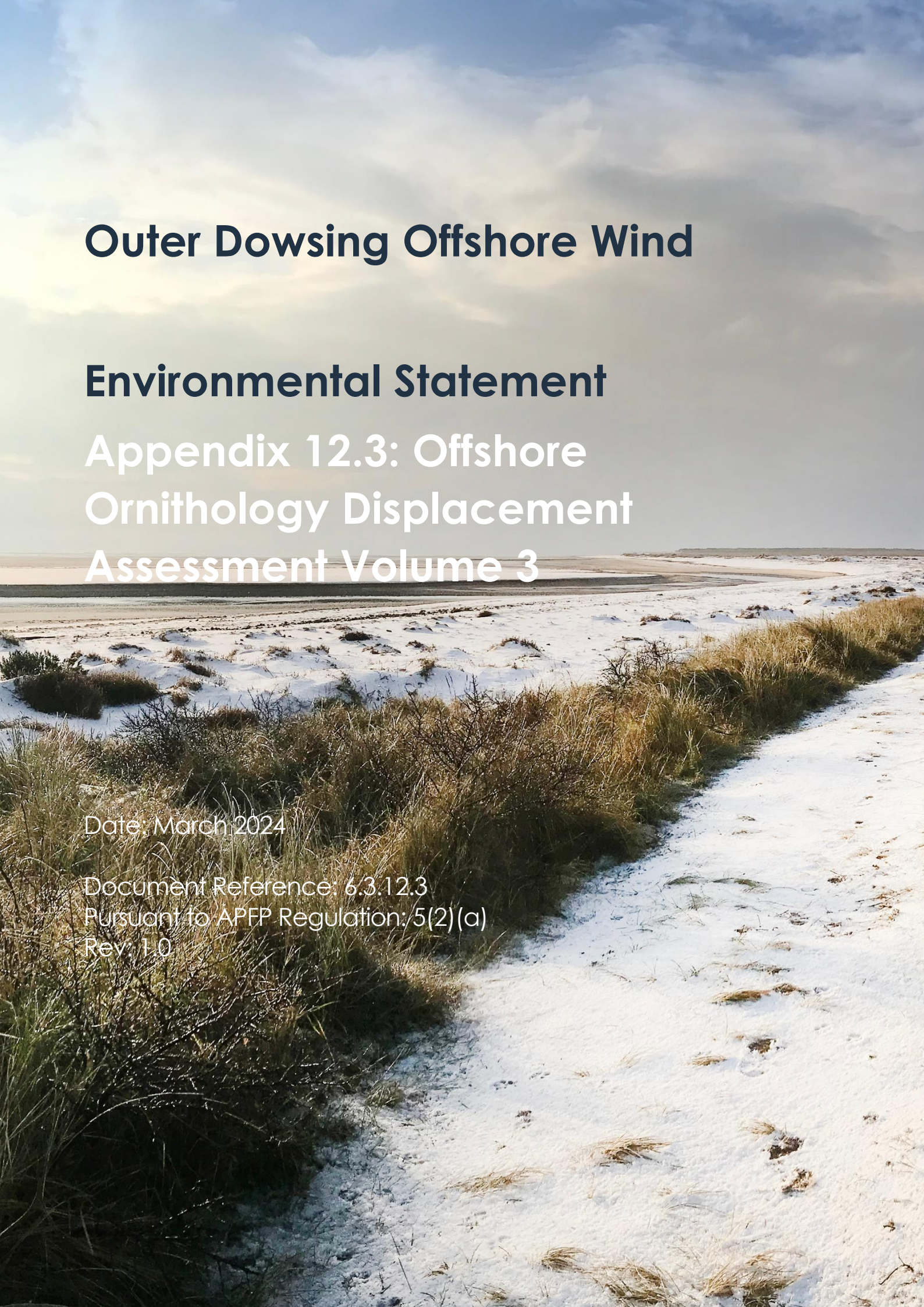

Outer Dowsing Offshore Wind

Environmental Statement

Appendix 12.3: Offshore Ornithology Displacement Assessment Volume 3

Date: March 2024

Document Reference: 6.3.12.3
Pursuant to APFP Regulation: 5(2)(a)
Rev: 1.0

Company:	**Outer Dowsing Offshore Wind**	Asset:	**Whole Asset**
Project:	**Whole Wind Farm**	Sub Project/Package:	Whole Asset
Document Title or Description:	Appendix 12.3 Offshore Ornithology Displacement Assessment		
Internal Document Number:	PP1-ODOW-DEV-CS-REP-0173	3rd Party Doc No (If applicable):	N/A

Rev No.	Date	Status / Reason for Issue	Author	Checked by	Reviewed by	Approved by
V1.0	March 2024	DCO Application	GoBe	GoBe	Sheperd and Wedderburn	Outer Dowsing

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Acronyms & Definitions

Abbreviations / Acronyms

Abbreviation / Acronym	Description
DAS	Digital Aerial Surveys
DCO	Development Consent Order
ECC	Export Cable Corridor
EIA	Environmental Impact Assessment
EPP	Evidence Plan Process
ES	Environmental Statement
ETG	Expert Topic Group
MDS	Maximum Design Scenario
OWF	Offshore Windfarm
RSPB	Royal Society for the Protection of Birds
SNCB	Statutory Nature Conservation Body
SPA	Special Protected Area
WTG	Wind Turbine Generator

Terminology

Term	Definition
The Applicant	GT R4 Ltd. The Applicant making the application for a DCO. The Applicant is GT R4 Limited (a joint venture between Corio Generation, Tota Energies and Gulf Energy Development (GULF)), trading as Outer Dowsing Offshore Wind. The Project is being developed by Corio Generation (a wholly owned Green Investment Group portfolio company), TotalEnergies and GULF.
Array area	The area offshore within which the generating station (including wind turbine generators (WTG) and inter array cables), offshore accommodation platforms, offshore transformer substations and associated cabling will be positioned.
Effect	Term used to express the consequence of an impact. The significance of an effect is determined by correlating the magnitude of the impact with the sensitivity of the receptor, in accordance with defined significance criteria.
Environmental Impact Assessment (EIA)	A statutory process by which certain planned projects must be assessed before a formal decision to proceed can be made. It involves the collection and consideration of environmental information, which fulfils the assessment requirements of the EIA Regulations, including the publication of an Environmental Statement (ES).
EIA Directive	European Union Directive 85/337/EEC, as amended by Directives 97/11/EC, 2003/35/EC and 2009/31/EC and then codified by Directive 2011/92/EU of 13 December 2011 (as amended in 2014 by Directive 2014/52/EU).
EIA Regulations	Infrastructure Planning (Environmental Impact Assessment) Regulations 2017.
Environmental Statement (ES)	The suite of documents that detail the processes and results of the EIA.
Impact	An impact to the receiving environment is defined as any change to its baseline condition, either adverse or beneficial.

Term	Definition
Landfall	The location at the land-sea interface where the offshore export cables and fibre optic cables will come ashore.
Maximum Design Scenario	The project design parameters, or a combination of project design parameters that are likely to result in the greatest potential for change in relation to each impact assessed
Outer Dowsing Offshore Wind (ODOW)	The Project.
Offshore Export Cable Corridor (ECC)	The Offshore Export Cable Corridor (Offshore ECC) is the area within the Order Limits within which the export cables running from the array to landfall will be situated.
Receptor	A distinct part of the environment on which effects could occur and can be the subject of specific assessments. Examples of receptors include species (or groups) of animals or plants, people (often categorised further such as 'residential' or those using areas for amenity or recreation), watercourses etc.
The Project	Outer Dowsing Offshore Wind, an offshore wind generating station together with associated onshore and offshore infrastructure.
Wind Turbine Generator (WTG)	A structure comprising a tower, rotor with three blades connected at the hub, nacelle and ancillary electrical and other equipment which may include J-tube(s), transition piece, access and rest platforms, access ladders, boat access systems, corrosion protection systems, fenders and maintenance equipment, helicopter landing facilities and other associated equipment, fixed to a foundation

Reference Documentation

Document Number	Title
6.1.3	Project Description

1 Offshore Ornithology Displacement Assessment

1.1 Introduction

1.1.1 Overview

1.1.1.1 Project Background

1. GT R4 Limited (trading as Outer Dowsing Offshore Wind) hereafter referred to as the 'Applicant', is proposing to develop The Project. The Project will be located approximately 54km from the Lincolnshire coastline in the southern North Sea. The Project will include both offshore and onshore infrastructure including an offshore generating station (windfarm), export cables to landfall, Offshore Reactive Compensation Platforms (ORCPs), onshore cables, connection to the electricity transmission network, ancillary and associated development and areas for the delivery of up to two Artificial Nesting Structures (ANS) and the creation of a biogenic reef (if these compensation measures are deemed to be required by the Secretary of State) (see Volume 1, Chapter 3: Project Description (document reference 6.1.3) for full details.
2. This technical annex has been produced to support the assessment of displacement effects on species that are considered sensitive to disturbance and/or displacement from activities associated with and/or the presence of offshore wind farms (OWFs) to support Volume 1, Chapter 12: Offshore and Intertidal Ornithology (document reference 6.1.12). A separate report (Volume 1, Appendix 12.1: Ornithology Technical Baseline (document reference 6.1.12.1)) provides the findings from offshore and intertidal ornithology surveys to determine the receptors that characterise the baseline and are of relevance to the assessment of potential impacts from The Project.
3. The consideration of offshore and intertidal ornithology for The Project has been discussed with consultees (Natural England and the Royal Society for the Protection of Birds [RSPB]) through The Project Evidence Plan Process (EPP). The latest Natural England and Statutory Nature Conservation Bodies (SNCB) advice has been followed (Parker *et al.*, 2022c; MIG-Birds, 2022). Where there is deviation from this guidance, any agreements made with consultees during the EPP regarding the displacement methodology can be found within document reference 6.1.12, Section 12.3.

1.1.1.2 Displacement Assessment

4. Wind turbine generators (WTGs) may directly disturb and displace vulnerable seabirds that would normally reside within and around The Project array area. This potential habitat loss may reduce the area available for those seabirds sensitive to disturbance to forage, rest and/or moult, particularly during the operational phase. There is also the potential for the construction and decommissioning of WTGs, substations, and cable laying, to directly disturb and displace seabirds within the array area and along the offshore export cable corridor (Offshore ECC). However, these potential impacts are more restricted spatially and temporally by virtue of the nature of those phases of the development.

5. Including birds in flight in the assessment accounts for potential barrier effects (i.e., birds that avoid flying through the space occupied by turbines and incur increased energy costs). Including sitting birds within the assessment accounts for potential habitat loss effects (i.e. birds are potentially displaced from an area of sea where they reside).
6. Six key seabird species, agreed through the EPP (document reference 6.1.12, Section 12.3), have been identified as requiring a displacement assessment in relation to The Project. These include:
   - Common scoter (*Melanitta nigra*);
   - Guillemot (*Uria aalge*);
   - Razorbill (*Alca torda*);
   - Puffin (*Fratacula arctica*).
   - Red-throated diver (*Gavia stellata*); and
   - Gannet (*Morus bassanus*).
7. The data contributing to this annex are from digital aerial surveys (DAS) (March 2021 to August 2023) of The Project array area plus a 2 km or 4 km buffer. Abundance data from these surveys are used for the assessment of potential displacement impacts from the array area and appropriate buffers for the five species of interest. In addition, using the data from Lawson *et al.* (2015), red-throated diver and common scoter have been assessed for potential displacement resulting from the offshore export cable laying activities within the Offshore ECC, as is outlined in Section 1.2.4.

1.2 Methodology

1.2.1 Guidance

8. The methodology for assessing displacement and barrier effects is based on UK joint SNCB guidance on displacement (MIG-Birds, 2022) and the latest guidance for offshore wind marine environmental assessments published by Natural England (Parker *et al.*, 2022c). These guidance documents outline how to present assessment information on the extent and potential consequences of seabird displacement from OWF developments. This approach has been agreed through EPP consultation and also through the Scoping Opinion as the most appropriate method to assess displacement and barrier effects on seabirds. The guidance states that the following inputs are required for the displacement assessments (MIG-Birds, 2022):
   - Monthly population estimates presented for a minimum two years pre-consent monitoring or another agreed period of time;
   - Site-based abundance estimates to include birds on water and in flight;
   - Counts to be assessed as mean seasonal peaks; and
   - Full details of the worst case and typical scenarios for the development footprint and development footprint plus relevant buffer.
9. In addition, the following inputs can be found within document 6.1.12.1:

- Full details of the survey techniques;
- Proportions of different age classes of birds;
- Raw count data; and
- Population estimates for development footprint and development footprint plus relevant buffers.

10. The results presented in this Appendix represent the Maximum Design Scenario (MDS) (i.e., The project design scenario giving rise to the greatest level of estimated displacement impact) and are used to subsequently inform the worst-case assessment within document 6.1.12. For displacement impacts the MDS considers that infrastructure would be laid out within the full Order Limits.
11. Displacement has been defined as *"a reduced number of birds occurring within or immediately adjacent to an OWF"* (Furness *et al.*, 2013). Both flying birds and birds on the water are considered in this displacement assessment as recommended by the SNCBs in their latest guidance (MIG-Birds, 2022). The inclusion of sitting birds within the analysis provides for an assessment of those individuals potentially displaced from an area of sea in which they reside, whilst the inclusion of flying birds provides an assessment of any potential barrier effects to birds moving through the area of interest.

1.2.2 Bio-seasons

12. Bio-seasons have been defined from Furness (2015) for each species and are presented in Table 1.1. Depending on the species involved, a different number of bio-seasons have been applied during the assessment; these are outlined further below.
13. The guidance recommends assessing the impacts of displacement based on the overall mean seasonal peak numbers of birds (averaged over the years of survey) in the development footprint and appropriate buffer. For this assessment, DAS data were available for 30 months (March 2021 to August 2023), including two surveys per month for the 2022 breeding season (March – August 2022). It was deemed that the most appropriate method to deal with the two monthly surveys was to calculate the monthly mean abundance of birds for 2022. The mean seasonal peak abundance was then calculated across the same bio-season between years.

Table 1.1. Bio-seasons used in the assessment for various seabird species (Furness (2015) for all species apart from Common Scoter. The bio-seasons for Common Scoter were taken from Cramp *et al.*, 1977).

Species	Breeding	Post-breeding migration	Return migration	Migration-free winter	Non-breeding
Common scoter	May-Aug	-	-	-	Sept-Apr
Guillemot	Mar-Jul	-	-	-	Aug-Feb
Razorbill	Apr-Jul	Aug-Oct	Jan-Mar	Nov-Dec	-
Puffin	Apr-Aug	-	-	-	Sept-Mar
Red-throated diver	May-Aug	-	-	-	Sept-Apr

Species	Breeding	Post-breeding migration	Return migration	Migration-free winter	Non-breeding
Gannet	Mar-Sept	Oct-Nov	Dec-Feb	-	-

1.2.3 The Matrix Approach

14. This report presents displacement matrices for the array area and appropriate buffers for five key species (gannet, puffin, guillemot, razorbill and red-throated diver), and for the Offshore ECC for two key species (red-throated diver and common scoter) that are considered sensitive to disturbance and displacement from the presence of OWFs and/or associated activity including vessel traffic. Common scoter are not assessed within the array and buffer as no birds were recorded in the array area over the 30 month survey period. Following SNCB guidance (MIG-Birds, 2022), displacement matrices include birds within the array area and a 2km buffer for gannet, puffin, guillemot and razorbill, and within a 4km buffer (the maximum extent of the surveys) for red-throated diver. Matrices for the Offshore ECC considered both red-throated diver and common scoter, using bird density data for the Greater Wash SPA extracted from the Lawson *et al.* (2016) data. Based on the evidence presented in Section 18, a displacement radius of 2km from cable laying vessels was assumed.
15. Displacement matrices are presented for a minimum of two seasons (breeding and non-breeding), as per SNCB guidance (MIG-Birds, 2022). Additional non-breeding bio-seasons are presented for some species (gannet and razorbill) as determined by Furness (2015) and recommended for other OWF projects within the southern North Sea (Natural England, 2022) (Table 1.1).

1.2.4 Displacement of Red-Throated Diver and Common Scoter in the Offshore ECC

16. Seabird species may be at risk of disturbance and displacement effects from construction activities associated with the offshore export cable installation within the offshore ECC, largely as a result of the activity of the cable laying vessel (s) present during the construction period.
17. The Greater Wash SPA, through which the inshore part of the Offshore ECC passes, is designated for two species which are considered sensitive to disturbance and displacement from vessel activity: red-throated diver and common scoter. Both of these species have been shown to be sensitive to vessels at a distance of up to 1km (Schwemmer *et al.*, 2011; Bradbury *et al.*, 2014).

18. Data used to assess the abundance and distributions of red-throated diver and common scoter in the Greater Wash SPA (Lawson *et al.* 2016) have been used to inform the assessment, providing the mean and maximum density of both species within the Offshore ECC as agreed at the expert topic group (ETG) (document 6.1.12, Section 12.3). The displacement of red-throated diver and common scoter was estimated within the Offshore ECC during the migration-free winter bio-season (January and February). Using the available evidence (Fliessbach *et al.* 2019), and applying a precautionary approach, both species were assumed to be disturbed from an area of 2km surrounding a maximum of three cable laying vessels spread across the full width of the Offshore ECC that lies within the Greater Wash SPA. This is a highly precautionary approach considering it is unlikely that three cable-laying vessels would be operational simultaneously for the installation of cables within the part of the offshore ECC overlapping with the Greater Wash SPA.

1.2.5 Data Limitations

19. The data presented in Lawson *et al.* (2016) for red-throated diver and common scoter densities within the Greater Wash SPA was collected between 2002 and 2008 and therefore may not be truly representative of the densities of these species within the Greater Wash SPA at the current time.

1.2.6 Mean and Peak Abundances

20. The mean peak abundances for each bio-season for the array area plus an appropriate buffer are presented for each species in Table 1.2. See document 6.1.12.1 for monthly abundances throughout the 30 months of DAS. For conciseness, matrices are only provided for the relevant buffer for each species within this report.
21. Design-based estimates were used to inform the results for all species (Table 1.2).

Table 1.2. Bio-season mean peak abundances calculated from design-based estimates of species in the array area + 2km buffer assessed for disturbance and displacement. Model-based estimates are also included for guillemot. The array area + 4km buffer was used for red-throated diver.

Species	Return migration	Breeding	Post-breeding migration	Non-breeding	Migration free winter
Guillemot	-	16,445	-	11,108	-
Razorbill	5,537	3,596	2,390	-	1,956
Puffin	-	760	-	636	-
Red-throated diver	-	15	-	188	-
Gannet	90	634	496	-	-

1.3 Results

22. The following sections display the displacement matrices for the Offshore ECC and array area and relevant buffer zone for each species. The number highlighted in the bottom right of each matrix is the estimated seasonal mean peak abundance of individuals within the array area and appropriate buffer. For each matrix the applicant's approach is highlighted in dark blue and the full range of displacement and mortality suggested by SNCBs highlighted in light blue.

1.3.1 Displacement of Red-Throated Diver and Common Scoter in the Offshore ECC

23. The mean and maximum density of red-throated divers estimated to be within The Project Offshore ECC during the migration free winter bio-season was 0.232 birds km^{-2} and 0.692 birds km^{-2}, respectively. Similarly, the estimated mean and maximum density for common scoter within the ECC was 0.004 birds km^{-2} and 0.029 birds km^{-2}, respectively. Based on a maximum of three cable laying vessels and a 2km disturbance radius, the total area of disturbance at any time was estimated at a maximum of 37.7km. This resulted in a mean (maximum) abundance of 8.75 (26.0) red-throated diver and 0.14 (1.1) common scoter at risk of displacement, highlighted in the bottom right cell of the displacement matrix (Table 1.3 and Table 1.5).

Table 1.3. Displacement matrix presenting the maximum number of red-throated diver in the Offshore ECC within a 2km buffer surrounding the cable laying vessels only, during the migration-free winter bio-season.

Displaced (%)	Mortality Rate (%)												
	1	2	5	10	20	30	40	50	60	70	80	90	100
10	0	0	0	0	1	1	1	1	2	2	2	2	3
20	0	0	0	1	1	2	2	3	3	4	4	5	5
30	0	0	0	1	2	2	3	4	5	5	6	7	8
40	0	0	1	1	2	3	4	5	6	7	8	9	10
50	0	0	1	1	3	4	5	7	8	9	10	12	13
60	0	0	1	2	3	5	6	8	9	11	13	14	16
70	0	0	1	2	4	5	7	9	11	13	15	16	18
80	0	0	1	2	4	6	8	10	13	15	17	19	21
90	0	0	1	2	5	7	9	12	14	16	19	21	23
100	0	1	1	3	5	8	10	13	16	18	21	23	26

Table 1.4. Displacement matrix presenting the mean number of red-throated diver in the Offshore ECC within a 2km buffer surrounding the cable laying vessels only, during the migration-free winter bio-season.

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

Table 1.5. Displacement matrix presenting the maximum number of common scoter in the Offshore ECC within a 2km buffer surrounding the cable laying vessels only, during the migration-free winter bio-season.

Displaced (%)	Mortality Rate (%)												
	1	2	5	10	20	30	40	50	60	70	80	90	100
10	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0	0	0	0	0	0	0
50	0	0	0	0	0	0	0	0	0	0	0	0	1
60	0	0	0	0	0	0	0	0	0	0	1	1	1
70	0	0	0	0	0	0	0	0	0	1	1	1	1
80	0	0	0	0	0	0	0	0	1	1	1	1	1
90	0	0	0	0	0	0	0	0	1	1	1	1	1
100	0	0	0	0	0	0	0	1	1	1	1	1	1

Table 1.6. Displacement matrix presenting the mean number of common scoter in the Offshore ECC within a 2km buffer surrounding the cable laying vessels only, during the migration-free winter bio-season.

Displaced (%)	Mortality Rate (%)												
	1	2	5	10	20	30	40	50	60	70	80	90	100
10	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0	0	0	0	0	0	0
50	0	0	0	0	0	0	0	0	0	0	0	0	0
60	0	0	0	0	0	0	0	0	0	0	0	0	0
70	0	0	0	0	0	0	0	0	0	0	0	0	0
80	0	0	0	0	0	0	0	0	0	0	0	0	0
90	0	0	0	0	0	0	0	0	0	0	0	0	0
100	0	0	0	0	0	0	0	0	0	0	0	0	0

1.3.2 Gannet

24. Confidence intervals for mean peak bio-season counts for gannet are presented in Table 1.7, and the impact at a range of displacement and mortality rates, over the relevant bio-seasons, in Table 1.8 to Table 1.10.

Table 1.7. Mean peak bio-season counts for gannet within the array area plus 2km buffer including upper and lower confidence intervals.

Bioseason	Period	Mean peak Count	Lower 95% CI	Upper 95% CI
Return Migration	Dec - Feb	90.5	58.5	127.0
Breeding	Mar - Sept	634.8	388.5	950.2
Post-breeding Migration	Oct - Nov	496.0	265.0	782.5

Table 1.8. Gannet return migration displacement matrix (array area plus 2km buffer), with the applicant's approach highlighted in dark blue and the full range suggested by SNCBs in light blue.

Return migration (2km Buffer)	Mortality Rate (%)												
Displaced (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	0	0	0	1	2	3	4	5	5	6	7	8	9
20	0	0	1	2	4	5	7	9	11	13	14	16	18
30	0	1	1	3	5	8	11	14	16	19	22	24	27
40	0	1	2	4	7	11	14	18	22	25	29	33	36
50	0	1	2	5	9	14	18	23	27	32	36	41	45
60	1	1	3	5	11	16	22	27	33	38	43	49	54
70	1	1	3	6	13	19	25	32	38	44	51	57	63
80	1	1	4	7	14	22	29	36	43	51	58	65	72
90	1	2	4	8	16	24	33	41	49	57	65	73	81
100	1	2	5	9	18	27	36	45	54	63	72	81	91

Table 1.9. Gannet breeding season displacement matrix (array area plus 2km buffer), with the applicant's approach highlighted in dark blue and the full range suggested by SNCBs in light blue.

Migration-free breeding (2km Buffer)	Mortality Rate (%)												
Displaced (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	1	1	3	6	13	19	25	32	38	44	51	57	63
20	1	3	6	13	25	38	51	63	76	89	102	114	127
30	2	4	10	19	38	57	76	95	114	133	152	171	190
40	3	5	13	25	51	76	102	127	152	178	203	229	254
50	3	6	16	32	63	95	127	159	190	222	254	286	317
60	4	8	19	38	76	114	152	190	229	267	305	343	381
70	4	9	22	44	89	133	178	222	267	311	356	400	444
80	5	10	25	51	102	152	203	254	305	356	406	457	508
90	6	11	29	57	114	171	229	286	343	400	457	514	571
100	6	13	32	63	127	190	254	317	381	444	508	571	635

Table 1.10. Gannet post-breeding migration displacement matrix (array area plus 2km buffer), with the applicant's approach highlighted in dark blue and the full range suggested by SNCBs in light blue..

Post migration (2km Buffer)	Mortality Rate (%)												
Displaced (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	0	1	2	5	10	15	20	25	30	35	40	45	50
20	1	2	5	10	20	30	40	50	60	69	79	89	99
30	1	3	7	15	30	45	60	74	89	104	119	134	149
40	2	4	10	20	40	60	79	99	119	139	159	179	198
50	2	5	12	25	50	74	99	124	149	174	198	223	248
60	3	6	15	30	60	89	119	149	179	208	238	268	298
70	3	7	17	35	69	104	139	174	208	243	278	312	347
80	4	8	20	40	79	119	159	198	238	278	317	357	397
90	4	9	22	45	89	134	179	223	268	312	357	402	446
100	5	10	25	50	99	149	198	248	298	347	397	446	496

1.3.3 Guillemot

25. Confidence intervals for peak bio-season counts for guillemot are presented in Table 1.11, and the impact at a range of displacement and mortality rates based on the design-based estimates, over the relevant bio-seasons, in Table 1.12 and Table 1.13.

Table 1.11. Mean peak bio-season counts for guillemot within the array area plus 2km buffer including upper and lower confidence intervals based on the design-based estimates.

Bioseason	Period	Peak Count	Lower 95% CI	Upper 95% CI
Breeding	Mar - July	16,445.3	12,458.0	21,072.7
Non-Breeding	Aug - Feb	11,208.0	8,548.7	14,918.8

Table 1.12. Guillemot breeding season displacement matrix (array area plus 2km buffer) based on the design-based estimates, with the applicant's approach highlighted in dark blue and the full range suggested by SNCBs in light blue..

Breeding (2km Buffer)	Mortality Rate (%)												
Displaced (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	16	42	104	208	416	624	832	1,040	1,248	1,456	1,664	1,872	2,080
20	33	83	208	416	832	1,248	1,664	2,080	2,496	2,912	3,328	3,744	4,160
30	49	125	312	624	1,248	1,872	2,496	3,120	3,744	4,368	4,992	5,617	6,241
40	66	166	416	832	1,664	2,496	3,328	4,160	4,992	5,825	6,657	7,489	8,321
50	82	208	520	1,040	2,080	3,120	4,160	5,201	6,241	7,281	8,321	9,361	10,401
60	99	250	624	1,248	2,496	3,744	4,992	6,241	7,489	8,737	9,985	11,233	12,481
70	115	291	728	1,456	2,912	4,368	5,825	7,281	8,737	10,193	11,649	13,105	14,561
80	132	333	832	1,664	3,328	4,992	6,657	8,321	9,985	11,649	13,313	14,977	16,642
90	148	374	936	1,872	3,744	5,617	7,489	9,361	11,233	13,105	14,977	16,850	18,722
100	164	416	1,040	2,080	4,160	6,241	8,321	10,401	12,481	14,561	16,642	18,722	16,445

Table 1.13. Guillemot non-breeding season displacement matrix (array area plus 2km buffer) based on the design-based estimates, with the applicant's approach highlighted in dark blue and the full range suggested by SNCBs in light blue.

Non-breeding (2km Buffer)	Mortality Rate (%)												
Displaced (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	11	12	31	62	125	187	250	312	374	437	499	562	624
20	22	25	62	125	250	374	499	624	749	874	998	1,123	1,248
30	34	37	94	187	374	562	749	936	1,123	1,311	1,498	1,685	1,872
40	45	50	125	250	499	749	998	1,248	1,498	1,747	1,997	2,247	2,496
50	56	62	156	312	624	936	1,248	1,560	1,872	2,184	2,496	2,808	3,120
60	67	75	187	374	749	1,123	1,498	1,872	2,247	2,621	2,995	3,370	3,744
70	78	87	218	437	874	1,311	1,747	2,184	2,621	3,058	3,495	3,932	4,368
80	90	100	250	499	998	1,498	1,997	2,496	2,995	3,495	3,994	4,493	4,992
90	101	112	281	562	1,123	1,685	2,247	2,808	3,370	3,932	4,493	5,055	5,617
100	112	125	312	624	1,248	1,872	2,496	3,120	3,744	4,368	4,992	5,617	11,208

1.3.4 Razorbill

26. Confidence intervals for peak bio-season counts for razorbill are presented in Table 1.14, and the impact at a range of displacement and mortality rates, over the relevant bio-seasons, in Table 1.15 to Table 1.18.

Table 1.14. Mean peak bio-season counts for razorbill within the array area plus 2km buffer including upper and lower confidence intervals.

Bioseason	Period	Peak Count	Lower 95% CI	Upper 95% CI
Return migration	Jan - Mar	5,536.7	4,739.0	7,856.0
Breeding	Apr - July	3,596.2	2,349.0	5,085.2
Post-breeding migration	Aug - Oct	2,390.5	1,139.5	4,167.0
Migration free winter	Nov - Dec	1,956.0	1,510.5	2,436.0

Table 1.15. Razorbill return migration displacement matrix (array area plus 2km buffer), with the applicant's approach highlighted in dark blue and the full range suggested by SNCBs in light blue.

Return migration (2km Buffer)	Mortality Rate (%)												
Displaced (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	6	11	28	55	111	166	221	277	332	388	443	498	554
20	11	22	55	111	221	332	443	554	664	775	886	997	1,107
30	17	33	83	166	332	498	664	831	997	1,163	1,329	1,495	1,661
40	22	44	111	221	443	664	886	1,107	1,329	1,550	1,772	1,993	2,215
50	28	55	138	277	554	831	1,107	1,384	1,661	1,938	2,215	2,492	2,768
60	33	66	166	332	664	997	1,329	1,661	1,993	2,325	2,658	2,990	3,322
70	39	78	194	388	775	1,163	1,550	1,938	2,325	2,713	3,101	3,488	3,876
80	44	89	221	443	886	1,329	1,772	2,215	2,658	3,101	3,543	3,986	4,429
90	50	100	249	498	997	1,495	1,993	2,492	2,990	3,488	3,986	4,485	4,983
100	55	111	277	554	1,107	1,661	2,215	2,768	3,322	3,876	4,429	4,983	5,537

Table 1.16. Razorbill breeding season displacement matrix (array area plus 2km buffer), with the applicant's approach highlighted in dark blue and the full range suggested by SNCBs in light blue.

Breeding (2km Buffer)	Mortality Rate (%)												
Displaced (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	4	7	18	36	72	108	144	180	216	252	288	324	360
20	7	14	36	72	144	216	288	360	432	503	575	647	719
30	11	22	54	108	216	324	432	539	647	755	863	971	1,079
40	14	29	72	144	288	432	575	719	863	1,007	1,151	1,295	1,438
50	18	36	90	180	360	539	719	899	1,079	1,259	1,438	1,618	1,798
60	22	43	108	216	432	647	863	1,079	1,295	1,510	1,726	1,942	2,158
70	25	50	126	252	503	755	1,007	1,259	1,510	1,762	2,014	2,265	2,517
80	29	58	144	288	575	863	1,151	1,438	1,726	2,014	2,301	2,589	2,877
90	32	65	162	324	647	971	1,295	1,618	1,942	2,265	2,589	2,913	3,236
100	36	72	180	360	719	1,079	1,438	1,798	2,158	2,517	2,877	3,236	3,596

Table 1.17. Razorbill post-breeding season displacement matrix (array area plus 2km buffer), with the applicant's approach highlighted in dark blue and the full range suggested by SNCBs in light blue.

Post-breeding dispersal (2km Buffer)	Mortality Rate (%)												
Displaced (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	2	5	12	24	48	72	96	120	143	167	191	215	239
20	5	10	24	48	96	143	191	239	287	335	382	430	478
30	7	14	36	72	143	215	287	359	430	502	574	645	717
40	10	19	48	96	191	287	382	478	574	669	765	861	956
50	12	24	60	120	239	359	478	598	717	837	956	1,076	1,195
60	14	29	72	143	287	430	574	717	861	1,004	1,147	1,291	1,434
70	17	33	84	167	335	502	669	837	1,004	1,171	1,339	1,506	1,673
80	19	38	96	191	382	574	765	956	1,147	1,339	1,530	1,721	1,912
90	22	43	108	215	430	645	861	1,076	1,291	1,506	1,721	1,936	2,151
100	24	48	120	239	478	717	956	1,195	1,434	1,673	1,912	2,151	2,391

Table 1.18. Razorbill migration free winter displacement matrix (array area plus 2km buffer), with the applicant's approach highlighted in dark blue and the full range suggested by SNCBs in light blue.

Non-breeding (2km Buffer)	Mortality Rate (%)												
Displaced (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	2	4	10	20	39	59	78	98	117	137	156	176	196
20	4	8	20	39	78	117	156	196	235	274	313	352	391
30	6	12	29	59	117	176	235	293	352	411	469	528	587
40	8	16	39	78	156	235	313	391	469	548	626	704	782
50	10	20	49	98	196	293	391	489	587	685	782	880	978
60	12	23	59	117	235	352	469	587	704	822	939	1,056	1,174
70	14	27	68	137	274	411	548	685	822	958	1,095	1,232	1,369
80	16	31	78	156	313	469	626	782	939	1,095	1,252	1,408	1,565
90	18	35	88	176	352	528	704	880	1,056	1,232	1,408	1,584	1,760
100	20	39	98	196	391	587	782	978	1,174	1,369	1,565	1,760	1,956

1.3.4.1 Puffin

27. Confidence intervals for peak bio-season counts for puffin are presented in Table 1.19, and the impact at a range of displacement and mortality rates, over the relevant bio-seasons, in Table 1.20 and Table 1.21.

Table 1.19. Mean peak bio-season counts for puffin within the array area plus 2km buffer including upper and lower confidence intervals.

Bioseason	Period	Peak Count	Lower 95% CI	Upper 95% CI
Breeding	Apr - Aug	760.0	510.7	1,062.8
Non-Breeding	Sept - Mar	636.5	457.0	859.5

Table 1.20. Puffin breeding season displacement matrix (array area plus 2km buffer), with the applicant's approach highlighted in dark blue and the full range suggested by SNCBs in light blue.

Breeding (2km Buffer)	Mortality Rate (%)												
Displaced (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	1	2	4	8	16	24	31	39	47	55	63	71	78
20	2	3	8	16	31	47	63	78	94	110	125	141	157
30	2	5	12	24	47	71	94	118	141	165	188	212	235
40	3	6	16	31	63	94	125	157	188	220	251	282	314
50	4	8	20	39	78	118	157	196	235	274	314	353	392
60	5	9	24	47	94	141	188	235	282	329	376	423	470
70	5	11	27	55	110	165	220	274	329	384	439	494	549
80	6	13	31	63	125	188	251	314	376	439	502	564	627
90	7	14	35	71	141	212	282	353	423	494	564	635	706
100	8	16	39	78	157	235	314	392	470	549	627	706	784

Table 1.21. Puffin non-breeding season displacement matrix (array area plus 2km buffer), with the applicant's approach highlighted in dark blue and the full range suggested by SNCBs in light blue.

Non-breeding (2km Buffer)	Mortality Rate (%)												
Displaced (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	1	1	3	6	13	19	26	32	39	45	52	58	65
20	1	3	6	13	26	39	52	65	77	90	103	116	129
30	2	4	10	19	39	58	77	97	116	135	155	174	194
40	3	5	13	26	52	77	103	129	155	181	206	232	258
50	3	6	16	32	65	97	129	161	194	226	258	290	323
60	4	8	19	39	77	116	155	194	232	271	310	348	387
70	5	9	23	45	90	135	181	226	271	316	361	406	452
80	5	10	26	52	103	155	206	258	310	361	413	464	516
90	6	12	29	58	116	174	232	290	348	406	464	522	581
100	6	13	32	65	129	194	258	323	387	452	516	581	645

1.3.4.2 Red-Throated Diver

28. Confidence intervals for peak bio-season counts for red-throated diver are presented in Table 1.22, and the impact at a range of displacement and mortality rates, over the relevant bio-seasons, in Table 1.23 and Table 1.24.

Table 1.22. Mean peak bio-season counts for red-throated diver within the array area plus 2km buffer including upper and lower confidence intervals.

Bioseason	Period	Peak Count	Lower 95% CI	Upper 95% CI
Breeding	May - Aug	188.0	108.3	277.5
Non-Breeding	Sept - Apr	15.0	0.0	31.5

Table 1.23. Red-throated diver breeding season displacement matrix (array area plus 4km buffer), with the applicant's approach highlighted in dark blue and the full range suggested by SNCBs in light blue.

Breeding (Array + 4km Buffer)	Mortality Rate (%)												
Displaced (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	0	0	0	0	0	0	1	1	1	1	1	1	2
20	0	0	0	0	1	1	1	2	2	2	2	3	3
30	0	0	0	0	1	1	2	2	3	3	4	4	5
40	0	0	0	1	1	2	2	3	4	4	5	5	6
50	0	0	0	1	2	2	3	4	5	5	6	7	8
60	0	0	0	1	2	3	4	5	5	6	7	8	9
70	0	0	1	1	2	3	4	5	6	7	8	9	11
80	0	0	1	1	2	4	5	6	7	8	10	11	12
90	0	0	1	1	3	4	5	7	8	9	11	12	14
100	0	0	1	2	3	5	6	8	9	11	12	14	15

Table 1.24. Red-throated diver non-breeding displacement matrix (array area plus 4km buffer), with the applicant's approach highlighted in dark blue and the full range suggested by SNCBs in light blue.

Non-breeding (Array + 4km Buffer)	Mortality Rate (%)												
Displaced (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	0	0	1	2	4	6	8	9	11	13	15	17	19
20	0	1	2	4	8	11	15	19	23	26	30	34	38
30	1	1	3	6	11	17	23	28	34	39	45	51	56
40	1	2	4	8	15	23	30	38	45	53	60	68	75
50	1	2	5	9	19	28	38	47	56	66	75	85	94
60	1	2	6	11	23	34	45	56	68	79	90	102	113
70	1	3	7	13	26	39	53	66	79	92	105	118	132
80	2	3	8	15	30	45	60	75	90	105	120	135	150
90	2	3	8	17	34	51	68	85	102	118	135	152	169
100	2	4	9	19	38	56	75	94	113	132	150	169	188

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