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## **Volume 7B Proposed Development (Offshore) Appendices**

Appendix 6-2 Offshore Ornithology Distributional Responses Technical Report

Caledonia Offshore Wind Farm Ltd

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# Volume 7B Appendix 6-2 Offshore Ornithology Distributional Responses Technical Report

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# Table of Contents

1	Introduction .....	1
2	Methodology.....	3
2.1	Guidance and Assessment .....	3
2.2	Species for Inclusion in Assessment .....	3
2.3	Spatial Scales.....	4
2.4	Abundance of Birds.....	4
2.5	Displacement and Mortality Rates .....	8
2.6	Seasonal Considerations.....	9
3	Results .....	11
3.1	Overview .....	11
3.2	Kittiwake .....	11
3.3	Guillemot.....	14
3.4	Razorbill .....	17
3.5	Puffin .....	20
3.6	Gannet.....	23
4	Summary.....	26
5	References .....	30

## List of Figures

Figure 1-1: Location of the Caledonia OWF, Caledonia North and Caledonia South, and Offshore Export Cable Corridor. .... 2

## List of Tables

Table 2–1: Monthly apportioned abundance estimates (design-based) of birds (in flight and on sea, and accounting for availability bias of birds on the water in the case of guillemot, razorbill and puffin) within the boundaries of the Caledonia OWF (+2km buffer), included in the distributional response assessment, derived from the 24 months of DAS data. ....	5
Table 2–2: Monthly apportioned abundance estimates (design-based) of birds (in flight and on sea, and accounting for availability bias of birds on the water in the case of guillemot, razorbill and puffin) within the boundaries of the Caledonia North Site (+2km buffer), included in the distributional response assessment, derived from the 24 months of DAS data. ....	6
Table 2–3: Monthly apportioned abundance estimates (design-based) of birds (in flight and on sea, and accounting for availability bias of birds on the water in the case of guillemot, razorbill and puffin) within the boundaries of the Caledonia South Site (+2km buffer), included in the distributional response assessment, derived from the 24 months of DAS data. ....	7
Table 2–4: Displacement and mortality rates used in the Matrix-based Method for the NatureScot Guidance Approach and the Applicant Approach. ....	8
Table 2–5: Defined seasons in the Scottish Marine Environment used in the assessment (NatureScot, 2020). ....	9
Table 2–6: Non-breeding season BDMPS periods based on Furness (2015) used in the assessment. ....	10
Table 3–1: Mean seasonal peaks of kittiwake within the Caledonia OWF (+2km buffer), Caledonia North Site (+2km buffer) and Caledonia South Site (+2km buffer), during the NatureScot (2020) defined seasons and the BDMPS non-breeding seasons as per Furness (2015). ....	12
Table 3–2: Estimated mortality of kittiwake following displacement from the Caledonia OWF (+2km buffer), Caledonia North Site (+2km buffer) and Caledonia South Site (+2km buffer) during the NatureScot (2020) defined seasons and the BDMPS non-breeding seasons as per Furness (2015). ....	13
Table 3–3: Mean seasonal peaks of guillemot within the Caledonia OWF (+2km buffer), Caledonia North Site (+2km buffer) and Caledonia South Site (+2km buffer), during the NatureScot (2020) defined seasons. ....	15
Table 3–4: Estimated mortality of guillemot following displacement from Caledonia OWF (+2km buffer), Caledonia North Site (+2km buffer) and	

Caledonia South Site (+2km buffer) during the NatureScot (2020) defined seasons. ....16

Table 3–5: Mean seasonal peaks of razorbill within the Caledonia OWF (+2km buffer), Caledonia North Site (+2km buffer) and Caledonia South Site (+2km buffer), during the NatureScot (2020) defined seasons and the BDMPS non-breeding seasons as per Furness (2015).....18

Table 3–6: Estimated mortality of razorbill following displacement from the Caledonia OWF (+2km buffer), Caledonia North Site (+2km buffer) and Caledonia South Site (+2km buffer) during the NatureScot (2020) defined seasons and the BDMPS non-breeding seasons as per Furness (2015).....19

Table 3–7: Mean seasonal peaks of puffin within the Caledonia OWF (+2km buffer), Caledonia North Site (+2km buffer) and Caledonia South Site (+2km buffer), during the NatureScot (2020) defined seasons. ....21

Table 3–8: Estimated mortality of puffin following displacement from the Caledonia OWF (+2km buffer), Caledonia North Site (+2km buffer) and Caledonia South Site (+2km buffer) during the NatureScot (2020) defined seasons. ....22

Table 3–9: Mean seasonal peaks of gannet within the Caledonia OWF (+2km buffer), Caledonia North Site (+2km buffer) and Caledonia South Site (+2km buffer), during the NatureScot (2020) defined seasons and the BDMPS non-breeding seasons as per Furness (2015).....24

Table 3–10: Estimated mortality of gannet following displacement from the Caledonia OWF (+2km buffer), Caledonia North Site (+2km buffer) and Caledonia South Site (+2km buffer) during the NatureScot (2020) defined seasons and the BDMPS non-breeding seasons as per Furness (2015).....25

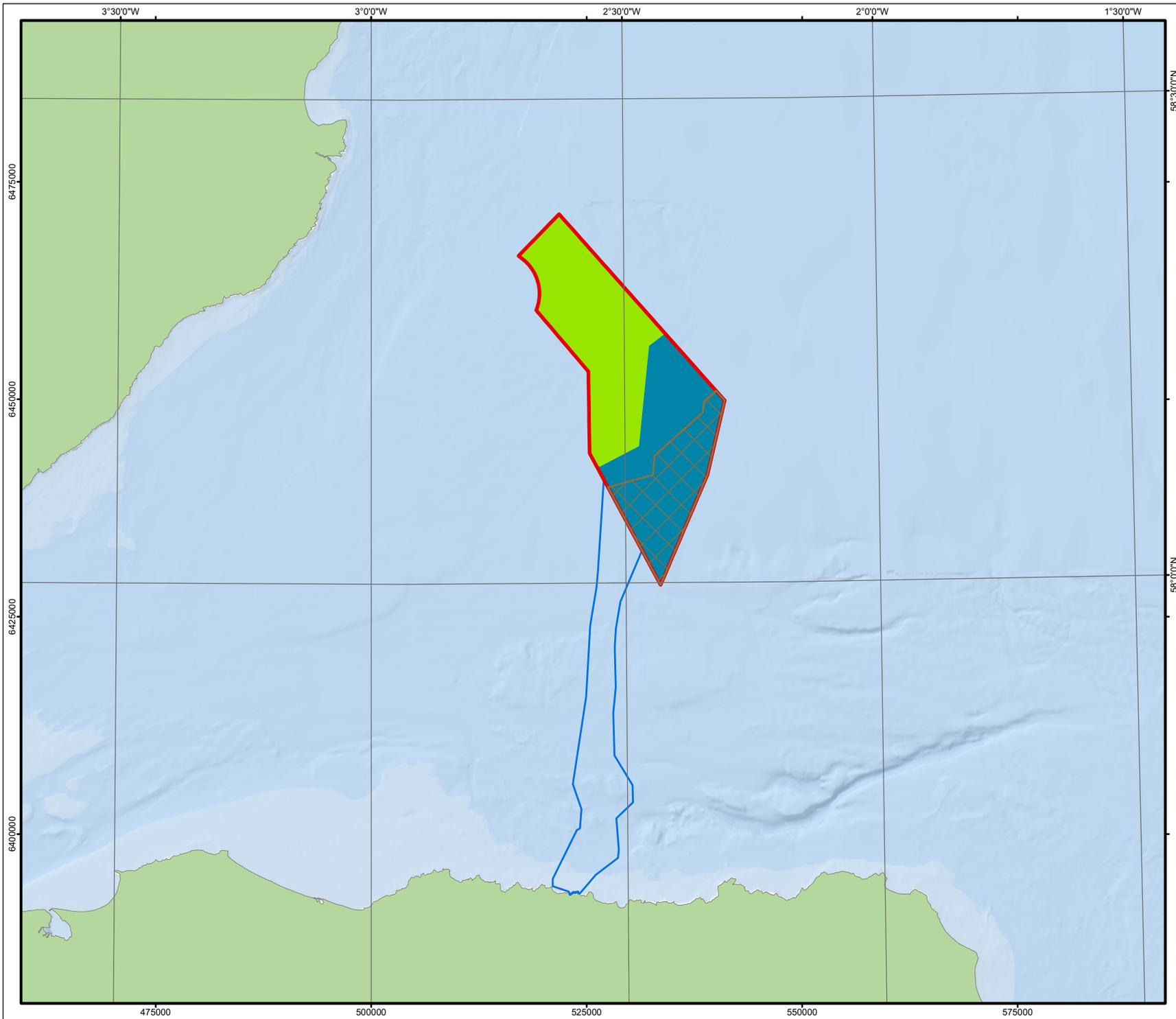
Table 4–1: Estimated mortality of key species following displacement from the Caledonia OWF (+2km buffer), Caledonia North Site (+2km buffer) and Caledonia South Site (+2km buffer) during the NatureScot (2020) defined seasons and the BDMPS non-breeding seasons as per Furness (2015).....27

## Acronyms and Abbreviations

<b>BDMPS</b>	Biologically Defined Minimum Population Scales
<b>DAS</b>	Digital Aerial Survey
<b>EIAR</b>	Environmental Impact Assessment Report
<b>MHS</b>	Mean High-Water Springs
<b>OWF</b>	Offshore Wind Farm
<b>SNCB</b>	Statutory Nature Conservation Body

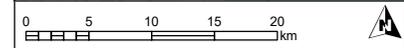
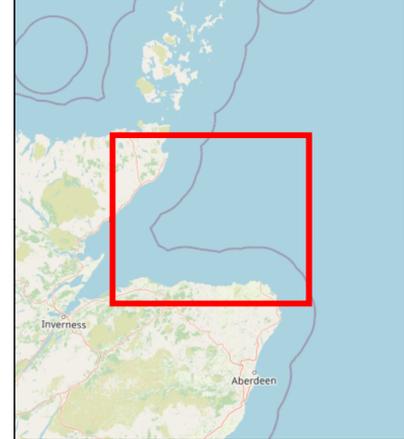
# 1 Introduction

- 1.1.1.1 This appendix provides the background information and methodology of the distributional responses assessment 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 disturbance/displacement 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 A distributional responses assessment has been carried out to estimate the potential risk of disturbance and displacement to ornithological receptors for all spatial extents. Separate assessments are provided for the Caledonia North Site, Caledonia South Site and the Caledonia OWF (i.e., the Caledonia North Site and Caledonia South Site combined), plus 2km buffers. Due to the potential for double counting and over-estimating potential impacts, estimated mortalities for the Caledonia OWF (+2km buffer) have been progressed within the cumulative and in-combination assessments.
- 1.1.1.4 The distributional responses assessment has been carried out following NatureScot (2023<sup>1</sup>) guidance, with any changes to this guidance having been discussed and agreed in advance with NatureScot. This approach will be referred to as the 'Guidance Approach' with any alternative approaches to assessment referred to as the 'Applicant Approach'. The Applicant Approach, which is being proposed by Caledonia Offshore Wind Farm Limited (i.e., the Applicant), presents an assessment which is methodologically identical to the Guidance Approach, but with a selection of input parameters changed to reflect parameters used within other OWF projects, and evidence from other OWFs within the Moray Firth.



- Caledonia OWF
- Caledonia North Array Area
- Caledonia South Array Area
- Proposed Floating Area
- Offshore Export Cable Corridor

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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
DRAWING NUMBER: N/A	SHEET NO: 01 of 01   REV: N/A

## 2 Methodology

### 2.1 Guidance and Assessment

- 2.1.1.1 The assessment presented within this Technical Report is primarily based on the NatureScot Guidance Note 8 (NatureScot, 2023<sup>1</sup>) regarding a Matrix-based method to assessment presented in the Joint Statutory Nature Conservation Body (SNCB) Interim Advice Note (SNCB, 2022<sup>2</sup>).
- 2.1.1.2 In addition to the Matrix-based method for all relevant species and seasons, estimation of potential displacement effects during the breeding season for a limited number of species using the SeabORD modelling tool (Searle *et al.*, 2018<sup>3</sup>) is recommended within the guidance note. However, due to technical challenges when using the SeabORD tool, this additional assessment could not be completed.

### 2.2 Species for Inclusion in Assessment

- 2.2.1.1 The list of five seabird species taken forward for assessment was discussed and agreed through consultation with NatureScot.
- 2.2.1.2 The data used to identify species requiring assessment was collected over a 24-month Digital Aerial Survey (DAS) programme within the Caledonia OWF (i.e., Array Area) and a 4km buffer (May 2021 to April 2023). The analysis of the survey data was undertaken for the Caledonia OWF, Caledonia North Site and Caledonia South Site separately. Density and abundance estimates of bird species were calculated using both design-based and model-based approaches. The distributional responses assessment has been run using the design-based and/or the model-based density estimates, with the full justification for this outlined in Volume 7B, Appendix 6-1: Offshore Ornithology Baseline Characterisation Report. This approach was presented to NatureScot (01 July 2024) and agreed with NatureScot within in an email dated 07 August 2024.
- 2.2.1.3 Five seabird species have been identified as requiring consideration of potential displacement risk in relation to the Proposed Development (Offshore). These are as follows:
- Kittiwake (*Rissa tridactyla*);
  - Common guillemot (*Uria aalge*), hereafter 'guillemot';
  - Razorbill (*Alca torda*);
  - Puffin (*Fratercula arctica*); and
  - Gannet (*Morus bassanus*).

## 2.3 Spatial Scales

2.3.1.1 As outlined above, the offshore ornithology displacement assessment has been carried out separately for the Caledonia OWF, Caledonia North Site and Caledonia South Site. As such displacement matrices were formulated for the following spatial scales, following the joint SNCB interim advice (SNCB, 2022<sup>2</sup>):

- Caledonia OWF plus a 2km buffer;
- Caledonia North Site plus a 2km buffer; and
- Caledonia South Site plus a 2km buffer.

## 2.4 Abundance of Birds

2.4.1.1 Monthly apportioned abundance estimates of birds (in flight and on sea, and accounting for availability bias of birds on the water in the case of guillemot, razorbill and puffin) within the boundaries of the Caledonia OWF, Caledonia North Site and Caledonia South Site, and their associated buffers, were determined using the 24 months of DAS data (see Section 2.2; also see Volume 7B, Appendix 6-1: Offshore Ornithology Baseline Characterisation Report). Mean monthly outputs are presented in Table 2-1, Table 2-2 and Table 2-3 for the Caledonia OWF, Caledonia North Site and Caledonia South Site, respectively.

2.4.1.2 The collection of DAS data started in May 2021. As per the NatureScot (2020)<sup>4</sup> Seasonal Definition Guidance, the majority of species-specific breeding seasons begin in April (or end of March for gannet) (see Section 0). When calculating the mean seasonal peaks for the distributional assessment, the survey in April 2023 has been combined with the Year 1 data in order to align with the defined breeding seasons. This approach provides two full years' worth of data covering the biologically relevant seasonal periods (Table 2-5).

Table 2-1: Monthly apportioned abundance estimates (design-based) of birds (in flight and on sea, and accounting for availability bias of birds on the water in the case of guillemot, razorbill and puffin) within the boundaries of the Caledonia OWF (+2km buffer), included in the distributional response assessment, derived from the 24 months of DAS data.

Species	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Kittiwake	1	40	120	106	691	931	1,560	3,811	907	741	345	578	121
	2	17	109	65	488	3,472	4,142	1,912	623	225	140	87	27
Guillemot	1	669	1,493	745	3,137	12,171	7,235	15,538	1,050	4,536	1,620	2,270	800
	2	813	2,419	3,304	1,942	19,546	13,314	11,529	981	11,408	979	94	529
Razorbill	1	63	627	93	600	974	886	1,437	921	449	72	0	314
	2	126	334	432	774	2,205	172	1,094	444	3,232	54	191	114
Puffin	1	0	0	14	53	491	364	527	3,583	122	245	0	0
	2	20	47	75	957	1,057	100	183	652	2,426	0	0	0
Gannet	1	11	21	5	79	63	528	122	280	379	525	74	23
	2	12	34	6	28	97	1,289	253	63	491	105	6	18

Note, DAS surveys were undertaken from May 2021 to April 2023 as such January to April 2023 has been added to the beginning of Year 1 for consistency of breeding seasons (see Section 2.2; also see Volume 7B, Appendix 6-1: Offshore Ornithology Baseline Characterisation Report).

Table 2-2: Monthly apportioned abundance estimates (design-based) of birds (in flight and on sea, and accounting for availability bias of birds on the water in the case of guillemot, razorbill and puffin) within the boundaries of the Caledonia North Site (+2km buffer), included in the distributional response assessment, derived from the 24 months of DAS data.

Species	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Kittiwake	1	28	94	75	51	354	220	997	295	74	200	548	91
	2	12	57	34	130	2,648	987	487	291	93	18	63	14
Guillemot	1	237	558	249	491	3,034	2,333	4,555	168	766	328	977	320
	2	348	1,082	1,918	810	12,962	4,919	3,078	198	703	303	64	255
Razorbill	1	10	454	57	69	465	246	413	404	192	10	0	116
	2	54	92	236	394	1,618	86	427	220	2,438	70	135	56
Puffin	1	0	0	0	14	276	135	183	2,385	49	105	0	0
	2	21	27	49	526	537	33	68	151	1,372	0	0	0
Gannet	1	0	0	0	0	40	272	29	113	233	349	29	11
	2	6	29	0	17	23	208	74	34	163	41	0	6
<p>Note, DAS surveys were undertaken from May 2021 to April 2023 as such January to April 2023 has been added to the beginning of Year 1 for consistency of breeding seasons (see Section 2.2; also see Volume 7B, Appendix 6-1: Offshore Ornithology Baseline Characterisation Report)</p>													

Table 2-3: Monthly apportioned abundance estimates (design-based) of birds (in flight and on sea, and accounting for availability bias of birds on the water in the case of guillemot, razorbill and puffin) within the boundaries of the Caledonia South Site (+2km buffer), included in the distributional response assessment, derived from the 24 months of DAS data.

Species	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Kittiwake	1	11	32	42	644	648	1,386	3,480	694	705	162	177	58
	2	6	57	41	412	1,159	3,492	1,649	411	149	138	52	25
Guillemot	1	512	1,033	606	2,804	9,720	5,537	12,351	1,099	4,034	1,403	1,598	549
	2	588	1,612	1,933	1,537	7,942	9,237	9,395	811	10,674	799	50	358
Razorbill	1	55	241	45	545	551	682	1,160	445	320	72	0	233
	2	78	249	261	422	830	84	771	297	1,286	8	95	68
Puffin	1	0	0	14	40	304	331	421	2,093	88	179	0	0
	2	0	27	34	502	634	80	128	581	1,358	0	0	0
Gannet	1	11	21	5	78	29	302	93	212	150	267	52	12
	2	11	11	6	17	75	1,113	220	51	388	98	6	12

Note, DAS surveys were undertaken from May 2021 to April 2023 as such January to April 2023 has been added to the beginning of Year 1 for consistency of breeding seasons (see Section 2.2; also see Volume 7B, Appendix 6-1: Offshore Ornithology Baseline Characterisation Report).

## 2.5 Displacement and Mortality Rates

### 2.5.1.1

Table 2–4 presents the Matrix-based Method displacement and mortality rates used in the Guidance Approach and the Applicant Approach. Displacement and mortality rates used in both approaches are highlighted in the species-specific matrices presented in the following annexes:

- Volume 7B, Appendix 6-2, Annex 1: Distributional Responses Results (Caledonia OWF);
- Volume 7B, Appendix 6-2, Annex 2: Distributional Responses Results (Caledonia North); and
- Volume 7B, Appendix 6-2, Annex 3: Distributional Responses Results (Caledonia South).

### 2.5.1.2

For a detailed justification of the displacement and mortality rates selected for the Applicant Approach, see Volume 7B, Appendix 6-2, Annex 4: Review of Relevant Evidence.

Table 2–4: Displacement and mortality rates used in the Matrix-based Method for the NatureScot Guidance Approach and the Applicant Approach.

Species	Displacement Rate	Mortality Rate – Breeding Season	Mortality Rate – Non-breeding Season
<b>Guidance Approach</b>			
Guillemot, Razorbill and Puffin	60%	3% and 5%	1% and 3%
Kittiwake	30%	1% and 3%	1% and 3%
Gannet	70%	1% and 3%	1% and 3%
<b>Applicant Approach</b>			
Guillemot and Razorbill	50%	1%	1%
Puffin	50%	1%	Not Assessed
Kittiwake		Not Assessed	
Gannet	70%	1%	1%

## 2.6 Seasonal Considerations

2.6.1.1 The results of the displacement assessment are presented by season, primarily using the seasonal definitions as per NatureScot (2020<sup>4</sup>) (see Table 2-5). Results for the non-breeding season have also been presented using the defined seasons in Furness (2015<sup>5</sup>), modified to align with the NatureScot breeding season periods (Table 2-6).

Table 2-5: Defined seasons in the Scottish Marine Environment used in the assessment (NatureScot, 2020<sup>4</sup>).

Species	Breeding Season	Post-breeding Season Migration	Non-breeding Season	Pre-breeding Migration Season
Kittiwake	<b>Mid-April to August</b>	-	<b>September to early April</b>	Early April
Guillemot	<b>April to mid-August</b>	Late-August to mid-October (flightless moult August to mid-October)	<b>Late August to March</b>	February to March
Razorbill	<b>April to mid-August</b>	Late-August to November (flightless moult August to November)	<b>Late August to March</b>	March
Puffin	<b>April to Mid-August</b>	Late August	<b>Late August to March</b>	Late March (flightless moult February to mid-March)
Gannet	<b>Mid-March to September</b>	-	<b>October to early March</b>	Mid-February to early-March

Note, time periods in **bold** are those used by the assessment.

Table 2–6: Non-breeding season BDMPs periods based on Furness (2015<sup>5</sup>) used in the assessment.

Species	Autumn Migration	Winter Period	Spring Migration	Non-breeding
Kittiwake	<b>September to December</b> (August to December)	-	<b>January to mid-April</b> (January to April)	-
Guillemot	-	-	-	Late-August to March (August to February)
Razorbill	<b>Late-August to October</b> (August to October)	<b>November to December</b>	<b>January to March</b>	-
Puffin	-	-	-	Late-August to March
Gannet	<b>October to November</b> (September to November)	-	<b>December to mid-March</b> (December to March)	-
<p>Seasonal definitions have been modified to align with the NatureScot breeding season periods (see Table 2–5), with the original definitions as per Furness (2015<sup>5</sup>) provided in parentheses where different. Species and seasonal definitions used for additional assessment are in bold.</p>				

## 3 Results

### 3.1 Overview

3.1.1.1 The following sections provide an overview of the estimated mortalities for each species and relevant defined seasons within the Caledonia OWF (plus a 2km buffer), Caledonia North Site (plus a 2km buffer) and Caledonia South Site (plus a 2km buffer). For the full matrix assessment tables, refer to the following annexes:

- Volume 7B, Appendix 6-2, Annex 1: Distributional Responses Results (Caledonia OWF);
- Volume 7B, Appendix 6-2, Annex 2: Distributional Responses Results (Caledonia North); and
- Volume 7B, Appendix 6-2, Annex 3: Distributional Responses Results (Caledonia South).

### 3.2 Kittiwake

3.2.1.1 The mean seasonal peaks of kittiwake (based on seasonal definitions presented in Table 2–5 and Table 2–6) are presented in Table 3–1 within the Caledonia OWF (plus a 2km buffer), Caledonia North Site (plus a 2km buffer) and Caledonia South Site (plus a 2km buffer).

3.2.1.2 When using the Furness (2015<sup>5</sup>) defined seasons, it should be noted the Applicant has decided to include the Year 3 April count (04 April 2023) in the breeding season rather than during the spring migration breeding season. This is due to the April 2023 abundance being considered to reflect nest site attendance rather than individuals present in the spring migration.

3.2.1.3 The estimated seasonal mortality of kittiwake following displacement from the Caledonia OWF (plus a 2km buffer), Caledonia North Site (plus a 2km buffer) and Caledonia South Site (plus a 2km buffer) are presented within Table 3–2 as per the displacement and mortalities rates detailed in Table 2–4 for the Guidance Approach.

Table 3-1: Mean seasonal peaks of kittiwake within the Caledonia OWF (+2km buffer), Caledonia North Site (+2km buffer) and Caledonia South Site (+2km buffer), during the NatureScot (2020<sup>4</sup>) defined seasons and the BDMPS non-breeding seasons as per Furness (2015<sup>5</sup>).

Defined Season	Caledonia OWF (+2km buffer)	Caledonia North Site (+2km buffer)	Caledonia South Site (+2km buffer)
<b>NatureScot Seasons</b>			
Breeding season (Mid-April to August)*	2,039 (1,868 July 2021 / 2,210 July 2022)	710 (426 August 2021 / 995 July 2022)	1,530 (1,650 July 2021 / 1,410 July 2022)
Non-breeding season (September to early-April)	483 (741 September 2021/ 225 September 2022)	321 (548 November 2021 / 93 September 2022)	427 (705 September 2021 / 149 September 2022)
<b>BDMPS Non-breeding Seasons</b>			
Autumn migration (September to December)	483 (741 September 2021/ 225 September 2022)	321 (548 November 2021 / 93 September 2022)	427 (705 September 2021 / 149 September 2022)
Spring migration (January to mid-April)	115 (120 February 2022 / 109 February 2023)	76 (94 February 2022 / 57 February 2023)	50 (42 March 2022 / 57 February 2023)
<p>Note, the seasonal peaks from Year 1 and Year 2 of DAS data used to calculate the mean seasonal peaks are provided within the brackets. Note, '*' identifies seasons for which model-based density estimates were used (see Volume 7B, Appendix 6-1: Offshore Ornithology Baseline Characterisation Report for full justification).</p>			

Table 3–2: Estimated mortality of kittiwake following displacement from the Caledonia OWF (+2km buffer), Caledonia North Site (+2km buffer) and Caledonia South Site (+2km buffer) during the NatureScot (2020<sup>4</sup>) defined seasons and the BDMPS non-breeding seasons as per Furness (2015<sup>5</sup>).

Defined Season	Caledonia OWF (+2km buffer) – Guidance Approach	Caledonia North Site (+2km buffer) – Guidance Approach	Caledonia South Site (+2km buffer) – Guidance Approach
<b>NatureScot Seasons</b>			
Breeding season*	6 / 18	2 / 6	5 / 14
Non-breeding season	1 / 4	1 / 3	1 / 4
<b>BDMPS Non-breeding Seasons</b>			
Autumn migration	1 / 4	1 / 3	1 / 4
Spring migration	0 / 1	0 / 1	0 / 0
<p>Note, estimated mortality as per the displacement and mortality rates presented in Table 2–4. Estimates are separated by a '/' where the NatureScot (2020) guidance instructs the use of multiple mortality rates. The Guidance Approach displacement rate is 30% and mortality rates are as follows: 1% and 3% (breeding season) and 1% and 3% (non-breeding season).</p> <p>Note, '*' identifies seasons for which model-based density estimates were used (see Volume 7B, Appendix 6-1: Offshore Ornithology Baseline Characterisation Report for full justification).</p>			

### 3.3 Guillemot

- 3.3.1.1 The mean seasonal peaks of guillemot (based on seasonal definitions presented in Table 2–5) are presented in Table 3–3 within the Caledonia OWF (plus a 2km buffer), Caledonia North Site (plus a 2km buffer) and Caledonia South Site (plus a 2km buffer).
- 3.3.1.2 The estimated seasonal mortality of guillemot following displacement from the Caledonia OWF (plus a 2km buffer), Caledonia North Site (plus a 2km buffer) and Caledonia South Site (plus a 2km buffer) are presented in Table 3–4 as per the displacement and mortalities rates detailed in Table 2–4 for both the Guidance and Applicant Approaches.

Table 3-3: Mean seasonal peaks of guillemot within the Caledonia OWF (+2km buffer), Caledonia North Site (+2km buffer) and Caledonia South Site (+2km buffer), during the NatureScot (2020<sup>4</sup>) defined seasons.

Defined Season	Caledonia OWF (+2km buffer)	Caledonia North Site (+2km buffer)	Caledonia South Site (+2km buffer)
<b>NatureScot Seasons</b>			
Breeding season (April to mid-August)*	16,092 (15,457 July 2021 / 16,727 May 2022)	7,220 (3,959 July 2021 / 10,481 May 2022)	11,323 (12,725 July 2021 / 9,921 July 2022)
Non-breeding season (Late-August to March)*	6,710 (4,705 September 2021 / 8,715 September 2022)	1,432 (1,593 November 2021 / 1,271 March 2023)	5,788 (3,487 September 2021 / 8,088 September 2022)
<p>Note, the seasonal peaks from Year 1 and Year 2 of DAS data used to calculate the mean seasonal peaks are provided within the brackets. Note, '*' identifies seasons for which model-based density estimates we used (see Volume 7B, Appendix 6-1: Offshore Ornithology Baseline Characterisation Report for full justification).</p>			

Table 3-4: Estimated mortality of guillemot following displacement from Caledonia OWF (+2km buffer), Caledonia North Site (+2km buffer) and Caledonia South Site (+2km buffer) during the NatureScot (2020<sup>4</sup>) defined seasons.

Defined Season	Caledonia OWF (+2km buffer)		Caledonia North Site (+2km buffer)		Caledonia South Site (+2km buffer)	
	Guidance Approach	Applicant Approach	Guidance Approach	Applicant Approach	Guidance Approach	Applicant Approach
<b>NatureScot Seasons</b>						
Breeding season*	290 / 483	80	130 / 217	36	130 / 217	57
Non-breeding season*	40 / 121	34	9 / 26	7	35 / 104	29
<p>Note, estimated mortality as per the displacement and mortality rates presented in Table 2-4. Estimates are separated by a '/' where the NatureScot (2020) guidance instructs the use of multiple mortality rates. The Guidance Approach displacement rate is 60% and mortality rates are as follows: 3% and 5% (breeding season) and 1% and 3% (non-breeding season). The Applicant Approach displacement rate is 50% and mortality rate is 1% (in the breeding and non-breeding season).</p> <p>Note, '*' identifies seasons for which model-based density estimates we used (see Volume 7B, Appendix 6-1: Offshore Ornithology Baseline Characterisation Report for full justification).</p>						

## 3.4 Razorbill

- 3.4.1.1 The mean seasonal peaks of razorbill (based on seasonal definitions presented in Table 2-5 Table 2-5Table 2-6) are presented in Table 3-5 within the Caledonia OWF (plus a 2km buffer), Caledonia North Site (plus a 2km buffer) and Caledonia South Site (plus a 2km buffer).
- 3.4.1.2 The estimated seasonal mortality of razorbill following displacement from the Caledonia OWF (plus a 2km buffer), Caledonia North Site (plus a 2km buffer) and Caledonia South Site (plus a 2km buffer) are presented in Table 3-6 as per the displacement and mortalities rates detailed in Table 2-4 for both the Guidance and Applicant Approaches.

Table 3-5: Mean seasonal peaks of razorbill within the Caledonia OWF (+2km buffer), Caledonia North Site (+2km buffer) and Caledonia South Site (+2km buffer), during the NatureScot (2020<sup>4</sup>) defined seasons and the BDMPS non-breeding seasons as per Furness (2015<sup>5</sup>).

Defined Season	Caledonia OWF (+2km buffer)	Caledonia North Site (+2km buffer)	Caledonia South Site (+2km buffer)
<b>NatureScot Seasons</b>			
Breeding season (April to mid-August)*	1,762 (1,510 July 2021 / 2,014 May 2022)	879 (527 June 2021 / 1,232 May 2022)	1,089 (1,156 July 2021 / 1,022 May 2022)
Non-breeding season (Late-August to March)	1,930 (627 February 2022 / 3,232 September 2022)	1,446 (454 February 2022 / 2,438 September 2022)	803 (320 September 2021 / 1,286 September 2022)
<b>BDMPS Non-breeding Seasons</b>			
Autumn migration (Late-August to October)	1,841 (449 September 2021 / 3,232 September 2022)	1,315 (192 September 2021 / 2,438 September 2022)	803 (320 September 2021 / 1,286 September 2022)
Winter period (November to December)	253 (314 December 2021 / 191 November 2022)	126 (116 December 2021 / 135 November 2022)	164 (233 December 2021/ 95 November 2022)
Spring migration (January to March)	530 (627 February 2022 / 432 March 2023)	345 (454 February 2022 / 236 March 2023)	251 (241 February 2022 / 261 March 2023)
<p>Note, the seasonal peaks from Year 1 and Year 2 of DAS data used to calculate the mean seasonal peaks are provided within the brackets. Note '*' identifies seasons for which model-based density estimates we used (see Volume 7B, Appendix 6-1: Offshore Ornithology Baseline Characterisation Report for full justification).</p>			

Table 3–6: Estimated mortality of razorbill following displacement from the Caledonia OWF (+2km buffer), Caledonia North Site (+2km buffer) and Caledonia South Site (+2km buffer) during the NatureScot (2020<sup>4</sup>) defined seasons and the BDMPS non-breeding seasons as per Furness (2015<sup>5</sup>).

Defined Season	Caledonia OWF (+2km buffer)		Caledonia North Site (+2km buffer)		Caledonia South Site (+2km buffer)	
	Guidance Approach	Applicant Approach	Guidance Approach	Applicant Approach	Guidance Approach	Applicant Approach
<b>NatureScot Seasons</b>						
Breeding season*	32 / 53	9	16 / 26	4	20 / 33	5
Non-breeding season	12 / 35	10	9 / 26	7	5 / 14	4
<b>BDMPS Non-breeding Seasons</b>						
Autumn migration	11 / 33	9	8 / 24	7	5 / 14	4
Winter period	2 / 5	1	1 / 2	1	1 / 3	1
Spring migration	3 / 10	3	2 / 6	2	2 / 5	1
<p>Note, estimated mortality as per the displacement and mortality rates presented in Table 2–4. Estimates are separated by a '/' where the NatureScot (2020) guidance instructs the use of multiple mortality rates. The Guidance Approach displacement rate is 60% and mortality rates are as follows: 3% and 5% (breeding season) and 1% and 3% (non-breeding season). The Applicant Approach displacement rate is 50% and the mortality rate is 1% (breeding season and non-breeding season).</p> <p>Note, '*' identifies seasons for which model-based density estimates we used (see Volume 7B, Appendix 6-1: Offshore Ornithology Baseline Characterisation Report for full justification).</p>						

## 3.5 Puffin

- 3.5.1.1 The mean seasonal peaks of puffin (based on seasonal definitions presented in Table 2–5Table 2–5) are presented in Table 3–7 within the Caledonia OWF (plus a 2km buffer), Caledonia North Site (plus a 2km buffer) and Caledonia South Site (plus a 2km buffer).
- 3.5.1.2 It should be noted the Applicant has decided to include the Year 1 August count in the non-breeding season rather than during the breeding season. This is due to the Year 1 August abundance being considered to reflect migration rather than individuals present in the breeding season. The mean seasonal peaks for puffin have also been presented with the August count included in the breeding season as per the Guidance Approach (see Table 3–7).
- 3.5.1.3 The estimated seasonal mortality of puffin following displacement from the Caledonia OWF (plus a 2km buffer), Caledonia North Site (plus a 2km buffer) and Caledonia South Site (plus a 2km buffer) are presented in Table 3–8 as per the displacement and mortalities rates detailed in Table 2–4 for both the Guidance and Applicant Approach.

Table 3-7: Mean seasonal peaks of puffin within the Caledonia OWF (+2km buffer), Caledonia North Site (+2km buffer) and Caledonia South Site (+2km buffer), during the NatureScot (2020<sup>4</sup>) defined seasons.

Defined Season	Caledonia OWF (+2km buffer)		Caledonia North Site (+2km buffer)		Caledonia South Site (+2km buffer)	
	Guidance Approach	Applicant Approach	Guidance Approach	Applicant Approach	Guidance Approach	Applicant Approach
<b>NatureScot Seasons</b>						
Breeding season (April to mid-August)*	2,061 (3,226 August 2022 / 896 May 2022)	698 (500 July 2021 / 896 May 2022)	1,309 (2,138 August 2021 / 479 April 2022)	367 (255 May 2021/ 479 April 2022)	1,209 (1,773 August 2021/ 644 May 2022)	514 (384 July 2021 / 644 May 2022)
Non-breeding season (Late-August to March)	1,336 (245 October 2021 / 2,426 September 2022)	3,005 (3,583 August 2021 / 2,426 September 2022)	739 (105 October 2021 / 1,372 September 2022)	1,879 (2,385 August 2021/ 1,372 September 2022)	769 (179 October 2021 / 1,358 September 2022)	1,726 (2,093 August 2021 / 1,358 September 2022)
<p>Note, the seasonal peaks from Year 1 and Year 2 of DAS data used to calculate the mean seasonal peaks are provided within the brackets. Note, '*' identifies seasons for which model-based density estimates we used (see Volume 7B, Appendix 6-1: Offshore Ornithology Baseline Characterisation Report for full justification).</p>						

Table 3–8: Estimated mortality of puffin following displacement from the Caledonia OWF (+2km buffer), Caledonia North Site (+2km buffer) and Caledonia South Site (+2km buffer) during the NatureScot (2020<sup>4</sup>) defined seasons.

Defined Season	Caledonia OWF (+2km buffer)		Caledonia North Site (+2km buffer)		Caledonia South Site (+2km buffer)	
	Guidance Approach	Applicant Approach	Guidance Approach	Applicant Approach	Guidance Approach	Applicant Approach
<b>NatureScot Seasons</b>						
Breeding season*	37 / 62	3	24 / 39	2	22 / 36	3
Non-breeding season	8 / 24	-	4 / 13	-	5 / 14	-
<p>Note, estimated mortality as per the displacement and mortality rates presented in Table 2–4. Estimates are separated by a '/' where the NatureScot (2020) guidance instructs the use of multiple mortality rates. The Guidance Approach displacement rate is 60% and mortality rates are as follows: 3% and 5% (breeding season) and 1% and 3% (non-breeding season). The Applicant Approach displacement rate is 50% and the mortality rate is 1% (breeding season) with puffin not being assessed during the non-breeding season.</p> <p>Note, '-' identifies seasons for which no assessment was undertaken, as such it was considered reasonable to assume no displacement will occur at this time of year.</p> <p>Note, '*' identifies seasons for which model-based density estimates we used (see Volume 7B, Appendix 6-1: Offshore Ornithology Baseline Characterisation Report for full justification).</p>						

## 3.6 Gannet

- 3.6.1.1 The mean seasonal peaks of gannet (based on seasonal definitions presented in Table 2–5Table 2–5) are presented in Table 3–9 within the Caledonia OWF (plus a 2km buffer), Caledonia North Site (plus a 2km buffer) and Caledonia South Site (plus a 2km buffer).
- 3.6.1.2 The estimated seasonal mortality of gannet following displacement from the Caledonia OWF (plus a 2km buffer), Caledonia North Site (plus a 2km buffer) and Caledonia South Site (plus a 2km buffer) are presented in Table 3–10 as per the displacement and mortalities rates detailed in Table 2–4 for both the Guidance and Applicant Approach.

Table 3-9: Mean seasonal peaks of gannet within the Caledonia OWF (+2km buffer), Caledonia North Site (+2km buffer) and Caledonia South Site (+2km buffer), during the NatureScot (2020<sup>4</sup>) defined seasons and the BDMPS non-breeding seasons as per Furness (2015<sup>5</sup>).

Defined Season	Caledonia OWF (+2km buffer)	Caledonia North Site (+2km buffer)	Caledonia South Site (+2km buffer)
<b>NatureScot Seasons</b>			
Breeding season (Mid-March to September)	909 (528 June 2021/ 1,289 June 2022)	240 (272 June 2021 / 208 June 2022)	708 (302 June 2021 / 1,113 June 2022)
Non-breeding season (October to early-March)	315 (525 October 2021 / 105 October 2022)	195 (349 October 2021 / 41 October 2022)	183 (267 October 2021 / 98 October 2022)
<b>BDMPS Non-breeding Seasons</b>			
Autumn migration (October to November)	315 (525 October 2021 / 105 October 2022)	195 (349 October 2021 / 41 October 2022)	183 (267 October 2021 / 98 October 2022)
Spring migration (December to mid-March)	29 (23 December 2021 / 34 February 2023)	20 (11 December 2021 / 29 February 2023)	17 (21 February 2022 / 12 December 2022)
Note, the seasonal peaks from Year 1 and Year 2 of DAS data used to calculate the mean seasonal peaks are provided within the brackets.			

Table 3–10: Estimated mortality of gannet following displacement from the Caledonia OWF (+2km buffer), Caledonia North Site (+2km buffer) and Caledonia South Site (+2km buffer) during the NatureScot (2020<sup>4</sup>) defined seasons and the BDMPS non-breeding seasons as per Furness (2015<sup>5</sup>).

Defined Season	Caledonia OWF (+2km buffer)		Caledonia North Site (+2km buffer)		Caledonia South Site (+2km buffer)	
	Guidance Approach	Applicant Approach	Guidance Approach	Applicant Approach	Guidance Approach	Applicant Approach
<b>NatureScot Seasons</b>						
Breeding season	6 / 19	6	2 / 5	2	5 / 15	5
Non-breeding season	2 / 7	2	1 / 4	1	1 / 4	1
<b>BDMPS Non-breeding Seasons</b>						
Autumn migration	2 / 7	2	1 / 4	1	1 / 4	1
Spring migration	0 / 1	0	0 / 0	0	0 / 0	0
<p>Note, estimated mortality as per the displacement and mortality rates presented in Table 2–4. Estimates are separated by a '/' where the NatureScot (2020) guidance instructs the use of multiple mortality rates. The Guidance Approach displacement rate is 70% and mortality rates are as follows: 1% and 3% (breeding season and non-breeding season). The Applicant Approach displacement rate is 70% and the mortality rate is 1% (breeding season and non-breeding season).</p>						

## 4 Summary

### 4.1.1.1

The potential mortalities of kittiwake, guillemot, razorbill, puffin, and gannet following displacement from the Caledonia OWF, Caledonia North Site and Caledonia South Site, with a 2km buffer, during the relevant seasonal definitions as per the NatureScot (2020) guidance and Furness (2015<sup>5</sup>) are provided in Table 4-1. For the full matrix assessment tables, refer to the following annexes:

- Volume 7B, Appendix 6-2, Annex 1: Distributional Responses Results (Caledonia OWF);
- Volume 7B, Appendix 6-2, Annex 2: Distributional Responses Results (Caledonia North); and
- Volume 7B, Appendix 6-2, Annex 3: Distributional Responses Results (Caledonia South).

Table 4-1: Estimated mortality of key species following displacement from the Caledonia OWF (+2km buffer), Caledonia North Site (+2km buffer) and Caledonia South Site (+2km buffer) during the NatureScot (2020<sup>4</sup>) defined seasons and the BDMPS non-breeding seasons as per Furness (2015<sup>5</sup>).

Species	Annual Total (NatureScot Seasons)	Breeding Season (NatureScot Season)	Non-breeding Season (NatureScot Season)	Spring Migration (BDMPS)	Winter Period (BDMPS)	Autumn Migration (BDMPS)
<b>Caledonia OWF (+2km buffer) – Guidance Approach</b>						
Kittiwake	8 / 23	6 / 18	1 / 4	0 / 1	-	1 / 4
Guillemot	330 / 604	290 / 483	40 / 121	-	-	-
Razorbill	43 / 88	32 / 53	12 / 35	3 / 10	2 / 5	11 / 33
Puffin	45 / 86	37 / 62	8 / 24	-	-	-
Gannet	9 / 26	6 / 19	2 / 7	0 / 1	-	2 / 7
<b>Caledonia OWF (+2km buffer) – Applicant Approach</b>						
Guillemot	114	80	34	-	-	-
Razorbill	19	9	10	3	1	9
Puffin	3	3	-	-	-	-
Gannet	9	6	2	0	-	2
<b>Caledonia North Site (+2km buffer) – Guidance Approach</b>						
Kittiwake	3 / 9	2 / 6	1 / 3	0 / 1	-	1 / 3
Guillemot	139 / 242	130 / 217	9 / 26	-	-	-

Species	Annual Total (NatureScot Seasons)	Breeding Season (NatureScot Season)	Non-breeding Season (NatureScot Season)	Spring Migration (BDMPS)	Winter Period (BDMPS)	Autumn Migration (BDMPS)
Razorbill	25 / 52	16 / 26	9 / 26	2 / 6	1 / 2	8 / 24
Puffin	28 / 53	24 / 39	4 / 13	-	-	-
Gannet	3 / 9	2 / 5	1 / 4	0 / 0	-	1 / 4
<b>Caledonia North Site (+2km buffer) – Applicant Approach</b>						
Guillemot	43	36	7	-	-	-
Razorbill	12	4	7	2	1	7
Puffin	2	2	-	-	-	-
Gannet	3	2	1	0	-	1
<b>Caledonia South Site (+2km buffer) – Guidance Approach</b>						
Kittiwake	6 / 19	5 / 14	1 / 4	0 / 0	-	1 / 4
Guillemot	239 / 444	204 / 340	35 / 104	-	-	-
Razorbill	24 / 47	20 / 33	5 / 14	2 / 5	1 / 3	5 / 14
Puffin	26 / 50	22 / 36	5 / 14	-	-	-
Gannet	6 / 19	5 / 15	1 / 4	0 / 0	-	1 / 4

Species	Annual Total (NatureScot Seasons)	Breeding Season (NatureScot Season)	Non-breeding Season (NatureScot Season)	Spring Migration (BDMPS)	Winter Period (BDMPS)	Autumn Migration (BDMPS)
<b>Caledonia South Site (+2km buffer) – Applicant Approach</b>						
Guillemot	86	57	29	-	-	-
Razorbill	9	5	4	1	1	4
Puffin	3	3	-	-	-	-
Gannet	6	5	1	0	-	1
<p>Note, estimated mortality as per the displacement and mortality rates presented in Table 2–4. Estimates are separated by a '/' where the Guidance Approach (NatureScot, 2020<sup>4</sup>) and/or Applicant Approach instructs the use of multiple mortality rates.</p> <p>Note, annual totals (estimated mortalities) are a sum of the total number of predicted mortalities based on all of the seasonal outputs according to NatureScot (2020<sup>4</sup>) defined seasons.</p> <p>Note, '-' indicates a season not applicable for the species.</p> <p>Note, model-based density estimates were used for breeding season and design-based for the non-breeding season for all species, with the exception of gannet for which design-based density estimates were used for both breeding and non-breeding seasons and guillemot for which model-based density estimates were used for both breeding and non-breeding seasons (see Volume 7B, Appendix 6-1: Offshore Ornithology Baseline Characterisation Report for full justification).</p>						

## 5 References

- <sup>1</sup> NatureScot (2023) 'Guidance Note 8: Guidance to support Offshore Wind Applications: Marine Ornithology Advice for assessing the distributional responses, displacement and barrier effects of Marine birds'. Available at: <https://www.nature.scot/doc/guidance-note-8-guidance-support-offshore-wind-applications-marine-ornithology-advice-assessing> (Accessed 15/05/2024)
- <sup>2</sup> Statutory Nature Conservation Bodies (SNCB) (2022) 'Joint SNCB Interim Displacement Advice Note'. Statutory Nature Conservation Bodies in this case comprising Natural Resources Wales, Department of Agriculture, Environment and Rural Affairs/Northern Ireland Environment Agency, Natural England, Scottish Natural Heritage (NatureScot) and Joint Nature Conservation Committee. Available at: <https://data.jncc.gov.uk/data/9aecb87c-80c5-4cfb-9102-39f0228dcc9a/joint-sncb-interim-displacement-advice-note-2022.pdf> (Accessed 15/05/2024)
- <sup>3</sup> Searle, K.R., Mobbs, D.C., Butler, A., Furness, R.W., Trinder, M.N. and Daunt, F. (2018) 'Finding out the fate of displaced birds'. *Scottish Marine and Freshwater Science*. 9(8): 149
- <sup>4</sup> NatureScot (2020) 'Guidance Note 9 - Guidance to support Offshore Wind Applications: Seasonal periods for Birds in the Scottish Marine Environment'. Available at: <https://www.nature.scot/doc/guidance-note-9-guidance-support-offshore-wind-applications-seasonal-periods-birds-scottish-marine> (Accessed 15/05/2024)
- <sup>5</sup> Furness, R.W. (2015) 'Non-breeding season populations of seabirds in UK waters: Population sizes for Biologically Defined Minimum Population Scales (BDMPS)'. *Natural England Commissioned Reports*, Number 164

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