ANNEX E. COLLISION RISK ASSESSMENTS

This annex has been prepared as part of the Value of Leven Wind Farm Additional Information (AI) Report and replaces Annex E of Technical Appendix 7.1 of the Value of Leven Environmental Impact Assessment (EIA) Report. It presents the results of updated collision risk assessments undertaken for the Amended Development, on account of a change in turbine specification i.e. change in reduction in turbine hub height from 164 m to 134 m.

A Collision Risk Analysis Area (CRAA) was created using a 500 m buffer of the Proposed Development's outermost wind turbine locations (see Figure 7.3 of the EIA Report). Using this buffer around the wind turbines accounts for possible inaccuracies in the recording of flightlines and ensures the assessment is precautionary.

The ultimate aim is to have 100 % coverage of the turbines and associated CRAA by the viewsheds, however in practice this is often unachievable as a result of the topography of the Site and limited to no access outwith the Application Boundary. For the Proposed Development, although some small areas of the CRAA remain 'invisible' at 20 m above ground level (**Figure 7.3**), much of the airspace above this level would be visible, including within the rotor swept area of the Amended Development.

Table E-1, **Table E-2** and **Table E-3** present the parameters for the Amended Development which apply to each Collision Risk Model (CRM).

Table E-1 Wind farm parameters

Size of wind farm envelope	530.89	hectares (ha)
Number of turbines	10	turbines
Rotor diameter	172	metres (m)
Hub height	134	m
Max. rotor depth	1.11	m (at 15° pitch angle)
Max. chord	4.3	m
Pitch	15	degrees (°)
Rotation period	4.96	seconds (secs)
Turbine operation time	85	percent (%)
Risk height: highest	220	m
Risk height: lowest	48	m
Flight risk volume	913132292	m^3

Table E-2 CRM parameters per species

Species	Length (m)	Wingspan (m)	Assumed flight speed, v (ms^{-1})	Avoidance rate	Probability of collision	Bird transit time (secs)
Golden plover	0.28	0.72	17.9	0.98	0.0425	0.0778
Goshawk	0.62	1.65	9.7	0.98	0.0840	0.1787
Greylag goose	0.825	1.635	17.1	0.998	0.0634	0.1133
Herring gull	0.64	1.5	12.8	0.98	0.0686	0.1369
Osprey	0.58	1.7	11.4	0.98	0.0723	0.1485
Pink-footed goose	0.675	1.525	17.3	0.998	0.0579	0.1003

Table E-3 Visible area within the CRAA per vantage point

VP	Area (ha)
1	129.89
2	372.11
3	433.34

Birds are assumed to be active during all the daylight hours and this is estimated by calculating the number of hours per day between sunrise and sunset (adjusting for correct latitude) for the survey seasons as defined in **Table E-4** below.

Table E-4 Season definitions per species/species group

Species	Breeding season			Non-breeding season		
	Start date	End date	Hours presumed present	Start date	End date	Hours presumed present
Geese and swans	15th May	31st August	1,803	1st September	14th May	2,695
Raptors	15th March	31st August	2,658	1st September	14th March	1,840
Waders	1st April	31st July	2,448	1st August	31st March	2,050
Other	15th March	31st August	2,658	1st September	14th March	1,840

Outputs for the CRM for the following species are presented in the following order below:

- Golden plover;
- Goshawk;
- Greylag goose;
- Herring gull;
- Osprey; and
- Pink-footed goose.

E.1 Golden Plover

Non-Breeding Season 2019/2020

Table E-5 Golden plover flight activity

VP	Seconds at risk height	Observation effort (HaHr)	Flying time at risk height (secsHahr^{-1})
1	0.00	4795.40	0.00
2	468.00	14419.28	0.000004
3	0.00	14950.37	0.00

Table E-6 Golden plover mortality estimates

Mean activity in wind farm at rotor height	0.0020	hr^{-1}
Total Combined rotor swept volume	323648.4563	m^3
Bird occupancy	4.1403	hrs/season
Bird occupancy of rotor swept volume	5.2829	bird-sec
No. of transits through rotors	67.8894	per season
Estimated collisions	2.8883	per season
Estimated collisions after correction for operation	2.4550	per season
Estimated collisions after avoidance factor	0.0491	per season
Equivalent to 1 bird every	20.3664	seasons

E.2 Goshawk

Breeding Season 2019

Table E-7 Goshawk flight activity

VP	Seconds at risk height	Observation effort (HaHr)	Flying time at risk height (secsHahr^{-1})
1	0.00	4675.90	0.00
2	0.00	13395.98	0.00
3	130.77	14602.40	0.000001

Table E-8 Goshawk mortality estimates

Mean activity in wind farm at rotor height	0.0006	hr^{-1}
Total Combined rotor swept volume	402648	m^3
Bird occupancy	1.5687	hrs/season
Bird occupancy of rotor swept volume	2.4902	bird-sec
No. of transits through rotors	13.9390	per season
Estimated collisions	1.1715	per season
Estimated collisions after correction for operation	0.9958	per season
Estimated collisions after avoidance factor	0.0199	per season
Equivalent to 1 bird every	50.2103	seasons

E.3 Greylag Goose

Non-Breeding Season 2019/2020

Table E-9 Greylag goose flight activity

VP	Seconds at risk height	Observation effort (HaHr)	Flying time at risk height (secsHahr^{-1})
1	0.00	4795.40	0.00
2	131.05	14419.28	0.000001
3	0.00	14950.37	0.00

Table E-10 Greylag goose mortality estimates

Mean activity in wind farm at rotor height	0.0006	hr^{-1}
Total Combined rotor swept volume	450280	m^3
Bird occupancy	1.5242	hrs/season
Bird occupancy of rotor swept volume	2.7058	bird-sec
No. of transits through rotors	23.8760	per season
Estimated collisions	1.5133	per season
Estimated collisions after correction for operation	1.2863	per season
Estimated collisions after avoidance factor	0.0026	per season
Equivalent to 1 bird every	388.7157	seasons

E.4 Herring Gull

Breeding Season 2019

Table E-11 Herring gull flight activity

VP	Seconds at risk height	Observation effort (HaHr)	Flying time at risk height (secsHahr^{-1})
1	666.30	4675.90	0.00001
2	1427.24	13395.98	0.00001
3	2327.64	14602.40	0.00002

Table E-12 Herring gull mortality estimates

Mean activity in wind farm at rotor height	0.0200	hr^{-1}
Total Combined rotor swept volume	407295	m^3
Bird occupancy	53.0371	hrs/season
Bird occupancy of rotor swept volume	85.1643	bird-sec
No. of transits through rotors	621.8779	per season
Estimated collisions	42.6337	per season
Estimated collisions after correction for operation	36.2387	per season
Estimated collisions after avoidance factor	0.7248	per season
Equivalent to 1 bird every	1.3797	seasons

E.5 Osprey

Breeding Season 2019

Table E-13 Osprey flight activity

VP	Seconds at risk height	Observation effort (HaHr)	Flying time at risk height (secsHahr^{-1})
1	0.00	4675.90	0.000000
2	240.03	13395.98	0.000002
3	0.00	14602.40	0.000000

Table E-14 Osprey mortality estimates

Mean activity in wind farm at rotor height	0.0011	hr^{-1}
Total Combined rotor swept volume	393354	m^3
Bird occupancy	2.8794	hrs/season
Bird occupancy of rotor swept volume	4.4654	bird-sec
No. of transits through rotors	30.0698	per season
Estimated collisions	2.1727	per season
Estimated collisions after correction for operation	1.8468	per season
Estimated collisions after avoidance factor	0.0369	per season
Equivalent to 1 bird every	27.0743	seasons

E.6 Pink-Footed Goose

Non-Breeding Season 2019/2020

Table E-15 Pink-footed goose flight activity

VP	Seconds at risk height	Observation effort (HaHr)	Flying time at risk height (secsHahr^{-1})
1	0	4795.397347	0
2	0	14419.28362	0
3	13083.5707	14950.37449	0.0001

Table E-16 Pink-footed goose mortality estimates

Mean activity in wind farm at rotor height	0.0565	hr^{-1}
Total Combined rotor swept volume	415428	m^3
Bird occupancy	152.1776	hrs/season
Bird occupancy of rotor swept volume	249.2384	bird-sec
No. of transits through rotors	2411.6403	per season
Estimated collisions	139.7522	per season
Estimated collisions after correction for operation	118.7893	per season
Estimated collisions after avoidance factor	0.2376	per season
Equivalent to 1 bird every	4.2091	seasons