Rhyswg Wind Farm
Appendix 9B: Collision Risk Modelling
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1 INTRODUCTION

1.1 This Appendix has been written as a supplement to Chapter 9 Ornithology of the Environmental Statement for the proposed Rhyswg Wind Farm (hereafter referred to as the 'Proposed Development'). It explains the process and results of the Collision Risk Modelling (CRM), which estimates the wind turbine collision risk to select bird species based on flight data from approximately three years of Vantage Point (VP) surveys.

1.2 The CRM methodology is based on Band et al. (2007)[1] as recommended by Natural Scotland (previously known as Scottish Natural Heritage (SNH) (SNH 2017)[2]. The model requires various data (turbine specification, species biometrics and flight characteristics and data on flights within the Collision Risk Zone (CRZ)) to calculate a theoretical collision rate by season, year and over the lifetime of the project to inform the assessment of potentially significant adverse effects. The ability of species to avoid turbines is also factored in (SNH 2018)[3].

2 METHODOLOGY

2.1 Parameters for the wind turbine model selected for the Proposed Development and used for the CRM are shown in **Table EDP 2.1**.

Table EDP 2.1: Turbine Dimensions Used in the CRM

Parameter	Value
Model	Vestas V136-3.45MW
Number of Turbines	3
Number of Blades	3
Blade Diameter (m)	136

[1] Band, W., Madders, M. & Whitfield, D.P. (2007) Developing Field and Analytical Methods to Assess Avian Collision Risk at Wind Farms. In: de Lucas, M., Janss, G. & Ferrer, M. (eds.) Birds and Wind Farms: Risk Assessment and Mitigation (pp. 259-275). Quercus, Madrid.

[2] Scottish Natural Heritage (2017) Recommended Bird Survey Methods to Inform Impact Assessment of Onshore Wind Farms. (online) Available at: https://www.nature.scot/sites/default/files/2018-06/Guidance Note - Recommended bird survey methods to inform impact assessment of onshore windfarms.pdf. Last accessed 04/07/22.

[3] Scottish Natural Heritage (2018) Avoidance Rates for the Onshore SNH Wind Farm Collision Risk Model. (online) Available at: https://www.nature.scot/sites/default/files/2018-09/Wind farm impacts on birds - Use of Avoidance Rates in the SNH Wind Farm Collision Risk Model.pdf. Last accessed 04/07/22.

Parameter	Value
Blade High Point (m)	180
Blade Low Point (m)	44
Maximum Blade Depth (m)	4
Flight Risk Area (m^2)	384,246
Flight Risk Volume (m^3)	52,257,439

2.2 Two VP locations were used, covering a combined area of approximately 91 hectares (ha). This area was calculated by combining the total area visible from each VP and therefore allows for the potential over-representation where these areas overlap. **Table EDP 2.2** shows the number of survey hours per VP location per season.

Table EDP 2.2: Survey Hours per VP Location per Season

Season	Hours per Survey	Number of Surveys per VP location	Total Number of Hours per VP Location	Total Number of Hours Surveyed across both VPs
Breeding 2020*	3	8	24	24
Non-breeding 2020-21	3	16	48	96
Breeding 2021	3	16	48	96
Non-breeding 2021-22	3	15	45	90
Breeding 2022	3	14	42	84
Breeding 2024	3	12	36	72
Non-breeding 2024-25	3	14	42	84
Total		**95**	**285**	**546**

*Surveys were instructed in the middle of the breeding season. It was later determined that a second survey location was needed to ensure sufficient coverage.

2.3 The CRM was completed separately for breeding (April to August) and non-breeding (September to March) seasons, covering the period from the end of the 2020 breeding season through to the breeding season of 2022, and then the breeding season of 2024 to the end of the non-breeding season of 2024-25.

2.4 Based on the flight data recorded, target species were selected for CRM. The species that were analysed were mallard (*Anas platyrhynchos*), herring gull (*Larus argentatus*), lesser black-backed gull (*Larus fuscus*), grey heron (*Ardea cinerea*), goshawk (*Accipiter gentilis*), hen harrier (*Circus cyaneus*), red kite (*Milvus milvus*), and kestrel (*Falco tinnunculus*). Owing to the number of buzzard (*Buteo buteo*) and raven (*Corvus corax*) flights recorded within the Site, these species were also subject to CRM despite their favourable conservation status.

2.5 Target species flight heights were recorded at 15 second intervals. Based on the worst-case turbine specifications at the outset of the Project, the following core height bands were used during the first year of surveys:

- <30m;

- 30-180m (CRZ); and
- >180m.

2.6 From the 2021 breeding season onwards, additional height bands were recorded in 15m increments to allow some flexibility should the turbine specification change.

2.7 In addition, to adopt a precautionary stance, an additional CRM was run in parallel with the standard approach. This precautionary approach adds the time that all birds spent flying in the height bands immediately below and above the CRZ, which includes 15m below (15m) and 20m above (200m) the turbine rotors into the time seen flying at CRZ height.

2.8 As none of these species were flying across the Site or Study Area in any sort of regular way, the 'Random Model' technique was used. The model takes into account the time that birds of each species were observed flying at the height of the turbine rotors (CRZ), as well as the time in which birds could be active, i.e. the number of daylight hours per month.

2.9 The Band (2007) model is a two-stage process. The first stage uses the flight data recorded on the VP survey, as set out in **Table EDP 2.3**, to estimate the number of birds flying through the areas swept by the turbine rotor blades per year.

Table EDP 2.3: Flight Observations for Stage 1 of Collision Risk Modelling

Species	Season	Total Observed Time (s)	Available Hours for Flight Activity	Time at CRZ Height (s) (30-180m)	Time at Precautionary CRZ Height (s) (30-180m 2020/15-200m 2021 onwards)
Buzzard (*Buteo buteo*)	Breeding 2020 (July-August)	990	951.26	195	240
	Non-breeding 2020-21 (September-March)	4365	2130.25	1890	2355
	Breeding 2021 (April-August)	4155	2351.19	3045	3705
	Non-breeding 2021-22 (September-March)	4740	2130.25	4185	4290
	Breeding Season 2022 (April-August)	5730	2351.19	5430	5700
	Breeding Season 2024 (April-August)	4995	2351.19	2820	3735
	Non-breeding 2024-25 (September-March)	4050	2130.25	3075	3780
Goshawk (*Accipiter gentilis*)	Breeding 2020 (July-August)	0	951.26	0	0
	Non-breeding 2020-21 (September-March)	0	2130.25	0	0
	Breeding 2021 (April-August)	180	2351.19	150	165
	Non-breeding 2021-22 (September-March)	1215	2130.25	1125	1185
	Breeding Season 2022 (April-August)	570	2351.19	540	570
	Breeding Season 2024 (April-August)	720	2351.19	15	75
	Non-breeding 2024-25 (September-March)	225	2130.25	195	225
Grey Heron (*Ardea cinerea*)	Breeding 2020 (July-August)	0	951.26	0	0
	Non-breeding 2020-21 (September-March)	255	2130.25	120	255
	Breeding 2021 (April-August)	90	2351.19	90	90
	Non-breeding 2021-22 (September-March)	315	2130.25	135	270
	Breeding Season 2022 (April-August)	255	2351.19	90	240
	Breeding Season 2024 (April-August)	0	2351.19	0	0
	Non-breeding 2024-25 (September-March)	0	2130.25	0	0
Herring Gull (*Larus argentatus*)	Breeding 2020 (July-August)	30	951.26	0	0
	Non-breeding 2020-21 (September-March)	105	2130.25	0	0
	Breeding 2021 (April-August)	195	2351.19	90	90

Species	Season	Total Observed Time (s)	Available Hours for Flight Activity	Time at CRZ Height (s) (30-180m)	Time at Precautionary CRZ Height (s) (30-180m 2020/15-200m 2021 onwards)
	Non-breeding 2021-22 (September-March)	0	2130.25	0	0
	Breeding Season 2022 (April-August)	465	2351.19	465	465
	Breeding Season 2024 (April-August)	75	2351.19	60	75
	Non-breeding 2024-25 (September-March)	0	2130.25	0	0
Hen Harrier (*Circus cyaneus*)	Breeding 2020 (July-August)	0	951.26	0	0
	Non-breeding 2020-21 (September-March)	90	2130.25	45	90
	Breeding 2021 (April-August)	0	2351.19	0	0
	Non-breeding 2021-22 (September-March)	0	2130.25	0	0
	Breeding Season 2022 (April-August)	0	2351.19	0	0
	Breeding Season 2024 (April-August)	0	2351.19	0	0
	Non-breeding 2024-25 (September-March)	0	2130.25	0	0
Kestrel (*Falco tinnunculus*)	Breeding 2020 (July-August)	135	951.26	135	135
	Non-breeding 2020-21 (September-March)	150	2130.25	120	150
	Breeding 2021 (April-August)	0	2351.19	0	0
	Non-breeding 2021-22 (September-March)	0	2130.25	0	0
	Breeding Season 2022 (April-August)	0	2351.19	0	0
	Breeding Season 2024 (April-August)	0	2351.19	0	0
	Non-breeding 2024-25 (September-March)	15	2130.25	0	0
Lesser Black-backed Gull (*Larus fuscus*)	Breeding 2020 (July-August)	45	951.26	0	0
	Non-breeding 2020-21 (September-March)	0	2130.25	0	0
	Breeding 2021 (April-August)	435	2351.19	180	180
	Non-breeding 2021-22 (September-March)	0	2130.25	0	0
	Breeding Season 2022 (April-August)	30	2351.19	0	30
	Breeding Season 2024 (April-August)	75	2351.19	0	75
	Non-breeding 2024-25 (September-March)	0	2130.25	0	0

Species	Season	Total Observed Time (s)	Available Hours for Flight Activity	Time at CRZ Height (s) (30-180m)	Time at Precautionary CRZ Height (s) (30-180m 2020/15-200m 2021 onwards)
Mallard (*Anas platyrhynchos*)	Breeding 2020 (July-August)	0	951.26	0	0
	Non-breeding 2020-21 (September-March)	0	2130.25	0	0
	Breeding 2021 (April-August)	0	2351.19	0	0
	Non-breeding 2021-22 (September-March)	15	2130.25	0	15
	Breeding Season 2022 (April-August)	0	2351.19	0	0
	Breeding Season 2024 (April-August)	0	2351.19	0	0
	Non-breeding 2024-25 (September-March)	0	2130.25	0	0
Merlin (*Falco columbarius*)	Breeding 2020 (July-August)	0	951.26	0	0
	Non-breeding 2020-21 (September-March)	0	2130.25	0	0
	Breeding 2021 (April-August)	0	2351.19	0	0
	Non-breeding 2021-22 (September-March)	15	2130.25	0	0
	Breeding Season 2022 (April-August)	0	2351.19	0	0
	Breeding Season 2024 (April-August)	0	2351.19	0	0
	Non-breeding 2024-25 (September-March)	0	2130.25	0	0
Raven (*Corvus corax*)	Breeding 2020 (July-August)	300	951.26	210	225
	Non-breeding 2020-21 (September-March)	3540	2130.25	1845	2370
	Breeding 2021 (April-August)	2235	2351.19	1260	1950
	Non-breeding 2021-22 (September-March)	3810	2130.25	2745	3420
	Breeding Season 2022 (April-August)	4635	2351.19	4320	4635
	Breeding Season 2024 (April-August)	945	2351.19	270	720
	Non-breeding 2024-25 (September-March)	2070	2130.25	1125	1710
Red Kite (*Milvus milvus*)	Breeding 2020 (July-August)	0	951.26	0	0
	Non-breeding 2020-21 (September-March)	120	2130.25	0	0
	Breeding 2021 (April-August)	30	2351.19	30	30

Species	Season	Total Observed Time (s)	Available Hours for Flight Activity	Time at CRZ Height (s) (30-180m)	Time at Precautionary CRZ Height (s) (30-180m 2020/15-200m 2021 onwards)
	Non-breeding 2021-22 (September-March)	0	2130.25	0	0
	Breeding Season 2022 (April-August)	0	2351.19	0	0
	Breeding Season 2024 (April-August)	0	2351.19	0	0
	Non-breeding 2024-25 (September-March)	0	2130.25	0	0

2.10 The flight risk area is defined as the area bounded by the extent of the outer-most turbine towers, plus a buffer of 68m, in order to include the turbine blade radius. The flight risk volume is this area multiplied by the diameter of the turbine blades.

2.11 The area of visibility was calculated using QGIS Geographic Information System (GIS) software, using a viewshed of 180° from each of the two VP locations, limited to a radius of 2km. It covers the area visible 25m above ground level, assuming an observer height of 1.75m, and uses a LiDAR 1m Digital Surface Model with vertical accuracy of ±5cm.

2.12 The second stage then estimates the probability of these birds actually being hit by the moving rotors. The results of this stage can be seen in **Table EDP 2.4**. This stage uses data of bird wingspan and body length (BTO 2022)[4] and flight speeds (Alerstam et al. 2007[5] and Bruderer & Boldt 2001)[6], which can be seen in **Table EDP 2.5**. Where these two data sources listed different flight speeds, the slower one was used in order to assume a worst case scenario.

2.13 These two stages are multiplied together to produce an estimate of bird casualties over a year, assuming that birds will take no measures to avoid collisions.

Table EDP 2.4: Calculation of Collision Probabilities for Birds Passing Through Area Swept by Rotor Blades

Species (in flapping flight)	Collision Probability Upwind (%)	Collision Probability Downwind (%)	Mean (%)
Buzzard	17.6%	11.8%	14.7%
Goshawk	20.5%	14.6%	17.5%
Grey Heron	21.7%	15.9%	18.8%
Herring Gull	16.8%	11.0%	13.9%
Hen Harrier	20.9%	14.9%	17.9%
Kestrel	17.7%	11.8%	14.7%
Lesser Black-Backed Gull	17.6%	11.8%	14.7%
Mallard	12.7%	7.1%	9.9%
Raven	15.6%	9.9%	12.8%
Red Kite	18.0%	12.2%	15.1%

Note: upwind and downwind probabilities are different due to wind speed affecting time taken to pass through the area swept by the rotor blades. These are therefore combined to give an average collision probability.

2.14 In reality, birds will avoid collisions if possible, so this assumption is unrealistic. Therefore SNH (2018)[7] have calculated avoidance rates based on observations of different species in the field, which are then applied to the bird collision risk estimate to provide a more

[4] British Trust for Ornithology (2022) Birdfacts (online) Available at: https://www.bto.org/understanding-birds/birdfacts. Last accessed 04/07/22.

[5] Alerstam T., Rosén M., Bäckman J., Ericson P.G.P., Hellgren, O. (2007). Flight Speeds among Bird Species: Allometric and Phylogenetic Effects. PLoS Biol 5(8): e197. DOI:10.1371/journal.pbio.0050197.

[6] Bruderer, B. & Boldt, A. 2001. Flight characteristics of birds 1: radar measurement of speeds. Ibis 143 (2): 178-204.

[7] Scottish Natural Heritage (2018) Avoidance Rates for the Onshore SNH Wind Farm Collision Risk Model. (online) Available at: https://www.nature.scot/sites/default/files/2018-09/Wind farm impacts on birds - Use of Avoidance Rates in the SNH Wind Farm Collision Risk Model.pdf. Last accessed 04/07/22.

realistic estimate. Furness (2019)[8] updated the avoidance rates of herring gull and lesser black backed gull. The avoidance rates used are shown in **Table EDP 2.5**.

Table EDP 2.5: Bird Biometrics and Avoidance Rates

Species	Body Length (m)	Wingspan (m)	Assumed Flight Speed (m/s)	Avoidance Rate (%)
Buzzard	0.54	1.20	11.6	98.0
Goshawk	0.55	1.10	9.7	98.0
Grey Heron	0.94	1.85	11.2	98.0
Hen Harrier	0.48	1.10	9.1	99.0
Herring Gull	0.60	1.44	12.8	99.5
Kestrel	0.34	0.76	10.1	95.0
Lesser Black-Backed Gull	0.58	1.42	11.9	99.5
Mallard	0.62	0.98	18.5	98.0
Raven	0.64	1.35	14.3	98.0
Red Kite	0.63	1.85	12.0	99.0

Limitations and Assumptions

2.15 The CRM assumes that the turbines will be operational at all times, and therefore accounts for the worst-case scenario. In reality, mechanical faults/maintenance and low wind speed will likely mean that operational time is more like 85-90%. If the rotors are not spinning, this would result in lower numbers of bird collisions than projected here.

2.16 Of the 546 total hours of VP surveys, a total of eight hours, or 1.5%, were undertaken in poor visibility (<1km), and a total of 94 hours, or 17.2% were undertaken in moderate visibility (1-2km). Therefore, a total of 18.7% of surveys were undertaken in less than optimal visibility conditions. However, the viewsheds did not cover distances of greater than 1km owing to the topography and therefore moderate visibility did not present a limitation.

2.17 No data was available on the wind turbine blade pitch angle which is used in the collision risk calculations. It was left as the default value of 30°. Band (2012)[9] considers 25-30° to be a reasonable assumption for a typical large turbine.

2.18 No data was available for the rotation period of the wind turbines, so this was left at the default value of 2.97 seconds per rotation (20.2 rotations per minute).

[8] Furness, R.W. (2019) Avoidance rates of herring gull, great black-backed gull and common gull for use in the assessment of terrestrial wind farms in Scotland. Scottish Natural Heritage Research Report No. 1019.
[9] Band, B. (2012). Using a Collision Risk Model to Assess Bird Collision Risks for Offshore Wind Farms. Report by British Trust for Ornithology (BTO). Report for The Crown Estate. (online) Accessed at https://www.bto.org/sites/default/files/u28/downloads/Projects/Final_Report_SOSS02_Band1ModelGuidance.pdf. Last accessed 25/08/22.

Results

2.19 The results of the CRM, showing seasonal, annual and longer-term collision risks, are shown in **Table EDP 2.6**.

2.20 As the 2020 breeding season only included 2 months of survey data it has been presented in the summary tables but not accounted for in the average collision rates, except with respect to kestrel. This is because the kestrel flights in the 2020 2-month period increase the average number of predicted collisions.

Table EDP 2.6: Projected Seasonal, Annual, and Longer-Term Collision Risk for Standard and Precautionary Approaches

Activity Season	Predicted Collisions	Standard Approach (30 – 180m CRZ)					Precautionary Approach (115 - 200m CRZ)				
		2020[10]	2020 / 2021	2021 / 2022	2024 / 2025	Average	2020	2020 / 2021	2021 / 2022	2024 / 2025	Average
Buzzard											
Non-breeding Season (September-March)	Predicted collisions per year	-	0.40	1.04	0.82	0.75	-	0.50	1.07	1.01	0.86
	Predicted collisions over 30 years	-	12.07	31.26	24.61	22.65	-	15.04	32.05	30.26	25.78
Breeding Season (April-August)	Predicted collisions per year	0.14	0.78	1.60	1.11	1.16	0.17	0.95	1.69	1.28	1.30
	Predicted collisions over 30 years	4.12	23.54	47.97	33.50	26.17	5.07	28.64	50.62	38.50	39.20
Annual Total	Predicted collisions per year	-	1.19	2.64	1.93	1.92	-	1.46	2.76	2.29	2.16
	Predicted collisions over 30 years	-	35.61	79.23	57.9	57.58	-	43.68	82.67	68.75	64.94
Goshawk											
Non-breeding Season (September-March)	Predicted collisions per year	-	0.00	0.28	0.05	0.11	-	0.00	0.29	0.06	0.12
	Predicted collisions over 30 years	-	0.00	8.39	1.56	3.32	-	0.00	8.84	1.80	3.55
Breeding Season (April-August)	Predicted collisions per year	0.00	0.04	0.16	< 0.01	0.07	0.00	0.04	0.17	0.03	0.08
	Predicted collisions over 30 years	0.00	1.16	4.76	0.15	2.03	0.00	1.27	5.03	0.77	2.36

[10] The 2020 data only included two months of breeding season data and has therefore only been included in the average on a precautionary basis where the results had an increased collision risk – this only applies to kestrel.

Activity Season	Predicted Collisions	Standard Approach (30 – 180m CRZ)					Precautionary Approach (115 - 200m CRZ)				
		2020[10]	2020 / 2021	2021 / 2022	2024 / 2025	Average	2020	2020 / 2021	2021 / 2022	2024 / 2025	Average
Annual Total	Predicted collisions per year	-	0.04	0.44	0.06	0.18	-	0.04	0.46	0.09	0.20
	Predicted collisions over 30 years	-	1.16	13.16	1.71	5.34	-	1.27	13.87	2.57	5.91
Grey Heron											
Non-breeding Season (September-March)	Predicted collisions per year	-	0.03	0.04	0.00	0.02	0.00	0.07	0.08	0.00	0.05
	Predicted collisions over 30 years	-	0.95	1.25	0.00	0.73	0.00	2.01	2.50	0.00	1.50
Breeding Season (April-August)	Predicted collisions per year	0.00	0.03	0.03	0.00	0.02	0.00	0.03	0.09	0.00	0.03
	Predicted collisions over 30 years	0.00	0.86	0.98	0.00	0.46	0.00	0.86	2.62	0.00	0.87
Annual Total	Predicted collisions per year	-	0.06	0.07	0.00	0.03	0.00	0.10	0.17	0.00	0.08
	Predicted collisions over 30 years	-	1.81	2.23	0.00	1.02	0.00	2.87	5.12	0.00	2.37
Hen Harrier											
Non-breeding Season (September-March)	Predicted collisions per year	-	< 0.01	0.00	0.00	< 0.01	0.00	< 0.01	0.00	0.00	0.00
	Predicted collisions over 30 years	-	0.14	0.00	0.00	0.05	0.00	0.27	0.00	0.00	0.09
Breeding Season (April-August)	Predicted collisions per year	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Activity Season	Predicted Collisions	Standard Approach (30 – 180m CRZ)					Precautionary Approach (115 - 200m CRZ)				
		2020[10]	2020 / 2021	2021 / 2022	2024 / 2025	Average	2020	2020 / 2021	2021 / 2022	2024 / 2025	Average
	Predicted collisions over 30 years	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Annual Total	Predicted collisions per year	-	< 0.01	0.00	0.00	< 0.01	0.00	< 0.01	0.00	0.00	0.00
	Predicted collisions over 30 years	-	0.14	0.00	0.00	0.05	0.00	0.27	0.00	0.00	0.09
Herring Gull											
Non-breeding Season (September-March)	Predicted collisions per year	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Predicted collisions over 30 years	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Breeding Season (April-August)	Predicted collisions per year	0.00	< 0.01	0.04	< 0.01	0.01	0.00	< 0.01	0.04	< 0.01	0.01
	Predicted collisions over 30 years	0.00	0.18	1.07	0.16	0.35	0.00	0.18	1.07	0.20	0.36
Annual Total	Predicted collisions per year	-	< 0.01	0.04	< 0.01	0.01	0.00	< 0.01	0.04	< 0.01	0.01
	Predicted collisions over 30 years	-	0.18	1.07	0.16	0.35	0.00	0.18	1.07	0.20	0.36
Kestrel											
Non-breeding Season (September-March)	Predicted collisions per year	-	0.06	0.00	0.00	0.02	-	0.07	0.00	0.00	0.02
	Predicted collisions over 30 years	-	1.80	0.00	0.00	0.56	-	2.09	0.00	0.00	0.69

Activity Season	Predicted Collisions	Standard Approach (30 – 180m CRZ)					Precautionary Approach (115 - 200m CRZ)				
		2020[10]	2020 / 2021	2021 / 2022	2024 / 2025	Average	2020	2020 / 2021	2021 / 2022	2024 / 2025	Average
Breeding Season (April-August)	Predicted collisions per year	0.21	0.00	0.00	0.00	0.05	0.21	0.00	0.00	0.00	0.05
	Predicted collisions over 30 years	6.24	0.00	0.00	0.00	1.56	6.24	0.00	0.00	0.00	1.56
Annual Total	Predicted collisions per year	0.21	0.06	0.00	0.00	0.07	0.21	0.07	0.00	0.00	0.07
	Predicted collisions over 30 years	6.24	1.80	0.00	0.00	2.12	6.24	2.09	0.00	0.00	2.25
Lesser Black-backed Gull											
Non-breeding Season (September-March)	Predicted collisions per year	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Predicted collisions over 30 years	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Breeding Season (April-August)	Predicted collisions per year	0.00	0.01	0.00	0.00	< 0.01	0.00	0.01	< 0.01	< 0.01	< 0.01
	Predicted collisions over 30 years	0.00	0.36	0.00	0.00	0.12	0.00	0.36	0.07	0.20	0.16
Annual Total	Predicted collisions per year	-	0.01	0.00	0.00	< 0.01	0.00	0.01	< 0.01	< 0.01	< 0.01
	Predicted collisions over 30 years	-	0.36	0.00	0.00	0.12	0.00	0.36	0.07	0.20	0.16
Mallard											
Non-breeding Season (September-March)	Predicted collisions per year	-	0.00	0.00	0.00	0.00	0.00	0.00	< 0.01	0.00	< 0.01
	Predicted collisions over 30 years	-	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.00	0.04

Activity Season	Predicted Collisions	Standard Approach (30 – 180m CRZ)					Precautionary Approach (115 - 200m CRZ)				
		2020[10]	2020 / 2021	2021 / 2022	2024 / 2025	Average	2020	2020 / 2021	2021 / 2022	2024 / 2025	Average
Breeding Season (April-August)	Predicted collisions per year	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Predicted collisions over 30 years	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Annual Total	Predicted collisions per year	-	0.00	0.00	0.00	0.00	0.00	0.00	< 0.01	0.00	< 0.01
	Predicted collisions over 30 years	-	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.00	0.04
Raven											
Non-breeding Season (September-March)	Predicted collisions per year	-	0.42	0.73	0.32	0.49	-	0.54	0.91	0.49	0.65
	Predicted collisions over 30 years	-	12.61	21.96	9.64	14.74	-	16.20	27.35	14.65	19.40
Breeding Season (April-August)	Predicted collisions per year	0.16	0.35	1.36	0.10	0.60	0.17	0.54	1.46	0.26	0.75
	Predicted collisions over 30 years	4.75	10.43	40.86	2.98	18.09	5.09	16.14	43.84	7.94	22.64
Annual Total	Predicted collisions per year	-	0.77	2.09	0.42	1.09	-	1.08	2.37	0.75	1.40
	Predicted collisions over 30 years	-	23.04	62.82	12.62	32.82	-	32.34	71.19	22.59	42.04
Red Kite											
	Predicted collisions per year	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Activity Season	Predicted Collisions	Standard Approach (30 – 180m CRZ)					Precautionary Approach (115 - 200m CRZ)				
		2020[10]	2020 / 2021	2021 / 2022	2024 / 2025	Average	2020	2020 / 2021	2021 / 2022	2024 / 2025	Average
Non-breeding Season (September-March)	Predicted collisions over 30 years	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Breeding Season (April-August)	Predicted collisions per year	0.00	< 0.01	0.00	0.00	< 0.01	0.00	< 0.01	0.00	0.00	< 0.01
	Predicted collisions over 30 years	0.00	0.12	0.00	0.00	0.04	0.00	0.12	0.00	0.00	0.04
Annual Total	Predicted collisions per year	-	< 0.01	0.00	0.00	< 0.01	0.00	< 0.01	0.00	0.00	< 0.01
	Predicted collisions over 30 years	-	0.12	0.00	0.00	0.04	0.00	0.12	0.00	0.00	0.04