addressed in this EIA Report
RSPB			
NatureScot, Marine Scotland Science and RSPB	Green Volt Offshore Windfarm Ornithology Working Group - 27th April 2022	With significant observations of European storm petrel recorded over the survey area the issue of how to assess the impacts on this species was raised.	The Applicant has followed the advice of NatureScot received on the 26th May 2022.
NatureScot, Marine Scotland Science and RSPB	Green Volt Offshore Windfarm Ornithology Working Group - 27th April 2022	Determining significance, was discussed to include expert guidance and recent CIEEM recommendations, to determine the final impact and effect levels rather than a rigid EIA matrix approach. Consideration to be given to impacts considered negligible in significance, early identification, and removal from assessment to be the goal where appropriate in order to focus the EIA Report on the main species and impacts of interest.	Impact assessment methodology is provided in **Section 12.8.1.**
NatureScot, Marine Scotland Science and RSPB	Green Volt Offshore Windfarm Ornithology Working Group - 27th April 2022	Discussion on CRM; fulmar to be screened out due to low collision risk and gannet, kittiwake, greater black backed gull, herring gull to be screened in. NatureScot advised using the deterministic approach using option 2 and 3 and recommended the method was aligned with other cases NatureScot are advising on to ensure consistency.	Species screened in for collision risk are shown in **Table 12.15.** This approach has been utilised see **Section 12.11.5** and have considered the written response from NatureScot on this issue, see below.
NatureScot, Marine Scotland Science and RSPB	Green Volt Offshore Windfarm Ornithology Working Group - 27th April 2022	NatureScot advised that the Biologically Defined Minimum Population Scales (BDMPS) are to be used to define population size for the non-breeding season with the exception for guillemot that should use breeding season foraging range data to define that population in the non-breeding season.	The Applicant has considered both approaches an example is shown in **Table 12.31** for guillemot displacement estimates during the operational phase.
NatureScot, Marine Scotland Science and RSPB	Green Volt Offshore Windfarm Ornithology Working Group - 27th April 2022	An Appendix should be presented containing SMP data clearly showing species count, colony, and date of count, to understand exactly which counts are being used to derive population estimates.	**Appendix 12.5** provides the SMP data used to derive population estimates for each species.
NatureScot, Marine Scotland Science and RSPB	Green Volt Offshore Windfarm Ornithology Working Group - 27th April 2022	NatureScot advise a preference not to use the SNCB matrix approach, but to explore the use of the SeabORD tool using a simplistic approach with distance decay and homogenous prey distribution parameters. NatureScot advice for the matrix approach is to include a range of values for mortality.	The Applicant issued a number of consultation papers on the applicability of the SeabORD modelling tool for the Project. The conclusions were that SeabORD would be unsuitable when applied outside the Forth and Tay region for which it was developed. Running a highly simplified model with data from the Project Study Area using homogenous prey distribution and with a distance decay function would not add any value to the assessment and pose further uncertainties compared to using a matrix approach. Agreement is pending on the use of a matrix approach with MS-LOT / MSS / NatureScot. Further details are provided in **Appendix 12.7.**
NatureScot,	Green Volt Offshore	NatureScot advice for the matrix approach is to include a range of values for	A range of values for mortality has been presented for the

Royal HaskoningDHV

GREEN VOLT

Consultee	Date	Issue Raised	How this is addressed in this EIA Report
Marine Scotland Science and RSPB	Windfarm Ornithology Working Group - 27th April 2022	mortality.	matrix approach as provided in the written responses by NatureScot.
NatureScot, Marine Scotland Science and RSPB	Green Volt Offshore Windfarm Ornithology Working Group - 27th April 2022	Impact pathways requiring qualitative consideration are also relevant to construction and decommissioning and would be useful to have these qualitative impacts laid out clearly e.g., disturbance elements of boat traffic, prey species, pollution. .	Although Impact pathways requiring qualitative consideration are also relevant to construction and decommissioning it was recognised in NatureScot's written responses that construction phase impacts (of a floating wind farm) to be reduced compared to a piled wind farm. Disturbance elements such as vessel traffic, prey species, pollution and lighting are clearly considered for the construction (**Section 12.10**) and decommissioning phases (**Section 12.12**).
NatureScot, Marine Scotland Science and RSPB	Green Volt Offshore Windfarm Ornithology Working Group - 27th April 2022	Construction of a floating wind farm is anticipated to have significantly lower impacts on the environment. To clearly assess this NatureScot advised that it would be helpful for the EIA Report to be as detailed as possible with the construction methods and the processes taking place.	Construction details are provided in **Table 12.9** and a description of construction phase activities are provided in **Section 12.10**.
NatureScot, Marine Scotland Science and RSPB	Green Volt Offshore Windfarm Ornithology Working Group - 7th June 2022	Issue raised by the Applicant on current availability factors, which are derived during the chick rearing period, for auks when working out abundance estimates, whether applying the same correction factor across all seasons is over precautionary and if a refinement could be incorporated.	Agreement that this was a valid point and NatureScot would provide further advice on this issue.
NatureScot, Marine Scotland Science and RSPB	Green Volt Offshore Windfarm Ornithology Working Group - 7th June 2022	Advice from the RSPB to check for autocorrelation in the transect survey data sets, as transect lines are closer together when surveys have a 25% coverage.	Abundance estimates are derived using a design-based method and are not modelled therefore checks for autocorrelation cannot be undertaken using this approach. However, MRSea modelling undertaken in **Appendix 12.4** on selected months tested for auto correlation and demonstrated non-existence.
NatureScot, Marine Scotland Science and RSPB	Green Volt Offshore Windfarm Ornithology Working Group - 7th June 2022	NatureScot and RSPB advised SeabORD tool to be used in preference to the Matrix approach using a simple distance decay function but were willing to consider the Applicant's opinion on the suitability of the SeabORD tool for use specifically for Green Volt data in a written response.	The Applicant issued (3rd August /2022) an initial position paper on the applicability of the SeabORD modelling tool for the Project. The conclusions were that SeabORD would be unsuitable when applied outside the Forth and Tay region for which it was developed. Running a highly simplified model with data from the Project Study Area using homogenous prey distribution and with a distance decay function would not add any value to the assessment and pose further uncertainties compared to using a matrix approach. Following receipt of further consultation responses a further method review paper was drafted with further details provided in

Consultee	Date	Issue Raised	How this is addressed in this EIA Report
			Appendix 12.7. Agreement is pending on the use of a matrix approach with MS-LOT / MSS / NatureScot.
NatureScot, Marine Scotland Science and RSPB	Green Volt Offshore Windfarm Ornithology Working Group - 7th June 2022	Advice to follow the Scottish approach for guillemot assessment, see Moray West OWF methodology as an example, with further guidance to be provided in written response.	This advice has been followed and a regional approach to the non-breeding assessment for guillemot has been undertaken (see **Section 12.9.2**).
NatureScot, Marine Scotland Science and RSPB	Green Volt Offshore Windfarm Ornithology Working Group - 7th June 2022	Request by the Applicant to consider the use of other evidence other than foraging distance to demonstrate connectivity to the Green Volt area for the purpose of deriving population estimates to assess against. Evidence was presented for razorbill and guillemot connectivity with colony tracking data and bidirectional flight paths from Green Volt aerial surveys.	NatureScot to review evidence and provide a written response on approach to use considering evidence presented by the Applicant. Pending response from NatureScot.
NatureScot, Marine Scotland Science and RSPB	Green Volt Offshore Windfarm Ornithology Working Group – 21st September 2022	Following review of **Appendix 12.7**; Position Paper issued on the 'Applicability of SeabORD for Green Volt' NatureScot and the RSPB uphold their view that the SeabORD tool should be used for assessment of displacement effects. UKCEH have demonstrated the use of SeabORD outside the Forth and Tay region although this information is not publicly available. The model is to be run using a distance decay function instead of colony tracking data and advice on how to validate outputs when the tool is run in this manner would be sought from the model developers.	Advice on running and validating SeabORD model runs using a distance decay function pending advice from model authors. This is being sought through NatureScot.
NatureScot, Marine Scotland Science and RSPB	Green Volt Offshore Windfarm Ornithology Working Group – 21st September 2022	Following review of the **Appendix 12.4;** Position Paper issued on 'Applicability of MRSea for Green Volt' NatureScot and the RSPB stated a preference for MRSea to be used where possible and that it would be beneficial to see a comparison between MRSea and design-based outputs given the model would be run with limited raw counts and only location as a covariant. This option was suggested to be applied for guillemot survey data with sufficient raw counts. Agreement was reached in this instance to seek advice from the model developer on whether it would be appropriate to use MRSea with only location as a covariant and low raw counts.	Advice on running MRSea using the Green Volt data discussed at Consultation Meeting on 18th October 2022.
NatureScot, Marine Scotland Science and RSPB	Green Volt Offshore Windfarm Ornithology Working Group – 21st September 2022	Advice sought on Applicant's displacement and mortality rates for gannet and auks considering emerging new evidence and publication of two reports reviewing auk (guillemot and razorbill) and gannet displacement rates at OWFs (APEM 2022a and 2022b). NatureScot stated until the reports and emerging new evidence had been reviewed the joint SNCB guidance on displacement and mortality rates is recommended.	Displacement impacts for all species are presented using the Applicant's approach and the SNCBs recommended approach in **Sections 12.10.1** and **12.11.1.**
NatureScot, Marine Scotland Science and RSPB	Green Volt Offshore Windfarm Ornithology Working Group – 21st September 2022	Advice sought by Applicant on the inclusion of displacement effects for kittiwake due to the low reported displacement rate, inconsistency of reporting in Scottish projects and exclusion in English and Welsh projects. NatureScot and the RSPB requested that displacement effects for kittiwake to be included in the assessment.	Displacement impacts for kittiwake are included in the assessment see **Sections 12.10.1, 12.11.1** and **12.12.2.** The inclusion of English and Welsh projects are not included for cumulative kittiwake displacement assessment, advice on this approach pending NatureScot written responses.

Consultee	Date	Issue Raised	How this is addressed in this EIA Report
NatureScot, Marine Scotland Science and RSPB	Green Volt Offshore Windfarm Ornithology Working Group – 21st September 2022	Advice sought on Applicants approach to connectivity between the Green Volt site and Scottish colonies using evidence from the seabird tracking database and flight lines from aerial survey data for establishing population sizes for assessment. NatureScot and RSPB confirmed the usefulness of the evidence and the complexity of the issue. An agreement was reached to include this evidence as an interim measure until further guidance could be provided.	Breeding population sizes for assessment of impacts to breeding season guillemot and razorbill have incorporated evidence of colony connectivity from tracking data and aerial survey flight direction data, see **Section 12.9.2.**
NatureScot, Marine Scotland Science and RSPB	Green Volt Offshore Windfarm Ornithology Working Group – 21st September 2022	Advice on the Applicant's approach to seasonal definitions for assessment that followed NatureScot Guidance note (NatureScot, 2020) with the exception of gannet and kittiwake, where the non-breeding season has been split to include migratory seasons. NatureScot advised the non-breeding season may include other seasons, but clarifications would be provided.	Both the Applicant's seasonal definitions and those stipulated in the NatureScot Guidance (NatureScot, 2020) note are presented in the assessment, with clarifications for splitting the non-breeding season for kittiwake and gannet provided in **Section 12.9.1.**
NatureScot, Marine Scotland Science and RSPB	Green Volt Offshore Windfarm Ornithology Working Group – 21st September 2022	Clarification on the latest figures to use for breeding populations at the East Caithness SPA and North Caithness SPA, due to discrepancies between SMP database figures and SNH reports 902 and 965. NatureScot explained that discrepancies maybe due to use SPA boundary changes and confirmation would be provided in written responses.	Pending clarifications from NatureScot the latest figures from the SNH reports have been used, which is consistent with the most recently consented Scottish projects also using data for these two SPAs, see **Table 12.18** and **Appendix 12.5.**
NatureScot, Marine Scotland Science and RSPB	Green Volt Offshore Windfarm Ornithology Working Group – 21st September 2022	Clarification on using the 1.34 correction factor for converting individual counts at colonies for guillemot and razorbill. NatureScot to confirm this correctional factor published by Harris *et al.* (2015).	The 1.34 correction factor has been applied, see **Appendix 12.5**, pending confirmation by NatureScot
NatureScot, Marine Scotland Science and RSPB	Green Volt Offshore Windfarm Ornithology Working Group – 21st September 2022	Clarification on whether to include an assessment of potential impacts on an annual basis in addition to the individual seasonal assessments, the latter being in line with impact assessments undertaken and agreed on previous consented Scottish OWFs.	Assessments have been presented seasonally in line with the approach taken in previous consented Scottish OWF impact assessments, see **Sections 12.10.1, 12.11.1** and **12.12.2.** Pending confirmation by NatureScot.
NatureScot, Marine Scotland Science and RSPB	Green Volt Offshore Windfarm Ornithology Working Group – 21st September 2022	Clarification on the incorporation of macro-avoidance for gannet and kittiwake for assessment of combined displacement and collision risk. NatureScot acknowledge the complexity of the issue and until new guidance on the topic is issued. NatureScot stated that if approaches with macro-avoidance are included in assessments they are to be presented alongside assessments without macro-avoidance.	Macro-avoidance has been incorporated into combined displacement and collision risk for project alone and cumulative assessments, see Sections **12.9.1, 12.13.4** and **Appendix 12.3**.
NatureScot, Marine Scotland Science and RSPB	Green Volt Offshore Windfarm Ornithology Working Group – 21st September 2022	The representativeness of the data was raised, especially the Fair Isle data, which was collected during a year where colonies suffered from poor food conditions. It was stated that the flight direction data is good, more meaningful for the auk species than for gannet or kittiwake. For gannet or kittiwake its meaningfulness would depend on behaviour state (e.g. foraging bird changing flight path often etc).	Advice from NatureScot and the RSPB on this issue has been taken forward in **Section 12.9** which describes the approach to population estimates for the breeding season.

Consultee	Date	Issue Raised	How this is addressed in this EIA Report
NatureScot	Written responses to meeting on the 21st September 2022 issued on the 11th October 2022	NatureScot advise that the values on the SMP database for North Caithness Cliffs SPA and East Caithness Cliffs SPA are up-to-date and that these values should be used	Due to uncertainty and age of the data NatureScot are suggesting to use, which is also contrary to advice provided to other Scottish offshore wind farm (OWF) projects for use in impact assessments, the Applicant used those data relating to the most up to date colony counts from the Scottish Natural Heritage (SNH) Reports (902 and 965)s provided to Moray West.
Consultation Meeting on MRSea	18th October 2022	Discussion on the suitability of MRSea modelling for Green Volt survey data. Agreement reached with NatureScot following advice with the model developer to determine whether the MRSea model can be run for guillemot using selected data from months with the highest likelihood of achieving a meaningful output. Outputs from these runs to be compared to design-based estimates to determine whether the MRSea results are sufficiently different with increased confidence to warrant the complete 24 months of survey data for guillemot and other species to be run through the MRSea model.	Following the OWG meeting, an MRSea Report has been produced as an Appendix to provide a comparison between MRSea and design based estimates of changes in abundance using some guillemot data from Green Volt to demonstrate how the model works for far offshore locations with limited/less data. This is presented in Appendix 12.4.
Consultation Meeting on MRSea	30th November 2022	Presentation of results of MRSea modelling for Green Volt survey data with sufficient numbers, and the limitations of the running the model with low numbers. Outputs compared with the design based estimates.	Written response from NatureScot on the 19th December 2022 advised for consistency across all INTOG and ScotWind sites the MRSea approach to be used to enable comparability, and consistency in the modelling approach across developments. Therefore, MRSea should be used for guillemot, for those months where there is sufficient data. The Applicant has presented MRSea modelling data for guillemot in **Appendix 12.4**.
NatureScot	Email 19th December 2022	Thank you for the discussions regarding the use of MRSea further offshore. Having reviewed the 'Comparative analysis of the design-based method and MRSea modelling using Green Volt survey data' report by APEM (December 2022) and having reflected on the discussions had at our previous meetings, we advise the following: • MRSea should be used for guillemot, for those months where there is sufficient data. This is the approach we will advise for all INTOG and ScotWind sites to enable comparability, but also importantly consistency in the modelling approach across developments. This has been an important exercise with useful discussions and has helped to inform NatureScot's advice in this instance. We continue to welcome opportunities for further discussion with developers and consultants on the practical application of tools and methodologies in the impact assessment process with regards to individual developments. "	Written response from NatureScot on the 19th December 2022 advised for consistency across all INTOG and ScotWind sites the MRSea approach to be used to enable comparability, and consistency in the modelling approach across developments. Therefore, MRSea should be used for guillemot, for those months where there is sufficient data. The Applicant has presented MRSea modelling data for guillemot in **Appendix 12.4**.

12.4 Methodology for baseline characterisation: offshore

12.4.1 Overview

26. Baseline data collection has been undertaken to obtain information across the Offshore Development Area described in **Chapter 5: Project Description**. This has been accomplished through the completion of a desk study and a programme of site-specific aerial digital video surveys.

12.4.2 Desk study

27. The data sources that have been collected and used to inform the offshore ornithology assessment are summarised in **Table 12.5**, though a full and comprehensive list of references associated with the entire chapter can be found at the end of this report.

Table 12.5 Data sources used to inform the offshore and intertidal ornithology chapter

Title	Source	Date	Author	Summary	Coverage of Study Area
Joint Nature Conservation Committee (JNCC) Online Special Protection Areas (SPA) standard data forms for Natura 2000 sites	JNCC	Multiple years	JNCC	Data on designated sites, including location, size and qualifying features.	UK-wide information on designated sites.
Wetland Bird Survey (WeBS) Annual Report and Report Online interface	Wetland Bird Survey (WeBS)	2021	Frost *et al.*	Data on wetland bird populations and demographic rates	Generic information applicable to the Project's ornithological receptors.
British Trust for Ornithology (BTO) BirdFacts: profiles of birds occurring in Britain and Ireland.	British Trust for Ornithology	2005	Robinson	Data on wetland and seabird populations and demographic rates.	Generic information applicable to the Project's ornithological receptors.
Non-breeding season populations of seabirds in UK waters: Population sizes for BDMPS	Natural England	2015	Furness	Data on seabird populations and demographic rates.	Generic information applicable to the Project's ornithological receptors.
At-Sea Turnover of Breeding Seabirds	Marine Scotland	2015	Searle *et al.*	Data on seabird populations and demographic rates.	Generic information applicable to the Project's ornithological receptors.
Population consequences of displacement from proposed offshore wind energy developments for seabirds breeding at Scottish SPAs	Marine Scotland	2014	Searle *et al.*	Data on seabird populations and demographic rates for use in assessments.	Generic information applicable to the Project's ornithological receptors.
Population estimates of birds in Great Britain	*British Birds* (journal)	2013	Musgrove *et al.*	Data on seabird populations and demographic rates.	This source contains information which can be drawn upon at a Project-

Title	Source	Date	Author	Summary	Coverage of Study Area
and the UK					specific scale, or a wider regional scale.
The State of the UK's Birds Report	RSPB	2020	Burns *et al.*	UK-wide information on the abundance and distribution of bird species.	This source contains information which can be drawn upon at a Project-specific scale, or a wider regional scale.
Seabird foraging ranges as a preliminary tool for identifying candidate Marine Protected Areas	British Trust for Ornithology	2012	Thaxter *et al.*	Data on seabird foraging ranges for use in assessments.	Generic information applicable to the Project's ornithological receptors.
Assessing the risk of offshore wind farm development to migratory birds designated as features of UK SPAs	Strategic Ornithological Support Services	2012	Wright *et al.*	Data on seabird populations and demographic rates for use in assessments.	This source contains information which can be drawn upon at a Project-specific scale, or a wider regional scale.
An analysis of the numbers and distribution of seabirds within the British Fishery Limit aimed at identifying areas that qualify as possible marine SPAs	JNCC	2010	Kober *et al.*	Data on seabird populations and demographic rates for use in assessments.	This source contains information which can be drawn upon at a Project-specific scale, or a wider regional scale.
A review of assessment methodologies for offshore wind farms	British Trust for Ornithology	2009	Maclean *et al.*	Published, peer reviewed scientific literature on ornithological impact assessment methodologies for OWF.	Information relating to the EIA process for offshore ornithology.
The Migration Atlas	British Trust for Ornithology	2002	Wernham *et al.*	Data on migratory bird populations and demographic rates.	Generic information applicable to the Project's ornithological receptors.
Atlas of seabird distribution in northwest European waters	JNCC	1995	Stone *et al.*	Data on migratory bird populations and demographic rates.	Generic information applicable to the Project's ornithological receptors.
Environmental Impact Assessment Handbook	SNH	2018	SNH	Guidelines for impact assessment in Scotland.	Information relating to the EIA process for offshore ornithology.
Barriers to movement: Modelling energetic costs of avoiding marine wind farms amongst breeding seabirds	Marine Pollution Bulletin (journal)	2010	Masden *et al*	Published, peer reviewed scientific literature on bird behaviour and potential impacts from OWF	Information relating to the EIA process for offshore ornithology.
Developing guidance on ornithological cumulative impact	Collaborative Offshore Wind Research Into the	2009	King *et al.*	Published, peer reviewed scientific literature on bird behaviour and potential impacts from OWF	Information relating to the EIA process for offshore ornithology.

Title	Source	Date	Author	Summary	Coverage of Study Area
assessment for offshore windfarm developers.	Environment (COWRIE)				
Developing an avian collision risk model to incorporate variability and uncertainty.	Scottish Marine and Freshwater Science Report	2015	Masden *et al.*	Published, peer reviewed scientific literature on bird behaviour and potential impacts from OWF	Information relating to the EIA process for offshore ornithology.
Mapping Seabird Sensitivity to Offshore Wind Farms.	*PLOS ONE* (Journal)	2014	Bradbury *et al.*	Published, peer reviewed scientific literature on bird behaviour and potential impacts from OWF	Information relating to the EIA process for offshore ornithology.
Joint SNCB Interim Displacement Guidance Note	JNCC	2022	JNCC *et al.*	Published, peer reviewed scientific literature on bird behaviour and potential impacts from OWF	Generic information applicable to the Project's ornithological receptors.
Joint Response from the Statutory Nature Conservation Bodies to the Marine Scotland Science Avoidance Rate Review	JNCC	2014	JNCC *et al.*	Published, peer reviewed scientific literature on bird behaviour and potential impacts from OWF	Information relating to the EIA process for offshore ornithology.

12.4.3 Offshore site surveys

28. Species accounts presented on offshore ornithology consist of the data collected during 24 site-specific aerial digital video surveys of the Windfarm Site plus 4 km buffer (see **Figure 12.1**) carried out between May 2020 and April 2022, as detailed in **Appendix 12.1: Offshore and intertidal ornithology baseline technical report**.

12.4.4 Data limitations

29. The marine environment is highly variable, both spatially and temporally, and as such bird numbers may fluctuate greatly between months, seasons (see **Section 12.9**) and between different years at any given location. The site-specific baseline survey data collected to inform the assessments within this chapter were collected over a 24-month period and the method used to collect these data (aerial digital video) may be considered to represent a snapshot of each month.

30. The baseline survey data are consistent with data obtained from surveys conducted for other recent offshore wind farm applications in UK waters and are in general agreement with information from the desk study literature and previous surveys conducted within the North Sea. However, in this instance the coverage of aerial digital video survey effort represents 25% of the Windfarm Site plus 4 km buffer, which is double the coverage in comparison to the majority of surveys undertaken in UK waters for baseline characterisation purposes. Thus, these baseline data are considered to be representative of the Windfarm Site for the purpose of baseline characterisation.

31. A desk study has been used to inform and corroborate the site-specific survey data collected to inform baseline characterisation. There is an inherent limitation in such an approach as the data available have not been specifically collected to inform this EIA chapter and therefore the temporal scale, spatial scale, and methodological approaches might not be optimised for that purpose. Data

availability for some sources may be several years old, and therefore may not fully reflect the changing environment.

12.5 Scope of the assessment

12.5.1 Overview

32. This section sets out the scope of the EIA assessment for offshore ornithology receptors. This scope has been developed as the Projects design has evolved in response to feedback received to-date as set out in **Section 12.3**.

12.5.2 Spatial scope

33. The spatial scope of the offshore ornithology assessment is defined as the offshore part of the Project together with the Zones of Influence (ZOIs) (**Figure 12.1**)

34. This is based on an area which is considered to represent a realistic maximum spatial extent of potential impacts on ornithological receptors, based on literature of disturbance impacts and sensitivities associated with anthropogenic marine activities and Statutory Nature Conservation Body (SNCBs) guidance notes (Bradbury.*et al*., 2014; Furness *et al*., 2013; MMO, 2018 and Joint SNCB Interim Displacement Advice Note, 2022). The Study Area for assessment includes the Windfarm Site an area of 116.8 km^2 (located approximately 80 km offshore), with a 4 km buffer, two Offshore Export Cable Corridors with a 1 km corridor width, one of approximately 20 km to supply the Buzzard oil and gas Platform Complex (Buzzard), and the second of approximately 90 km to an onshore substation at New Deer in Aberdeenshire and the landfall onshore/offshore interface for the Offshore Export Cable area seaward of MHWS installed through horizontal directional drilling (HDD) 200-300 m offshore. Two potential landfalls are under consideration;

- Option one - NorthConnect Parallel south of Peterhead, runs alongside the consented NorthConnect Offshore Export Cable Corridor HVDC Link route.
- Option two - St Fergus South, north of Peterhead.

35. The array will comprise up to 35 WTGs and floating substructures, inter-array cables and one fixed offshore substation with a piled or suction type foundation. Each WTG is anticipated to have a rated capacity of between 14-16 MW and be anchored to the seabed by up to six mooring lines. The bathymetry of the Windfarm Site is generally a flat seabed with predominantly sand or muddy sand sediments and no significant underwater slopes or features. The Windfarm Site is located in water depths of approximately 110 m (against lowest astronomical tide (LAT)) (range 100 m to 115 m).

36. The Landfall Export Cable Corridors extends from the Windfarm Site to the landfall locations along the Aberdeenshire shore for connection to the electricity transmission network. A maximum of two dual redundant export cables will be installed to landfall that will run in proximity (up to 250 m) within the same cable corridor. Both landfall options are anticipated to be installed through HDD. HDD will be used to take the cable from a location 200-300 m offshore to the transition jointing pit for connection to onshore export cable. The Study Area for this component considers the Offshore Export Cable Corridors and the cable landfall area seaward of MHWS.

12.5.3 Temporal scope

37. The temporal scope of the assessment of offshore ornithology is the entire lifetime of the Project, which therefore covers the construction, operation and maintenance, and decommissioning phases.

38. It is anticipated that construction will begin in 2025, with an earliest operational date in 2027. The anticipated operational lifetime of the OWF will be 35 years; and decommissioning activities will take a maximum of two years.

12.5.4 Potential receptors

39. The spatial and temporal scope of the assessment enables the identification of offshore and intertidal ornithology receptors which may experience a change as a result of the Project. To determine the offshore ornithology baseline, site-specific aerial digital video surveys have been conducted for the Project as detailed in **Appendix 12.1: Offshore ornithology and intertidal baseline technical report**.

40. To determine intertidal ornithology associated with HDD landfall onshore/offshore interface for the Offshore Export Cable Corridor, surveys of breeding seabirds utilising the cliffs and vantage point surveys of birds utilising waters up to 500 m from shore at the NorthConnect Parallel Landfall site have been conducted for the Project as detailed in **Appendix 12.1: Offshore and intertidal ornithology baseline technical report**. This is due to the location of the Buchan Ness SPA breeding colony and the location of the proposed (and assessed) NorthConnect HDD drilling location on the cliff top overlooking the SPA. All offshore ornithology receptors identified during the baseline surveys that may interact with the Project are summarised in **Table 12.7.**

41. The St Fergus South Landfall Export Cable Corridor Option is located away from all known breeding locations and as HDD is proposed for the method of installation no impact is considered for the intertidal zone and subsequent impacts on winter breeding birds. Additionally, the HDD drilling compound will be located at least 200 m from the shoreline and will therefore have no impact on the intertidal zone as it is shielded by the Peterhead golf course and will only be present during the construction phase. After the construction phase, it will be a buried cable landing pit as per a standard HDD installation.

12.5.5 Potential impacts

42. The potential impacts on offshore ornithology receptors that have been scoped in for assessment are summarised in **Table 12.6.**

Table 12.6 Potential effects on offshore ornithology receptors scoped in for further assessment

Impact	Project Phase			Potential Effect
	C	O/M	D	
Temporary displacement and disturbance	✓	x	✓	Presence of vessels and installation and decommissioning works may temporarily disturb birds from foraging or resting areas.
Displacement and disturbance and barrier effects	x	✓	x	Presence of operational wind turbines and associated maintenance activities may disturb birds and displace them from their foraging or resting areas. Barrier effects arise when birds avoid passing through a wind farm either on migration or as part of its foraging routine.
Collision	x	✓	x	The operation of wind turbines has the potential to result in mortality through collisions to birds in flight.
Indirect effects via changes in prey or habitat availability	✓	✓	✓	Changes in prey or habitat availability may impact foraging success potentially reducing the survival or reproductive fitness of the birds impacted.
Entanglement with mooring lines	x	✓	x	Derelict/lost fishing gear could entangle in mooring lines with the potential for diving seabirds to become entangled.
Cumulative	✓	✓	✓	There is potential for the impacts from the Project to interact with those from other projects, plans and activities, resulting in a

Impact	Project Phase			Potential Effect
	C	O/M	D	
				cumulative effect on offshore ornithology
Transboundary	x	✓	x	Some of the offshore ornithology receptors considered within the project alone and cumulative impact assessments may also potentially encounter OWFs and other projects located outside UK territorial waters.

12.5.6 Activities or impacts scoped out for assessment

43. No potential impacts have been scoped out from further assessment, due to being determined as not having the potential to lead to a significant effect. These conclusions have been made based on the knowledge of the baseline environment, the nature of planned works and the wealth of evidence on the potential for impact from such projects more widely. The recommendations from the **Scoping Opinion** (**Appendix 1.1** of the **Offshore EIA Report**) and conclusions from the consultation process was that all activities and potential impacts, with inclusion of entanglement with mooring lines, should remain scoped in.

12.6 Existing environment

12.6.1 Current baseline conditions

44. A total of 21 species were recorded across the site-specific baseline surveys, with guillemot, fulmar, kittiwake and gannet the most frequently encountered species. These four species accounted for 93.2% of all birds recorded; guillemot (72.9%), fulmar (14.8%), kittiwake (2.8%) and gannet (2.7%).

45. Aerial surveys undertaken for baseline characterisation of the offshore windfarm site includes a surrounding 4 km buffer area agreed during stakeholder engagement (**Scoping Opinion Appendix I: Consultation Responses and Advice**). The size of the surrounding buffer area used for impact assessment takes into consideration the key species scoped in for assessment, advice from stakeholder consultation (**Table 12.4**) and the Joint SNCBs Interim Displacement Advice Note (2022) to reflect the potential distance from source impacts may have on a receptor

46. The bird species presented in **Table 12.7** were recorded within the site-specific baseline surveys. A number of species were only recorded in the site-specific baseline surveys in numbers determined by expert judgement to be too low to warrant detailed assessment due to the risk being considered to be very low (these species are in italic font within **Table 12.7**). Species determined to be screened in for further assessment were based on peak abundance and frequency of occurrence (**Table 12.15**), conservation status (**Table 12.8**) regional and national populations and consultation advice (**Table 12.3**). The species highlighted in bold in **Table 12.7**, considered to be the key bird species, form the basis of detailed assessments for this report.

Table 12.7 Bird species recorded in site-specific aerial digital surveys of the Project's array plus 4 km buffer. Species given in italics were recorded at too low levels to warrant detailed assessment.

Divers and pelagic species	Gulls	Terns	Auks	Other
Fulmar *Fulmarus glacialis*	**Kittiwake** *Rissa tridactyla*	*Arctic tern* *Sterna paradisaea*	**Guillemot** *Uria aalge*	*Fieldfare* *Turdus pilaris*
Gannet *Morus bassanus*	*Common gull* *Larus canus*	*Arctic / common tern* *Sterna paradisaea /hirundo*	**Razorbill** *Alca torda*	*Redwing* *Turdus iliacus*

Divers and pelagic species	Gulls	Terns	Auks	Other
Arctic skua (Stercorarius parasiticus	**Great black-backed gull** *Larus marinus*		**Puffin** *Fratercula arctica*	
Great skua Stercorarius skua	**Herring gull** *Larus argentatus*		*Little auk Alle alle*	
Manx shearwater (Puffinus puffinus	*Lesser black-backed gull Larus fuscus*			
Red-throated diver Gavia stellata				
European storm-petrel *Hydrobates pelagicus*				

47. Relevant surveys were utilised for assessment of the Offshore Export Cable Corridors and HDD offshore exit point to assess receptor baselines of species identified as utilising the proposed development site and surrounding areas. These included colonial counts and vantage point survey data. The final landfall location has not yet been selected, with two potential sites north or south of Peterhead; however, only the southern route has the potential to interact with the Buchan Ness to Collieston SPA and Special Area of Conservation (SAC), dependent on cabling route to the transition jointing location at New Deer. Desk-based studies including consulting publicly available online resources and most recently updated guidance documents enabled informed consideration of species that utilise solely terrestrial and terrestrial and marine environments, including gaining information on seasonal and annual timings and foraging characteristics. See **Section 2** of **Appendix 12.1: Offshore and Intertidal Ornithology Baseline Technical Report** for the full list of resources used for the desk-based study.

48. The northern route landfall area, the St Fergus South Landfall, extends south from Cuttie Burn stream, Aberdeenshire to north of Buchanhaven, Peterhead, Aberdeenshire adjacent to North Ugie Water, extending along *c.* 2.36 km of coastline. The southern route landfall area, the NorthConnect Parallel Landfall, stretches south from the Cave of Inch More, Boddam, Aberdeenshire to the mainland adjacent to the island of Hare Craig, Aberdeenshire extending along *c.* 2.81 km of coastline. Landfall locations are presented in **Figure 12.2.** Note that no site-specific survey data was available for the northern half of the NorthConnect Parallel landfall or for the St Fergus South landfall.

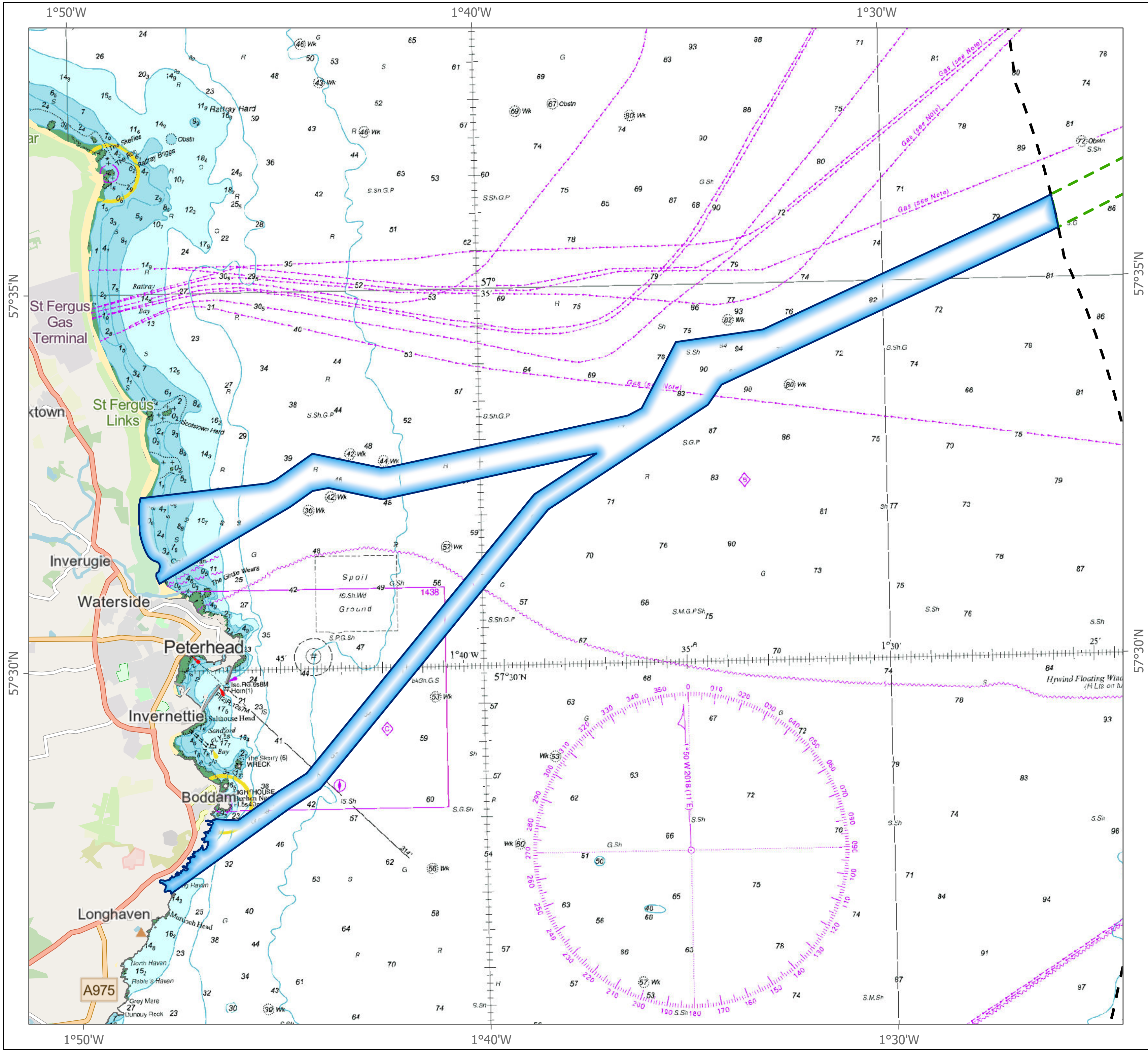
12.6.1.1 St Fergus South, north of Peterhead option

49. The northern route (north of Peterhead, the St Fergus South Landfall) is located in an area where there are no designated sites or noted breeding sites. As HDD drilling is also proposed for this location with potential exit points between 200 - 300 m from the shoreline there is no interaction with intertidal over wintering birds that may be present in this area of the coastline (the coastline is sandy beaches backed by the Peterhead golf club). Desk based literature reviews identified low densities of nine key species with potential utilization of the nearshore area:

- Kittiwake;
- Black-headed gull;
- Common gull;
- Great black-backed gull;
- Razorbill.
- Guillemot;
- Herring gull;
- Lesser black-backed gull;
- Sandwich tern and;

12.6.1.2 NorthConnect Parallel south of Peterhead option

50. Survey data (NorthConnect, 2017) that encompasses areas of the southern landfall area south of Peterhead (NorthConnect Parallel Landfall) has been used to assess impacts upon bird species within this area. The NorthConnect (2017) survey area comprised the southern half of the NorthConnect Parallel Landfall location, extending *c.* 2.32 km south from Cat's Bank, Aberdeenshire to approximately 1.24 km beyond the landfall southern boundary.



LEGEND

- Inshore cable route options
- Offshore cable route
- Scottish Inshore Region limit (from Mean High Water Springs to 12 nautical miles)

0 — 6 Kilometres

Data:
UKHO, © British Crown and OceanWise, 2022. All rights reserved. License No. EK001-FN800-004794. Not to be used for Navigation.

Esri, HERE, Garmin, USGS
Esri, HERE
Map data © OpenStreetMap contributors, Microsoft, Facebook, Inc. and its affiliates, Esri Community Maps contributors, Map layer by Esri

PROJECT: GREEN VOLT

TITLE: Fig 12.2 Location of Green Volt Offshore Export Cable Corridors Landfall Options

REV	DATE	COMMENTS	DRAWN	CHECKED
001	05/07/2022		SK	VC

ARCGIS REF: FLO_GRE_GIS_PRJ001_Green_Volt_Rev001
DRAWING: FLO-GRE-GIS-MAP011-Inshore Route Options-Rev001

SCALE:	PAGE SIZE:	COORDINATE SYSTEM:
1:125,000	A4	WGS 1984 UTM Zone 30N

GREEN VOLT

51. The data identified some areas of very low densities of seabirds nesting on cliffs during the peak breeding months (May 2014). One area consisted of a grass bank with a small stony beach at the base, with the only notable bird activity being kittiwakes collecting nesting materials. Vantage point surveys out to 2 km from the coast conducted between February 2016 and January 2017 recorded thirteen seabird species, with highest total counts being from June (9,819 birds), reaching lowest numbers in February. Six key species were identified including:

- Fulmar;
- Kittiwake;
- Guillemot;
- Razorbill;
- Herring gull; and
- Shag.

52. During the non-breeding period, the majority of these birds consisted of guillemot. A high number of juvenile kittiwakes were observed in August, predominantly observed on the water close to the cliffs but not on land. On the water, only fulmar and herring gull were observed within an area that would potential reside within a 100 m buffer of the HDD offshore emergence point. A small number of other species were recorded using the cliffs or sea within the survey area, including cormorant, eider, red-throated diver, northern gannet, puffin, lesser black-backed gull and great black-backed gull.

12.6.2 Conservation status of offshore ornithology receptors

53. The conservation status of the key species recorded during the survey programme and form the basis of detailed assessments are provided in **Table 12.8** below. Red list status is from the fifth edition of Birds of Conservation Concern in the United Kingdom (BoCC5; Stanbury *et al.*, 2021).

Table 12.8 Summary of nature conservation value of species considered at potential risk of impacts

Species	Conservation status
Fulmar	BoCC5 Amber listed; Birds Directive Migratory Species
Gannet	BoCC5 Amber listed; Birds Directive Migratory Species
Kittiwake	BoCC5 Red listed; Birds Directive Migratory Species, OSPAR listed Species (threatened/declining)
Great black-backed gull	BoCC5 Amber listed; Birds Directive Migratory Species
Herring gull	BoCC5 Red listed; Birds Directive Migratory Species
Guillemot	BoCC5 Amber listed; Birds Directive Migratory Species
Razorbill	BoCC5 Amber listed; Birds Directive Migratory Species
Puffin	BoCC5 Red listed; Birds Directive Migratory Species
European storm-petrel	BoCC5 Amber listed; Birds Directive Migratory Species; Birds Directive Annex 1

12.6.3 Future baseline offshore

54. There are currently no known other proposed developments within close proximity likely to influence the Project's offshore Study Area. In the absence of significant local impacts, it is likely that the populations of bird species present will evolve in accordance with regional and national trends. The earliest possible date for the start of the offshore construction of the Project is Q4 2025 with an anticipated operational life of 35 years and therefore there exists the potential for the baseline to evolve between the time of assessment and point of impact. Outside of short-term or seasonal fluctuations, changes to the baseline in relation to offshore ornithology usually occur over an extended period. Based on current information regarding reasonably foreseeable events over the next two years, the baseline would not normally be anticipated to fundamentally change from its current state at the point in time when impacts occur. However, it is acknowledged that there has been reported bird mortality from Highly Pathogenic Avian Influenza (H5N1) during the 2022 breeding season, which has caused impacts that have varied considerably between species and colonies. At present, as it is uncertain what the wider population effects are for individual species or

at different bio-geographical scales to interpret changes to the baseline for key species in the assessment. However, as determined by a recent Natural England recommendation to the Department of Environment, Food and Rural Affairs (DEFRA) on bird flu (Natural England, 2022) as the baseline data for the Project were collected prior to the current outbreak of Bird Flu the assessments within this report remain a valid representation of typical seabird distribution and density, which are also able to be assessed against the baseline populations prior to the outbreak.

55. The baseline environment for operational / decommissioning impacts is expected to evolve on a species by species basis, which is described in detail in the impact assessments when population level impacts are considered (mostly at the cumulative level in **Section 12.13.1**) over the lifetime of the Project of 35 years. Additional consideration that any changes during the construction phase will have altered the baseline environment to a degree are also set out in this chapter. Changes in populations are highly likely to result from climatic change, other natural phenomena (such as the recent avian influenza epidemic) and anthropogenic activities such as changes in fishing activities indirectly affecting offshore ornithology receptors. Baseline conditions are therefore not static and are likely to exhibit some degree of change over time, with or without the Project in place.

12.7 Basis for EIA assessment

12.7.1 Key parameters for assessment

56. Assessing using a parameter-based design envelope approach means that the assessment considers a maximum design scenario, whilst allowing the flexibility to make improvements in the future in ways that cannot be predicted at the time of submission of the **Offshore EIA Report** as part of the Marine Licence Application. The assessment of the maximum adverse scenario for each receptor establishes the maximum potential adverse impact and as a result impacts of greater adverse significance would not arise should any other development scenario (as described in **Chapter 5: Project Description**) to that assessed within this Chapter be taken forward in the final scheme design.

12.7.2 Worst Case

57. The maximum parameters and assessment assumptions that have been identified to be relevant to offshore ornithology are outlined in **Table 12.9** and are in line with the **Chapter 5: Project Description**.

Table 12.9 Worst case assumptions

Impacts	Parameters	Notes and Rationale
Construction		
Construction activities within the Windfarm Site associated with foundations and WTGs may lead to disturbance and displacement of species within the array and different degrees of buffers surrounding it to a lower extent.	Construction vessels – indicative maximums and return trips to port. *FOWT Seabed Preparation: Supply Vessel / Survey Vessel* 2 vessels in total / on site at one time for TLP with suction piles with 2 return trips. 2 in total / on site at one time for drag anchors. 2 return trips. *FOWT Foundation Installation: Tugs / Anchor Handling Vessel* 3 in total / 2 on site at one time for TLP with suction piles. 90 return trips. 3 in total / 2 on site at one time for drag anchors/suction anchors. 60 return trips. *FOWT Installation: Wind farm service vessel* 1 in total / on site at one time for TLP with suction piles. 30 return trips. 1 in total / on site at one time for drag anchors. 30 return trips. *FOWT Installation: Tugs / Anchor Handling Vessel* 2 in total / on site at one time for TLP with suction piles. 70 return trips. 2 in total / on site at one time for drag anchors. 70 return trips. *OSP / OCP Installation: Support Vessels* 1 in total / on site at one time for TLP with suction piles. 3 return trips. 1 in total / on site at one time for drag anchors. 3 return trips. *OSP / OCP Installation: Dynamic Position Heavy Lift Vessels* 1 in total / on site at one time for TLP with suction piles. 2 return trips. 1 in total / on site at one time for drag anchors. 2 return trips.	Disturbance and displacement reduce the amount of functional habitat available for foraging, resting and other activities and may therefore reduce survival or reproductive fitness of the birds involved. The maximum estimated number of development areas within the Windfarm Site with vessels operating concurrently would cause the greatest disturbance to birds on site.
Construction activities associated with export cable laying may lead to disturbance and displacement of species within the Offshore Export Cable Corridors and different degrees of buffers surrounding it to a lower extent.	Construction vessels – indicative maximums *Cable Installation: IA Cable Installation Vessels* 1 in total / on site at one time for TLP with suction piles. 5 return trips. 1 in total / on site at one time for drag anchors. 5 return trips. *Cable Installation: Export Cable Installation Vessels:* 1 in total / on site at one time for TLP with suction piles. 3 return trips. 1 in total / on site at one time for drag anchors. 3no return trips.	Disturbance and displacement reduce the amount of functional habitat available for foraging, resting and other activities and may therefore reduce survival or reproductive fitness of the birds involved. The assumption is that vessels would be *in situ* from start to finish, so any disturbance events would be throughout entire period.

Impacts	Parameters	Notes and Rationale
	Cable Installation: Pre-trenching Vessels: 1 in total / on site at one time for TLP with suction piles. 3 return trips. 1 in total / on site at one time for drag anchors. 3 return trips. *Cable Installation: Cable Survey Vessels:* 1 in total / on site at one time for TLP with suction piles. 3 return trips. 1 in total / on site at one time for drag anchors. 3 return trips. *Cable Installation: Commissioning Vessels:* 1 in total / on site at one time for TLP with suction piles. 1 return trips. 1 in total / on site at one time for drag anchors. 1 return trips. *Other Vessels: Crew transfer* 1 in total / on site at one time for TLP with suction piles. Unknown return trips. 1 in total / on site at one time for drag anchors. Unknown return trips.	
Indirect impacts during the construction phase within the Windfarm Site through effects on habitats and prey species. Array Turbine, OSP and array cable installation would lead to temporary disturbance of the seabed leading to an increase in suspended sediments (e.g. during installation of cables). These may alter the distribution, physiology or behaviour of bird prey species. It may also make it harder for foraging seabirds to locate their prey in the water column. These mechanisms could potentially result in less prey being available in the area adjacent to active construction works to foraging seabirds.	See Maximum Design Scenario for **Chapter 9 Benthic Ecology** and **Chapter 10: Fish and Shellfish Ecology.**	A reduction in prey availability may reduce the survival or reproductive fitness of the birds involved. Indirect effects on birds could occur through changes to any of the species and habitats considered within **Chapter 9 Benthic Ecology** and **Chapter 10: Fish and Shellfish Ecology.**. The maximum indirect impact on birds would result from the maximum direct impact on fish, shellfish and benthic species and habitats. The maximum design scenario is therefore as per justifications within **Chapter 9 Benthic Ecology** and **Chapter 10: Fish and Shellfish Ecology.**.
Operation		
Operational activities associated with moving turbines and maintenance vessels may lead to disturbance and displacement of species within the Windfarm Site and different degrees of buffers surrounding it.	Windfarm Site Total Windfarm Site: 116 km^2. WTGs Max no. WTG: 35 Maximum height of lowest blade tip above LAT (TLP) / MSL (catenary): 264 m	Displacement would be assumed from the entire Windfarm Site that contains WTGs and other associated structures, which maximises the potential for disturbance and displacement. Assessment of extent / varying displacement from Windfarm Site and a buffer is species specific due to their sensitivity levels.

Impacts	Parameters	Notes and Rationale
	Minimum height of lowest blade tip above LAT (TLP) / MSL (catenary): 22 m Maximum rotor blade radius: 110 m Maximum blade width: 8 m O&M Maintenance campaigns: 2 Vessels: 1 in total / on site Small O&M Vessel 1 in total / on site Lift Vessel 1 in total / on site Cable Maintenance Vessel 1 in total / on site Auxiliary Vessels O&M vessel round trip per vessel: Upper estimate of a single movement: 150 km Lower estimate of a single movement: 100 km Helicopter trips to Site per week: 0.2	
The presence of WTGs could create a barrier to the migratory or regular foraging movements of seabirds.	Minimum spacing between WTG: 1,540 m Maximum spacing between WTG: 1,936 m	The measurement would be North to South to define the additional effort required for birds to fly around the Windfarm Site to the North or South from FFC colony during the breeding if assumed to be commuting to foraging areas beyond Windfarm Site to the East.
Seabirds flying through the Windfarm Site during the operational phase are at risk of collision with WTG rotors and associated infrastructure.	Windfarm Site WTG deployment across the full Windfarm Site (116 km^2). WTGs Max no. WTG: 35 Maximum height of lowest blade tip above LAT (TLP) / MSL (catenary): 264 m Minimum height of lowest blade tip above LAT (TLP) / MSL (catenary): 22 m Maximum rotor blade radius: 121 m Maximum blade width: 8 m	This represents the maximum number of the largest WTGs, which represents the greatest total swept area to be considered for collision risk.
Indirect effects via prey / habitats: array		

Impacts	Parameters	Notes and Rationale
Decommissioning		
Decommissioning activities associated with moving turbines and maintenance vessels may lead to disturbance and displacement of species within the Windfarm Site and different degrees of buffers surrounding it.	Decommissioning vessels – indicative maximums and return trips to port. *FOWT Seabed Preparation: Supply Vessel / Survey Vessel* 2 vessels in total / on site at one time for TLP with suction piles with 2 return trips. 2 in total / on site at one time for drag anchors. 2 return trips. *FOWT Foundation Removal: Tugs / Anchor Handling Vessel* 3 in total / 2 on site at one time for TLP with suction piles. 90 return trips. 3 in total / 2 on site at one time for drag anchors. 60 return trips. *FOWT Removal: Wind farm service vessel* 1 in total / on site at one time for TLP with suction piles. 30 return trips. 1 in total / on site at one time for drag anchors. 30 return trips. *FOWT Removal: Tugs / Anchor Handling Vessel* 2 in total / on site at one time for TLP with suction piles. 70 return trips. 2 in total / on site at one time for drag anchors. 70 return trips. *OSP / OCP Removal: Support Vessels* 1 in total / on site at one time for TLP with suction piles. 3 return trips. 1 in total / on site at one time for drag anchors. 3 return trips. *OSP / OCP Removal: Dynamic Position Heavy Lift Vessels* 1 in total / on site at one time for TLP with suction piles. 2 return trips. 1 in total / on site at one time for drag anchors. 2 return trips.	Disturbance and displacement reduce the amount of functional habitat available for foraging, resting and other activities and may therefore reduce survival or reproductive fitness of the birds involved. The maximum estimated number of development areas within the Windfarm Site with vessels operating concurrently would cause the greatest disturbance to birds on site.
Decommissioning activities associated with export cable laying may lead to disturbance and displacement of species within the Offshore Export Cable Corridors and different degrees of buffers surrounding it.	Decommissioning vessels – indicative maximums Cable Removal: IA Cable Installation Vessels 1 in total / on site at one time for TLP with suction piles. 5 return trips. 1 in total / on site at one time for drag anchors. 5 return trips. Cable Removal: Export Cable Installation Vessels: 1 in total / on site at one time for TLP with suction piles. 3 return trips. 1 in total / on site at one time for drag anchors. 3no return trips. Cable Removal: Pre-trenching Vessels:	Disturbance and displacement reduce the amount of functional habitat available for foraging, resting and other activities and may therefore reduce survival or reproductive fitness of the birds involved. The assumption is that vessels would be in situ from start to finish, so any disturbance events would be throughout entire period.

Impacts	Parameters	Notes and Rationale
	1 in total / on site at one time for TLP with suction piles. 3 return trips. 1 in total / on site at one time for drag anchors. 3 return trips. Cable Removal: Cable Survey Vessels: 1 in total / on site at one time for TLP with suction piles. 3 return trips. 1 in total / on site at one time for drag anchors. 3 return trips. Cable Removal: Commissioning Vessels: 1 in total / on site at one time for TLP with suction piles. 1 return trips. 1 in total / on site at one time for drag anchors. 1 return trips. Other Vessels: Crew transfer 1 in total / on site at one time for TLP with suction piles. Unknown no. return trips. 1 in total / on site at one time for drag anchors. Unknown no. return trips.	
Indirect impacts during the decommissioning phase within the Offshore Export Cable Corridors and landfall through effects on habitats and prey species.	See Maximum Design Scenario for **Chapter 9 Benthic Ecology** and **Chapter 10: Fish and Shellfish Ecology.**	Indirect effects on birds could occur through changes to any of the species and habitats considered within **Chapter 9 Benthic Ecology** and **Chapter 10: Fish and Shellfish Ecology.** The maximum indirect impact on birds would result from the maximum direct impact on fish, shellfish and benthic species and habitats. The maximum design scenario is therefore as per justifications **Chapter 9 Benthic Ecology** and **Chapter 10: Fish and Shellfish Ecology.**

12.7.3 Embedded mitigation

58. As part of the Project design process, a number of embedded mitigation measures have been adopted to reduce the potential for adverse effects on offshore ornithology receptors.

59. These measures typically include those that have been identified as good or standard practice and include actions that would be undertaken to meet existing requirements. the Project is committed to implementing these mitigation measures as they form of the design of the Project.

60. **Table 12.10** sets out the relevant embedded mitigation measures that are considered to be of benefit to offshore ornithology receptors to reduce potential effects.

Table 12.10 Relevant offshore ornithology embedded environmental measures

ID	Environmental measure proposed	Project phase measure introduced	How the environmental measures will be secured	Relevance to offshore and intertidal ornithology assessment
1	Initial site selection process for the Green Volt windfarm site. An initial site selection assessment was undertaken using the recently (Cleasby *et al.* 2018) published RSPB Hotspot mapping GIS data layers. These data were used to help support the selection of the windfarm site over sites to the west and due east of the Buzzard oil and gas platform. These data suggested higher seabird numbers than the Windfarm Site and therefore the Site was selected. Additionally, in 2019, the site was outside the maximum foraging range for Kittiwake from any Scottish bird colony.	Site selection	Distance from the nearest breeding colony.	Enhanced distance from identified colonies will significantly lower the potential bird numbers observed at site and therefore potential number of seabirds reduced significantly.
2	Development of and adherence to a Project Environmental Monitoring Programme (PEMP), which will set out commitments to environmental monitoring in pre-, during and post-construction Project phases.	All phases	Required under Section 36 and Marine Licence consent conditions.	Monitor and validate the impacts predicted within this chapter.
3	Development of and adherence to a Vessel Management Plan (VMP). The VMP will confirm the types and numbers of vessels that will be engaged on the Project and consider vessel coordination including indicative transit route planning.	All phases	Required under Section 36 and Marine Licence consent conditions.	Reduced the spatial extent and magnitude of impact from disturbance and displacement of construction and maintenance vessels.
4	Development of and adherence to a Lighting and Marking Plan (LMP). The LMP will confirm compliance with legal requirements with regards to shipping, navigation and aviation marking and lighting.	All phases	Required under Section 36 and Marine Licence consent conditions.	Minimise the risk of birds becoming attracted to or disorientated by WTGs at night or in poor weather
5	HDD works at the NorthConnect Parallel landfall option (if chosen) will be undertaken outside the bird breeding season (Apr-Aug incl) to avoid disturbance of cliff nesting birds in the Buchan Ness to Collieston Coast SPA.	Construction phase	The Applicant will commit to this seasonal restriction in HDD works.	HDD works outside the breeding season will avoid disturbance to nesting cliff birds and provisioning.

12.8 Assessment Methodology for EIA

12.8.1 Impact Assessment Methodology

61. The general method for EIA is described in **Chapter 6: EIA Methodology**. Details relating specifically to the assessment of offshore ornithology are provided below. The assessment approach uses a 'source-pathway-receptor' model, which identifies likely impacts on offshore ornithology receptors resulting from the proposed construction, operation and decommissioning of the offshore infrastructure. The parameters of this model are defined as follows:

- Source – the origin of a potential impact (noting that one source may have several pathways and receptors) e.g., an activity such as cable installation and a resultant effect such as re-suspension of sediments.
- Pathway – the means by which the effect of the activity could impact the receptor e.g., for the example above, re-suspended sediment could settle and smother immobile benthic species, causing a reduction in prey availability.
- Receptor – the element of the receiving environment that is impacted e.g., for the above example, seabirds which are unable to forage effectively due to a reduction in benthic prey availability.

12.8.1.1 Evaluating potential receptors

62. The assessment process involves identifying Valued Ornithological Receptors (VORs). These receptors and their conservation value are determined by the criteria defined in **Table 12.11**. These criteria are intended as a guide and are not definitive.

Table 12.11 Definition of conservation value levels for ornithological receptors

Value	Definition
High	A species for which individuals at risk can be clearly connected to a particular SPA or is found in numbers of international importance within the Windfarm Site during a particular season.
Medium	A species for which individuals at risk are probably drawn from particular SPA populations or found in numbers of national importance within the Windfarm Site during a particular season, although other colonies (both SPA and non-SPA) may also contribute to individuals observed in the offshore and intertidal ornithology Study Area.
Low	A species for which it is not possible to attribute to particular SPAs and may be found in regionally or locally important numbers during specific seasons within the offshore and intertidal ornithology study area.
Negligible	All other species that are widespread and common and which are not present in locally important (or greater) numbers and which are of low conservation concern (e.g. UK BoCC5 Green List species; Stanbury *et al.*, 2021).

63. The assessment of potential receptors considers the importance of the Study Area (including the Windfarm Site, appropriate buffers surrounding it, the Offshore Export Cable Corridors area and cable landfall) for the bird species under consideration. To illustrate the rationale of this approach, whilst little gull may be a species of high conservation importance using the criteria in **Table 12.11**, by virtue of being a schedule one species, the importance of the Study Area to this species is considered limited if only one sighting of four birds flying over the Study Area have been identified in the baseline. As such, while the conservation value of the species is considered, the number of individuals of that species using the Study Area, and the nature and level of this use, is also considered. An assessment is then made of the importance of the Windfarm Site to the species in question.

12.8.1.2 Characterising potential impacts

64. The sensitivity of the offshore and intertidal ornithology receptors to potential impacts is determined subjectively based on species' ecology and behaviour, using the criteria set out in **Table 12.12**. The

judgement takes account of information available on the responses of birds to various stimuli (e.g. predators, noise and visual disturbance, existing OWFs where such data exist) and whether a species' ecology makes it vulnerable to potential impacts (e.g. bird species that typically fly at heights that overlap with the rotor-swept area are considered to be more sensitive to collision risk with the moving blades of WTGs than species that fly much higher or lower than the rotor-swept area that avoid collision risk). A description is provided in **Table 12.12** of how sensitivity might be assessed for the impact of disturbance by human activities, but the general approach can be applied to any impact.

Table 12.12 Definitions of level of sensitivity for ornithological receptors

Sensitivity	Definition
High	Bird species has very limited tolerance to sources of disturbance such as noise, light, vessel movements and the sight of people
Medium	Bird species has limited tolerance to sources of disturbance such as noise, light, vessel movements and the sight of people
Low	Bird species has some tolerance to sources of disturbance such as noise, light, vessel movements and the sight of people
Negligible	Bird species is generally tolerant to sources of disturbance such as noise, light, vessel movements and the sight of people

65. Sensitivity can differ between similar species, between different populations of the same species, between different individuals within a population and also differ in the same individual during different times. Thus, the behavioural responses of offshore ornithology receptors are likely to vary with both the nature and context of the stimulus and the experience of the individual bird. Sensitivity also depends on the activity of the bird.

66. In addition, individual birds of the same species will differ in their tolerance depending on the level of human disturbance that they regularly experience in a particular area, and have become habituated to (e.g., individuals that forage within close proximity to an area with high human activity levels are likely to have a greater tolerance than those that occupy remote locations with little or no human presence).

67. Consideration of the level of sensitivity with regards to individual ornithology receptors is one of the core components of the assessment of potential impacts and their effects.

68. In addition, each receptor's conservation value is also considered using reasoned judgement when determining their overall sensitivity to any potential impact or effect. For example, herring gull is a red listed species of conservation concern across the UK in BoCC5 (Stanbury *et al.*, 2021), but not judged to be sensitive to anthropogenic disturbance given its propensity to forage successfully on active landfill sites, utilise development structures including WTGs to perch on and to breed within urban environments on industrial and residential building roof tops. Such reasoned judgement is an important part of the overall narrative used to determine potential impact significance and is used, where relevant, as a mechanism for modifying the sensitivity of an effect assigned to a specific receptor.

69. Using expert judgement (CIEEM, 2019), both the conservation value (**Table 12.11**) and sensitivity (**Table 12.12**) of a receptor are used to determine their overall sensitivity in the assessment as summarised in **Table 12.15**.

12.8.1.3 Magnitude

70. Impacts on receptors are judged in terms of their magnitude. Magnitude refers to the scale of an impact and is determined on a quantitative basis where possible. This may relate to the area of habitat lost to the development footprint in the case of a habitat feature or predicted loss of

individuals in the case of a population of a species of bird. Magnitude is assessed within four levels, as detailed in **Table 12.13**.

Table 12.13 Definition of levels of potential magnitude of change for ornithological receptors

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

71. Knowledge of how rapidly the population or performance of a species is likely to recover following loss or disturbance (e.g., by individuals being recruited from other populations elsewhere) is also used to assess impact magnitude, where such information is available.

12.8.1.4 Impact Significance

72. The CIEEM guidelines (2019) use only two categories to classify effects: “significant” or “not significant”. The significance of an effect is determined by considering the overall importance (defined here as the overall sensitivity) of the receptor and the magnitude of the impact using a matrix-based approach (**Table 12.14**) and applying professional judgement as to whether the integrity of the feature will be affected.

73. Effects are more likely to be considered significant where they affect ornithological features of higher overall sensitivity or where the magnitude of the impact is high. Effects not considered to be significant would be those where the integrity of the feature is not threatened, effects on features of lower overall sensitivity, or where the magnitude of the impact is low.

Table 12.14 Matrix used for the assessment / assignment of the potential significance of effect

		Negative Magnitude				Beneficial Magnitude			
		High	Medium	Low	Negligible	Negligible	Low	Medium	High
Sensitivity	High	Major	Major	Moderate	Minor	Minor	Moderate	Major	Major
	Medium	Major	Moderate	Minor	Minor	Minor	Minor	Moderate	Major
	Low	Moderate	Minor	Minor	Negligible	Negligible	Minor	Minor	Moderate
	Negligible	Minor	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Minor

12.8.1.5 Evaluation of potential receptors and impacts

74. The assessment of impacts within this **Offshore EIA Report** follows CIEEM guidelines (CIEEM, 2019) with regards to the emphasis being on “significant effects rather than all ecological effects”. Therefore, potential receptors which are determined to be of low or negligible sensitivity or are assessed as being subject to impacts of negligible magnitude are not considered further in this assessment. Significant effects on these species are not predicted given their infrequent occurrence in the survey area and/or low conservation status. The Applicant’s justification for scoping in or out ornithological receptors is provided in **Table 12.15** below.

Royal HaskoningDHV   GREEN VOLT

Table 12.15 Summary of Valued Ornithological Receptors and Potential Impacts.

Potential receptor	Behaviour Sensitivity Rationale (Table 12.12; Bradbury et al., 2014; Furness et al., 2012; Joint SNCB (Updated, 2022))		Conservation Value Rationale (Table 12.11)	Conservation value (Table 12.11)	Overall value (Table 12.12 & Table 12.11)	Peak abundance within Windfarm Site / Windfarm Site plus 4 km buffer (individuals)	Frequency of months recorded within Windfarm Site / Windfarm Site plus 4 km buffer	Potential Impacts		
								Collision Risk	Disturbance and displacement	Entanglement
Guillemot	Medium	Low	Individuals recorded within the project area are likely be a mix of qualifying features of different designated sites within foraging range (SPAs, Ramsar sites) and individuals not associated with designated sites. Species afforded special protection under Schedule 1 / Annex 1 and are either BoCC5 amber or red-listed (Stanbury *et al.*, 2021).	Medium	Medium	18,045 / 43,507	24 / 24	× a	✓	✓
Fulmar	Low	Low		Medium	Low	955 / 3,169	24 / 24	× a	× b	× c
Kittiwake	Low	High		Medium	Medium	269 / 404	23 / 24	✓	× b	× c
Gannet	Low	High		Medium	Medium	184 / 349	19 / 24	✓	✓	✓
Razorbill	Medium	Low		Medium	Medium	340 / 1,030	15 / 20	× a	✓	✓
Puffin	Medium	Low		Medium	Medium	244 / 560	14 / 15	× a	✓ d	✓
European storm petrel	Low	Low		Medium	Low	51 / 52	2 / 3	× a	× b	× c
Great black-backed gull	Low	High	Individuals not a qualifying feature of any designated site within species foraging range but afforded species protection under Schedule 1 / Annex 1 and/ or BoCC5 amber or red-listed (Stanbury *et al.*, 2021).	Low	Medium	67 / 291	9 / 15	✓	× b	× c
Herring gull	Low	High		Low	Medium	78 / 136	5 / 14	✓	× b	× c
'Commic' tern*	Low	Medium	Migratory Individuals unlikely to be a qualifying feature of any designated site within species foraging range and recorded infrequently but afforded species protection under Schedule 1 / Annex 1 and/ or BoCC5 amber or red-	Low	Low	51 / 123	2 / 2	× e, f	× b	× c
Arctic tern	Low	Low		Low	Low	0 / 4	0 / 1	× e, f	× b	× c
Great skua	Low	Medium		Low	Low	8 / 17	1 / 3	× e, f	× b	× c
Arctic skua	Low	Medium		Low	Low	0 / 4	0 / 1	× e, f	× b	× c

Potential receptor	Behaviour Sensitivity Rationale (Table 12.12; Bradbury et al., 2014; Furness et al., 2012; Joint SNCB (Updated, 2022))		Conservation Value Rationale (Table 12.11)	Conservation value (Table 12.11)	Overall value (Table 12.12 & Table 12.11)	Peak abundance within Windfarm Site / Windfarm Site plus 4 km buffer (individuals)	Frequency of months recorded within Windfarm Site / Windfarm Site plus 4 km buffer	Potential Impacts		
								Collision Risk	Disturbance and displacement	Entanglement
Manx shearwater	Low	Low	listed (Stanbury *et al.*, 2021).	Low	Low	4 / 4	1 / 1	× a	× b	× c
Red-throated diver	High	Medium	Individuals not a qualifying feature of any designated site within species foraging range and recorded infrequently but afforded species protection under Schedule 1 / Annex 1 and/ or BoCC5 amber or red-listed (Stanbury *et al.*, 2021).	Low	Low	0 / 8	0 / 1	× a	× f	× f
Lesser black-backed gull	Low	High		Low	Low	17/25	1/1	× f	× b	× c
Common gull	Low	High		Low	Low	17 / 38	2 / 6	× f	× b	× c
Little gull	Low	Medium		Low	Low	4 / 4	1 / 2	× f	× b	× c
Little auk	Low	Low		Low	Low	16 / 16	1 / 1	× a	× b	× c
Redwing	N/A	N/A		Low	Low	0 / 235	0 / 1	× f	× f	× c
Fieldfare	N/A	N/A		Low	Low	0 / 20	0 / 1	× f	× f	× c

Notes: a. Species flight behaviour indicates as very low risk of collision (Bradbury *et al.*, 2014); b. Classified as having low to very low vulnerability to disturbance and displacement.; (Furness *et al.*, 2012; Bradbury *et al.*, 2014).; c. non-deep diving species therefore at low risk of underwater entanglement due to its foraging behaviour.; d. Despite species being classified as low vulnerability to disturbance and displacement screened in based on Joint SNCB (Updated, 2022) guidance.; e. Recorded in limited number of months and only and likely only present on migration, therefore limited risk of collision.; f. Recorded in negligible numbers; therefore, the level of potential impact would be indistinguishable from natural fluctuations in BDMPS baseline mortality rate.

12.8.2 European storm petrel

75. European storm-petrels are a summer and passage visitor to eastern Scotland and were recorded on two occasions (May 2020 and August 2021) within the Windfarm Site in estimated abundances of 21 and 51 birds, respectively, during the two years of baseline surveys. The species was recorded in flight with a directional heading either southeast to open water or towards northern colonies.

76. Given the breeding season for European storm petrel is from mid-May to October (NatureScot, 2020) the birds recorded are likely to be breeding birds from northern colonies. Further evidence to support this is shown in data from tracking studies on birds from Mousa SPA (Bolton, 2021), an island off the southeast of Shetland, which is the UK's largest colony of European storm petrel. This study suggests the potential for European storm petrel foraging trips to extend or pass through the Windfarm Site from breeding colonies to the north. However, the study data indicated the Windfarm Site is not a favoured or important area for foraging by birds from this colony, given it is located outside the 95% utilisation distribution (Bolton, 2021).

77. European storm-petrel is not considered in the BDMPS review by Furness (2015), but the analysis of ESAS data undertaken by Stone *et al*. (1995) indicates mean densities of around 0.1 birds / km^2 from July to September for the western North Sea. More recent modelled distribution maps support considerably low usage (<0.1 birds / km^2) of the Windfarm Site and surrounding area by European storm petrel in comparison to areas further offshore and more northerly on the continental shelf (Waggit *et al*., 2019). Mean peak density across the Windfarm Site plus 4 km buffer was 0.11 birds/km^2 during the breeding season suggesting the Windfarm Site is not of a high importance as a foraging area. The current breeding population estimate for Scotland is 21,370 (apparently occupied sites (AOS)) and 10,778 AOS at Mousa SPA (SMP Report, 2021). On this basis the estimated bird numbers using the Windfarm Site plus 4 km buffer are likely to represent 0.12% of the Scottish breeding population and 0.24% of the regional population (based on Mousa SPA only) and thus the Windfarm Site plus 4 km buffer is considered to have low importance as a foraging area for these populations.

78. European storm-petrels are considered to have very low vulnerability to vessel disturbance and displacement by offshore structures, low vulnerability to offshore wind turbine collision risk (Bradbury *et al*., 2014; Furness *et al*., 2013), and considering their surface feeding habit very low vulnerability to entanglement on mooring lines.

79. Storm petrel species have shown some attraction to artificial lighting, however individuals found to have become disorientated/stranded in the majority of cases tend to be recently fledged juveniles (Miles *et al*., 2010) or adults that have shown attraction to the significantly brighter lights and flares on offshore oil and gas platforms or offshore island villages and towns (Gjerdrum *et al*., 2021; Collins *et al*., 2022). Therefore, there is evidence that the potential attractant effects of light may cause some immediate changes to bird movement, alter habitat selection, and increase energy expenditure or displacement during nocturnal foraging (reviewed in Drewitt and Langston, 2008). These behavioural effects are predominantly weather and moonlight dependent, potentially impacting navigation when visibility is low during overcast nights with drizzle and fog (Gjerdrum *et al*., 2021). However, evidence for this potential impact on nocturnal birds at operational OWFs is likely to be less than predicted from studies (which are predominantly based on offshore platforms and attraction to onshore lighting), as lighting on WTGs are for navigational safety and of a different colour and lower intensity than lighting from offshore oil and gas platforms.

80. Lighting of WTGs is required to meet minimum legal (and safety) requirements, namely as set out in the International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) Recommendation O117 on 'The Marking of Offshore Wind Farms' for navigation lighting and by the Civil Aviation Authority in the Air Navigation Orders (CAP 393 and guidance in CAP 764). In keeping with the minimum legal requirements for appropriate lighting of WTGs, this will minimise the risk of

birds becoming attracted to or disorientated by WTGs at night or in poor weather. The proposed design with respect to lighting, is, therefore, consistent with the OSPAR convention guidance and NPS EN-3. The design aims to minimise the emission of light, whilst still complying with safety protocols and regulations in relation to aviation and shipping navigation. WTGs will therefore not be as extensively lit as, for example, oil and gas installations.

81. Even if some birds are attracted to lighting were to become disorientated and stranded on the floating sub-structures, they would not be vulnerable to predation and could potentially recover and resume foraging. Furthermore, the tracking study of Bolton (2021) indicated that the nocturnal foraging range from the breeding colony was considerably reduced compared to day-time foraging, suggesting an even lower likelihood that the Project area is regularly used for nocturnal foraging.

82. Consideration should also be given to the Bolton (2021) study demonstrating the home range of European storm petrel from Mousa SPA during the breeding season overlaps with 14 operating oil and gas platforms, however breeding numbers at Mousa SPA have shown an approximate 100% increase since the Seabird 2000 colony counts to the latest count in 2015 (SMP, 2021). This would suggest despite their predicted sensitivity and vulnerability to lighting impacts from offshore platforms the impact appears to be negligible at a colony level.

83. On account of the above information, storm-petrel is considered to be a species of low priority to the EIA assessment, with predicted limited or negligible sensitivity to lighting from WTGs and on the basis from current evidence potential impacts from WTG lighting on storm-petrels are also expected to be negligible and therefore the significance of effect is considered to be negligible.

12.9 Biological seasons, reference populations and demographics for offshore ornithology receptors

12.9.1 Biological seasons

84. Bird behaviour and abundance is recognised to differ across a calendar year dependent upon the biological seasons that may be applicable to different offshore ornithology receptors. Separate seasons are recognised in this chapter in order to establish the level of importance any seabird species has within the offshore ornithology Study Area during any particular period of time. Species-specific seasons have been defined primarily referring to the guidance note from NatureScot, who have provided suggested definitions for all regularly occurring birds in the Scottish marine environment (NatureScot, 2020). The biologically defined minimum population scales (BDMPS) bio-seasons based on those in Furness (2015), are considered where appropriate (**Table 12.16**). The seasons are defined within this chapter as: breeding and non-breeding following NatureScot guidance, and pre-breeding migration and post-breeding migration seasons following Furness (2015), which followed seasonal definitions agreed during stakeholder consultation (**Table 12.4**). These four seasons can be applied to different periods within the annual cycle for most species, though not all four are applicable for all seabird species, with different combinations used depending on the biology and life history of a species:

85. Based on NatureScot (2020) guidance note:

- Breeding: when birds are strongly associated with the nest site; and
- Non-breeding: non-breeding (or winter) period.

86. Based on Furness (2015):

- Pre-breeding migration: when birds are migrating to breeding colonies;
- Post-breeding migration: when birds are migrating to wintering areas or dispersing from colonies.

87. Kittiwake is presented with two and three season options; using two seasons defined by NatureScot guidance and three seasons by incorporating the migratory periods pre- and post-breeding defined in Furness (2015). These options are provided to maximise interpretation of peak abundance estimates and behaviour over the Study Area of this species. Gannet is presented with three seasons to account for extensive population movements occurring during migratory periods.

88. The seasons for each of the key species are provided in **Table 12.16**.

Table 12.16 Species specific defined seasons.

Species	Furness (2015)		NatureScot (2020)	
	Pre-Breeding Migration	**Post-breeding Migration**	**Breeding**	**Non-breeding**
Gannet	December to mid-March	October to November	Mid-March to September	N/A
Kittiwake	January to mid-April	September to December	mid-April to August	September to mid-April
Herring gull	N/A	N/A	April to August	September to March
Great black-backed gull	N/A	N/A	April to August	September to March
Guillemot	N/A	N/A	April to mid-August	April to mid-August
Razorbill	N/A	N/A	April to mid-August	April to mid-August
Puffin	N/A	N/A	April to mid-August	April to mid-August

12.9.2 Reference populations

89. Furness (2015) provides population estimates for each species in each non-breeding bio-season in each BDMPS region (**Table 12.17**). Total population sizes for the biogeographic population with connectivity to UK waters are also provided in Furness (2015).

Table 12.17 BDMPS population sizes and biogeographic population.

Species	Furness (2015)		NatureScot (2020)		Biogeographic population (Furness, 2015)
	Pre-Breeding Migration	**Post-breeding Migration**	**Breeding**	**Non-breeding**	
Gannet	248,385	456,298	804,425	N/A	1,180,000
Kittiwake	627,816	829,937	380,104	829,937	5,100,000
Herring gull	N/A	N/A	13,267	466,511	1,098,000
Great black-backed gull	N/A	N/A	1,106	91,399	235,000
Guillemot	N/A	N/A	577,117	577,117*	4,125,000
Razorbill	N/A	N/A	97,622	591,874	1,707,000
Puffin	N/A	N/A	441,350	231,957	11,840,000

*Based on regionally breeding population

90. Breeding population sizes are based on colony counts from the Seabird Monitoring Programme database (JNCC, 2022) for all colonies within mean maximum (mean max) plus one Standard Deviation (+1 SD) foraging range (Woodward *et al.*, 2019), with the exception of two species; guillemot and razorbill:

- Use of mean max+1SD, including data from Fair Isle for all Northern Isles designated sites; and
- For all designated sites south of the Pentland Firth (i.e., excluding the Northern Isles, use of mean max+1SD discounting Fair Isle values.

91. Evidence has also been gathered from bidirectional flight data from the aerial surveys and the Seabird Tracking Database (http://www.seabirdtracking.org/), to include colonies that show flight headings to and from the Windfarm Site or show tracks across the Windfarm Site and 4 km buffer out with mean max +1SD foraging range to include in the breeding population. This resulted in a revised breeding population for guillemot and razorbill (**Table 12.18**).

92. A further exception in the case of gannet has been incorporated, where three separate sites have exceeded the mean max; Forth Islands, Grassholm and St. Kilda SPAs where maximum foraging range (Woodward *et al*., 2019) has been used.

93. One apparently occupied nest (AON) was assumed to equal two breeding birds. Where possible, the average count from 2020 and 2022 was used (i.e., corresponding to the same years as the available aerial digital survey data), or the most recent count otherwise.

94. During the breeding season, in addition to breeding adult birds associated with breeding colonies, there will be immature birds, juvenile birds and "sabbatical" birds (mature birds not breeding in a given year) present within the region, including the Study Area. The breeding season population was calculated by using the derived estimated number of immatures per breeding adult in a typical population of each species from Furness (2015), presuming all immature birds remain within the BDMPS region, to estimate the breeding season population.

95. The total regional population within the breeding season is therefore the sum of breeding adults associated with nearby colonies plus the estimated immatures per breeding adult. This is shown in **Table 12.18.**

Table 12.18 Calculation of regional population during the breeding season

Species	Breeding population at colonies within mean-max + 1SD foraging range (JNCC, 2021)	BDMPS return migration populations size (Furness, 2015)	Estimated immatures per breeding adult in population (Furness, 2015)	Juvenile, immature and non-breeding individuals	Potential total regional baseline population during the breeding season
Gannet	444,434	248,385	0.81	359,991	804,425
Kittiwake	212,798	691,526	0.47	167,306	380,104
Herring gull	6,348	466,511	1.09	6,919	13,267
Great black-backed gull*	534	17,742	0.56	572	1,106
Guillemot	76,960	1,617,306	0.74	56,950	133,910
Guillemot**	373,971	1,617,306	0.43	203,146	577,117
Razorbill	13,844	591,874	0.75	10,383	24,227
Razorbill**	63,095	591,874	0.43	34,527	97,622
Puffin	216,364	17,742	0.51	224,986	441,350

*no colonies within mean max +1SD of survey area, population based on nearest colony at East Caithness SPA.

**includes colonies with evidence from the seabird tracking database and aerial survey flight directions.

12.9.3 Demographics

96. The potential effect from additional mortality to the relevant background population due to the impacts of the Project is assessed in terms of any change in relation to the baseline mortality rate for any given species within each of the recognised seasons. The average mortality across all age classes for each species are presented in **Table 12.19**. Demographic rates for each species were obtained from Horswill and Robinson (2015). These data were used to calculate the expected stable proportions in each age class for each species. Each age class survival rate was then multiplied by its stable age proportion and the total for all ages summed to give the weighted average survival rate converted to an average mortality rate.

Table 12.19 Demographic rates and population age ratio for each key species assessed in this report

Species	Parameter	Survival (age class)							Productivity (chicks per pair)	Average mortality
		0-1	1-2	2-3	3-4	4-5	5-6	Adult		
Gannet	Demographic rate	0.424	0.829	0.891	0.895	0.895	-	0.919	0.700	0.187
	Population age ratio	0.191	0.081	0.067	0.060	0.054	-	0.547		
Kittiwake	Demographic rate	0.790	0.854	0.854	0.854	0.854	0.854	0.854	0.690	0.156
	Population age ratio	0.153	0.121	0.103	0.088	-	-	0.535		
Great black-backed gull	Demographic rate	0.798	0.816	0.816	0.816	0.816	-	0.885	0.890	0.160
	Population age ratio	0.177	0.141	0.115	0.094	0.076	-	0.397		
Herring gull	Demographic rate	0.798	0.834	0.834	0.834	0.834	-	0.834	0.920	0.172
	Population age ratio	0.177	0.141	0.118	0.098	0.082	-	0.384		
Guillemot	Demographic rate	0.560	0.792	0.917	0.0917	0.939	0.939	0.939	0.672	0.138
	Population age ratio	0.160	0.090	0.071	0.065	0.061	0.57	0.496		
Razorbill	Demographic rate	0.630	0.630	0.630	0.895	0.895	-	0.895	0.570	0.193
	Population age ratio	0.163	0.103	0.065	0.041	0.037	-	0.591		
Puffin	Demographic rate	0.709	0.709	0.709	0.760	0.805	-	0.906	0.617	0.175
	Population age ratio	0.158	0.112	0.079	0.056	0.043	-	0.552		

12.10 Environmental impact: construction phase

12.10.1 Temporary disturbance and displacement: Windfarm Site

Overview

97. Industry understanding and agreement around the specific impacts of floating OWFs on offshore ornithology receptors are still developing. One of the main potential advantages of floating OWF substructures compared to the equivalent fixed bottom counterpart is that a considerable amount of the offshore site construction activity can take place onshore in port before the fully assembled units are towed out to site for mooring and electrical cable connection. This will substantially reduce the extent of marine operations associated with the Project construction. A floating substructure will support each of the WTGs, which require moorings to anchors on the seabed to maintain position. During construction there is limited use of large offshore construction vessels at the development site and none of the extensive piling operations associated with fixed bottom WTGs. Construction noise associated with installation of anchors is, therefore, substantially lower than that produced during piling activities, whilst both its duration and the distance of disturbance are also considered to be considerably shorter. The number of vessels moving into and out of the Windfarm Site during the construction phase is also significantly reduced to lower intensity activities required at site and with no piling events required to secure floating WTGs to the seabed large vessels are not required for long periods of time at any one location. In addition, the WTGs themselves are constructed within assembly ports (such as Invergordon/Nigg) where they are fully assembled and tested before being moved to their locations within the Windfarm Site. Therefore, there is not the requirement for multiple support vessels to enable construction in comparison to standard fixed bottom WTG construction activities. An offshore substation platform (OSPs) will require small scale pin piles (up to 3 m diameter) to secure the jacket to the seafloor; however, piling activities will be minimal in scope.

98. Disturbance and subsequent potential displacement of offshore ornithology receptors during the construction phase is primarily centred around where construction vessels and anchoring and cable connection activities are planned to occur. The activities may displace individuals that would normally occur within and around the area of sea where the Project is proposed to be developed. This potentially reduces the area available to those seabirds to forage, loaf and/ or moult.

99. This displacement may contribute to individual birds experiencing fitness consequences, which at an extreme level could theoretically lead to the mortality of individuals (Searle *et al*., 2018), though this is unlikely during the construction phase of an OWF as such activities are spatially and temporally restricted.

100. Given that potential disturbance activities during the construction phase will be both temporally and spatially restricted compared to the operation and maintenance phase, the potential impacts due to disturbance and displacement are highly likely to be lower during the construction phase.

101. Few studies have provided definitive empirical displacement rates for the construction phase of OWF developments. Krijgsveld *et al*., (2011) demonstrated higher flight paths of gannets next to operating vs non-operating WTGs. Displacement rates for auks during construction have been shown to be either significantly lower or comparable to the operation phase (Percival, 2013; Vallejo *et al*., 2017). These studies suggest that although the level of disturbance from construction activities can be high it is focussed around a spatially restricted area or areas within the development. Therefore, displacement rates for the entire Windfarm Site reflect reduced displacement within the Windfarm Site away from construction areas including areas where built non-operational WTGs are present.

102. As actual rates of displacement during the construction phase are difficult to determine from the available studies, the following methodology has been applied to determine potential impact levels. Given that construction is limited both spatially and temporarily and that any potential effects are unlikely to reach the same level as during the operation, especially given the level of construction disturbance of a floating WTGs compared to disturbance from fixed bottom WTGs construction activities, the level to be used is a 50% reduction in the displacement rate used for operational phase assessments.

103. The evidence for displacement rates and appropriate buffer zones is discussed in detail in the operational phase assessment, as most evidence has been sourced from operational projects (see **Section 12.11**). The level of displacement assessed for each species during the construction phase is provided below with the SNCB's position (NatureScot in this instance) represented as a 50% reduction in their recommended rates used for operational phase assessments for comparison with the Applicants position:

- For gannet, the operational phase displacement assessment considered for the Windfarm Site only (the area to be considered as advised in the consultation process (**Table 12.4**)) assumes a displacement rate of 70%, with the Applicant's position being a displacement rate of 40-60% for the breeding season and 60-80% for the non-breeding season. This therefore equates to a construction phase displacement rate of 35%, with the Applicant's position being a displacement rate of 20-30% for the breeding season and 30-40% for the non-breeding season;
- For guillemot and razorbill, the operational phase displacement assessment considered for the Windfarm Site and surrounding 2 km buffer is a displacement rate of 60%, with the Applicant's position being a displacement rate of 50%. This therefore equates to a construction phase displacement rate of 30%, with the Applicant's position being a displacement rate of 25%;
- For kittiwake, the operational phase displacement assessment considered for the Windfarm Site and surrounding 2 km buffer is a displacement rate of 30%. This therefore equates to a construction phase displacement rate of 15%.

104. To ensure that assessments are sufficiently precautionary for all species, the mortality rates considered for the construction phase remain the same as those used for operational phase impacts. The Applicant's position being a mortality rate of 1% for all species. It should be noted however that due to construction phase displacement impacts being both temporally and spatially restricted, it's highly likely that any associated consequential mortality rate will be less than that from operational impacts.

105. The main focus of the impact assessment is based on the Applicant's approach however, for comparison to the SNCBs recommended approach displacement estimates are presented in parallel in a separate table for each species.

106. Evidence suggests that some species are more susceptible than others to disturbance from OWF construction activities, which may lead to subsequent displacement. Dierschke *et al*., (2016) noted both avoidance and attraction to varying degrees to operational wind farms, depending upon the species in question. A screening process was undertaken for the Project to identify those species which are considered to be vulnerable to disturbance and displacement from OWF construction activities (**Table 12.15**).

107. Species which are known to be sensitive to disturbance and displacement but have been recorded in 'trivial' numbers during baseline data collection, are not considered further in the assessment (**Table 12.15**). This is because the numbers of birds at risk from displacement are so small that there is no possibility of a significant effect occurring following the method to determine significance laid out in **Section 12.8.1**.

Gannet

Potential magnitude of impact

108. The main focus of impact assessment is based on the Applicant's approach of a displacement rate of 20-30% during the breeding season and 30-40% during the non-breeding season and a 1% mortality rate for construction phase displacement, considering the temporal and spatial restriction of construction impacts (**Table 12.20**). Presentation of displacement impacts following NatureScot's preferred rates (**Section 12.3.3**) which extrapolates to a displacement rate of 35% and a mortality rate of up to 3% for the construction phase is provided in **Table 12.21** for comparison.

Table 12.20 Applicant's approach for gannet season displacement estimates for the Project (construction).

Season (months)	Mean peak seasonal abundance (Windfarm Site only)	Regional baseline population and baseline mortality rates (individuals per annum)		Estimated number of gannet subject to mortality (individuals per annum)			Increase in baseline mortality rate (%)		
		Population size	Baseline mortality	20% Displacement; 1% Mortality	30% Displacement; 1% Mortality	40% Displacement; 1% Mortality	20% Displacement; 1% Mort	30% Displacement; 1% Mortality	40% Displacement; 1% Mortality
Return Migration	49	248,385	46,448		0.1	0.2		<0.001%	<0.001%
Migration-free Breeding	120	804,425	150,427	0.2	0.4		<0.001%	<0.001%	
Post-breeding migration	16	456,298	85,328		0.0	0.1		<0.001%	<0.001%

Table 12.21 SNCBs approach for gannet season displacement estimates for the Project (construction).

Season (months)	Mean peak seasonal abundance (Windfarm Site only)	Regional baseline population and baseline mortality rates (individuals per annum)		Estimated number of gannet subject to mortality (individuals per annum)		Increase in baseline mortality rate (%)	
		Population size	Baseline mortality	35% Displacement; 1% Mortality	35% Displacement; 3% Mortality	35% Displacement; 1% Mortality	35% Displacement; 3% Mortality
Return Migration	49	248,385	46,448	0.2	0.5	<0.001%	0.001%
Migration-free Breeding	120	804,425	150,427	0.4	1.3	<0.001%	0.001%
Post-breeding Migration	16	456,298	85,328	0.1	0.2	<0.001%	<0.001%

109. During the return migration season, the mean peak abundance for gannet is 49 individuals within the Windfarm Site, which would result in under one (0.1-0.2) gannet being subject to mortality. The BDMPS population in the return migration season is defined as 248,385 individuals (**Table 12.17**) and, using the average all age class baseline mortality rate of 0.187 (**Table 12.19**), the natural predicted mortality in the return migration season is 46,448 individuals per annum. The prediction of less than one mortality per annum would result in no material change to the baseline mortality rate (<0.001%).

110. This level of impact is considered to be of **negligible magnitude during the return migration season**, as it represents no discernible difference to the baseline conditions.

111. During the migration-free breeding season, the peak abundance for gannet is 120 individuals within the Windfarm Site, which would result in under one (0.2-0.4) gannet being subject to mortality. The BDMPS population in the migration-free breeding season is defined as 804,425 individuals (**Table 12.17**) and, using the average baseline mortality rate of 0.187 (**Table 12.19**), the natural predicted mortality in the migration-free breeding season is 150,427 individuals per annum. The prediction of less than one mortality per annum would result in no material change to the baseline mortality rate (<0.001%).

112. This level of impact is considered to be of **negligible magnitude during the migration-free breeding season**, as it represents no discernible difference to the baseline conditions.

113. During the post-breeding migration season, the peak abundance for gannet is 16 individuals within the Windfarm Site which would result in between zero and under one (0.0-0.1) gannets being subject to mortality. The BDMPS population in the post-breeding migration season is defined as 456,298 individuals (**Table 12.17**) and, using the average baseline mortality rate of 0.187 (**Table 12.19**), the natural predicted mortality in the return migration season is 85,328 individuals per annum. The prediction of less than one mortality per annum would result in no material change to the baseline mortality rate (<<0.001%).

114. This level of impact is considered to be of **negligible magnitude during the post-breeding migration season**, as it represents no discernible difference to the baseline conditions.

115. Due to the very small number of estimated mortalities (less than one mortality in each season) from construction phase displacement, irrespective of the sensitivity of the receptor, the significance of the impact is not significant as defined in the assessment of significance matrix (**Table 12.14**) and is not considered further in this assessment.

Guillemot

Potential magnitude of impact

116. The main focus of impact assessment is based on the Applicant's approach of a displacement rate of 25% and a 1% mortality rate for construction phase displacement, considering the temporal and spatial restriction of construction impacts (**Table 12.22**). Presentation of displacement impacts following NatureScot's preferred rates (**Section 12.3.3**) which extrapolates to a displacement rate of 30% and a mortality rate of up to 5% for the construction phase, is provided in **Table 12.23** for comparison.

Table 12.22 Applicant's approach for guillemot season displacement estimates for the Project (construction).

Season (months)	Mean peak seasonal abundance (Windfarm Site plus 2 km buffer)	Regional baseline population and baseline mortality rates (individuals per annum)		Estimated number of guillemot subject to mortality (individuals per annum)	Increase in baseline mortality rate (%)
		Population size	Baseline mortality	25% displacement rate; 1% mortality rate	25% displacement rate; 1% mortality rate
Breeding	4,429	577,117	79,642	11.1	0.014%
Non-breeding	16,105	577,117*	79,642	40.3	0.051%

*Population based on regional breeding population as advised during consultation process (**Table 12.4**)

Table 12.23 SNCBs approach for guillemot season displacement estimates for the Project (construction).

Season (months)	Mean peak seasonal abundance (Windfarm Site plus 2 km buffer)	Regional baseline population and baseline mortality rates (individuals per annum)		Estimated number of guillemot subject to mortality (individuals per annum)			Increase in baseline mortality rate (%)		
		Population size	Baseline mortality	30% Displacement; 1% Mortality	30% Displacement; 3% Mortality	30% Displacement; 5% Mortality	30% Displacement; 1% Mortality	30% Displacement; 3% Mortality	30% Displacement; 5% Mortality
Breeding	4,429	577,117	79,642		39.9	132.9		0.050%	0.167%
Non-breeding	16,105	577,117 *	79,642	48.3	144.9		0.022%	0.065%	

*Population based on regional breeding population as advised during consultation process (**Table 12.4**).

117. During the breeding season, the peak abundance for guillemot is 4,429 individuals within the Windfarm Site and 2 km buffer, which would result in 11 (11.1) guillemots being subject to mortality. The BDMPS population in the breeding season is defined as 577,117 individuals (**Table 12.18**) and, using the average baseline mortality rate of 0.138 (**Table 12.19**), the natural predicted mortality in the breeding season is 79,642 individuals per annum. The addition of 11 predicted additional mortalities per annum would increase baseline mortality rate by 0.014%.

118. This level of impact is considered to be of **negligible magnitude during the breeding season**, as it represents no discernible difference to the baseline conditions.

119. During the non-breeding season, the peak abundance for guillemot is 16,105 individuals within the Windfarm Site and 2 km buffer, which would result in 40 (40.3) guillemots being subject to mortality. The regional non-breeding population, considering a regional population based on foraging range as advised during the consultation process is defined as 577,117 individuals (**Table 12.22**) and, using the average baseline mortality rate of 0.138 (**Table 12.19**), the natural predicted mortality in the non-breeding season is 79,642 individuals per annum. The addition of 40 predicted additional mortalities per annum would increase baseline mortality rate by 0.051%.

120. This level of impact is considered to be of **negligible magnitude during the non-breeding season**, as it represents no discernible difference to the baseline conditions.

121. The level of impact is considered to be of negligible magnitude for both seasons, as it represents no discernible increase to baseline mortality rate levels. However, as the number of individuals that may be subject to displacement consequent mortality are up to 40 individuals in a given season, further consideration is provided to determine the significance of effect in this instance.

Sensitivity of the receptor

122. This receptor is a designated feature of seven SPAs (Buchan Ness to Collieston Coast, Troup, Pennan and Lion's Head, Fair Isle, East Caithness Cliffs, North Caithness Cliffs, Copinsay, Pentland Firth Islands) with potential connectivity to the project, and is Amber listed in BoCC5 (Stanbury *et al*., 2021). With respect to behavioural sensitivity to disturbance and displacement, it is considered to be **medium** (**Table 12.15**). As it is of medium behavioural sensitivity, and it is of medium conservation value the overall sensitivity of this receptor to disturbance and displacement is considered to be **medium**.

Significance of effect

123. Given a negligible magnitude of impact and a sensitivity of medium, following the matrix approach set out in **Table 12.14**, the potential effect of displacement and disturbance from construction activities in the Windfarm Site plus 2 km buffer on guillemot has been assessed as minor, which is not significant in EIA terms.

Razorbill

Potential magnitude of impact

124. The main focus of impact assessment is based on the Applicant's approach of a displacement rate of 25% and a 1% mortality rate for construction phase displacement, considering the temporal and spatial restriction of construction impacts (**Table 12.24**). Presentation of displacement impacts following NatureScot's preferred rates (**Section 12.3.3**) which extrapolates to a displacement rate of 30% and a mortality rate of up to 5% for the construction phase, is provided in **Table 12.25** for comparison.

Table 12.24 Applicant's approach for razorbill season displacement estimates for the Project (construction).

Season (months)	Mean peak seasonal abundance (Windfarm Site plus 2 km buffer)	Regional baseline population and baseline mortality rates (individuals per annum)		Estimated number of razorbill subject to mortality (individuals per annum)	Increase in baseline mortality rate (%)
		Population size	Baseline mortality	25% displacement rate; 1% mortality rate	25% displacement rate; 1% mortality rate
Breeding	457	97,622	18,841	1.1	0.006%
Non-breeding	58	591,874	114,232	0.1	<0.001%

Table 12.25 SNCBs approach for razorbill season displacement estimates for the Project (construction).

Season (months)	Mean peak seasonal abundance (Windfarm Site plus 2 km buffer)	Regional baseline population and baseline mortality rates (individuals per annum)		Estimated number of razorbill subject to mortality (individuals per annum)			Increase in baseline mortality rate (%)		
		Population size	Baseline mortality	30% Displacement; 1% Mortality	30% Displacement; 3% Mortality	30% Displacement; 5% Mortality	30% Displacement; 1% Mortality	30% Displacement; 3% Mortality	30% Displacement; 5% Mortality
Breeding	457	97,622	18,841		4.1	6.9		0.022%	0.036%
Non-breeding	58	591,874	114,232	0.2	0.5		<0.001%	<0.001%	

125. During the breeding season, the peak abundance for razorbill is 457 individuals within the Windfarm Site and 2 km buffer, which would result in one (1.1) razorbill being subject to mortality. The BDMPS population in the breeding season is defined as 97,622 individuals (**Table 12.17**) and, using the average baseline mortality rate of 0.193 (**Table 12.19**), the natural predicted mortality in the breeding season is 18,841 individuals per annum. The addition of one predicted additional mortality per annum would increase baseline mortality rate by 0.006%.

126. This level of impact is considered to be of **negligible magnitude during the breeding season**, as it represents no discernible difference to the baseline conditions.

127. During the non-breeding season, the peak abundance for razorbill is 58 individuals within the Windfarm Site and 2 km buffer, which would result in zero (0.1) razorbill being subject to mortality. The BDMPS population in the non-breeding season is defined as 591,874 individuals (**Table 12.17**) and, using the average baseline mortality rate of 0.193 (**Table 12.19**), the natural predicted mortality in the non-breeding season is 114,232 individuals per annum. The prediction of less than one mortality per annum would result in no material change to the baseline mortality rate (<0.001%).

128. This level of impact is considered to be of **negligible magnitude during the breeding season**, as it represents no discernible difference to the baseline conditions.

129. Due to the very small number of estimated mortalities (up to one mortality in each season) from construction phase displacement, irrespective of the sensitivity of the receptor, the significance of the impact is not significant as defined in the assessment of significance matrix (**Table 12.14**) and is not considered further in this assessment.

Puffin

Potential magnitude of impact

130. The main focus of impact assessment is based on the Applicant's approach of a displacement rate of 25% and a 1% mortality rate for construction phase displacement, considering the temporal and spatial restriction of construction impacts (**Table 12.26**). Presentation of displacement impacts following NatureScot's preferred rates (**Section 12.3.3**) which extrapolates to a displacement rate of 30% and a mortality rate of up to 5% for the construction phase, is provided in **Table 12.27** for comparison.

Table 12.26 Applicant's approach for puffin season displacement estimates for the Project (construction).

Season (months)	Mean peak seasonal abundance (Windfarm Site plus 2 km buffer)	Regional baseline population and baseline mortality rates (individuals per annum)		Estimated number of puffin subject to mortality (individuals per annum)	Increase in baseline mortality rate (%)
		Population size	Baseline mortality	25% displacement rate; 1% mortality rate	25% displacement rate; 1% mortality rate
Breeding	250	441,350	77,236	0.6	0.001%
Non-breeding	41	231,957	40,592	0.1	<0.001%

Table 12.27 SNCBs approach for puffin season displacement estimates for the Project (construction).

Season (months)	Mean peak seasonal abundance (Windfarm Site plus 2 km buffer)	Regional baseline population and baseline mortality rates (individuals per annum)		Estimated number of puffin subject to mortality (individuals per annum)			Increase in baseline mortality rate (%)		
		Population size	Baseline mortality	30% Displacement; 1% Mortality	30% Displacement; 3% Mortality	30% Displacement; 5% Mortality	30% Displacement; 1% Mortality	30% Displacement; 3% Mortality	30% Displacement; 5% Mortality
Breeding	250	441,350	77,236		2.3	3.8		0.003%	0.005%
Non-breeding	41	231,957	40,592	0.1	0.4		<0.001%	0.001%	

131. During the breeding season, the peak abundance for puffin is 250 individuals within the Windfarm Site and 2 km buffer, which would result in approximately one (0.6) puffin being subject to mortality. The BDMPS population in the breeding season is defined as 441,350 individuals (**Table 12.17**) and, using the average baseline mortality rate of 0.175 (**Table 12.19**), the natural predicted mortality in the breeding season is 77,236 individuals per annum. The addition of one predicted additional mortality per annum would increase baseline mortality rate by 0.001%.

132. This level of impact is considered to be of **negligible magnitude during the breeding season**, as it represents no discernible difference to the baseline conditions.

133. During the non-breeding season, the peak abundance for puffin is 41 individuals within the Windfarm Site and 2 km buffer, which would result in zero (0.1) puffin being subject to mortality. The BDMPS population in the non-breeding season is defined as 231,957 individuals (**Table 12.17**) and, using the average baseline mortality rate of 0.175 (**Table 12.19**), the natural predicted mortality in the breeding season is 40,592 individuals per annum. The prediction of less than one mortality per annum would result in no material change to the baseline mortality rate (<0.001%).

134. This level of impact is considered to be of **negligible magnitude during the breeding season**, as it represents no discernible difference to the baseline conditions.

135. Due to the very small number of estimated mortalities (less than one mortality in each season) from construction phase displacement, irrespective of the sensitivity of the receptor, the significance of the impact is not significant as defined in the assessment of significance matrix (**Table 12.14**) and is not considered further in this assessment.

Kittiwake

Potential magnitude of impact

136. The Applicant does not consider that disturbance and displacement assessment is necessary for kittiwake given the species' low sensitivity to displacement (**Table 12.15**) and is only provided due to being requested by NatureScot.

137. Kittiwake is presented with two and three season options; using two seasons defined by NatureScot guidance and three seasons by incorporating the migratory periods pre- and post-breeding defined in Furness (2015). These options are provided to maximise interpretation of peak abundance estimates and behaviour over the Study Area of this species.

138. When considering NatureScot's preferred rates (**Section 12.3.3**) which extrapolates to a displacement rate of 15% and a mortality rate of up to 3%, the annual estimated mortality for kittiwake resulting from disturbance and displacement during construction is two (1.9) individuals. This is further broken down into relevant seasons in **Table 12.28**.

Table 12.28 Kittiwake displacement estimates for the Applicant's preferred seasons (top) and SNCBs preferred seasons (bottom) for the Project (construction).

Season (months)	**Mean peak seasonal abundance (Windfarm Site plus 2 km buffer)**	**Regional baseline population and baseline mortality rates (individuals per annum)**		**Estimated number of kittiwake subject to mortality (individuals per annum)**		**Increase in baseline mortality rate (%)**	
		Population size	Baseline mortality	15 % displacement rate; 1% mortality rate	15 % displacement rate; 3% mortality rate	15 % displacement rate; 1% mortality rate	15 % displacement rate; 3% mortality rate
Return Migration	83	627,816	97,939	0.1	0.4	<0.001%	<0.001%
Migration-free Breeding	183	380,104	59,296	0.3	0.8	<0.001%	0.001%
Post-breeding migration	149	829,937	129,470	0.2	0.7	<0.001%	0.001%
Breeding	183	380,104	59,296	0.3	0.8	<0.001%	0.001%
Non-breeding	232	829,937	129,470	0.3	1.0	<0.001%	0.001%

139. During the breeding season, the peak abundance for kittiwake is 183 individuals within the Windfarm Site and 2 km buffer, which would result in zero (0.3) kittiwake being subject to mortality. The BDMPS population in the breeding season is defined as 380,104 individuals (**Table 12.17**) and, using the average baseline mortality rate of 0.156 (**Table 12.19**), the natural predicted mortality in the breeding season is 59,296 individuals per annum. The prediction of less than one mortality per annum would result in no material change to the baseline mortality rate (<0.001%.

140. This level of impact is considered to be of **negligible magnitude during the breeding season**, as it represents no discernible difference to the baseline conditions.

141. During the return migration season, the peak abundance for kittiwake is 83 individuals within the Windfarm Site and 2 km buffer, which would result in zero (0.1) kittiwake being subject to mortality. The BDMPS population in the non-breeding season is defined as 627,816 individuals (**Table 12.17**) and, using the average baseline mortality rate of 0.156 (**Table 12.19**), the natural predicted mortality in the breeding season is 97,939 individuals per annum. The prediction of less than one mortality per annum would result in no material change to the baseline mortality rate (<0.001%).

142. This level of impact is considered to be of **negligible magnitude during the breeding season**, as it represents no discernible difference to the baseline conditions.

143. During the post-breeding migration season, the peak abundance for kittiwake is 149 individuals within the Windfarm Site and 2 km buffer, which would result in zero (0.2) kittiwake being subject to mortality. The BDMPS population in the non-breeding season is defined as 829,937 individuals (**Table 12.17**) and, using the average baseline mortality rate of 0.156 (**Table 12.19**), the natural predicted mortality in the breeding season is 129,470 individuals per annum. The prediction of less than one mortality per annum would result in no material change to the baseline mortality rate (<0.001%).

144. This level of impact is considered to be of **negligible magnitude during the breeding season**, as it represents no discernible difference to the baseline conditions.

145. During the non-breeding season, the peak abundance for kittiwake is 232 individuals within the Windfarm Site and 2 km buffer, which would result in zero (0.3) kittiwake being subject to mortality. The BDMPS population in the breeding season is defined as 829,937 individuals (**Table 12.17**) and, using the average baseline mortality rate of 0.156 (**Table 12.19**), the natural predicted mortality in the breeding season is 129,470 individuals per annum. The prediction of less than one mortality per annum would result in no material change to the baseline mortality rate (<0.001%).

146. This level of impact is considered to be of **negligible magnitude during the non-breeding season**, as it represents no discernible difference to the baseline conditions.

147. Due to the very small number of estimated mortalities (up to one mortality in each season) from construction phase displacement, irrespective of the sensitivity of the receptor, the significance of the impact is not significant as defined in the assessment of significance matrix (**Table 12.14**) and is not considered further in this assessment.

12.10.2 Temporary Disturbance and displacement: Offshore Export Cable Corridors and cable landfall

Overview

148. The Green Volt OWF will connect directly to the Buzzard oil and gas platform via an electrical cable from the (newly built) offshore substation, which is expected to be ~15 km in length. An offshore export cable will carry the power ~90 km to the landfall location along the Aberdeenshire shore. The Project will have a maximum of two, dual redundant export cables to landfall. It is expected that both export cables will run in close proximity and within the same cable corridor. Two potential landfalls are under consideration and landfall is anticipated to be installed through horizontal directional drilling (HDD). It is expected that for either location, HDD will be used to take the cable from the jointing pit to a location 200-300 m offshore. Open trenching will only be used in the event that HDD cannot be used due to technical or engineering constraints; no open trenching is proposed within the Buchan Ness to Collieston SAC or SPA to avoid direct impacts on the vegetated sea cliff features.

149. During the cable pull and cable laying activities there will be a number of vessels required which may result in the following disturbance:

- Disturbance due to displacement from foraging habitat; and
- Disturbance due to noise and light pollution from the vessels

150. Construction activities associated with offshore export cable installation may lead to disturbance and displacement of species within the Offshore Export Cable Corridors and potentially within surrounding buffers to a lower extent. The laying of the export cable between the array and cable landfall for Green Volt would be undertaken across 2 x 14-day periods for laying two dual redundant cables, and 2 x 5-day periods for laying two dual redundant cables between the array and the Buzzard platform, involving a total of 3 and 5 vessel movements, respectively. There is therefore potential for construction activities associated with seabed preparation and cable laying, namely the physical presence of the installation vessels, to lead to disturbance and displacement.

151. For the proposed northern cable landfall site, seabird species expected to be in the area and, therefore, could be prone to disturbance through HDD activities in the nearshore environment are fulmar, guillemot, herring gull and kittiwake as well as shag and razorbill (Wakefield *et al*., 2017). The proposed cable landfall site is a sandy beach and so there would be no onshore nesting by these seabird species and so any disturbance caused by the HDD would only at most temporarily affect potential foraging and loafing activities. The vessels used for construction are mostly static and emit low levels of noise meaning the potential magnitude of impact to these seabird species are expected to be very low. Vessel activity would also be temporary and spatially restricted meaning any potential disturbance and subsequent displacement of birds would also be limited in nature, with birds expected to return to the site once work is completed. Therefore, the potential impact on foraging seabirds is considered to be limited as the activities are localised and there is plenty of available foraging habitat nearby in the area. Overall, potential impacts on seabirds for the northern cable corridor site are minimal.

152. For the proposed southern cable landfall site HDD activity would be conducted outside of the breeding season, so any seabirds nesting within any seabird colonies that may interact with the area would not be impacted by the activities. As described in the baseline technical report (**Appendix 12.1: Offshore and intertidal ornithology baseline technical report**) the main seabird species recorded in the area were fulmar, shag, herring gull, kittiwake, guillemot and razorbill. Similar to the northern cable landfall site, the main potential impacts to these seabird species from HDD activities are linked to disturbance by vessel traffic and displacement from foraging habitat. These seabird

species generally have low sensitivity to the vessel traffic proposed for this element of the project and so the nature of the impact is considered to be negligible in nature. Any potential effects would also be both localised and temporary in nature, meaning any disturbance and displacement of seabirds from a foraging area would be both spatially restricted and temporary with birds returning after construction activities are completed. There is also plenty of available foraging habitat nearby for any displaced seabirds, meaning that displacement from a foraging area would not pose a significant impact.

153. Overall, as the baseline characterisation report did not identify any species of high sensitivity or high densities within the Offshore Export Cable Corridors and landfall options (**Appendix 12.1: Offshore and intertidal ornithology baseline technical report**) and considering the spatially and temporally restricted nature of the works, the level of impact is considered to be of **negligible magnitude on all receptors** from disturbance and displacement. Accordingly, the effect has been assessed as not significant regardless of the sensitivity of the receptor and is not considered further in this assessment.

12.10.3 Indirect effects via changes in prey or habitat availability

154. Indirect impacts during the construction phase are likely to be predominantly from benthic disturbance when deploying anchors and chain to the seabed. On site vessels and equipment movement will increase noise within the environment, though due to the floating design this is likely below the levels observed during piling activities within other array designs. Such potential effects on benthic invertebrates and fish have been assessed in **Chapter 9: Benthic Ecology** and **Chapter 10: Fish and Shellfish Ecology** and the conclusions of those assessments inform this assessment of indirect effects on ornithology receptors.

155. With regard to noise impacts on fish, **Chapter 10: Fish and Shellfish Ecology** discusses the potential impacts upon fish relevant to ornithology as prey species of the Project. For species such as herring, sprat and sandeel, which are the main prey items of seabirds such as gannet and auks, underwater noise impacts (physical injury or behavioural changes) during construction are considered to be negligible (see **Chapter 10: Fish and Shellfish Ecology**, summarised in **Section 10.11** and **Table 10.49**). With a negligible impact on fish that are bird prey species, it is concluded that the indirect impact significance on seabirds occurring in or around the Project during the construction phase is similarly a negligible adverse impact.

156. With regard to changes to the seabed and to suspended sediment levels, **Chapter 7: Marine Geology, Oceanography and Physical Processes**, **Chapter 8: Marine Sediment and Water Quality** and **Chapter 9: Benthic Ecology** discusses the nature of any change and impacts on the seabed and benthic habitats. Impacts that have been assessed are considered to be low or negligible and are anticipated to result in changes of minor adverse significance (see **Chapter 9: Benthic Ecology**, summarised in **Section 9.11** and **Table 9.16**). The consequent indirect impact on fish through habitat loss is considered to be negligible (see **Chapter 10: Fish and Shellfish Ecology** summarised in **Section 10.11** and **Table 10.49**) for species such as herring, sprat and sandeel, which are the main prey items of seabirds such as gannet and auks. With a minor or negligible impact on fish that are bird prey species, it is concluded that the indirect impact significance on seabirds occurring in or around the Project during the construction phase is similarly a minor or negligible adverse impact. Therefore, it can be concluded there is **no significant effect in EIA terms during the construction phase.**

12.11 Environmental impact: operational and maintenance phase

12.11.1 Disturbance and displacement: Windfarm Site

Overview

157. The presence of WTGs has the potential to directly disturb and displace seabirds that would normally reside within and around the area of sea where the Project is proposed to be developed. This potentially reduces the area available to those seabirds to forage, loaf and/ or moult. Displacement may contribute to individual birds experiencing fitness consequences, which at an extreme level could lead to the mortality of individuals.

158. Seabird species vary in their response to the presence of operational infrastructure associated with OWFs, such as WTGs and shipping activity related to maintenance activities. OWFs are a new feature in the marine environment and as a result there is limited evidence as to the effects of disturbance and displacement by operational infrastructure in the long-term. Current evidence suggests that the response of seabirds to OWFs varies depending on the species and of life stage of the individual birds. The levels both spatially and temporally to which birds avoid OWFs are likely to be based on key factors such as competition levels within the wider area and prey abundance within the OWF. The consequence of such avoidance may result in reduced foraging areas available to individuals. Mortalities are likely to correlate strongly with the quality of the area within the OWF that some individuals are displaced from, but conversely may offer increased foraging efficiency for those still entering the OWF area. If the OWF area is considered to be a key a foraging area and the area outside of the OWF is close to carrying capacity, then higher mortality rates may occur (Busche and Garthe 2016; SNCBs, 2017). Conversely, if birds are being displaced into an area of optimal habitat and closer to breeding colonies, then this could result in a positive impact due to species having a reduction in energy expenditure foraging (Searle *et al.*, 2019).

159. Garthe and Hüppop (2004) developed a scoring system for such disturbance factors, which has been widely applied in OWF EIAs. Furness and Wade (2012) developed a similar system with disturbance ratings for particular species that was applied alongside scores for habitat flexibility and conservation importance to define an index value that highlights the sensitivity of each species to disturbance and displacement. Bradbury *et al.*, (2014) provided an update to the Furness and Wade (2012) paper to consider seabirds in English waters.

160. Natural England and JNCC issued a joint Interim Displacement Advice Note (Natural England and JNCC, 2012), which provides recommendations for presenting information to enable the assessment of displacement effects in relation to OWF developments. This has been superseded more recently by a joint SNCB interim displacement advice note initially issued in 2017 and further updated in 2022 (SNCBs, 2022), which provides the latest advice for UK development applications on how to consider, assess and present information and potential consequences of seabird displacement from OWFs. These guidance notes have shaped the assessment provided below.

161. Some species are more susceptible than others to disturbance from OWF operation, which may lead to subsequent displacement. Dierschke *et al.* (2016) noted both displacement and avoidance to varying degrees by some seabird species while others were attracted to OWFs. A screening process was undertaken for the Project to identify those species that may be more susceptible than others and therefore which species may be considered for further assessment (**Table 12.6**).

162. Following the screening process of VOR (**Table 12.15),** an assessment of displacement was carried out for the Project, with detailed methods and results presented in **Appendix 12.2** to provide information for six seabird species of interest identified as potentially at risk and of interest for impact assessment.

163. For each of the six species a review was undertaken of recent displacements rates applied by other assessments of displacement for OWFs. A further review of the displacement values derived from multiple post-consent monitoring reports was undertaken to quantify a suitable evidence-led approach and to provide SNCBs with transparency on how the displacement rates were calculated for this assessment.

Gannet

164. Gannets show a low level of sensitivity to ship and helicopter traffic (Garthe and Hüppop, 2004; Furness and Wade, 2012). A study by Krijgsveld *et al*., (2011) using radar and visual observations to monitor the post-construction effects of the OWEZ established that 64% of gannets avoided entering the wind farm (macro-avoidance). The results of the post-consent monitoring surveys for Thanet OWF found that gannet densities reduced within the site in the third year, but the report did not quantify this (Royal Haskoning DHV, 2013). A more recent study by APEM (APEM, 2014) provided evidence that during their migration most gannets would avoid flying into areas with operational WTGs (macro-avoidance), with the estimated macro-avoidance being 95%. The position of the SNCBs following current guidance (see consultation advice **Table 12.4**) is that the level of displacement considered across all seasons is 70%.

165. However, evidence from a recent review (APEM, 2022a), which has collated and critically appraised studies from 25 OWF, supports the application of seasonal displacement rates of 40-60% during the breeding season and 60-80% during the non-breeding season.

166. A mortality rate of 1% was selected for this assessment, based on expert judgement (reviewed in APEM, 2022a) supported by additional evidence that suggests that gannet have a large mean max (315 km) and maximum (709 km) foraging range (Woodward *et al*., 2019) and feed on a variety of different prey items that provide sufficient alternative foraging opportunities despite the potential reduced foraging activities within the Windfarm Site.

Potential magnitude of impact

167. The main focus of impact assessment is based on the Applicant's approach of a displacement rate of 40-60% for the breeding season and 60-80% for the non-breeding season and a 1% mortality rate for operational phase displacement (**Table 12.29**). As detailed in **Section 12.3.3**, for gannet NatureScot consider that displacement assessment should be based on a displacement rate of 70% and a mortality rate of up to 3%. Presentation of displacement impacts following NatureScot's preferred approach for the operational phase is provided in **Table 12.30** for comparison.

Table 12.29 Applicant's approach for gannet season displacement estimates for the Project (operational).

Season (months)	Mean peak seasonal abundance (Windfarm Site only)	Regional baseline population and baseline mortality rates (individuals per annum)		Estimated number of gannet subject to mortality (individuals per annum)			Increase in baseline mortality rate (%)		
		Population size	Baseline mortality	40% Displacement; 1% Mortality	60% Displacement; 1% Mortality	80% Displacement; 1% Mortality	40% Displacement; 1% Mortality	60% Displacement; 1% Mortality	80% Displacement; 1% Mortality
Return Migration	49	248,385	46,448		0.3	0.4		0.001%	0.001%
Migration-free Breeding	120	804,425	150,427	0.5	0.7		<0.001%	<0.001%	
Post-breeding migration	16	456,298	85,328		0.1	0.1		<0.001%	<0.001%

Table 12.30 SNCBs approach for gannet season displacement estimates for the Project (operational).

Season (months)	Mean peak seasonal abundance (Windfarm Site only)	Regional baseline population and baseline mortality rates (individuals per annum)		Estimated number of gannet subject to mortality (individuals per annum)		Increase in baseline mortality rate (%)	
		Population size	Baseline mortality	70% Displacement; 1% Mortality	70% Displacement; 3% Mortality	70% Displacement; 1% Mortality	70% Displacement; 3% Mortality
Return Migration	49	248,385	46,448	0.3	1.0	0.001%	0.002%
Migration-free Breeding	120	804,425	150,427	0.8	2.5	0.001%	0.002%
Post-breeding Migration	16	456,298	85,328	0.1	0.3	<0.001%	<0.001%

168. During the return migration season, the peak abundance for gannet is 49 individuals within the Windfarm Site, which would result in approximately zero (0.3-0.4) gannets being subject to mortality. The BDMPS population in the return migration season is defined as 248,385 individuals (**Table 12.17**) and, using the average baseline mortality rate of 0.187 (**Table 12.19**), the natural predicted mortality in the return migration season is 46,448 individuals per annum. The prediction of less than one mortality per annum would result in no material change to the baseline mortality rate (0.001%).

169. This level of impact is considered to be of **negligible magnitude during the return migration season**, as it represents no discernible difference to the baseline conditions.

170. During the migration-free breeding season, the peak abundance for gannet is 120 individuals within the Windfarm Site, which would result in approximately one (0.5-0.7) gannet being subject to mortality. The BDMPS population in the migration-free breeding season is defined as 804,425 individuals (**Table 12.17**) and, using the average baseline mortality rate of 0.187 (**Table 12.19**), the natural predicted mortality in the return migration season is 150,427 individuals per annum. The addition of one predicted additional mortality per annum would result in no material change to the baseline mortality rate (<0.001%).

171. This level of impact is considered to be of **negligible magnitude during the migration-free breeding season**, as it represents no discernible difference to the baseline conditions.

172. During the post-breeding migration season, the peak abundance for gannet is 16 individuals within the Windfarm Site, which would result in zero (0.1-0.1) gannets being subject to mortality. The BDMPS population in the post-breeding migration season is defined as 456,298 individuals (**Table 12.17**) and, using the average baseline mortality rate of 0.187 (**Table 12.19**), the natural predicted mortality in the return migration season is 85,328 individuals per annum. The prediction of less than one mortality per annum would result in no material change to the baseline mortality rate (<0.001%).

173. This level of impact is considered to be of **negligible magnitude during the post-breeding migration season**, as it represents no discernible difference to the baseline conditions.

174. Due to the very small number of estimated mortalities (less than one mortality in each season) from operational phase displacement, irrespective of the sensitivity of the receptor, the significance of the impact is not significant as defined in the assessment of significance matrix (**Table 12.14**) and is not considered further in this assessment.

Auk species displacement rate evidence base

175. Auk species show a medium level of sensitivity to ship and helicopter traffic (Garthe and Hüppop, 2004; Furness and Wade, 2012; Langston, 2010; Bradbury *et al*., 2014). Displacement impacts from post-consent monitoring studies were collated and reviewed by Dierschke *et al*., (2016). This review summarises evidence of auk displacement obtained from studies of thirteen different European OWF sites that compared changes in seabird abundance between baseline and post-construction. The review concluded that the mean outcome across all OWFs for auks was 'weak displacement' but highly variable. Since the publication of this review, there have been a number of additional OWF sites which have reported displacement effects on auks (APEM 2017; Webb *et al*. 2017; Vanermen *et al*. 2019; Peschko *et al*. 2020; MacArthur Green 2021). Furthermore, previously published datasets from three OWF sites have recently been re-analysed utilising a novel modelling approach, which has resulted in different displacement effects being concluded for some (R-INLA; Zuur 2018; Leopold *et al*. 2018).

176. Since the Dierschke *et al*., (2016) review, a further study has been published using data from OWFs in the German North Sea indicating guillemot displacement rates are reduced during the breeding season compared to the non-breeding season by ~20% (Peschko *et al*, 2020). This is of important consideration as the mean displacement rates derived from the Dierschke *et al*., (2016)

review was predominantly from data collected in the non-breeding season. Therefore, by applying a single displacement rate across all seasons of 50% within the Windfarm Site and out to a 2 km buffer would ensure a precautionary rate is used for the assessment of displacement.

177. Hornsea Four OWF (Orsted, 2021) has recently submitted a summary review of all current post consent-monitoring studies undertaken to date within the North Sea and UK Western Waters. This review was completed by APEM (APEM, 2022b), which provides an extensive study and analysis of empirical data from multiple OWFs. The conclusion from this literature review suggested that a displacement rate of up to 50% for the Windfarm Site and 2 km buffer would be the most applicable, whilst still being suitably precautionary for assessment.

178. Furthermore, evidence that an auk displacement rate of 50% is precautionary comes from studies that indicate auk habituation to OWFs. This was recently demonstrated at Thanet OWF, where auk displacement was shown to be statistically significant, but only in the short term, with abundances increasing within the wind farm from year two post-construction suggesting some level of habituation after one year of operation. Indeed, year two and three displacement rates for auks fell from a range of 75% to 85% in the first year of operation to a low of 31% to 41% within year two and three of operations (Royal Haskoning, 2013). There is also further emerging evidence as additional post-construction monitoring of OWFs continues, with reports of auk numbers increasing and observations of foraging behaviour within wind farms such as at Luchterduinen and Belgian OWF concession zone (Leopold & Verdaat 2018 and Degraer *et al.*, 2021)). This would suggest that displacement rates are expected to diminish over the operational life of OWFs.

179. Therefore, in conclusion, there is strong evidence to support an auk displacement rate of 50% within OWF Windfarm Sites and out to a 2 km buffer, which would still be considered as precautionary.

Effects of displacement on auk mortality

180. For auk species SNCBs current guidance is to present and consider assessing displacement impacts using a mortality rate of up to 10% based on expert opinion, due to the lack of empirical evidence and to allow for precaution in assessments (SNCBs, 2017). As presented by Hornsea Four OWF (Orsted, 2021), since the interim guidance on displacement was published there have been two detailed studies with updates to predict consequence of displaced seabirds, including auks, from OWFs (Searle *et al*. 2014 and 2018, and van Kooten *et al*. 2019), and anecdotal evidence of implied low additional mortality rates from auk colony stability on Helgoland, where OWFs have been in operation since 2014 and auk displacement rates have been reported to be between 44-63% (Peschko *et al*. 2020).

181. Van Kooten *et al*. (2019) determined the cost of birds avoiding areas based on energy-budget models for two scenarios: using habitat utilization maps and a fixed 10% mortality rate. The results demonstrated that an additional 1% mortality for displaced auks is a more appropriate evidenced-based rate, in comparison to the overly precautionary 10% mortality rate.

182. Searle *et al*. (2014 and 2018) assessed the effects displacement and barrier effects on breeding seabirds. The study was based on time and energy budget models being created to estimate the displacement effects on the breeding population of seabirds, including auks during the chick rearing period. The models provided evidence that displacement has the potential to impact on future survival prospects of an auk due to changes in time and energy budgets. The simulations concluded however, that during the breeding and non-breeding season displacement effects are unlikely to exceed an increase in mortality of 0.5%.

183. Further anecdotal evidence of low mortality rates as a consequence of displacement comes from the post monitoring of the Helgoland auk colony in the German North Sea. OWFs have been in

operation in the area since 2014 and the displacement rate of auks is predicted to be between 44-63% (Peschko *et al.*, 2020). The OWFs have therefore been in operation long enough for any correlations between colony demographics and operation of the OWF to be identified. The latest breeding population status on Helgoland shows a continued increase for both razorbill and guillemot over the latest five-year period, which has remained unchanged compared to long-term data (Gerlach *et al.*, 2019), supporting an inferred conclusion that high mortality rates due to displacement are not occurring at the colony.

184. The detailed findings from the APEM study (APEM, 2022) into auk displacement mortality rates provide an extensive study and analysis to further inform the assessment process. Therefore, based on these studies the Applicant considers a mortality rate of 1% to be sufficiently precautionary for assessment of consequential displacement mortality for auks.

Guillemot

Potential magnitude of impact

185. The main focus of impact assessment is based on the Applicant's approach of a displacement rate of 50% and a 1% mortality rate for operational phase displacement (**Table 12.31**). As detailed in **Section 12.3.3**, for guillemot NatureScot consider that displacement assessment should be based on a displacement rate of 60% and a mortality rate of up to 5%. Presentation of displacement impacts following NatureScot's preferred approach for the operational phase is provided in **Table 12.32.**

Table 12.31 Applicant's approach for guillemot season displacement estimates for the Project (operational).

Season (months)	**Mean peak seasonal abundance (Windfarm Site plus 2 km buffer)**	**Regional baseline population and baseline mortality rates (individuals per annum)**		**Estimated number of guillemot subject to mortality (individuals per annum)**	**Increase in baseline mortality rate (%)**
		Population size	Baseline mortality	50% displacement rate; 1% mortality rate	50% displacement rate; 1% mortality rate
Breeding	4,429	577,117	79,642	22.1	0.028%
Non-breeding	16,105	577,117*	79,642	80.5	0.101%

*Population based on regional breeding population as advised during consultation process (Table 5).

Table 12.32 SNCB's approach for guillemot season displacement estimates for the Project (operational).

Season (months)	**Mean peak seasonal abundance (Windfarm Site plus 2 km buffer)**	**Regional baseline population and baseline mortality rates (individuals per annum)**		**Estimated number of guillemot subject to mortality (individuals per annum)**			**Increase in baseline mortality rate (%)**		
		Population size	Baseline mortality	60% Displacement; 1% Mortality	60% Displacement; 3% Mortality	60% Displacement; 5% Mortality	60% Displacement; 1% Mortality	60% Displacement; 3% Mortality	60% Displacement; 5% Mortality
Breeding	4,429	577,117	79,642		79.7	132.9		0.100%	0.167%
Non-breeding	16,105	577,117 *	79,642	96.6	289.9		0.121%	0.364%	

186. During the breeding season, the peak abundance for guillemot is 4,429 individuals within the Windfarm Site and 2 km buffer, which would result in 22 (22.1) guillemot being subject to mortality. The BDMPS population in the breeding season is defined as 577,117 individuals (**Table 12.17**) and, using the average baseline mortality rate of 0.138 (**Table 12.19**), the natural predicted mortality in the breeding season is 79,642 individuals per annum. The addition of 22 predicted additional mortalities per annum would increase baseline mortality rate by 0.028%.

187. This level of impact is considered to be of **negligible magnitude during the breeding season**, as it represents no discernible difference to the baseline conditions.

188. During the non-breeding season, the peak abundance for guillemot is 16,105 individuals within the Windfarm Site and 2 km buffer, which would result in approximately 81 (80.5) guillemot being subject to mortality. The regional non-breeding population, considering a regional population based on breeding foraging range as advised during the consultation process is defined as 577,117 individuals (**Table 12.17**) and, using the average baseline mortality rate of 0.138 (**Table 12.19**), the natural predicted mortality in the non-breeding season is 79,642 individuals per annum. The addition of 81 predicted additional mortalities per annum would increase baseline mortality rate by 0.101%.

189. This level of impact is considered to be of **low magnitude during the non-breeding season at the regional scale**, as it represents only a slight difference to the baseline conditions.

190. The level of impact is considered to be of up to low magnitude for both seasons, as it represents only a slight increase to baseline mortality rate levels. However, as the number of individuals that may be subject to operational phase displacement consequent mortality are up to 81 individuals in a given season, further consideration is provided to determine the significance of effect in this instance.

Sensitivity of the receptor

191. As detailed in **Section 12.10**, this receptor is afforded a feature conservation level of **medium** (**Table 12.11**). With respect to behavioural sensitivity to disturbance and displacement, it is considered to be **medium** (**Table 12.15**). As it is of medium behavioural sensitivity, and it is of medium conservation value the overall sensitivity of this receptor to disturbance and displacement is considered to be **medium**.

Significance of effect

192. Given a negligible to low magnitude of impact and a sensitivity of medium, following the matrix approach set out in **Table 12.14**, the potential effect of displacement and disturbance from operational and maintenance activities in the array plus 2 km buffer on guillemot has been assessed as **minor**, which is **not significant in EIA terms**.

Razorbill

Potential magnitude of impact

193. The main focus of impact assessment is based on the Applicant's approach of a displacement rate of 50% and a 1% mortality rate for operational phase displacement (**Table 12.33**). As detailed in **Section 12.3.3**, for razorbill NatureScot consider that displacement assessment should be based on a displacement rate of 60% and a mortality rate of up to 5%. Presentation of displacement impacts following NatureScot's preferred approach for the operational phase is provided in **Table 12.34** for comparison.

Table 12.33 Applicant's approach for razorbill season displacement estimates for the Project (operational).

Season (months)	Mean peak seasonal abundance (Windfarm Site plus 2 km buffer)	Regional baseline population and baseline mortality rates (individuals per annum)		Estimated number of razorbill subject to mortality (individuals per annum)	Increase in baseline mortality rate (%)
		Population size	Baseline mortality	50% displacement rate; 1% mortality rate	50% displacement rate; 1% mortality rate
Breeding	457	97,622	18,841	2.3	0.012%
Non-breeding	58	591,874	114,232	0.3	<0.001%

Table 12.34 SNCB's approach for razorbill season displacement estimates for the Project (operational).

Season (months)	Mean peak seasonal abundance (Windfarm Site plus 2 km buffer)	Regional baseline population and baseline mortality rates (individuals per annum)		Estimated number of razorbill subject to mortality (individuals per annum)			Increase in baseline mortality rate (%)		
		Population size	Baseline mortality	60% Displacement; 1% Mortality	60% Displacement; 3% Mortality	60% Displacement; 5% Mortality	60% Displacement; 1% Mortality	60% Displacement; 3% Mortality	60% Displacement; 5% Mortality
Breeding	457	97,622	18,841		8.2	13.7		0.044%	0.073%
Non-breeding	58	591,874	114,232	0.3	1.0		<0.001%	0.001%	

194. During breeding season, the peak abundance for razorbill is 457 individuals within the Windfarm Site and 2 km buffer, which would result in two (2.3) razorbill being subject to mortality. The BDMPS population in the breeding season is defined as 97,622 individuals (**Table 12.17**) and, using the average baseline mortality rate of 0.193 (**Table 12.19**), the natural predicted mortality in the breeding season is 18,841 individuals per annum. The addition of two predicted additional mortalities per annum would increase baseline mortality rate by 0.012%.

195. This level of impact is considered to be of **negligible magnitude during the breeding season**, as it represents no discernible difference to the baseline conditions.

196. During non-breeding season, the peak abundance for razorbill is 58 individuals within the Windfarm Site and 2 km buffer, which would result in approximately zero (0.3) razorbill being subject to mortality. The BDMPS population in the non-breeding season is defined as 591,874 individuals (**Table 12.17**) and, using the average baseline mortality rate of 0.193 (**Table 12.19**), the natural predicted mortality in the breeding season is 114,232 individuals per annum. The prediction of less than one mortality per annum would result in no material change to the baseline mortality rate (<0.001%).

197. This level of impact is considered to be of **negligible magnitude during the non-breeding season**, as it represents no discernible difference to the baseline conditions.

198. Due to the very small number of estimated mortalities (up to two mortalities in any given season) from operational phase displacement, irrespective of the sensitivity of the receptor, the significance of the impact is not significant as defined in the assessment of significance matrix (**Table 12.14**) and is not considered further in this assessment.

Puffin

Potential magnitude of impact

199. The main focus of impact assessment is based on the Applicant's approach of a displacement rate of 50% and a 1% mortality rate for operational phase displacement (**Table 12.35**). As detailed in **Section 12.3.3**, for puffin NatureScot consider that displacement assessment should be based on a displacement rate of 60% and a mortality rate of up to 5%. Presentation of displacement impacts following NatureScot's preferred approach to for the operational phase is provided in **Table 12.36** for comparison.

Table 12.35 Applicant's approach for puffin season displacement estimates for the Project (operational).

Season (months)	Mean peak seasonal abundance (Windfarm Site plus 2 km buffer)	Regional baseline population and baseline mortality rates (individuals per annum)		Estimated number of puffin subject to mortality (individuals per annum)	Increase in baseline mortality rate (%)
		Population size	Baseline mortality	50% displacement rate; 1% mortality rate	50% displacement rate; 1% mortality rate
Breeding	250	441,350	77,236	1.3	0.002%
Non-breeding	41	231,957	40,592	0.2	0.001%

Table 12.36 SNCB's approach for puffin season displacement estimates for the Project (operational).

Season (months)	Mean peak seasonal abundance (Windfarm Site plus 2 km buffer)	Regional baseline population and baseline mortality rates (individuals per annum)		Estimated number of puffin subject to mortality (individuals per annum)			Increase in baseline mortality rate (%)		
		Population size	Baseline mortality	60% Displacement; 1% Mortality	60% Displacement; 3% Mortality	60% Displacement; 5% Mortality	60% Displacement; 1% Mortality	60% Displacement; 3% Mortality	60% Displacement; 5% Mortality
Breeding	250	441,350	77,236		4.5	7.5		0.006%	0.010%
Non-breeding	41	231,957	40,592	0.2	0.7		0.001%	0.002%	

200. During breeding season, the peak abundance for puffin is 250 individuals within the Windfarm Site and 2 km buffer, which would result in approximately one (1.3) puffin being subject to mortality. The BDMPS population in the breeding season is defined as 441,350 individuals (**Table 12.17**) and, using the average baseline mortality rate of 0.175 (**Table 12.19**), the natural predicted mortality in the breeding season is 77,236 individuals per annum. The addition of one predicted additional mortality per annum would increase baseline mortality rate by 0.002%.

201. This level of impact is considered to be of **negligible magnitude during the breeding season**, as it represents no discernible difference to the baseline conditions.

202. During non-breeding season, the peak abundance for puffin is 41 individuals within the Windfarm Site and 2 km buffer, which would result in zero (0.2) puffin being subject to mortality. The BDMPS population in the non-breeding season is defined as 231,957 individuals (**Table 12.17**) and, using the average baseline mortality rate of 0.175 (**Table 12.19**), the natural predicted mortality in the breeding season is 40,592 individuals per annum. . The prediction of less than one mortality per annum would result in no material change to the baseline mortality rate (0.001%).

203. This level of impact is considered to be of **negligible magnitude during the non-breeding season**, as it represents no discernible difference to the baseline conditions.

204. Due to the very small number of estimated mortalities (up to one mortality in any season) from operational phase displacement, irrespective of the sensitivity of the receptor, the significance of the impact is not significant as defined in the assessment of significance matrix (**Table 12.14**) and is not considered further in this assessment.

Kittiwake

Potential magnitude of impact

205. Kittiwake is presented with two and three season options; using two seasons defined by NatureScot guidance and three seasons by incorporating the migratory periods pre- and post-breeding defined in Furness (2015). These options are provided to maximise interpretation of peak abundance estimates and behaviour over the Study Area of this species.

206. The Applicant does not agree with disturbance and displacement assessment being required for kittiwake given the species low sensitivity to displacement (**Table 12.15**) and is only provided due to being requested by NatureScot.

207. The annual estimated mortality (when considering a displacement rate of 30% and a mortality rate of up to 3%) for kittiwake resulting from disturbance and displacement during operation is approximately four (3.7) individuals. This is further broken down into relevant seasons in **Table 12.37**.

Table 12.37 Kittiwake displacement estimates for the Applicant's preferred seasons (top) and SNCBs preferred seasons (bottom) for the Project (operational).

Season (months)	Mean peak seasonal abundance (Windfarm Site plus 2 km buffer)	Regional baseline population and baseline mortality rates (individuals per annum)		Estimated number of kittiwake subject to mortality (individuals per annum)		Increase in baseline mortality rate (%)	
		Population size	Baseline mortality	30 % displacement; 1% mortality	30 % displacement; 3% mortality	30 % displacement; 1% mortality	30 % displacement; 3% mortality
Return Migration	83	627,816	97,939	0.2	0.7	<0.001%	0.001%
Migration-free Breeding	183	380,104	59,296	0.5	1.6	0.001%	0.003%
Post-breeding migration	149	829,937	129,470	0.4	1.3	<0.001%	0.001%
Breeding	183	380,104	59,296	0.5	1.6	0.001%	0.003%
Non-breeding	232	829,937	129,470	0.7	2.1	<0.001%	0.001%

208. During the migration-free breeding season, the peak abundance for kittiwake is 183 individuals within the Windfarm Site and 2 km buffer, which would result in one (0.5 to 1.6) kittiwake being subject to mortality. The BDMPS population in the breeding season is defined as 380,104 individuals (**Table 12.17**) and, using the average baseline mortality rate of 0.156 (**Table 12.19**), the natural predicted mortality in the breeding season is 59,296 individuals per annum. The prediction of less than one mortality per annum would result in no material change to the baseline mortality rate (0.001% to 0.003%).

209. This level of impact is considered to be of **negligible magnitude during the breeding season**, as it represents no discernible difference to the baseline conditions.

210. During the return migration season, the peak abundance for kittiwake is 83 individuals within the Windfarm Site and 2 km buffer, which would result in zero (0.2 to 0.7) kittiwake being subject to mortality. The BDMPS population in the non-breeding season is defined as 627,816 individuals (**Table 12.17**) and, using the average baseline mortality rate of 0.156 (**Table 12.19**), the natural predicted mortality in the breeding season is 97,939 individuals per annum. The prediction of less than one mortality per annum would result in no material change to the baseline mortality rate (<0.001% to 0.001%).

211. This level of impact is considered to be of **negligible magnitude during the breeding season**, as it represents no discernible difference to the baseline conditions.

212. During the post-breeding migration season, the peak abundance for kittiwake is 149 individuals within the Windfarm Site and 2 km buffer, which would result in zero (0.4 to 1.3) kittiwake being subject to mortality. The BDMPS population in the non-breeding season is defined as 829,937 individuals (**Table 12.17**) and, using the average baseline mortality rate of 0.156 (**Table 12.19**), the natural predicted mortality in the breeding season is 129,470 individuals per annum. The prediction of less than one mortality per annum would result in no material change to the baseline mortality rate (<0.001% to 0.001%).

213. This level of impact is considered to be of **negligible magnitude during the breeding season**, as it represents no discernible difference to the baseline conditions.

214. During the non-breeding season, the peak abundance for kittiwake is 232 individuals within the Windfarm Site and 2 km buffer, which would result in one (0.7 to 2.1) kittiwake being subject to mortality. The BDMPS population in the non-breeding season is defined as 829,937 individuals (**Table 12.17**) and, using the average baseline mortality rate of 0.156 (**Table 12.19**), the natural predicted mortality in the breeding season is 129,470 individuals per annum. The prediction of one mortality per annum would result in no material change to the baseline mortality rate (<0.001% to 0.001%).

215. This level of impact is considered to be of **negligible magnitude during the non-breeding season**, as it represents no discernible difference to the baseline conditions.

216. Due to the very small number of estimated mortalities (up to two mortalities in any season) from operational phase displacement, irrespective of the sensitivity of the receptor, the significance of the impact is not significant as defined in the assessment of significance matrix (**Table 12.14**) and is not considered further in this assessment.

12.11.2 Disturbance and displacement: Offshore Export Cable Corridors and cable landfall

217. The worst case scenario for disturbance and displacement in the Offshore Export Cable Corridors assumes occasional routine monitoring activity. Overall, the potential for disturbance and displacement will be very restricted both temporally and spatially. Whilst unscheduled repair events may occur at any time of year they are expected to be very rare occurrences and any disturbance and displacement will be spatially restricted to the vicinity of the repair site and access routes and temporally restricted to the time taken to conduct the repairs. Repairs will generally be undertaken in the shortest timespan possible in order to limit disruption to the operation and revenue generation of the OWF. Therefore this can be considered of minor magnitude of impact, regardless of the species sensitivity, which is **not significant in EIA terms**.

12.11.3 Indirect effects via changes in prey or habitat availability

218. Indirect impacts during the operational phase are likely to be predominantly from any movement in the cables caused due to wind, wave and tidal effects on turbine structures along with any required maintenance works.

219. The baseline characterisation report did not identify any species of high sensitivity or high densities within the Offshore Export Cable Corridors (**Appendix 12.1: Offshore and intertidal ornithology baseline technical report**). Works within the Offshore Export Cable Corridors are likely to be spatially and temporally restricted, as described above.

220. Impacts, namely from the production of suspended sediments, may alter the distribution, physiology and behaviour of prey species and habitats. These mechanisms could potentially result in reduced prey availability in areas adjacent operation floating wind sites to seabird foraging areas. This may result in disturbance and displacement effects, effectively reducing habitat availability for foraging and other activities. Any form of indirect effect (including reductions in prey and habitat availability) may cause reduced survival or reproductive fitness of the species deemed at risk. The maximum impact on ornithological receptors will result from the maximum impact on fish and benthic organisms.

221. These potential indirect impacts may occur during the operational phase of the Project. Potential impacts are likely to occur within or immediately next to the Windfarm Site footprint, the Offshore Export Cable Corridor and areas of intertidal landfall through effects on benthic habitat and prey species. Such potential effects on benthic invertebrates and fish have been assessed in **Chapter 9: Benthic Ecology** and **Chapter 10: Fish and Shellfish Ecology** and the conclusions of those assessments inform this assessment of indirect effects on ornithology receptors.

222. With regard to changes to the seabed and to suspended sediment levels, **Chapter 7: Marine Geology, Oceanography and Physical Processes, Chapter 8: Marine Sediment and Water Quality** and **Chapter 9: Benthic Ecology** discusses the nature of any change and impacts on the seabed and benthic habitats. Impacts that have been assessed are considered to be low or negligible and are anticipated to result in changes of minor adverse significance. (see C**hapter 9: Benthic Ecology**, summarised in **Section 9.11** and **Table 9.16**). The consequent indirect impact on fish through habitat loss is considered to be negligible (see **Chapter 10: Fish and Shellfish Ecology** summarised in **Section 10.11** and **Table 10.49**) for species such as herring, sprat and sandeel, which are the main prey items of seabirds such as gannet and auks. With a minor or negligible impact on fish that are bird prey species, it is concluded that the indirect impact significance on seabirds occurring in or around the Project during the operational and maintenance phase is similarly a minor or negligible adverse impact. Therefore, it can be concluded there is **no significant effect in EIA terms during the operational and maintenance phase**.

12.11.4 Entanglement with mooring lines

223. There is a potential risk to birds resulting from entanglement with mooring cables, with indirect factors predominantly influencing the extent of this risk. Here, comments are made on these influencing factors, however, it is highlighted that there is currently no clear guidance on the assessment and monitoring approaches required for floating WTG designs for bird entanglement. Similarly, a short review of published reports from similar floating OWF projects and other moored infrastructures do not provide examples of where entanglement for seabirds has been scoped in for assessment and therefore the basis and evidence for this consideration is unclear. This is most likely due to this potential impact pathway being an incredibly rare occurrence and considering that floating structures in relation to the oil and gas industry have been present in this region of the North Sea for several decades it is unlikely that such a potential impact on seabirds is likely.

224. Direct entanglement risk is thought to be unlikely due to the design parameters, with the mooring lines being under tension and the dimensions of the chain reducing the likelihood of full or partial entanglement to negligible. The embedded maintenance and monitoring practices of the deployed infrastructure will likely contribute to this decreased risk.

225. Offshore infrastructure may act as hard substrate leading to likely habitat development, acting as a fish aggregation device (FAD), providing refuge for prey species increasing attraction factors within the array footprint and may increase entanglement risk. While possible in theory, best available evidence from the Dounreay Tri Floating Wind demonstration project indicates that the level of fish aggregation around floating WTG designs is minimal and therefore decreases the likelihood of increased prey fish densities influencing bird collision risk.

226. Entangled fishing gear on the mooring lines may increase the extent infrastructure will act as a FAD along with the risk of indirect entanglement by diving birds within entangled netting within the array footprint. The embedded maintenance (**Table 12.10**) and monitoring practices of the deployed infrastructure will likely contribute to this decreased risk, which are to include maintenance inspections to collect and remove debris (such as abandoned fishing nets, pots and other marine rubbish) amongst the mooring lines. This embedded mitigation will help reduce the potential likelihood of any entanglement. Therefore, it is concluded that the indirect impact significance on seabirds from entanglement would be a negligible adverse impact. Therefore, it can be concluded there is **no significant effect in EIA terms during the operational and maintenance phase**.

12.11.5 Collision risk: array

Overview

227. There is potential risk to birds from offshore wind farms through collision with WTGs resulting in injury or fatality. This may occur when birds fly through the Project array whilst foraging for food, commuting between breeding sites and foraging areas, or during migration.

228. Collision risk modelling (CRM) has been carried out for the Project, with detailed methods and results presented in **Appendix 12.3: Offshore ornithology collision risk modelling**, to provide information for seabird species of interest identified as potentially at risk and of interest for impact assessment. An evaluation was undertaken based on the species abundance of flying birds recorded within the Windfarm Site, consideration of their vulnerability to collision (identified from the published literature) and conservation value, with the results presented in **Table 12.15**. Following the evaluation process (**Section 12.8**), four species were scoped in for assessment: gannet, kittiwake, great black-backed gull and herring gull as agreed with the Green Volt Ornithology Working Group.

229. CRM was undertaken using the stochastic (sCRM), developed by Marine Scotland (McGregor, 2018), run deterministically for each seabird species, to determine the risk of collision.

230. CRM accounts for several different species-specific behavioural aspects of the seabirds being assessed, including the height at which birds fly, their ability to avoid moving or static structures and how active they are diurnally and nocturnally. Details of these considerations are provided in **Appendix 12.3: Offshore ornithology collision risk modelling.**

231. In order to provide a range of values to capture variability for each species, the key input parameters were reviewed in order to provide 'mean', 'minimum' and 'maximum' estimates of collision rates for each species, with the focus of assessments being on the mean impacts. Full details of the parameters used to calculate each estimate are given in **Appendix 12.3: Offshore ornithology collision risk modelling**.

232. All estimates are presented using Band Option 2 (BO2), while for the large gulls Band Option 3 (BO3) is additionally presented. Robustly estimating site-specific flight heights from aerial digital imagery requires a sufficient sample size of birds of each species from which flight height can be determined. Not all individuals are suitable for flight height estimation, as the method requires clear imagery of individuals in straight and level flight, with wings fully extended. Following completion of the full 24 months of site-specific baseline surveys, sample sizes were insufficient to accurately calculate site-specific flight heights for the four species selected for CRM, therefore Band Option 1 has not been modelled.

233. BO2 applies a uniform distribution of bird flights between the lowest and the highest levels of the rotors. The proportion of birds at Potential Collision Height (PCH) was determined from the results of the Strategic Ornithological Support Services SOSS-02 project (Cook *et al*., 2012) that analysed the flight height measurements taken from boat surveys conducted around the UK. The project was updated following Johnston *et al*. (2014) and its associated corrigendum, and the revised published spreadsheet is used to determine the 'generic' percentage of flights at PCH for each species based on the proposed project's WTG parameters. This Band option has been considered for all four species.

234. The Extended Band model (i.e., BO3) accounts for the skewed vertical distribution of bird flight heights between the lowest and the highest levels of the rotors. Most seabird species are observed flying more frequently at the lower level of the rotor swept height, which presents lower risk of collision (i.e., closer to the sea surface) than at heights equivalent to the rotor hub height where collision risk is greater or at the upper levels. By understanding the variation of bird flight through the rotor swept area the Extended Band model considers and applies different probabilities of being struck by the moving rotor blades through the rotor swept area vertically. The Extended Band model relies on the data spreadsheet that accompanies Johnston *et al*., (2014), which is the result of a statistical analysis of a large number of offshore surveys across multiple study sites. These data are fed into the model in order to allow for the flight distribution to be calculated based upon the OWF parameters of the proposed project. This Band Option is considered the most appropriate for assessing both herring gull and great black-backed gull, in line with SNCB advice (JNCC *et al*. 2014).

Precautionary nature of the CRM

235. It must be noted that a number of elements of additional precaution were included in the input parameters applied in the sCRM for this assessment, including considering a range of nocturnal activity factors and lower avoidance rates than that currently predicted from the latest scientific evidence. The nature of such precaution is evidenced through the findings of the Bird Collision Avoidance Study funded by ORJIP (Offshore Renewables Joint Industry Programme), which undertook a study to understand seabird behaviour at sea around offshore wind farms (Skov *et al*., 2018). The ORJIP project studied birds around Thanet Offshore Wind Farm for a two-year period (between 2014 and 2016) recording over 12,000 bird movements throughout the day and night (Skov *et al*., 2018). The findings of this study presented updated values for both nocturnal activity,

flight speeds and avoidance behaviour from an empirical data source, which is recommended for future incorporation in CRM to provide greater confidence in predicted impacts and reduce the current levels of uncertainty in assessments. It also reported that only six birds (all gull species) collided with WTGs from over 12,000 birds recorded during the two-year period, providing evidence of the current level of precautionary nature of collision risk modelling for all species of seabirds assessed for the project.

236. A further review of the data from the ORJIP project was undertaken by Bowgen and Cook (2018), which analysed all the data collected across the two-year period to understand more about seabird behaviour and provide evidence to support updates to the previous avoidance rates from Cook *et al*. (2014). The findings from this study were that for gannet and kittiwake higher avoidance rates were more appropriate of 99.5% and 99.0%, respectively. It concluded that even when applying these higher rates of avoidance, appropriate levels of precaution remained within the estimated number of collision mortality rates.

237. Another study on gannets by APEM Ltd during the migratory period (APEM, 2014) found that overall avoidance of WTGs was certainly higher than the SNCBs recommended rate of 98.9%. This study found that all gannets avoided the WTGs within the Study Area which can be considered a macro avoidance response, which provided evidence that gannets may actually have an avoidance rate as high as 100% during migratory periods at least. However, the concluding recommendation from APEM's research suggested that if it was not appropriate to use a 100% avoidance rate, then a rate of 99.5% for the autumn migration would still offer suitable precaution in collision estimates. This indicates that when estimating gannet collision mortality rates, the use of an avoidance rate of 98.9% is understood to overestimate the risk to this species, as noted by Cook *et al*., (2014), who acknowledged that precaution remained within the avoidance rates put forward for gannets and gull species.

238. Therefore, it is considered that the CRM input parameters used in the assessment of collision risk to seabirds for the Project and those from other developments at the cumulative level incorporate a high degree of precaution.

Results

239. The monthly collision rates and total annual collisions for all species assessed is shown in **Table 12.38**.

Table 12.38 Monthly and annual collision estimates for each species considered. Collision estimates presented are based on mean values with the minimum and maximum values in parentheses

Month	Gannet (BO2)	Kittiwake (BO2)	Herring gull		Great black-backed gull	
			BO2	BO3	BO2	BO3
January	1.29 (0.22-4.31)	1.18 (0.77-2.29)	3.05 (2.44-5.00)	1.72 (1.38-2.82)	2.43 (1.95-3.98)	1.61 (1.32-2.59)
February	0.54 (0.02-1.74)	0.55 (0.30-1.12)	0.32 (0.26-0.49)	0.18 (0.14-0.28)	0.54 (0.24-1.22)	0.36 (0.16-0.79)
March	0.75 (0.06-2.12)	1.58 (0.30-3.97)	0.00 (0.00-0.00)	0.00 (0.00-0.00)	0.00 (0.00-0.00)	0.00 (0.00-0.00)
April	1.41 (0.38-3.25)	1.04 (0.50-2.01)	0.00 (0.00-0.00)	0.00 (0.00-0.00)	0.00 (0.00-0.00)	0.00 (0.00-0.00)
May	2.00 (0.00-5.32)	1.27 (1.04-1.65)	0.00 (0.00-0.00)	0.00 (0.00-0.00)	0.00 (0.00-0.00)	0.00 (0.00-0.00)
June	4.26 (0.85-9.57)	2.64 (0.37-6.15)	0.00 (0.00-0.00)	0.00 (0.00-0.00)	0.00 (0.00-0.00)	0.00 (0.00-0.00)
July	5.1 (1.49-10.84)	3.34 (1.67-5.96)	0.00 (0.00-0.00)	0.00 (0.00-0.00)	0.00 (0.00-0.00)	0.00 (0.00-0.00)
August	1.28 (0.31-2.95)	0.20 (0.16-0.26)	0.00 (0.00-0.00)	0.00 (0.00-0.00)	0.00 (0.00-0.00)	0.00 (0.00-0.00)
September	4.64 (2.26-9.37)	2.31 (1.89-3.21)	0.00 (0.00-0.00)	0.00 (0.00-0.00)	0.00 (0.00-0.00)	0.00 (0.00-0.00)
October	0.38 (0.00-1.21)	0.76 (0.63-1.13)	0.00 (0.00-0.00)	0.00 (0.00-0.00)	0.40 (0.32-0.60)	0.27 (0.22-0.39)
November	0.09 (0.00-0.79)	2.50 (1.07-5.81)	0.14 (0.00-0.59)	0.08 (0.00-0.33)	0.61 (0.08-1.80)	0.40 (0.05-1.17)
December	0.00 (0.00-0.00)	1.56 (0.26-4.63)	0.29 (0.00-0.98)	0.16 (0.00-0.56)	0.31 (0.07-0.90)	0.21 (0.05-0.58)
Annual Total	**21.75 (5.61-51.47)**	**18.94 (8.95-38.18)**	**3.79 (2.70-7.07)**	**2.14 (1.52-3.99)**	**4.30 (2.65-8.49)**	**2.84 (1.79-5.53)**

Gannet

Potential magnitude of impact

240. The monthly estimated mortality rates for gannet are presented in **Table 12.38,** which vary from a minimum of less than one individual for five months to a maximum of approximately five individuals in July. The estimated mortality rate for collision risk from the Project are broken down into relevant seasons in **Table 12.39.**

Table 12.39 Gannet season collision risk estimates.

Season (months)	Predicted collisions (BO2)	Regional baseline populations and baseline mortality (individuals per annum)		Increase in baseline mortality rate (%)
		Population	Baseline Mortality	
Return Migration (Dec-Mar)	2.6 (0.3-8.2)	248,385	46,448	0.006% (0.001-0.018%)
Migration-free Breeding (Apr-Sep)	18.7 (5.3-41.3)	804,425	150,427	0.012% (0.004-0.027%)
Post-breeding migration (Oct-Nov)	0.5 (0.0-2.0)	456,298	85,328	0.001% (0.000-0.002%)

241. During the return migration season, three (2.6) gannets may be subject to collision mortality. During the return migration season, the total regional baseline population is predicted to be 248,385 gannets (**Table 12.17**). When the average baseline mortality rate of 0.187 (**Table 12.19**) is applied, the natural predicted mortality for the return migration season is 46,448 individuals per annum. The addition of three predicted additional mortalities per annum due to collision would increase baseline mortality rate by 0.006%.

242. This level of impact is considered to be of **negligible magnitude during the return migration season**, as it represents no discernible difference to the baseline conditions due to the small number of estimated collisions.

243. During the migration-free breeding season, 19 (18.7) gannets may be subject to collision mortality. During the migration-free breeding season, the total regional baseline population is predicted to be 804,425 gannets (**Table 12.17**). When the average baseline mortality rate of 0.187 (**Table 12.19**) is applied, the natural predicted mortality for the migration-free breeding season is 150,427 individuals per annum. The addition of 19 predicted additional mortalities per annum due to collision would increase baseline mortality rate by 0.012%.

244. This level of impact is considered to be of **negligible magnitude during the migration-free breeding season**, as it represents no discernible difference to the baseline conditions due to the small number of estimated collisions.

245. During the post-breeding migration season, less than a single (0.5) gannet may be subject to collision mortality. During the post-breeding migration season, the total regional baseline population is predicted to be 456,298 (**Table 12.16**). When the average baseline mortality rate **(Table 12.19**) is applied, the natural predicted mortality for the post-breeding migration season is 85,328 individuals per annum. The addition of less than a single predicted additional mortalities per annum due to collision would increase baseline mortality rate by 0.001%.

246. This level of impact is considered to be of **negligible magnitude during the migration-free breeding season**, as it represents no discernible difference to the baseline conditions due to the number of estimated collisions being less than a single individual.

247. The level of impact is considered to be of negligible magnitude in any season, as it represents only a slight increase to baseline mortality rate levels. However, as the number of individuals that may be subject to collision mortality is up to 19 individuals in a given season, further consideration is provided to determine the significance of effect in this instance.

Sensitivity of the receptor

248. As detailed in **Section 12.10**, this receptor is afforded a feature conservation value of **medium**. With respect to behavioural sensitivity to collision, it is considered to be **high** (**Table 12.15**). As it is of **high** behavioural sensitivity, and of **medium** conservation value, this leads to an overall sensitivity of this receptor to collision risk of **medium**.

Significance of effect

249. Following the matrix approach set out in **Table 12.14**, given a sensitivity of medium and a magnitude of negligible, the overall effect is concluded to be **minor, which is not significant in EIA terms**.

Kittiwake

Potential magnitude of impact

250. The monthly estimated mortality rates for kittiwake are presented in **Table 12.38**, which vary from a minimum of less than one individual for three months to a maximum of approximately three individuals in July. The estimated mortality rate for collision risk from the Project is broken down into relevant seasons in **Table 12.40** and **Table 12.41**.

Table 12.40 Kittiwake collision risk estimates using the Applicant's preferred seasons.

Season (months)	Predicted collisions (BO2)	Regional baseline populations and baseline mortality (individuals per annum)		Increase in baseline mortality rate (%)
		Population	Baseline Mortality	
Return Migration (Jan – mid Apr)	4.4 (1.9-9.4)	627,816	97,939	0.004% (0.002-0.010)
Migration-free Breeding (mid Apr-Aug)	7.4 (3.2-14.0)	380,104	59,296	0.013% (0.005-0.024)
Post-breeding Migration (Sep-Dec)	7.1 (3.8-14.8)	829,937	129,470	0.006% (0.003-0.011)

Table 12.41 Kittiwake collision risk estimates using SNCB's preferred seasons.

Season (months)	Predicted collisions (BO2)	Regional baseline populations and baseline mortality (individuals per annum)		Increase in baseline mortality rate (%)
		Population	Baseline Mortality	
Migration-free Breeding (mid Apr-Aug)	7.4 (3.2-14.0)	380,104	59,296	0.013% (0.005-0.024)
Non-breeding (Sep-mid Apr)	11.5 (5.7-24.2)	829,937	129,470	0.009% (0.004-0.019%)

251. During the return migration season, four (4.4) kittiwakes may be subject to collision mortality. During the return migration season, the total regional baseline population is predicted to be 627,816 kittiwakes (**Table 12.17**). When the average baseline mortality rate of 0.156 (**Table 12.19**) is applied, the natural predicted mortality for the return migration season is 97,939 individuals per annum. The addition of four predicted additional mortalities per annum due to collision would increase baseline mortality rate by 0.004%.

252. This level of impact is considered to be of **negligible magnitude during the return migration season**, as it represents no discernible difference to the baseline conditions due to the small number of estimated collisions.

253. During the migration-free breeding season, seven (7.4) kittiwakes may be subject to collision mortality. During the migration-free breeding season, the total regional baseline population is predicted to be 380,104 kittiwakes **(Table 12.17**). When the average baseline mortality rate of 0.156 (**Table 12.19**) is applied, the natural predicted mortality for the migration-free breeding season is 59,296 individuals per annum. The addition of seven predicted additional mortalities per annum due to collision would increase baseline mortality rate by 0.013%.

254. This level of impact is considered to be of **negligible magnitude during the migration-free breeding season**, as it represents only a slight difference to the baseline conditions due to the small number of estimated collisions.

255. During the post-breeding migration season, seven (7.1) kittiwakes may be subject to collision mortality. During the post-breeding migration season, the total regional baseline population is predicted to be 829,937 kittiwakes (**Table 12.17**). When the average baseline mortality rate of 0.156 (**Table 12.19**) is applied, the natural predicted mortality for the post-breeding migration season is 129,470 individuals per annum. The addition of seven predicted additional mortalities per annum due to collision would increase baseline mortality rate by 0.006%.

256. This level of impact is considered to be of **negligible magnitude during the migration-free breeding season**, as it represents no discernible difference to the baseline conditions due to the small number of estimated collisions.

257. The level of impact is considered to be of negligible magnitude in any season, as it represents only a slight increase to baseline mortality rate levels. However, as the number of individuals that may be subject to collision mortality is up to 7.4 individuals in a given season, further consideration is provided to determine the significance of effect in this instance.

Sensitivity of the receptor

258. As detailed in **Section 12.10**, this receptor is afforded a feature conservation level of **medium** (**Table 12.11**). With respect to behavioural sensitivity to collision, it is considered to be **high** (**Table 12.15**). As it is of high behavioural sensitivity, and it is of medium conservation value, this leads to an overall sensitivity of this receptor to collision risk of **medium**.

Significance of effect

259. Following the matrix approach set out in **Table 12.14**, given a sensitivity of medium and a magnitude of negligible, the overall effect is concluded to be **minor, which is not significant in EIA terms**.

Herring gull
Potential magnitude of impact

260. The monthly estimated mortality rates for herring gull are presented in **Table 12.38**. For the purpose of this assessment, the Applicant considers B03 to be the most appropriate model, as it takes into account skewed vertical distribution of bird flight heights between the lowest and the highest levels of the rotors. The monthly estimated collisions vary from zero individuals for eight months to a maximum of approximately two individuals in January. The estimated mortality rate for collision risk from the Project is further broken down into relevant seasons in **Table 12.42.**

Table 12.42 Herring gull season collision risk estimates.

Season (months)	Predicted collisions		Regional baseline populations and baseline mortality (individuals per annum)		Increase in baseline mortality rate (%)	
	BO2	BO3	Population	Baseline Mortality	BO2	BO3
Breeding (April-Aug)	0.0 (0.0-0.0)	0.0 (0.0-0.0)	13,267	2,282	0.000% (0.000-0.000%)	0.000% (0.000-0.000%)
Non-breeding (Sep-Mar)	3.8 (2.7-7.1)	2.1 (1.5-4)	466,511	80,240	0.005% (0.003-0.009%)	0.003% (0.002-0.005%)

261. During breeding season, zero herring gulls are expected to be subject to mortality. There is therefore **no impact in the breeding season**.

262. During the non-breeding season, two (2.1) herring gulls may be subject to collision mortality. During the non-breeding migration season, the total regional baseline population is predicted to be 466,511 herring gulls (**Table 12.17**). When the average baseline mortality rate of 0.172 (**Table 12.19**) is applied, the natural predicted mortality for the post-breeding migration season is 80,240 individuals per annum. The addition of two predicted additional mortalities per annum due to collision would increase baseline mortality rate by 0.003%.

263. This level of impact is considered to be of **negligible magnitude during the migration-free breeding season**, as it represents no discernible difference to the baseline conditions due to the very small number of estimated collisions.

264. The level of impact is considered to be of negligible magnitude in any season, as it represents no discernible increase to baseline mortality rate levels due to the very small number of estimated collisions. Irrespective of the sensitivity of the receptor, the significance of the impact is not significant as defined in the assessment of significance matrix (**Table 12.14**) and is not considered further in this assessment.

Great black-backed gull
Potential magnitude of impact

265. The monthly estimated mortality rates for great black-backed gull are presented in **Table 12.38**. For the purpose of this assessment, the Applicant considers B03 to be the most appropriate model, as it takes into account skewed vertical distribution of bird flight heights between the lowest and the highest levels of the rotors. The monthly estimated collisions vary from zero individuals for seven months to a maximum of approximately two individuals in January. The estimated mortality rate for collision risk from the Project is further broken down into relevant seasons in **Table 12.43**.

Table 12.43 Great black-backed gull season collision risk estimates

Season (months)	Predicted collisions		Regional baseline populations and baseline mortality (individuals per annum)		Increase in baseline mortality rate(%)	
	BO2	BO3	Population	Baseline Mortality	BO2	BO3
Breeding (April-Aug)	0.0 (0.0-0.0)	0.0 (0.0-0.0)	1,026	164	0.000% (0.000-0.000%)	0.000% (0.000-0.000%)
Non-breeding (Sep-Mar)	4.3 (2.7-8.5)	2.8 (1.8-5.5)	91,399	14,624	0.029% (0.018-0.058%)	0.019% (0.012-0.038%)

266. During breeding season, zero great black-backed gulls are expected to be subject to mortality. There is therefore **no impact in the breeding season**.

267. During the non-breeding season, three (2.8) great black-backed gulls may be subject to collision mortality. During the non-breeding migration season, the total regional baseline population is predicted to be 91,399 great black-backed gulls (**Table 12.17**). When the average baseline mortality rate of 0.160 (**Table 12.19**) is applied, the natural predicted mortality for the post-breeding migration season is 14,624 individuals per annum. The addition of three predicted additional mortalities per annum due to collision would increase baseline mortality rate by 0.019%.

268. This level of impact is considered to be of **negligible magnitude during the migration-free breeding season**, as it represents no discernible difference to the baseline conditions due to the very small number of estimated collisions.

269. The level of impact is considered to be of negligible magnitude in any season, as it represents no discernible increase to baseline mortality rate levels due to the very small number of estimated collisions. Irrespective of the sensitivity of the receptor, the significance of the impact is not significant as defined in the assessment of significance matrix (**Table 12.14**) and is not considered further in this assessment.

12.11.6 Combined Operational Displacement and collision risk

270. Due to gannet and kittiwake being scoped in for both displacement and collision risk assessments during the operation and maintenance phase, there is potential for these two potential impacts to adversely affect gannet and kittiwake populations in a combined effect. Previous sections have concluded negligible predicted magnitudes of impact with respect to displacement or collision risk acting alone; however, the combined impact of both collision risk and displacement may be greater than either one acting alone. Further consideration of both impacts acting together is therefore required.

271. However, it is recognised that assessing these two potential impacts together may in this instance amount to double counting, as birds that are subject to displacement would not be subject to potential collision risk as they are already assumed to have not entered the Windfarm Site. Equally, birds estimated to be subject to collision risk mortality would not be able to be subjected to displacement consequent mortality as well.

Gannet

272. The latest guidance paper on avoidance rates for collision risk modelling (Cook, 2021) included acknowledgement of the double counting of collision risk and displacement for gannet and proposed that assessments of gannet should take into account observed high levels of macro avoidance within collision risk modelling to reduce the over-inflation of impacts when combining the two together (APEM, 2014; Dierschke *et al.*, 2016; APEM, 2022).

273. The issue of over-inflating displacement and collision when combining the two for assessing the potential impacts on gannet from OWFs is also noted in the joint SNCBs interim advice note on displacement (SNCBs, updated 2022). Despite updated guidance not being issued for gannet collision risk modelling to account for a greater degree of macro avoidance consideration has been provided in this report of such potential additional macro avoidance in an alternate set of CRM outputs. These revised CRM outputs altered the monthly mean density estimates for gannet to account for a macro avoidance of 70% (the upper end of the displacement range of 60 to 70% advocated by NatureScot) and are presented in **Appendix 12.3 Offshore Ornithology: Collision Risk Modelling**, **Table 19** and **Table 20,** respectively.

274. When considering the inclusion of macro avoidance in the assessment of collision risk to gannet, the mean annual predicted collision mortality rate for the Project is 6.5 individuals per annum compared to 21.8 individuals when macro avoidance is unaccounted. The significant difference between the two approaches highlights the current over precaution in the assessment of gannet collision risk, due to macro avoidance not being accounted for.

Potential magnitude of impact

275. As detailed in **Table 12.29** and **Appendix 12.3 Offshore Ornithology: Collision Risk Modelling** in **Table 20**, following the Applicant's evidence-led assessments the combined predicted mortality in the operation and maintenance phase equates to 8 predicted additional mortalities per annum. This comes from the estimated mortality rate of 1.5 individuals from displacement and 6.5 individuals from collision risk.

276. Using the largest BDMPS population of 456,298 (**Table 12.17**), as a proxy for the annual BDMPS population, with an average baseline mortality rate of 0.187 (**Table 12.19**), the natural predicted mortality for gannet is 85,328 individuals per annum. The addition of 8 predicted mortalities would increase the baseline mortality rate by 0.009 % of the annual BDMPS population. When considering the annual potential level of change at the biogeographic scale the natural predicted mortality for the biogeographic population of 1,180,000 (**Table 12.17**) across all seasons is 220,660 individuals per annum. On a biogeographic scale the addition of 8 predicted mortalities would increase baseline mortality rate by 0.003%.

277. This level of potential impact is considered to be an impact of **negligible magnitude on an annual basis at both the BDMPS and bio-geographic scales**, as it represents no discernible increase to baseline mortality rate levels due to the small number of estimated mortalities from both operational phase displacement and estimated collisions combined. Irrespective of the sensitivity of the receptor, the significance of the impact is not significant as defined in the assessment of significance matrix (**Table 12.14**) and is not considered further in this assessment.

Significance of effect

278. Given a negligible magnitude of impact and a sensitivity of minor, following the matrix approach set out in **Table 12.14**, the potential effect of displacement and disturbance from operational and maintenance activities in the Windfarm Site plus 2 km buffer on gannet has been assessed as **minor**, which is **not significant in EIA terms**.

Kittiwake

Potential magnitude of impact

279. As detailed in **Table 12.29** and **Appendix 12.3 Offshore Ornithology Collision Risk Modelling** in **Table 20**, following the Applicant's evidence-led assessments the combined predicted mortality in the operation and maintenance phase equates to 23 (22.7) predicted additional mortalities per annum. This comes from the estimated mortality rate of 3.7 individuals from displacement and 18.9 individuals from collision risk.

280. Using the largest BDMPS population of 829,937 (**Table 12.17**), as a proxy for the annual BDMPS population, with an average baseline mortality rate of 0.156 (**Table 12.19**), the natural predicted mortality for kittiwake is 129,470 individuals per annum. The addition of 23 predicted mortalities would increase the baseline mortality rate by 0.003 % of the annual BDMPS population. When considering the annual potential level of change at the biogeographic scale the natural predicted mortality for the biogeographic population of 5,100,100 (**Table 12.17**) across all seasons is 795,616 individuals per annum. On a biogeographic scale the addition of 8 predicted mortalities would increase baseline mortality rate by 0.003%.

281. This level of potential impact is considered to be an impact of **negligible magnitude on an annual basis at both the BDMPS and bio-geographic scales**, as it represents no discernible increase to baseline mortality rate levels due to the small number of estimated mortalities from both operational phase displacement and estimated collisions combined. Irrespective of the sensitivity of the receptor, the significance of the impact is not significant as defined in the assessment of significance matrix (**Table 12.14**) and is not considered further in this assessment.

Significance of effect

282. Given a negligible magnitude of impact and a sensitivity of minor, following the matrix approach set out in **Table 12.14,** the potential effect of displacement and disturbance from operational and maintenance activities in the Windfarm Site plus 2 km buffer on kittiwake has been assessed as **minor, which is not significant in EIA terms**.

12.11.7 Barrier effects: Windfarm Site

283. In the operation and maintenance phase of the Project, the presence of WTGs could create a barrier to the movements of flying birds. This may result in permanent changes in the flight routes for the birds concerned and an increase in energy demands associated with those movements. This might result in a lower rate of breeding success or in reduced survival chances for the individuals affected. This could affect both birds on annual migrations as well as diurnal movements between roosting/ breeding area and foraging sites.

284. For the purposes of assessment, however, it is usually not possible to distinguish between displacement and barrier effects. Therefore, it should be noted that the effects of displacement from the array during the operational phase of the Project encapsulate potential barrier effects for the receptors considered, due to the inclusion of flying and sitting birds (all behaviours) within the assessment of displacement, as recommended in joint SNCB's guidance (Updated, 2022).

12.11.8 Annual migrations

285. The small risk of impact to migrating birds resulting from flying around rather than through the WTG array of an OWF is considered a potential barrier effect. Speakman *et al.*, (2009) and Masden *et al.*, (2010, 2012) calculated that the costs of one-off avoidances during migration were small, accounting for less than 2% of available fat reserves. Therefore, the potential magnitude of impacts on birds that only migrate through the site (including seabirds, waders and waterbirds on passage) are considered negligible. As such, following the matrix approach set out in **Table 12.14**, this effect

has been assessed **as not significant in EIA terms for all receptors regardless of their sensitivity**.

12.11.9 Impacts of aviation and navigation lighting: array

Sensitivity of the receptor

286. There is the potential that aviation and navigation lighting on WTGs could attract or repel birds moving through the Windfarm Site at night. There is evidence that nocturnal lighting may cause changes in bird behaviour and habitat selection (reviewed in Drewitt and Langston, 2008) but as WTGs are less intensively lit in comparison with oil and gas platforms, which much of the evidence is based upon, so the impacts are likely to be less extreme.

287. The species that are likely to be present in largest numbers (fulmar, gannet, kittiwake and auk species) are unlikely to be active at night, either returning to colonies or roosting on the sea surface (Wade *et al*., 2016). A tracking study by Furness *et al*., (2018) reported that gannet flight and diving activity was minimal during the night. Gulls are known to have low to moderate levels of nocturnal activity, being visual foragers that are known to be attracted to lit fishing vessels and well-lit oil and gas platforms that attract fish to the surface waters (Burke *et al*., 2012). Kotzerka *et al*., (2010) reported that kittiwake foraging trips mainly occurred during daylight and birds were largely inactive at night and therefore at lower risk. Fulmar has a relatively high nocturnal activity rate, however very few flights are likely to be at collision risk height (Wade *et al*., 2016). Therefore, it is likely that all bird species in the marine environment would exhibit no more than a low to medium sensitivity to lighting from the Project.

Potential magnitude of impact

288. A significant impact would only occur if large numbers of susceptible migrants (e.g., Manx shearwater) pass through the site on migration, leading to mass disorientation or collisions. However, there is insufficient evidence from existing literature or any existing UK OWFs to suggest mass collision events occur as a result of aviation and navigation lighting that is typical for UK OWFs. Evidence from Kerlinger *et al*., (2010) and Welcker *et al*., (2017) found nocturnal migrants do not have a higher risk of collision with wind energy facilities than do diurnally active species, nor do mortality rates increase at OWFs with lighting compared to those without. Furthermore, studies have shown that nocturnal flight is altered to counteract the risk of WTG collision (Dirksen *et al*., 1998 and Desholm and Kahlert, 2005). Therefore, the potential **magnitude of impacts would be no greater than negligible** to birds with respect to lighting.

Significance of effect

289. As the magnitude of this impact is considered to be negligible, irrespective of the sensitivity of the receptor, the significance of the residual effect is not significant as defined in **Table 12.14** and is not considered further in this assessment.

12.12 Environmental impact: decommissioning phase

12.12.1 Overview

290. A Decommissioning Programme will be prepared prior to construction, in line with the requirements of the Energy Act 2004 (as amended). However, for the purpose of this assessment the following has been assumed: floating substructures components would be removed, where practicable, with mooring lines, and piles to be cut just below seabed and removed. The approach to decommissioning, including cable decommissioning, will be reviewed as part of the

Decommissioning Programme. It is expected that decommissioning will require similar vessels to those used in construction and take a similar period of time.

291. The impacts of the offshore decommissioning of the Project have been assessed for offshore ornithology features. The worst case scenario against which each decommissioning phase impact has been assessed is presented in **Table 12.9.**

12.12.2 Temporary disturbance and displacement: array

292. Decommissioning activities within the Windfarm Site associated with WTGs may lead to disturbance and displacement of species within the array and different degrees of buffers surrounding it. A degree of temporary disturbance and displacement is likely to occur throughout the decommissioning phase. The magnitude and significance of any effects is likely to be of a similar or identical scale to those presented for the construction phase above in **Section 12.10.1**. The assessment for disturbance and displacement during the construction phase was concluded as not significant in EIA terms for all receptors therefore, it can be concluded there **is no significant effect in EIA terms during the decommissioning phase**.

12.12.3 Temporary disturbance and displacement: Offshore Export Cable Corridors and cable landfall

293. Decommissioning activities within the Offshore Export Cable Corridors associated with the decommissioning of the Offshore Export Cables may lead to disturbance and displacement of species within the offshore export cable corridor and different degrees of buffers surrounding it.

294. The worst case scenario for decommissioning activities within the Windfarm Site is equal to or less than worst case scenario for the construction phase within the Windfarm Site. Therefore, for the purposes of this assessment it is assumed that the impacts are likely to be similar. Closer to the time of decommissioning it may be decided that removal would lead to a greater environmental impact than leaving some components in situ in which case certain components may be cut off at seabed level, reducing the amount of vessel activity required. The magnitude and significance of any effects is likely to be of a similar or identical scale to those presented for the construction phase above in **Section 12.10.2**. The assessment for disturbance and displacement during the construction phase was concluded as not significant in EIA terms for all receptors therefore, it can be concluded there is **no significant effect in EIA terms during the decommissioning phase**.

12.12.4 Indirect effects via changes in prey or habitat availability

295. Indirect impacts during the decommissioning phase are likely to be predominantly from benthic disturbance when removing anchors and chain that has embedded in the sediment. There will likely be increases in vessel traffic and noise compared to the operational stage which will contribute to any cumulative effects.

296. Impacts, namely from the production of suspended sediments, may alter the distribution, physiology and behaviour of prey species and habitats. These mechanisms could potentially result in reduced prey availability in areas adjacent to active construction sites to seabird foraging areas. This may result in disturbance and displacement effects, effectively reducing habitat availability for foraging and other activities. Any form of indirect effect (including reductions in prey and habitat availability) may cause reduced survival or reproductive fitness of the species deemed at risk. The maximum impact on ornithological receptors will result from the maximum impact on fish and benthic organisms.

297. These potential indirect impacts may occur during the decommissioning phase of the Project. Potential impacts are likely to occur within or immediately next to the Windfarm Site, the Offshore Export Cable Corridor and areas of intertidal landfall through effects on benthic habitat and prey species when infrastructure is removed.

298. Such potential effects on benthic invertebrates and fish have been assessed in **Chapter 9: Benthic Ecology** and **Chapter 10: Fish and Shellfish Ecology** and the conclusions of those assessments inform this assessment of indirect effects on ornithology receptors.

299. With regard to noise impacts on fish, **Chapter 10: Fish and Shellfish Ecology** discusses the potential impacts upon fish relevant to ornithology as prey species of the Project. For species such as herring, sprat and sandeel, which are the main prey items of seabirds such as gannet and auks, underwater noise impacts (physical injury or behavioural changes) during decommissioning phase are considered to be less than that during the construction phase and predicted to be negligible. With a negligible impact on fish that are bird prey species, it is concluded that the indirect impact significance on seabirds occurring in or around the Project during the construction phase is similarly a negligible adverse impact.

300. With regard to changes to the seabed and to suspended sediment levels, **Chapter 7: Marine Geology, Oceanography and Physical Processes**, **Chapter 8: Marine Sediment and Water Quality** and **Chapter 9: Benthic Ecology** discusses the nature of any change and impacts on the seabed and benthic habitats. Impacts that have been assessed are considered to be low or negligible and are anticipated to result in changes of minor adverse significance. (see **Chapter 9: Benthic Ecology**). The consequent indirect impact on fish through habitat loss is considered to be negligible (see **Chapter 10: Fish and Shellfish Ecology**) for species such as herring, sprat and sandeel, which are the main prey items of seabirds such as gannet and auks. With a negligible impact on fish that are bird prey species, it is concluded that the indirect impact significance on seabirds occurring in or around the Project during the decommissioning phase is similarly a minor or negligible adverse impact. Therefore, it can be concluded there is **no significant effect in EIA terms during the decommissioning phase.**

12.13 Cumulative Effects Assessment

12.13.1 Overview

301. Cumulative effects can be defined as effects upon a single receptor from the Project when considered alongside other proposed and reasonably foreseeable plans and projects. This includes all developments that result in a comparative effect that is not intrinsically considered as part of the existing environment and is not limited to offshore wind projects.

302. Following the Planning Inspectorate's Advice Note Seventeen (PINS, 2019) and components of the RenewableUK cumulative impact assessment guidelines (RenewableUK, 2013), a number of reasonably foreseeable plans and projects were identified which may act cumulatively with the Project. In assessing the potential cumulative impacts for the Project, it is important to bear in mind that some developments, predominantly those 'proposed' or identified in development plans, may not actually be taken forward, or fully built out as described within their worst case scenario. There is therefore a need to build in some consideration of certainty (or uncertainty) with respect to the potential impacts which might arise from such proposals. For example, those other developments under construction are likely to contribute to cumulative impacts (providing effect or spatial pathways exist), whereas those proposals not yet approved are less likely to contribute to such an impact, as some may not achieve approval or may not ultimately be built due to other factors.

303. With this in mind, all other plans and projects considered alongside the Project have been allocated into 'tiers' and 'sub-tiers' reflecting their current stage within the planning and development process. This allows the cumulative impact assessment to present several future development scenarios, each with a differing potential for being ultimately built out. This approach also allows appropriate weight to be given to each scenario (tier) when considering the potential cumulative impact. The proposed tier structure is intended to ensure that there is a clear understanding of the level of confidence in the cumulative assessments provided in this report. An explanation of each tier is included in **Table 12.44**.

Table 12.44 Description of tiers of other developments considered for Cumulative Effects Assessment (CEA) (adapted from PINS Advice Note 17).

Tier	Sub-Tier	Description of stage of development of project
Tier 1	Tier 1a	Project in operation
	Tier 1b	Project under construction
	Tier 1c	Permitted applications, whether under the Planning Act 2008 or other regimes, but not yet implemented
	Tier 1d	Submitted applications, whether under the Planning Act 2008 or other regimes, but not yet determined
Tier 2	N/A	Projects on the Planning Inspectorate's Programme of Projects where a Scoping Report has been submitted
Tier 3	Tier 3a	Projects on the Planning Inspectorate's Programme of Projects where a Scoping Report has not been submitted
	Tier 3b	Identified in the relevant Development Plan (and emerging Development Plans with appropriate weight being given as they move closer to adoption) recognising that much information on any relevant proposals will be limited
	Tier 3c	Identified in other plans and programmes (as appropriate) which set the framework for future development consents/approvals, where such development is reasonably likely to come forward

The plans and projects selected as relevant to the cumulative effects assessment (CEA) of impacts to offshore ornithology are based on a screening exercise undertaken on the long list. Consideration of the effect-receptor pathways, data confidence and temporal and spatial scales have been considered to select projects for the final list presented in ***Table 12.45.***

304. Advice has been followed from consultation process (**Table 12.4**) to the ranking of offshore wind projects as follows for consideration:

- Operational wind farms – Beatrice, Moray East, HyWind Scotland, European Offshore Wind Deployment Centre and Kincardine. (There may also be a need to consider wind farms either in English waters or in other non-UK parts of the North Sea.).
- Under construction - SeaGreen, Neart na Gaoithe,
- Consented, but not yet under construction – Moray West, Inch Cape

305. Planned and operational projects were screened out of further consideration for potential cumulative effects on offshore ornithology based on there not being a potential impact-receptor-pathway across development phases for the following reasons:

- The plan/project has already been accounted for within the offshore ornithology baseline;
- There is no conceptual effect-receptor pathway between plans/ projects;
- There is no physical effect-receptor overlap between plans/ projects;
- There is no temporal overlap between plans/ projects; or
- There is low data confidence or data not available.

306. The CEA is limited by the data available upon which to base the assessment. Due to the age of developments in the North Sea and surrounding areas which have the potential to have a cumulative impact upon receptors, few have comparable datasets upon which to base an assessment. Many of the older developments did not address cumulative effects as fully as is required presently whilst those developments which are not fully realised have not released their data into the public domain. As such the CEA is carried out with the fullest dataset available whilst acknowledging that further cumulative effects may occur from existing or planned developments.

307. Those plans/projects screened into the CEA for offshore ornithology using the criteria set out above are presented in **Table 12.45** below. Prior to commencement of the cumulative assessments, the final list of projects screened in for consideration within the cumulative assessments as presented in **Table 12.45** below was reviewed and approved by MS-LOT (MS-LOT written responses 13th June 2022; **Table 12.4)** for the Project. A total of 63 plans / projects were considered to have the potential to give rise to cumulative effects including offshore renewables.

308. For the breeding season, the CEA considers effects from projects within foraging range of the colony SPA under consideration. This has been applied for the assessments below. The approach applied to the non-breeding season depends but typically incorporates effects from all projects within the defined BDMPS (Furness, 2015) for each species, with the exception of guillemot where a regional approach is considered as wintering birds remain in local waters. BDMPS is defined from the total number of birds present in all UK territorial waters during a defined season allocated into spatially distinct BDMPS populations during that defined season. The Project lies within a defined UK North Sea and Channel non-breeding BDMPS. Therefore, any potential cumulative effects on the VORs will only occur if the development phases of wind farm projects within a particular spatial extent (for example foraging range during breeding season or the local regional area / North Sea in winter) are coincidental or sequential, leading to a temporal impact.

Table 12.45 Plans/ projects considered within the offshore ornithology cumulative effect assessment

Project	Status	Distance from Green Volt Site (km) [1]	Distance from Green Volt offshore cable route (km) [2]	Project status	Included in CIA	Rationale
Aberdeen Offshore Windfarm	1a	97.5	38.3	In operation/ pre-application	Yes	Potential temporal overlap of operation with the Project
Beatrice Offshore Windfarm	1a	130.3	129.5	Operational	Yes	Potential temporal overlap of operation with the Project
Bellrock	3	106.6	106.8	Planning	No	Potential temporal overlap of construction and operation with the Project
Berwick Bank Offshore Windfarm	1d[3]	156.0	109.0	Planning	Yes	Potential temporal overlap of construction and operation with the Project
Blyth Demonstration Sites (1 & 2)	1a	299.0	258.5	Operational	Yes	Potential temporal overlap of operation with the Project
Broadshore	3	68.0	59.9	Planning	No	Potential temporal overlap of construction and operation with the Project
Caledonia Offshore Windfarm	2	96.9	70.3	Planning	No	Potential temporal overlap of construction and operation with the Project
CampionWind	3	45.0	48.5	Planning	No	Potential temporal overlap of construction and operation with the Project
Cluaran Deas Ear Offshore Windfarm	3	94.8	56.2	Planning	No	Potential temporal overlap of construction and operation with the Project
Cluaran Ear-Thuan Offshore Windfarm	3	122.3	131.8	Planning	No	Potential temporal overlap of construction and operation with the Project
Dogger Bank C Offshore Windfarm	1c	359.0	364.9	Consented	Yes	Potential temporal overlap of operation with the Project
Dogger Bank Creyke Beck A Offshore Windfarm	1b	361.0	359.8	Under Construction	Yes	Potential temporal overlap of operation with the Project

[1] *Shortest distance between the considered project and Green Volt – unless specified otherwise.*
[2] *Shortest distance between the considered project and the Green Volt offshore cable route.*
[3] *Berwick Bank Offshore Windfarm status was Tier 2 at the time of the cumulative assessment of the Project, application submitted subsequently on the 21/12/2022,*

Project	Status	Distance from Green Volt Site (km) [1]	Distance from Green Volt offshore cable route (km) [2]	Project status	Included in CIA	Rationale
Dogger Bank Creyke Beck B Offshore Windfarm	1b	335.0	334.5	Under Construction	Yes	Potential temporal overlap of operation with the Project
Dudgeon Extension Project Offshore Windfarm	1d	511.0	500.3	Planning	Yes	Potential temporal overlap of construction and operation with the Project
Dudgeon Offshore Windfarm	1a	519.3	500.3	Operational	Yes	Potential temporal overlap of operation with the Project
East Anglia One North Offshore Windfarm	1c	629.0	625.9	Consented	Yes	Potential temporal overlap of operation with the Project
East Anglia One Offshore Windfarm	1a	651.3	641.8	Operational	Yes	Potential temporal overlap of operation with the Project
East Anglia Three Offshore Windfarm	1b	615.1	604.2	Under Construction	Yes	Potential temporal overlap of operation with the Project
East Anglia Two Offshore Windfarm	1c	639.0	632.3	Consented	Yes	Potential temporal overlap of operation with the Project
Five Estuaries Offshore Windfarm	2	672.0	665.9	Planning	Yes	Potential temporal overlap of construction and operation with the Project
Floating Energy Alliance (ScotWind NE8)	3	49.0	55.9	Planning	No	Potential temporal overlap of construction and operation with the Project
Galloper Offshore Windfarm	1a	674.1	663.9	Operational	Yes	Potential temporal overlap of operation with the Project
Greater Gabbard Offshore Windfarm	1a	676.1	664.3	Operational	Yes	Potential temporal overlap of operation with the Project
Gunfleet Sands Offshore Windfarm	1a	691.0	675.2	Operational	Yes	Potential temporal overlap of operation with the Project
Hornsea Four Offshore Windfarm	1d	413.0	406.6	Planning	Yes	Potential temporal overlap of construction and operation with the Project
Hornsea Project One Offshore Windfarm	1a	464.1	461.1	Operational	Yes	Potential temporal overlap of operation with the Project
Hornsea Project Two Offshore Windfarm	1b	445.0	446.1	Operational	Yes	Potential temporal overlap of operation with the Project

Project	Status	Distance from Green Volt Site (km) [1]	Distance from Green Volt offshore cable route (km) [2]	Project status	Included in CIA	Rationale
Hornsea Three Offshore Windfarm	1c	463.0	462.1	Consented	Yes	Potential temporal overlap of operation with the Project
Humber Gateway Offshore Windfarm	1a	468.9	450.4	Operational	Yes	Potential temporal overlap of operation with the Project
Hywind Scotland Pilot Park	1a	51.5	10.4	Operational	Yes	Potential temporal overlap of operation with the Project
Inch Cape Offshore Windfarm	1c	163.7	111.6	Consented	Yes	Potential temporal overlap of operation with the Project
Kentish Flats Offshore Windfarm	1a	718.6	700.5	Operational	Yes	Potential temporal overlap of operation with the Project
Kincardine Offshore Windfarm	1a	110.7	58.7	Operational	Yes	Potential temporal overlap of operation with the Project
Lincs, Lynn and Inner Dowsing Offshore Windfarm	1a	519.3	499.8	Operational	Yes	Potential temporal overlap of operation with the Project
London Array Offshore Windfarm	1a	699.6	685.8	Operational	Yes	Potential temporal overlap of operation with the Project
MarramWind Offshore Windfarm	3	8.7	21.7	Planning	No	Potential temporal overlap of construction and operation with the Project
Marubeni, SSE Renewables and CIP (ScotWind)	3	101.0	87.0	Planning	No	Potential temporal overlap of construction and operation with the Project
Methil Offshore Wind Demonstration Zone	1a	235.2	176.6	Operational	Yes	Potential temporal overlap of operation with the Project
Moray East Offshore Windfarm	1a	112.6	114.7	Operational	Yes	Potential temporal overlap of operation with the Project
Moray West Offshore Windfarm	1b	127.5	130.6	Under Construction	Yes	Potential temporal overlap of operation with the Project
Morven Offshore Windfarm	3	105.4	79.2	Planning	No	Potential temporal overlap of construction and operation with the Project
Neart na Gaoithe Offshore Windfarm	1b	191.4	141.0	Under Construction	Yes	Potential temporal overlap of operation with the Project

Project	Status	Distance from Green Volt Site (km) [1]	Distance from Green Volt offshore cable route (km) [2]	Project status	Included in CIA	Rationale
Norfolk Boreas Offshore Windfarm	1c	560.0	562.5	Consented	Yes	Potential temporal overlap of operation with the Project
Norfolk Vanguard Offshore Windfarm	1c	569.0	580.9	Consented	Yes	Potential temporal overlap of operation with the Project
North Falls Offshore Windfarm	2	668.0	660.5	Planning	Yes	Potential temporal overlap of construction and operation with the Project
Outer Dowsing Offshore Windfarm	2	481.0	474.6	Planning	Yes	Potential temporal overlap of construction and operation with the Project
Pentland Floating Offshore Windfarm	1d	210.8	203.1	Planning	Yes	Potential temporal overlap of construction and operation with the Project
Race Bank Offshore Windfarm	1a	511.7	494.9	Operational	Yes	Potential temporal overlap of operation with the Project
Rampion 2 Offshore Windfarm	2	800.2	771.1	Planning	Yes	Potential temporal overlap of construction and operation with the Project
Rampion Offshore Windfarm	1a	796.1	768.6	Operational	Yes	Potential temporal overlap of operation with the Project
Salamander Offshore Windfarm	3	36.0	0	Planning	No	Potential temporal overlap of construction and operation with the Project
Scroby Sands Offshore Windfarm	1a	600.1	587.8	Operational	Yes	Potential temporal overlap of operation with the Project
Seagreen Offshore Windfarm	1b	140.0	99.4	Under Construction	Yes	Potential temporal overlap of operation with the Project
Sheringham Shoal Extension Project Offshore Windfarm	1d	522.0	513.4	Planning	Yes	Potential temporal overlap of construction and operation with the Project
Sheringham Shoal Offshore Windfarm	1a	538.2	513.4	Operational	Yes	Potential temporal overlap of operation with the Project
Sofia Offshore Windfarm	1b	346.0	346.1	Under Construction	Yes	Potential temporal overlap of operation with the Project
Stromar Offshore Windfarm	3	98.7	95.3	Planning	No	Potential temporal overlap of construction and operation with the Project

Project	Status	Distance from Green Volt Site (km) [1]	Distance from Green Volt offshore cable route (km) [2]	Project status	Included in CIA	Rationale
Teesside Offshore Windfarm	1a	356.3	324.0	Operational	Yes	Potential temporal overlap of operation with the Project
Thanet Offshore Windfarm	1a	726.1	713.0	Operational	Yes	Potential temporal overlap of operation with the Project
Triton Knoll Offshore Windfarm	1a	492.0	473.3	Operational	Yes	Potential temporal overlap of operation with the Project
Vattenfall / Fred Olsen Seawind (ScotWind)	3	38.5	103.2	Planning	No	Potential temporal overlap of construction and operation with the Project
West of Orkney Offshore Windfarm	2	216.6	202.2	Planning	Yes	Potential temporal overlap of construction and operation with the Project
Westermost Rough Offshore Windfarm	1a	449.3	430.0	Operational	Yes	Potential temporal overlap of operation with the Project

309. Certain impacts assessed for the project alone are not considered in the cumulative assessment due to:

- The highly localised nature of the impacts (i.e., they occur entirely within the Project boundary only).
- Management measures proposed by the Project will also be in place for other projects reducing the risk of occurring; and/ or
- Where potential significance of the impact from the Project alone has been assessed as negligible and considered not to contribute in any meaningful way to an existing potential cumulative impact.

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

- Displacement of seabirds during the construction phase of the Project due to the potential impacts and effects predicted for the Project being negligible/ minor at most, spatially restricted and no plans or projects being identified that may have a source-impact-pathway that coincide spatially or temporally with the Project;
- Indirect impacts during any phase of the Project, as they will be spatially limited, and all were predicted as negligible at most at a project level; and
- All impacts during the decommissioning phase, as potential impacts during this phase were all predicted to be negligible and there is no data or low confidence in data in relation to other plans and projects with respect to this potential source of impact.

311. Therefore, the impacts that are considered for cumulative assessment are as follows:

- Displacement of guillemot, razorbill, gannet, puffin and kittiwake during the operational and maintenance phase of the Project cumulatively with other planned, in-construction and operational developments screened in for CEA in **Table 12.45** and;
- Collision risk to gannet, kittiwake, herring gull and great black-backed gull during the operational and maintenance phase of the Project cumulatively with other planned, in-construction and operational developments screened in for CEA in **Table 12.45**

312. The cumulative worst case scenario described in **Table 12.46** below has been selected as having the potential to result in the greatest cumulative effect on an identified receptor group. The cumulative impacts presented and assessed in this section have been selected from the information available on other developments and plans in order to inform a cumulative worst case scenario.

313. For the purpose of this assessment, it is assumed that all projects are developed to the full extent of the proposed design. This is precautionary as some projects may not ultimately receive consent, may reduce the proposed design prior to consent, or may not fully develop the area consented.

314. Effects of greater adverse significance are not predicted to arise should any other development scenario, based on details within the project design envelope compared to that assessed here, be taken forward in the final Project design.

315. Assessment of potential disturbance and displacement impacts for the Pentland Floating OWF was undertaken using SeabORD modelling for the breeding season as well as using the Matrix approach. The outputs from the SeabORD modelling predicted mortality levels of similar levels to the Matrix approach, when using NatureScot's advocated displacement rates and mortality rate ranges respectively, for all species (gannet, kittiwake, guillemot and razorbill) with the exception of puffin. The predicted mortality levels from SeabORD modelling for puffin showed a significant discrepancy

in the methods used when comparing with the Matrix approach presented, the latter of which predicted higher mortality levels. In order for a consistent approach to be taken to assess cumulative impacts for the Project across all seasons and accounting for all plans and projects the Matrix approach has been used with the abundance data from all projects, including the Pentland Floating OWF project which also incorporates a level of precaution for the higher numbers of puffin mortalities predicted by using the Matrix approach.

Table 12.46 Potential Cumulative Impacts

Impact	Potential for cumulative impact	Scenario	Rationale
Operation – Disturbance and displacement	Yes	Worst case scenario for the Project plus the cumulative full development of the following projects within UK North Sea and Channel (where appropriate): Tier 1: • Operational offshore wind farms in the UK North Sea and Channel (where appropriate); • Offshore wind farms under construction in the UK North Sea and Channel (where appropriate); • Permitted offshore wind farm projects not yet implemented; and • Offshore wind farm projects with the submitted applications not yet determined. Tier 2: • No Tier 2 projects identified with quantitative data available from Preliminary Environmental Information Reports on developer's website (not yet available via PINS). Tier 3: • No Tier 3 projects identified as quantitative data not available on displacement of seabirds at this stage.	Maximum potential for interactive effects from operation and maintenance activities associated with the operational effects of other developments considered within the relevant ZoI. This region was chosen as seabirds associated with the Project are expected to come from or move to other areas within the ZoI, that are also subject to interaction with other developments within this region.
Operation – Collision risk	Yes	worst case scenario for the Project plus the cumulative full development of the following projects within UK North Sea and Channel (where appropriate): Tier 1: • Operational offshore wind farms in the UK North Sea and Channel (where appropriate); • Offshore wind farms under construction in the UK North Sea and Channel (where appropriate); • Permitted offshore windfarm projects not yet implemented; and • Offshore wind farm projects with the submitted applications not yet determined. Tier 2: • No Tier 2 projects identified with quantitative data available from Preliminary Environmental Information Reports on developer's website (not yet available via PINS). Tier 3: • No Tier 3 projects identified as quantitative data not available on collision risk of seabirds at this stage.	Maximum potential for interactive effects from collision risk from other developments considered within the relevant ZoI. This region was chosen as seabirds associated with the Project are expected to move to other areas within the ZoI that are also subject to interaction with other developments within this region.

Royal HaskoningDHV

GREEN VOLT

12.13.2 Cumulative disturbance and displacement: operational phase

316. There is potential for cumulative displacement as a result of operational and maintenance activities associated with the Project and other developments (**Table 12.45**). Developments in addition to the Project identified for this CEA are categorised as Tier 1 (sub-tiers 1a to 1d), as described in **Table 12.44**. Note that some of the other developments screened into assessment have been in operation for a number of years, and therefore may be decommissioned within the Project's operational lifespan or even prior to the Project's construction. It is therefore precautionary to carry out this CEA on the basis of all other developments having temporal overlap within the operational phase.

317. As stated above potential cumulative effects on the VORs are assessed on the basis that they only occur if the development phases of wind farm projects within a particular spatial extent (for example foraging range during breeding season or the local regional area for guillemot / wider North Sea for all other species in winter) are coincidental or sequential, leading to a temporal impact.

318. The presence of WTGs has the potential to directly disturb and displace seabirds that would normally reside within and around the area of sea where OWFs are located. This in effect potentially reduces the area available to those seabirds to forage, loaf and/ or moult that currently occur within and around OWFs that may be susceptible to displacement from such developments. Displacement may contribute to individual birds experiencing fitness consequences, which at an extreme level could lead to the mortality of individuals. Displacement may also contribute to individual birds being more productive during the breeding season, if they are deterred from foraging further than they may need to, therefore allowing for more efficient chick rearing. Cumulative displacement therefore has the potential to lead to effects on a wider scale, which in this case is defined as the wider non-breeding BDMPS populations of each species (adults and immature) within the relevant BDMPS defined by Furness (2015).

Gannet

319. The subsequent seasonal abundance estimates for gannet associated with each of the projects identified in **Table 12.45** are presented in **Table 12.47**. Latest evidence displacement and mortality rates (APEM, 2022a) are applied in the assessment of 40-60% for displacement during the breeding season and 60-80% displacement rate for return and post-breeding migration seasons, with a 1% mortality rate applied for all seasons.

Table 12.47: Gannet cumulative season and total abundance estimates

Development	Predicted abundance		
	Return Migration	Migration-free breeding*	Post-breeding Migration
Green Volt	49	120	16
Beatrice	0	151	0
Blyth Demonstration	-		-
Dudgeon	11	53	25
East Anglia One	76	161	3,638
Hywind 2 Demonstration	4	10	0
Kincardine	0	120	0
Moray East	27	564	292
Aberdeen OWF (EOWDC)	0	35	5
Methil	0		0

Development	Predicted abundance		
	Return Migration	Migration-free breeding*	Post-breeding Migration
Galloper	276		907
Greater Gabbard	105		69
Gunfleet Sands	9		12
Hornsea Project One	250	671	694
Humber Gateway	-		-
Kentish Flats	0		13
Lincs, Lynn and Inner Dowsing	-		-
London Array	-		-
Race Bank	29	92	32
Rampion	0		590
Scroby Sands	-		-
Sheringham Shoal	2	47	31
Teesside	0	1	0
Thanet	-		-
Westermost Rough	-		-
Neart na Gaoithe	281	1,987	552
Seagreen Alpha	138	1,716	296
Seagreen Bravo	194	1,240	368
Triton Knoll	24	211	15
Dogger Bank Creyke Beck B	218	637	1,132
Sofia	238	1,282	508
Dogger Bank Creyke Beck A	176	518	916
Hornsea Project Two	124	457	1,140
Norfolk Vanguard	437	271	2,453
East Anglia ONE North	44	149	468
East Anglia Two	192	192	891
Inch Cape	212	2,398	703
Norfolk Boreas	526	1,229	1,723
Dogger Bank C	226	968	379
Hornsea Three	524	1,333	984
East Anglia Three	524	412	1,269
Moray West	144	2,827	439
Total (consented projects only)	5,060	19,852	20,560
Hornsea Four	401	976	790
Pentland	8	166	24
Outer Dowsing	-		-
Dudgeon Extension Project	47	361	343
Rampion 2	70		119

Development	Predicted abundance		
	Return Migration	Migration-free breeding*	Post-breeding Migration
Sheringham Shoal Extension Project	0	40	295
Five Estuaries	-		-
North Falls	-		-
Total (All projects)	**5,586**	**21,395**	**22,131**

*Projects connected to regional breeding population as defined in **Section 12.9.2**.

Potential magnitude of impact

320. During the return-migration season, the cumulative abundance for gannet is 5,586 individuals for all projects considered in **Table 12.47,** which would result in approximately 34-45 gannets being subject to mortality. During the return migration season the total gannet regional baseline population, including breeding adults and immature birds, is predicted to be 248,385 individuals (**Table 12.17**). Using the average baseline mortality rate of 0.187 (**Table 12.19**), the natural predicted mortality of gannets in the breeding season is 46,448 individuals per annum. The addition of 34-45 predicted mortalities due to cumulative displacement, would increase baseline mortality rate by 0.072-0.096%.

321. This level of potential change is considered to be an impact of **negligible magnitude during the return migration season**, as it represents well under a 1% difference to the baseline conditions due to the small number of individuals subject to potential mortality as a result of displacement.

322. During the migration-free breeding season, considering only the projects within foraging distance from regional colonies are considered, the cumulative abundance for gannet is 21,395 individuals for the projects listed in **Table 12.47**, this would result in approximately 86-128 gannets being subject to mortality. The BDMPS for the migration-free breeding season is defined as 804,425 individuals (**Table 12.17**) and, using the average baseline mortality rate of 0.187 (**Table 12.19**), the natural predicted mortality in the non-breeding season is 150,427 individuals per annum. The addition of 86-128 predicted mortalities due to cumulative displacement, would increase the baseline mortality rate by 0.057-0.085%.

323. This level of potential change is considered to be an impact of **negligible magnitude during the migration-free breeding season**, as it represents a less than 1% difference to the baseline conditions due to the small number of individuals subject to potential mortality as a result of displacement.

324. During the post-breeding migration season, the cumulative abundance for gannet is 22,131 individuals for all projects considered in **Table 12.47**, this would result in approximately 133-177 gannets being subject to mortality. The BDMPS for the migration-free breeding season is defined as 456,298 individuals (**Table 12.17**) and, using the average baseline mortality rate of 0.187 (**Table 12.19**), the natural predicted mortality in the non-breeding season is 85,328 individuals per annum. The addition of 133-177 predicted mortalities due to cumulative displacement, would increase baseline mortality rate by 0.156-0.207%.

325. This level of potential change is considered to be an impact of **low magnitude during the post-breeding migration season**, as it represents a less than 1% difference to the baseline conditions due to the small number of individuals subject to potential mortality as a result of displacement.

Sensitivity of the receptor

326. As detailed in **Section 12.11.1**, as this receptor is classified as low behavioural sensitivity (**Table 12.15**) and it is of medium conservation value (**Table 12.11**), this leads to an overall sensitivity of this receptor to disturbance and displacement of **medium**.

Significance of the effect

327. Given a negligible to low magnitude of impact resulting from cumulative disturbance and displacement and a sensitivity of medium, following the matrix approach set out in **Table 12.14**, the significance of the residual effect is **minor, which is not significant in EIA terms**.

Guillemot

328. The subsequent seasonal abundance estimates for guillemot associated with each of the projects identified in **Table 12.45** are presented in **Table 12.48**. Projects are only considered when within foraging distance of regional colonies in the breeding season and the non-breeding season as wintering populations remain within this regional area (see paragraph 308). Displacement rate of 50% and a 1% mortality rate are applied in the assessment for all seasons derived from the latest evidence (APEM, 2022b).

Table 12.48: Guillemot cumulative season and total abundance estimates

Development	Predicted abundance	
	Breeding*	Non-breeding (projects connected to regional breeding population)
Green Volt	4,429	16,105
Beatrice	13,610	2,755
Blyth Demonstration		
Dudgeon		
East Anglia One		
Hywind 2 Demonstration	249	2,136
Kincardine	632	0
Moray East	9,820	547
Aberdeen OWF (EOWDC)	547	225
Methil		
Galloper		
Greater Gabbard		
Gunfleet Sands		
Hornsea Project One		
Humber Gateway		
Kentish Flats		
Lincs, Lynn and Inner Dowsing		

Development	Predicted abundance	
	Breeding*	Non-breeding (projects connected to regional breeding population)
London Array		
Race Bank		
Rampion		
Scroby Sands		
Sheringham Shoal		
Teesside		
Thanet		
Westermost Rough		
Neart na Gaoithe		
Seagreen Alpha	13,606	4,688
Seagreen Bravo	11,118	4,112
Triton Knoll		
Dogger Bank Creyke Beck B		
Sofia		
Dogger Bank Creyke Beck A		
Hornsea Project Two		
Norfolk Vanguard		
East Anglia ONE North		
East Anglia Two		
Inch Cape		
Norfolk Boreas		
Dogger Bank C		
Hornsea Three		
East Anglia Three		
Moray West	24,426	38,174
Total (Consented projects only)	**78,437**	**68,742**
Hornsea Four		
Pentland	1,146	650
Outer Dowsing		
Dudgeon Extension Project		
Rampion 2		
Sheringham Shoal Extension Project		

Development	Predicted abundance	
	Breeding*	Non-breeding (projects connected to regional breeding population)
Five Estuaries		
North Falls		
Total (All Projects)	**79,583**	**69,392**

*Projects connected to regional breeding population as defined in **Section 12.9.2.**

Potential magnitude of impact

329. During the breeding season, when considering only the projects within foraging distance from the regional colonies, the cumulative abundance for guillemot is 79,583 individuals for the projects listed in **Table 12.48**, which would result in approximately 398 guillemots being subject to mortality. During the breeding season the total guillemot regional baseline population, including breeding adults and immature birds, is predicted to be 577,117 individuals (**Table 12.17**) and, using the average baseline mortality rate of 0.138 (**Table 12.19**), the natural predicted mortality in the breeding season is 79,642 individuals per annum. The addition of 398 predicted mortalities due to cumulative displacement, would increase the baseline mortality rate by 0.500%.

330. This level of potential change is considered to be an impact of **low magnitude during the breeding season**, as it represents less than 1% difference to the baseline conditions due to the small number of individuals subject to potential mortality as a result of displacement.

331. During the non-breeding season, the cumulative abundance for guillemot is 69,392 individuals for all projects considered in **Table 12.48**, this would result in approximately 347 guillemots being subject to mortality. The regional non-breeding population, considering a regional population based on breeding foraging range as advised during the consultation process is defined as 577,117 individuals (**Table 12.17**) and, using the average baseline mortality rate of 0.138 (**Table 12.19**), the natural predicted mortality in the non-breeding season is 79,642 individuals per annum. The addition of 347 predicted mortalities due to cumulative displacement, would increase baseline mortality rate by 0.4361%.

332. This level of potential change is considered to be an impact of **low magnitude during the non-breeding season**, as it represents a less than 1% difference to the baseline conditions due to the small number of individuals subject to potential mortality as a result of displacement.

Sensitivity of the receptor

333. As detailed in **Section 12.11.1**, as this receptor is classified as medium behavioural sensitivity (**Table 12.15**) and it is of medium conservation value (**Table 12.11**), this leads to an overall sensitivity of this receptor to disturbance and displacement of **medium**.

Significance of the effect

334. Given a low magnitude of impact resulting from cumulative disturbance and displacement and a sensitivity of medium, following the matrix approach set out in **Table 12.14**, the significance of the residual effect is **minor, which is not significant in EIA terms**.

Razorbill

335. The subsequent seasonal abundance estimates for razorbill associated with each of the projects identified in **Table 12.45** are presented in **Table 12.49**. Displacement rate of 50% and a 1% mortality rate are applied in the assessment for all seasons derived from the latest evidence (APEM, 2022b).

Table 12.49: Razorbill cumulative season and total abundance estimates

Development	Predicted abundance	
	Breeding*	Non-breeding
Green Volt	457	58
Beatrice	873	833
Blyth Demonstration		91
Dudgeon		745
East Anglia One		336
Hywind 2 Demonstration	30	719
Kincardine	22	0
Moray East	2,423	1,103
Aberdeen OWF (EOWDC)	161	64
Methil		0
Galloper		394
Greater Gabbard		387
Gunfleet Sands		30
Hornsea Project One		4,812
Humber Gateway		20
Kentish Flats		-
Lincs, Lynn and Inner Dowsing		34
London Array		20

Development	Predicted abundance	
	Breeding*	Non-breeding
Race Bank		42
Rampion		3,327
Scroby Sands		-
Sheringham Shoal		1,343
Teesside		61
Thanet		21
Westermost Rough		152
Neart na Gaoithe	331	5,492
Seagreen Alpha	5,876	1,103
Seagreen Bravo	3,698	1,272
Triton Knoll		855
Dogger Bank Creyke Beck B		5,119
Sofia		2,953
Dogger Bank Creyke Beck A		4,149
Hornsea Project Two		4,221
Norfolk Vanguard		924
East Anglia ONE North		207
East Anglia Two		230
Inch Cape	1,436	2,870
Norfolk Boreas		1,065
Dogger Bank C		1,919

Development	Predicted abundance	
	Breeding*	Non-breeding
Hornsea Three		3,649
East Anglia Three		1,524
Moray West	2,808	3,585
Total (Consented projects only)	**18,115**	**55,729**
Hornsea Four		4,311
Pentland	134	47
Outer Dowsing		-
Dudgeon Extension Project		3,649
Rampion 2		6,897
Sheringham Shoal Extension Project		646
Five Estuaries		-
North Falls		-
Total (All projects)	**18,249**	**71,279**

*Projects connected to regional breeding population as defined in **Section 12.9.2.**

Potential magnitude of impact

336. During the breeding season, when considering only the projects within foraging distance from the regional colonies, the cumulative abundance for razorbill is 18,249 individuals for the projects listed in **Table 12.49**, this would result in approximately 91 razorbills being subject to mortality. During the breeding season the total razorbill regional baseline population, including breeding adults and immature birds, is predicted to be 97,622 individuals (**Table 12.17**). Using the average baseline mortality rate of 0.193 (**Table 12.19**), the natural predicted mortality of razorbills in the breeding season is 18,841 individuals per annum. The addition of 91 predicted mortalities due to cumulative displacement, would increase the baseline mortality rate by 0.484%.

337. This level of potential change is considered to be an impact of **low magnitude during the breeding season**, as it represents less than 1% difference to the baseline conditions due to the small number of individuals subject to potential mortality as a result of displacement.

338. During the non-breeding season, the cumulative abundance for razorbill is 71,279 individuals for all projects considered in **Table 12.49**, this would result in approximately 356 razorbills being subject

to mortality. The BDMPS for the non-breeding season is defined as 591,874 individuals (**Table 12.16**) and, using the average baseline mortality rate of 0.193 (**Table 12.19**), the natural predicted mortality in the non-breeding season is 114,232 individuals per annum. The addition of 356 predicted mortalities due to cumulative displacement, would increase baseline mortality rate by 0.312%.

339. This level of potential change is considered to be an impact of **low magnitude during the non-breeding season**, as it represents a less than 1% difference to the baseline conditions due to the small number of individuals subject to potential mortality as a result of displacement.

Sensitivity of the receptor

340. As detailed in **Section 12.11.1**, as this receptor is classified as medium behavioural sensitivity (Table 12.15) and it is of medium conservation value (**Table 12.11**), this leads to an overall sensitivity of this receptor to disturbance and displacement of **medium**.

Significance of the effect

341. Given a low magnitude of impact resulting from cumulative disturbance and displacement and a sensitivity of medium, following the matrix approach set out in **Table 12.14**, the significance of the residual effect is **minor, which is not significant in EIA terms**.

Puffin

342. The subsequent seasonal abundance estimates for puffin associated with each of the projects identified in **Table 12.45** are presented in **Table 12.50**. Displacement rate of 50% and a 1% mortality rate are applied in the assessment for all seasons derived from the latest evidence (APEM, 2022b) (see **Section 12.11.1**).

Table 12.50: Puffin cumulative season and total abundance estimates

Development	Predicted abundance	
	Breeding*	Non-breeding
Beatrice	2,858	2,435
Blyth Demonstration	235	123
Dudgeon		3
East Anglia One		32
Hywind 2 Demonstration	119	85
Kincardine	19	0
Moray East	2,795	656
Aberdeen OWF (EOWDC)	42	82
Methil		0
Galloper		1
Greater Gabbard		1
Gunfleet Sands		-
Hornsea Project One		1,257
Humber Gateway		10
Kentish Flats		6

Development	Predicted abundance	
	Breeding*	Non-breeding
Lincs, Lynn and Inner Dowsing		6
London Array		1
Race Bank		10
Rampion		0
Scroby Sands		-
Sheringham Shoal		26
Teesside	35	18
Thanet		0
Westermost Rough		35
Neart na Gaoithe	2,562	2,103
Seagreen Alpha	2,572	1,526
Seagreen Bravo	3,582	3,863
Triton Knoll		71
Dogger Bank Creyke Beck B		743
Sofia		329
Dogger Bank Creyke Beck A		295
Hornsea Project Two		2,039
Norfolk Vanguard		112
East Anglia ONE North		-
East Anglia Two		0
Inch Cape	2,956	2,688
Norfolk Boreas		23
Dogger Bank C		273
Hornsea Three		67
East Anglia Three		307
Moray West	1,115	3,966
Green Volt	250	41
Total (Consented projects only)	**19,140**	**23,232**
Hornsea Four	203	442
Pentland	6,521	6
Outer Dowsing		-
Dudgeon Extension Project	0	17
Rampion 2		-
Sheringham Shoal Extension Project	0	11
Five Estuaries		-
North Falls		-
Total (All projects)	**25,864**	**23,708**

*Projects connected to regional breeding population as defined in **Section 12.9.2.**

Potential magnitude of impact

343. During the breeding season, when considering only the projects within foraging distance from the regional colonies, the cumulative abundance for puffin is 25,864 individuals for the projects considered in **Table 12.50**, this would result in approximately 129 puffins being subject to mortality. During the breeding season the total puffin regional baseline population, including breeding adults and immature birds, is predicted to be 441,350 individuals (**Table 12.17**). Using the average baseline mortality rate of 0.175 (**Table 12.19**), the natural predicted mortality in the breeding season is 77,236 individuals per annum. The addition of 129 predicted mortalities due to cumulative displacement, would increase the baseline mortality rate by 0.167%.

344. This level of potential change is considered to be an impact of **low magnitude during the breeding season**, as it represents less than 1% difference to the baseline conditions due to the small number of individuals subject to potential mortality as a result of displacement.

345. During the non-breeding season, the cumulative abundance for puffin is 23,708 individuals for all projects considered in **Table 12.50**, this would result in approximately 119 puffins being subject to mortality. The BDMPS for the non-breeding season is defined as 231,957 individuals and, using the average baseline mortality rate of 0.175 (**Table 12.19**), the natural predicted mortality in the non-breeding season is 40,592 individuals per annum. The addition of 119 predicted mortalities due to cumulative displacement, would increase baseline mortality rate by 0.292%.

346. This level of potential change is considered to be an impact of **low magnitude during the non-breeding season**, as it represents a less than 1% difference to the baseline conditions due to the small number of individuals subject to potential mortality as a result of displacement.

Sensitivity of the receptor

347. As detailed in **Section 12.11.1**, as this receptor is classified as medium behavioural sensitivity (**Table 12.15**) and it is of medium conservation value (**Table 12.11**), this leads to an overall sensitivity of this receptor to disturbance and displacement of **medium**.

Significance of the effect

348. Given a low magnitude of impact resulting from cumulative disturbance and displacement and a sensitivity of medium, following the matrix approach set out in **Table 12.14**, the significance of the residual effect is **minor, which is not significant in EIA terms**.

Kittiwake

349. Due to differences in assessment methodologies between OWFs in English and Scottish waters, the majority of OWFs in the North Sea scoped kittiwake out of this impact. The subsequent seasonal abundance estimates for kittiwake associated with each of the projects identified in Table 47 and were considered for assessment are presented in **Table 12.51**. However, the Applicant does not agree with disturbance and displacement assessment being required for kittiwake given the species low sensitivity to displacement (**Table 12.12**) and is only provided due to being requested by NatureScot. Furthermore, assessment of displacement effects on kittiwake from the Project alone contributes less than two birds for each season and only 3.7 birds on an annual basis, making the Project's contribution to any cumulative effect from displacement negligible. The assessment is based on the SNCB's recommended displacement rate of 30% and the upper mortality rate of 3%.

Table 12.51 Kittiwake cumulative season and total abundance estimates

Development	Predicted abundance		
	Return Migration	Migration-free Breeding*	Post-breeding Migration
Hywind 2 Demonstration	-	112	-
Kincardine	-	229	-
Neart na Gaoithe	-	2,164	2,016
Seagreen Alpha and Bravo	1,966	4,538	4,598
Inch Cape	917	2,249	1,357
Green Volt	83	183	149
Moray West	-	6902	-
Moray East	-	980	-
Pentland	41	546	118
Beatrice	-	786	-
Total (all projects)	**3,007**	**18,689**	**8,238**

*Projects connected to regional breeding population as defined in **Section 12.9.2**.

Potential magnitude of impact

350. During the return-migration season, the cumulative abundance for kittiwake is 3,007 individuals for all projects available for consideration in **Table 12.51**, this would result in approximately 27 kittiwakes being subject to mortality. During the return migration season the total kittiwake regional baseline population, including breeding adults and immature birds, is predicted to be 627,816 individuals (**Table 12.17**). Using the average baseline mortality rate of 0.156 (**Table 12.19**), the natural predicted mortality of kittiwakes in the breeding season is 97,939 individuals per annum. The addition of 27 predicted mortalities due to cumulative displacement, would increase baseline mortality rate by 0.028%.

351. This level of potential change is considered to be an impact of **negligible magnitude during the return migration season**, as it represents well under a 1% difference to the baseline conditions due to the small number of individuals subject to potential mortality as a result of displacement.

352. During the migration-free breeding season, the cumulative abundance for kittiwake is 18,689 individuals for all projects considered in **Table 12.51**, this would result in approximately 168

kittiwakes being subject to mortality. The BDMPS for the migration-free breeding season is defined as 380,104 individuals (**Table 12.17**) and, using the average baseline mortality rate of 0.156 (**Table 12.19**), the natural predicted mortality in the non-breeding season is 59,296 individuals per annum. The addition of 168 predicted mortalities due to cumulative displacement, would increase baseline mortality rate by 0.283%.

353. This level of potential change is considered to be an impact of **low magnitude during the migration-free breeding season**, as it represents a less than 1% difference to the baseline conditions due to the small number of individuals subject to potential mortality as a result of displacement.

354. During the post-breeding migration season, the cumulative abundance for kittiwake is 8,238 individuals for all projects considered in **Table 12.51**, this would result in approximately 74 kittiwakes being subject to mortality. The BDMPS for the migration-free breeding season is defined as 829,937 individuals (**Table 12.17**) and, using the average baseline mortality rate of 0.156 (**Table 12.19**), the natural predicted mortality in the non-breeding season is 129,470 individuals per annum. The addition of 74 predicted mortalities due to cumulative displacement, would increase baseline mortality rate by 0.057%.

355. This level of potential change is considered to be an impact of **negligible magnitude during the post-breeding migration season**, as it represents well under a 1% difference to the baseline conditions due to the small number of individuals subject to potential mortality as a result of displacement.

Sensitivity of the receptor

356. As detailed in **Section 12.11.1**, as this receptor is classified as low behavioural sensitivity (**Table 12.15**) and it is of medium conservation value (**Table 12.11**), this leads to an overall sensitivity of this receptor to disturbance and displacement of **medium**.

Significance of the effect

357. Given a negligible to low magnitude of impact resulting from cumulative disturbance and displacement and a sensitivity of medium, following the matrix approach set out in **Table 12.14**, the significance of the residual effect is **minor, which is not significant in EIA terms**.

12.13.3 Cumulative collision risk

358. There is potential for cumulative collision risk to birds as a result of operational activities associated with the Project and other developments. The risk to birds is through potential collision with WTGs and associated infrastructure from OWFs, resulting in injury or fatality. This may occur when birds fly through the OWFs whilst foraging for food, commuting between breeding sites and foraging areas, or during migration. The only projects identified for this CEA are those defined as being within Tier 1 and Tier 2, as described in **Table 12.52**. The approach taken to assessing cumulative collision risk is a quantitative one, drawing upon the published information produced by the respective project developers. As such, the input parameters to CRM may vary from those put forward in this report.

Gannet

359. The subsequent season estimated collision risk for gannet associated with each of the projects identified in **Table 12.45** are presented in **Table 12.52**.

Table 12.52 Gannet cumulative season and total estimates for collision risk

Development	Predicted collision risk estimates		
	Return Migration	Migration-free breeding*	Post-breeding Migration
Green Volt	2.6	18.7	0.5
Beatrice	9.5	37.4	48.8
Blyth Demonstration	2.8	3.5	2.1
Dudgeon	19.1	22.3	38.9
East Anglia One	6.3	3.4	131.0
Hywind 2 Demonstration	0.8	5.6	0.8
Kincardine	0.0	3.0	0.0
Moray East	8.9	80.6	35.4
Aberdeen OWF (EOWDC)	0.1	4.2	5.1
Methil	-		-
Galloper	12.6		30.9
Greater Gabbard	4.8		8.8
Gunfleet Sands	-		-
Hornsea Project One	22.5	11.5	32.0
Humber Gateway	1.5	1.9	1.1
Kentish Flats	1.1		0.8
Lincs, Lynn and Inner Dowsing	1.9	2.3	1.4
London Array	1.8		1.4
Race Bank	4.1	33.7	11.7
Rampion	2.1		63.5
Scroby Sands	-		-
Sheringham Shoal	0.0	14.1	3.5
Teesside	0.0	4.9	1.7
Thanet	0.0		0.0
Westermost Rough	0.2	0.2	0.1
Neart na Gaoithe	23.0	143.0	47.0
Seagreen Alpha & Bravo	65.8	800.8	49.3
Triton Knoll	30.1	26.8	64.1
Dogger Bank A & B	54.4	81.1	83.5
Dogger Bank C & Sofia	10.8	14.8	10.1
Hornsea Project Two	6.0	7.0	14.0
Norfolk Vanguard	5.3	8.2	18.6
East Anglia ONE North	1.1	12.4	11.0

Development	Predicted collision risk estimates		
	Return Migration	Migration-free breeding*	Post-breeding Migration
East Anglia TWO	4.0	12.5	23.1
Inch Cape	5.2	336.9	29.2
Norfolk Boreas	3.9	14.1	12.7
Hornsea Three	4.3	10.1	4.5
East Anglia Three	8.4	4.8	28.5
Moray West	1.0	10.0	2.0
Total (consented projects only)	**326.0**	**1,729.8**	**817.1**
Hornsea Four	1.8	11.0	4.4
Pentland	0	2	0
Outer Dowsing	-		-
Dudgeon Extension Project	0.4	3.6	4.9
Rampion 2	1.6		3.4
Sheringham Shoal Extension Project	0.0	0.3	1.4
Five Estuaries	-		-
North Falls	-		-
Total Applicant's Approach (All projects)	**329.8**	**1,746.7**	**831.2**

*Projects connected to regional breeding as defined in **Section 12.9.2.**

Potential magnitude of impact

360. During the return migration season, a total of 330 gannets may be subject to mortality. The BDMPS for the return migration season (**Table 12.17**) is 248,385 and using the average baseline mortality rate of 0.187 (**Table 12.19**), the natural predicted mortality in the return migration season is 46,448. The addition of 330 mortalities would represent an increase in mortality relative to the baseline mortality rate of 0.710%

361. This level of potential change is considered to be of **low magnitude during the return migration season**, as it represents only a slight increase to baseline mortality rate levels due to the small number of estimated collisions.

362. During the migration-free breeding season, when considering only the projects within foraging distance from the regional colonies, 1,747 gannets may be subject to mortality. During the migration-free breeding season, the total regional baseline population of breeding adults and immature birds is predicted to be 804,425 gannets (**Table 12.17**). When the average baseline mortality rate of 0.187 (**Table 12.19**) is applied, the natural predicted mortality in the migration-free breeding season is 150,427. The addition of 1,747 mortalities would represent a 1.161% increase in mortality relative to the baseline mortality rate.

363. This level of potential change is considered to be an impact of **medium magnitude during the breeding season**, as it represents more than 1% difference to the baseline conditions.

364. During the post-breeding migration season, 831 gannets may be subject to mortality. The BDMPS for the post-breeding migration season is defined as 456,298 (Furness, 2015) and using the average baseline mortality rate of 0.187 (**Table 12.19**), the natural predicted mortality in the post-breeding

migration season is 85,328. The addition of 831 mortalities would represent a 0.974% increase in mortality relative to the baseline mortality rate.

365. This level of potential change is considered to be of **low magnitude during the post-breeding migration season**, as it represents only a slight increase to baseline mortality rate levels due to the small number of estimated collisions.

366. With regards to the predicted magnitude of impacts above it should be noted that no consideration for macro-avoidance has been applied for projects included in the cumulative assessment. As detailed in the **Appendix 12.2 (Offshore Ornithology: Collision Risk Modelling)** the inclusion of macro-avoidance within the collision risk modelling undertaken for the project resulted in a reduction in predicted impact of approximately 70%. Therefore, it can be concluded that the predicted magnitude of impact is likely to be considerably less and represents an overly precautionary estimate. Revised guidance is expected to be published on the inclusion of macro-avoidance in collision risk modelling in in the near future. Therefore, if macro-avoidance was accounted for in the cumulative assessment the level of potential change would be below the 1% increase in mortality relative to baseline mortality rate level, which is the commonly used threshold for more detailed consideration.

367. As the predicted cumulative increase in baseline mortality of the gannet breeding population exceeds an increase in 1%, further consideration of such an impact through Population Viability Analysis (PVA) are provided in this instance. PVA was conducted using the Natural England PVA Tool (Searle *et al*, 2019). Full details of the methodology are presented in **Appendix 12.6: Offshore ornithology population viability analysis**. The predicted cumulative mortality rate due to collisions associated with the Project and other proposed, planned and operational OWFs is 1,747 individuals during the breeding season. A range around this level of impact (1,670 – 1,970) was assessed in the PVA against the breeding population (**Table 12.18**) of 804,425 individuals (adults and immatures). The population growth rate is expected to decline to between 0.23 and 0.28% of the counterfactual (no impact) growth rate, which after 35 years would result in a reduction in population size by 8.94 to 10.79% compared to the counterfactual. Further details regarding the approach taken can be found in **Appendix 12.6: Offshore ornithology population viability analysis**.

368. Therefore, following consideration of PVA for each of the three seasons and regardless of the receptor's current population trend, when considering such a minimal increase in impact on growth rate and population size this predicted impact would almost certainly be indistinguishable from natural fluctuations in the population and therefore the resulting **magnitude of impact is low**.

Sensitivity of the receptor

369. As detailed in **Section 12.11.5**, as this receptor is classified as high behavioural sensitivity (**Table 12.15**) and it is of medium conservation value (**Table 12.11**), this leads to an overall sensitivity of this receptor to collision risk of **medium**.

Significance of the effect

370. It is also worth noting that considering macro-avoidance is not taken into consideration in this assessment and therefore, as the increase in baseline mortality only just exceeds 1% in the breeding season and the PVA provides evidence that the realistic magnitude of impact is most likely to be low without accounting for macro-avoidance then this assessment is precautionary. Given a low magnitude of impact resulting from cumulative collision risk when considering the outputs from the PVAs and a sensitivity of medium, following the matrix approach set out in **Table 12.14**, the significance of the residual effect is **minor, which is not significant in EIA terms**.

Kittiwake

371. The subsequent season abundance estimates for collision risk for kittiwake associated with each of the projects identified in **Table 12.45** are presented in **Table 12.53.**

Table 12.53 Kittiwake cumulative season and total estimates for collision risk

Development	Predicted collision risk estimates		
	Return Migration	Migration-free breeding*	Post-breeding Migration
Green Volt	4.4	7.5	7.1
Beatrice	39.8	94.7	10.7
Blyth Demonstration Site	1.4	1.7	2.3
Dudgeon	-		-
East Anglia One	46.8		160.4
Hywind 2 Demonstration	0.9	16.6	0.9
Kincardine	1.0	22.0	9.0
Moray East	19.3	43.6	2.0
Aberdeen OWF (EOWDC)	1.1	11.8	5.8
Galloper	31.8		27.8
Greater Gabbard	11.4		15.0
Gunfleet Sands	-		-
Hornsea Project One	20.9		55.9
Humber Gateway	1.9		3.2
Kentish Flats	3.4		0.9
Lincs, Lynn & Inner Dowsing	1.2		0.7
London Array	1.8		2.3
Race Bank	5.6		23.9
Rampion	29.7		37.4
Scroby Sands	-		-
Sheringham Shoal	-		-
Teesside	2.5	38.4	24.0
Thanet	0.4		0.5
Westermost Rough	0.1		0.2
Neart na Gaoithe	4.4	32.9	56.1
Seagreen Alpha & Bravo	247.6	153.1	313.1
Triton Knoll	45.4		139.0
Dogger Bank A & B	295.4	288.6	135.0
Dogger Bank C & Sofia	216.9	136.9	90.7
Hornsea Project Two	3.0		9.0
Norfolk Vanguard	19.3		16.4
East Anglia ONE North	3.5		8.1
East Anglia TWO	7.4		5.4

Development	Predicted collision risk estimates		
	Return Migration	Migration-free breeding*	Post-breeding Migration
Inch Cape	63.5	13.1	224.8
Norfolk Boreas	11.9		32.2
Hornsea Three	6.1		38.5
East Anglia Three	30.8		56.5
Moray West	7.0	79.0	24.0
Total (consented projects only)	**1,187.6**	**939.9**	**1,538.8**
Hornsea Four	13.5		31.7
Pentland	0	7	1
Outer Dowsing	-		-
Dudgeon Extension Project	2.20		8.55
Rampion 2	15.10		10.70
Sheringham Shoal Extension Project	0.00		1.91
Five Estuaries	-		-
North Falls	-		-
Total Applicant's Approach (All projects)	**1,218.4**	**946.9**	**1,592.7**

*Projects connected to regional breeding population as defined in **Section 12.9.2**.

Potential magnitude of impact

372. During the return migration season, a total of 1,218 kittiwakes may be subject to mortality. The BDMPS for the return migration season (**Table 12.17**) is 627,816 and using the average baseline mortality rate of 0.156 (**Table 12.19**), the natural predicted mortality in the return migration season is 97,939. The addition of 1,218 mortalities would represent an increase in mortality relative to the baseline mortality rate of 1.244%

373. This level of potential change is considered to be of **medium magnitude during the return migration season**, as it represents an increase of over 1% relative to the baseline mortality rate levels due to the small number of estimated collisions.

374. During the migration-free breeding season, when considering only the projects within foraging distance from the regional colonies, 947 kittiwakes may be subject to mortality. During the migration-free breeding season, the total regional baseline population of breeding adults and immature birds is predicted to be 380,104 kittiwakes (**Table 12.17**). When the average baseline mortality rate of 0.156 (**Table 12.19**) is applied, the natural predicted mortality in the migration-free breeding season is 59,296. The addition of 947 mortalities would represent a 1.597% increase in mortality relative to the baseline mortality rate.

375. This level of potential change is considered to be an impact of **medium magnitude during the breeding season**, as it represents more than 1% difference to the baseline conditions.

376. During the post-breeding migration season, 1,593 kittiwakes may be subject to mortality. The BDMPS for the post-breeding migration season is defined as 829,937 (**Table 12.17**) and using the average baseline mortality rate of 0.156 (**Table 12.19**), the natural predicted mortality in the post-breeding migration season is 129,470. The addition of 1,593 mortalities would represent a 1.230% increase in mortality relative to the baseline mortality rate.

377. This level of potential change is considered to be of **medium magnitude during the post-breeding migration season**, as it represents an increase of over 1% relative to baseline mortality rate levels due to the small number of estimated collisions.

378. As the predicted cumulative increase in baseline mortality of the kittiwake during the pre-breeding, breeding and post-breeding seasons exceeds an increase in 1%, further consideration of such impacts through PVA are provided in this instance. PVA was conducted using the Natural England PVA Tool (Searle *et a*l, 2019). Full details of the methodology are presented in **Appendix 12.6: Offshore ornithology population viability analysis**.

379. For the return-breeding season, the predicted cumulative mortality rate due to collisions associated with Green Volt and other proposed, planned and operational OWFs is 1,218 individuals per annum. A range around this level of impact (1,143 – 1,443) was assessed in the PVA against the pre-breeding BDMPS population of 627,816 individuals (adults and immatures). The population growth rate is expected to decline to between 0.21 and 0.26% of the counterfactual (no impact) growth rate, which after 35 years would result in a reduction in population size by 8.09 to 9.82% compared to the counterfactual.

380. For the migration-free breeding season, the predicted cumulative mortality rate is 947 individuals per annum. A range around this level of impact (865 – 1,165) was assessed in the PVA against the breeding population of 357,426 individuals (adults and immatures). The population growth rate is expected to decline to between 0.28 and 0.38% of the counterfactual (no impact) growth rate, which after 35 years would result in a reduction in population size by 10.81 to 14.75% compared to the counterfactual.

381. During the post-breeding migration season, the predicted cumulative mortality rate is 1,593 individuals per annum. A range around this level of impact (1,517 – 1,837) was assessed in the PVA against the post-breeding migration BDMPS population of 829,937 individuals (adults and immatures). The population growth rate is expected to decline to between 0.21 and 0.26% of the counterfactual (no impact) growth rate, which after 35 years would result in a reduction in population size by 7.99 to 9.78% compared to the counterfactual. Further details regarding the approach taken can be found in **Appendix 12.6: Offshore ornithology population viability analysis**.

382. Therefore, following consideration of PVA outputs for each of the three seasons and regardless of the receptor's current population trend, when considering such a minimal increase in impact on growth rate and population size these predicted impacts would almost certainly be indistinguishable from natural fluctuations in the population and therefore the resulting **magnitude of impact is low**.

Sensitivity of the receptor

383. As detailed in **Section 12.11.5**, as this receptor is classified as high behavioural sensitivity (**Table 12.15**) and it is of medium conservation value (**Table 12.11**), this leads to an overall sensitivity of this receptor to collision risk of **medium**.

Significance of the effect

384. It is worth noting that consideration no consideration of macro-avoidance and the substantially small contribution from the project of 0.36-0.79% (4.4 to 7.5 birds, respectively) to the seasonal cumulative totals that range from 940 to 1,592 birds were given in this assessment. The contribution of the Project to the cumulative totals in all seasons is considered to be minimal at most (**Section 12.11.5**). Given a low magnitude of impact resulting from cumulative collision risk when considering the outputs from the PVAs for all seasons and a sensitivity of medium, following the matrix approach set out in **Table 12.17**, the significance of the residual effect is **minor, which is not significant in EIA terms**.

Herring gull

385. The subsequent season abundance estimates for collision risk for herring gull associated with each of the projects identified in **Table 12.45** are presented in **Table 12.54**.

Table 12.54 Herring gull cumulative season and total estimates for collision risk

Development	Predicted collision risk estimates	
	Breeding*	Non-breeding
Green Volt (BO3)	0	2.14
Beatrice		197.4
Blyth Demonstration		-
Dudgeon		-
East Anglia One		19.0
Hywind 2 Demonstration	0.6	7.8
Kincardine	1.0	0.0
Moray East		0.0
Aberdeen OWF (EOWDC)		
Methil		3.7
Galloper		-
Greater Gabbard		-
Gunfleet Sands		-
Hornsea Project One		11.6
Humber Gateway		1.1
Kentish Flats		1.7
Lyncs, Lynn and Inner Dowsing		-
London Array		-
Race Bank		-
Rampion		-
Scroby Sands		-
Sheringham Shoal		-
Teesside		34.5
Thanet		19.6
Westermost Rough		0.0
Neart na Gaoithe		12.5
Seagreen Alpha & Bravo	10.0	21.0
Triton Knoll		-
Dogger Bank A & B		
Dogger Bank C & Sofia		0.0
Hornsea Project Two		
Norfolk Vanguard		7.1
East Anglia ONE North		0

Development	Predicted collision risk estimates	
	Breeding*	Non-breeding
East Anglia TWO		0.5
Inch Cape		13.5
Norfolk Boreas		5.4
Hornsea Three		4.0
East Anglia Three		23.0
Moray West		1.0
Total (consented projects only)	**11.6**	**386.5**
Hornsea Four		0.8
Pentland	0	0
Outer Dowsing		-
DEP and SEP		-
Rampion 2		14.2
Five Estuaries		0
North Falls		-
Total (All Projects)	**11.6**	**401.5**

*Projects connected to regional breeding population as defined in **Section 12.9.2.**

Potential magnitude of impact

386. During the breeding season there were no herring gulls in the Windfarm Site and so there is **no contribution to the cumulative impact in the breeding season**.

387. During the non-breeding season, a total of 402 herring gulls may be subject to mortality. The BDMPS for the non-breeding season is 466,511 (**Table 12.17**) and using the average baseline mortality rate of 0.172 (**Table 12.19**), the natural predicted mortality in the non-breeding season is 80,240. The addition of 402 mortalities would represent an increase in the mortality relative to the baseline mortality rate of 0.501%.

388. This level of potential change is considered to be of **low magnitude during the non-breeding season**, as it represents only a slight increase to baseline mortality rate levels due to the small number of estimated collisions.

Sensitivity of the receptor

389. As detailed in **Section 12.11.5**, as this receptor is classified as high behavioural sensitivity (**Table 12.15**) and it is of low conservation value (**Table 12.11**), this leads to an overall sensitivity of this receptor to collision risk of **medium**.

Significance of the effect

390. Therefore, the magnitude of impact resulting from cumulative collision risk is considered to be low and the sensitivity is medium. The significance of the residual effect is therefore **minor, which is not significant in EIA terms**.

Great black-backed gull

391. The subsequent season abundance estimates for collision risk for great black-backed gull associated with each of the projects identified in **Table 12.45** are presented in **Table 12.55**.

Table 12.55 Great black-backed gull cumulative season and total estimates for collision risk

Development	Predicted collision risk estimates	
	Breeding*	Non-breeding
Green Volt (BO3)	0	2.84
Beatrice	30.2	120.8
Blyth Demonstration		5.1
Dudgeon		0.0
East Anglia One		46.0
Hywind 2 Demonstration	0.3	4.5
Kincardine	0.0	0.0
Moray East	9.5	25.5
Aberdeen OWF (EOWDC)	0.6	2.4
Galloper		18.0
Greater Gabbard		60.0
Gunfleet Sands		-
Hornsea Project One		68.6
Humber Gateway		5.1
Kentish Flats		0.2
Lincs, Lynn and Inner Dowsing		0.0
London Array		-
Race Bank		0.0
Rampion		
Scroby Sands		-
Sheringham Shoal		0.0
Teesside		34.8
Thanet		0.4
Westermost Rough		0.0
Neart na Gaoithe		3.6
Seagreen Alpha & Bravo		53.4
Triton Knoll		97.6
Dogger Bank A & B		23.3
Dogger Bank C & Sofia		25.5
Hornsea Project Two		20.0
Norfolk Vanguard		21.5
East Anglia ONE North		1.2
East Anglia TWO		3.4

Development	Predicted collision risk estimates	
	Breeding*	Non-breeding
Inch Cape		36.8
Norfolk Boreas		28.7
Hornsea Three		27.1
East Anglia Three		30.3
Moray West	4.0	5.0
Total (consented projects only)	**44.6**	**771.7**
Hornsea Four		4.0
Pentland	0	0
Outer Dowsing		-
Dudgeon Extension Project		1.6
Rampion 2		2.5
Sheringham Shoal Extension Project		5.3
Five Estuaries		-
North Falls		-
Total (All Projects)	**44.6**	**785.0**

*Projects connected to regional breeding population as defined in Section 12.9.2.

Potential magnitude of impact

392. During the breeding season there were no great black-backed gulls in the Windfarm Site and so there is **no contribution to the cumulative impact in the breeding season**.

393. During the non-breeding season, a total of 785 great black-backed gulls are predicted to be subject to mortality with the Project contributing 0.36% of these collisions. The regional population during the non-breeding season is 91,399 (**Table 12.17**) and using the average baseline mortality rate of 0.160 (**Table 12.19**), the natural predicted mortality in the non-breeding season is 14,624. The addition of 785 mortalities would represent a 5.368% increase in mortality relative to the baseline mortality rate.

394. This level of potential change is considered to be an impact of **medium magnitude during the non-breeding season**, as it represents more than 1% difference to the baseline conditions.

395. As the predicted cumulative increase in baseline mortality of the great black-backed gull non-breeding population exceeds an increase in 1%, further consideration of such a potential impact through PVA is provided in this instance. PVA was conducted using the Natural England PVA Tool (Searle *et al*, 2019). Full details of the methodology are presented in **Appendix 12.6: Offshore ornithology population viability analysis**. The predicted cumulative mortality rate is 785 individuals per annum. A range around this level of impact (760 - 860) was assessed in the PVA against the non-breeding BDMPS population of 91,399 individuals (adults and immatures). The population growth rate is expected to decline to between 0.98 to 1.11% of the counterfactual (no impact) growth rate, which after 35 years would result in a reduction in population size by 42.28 to 48.95% compared to the counterfactual. Further details regarding the approach taken can be found in **Appendix 12.6: Offshore ornithology population viability analysis.**

396. Therefore, following consideration of PVA for the non-breeding season and regardless of the receptors current population trend, when considering such a minimal increase in impact on growth

rate and population size this predicted impact would almost certainly be indistinguishable from natural fluctuations in the population and therefore the resulting **magnitude of impact is low**.

Sensitivity of the receptor

397. As detailed in **Section 12.11.5**, as this receptor is classified as high behavioural sensitivity (**Table 12.15**) and it is of low conservation value (**Table 12.11**), this leads to an overall sensitivity of this receptor to collision risk of medium.

Significance of the effect

398. It should be noted that the Project has a substantially small contribution of 0.36% (2.8 birds) to the cumulative total of 785 birds. Given a low magnitude of impact resulting from cumulative collision risk when considering the outputs from the PVAs for the non-breeding season and the sensitivity is medium, the significance of the residual effect should be considered **minor, which is not significant in EIA terms**.

12.13.4 Cumulative combined operational displacement and collision risk

Gannet

399. Due to gannet being scoped in for both displacement and collision risk assessments during the operational and maintenance phase, there is potential for these two impacts to cumulatively adversely affect gannet populations when combined. Previous sections have concluded a low to medium magnitude of impact from collision risk cumulatively and a negligible to low magnitude of impact from displacement cumulatively.

400. However, the combined impact of both cumulative collision risk and cumulative displacement may be greater than either one acting alone. Further consideration of both impacts acting together is therefore required. It is recognised that assessing these two potential impacts together amounts to double counting, as birds that are subject to displacement would not be subject to potential collision risk as they are already assumed to have not entered the Windfarm Site. Equally, birds estimated to be subject to collision risk mortality would not be able to be subjected to displacement consequent mortality as well.

401. The latest guidance paper on avoidance rates for collision risk modelling (Cook, 2021) included acknowledgement of the double counting of collision risk and displacement for gannet and proposed that assessments of gannet should take into account observed high levels of macro avoidance within collision risk modelling to reduce the over-inflation of impacts when combining the two together (APEM, 2014; Dierschke *et al.*, 2016; Orsted, 2022). As described in **Section 12.11.6** consideration has been provided in this report of such potential additional macro avoidance by applying a macro-avoidance of 70% to CRM estimates (i.e. reducing collision risk estimates by 70% to account for bird displacement) when assessing the combined impacts of displacement and collision risk.

Potential magnitude of impact

402. As detailed in **Table 12.47** and **Table 12.52**, following the evidence led assessments the combined predicted mortality in the operational and maintenance phase (considering the evidence-based displacement and mortality rates of 60-80% and 1%, respectively and 70% macro avoidance applied to collision risk estimates) during the return-migration season equates to between 133 (34 + (0.3 x 329.8)) and 144 (45 + (0.3 x 329.8) cumulative predicted additional mortalities. Using the return-migration BDMPS population of 248,385 (**Table 12.17**), with an average baseline mortality

rate of 0.187 (**Table 12.19**), the natural predicted mortality is 46,448 individuals per annum. The addition of 133 to 144 predicted mortalities would increase the baseline mortality rate by 0.286-0.310%.

403. This level of potential change is considered to be an impact of **low magnitude during the return-migration season**, as it represents a difference of less than 1% to the baseline conditions.

404. During the migration-free breeding season the combined predicted mortality in the operation and maintenance phase (considering the evidence-based displacement and mortality rates of 40-60% and 1%, respectively and 70% macro avoidance applied to collision risk estimates) equates to between 610 (86 + (0.3 x 1,746.7)) and 652 (128 + (0.3 x 1,746.7)) cumulative predicted additional mortalities. Using the breeding season population of 804,425 (**Table 12.17**), taken from the latest colony counts, with an average baseline mortality rate 0.187 (**Table 12.19**), the natural predicted mortality is 150,427 individuals per annum. The addition of 610 to 652 predicted mortalities would increase the baseline mortality rate by 0.406– 0.433%.

405. This level of potential change is considered to be an impact of **low magnitude during the migration-free breeding season**, as it represents a difference of less than 1% to the baseline conditions.

406. During the post-breeding migration season the combined predicted mortality in the operation and maintenance phase (considering the latest evidence based (APEM, 2022a) displacement and mortality rates of 60–80% and 1% respectively and 70% macro avoidance applied to collision risk estimates) equates to between 382 (133 + (0.3 x 831.2)) and 426 (177 + (0.3 x 831.2)) cumulative predicted additional mortalities. Using the post-breeding migration BDMPS population of 456,298 (**Table 12.17**), with an average baseline mortality of 0,187 (**Table 12.19**), the natural predicted mortality is 85,328 individuals per annum. The addition of 382 to 426 predicted mortalities would increase the baseline mortality rate by 0.448 – 0.499%.

407. This level of potential change is considered to be an impact of **low magnitude during the post-breeding migration season**, as it represents a difference of less than 1% to the baseline conditions.

Sensitivity of the receptor

408. As detailed in **Section 12.13.2** and **Section 12.13.3**, this receptor is afforded a feature conservation value of ‘medium’ (**Table 12.11**). With respect to behavioural sensitivity, it is considered to be medium (**Table 12.15**). As this receptor is of medium behavioural sensitivity, and it is of medium conservation value, this leads to an overall sensitivity of this receptor to disturbance and displacement of **medium**.

Significance of effect

409. It should be taken into consideration that the potential magnitude of impact from the Project is a substantially small contribution of 0.7% (8 birds) to the overall cumulative totals for any seasons. Therefore, the magnitude of impact resulting from collision risk and displacement combined on a seasonal basis is considered to be low and the sensitivity is medium. The significance of the residual effect is therefore, **minor, which is not significant in EIA terms**.

Kittiwake

410. Due to kittiwake being scoped in for both displacement and collision risk assessments during the operation and maintenance phase, there is potential for these two impacts to cumulatively adversely affect kittiwake populations when combined.

411. However, the Applicant's position as previously stated does not agree with disturbance and displacement assessment being required for kittiwake given the species low sensitivity to displacement (**Table 12.15**) and has only been provided due to being requested by NatureScot. Furthermore, the cumulative assessment for displacement effect is incomplete as many other projects have not included kittiwake in their assessment for displacement due to its low vulnerability to this effect. Therefore, the value of a combined assessment is questionable.

412. Previous sections have concluded a medium magnitude of impact from collision risk cumulatively and a low magnitude of impact from displacement cumulatively. However, the combined impact of both cumulative collision risk and cumulative displacement may be greater than either one acting alone. Further consideration of both impacts acting together is therefore required. It is recognised that assessing these two potential impacts together amounts to double counting, as birds that are subject to displacement would not be subject to potential collision risk as they are already assumed to have not entered the Windfarm Site. Equally, birds estimated to be subject to collision risk mortality would not be able to be subjected to displacement consequent mortality as well. As a more refined method to consider displacement and collision together whilst reducing any double counting of impacts is not agreed with SNCBs the precautionary and highly unlikely approach is presented in this assessment.

Potential magnitude of impact

413. As detailed in **Table 12.51** and **Table 12.53**, following the evidence led assessments the combined predicted mortality in the operation and maintenance phase during the return-migration season (considering the SNCB's recommended displacement and mortality rates of 30% and 3%, respectively and collision risk estimates) equates to 1,245 (27+1218) cumulative predicted additional mortality per annum. Using the return-migration season BDMPS population of 627,816 (**Table 12.17**), with an average baseline mortality rate of 0.156 (**Table 12.19**), the natural predicted mortality is 97,939 individuals per annum. The addition of 1,245 predicted mortalities would increase the baseline mortality rate by 1.271%.

414. This level of potential change is considered to be an impact of **medium magnitude during the return-migration season**, as it represents a difference of more than 1% to the baseline conditions.

415. During the migration-free breeding season the combined predicted mortality in the operation and maintenance phase (considering the SNCB's recommended displacement and mortality rates of 30% and 3%, respectively and collision risk estimates) equates to 1,115 (168+947)cumulative predicted additional mortality per annum. Using the breeding season population of 357,426 (**Table 12.17**), taken from the latest colony counts, with an average baseline mortality rate of 0.156 (**Table 12.19**), the natural predicted mortality is 55,758 individuals per annum. The addition of 1,115 predicted mortalities would increase the baseline mortality rate by 2.000%.

416. This level of potential change is considered to be an impact of **medium magnitude during the migration-free breeding season**, as it represents a difference of more than 1% to the baseline conditions.

417. During the post-breeding migration season the combined predicted mortality in the operation and maintenance phase (considering the SNCB's recommended displacement and mortality rates of 30% 3%, respectively and collision risk estimates) equates to 1,667 (74+1593)cumulative predicted additional mortality per annum. Using the post-breeding migration season BDMPS population of 829,937 (**Table 12.17**), with an average baseline mortality rate of 0.156 (**Table 12.19**), the natural predicted mortality is 129,470 individuals per annum. The addition of 1,667 predicted mortalities would increase the baseline mortality rate by 1.288%.

418. It should be noted that the impacts associated with the simplistic additive manner are almost certainly an overestimate, as a bird which has been displaced from the array area can no longer collide with a turbine and vice versa.

Sensitivity of the receptor

419. As detailed in **Section 12.13.2** and **Section 12.13.3**, this receptor is afforded a feature conservation value of ‘medium’ (**Table 12.11**). With respect to behavioural sensitivity, it is considered to be medium (**Table 12.15**). As this receptor is of medium behavioural sensitivity, and it is of medium conservation value, this leads to an overall sensitivity of this receptor to disturbance and displacement of **medium**.

Significance of effect

420. Following consideration of PVA outputs (see **Appendix 12.6 Offshore Ornithology: Population Viability Analysis**) for each of the three seasons as demonstrated for kittiwake cumulative collision risk (see Section 12.13.3), when considering such a minimal increase in impact on growth rate and population size these predicted impacts would almost certainly be indistinguishable from natural fluctuations in the population and therefore, the resulting magnitude of impact is predicted to be low for all seasons. Therefore, the magnitude of impact resulting from collision risk and displacement combined on a seasonal basis is considered to be low and the sensitivity is medium. The significance of the residual effect is, therefore, **minor, which is not significant in EIA terms**.

12.13.5 Cumulative barrier effects

421. There is the potential for barrier effects to act cumulatively if individual birds have to fly further or are unable to access larger areas of foraging as the result of avoiding more than one OWF. This CEA focuses on receptors that conduct short-range diurnal movements. While it is possible that long distance migrants or seabirds that have a maximum foraging range of <100 km may encounter more than one OWF, this would be unlikely and would not correspond to any direct migratory routes or foraging pathways. The additional distance would therefore be negligible compared to the journey as a whole, and far less significant than the impact of normal variation in weather conditions, therefore can be considered **negligible magnitude of impact, regardless of the species sensitivity, which is not significant in EIA terms**.

12.14 Transboundary Impact Assessment

422. Transboundary effects arise when impacts from a development within one European Economic Area (EEA) state is likely to have a significant effect on the environment in another EEA state. Transboundary impacts upon offshore ornithological receptors are possible due to the wide foraging and migratory ranges of typical bird species in the North Sea.

423. Screening of transboundary impacts and any potential for significant transboundary effects with regard to offshore and intertidal ornithology from the Project upon the interests of other EEA States has been assessed. The potential transboundary impacts considered are:

- disturbance from construction activities;
- disturbance from operation and maintenance activities;
- barrier effects;
- displacement from presence of wind turbines and;
- collisions with wind turbines.

424. Based on the location of the Project and the key receptors identified, it is considered that there will be no significant transboundary effects on birds in the breeding season, on the basis that there are no non-UK seabird colonies within mean-maximum foraging range (+1SD) or other evidence to suggest connectivity (Wakefield *et al.*, 2017; Woodward *et al.*, 2019). Therefore, colonies outside of UK waters will not contribute to any transboundary effects in the breeding season.

425. During the non-breeding season, key receptors are able to travel more widely and as such, may come into contact with OWFs in other EEA states. Given the larger spatial scale and the far-ranging behaviour of key receptors in the non-breeding season, any potential transboundary effects would be in relation to much larger populations than those considered at the UK-scale.

426. Considering potential impact; barrier and displacement effects in the non-breeding season would not impose significant additional costs from flying around or foraging outside the Project area, as birds would be likely to be moving through the area. Collisions with WTGs in the non-breeding season will involve individuals from a wide geographical area, therefore no single colony would be significantly impacted Therefore, when considering potential transboundary impacts during the non-breeding season these are unlikely to be significant.

12.15 Inter-relationships

427. The inter-related effects assessment considers potentially significant effects from multiple impacts and activities from the construction, operation and decommissioning of the Project on the same receptor, or group of receptors. These can include:

- *Project lifetime effects*: assessment of the scope for effects that occur throughout more than one phase of the project (construction, operational and maintenance, and decommissioning), to interact to potentially create a more significant effect on a receptor than if just assessed in isolation in these three key project stages (e.g., vessel activity); 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 offshore ornithology, such as collision risk, disturbance and displacement, barrier effect and indirect effects 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, or incorporate longer-term effects.

428. Consideration of the inter-relationships between EIA topics that may lead to environmental effects. These may occur where a number of separate impacts, (e.g., noise and air quality), affect a single receptor such as fauna.

429. The approach to the assessment of inter-related effects considers receptor-led effects; that is effects that interact spatially and/ or temporally resulting in interrelated effects upon a single receptor.

430. The assessment of inter-related effects has also been undertaken with specific reference to the potential for such effects to arise in relation to receptor groups. The term ‘receptor group’ is used to highlight the fact that the proposed approach to inter-relationships assessment has not, in the main, assessed every individual receptor assessed at the EIA stage, but rather, potentially sensitive groups of receptors.

431. The broad approach to inter-related effects assessment has followed the following key steps:

- Review of effects for individual EIA topics;
- Review of the assessment carried out for each EIA topic area, to identify “receptor groups requiring assessment;

- Potential inter-related effects on these receptor groups identified via review of the assessment carried out across a range of topics;
- Development of lists for all potential receptor-led effects; and
- Qualitative assessment on how individual effects may combine to create interrelated effects.

432. It is important to note that the inter-relationships assessment has only considered effects produced by the Project, and not those from other developments (these will be considered within the Cumulative Effects Assessment in **Section 12.13**). Note that for receptors/ impacts scoped out of the EIA process based on the findings of the *Impacts* Register and the Scoping Report (Innogy, 2020), no inter-related assessment has been undertaken.

433. The construction, operation and decommissioning phases of the Project may cause a range of effects on offshore ornithological receptors. The magnitude of these effects has been assessed individually using expert judgement, drawing from a wide science base that includes project-specific surveys and previously acquired knowledge of the bird ecology of the North Sea.

434. These effects have the potential to form an inter-relationship, directly impacting the seabird receptors. They also have the potential to manifest as sources for impacts upon receptors other than those considered within the context of offshore ornithology.

435. In terms of how impacts to offshore ornithological interests may form inter-relationships with other receptor groups, assessments of significance are provided in the chapters listed in the second column of **Table 12.56**. In addition, the table shows where other chapters have been used to inform the offshore ornithology inter-relationships assessment.

Table 12.56 Chapter topic inter-relationships

Topic and description	Related chapter	Where addressed in this chapter
Indirect impacts through effects on habitats and prey during construction.	**Chapter 9: Benthic Ecology and Chapter 10: Fish and Shellfish Ecology**	**Section 12.10.3**
Indirect impacts through effects on habitats and prey during operation.		**Section 12.11.3**
Indirect impacts through effects on habitats and prey during decommissioning.		**Section 12.12.4**

436. However, as none of the offshore impacts on birds were assessed individually to have any greater than a minor adverse effect, it is considered highly unlikely that they will inter-relate to form an overall significant effect on offshore ornithology receptors.

12.16 Summary of effects

437. **Table 12.57** below presents a summary of the preliminary assessment of significant effects, any relevant embedded environmental measures, and residual effects on offshore ornithology receptors.

Table 12.57 Summary of effects

Potential Impact	Receptor	Magnitude	Sensitivity of Receptor	**Effect Significance**
Construction				
Temporary Disturbance and Displacement: Array	Gannet	Negligible	Medium	Negligible (not significant)
	Guillemot	Negligible	Medium	Minor (not significant)
	Razorbill	Negligible	Medium	Negligible (not significant)
	Puffin	Negligible	Medium	Negligible (not significant)
	Kittiwake	Negligible	Medium	Negligible (not significant)
Temporary disturbance and displacement: Offshore Export Cable Corridors and cable landfall	All Receptors	Negligible	N/A	Negligible (not significant)
Indirect effects via changes in prey or habitat availability	All Receptors	Negligible	N/A	Negligible (not significant)
Operation and Maintenance				
Disturbance and displacement: array	Gannet	Negligible	Medium	Negligible (not significant)
	Guillemot	Low	Medium	Minor (not significant)
	Razorbill	Negligible	Medium	Negligible (not significant)
	Puffin	Negligible	Medium	Negligible (not significant)
	Kittiwake	Negligible	Medium	Negligible (not significant)
Disturbance and displacement: Offshore Export Cable Corridors and cable landfall	All Receptors	Negligible	N/A	Negligible (not significant)
Indirect effects via changes in prey or habitat availability	All Receptors	Negligible	N/A	Negligible (not significant)
Entanglement with mooring lines	All Receptors	Negligible	N/A	Negligible (not significant)
Collision risk: array	Gannet	Negligible	Medium	Minor (not significant)
	Kittiwake	Negligible	Medium	Minor (not significant)
	Herring gull	Negligible	Medium	Negligible (not significant)
	Great Black-backed gull	Negligible	Medium	Negligible (not significant)
Combined Operational	Gannet	Negligible	Medium	Minor (not significant)

Potential Impact	Receptor	Magnitude	Sensitivity of Receptor	Effect Significance
Displacement and collision risk	Kittiwake	Negligible	Medium	Minor (not significant)
Barrier effects: array	All Receptors	Negligible	Low to Medium	Negligible to Minor (not significant)
Impacts of aviation and navigation lighting: array	All Receptors	Negligible	Low to Medium	Negligible to Minor (not significant)
Decommissioning				
Temporary Disturbance and Displacement: Array	All Receptors	Negligible	N/A	Negligible to Minor (not significant)
Temporary disturbance and displacement: Offshore Export Cable Corridors and cable landfall	All Receptors	Negligible	N/A	Negligible (not significant)
Indirect effects via changes in prey or habitat availability	All Receptors	Negligible	N/A	Negligible (not significant)
Cumulative				
Disturbance and displacement: operational phase	Gannet	Low	Medium	Minor (not significant)
	Guillemot	Low	Medium	Minor (not significant)
	Razorbill	Low	Medium	Minor (not significant)
	Puffin	Low	Medium	Minor (not significant)
	Kittiwake	Low	Medium	Minor (not significant)
Collision risk	Gannet	Medium	Medium	Minor (not significant)
	Kittiwake	Medium	Medium	Minor (not significant)
	Herring gull	Low	Medium	Minor (not significant)
	Great Black-backed gull	Medium	Medium	Minor (not significant)
Combined operational displacement and collision risk	Gannet	Low	Medium	Minor (not significant)
	Kittiwake	Low	Medium	Minor (not significant)
Transboundary				
None identified				

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