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Volume 7B Proposed Development (Offshore) Appendices

Appendix 6-3 Offshore Ornithology Collision Risk Modelling Technical Report

Caledonia Offshore Wind Farm Ltd

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Volume 7B Appendix 6-3 Offshore Ornithology Collision Risk Modelling Technical Report

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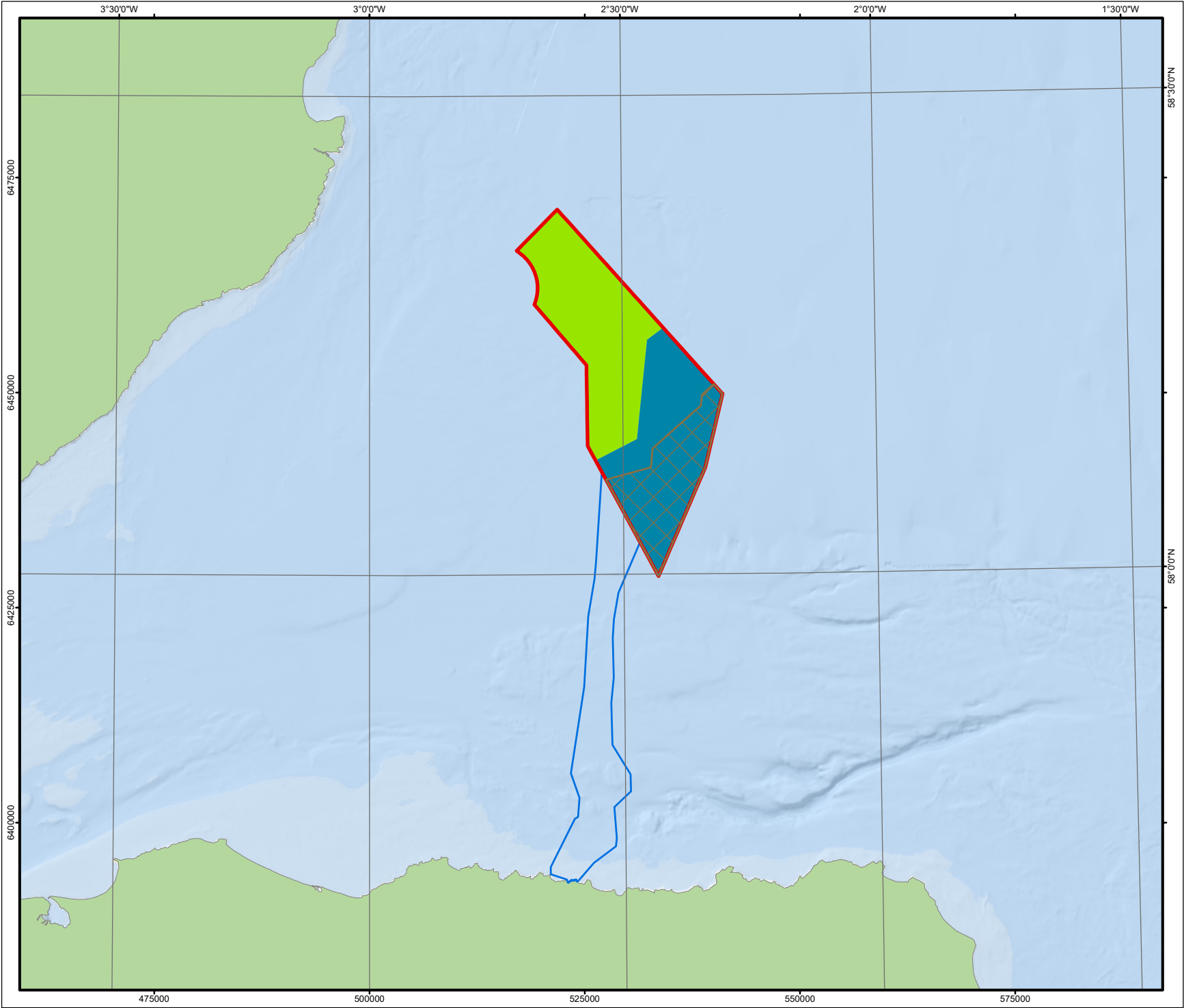
Acronyms and Abbreviations

BDMPS	Biologically Defined Minimum Population Scales
CI	Confidence Interval
CRM	Collision Risk Modelling
DAS	Digital Aerial Survey
DE	Design Envelope
EIAR	Environmental Impact Assessment Report
HAT	Highest Astronomical Tide
JNCC	Joint Nature Conservation Committee
km	Kilometre
m	Metre
MLS	Most Likely Scenario
MSL	Mean Sea Level
MRSea	Marine Renewables Strategic Environmental Assessment
NAF	Nocturnal Activity Factor
OWF	Offshore Wind Farm
rpm	Revolutions Per Minute
sCRM	Stochastic Collision Risk Modelling
SD	Standard Deviation
SNCB	Statutory Nature Conservation Body
WCS	Worst-Case Scenario
WTG	Wind Turbine Generator

1 Introduction

- 1.1.1.1 This appendix provides background information and methodology of the collision risk modelling (CRM) scenarios carried out for the Proposed Development (Offshore), located in the Moray Firth, Scotland. This includes the Caledonia Offshore Wind Farm (OWF) (i.e., Array Area) and the Caledonia Offshore Export Cable Corridor (OECC) seaward of Mean High-Water Springs (MHWS). Results are presented for five seabird species identified as requiring consideration of potential collision risk from the Proposed Development (Offshore).
- 1.1.1.2 The Proposed Development (Offshore) will be developed in two phases (see Volume 1, Chapter 5: Proposed Development Phasing), referred to as Caledonia North and Caledonia South (see Figure 1-1). The Array Areas of the two phases are referred to as the Caledonia North Site and the Caledonia South Site. It is assumed that construction of the two application areas could be progressed in either order (e.g., Caledonia North constructed in the first phase, then Caledonia South in the second phase, or vice-versa) or at the same time. This has been assessed within a single Environmental Impact Assessment Report (EIAR) covering the Proposed Development (Offshore) as well as Caledonia North and Caledonia South alone.
- 1.1.1.3 CRM has been carried out separately for Caledonia North, Caledonia South and the Caledonia OWF (i.e., the Caledonia North Site and Caledonia South Site combined) to estimate the potential risk of collision to ornithological features for each spatial extent. The predicted mortalities for Caledonia North, Caledonia South and the Caledonia OWF have been presented as a worst-case scenario (WCS); i.e., the largest number of the smallest turbines considered within the Design Envelope (DE) for the Proposed Development (Offshore). The Caledonia OWF WCS is based on the maximum number of turbines (bottom-fixed and floating) that could be constructed, rather than an addition of Caledonia North and Caledonia South, as to base the design on this assumption would overestimate any potential impacts (see Volume 1, Chapter 6: Site Selection and Alternatives). The WCS for the Caledonia OWF is being progressed within the cumulative and in-combination assessments. For more information on the DE, refer to Volume 1, Chapter 3: Proposed Development Description (Offshore) and Volume 1, Chapter 5: Proposed Development Phasing.
- 1.1.1.4 The CRM was run following the NatureScot (2023¹) guidance. Where the guidance did not cover the scenarios or receptors included in the CRM assessment, appropriate parameters were agreed during consultation with NatureScot. Throughout this appendix, this approach has been referred to as the 'Guidance Approach'. An alternative approach to assessment for gannet has also been presented when using an alternative method for the inclusion of macro-avoidance rates. This has been referred to as the 'Applicant Approach'. The use of presenting an 'Applicant Approach' along with a 'Guidance

Approach' has been agreed in consultation with NatureScot. The Applicant Approach allows Caledonia Offshore Wind Farm Limited (i.e., the Applicant) to include models incorporating site-specific alterations to the Guidance Approach based upon other relevant evidence, the parameters used within other OWF projects, and other expert advice from statisticians and ornithologists.



Caledonia OWF

Caledonia North Array Area

Caledonia South Array Area

Proposed Floating Area

Offshore Export Cable Corridor

Service Layer Credits: © OpenStreetMap (and) contributors, CC-BY-SA, Esri, Garmin, GEBCO, NOAA NGDC, and other contributors
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km

01	19/09/2024	Approved	EV	BB	DH
REV	DATE	DOC STATUS	ORIGIN	REVIEW	APP

CALEDONIA

Offshore Wind Farm

GoBe

APEM Group

CONTRACTOR DRAWING NO

UKCAL1_GO_WNF_ORN_MAP_00151

CONTRACTOR REV

01

COORDINATE PARAMETERS

WGS 84 / UTM zone 30N (EPSG: 32630)

DRAWING TITLE

Figure 1-1: Location of the Caledonia OWF, Caledonia North and Caledonia South, and Offshore Export Cable Corridor

STATUS

Approved

SCALE

1:600,000

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N/A

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N/A

2 Methodology

2.1 Guidance and Models

- 2.1.1.1 CRM was undertaken using the web-browser version of the Marine Science Scotland Stochastic Collision Risk Model Shiny Application ("sCRM App"; Caneco, 2022²), as recommended by NatureScot (2023¹). All CRM was run between 26 January 2024 and 13 August 2024 using V0.1.1 and V0.1.2.
- 2.1.1.2 The sCRM App was run stochastically and deterministically using the 'basic' Band (2012³) model Option 2, using the Johnston *et al.* (2014a⁴; 2014b⁵) generic flight height distribution dataset as recommended by NatureScot (2023¹). The basic CRM assumes flight height distribution is uniform across the rotor swept height. The NatureScot (2023¹) guidance requests the use of Option 3 'extended' Band (2012³) model. However, the use of the Option 3 is no longer required, as highlighted within the Morven OWF Scoping Opinion (Marine Directorate, 2023⁶), which stated that the guidance will subsequently be updated in due course.
- 2.1.1.3 For the stochastic model, uncertainty in each relevant parameter was incorporated into the model using distributions set by standard deviations (SD). A total of 1,000 simulations were run stochastically for each scenario.

2.2 Species for Inclusion in Modelling

- 2.2.1.1 The list of seabird species taken forward for CRM have been included due to their densities observed in the Digital Aerial Surveys (DAS) (see Section 2.3) and the susceptibility to collision due to their flight height distribution/ behaviours (Bradbury *et al.*, 2014⁷), as discussed within the EIAR chapters (Volumes 2, 3 and 4, Chapter 6: Offshore Ornithology). These species were discussed and agreed through consultation with NatureScot:

- Kittiwake (*Rissa tridactyla*);
- Great black-backed gull (*Larus marinus*);
- Herring gull (*Larus argentatus*);
- Great skua (*Stercorarius skua*); and
- Gannet (*Morus bassanus*).

2.3 Density of Birds in Flight

- 2.3.1.1 The data used to identify species requiring CRM was collected over a 24-month (DAS) programme within the Caledonia OWF plus 4km buffer (May 2021 to April 2023; see Volume 7, Appendix 19 for figure of surveys and relevant buffers). The analysis of the survey data was undertaken for the Caledonia OWF, as well as Caledonia North and Caledonia South separately.

Density and abundance estimates of bird species were calculated using both design-based (Volume 7B, Appendix 6-1: Offshore Ornithology Baseline Characterisation Report) and model-based (Volume 7B, Appendix 6-1, Annex 15: MRSea Method Statement) approaches. The CRM has been run using the design-based density estimates only. The densities recorded within the 24-months of surveys are presented, by survey, in Table 2-1 to Table 2-3.

- 2.3.1.2 Monthly mean density estimates (design-based) of birds in flight within the Caledonia OWF, and their associated SD (Table 2-4 to Table 2-6), were determined using the 24 months of DAS data. The method for calculating SD is described below.
- 2.3.1.3 One SD is estimated to be about 25% of the 95% confidence limits, consistent with a normal distribution. While the actual distribution may not be perfectly normal and could be skewed, the method below offers a reasonable approximation for SD, especially with large sample sizes. The approximation is necessary due to the complexities of accounting for uncertainty in apportioning unidentified birds to species, which depends on species abundances and sometimes requires broader or alternative data. Thus, this approach is considered the best available option.
- 2.3.1.4 SDs for mean densities were calculated based on 95% confidence intervals (CL) for each calendar month, using the following equation:
- $$1 \text{ SD} = (\text{Upper CI} - \text{Lower CI})/4$$
- 2.3.1.5 Following NatureScot (2023¹) guidance, when running stochastic CRM, the mean densities and SDs were input into the sCRM app using the “truncated normal distribution” option. Densities are provided for Caledonia North, Caledonia South and the Caledonia OWF to assess all potential scenarios in line with the two consent applications (see Section 1). Birds not identified to species level have been apportioned appropriately (Volume 7B, Appendix 6-1: Offshore Ornithology Baseline Characterisation Report) and are included in the mean density estimates presented in Table 2-4 to Table 2-6.

Table 2-1: Monthly densities (birds/km²) of flying birds for 24-months of surveys for five species included in the assessment of potential collision risk within the Caledonia North Site.

Survey Date	Species				
	Kittiwake	Great black-backed gull	Herring gull	Great skua	Gannet
15/05/2021	1.18	-	-	0.03	-
10/06/2021	0.57	-	-	0.03	0.3
02/07/2021	0.57	-	-	0.03	0.08
01/08/2021	0.58	-	-	0.08	0.24
14/09/2021	0.13	0.11	0.03	-	0.37
04/10/2021	0.43	-	0.03	-	0.59
15/11/2021	1.63	0.16	-	-	0.05
06/12/2021	0.13	0.05	0.05	-	0.05
09/01/2022	0.13	0.08	-	-	-
13/02/2022	0.10	0.1	-	-	-
03/03/2022	0.22	-	-	-	-
26/04/2022	0.34	-	-	-	0.05
14/05/2022	1.75	-	-	-	-
05/06/2022	2.32	-	-	-	0.31
05/07/2022	0.75	-	-	-	0.13
10/08/2022	0.76	-	-	-	0.03
11/09/2022	0.26	0.05	-	-	0.29
14/10/2022	0.03	0.05	-	-	0.11
25/11/2022	0.11	0.08	-	-	-
17/12/2022	-	0.03	0.03	-	-
09/01/2023	0.03	0.21	-	-	-
13/02/2023	0.13	-	-	-	0.03
10/03/2023	0.03	-	-	-	-
04/04/2023	0.18	-	-	-	-

Table 2-2: Monthly densities (birds/km²) of flying birds for 24-months of surveys for five species included in the assessment of potential collision risk within the Caledonia South Site.

Survey Date	Species				
	Kittiwake	Great black-backed gull	Herring gull	Great skua	Gannet
15/05/2021	0.47	-	-	-	0.03
10/06/2021	1.52	-	-	-	0.28
02/07/2021	3.18	-	-	-	0.09
01/08/2021	0.99	-	-	0.03	0.25
14/09/2021	0.17	-	-	-	0.17
04/10/2021	0.42	-	-	-	0.28
15/11/2021	0.22	0.3	0.03	-	0.14
06/12/2021	0.11	0.06	-	-	-
09/01/2022	0.06	0.08	0.03	-	0.03
13/02/2022	0.08	0.13	0.02	-	-
03/03/2022	0.08	-	-	-	0.02
26/04/2022	0.6	-	-	-	0.03
14/05/2022	0.77	-	-	-	0.03
05/06/2022	6.39	-	-	-	2.12
05/07/2022	3.07	-	-	0.03	0.28
10/08/2022	1.28	-	-	-	0.14
11/09/2022	0.25	-	-	-	0.56
14/10/2022	0.14	-	-	-	0.11
25/11/2022	0.06	0.04	0.08	-	0.03
17/12/2022	0.07	-	0.07	-	0.03
09/01/2023	0.03	0.14	-	-	0.03
13/02/2023	0.11	0.08	0.03	-	-
10/03/2023	-	-	-	-	-
04/04/2023	1.97	-	-	-	0.16

Table 2-3: Monthly densities (birds/km²) of flying birds for 24-months of surveys for five species included in the assessment of potential collision risk within the Caledonia OWF.

Survey Date	Species				
	Kittiwake	Great black-backed gull	Herring gull	Great skua	Gannet
15/05/2021	0.83	-	-	0.01	0.01
10/06/2021	1.04	-	-	0.01	0.29
02/07/2021	1.77	-	-	0.01	0.08
01/08/2021	0.79	-	-	0.05	0.24
14/09/2021	0.15	0.05	0.01	-	0.27
04/10/2021	0.42	-	0.01	-	0.44
15/11/2021	0.94	0.23	0.02	-	0.1
06/12/2021	0.12	0.05	0.03	-	0.03
09/01/2022	0.1	0.08	0.01	-	0.01
13/02/2022	0.09	0.11	0.01	-	-
03/03/2022	0.15	-	-	-	0.01
26/04/2022	0.47	-	-	-	0.04
14/05/2022	1.27	-	-	-	0.01
05/06/2022	4.31	-	-	-	1.2
05/07/2022	1.9	-	-	0.01	0.21
10/08/2022	1.02	-	-	-	0.08
11/09/2022	0.26	0.03	-	-	0.42
14/10/2022	0.08	0.03	-	-	0.11
25/11/2022	0.08	0.07	0.03	-	0.01
17/12/2022	0.03	0.02	0.05	-	0.01
09/01/2023	0.03	0.18	-	-	0.01
13/02/2023	0.12	0.04	0.01	-	0.01
10/03/2023	0.01	-	-	-	-
04/04/2023	1.06	-	-	-	0.08

Table 2-4: Monthly mean densities (birds/km²) and SD of flying birds in the Caledonia North Site for five species included in the assessment of potential collision risk.

Species	Value	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Kittiwake	Mean	0.08	0.12	0.13	0.26	1.47	1.45	0.66	0.67	0.20	0.23	0.87	0.13
	SD	0.04	0.06	0.06	0.09	0.49	0.70	0.20	0.18	0.11	0.10	0.24	0.07
Great black-backed gull	Mean	0.15	0.10	0	0	0	0	0	0	0.08	0.05	0.12	0.04
	SD	0.05	0.04	0	0	0	0	0	0	0.05	0.02	0.05	0.03
Herring gull	Mean	0	0	0	0	0	0	0	0	0.03	0.03	0	0.04
	SD	0	0	0	0	0	0	0	0	0.02	0.02	0	0.02
Great skua	Mean	0	0	0	0	0.03	0.03	0.03	0.08	0	0	0	0
	SD	0	0	0	0	0.02	0.02	0.02	0.04	0	0	0	0
Gannet	Mean	0	0.03	0	0.05	0	0.31	0.11	0.14	0.33	0.35	0.05	0.05
	SD	0	0.02	0	0.03	0	0.12	0.07	0.06	0.14	0.12	0.04	0.03

Table 2-5: Monthly mean densities (birds/km²) and SD of flying birds in the Caledonia South Site for five species included in the assessment of potential collision risk.

Species	Value	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Kittiwake	Mean	0.05	0.10	0.08	1.29	0.62	3.96	3.13	1.14	0.21	0.28	0.14	0.09
	SD	0.03	0.04	0.03	0.68	0.20	1.45	1.35	0.34	0.07	0.10	0.08	0.05
Great black-backed gull	Mean	0.11	0.11	0	0	0	0	0	0	0	0	0.17	0.06
	SD	0.05	0.05	0	0	0	0	0	0	0	0	0.08	0.03
Herring gull	Mean	0.03	0.03	0	0	0	0	0	0	0	0	0.06	0.07
	SD	0.02	0.02	0	0	0	0	0	0	0	0	0.04	0.05
Great skua	Mean	0	0	0	0	0	0	0.03	0.03	0	0	0	0
	SD	0	0	0	0	0	0	0.02	0.02	0	0	0	0
Gannet	Mean	0.03	0	0.02	0.10	0.03	1.20	0.19	0.20	0.37	0.20	0.09	0.03
	SD	0.02	0	0.02	0.06	0.02	0.70	0.07	0.05	0.10	0.06	0.04	0.02

Table 2-6: Monthly mean densities (birds/km²) and SD of flying birds in the Caledonia OWF for five species included in the assessment of potential collision risk.

Species	Value	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Kittiwake	Mean	0.07	0.11	0.08	0.77	1.05	2.68	1.84	0.91	0.21	0.25	0.51	0.08
	SD	0.03	0.05	0.03	0.36	0.30	1.02	0.68	0.18	0.06	0.07	0.16	0.03
Great black-backed gull	Mean	0.13	0.08	0	0	0	0	0	0	0.04	0.03	0.15	0.04
	SD	0.05	0.04	0	0	0	0	0	0	0.03	0.02	0.06	0.02
Herring gull	Mean	0.01	0.01	0	0	0	0	0	0	0.01	0.01	0.03	0.04
	SD	0.01	0.01	0	0	0	0	0	0	0.01	0.01	0.02	0.03
Great skua	Mean	0	0	0	0	0.01	0.01	0.01	0.05	0	0	0	0
	SD	0	0	0	0	0.01	0.01	0.01	0.03	0	0	0	0
Gannet	Mean	0.01	0.01	0.01	0.06	0.01	0.75	0.15	0.16	0.35	0.28	0.06	0.02
	SD	0.01	0.01	0.01	0.04	0.01	0.38	0.05	0.04	0.10	0.07	0.02	0.02

2.4 Avoidance Rates

- 2.4.1.1 The advice provided within the Scoping Opinion (Volume 7, Appendix 3) for the Proposed Development (Offshore) advised that the assessment should use published avoidance rates from Joint Statutory Nature Conservation Body (SNCB, 2014⁸) guidance. However, these avoidance rates have since been superseded by those published by , Ozsanlev-Harris *et al.* (2023⁹) (Table 2-7), which are presented in NatureScot, (2023)¹ as interim avoidance rates. These avoidance rates have therefore been used in the assessment.
- 2.4.1.2 It should be noted that updated avoidance rates were presented in Joint Nature Conservation Committee (JNCC) guidance published in August 2024 (JNCC, 2024¹⁰). However, these rates could not be used in the assessment because the assessment had been completed prior to the publication of the new guidance.

Table 2-7: Avoidance rates used for basic deterministic and stochastic CRM.

Species	Rate Name	Deterministic Avoidance Rate	Stochastic Avoidance Rate (SD)
Kittiwake	All gulls	0.992	0.993 (±0.0003)
Great black-backed gull	Large gulls	0.994	0.994 (±0.0004)
Herring gull	Large gulls	0.994	0.994 (±0.0004)
Great skua	All gulls	0.992	0.993 (±0.0003)
Gannet	All gulls	0.992	0.993 (±0.0003)
Note, associated SD used for stochastic CRM provided in brackets.			

2.5 Biological Parameters

- 2.5.1.1 The physical and behavioural biological input parameters provided in the latest NatureScot (2023¹) guidance was used to inform the CRM and is presented in Table 2-8. Great skua parameters were not presented in the NatureScot (2023¹) guidance and, therefore, were agreed with NatureScot through consultation.
- 2.5.1.2 The deterministic Nocturnal Activity Factor (NAF) rates are based on the NatureScot (2023¹) guidance. For gull species, the stochastic NAF was determined based on the central value of the recommended deterministic NAF, with the range (0.25 to 0.50) being captured within the 95% confidence intervals (CIs). These values were presented during consultation with NatureScot in May 2023.

- 2.5.1.3 It should be noted that updated biological parameters were presented in JNCC guidance published in August 2024 (JNCC, 2024¹⁰). However, the updated parameters could not be used in the assessment because the assessment had been completed prior to the publication of the new guidance.

Table 2-8: Species-specific biometric parameters used for deterministic and stochastic CRM.

Species	Body Length (m)	Wingspan (m)	NAF (%)		Flight Speed (m/s)	Flight Type
			Deterministic	Stochastic		
NatureScot Guidance Parameters						
Kittiwake	0.39 (0.005)	1.08 (0.0625)	0.25 and 0.50	0.375 (0.0637)	13.1 (0.4)	Flapping
Great black-backed gull	0.71 (0.035)	1.58 (0.0375)	0.25 and 0.50	0.375 (0.0637)	13.7 (1.2)	Flapping
Herring gull	0.60 (0.0225)	1.44 (0.03)	0.25 and 0.50	0.375 (0.0637)	12.8 (1.8)	Flapping
Gannet	0.94 (0.0325)	1.72 (0.0375)	0.08	0.08 (0.1)	14.9 (0)	Gliding
Additional Species Parameters						
Great skua	0.56 (0)*	1.36* (0)	0**	0 (0)**	14.9 (0)***	Flapping
Note, associated SDs used for stochastic CRM are provided in brackets.						
* Snow and Perrins (1998 ¹¹); ** Garthe and Hüppop (2004 ¹²); R.W. Furness, <i>pers. comm</i> (June 2023); *** Pennycuik (1997 ¹³).						

2.6 Turbine Parameters

- 2.6.1.1 The WTG and OWF (Array Areas) input parameters used within the CRM are presented below, which have been separated for Caledonia North (Table 2-9) and Caledonia South (Table 2-10). The Caledonia OWF (i.e., the Caledonia North Site and Caledonia South Site combined) parameters are presented within Table 2-11, which provides the maximum potential construction design. It should be noted that the WCS for the Caledonia OWF is not the sum of the WCS for Caledonia North and Caledonia South; the deployment of the WCS for both Caledonia North and Caledonia South is not possible under the WCS for the Caledonia OWF.
- 2.6.1.2 Within NatureScot (2023¹), the presentation of CRM for a Most Likely Scenario (MLS) as well as the CRM for the WCS is recommended. Due to external factors beyond the control of the Applicant, it has not been possible to define

a MLS. The assessment, therefore, focuses on CRM calculated using the WCS only.

- 2.6.1.3 Whilst the design for Caledonia North consists entirely of bottom-fixed foundation WTGs, the design for Caledonia South (and thus the Caledonia OWF) includes an option for floating WTGs (see Volume 1, Chapter 3: Proposed Development Description (Offshore)).
- 2.6.1.4 Two options have been presented for Caledonia North:
- 47 bottom-fixed turbines with the largest parameters of the DE; and
 - 77 bottom-fixed turbines with the smallest parameters of the DE.
- 2.6.1.5 Three options are presented for Caledonia South:
- 24 bottom-fixed turbines with the largest parameters of the DE and 29 floating turbines with the largest floating turbine parameters within the DE;
 - 47 bottom-fixed turbines with the largest parameters of the DE; and
 - 39 bottom-fixed turbines with the smallest parameters of the DE and 39 floating turbines with the smallest floating turbine parameters within the DE.
- 2.6.1.6 Three options are presented for Caledonia OWF:
- 140 bottom-fixed turbines with the smallest parameters of the DE;
 - 62 bottom-fixed turbines with the largest parameters of the DE and 29 floating turbines with the largest floating turbine parameters within the DE; and
 - 84 bottom-fixed turbines with the largest parameters of the DE.
- 2.6.1.7 Table 2-12 provides wind resource and turbine downtime parameters relevant for all scenarios: bottom-fixed, floating and combination. The air gap presented is relative to Highest Astronomical Tide (HAT). The air gap used for the bottom-fixed turbine was 32.81m (35m relative to Mean Sea Level (MSL)) within the CRM.
- 2.6.1.8 The SD for average rotation speed and average pitch were set to 0 due to lack of data. However, since it is known that the outputs of CRM are relatively insensitive to these parameters (Chamberlain *et al.*, 2006¹⁴), it is considered that the sensitivity of the model to their SDs is lower still. The exclusion of these parameters therefore does not substantially impact the outcome of the modelling exercise.

Table 2-9: OWF and WTG parameters used for CRM for Caledonia North.

Parameter	WTG 1 (N)	WTG 2 (N)
Number of WTGs	47	77
Latitude (degrees)	58.26	58.26
Width (km)	29.5	29.5
Tidal offset (m)	2.19	2.19
Number of blades	3	3
Rotor radius (m)	155	118
Air gap relative to HAT (m)	35	35
Blade width (m)	7.5	7.5
Average pitch (°)	2	2
Average pitch SD (°)	No data (assumed 0)	No data (assumed 0)
Rotation speed (rpm)	8.4	8.4
Rotation speed SD (rpm)	No data (assumed 0)	No data (assumed 0)

Table 2-10: OWF and WTG parameters used for CRM for Caledonia South.

Parameter	WTG 1 (S)		WTG 2 (S)	WTG 3 (S)	
	Fixed	Floating	Fixed	Fixed	Floating
Number of WTGs	24	29	47	39	39
Latitude (degrees)	58.13	58.13	58.13	58.13	58.13
Width (km)	28.90	28.90	28.90	28.90	28.90
Tidal offset (m)	2.19	0	2.19	2.19	0
Number of blades	3	3	3	3	3
Rotor radius (m)	155	145	155	118	118
Air gap relative to HAT (m)	32.81	35	32.81	32.81	35
Blade width (m)	7.50	7.50	7.50	7.50	7.50
Average pitch (°)	2	2	2	2	2
Average pitch SD (°)	No data (assumed 0)	No data (assumed 0)	No data (assumed 0)	No data (assumed 0)	No data (assumed 0)
Rotation speed (rpm)	8.4	8.4	8.4	8.4	8.4
Rotation speed SD (rpm)	No data (assumed 0)	No data (assumed 0)	No data (assumed 0)	No data (assumed 0)	No data (assumed 0)

Table 2-11: OWF and WTG parameters used for CRM for the Caledonia OWF.

Parameter	WTG 1	WTG 2		WTG 3
	Fixed	Fixed	Floating	Fixed
Number of WTGs	140	62	29	84
Latitude (degrees)	58.19	58.19	58.19	58.19
Width (km)	44.0	44.0	44.0	44.0
Tidal offset (m)	2.19	2.19	0	2.19
Number of blades	3	3	3	3
Rotor radius (m)	118	155	145	155
Air gap relative to HAT (m)	32.81	32.81	35	32.81
Blade width (m)	7.50	7.50	7.50	7.50
Average pitch (°)	2	2	2	2
Average pitch SD (°)	No data (assumed 0)	No data (assumed 0)	No data (assumed 0)	No data (assumed 0)
Rotation speed (rpm)	8.4	8.4	8.4	8.4
Rotation speed SD (rpm)	No data (assumed 0)	No data (assumed 0)	No data (assumed 0)	No data (assumed 0)

Table 2-12: Operational parameters used within the CRM for bottom-fixed and floating turbines.

Month	Wind Availability (%)	Mean Downtime (%)	SD Downtime (%)
January	97.90	2.10	1.37
February	97.18	2.82	2.31
March	96.33	3.67	2.39
April	95.64	4.36	2.31
May	93.71	6.29	2.85
June	92.83	7.17	3.07
July	91.66	8.34	3.64
August	92.81	7.19	3.37
September	95.00	5.00	2.78
October	96.66	3.34	1.96
November	98.30	1.70	1.14
December	97.80	2.20	2.38

2.7 Seasonal Considerations

- 2.7.1.1 The CRM results are presented principally using seasonal definitions as per NatureScot (2020¹⁵) (Table 2-13). For seasons that begin/end within the middle of a month, the estimated collision mortalities were split between the two seasons. For applicable species, CRM results for the non-breeding season have also been presented using the defined seasons in Furness (2015¹⁶) for kittiwake, great skua and gannet, modified to align with the NatureScot breeding season periods (Table 2-14).
- 2.7.1.2 The CRM results are also presented by month in Volume 7B, Appendix 6-3, Annexes 1, 2 and 3 for the Caledonia OWF, Caledonia North and Caledonia South respectively.

Table 2-13: Defined seasons in the Scottish Marine Environment (NatureScot, 2020¹⁵).

Species	Breeding Season	Post-breeding Season	Non-breeding Season	Pre-breeding Season
Kittiwake	Mid-April to August	-	September to Early April	Early April
Great black-backed gull	April to August	-	September to March	March
Herring gull	April to August	-	September to March	March
Great skua	Mid-April to Mid-September	-	Mid-September to Mid-April	Early April
Gannet	Mid-March to September	-	October to Early-March	Mid-February to Mid-March
Note, time periods in bold are those used in the assessment.				

Table 2-14: Non-breeding season BDMPS periods based on Furness (2015¹⁶) used in the apportionment of species to specific designated populations.

Species	NatureScot Breeding Season	Autumn Migration	Winter Period	Spring Migration
Kittiwake	Mid-April to August	September to December (August to December)	-	January to Mid-April (January to April)
Great skua	Mid-April to Mid-September	Mid-September to October (August to October)	November to February	March to Mid-April (March to April)
Gannet	Mid-March to September	October to November (September to November)	-	December to Mid-March (December to March)
Note, seasonal definitions have been modified to align with the NatureScot breeding season periods (see Table 2-13), with the original definitions as per Furness (2015 ¹⁶) provided in parentheses where different. Species and seasonal definitions used for the apportioning assessments are in bold.				

2.8 Collision and Distribution Impacts

2.8.1 Overview

- 2.8.1.1 Gannet was assessed for both distributional responses (Volume 7B, Appendix 6-2: Offshore Ornithology Distributional Responses Technical Report) and collision risk. The suggestion within NatureScot (2023¹) is to use an additive approach (i.e., total predicted annual mortality = total predicted collision mortality + total predicted distributional responses mortality) (to note, NatureScot advice has been updated (see Section 2.8.2). However, this approach does not consider that birds that have been displaced from the OWF are not at risk from collision. Such an approach will therefore lead to the overestimation of the combined impact of collision and distributional responses.
- 2.8.1.2 To avoid this overestimation, macro-avoidance rate has been applied to densities used within the CRM, by adding a “correction” step (Pavat *et al.*, 2023¹⁷). As per the interim advice on updated CRM parameters (Joint SNCB, 2022¹⁸), it is recommended that the density of gannets in flight is reduced by 70% when conducting CRM.

2.8.2 Guidance Approach

- 2.8.2.1 As agreed in consultation, a macro-avoidance rate of 70% has been applied during the non-breeding season (October – mid-March). During the breeding season (mid-March – September), the monthly in-flight densities have not been adjusted for macro-avoidance. As March is both within the breeding and non-breeding season, the predicted impacts have been split between both defined seasons. The March breeding season predicted mortalities was not adjusted for macro-avoidance, however, the predicted mortalities associated within the non-breeding season have been adjusted accordingly.

2.8.3 Applicant Approach

The Applicant Approach has also been presented, with the macro-avoidance rate applied to the predicted mortalities in all months.

3 Results

3.1 Overview

3.1.1.1 The outputs from the CRM assessment for each of the five seabird species by biologically relevant season are presented in this section, as follows:

- Kittiwake (Section 3.2);
- Great black-backed gull (Section 3.3);
- Herring gull (Section 3.4);
- Great skua (Section 3.5); and
- Gannet (Sections 3.6 and 3.7).

3.1.1.2 The 95% CIs are included for the stochastic CRM outputs and provide an indication of the level of variation around the mean collision estimates. The estimated monthly collisions for each species within the Caledonia OWF, Caledonia North and Caledonia South are presented within:

- Volume 7B, Appendix 6-3, Annex 1: Offshore Ornithology Collision Risk Modelling Results (Caledonia OWF);
- Volume 7B, Appendix 6-3, Annex 2: Offshore Ornithology Collision Risk Modelling Results (Caledonia North); and
- Volume 7B, Appendix 6-3, Annex 3: Offshore Ornithology Collision Risk Modelling Results (Caledonia South).

3.2 Kittiwake

3.2.1 Overview

3.2.1.1 The CRM results for kittiwake are presented below, using two WTG scenarios for Caledonia North (Table 2-9), three WTG scenarios for Caledonia South (Table 2-10), and three WTG scenarios for Caledonia OWF (Table 2-11). The seasonal definitions are those presented within the NatureScot (2020¹⁵) guidance and Furness (2015¹⁶) as detailed in Table 2-13 and Table 2-14.

3.2.2 Caledonia North

3.2.2.1 The estimated mean seasonal collisions for kittiwake within the Caledonia North Site are presented below for two WTG scenarios (WTG 1 (N) and WTG 2 (N)) as described in Table 2-9.

NatureScot Seasons

Table 3-1: Summary of estimated mean seasonal collisions (NatureScot seasons) for kittiwake for two WTG scenarios (WTG 1 (N) and WTG 2 (N)) for deterministic Band Option 2 using 25% and 50% Nocturnal Activity Factors (NAF).

Scenario	NAF (%)	Breeding Season Total Collision	Non-breeding Season Total Collision	Annual Total
WTG 1 (N)	25	14.28	4.63	18.91
	50	15.61	5.93	21.54
WTG 2 (N)	25	21.51	6.98	28.49
	50	23.52	8.94	32.46

Table 3-2: Summary of estimated mean seasonal collisions (NatureScot seasons) for kittiwake for two WTG scenarios (WTG 1 (N) and WTG 2 (N)) for stochastic Band Option 2.

Scenario	Breeding Season Total Collision	Non-breeding Season Total Collision	Annual Total
WTG 1 (N)	13.06 (4.01 – 24.21)	4.62 (1.40 – 9.02)	17.67 (5.41 – 33.23)
WTG 2 (N)	19.75 (5.80 – 36.50)	6.94 (1.92 – 13.29)	26.69 (7.72 – 49.79)
Note, 95% CI shown in brackets.			

BDMPS Seasons

Table 3-3: Summary of estimated mean seasonal collisions (BDMPS seasons) for kittiwake for two WTG scenarios (WTG 1 (N) and WTG 2 (N)) for deterministic Band Option 2 using 25% and 50% Nocturnal Activity Factors (NAF).

Scenario	NAF (%)	Breeding Season Total Collision	Autumn Migration Total Collision	Spring Migration Total Collision	Annual Total
WTG 1 (N)	25	14.28	3.43	1.21	18.91
	50	15.61	4.45	1.48	21.54
WTG 2 (N)	25	21.51	5.16	1.82	28.49
	50	23.52	6.71	2.23	32.46

Table 3-4: Summary of estimated mean seasonal collisions (BDMPS seasons) for kittiwake for two WTG scenarios (WTG 1 (N) and WTG 2 (N)) for stochastic Band Option 2.

Scenario	Breeding Season Total Collision	Autumn Migration Total Collision	Spring Migration Total Collision	Annual Total
WTG 1 (N)	13.06 (4.01 – 24.21)	3.43 (1.16 – 6.63)	1.18 (0.24 – 2.39)	17.67 (5.41 – 33.23)
WTG 2 (N)	19.75 (5.80 – 36.50)	5.16 (1.57 – 9.72)	1.77 (0.35 – 3.57)	26.69 (7.72 – 49.79)
Note, 95% CIs shown in brackets.				

3.2.3 Caledonia South

3.2.3.1 The estimated mean seasonal collisions for kittiwake within the Caledonia South Site are presented below for three WTG scenarios (WTG 1 (S), WTG 2 (S) and WTG 3 (S)) as described in Table 2-10.

NatureScot Seasons

Table 3-5: Summary of estimated mean seasonal collisions (NatureScot seasons) for kittiwake for three WTG scenarios (WTG 1 (S), WTG 2 (S) and WTG 3 (S)) for deterministic Band Option 2 using 25% and 50% Nocturnal Activity Factors (NAF).

Scenario	NAF (%)	Breeding Season Total Collision	Non-breeding Season Total Collision	Annual Total
WTG 1 (S)	25	34.30	4.84	39.14
	50	37.39	5.84	43.23
WTG 2 (S)	25	30.80	4.34	35.14
	50	33.57	5.25	38.82
WTG 3 (S)	25	47.01	6.63	53.64
	50	51.24	8.01	59.25

Table 3-6: Summary of estimated mean seasonal collisions (NatureScot seasons) for kittiwake for three WTG scenarios (WTG 1 (S), WTG 2 (S) and WTG 3 (S)) for stochastic Band Option 2.

Scenario	Breeding Season Total Collision	Non-breeding Season Total Collision	Annual Total
WTG 1 (S)	31.05 (8.26 – 59.47)	4.69 (0.93 - 9.54)	35.75 (9.19 – 69.01)
WTG 2 (S)	28.21 (7.30 - 55.18)	4.24 (0.85 - 8.51)	32.45 (8.15 - 63.69)
WTG 3 (S)	42.94 (11.74 - 81.93)	6.52 (1.34- 13.51)	49.46 (13.08- 95.44)
Note, 95% CIs shown in brackets.			

BDMPS Seasons

Table 3-7: Summary of estimated mean seasonal collisions (BDMPS seasons) for kittiwake for three WTG scenarios (WTG 1 (S), WTG 2 (S) and WTG 3 (S)) for deterministic Band Option 2 using 25% and 50% Nocturnal Activity Factors (NAF).

Scenario	NAF (%)	Breeding Season Total Collision	Autumn Migration Total Collision	Spring Migration Total Collision	Annual Total
WTG 1 (S)	25	34.30	2.04	2.80	39.14
	50	37.39	2.56	3.28	43.23
WTG 2 (S)	25	30.80	1.83	2.51	35.14
	50	33.57	2.30	2.94	38.82
WTG 3 (S)	25	47.01	2.80	3.83	53.64
	50	51.24	3.51	4.49	59.25

Table 3-8: Summary of estimated mean seasonal collisions (BDMPS seasons) for kittiwake for three WTG scenarios (WTG 1 (S), WTG 2 (S) and WTG 3 (S)) for stochastic Band Option 2.

Scenario	Breeding Season Total Collision	Autumn Migration Total Collision	Spring Migration Total Collision	Annual Total
WTG 1 (S)	31.05 (8.26 – 59.47)	2.02 (0.54 – 3.91)	2.68 (0.38 – 5.63)	35.75 (9.19 – 69.01)
WTG 2 (S)	28.21 (7.30 – 55.18)	1.81 (0.51 – 3.52)	2.43 (0.34 – 4.99)	32.45 (8.15 – 63.69)
WTG 3 (S)	42.94 (11.74 – 81.93)	2.77 (0.68 – 5.50)	3.75 (0.66 – 8.01)	49.46 (13.08 – 95.44)
Note, 95% CIs shown in brackets.				

3.2.4 Caledonia OWF

3.2.4.1 The estimated mean seasonal collisions for kittiwake within the Caledonia OWF (i.e., the Caledonia North Site and Caledonia South Site) are presented below for three WTG scenarios (WTG 1, WTG 2 and WTG 3) as described in Table 2-11.

NatureScot Seasons

Table 3-9: Summary of estimated mean seasonal collisions (NatureScot seasons) for kittiwake for three WTG scenarios (WTG 1, WTG 2 and WTG 3) for deterministic Band Option 2 using 25% and 50% Nocturnal Activity Factors (NAF).

Scenario	NAF (%)	Breeding Season Total Collision	Non-breeding Season Total Collision	Annual Total
WTG 1	25	61.10	11.98	73.08
	50	66.67	14.90	81.57
WTG 2	25	42.87	8.40	51.28
	50	46.78	10.45	57.23
WTG 3	25	39.86	7.81	47.68
	50	43.49	9.72	53.21

Table 3-10: Summary of estimated mean seasonal collisions (NatureScot seasons) for kittiwake for three WTG scenarios (WTG 1, WTG 2 and WTG 3) for stochastic Band Option 2.

Scenario	Breeding Season Total Collision	Non-breeding Season Total Collision	Annual Total
WTG 1	55.27 (17.78 – 103.10)	11.74 (3.61 – 22.18)	67.01 (21.40 – 125.28)
WTG 2	39.16 (12.35 – 71.69)	8.18 (2.36 – 15.49)	47.34 (14.71 – 87.19)
WTG 3	36.69 (11.31 – 67.12)	7.69 (2.26 – 14.51)	44.38 (13.57 – 81.63)
Note, 95% CIs shown in brackets.			

BDMPS Seasons

Table 3-11: Summary of estimated mean seasonal collisions (BDMPS seasons) for kittiwake for three WTG scenarios (WTG 1, WTG 2 and WTG 3) for deterministic Band Option 2 using 25% and 50% Nocturnal Activity Factors (NAF).

Scenario	NAF (%)	Breeding Season Total Collision	Autumn Migration Total Collision	Spring Migration Total Collision	Annual Total
WTG 1	25	61.10	7.06	4.91	73.08
	50	66.67	9.05	5.85	81.57
WTG 2	25	42.87	4.96	3.45	51.28
	50	46.78	6.35	4.11	57.23
WTG 3	25	39.86	4.61	3.21	47.68
	50	43.49	5.90	3.82	53.21

Table 3-12: Summary of estimated mean seasonal collisions (BDMPS seasons) for kittiwake for three WTG scenarios (WTG 1, WTG 2 and WTG 3) for stochastic Band Option 2.

Scenario	Breeding Season Total Collision	Autumn Migration Total Collision	Spring Migration Total Collision	Annual Total
WTG 1	55.27 (17.78 – 103.10)	6.99 (2.53 – 12.50)	4.75 (1.09 – 9.68)	67.01 (21.40 – 125.28)
WTG 2	39.16 (12.35 – 71.69)	4.91 (1.78 – 8.87)	3.27 (0.58 – 6.62)	47.34 (14.71 – 87.19)
WTG 3	36.69 (11.31 – 67.12)	4.58 (1.67 – 8.18)	3.11 (0.59 – 6.33)	44.38 (13.57 – 81.63)
Note, 95% CIs shown in brackets.				

3.3 Great Black-Backed Gull

3.3.1 Overview

3.3.1.1 The CRM results for great black-backed gull are presented below, using two WTG scenarios for Caledonia North (Table 2-9), three WTG scenarios for Caledonia South (Table 2-10), and three WTG scenarios for Caledonia OWF (Table 2-11). The seasonal definitions are those presented within the NatureScot (2020¹⁵) guidance as detailed in Table 2-13.

3.3.2 Caledonia North

3.3.2.1 The estimated mean seasonal collisions for great black-backed gull within the Caledonia North Site are presented below for two WTG scenarios (WTG 1 (N) and WTG 2 (N)) as described in Table 2-9.

NatureScot Seasons

Table 3-13: Summary of estimated mean seasonal collisions (NatureScot seasons) for great black-backed gull for two WTG scenarios (WTG 1 (N) and WTG 2 (N)) for deterministic Band Option 2 using 25% and 50% Nocturnal Activity Factors (NAF).

Scenario	NAF (%)	Breeding Season Total Collision	Non-breeding Season Total Collision	Annual Total
WTG 1 (N)	25	0	4.77	4.77
	50	0	6.22	6.22
WTG 2 (N)	25	0	7.05	7.05
	50	0	9.18	9.18

Table 3-14: Summary of estimated mean seasonal collisions (NatureScot seasons) for great black-backed gull for two WTG scenarios (WTG 1 (N) and WTG 2 (N)) for stochastic Band Option 2.

Scenario	Breeding Season Total Collision	Non-breeding Season Total Collision	Annual Total
WTG 1 (N)	0	6.46 (1.50 – 13.58)	6.46 (1.50 – 13.58)
WTG 2 (N)	0	9.66 (2.17 – 20.75)	9.66 (2.17 – 20.75)
Note, 95% CIs shown in brackets.			

3.3.3 Caledonia South

3.3.3.1 The estimated mean seasonal collisions for great black-backed gull within the Caledonia South Site are presented below for three WTG scenarios (WTG 1 (S), WTG 2 (S) and WTG 3 (S)) as described in Table 2-10.

NatureScot Seasons

Table 3-15: Summary of estimated mean seasonal collisions (NatureScot seasons) for great black-backed gull for three WTG scenarios (WTG 1 (S), WTG 2 (S) and WTG 3 (S)) for deterministic Band Option 2 using 25% and 50% Nocturnal Activity Factors (NAF).

Scenario	NAF (%)	Breeding Season Total Collision	Non-breeding Season Total Collision	Annual Total
WTG 1 (S)	25	0	4.21	4.21
	50	0	5.63	5.63
WTG 2 (S)	25	0	3.79	3.79
	50	0	5.07	5.07
WTG 3 (S)	25	0	5.67	5.67
	50	0	7.58	7.58

Table 3-16: Summary of estimated mean seasonal collisions (NatureScot seasons) for great black-backed gull for three WTG scenarios (WTG 1 (S), WTG 2 (S) and WTG 3 (S)) for stochastic Band Option 2.

Scenario	Breeding Season Total Collision	Non-breeding Season Total Collision	Annual Total
WTG 1 (S)	0	5.75 (0.98 – 12.25)	5.75 (0.98 – 12.25)
WTG 2 (S)	0	5.18 (0.74 – 10.71)	5.18 (0.74 – 10.71)
WTG 3 (S)	0	7.72 (1.32 – 16.48)	7.72 (1.32 – 16.48)
Note, 95% CIs shown in brackets.			

3.3.4 Caledonia OWF

3.3.4.1 The estimated mean seasonal collisions for great black-backed gull within the Caledonia OWF (i.e., the Caledonia North Site and Caledonia South Site) are presented below for three WTG scenarios (WTG 1, WTG 2 and WTG 3) as described in Table 2-11.

NatureScot Seasons

Table 3-17: Summary of estimated mean seasonal collisions (NatureScot seasons) for great black-backed gull for three WTG scenarios (WTG 1, WTG 2 and WTG 3) for deterministic Band Option 2 using 25% and 50% Nocturnal Activity Factors (NAF).

Scenario	NAF (%)	Breeding Season Total Collision	Non-breeding Season Total Collision	Annual Total
WTG 1	25	0	10.96	10.96
	50	0	14.44	14.44
WTG 2	25	0	7.84	7.84
	50	0	10.32	10.32
WTG 3	25	0	7.30	7.30
	50	0	9.61	9.61

Table 3-18: Summary of estimated mean seasonal collisions (NatureScot seasons) for great black-backed gull for three WTG scenarios (WTG 1, WTG 2 and WTG 3) for stochastic Band Option 2.

Scenario	Breeding Season Total Collision	Non-breeding Season Total Collision	Annual Total
WTG 1	0 (0 - 0)	14.98 (2.87 - 32.81)	14.98 (2.87 - 32.81)
WTG 2	0 (0 - 0)	10.59 (1.98 - 22.10)	10.59 (1.98 - 22.10)
WTG 3	0 (0 - 0)	9.98 (1.86 - 20.99)	9.98 (1.86 - 20.99)
Note, 95% CIs shown in brackets.			

3.4 Herring Gull

3.4.1 Overview

- 3.4.1.1 The CRM results for herring gull are presented below, using two WTG scenarios for Caledonia North (Table 2-9), three WTG scenarios for Caledonia South (Table 2-10), and three WTG scenarios for Caledonia OWF (Table 2-11). The seasonal definitions are those presented within the NatureScot (2020¹⁵) guidance as detailed in Table 2-13.

3.4.2 Caledonia North

3.4.2.1 The estimated mean seasonal collisions for herring gull within the Caledonia North Site are presented below for two WTG scenarios (WTG 1 (N) and WTG 2 (N)) as described in Table 2-9.

NatureScot Seasons

Table 3-19: Summary of estimated mean seasonal collisions (NatureScot seasons) for herring gull for two WTG scenarios (WTG 1 (N) and WTG 2 (N)) for deterministic Band Option 2 using 25% and 50% Nocturnal Activity Factors (NAF).

Scenario	NAF (%)	Breeding Season Total Collision	Non-breeding Season Total Collision	Annual Total
WTG 1 (N)	25	0	0.80	0.80
	50	0	1.01	1.01
WTG 2 (N)	25	0	1.18	1.18
	50	0	1.51	1.51

Table 3-20: Summary of estimated mean seasonal collisions (NatureScot seasons) for herring gull for two WTG scenarios (WTG 1 (N) and WTG 2 (N)) for stochastic Band Option 2.

Scenario	Breeding Season Total Collision	Non-breeding Season Total Collision	Annual Total
WTG 1 (N)	0	0.99 (0.10 – 2.35)	0.99 (0.10 – 2.35)
WTG 2 (N)	0	1.52 (0.17 – 3.56)	1.52 (0.17 – 3.56)
Note, 95% CIs shown in brackets.			

3.4.3 Caledonia South

3.4.3.1 The estimated mean seasonal collisions for herring gull within the Caledonia South Site are presented below for three WTG scenarios (WTG 1 (S), WTG 2 (S) and WTG 3 (S)) as described in Table 2-10.

NatureScot Seasons

Table 3-21: Summary of estimated mean seasonal collisions (NatureScot seasons) for herring gull for three WTG scenarios (WTG 1 (S), WTG 2 (S) and WTG 3 (S)) for deterministic Band Option 2 using 25% and 50% Nocturnal Activity Factors (NAF).

Scenario	NAF (%)	Breeding Season Total Collision	Non-breeding Season Total Collision	Annual Total
WTG 1 (S)	25	0	1.51	1.51
	50	0	2.04	2.04
WTG 2 (S)	25	0	1.35	1.35
	50	0	1.83	1.83
WTG 3 (S)	25	0	2.04	2.04
	50	0	2.76	2.76

Table 3-22: Summary of estimated mean seasonal collisions (NatureScot seasons) for herring gull for three WTG scenarios (WTG 1 (S), WTG 2 (S) and WTG 3 (S)) for stochastic Band Option 2.

Scenario	Breeding Season Total Collision	Non-breeding Season Total Collision	Annual Total
WTG 1 (S)	0	2.02 (0.18 – 4.99)	2.02 (0.18 – 4.99)
WTG 2 (S)	0	1.84 (0.20 – 4.39)	1.84 (0.20 – 4.39)
WTG 3 (S)	0	2.72 (0.24 – 6.73)	2.72 (0.24 – 6.73)
Note, 95% CIs shown in brackets.			

3.4.4 Caledonia OWF

3.4.4.1 The estimated mean seasonal collisions for herring gull within the Caledonia OWF (i.e., the Caledonia North Site and Caledonia South Site) are presented below for three WTG scenarios (WTG 1, WTG 2 and WTG 3) as described in Table 2-11.

NatureScot Seasons

Table 3-23: Summary of estimated mean seasonal collisions (NatureScot seasons) for herring gull for three WTG scenarios (WTG 1, WTG 2 and WTG 3) for deterministic Band Option 2 using 25% and 50% Nocturnal Activity Factors (NAF).

Scenario	NAF (%)	Breeding Season Total Collision	Non-breeding Season Total Collision	Annual Total
WTG 1	25	0	2.19	2.19
	50	0	2.91	2.91
WTG 2	25	0	1.56	1.56
	50	0	2.07	2.07
WTG 3	25	0	1.45	1.45
	50	0	1.93	1.93

Table 3-24: Summary of estimated mean seasonal collisions (NatureScot seasons) for herring gull for three WTG scenarios (WTG 1, WTG 2 and WTG 3) for stochastic Band Option 2.

Scenario	Breeding Season Total Collision	Non-breeding Season Total Collision	Annual Total
WTG 1	0 (0 – 0)	3.12 (0.23 – 7.95)	3.12 (0.23 – 7.95)
WTG 2	0 (0 – 0)	2.27 (0.19 – 5.81)	2.27 (0.19 – 5.81)
WTG 3	0 (0 – 0)	2.08 (0.15 – 5.17)	2.08 (0.15 – 5.17)
Note, 95% CIs shown in brackets.			

3.5 Great Skua

3.5.1 Overview

3.5.1.1 The CRM results for great skua are presented below, using two WTG scenarios for Caledonia North (Table 2-9), three WTG scenarios for Caledonia South (Table 2-10), and three WTG scenarios for Caledonia OWF (Table 2-11). The seasonal definitions are those presented within the NatureScot (2020¹⁵) guidance as detailed in Table 2-13.

3.5.2 Caledonia North

3.5.2.1 The estimated mean seasonal collisions for great skua within the Caledonia North Site are presented below for two WTG scenarios (WTG 1 (N) and WTG 2 (N)) as described in Table 2-9.

NatureScot Seasons

Table 3-25: Summary of estimated mean seasonal collisions (NatureScot seasons) for great skua for two WTG scenarios (WTG 1 (N) and WTG 2 (N)) for deterministic Band Option 2.

Scenario	Breeding Season Total Collision	Non-breeding Season Total Collision	Annual Total
WTG 1 (N)	0.12	0	0.12
WTG 2 (N)	0.17	0	0.17

Table 3-26: Summary of estimated mean seasonal collisions (NatureScot seasons) for great skua for two WTG scenarios (WTG 1 (N) and WTG 2 (N)) for stochastic Band Option 2.

Scenario	Breeding Season Total Collision	Non-breeding Season Total Collision	Annual Total
WTG 1 (N)	0.11 (0.01 – 0.23)	0	0.11 (0.01 – 0.23)
WTG 2 (N)	0.16 (0.02 – 0.33)	0	0.16 (0.02 – 0.33)
Note, 95% CIs shown in brackets.			

BDMPS Seasons

Table 3-27: Summary of estimated mean seasonal collisions (BDMPS seasons) for great skua for two WTG scenarios (WTG 1 (N) and WTG 2 (N)) for deterministic Band Option 2.

Scenario	Breeding Season Total Collision	Autumn Migration Total Collision	Spring Migration Total Collision	Annual Total
WTG 1 (N)	0.12	0	0	0.12
WTG 2 (N)	0.17	0	0	0.17

Table 3-28: Summary of estimated mean seasonal collisions (BDMPS seasons) for great skua for two WTG scenarios (WTG 1 (N) and WTG 2 (N)) for stochastic Band Option 2.

Scenario	Breeding Season Total Collision	Autumn Migration Total Collision	Spring Migration Total Collision	Annual Total
WTG 1 (N)	0.11 (0.01 – 0.23)	0	0	0.11 (0.01 – 0.23)
WTG 2 (N)	0.16 (0.02 – 0.33)	0	0	0.16 (0.02 – 0.33)
Note, 95% CIs shown in brackets.				

3.5.3 Caledonia South

3.5.3.1 The estimated mean seasonal collisions for great skua within the Caledonia South Site are presented below for three WTG scenarios (WTG 1 (S), WTG 2 (S) and WTG 3 (S)) as described in Table 2-10.

NatureScot Seasons

Table 3-29: Summary of estimated mean seasonal collisions (NatureScot seasons) for great skua for three WTG scenarios (WTG 1 (S), WTG 2 (S) and WTG 3 (S)) for deterministic Band Option 2.

Scenario	Breeding Season Total Collision	Non-breeding Season Total Collision	Annual Total
WTG 1 (S)	0.05	0	0.05
WTG 2 (S)	0.04	0	0.04
WTG 3 (S)	0.06	0	0.06

Table 3-30: Summary of estimated mean seasonal collisions (NatureScot seasons) for great skua for three WTG scenarios (WTG 1 (S), WTG 2 (S) and WTG 3 (S)) for stochastic Band Option 2.

Scenario	Breeding Season Total Collision	Non-breeding Season Total Collision	Annual Total
WTG 1 (S)	0.04 (0.01 – 0.10)	0	0.04 (0.01 – 0.10)
WTG 2 (S)	0.04 (0 – 0.09)	0	0.04 (0 – 0.09)
WTG 3 (S)	0.06 (0.01 – 0.13)	0	0.06 (0.01 – 0.13)
Note, 95% CIs shown in brackets.			

BDMPS Seasons

Table 3-31: Summary of estimated mean seasonal collisions (BDMPS seasons) for great skua for three WTG scenarios (WTG 1 (S), WTG 2 (S) and WTG 3 (S)) for deterministic Band Option.

Scenario	Breeding Season Total Collision	Autumn Migration Total Collision	Spring Migration Total Collision	Annual Total
WTG 1 (S)	0.05	0	0	0.05
WTG 2 (S)	0.04	0	0	0.04
WTG 3 (S)	0.06	0	0	0.06

Table 3-32: Summary of estimated mean seasonal collisions (BDMPS seasons) for great skua for three WTG scenarios (WTG 1 (S), WTG 2 (S) and WTG 3 (S)) for stochastic Band Option 2.

Scenario	Breeding Season Total Collision	Autumn Migration Total Collision	Spring Migration Total Collision	Annual Total
WTG 1 (S)	0.04 (0.01 – 0.10)	0	0	0.04 (0.01 – 0.10)
WTG 2 (S)	0.04 (0 – 0.09)	0	0	0.04 (0 – 0.09)
WTG 3 (S)	0.06 (0.01 – 0.13)	0	0	0.06 (0.01 – 0.13)
Note, 95% CIs shown in brackets.				

3.5.4 Caledonia OWF

3.5.4.1 The estimated mean seasonal collisions for great skua within the Caledonia OWF (i.e., the Caledonia North Site and Caledonia South Site) are presented below for three WTG scenarios (WTG 1, WTG 2 and WTG 3) as described in Table 2-11.

NatureScot Seasons

Table 3-33: Summary of estimated mean seasonal collisions (NatureScot seasons) for great skua for three WTG scenarios (WTG 1, WTG 2 and WTG 3) for deterministic Band Option 2.

Scenario	Breeding Season Total Collision	Non-breeding Season Total Collision	Annual Total
WTG 1	0.15	0	0.15
WTG 2	0.11	0	0.11
WTG 3	0.10	0	0.10

Table 3-34: Summary of estimated mean seasonal collisions (NatureScot seasons) for great skua for three WTG scenarios (WTG 1, WTG 2 and WTG 3) for stochastic Band Option 2.

Scenario	Breeding Season Total Collision	Non-breeding Season Total Collision	Annual Total
WTG 1	0.15 (0.02 – 0.33)	0	0.15 (0.02 – 0.33)
WTG 2	0.11 (0.01 – 0.23)	0	0.11 (0.01 – 0.23)
WTG 3	0.10 (0.01 – 0.22)	0	0.10 (0.01 – 0.22)
Note, 95% CIs shown in brackets.			

BDMPS Seasons

Table 3-35: Summary of estimated mean seasonal collisions (BDMPS seasons) for great skua for three WTG scenarios (WTG 1, WTG 2 and WTG 3) for deterministic Band Option 2.

Scenario	Breeding Season Total Collision	Autumn Migration Total Collision	Spring Migration Total Collision	Annual Total
WTG 1	0.15	0	0	0.15
WTG 2	0.11	0	0	0.11
WTG 3	0.10	0	0	0.10

Table 3-36: Summary of estimated mean seasonal collisions (BDMPS seasons) for great skua for three WTG scenarios (WTG 1, WTG 2 and WTG 3) for stochastic Band Option 2.

Scenario	Breeding Season Total Collision	Autumn Migration Total Collision	Spring Migration Total Collision	Annual Total
WTG 1	0.15 (0.02 – 0.33)	0	0	0.15 (0.02 – 0.33)
WTG 2	0.11 (0.01 – 0.23)	0	0	0.11 (0.01 – 0.23)
WTG 3	0.10 (0.01 – 0.22)	0	0	0.10 (0.01 – 0.22)
Note, 95% CIs shown in brackets.				

3.6 Gannet (Guidance Approach)

3.6.1 Overview

- 3.6.1.1 The CRM results for gannet (Guidance Approach) are presented below, using two WTG scenarios for Caledonia North (Table 2-9), three WTG scenarios for Caledonia South (Table 2-10), and three WTG scenarios for Caledonia OWF (Table 2-11). The seasonal definitions are those presented within the NatureScot (2020¹⁵) guidance and Furness (2015¹⁶) as detailed in Table 2-13 and Table 2-14.
- 3.6.1.2 The Guidance Approach for assessing potential impacts of the Proposed Development (Offshore) on gannet does not account for distributional responses during the breeding season, as described in Section 0. Therefore, there is potential for overestimation of potential impacts on gannet when using this approach during those months.
- 3.6.1.3 The CRM results for gannet, without applying the macro-avoidance correction factor, are presented in the relevant annexes (Volume 7B, Appendix 6-3, Annexes 1, 2, and 3).

3.6.2 Caledonia North

- 3.6.2.1 The estimated mean seasonal collisions for gannet within the Caledonia North Site using the Guidance Approach are presented below for two WTG scenarios (WTG 1 (N) and WTG 2 (N)) as described in Table 2-9.

NatureScot Seasons

Table 3-37: Summary of estimated mean seasonal collisions (NatureScot seasons) for gannet for two WTG scenarios (WTG 1 (N) and WTG 2 (N)) for deterministic Band Option 2 using the Guidance Approach.

Scenario	Breeding Season Total Collision	Non-breeding Season Total Collision	Annual Total
WTG 1 (N)	2.94	0.33	3.26
WTG 2 (N)	4.18	0.46	4.64

Table 3-38: Summary of estimated mean seasonal collisions (NatureScot seasons) for gannet for two WTG scenarios (WTG 1 (N) and WTG 2 (N)) for stochastic Band Option 2 using the Guidance Approach.

Scenario	Breeding Season Total Collision	Non-breeding Season Total Collision	Annual Total
WTG 1 (N)	3.03 (0.35 – 8.42)	0.34 (0.04 – 0.94)	3.37 (0.39 – 9.35)
WTG 2 (N)	4.29 (0.49 – 12.16)	0.49 (0.06 – 1.42)	4.78 (0.55 – 13.58)
Note, 95% CIs shown in brackets.			

BDMPS Seasons

Table 3-39: Summary of estimated mean seasonal collisions (BDMPS seasons) for gannet for two WTG scenarios (WTG 1 (N) and WTG 2 (N)) for deterministic Band Option 2 using the Guidance Approach.

Scenario	Breeding Season Total Collision	Autumn Migration Total Collision	Spring Migration Total Collision	Annual Total
WTG 1 (N)	2.94	0.28	0.04	3.26
WTG 2 (N)	4.18	0.40	0.06	4.64

Table 3-40: Summary of estimated mean seasonal collisions (BDMPS seasons) for gannet for two WTG scenarios (WTG 1 (N) and WTG 2 (N)) for stochastic Band Option 2 using the Guidance Approach.

Scenario	Breeding Season Total Collision	Autumn Migration Total Collision	Spring Migration Total Collision	Annual Total
WTG 1 (N)	3.03 (0.35 – 8.42)	0.29 (0.04 – 0.78)	0.05 (0 – 0.15)	3.37 (0.39 – 9.35)
WTG 2 (N)	4.29 (0.49 – 12.16)	0.42 (0.06 – 1.21)	0.07 (0 – 0.21)	4.78 (0.55 – 13.58)
Note, 95% CIs shown in brackets.				

3.6.3 Caledonia South

3.6.3.1 The estimated mean seasonal collisions for gannet within the Caledonia South Site using the Guidance Approach are presented below for three WTG scenarios (WTG 1 (S), WTG 2 (S) and WTG 3 (S)) as described in Table 2-10.

NatureScot Seasons

Table 3-41: Summary of estimated mean seasonal collisions (NatureScot seasons) for gannet for three WTG scenarios (WTG 1 (S), WTG 2 (S) and WTG 3 (S)) for deterministic Band Option 2 using the Guidance Approach.

Scenario	Breeding Season Total Collision	Non-breeding Season Total Collision	Annual Total
WTG 1 (S)	7.59	0.26	7.86
WTG 2 (S)	6.88	0.24	7.12
WTG 3 (S)	9.91	0.34	10.25

Table 3-42: Summary of estimated mean seasonal collisions (NatureScot seasons) for gannet for three WTG scenarios (WTG 1 (S), WTG 2 (S) and WTG 3 (S)) for stochastic Band Option 2 using the Guidance Approach.

Scenario	Breeding Season Total Collision	Non-breeding Season Total Collision	Annual Total
WTG 1 (S)	7.19 (0.87 – 22.09)	0.27 (0.04 – 0.74)	8.18 (0.91 – 22.83)
WTG 2 (S)	7.30 (0.84 – 19.95)	0.25 (0.04 – 0.72)	7.56 (0.87 – 20.67)
WTG 3 (S)	10.44 (1.11 – 29.56)	0.36 (0.05 – 1.02)	10.80 (1.16 – 30.58)
Note, 95% CIs shown in brackets.			

BDMPS Seasons

Table 3-43: Summary of estimated mean seasonal collisions (BDMPS seasons) for gannet for three WTG scenarios (WTG 1 (S), WTG 2 (S) and WTG 3 (S)) for deterministic Band Option 2 using the Guidance Approach.

Scenario	Breeding Season Total Collision	Autumn Migration Total Collision	Spring Migration Total Collision	Annual Total
WTG 1 (S)	7.59	0.22	0.04	7.86
WTG 2 (S)	6.88	0.20	0.04	7.12
WTG 3 (S)	9.91	0.29	0.06	10.25

Table 3-44: Summary of estimated mean seasonal collisions (BDMPS seasons) for gannet for three WTG scenarios (WTG 1 (S), WTG 2 (S) and WTG 3 (S)) for stochastic Band Option 2 using the Guidance Approach.

Scenario	Breeding Season Total Collision	Autumn Migration Total Collision	Spring Migration Total Collision	Annual Total
WTG 1 (S)	7.91 (0.87 – 22.09)	0.22 (0.04 – 0.57)	0.05 (0 – 0.16)	8.18 (0.91 – 22.83)
WTG 2 (S)	7.30 (0.84 – 19.95)	0.21 (0.03 – 0.56)	0.05 (0 – 0.15)	7.56 (0.87 – 20.67)
WTG 3 (S)	10.44 (1.11 – 29.56)	0.29 (0.05 – 0.80)	0.07 (0 – 0.22)	10.80 (1.16 – 30.58)

Note, 95% CIs shown in brackets.

3.6.4 Caledonia OWF

3.6.4.1 The estimated mean seasonal collisions for gannet within the Caledonia OWF (i.e., the Caledonia North Site and Caledonia South Site) using the Guidance Approach are presented below for three WTG scenarios (WTG 1, WTG 2 and WTG 3) as described in Table 2-11.

NatureScot Seasons

Table 3-45: Summary of estimated mean seasonal collisions (NatureScot seasons) for gannet for three WTG scenarios (WTG 1, WTG 2 and WTG 3) for deterministic Band Option 2 using the Guidance Approach.

Scenario	Breeding Season Total Collision	Non-breeding Season Total Collision	Annual Total
WTG 1	12.41	0.68	13.09
WTG 2	9.18	0.50	9.68
WTG 3	8.58	0.47	9.05

Table 3-46: Summary of estimated mean seasonal collisions (NatureScot seasons) for gannet for three WTG scenarios (WTG 1, WTG 2 and WTG 3) for stochastic Band Option 2 using the Guidance Approach.

Scenario	Breeding Season Total Collision	Non-breeding Season Total Collision	Annual Total
WTG 1	12.35 (1.73 – 34.10)	0.67 (0.11 – 1.79)	13.02 (1.85 – 35.89)
WTG 2	9.50 (1.24 – 26.53)	0.52 (0.09 – 1.37)	10.02 (1.33 – 27.90)
WTG 3	9.02 (1.16 – 24.83)	0.49 (0.09 – 1.26)	9.51 (1.25 – 26.09)
Note, 95% CIs shown in brackets.			

BDMPS Seasons

Table 3-47: Summary of estimated mean seasonal collisions (BDMPS seasons) for gannet for three WTG scenarios (WTG 1, WTG 2 and WTG 3) for deterministic Band Option 2 using the Guidance Approach.

Scenario	Breeding Season Total Collision	Autumn Migration Total Collision	Spring Migration Total Collision	Annual Total
WTG 1	12.41	0.62	0.07	13.09
WTG 2	9.18	0.46	0.05	9.68
WTG 3	8.58	0.43	0.05	9.05

Table 3-48: Summary of estimated mean seasonal collisions (BDMPS seasons) for gannet for three WTG scenarios (WTG 1, WTG 2 and WTG 3) for stochastic Band Option 2 using the Guidance Approach.

Scenario	Breeding Season Total Collision	Autumn Migration Total Collision	Spring Migration Total Collision	Annual Total
WTG 1	12.35 (1.73 – 34.10)	0.59 (0.11 – 1.50)	0.08 (0 – 0.29)	13.02 (1.85 – 35.89)
WTG 2	9.50 (1.24 – 26.53)	0.46 (0.08 – 1.15)	0.06 (0 – 0.22)	10.02 (1.33 – 27.90)
WTG 3	9.02 (1.16 – 24.83)	0.43 (0.09 – 1.05)	0.06 (0 – 0.20)	10.66 (1.47 – 29.02)
Note, 95% CIs shown in brackets.				

3.7 Gannet (Applicant Approach)

3.7.1 Overview

- 3.7.1.1 The CRM results for gannet (Applicant Approach) are presented below, using two WTG scenarios for Caledonia North (Table 2-9), three WTG scenarios for Caledonia South (Table 2-10), and three WTG scenarios for Caledonia OWF (Table 2-11). The seasonal definitions are those presented within the NatureScot (2020¹⁵) guidance and Furness (2015¹⁶) as detailed in Table 2-13 and Table 2-14.
- 3.7.1.2 The Applicant approach to the potential impacts on gannet applies a 70% correction factor to account for distributional responses, as described in Section 0.
- 3.7.1.3 The CRM results for gannet, without applying the macro-avoidance correction factor, are presented in the relevant annexes (Volume 7B, Appendix 6-3, Annexes 1, 2, and 3).

3.7.2 Caledonia North

- 3.7.2.1 The estimated mean seasonal collisions for gannet within the Caledonia North Site using the Applicant Approach are presented below for two WTG scenarios (WTG 1 (N) and WTG 2 (N)) as described in Table 2-9.

NatureScot Seasons

Table 3-49: Summary of estimated mean seasonal collisions (NatureScot seasons) for gannet for two WTG scenarios (WTG 1 (N) and WTG 2 (N)) for deterministic Band Option 2 using the Applicant Approach.

Scenario	Breeding Season Total Collision	Non-breeding Season Total Collision	Annual Total
WTG 1 (N)	0.88	0.33	1.21
WTG 2 (N)	1.25	0.46	1.72

Table 3-50: Summary of estimated mean seasonal collisions (NatureScot seasons) for gannet for two WTG scenarios (WTG 1 (N) and WTG 2 (N)) for stochastic Band Option 2 using the Applicant Approach.

Scenario	Breeding Season Total Collision	Non-breeding Season Total Collision	Annual Total
WTG 1 (N)	0.91 (0.10 – 2.53)	0.34 (0.04 – 0.94)	1.25 (0.15 – 3.46)
WTG 2 (N)	1.29 (0.15 – 3.65)	0.49 (0.06 – 1.42)	1.78 (0.21 – 5.07)
Note, 95% CIs shown in brackets.			

BDMPS Seasons

Table 3-51: Summary of estimated mean seasonal collisions (BDMPS seasons) for gannet for two WTG scenarios (WTG 1 (N) and WTG 2 (N)) for deterministic Band Option 2 using the Applicant Approach.

Scenario	Breeding Season Total Collision	Autumn Migration Total Collision	Spring Migration Total Collision	Annual Total
WTG 1 (N)	0.88	0.28	0.04	1.21
WTG 2 (N)	1.25	0.40	0.06	1.72

Table 3-52: Summary of estimated mean seasonal collisions (BDMPS seasons) for gannet for two WTG scenarios (WTG 1 (N) and WTG 2 (N)) for stochastic Band Option 2 using the Applicant Approach.

Scenario	Breeding Season Total Collision	Autumn Migration Total Collision	Spring Migration Total Collision	Annual Total
WTG 1 (N)	0.91 (0.10 – 2.53)	0.29 (0.04 – 0.78)	0.05 (0 – 0.15)	1.25 (0.15 – 3.46)
WTG 2 (N)	1.29 (0.15 – 3.65)	0.42 (0.06 – 1.21)	0.07 (0 – 0.21)	1.78 (0.21 – 5.07)
Note, 95% CIs shown in brackets.				

3.7.3 Caledonia South

3.7.3.1 The estimated mean seasonal collisions for gannet within the Caledonia South Site using the Applicant Approach are presented below for three WTG scenarios (WTG 1 (S), WTG 2 (S) and WTG 3 (S)) as described in Table 2-10.

NatureScot Seasons

Table 3-53: Summary of estimated mean seasonal collisions (NatureScot seasons) for gannet for three WTG scenarios (WTG 1 (S), WTG 2 (S) and WTG 3 (S)) for deterministic Band Option 2 using the Applicant Approach.

Scenario	Breeding Season Total Collision	Non-breeding Season Total Collision	Annual Total
WTG 1 (S)	2.28	0.26	2.54
WTG 2 (S)	2.06	0.24	2.30
WTG 3 (S)	2.97	0.34	3.32

Table 3-54: Summary of estimated mean seasonal collisions (NatureScot seasons) for gannet for three WTG scenarios (WTG 1 (S), WTG 2 (S) and WTG 3 (S)) for stochastic Band Option 2 using the Applicant Approach.

Scenario	Breeding Season Total Collision	Non-breeding Season Total Collision	Annual Total
WTG 1 (S)	2.37 (0.26 – 6.63)	0.27 (0.04 – 0.74)	2.64 (0.30 – 7.36)
WTG 2 (S)	2.19 (0.25 – 5.99)	0.25 (0.04 – 0.72)	2.44 (0.29 – 6.70)
WTG 3 (S)	3.13 (0.33 – 8.87)	0.36 (0.05 – 1.02)	3.49 (0.38 – 9.89)
Note, 95% CIs shown in brackets.			

BDMPS Seasons

Table 3-55: Summary of estimated mean seasonal collisions (BDMPS seasons) for gannet for three WTG scenarios (WTG 1 (S), WTG 2 (S) and WTG 3 (S)) for deterministic Band Option 2 using the Applicant Approach.

Scenario	Breeding Season Total Collision	Autumn Migration Total Collision	Spring Migration Total Collision	Annual Total
WTG 1 (S)	2.28	0.22	0.04	2.54
WTG 2 (S)	2.06	0.20	0.04	2.30
WTG 3 (S)	2.97	0.29	0.06	3.32

Table 3-56: Summary of estimated mean seasonal collisions (BDMPS seasons) for gannet for three WTG scenarios (WTG 1 (S), WTG 2 (S) and WTG 3 (S)) for stochastic Band Option 2 using the Applicant Approach.

Scenario	Breeding Season Total Collision	Autumn Migration Total Collision	Spring Migration Total Collision	Annual Total
WTG 1 (S)	2.37 (0.26 – 6.63)	0.22 (0.04 – 0.57)	0.05 (0 – 0.16)	2.64 (0.30 – 7.36)
WTG 2 (S)	2.19 (0.25 – 5.99)	0.21 (0.03 – 0.56)	0.05 (0 – 0.15)	2.44 (0.29 – 6.70)
WTG 3 (S)	3.13 (0.33 – 8.87)	0.29 (0.05 – 0.80)	0.07 (0 – 0.22)	3.49 (0.38 – 9.89)

Note, 95% CIs shown in brackets.

3.7.4 Caledonia OWF

3.7.4.1 The estimated mean seasonal collisions for gannet within the Caledonia OWF (i.e., the Caledonia North Site and Caledonia South Site) using the Applicant Approach are presented below for three WTG scenarios (WTG 1, WTG 2 and WTG 3) as described in Table 2-11.

NatureScot Seasons

Table 3-57: Summary of estimated mean seasonal collisions (NatureScot seasons) for gannet for three WTG scenarios (WTG 1, WTG 2 and WTG 3) for deterministic Band Option 2 using the Applicant Approach.

Scenario	Breeding Season Total Collision	Non-breeding Season Total Collision	Annual Total
WTG 1	3.72	0.68	4.41
WTG 2	2.75	0.50	3.26
WTG 3	2.57	0.47	3.04

Table 3-58: Summary of estimated mean seasonal collisions (NatureScot seasons) for gannet for three WTG scenarios (WTG 1, WTG 2 and WTG 3) for stochastic Band Option 2 using the Applicant Approach.

Scenario	Breeding Season Total Collision	Non-breeding Season Total Collision	Annual Total
WTG 1	3.70 (0.52 – 10.23)	0.67 (0.11 – 1.79)	4.38 (0.63 – 12.02)
WTG 2	2.85 (0.37 – 7.96)	0.52 (0.09 – 1.37)	3.37 (0.46 – 9.32)
WTG 3	2.71 (0.35 – 7.45)	0.49 (0.09 – 1.26)	3.20 (0.44 – 8.71)
Note, 95% CIs shown in brackets.			

BDMPS Seasons

Table 3-59: Summary of estimated mean seasonal collisions (BDMPS seasons) for gannet for three WTG scenarios (WTG 1, WTG 2 and WTG 3) for deterministic Band Option 2 using the Applicant Approach.

Scenario	Breeding Season Total Collision	Autumn Migration Total Collision	Spring Migration Total Collision	Annual Total
WTG 1	3.72	0.62	0.07	4.41
WTG 2	2.75	0.46	0.05	3.26
WTG 3	2.57	0.43	0.05	3.04

Table 3-60: Summary of estimated mean seasonal collisions (BDMPS seasons) for gannet for three WTG scenarios (WTG 1, WTG 2 and WTG 3) for stochastic Band Option 2 using the Applicant Approach.

Scenario	Breeding Season Total Collision	Autumn Migration Total Collision	Spring Migration Total Collision	Annual Total
WTG 1	3.70 (0.52 – 10.23)	0.59 (0.11 – 1.50)	0.08 (0 – 0.29)	4.38 (0.63 – 12.02)
WTG 2	2.85 (0.37 – 7.96)	0.46 (0.08 – 1.15)	0.06 (0 – 0.22)	3.37 (0.46 – 9.32)
WTG 3	2.71 (0.35 – 7.45)	0.43 (0.09 – 1.05)	0.06 (0 – 0.20)	3.20 (0.44 – 8.71)
Note, 95% CIs shown in brackets.				

4 Summary

4.1.1.1 The summary of results from the potential WCS, based on the data presented within Volume 7B, Appendix 6-3, Annexes 1, 2 and 3, is presented below. The collision mortalities of kittiwake, great black-backed gull, herring gull, great skua and gannet from Caledonia North, Caledonia South and the Caledonia OWF during the relevant seasonal definitions, as per the NatureScot (2020¹⁵) guidance and Furness (2015¹⁶), are presented Table 4-1 and Table 4-2 respectively.

4.1.1.2 For the full CRM assessment results, refer to the following annexes:

- Volume 7B, Appendix 6-3, Annex 1: Offshore Ornithology Collision Risk Modelling Results (Caledonia OWF);
- Volume 7B, Appendix 6-3, Annex 2: Offshore Ornithology Collision Risk Modelling Results (Caledonia North); and
- Volume 7B, Appendix 6-3, Annex 3: Offshore Ornithology Collision Risk Modelling Results (Caledonia South).

Table 4-1: Summary of estimated collision mortalities of key species from Caledonia North, Caledonia South and Caledonia OWF, presenting the WCS using the NatureScot (2023¹) seasonal definitions.

Species	Scenario	Model Type	NAF (%)	Breeding	Non-breeding	Annual Total
Caledonia North						
Kittiwake	WTG 2 (N)	Deterministic	25	21.51	6.98	28.49
			50	23.52	8.94	32.46
		Stochastic	37.5 (0.0637)	19.75 (5.80 - 36.5)	6.94 (1.92 - 13.29)	26.69 (7.72 - 49.79)
Great black-backed gull	WTG 2 (N)	Deterministic	25	0	7.05	7.05
			50	0	9.18	9.18
		Stochastic	37.5 (0.0637)	0 (0 - 0)	9.66 (2.17 - 20.75)	9.66 (2.17 - 20.75)
Herring gull	WTG 2 (N)	Deterministic	25	0	1.18	1.18
			50	0	1.51	1.51
		Stochastic	37.5 (0.0637)	0 (0 - 0)	1.52 (0.17 - 3.56)	1.52 (0.17 - 3.56)
Great skua	WTG 2 (N)	Deterministic	0	0.17	0	0.17
		Stochastic		0.16 (0.02 - 0.33)	0	0.16 (0.02 - 0.33)
Gannet – Guidance Approach	WTG 2 (N)	Deterministic	8	4.18	0.46	4.64
		Stochastic		4.29 (0.49 - 12.16)	0.49 (0.06 - 1.42)	4.78 (0.55 - 13.58)

Species	Scenario	Model Type	NAF (%)	Breeding	Non-breeding	Annual Total
Gannet – Applicant Approach	WTG 2 (N)	Deterministic	8	1.25	0.46	1.72
		Stochastic		1.29 (0.15 – 3.65)	0.49 (0.06 – 1.42)	1.78 (0.21 – 5.17)
Caledonia South						
Kittiwake	WTG 3 (S)	Deterministic	25	47.01	6.63	53.64
			50	51.24	8.01	59.25
		Stochastic	37.5 (0.0637)	42.94 (11.74 - 81.93)	6.52 (1.34- 13.51)	49.46 (13.08- 95.44)
Great black-backed gull	WTG 3 (S)	Deterministic	25	0	5.67	5.67
			50	0	7.58	7.58
		Stochastic	37.5 (0.0637)	0 (0 – 0)	7.72 (1.32 – 16.48)	7.72 (1.32 – 16.48)
Herring gull	WTG 3 (S)	Deterministic	25	0	2.04	2.04
			50	0	2.76	2.76
		Stochastic	37.5 (0.0637)	0 (0 – 0)	2.72 (0.24 – 6.73)	2.72 (0.24 – 6.73)
Great skua	WTG 3 (S)	Deterministic	0	0.06	0	0.06
		Stochastic		0.06 (0.01 – 0.13)	0	0.06 (0.01 – 0.13)

Species	Scenario	Model Type	NAF (%)	Breeding	Non-breeding	Annual Total
Gannet – Guidance Approach	WTG 3 (S)	Deterministic	8	9.91	0.34	10.25
		Stochastic		10.44 (1.11 – 29.56)	0.36 (0.05 – 1.02)	10.80 (1.16 – 30.58)
Gannet – Applicant Approach	WTG 3 (S)	Deterministic	8	2.97	0.34	3.32
		Stochastic		3.13 (0.33 – 8.87)	0.36 (0.05 – 1.02)	3.49 (0.38 – 9.89)
Caledonia OWF						
Kittiwake	WTG 1	Deterministic	25	61.10	11.98	
			50	66.67	14.90	81.57
		Stochastic	37.5 (0.0637)	55.27 (17.78 – 103.10)	11.74 (3.61 – 22.18)	67.01 (21.40 – 125.28)
Great black-backed gull	WTG 1	Deterministic	25	0	10.96	10.96
			50	0	14.44	14.44
		Stochastic	37.5 (0.0637)	0 (0 - 0)	14.98 (2.87 - 32.81)	14.98 (2.87 - 32.81)
Herring gull	WTG 1	Deterministic	25	0	2.19	2.19
			50	0	2.91	2.91
		Stochastic	37.5 (0.0637)	0 (0 – 0)	3.12 (0.23 – 7.95)	3.12 (0.23 – 7.95)

Species	Scenario	Model Type	NAF (%)	Breeding	Non-breeding	Annual Total
Great skua	WTG 1	Deterministic	0	0.15	0	0.15
		Stochastic		0.15 (0.02 – 0.33)	0	0.15 (0.02 – 0.33)
Gannet – Guidance Approach	WTG 1	Deterministic	8	12.41	0.68	13.09
		Stochastic		12.35 (1.73 – 34.10)	0.67 (0.11 – 1.79)	13.02 (1.85 – 35.89)
Gannet – Applicant Approach	WTG 1	Deterministic	8	3.72	0.68	4.41
		Stochastic		3.70 (0.52 – 10.23)	0.67 (0.11 – 1.79)	4.38 (0.63 – 12.02)
Note, 95% CIs shown in brackets.						

Table 4-2: Summary of estimated collision mortalities of key species from Caledonia North, Caledonia South and Caledonia OWF, presenting the WCS using the Furness (2015¹⁶) non-breeding seasonal definitions.

Species	Scenario	Model Type	NAF (%)	Breeding	Autumn Migration	Spring Migration	Annual Total
Caledonia North							
Kittiwake	WTG 2 (N)	Deterministic	25	21.51	5.16	1.82	28.49
			50	23.52	6.71	2.23	32.46
		Stochastic	37.5 (0.0637)	19.75 (5.80 - 36.50)	5.16 (1.57 - 9.72)	1.77 (0.35 - 3.57)	26.69 (7.72 - 49.79)
Great skua	WTG 2 (N)	Deterministic	0	0.17	0	0	0.17
		Stochastic		0.16 (0.02 – 0.33)	0	0	0.16 (0.02 – 0.33)
Gannet – Guidance Approach	WTG 2 (N)	Deterministic	8	4.18	0.40	0.06	4.64
		Stochastic		4.29 (0.49 - 12.16)	0.42 (0.06 – 1.21)	0.07 (0 – 0.21)	4.78 (0.55 – 13.58)
Gannet – Applicant Approach	WTG 2 (N)	Deterministic	8	1.25	0.40	0.06	1.72
		Stochastic		1.29 (0.15 - 3.65)	0.42 (0.06 - 1.21)	0.07 (0 - 0.21)	1.78 (0.21 - 5.07)
Caledonia South							
Kittiwake	WTG 3 (S)	Deterministic	25	47.01	2.80	3.83	53.64
			50	51.24	3.51	4.49	59.25

Species	Scenario	Model Type	NAF (%)	Breeding	Autumn Migration	Spring Migration	Annual Total
		Stochastic	37.5 (0.0637)	42.94 (11.74 – 81.93)	2.77 (0.68 - 5.50)	3.75 (0.66 – 8.01)	49.46 (13.08 – 95.44)
Great skua	WTG 3 (S)	Deterministic	0	0.06	0	0	0.06
		Stochastic		0.06 (0.01 – 0.13)	0	0	0.06 (0.01 – 0.13)
Gannet – Guidance Approach	WTG 3 (S)	Deterministic	8	9.91	0.29	0.06	10.25
		Stochastic		10.44 (1.11 – 29.56)	0.29 (0.05 – 0.80)	0.07 (0 – 0.22)	10.80 (1.16 – 30.58)
Gannet – Applicant Approach	WTG 3 (S)	Deterministic	8	2.97	0.29	0.06	3.32
		Stochastic		3.13 (0.33 – 8.87)	0.29 (0.05 – 0.80)	0.07 (0 – 0.22)	3.49 (0.38 – 9.89)
Caledonia OWF							
Kittiwake	WTG 1	Deterministic	25	61.10	7.06	4.91	73.08
			50	66.67	9.05	5.85	81.57
		Stochastic	37.5 (0.0637)	55.27 (17.78 – 103.10)	6.99 (2.53 – 12.50)	4.75 (1.09 – 9.68)	67.01 (21.40 – 125.28)
Great skua	WTG 1	Deterministic	0	0.15	0	0	0.15

Species	Scenario	Model Type	NAF (%)	Breeding	Autumn Migration	Spring Migration	Annual Total
		Stochastic		0.10 (0.01 – 0.22)	0	0	0.10 (0.01 – 0.22)
Gannet – Guidance Approach	WTG 1	Deterministic	8	12.41	0.62	0.07	13.09
		Stochastic		12.35 (1.73 – 34.10)	0.59 (0.11 – 1.50)	0.08 (0 – 0.29)	13.02 (1.85 – 35.89)
Gannet – Applicant Approach	WTG 1	Deterministic	8	3.72	0.62	0.07	4.41
		Stochastic		3.70 (0.52 – 10.23)	0.59 (0.11 – 1.50)	0.08 (0 – 0.29)	4.38 (0.63 – 12.02)
Note, 95% CIs shown in brackets.							

5 References

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- ³ Band, W. (2012) 'Using a Collision Risk Model to Assess Bird Collision Risks for Offshore Wind Farms'. Report by BTO. Report for The Crown Estate
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- ⁵ Johnston, A., Cook, A.S.C.P., Wright, L.J., Humphreys, E.M. and Burton, N.H.K. (2014b) 'Corrigendum to Modelling flight heights of marine birds to more accurately assess collision risk with offshore wind turbines'. Journal of Applied Ecology 51: 1126–1130
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