Technical Appendix 6.2 Collision Risk Modelling

This page is intentionally blank.

Contents

1.1	Introduction	1
1.2	Collision Risk Modelling	1
1.3	Methods	3
1.4	Results	3
1.5	Species Accounts	3
1.6	References	16

Figures

TA6.2 Figure 1 Vanta	age Points and Viewsheds
----------------------	--------------------------

TA6.2 Figure 2 Flightlines

This page is intentionally blank.

1 Collision Risk Modelling Report

1.1 Introduction

1.1.1 ITPEnergised (now SLR) was appointed by the Applicant to undertake collision risk modelling using data taken from their ornithological surveys (as commissioned by the Applicant) in support of a proposed renewable energy development north of Muirkirk (the 'Proposed Development'). In order to assess the likely impacts of the Proposed Development on the local bird population, analysis for the potential collision risk has been undertaken on target species as defined in **Technical Appendix 6.1**. The analysis has been undertaken using the turbine layout and development boundary, as displayed in **Technical Appendix 6.2: Figure 1**, and a candidate turbine specification as outlined in **Table 1**.

Table Heading	Heading
Number of turbines	18
Rotor Diameter	163 m
Hub Height	148.5 m (1 turbine @ 118.5 m)
Rotor Sweep	67-230 m (1 turbine @ 37-200 m)
Max chord	4.15
Pitch	Variable (use 6 degrees)
Rotation period	7.45 sec (Blades will rotate at approximately 6.1 – 10.1 revolutions per minute - average =8.1)
Turbine 'lifetime'	40 years

Table 1 – Candidate Turbine - Nordex N163 at 4.8MW

Site Description

- 1.1.2 The Proposed Development is split into two main development areas, with the wind turbines located within the northern development area (Dungavel Forest), and the solar, BESS and substation located within the southern development area (Netherwood) refer to **Figure 1.2** (EIA Report Volume 2).
- 1.1.3 The northern development area, which is the only section relevant to the collision risk modelling is located within the western part of Dungavel Forest, directly to the west and south of the operational Dungavel and Kype Muir Extension Wind Farms, within South Lanarkshire.

1.2 Collision Risk Modelling

- 1.2.1 Band *et al.* (2007) described a method by which field data on bird flight activity can be gathered and used to crudely quantify the likelihood of collisions with turbines: the 'Band' Collision Risk Model (CRM). This method is more suitable for some species than others (Madders & Whitfield, 2006). For example, fast moving raptors like merlin and most songbirds are difficult to detect beyond a distance of a few hundred metres and nocturnal species are difficult to detect at all. As a result, it is rarely possible to generate reliable estimates of flight activity for these species and collision risk is best determined qualitatively.
- 1.2.2 The Band CRM has recently been modified and an updated version released by NatureScot in December 2024 (NatureScot, 2024). The updated approach builds on previous models developed by Band *et al.* (2007) and Band (2000) and does not change the single transit probability calculation but adds the other stages of the model, to standardise these calculations. The approach is intended to provide collision risk estimates that are comparable across different wind farms (NatureScot, 2024).



Data Collection and Species Selection

- 1.2.3 Surveys were undertaken over the northern development area from four Vantage Points ('VPs') between April 2022 and February 2024 (VP9-VP12) with a total of 144 hours undertaken at VPs 9-11 and 72 hours at V12. This time period constitutes two complete years of survey VP9-11 and one full year for VP12. The VP locations were used across the survey period and the VPs are shown along with the viewsheds in **Figure 6.1** (EIA Report Volume 2).
- 1.2.4 A total of 12 target species were recorded from the VP surveys and recorded activity is summarised below in Table 2. All the survey flights were recorded onto ArcGIS and the data entered into an excel spreadsheet and further analysed in order to select all the flights which were recorded at least in part at potential collision height ('PCH') within the 2 km viewshed of the VP. PCH is the height between the low and high points of the rotor sweep of the turbine blades, as shown for the differing turbine sizes in **Table 1**, all flights and the total number of individuals recorded at PCH within the viewshed of the VP are displayed below in **Table 2**.
- 1.2.5 The collision risk modelling was completed using all the flights recorded during the VP surveys and the 2 km viewsheds (180 arc in front of the VP locations at PCH) and this methodology creates an average collision figure which covers the entire area covered by the viewsheds. A summary of the results showing all target species is detailed below in **Table 2** which shows:-
 - the total number of flights recorded for the whole northern development area;
 - the total number of birds recorded for the whole northern Development area;
 - The total number of full and / or in-part flights at PCH, defined as between 67 m-230 m (adjusted to 37-200 m for Turbine 17);
 - 'At-risk' flight seconds, *i.e.* number of birds x at-risk seconds; and
 - Whether the species was taken for forward for CRM;

Species	– Flights	Individuals		– Flight seconds 'at-risk'	Taken forward for CRM
Common Sandpiper	2	2	0	-	NO
Curlew	7	8	2	14.4	YES
Golden Plover	3	13	3	1,300	YES
Goshawk	4	4	1	10.4	YES
Greylag Goose	2	15	1	99.8	NO*
Hen Harrier	1	1	0	-	NO
Osprey	1	1	1	176	YES
Peregrine	2	2	2	373	YES
Pink-footed Goose	19	884	15	74,460.2	NO*
Red Kite	4	4	3	280.2	YES
Woodcock	1	1	0	-	NO
Whooper Swan	1	12	1	573.3	NO*

Table 2 – Target Species Recorded

* CRM not carried out for these species as not considered linked to a SPA/Ramsar/SSSI population.

1.2.6 A total of three species (common sandpiper, hen harrier and woodcock) were recorded during VP surveys but had no 'at-risk' flight seconds over the 2-year period are not considered to be affected by collision risk with the proposed turbines (**Table 2**). Pink-footed goose were recorded on 19 occasions 'at-risk' but as a very common species on migration and not linked to a protected site,



greylag geese were recorded twice and whooper swan once, these species were not taken forward for collision risk modelling.

1.3 Methods

- 1.3.1 Collision risk has been calculated based as an average figure for the area covered by the viewsheds (Technical Appendix 6.2: Figure 1) and based on a layout of 18 wind turbines of the specifications outlined in Table 1. It should be noted that the resultant figures provide an average for the site as a whole and do not allow for the potential of configuring a layout in order to minimise the impacts of the proposed turbines.
- 1.3.2 The predicted level of collision mortality is based on results obtained from a collision risk model which uses flight activity data, species' parameters and turbine specifications to obtain a collision rate as outlined in NatureScot guidance (NatureScot, 2024).
- 1.3.3 The guidance also outlines bird biometrics including bird length and wingspan as well as flight speeds and recommended avoidance rates which are inputs into the model and the figures for the species carried forward for collision risk in this assessment are outlined in **Table 3** below.
- 1.3.4 Data on bird flight speed and biometrics were taken from Alerstam *et al.* (2007) and the published avoidance rates were used (SNH 2017).
- 1.3.5 Detailed data on survey dates, times and weather can be found in **Appendix 6.1: Annex A: Table A1**. For reference, all target flights are presented in **Technical Appendix 6.2 Figure 2**.

Species Name	Bird length (m)	Wingspan (m)	Flight speed (m/s)	Avoidance Rate (%)
Curlew	0.55	0.90	16.3	98
Golden Plover	0.28	0.72	13.7	98
Goshawk	0.55	1.5	13.0	98
Osprey	0.56	1.58	13.0	98
Peregrine	0.42	1.02	16.0	98
Red Kite	0.63	1.85	13.0	99

Table 3 – Target Species Bird Biometrics

1.4 Results

Table 4 - Collision Risk Modelling Results

Species Name	Collisions - Non- breeding season	Collisions - Breeding season	Collisions - Annual	Collisions - Scheme Lifetime (40 years)	Years per collision
Curlew	0	<0.01	<0.01	n/a	n/a
Golden Plover	0.03	0.01	0.04	1	25
Goshawk	0	<0.01	<0.01	n/a	n/a
Osprey	0	0.01	0.01	0.25	100
Peregrine	<0.01	0.01	0.01	0.25	100
Red Kite	<0.01	0	<0.01	n/a	n/a

1.5 Species Accounts

The workings for each species are displayed below.

^{1.4.1} Six species were taken forward for collision risk modelling, and the results are summarised in **Table 4** below.

CURLEW

CRM input vales

CURLEW			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Transfer to XL Sheet	VP	Flight Time	0	0	0	156	58	99	30	0	0	0	0	0	343
		CRH flight time	0	0	0	0	0	14.4	0	0	0	0	0	0	14.4
		% time CRH													4.198251
	A = VP Area km2	hours													
VP9	5.75	hours	6	12	12	12	12	12	12	24	12	12	12	6	144
		t - seconds	21600	43200	43200	43200	43200	43200	43200	86400	43200	43200	43200	21600	
		b flight seconds	0	0	0	0	0	44	30	0	0	0	0	0	
		Da = b / (t x A) m-2	0	0	0	0	0	0.000177	0.000121	0	0	0	0	0	
VP10	6.06	hours	6	12	12	12	12	12	12	24	12	12	12	6	144
		t - seconds	21600	43200	43200	43200	43200	43200	43200	86400	43200	43200	43200	21600	
		b flight seconds	0	0	0	156	0	0	0	0	0	0	0	0	
		Da = b / (t x A) m-2	0	0	0	0.000596	0	0	0	0	0	0	0	0	
VP11	5.56	hours	6	12	12	12	12	12	12	24	12	12	12	6	144
		t - seconds	21600	43200	43200	43200	43200	43200	43200	86400	43200	43200	43200	21600	
		b flight seconds	0	0	0	0	58	55	0	0	0	0	0	0	
		Da = b / (t x A) m-2	0	0	0	0	0.000241	0.000229	0	0	0	0	0	0	
VP12	5.99	hours	6	6	0	6	6	6	6	12	6	6	6	6	72
		t - seconds	21600	21600	0	21600	21600	21600	21600	43200	21600	21600	21600	21600	
		b flight seconds	0	0	0	0	0	0	0	0	0	0	0	0	
		Da = b / (t x A) m-2	0	0	0	0	0	0	0	0	0	0	0	0	
		Da Average	0	0	0	0.000149	6.04E-05	0.000102	3.02E-05	0	0	0	0	0	

COLLISION RISK MODEL		Required in	nput data is in	orange	boxes												
		Calculated	output is in	blue	boxes												
				green	boxes are f	or informat	ion only, to	o show vari	iables used	at each sta	ge						
		Value	Units		-			Value	Units		-	-		Value	Units		
Bird data					Vindfarm	n data					Turbi	ne data					
Species name		Curles				Site name		HEC VE				Model	nc	ordic 163			
Bird length	L	0.55	m			Latitude		55.6	degrees		н	ub height		148.5	m		
Wingspan	V	0.9	m		No a	of turbines	т	18			Rol	tor radius	R	81.5	m		
Bird flight speed	v	16.3	m s ⁻¹		Width of	f windfarm	w	3	km		No	of blades	ь	3			
Flight type, flapping or gliding		flapping									Rotati	on speed	Ω	8.1	rpm		
% of flights upwind/downwind		50%	50%									ade width	С	4.15	m		
Nocturnal activity ranking 1-5		1									BI	ade pitch	λ	15	degrees		
Nocturnal activity factor	Fargar	0%									Risk hei	ght range		67-230	m		
normal approach		Set to 'nor	mal approach' to) use survey data	on bird dens	situ											
			and a set the behavior of an art of the set of	o use 'Migrant co			e of Stag	e A									
Stage A					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avg
Daytime bird density	De		birds/km²		0	0	0	0.000149	6.04E-05	0.000102	3.02E-05	0	0	0	0	0	0.000
Proportion at rotor risk height	QzR	4.20%															
At latitude 55.6		Daylight	hours per mo	nth	239.9	268.0	365.7	423.6	502.5	522.0	523.6	466.6	384.4	325.9	251.7	222.1	4496.
		Nighttim	e hours per m	ionth	504.1	404.0	378.3	296.4	241.5	198.0	220.4	277.4	335.6	418.1	468.3	521.9	4264.0
Stage B	10357	31.53															
No of turbines	Т	18															
Rotor radius	R	81.5	m														
		Total rot	or frontal ar	375610													
Nocturnal activity factor	Faight	0%															
Bird flight speed	V.	16.3	ms ⁻¹		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct		Dec	year tota
		Projecte	d number of r	otor transits	0.0	0.0	0.0	0.4	0.2	0.3	0.1	0.0	0.0	0.0	0.0	0.0	
Stage C	- 22							0.55									
No of blades	Ь	3 8.1				Bird length	1	0.55	m								
Rotation speed	۵		rpm			Wingspan	w		m								
Rotor radius Max blade width	R C	81.5 4.15	m			ight speed	v	16.3	m s ⁻¹								
Pitch	λ	4.15	m degrees	14 af (6)	ghts upwind/	Flight type		flapping 50%	50%								
Blade profile			de profile sheet	2. Or hig	yrics apwinar	aownwina		50%	50%								
Biade prome		Single tra		upwind	6.01%												
		Single us	III SIX II SK	downwind	3.15%												
				eighted mean	4.58%												
Stage D			1		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q.,				87.4%	89.3%	87.4%	84.6%	68.0%	68.9%	68.9%	77.3%	85.6%	91.2%		86.5%	81.9%
- 43°	200																
					Collision	rates bel	fore avo	idance									year tota
					0.00	0.00	0.00	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	
Stage E											1						
Allow for large array correction?		No															
Width of windfarm	W	3	km														
			large arrag		Jan	Feb	Mar	Apr		Jun	Jul	Aug	Sep	Oct	Nov	Dec	per yea
			correction		Collision												
Avoidance rates modelled		95.00%	100.00%		0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.0
		98.00%	100.00%		0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.0
		99.00%	100.00%		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.0
		99.50%	100.00%		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	

Results Sheet 1 CRM Results - Curlew

GOLDEN PLOVER

GOLDEN PLOVER			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Transfer to XL Sheet	VP	Flight Time	0	0	0	1064	0	0	0	336	0	0	0	0	1400
		CRH flight time	0	0	0	963.5	0	0	0	336	0	0	0	0	1299.5
		% time CRH													92.82143
	A = VP Area km2	hours													
VP9	5.75	hours	6	12	12	12	12	12	12	24	12	12	12	6	144
		t - seconds	21600	43200	43200	43200	43200	43200	43200	86400	43200	43200	43200	21600	
		b flight seconds	0	0	0	0	0	0	0	336	0	0	0	0	
		Da = b / (t x A) m-2	0	0	0	0	0	0	0	0.000676	0	0	0	0	
VP10	6.06	hours	6	12	12	12	12	12	12	24	12	12	12	6	144
		t - seconds	21600	43200	43200	43200	43200	43200	43200	86400	43200	43200	43200	21600	
		b flight seconds	0	0	0	944	0	0	0	0	0	0	0	0	
		Da = b / (t x A) m-2	0	0	0	0.003606	0	0	0	0	0	0	0	0	
VP11	5.56	hours	6	12	12	12	12	12	12	24	12	12	12	6	144
		t - seconds	21600	43200	43200	43200	43200	43200	43200	86400	43200	43200	43200	21600	
		b flight seconds	0	0	0	120	0	0	0	0	0	0	0	0	
		Da = b / (t x A) m-2	0	0	0	0.0005	0	0	0	0	0	0	0	0	
VP12	5.99	hours	6	6	0	6	6	6	6	12	6	6	6	6	72
		t - seconds	21600	21600	0	21600	21600	21600	21600	43200	21600	21600	21600	21600	
		b flight seconds	0	0	0	0	0	0	0	0	0	0	0	0	
		Da = b / (t x A) m-2	0	0	0	0	0	0	0	0	0	0	0	0	
		Da Average	0	0	0	0.001026	0	0	0	0.000169	0	0	0	0	

COLLISION RISK MODEL		Required in	put data is in	orange	boxes												
			output is in	blue	boxes												
				green	boxes are f	or informat	ion only, to	o show vari	ables used a	t each stag	e						
		Value	Units					Value	Units					Value	Units		-
Bird data			1		Vindfarm	data					Turbi	ine data					
Species name	Gold	ien Plover	r			Site name		HEC VE				Model	nc	ordic 163			
Bird length	L	0.28	m			Latitude		55.6	degrees		H	lub height		148.5	m		
Wingspan	V	0.72	m		Noc	of turbines	т	18	op soletion -		Ro	tor radius	R	81.5	m		
Bird flight speed	v	13.7	m s ⁻¹		Width of	windfarm	w	3	km		No	of blades	ь	3			
Flight type, flapping or gliding		flapping									Rotat	ion speed	Ω	8.1	rpm		
% of flights upwind/downwind		50%	50%									lade width	С	4.15	m		
Nocturnal activity ranking 1-5		1										lade pitch	λ	15	degrees		
Nocturnal activity factor	f.c.st	0%									Risk he	ight range		67-230	m		
normal approach		Set to 'norr	nal approach' t	o use survey data	on bird dens	ity			n n								
			and and then the second of the second second second	to use 'Migrant co		· · ·		A .									
Stage A			1. 66		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	De		birds/km²		0	0	0	0.001026	0	0	0	0.000169	0	0	0	0	0.000
Proportion at rotor risk height	QzR	92.80%															
At latitude 55.6		Daylight I	hours per ma	onth	239.9	268.0	365.7	423.6	502.5	522.0	523.6	466.6	384.4	325.9	251.7	222.1	4496.0
		Nighttime	e hours per r	nonth	504.1	404.0	378.3	296.4	241.5	198.0	220.4	277.4	335.6	418.1	468.3	521.9	4264.0
Stage B																	
No of turbines	Т	18															
Rotor radius	R	81.5	m														
			or frontal ar	375610													
Nocturnal activity factor	Faight	0%								l.							
Bird flight speed	v	13.7	ms ⁻¹		Jan 0.0	Feb 0.0	Mar 0.0	Apr 45.9	May 0.0	Jun 0.0	Jul 0.0	Aug 8.3	Sep 0.0	Oct 0.0		Dec 0.0	year tota 54
Stage C	_	Projecter	a number of	rotor transits	0.0	0.0	0.0	40.3	0.0	0.0	0.0	ð.J	0.0	0.0	0.0	0.0	94
No of blades	ь	3			F	Bird length	1	0.28	m								
Rotation speed	Ω	8.1	rpm			Wingspan	W		m								
Rotor radius	B	81.5	m			ght speed	ÿ		m s' ¹								
Max blade width	c	4.15	m			Flight type		flapping									
Pitch	λ	15	degrees	% of flie	ghts upwind/			50%	50%								
Blade profile			de profile sheet							1							
		Single tra		upwind	5.76%												
				downwind	2.45%												
				veighted mean	4.10%												
Stage D					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct		Dec	year avge
Proportion of time operational	Q.,				87.4%	89.3%	87.4%	84.6%	68.0%	68.9%	68.9%	77.3%	85.6%	91.2%	87.4%	86.5%	81.9>
					Collision												year tota
Change E			_	-	0.00	0.00	0.00	1.59	0.00	0.00	0.00	0.26	0.00	0.00	0.00	0.00	2
Stage E Allow for large array correction?		No															
Width of windfarm	W	3	km							-							-
wider or whitham	w	2	large arrag		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per yea
			correction		Collision					oun	our	Aug	Seb	Oct	1004	Dec	per yea
Avoidance rates modelled		95.00%	100.00%		0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.
amanendiddididdidid.		98.00%	100.00%		0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.01	0.00	0.00		0.00	0.0
		99.00%	100.00%		0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.0
		99.50%	100.00%		0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.0

Results Sheet 2 CRM Results - golden plover

Goshawk

GOSHAWK			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Transfer to XL Sheet		Flight Time	0	0	0	60	0	39	0	0	77	107	0	0	283
		CRH flight time	0	0	0	0	0	0	0	0	10.4	0	0	0	10.4
		% time CRH													3.674912
	A = VP Area km2	hours													
VP9	5.75	hours	6	12	12	12	12	12	12	24	12	12	12	6	144
		t - seconds	21600	43200	43200	43200	43200	43200	43200	86400	43200	43200	43200	21600	
		b flight seconds	0	0	0	0	0	0	0	0	0	107	0	0	
		Da = b / (t x A) m-2	0	0	0	0	0	0	0	0	0	0.000431	0	0	
VP10	6.06	hours	6	12	12	12	12	12	12	24	12	12	12	6	144
		t - seconds	21600	43200	43200	43200	43200	43200	43200	86400	43200	43200	43200	21600	
		b flight seconds	0	0	0	0	0	0	0	0	77	0	0	0	
		Da = b / (t x A) m-2	0	0	0	0	0	0	0	0	0.000294	0	0	0	
VP11	5.56	hours	6	12	12	12	12	12	12	24	12	12	12	6	144
		t - seconds	21600	43200	43200	43200	43200	43200	43200	86400	43200	43200	43200	21600	
		b flight seconds	0	0	0	60	0	39	0	0	0	0	0	0	
		Da = b / (t x A) m-2	0	0	0	0.00025	0	0.000162	0	0	0	0	0	0	
VP12	5.99	hours	6	6	0	6	6	6	6	12	6	6	6	6	72
		t - seconds	21600	21600	0	21600	21600	21600	21600	43200	21600	21600	21600	21600	
		b flight seconds	0	0	0	0	0	0	0	0	0	0	0	0	
		Da = b / (t x A) m-2	0	0	0	0	0	0	0	0	0	0	0	0	
		Da Average	0	0	0	6.25E-05	0	4.06E-05	0	0	7.35E-05	0.000108	0	0	

	-	-	2						×			1.1		-		4	
Species name		Goshawk	۲		1	Site name		HEC WE				Model	no	rdic 163			
Bird length	L	0.55	m			Latitude		55.6	degrees		н	ub height		148.5	m		
Wingspan	W	1.5	m		Noo	fturbines	Т	18			Ro	tor radius	R	81.5	m		
Bird flight speed	v	13	m s ⁻¹		Width of	windfarm	W	3	km		No	of blades	ь	3			
Flight type, flapping or gliding		flapping							1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		Rotati	on speed	Ω	8.1	rpm		
% of flights upwind/downwind		50%	50%								Max bla	ade width	С	4.15	m		
Nocturnal activity ranking 1-5		1									BL	ade pitch	λ	6	degrees		
Nocturnal activity factor	fnight	0%									Risk heig	ghtrange		67-230	m		
normal approach		Set to 'norn	nal approach' to	use survey data	a on bird der	nsity											
210		Set to 'birds	s on migration' to	o use 'Migrant oc	llision risk' s	heet in plac	e of Stag	e A									
Stage A			10000		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
 Daytime bird density	Da		birds/km ²		0	0	0	6.2E-05	0	4.1E-05	0	0	7.4E-05	0.00011	0	0	0.0000
Proportion at rotor risk height	Q _{2B}	3.67%															
At latitude 55.6	-sen		hours per mo	oth	239.9	268.0	365.7	423.6	502.5	522.0	523.6	466.6	384.4	325.9	251.7	222.1	4496.0
Actaticade 55.5			hours per m		504.1	404.0	378.3	296.4	241.5	198.0	220.4	277.4	335.6	418.1	468.3	521.9	4264.0
Stage B			and part in				2.2.0		21.00					,			
No of turbines	Т	18															
Rotor radius	B	81.5	m														
Hotorradius	110		or frontal are	375610													
Nocturnal activity factor		O%	or montal are	313010													-
	fnight					5200						0920	-		1000		
Bird flight speed	<u>.</u> У	13	ms ⁻¹		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
		Projected	d number of r	otor transits	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.1	0.1	0.0	0.0	0
Stage C	- 72	- 14				988 - 19	- 22	2000									-
No of blades	ь	3				ird length	12		m								
Rotation speed	Ω	8.1	rpm			vingspan	W	1.5	m								
Rotor radius	R	81.5	m			ght speed	v	13	m s ⁻¹								
Max blade width	С	4.15	m			Flight type		flapping									
Pitch	λ	6	degrees	% of fligh	nts upwind/c	downwind		50%	50%								
Blade profile		see Blad	e profile sheet														
		Single tra	ansit risk	upwind	5.97%												
				downwind	4.51%												
			We	eighted mean	5.24%												
Stage D					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Que				87.4%	89.3%	87.4%	84.6%	68.0%	68.9%	68.9%	77.3%	85.6%	91.2%	87.4%	86.5%	81.9%
					Collision	rates bef	ore avoi	idance									year total
					0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0
Stage E																	
Allow for large array correction?		No															
Width of windfarm	w	3	km														
			large arrag		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	peryear
			correction		Collision	rates allo	wing for	avoidan	ice				1				36 38
Avoidance rates modelled		95.00%	100.00%		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		98.00%	100.00%		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		00.000	100.001/		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		99.00%	100.00%		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0

Results Sheet 3 - CRM Results goshawk

Osprey

OSPREY			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Transfer to XL Sheet		Flight Time	0	0	0	176	0	0	0	0	0	0	0	0	176
		CRH flight time	0	0	0	176	0	0	0	0	0	0	0	0	176
		% time CRH													100
	A = VP Area km2	hours													
VP9	5.75	hours	6	12	12	12	12	12	12	24	12	12	12	6	144
		t - seconds	21600	43200	43200	43200	43200	43200	43200	86400	43200	43200	43200	21600	
		b flight seconds	0	0	0	0	0	0	0	0	0	0	0	0	
		Da = b / (t x A) m-2	0	0	0	0	0	0	0	0	0	0	0	0	
VP10	6.06	hours	6	12	12	12	12	12	12	24	12	12	12	6	144
		t - seconds	21600	43200	43200	43200	43200	43200	43200	86400	43200	43200	43200	21600	
		b flight seconds	0	0	0	176	0	0	0	0	0	0	0	0	
		Da = b / (t x A) m-2	0	0	0	0.000672	0	0	0	0	0	0	0	0	
VP11	5.56	hours	6	12	12	12	12	12	12	24	12	12	12	6	144
		t - seconds	21600	43200	43200	43200	43200	43200	43200	86400	43200	43200	43200	21600	
		b flight seconds	0	0	0	0	0	0	0	0	0	0	0	0	
		Da = b / (t x A) m-2	0	0	0	0	0	0	0	0	0	0	0	0	
VP12	5.99	hours	6	6	0	6	6	6	6	12	6	6	6	6	72
		t - seconds	21600	21600	0	21600	21600	21600	21600	43200	21600	21600	21600	21600	
		b flight seconds	0	0	0	0	0	0	0	0	0	0	0	0	
		Da = b / (t x A) m-2	0	0	0	0	0	0	0	0	0	0	0	0	
		Da Average	0	0	0	0.000168	0	0	0	0	0	0	0	0	

Species name		Osprey				Site name		HEC WE				Model	no	rdic 163			
Bird length	L	0.56	m			Latitude		55.6	degrees			ub height		148.5	m		
Wingspan	W	1.58	m		225/3	fturbines	Т	18				torradius	R		m		
Bird flight speed	v	13	m s ⁻¹		Width of	windfarm	W	3	km		No	of blades	ь	3			
Flight type, flapping or gliding		flapping							No. CO		Rotatio	on speed	Ω	8.1	rpm		
% of flights upwind/downwind		50%	50%								Max bla	ade width	С	4.15	m		
Nocturnal activity ranking 1-5		1									Bla	ade pitch	λ	6	degrees		
Nocturnal activity factor	fnight	0%									Risk heig	ghtrange		67-230	m		
		0.1	1													_	
normal approach				o use survey data to use 'Migrant co			e of Stag	еA									
Stage A			0.02		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	DA		birds/km ²		0	0	0	0.00017	0	0	0	0	0	0	0	0	0.0000
Proportion at rotor risk height	Q _{2B}	100.00%															
At latitude 55.6	1000	Davlight	hours per mo	onth	239.9	268.0	365.7	423.6	502.5	522.0	523.6	466.6	384.4	325.9	251.7	222.1	4496.0
			hours per m		504.1	404.0	378.3	296.4	241.5	198.0	220.4	277.4	335.6	418.1	468.3	521.9	4264.0
Stage B				- 11													1
No of turbines	Т	18															
Rotor radius	B	81.5	m														
		Total roto	or frontal are	375610													
Nocturnal activity factor	fnight	0%															
Bird flight speed	v	13	m s ⁻¹		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	vear total
Diratilgi Kopeca				rotor transits	0.0	0.0	0.0	7.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8
Stage C																	
No of blades	ь	3			E	ird length	- E	0.56	m								
Rotation speed	Ω	8.1	rpm		3	vingspan	w	1.58	m								
Rotorradius	R	81.5	m		Bird flig	ht speed	v	13	m s ⁻¹								
Max blade width	С	4.15	m			Flight type		flapping									
Pitch	λ	6	degrees	% of fligh	nts upwind/o			50%	50%								
Blade profile		see Blad	e profile sheet		1												
		Single tra	ansit risk	upwind	6.03%												
				downwind	4.58%												
				eighted mean	5.31%												
Stage D					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q _{ep}				87.4%	89.3%	87.4%	84.6%	68.0%	68.9%	68.9%	77.3%	85.6%	91.2%	87.4%	86.5%	81.9%
					Collision	rates bef	ore anai	dance									veartotal
					0.00	0.00	0.00	0.34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	gear total 0
Stage E																	
Allow for large array correction?		No															
Width of windfarm	W	3	km														
			large array		Jan	Feb	Mar	Apr		Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			correction		Collision			avoidar									
Avoidance rates modelled		95.00%	100.00%		0.00	0.00	0.00	0.02		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		98.00%	100.00%		0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		99.00%	100.00%		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		99.50%	100.00%		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0

Results Sheet 4 - CRM results - Osprey

Peregrine

PEREGRINE			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Transfer to XL Sheet		Flight Time	0	146	0	0	0	0	0	227	0	0	0	0	373
		CRH flight time	0	146	0	0	0	0	0	227	0	0	0	0	373
		% time CRH													100
	A = VP Area km2	hours													
VP9	5.75	hours	6	12	12	12	12	12	12	24	12	12	12	6	144
		t - seconds	21600	43200	43200	43200	43200	43200	43200	86400	43200	43200	43200	21600	
		b flight seconds	0	146	0	0	0	0	0	227	0	0	0	0	
		Da = b / (t x A) m-2	0	0.000588	0	0	0	0	0	0.000457	0	0	0	0	
VP10	6.06	hours	6	12	12	12	12	12	12	24	12	12	12	6	144
		t - seconds	21600	43200	43200	43200	43200	43200	43200	86400	43200	43200	43200	21600	
		b flight seconds	0	0	0	0	0	0	0	0	0	0	0	0	
		Da = b / (t x A) m-2	0	0	0	0	0	0	0	0	0	0	0	0	
VP11	5.56	hours	6	12	12	12	12	12	12	24	12	12	12	6	144
		t - seconds	21600	43200	43200	43200	43200	43200	43200	86400	43200	43200	43200	21600	
		b flight seconds	0	0	0	0	0	0	0	0	0	0	0	0	
		Da = b / (t x A) m-2	0	0	0	0	0	0	0	0	0	0	0	0	
VP12	5.99	hours	6	6	0	6	6	6	6	12	6	6	6	6	72
		t - seconds	21600	21600	0	21600	21600	21600	21600	43200	21600	21600	21600	21600	
		b flight seconds	0	0	0	0	0	0	0	0	0	0	0	0	
		Da = b / (t x A) m-2	0	0	0	0	0	0	0	0	0	0	0	0	
		Da Average	0	0.000147	0	0	0	0	0	0.000114	0	0	0	0	

COLLISION RISK MODEL		Required in	put data is in	orange	boxes		0.00		10 - 10 - F	20225							031
COLLISION NISK MODEL		and a starting has been been as the start has been	output is in	blue	boxes												
		Calculated	output is in	green		for informat	ion only, to	show var	iables used a	at each stag	e						
		Value	Units			NO SOCIAL D		Value	Units					Value	Units		
Bird data		-			Vindfarm	5. CT (CT (CT ())					Turb	ine data					
Species name		Peregrine				Site name Latitude	2	HEC VE 55.6				Model	no	148.5	m		_
Bird length	L	0.42	m		16121	of turbines	т	55.6 18	degrees			Hub height htor radius	в	148.5 81.5	m m		_
Wingspan Died (lieb) es es d	Ű	16	т т s ⁻¹			f windfarm	w		h			of blades	h	3	m		
Bird flight speed Flight type, flapping or gliding	•	flapping	m s ·		width of	rwindrarm	w	3	lkm		00000000	ion speed	0	8.1	rpm		-
% of flights upwind/downwind		50%	50%									lade width	c	4.15	m		
Nocturnal activity ranking 1-5		1	507.									lade pitch	Å.	6	degrees		-
Nocturnal activity factor	Facat	0%										ight range	~	67-230	m		
Nociamaracityity racio	faight	07.									FISK DE	ignerange		01-200			
normal approach		Set to 'norr	nal approach' t	o use survey data	on bird dens	situ											-
<u>.</u>				to use 'Migrant co			ce of Stag	A	2 2						1 S		
Stage A					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	De		birds/km²		0	0.000147	0	0	0	0	0	0.000114	0	0	0	0	0.0000
Proportion at rotor risk height	QzR	100.00%															
At latitude 55.6		Daylight I	hours per mo	onth	239.9	268.0	365.7	423.6	502.5	522.0	523.6	466.6	384.4	325.9	251.7	222.1	4496.0
		Nighttime	e hours per n	nonth	504.1	404.0	378.3	296.4	241.5	198.0	220.4	277.4	335.6	418.1	468.3	521.9	4264.0
Stage B		1.27							1								
No of turbines	т	18															
Rotor radius	B	81.5	m														
			or frontal ar	375610													
Nocturnal activity factor	f.i.st	0%															
Bird flight speed	v	16	m s'1		Jan	Feb	Mar	Apr		Jun	Jul	Aug	Sep	Oct	Nov	Dec	year tota
1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.		Projecter	d number of	rotor transits	0.0	5.2	0.0	0.0	0.0	0.0	0.0	7.1	0.0	0.0	0.0	0.0	12
Stage C																	
No of blades	ь	3	1.111			Bird length	1	0.42	m								_
Rotation speed	Ω	8.1	rpm			Wingspan	W	1.02 16	m m s ^{.1}								
Rotor radius Max blade width	B	81.5 4.15	m 			ight speed	v		ms.								
Pitch	λ	4.15	m degrees	14 - C (B)	ghts upwind/	Flight type		flapping 50%	50%								-
Blade profile	^		degrees de profile sheet		grics apwindi	ndownwind		30%	50%								
Diade prome		Single tra		upwind	5.08%												
		-shight the	and the second	downwind	3.90%	-							-				-
				reighted mean	4.49%	-											
Stage D					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q.,				87.4%	89.3%	87.4%	84.6%	and the second se	68.9%	68.9%	77.3%	85.6%	91.2%	87.4%	86.5%	81.9%
					Collision	rates be	fore avo	idance									year total
					0.00	0.21	0.00	0.00	0.00	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0
Stage E																	
Allow for large array correction?		No															
Width of windfarm	W	3	km								1000	1 12 11			- 55 - 1	<u></u>	
			large array		Jan	Feb	Mar	Apr		Jun	Jul	Aug	Sep	Oct	Nov	Dec	peryea
Avaidan as set as modellad		05.00*4	correction		Collision		owing fo 0.00			0.00	0.00	0.01	0.00	0.00	0.00	0.00	
Avoidance rates modelled		95.00% 98.00%	100.00%		0.00	0.01	0.00	0.00 0.00		0.00	0.00	0.01	0.00	0.00	0.00 0.00	0.00	0.0
		98.00%	100.00%		0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		99.50%	100.00%		0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		33.30%	100.00%	2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0

Results Sheet 5 - CRM Results peregrine

RED KITE

RED KITE			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Transfer to XL Sheet		Flight Time	0	109	151	0	0	0	0	0	286	236	0	0	782
		CRH flight time	0	0	110.5	0	0	0	0	0	92.95	76.7	0	0	280.15
		% time CRH													35.82481
	A = Area km2	hours													
VP9		hours 144	6	12	12	12	12	12	12	24	12	12	12	6	
		t - seconds	21600	43200	43200	43200	43200	43200	43200	86400		43200	43200	21600	
		b flight seconds	0	0	0	0	0	0	0	0	0	0	0	0	
		Da = b / (t x A) m-	0	0	0	0	0	0	0	0	0	0	0	0	
VP10	6.06	144	12	12	12	12	12	12	12	24	12	12	12	6	
		t - seconds	43200	43200	43200	43200	43200	43200	43200	86400	43200	43200	43200	21600	
		b flight seconds	0	286	151	0	0	0	0	0	286	0	0	0	
		Da = b / (t x A) m-	0	0.00109247	0.00057679	0	0	0	0	0	0.001092	0	0	0	
VP11	5.56	144	6	12	12	12	12	12	12	24	12	12	12	6	
		t - seconds	21600	43200	43200	43200	43200	43200	43200	86400	43200	43200	43200	21600	
		b flight seconds	0	0	0	0	0	0	0	0	0	0	0	0	
		Da = b / (t x A) m-	0	0	0	0	0	0	0	0	-	0	0	0	
VP12	5.99	72	6	6	0	6	6	6	6	12		6	6	6	
		t - seconds	21600	21600	0	21600	21600	21600	21600	43200	21600	21600	21600	21600	
		b flight seconds	0	0	0	0	0	0	0	0	0	0	0	0	
		Da = b / (t x A) m-	0	0	0	0	0	0	0	0	0	0	0	0	
		Da Average	0	0.000273118	0.0001442	0	0	0	0	0	0.000273	0	0	0	

COLLISION RISK MODEL		Required in	put data is in	orange	boxes												
		Calculated	output is in	blue	boxes												
				green	boxes are	for informa	tion only, to	o show var	iables used a	it each stag	e						
		Value	Units	111.101.101.17	1.00 MA 1.0 M 10 M 10 M 10			Value	Units					Value	Units		-
Bird data		value	Units		Vindfarr	n data		value	Units		Turbi	ne data		value	Units		
Species name		Red kite				Site name	3	HEC VE				Model	nc	rdic 163			
Bird length	L	0.63	m			Latitude		55.6	degrees		н	ub height			m		
Wingspan	Ŵ	1.85	m		No	of turbines	т	18				orradius	в	81.5	m		
Bird flight speed	ÿ	13	m s ⁻¹		1000000000	f windfarm	ŵ	2	km.			of blades	ь	3			
Flight type, flapping or gliding		flapping	111.2		moure	- annarann	1.0	-	KIII			on speed	o o	8.1	rpm		
% of flights upwind/downwind		50%	50%									ade width	č	4.15	m		
Nocturnal activity ranking 1-5		1	007.									ade pitch	λ	6	degrees		
Nocturnal activity factor	Facility	0%										ght range	-	67-230	m		
Noctamaractivity ractor	Taight	07.									HISK Hei	gnerange		01-200	m		
normal approach		Set to 'norr	nal approach' to	o use survey data :	on bird den	situ											
				to use 'Migrant co			ce of Stag	e A									
Stage A				. <u>508</u> .04	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	De		birds/km²		0	0.000273	0.000144	0	0	0	0	0	0.000273	0	0	0	0.0001
Proportion at rotor risk height	Qze	35.80%			100												
At latitude 55.6	1000000		nours per mo	onth	239.9	268.0	365.7	423.6	502.5	522.0	523.6	466.6	384.4	325.9	251.7	222.1	4496.0
1/4 V			hours per n		504.1	404.0	378.3	296.4	241.5	198.0	220.4	277.4	335.6	418.1	468.3	521.9	4264.0
Stage B	- 25	00.02											_				
No of turbines	т	18															
Rotor radius	B	81.5	m														
1.10.47.00.000		Total rote	or frontal an	375610													
Nocturnal activity factor	f _{alght}	0%															
Bird flight speed	v	13	m s' ¹		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
			I number of	rotor transits	0.0	2.8	2.0	0.0		0.0	0.0	0.0	4.1	0.0	0.0	0.0	9
Stage C																	
No of blades	ь	3				Bird length	1	0.63	m								
Rotation speed	Ω	8.1	rpm			Wingspan	W	1.85	m								
Rotor radius	в	81.5	m		Bird f	light speed	v	13	m s ⁻¹								
Max blade width	С	4.15	m			Flight type		flapping									
Pitch	λ	6	degrees	% of flig	hts upwind	/downwind		50%	50%								
Blade profile		see Blad	le profile sheet	1.000													
		Single tra	nsit risk	upwind	6.35%												
				downwind	4.90%												
				reighted mean	5.62%												
Stage D				1	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q.,				87.4%	89.3%	87.4%	84.6%	68.0%	68.9%	68.9%	77.3%	85.6%	91.2%	87.4%	86.5%	81.9%
52 - 572 - 572																	
						n rates be											year total
					0.00	0.14	0.10	0.00	0.00	0.00	0.00	0.00	0.20	0.00	0.00	0.00	0
Stage E																	
Allow for large array correction?		No	4														
Width of windfarm	W	2	km														
			large array		Jan	Feb	Mar	Apr		Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
· · · · · · · · · · · · · · · · · · ·		05.000	correction		Collision												-
Avoidance rates modelled		95.00%	100.00%		0.00	0.01	0.01	0.00		0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.0
		98.00%	100.00%		0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		99.00%	100.00%		0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		99.50%	100.00%		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0

Results Sheet 6 CRM Results - red kite

1.6 References

Alerstam T., Rosén M., Bäckman J., Ericson P.G.P., Hellgren O., (2007). Flight speeds among bird species: allometric and phylogenetic effects. PLoS Biol, 5, 1656-1662. DOI:10.1371/journal.pbio.0050197

Band, W., Madders, M. & Whitfield, D.P. (2007). Developing field and analytical methods to assess avian collision risk at wind farms. In de Lucas, M, Janss, G. and Ferrer, M. (eds) Birds and Wind Power. Lynx Edicions, Barcelona.

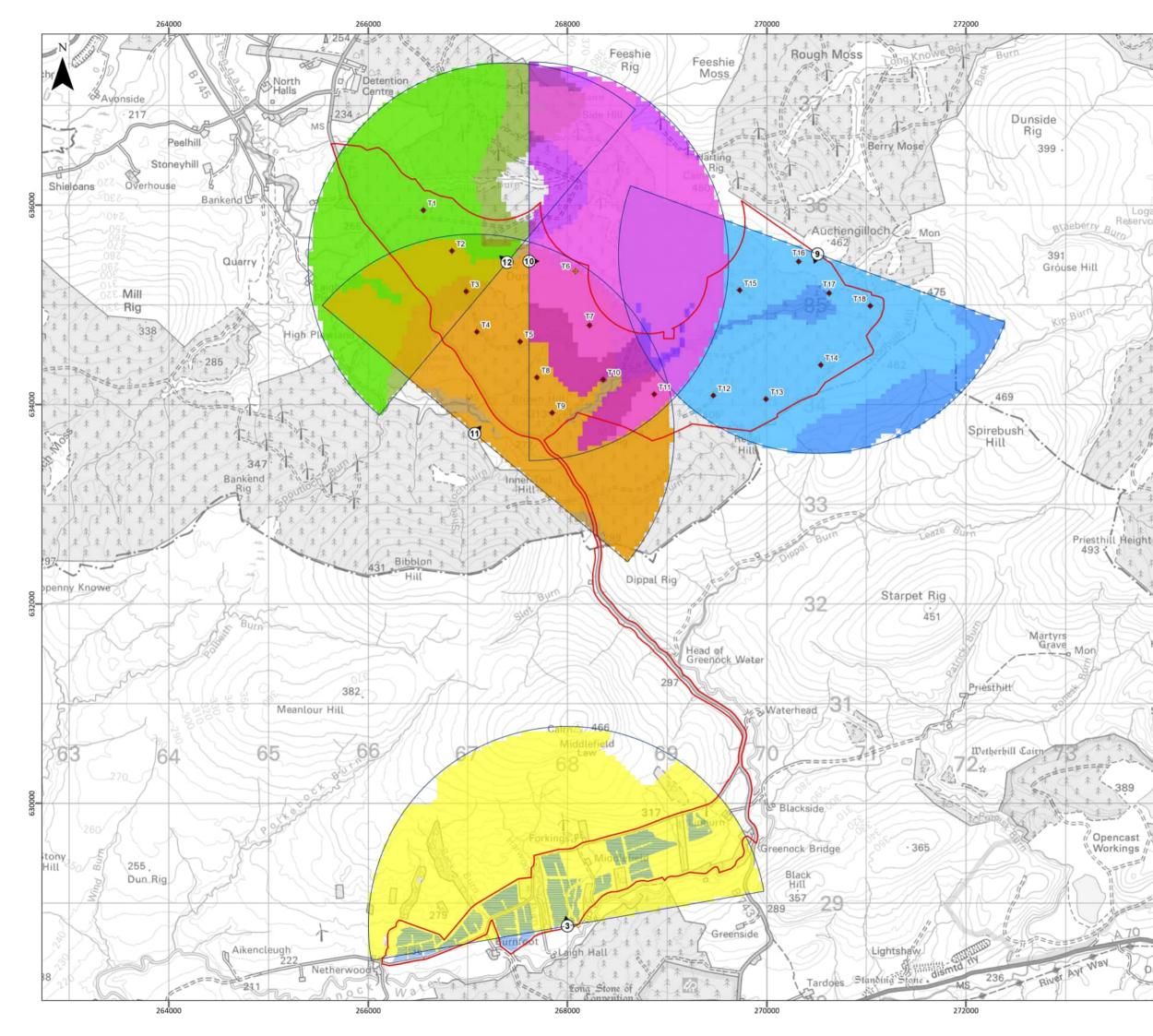
Cook, A.S.C.P., Humphreys, E.M., Masden, E.A. & Burton, N.H.K. 2014. The avoidance rates of collision between birds and offshore turbines. BTO Research Report No. 656.

NatureScot (2024). Guidance on using an updated collision risk model to assess bird collision risk at onshore wind farms. Available at: <u>https://www.nature.scot/doc/guidance-using-updated-collision-risk-model-assess-bird-collision-risk-onshore-wind-farms</u>

SNH (2017). Avoidance Rates for the onshore SNH Wind Farm Collision Risk Model. SNH Information and Guidance Note. SNH, Battleby.

SNH (2017). Avoidance Rates for the onshore SNH Wind Farm Collision Risk Model. SNH Information and Guidance Note. SNH, Battleby.

Whitfield, D.P. and M. Madders. 2006. A review of the impacts of wind farms on hen harriers Circus cyaneus and an estimation of collision avoidance rates. Natural Research Information Note 1 (revised). Natural Research Ltd, Banchory, UK.





+

.

Ô

Logar

Ś

==='

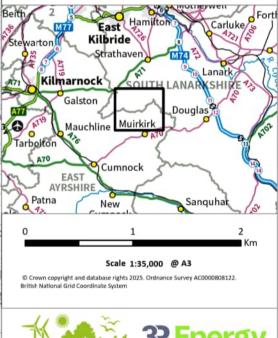
Da

Reservo



- Turbine Location (200m to tip)
- Turbine Location (230m to tip)
- Solar PV Module
- Vantage Point (VP)
- Theoretical Visibility from Vantage Point 3 (Offset 20 m)
- Theoretical Visibility from Vantage Point 9 (Offset 20 m)
- Theoretical Visibility from Vantage Point 9 (Offset 67.5 m)
- Theoretical Visibility from Vantage Point 10 (Offset 20 m)
- Theoretical Visibility from Vantage Point 10 (Offset 67.5 m)
- Theoretical Visibility from Vantage Point 12 (Offset 20 m)
- Theoretical Visibility from Vantage Point 12 (Offset 67.5 m)
- Theoretical Visibility from Vantage Point 11 (Offset 20 m)
- Theoretical Visibility from Vantage Point 11 (Offset 67.5 m)

NOTE: This Zone of Theoretical Visibility (ZTV) has been generated using ESRI ArcGIS Spatial Analyst extension. The digital terrain model (DTM) has been derived from OS Terrain 50 m dataset (accuracy: 4m RMSE). The ZTV has been generated from a viewing height of 1.6 m above ground level, and a surface offset of 20 m and 67.5 m. The ZTV is generated from a bare earth terrain and does not account for the screening effect of features within the landscape such as woodland.





Hagshaw Energy Cluster - Western Expansion Phase 1 EIA Report

TA 6.2 Collision Risk Modelling Figure 1 Vantagepoints and Viewsheds

97	7.2%								
~ (1	Date:	20/03/2025	Drawn by:	RD	Checked by:	JRS	Version:	V1

