MWP

Appendix 7B – Collision Risk Modelling Report

Ballynisky Wind Farm

Ballynisky Green Energy Ltd.

December 2025

APPENDIX 7B: COLLISION RISK MODELLING REPORT

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Executive Summary

1. RSK Biocensus was appointed by Ballynisky Green Energy Limited to complete collision risk modelling for the proposed Ballynisky Wind Farm Project in order to identify the potential impacts of the Proposed Development on target bird species through collisions with new wind turbines, and to inform mitigation measures should they be required.

2. Vantage point surveys were carried out by MWP and Irish Ornithological Society between April 2020 and March 2025 following good practice guidance. Surveys were undertaken in relation to the proposed construction of a six-turbine windfarm utilising the Vestas V136 model. These surveys provided the basis for identifying target species for collision risk modelling. The desk study and field data identified a total of seven target species as being potentially susceptible to collision impacts with new wind turbines, specifically black-headed gull, buzzard, common gull, golden plover, kestrel, lesser black-backed gull, and peregrine. The standard modelling approach was used for all species while an additional migration approach was used for black-headed gull due to the potential presence of a migration route through the site for qualifying populations associated with the River Shannon and Fergus Estuaries SPA.

3. Collision risk modelling followed best practice guidance from NatureScot. The results of this report can be used to inform future assessments, such as an Ecological Impact Assessment and mitigation strategy.

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1 Introduction

1.1 Purpose of the report

1.1.1 RSK Biocensus was appointed by Ballynisky Green Energy Limited to complete collision risk modelling for vantage point surveys for the proposed Ballynisky Wind Farm Project (hereafter referred to as 'the project').

1.1.2 This report presents the methodology and findings of bird collision risk modelling for the project. This report forms a technical appendix to Chapter 7 of the Environmental Impact Assessment Report (EIAR) for the project and has been produced using field survey data presented in **Appendix 7A** – Ornithology Baseline Report, which also supports the EIAR. This study was undertaken by RSK Biocensus on behalf of Ballynisky Green Energy Limited.

1.1.3 This collision risk modelling study has been undertaken in order to identify the potential impacts of the project on target bird species through collisions with new wind turbines, and to inform any requirement for mitigation measures.

1.1.4 The collision risk modelling study presented in this report has been prepared in reference to current best practice guidance, using field data from monthly Vantage Point (VP) surveys undertaken between 2020 and 2025 inclusive. Detailed methods for these surveys are described in EIAR **Appendix 7A** – Ornithology Baseline Report.

1.1.5 This report should be read in conjunction with the following figures:

- Figure 1 – Site location;
- Figure 2 – Designated sites;
- Figure 3 – VP locations;
- Figure 4a – Flight observations from VP surveys for target species in Year 1;
- Figure 4b – Flight observations from VP surveys for target species in Year 2;
- Figure 4c – Flight observations from VP surveys for target species in Year 3;
- Figure 4d – Flight observations from VP surveys for target species in Year 4;
- Figure 4e – Flight observations from VP surveys for target species in Year 5; and
- Figure 4f – Migration passages for black-headed gull in all survey years

1.1.6 Throughout this report, species are presented in taxonomic order and bird names follow British (English) vernacular names (BOU, 2022).

1.2 Site overview

1.2.1 The project site (hereafter referred to as 'the site') is located in the townland of Ballynisky, Co. Limerick, and is approximately 5 kilometres (km) north of Ardagh village. The site (Figure 1) is located in a rural area and predominantly comprises improved agricultural grassland bordered by hedgerows and treelines. Additional habitats present include ditches, mixed broadleaved woodland and wet grassland, as well as nearby watercourses (namely the Ahacronane River and Riddlestown Stream). The site is in a lowland location with elevation ranging from approximately 45-55 metres (m) Above Ordnance Datum (AOD).

1.2.2 A desk-based search for relevant designated sites with features of ornithological interest (notably Special Protection Areas (SPAs) and Ramsar sites) was undertaken within a 20 km buffer around the site (Figure 2), in accordance with best practice guidance (Scottish Natural Heritage, 2016). This identified two designated sites within 20 km of the project site, as summarised in Table 1 below (detailed information on these sites is provided in EIAR **Appendix 7A** – Ornithology Baseline Report).

1.2.3 Relevant species listed on the citations for these internationally designated sites have been considered for inclusion within collision risk modelling, with those recorded in the flight risk volume included in collision risk modelling on a precautionary basis (as described in Section 3.3).

Table 1: Relevant Designated Sites

Designated site	Distance from project site	Description
Stack's to Mullaghareirk Mountains, West Limerick Hills and Mount Eagle SPA (004161) / Important Bird Area (IBA)	3.7 km west of T1 1.7 km west of existing Carrons substation	Extensive upland site with habitats including blanket bog, heath, coniferous forest and rough grassland. Qualifies on account of supporting the largest concentration of hen harrier (*Circus cyaneus*) in Ireland (with 45 pairs recorded in 2005 representing 20% of the all-Ireland population), containing optimal habitat conditions for this species. Breeding species listed on the SPA citation but not comprising qualifying features for SPA designation include short-eared owl (*Asio flammeus*), merlin (*Falco columbarius*) and red grouse (*Lagopus lagopus*).
River Shannon and River Fergus Estuaries SPA (OO4077) / IBA	6.8 km north of the project site	Estuaries forming the largest estuarine complex in Ireland. Qualifies on account of regularly supporting over 20,000 waterbirds during the non-breeding season, and due to its important wintering populations of numerous waterbird species including whooper swan (*Cygnus cygnus*), light-bellied brent goose (*Branta bernicla hrota*), shelduck (*Tadorna tadorna*) and golden plover (*Pluvialis apricaria*). Additional Special Conservation Interest (SCI) features include the wintering population of black-headed gull (*Chroicocephalus ridibundus*).

1.3 Guidance

1.3.1 Table 2 below provides a summary of the guidance considered in this assessment. Information in this table has been used to inform the approach adopted in this report, ensuring modelling has been undertaken in reference to key industry best practice guidance.

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Table 2: Guidance considered in this assessment

Guidance	Notes
Recommended Bird Survey Methods To Inform Impact Assessment of Onshore Windfarms (NatureScot, 2017)	The collision risk modelling presented in this report is based on the updated guidance published in 2025 by NatureScot. This supersedes the previous version published in 2017.
Recommended bird survey methods to inform impact assessment of onshore wind farms (NatureScot, 2025)	Bird survey guidance for ornithological surveys completed for the Proposed Wind Farm Development
Guidance on using an updated collision risk model to assess bird collision risk at onshore wind farms (NatureScot, 2024)	Best practice guidance detailing the methodology for undertaking collision risk modelling for wind farms.
Using a collision risk model to assess bird collision risks for onshore wind farms (Band, 2024). NatureScot Research Report 909	Worked example used as basis for the collision risk modelling guidance produced by NatureScot in 2024.
Avoidance Rates for the onshore SNH Wind Farm Collision Risk Model (SNH, 2018)	Provides guidance for default avoidance rates for species of potential collision risk from wind farms
Gilbert, G., et al. (2021) Birds of Conservation Concern in Ireland 4: 2020-2026	National population guidance for the status of species identified in this assessment.

2 Development design

2.1 Wind Farm and Turbine Specification

2.1.1 Collision risk modelling within this report has been based on information provided by the client in regards to the Proposed Development and turbine specifications provided in Table 3 below. It is understood that the turbines will have an operational lifespan of 35 years.

Table 3. Turbine technical specifications

Specification	Value
Name of Wind Farm	Ballynisky Wind Farm
Turbine model	Vestas V136
Central latitude of wind farm (°)	52.5
Width of wind farm (km)	1.1
Number of turbines within the Proposed Development	6
Number of blades per turbine	3
Hub height (m)	90
Rotor radius (m)	66.66
Rotation speed (rpm)	4.286
Maximum blade width (m)	4.1
Blade pitch (°)	6
Average proportion of time operational (%)	85

3 Methodology

3.1 Survey methods

3.1.1 Field data used for collision risk modelling were collected during VP surveys undertaken at the site in 2020 to 2025 inclusive. Survey locations, methods and effort are described in full in EIAR **Appendix 7A** – Ornithology Baseline Report. Detailed viewshed analysis of these locations was also undertaken to produce the total visible survey area coverage as shown in Figure 3.

3.1.2 VP surveys were undertaken in accordance with good practice guidance (NatureScot 2025) in order to record bird flight activity throughout the site year-round for 5 years. Years run from April to March of the following years: Year 1 (2020-2021), Year 2 (2021-2022), Year 3 (2022-2023), Year 4 (2023-2024), Year 5 (2024-2025). As such, data were collected during the breeding season, winter season and during the spring and autumn passage periods. 2 VPs were surveyed, with survey effort exceeding the recommended minimum of 72 hours per year specified by good practice guidance (NatureScot 2025). Survey effort for each VP during the five years surveyed is summarised in Table 4 below. Full details for flight records included within the modelling are provided in Annex A.

Table 4. Summary of Vantage Point survey effort

VP	Hours of observation										
	Year 1		Year 2		Year 3		Year 4		Year 5		Total
	B 2020	NB 2020/21	B 2021	NB 2021/22	B 2022	NB 2022/23	B 2023	NB 2023/24	B 2024	NB 2024/25	
VP1	36	36	54	72	48	36	36	36	37	36	**427**
VP2	37	36	54	78	48	36	36	36	36	36	**433**
Total	**73**	**72**	**108**	**150**	**96**	**72**	**72**	**72**	**73**	**72**	**860**

3.2 Recording of Flight data

3.2.1 Parameters for target species observed flying within or in close proximity to the site were recorded to enable collision risk modelling. Parameters recorded were as follows:

- Start time of flight observation;
- Duration of flight observation
- Species and number of individuals;
- Approximate height of flight in metres, with the time spent in each flight height category; and
- The likely purpose of the flight (e.g. foraging, displaying, commuting, etc).

3.2.2 The following flight height categories were used during the VP surveys undertaken between April 2020 and March 2025 inclusive:

- Non-flight
- 0-20m
- 20-50m
- 50-100m

- 100-180m
- Over 180m

3.2.3 Based on the turbine specifications described in Table 3, flight records included within collision risk modelling (i.e. flights at 'collision risk height' and therefore included within the 'flight risk volume') were those recorded in the 20-50 m, 50-100 m and 100-180 m height categories described above.

3.3 Collision risk modelling

3.3.1 This section presents the methods used for collision risk modelling, including survey coverage, identification of target species and collision risk model selection.

3.3.2 Collision risk modelling was undertaken using the standard approach described in the good practice guidance and calculation tools specified in Section 1.3.

3.3.3 Collision risk modelling is essentially a six-stage process:

- **Stage A**: Initial modelling uses field survey data on bird flight activity, in the absence of displacement, avoidance or attraction effects to the wind farm, to estimate the number of birds at risk from the proposed wind farm through the calculation of monthly bird densities within the total vantage point survey viewshed, factoring in species underrepresentation due to nocturnal activity and consideration of the proportion of birds within the density calculations which would be flying at collision risk height. Estimates of aerial density were produced for the vantage point survey results for each vantage point location with an average generated for bird occupancy present within the airspace of each associated viewshed within a survey year;
- **Stage B**: Modelling then follows the principle that the total number of bird transits expected through the wind farm rotors is proportional to the number and cross-sectional area of the rotors, and to the density of birds in the airspace at risk height. Therefore, Stage B estimates the monthly and yearly number of bird transits potentially flying through rotors during the survey period through use of: Aerial density outputs from Stage A, turbine specifications, bird flight speed and nocturnal activity factors.
- **Stage C**: Following on from the estimation of the number of transits, Stage C aims to use the turbine specifications and species biometrics to estimate the risk of collision of a bird flying through a rotating turbine blade. Stage C evaluates the probability of collision if a bird passes at random at any point through the rotor disk on a flight path perpendicular to the rotor plane with the assumption of no influence from alternative angles of approach, turbulence and slipstream effects. Probability of wind direction and potential bias from upwind and down wind flights are also factored into the model. If no influence from predominant wind direction is anticipated an equal probability of upwind and downwind flights is used. Further consideration of the blade profile is made through measurements of chord width using 5% intervals along the length of the blade from the turbine hub. An average collision risk probability is then generated for the passage of a bird at any point across the rotor.
- **Stage D**: This stage multiplies the outputs of the number of flights through rotors across the wind farm (Stage B) and calculated risk of collision for a single bird transit through a rotor (Stage C). An estimate of total potential collision risk is produced when adjusted to factor in the proportion of time the wind farm turbines are operational.

- **Stage E**: Previous calculations assume no avoiding action is taken in response to turbine operation. Stage E applies a standard avoidance rate percentage (e.g. 98%) or avoidance rates provided in referenced literature to determine the potential collision risk mortality outlined in Stage D, inclusive of avoidance rates. Further consideration should be given for attraction effects from wind farm infrastructure, which may pose additional risk to birds. Where the wind farm is arranged in rows and collision risk is additive, an additional large array correction is also provided where birds may pass through the early rows of the array and therefore also be exposed to later rows.
- **Stage F**: The final stage outlines the potential variability and uncertainty inherent in mathematical modelling. The output of Stage E should convey the uncertainty in a collision risk estimate by indicating the results are a best estimate with a range of confidence around that estimate reflecting variability due to flight activity data, nocturnal data confidence, variability of bird dimensions and flight speed, simplification of turbine profile in the model and any unconfirmed designs.

3.4 Target species

3.4.1 Selection of target species to be recorded during VP surveys and subsequently considered within collision risk modelling was informed by the following characteristics:

- their known or likely presence within or in close proximity to the Site;
- their potential sensitivity to the Project (particularly their potential collision risk and/or susceptibility to disturbance from new wind turbines);
- their level of legislative protection and/or conservation concern; and
- their relevance to any nearby designated sites (e.g., SPA, IBA).

3.4.2 Based on these characteristics, species identified as target species for this study included all waterfowl, raptor, owl, wader and gull species. Target species requiring particular consideration due to their conservation status, potential sensitivity and/or relevance to nearby designated sites are summarised in Table 5.

Table 5. Target species for particular consideration

Target species	Conservation status
Barn owl (*Tyto alba*)	BoCCI Red listed / Wildlife Acts
Black-tailed godwit (*Limosa limosa*)	BoCCI Red listed / Wildlife Acts / SS (Selection Species for a relevant designated site)
Bar-tailed godwit (*Limosa lapponica*)	Annex I EU Birds Directive / BoCCI Red listed / Wildlife Acts / SS
Black-headed gull (*Chroicocephalus ridibundus*)	BoCCI Amber listed / Wildlife Acts / SCI (Special Conservation Interest for a relevant designated site)
Buzzard (*Buteo buteo*)	BoCCI Green listed / Wildlife Acts
Common gull *(Larus canus)*	BoCCI Amber listed / Wildlife Acts
Cormorant (*Phalacrocorax carbo*)	BoCCI Amber listed / Wildlife Acts / SS
Curlew (*Numenius arquata*)	BoCCI Red listed / Wildlife Acts / SS
Dunlin (*Calidris alpina*)	BoCCI Red listed / Wildlife Acts / SS

Target species	Conservation status
Golden plover (*Pluvialis apricaria*)	Annex I EU Birds Directive / BoCCI Red listed / Wildlife Acts / SS
Greenshank (*Tringa nebularia*)	BoCCI Green listed / Wildlife Acts / SS
Hen harrier (*Circus cyaneus*)	Annex I EU Birds Directive / BoCCI Amber listed / Wildlife Acts / SS
Kestrel (*Falco tinnunculus*)	BoCCI Red listed / Wildlife Acts
Lapwing (*Vanellus vanellus*)	BoCCI Red listed / Wildlife Acts / SS
Lesser black-backed gull *(Larus fuscus)*	BoCCI Amber listed / Wildlife Acts
Little egret (*Egretta garzetta*)	Annex I EU Birds Directive / BoCCI Green listed / Wildlife Acts
Long-eared owl (*Asio otus*)	BoCCI Green listed / Wildlife Acts
Merlin (*Falco columbarius*)	Annex I EU Birds Directive / BoCCI Amber listed / Wildlife Acts
Mute swan (*Cygnus olor*)	BoCCI Amber listed / Wildlife Acts
Peregrine (*Falco peregrinus*)	Annex I EU Birds Directive / BoCCI Green listed / Wildlife Acts
Pintail (*Anas acuta*)	BoCCI Amber listed / Wildlife Acts / SCI
Red grouse (*Lagopus lagopus*)	BoCCI Red listed / Wildlife Acts
Redshank (*Tringa totanus*)	BoCCI Red listed / Wildlife Acts / SS
Scaup (*Aythya marila*)	BoCCI Red listed / Wildlife Acts / SCI
Shelduck (*Tadorna tadorna*)	BoCCI Amber listed / Wildlife Acts / SS
Short-eared owl (*Asio flammeus*)	Annex I EU Birds Directive / BoCCI Amber listed / Wildlife Acts
Shoveler (*Spatula clypeata*)	BoCCI Red listed / Wildlife Acts / SCI
Snipe (*Gallinago gallinago*)	BoCCI Red listed / Wildlife Acts
Sparrowhawk (*Accipiter nisus*)	BoCCI Green listed / Wildlife Acts
Teal (*Anas crecca*)	BoCCI Amber listed / Wildlife Acts / SS
Tufted duck (*Aythya fuligula*)	BoCCI Amber listed / Wildlife Acts
Whooper swan (*Cygnus cygnus*)	Annex I EU Birds Directive / BoCCI Amber listed / Wildlife Acts / SS
Wigeon (*Mareca penelope*)	BoCCI Amber listed / Wildlife Acts / SS
Woodcock (*Scolopax rusticola*)	BoCCI Red listed / Wildlife Acts

3.4.3 Selection of target species recorded during the VP surveys for detailed collision risk modelling to assess potential impacts was based on the following factors:

- their level of legal protection (e.g., inclusion on Annex 1 of the Birds Directive) and/or conservation concern (e.g., inclusion on the Birds of Conservation Concern in Ireland (BoCCI) Red or Amber Lists (Gilbert *et al*., 2021));
- their relevance to any nearby designated sites (as described in Table 1);
- the assessed importance of the Site to the species at an international, national, regional or local level; and

- their level of flight activity recorded with the flight risk volume during VP surveys.

3.4.4 As such, a total of seven species were identified as target species requiring detailed collision risk modelling, as detailed in Table 6. Considering the above factors, no other species were identified as target species requiring detailed collision risk modelling.

Table 6. Target species for collision risk modelling

Species	Reasons for selection
Black-headed gull	A species of conservation concern in Ireland, reflected by its inclusion on the BoCCI Amber List, and an SCI for River Shannon and River Fergus Estuaries SPA. High levels of flight activity were recorded within the site during the non-breeding season, with birds observed flying throughout the airspace over the site.
Buzzard	Whilst a common and widespread species in Ireland, reflected by its inclusion on the BoCCI Green List, high levels of flight activity were recorded within the site. Buzzard activity was recorded within the site throughout the breeding and non-breeding seasons.
Common gull	Common gull is a species of conservation concern in Ireland due to its inclusion on the BoCCI Amber list. High levels of flight activity were recorded within the site during non-breeding seasons.
Golden plover	A species of high conservation concern in Ireland, reflected by its inclusion on the BoCCI Red List. It is also afforded additional legal protections due to its inclusion on Annex 1 of the Birds Directive. Golden plover activity was recorded infrequently on the site.
Kestrel	A species of high conservation importance in Ireland due to its inclusion on the BoCCI Red List. Kestrel flight activity was recorded during the breeding and non-breeding seasons, including flying through and hunting by multiple individuals.
Lesser black-backed gull	Lesser black-backed gull is a species of conservation concern in Ireland with its inclusion on the BoCCI Amber list. High levels of flight activity were recorded during both breeding and non-breeding season.
Peregrine	A locally common and increasing species in Ireland, reflected by its inclusion on the BoCCI Green List. Afforded additional legal protection due to its inclusion on Annex 1 of the Birds Directive. Peregrine activity was recorded infrequently within the site.

3.4.5 An additional 15 target species recorded during the VP surveys would potentially merit inclusion in collision risk modelling on account of their conservation status, relevance to nearby designated sites and/or potential sensitivity to the Proposed Development: cormorant, curlew, great black-backed gull, great white egret, grey heron, hen harrier, lapwing, little egret, mallard, mute swan, snipe, sparrowhawk, whimbrel, herring gull, whooper swan. However, flight activity by these species recorded during the VP surveys was either at a very low level in the context of their population statuses, and/or outside of the flight risk volume for collision with the turbines. These species were therefore not selected as target species for inclusion in collision risk modelling.

3.4.6 To maximise the accuracy of collision risk modelling outputs, collision risk calculations were undertaken for a duration of time appropriate to the species in question. Collision risk modelling requires the typical measurements and flight parameters of modelled species. Additional consideration is given in Stage B through the use of a nocturnal activity rating to adjust the model for species potentially underrepresented from vantage point surveys during the survey period. Relevant data for modelled species based on existing literature are detailed in Table 7 below.

Table 7. Species information for target species included in collision risk modelling

Species	Average body length (m)	Average wingspan (m)	Average flight speed (m/s)	Nocturnal activity rating	Data sources
Black-headed gull	0.38	1.00	11.90	1	Alerstam et al. (2007), BTO BirdFacts (2023)
Buzzard	0.54	1.20	9.45	1	BTO BirdFacts (2023); Hawk & Owl Trust (2023); Robinson (2005); Snow & Perrins (1998); Bruderer & Boldt (2001)
Common gull	0.43	1.07	13.40	1	Collins (2023); Alerstam et al. (2007)
Golden plover	0.27	0.56	17.90	3	Collins (2023); Alerstam et al. (2007), Grey plover biometrics used.
Kestrel	0.34	0.76	9.95	1	BTO BirdFacts (2023); Hawk & Owl Trust (2023); Robinson (2005); Snow & Perrins (1998); Bruderer & Boldt (2001)
Lesser black-backed gull	0.52	1.26	12.40	1	Bruderer & Boldt (2001); Alerstam et al. (2007); Collins (2023)
Peregrine	0.42	1.02	12.10	1	BTO BirdFacts (2023); Alerstam et al. (2007)

3.5 Aerial density

3.5.1 NatureScot has published one consistent model for assessing flight activity. This model relies on the calculation of aerial density for individual species. Viewshed analysis as detailed in Section 3.1.1 of the two vantage points assessed during the survey period identified a combined total viewshed area of 7.91 km^2. In Stage A, the total viewshed area and monthly survey effort at the VP's (as shown in Table 4) was used to calculate the monthly aerial densities (birds per km^2) for each target species included in the collision risk modelling.

3.6 Migrant Collision Risk

3.6.1 As an additional alternative to Stage A, the migrant collision risk sheet was used for black-headed gull for calculating aerial densities for this species. Total 'migration passages' were calculated for the populations of birds associated with sites of conservation importance that were anticipated to be migrating through the viewshed of the site during passage periods. In the context of black-headed gull, a migration passage are flightlines recorded within the swept range of the turbines with a clear north or south direction within the viewshed of the vantage points, for individuals potentially associated with the River Shannon and Fergus Estuaries SPA. Using the species biometrics outlined in Table 7, the width of the migration corridor and proportion of flights recorded at collision height aerial densities are produced for inclusion in Stage B.

3.7 Rotor transit collision risk

3.7.1 The aerial density values for each species calculated in Stage A is factored into the model to produce an estimated number of monthly transits whereby the species assessed would fly directly through the volume of the turbine rotors in Stage B, and therefore be at risk of collision. Following this, detailed turbine specifications provided in **Table 3** and species biometrics outlined in **Table 6** were factored into the model in Stage C, to produce an estimate of the number of transits of a species that would be at direct risk of collision due to the Proposed Development.

3.7.2 Wind farms are not typically operational throughout the entirety of the year due to minimum/maximum wind thresholds not being suitable for operational activity, regular maintenance or scheduled curtailment. Therefore, further consideration should be given for the operational time of the Proposed Development in the model. This was considered in Stage D, whereby a percentage of operational time per month is provided to produce an average operational time whereby a species would potentially be at risk of collision with the turbines, to estimate a proportion of the total bird transits which would occur during the operational period of the Proposed Development.

3.8 Avoidance rates

3.8.1 Stage E of collision risk modelling takes account of the understanding that birds will often take action to avoid collision with wind turbines, either by avoiding the wind farm entirely (i.e., displacement), by flying above or below operational turbines, or by performing ‘emergency’ manoeuvres to avoid moving turbine blades.

3.8.2 Avoidance rates are generally derived by comparing data on actual observed collisions with the predicted no-avoidance collision estimate. *SNH Avoidance Rates for the onshore SNH Wind Farm Collision Risk Model* (SNH, 2018) collates species-specific estimates of avoidance rates from a range of information sources to determine estimates of avoidance that should be used for bird species included in the collision risk modelling.

3.8.3 Avoidance rates used are indicated in Table 7 below. As per SNH guidance (SNH, 2018), a default avoidance rate of 98% has been applied for species for which a specific avoidance rate is not specified (due to a lack of empirical evidence to the contrary).

Table 8. Avoidance rate for target species (SNH, 2018)

Species	Avoidance rate (%)
Black-headed gull	98%
Buzzard	98%
Common gull	98%
Golden plover	98%

Species	Avoidance rate (%)
Kestrel	95%
Lesser black-backed gull	98%
Peregrine	98%

3.9 Limitations and assumptions

3.9.1 This report is based on field data collected during VP surveys undertaken at the site in 2020-2025 inclusive. Limitations of these field data are discussed in EIAR **Appendix 7A** – Ornithology Baseline Report

3.9.2 As stated in Section 3.2, collision risk modelling assumes all bird collisions with turbines will be fatal during transits, which may not necessarily be the case. On a precautionary basis, all birds flying between the rotor swept area for the Vestas V136 model between 20 m and 180 m would be included within collision risk modelling, despite the proposed turbines having a swept range between 23 m and 157 m. As the data gathered is recorded in flight bands, all flight lines within this flight band have been included in the modelling. Some of the flight activity recorded would therefore be outside of the 23 m to 157 m swept range but within the range of the flight band. As such, based on these assumptions and methods, collision risk modelling is considered to represent a conservative scenario of collision fatalities.

3.9.3 Modelling considers the potential effects from the presence of a prevailing wind direction which could impair or improve movement through a turbine during an individual transit of a bird. As no prevailing wind direction was identified during the surveys, good practice guidance from NatureScot states a standard 50:50 ratio for the proportion of transits upwind or downwind should be used (NatureScot, 2024).

3.9.4 A blade profile is required in the collision modelling for providing a single transit risk percentage for flights upwind or downwind in Stage C. This information was requested by the client but unable to be acquired from the manufacturer. A default blade profile provided by NatureScot in the example spreadsheet based upon a 5 MW turbine has been used to calculate the single transit risk for birds in flight.

3.9.5 Operational time for the wind farm has been assumed to be 85%, whereby the wind farm is operational for 85% of the time with an expected 15% downtime likely due to maintenance or shutdown during high/low wind speeds. This value is provided in guidance from NatureScot and is not considered to be a limitation to the assessment.

3.9.6 A nocturnal activity factor is applied within the model to adjust aerial density estimates for species potentially underrepresented by vantage point surveys which require survey during daylight periods and, therefore, are limited in the assessment of crepuscular or nocturnal species (e.g. golden plover). Professional judgement and relevant literature have been used in this assessment to assign values for the level at which a species may be active at sunrise, sunset and overnight.

3.9.7 Collision risk modelling assumes bird activity observed during the VP surveys is representative of the site, in the absence of the Proposed Development. It does not account for any displacement of birds which may result from the physical presence of the turbines and other associated infrastructure, which may reduce the levels of bird activity within the turbine area during the operational period. This represents an additional contributory factor to the precautionary nature of the collision risk modelling calculations.

4 Results

4.1.1 Flight times for target species within collision risk range were calculated as the number of birds observed within the viewshed at collision risk height (see Section 3.1) during each observation, multiplied by the number of seconds spent within the rotor swept area. For example, two birds flying at a height of 80 m for 15 seconds would constitute 30 flight seconds within collision risk height.

4.1.2 The following flight seconds for each target species at collision risk height were recorded during the surveys (as provided in full in Annex A):

- Black-headed gull: 77,359 seconds;
- Buzzard: 28,979 seconds;
- Common gull: 30,482 seconds;
- Golden plover: 2,208 seconds;
- Kestrel: 6,343 seconds;
- Lesser black-backed gull: 34,226 seconds; and
- Peregrine: 265 seconds

4.1.3 Flight observations for target species recorded during the Vantage Point surveys are shown on Figures 4a - 4e. Species-specific collision risk models for each target species are summarised below. Collision risk modelling analysis is summarised in Annex B.

4.2 Black-headed Gull

Standard approach

4.2.1 As a diurnal species, black-headed gull was frequently recorded during the VP surveys undertaken between 2020 and 2025, with observations at collision risk height within the vantage point survey area totalling 77,359 flight seconds.

4.2.2 Based on the blade profile, measurements and flight parameters for the Vestas V136 turbine described in Table 2, and the bird biometrics are described in Table 7, the flight seconds recorded would be equivalent to 0 transits through the collision risk window of the turbines in Year 1, 7 transits in Year 2, 59 transits in Year 3, 370 transits in Year 4, and 489 transits in Year 5. Using the turbine specifications, the probability of a black-headed gull flying through an operational turbine resulting in a collision during a single transit, in the absence of any avoiding actions, is 4.55%.

4.2.3 Therefore, in the absence of any avoiding actions, the estimated number of black-headed gull fatalities per year (based on the 2020-2025 data) whilst the turbines are operational is 0 birds in Year 1, 0.262 birds in Year 2, 2.280 birds in Year 3, 14.305 birds in Year 4, and 18.920 birds in Year 5.

4.2.4 Taking into consideration an avoidance rate of 98% (in line with SNH guidance), the average estimated number of annual black-headed gull collision fatalities per year is 0.143. This would equate to an estimated 5.007 collision fatalities over the anticipated lifespan of the wind farm (35 years). Collision risk modelling for black-headed gull is summarised in Table 9 below.

Table 9. Black-headed gull collision risk model summary

Period	Avoidance rate (%)	Estimated collision fatalities	
		Per year	35 years
Year 1 (April 2020 – March 2021)	98	0.000	0.000
Year 2 (April 2021 – March 2022)		0.005	0.184
Year 3 (April 2022 – March 2023)		0.046	1.596
Year 4 (April 2023 – March 2024)		0.286	10.013
Year 5 (April 2024 – March 2025)		0.378	13.244
Average		**0.143**	**5.007**

Migration approach

4.2.5 Using flightlines considered to be a migration passage and therefore potentially associated with the River Shannon and Fergus Estuaries SPA, the migration approach identified one migration passage in Year 1, zero migration passages in Year 2, 77 migration passages in Year 3, 92 migration passages in Year 4 and 195 migration passages in Year 5. Flightlines associated with migration passages are shown on Figure 4f.

4.2.6 Based on the blade profile, measurements and flight parameters for the Vestas V136 turbine described in Table 2, and the bird biometrics are described in Table 7, the flight seconds recorded would be equivalent to 0 transits through the collision risk window of the turbines in Year 1, 0 transits in Year 2, 23 transits in Year 3, 14 transits in Year 4, and 50 transits in Year 5. Using the turbine specifications, the probability of a black-headed gull flying through an operational turbine resulting in a collision during a single transit, in the absence of any avoiding actions, is 4.55%.

4.2.7 Therefore, in the absence of any avoiding actions, the estimated number of black-headed gull fatalities per year (based on the 2020-2025 data) whilst the turbines are operational is 0.000 birds in Year 1, 0.000 birds in Year 2, 0.890 birds in Year 3, 0.537 birds in Year 4, and 1.944 birds in Year 5.

4.2.8 Taking into consideration an avoidance rate of 98% (in line with SNH guidance), the average estimated number of annual black-headed gull collision fatalities per year is 0.014. This would equate to an estimated 0.472 collision fatalities over the anticipated lifespan of the wind farm (35 years). Collision risk modelling for black-headed gull is summarised in **Table 10** below.

Table 10. Black-headed gull collision risk model summary

Period	Avoidance rate (%)	Estimated collision fatalities	
		Per year	35 years
Year 1 (April 2020 – March 2021)	98	0.000	0.000

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Period	Avoidance rate (%)	Estimated collision fatalities	
		Per year	35 years
Year 2 (April 2021 – March 2022)		0.000	0.000
Year 3 (April 2022 – March 2023)		0.018	0.623
Year 4 (April 2023 – March 2024)		0.011	0.376
Year 5 (April 2024 – March 2025)		0.039	1.361
Average		**0.014**	**0.472**

4.3 Buzzard

4.3.1 As a diurnal species, buzzard was frequently recorded during the VP surveys undertaken between 2020 and 2025, with observations at collision risk height within the vantage point survey area totalling 28,979 flight seconds.

4.3.2 Based on the blade profile, measurements and flight parameters for the Vestas V136 turbine described in Table 2, and the bird biometrics are described in Table 7, the flight seconds recorded would be equivalent to 5 transits through the collision risk window of the turbines in Year 1, 18 transits in Year 2, 128 transits in Year 3, 38 transits in Year 4, and 455 transits in Year 5. Using the turbine specifications, the probability of a buzzard flying through an operational turbine resulting in a collision during a single transit, in the absence of any avoiding actions, is 4.65%.

4.3.3 Therefore, in the absence of any avoiding actions, the estimated number of buzzard fatalities per year (based on the 2020-2025 data) whilst the turbines are operational is 0.203 birds in Year 1, 0.723 birds in Year 2, 5.061 birds in Year 3, 1.514 birds in Year 4, and 17.994 birds in Year 5.

4.3.4 Taking into consideration an avoidance rate of 98% (in line with SNH guidance), the average estimated number of annual buzzard collision fatalities per year is 0.102. This would equate to an estimated 3.569 collision fatalities over the anticipated lifespan of the wind farm (35 years). Collision risk modelling for buzzard is summarised in 9 below.

Table 9. Buzzard collision risk model summary

Period	Avoidance rate (%)	Estimated collision fatalities	
		Per year	35 years
Year 1 (April 2020 – March 2021)	98	0.004	0.142
Year 2 (April 2021 – March 2022)		0.014	0.506
Year 3 (April 2022 – March 2023)		0.101	3.543
Year 4 (April 2023 – March 2024)		0.030	1.060
Year 5 (April 2024 – March 2025)		0.360	12.595

Period	Avoidance rate (%)	Estimated collision fatalities	
		Per year	35 years
Average		**0.102**	**3.569**

4.4 Common Gull

4.4.1 As a diurnal species, common gull was frequently recorded during the VP surveys undertaken between 2020 and 2025, with observations at collision risk height within the vantage point survey area totalling 30,482 flight seconds.

4.4.2 Based on the blade profile, measurements and flight parameters for the Vestas V136 turbine described in Table 2, and the bird biometrics are described in Table 7, the flight seconds recorded would be equivalent to 683 transits through the collision risk window of the turbines in Year 1, 11 transits in Year 2, 0 transits in Year 3, 336 transits in Year 4, and 1 transit in Year 5. Using the turbine specifications, the probability of a common gull flying through an operational turbine resulting in a collision during a single transit, in the absence of any avoiding actions, is 4.65%.

4.4.3 Therefore, in the absence of any avoiding actions, the estimated number of common gull fatalities per year (based on the 2020-2025 data) whilst the turbines are operational is 26.958 birds in Year 1, 0.428 birds in Year 2, 0 birds in Year 3, 13.275 birds in Year 4, and 0.027 birds in Year 5.

4.4.4 Taking into consideration an avoidance rate of 98% (in line with SNH guidance), the average estimated number of annual common gull collision fatalities per year is 0.163. This would equate to an estimated 5.696 collision fatalities over the anticipated lifespan of the wind farm (35 years). Collision risk modelling for common gull is summarised in Table 10 below.

Table 10. Common Gull collision risk model summary

Period	Avoidance rate (%)	Estimated collision fatalities	
		Per year	35 years
Year 1 (April 2020 – March 2021)	98	0.539	18.871
Year 2 (April 2021 – March 2022)		0.009	0.300
Year 3 (April 2022 – March 2023)		0.000	0.000
Year 4 (April 2023 – March 2024)		0.265	9.292
Year 5 (April 2024 – March 2025)		0.001	0.019
Average		**0.163**	**5.696**

4.5 Golden Plover

4.5.1 Golden plover was infrequently recorded during the VP surveys undertaken between 2020 and 2025, with observations at collision risk height within the vantage point survey area totalling 2,208 flight seconds.

4.5.2 Based on the blade profile, measurements and flight parameters for the Vestas V136 turbine described in Table 2, and the bird biometrics are described in Table 7, the flight seconds recorded would be equivalent to 0 transits through the collision risk window of the turbines in Year 1, 0 transits in Year 2, 0 transits in Year 3, 129 transits in Year 4, and 0 transits in Year 5. Using the turbine specifications, the probability of a golden plover flying through an operational turbine resulting in a collision during a single transit, in the absence of any avoiding actions, is 3.93%.

4.5.3 Therefore, in the absence of any avoiding actions, the estimated number of golden plover fatalities per year (based on the 2020-2025 data) whilst the turbines are operational is 0 birds in Year 1, 0 birds in Year 2, 0 birds in Year 3, 4.329 birds in Year 4, and 0 birds in Year 5.

4.5.4 Taking into consideration an avoidance rate of 98% (in line with SNH guidance), the average estimated number of annual golden plover collision fatalities per year is 0.087. This would equate to an estimated 3.030 collision fatalities over the anticipated lifespan of the wind farm (35 years). Collision risk modelling for golden plover is summarised in Table 11 below.

Table 11. Golden Plover collision risk model summary

Period	Avoidance rate (%)	Estimated collision fatalities	
		Per year	35 years
Year 1 (April 2020 – March 2021)	98	0.000	0.000
Year 2 (April 2021 – March 2022)		0.000	0.000
Year 3 (April 2022 – March 2023)		0.000	0.000
Year 4 (April 2023 – March 2024)		0.087	3.030
Year 5 (April 2024 – March 2025)		0.000	0.000
Average		**0.087**	**3.030**

4.6 Kestrel

4.6.1 A diurnal species, kestrel was frequently recorded during the VP surveys undertaken between 2020 and 2025, with observations at collision risk height within the vantage point survey area totalling 6,343 flight seconds.

4.6.2 Based on the blade profile, measurements and flight parameters for the Vestas V136 turbine described in Table 2, and the bird biometrics are described in Table 7, the flight seconds recorded would be equivalent to 4 transits through the collision risk window of the turbines in Year 1, 5 transits in Year 2, 2 transits in Year 3, 27 transits in Year 4, and 55 transits in Year 5. Using the turbine specifications, the probability of a kestrel flying through an operational turbine resulting in a collision during a single transit, in the absence of any avoiding actions, is 4.26%.

4.6.3 Therefore, in the absence of any avoiding actions, the estimated number of kestrel fatalities per year (based on the 2020-2025 data) whilst the turbines are operational is 0.131 birds in Year 1, 0.195 birds in Year 2, 0.076 birds in Year 3, 0.983 birds in Year 4, and 2.006 birds in Year 5.

4.6.4 Taking into consideration an avoidance rate of 95% (in line with SNH guidance), the average estimated number of annual kestrel collision fatalities per year is 0.100. This would equate to an estimated 3.511 collision fatalities over the anticipated lifespan of the wind farm (35 years). Collision risk modelling for kestrel is summarised in Table 12 below.

Table 12. Kestrel collision risk model summary

Period	Avoidance rate (%)	Estimated collision fatalities	
		Per year	35 years
Year 1 (April 2020 – March 2021)	95	0.007	0.229
Year 2 (April 2021 – March 2022)		0.010	0.341
Year 3 (April 2022 – March 2023)		0.004	0.133
Year 4 (April 2023 – March 2024)		0.049	1.720
Year 5 (April 2024 – March 2025)		0.100	3.511
Average		**0.034**	**1.187**

4.7 Lesser black-backed gull

4.7.1 As a diurnal species, lesser black-backed gull was frequently recorded during the VP surveys undertaken between 2020 and 2025, with observations at collision risk height within the vantage point survey area totalling 34,226 flight seconds.

4.7.2 Based on the blade profile, measurements and flight parameters for the Vestas V136 turbine described in Table 2, and the bird biometrics are described in Table 7, the flight seconds recorded would be equivalent to 101 transits through the collision risk window of the turbines in Year 1, 106 transits in Year 2, 32 transits in Year 3, 23 transits in Year 4, and 806 transits in Year 5. Using the turbine specifications, the probability of a lesser black-backed gull flying through an operational turbine resulting in a collision during a single transit, in the absence of any avoiding actions, is 4.91%.

4.7.3 Therefore, in the absence of any avoiding actions, the estimated number of lesser black-backed gull fatalities per year (based on the 2020-2025 data) whilst the turbines are operational is 4.202 birds in Year 1, 4.425 birds in Year 2, 1.342 birds in Year 3, 0.961 birds in Year 4, and 33.622 birds in Year 5.

4.7.4 Taking into consideration an avoidance rate of 98% (in line with SNH guidance), the average estimated number of annual lesser black-backed gull collision fatalities per year is 0.672. This would equate to an estimated 23.535 collision fatalities over the anticipated lifespan of the wind farm (35 years). Collision risk modelling for lesser black-backed gull is summarised in Table 13 below.

Table 13. Lesser Black-backed Gull collision risk model summary

Period	Avoidance rate (%)	Estimated collision fatalities	
		Per year	35 years
Year 1 (April 2020 – March 2021)	98	0.084	2.941
Year 2 (April 2021 – March 2022)		0.089	3.098
Year 3 (April 2022 – March 2023)		0.027	0.940
Year 4 (April 2023 – March 2024)		0.019	0.673
Year 5 (April 2024 – March 2025)		0.672	23.535
Average		**0.178**	**6.237**

4.8 Peregrine

4.8.1 Peregrine was infrequently recorded during the VP surveys undertaken between 2020 and 2025, with observations at collision risk height within the vantage point survey area totalling 265 flight seconds.

4.8.2 Based on the blade profile, measurements and flight parameters for the Vestas V136 turbine described in Table 2, and the bird biometrics are described in Table 7, the flight seconds recorded would be equivalent to 0 transits through the collision risk window of the turbines in Year 1, 0 transits in Year 2, 1 transit in Year 3, 0 transits in Year 4, and 8 transits in Year 5. Using the turbine specifications, the probability of a peregrine flying through an operational turbine resulting in a collision during a single transit, in the absence of any avoiding actions, is 4.23%.

4.8.3 Therefore, in the absence of any avoiding actions, the estimated number of peregrine fatalities per year (based on the 2020-2025 data) whilst the turbines are operational is 0 birds in Year 1, 0 birds in Year 2, 0.028 birds in Year 3, 0 birds in Year 4, and 0.293 birds in Year 5.

4.8.4 Taking into consideration an avoidance rate of 98% (in line with SNH guidance), the average estimated number of annual peregrine collision fatalities per year is 0.006. This would equate to an estimated 0.205 collision fatalities over the anticipated lifespan of the wind farm 35 years). Collision risk modelling for peregrine is summarised in Table 14 below.

Table 14. Peregrine collision risk model summary

Period	Avoidance rate (%)	Estimated collision fatalities	
		Per year	35 years
Year 1 (April 2020 – March 2021)	98	0.000	0.000
Year 2 (April 2021 – March 2022)		0.000	0.000
Year 3 (April 2022 – March 2023)		0.001	0.019
Year 4 (April 2023 – March 2024)		0.000	0.000
Year 5 (April 2024 – March 2025)		0.006	0.205
Average		**0.001**	**0.045**

5 Discussion

5.1.1 Based on the VP survey data recorded at the Proposed Development site between 2020 and 2025 inclusive, seven target species were identified as being potentially susceptible to collision impacts with new wind turbines: specifically black-headed gull, buzzard, common gull, golden plover, kestrel, lesser black-backed gull, and peregrine. Of these species, some are susceptible during specific seasonal periods throughout the year. Black-headed gull, common gull and golden plover are potentially susceptible during the wintering season. Buzzard, kestrel, lesser black-backed gull and peregrine are potentially susceptible to collision impacts year-round.

5.1.2 Estimated collision risk fatalities for these species as a result of the new turbines, both annually and during the anticipated operational lifespan of the Proposed Development (35 years), are presented in Section 4.

5.1.3 It should be noted that, for the reasons specified in Section 3.9, these calculations represent a precautionary scenario of collision fatalities from the Proposed Development.

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