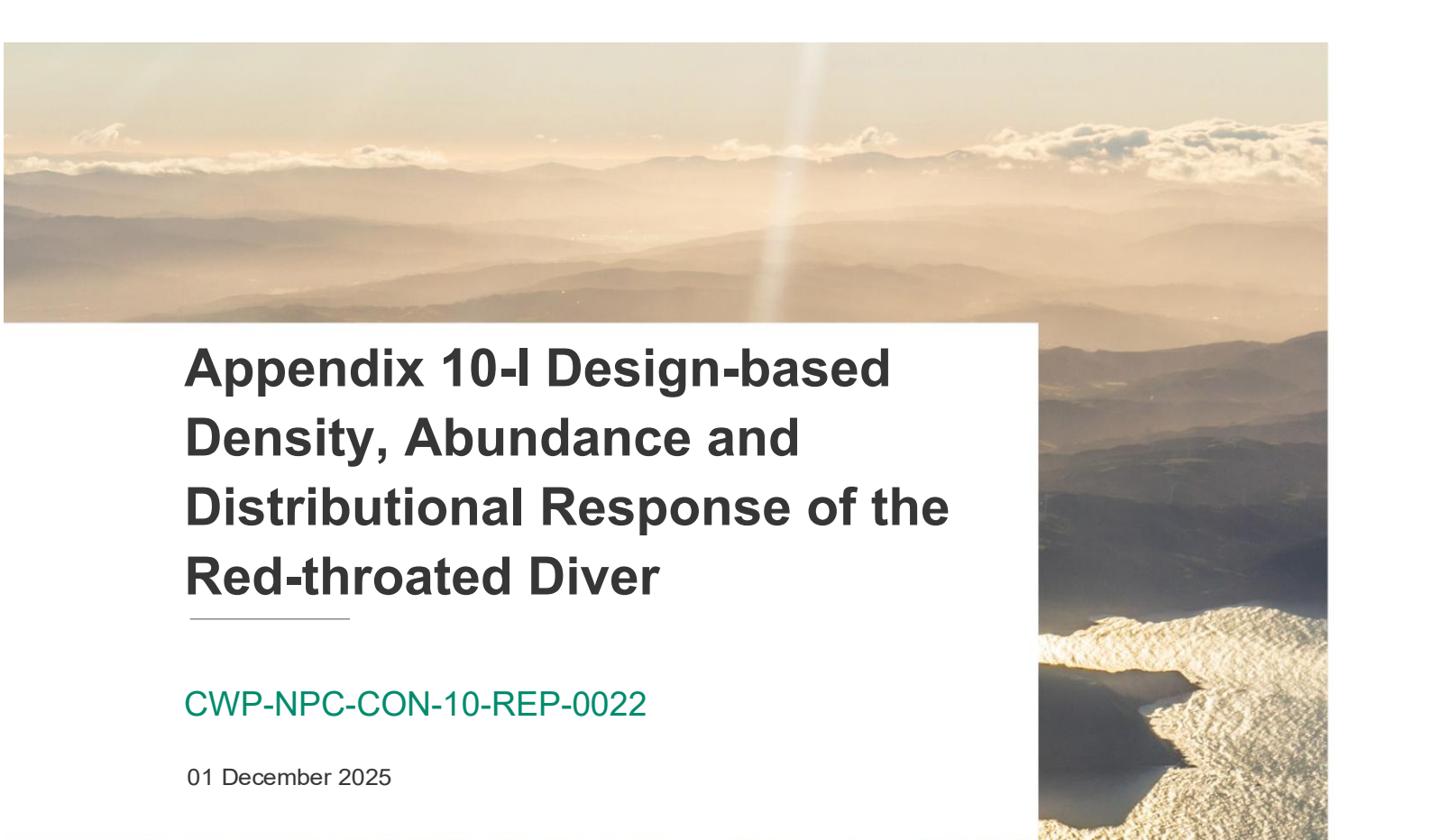




## EIAR Addendum

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Appendix 10-I Design-based  
Density, Abundance Estimates  
and Distributional Response of  
the Red-throated Diver



# Appendix 10-I Design-based Density, Abundance and Distributional Response of the Red-throated Diver

CWP-NPC-CON-10-REP-0022

01 December 2025



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# Document history

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# 1. Introduction

## 1.1. Background

Codling Wind Park Limited (CWPL) is proposing to develop the Codling Wind Park (CWP) Project, which is located in the Irish sea approximately 13 - 22 km off the east coast of Ireland, at County Wicklow.

On Friday 6<sup>th</sup> September 2024 CWPL (referred to hereafter as the 'Applicant') applied for planning permission to An Coimisiún Pleanála (ACP) (referred to hereafter as the 'Commission') under Section 291 of the Planning and Development Act (PDA) 2000, as amended, for the construction, operation and decommissioning of the CWP Project.

On 1<sup>st</sup> August 2025, having reviewed the application documentation, including the Environmental Impact Assessment Report (EIAR) and the Natura Impact Statement (NIS), the Commission issued a Further Information Request (FIR) in relation to the CWP Project.

This Appendix forms part of the Applicant's response to Item 7f and Item 7k of the Commission's FIR (see FIR Response Document) and supports **Section 10.10** of the **EIAR Addendum**. Specifically, this Technical Appendix provides an overview and the methodology used to predict the potential impact of the CWP Project on the red-throated diver (*Gavia stellata*) populations through displacement and barrier effects.

FIR Item 7f states that:

*"The applicant is requested to obtain and analyse additional data on Red-throated Diver density and abundance to fill the data gap between 4km and 10km to the west of the array site (i.e., in the direction of The Murrough SPA)" and "...additional data should be used to update and revise the impact assessment from the proposed development in relation to displacement of Red-throated Diver from The Murrough SPA and within 10km of the array area boundary..."*

FIR Item 7k states that:

*"The applicant is requested to assess displacement effects up to 10km from the proposed array site during operation, with the assessment informed by additional data..."*

## 2. Methods

### 2.1. Red-throated diver density and abundance

#### 2.1.1. Digital aerial survey (DAS) data

Digital Aerial Surveys (DAS) were performed by HiDef, recording bird species (including red-throated divers) within the Codling Array Area and buffer areas. Aerial surveys were conducted monthly from April 2024 to September 2025. Information relating to these surveys is presented within **Appendix 10-J Parameterisation of Red-throated Diver Displacement Rates** of the **EIAR addendum**. Survey data were used to evaluate red-throated diver presence during the seasons covered by the survey, which were: Post-breeding migration (PBM; November); Migration-free non-breeding (MFNB; December-January); Return migration (RM; February-April); all non-breeding season (NB; November - April). It should be noted that a further DAS campaign has been undertaken within the same survey area during the winter of April 2025 to January 2026. Raw data presented in **Section 2.1.4** indicate no meaningful deviation from previous datasets, further validating the baseline characterisation of this species' occurrence within the region.

#### 2.1.2. Density and abundance estimation

Densities and abundances were estimated using the DAS data for the red-throated diver, by survey, behaviour (in flight and on the sea), and region (Array Area plus 0-5km, and Array Area plus 5-10km buffers, over areas of suitable habitat). The rationale for the selection of the areas of suitable habitat is provided in **Appendix 10-J** of the **EIAR Addendum**. Red-throated diver density and abundances were estimated separately within the Array Area and within each buffer area (0-5 km and 5-10 km around the Array Area) to allow for the application of different displacement rates based on distance from the Array Area.

Density was calculated as the number of records per km<sup>2</sup> surveyed based on a 250 m strip width. Abundances were calculated by multiplying the densities by the area of the relevant region. Block bootstrapping (sampling with replacement) was used to derive 95% confidence intervals around densities and abundances. Survey-transect was used as a blocking variable to incorporate spatial dependency. The resampling units for the bootstrapping were survey-transect segments of 500 m in length (with shorter segments at the end of transect lines within each area, where the lines lengths were not divisible by 500 m). Bootstrapping was run for 1,000 iterations, and the resulting distribution of densities was used to calculate a mean, and upper and lower 95% confidence intervals. The block bootstrapping approach is standard practice, as well as being advocated by NatureScot (NatureScot, 2023<sup>1</sup>) used in generating design-based estimates which capture uncertainty around values.

#### 2.1.3. Accounting for records not identified to species level

Data records of all diver species were selected, including those identified as red-throated diver. It is standard practise to scale identified species by a correction factor calculated to include animals not identified to species level in assessments. If a correction factor was calculated, it would be derived from the proportion of all sightings of divers identified to species level from each species identifications (in this case, red-throated diver or great northern diver), in each survey and behavioural state (in-flight or on sea), and area (Array site and buffer zones). Adjusted numbers based on these ratios would then be combined with the red-throated diver observations to apportion the unidentified diver species records. This methodology assumes that all species within groupings are equally likely to be assigned to an unidentified species group. This process is used to generate a single correction factor for each species-survey-behaviour combination which are then used to correct design-based estimates.

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<sup>1</sup> NatureScot (2023) Guidance note 2: Advice for Marine Ornithology Baseline Characterisation Surveys and Reporting. Available at <https://www.nature.scot/doc/guidance-note-2-guidance-support-offshore-wind-applications-advice-marine-ornithology-baseline> [Last accessed 12/02/2026]

However, in the present analysis, 174 diver species individuals were identified, including 4 great northern divers, 169 red-throated diver and only one individual recorded as an unidentified diver species. Given this context, and because the unidentified individual was observed in proximity to other red-throated diver (**Figure 2-1**), this record was treated as a red throated diver, providing a more conservative model. It is noted that 2025 to 2026 DAS coverage was also inclusive of the areas shown in **Figure 2-1**.

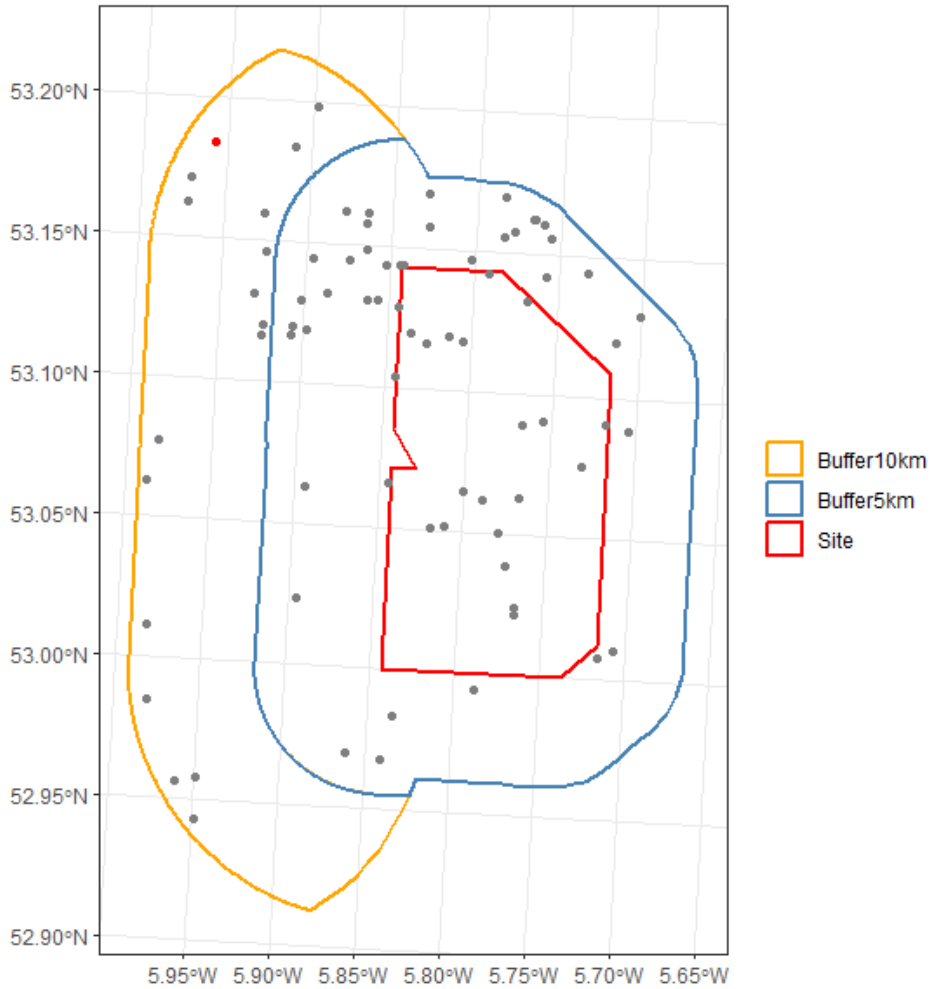


Figure 2-1 Red-throated diver individuals recorded within the Array Area and at distances of 5 km and 10 km from the Array Area are shown as grey points. The single unidentified (diver species) individual is represented by a red point.

#### 2.1.4. September 2025 to February 2026 raw DAS count data

**Table 2-1** shows the raw counts of red-throated diver recorded during regional DAS visits from September 2025 to February 2026. Counts are given in numbers of individuals per region. No birds were recorded within the survey areas between September and November 2025. These months coincide with the September to November post-breeding migration period through UK waters (Furness, 2015). Small numbers were recorded during December to February 2026, with a peak count of nine individuals within the 0 to 2 km buffer in February 2026. This month coincides with the red-throated diver return migration period through UK waters (Furness, 2015).

**Table 2-1 Raw counts of red-throated diver recorded within the DAS regions during winter 2025/2026**

Area	2025				2026	
	September	October	November	December	January	February
Array site	0	0	0	1	2	8
0 to 2 km buffer	0	0	0	2	0	9
0 to 4 km buffer	0	0	0	0	0	3
4 to 10 km buffer	0	0	0	3	1	8
4 to 10 km buffer and The Murrough SPA	0	0	0	0	0	2

Source: Natural Power

## 2.2. Red throated diver displacement

### 2.2.1. Matrix-based Approach

As requested within the FIR, assessment of displacement impacts followed the ‘matrix approach’ of the UK Statutory Nature Conservation Bodies’ (SNCB) displacement guidance note (SNCB, 2022), which uses precautionary estimates to displacement and mortality to calculate mortality estimates arising from displacement.

The point estimate abundances evaluated, as described in section 2.1.1, were used to generate displacement matrices. The peak abundance was evaluated for each season (see section 3.1.22.2.2) and each area.

### 2.2.2. Displacement bio-seasons

Current UK guidance on assessing displacement impacts (SNCB, 2022) recommends assessing displacement impacts using at least two seasonal matrices (breeding and non-breeding season). Furness (2015) is indicated as the source for seasonal division for a range of seabird species.

For each season considered, the seasonal peak abundance was selected as the maximum monthly abundance for that season. As the abundance was evaluated separately for each buffer zone, the month of peak abundance per season may differ across zones. This method is considered precautionary, as it is highly unlikely that the abundance within a given bio-season remains at such a high level (i.e. mean peak) throughout that bio-season. Red-throated diver seasons were determined using details provided in Furness (2015) and are provided in **Table 2-2**. The following seasons were used in the displacement analysis: Post-breeding migration (PBM; November); Migration-free non-breeding (MFNB; December to January); Return migration (RM; February-April); and the overall non-breeding season (NB; November to April).

**Table 2-2 Definition of red-throated diver bio-seasons.**

	Return migration (RM)	Migration-free breeding (MFB)	Post-breeding migration (PBM)	Migration-free non-breeding (MFNB)
Red-throated diver	Feb-Apr	May-Aug	Sep-Nov	Dec-Jan

Source: Furness (2015)

### 2.2.3. Matrix approach

Possible displacement mortality is presented as a matrix where a range of possible displacement levels (from 0% to 100% in 10% increments) on one axis and mortality levels (from 0% to 100% in 10% increments with an additional 0% to 5% in 1% increments) on the other are considered. The value at 100% levels of mortality and displacement represents the maximum seasonal abundance and other values within the matrix represent numbers of mortalities that would be associated with different combinations of displacement and mortality rates as described above.

## 2.3. Abundance and displacement of records in The Murrough SPA area.

DAS covered an area extending beyond the 10 km buffer to the west of the Array Area to encompass the entire offshore area contained within The Murrough SPA. The density and abundance of red-throated divers was estimated within The Murrough SPA. Observations were first categorised based on whether they occurred in the portion of the SPA inside the 10 km buffer zone around the Array Area or in the portion outside of the 10 km buffer. Abundance

estimates were then calculated separately for each zone, survey and season, following the same method described in section 2.1.

## 3. Results

### 3.1. Red-throated diver abundance

#### 3.1.1. Density and abundance

The point abundance estimated for the Array Area, and 0-5 km and 5-10 km buffer zones around the Array Area are presented in **Table 3-1**, using the 2024/2025 data (raw count data for 2025/2026 included in Table 2-1). These results were used to evaluate displacement matrices in section 3.2. The mean estimated abundance within 95% bootstrapped Confidence Intervals are presented in **Table 3-2**.

Table 3-1: Point estimate abundance for the red-throated diver evaluated within the Array Area and within 0-5 km and 5-10 km buffers around the Array Area.

Area	Point estimates					
	PBM	MFNB			RM	
	Nov	Dec	Jan	Feb	Mar	Apr
Array Site	-	28.49	-	28.49	8.14	12.21
0-5 km buffer	7.64	19.09	15.27	99.27	37.30	7.64
5-10 km buffer	14.71	31.23	-	7.81	7.81	7.81
<b>Total</b>	<b>22.35</b>	<b>78.81</b>	<b>15.27</b>	<b>135.57</b>	<b>53.25</b>	<b>27.65</b>

Table 3-2: Mean estimated abundance (with 95% bootstrapped Confidence Intervals in brackets) of the red-throated diver evaluated within the Array Area and within 0-5 km and 5-10 km buffers around the Array Area.

Area	Mean estimated abundance (95% CIs)					
	PBM	MFNB			RM	
	Nov	Dec	Jan	Feb	Mar	Apr
Array Area	0 (0 - 0)	28.651 (11.945 - 49.217)	0 (0 - 0)	28.601 (12.021 - 49.571)	8.15 (0 - 20.362)	12.144 (0 - 28.189)
0-5 km buffer	7.66 (0 - 19.184)	19.043 (3.836 - 35.23)	15.299 (0 - 41.537)	99.53 (59.703 - 147.029)	37.472 (11.459 - 70.421)	7.77 (0 - 23.163)
5-10 km buffer	14.668 (3 - 29.551)	31.144 (11.581 - 55.163)	0 (0 - 0)	7.832 (0 - 19.593)	7.827 (0 - 19.516)	7.784 (0 - 19.661)
<b>Total</b>	<b>22.328</b>	<b>78.838</b>	<b>15.299</b>	<b>135.963</b>	<b>53.449</b>	<b>27.698</b>

### 3.1.2. Peak abundances

The seasonal peak abundances of red-throated diver are displayed in **Table 3-3**.

**Table 3-3: Peak seasonal abundance (derived from point estimates) of red-throated Diver in the Array Area, 0-5 km buffer and 5-10 km buffer.**

Season	Area		
	Array Area	0-5 km	5-10 km
Post-Breeding Migration (PBM)	0 (All)	7.64 (November)	14.71 (November)
Migration-free non-breeding (MFNB)	28.49 (December)	19.09 (December)	31.23 (December)
Return migration (RM)	28.49 (February)	99.27 (February)	7.81 (February)
Non-breeding (NB)	56.98	126.00	53.75

### 3.2. Displacement matrices with the Array Area and 10 km buffers

Displacement matrices were evaluated, using the 2025 data, for the red-throated diver within the Array Area, 0-5 km buffer, and 5-10 km buffer area around the Array Area, and for each of the three seasons and all non-breeding seasons: Post-breeding migration (PBM), Migration-free non-breeding (MFNB), return migration (RM) and all non-breeding seasons (NB). Seasonal displacement matrices per buffers are presented in section 3.2.1, section 3.2.2, section 3.2.3 and section 3.2.4.

#### 3.2.1. Post-breeding migration (PBM)

##### 3.2.1.1. Array Area:

Table 3-4: Post-breeding migration (PBM, Nov) displacement matrix for red-throated divers within the Array Area

		Mortality level (%)															
		0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
Displacement level (%)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	10	0	0	0	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	0	0	0
	30	0	0	0	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	0	0	0
	50	0	0	0	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	0	0	0
	70	0	0	0	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	0	0	0
	90	0	0	0	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	0	0	0

### 3.2.1.2. Buffer zone: 0-5 km

Table 3-5: Post-breeding migration (PBM, Nov) displacement matrix for red-throated divers within the 0-5km buffer zone around the Array Area.

		Mortality level (%)															
		0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
Displacement level (%)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1	0	0	0	0	0	0	0.01	0.02	0.02	0.03	0.04	0.05	0.05	0.06	0.07	0.08
	10	0	0.01	0.02	0.02	0.03	0.04	0.08	0.15	0.23	0.31	0.38	0.46	0.53	0.61	0.69	0.76
	20	0	0.02	0.03	0.05	0.06	0.08	0.15	0.31	0.46	0.61	0.76	0.92	1.07	1.22	1.37	1.53
	30	0	0.02	0.05	0.07	0.09	0.11	0.23	0.46	0.69	0.92	1.15	1.37	1.6	1.83	2.06	2.29
	40	0	0.03	0.06	0.09	0.12	0.15	0.31	0.61	0.92	1.22	1.53	1.83	2.14	2.44	2.75	3.05
	50	0	0.04	0.08	0.11	0.15	0.19	0.38	0.76	1.15	1.53	1.91	2.29	2.67	3.05	3.44	3.82
	60	0	0.05	0.09	0.14	0.18	0.23	0.46	0.92	1.37	1.83	2.29	2.75	3.21	3.67	4.12	4.58
	70	0	0.05	0.11	0.16	0.21	0.27	0.53	1.07	1.6	2.14	2.67	3.21	3.74	4.28	4.81	5.35
	80	0	0.06	0.12	0.18	0.24	0.31	0.61	1.22	1.83	2.44	3.05	3.67	4.28	4.89	5.5	6.11
	90	0	0.07	0.14	0.21	0.27	0.34	0.69	1.37	2.06	2.75	3.44	4.12	4.81	5.5	6.19	6.87
100	0	0.08	0.15	0.23	0.31	0.38	0.76	1.53	2.29	3.05	3.82	4.58	5.35	6.11	6.87	7.64	

### 3.2.1.3. Buffer zone : 10 km

Table 3-6: Post-breeding migration (PBM; Nov) displacement matrix for red-throated divers within the 10 km buffer zone around the Array Area.

		Mortality level (%)															
		0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
Displacement level (%)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1	0	0	0	0	0.01	0.01	0.01	0.03	0.04	0.06	0.07	0.09	0.1	0.12	0.13	0.15
	10	0	0.01	0.03	0.04	0.06	0.07	0.15	0.29	0.44	0.59	0.74	0.88	1.03	1.18	1.32	1.47
	20	0	0.03	0.06	0.09	0.12	0.15	0.29	0.59	0.88	1.18	1.47	1.77	2.06	2.35	2.65	2.94
	30	0	0.04	0.09	0.13	0.18	0.22	0.44	0.88	1.32	1.77	2.21	2.65	3.09	3.53	3.97	4.41
	40	0	0.06	0.12	0.18	0.24	0.29	0.59	1.18	1.77	2.35	2.94	3.53	4.12	4.71	5.3	5.89
	50	0	0.07	0.15	0.22	0.29	0.37	0.74	1.47	2.21	2.94	3.68	4.41	5.15	5.89	6.62	7.36
	60	0	0.09	0.18	0.26	0.35	0.44	0.88	1.77	2.65	3.53	4.41	5.3	6.18	7.06	7.95	8.83
	70	0	0.1	0.21	0.31	0.41	0.51	1.03	2.06	3.09	4.12	5.15	6.18	7.21	8.24	9.27	10.3
	80	0	0.12	0.24	0.35	0.47	0.59	1.18	2.35	3.53	4.71	5.89	7.06	8.24	9.42	10.59	11.77
	90	0	0.13	0.26	0.4	0.53	0.66	1.32	2.65	3.97	5.3	6.62	7.95	9.27	10.59	11.92	13.24
	100	0	0.15	0.29	0.44	0.59	0.74	1.47	2.94	4.41	5.89	7.36	8.83	10.3	11.77	13.24	14.71

### 3.2.2. Migration-free non-breeding (MFNB)

#### 3.2.2.4. Array Area

Table 3-7: Migration-free non-breeding (MFNB; Dec-Jan) displacement matrix for red-throated divers within the Array Area.

		Mortality level (%)															
		0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
Displacement level (%)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1	0	0	0.01	0.01	0.01	0.01	0.03	0.06	0.09	0.11	0.14	0.17	0.2	0.23	0.26	0.28
	10	0	0.03	0.06	0.09	0.11	0.14	0.28	0.57	0.85	1.14	1.42	1.71	1.99	2.28	2.56	2.85
	20	0	0.06	0.11	0.17	0.23	0.28	0.57	1.14	1.71	2.28	2.85	3.42	3.99	4.56	5.13	5.7
	30	0	0.09	0.17	0.26	0.34	0.43	0.85	1.71	2.56	3.42	4.27	5.13	5.98	6.84	7.69	8.55
	40	0	0.11	0.23	0.34	0.46	0.57	1.14	2.28	3.42	4.56	5.7	6.84	7.98	9.12	10.26	11.4
	50	0	0.14	0.28	0.43	0.57	0.71	1.42	2.85	4.27	5.7	7.12	8.55	9.97	11.4	12.82	14.24
	60	0	0.17	0.34	0.51	0.68	0.85	1.71	3.42	5.13	6.84	8.55	10.26	11.97	13.67	15.38	17.09
	70	0	0.2	0.4	0.6	0.8	1	1.99	3.99	5.98	7.98	9.97	11.97	13.96	15.95	17.95	19.94
	80	0	0.23	0.46	0.68	0.91	1.14	2.28	4.56	6.84	9.12	11.4	13.67	15.95	18.23	20.51	22.79
	90	0	0.26	0.51	0.77	1.03	1.28	2.56	5.13	7.69	10.26	12.82	15.38	17.95	20.51	23.08	25.64
100	0	0.28	0.57	0.85	1.14	1.42	2.85	5.7	8.55	11.4	14.24	17.09	19.94	22.79	25.64	28.49	

### 3.2.2.5. 5 km buffer zone

Table 3-8: Migration-free non-breeding (MFNB; Dec-Jan) displacement matrix for red-throated divers within the 0-5 km buffer around the Array Area.

		Mortality level (%)															
		0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
Displacement level (%)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1	0	0	0	0.01	0.01	0.01	0.02	0.04	0.06	0.08	0.1	0.11	0.13	0.15	0.17	0.19
	10	0	0.02	0.04	0.06	0.08	0.1	0.19	0.38	0.57	0.76	0.95	1.15	1.34	1.53	1.72	1.91
	20	0	0.04	0.08	0.11	0.15	0.19	0.38	0.76	1.15	1.53	1.91	2.29	2.67	3.05	3.44	3.82
	30	0	0.06	0.11	0.17	0.23	0.29	0.57	1.15	1.72	2.29	2.86	3.44	4.01	4.58	5.15	5.73
	40	0	0.08	0.15	0.23	0.31	0.38	0.76	1.53	2.29	3.05	3.82	4.58	5.35	6.11	6.87	7.64
	50	0	0.1	0.19	0.29	0.38	0.48	0.95	1.91	2.86	3.82	4.77	5.73	6.68	7.64	8.59	9.55
	60	0	0.11	0.23	0.34	0.46	0.57	1.15	2.29	3.44	4.58	5.73	6.87	8.02	9.16	10.31	11.45
	70	0	0.13	0.27	0.4	0.53	0.67	1.34	2.67	4.01	5.35	6.68	8.02	9.35	10.69	12.03	13.36
	80	0	0.15	0.31	0.46	0.61	0.76	1.53	3.05	4.58	6.11	7.64	9.16	10.69	12.22	13.75	15.27
	90	0	0.17	0.34	0.52	0.69	0.86	1.72	3.44	5.15	6.87	8.59	10.31	12.03	13.75	15.46	17.18
100	0	0.19	0.38	0.57	0.76	0.95	1.91	3.82	5.73	7.64	9.55	11.45	13.36	15.27	17.18	19.09	

### 3.2.2.6. 10 km buffer zone

Table 3-9: Migration-free non-breeding (MFNB; Dec-Jan) displacement matrix for red-throated divers within the 5-10 km buffer around the Array Area.

		Mortality level (%)															
		0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
Displacement level (%)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1	0	0	0.01	0.01	0.01	0.02	0.03	0.06	0.09	0.12	0.16	0.19	0.22	0.25	0.28	0.31
	10	0	0.03	0.06	0.09	0.12	0.16	0.31	0.62	0.94	1.25	1.56	1.87	2.19	2.5	2.81	3.12
	20	0	0.06	0.12	0.19	0.25	0.31	0.62	1.25	1.87	2.5	3.12	3.75	4.37	5	5.62	6.25
	30	0	0.09	0.19	0.28	0.37	0.47	0.94	1.87	2.81	3.75	4.68	5.62	6.56	7.5	8.43	9.37
	40	0	0.12	0.25	0.37	0.5	0.62	1.25	2.5	3.75	5	6.25	7.5	8.74	9.99	11.24	12.49
	50	0	0.16	0.31	0.47	0.62	0.78	1.56	3.12	4.68	6.25	7.81	9.37	10.93	12.49	14.05	15.61
	60	0	0.19	0.37	0.56	0.75	0.94	1.87	3.75	5.62	7.5	9.37	11.24	13.12	14.99	16.86	18.74
	70	0	0.22	0.44	0.66	0.87	1.09	2.19	4.37	6.56	8.74	10.93	13.12	15.3	17.49	19.67	21.86
	80	0	0.25	0.5	0.75	1	1.25	2.5	5	7.5	9.99	12.49	14.99	17.49	19.99	22.49	24.98
	90	0	0.28	0.56	0.84	1.12	1.41	2.81	5.62	8.43	11.24	14.05	16.86	19.67	22.49	25.3	28.11
	100	0	0.31	0.62	0.94	1.25	1.56	3.12	6.25	9.37	12.49	15.61	18.74	21.86	24.98	28.11	31.23

### 3.2.3. Return Migration (RM)

#### 3.2.3.7. Array Area

Table 3-10: Return-migration (RM; Feb-Apr) displacement matrix for red-throated divers within the Array Area

		Mortality level (%)															
		0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
Displacement level (%)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1	0	0	0.01	0.01	0.01	0.01	0.03	0.06	0.09	0.11	0.14	0.17	0.2	0.23	0.26	0.28
	10	0	0.03	0.06	0.09	0.11	0.14	0.28	0.57	0.85	1.14	1.42	1.71	1.99	2.28	2.56	2.85
	20	0	0.06	0.11	0.17	0.23	0.28	0.57	1.14	1.71	2.28	2.85	3.42	3.99	4.56	5.13	5.7
	30	0	0.09	0.17	0.26	0.34	0.43	0.85	1.71	2.56	3.42	4.27	5.13	5.98	6.84	7.69	8.55
	40	0	0.11	0.23	0.34	0.46	0.57	1.14	2.28	3.42	4.56	5.7	6.84	7.98	9.12	10.26	11.4
	50	0	0.14	0.28	0.43	0.57	0.71	1.42	2.85	4.27	5.7	7.12	8.55	9.97	11.4	12.82	14.24
	60	0	0.17	0.34	0.51	0.68	0.85	1.71	3.42	5.13	6.84	8.55	10.26	11.97	13.67	15.38	17.09
	70	0	0.2	0.4	0.6	0.8	1	1.99	3.99	5.98	7.98	9.97	11.97	13.96	15.95	17.95	19.94
	80	0	0.23	0.46	0.68	0.91	1.14	2.28	4.56	6.84	9.12	11.4	13.67	15.95	18.23	20.51	22.79
	90	0	0.26	0.51	0.77	1.03	1.28	2.56	5.13	7.69	10.26	12.82	15.38	17.95	20.51	23.08	25.64
100	0	0.28	0.57	0.85	1.14	1.42	2.85	5.7	8.55	11.4	14.24	17.09	19.94	22.79	25.64	28.49	

### 3.2.3.8. Buffer zone: 0-5 km

Table 3-11: Return migration (RM; Feb-Apr) displacement matrix for red-throated divers within 0-5 km buffer around the Array Area.

		Mortality level (%)															
		0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
Displacement level (%)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1	0	0.01	0.02	0.03	0.04	0.05	0.1	0.2	0.3	0.4	0.5	0.6	0.69	0.79	0.89	0.99
	10	0	0.1	0.2	0.3	0.4	0.5	0.99	1.99	2.98	3.97	4.96	5.96	6.95	7.94	8.93	9.93
	20	0	0.2	0.4	0.6	0.79	0.99	1.99	3.97	5.96	7.94	9.93	11.91	13.9	15.88	17.87	19.85
	30	0	0.3	0.6	0.89	1.19	1.49	2.98	5.96	8.93	11.91	14.89	17.87	20.85	23.83	26.8	29.78
	40	0	0.4	0.79	1.19	1.59	1.99	3.97	7.94	11.91	15.88	19.85	23.83	27.8	31.77	35.74	39.71
	50	0	0.5	0.99	1.49	1.99	2.48	4.96	9.93	14.89	19.85	24.82	29.78	34.75	39.71	44.67	49.64
	60	0	0.6	1.19	1.79	2.38	2.98	5.96	11.91	17.87	23.83	29.78	35.74	41.7	47.65	53.61	59.56
	70	0	0.69	1.39	2.08	2.78	3.47	6.95	13.9	20.85	27.8	34.75	41.7	48.64	55.59	62.54	69.49
	80	0	0.79	1.59	2.38	3.18	3.97	7.94	15.88	23.83	31.77	39.71	47.65	55.59	63.54	71.48	79.42
	90	0	0.89	1.79	2.68	3.57	4.47	8.93	17.87	26.8	35.74	44.67	53.61	62.54	71.48	80.41	89.35
	100	0	0.99	1.99	2.98	3.97	4.96	9.93	19.85	29.78	39.71	49.64	59.56	69.49	79.42	89.35	99.27

### 3.2.3.9. Buffer zone: 10 km

Table 3-12: Return migration (RM; Feb-Apr) displacement matrix for red-throated divers within 5-10 km buffer around the Array Area.

		Mortality level (%)															
		0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
Displacement level (%)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1	0	0	0	0	0	0	0.01	0.02	0.02	0.03	0.04	0.05	0.05	0.06	0.07	0.08
	10	0	0.01	0.02	0.02	0.03	0.04	0.08	0.16	0.23	0.31	0.39	0.47	0.55	0.62	0.7	0.78
	20	0	0.02	0.03	0.05	0.06	0.08	0.16	0.31	0.47	0.62	0.78	0.94	1.09	1.25	1.41	1.56
	30	0	0.02	0.05	0.07	0.09	0.12	0.23	0.47	0.7	0.94	1.17	1.41	1.64	1.87	2.11	2.34
	40	0	0.03	0.06	0.09	0.12	0.16	0.31	0.62	0.94	1.25	1.56	1.87	2.19	2.5	2.81	3.12
	50	0	0.04	0.08	0.12	0.16	0.2	0.39	0.78	1.17	1.56	1.95	2.34	2.73	3.12	3.51	3.9
	60	0	0.05	0.09	0.14	0.19	0.23	0.47	0.94	1.41	1.87	2.34	2.81	3.28	3.75	4.22	4.68
	70	0	0.05	0.11	0.16	0.22	0.27	0.55	1.09	1.64	2.19	2.73	3.28	3.83	4.37	4.92	5.47
	80	0	0.06	0.12	0.19	0.25	0.31	0.62	1.25	1.87	2.5	3.12	3.75	4.37	5	5.62	6.25
	90	0	0.07	0.14	0.21	0.28	0.35	0.7	1.41	2.11	2.81	3.51	4.22	4.92	5.62	6.32	7.03
100	0	0.08	0.16	0.23	0.31	0.39	0.78	1.56	2.34	3.12	3.9	4.68	5.47	6.25	7.03	7.81	

### 3.2.4. Non-breeding period (NB)

#### 3.2.4.10. Array Area

Table 3-13: Non-breeding (all; Nov-Apr) displacement matrix for red-throated divers within the Array Area.

		Mortality level (%)															
		0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
Displacement level (%)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1	0	0.01	0.01	0.02	0.02	0.03	0.06	0.11	0.17	0.23	0.28	0.34	0.4	0.46	0.51	0.57
	10	0	0.06	0.11	0.17	0.23	0.28	0.57	1.14	1.71	2.28	2.85	3.42	3.99	4.56	5.13	5.7
	20	0	0.11	0.23	0.34	0.46	0.57	1.14	2.28	3.42	4.56	5.7	6.84	7.98	9.12	10.26	11.4
	30	0	0.17	0.34	0.51	0.68	0.85	1.71	3.42	5.13	6.84	8.55	10.26	11.97	13.67	15.38	17.09
	40	0	0.23	0.46	0.68	0.91	1.14	2.28	4.56	6.84	9.12	11.4	13.67	15.95	18.23	20.51	22.79
	50	0	0.28	0.57	0.85	1.14	1.42	2.85	5.7	8.55	11.4	14.24	17.09	19.94	22.79	25.64	28.49
	60	0	0.34	0.68	1.03	1.37	1.71	3.42	6.84	10.26	13.67	17.09	20.51	23.93	27.35	30.77	34.19
	70	0	0.4	0.8	1.2	1.6	1.99	3.99	7.98	11.97	15.95	19.94	23.93	27.92	31.91	35.9	39.88
	80	0	0.46	0.91	1.37	1.82	2.28	4.56	9.12	13.67	18.23	22.79	27.35	31.91	36.47	41.02	45.58
	90	0	0.51	1.03	1.54	2.05	2.56	5.13	10.26	15.38	20.51	25.64	30.77	35.9	41.02	46.15	51.28
	100	0	0.57	1.14	1.71	2.28	2.85	5.7	11.4	17.09	22.79	28.49	34.19	39.88	45.58	51.28	56.98

### 3.2.4.11. Buffer zone: 5 km

Table 3-14: Non-breeding (all; Nov-Apr) displacement matrix for red-throated divers within 0-5 km buffer around the Array Area.

		Mortality level (%)															
		0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
Displacement level (%)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1	0	0.01	0.03	0.04	0.05	0.06	0.13	0.25	0.38	0.5	0.63	0.76	0.88	1.01	1.13	1.26
	10	0	0.13	0.25	0.38	0.5	0.63	1.26	2.52	3.78	5.04	6.3	7.56	8.82	10.08	11.34	12.6
	20	0	0.25	0.5	0.76	1.01	1.26	2.52	5.04	7.56	10.08	12.6	15.12	17.64	20.16	22.68	25.2
	30	0	0.38	0.76	1.13	1.51	1.89	3.78	7.56	11.34	15.12	18.9	22.68	26.46	30.24	34.02	37.8
	40	0	0.5	1.01	1.51	2.02	2.52	5.04	10.08	15.12	20.16	25.2	30.24	35.28	40.32	45.36	50.4
	50	0	0.63	1.26	1.89	2.52	3.15	6.3	12.6	18.9	25.2	31.5	37.8	44.1	50.4	56.7	63
	60	0	0.76	1.51	2.27	3.02	3.78	7.56	15.12	22.68	30.24	37.8	45.36	52.92	60.48	68.04	75.6
	70	0	0.88	1.76	2.65	3.53	4.41	8.82	17.64	26.46	35.28	44.1	52.92	61.74	70.56	79.38	88.2
	80	0	1.01	2.02	3.02	4.03	5.04	10.08	20.16	30.24	40.32	50.4	60.48	70.56	80.64	90.72	100.8
	90	0	1.13	2.27	3.4	4.54	5.67	11.34	22.68	34.02	45.36	56.7	68.04	79.38	90.72	102.06	113.4
100	0	1.26	2.52	3.78	5.04	6.3	12.6	25.2	37.8	50.4	63	75.6	88.2	100.8	113.4	126	

### 3.2.4.12. Buffer zone: 10 km

Table 3-15: Non-breeding (all; Nov-Apr) displacement matrix for red-throated divers within 5-10 km buffer around the Array Area

		Mortality level (%)															
		0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
Displacement level (%)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1	0	0.01	0.01	0.02	0.02	0.03	0.05	0.11	0.16	0.22	0.27	0.32	0.38	0.43	0.48	0.54
	10	0	0.05	0.11	0.16	0.22	0.27	0.54	1.08	1.61	2.15	2.69	3.23	3.76	4.3	4.84	5.38
	20	0	0.11	0.22	0.32	0.43	0.54	1.08	2.15	3.23	4.3	5.38	6.45	7.53	8.6	9.68	10.75
	30	0	0.16	0.32	0.48	0.65	0.81	1.61	3.23	4.84	6.45	8.06	9.68	11.29	12.9	14.51	16.13
	40	0	0.22	0.43	0.65	0.86	1.08	2.15	4.3	6.45	8.6	10.75	12.9	15.05	17.2	19.35	21.5
	50	0	0.27	0.54	0.81	1.08	1.34	2.69	5.38	8.06	10.75	13.44	16.13	18.81	21.5	24.19	26.88
	60	0	0.32	0.65	0.97	1.29	1.61	3.23	6.45	9.68	12.9	16.13	19.35	22.58	25.8	29.03	32.25
	70	0	0.38	0.75	1.13	1.51	1.88	3.76	7.53	11.29	15.05	18.81	22.58	26.34	30.1	33.86	37.63
	80	0	0.43	0.86	1.29	1.72	2.15	4.3	8.6	12.9	17.2	21.5	25.8	30.1	34.4	38.7	43
	90	0	0.48	0.97	1.45	1.94	2.42	4.84	9.68	14.51	19.35	24.19	29.03	33.86	38.7	43.54	48.38
	100	0	0.54	1.08	1.61	2.15	2.69	5.38	10.75	16.13	21.5	26.88	32.25	37.63	43	48.38	53.75

### 3.3. Red-throated diver abundances detected within The Murrough SPA

#### 3.3.1. Density and abundances

The density and abundance of red-throated diver were estimated for records within The Murrough SPA. The point estimate abundances for the 2024/2025 winter are presented in **Table 3-16** and used to evaluate displacement matrices in section 3.3.3. Adopting the same approach applied to red-throated diver within the array and buffer areas, the mean abundance values and 95% bootstrapped Confidence Intervals (CI) presented in **Table 3-17**, were estimated by season and by whether records occurred within the SPA portion inside the 10 km buffer zone or outside the 10 km buffer around the Array Area.

**Table 3-16: Point estimates abundances of the red-throated diver occurring within The Murrough SPA area. Abundance is categorised based on whether individuals occur within the 10 km around the Array Area or beyond the 10 km buffer.**

Area of the Murrough SPA	Point estimates					
	PBM	MFNB			RM	
	Nov	Dec	Jan	Feb	Mar	Apr
Inside the 10 km buffer	-	15.21	-	-	-	-
Outside of the 10 km buffer	89.29	196.43	52.54	22.32	-	4.46
Total	89.29	211.64	52.54	22.32	0.00	4.46

Table 3-17: Mean estimated abundance (95% bootstrapped Confidence Intervals) of the red-throated diver occurring within The Murrough SPA area. Abundance is categorised based on whether individuals occur within the 10 km around the Array Area or beyond the 10 km buffer.

Area of the Murrough SPA	Mean estimated abundance (95% CIs)					
	PBM	MFNB			RM	
	Nov	Dec	Jan	Feb	Mar	Apr
Inside the 10 km buffer	0 (0 - 0)	15.141 (0 - 32.765)	0 (0 - 0)	0 (0 - 0)	0 (0 - 0)	0 (0 - 0)
Outside of the 10 km buffer	89.482 (27.49 - 162.137)	197.383 (109.413 - 294.252)	52.797 (26.466 - 82.53)	22.269 (4.417 - 44.369)	0 (0 - 0)	4.363 (0 - 13.588)
<b>Total</b>	89.482	212.524	52.797	22.269	0	4.363

### 3.3.2. Peak abundances

The seasonal peak abundances of red-throated diver within The Murrrough SPA are displayed in **Table 3-18**.

**Table 3-18: Season peak abundance within the Murrrough SPA, divided into the zone of the SPA which is inside the 10 km buffer around the Array Array and the zone of the SPA outside of the 10 km buffer.**

Season	Area of the Murrrough SPA	
	Within 10 km of Array Area	Beyond 10 km from Array Area
Post-Breeding Migration (PBM)	0 (All)	89.29 (November)
Migration-free non-breeding (MFNB)	15.21 (December)	196.43 (December)
Return migration (RM)	0 (All)	22.32 (February)

### 3.3.3. Displacement rates

The number of predicted mortalities at the selected displacement and mortality levels are presented in **Table 3-19**. Displacement matrices with all rates applied are presented in section 3.3.4 below.

**Table 3-19: Summary of number of predicted mortalities from the displacement matrices for the Red-throated diver in the portion of The Murrough Area inside the 10 km buffer.**

Area of the Murrough SPA	Season	Displacement rate	Mortality rate	Mortalities
Inside the 10 km buffer zone	Post-Breeding Migration (PBM)			0.000
	Migration-free non-breeding (MFNB)	34%	1%	0.052
	Return migration (RM)			0.000
	Non-breeding (NB)			0.052

### 3.3.4. Displacement matrices of red-throated divers detected within The Murrough SPA

Displacement matrices were generated for the red-throated divers recorded within The Murrough SPA area using the 2024/2025 data. The displacement was evaluated for each season for which data was recorded and according to whether they fell inside or outside the 10 km buffer around the Array Area. These results are presented in sections 3.3.4.1 for the post-breeding migration, section 3.3.4.2 for the migration-free non-breeding, section 3.3.4.3 for the return-migration and, 3.3.4.4 for all non-breeding season.



### 3.3.4.2. Migration-free non-breeding (MFNB) (Dec-Jan)

#### 3.3.4.2.2. Zone of The Murrough SPA inside the 10 km buffer

Table 3-21: Migration-free non-breeding (MFNB; Dec-Jan) displacement matrix for red-throated divers within the portion of The Murrough SPA inside the 10 km buffer around the Array Area.

		Mortality level (%)															
		0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
Displacement level (%)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1	0	0	0	0	0.0 1	0.0 1	0.0 2	0.0 3	0.0 5	0.0 6	0.0 8	0.0 9	0.11	0.12	0.14	0.15
	10	0	0.0 2	0.0 3	0.0 5	0.0 6	0.0 8	0.1 5	0.3	0.4 6	0.6 1	0.7 6	0.9 1	1.06	1.22	1.37	1.52
	20	0	0.0 3	0.0 6	0.0 9	0.1 2	0.1 5	0.3	0.6 1	0.9 1	1.2 2	1.5 2	1.8 2	2.13	2.43	2.74	3.04
	30	0	0.0 5	0.0 9	0.1 4	0.1 8	0.2 3	0.4 6	0.9 1	1.3 7	1.8 2	2.2 8	2.7 4	3.19	3.65	4.11	4.56
	40	0	0.0 6	0.1 2	0.1 8	0.2 4	0.3	0.6 1	1.2 2	1.8 2	2.4 3	3.0 4	3.6 5	4.26	4.87	5.47	6.08
	50	0	0.0 8	0.1 5	0.2 3	0.3	0.3 8	0.7 6	1.5 2	2.2 8	3.0 4	3.8	4.5 6	5.32	6.08	6.84	7.6
	60	0	0.0 9	0.1 8	0.2 7	0.3 6	0.4 6	0.9 1	1.8 2	2.7 4	3.6 5	4.5 6	5.4 7	6.39	7.3	8.21	9.12
	70	0	0.1 1	0.2 1	0.3 2	0.4 3	0.5 3	1.0 6	2.1 3	3.1 9	4.2 6	5.3 2	6.3 9	7.45	8.52	9.58	10.6 4
	80	0	0.1 2	0.2 4	0.3 6	0.4 9	0.6 1	1.2 2	2.4 3	3.6 5	4.8 7	6.0 8	7.3	8.52	9.73	10.9 5	12.1 7
	90	0	0.1 4	0.2 7	0.4 1	0.5 5	0.6 8	1.3 7	2.7 4	4.1 1	5.4 7	6.8 4	8.2 1	9.58	10.9 5	12.3 2	13.6 9
	100	0	0.1 5	0.3 6	0.4 6	0.6 1	0.7 6	1.5 2	3.0 4	4.5 6	6.0 8	7.6	9.1 2	10.6 4	12.1 7	13.6 9	15.2 1



### 3.3.4.4. Non-breeding (NB)

#### 3.3.4.4.4. Zone of The Murrough SPA inside the 10km buffer

Table 3-23: Non-breeding (all months; Nov-Apr) displacement matrix for red-throated divers within the portion of The Murrough SPA inside the 10 km buffer around the Array Area.

		Mortality level (%)															
		0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
Displacement level (%)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1	0	0	0	0	0.0 1	0.0 1	0.0 2	0.0 3	0.0 5	0.0 6	0.0 8	0.0 9	0.11	0.12	0.14	0.15
	10	0	0.0 2	0.0 3	0.0 5	0.0 6	0.0 8	0.1 5	0.3	0.4 6	0.6 1	0.7 6	0.9 1	1.06	1.22	1.37	1.52
	20	0	0.0 3	0.0 6	0.0 9	0.1 2	0.1 5	0.3	0.6 1	0.9 1	1.2 2	1.5 2	1.8 2	2.13	2.43	2.74	3.04
	30	0	0.0 5	0.0 9	0.1 4	0.1 8	0.2 3	0.4 6	0.9 1	1.3 7	1.8 2	2.2 8	2.7 4	3.19	3.65	4.11	4.56
	40	0	0.0 6	0.1 2	0.1 8	0.2 4	0.3 4	0.6 1	1.2 2	1.8 2	2.4 3	3.0 4	3.6 5	4.26	4.87	5.47	6.08
	50	0	0.0 8	0.1 5	0.2 3	0.3 3	0.3 8	0.7 6	1.5 2	2.2 8	3.0 4	3.8 4	4.5 6	5.32	6.08	6.84	7.6
	60	0	0.0 9	0.1 8	0.2 7	0.3 6	0.4 6	0.9 1	1.8 2	2.7 4	3.6 5	4.5 6	5.4 7	6.39	7.3	8.21	9.12
	70	0	0.1 1	0.2 1	0.3 2	0.4 3	0.5 3	1.0 6	2.1 3	3.1 9	4.2 6	5.3 2	6.3 9	7.45	8.52	9.58	10.6 4
	80	0	0.1 2	0.2 4	0.3 6	0.4 9	0.6 1	1.2 2	2.4 3	3.6 5	4.8 7	6.0 8	7.3	8.52	9.73	10.9 5	12.1 7
	90	0	0.1 4	0.2 7	0.4 1	0.5 5	0.6 8	1.3 7	2.7 4	4.1 1	5.4 7	6.8 4	8.2 1	9.58	10.9 5	12.3 2	13.6 9
	100	0	0.1 5	0.3	0.4 6	0.6 1	0.7 6	1.5 2	3.0 4	4.5 6	6.0 8	7.6	9.1 2	10.6 4	12.1 7	13.6 9	15.2 1

## 4. References

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