APPENDIX 8

COLLISION RISK ASSESSMENT

Planning and Environmental Consultants

Collision Risk Assessment

Slievegrine Renewable Energy Development, Co. Waterford

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1. INTRODUCTION

This document outlines the methodology used to conduct a collision risk assessment of the Proposed Wind Farm. This assessment calculates an annual collision rate using a mathematical model to predict the number of birds that may be killed by collision with moving wind turbine rotor blades. The modelling method used is provided by Band (2024). This method is recommended by NatureScot (2024) and provides a standardised approach to collision risk assessment for onshore wind farms. Note that these are theoretical predictions; therefore, the results must be interpreted with a degree of caution.

2. METHODOLOGY

2.1 Modelling Process

The collision risk model estimates the number of collisions through the following stages:

- **Stage A Flight activity** - uses bird survey data to establish the density of flying birds in the vicinity of the turbines, and the proportion flying at a risk height (between the lowest and highest points of the rotors).
- **Stage B Number of flights through rotors** – makes an estimate, based on the bird density and proportion at risk height, of the potential number of bird passages through rotors. The initial assumption is that birds will continue to make flights within the area at the same intensity as before.
- **Stage C Probability of collision** - calculates the probability of collision during a single bird rotor transit.
- **Stage D Expected collisions** - multiplies the outputs of stage B and C to yield the potential collision rate for the bird species, assuming current levels of bird use of the site but allowing for the proportion of time that turbines are not operational.
- **Stage E Allowing for avoidance and attraction** - takes account of the proportion of birds likely to avoid the wind farm or its turbines, either because they have been displaced from the site or because they take evasive action or are attracted to the wind farm.
- **Stage F Uncertainty** - each of these five stages is followed by a further stage, stage F, which describes how to express the uncertainty surrounding a collision risk estimate.

The general features and assumptions of the collision risk model are discussed in further detail in Band (2024)[1]. Using the model, a final predicted annual collision rate can be predicted for each species that can be used in the impact assessment

2.2 Turbine Specifications

Three turbine models with differing dimensions (e.g., different hub height and rotor diameter) are proposed at the Proposed Wind Farm. To account for this, three models were run for turbines of each different specification and summed to provide a final total collision rate for all turbines. The turbine specifications used in the models are provided in Table 7 - 6 - 1. The expected operational time of the turbines is 85% according to reporting provided by the British Wind Energy Association and Xiao *et al.* (2021) which identifies the standard operational period of the wind turbines.

[1] *This assessment follows the standard methodology described by Band (2024), although it is acknowledged that there may be some scientific issues with some aspects of this methodology.*

Table 7 - 6 - 1 Turbines specifications

Component	Lowest Swept Height of 20m	Lowest Swept Height of 23m	Lowest Swept Height of 25m
Latitude (°N)	52	52	52
Turbine model	Vestas V150	Vestas V162	Vestas V150
Number of turbines	2	6	15
Hub height (m)	95	104	100
Rotor diameter (m)	150	162	150
Blade pitch (°)	6	6	6
Maximum blade width (m)	4.2	4.3	4.2
Rotational speed (rpm)	12.6	12.1	12.6
Number of blades	3	3	3

The turbine blade profile used in the model is presented in Table 7 - 6 - 2. In the absence of a specific blade profile for each turbine model, the blade profile provided in the collision risk model spreadsheet in Band (2024) has been used in the three scenarios. This table provides the chord width values at 20 evenly spaced points along the blade, expressed relative to the maximum chord width. The ratio r/R represents the relative radial position along the blade, where 0 corresponds to the hub and 1 corresponds to the blade tip, while the ratio c/C represents the relative chord width. Further information on blade profiles is in Section 4 'Worked Example'.

Table 7 - 6 - 2 Turbine blade profile

r/R	c/C
0.00	0.690
0.05	0.730
0.10	0.790
0.15	0.880
0.20	0.960
0.25	1.000
0.30	0.980
0.35	0.920
0.40	0.850
0.45	0.800
0.50	0.750
0.55	0.700
0.60	0.640
0.65	0.580
0.70	0.520
0.75	0.470
0.80	0.410
0.85	0.370
0.90	0.300
0.95	0.240
1.00	0.000

2.3 Vantage Point Surveys

The assessment is based on vantage point surveys to monitor flight activity undertaken between April 2024 and March 2026. This represents a 24-month period, consisting of two breeding seasons and two winter seasons, which is in full compliance with guidance from NatureScot (formerly Scottish Natural

Heritage [SNH]) outlined in SNH (2017), which was revised in NatureScot (2025a). Surveys remain in accordance with the updated guidance. Surveys were undertaken at 16 vantage points. The vantage points, the minimum swept height and the area watched (i.e., the area of the viewsheds) are listed in Table 7 - 6 - 3.

Table 7 - 6 - 3 Vantage points

Vantage Point	Minimum swept height (m)	Area watched (ha)
VP1	25	427
VP2	25	202
VP3	25	407
VP4	25	98
VP5	25	304
VP6	25	206
VP7	25	119
VP8	23	583
VP9	23	635
VP10	23	620
VP11	23	510
VP12	25	291
VP13	25	504
VP14	25	421
VP15	20	342
VP16	20	220

Survey methodology followed SNH (2017) and NatureScot (2025a). The surveyor collected data on bird observations and flight activity from the scanning arc of 180° to a 2km radius at the fixed vantage point locations for at least 6 hours per month. The survey effort is presented in Table 7 - 6 - 4, expressed in terms of hours and seconds per month over the entire survey period.

Table 7 - 6 - 4 Survey effort

Vantage Point	Month	Hours Survey	Seconds Survey
VP1	Jan	12.50	45,000
VP10	Jan	13.00	46,800
VP11	Jan	13.00	46,800
VP12	Jan	19.00	68,400
VP13	Jan	13.00	46,800
VP14	Jan	14.50	52,200
VP15	Jan	10.33	37,188
VP16	Jan	9.00	32,400
VP2	Jan	12.50	45,000
VP3	Jan	12.50	45,000
VP4	Jan	12.50	45,000
VP5	Jan	12.50	45,000
VP6	Jan	13.00	46,800
VP7	Jan	13.00	46,800
VP8	Jan	13.00	46,800
VP9	Jan	12.00	43,200
VP1	Feb	13.50	48,600

Vantage Point	Month	Hours Survey	Seconds Survey
VP10	Feb	12.50	45,000
VP11	Feb	12.00	43,200
VP12	Feb	13.00	46,800
VP13	Feb	13.00	46,800
VP14	Feb	13.00	46,800
VP15	Feb	13.00	46,800
VP16	Feb	13.00	46,800
VP2	Feb	13.00	46,800
VP3	Feb	13.00	46,800
VP4	Feb	13.00	46,800
VP5	Feb	6.00	21,600
VP6	Feb	12.50	45,000
VP7	Feb	12.50	45,000
VP8	Feb	12.50	45,000
VP9	Feb	12.50	45,000
VP1	Mar	14.00	50,400
VP10	Mar	13.00	46,800
VP11	Mar	12.50	45,000
VP12	Mar	12.75	45,900
VP13	Mar	12.00	43,200
VP14	Mar	13.00	46,800
VP15	Mar	13.50	48,600
VP16	Mar	13.63	49,068
VP2	Mar	14.00	50,400
VP3	Mar	14.00	50,400
VP4	Mar	15.00	54,000
VP5	Mar	13.00	46,800
VP6	Mar	14.00	50,400
VP7	Mar	12.75	45,900
VP8	Mar	13.00	46,800
VP9	Mar	13.00	46,800
VP1	Apr	19.00	68,400
VP10	Apr	12.40	44,640
VP11	Apr	18.50	66,600
VP12	Apr	13.00	46,800
VP13	Apr	7.00	25,200
VP14	Apr	13.00	46,800
VP15	Apr	13.00	46,800
VP16	Apr	13.00	46,800
VP2	Apr	18.00	64,800
VP3	Apr	19.00	68,400
VP4	Apr	19.00	68,400
VP5	Apr	18.28	65,808

Vantage Point	Month	Hours Survey	Seconds Survey
VP6	Apr	18.33	65,988
VP7	Apr	24.50	88,200
VP8	Apr	14.22	51,192
VP9	Apr	12.33	44,388
VP1	May	13.00	46,800
VP10	May	13.00	46,800
VP11	May	13.13	47,268
VP12	May	12.63	45,468
VP13	May	12.47	44,892
VP14	May	12.67	45,612
VP15	May	12.87	46,332
VP16	May	12.63	45,468
VP2	May	13.00	46,800
VP3	May	13.00	46,800
VP4	May	18.00	64,800
VP5	May	13.00	46,800
VP6	May	13.00	46,800
VP7	May	13.00	46,800
VP8	May	13.00	46,800
VP9	May	13.00	46,800
VP1	Jun	12.45	44,820
VP10	Jun	13.00	46,800
VP11	Jun	13.00	46,800
VP12	Jun	13.00	46,800
VP13	Jun	13.00	46,800
VP14	Jun	12.87	46,332
VP15	Jun	13.00	46,800
VP16	Jun	13.00	46,800
VP2	Jun	12.55	45,180
VP3	Jun	12.53	45,108
VP4	Jun	12.07	43,452
VP5	Jun	12.45	44,820
VP6	Jun	12.00	43,200
VP7	Jun	12.00	43,200
VP8	Jun	13.00	46,800
VP9	Jun	13.00	46,800
VP1	Jul	13.00	46,800
VP10	Jul	13.00	46,800
VP11	Jul	13.00	46,800
VP12	Jul	12.50	45,000
VP13	Jul	12.00	43,200
VP14	Jul	12.50	45,000
VP15	Jul	12.00	43,200

Vantage Point	Month	Hours Survey	Seconds Survey
VP16	Jul	13.00	46,800
VP2	Jul	13.00	46,800
VP3	Jul	13.00	46,800
VP4	Jul	13.00	46,800
VP5	Jul	13.00	46,800
VP6	Jul	13.00	46,800
VP7	Jul	13.00	46,800
VP8	Jul	12.00	43,200
VP9	Jul	13.00	46,800
VP1	Aug	12.00	43,200
VP10	Aug	12.00	43,200
VP11	Aug	13.00	46,800
VP12	Aug	13.00	46,800
VP13	Aug	13.00	46,800
VP14	Aug	13.00	46,800
VP15	Aug	13.00	46,800
VP16	Aug	13.00	46,800
VP2	Aug	12.00	43,200
VP3	Aug	12.00	43,200
VP4	Aug	11.50	41,400
VP5	Aug	12.00	43,200
VP6	Aug	13.00	46,800
VP7	Aug	13.00	46,800
VP8	Aug	13.00	46,800
VP9	Aug	13.00	46,800
VP1	Sep	12.00	43,200
VP10	Sep	13.50	48,600
VP11	Sep	13.50	48,600
VP12	Sep	6.00	21,600
VP13	Sep	13.00	46,800
VP14	Sep	13.00	46,800
VP15	Sep	13.00	46,800
VP16	Sep	11.00	39,600
VP2	Sep	13.00	46,800
VP3	Sep	12.96	46,656
VP4	Sep	13.00	46,800
VP5	Sep	12.00	43,200
VP6	Sep	12.00	43,200
VP7	Sep	12.50	45,000
VP8	Sep	12.50	45,000
VP9	Sep	13.50	48,600
VP1	Oct	13.00	46,800
VP10	Oct	11.00	39,600

Vantage Point	Month	Hours Survey	Seconds Survey
VP11	Oct	13.00	46,800
VP12	Oct	6.50	23,400
VP13	Oct	7.00	25,200
VP14	Oct	12.50	45,000
VP15	Oct	13.50	48,600
VP16	Oct	12.00	43,200
VP2	Oct	6.00	21,600
VP3	Oct	12.00	43,200
VP4	Oct	13.00	46,800
VP5	Oct	13.00	46,800
VP6	Oct	13.00	46,800
VP7	Oct	13.00	46,800
VP8	Oct	13.00	46,800
VP9	Oct	13.00	46,800
VP1	Nov	12.33	44,388
VP10	Nov	13.17	47,412
VP11	Nov	13.50	48,600
VP12	Nov	13.50	48,600
VP13	Nov	13.50	48,600
VP14	Nov	12.50	45,000
VP15	Nov	13.63	49,068
VP16	Nov	13.50	48,600
VP2	Nov	12.50	45,000
VP3	Nov	12.50	45,000
VP4	Nov	12.50	45,000
VP5	Nov	13.00	46,800
VP6	Nov	13.50	48,600
VP7	Nov	13.50	48,600
VP8	Nov	13.50	48,600
VP9	Nov	13.50	48,600
VP1	Dec	13.00	46,800
VP10	Dec	12.50	45,000
VP11	Dec	12.50	45,000
VP12	Dec	13.00	46,800
VP13	Dec	13.00	46,800
VP14	Dec	13.00	46,800
VP15	Dec	13.00	46,800
VP16	Dec	13.00	46,800
VP2	Dec	13.00	46,800
VP3	Dec	13.00	46,800
VP4	Dec	13.00	46,800
VP5	Dec	13.00	46,800
VP6	Dec	12.50	45,000

Vantage Point	Month	Hours Survey	Seconds Survey
VP7	Dec	12.00	43,200
VP8	Dec	12.50	45,000
VP9	Dec	12.50	45,000

Flight activity of target species was mapped and recorded as per defined flight bands which were chosen in relation to the dimensions of potential turbine models at the outset of surveys. These heights bands were:

- Band 1 = 0-20m
- Band 2 = 20-50m
- Band 3 = 50-100m
- Band 4 = 100-200m
- Band 5 = >200m

The risk height ranges of the turbines are 20-170m, 23-185m or 25-175m. As such, all flight activity in Bands 2, 3 and 4 are considered to be at potential collision height.

2.4 Species Assessed

Collision rates were estimated for the species listed in Table 7 - 6 - 5. The months included for each species are also presented.

Table 7 - 6 - 5 Species assessed

Species	Months	Model
Golden Plover	Aug-May	nondirectional
Peregrine Falcon	Oct-Sep	nondirectional
Red Kite	Oct-Mar	nondirectional
White-tailed Eagle	Oct-Sep	nondirectional
Hen Harrier	Aug-Mar	nondirectional
Black-tailed Godwit	Oct-Sep	nondirectional
Curlew	Oct-Sep	nondirectional
Common Gull	Oct-Sep	nondirectional
Herring Gull	Apr-Sep	nondirectional
Herring Gull	Oct-Mar	nondirectional
Lesser Black-backed Gull	Oct-Mar	nondirectional
Kestrel	Oct-Sep	nondirectional
Snipe	Oct-Sep	nondirectional
Buzzard	Oct-Sep	nondirectional
Sparrowhawk	Oct-Sep	nondirectional

Species biometrics, such as body length, body width (i.e., wingspan) and flight speed, as well as whether a bird typically flaps or glides in flight, are required to calculate collision risk. This information was sourced from the best available literature.

In addition, a 'nocturnal activity factor is required'. There is considerable uncertainty about levels of bird flight activity by night (Band, 2024). There are no standard expert rankings available for terrestrial species and levels of activity may vary from season to season. Because of this, each species is ranked with a nocturnal activity factor of 0%, 25%, 50%, 75% and 100%. A ranking of 0% is given to represent hardly any flight activity at night and of 100% for much flight activity at night. As such, the figures used in the

collision risk model take both day and night flights into account. The biometrics, flight type and nocturnal activity factor used in the model are presented in Table 7 - 6 - 6.

Table 7 - 6 - 6 Species biometrics, flight type and nocturnal activity factor

Species	Length (cm)	Width (cm)	Flight Speed (m/s)	Nocturnal Activity Factor	Flight Type
Black-tailed Godwit	42	76	18.3	50%	flapping
Buzzard	54	120.5	11.6	0%	gliding
Common Gull	41	120	13.4	25%	flapping
Curlew	55	90	16.3	50%	flapping
Golden Plover	27.5	71.5	17.9	25%	flapping
Hen Harrier	48	110	8	0%	flapping
Herring Gull	57	140	12.8	25%	flapping
Kestrel	33.5	75.5	10.1	0%	flapping
Lesser Black-backed Gull	58	142.5	11.9	25%	flapping
Peregrine Falcon	44.5	105	12.1	0%	flapping
Red Kite	63	185	12	0%	flapping
Snipe	25.5	42	17.1	100%	flapping
Sparrowhawk	33	62.5	10	0%	flapping
White-tailed Eagle	80	220	13.6	0%	flapping

To prepare the field survey data for analysis, the number of 'bird-seconds' per month per vantage point was calculated for each observation by multiplying the number of birds aloft by the duration of the flight (in seconds). This included time spent in all recorded height bands, not just those bands within potential collision height. These values are presented per vantage point per month for each species in Table 7 - 6 - 7, along with bird-seconds at potential collision height.

Table 7 - 6 - 7 Bird-seconds per vantage point per month

Species	Month	Vantage Point	Bird-Seconds	Potential Collision Height Bird-Seconds
Black-tailed Godwit	Nov	VP10	5,360	5360
	Aug	VP3	1,309	1309
	Aug	VP6	1,260	0
	Jul	VP7	6,180	6180
	Aug	VP7	352	352
	Aug	VP9	11,872	11872
Buzzard	Jan	VP1	115	75
	Mar	VP1	66	66
	Apr	VP1	545	439
	May	VP1	170	170
	Jun	VP1	1,290	1290
	Jul	VP1	2,010	1444
	Sep	VP1	50	50
	Nov	VP1	85	85
	Dec	VP1	131	47
	Feb	VP10	20	20
	Mar	VP10	14,241	14216
	Apr	VP10	19,560	13500

Species	Month	Vantage Point	Bird-Seconds	Potential Collision Height Bird-Seconds
	May	VP10	1,935	1599
	Jun	VP10	20	0
	Jul	VP10	1,260	900
	Aug	VP10	160	160
	Sep	VP10	115	115
	Oct	VP10	180	180
	Nov	VP10	960	960
	Dec	VP10	675	75
	Jan	VP11	201	80
	Feb	VP11	2,946	2916
	Mar	VP11	3,110	3110
	Apr	VP11	357	357
	May	VP11	5,648	4495
	Jun	VP11	505	505
	Jul	VP11	180	180
	Aug	VP11	110	110
	Sep	VP11	100	0
	Oct	VP11	8,983	2256
	Nov	VP11	105	105
	Dec	VP11	75	75
	Jan	VP12	153	90
	Feb	VP12	190	190
	Mar	VP12	545	545
	Apr	VP12	2,074	2074
	May	VP12	600	300
	Jun	VP12	114	114
	Nov	VP12	1,142	1082
	Feb	VP13	1,223	1201
	Mar	VP13	4,327	4327
	Apr	VP13	1,305	1305
	May	VP13	540	360
	Jun	VP13	1,483	1195
	Jul	VP13	995	995
	Aug	VP13	3,960	3194
	Sep	VP13	1,303	1180
	Oct	VP13	3,814	3598
	Nov	VP13	271	240
	Dec	VP13	25	25
	Jan	VP14	1,080	880
	Feb	VP14	319	299
	Mar	VP14	9,780	8388
	Apr	VP14	580	580
	May	VP14	300	0

Species	Month	Vantage Point	Bird-Seconds	Potential Collision Height Bird-Seconds
	Jun	VP14	5,413	5076
	Jul	VP14	92	92
	Aug	VP14	3,965	3820
	Sep	VP14	331	285
	Oct	VP14	20	0
	Nov	VP14	158	70
	Dec	VP14	309	309
	Jan	VP15	2,031	2031
	Feb	VP15	1,436	1070
	Mar	VP15	1,385	1385
	Apr	VP15	995	965
	May	VP15	480	240
	Jun	VP15	2,634	1863
	Jul	VP15	605	270
	Aug	VP15	1,715	1378
	Sep	VP15	3,210	1010
	Oct	VP15	130	35
	Nov	VP15	3,013	197
	Dec	VP15	380	335
	Jan	VP16	43	0
	Feb	VP16	2,827	2037
	Mar	VP16	4,800	3600
	Apr	VP16	335	335
	May	VP16	2,040	1440
	Jun	VP16	4,560	3177
	Jul	VP16	2,917	877
	Aug	VP16	4,334	1006
	Sep	VP16	352	66
	Oct	VP16	120	120
	Nov	VP16	34	0
	Dec	VP16	224	224
	Jan	VP2	220	220
	Feb	VP2	284	68
	Mar	VP2	222	222
	Apr	VP2	4,799	3670
	May	VP2	134	134
	Jun	VP2	2,520	2100
	Jul	VP2	2,256	926
	Aug	VP2	10,890	50
	Sep	VP2	279	155
	Oct	VP2	110	110
	Nov	VP2	235	175
	Dec	VP2	4,019	474

Species	Month	Vantage Point	Bird-Seconds	Potential Collision Height Bird-Seconds
	Jan	VP3	401	401
	Mar	VP3	3,074	2624
	Apr	VP3	238	235
	May	VP3	323	323
	Jun	VP3	6,000	4800
	Jul	VP3	19,433	16165
	Aug	VP3	10,800	0
	Sep	VP3	1,705	866
	Oct	VP3	30	0
	Nov	VP3	120	120
	Dec	VP3	3,490	2361
	Jan	VP4	68	38
	Mar	VP4	1,390	1390
	Apr	VP4	4,152	3700
	May	VP4	4,319	4319
	Jun	VP4	1,620	1020
	Jul	VP4	255	251
	Aug	VP4	3,600	3300
	Sep	VP4	2,740	1907
	Oct	VP4	95	95
	Nov	VP4	1,800	0
	Dec	VP4	356	356
	Jan	VP5	92	92
	Feb	VP5	63	63
	Apr	VP5	1,143	1103
	May	VP5	1,002	1002
	Jun	VP5	300	300
	Jul	VP5	573	539
	Aug	VP5	720	720
	Sep	VP5	651	542
	Oct	VP5	253	253
	Nov	VP5	35	35
	Dec	VP5	976	976
	Jan	VP6	139	139
	Feb	VP6	162	162
	Mar	VP6	6,121	5152
	Apr	VP6	9,003	8793
	May	VP6	3,880	3496
	Jun	VP6	16	0
	Jul	VP6	250	28
	Aug	VP6	105	105
	Sep	VP6	400	360
	Oct	VP6	110	110

Species	Month	Vantage Point	Bird-Seconds	Potential Collision Height Bird-Seconds
	Nov	VP6	418	418
	Dec	VP6	1,620	0
	Jan	VP7	170	170
	Feb	VP7	265	265
	Mar	VP7	2,324	2094
	Apr	VP7	3,044	3000
	May	VP7	160	160
	Jun	VP7	462	462
	Jul	VP7	130	130
	Aug	VP7	305	140
	Sep	VP7	25	0
	Dec	VP7	280	280
	Jan	VP8	493	493
	Feb	VP8	268	268
	Mar	VP8	2,316	2316
	Apr	VP8	12,000	7200
	May	VP8	199	184
	Jun	VP8	240	240
	Jul	VP8	600	300
	Aug	VP8	230	165
	Oct	VP8	498	434
	Dec	VP8	1,200	1200
	Jan	VP9	145	130
	Feb	VP9	388	388
	Mar	VP9	3,366	3115
	May	VP9	2,843	2843
	Jul	VP9	120	120
	Aug	VP9	48	48
	Sep	VP9	200	200
	Oct	VP9	586	586
	Nov	VP9	370	370
	Dec	VP9	4,076	2980
Common Gull	Jan	VP14	120	0
	Jan	VP15	1,200	1200
	Dec	VP15	600	600
	Sep	VP9	40	40
Curlew	Aug	VP1	20	20
	Jul	VP10	190	190
	Sep	VP10	120	0
	Jun	VP11	115	115
	Sep	VP11	25	25
	Sep	VP12	1,548	1548
	Sep	VP2	51	0

Species	Month	Vantage Point	Bird-Seconds	Potential Collision Height Bird-Seconds
	Sep	VP5	30	30
	Jul	VP6	907	66
	Aug	VP6	97,249	0
	Sep	VP6	63,130	600
	Oct	VP6	80	0
	Nov	VP6	246	0
	Jul	VP7	1,538	1538
	Jun	VP8	352	352
	Aug	VP9	128	0
	Dec	VP9	624	0
Golden Plover	Jan	VP1	70,520	69120
	Mar	VP1	148	148
	Sep	VP1	61,416	53736
	Oct	VP1	166,650	166650
	Nov	VP1	45,780	45780
	Dec	VP1	1,211	1211
	Jan	VP10	16,094	15254
	Feb	VP10	1,140	630
	Mar	VP10	2,240	2240
	Nov	VP10	1,572	792
	Dec	VP10	12	12
	Jan	VP11	49,272	2512
	Feb	VP11	7,128	7128
	Oct	VP11	12,541	12521
	Nov	VP11	6,880	5040
	Jan	VP12	480	480
	Nov	VP12	1,848	1848
	Jan	VP13	6,750	6750
	Jan	VP14	1,628	0
	Nov	VP14	1,627	1627
	Nov	VP15	497,644	297370
	Jan	VP16	91,193	3060
	Jan	VP2	1,427	1427
	Oct	VP2	345	345
	Dec	VP2	2,680	2680
	Jan	VP3	1,050	1050
	Feb	VP3	970	970
	Mar	VP3	51,230	32050
	Sep	VP3	2,088	2088
	Oct	VP3	2,421	1719
	Nov	VP3	128,405	128405
	Feb	VP4	12,570	12570
	Mar	VP4	856	856

Species	Month	Vantage Point	Bird-Seconds	Potential Collision Height Bird-Seconds
	Dec	VP4	7,560	5040
	Jan	VP5	40	0
	Feb	VP5	345	0
	Mar	VP6	30	18
	Apr	VP6	50	0
	Oct	VP6	6,600	6600
	Nov	VP6	480	480
	Dec	VP6	18,000	18000
	Feb	VP8	20	0
	Feb	VP9	6,460	6460
	Mar	VP9	874	0
	Sep	VP9	440	440
	Oct	VP9	79,240	73480
	Nov	VP9	24	24
Hen Harrier	Nov	VP1	45	45
	Aug	VP10	160	130
	Feb	VP11	174	44
	Nov	VP11	30	0
	Jan	VP12	125	0
	Apr	VP12	52	12
	Nov	VP14	60	0
	Jan	VP2	50	0
	Aug	VP3	55	55
	Nov	VP3	80	0
	Jan	VP6	18	18
	Feb	VP9	320	320
Herring Gull	Apr	VP1	294	180
	May	VP1	90	90
	Jun	VP1	2,100	1260
	Jul	VP1	1,512	933
	Aug	VP1	2,324	2244
	Dec	VP1	3,146	3146
	Jan	VP10	532	532
	May	VP10	3,077	2472
	Jun	VP10	405	385
	Jul	VP10	9,120	7370
	Sep	VP10	7,950	7950
	Dec	VP10	6,000	6000
	May	VP11	13,732	12783
	Jun	VP11	1,106	1106
	Jul	VP11	23,493	1719
	Aug	VP11	462	462
	Dec	VP11	38	38

Species	Month	Vantage Point	Bird-Seconds	Potential Collision Height Bird-Seconds
	Apr	VP12	1,780	1780
	May	VP12	300	300
	Jun	VP12	286	286
	Jul	VP12	402	402
	Dec	VP12	120	120
	May	VP13	1,650	825
	Jun	VP13	304	194
	Aug	VP13	3,770	3530
	Nov	VP13	92	92
	Dec	VP13	455	455
	May	VP14	300	0
	Jun	VP14	3,994	3565
	Jul	VP14	355	325
	Aug	VP14	2,540	503
	Sep	VP14	330	330
	Dec	VP14	3,850	3850
	Jan	VP15	11,481	11481
	May	VP15	1,350	1200
	Jun	VP15	687	537
	Jul	VP15	3,650	3250
	Aug	VP15	930	713
	Sep	VP15	100	100
	Dec	VP15	2,288	2288
	Jan	VP16	19,680	0
	Jun	VP16	790	401
	Jul	VP16	2,244	822
	Aug	VP16	1,953	1923
	Oct	VP16	210	210
	Dec	VP16	70	70
	May	VP2	15	15
	Jun	VP2	1,040	1040
	Jul	VP2	4,605	4590
	Aug	VP2	105	70
	Sep	VP2	869	830
	Jan	VP3	14,640	14640
	May	VP3	380	380
	Jun	VP3	1,342	600
	Jul	VP3	854	762
	Sep	VP3	45	45
	Dec	VP3	272	0
	Apr	VP4	250	250
	May	VP4	1,700	1700
	Jun	VP4	358	358

Species	Month	Vantage Point	Bird-Seconds	Potential Collision Height Bird-Seconds
	Jun	VP5	68	38
	Jul	VP5	118	0
	Sep	VP5	21	0
	Dec	VP5	154	104
	Apr	VP6	9,920	9920
	May	VP6	1,355	135
	Jun	VP6	815	425
	Jul	VP6	1,180	165
	Aug	VP6	2,371	1717
	Sep	VP6	608	0
	Nov	VP6	315	315
	Dec	VP6	1,800	1800
	Jan	VP7	377	377
	May	VP7	24	24
	Jun	VP7	300	300
	Jul	VP7	750	750
	Feb	VP8	945	945
	May	VP8	2,597	2597
	Jun	VP8	750	750
	Jul	VP8	6,730	3430
	Aug	VP8	21,393	20372
	Nov	VP8	600	600
	Jan	VP9	40	40
	Feb	VP9	2,060	2060
	Mar	VP9	18,000	0
	May	VP9	500	228
	Jun	VP9	1,055	1055
	Jul	VP9	66,715	18315
	Aug	VP9	8,218	7533
	Sep	VP9	720	720
	Oct	VP9	489	489
	Nov	VP9	3,256	3256
	Dec	VP9	5,315	5226
Kestrel	Jan	VP1	10	0
	Apr	VP1	78	68
	May	VP1	24	24
	Jul	VP1	1,357	509
	Aug	VP1	3,480	1800
	Sep	VP1	1,634	829
	Oct	VP1	65	65
	Nov	VP1	1,860	0
	Dec	VP1	1,130	242
	Mar	VP10	63	63

Species	Month	Vantage Point	Bird-Seconds	Potential Collision Height Bird-Seconds
	Apr	VP10	39	0
	May	VP10	98	0
	Aug	VP10	44	44
	Jan	VP11	110	110
	Apr	VP11	30	0
	May	VP11	415	235
	Jun	VP11	120	120
	Jul	VP11	164	0
	Sep	VP11	71	71
	Oct	VP11	1,808	1398
	Nov	VP11	255	255
	Jan	VP12	729	0
	Mar	VP12	636	636
	May	VP12	244	242
	Jun	VP12	110	110
	Jul	VP12	8,460	1260
	Aug	VP12	803	750
	Oct	VP12	75	75
	Nov	VP12	1,203	0
	Dec	VP12	183	183
	May	VP13	300	300
	Jun	VP13	210	210
	Jul	VP13	355	355
	Aug	VP13	121	121
	Sep	VP13	1,586	1422
	Oct	VP13	1,269	1193
	Nov	VP13	3,223	2456
	Dec	VP13	84	84
	Apr	VP14	660	300
	May	VP14	46	0
	Aug	VP14	1,067	322
	Oct	VP14	20	20
	Nov	VP14	607	360
	Jun	VP15	291	93
	Jul	VP15	30	0
	Aug	VP15	30	0
	Oct	VP15	95	95
	Nov	VP15	36	36
	May	VP16	180	0
	Aug	VP16	1,569	720
	Oct	VP16	30	30
	Feb	VP2	156	123
	Apr	VP2	989	661

Species	Month	Vantage Point	Bird-Seconds	Potential Collision Height Bird-Seconds
	Jun	VP2	420	420
	Jul	VP2	1,031	386
	Sep	VP2	46	46
	Dec	VP2	826	360
	Mar	VP3	18	0
	Apr	VP3	320	250
	Jun	VP3	1,020	1020
	Jul	VP3	75	0
	Aug	VP3	180	0
	Sep	VP3	1,450	412
	Oct	VP3	439	239
	Dec	VP3	178	120
	Jan	VP4	165	165
	Mar	VP4	290	290
	Apr	VP4	246	246
	May	VP4	384	165
	Jun	VP4	120	0
	Aug	VP4	167	45
	Sep	VP4	892	211
	Oct	VP4	29	29
	Dec	VP4	178	178
	Jan	VP5	255	255
	Feb	VP5	124	0
	May	VP5	300	300
	Jul	VP5	28	28
	Aug	VP5	4,214	74
	Sep	VP5	190	71
	Dec	VP5	615	0
	Jan	VP6	20	20
	Mar	VP6	130	86
	Apr	VP6	183	183
	Jul	VP6	120	120
	Aug	VP6	50	50
	Oct	VP6	2,180	2180
	Jan	VP7	65	65
	Mar	VP7	2,042	1459
	Apr	VP7	1,745	1569
	May	VP7	624	554
	Jun	VP7	300	300
	Jul	VP7	180	180
	Aug	VP7	364	0
	Sep	VP7	25	0
	Oct	VP7	2,462	200

Species	Month	Vantage Point	Bird-Seconds	Potential Collision Height Bird-Seconds
	Nov	VP7	250	135
	Jan	VP8	240	240
	Feb	VP8	15	0
	Mar	VP8	402	371
	May	VP8	20	0
	Jun	VP8	34	34
	Jul	VP8	3,070	360
	Aug	VP8	63	12
	Sep	VP8	115	95
	Oct	VP8	288	252
	Nov	VP8	115	105
	Dec	VP8	1,235	50
	Jan	VP9	80	80
	Jul	VP9	120	0
	Aug	VP9	120	0
	Nov	VP9	72	72
Lesser black-backed gull	Feb	VP1	3,744	3744
	May	VP1	45	45
	Aug	VP1	4,440	4440
	Sep	VP1	45	45
	Oct	VP1	45	45
	Dec	VP1	1,088	992
	Jan	VP10	125	125
	May	VP10	150	102
	Jul	VP10	12,557	6675
	Aug	VP10	23	23
	Nov	VP10	1,129	1129
	Jan	VP11	385	135
	Apr	VP11	40	0
	Jun	VP11	62	62
	Jul	VP11	245	245
	Aug	VP11	636	636
	Sep	VP11	2,203	2120
	Nov	VP11	780	780
	Jun	VP12	40	40
	Jul	VP12	268	268
	Dec	VP12	840	840
	Jan	VP13	200	200
	May	VP13	540	540
	Jul	VP13	40	40
	Aug	VP13	696	696
	Sep	VP13	270	270
	Nov	VP13	38	38

Species	Month	Vantage Point	Bird-Seconds	Potential Collision Height Bird-Seconds
	Dec	VP13	740	740
	Jan	VP14	600	600
	Mar	VP14	2,555	2555
	May	VP14	936	936
	Aug	VP14	417	0
	Sep	VP14	150	114
	Oct	VP14	105	105
	Nov	VP14	450	450
	Dec	VP14	962	962
	May	VP15	1,272	1272
	Jun	VP15	51	0
	Jul	VP15	2,240	1940
	Sep	VP15	596	596
	Oct	VP15	40	40
	Nov	VP15	8,000	7265
	Dec	VP15	1,640	1640
	Feb	VP16	40	40
	Aug	VP16	815	289
	Sep	VP16	4,340	4310
	Oct	VP16	45	45
	Nov	VP16	10,528	10528
	Dec	VP16	292	292
	Jun	VP2	160	160
	Aug	VP2	1,005	1005
	Sep	VP2	6,359	6359
	May	VP3	136	136
	Jul	VP3	152	0
	Aug	VP3	4,600	1840
	Sep	VP3	70	70
	Oct	VP3	96	96
	Nov	VP3	180	180
	Aug	VP4	6,370	6370
	Sep	VP4	70	70
	Aug	VP5	1,278	1278
	Sep	VP5	100	100
	Nov	VP5	100	100
	Dec	VP5	45	22
	Mar	VP6	1,680	1680
	Apr	VP6	39,680	39680
	May	VP6	180	0
	Aug	VP6	1,878	1878
	Sep	VP6	102	0
	Oct	VP6	145	145

Species	Month	Vantage Point	Bird-Seconds	Potential Collision Height Bird-Seconds
	Nov	VP6	265	265
	Dec	VP6	1,560	1560
	Apr	VP7	288	288
	May	VP7	16	16
	Jun	VP7	55	55
	Aug	VP7	496	496
	Nov	VP7	140	140
	Mar	VP8	5,381	5381
	Jul	VP8	960	480
	Aug	VP8	360	360
	Sep	VP8	30	30
	Oct	VP8	140	140
	Dec	VP8	16,800	16800
	Jan	VP9	590	590
	Feb	VP9	380	380
	Jun	VP9	315	315
	Jul	VP9	3,960	2880
	Aug	VP9	1,680	1680
	Sep	VP9	755	755
	Nov	VP9	120	120
Peregrine Falcon	Apr	VP1	107	107
	Jul	VP1	154	154
	Oct	VP1	22	0
	Jan	VP10	45	45
	Jul	VP10	130	90
	Nov	VP10	154	51
	Jul	VP11	620	620
	Oct	VP11	72	67
	Mar	VP13	26	26
	Mar	VP15	20	20
	Oct	VP15	40	40
	Feb	VP16	32	16
	Jul	VP2	369	181
	Mar	VP3	92	92
	May	VP3	6	0
	Sep	VP4	193	176
	Apr	VP6	66	66
	May	VP6	345	345
	Jun	VP6	207	37
	Jun	VP7	27	27
	Oct	VP7	314	314
	Aug	VP8	345	345
	Jul	VP9	185	170

Species	Month	Vantage Point	Bird-Seconds	Potential Collision Height Bird-Seconds
Red Kite	Feb	VP14	45	45
	Mar	VP16	600	600
	Dec	VP3	397	199
	Jan	VP6	4,500	4500
Snipe	Jan	VP1	274	234
	Feb	VP1	200	0
	Mar	VP1	18	0
	Sep	VP1	42	0
	Nov	VP1	860	20
	Feb	VP10	20	20
	Sep	VP10	20	0
	Oct	VP10	199	0
	Nov	VP10	35	10
	Dec	VP10	4,500	0
	Jan	VP11	57	33
	Feb	VP11	10	0
	Mar	VP11	88	0
	Oct	VP11	15	0
	Nov	VP11	445	445
	Dec	VP11	480	0
	Jan	VP12	5	0
	Mar	VP12	9	0
	Nov	VP12	23	0
	Dec	VP12	48	0
	Sep	VP13	20	20
	Nov	VP13	50	50
	Jan	VP14	165	96
	Oct	VP14	180	0
	Nov	VP14	660	400
	Jan	VP16	6	0
	Feb	VP16	10	0
	Oct	VP16	80	80
	Nov	VP16	205	197
	Dec	VP16	9	0
	Jan	VP2	210	210
	Oct	VP2	40	40
	Jan	VP3	50	25
	Feb	VP3	14	0
	Mar	VP3	30	30
	Oct	VP3	145	130
	Nov	VP3	60	60
	Jan	VP4	84	84
	Apr	VP4	5	0

Species	Month	Vantage Point	Bird-Seconds	Potential Collision Height Bird-Seconds
	Nov	VP4	225	0
	Jan	VP5	50	40
	Oct	VP5	23	0
	Jan	VP6	26	26
	Feb	VP6	232	154
	Sep	VP6	10	0
	Nov	VP6	40	20
	Feb	VP7	40	30
	Oct	VP7	78	53
	Dec	VP7	60	0
	Mar	VP8	20	0
	Oct	VP8	2,457	1620
	Nov	VP8	28	28
	Jan	VP9	75	70
	Aug	VP9	56	0
	Sep	VP9	50	40
	Oct	VP9	1,214	1214
	Nov	VP9	34	34
	Dec	VP9	7	6
Sparrowhawk	Jan	VP1	10	0
	Sep	VP1	45	5
	Dec	VP1	78	55
	May	VP10	66	0
	Jul	VP10	45	42
	Nov	VP10	172	172
	Jan	VP11	40	0
	Feb	VP11	10	0
	Mar	VP11	78	0
	Apr	VP11	30	0
	Jul	VP11	125	111
	Aug	VP11	194	190
	Oct	VP11	67	20
	Nov	VP11	246	220
	Dec	VP11	492	0
	Apr	VP12	23	23
	Nov	VP12	79	79
	Feb	VP13	18	18
	Mar	VP13	374	360
	Jul	VP13	60	15
	Sep	VP13	266	266
	Nov	VP13	13	0
	Jun	VP14	39	0
	Jul	VP14	50	30

Species	Month	Vantage Point	Bird-Seconds	Potential Collision Height Bird-Seconds
	Aug	VP14	406	378
	Dec	VP14	76	76
	Jan	VP15	341	336
	Feb	VP15	129	121
	Apr	VP15	27	27
	Jun	VP15	456	456
	Aug	VP15	54	0
	Oct	VP15	139	107
	Nov	VP15	14	0
	Jan	VP16	340	151
	Apr	VP16	13	0
	Jun	VP16	15	0
	Jul	VP16	25	0
	Aug	VP16	17	0
	Nov	VP16	228	0
	Feb	VP2	23	0
	Apr	VP2	8	0
	Jun	VP2	5	0
	Jul	VP2	20	20
	Aug	VP2	4	0
	Sep	VP2	39	0
	Dec	VP2	551	0
	Jan	VP3	60	0
	Feb	VP3	20	0
	Jan	VP4	255	255
	Apr	VP4	50	50
	May	VP4	60	55
	Aug	VP4	33	33
	Sep	VP4	162	0
	Dec	VP4	142	39
	Feb	VP5	58	0
	Aug	VP5	840	720
	Sep	VP5	295	250
	Dec	VP5	8	0
	Feb	VP6	20	0
	Mar	VP6	123	118
	Apr	VP6	20	0
	Sep	VP6	220	100
	Oct	VP6	6	0
	Nov	VP6	35	0
	Dec	VP6	140	120
	Feb	VP7	8	0
	Apr	VP7	545	425

Species	Month	Vantage Point	Bird-Seconds	Potential Collision Height Bird-Seconds
	Jun	VP7	60	60
	Jul	VP7	74	0
	Sep	VP7	50	0
	Jan	VP8	14	14
	Aug	VP8	82	82
	Sep	VP8	190	170
	Oct	VP8	333	164
	Jan	VP9	30	10
	Apr	VP9	210	210
	May	VP9	138	138
	Jun	VP9	22	22
	Jul	VP9	7	0
	Oct	VP9	84	84
	Nov	VP9	60	60
White-tailed Eagle	Jan	VP1	65	55
	Jun	VP16	355	355
	Jul	VP16	90	0
	Jun	VP3	1,740	1560
	Nov	VP6	150	150

2.5 Photoperiod

The photoperiod at the latitude of the turbines was acquired for the survey period. The daylight and nighttime hours per month are shown in Table 7 - 6 - 8. The total daylight hours were 4,482 and night-time hours was 4,278.

Table 7 - 6 - 8 Photoperiod

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daylight hours	258.1	276.9	366.7	415.7	485.1	499.1	502.7	454.6	381.6	331.9	266.3	243.3
Nighttime hours	485.9	395.1	377.3	304.3	258.9	220.9	241.3	289.4	338.4	412.1	453.7	500.7

3. RESULTS

3.1 Stage A Flight Activity

Stage A of the modelling process uses the field survey data to establish the aerial density of flying birds in the vicinity of the turbines and the proportion flying at a risk height (between the lowest and highest points of the rotors). Aerial density was calculated following the formula provided by Band (2024; also see Section 4 'Worked Example'). Similarly, the proportion flying at risk height was calculated following the method in Band (2024; also see Section 4 'Worked Example'). The aerial density per month and the proportion flying at risk height for each species is shown for each lowest swept height in Table 7 - 6 - 9 to Table 7 - 6 - 11.

Table 7 - 6 - 9 Aerial density and proportion flying at risk height – lowest swept height of 20m

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Proportion
Golden Plover	0.6	0	0	0	0	-	-	0	0	0	1	0	0.77
Peregrine Falcon	0	0.0002	0.00006	0	0	0	0	0	0	0.0001	0	0	0.93
Red Kite	0	0	0.003	-	-	-	-	-	-	0	0	0	1.26
White-tailed Eagle	0	0	0	0	0	0.002	0.0004	0	0	0	0	0	1.17
Hen Harrier	0	0	0	-	-	-	-	0	0	0	0	0	0.47
Black-tailed Godwit	0	0	0	0	0	0	0	0	0	0	0	0	0.74
Curlew	0	0	0	0	0	0	0	0	0	0	0	0	0.37
Common Gull	0.005	0	0	0	0	0	0	0	0	0	0	0.002	0.76
Herring Gull	-	-	-	0	0.004	0.006	0.02	0.01	0.0003	-	-	-	0.92
Herring Gull	0.2	0	0	-	-	-	-	-	-	0.001	0	0.007	0.96
Lesser Black-backed Gull	0	0.0002	0	-	-	-	-	-	-	0.0004	0.07	0.007	1.06
Kestrel	0	0	0	0	0.0009	0.0009	0.0001	0.008	0	0.0004	0.0001	0	0.67
Snipe	0.00004	0.00005	0	0	0	0	0	0	0	0.0004	0.001	0.00004	0.54
Buzzard	0.008	0.02	0.03	0.005	0.01	0.03	0.02	0.03	0.01	0.001	0.009	0.002	0.93
Sparrowhawk	0.004	0.0004	0	0.0001	0	0.001	0.0001	0.0003	0	0.0004	0.001	0	0.57

Table 7 - 6 - 10 Aerial density and proportion flying at risk height – lowest swept height of 23m

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Proportion
Golden Plover	0.07	0.01	0.003	0	0	-	-	0	0.0004	0.08	0.008	0.00001	0.72
Peregrine Falcon	0.00004	0	0	0	0	0	0.0009	0.0003	0	0.00008	0.0001	0	0.87
Red Kite	0	0	0	-	-	-	-	-	-	0	0	0	1.18
White-tailed Eagle	0	0	0	0	0	0	0	0	0	0	0	0	1.09
Hen Harrier	0	0.0005	0	-	-	-	-	0.0001	0	0	0.00003	0	0.40
Black-tailed Godwit	0	0	0	0	0	0	0	0.01	0	0	0.005	0	0.77
Curlew	0	0	0	0	0	0.0004	0.0002	0.0001	0.0001	0	0	0.0005	0.31
Common Gull	0	0	0	0	0	0	0	0	0.00003	0	0	0	0.70
Herring Gull	-	-	-	0	0.02	0.003	0.1	0.03	0.007	-	-	-	0.85
Herring Gull	0.0005	0.003	0.02	-	-	-	-	-	-	0.0004	0.003	0.01	0.91
Lesser Black-backed Gull	0.001	0.0003	0.005	-	-	-	-	-	-	0.0001	0.002	0.02	1.00
Kestrel	0.0004	0.00001	0.0004	0.00006	0.0005	0.0002	0.003	0.0002	0.0002	0.002	0.0004	0.001	0.59
Snipe	0.0001	0.00003	0.0001	0	0	0	0	0.00005	0.00006	0.003	0.0005	0.005	0.46
Buzzard	0.0008	0.004	0.02	0.03	0.01	0.0008	0.002	0.0005	0.0004	0.01	0.001	0.005	0.87
Sparrowhawk	0.00008	0.00001	0.00008	0.0002	0.0002	0.00002	0.0002	0.0003	0.0002	0.0004	0.0004	0.0005	0.52

Table 7 - 6 - 11 Aerial density and proportion flying at risk height – lowest swept height of 25m

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Proportion
Golden Plover	0.04	0.03	0.03	0.00004	0	-	-	0	0.03	0.09	0.1	0.04	0.69
Peregrine Falcon	0	0	0.00006	0.00009	0.0004	0.0003	0.0005	0	0.0004	0.0006	0	0	0.83
Red Kite	0.005	0.00002	0	-	-	-	-	-	-	0	0	0.0002	1.13
White-tailed Eagle	0.00003	0	0	0	0	0.0009	0	0	0	0	0.0001	0	1.02
Hen Harrier	0.0001	0	0	-	-	-	-	0.00003	0	0	0.0001	0	0.38

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Proportion
Black-tailed Godwit	0	0	0	0	0	0	0.01	0.003	0	0	0	0	0.72
Curlew	0	0	0	0	0	0	0.004	0.1	0.07	0.00008	0.0002	0	0.30
Common Gull	0.00005	0	0	0	0	0	0	0	0	0	0	0	0.67
Herring Gull	-	-	-	0.009	0.005	0.008	0.009	0.007	0.002	-	-	-	0.81
Herring Gull	0.009	0	0	-	-	-	-	-	-	0	0.0004	0.006	0.87
Lesser Black-backed Gull	0.0004	0.002	0.003	-	-	-	-	-	-	0.0003	0.0009	0.004	0.96
Kestrel	0.001	0.0004	0.005	0.003	0.002	0.002	0.009	0.007	0.005	0.008	0.004	0.003	0.55
Snipe	0.0007	0.0004	0.00003	0.000007	0	0	0	0	0.00004	0.0004	0.001	0.0002	0.44
Buzzard	0.002	0.002	0.02	0.02	0.01	0.02	0.02	0.03	0.009	0.004	0.006	0.01	0.82
Sparrowhawk	0.0006	0.0002	0.0003	0.0006	0.00009	0.0001	0.0002	0.0009	0.001	0.000006	0.0001	0.001	0.49

3.2 Stage B Number of Flights Through Rotors

Stage B of the modelling process makes an estimate, based on the aerial density and proportion flying at risk height, of the potential number of bird passages through rotors. The projected number of transits through the rotor risk area was calculated following the formula provided by Band (2024; also see Section 4 'Worked Example'). Table 7 - 6 - 12 to Table 7 - 6 - 14 shows the projected number of transits per month for each species for each lowest swept height.

Table 7 - 6 - 12 Projected number of transits – lowest swept height 20m

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Golden Plover	2853	0	0	0	0	-	-	0	0	0	6615	0	9467.82
Peregrine Falcon	0	0.4	0.2	0	0	0	0	0	0	0.4	0	0	1.00
Red Kite	0	0	13	-	-	-	-	-	-	0	0	0	13.09
White-tailed Eagle	0	0	0	0	0	12	3	0	0	0	0	0	14.57
Hen Harrier	0	0	0	-	-	-	-	0	0	0	0	0	0.00
Black-tailed Godwit	0	0	0	0	0	0	0	0	0	0	0	0	0.00

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Curlew	0	0	0	0	0	0	0	0	0	0	0	0	0.00
Common Gull	16	0	0	0	0	0	0	0	0	0	0	6	21.49
Herring Gull	-	-	-	0	23	33	130	65	1	-	-	-	253.33
Herring Gull	726	0	0	-	-	-	-	-	-	5	0	29	760.06
Lesser Black-backed Gull	0	0.8	0	-	-	-	-	-	-	2	296	26	324.52
Kestrel	0	0	0	0	2	3	0.3	20	0	0.8	0.2	0	26.36
Snipe	0.2	0.3	0	0	0	0	0	0	0	2	5	0.3	8.60
Buzzard	20	46	89	18	52	139	75	110	42	3	22	5	620.97
Sparrowhawk	5	0.5	0	0.3	0	4	0.3	0.6	0	0.7	1	0	12.14

Table 7 - 6 - 13 Projected number of transits – lowest swept height 23m

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Golden Plover	878	196	43	0	0	-	-	0	6	1226	111	0.1	2461.43
Peregrine Falcon	0.3	0	0	0	0	0	13	4	0	0.7	1	0	19.56
Red Kite	0	0	0	-	-	-	-	-	-	0	0	0	0.00
White-tailed Eagle	0	0	0	0	0	0	0	0	0	0	0	0	0.00
Hen Harrier	0	1	0	-	-	-	-	0.6	0	0	0.07	0	1.84
Black-tailed Godwit	0	0	0	0	0	0	0	231	0	0	87	0	317.90
Curlew	0	0	0	0	0	4	1	0.9	1	0	0	4	10.93
Common Gull	0	0	0	0	0	0	0	0	0.4	0	0	0	0.39
Herring Gull	-	-	-	0	323	51	1601	425	100	-	-	-	2500.25
Herring Gull	6	32	223	-	-	-	-	-	-	6	38	118	423.15
Lesser Black-backed Gull	13	4	74	-	-	-	-	-	-	2	23	192	308.17
Kestrel	2	0.06	3	0.4	4	1	27	1	1	12	2	5	58.41

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Snipe	2	0.4	2	0	0	0	0	0.8	0.9	57	8	74	145.00
Buzzard	6	30	209	321	135	11	27	6	4	97	9	36	891.00
Sparrowhawk	0.3	0.04	0.4	1	1	0.1	1	2	1	2	2	2	12.99

Table 7 - 6 - 14 Projected number of transits – lowest swept height 25m

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Golden Plover	1266	834	961	1	0	-	-	0	1252	3138	2873	1132	11457.79
Peregrine Falcon	0	0	1	2	11	9	15	0	10	12	0	0	61.40
Red Kite	104	0.5	0	-	-	-	-	-	-	0	0	4	108.77
White-tailed Eagle	0.8	0	0	0	0	42	0	0	0	0	4	0	46.10
Hen Harrier	0.7	0	0	-	-	-	-	0.3	0	0	0.5	0	1.46
Black-tailed Godwit	0	0	0	0	0	0	583	136	0	0	0	0	718.53
Curlew	0	0	0	0	0	0	72	1897	1270	1	4	0	3244.81
Common Gull	1	0	0	0	0	0	0	0	0	0	0	0	1.18
Herring Gull	-	-	-	294	199	283	343	234	56	-	-	-	1408.89
Herring Gull	234	0	0	-	-	-	-	-	-	0	10	157	400.75
Lesser Black-backed Gull	10	49	97	-	-	-	-	-	-	9	26	98	289.25
Kestrel	10	3	64	50	39	36	159	121	61	96	37	22	699.39
Snipe	26	14	1	0.3	0	0	0	0	1	15	49	5	111.29
Buzzard	28	32	487	582	385	459	475	894	206	76	95	149	3868.00
Sparrowhawk	5	1	3	8	1	2	3	13	13	0.06	0.8	9	60.23

3.3 Stage C Probability of Collision

Stage C of the modelling process calculates the probability of collision during a single bird rotor transit. The likelihood of a bird colliding with a turbine blade during a single pass through the rotor was calculated using the turbine specifications, species biometrics and flight characteristics outlined in the previous sections.

Collision risk was assessed across different parts of the rotor, as blade speed and width varies from the hub to the tip. Because of the geometry of the blades in relation to the flight direction, the collision risk for upwind flight is higher than for downwind (even if the bird's flight speed relative to the ground is taken to be the same), therefore collision risk probabilities were calculated separately for birds flying upwind and downwind. These were then averaged assuming a 50:50 weighting because both upwind and downwind flights are equally likely (further information in Section 4 'Worked Example'). This produced a probability of collision for a bird during a single transit of the rotor, which is presented for each species for each lowest swept height in Table 7 - 6 - 15 to Table 7 - 6 - 17.

Table 7 - 6 - 15 Probability of collision – lowest swept height 20m

Species	Upwind	Downwind	Average
Golden Plover	0.054	0.038	0.046
Peregrine Falcon	0.071	0.047	0.059
Red Kite	0.083	0.059	0.071
White-tailed Eagle	0.087	0.065	0.076
Hen Harrier	0.092	0.055	0.073
Black-tailed Godwit	0.058	0.042	0.05
Curlew	0.066	0.048	0.057
Common Gull	0.067	0.045	0.056
Herring Gull	0.076	0.053	0.065
Lesser Black-backed Gull	0.08	0.055	0.067
Kestrel	0.071	0.041	0.056
Snipe	0.053	0.036	0.044
Buzzard	0.077	0.052	0.064
Sparrowhawk	0.071	0.041	0.056

Table 7 - 6 - 16 Probability of collision – lowest swept height 23m

Species	Upwind	Downwind	Average
Golden Plover	0.052	0.035	0.043
Peregrine Falcon	0.068	0.044	0.056
Red Kite	0.08	0.055	0.067
White-tailed Eagle	0.083	0.061	0.072
Hen Harrier	0.088	0.052	0.07
Black-tailed Godwit	0.056	0.04	0.048
Curlew	0.063	0.045	0.054
Common Gull	0.064	0.042	0.053
Herring Gull	0.073	0.05	0.062
Lesser Black-backed Gull	0.076	0.052	0.064
Kestrel	0.068	0.039	0.053
Snipe	0.051	0.034	0.042
Buzzard	0.074	0.049	0.061
Sparrowhawk	0.068	0.038	0.053

Table 7 - 6 - 17 Probability of collision – lowest swept height 25m

Species	Upwind	Downwind	Average
Golden Plover	0.054	0.038	0.046
Peregrine Falcon	0.071	0.047	0.059
Red Kite	0.083	0.059	0.071
White-tailed Eagle	0.087	0.065	0.076
Hen Harrier	0.092	0.055	0.073
Black-tailed Godwit	0.058	0.042	0.05
Curlew	0.066	0.048	0.057
Common Gull	0.067	0.045	0.056
Herring Gull	0.076	0.053	0.065
Lesser Black-backed Gull	0.08	0.055	0.067

Species	Upwind	Downwind	Average
Kestrel	0.071	0.041	0.056
Snipe	0.053	0.036	0.044
Buzzard	0.077	0.052	0.064
Sparrowhawk	0.071	0.041	0.056

3.4 Stage D Expected Collisions

Stage D of the modelling process multiplies the outputs of stage B and C to yield the expected collision rate for each bird species, accounting for the proportion of time the Proposed Wind Farm is expected to be operational. This is before considering avoidance behaviour, which is stage E. The number of expected collisions per month and the year total for each species are presented for each lowest swept height in Table 7 - 6 - 18 to Table 7 - 6 - 20.

Table 7 - 6 - 18 Expected collisions without avoidance – lowest swept height 20m

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Golden Plover	111	0	0	0	0	-	-	0	0	0	258	0	369
Peregrine Falcon	0	0.021	0.011	0	0	0	0	0	0	0.019	0	0	0.05
Red Kite	0	0	0.79	-	-	-	-	-	-	0	0	0	0.79
White-tailed Eagle	0	0	0	0	0	0.75	0.19	0	0	0	0	0	0.94
Hen Harrier	0	0	0	-	-	-	-	0	0	0	0	0	0
Black-tailed Godwit	0	0	0	0	0	0	0	0	0	0	0	0	0
Curlew	0	0	0	0	0	0	0	0	0	0	0	0	0
Common Gull	0.74	0	0	0	0	0	0	0	0	0	0	0.29	1
Herring Gull	-	-	-	0	1.3	1.8	7.2	3.6	0.08	-	-	-	14
Herring Gull	40	0	0	-	-	-	-	-	-	0.28	0	1.6	42
Lesser Black-backed Gull	0	0.045	0	-	-	-	-	-	-	0.095	17	1.5	19
Kestrel	0	0	0	0	0.12	0.12	0.014	0.95	0	0.04	0.0078	0	1.3
Snipe	0.0092	0.0096	0	0	0	0	0	0	0	0.092	0.2	0.0096	0.32

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Buzzard	1.1	2.5	4.9	0.99	2.8	7.6	4.1	6	2.3	0.17	1.2	0.28	34
Sparrowhawk	0.22	0.026	0	0.014	0	0.17	0.014	0.026	0	0.032	0.068	0	0.57

Table 7 - 6 - 19 Expected collisions without avoidance – lowest swept height 23m

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Golden Plover	32	7.3	1.6	0	0	-	-	0	0.22	45	4.1	0.0052	91
Peregrine Falcon	0.014	0	0	0	0	0	0.64	0.2	0	0.035	0.048	0	0.93
Red Kite	0	0	0	-	-	-	-	-	-	0	0	0	0
White-tailed Eagle	0	0	0	0	0	0	0	0	0	0	0	0	0
Hen Harrier	0	0.07	0	-	-	-	-	0.036	0	0	0.0042	0	0.11
Black-tailed Godwit	0	0	0	0	0	0	0	9.4	0	0	3.5	0	13
Curlew	0	0	0	0	0	0.17	0.066	0.042	0.045	0	0	0.17	0.5
Common Gull	0	0	0	0	0	0	0	0	0.018	0	0	0	0.018
Herring Gull	-	-	-	0	17	2.7	84	22	5.2	-	-	-	131
Herring Gull	0.31	1.7	12	-	-	-	-	-	-	0.3	2	6.2	22
Lesser Black-backed Gull	0.71	0.22	4	-	-	-	-	-	-	0.099	1.2	10	17
Kestrel	0.078	0.0029	0.12	0.018	0.19	0.058	1.2	0.067	0.051	0.53	0.082	0.21	2.6
Snipe	0.074	0.015	0.066	0	0	0	0	0.027	0.032	2	0.3	2.6	5.2
Buzzard	0.3	1.6	11	17	7.1	0.55	1.4	0.34	0.2	5	0.47	1.9	46
Sparrowhawk	0.014	0.002	0.02	0.055	0.054	0.0059	0.056	0.081	0.044	0.095	0.075	0.083	0.58

Table 7 - 6 - 20 Expected collisions without avoidance – lower swept height 25m

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Golden Plover	49	33	37	0.055	0	-	-	0	49	122	112	44	447
Peregrine Falcon	0	0	0.067	0.11	0.56	0.46	0.75	0	0.52	0.61	0	0	3.1
Red Kite	6.3	0.033	0	-	-	-	-	-	-	0	0	0.26	6.6

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
White-tailed Eagle	0.05	0	0	0	0	2.7	0	0	0	0	0.23	0	3
Hen Harrier	0.042	0	0	-	-	-	-	0.017	0	0	0.032	0	0.091
Black-tailed Godwit	0	0	0	0	0	0	25	5.8	0	0	0	0	31
Curlew	0	0	0	0	0	0	3.5	92	61	0.068	0.18	0	157
Common Gull	0.057	0	0	0	0	0	0	0	0	0	0	0	0.057
Herring Gull	-	-	-	16	11	16	19	13	3.1	-	-	-	78
Herring Gull	13	0	0	-	-	-	-	-	-	0	0.52	8.7	22
Lesser Black-backed Gull	0.56	2.8	5.6	-	-	-	-	-	-	0.51	1.5	5.6	17
Kestrel	0.47	0.17	3	2.4	1.9	1.7	7.6	5.8	2.9	4.6	1.8	1	33
Snipe	0.97	0.51	0.04	0.0096	0	0	0	0	0.055	0.57	1.8	0.2	4.2
Buzzard	1.5	1.7	27	32	21	25	26	49	11	4.2	5.2	8.1	212
Sparrowhawk	0.23	0.068	0.16	0.39	0.067	0.1	0.15	0.62	0.61	0.003	0.038	0.4	2.8

3.5 Stage E Allowing for Avoidance and Attraction

Stage E of the modelling process takes account of the proportion of birds likely to avoid the wind farm or turbines, either because they have been displaced from the site or because they take evasive action or are attracted to the wind farm. Band (2024) states that the collision rate estimate should show potential collision mortality using a range of assumed avoidance rates. In the absence of specific avoidance information for the species in question, it is recommended that collision risks be evaluated assuming avoidance factors of 95%, 98%, 99%, 0.992%, 99.5% and 99.6%. These are presented for each lowest swept height in The species for which no flight activity and associated expected collisions were calculated for individual scenarios are excluded from the relevant tables.

Table 7 - 6 - 21 to Table 7 - 6 - 23. The species for which no flight activity and associated expected collisions were calculated for individual scenarios are excluded from the relevant tables.

Table 7 - 6 - 21 Expected collisions with avoidance – lower swept height 20m

Species	Avoidance Factor	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Golden Plover	0.95	5.6	0	0	0	0	-	-	0	0	0	13	0	18

Species	Avoidance Factor	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
	0.98	2.2	0	0	0	0	-	-	0	0	0	5.2	0	7.4
	0.99	1.1	0	0	0	0	-	-	0	0	0	2.6	0	3.7
	0.995	0.56	0	0	0	0	-	-	0	0	0	1.3	0	1.8
	0.996	0.44	0	0	0	0	-	-	0	0	0	1	0	1.5
Peregrine Falcon	0.95	0	0.001	0.00053	0	0	0	0	0	0	0.00096	0	0	0.0025
	0.98	0	0.00041	0.00021	0	0	0	0	0	0	0.00038	0	0	0.001
	0.99	0	0.00021	0.00011	0	0	0	0	0	0	0.00019	0	0	0.0005
	0.995	0	0.0001	0.000053	0	0	0	0	0	0	0.000096	0	0	0.00025
	0.996	0	0.000083	0.000042	0	0	0	0	0	0	0.000077	0	0	0.0002
Red Kite	0.95	0	0	0.039	-	-	-	-	-	-	0	0	0	0.039
	0.98	0	0	0.016	-	-	-	-	-	-	0	0	0	0.016
	0.99	0	0	0.0079	-	-	-	-	-	-	0	0	0	0.0079
	0.995	0	0	0.0039	-	-	-	-	-	-	0	0	0	0.0039
	0.996	0	0	0.0032	-	-	-	-	-	-	0	0	0	0.0032
White-tailed Eagle	0.95	0	0	0	0	0	0.037	0.0096	0	0	0	0	0	0.047
	0.98	0	0	0	0	0	0.015	0.0038	0	0	0	0	0	0.019
	0.99	0	0	0	0	0	0.0075	0.0019	0	0	0	0	0	0.0094
	0.995	0	0	0	0	0	0.0037	0.00096	0	0	0	0	0	0.0047
	0.996	0	0	0	0	0	0.003	0.00077	0	0	0	0	0	0.0038
Common Gull	0.95	0.037	0	0	0	0	0	0	0	0	0	0	0.014	0.051
	0.98	0.015	0	0	0	0	0	0	0	0	0	0	0.0057	0.021
	0.99	0.0074	0	0	0	0	0	0	0	0	0	0	0.0029	0.01
	0.992	0.0059	0	0	0	0	0	0	0	0	0	0	0.0023	0.0082
	0.995	0.0037	0	0	0	0	0	0	0	0	0	0	0.0014	0.0051
	0.996	0.003	0	0	0	0	0	0	0	0	0	0	0.0011	0.0041
Herring Gull	0.95	-	-	-	0	0.064	0.091	0.36	0.18	0.004	-	-	-	0.7

Species	Avoidance Factor	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
	0.98	-	-	-	0	0.026	0.036	0.14	0.072	0.0016	-	-	-	0.28
	0.99	-	-	-	0	0.013	0.018	0.072	0.036	0.0008	-	-	-	0.14
	0.995	-	-	-	0	0.0064	0.0091	0.036	0.018	0.0004	-	-	-	0.07
	0.996	-	-	-	0	0.0051	0.0073	0.029	0.014	0.00032	-	-	-	0.056
	0.95	2	0	0	-	-	-	-	-	-	0.014	0	0.079	2.1
	0.98	0.8	0	0	-	-	-	-	-	-	0.0055	0	0.032	0.84
	0.99	0.4	0	0	-	-	-	-	-	-	0.0028	0	0.016	0.42
	0.995	0.2	0	0	-	-	-	-	-	-	0.0014	0	0.0079	0.21
	0.996	0.16	0	0	-	-	-	-	-	-	0.0011	0	0.0063	0.17
Lesser Black-backed Gull	0.95	0	0.0022	0	-	-	-	-	-	-	0.0047	0.85	0.074	0.93
	0.98	0	0.00089	0	-	-	-	-	-	-	0.0019	0.34	0.029	0.37
	0.99	0	0.00045	0	-	-	-	-	-	-	0.00095	0.17	0.015	0.19
	0.995	0	0.00022	0	-	-	-	-	-	-	0.00047	0.085	0.0074	0.093
	0.996	0	0.00018	0	-	-	-	-	-	-	0.00038	0.068	0.0059	0.074
Kestrel	0.95	0	0	0	0	0.0059	0.0062	0.00069	0.048	0	0.002	0.00039	0	0.063
	0.98	0	0	0	0	0.0024	0.0025	0.00028	0.019	0	0.0008	0.00016	0	0.025
	0.99	0	0	0	0	0.0012	0.0012	0.00014	0.0095	0	0.0004	0.000078	0	0.013
	0.995	0	0	0	0	0.00059	0.00062	0.000069	0.0048	0	0.0002	0.000039	0	0.0063
	0.996	0	0	0	0	0.00047	0.00049	0.000055	0.0038	0	0.00016	0.000031	0	0.005
Snipe	0.95	0.00046	0.00048	0	0	0	0	0	0	0	0.0046	0.01	0.00048	0.016
	0.98	0.00018	0.00019	0	0	0	0	0	0	0	0.0018	0.0041	0.00019	0.0065
	0.99	0.000092	0.000096	0	0	0	0	0	0	0	0.00092	0.002	0.000096	0.0032
	0.995	0.000046	0.000048	0	0	0	0	0	0	0	0.00046	0.001	0.000048	0.0016
	0.996	0.000037	0.000038	0	0	0	0	0	0	0	0.00037	0.00081	0.000038	0.0013
Buzzard	0.95	0.054	0.13	0.24	0.049	0.14	0.38	0.2	0.3	0.12	0.0085	0.061	0.014	1.7
	0.98	0.021	0.051	0.097	0.02	0.057	0.15	0.082	0.12	0.046	0.0034	0.024	0.0056	0.68

Species	Avoidance Factor	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
	0.99	0.011	0.025	0.049	0.0099	0.028	0.076	0.041	0.06	0.023	0.0017	0.012	0.0028	0.34
	0.995	0.0054	0.013	0.024	0.0049	0.014	0.038	0.02	0.03	0.012	0.00085	0.0061	0.0014	0.17
	0.996	0.0043	0.01	0.019	0.0039	0.011	0.03	0.016	0.024	0.0092	0.00068	0.0049	0.0011	0.14
Sparrowhawk	0.95	0.011	0.0013	0	0.00071	0	0.0086	0.0007	0.0013	0	0.0016	0.0034	0	0.029
	0.98	0.0044	0.00051	0	0.00028	0	0.0034	0.00028	0.00053	0	0.00064	0.0014	0	0.011
	0.99	0.0022	0.00026	0	0.00014	0	0.0017	0.00014	0.00026	0	0.00032	0.00068	0	0.0057
	0.995	0.0011	0.00013	0	0.000071	0	0.00086	0.00007	0.00013	0	0.00016	0.00034	0	0.0029
	0.996	0.00089	0.0001	0	0.000057	0	0.00069	0.000056	0.00011	0	0.00013	0.00027	0	0.0023

Table 7 - 6 - 22 Expected collisions with avoidance – lowest swept height 23m

Species	Avoidance Factor	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Golden Plover	0.95	1.6	0.36	0.08	0	0	-	-	0	0.011	2.3	0.21	0.00026	4.5
	0.98	0.65	0.15	0.032	0	0	-	-	0	0.0043	0.91	0.082	0.0001	1.8
	0.99	0.32	0.073	0.016	0	0	-	-	0	0.0022	0.45	0.041	0.000052	0.91
	0.995	0.16	0.036	0.008	0	0	-	-	0	0.0011	0.23	0.021	0.000026	0.45
	0.996	0.13	0.029	0.0064	0	0	-	-	0	0.00087	0.18	0.016	0.000021	0.36
Peregrine Falcon	0.95	0.00069	0	0	0	0	0	0.032	0.0099	0	0.0017	0.0024	0	0.047
	0.98	0.00028	0	0	0	0	0	0.013	0.004	0	0.00069	0.00097	0	0.019
	0.99	0.00014	0	0	0	0	0	0.0064	0.002	0	0.00035	0.00048	0	0.0093
	0.995	0.000069	0	0	0	0	0	0.0032	0.00099	0	0.00017	0.00024	0	0.0047
	0.996	0.000055	0	0	0	0	0	0.0026	0.0008	0	0.00014	0.00019	0	0.0037
Hen Harrier	0.95	0	0.0035	0	-	-	-	-	0.0018	0	0	0.00021	0	0.0055
	0.98	0	0.0014	0	-	-	-	-	0.00071	0	0	0.000085	0	0.0022
	0.99	0	0.0007	0	-	-	-	-	0.00036	0	0	0.000042	0	0.0011
	0.995	0	0.00035	0	-	-	-	-	0.00018	0	0	0.000021	0	0.00055
	0.996	0	0.00028	0	-	-	-	-	0.00014	0	0	0.000017	0	0.00044
Black-tailed Godwit	0.95	0	0	0	0	0	0	0	0.47	0	0	0.18	0	0.64

Species	Avoidance Factor	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
	0.98	0	0	0	0	0	0	0	0.19	0	0	0.07	0	0.26
	0.99	0	0	0	0	0	0	0	0.094	0	0	0.035	0	0.13
	0.995	0	0	0	0	0	0	0	0.047	0	0	0.018	0	0.064
	0.996	0	0	0	0	0	0	0	0.037	0	0	0.014	0	0.051
Curlew	0.95	0	0	0	0	0	0.0087	0.0033	0.0021	0.0022	0	0	0.0087	0.025
	0.98	0	0	0	0	0	0.0035	0.0013	0.00084	0.00089	0	0	0.0035	0.01
	0.99	0	0	0	0	0	0.0017	0.00066	0.00042	0.00045	0	0	0.0017	0.005
	0.995	0	0	0	0	0	0.00087	0.00033	0.00021	0.00022	0	0	0.00087	0.0025
	0.996	0	0	0	0	0	0.0007	0.00026	0.00017	0.00018	0	0	0.0007	0.002
Common Gull	0.95	0	0	0	0	0	0	0	0	0.00088	0	0	0	0.00088
	0.98	0	0	0	0	0	0	0	0	0.00035	0	0	0	0.00035
	0.99	0	0	0	0	0	0	0	0	0.00018	0	0	0	0.00018
	0.992	0	0	0	0	0	0	0	0	0.00014	0	0	0	0.00014
	0.995	0	0	0	0	0	0	0	0	0.000088	0	0	0	0.000088
	0.996	0	0	0	0	0	0	0	0	0.000071	0	0	0	0.000071
Herring Gull	0.95	-	-	-	0	0.85	0.13	4.2	1.1	0.26	-	-	-	6.5
	0.98	-	-	-	0	0.34	0.053	1.7	0.44	0.1	-	-	-	2.6
	0.99	-	-	-	0	0.17	0.027	0.84	0.22	0.052	-	-	-	1.3
	0.995	-	-	-	0	0.085	0.013	0.42	0.11	0.026	-	-	-	0.65
	0.996	-	-	-	0	0.068	0.011	0.34	0.089	0.021	-	-	-	0.52
	0.95	0.016	0.085	0.58	-	-	-	-	-	-	0.015	0.1	0.31	1.1
	0.98	0.0063	0.034	0.23	-	-	-	-	-	-	0.006	0.04	0.12	0.44
	0.99	0.0031	0.017	0.12	-	-	-	-	-	-	0.003	0.02	0.062	0.22
	0.995	0.0016	0.0085	0.058	-	-	-	-	-	-	0.0015	0.01	0.031	0.11
	0.996	0.0013	0.0068	0.047	-	-	-	-	-	-	0.0012	0.008	0.025	0.089
Lesser Black-backed Gull	0.95	0.035	0.011	0.2	-	-	-	-	-	-	0.0049	0.062	0.52	0.84

Species	Avoidance Factor	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
	0.98	0.014	0.0044	0.081	-	-	-	-	-	-	0.002	0.025	0.21	0.34
	0.99	0.0071	0.0022	0.04	-	-	-	-	-	-	0.00099	0.012	0.1	0.17
	0.995	0.0035	0.0011	0.02	-	-	-	-	-	-	0.00049	0.0062	0.052	0.084
	0.996	0.0028	0.00089	0.016	-	-	-	-	-	-	0.0004	0.005	0.042	0.067
Kestrel	0.95	0.0039	0.00015	0.0058	0.00088	0.0096	0.0029	0.062	0.0034	0.0026	0.027	0.0041	0.011	0.13
	0.98	0.0016	0.000059	0.0023	0.00035	0.0038	0.0012	0.025	0.0013	0.001	0.011	0.0016	0.0043	0.053
	0.99	0.00078	0.000029	0.0012	0.00018	0.0019	0.00058	0.012	0.00067	0.00051	0.0053	0.00082	0.0021	0.026
	0.995	0.00039	0.000015	0.00058	0.000088	0.00096	0.00029	0.0062	0.00034	0.00026	0.0027	0.00041	0.0011	0.013
	0.996	0.00031	0.000012	0.00046	0.000071	0.00077	0.00023	0.005	0.00027	0.00021	0.0021	0.00033	0.00085	0.011
Snipe	0.95	0.0037	0.00077	0.0033	0	0	0	0	0.0014	0.0016	0.1	0.015	0.13	0.26
	0.98	0.0015	0.00031	0.0013	0	0	0	0	0.00055	0.00064	0.041	0.006	0.053	0.1
	0.99	0.00074	0.00015	0.00066	0	0	0	0	0.00027	0.00032	0.02	0.003	0.026	0.052
	0.995	0.00037	0.000077	0.00033	0	0	0	0	0.00014	0.00016	0.01	0.0015	0.013	0.026
	0.996	0.0003	0.000061	0.00027	0	0	0	0	0.00011	0.00013	0.0081	0.0012	0.011	0.021
Buzzard	0.95	0.015	0.079	0.54	0.84	0.35	0.028	0.071	0.017	0.0098	0.25	0.023	0.094	2.3
	0.98	0.0059	0.032	0.22	0.33	0.14	0.011	0.029	0.0067	0.0039	0.1	0.0094	0.038	0.93
	0.99	0.003	0.016	0.11	0.17	0.071	0.0055	0.014	0.0034	0.002	0.05	0.0047	0.019	0.46
	0.995	0.0015	0.0079	0.054	0.084	0.035	0.0028	0.0071	0.0017	0.00098	0.025	0.0023	0.0094	0.23
	0.996	0.0012	0.0063	0.044	0.067	0.028	0.0022	0.0057	0.0013	0.00079	0.02	0.0019	0.0076	0.19
Sparrowhawk	0.95	0.00068	0.0001	0.001	0.0028	0.0027	0.00029	0.0028	0.004	0.0022	0.0047	0.0038	0.0042	0.029
	0.98	0.00027	0.000041	0.0004	0.0011	0.0011	0.00012	0.0011	0.0016	0.00088	0.0019	0.0015	0.0017	0.012
	0.99	0.00014	0.00002	0.0002	0.00055	0.00054	0.000059	0.00056	0.00081	0.00044	0.00095	0.00075	0.00083	0.0058
	0.995	0.000068	0.00001	0.0001	0.00028	0.00027	0.000029	0.00028	0.0004	0.00022	0.00047	0.00038	0.00042	0.0029
	0.996	0.000054	0.0000081	0.00008	0.00022	0.00021	0.000024	0.00023	0.00032	0.00018	0.00038	0.0003	0.00033	0.0023

Table 7 - 6 - 23 Expected collisions with avoidance – lowest swept height 25m

Species	Avoidance Factor	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Golden Plover	0.95	2.5	1.6	1.9	0.0028	0	-	-	0	2.4	6.1	5.6	2.2	22
	0.98	0.99	0.65	0.75	0.0011	0	-	-	0	0.98	2.4	2.2	0.88	8.9
	0.99	0.49	0.33	0.37	0.00055	0	-	-	0	0.49	1.2	1.1	0.44	4.5
	0.995	0.25	0.16	0.19	0.00028	0	-	-	0	0.24	0.61	0.56	0.22	2.2
	0.996	0.2	0.13	0.15	0.00022	0	-	-	0	0.2	0.49	0.45	0.18	1.8
Peregrine Falcon	0.95	0	0	0.0033	0.0057	0.028	0.023	0.038	0	0.026	0.031	0	0	0.15
	0.98	0	0	0.0013	0.0023	0.011	0.0091	0.015	0	0.01	0.012	0	0	0.062
	0.99	0	0	0.00067	0.0011	0.0056	0.0046	0.0075	0	0.0052	0.0061	0	0	0.031
	0.995	0	0	0.00033	0.00057	0.0028	0.0023	0.0038	0	0.0026	0.0031	0	0	0.015
	0.996	0	0	0.00027	0.00045	0.0022	0.0018	0.003	0	0.0021	0.0024	0	0	0.012
Red Kite	0.95	0.31	0.0016	0	-	-	-	-	-	-	0	0	0.013	0.33
	0.98	0.13	0.00066	0	-	-	-	-	-	-	0	0	0.0053	0.13
	0.99	0.063	0.00033	0	-	-	-	-	-	-	0	0	0.0026	0.066
	0.995	0.031	0.00016	0	-	-	-	-	-	-	0	0	0.0013	0.033
	0.996	0.025	0.00013	0	-	-	-	-	-	-	0	0	0.0011	0.026
White-tailed Eagle	0.95	0.0025	0	0	0	0	0.13	0	0	0	0	0.011	0	0.15
	0.98	0.001	0	0	0	0	0.054	0	0	0	0	0.0046	0	0.06
	0.99	0.0005	0	0	0	0	0.027	0	0	0	0	0.0023	0	0.03
	0.995	0.00025	0	0	0	0	0.013	0	0	0	0	0.0011	0	0.015
	0.996	0.0002	0	0	0	0	0.011	0	0	0	0	0.00091	0	0.012
Hen Harrier	0.95	0.0021	0	0	-	-	-	-	0.00085	0	0	0.0016	0	0.0045
	0.98	0.00084	0	0	-	-	-	-	0.00034	0	0	0.00063	0	0.0018
	0.99	0.00042	0	0	-	-	-	-	0.00017	0	0	0.00032	0	0.00091
	0.995	0.00021	0	0	-	-	-	-	0.000085	0	0	0.00016	0	0.00045
	0.996	0.00017	0	0	-	-	-	-	0.000068	0	0	0.00013	0	0.00036
Black-tailed Godwit	0.95	0	0	0	0	0	0	1.2	0.29	0	0	0	0	1.5

Species	Avoidance Factor	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
	0.98	0	0	0	0	0	0	0.5	0.12	0	0	0	0	0.61
	0.99	0	0	0	0	0	0	0.25	0.058	0	0	0	0	0.31
	0.995	0	0	0	0	0	0	0.12	0.029	0	0	0	0	0.15
	0.996	0	0	0	0	0	0	0.099	0.023	0	0	0	0	0.12
Curlew	0.95	0	0	0	0	0	0	0.17	4.6	3.1	0.0034	0.0092	0	7.8
	0.98	0	0	0	0	0	0	0.07	1.8	1.2	0.0014	0.0037	0	3.1
	0.99	0	0	0	0	0	0	0.035	0.92	0.61	0.00068	0.0018	0	1.6
	0.995	0	0	0	0	0	0	0.017	0.46	0.31	0.00034	0.00092	0	0.78
	0.996	0	0	0	0	0	0	0.014	0.37	0.25	0.00027	0.00073	0	0.63
Common Gull	0.95	0.0028	0	0	0	0	0	0	0	0	0	0	0	0.0028
	0.98	0.0011	0	0	0	0	0	0	0	0	0	0	0	0.0011
	0.99	0.00057	0	0	0	0	0	0	0	0	0	0	0	0.00057
	0.992	0.00045	0	0	0	0	0	0	0	0	0	0	0	0.00045
	0.995	0.00028	0	0	0	0	0	0	0	0	0	0	0	0.00028
	0.996	0.00023	0	0	0	0	0	0	0	0	0	0	0	0.00023
Herring Gull	0.95	-	-	-	0.81	0.55	0.78	0.94	0.64	0.15	-	-	-	3.9
	0.98	-	-	-	0.32	0.22	0.31	0.38	0.26	0.061	-	-	-	1.6
	0.99	-	-	-	0.16	0.11	0.16	0.19	0.13	0.031	-	-	-	0.78
	0.995	-	-	-	0.081	0.055	0.078	0.094	0.064	0.015	-	-	-	0.39
	0.996	-	-	-	0.065	0.044	0.062	0.075	0.051	0.012	-	-	-	0.31
	0.95	0.64	0	0	-	-	-	-	-	-	0	0.026	0.43	1.1
	0.98	0.26	0	0	-	-	-	-	-	-	0	0.01	0.17	0.44
	0.99	0.13	0	0	-	-	-	-	-	-	0	0.0052	0.087	0.22
	0.995	0.064	0	0	-	-	-	-	-	-	0	0.0026	0.043	0.11
	0.996	0.052	0	0	-	-	-	-	-	-	0	0.0021	0.035	0.088
Lesser Black-backed Gull	0.95	0.028	0.14	0.28	-	-	-	-	-	-	0.025	0.073	0.28	0.83

Species	Avoidance Factor	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
	0.98	0.011	0.056	0.11	-	-	-	-	-	-	0.01	0.029	0.11	0.33
	0.99	0.0056	0.028	0.056	-	-	-	-	-	-	0.0051	0.015	0.056	0.17
	0.995	0.0028	0.014	0.028	-	-	-	-	-	-	0.0025	0.0073	0.028	0.083
	0.996	0.0023	0.011	0.022	-	-	-	-	-	-	0.002	0.0058	0.022	0.066
Kestrel	0.95	0.023	0.0083	0.15	0.12	0.094	0.087	0.38	0.29	0.15	0.23	0.088	0.052	1.7
	0.98	0.0094	0.0033	0.061	0.048	0.038	0.035	0.15	0.12	0.058	0.092	0.035	0.021	0.67
	0.99	0.0047	0.0017	0.03	0.024	0.019	0.017	0.076	0.058	0.029	0.046	0.018	0.01	0.33
	0.995	0.0023	0.00083	0.015	0.012	0.0094	0.0087	0.038	0.029	0.015	0.023	0.0088	0.0052	0.17
	0.996	0.0019	0.00066	0.012	0.0096	0.0075	0.0069	0.03	0.023	0.012	0.018	0.007	0.0042	0.13
Snipe	0.95	0.049	0.026	0.002	0.00048	0	0	0	0	0.0027	0.028	0.091	0.01	0.21
	0.98	0.019	0.01	0.00079	0.00019	0	0	0	0	0.0011	0.011	0.037	0.004	0.084
	0.99	0.0097	0.0051	0.0004	0.000096	0	0	0	0	0.00055	0.0057	0.018	0.002	0.042
	0.995	0.0049	0.0026	0.0002	0.000048	0	0	0	0	0.00027	0.0028	0.0091	0.001	0.021
	0.996	0.0039	0.0021	0.00016	0.000038	0	0	0	0	0.00022	0.0023	0.0073	0.00081	0.017
Buzzard	0.95	0.075	0.087	1.3	1.6	1.1	1.3	1.3	2.4	0.56	0.21	0.26	0.41	11
	0.98	0.03	0.035	0.53	0.64	0.42	0.5	0.52	0.98	0.23	0.083	0.1	0.16	4.2
	0.99	0.015	0.017	0.27	0.32	0.21	0.25	0.26	0.49	0.11	0.042	0.052	0.081	2.1
	0.995	0.0075	0.0087	0.13	0.16	0.11	0.13	0.13	0.24	0.056	0.021	0.026	0.041	1.1
	0.996	0.006	0.0069	0.11	0.13	0.084	0.1	0.1	0.2	0.045	0.017	0.021	0.033	0.85
Sparrowhawk	0.95	0.012	0.0034	0.0078	0.019	0.0034	0.0052	0.0077	0.031	0.031	0.00015	0.0019	0.02	0.14
	0.98	0.0047	0.0014	0.0031	0.0077	0.0013	0.0021	0.0031	0.012	0.012	0.000061	0.00075	0.0081	0.057
	0.99	0.0023	0.00068	0.0016	0.0039	0.00067	0.001	0.0015	0.0062	0.0061	0.00003	0.00038	0.004	0.028
	0.995	0.0012	0.00034	0.00078	0.0019	0.00034	0.00052	0.00077	0.0031	0.0031	0.000015	0.00019	0.002	0.014
	0.996	0.00093	0.00027	0.00063	0.0015	0.00027	0.00042	0.00061	0.0025	0.0025	0.000012	0.00015	0.0016	0.011

3.6 Stage F Uncertainty

There are many sources of variability or uncertainty in the output of the Collision Risk Model. The main sources of uncertainty outlined in Band (2024) are:

- survey data is sampled, often both in time and space, and usually exhibits a high degree of variability. Mean estimates can only be representative of flight activity;
- survey data is unavailable for certain conditions, including nighttime and storm conditions;
- natural variability in bird populations, over time and space, for ecological reasons;
- flight height information may be subject to observer bias;
- the collision risk model uses a simplified geometry for turbine blades and bird shape;
- it does not include any risk of collision with turbine towers;
- details of blade dimension and pitch may be unavailable when making the estimate;
- turbines deployed may differ from those used in the collision risk analysis;
- bird parameters (length, wingspan, flight speed) are not fixed but have a distribution;
- bird speed is not a constant but is dependent on wind speed;
- insufficient knowledge about bird displacement and attraction effects;
- there is limited firm information on bird avoidance behaviour.

Because of this, a range of uncertainty is calculated for the predicted collision rates. The range of uncertainty should reflect:

- uncertainty or variability in flight activity data (including imprecision on flight height estimates and lack of knowledge about night-time behaviour);
- uncertainty due to the limitations of the collision model, including the variability of bird dimensions and flight speed, the simplification in shape of a bird and turbine blades;
- uncertainty arising from turbine options yet to be decided, in number, size and speed. These options should include a 'worst case' in terms of the option likely to present greatest bird collision risk.

To provide a measure of uncertainty in aerial density, the mean, standard deviation and relative standard deviation of the mean for the monthly values was calculated (see Section 4 'Worked Example'). Uncertainty due to simplifications in the collision risk model was assumed to be 0.20 (Band, 2024). Finally, uncertainty due to design options (including the blade profile, pitch, rotational speed and expected time operational) was considered to be 0.28. The overall range of uncertainty for each species is presented in for each lowest swept height in Table 7 - 6 - 24 to Table 7 - 6 - 26. The species for which no flight activity and associated expected collisions were calculated for individual scenarios are excluded from the relevant tables.

Table 7 - 6 - 24 Range of uncertainty – lowest swept height 20m

Species	Months	Model	Mean	Standard Deviation	Relative Standard Deviation	Uncertainty
Golden Plover	Aug-May	non-directional	0.2122	0.4645	2.1884	2.22
Peregrine Falcon	Oct-Sep	non-directional	<0.001	0.0001	1.8691	1.9
Red Kite	Oct-Mar	non-directional	0.0005	0.001	2.2361	2.26
White-tailed Eagle	Oct-Sep	non-directional	0.0002	0.0005	2.6698	2.69
Common Gull	Oct-Sep	non-directional	0.0005	0.0014	2.4731	2.5
Herring Gull	Apr-Sep	non-directional	0.0077	0.0081	1.0504	1.11
Herring Gull	Oct-Mar	non-directional	0.032	0.0677	2.1175	2.15
Lesser Black-backed Gull	Oct-Mar	non-directional	0.0134	0.0268	2.0063	2.04
Kestrel	Oct-Sep	non-directional	0.0008	0.0021	2.4722	2.5
Snipe	Oct-Sep	non-directional	0.0001	0.0003	2.1843	2.21
Buzzard	Oct-Sep	non-directional	0.0139	0.0094	0.6746	0.76
Sparrowhawk	Oct-Sep	non-directional	0.0006	0.001	1.6205	1.66

Table 7 - 6 - 25 Range of uncertainty – lowest swept height 23m

Species	Months	Model	Mean	Standard Deviation	Relative Standard Deviation	Uncertainty
Golden Plover	Aug-May	non-directional	0.0171	0.0283	1.6516	1.69
Peregrine Falcon	Oct-Sep	non-directional	0.0001	0.0003	2.0737	2.1
Hen Harrier	Aug-Mar	non-directional	0.0001	0.0002	1.9116	1.94
Black-tailed Godwit	Oct-Sep	non-directional	0.0012	0.0029	2.4157	2.44
Curlew	Oct-Sep	non-directional	0.0001	0.0002	1.5586	1.6
Common Gull	Oct-Sep	non-directional	<0.001	<0.001	3.3166	3.33
Herring Gull	Apr-Sep	non-directional	0.0254	0.0326	1.2865	1.33
Herring Gull	Oct-Mar	non-directional	0.0053	0.0054	1.0214	1.08
Lesser Black-backed Gull	Oct-Mar	non-directional	0.004	0.0056	1.3784	1.42
Kestrel	Oct-Sep	non-directional	0.0008	0.001	1.2789	1.32
Snipe	Oct-Sep	non-directional	0.0007	0.0015	1.9951	2.02

Species	Months	Model	Mean	Standard Deviation	Relative Standard Deviation	Uncertainty
Buzzard	Oct-Sep	non-directional	0.007	0.0086	1.2215	1.27
Sparrowhawk	Oct-Sep	non-directional	0.0002	0.0002	0.7558	0.83

Table 7 - 6 - 26 Range of uncertainty – lowest swept height 25m

Species	Months	Model	Mean	Standard Deviation	Relative Standard Deviation	Uncertainty
Golden Plover	Aug-May	non-directional	0.0361	0.0331	0.918	0.98
Peregrine Falcon	Oct-Sep	non-directional	0.0002	0.0002	1.1158	1.17
Red Kite	Oct-Mar	non-directional	0.0008	0.0017	2.1114	2.14
White-tailed Eagle	Oct-Sep	non-directional	0.0001	0.0003	2.7643	2.79
Hen Harrier	Aug-Mar	non-directional	0	0.0001	1.5184	1.56
Black-tailed Godwit	Oct-Sep	non-directional	0.0011	0.0031	2.6901	2.71
Curlew	Oct-Sep	non-directional	0.0149	0.0328	2.2088	2.24
Common Gull	Oct-Sep	non-directional	<0.001	<0.001	3.3166	3.33
Herring Gull	Apr-Sep	non-directional	0.0067	0.0025	0.3791	0.51
Herring Gull	Oct-Mar	non-directional	0.0025	0.0035	1.3996	1.44
Lesser Black-backed Gull	Oct-Mar	non-directional	0.0017	0.0013	0.7692	0.84
Kestrel	Oct-Sep	non-directional	0.0041	0.0027	0.6466	0.73
Snipe	Oct-Sep	non-directional	0.0003	0.0004	1.5397	1.58
Buzzard	Oct-Sep	non-directional	0.0128	0.009	0.7061	0.79
Sparrowhawk	Oct-Sep	non-directional	0.0005	0.0004	0.8775	0.94

3.7 Predicted Collision Rates

To provide a best estimate of the collision rate for each species, the guidance on avoidance rates provided in NatureScot (2025b) was consulted. This guidance suggests the most appropriate avoidance rate for each species; however it should be noted that the lack of research on most species' avoidance rates means that the confidence interval of the

prediction may extend from the lowest to the highest avoidance rate inThe species for which no flight activity and associated expected collisions were calculated for individual scenarios are excluded from the relevant tables.

Table 7 - 6 - 21 to Table 7 - 6 - 23. For each species and lowest swept height, the predicted number of collisions corresponding to the recommended avoidance rate was identified. These are presented in Table 7 - 6 - 27 to Table 7 - 6 - 29, along with the range of uncertainty, the predicted number of collisions over the operational lifetime of the facility and an estimation of the number of years for one collision to occur (details on these calculations are shown in Section 4 'Worked Example').

Table 7 - 6 - 27 to Table 7 - 6 - 29 presents the predicted annual collision rate for each lowest swept height used for the assessment. Table 7 – 6 – 30 presents the predicted annual collision rate for the entire assessment (sum of the predicted annual collision rate of each lowest swept height data encompassing all turbines). The results should be considered as a best estimate of collision risk, rather than a precise figure. The species for which no flight activity and associated expected collisions were calculated for individual scenarios are excluded from the relevant tables.

Table 7 - 6 - 27 Predicted collision rates – lowest swept height 20m

Species	Months	Model	Avoidance Factor	Annual Collision Rate	Range of Uncertainty	Collisions Over Lifetime	Years to One Collision
Golden Plover	Aug-May	non-directional	0.996	1.48	0-4.76	51.7	<1
Peregrine Falcon	Oct-Sep	non-directional	0.98	0.00101	0-0.00293	0.0353	>35
Red Kite	Oct-Mar	non-directional	0.99	0.0079	0-0.0257	0.276	>35
White-tailed Eagle	Oct-Sep	non-directional	0.95	0.047	0-0.174	1.65	21
Common Gull	Oct-Sep	non-directional	0.992	0.00821	0-0.0287	0.287	>35
Herring Gull	Apr-Sep	non-directional	0.995	0.0697	0-0.147	2.44	14
Herring Gull	Oct-Mar	non-directional	0.995	0.209	0-0.659	7.32	5
Lesser Black-backed Gull	Oct-Mar	non-directional	0.995	0.0927	0-0.282	3.24	11
Kestrel	Oct-Sep	non-directional	0.95	0.0628	0-0.22	2.20	16
Snipe	Oct-Sep	non-directional	0.98	0.00648	0-0.0208	0.227	>35
Buzzard	Oct-Sep	non-directional	0.98	0.68	0.163-1.2	23.8	1
Sparrowhawk	Oct-Sep	non-directional	0.98	0.0115	0-0.0305	0.402	>35

Table 7 - 6 - 28 Predicted collision rates – lowest swept height 23m

Species	Months	Model	Avoidance Factor	Annual Collision Rate	Range of Uncertainty	Collisions Over Lifetime	Years to One Collision
Golden Plover	Aug-May	non-directional	0.996	0.364	0-0.979	12.7	3

Species	Months	Model	Avoidance Factor	Annual Collision Rate	Range of Uncertainty	Collisions Over Lifetime	Years to One Collision
Peregrine Falcon	Oct-Sep	non-directional	0.98	0.0187	0-0.0579	0.654	>35
Hen Harrier	Aug-Mar	non-directional	0.99	0.0011	0-0.00322	0.0384	>35
Black-tailed Godwit	Oct-Sep	non-directional	0.98	0.257	0-0.885	9.01	4
Curlew	Oct-Sep	non-directional	0.98	0.01	0-0.0261	0.351	>35
Common Gull	Oct-Sep	non-directional	0.992	0.000142	0-0.000613	0.00495	>35
Herring Gull	Apr-Sep	non-directional	0.995	0.654	0-1.52	22.9	2
Herring Gull	Oct-Mar	non-directional	0.995	0.111	0-0.23	3.87	9
Lesser Black-backed Gull	Oct-Mar	non-directional	0.995	0.0838	0-0.203	2.93	12
Kestrel	Oct-Sep	non-directional	0.95	0.132	0-0.307	4.64	8
Snipe	Oct-Sep	non-directional	0.98	0.104	0-0.313	3.63	10
Buzzard	Oct-Sep	non-directional	0.98	0.929	0-2.11	32.5	1
Sparrowhawk	Oct-Sep	non-directional	0.98	0.0117	0.00199-0.0214	0.409	>35

Table 7 - 6 - 29 Predicted collision rates – lowest swept height 25m

Species	Months	Model	Avoidance Factor	Annual Collision Rate	Range of Uncertainty	Collisions Over Lifetime	Years to One Collision
Golden Plover	Aug-May	non-directional	0.996	1.79	0.0357-3.54	62.5	<1
Peregrine Falcon	Oct-Sep	non-directional	0.98	0.0616	0-0.134	2.16	16
Red Kite	Oct-Mar	non-directional	0.99	0.0656	0-0.206	2.30	15
White-tailed Eagle	Oct-Sep	non-directional	0.95	0.149	0-0.564	5.21	7
Hen Harrier	Aug-Mar	non-directional	0.99	0.000909	0-0.00233	0.0318	>35
Black-tailed Godwit	Oct-Sep	non-directional	0.98	0.612	0-2.27	21.4	2
Curlew	Oct-Sep	non-directional	0.98	3.13	0-10.2	110	<1
Common Gull	Oct-Sep	non-directional	0.992	0.000452	0-0.00196	0.0158	>35
Herring Gull	Apr-Sep	non-directional	0.995	0.388	0.19-0.585	13.6	3
Herring Gull	Oct-Mar	non-directional	0.995	0.11	0-0.269	3.86	9

Species	Months	Model	Avoidance Factor	Annual Collision Rate	Range of Uncertainty	Collisions Over Lifetime	Years to One Collision
Lesser Black-backed Gull	Oct-Mar	non-directional	0.995	0.0826	0.0132-0.152	2.89	12
Kestrel	Oct-Sep	non-directional	0.95	1.67	0.45-2.88	58.3	<1
Snipe	Oct-Sep	non-directional	0.98	0.0838	0-0.216	2.93	12
Buzzard	Oct-Sep	non-directional	0.98	4.23	0.889-7.58	148	<1
Sparrowhawk	Oct-Sep	non-directional	0.98	0.057	0.00342-0.111	1.99	18

Table 7 - 6 - 30 Predicted collision rates – total for Proposed Wind Farm

Species	Months	Model	Avoidance Factor	Annual Collision Rate	Range of Uncertainty	Collisions Over Lifetime	Years to One Collision
Golden Plover	Aug-May	non-directional	0.996	3.634	0.0357-9.279	126.9	<1
Peregrine Falcon	Oct-Sep	non-directional	0.98	0.08131	0-0.19483	2.8493	12
Red Kite	Oct-Mar	non-directional	0.99	0.0735	0-0.2317	2.576	14
White-tailed Eagle	Oct-Sep	non-directional	0.95	0.196	0-0.738	6.86	5
Hen Harrier	Aug-Mar	non-directional	0.99	0.002009	0-0.00555	0.0702	>35
Black-tailed Godwit	Oct-Sep	non-directional	0.98	0.869	0-3.155	30.41	1
Cormorant	Oct-Sep	non-directional	0.98	0.13131	0-0.08947	4.5953	8
Curlew	Oct-Sep	non-directional	0.98	3.14	0-10.2261	110.351	<1
Common Gull	Oct-Sep	non-directional	0.992	0.008804	0-0.031273	0.30775	>35
Herring Gull	Apr-Sep	non-directional	0.995	1.1117	0.19-2.252	38.94	<1
Herring Gull	Oct-Mar	non-directional	0.995	0.43	0-1.158	15.05	2
Lesser Black-backed Gull	Oct-Mar	non-directional	0.995	0.2591	0.0132-0.637	9.06	4
Kestrel	Oct-Sep	non-directional	0.95	1.8648	0.45-3.407	65.14	<1
Snipe	Oct-Sep	non-directional	0.98	0.19428	0-0.5498	6.787	5
Buzzard	Oct-Sep	non-directional	0.98	5.839	1.052-10.89	204.3	<1
Sparrowhawk	Oct-Sep	non-directional	0.98	0.0802	0.00541-0.1629	2.801	12

4. WORKED EXAMPLE

This section provides a worked example of the collision rate prediction for sparrowhawk at an imaginary facility. This example is deliberately simplified to assist readers with following the steps. The prediction is made using a short imaginary dataset presented in Section 4.2.

4.1 Proposed Development Scenario

In this example, a wind farm is proposed in farmland at a latitude of 53.4°N. The development consists of seven turbines. Each turbine has a hub height of 105m and rotor diameter of 150m, giving a rotor-swept height range of 30-180m. The turbines have a blade radius (R) of 75m, a blade pitch (λ) of 6°, and a maximum blade chord width (C) of 4.2m. Each turbine has 3 blades (b) and operates at an average rotational speed (Ω) of 11.4rpm. The proposed operational lifetime of 35 years, with turbines expected to be operational approximately 85% of the time.

The blade profile of the turbines is presented in Table 7 - 6 - 31. This table provides the chord width values at 20 evenly spaced points along the blade, expressed relative to the maximum chord width. In this context, r denotes the distance from the hub, and R represents the total blade length (i.e., the rotor radius). The ratio r/R therefore represents the relative radial position along the blade, where 0 corresponds to the hub and 1 corresponds to the blade tip. Similarly, c represents the chord width at a given distance (r) from the hub, and C is the maximum chord width of the blade. Therefore, the ratio c/C represents the relative chord width.

Table 7 - 6 - 31 Blade profile of the turbines

r/R	c/C
0.00	0.690
0.05	0.730
0.10	0.790
0.15	0.880
0.20	0.960
0.25	1.000
0.30	0.980
0.35	0.920
0.40	0.850
0.45	0.800
0.50	0.750
0.55	0.700
0.60	0.640
0.65	0.580
0.70	0.520
0.75	0.470
0.80	0.410
0.85	0.370
0.90	0.300
0.95	0.240
1.00	0.000

4.2 Bird Survey Scenario

In this example, bird surveys were conducted at the proposed wind farm site for a two year period (April 2023 to March 2025). Vantage point surveys to monitor flight activity were undertaken at two vantage points. The combined viewsheds from these vantage points provided at least 500m coverage around all turbines in addition to coverage of the site and surrounds (Figure 7 - 6 - 1). The total viewshed area was 5.23km^2 for VP1 and 5.92km^2 for VP2.

Both vantage points were surveyed for 6 hours per month throughout the survey period, totalling 144 hours of survey at each location. For each recorded flight, the duration (in seconds) that bird spent within pre-defined height bands was recorded. These heights bands were:

- Band 1 = 0-15m
- Band 2 = 15-25m
- Band 3 = 25-200m
- Band 4 = 200m+

As the risk height range of the turbine is 30-180m, all flight activity in Band 3 is considered to be at potential collision height.

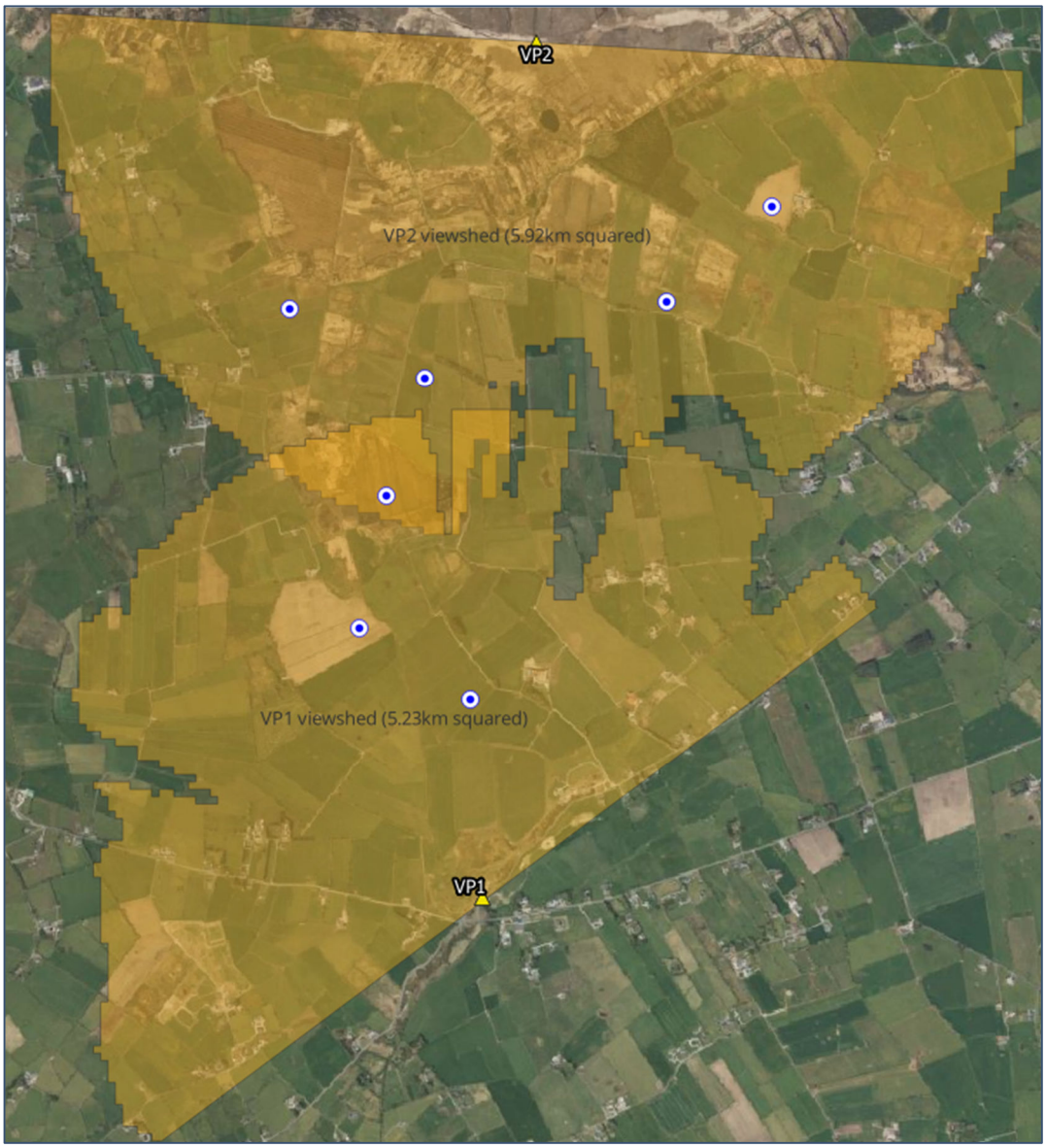

Figure 7 - 6 - 1 Vantage point survey locations and viewshed areas

In this example, a collision risk model will be conducted for the species sparrowhawk. All records for sparrowhawk collected during vantage point surveys are presented in Table 7 - 6 - 32. Records denoted '-' represent non-flight activity, for example when a bird is perched.

The data in Table 7 - 6 - 32 shows that sparrowhawk was present at the site throughout the survey period, in both the breeding and winter season. Therefore, all months of the year will be modelled.

Table 7 - 6 - 32 Sparrowhawk records from vantage point surveys

VP	Date	Time	Species	Number	Band 1	Band 2	Band 3	Band 4
VP2	17/11/2023	07:36	Sparrowhawk	1	17	0	0	0
VP2	17/11/2023	07:43	Sparrowhawk	1	-	-	-	-
VP1	12/12/2023	11:24	Sparrowhawk	1	-	-	-	-
VP1	12/01/2024	12:14	Sparrowhawk	2	14	0	15	0
VP2	30/01/2024	11:34	Sparrowhawk	1	87	0	0	0
VP2	21/02/2024	16:19	Sparrowhawk	1	35	0	0	0
VP1	14/03/2024	11:48	Sparrowhawk	1	50	12	0	0
VP1	03/05/2024	11:25	Sparrowhawk	2	19	0	0	0
VP2	09/05/2024	09:56	Sparrowhawk	1	6	0	0	0
VP1	19/06/2024	10:14	Sparrowhawk	1	15	3	0	0
VP1	19/06/2024	14:22	Sparrowhawk	1	0	0	139	0
VP1	09/07/2024	16:56	Sparrowhawk	1	21	0	0	0
VP2	26/07/2024	13:37	Sparrowhawk	1	17	0	0	0
VP1	03/10/2024	14:02	Sparrowhawk	1	32	9	0	0
VP1	06/11/2024	12:15	Sparrowhawk	1	14	4	0	0
VP1	29/11/2024	13:09	Sparrowhawk	1	0	18	81	0
VP1	29/11/2024	15:57	Sparrowhawk	1	16	0	0	0
VP2	31/01/2025	13:07	Sparrowhawk	1	20	48	0	0
VP2	13/03/2025	08:46	Sparrowhawk	1	0	83	0	0

4.3 Stage A: Flight Activity

Aerial bird density

In order to calculate the aerial bird density (D_A) for sparrowhawk, the following formula was used:

$$DA = b / (t \times A) \text{ bird-seconds m}^2$$

To calculate parameter b, the number of 'bird-seconds' per month per vantage point was calculated by multiplying the number of birds aloft by the duration of the flight (in seconds). This included time spent in all recorded height bands, not just those bands within potential collision height. These values are presented in Table 7 - 6 - 33. Note that sparrowhawk was not recorded in every month, therefore some months are not present in the table.

Table 7 - 6 - 33 Bird-seconds per vantage point per month

Month	Vantage Point	Bird-Seconds
Jan	VP1	58
Mar	VP1	62
May	VP1	38
Jun	VP1	157

Month	Vantage Point	Bird-Seconds
Jul	VP1	21
Oct	VP1	41
Nov	VP1	133
Jan	VP2	155
Feb	VP2	35
Mar	VP2	83
May	VP2	6
Jul	VP2	17
Nov	VP2	17

Parameter t, the time that the vantage point was watched, was obtained from the survey effort. The breakdown of survey time at each vantage point is presented in Table 7 - 6 - 34.

Table 7 - 6 - 34 Survey time at each vantage point in hours and seconds according to month

Vantage Point	Month	Time in hours	Time in seconds
VP1	Jan	12	43200
VP2	Jan	12	43200
VP1	Feb	12	43200
VP2	Feb	12	43200
VP1	Mar	12	43200
VP2	Mar	12	43200
VP1	Apr	12	43200
VP2	Apr	12	43200
VP1	May	12	43200
VP2	May	12	43200
VP1	Jun	12	43200
VP2	Jun	12	43200
VP1	Jul	12	43200
VP2	Jul	12	43200
VP1	Aug	12	43200
VP2	Aug	12	43200
VP1	Sep	12	43200
VP2	Sep	12	43200
VP1	Oct	12	43200
VP2	Oct	12	43200
VP1	Nov	12	43200
VP2	Nov	12	43200
VP1	Dec	12	43200
VP2	Dec	12	43200

Parameter A is the entire area of the vantage point viewsheds. As described above, these were:

- VP1 = 5.23km^2
- VP2 = 5.92km^2

The aerial bird density (D_A) was calculated for all vantage points, and then a mean value was obtained for each month. For example, D_A for January was calculated as:

VP1
b = 58
t = 43200
A = 5.23
D_A = 0.0002563467

VP2
b = 155
t = 43200
A = 5.92
D_A = 0.0006055715

Mean D_A for the month of January

(0002563467 X 0.0006055715)/2 = 0.0004309591

D_A for all months is presented in Table 7 - 6 - 35. Zero is input for months in which sparrowhawk was not recorded.

Table 7 - 6 - 35 Aerial bird density

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.0004	0.0001	0.0003	0	0.0001	0.0003	0.0001	0	0	0.0001	0.0003	0

Proportion of birds flying at risk height

The proportion of sparrowhawk flying at risk height (Q_2R) was calculated from the survey data in Table 7 - 6 - 32. Note that non-flight records are excluded from this calculation.

First, for each height band, the proportion of flights within that band relative to the total number of flights was calculated. Second, the proportion of each height band overlapping the rotor risk height (30-180m) was determined. Finally, these two proportions were multiplied. The workings for Band 3 (25-200m) are below.

Band 3
Total number of sparrowhawk flights = 17
Total number of sparrowhawk flights in band = 3
Proportion of flights in band = 0.176
Proportion of band overlapping rotor risk height = 0.858
0.176 X 0.858 = 0.151

This calculation was made for all bands. Then, the result from each band was summed to provide a total proportion of birds flying at risk height. Note that the result for bands that do not overlap with rotor risk height will be 0. Because Band 3 was the only band that overlapped with rotor risk height in this example, the final proportion of birds flying at risk height (Q_2R) was 0.151 or 15.1%.

Photoperiod

The photoperiod at the latitude of the site was acquired for the survey period. The daylight and nighttime hours per month (tday and tnight respectively) are shown in Table 7 - 6 - 36. The total daylight hours was 4,487.093 and night-time hours was 4,272.907.

Table 7 - 6 - 36 Photoperiod

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daylight Hours	251.5	273.7	366.3	418.6	491.5	507.3	510.3	459.0	382.6	329.7	261.0	235.6
Nighttime Hours	492.5	398.3	377.7	301.4	252.5	212.7	233.7	285.0	337.4	414.3	459.0	508.4

4.4 Stage B: Number of Flights Through Rotors

To estimate the number of sparrowhawk flights through the rotors, firstly the total rotor frontal area for all turbines was calculated as:

$$\text{rotor frontal area} = T \ \pi R^2$$

where T is the number of turbines. In this example, that is $7 \text{ X } \pi \text{ X } 75^2 = 123700.2\text{m}^2$

Sparrowhawk biometrics were taken from the best available literature:

- Length (l) = 0.33m
- Wingspan (w) = 0.625m
- Flight speed (v) = 10m/s
- Flight type = flapping
- Nocturnal activity ranking (fnight) = 1 (0% nighttime activity)

Using the values from previous sections, the density (D_v) for each month was calculated as:

$$Dv = (D_\lambda * Q_2R)/(2*R)$$

Then the projected number of transits through the rotor risk area was calculated as:

$$\text{transits} = v * Dv * \text{rotor frontal area} * ((tday + (tnight * (fnight/100))) * 3600)$$

In this example, the density for the month of January was $(0.0004 \text{ X } 0.151)/(2 \text{ X } 75) = 4.349921^{-13}$

The number of transits for the month of January was $10 \text{ X } 4.349921^{-13} \text{ X } 123700.2 \text{ X } ((251.519 + (492.481 \text{ X } (0/100))) \text{ X } 3600) = 0.4872201$. Table 7 - 6 - 37 shows the projected number of transits for all months. Note that a zero is input for months in which sparrowhawk was not recorded.

Table 7 - 6 - 37 Number of transits per month

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.487	0.084	0.493	0	0.211	0.791	0.183	0	0	0.134	0.384	0

4.5 Stage C: Probability of Collision

The probability of a sparrowhawk collision during a single rotor transit was calculated. Sparrowhawk biometrics, flight behaviour and the turbine specifications outlined in the previous sections were used to define how the bird interacts with the moving blades and derive the geometric parameters described below. Collision probability was determined separately for upwind and downwind flight directions. It was calculated as a function of radial position across the rotor disc, at increments of 0.05 from 0.05 to 1.0 (excluding the rotor centre).

At each radial position, collision probability was calculated for flight angles at increments of 10° from 0° to 180°, which assumes a uniform distribution of bird approach angles. For each flight angle, the flight angle (Φ) was converted from degrees to radians and turbine rotation speed (Ω) was converted from rpm to radians per second. The dimensionless radial position (radius) was converted to an absolute distance from the hub in metres. Then, the blade chord width at the radial position was estimated by interpolating

the blade profile and scaling it by the maximum chord width, to reflect blade width changes from hub to tip. Flight direction (d) was set as 1 for upwind flight directions and -1 for downwind.

A standard dimensionless blade encounter rate multiplier was defined as:

$$b\ \Omega/2\ \pi v$$

where b is number of blades, Ω is rotation speed (now in rad s^{-1}), and v is bird flight speed.

The ratio of bird speed to blade tangential speed (α) was calculated as:

$$\alpha = v/\text{radius}\ \Omega$$

The blade pitch (λ) was converted from degrees to radians to obtain the blade tilt angle (θ) relative to the rotor plane:

$$\theta = \lambda\pi/180$$

Using these values, two collision lengths were calculated. The first was a blade-related component (accounting for blade chord width [c], blade tilt [θ], bird flight direction [d] and the ratio of bird speed to blade tangential speed [α]), which represents the effective 'interaction length' associated with blade motion and geometry:

$$|\ d\ c\ \sin(\theta)+\alpha\ c\ \cos(\theta)|$$

The second was a bird-size-related component (accounting for body length [l], wingspan [w] and flight type):

$$\max(l, w_{eff}\ \alpha)$$

Here, w_{eff} is the effective wingspan. For flapping flight, the full wingspan was used, but for gliding flight, the wingspan would be reduced by the absolute value of the cosine of the flight angle relative to the rotor plane (Φ) to represent the reduced projected cross-section when the bird's wings are angled relative to the rotor plane.

Finally, the collision probability was calculated as the blade encounter rate multiplier multiplied by the sum of the two collision lengths. The result is capped at a maximum of 1 so that probabilities cannot exceed 100%. This collision probability was then averaged over the flight angles at the radial position. The upwind and downwind collision probabilities calculated for each radial position for sparrowhawk are presented in Table 7 - 6 - 38.

Table 7 - 6 - 38 Upwind and downwind collision probabilities

Radial Position	Upwind	Downwind
0.05	0.486082	0.449547
0.1	0.269631	0.230093
0.15	0.204551	0.160508
0.2	0.171557	0.123511
0.25	0.1502	0.100152
0.3	0.130199	0.081152
0.35	0.11173	0.065686
0.4	0.096588	0.054047
0.45	0.086103	0.046065
0.5	0.077465	0.039929
0.55	0.070171	0.035137

Radial Position	Upwind	Downwind
0.6	0.06319	0.031159
0.65	0.057052	0.028024
0.7	0.051576	0.025551
0.75	0.047235	0.023713
0.8	0.042698	0.022178
0.85	0.039644	0.021126
0.9	0.035181	0.020167
0.95	0.031534	0.019522
1	0.01881	0.01881

Next, the collision probabilities were averaged for flights through the rotor disk for upwind values and downwind values as follows:

$$P = 2[(i=1\sum n-1 r_i p_i)+2p_n]\Delta r$$

Where P is the mean single-transit collision probability (upwind or downwind), r_i is the radial position, p_i is the collision probability at radial position r_i, p_n is the collision probability at the outermost radial position (i.e., the blade tip), $\Delta r = 0.05$ (i.e., the radial increments) and n is the number of evaluated radial positions

The average collision risk for flights through the rotor when moving upwind was calculated as 0.0672, and for downwind as 0.0402. A 50:50 weighting of upwind and downwind flight was assumed. Thus, the final probability of a sparrowhawk collision during a single rotor transit was calculated as the weighted average of these two estimates. The estimated probability of collision for a sparrowhawk during a single rotor transit was 0.0537.

4.6 Stage D Expected Collisions

The outputs of stage B and C were multiplied to yield the expected collision rate for sparrowhawk, and the product was multiplied by the proportion of time the wind farm is expected to be operational. In this example, the expected collisions for January was calculated as:

$$0.487 \text{ X } 0.0537 \text{ X } 0.85 = 0.02224467$$

The predicted number of collisions for each month is presented in Table 7 - 6 - 39. Note that these rates assume no avoidance of turbines or wind farms by sparrowhawk.

Table 7 - 6 - 39 Expected collisions per month (without avoidance)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.022	0.004	0.023	0.000	0.010	0.036	0.008	0.000	0.000	0.006	0.018	0.000

4.7 Stage E Allowing for Avoidance and Attraction

Stage E of the modelling process takes account of the proportion of sparrowhawk likely to avoid the wind farm or its turbines. This is calculated for a range of avoidance factors: 95%, 98%, 99% and 99.5%. The expected collisions per month calculated in stage D are multiplied by the avoidance rates to provide a collision rate with avoidance. These values are presented in Table 7 - 6 - 40.

Table 7 - 6 - 40 Expected collisions per month (with avoidance)

Avoidance Factor	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.95	0.0011	0.0002	0.0011	0.0000	0.0005	0.0018	0.0004	0.0000	0.0000	0.0003	0.0009	0.0000
0.98	0.0004	0.0001	0.0005	0.0000	0.0002	0.0007	0.0002	0.0000	0.0000	0.0001	0.0004	0.0000
0.99	0.0002	0.0000	0.0002	0.0000	0.0001	0.0004	0.0001	0.0000	0.0000	0.0001	0.0002	0.0000
0.995	0.0001	0.0000	0.0001	0.0000	0.0001	0.0002	0.0000	0.0000	0.0000	0.0000	0.0001	0.0000

4.8 Stage F: Uncertainty

To provide a measure of uncertainty in aerial density (u1), the relative standard deviation for the monthly values was used. First, the mean aerial density ($\bar{D}_x$) for all months was calculated to be 0.0001445. Then, the relative standard deviation (RSD) was calculated as:

$$RSD = s / \bar{D}_x$$

where s is the standard deviation of the monthly values. In this example:

$$0.00015/0.0001445 = 1.038062$$

Note that zero values (i.e., months in which the sparrowhawk was not recorded, such as April) were retained in this equation as they may represent true absence or intermittent use of the site.

Uncertainty due to simplifications in the collision risk model (u2) was assumed to be 20% (Band, 2024). Finally, uncertainty due to design options (u3) was considered to be 28%, as 4 of 14 turbine specifications were either not finalised or were approximate (blade profile, pitch, rotational speed and expected time operational). The overall range of uncertainty (u) was thus:

$$\sqrt{(u1^2 + u2^2 + u3^2)}$$

In this example, that is:

$$\sqrt{(1.038062^2 + 0.2^2 + 0.28^2)} = 1.093605$$

4.9 Worked Example Collision Rates

To provide a best estimate of the collision rate for sparrowhawk, the guidance on avoidance rates provided by NatureScot in NatureScot (2025b) was consulted. This guidance recommends a 98% avoidance rate for sparrowhawk. As such the predicted number of collisions corresponding to a 98% avoidance rate was identified and is presented in Table 7 - 6 - 41, along with the range of uncertainty and an estimation of the number of years for one collision to occur.

The column 'Annual Collision Rate' in Table 7 - 6 - 41 presents the final predicted annual collision rate for sparrowhawk that would be used in the impact assessment for this proposed development scenario: 0.0025 sparrowhawk per year. Due to the uncertainties discussed in stage F, this may range up to 0.0052 sparrowhawk per year. Dividing 1 by 0.0025 provides the number of years it would be expected for a collision to occur based on the model predictions.

Table 7 - 6 - 41 Predicted annual collision rate

Species	Annual Collision Rate	Range of Uncertainty	Years to one collision
Sparrowhawk	0.0025	0-0.0052	395

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