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Clune Wind Farm

EIA Further Environmental Information

Chapter 8: Ornithology

RES Group

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1. Ornithology

1.1 Introduction

This chapter provides an updated assessment of potential impacts and associated effects on ornithological features (specifically Golden eagle *Aquila chrysaetos* and White-tailed eagle *Haliaeetus albicilla*) during the operational phase of the Proposed Development, as originally described in **Chapter 8: Ornithology** of the submitted Environmental Impact Assessment (EIA) Report for Clune Wind Farm (RES, 2025). This is as a result of a Kernel Density Analysis using purchased satellite tagging data and revised Collision Risk Modelling (CRM) for both species.

This chapter has been prepared by Atmos Consulting Ltd., led by James Wilson (Associate Director, Atmos Consulting Ltd.), an experienced ecologist with more than 20 years' experience respectively in ecology and ornithology, including both undertaking and managing ornithology surveys in support of predominantly mineral and wind farm developments. James has undertaken a number of impact assessments and produced EIA chapters for wind farms and other development types. He is experienced in the subject matter and in the species regularly encountered in the area in which the Proposed Development is located.

This chapter should be read in conjunction with the following documents:

- **EIA Further Environmental Information (FEI) Technical Appendix 8.1: Kernel Density Analysis**;
- **Chapter 8: Ornithology** of the **EIA Report (EIAR)** as submitted to the planning authority in February 2025, together with the following technical appendices:
  - **Technical Appendix 8.1: Ornithology;**
  - **Technical Appendix 8.2: Confidential Ornithology:**
  - **Technical Appendix 8.3: Shadow Habitats Regulations Appraisal (HRA); and**
  - **Technical Appendix 8.4: Ornithological Modelling.**

1.2 Consultation

Table 8.1 summarises the comments of consultees on the matters post-application of the EIAR related to ornithology.

Table 8.1: Post-application Consultation

Consultee	Responses Relevant to Avian Ecology	Comment
NatureScot 27 June 2025	**Kinveachy Forest Special Protection Area (SPA) and SAC** The proposed development site lies 0.6km from this SPA and SAC, with the nearest turbine around 1km from the boundary. The SPA is protected for breeding capercaillie and Scottish crossbill. The SAC is protected for its Caledonian forest and Bog woodland. Although baseline conditions indicate that the wind farm itself would be unlikely to affect the features of the SPA and SAC, the proposed expansion of woodland into the wind farm site as part of the Outline Habitat Management and Biodiversity Enhancement Plan could create an increased risk of collision for capercaillie. In addition, although we recognise the potential benefits of woodland expansion, there are also potential risks to the Caledonian forest, particularly where planting is proposed, which have not been considered in the EIAR (a).	(a) Noted and the OHMBEP has been updated (**FEI Technical Appendix 8.2** refers). As the proposed woodland expansion will be at a minimum of 1km distance from the nearest infrastructure of the proposed wind farm, there will be no increased collision risk for Capercaillie. (b) Noted and the OHMBEP has been updated to incorporate the proposed changes (**FEI Technical Appendix 8.2** refers).

Consultee	Responses Relevant to Avian Ecology	Comment
	Our advice is that this proposal is likely to have a significant effect on the SPA capercaillie population and the SAC Caledonian Forest. Consequently, the Scottish Government, as competent authority, is required to carry out an appropriate assessment in view of the sites' conservation objectives for its qualifying interests. To help you do this, we advise that on the basis of the information provided, if the proposal is carried out strictly in accordance with the following changes, our conclusion is that the proposal will not adversely affect the integrity of the site: **i) Turbines 1 and 2 should not be microsited closer to the SAC/SPA boundary (they are currently around 1km from the SPA/SAC boundary).** **ii) If the wind farm is consented, the final Habitat Management and Biodiversity Enhancement Plan should be agreed with the consenting authority in consultation with NatureScot. The Plan should include the following mitigation:** • **There should be no tree planting within 1km of the proposed turbines.** • **Tree regeneration within 1km of the proposed turbines should be managed to ensure it does not increase the collision risk to capercaillie. Details of how this would be achieved should be included in the final Plan.** • **There should be no additional fencing within the Plan area.** • **A Species Protection Plan for capercaillie. This should set out the mitigation that would be in place to avoid the risk of disturbance to capercaillie during works associated with the Plan.** • **Expansion of pine woodland within the combined regeneration and buffer zone around the core Caledonian Pinewood Inventory area should be achieved by natural regeneration.** The appraisal we carried out considered the impact of the proposals on the following factors: **Kinveachy Forest SPA** • There is a likely significant effect for the following SPAs, protected for capercaillie, which are within dispersal distance of the proposed development: Darnaway and Lethen Forest SPA (located to the north-east of the proposed development); and Kinveachy Forest, Abernethy Forest, Craigmore Wood, Anagach Woods and Cairngorms SPAs (located to the east and south-east of the proposed development). • The risk of collision and disturbance to capercaillie from the proposed wind farm itself is likely to be low, provided turbines are not microsited closer to the SPA. This is due to the existing baseline, including habitats on site, and distance and location of the proposed wind farm in relation to the above SPAs and capercaillie records. • The proposed woodland expansion within the Outline Habitat Management and Biodiversity Enhancement Plan could however change this existing baseline through increasing habitat suitability within and closer to the proposed wind farm. This could increase the collision risk to capercaillie - although evidence suggests that capercaillie are likely to be displaced by operational turbines, there is also evidence that complete avoidance does not occur with observations from mainland Europe indicating that capercaillie collisions with turbine bases	

Consultee	Responses Relevant to Avian Ecology	Comment
	do occur. This risk would need to be mitigated by ensuring there is no increase in tree cover within 1km of the proposed turbines. • Woodland management is proposed close to the SPA and other areas of suitable habitat for capercaillie. A Species Protection Plan would be required to set out the necessary mitigation to avoid the risk of disturbance to lekking and breeding capercaillie. • There should be no additional fencing within the Plan area as fencing close to suitable capercaillie habitat could increase the risk of collision to capercaillie. We recommend instead that any woodland expansion proposals would need secured by an effective Deer Management Plan (b).	
	b. Kinveachy Forest Site of Special Scientific Interest (SSSI) The proposed development site includes part of this SSSI, with the nearest turbine around 0.1km from the SSSI boundary. The SSSI is protected for its breeding bird assemblage and native pinewood. In relation to the breeding bird assemblage feature of the SSSI, there are natural heritage interests of national importance on the site, which could be affected by the proposal. We require further information (detailed below) to determine if the proposal will affect the integrity of the SSSI. We therefore object to the proposal until the further information detailed below is obtained from the applicant and considered by the Energy Consents Unit: • **A further year of bird survey work is to be completed across the proposed development site, following the methods set out in our bird survey guidance at: https://www.nature.scot/doc/recommended-bird-survey-methods-inform-impact-assessment-onshore-windfarms.** The breeding bird assemblage is a woodland bird assemblage. The applicants should note that this includes a range of woodland birds such as black grouse, osprey and red kite, and is not limited to capercaillie, Scottish crossbill and crested tit. We recommend that the applicants contact us to agree the scope of additional survey work required. Depending on the outcome of the initial results further survey work may be required. Following this, assessment of impacts will be required, which considers the potential for collision risk, disturbance and displacement. We will comment further once the additional information is available. Our advice for the native pinewood feature is covered by the advice for the Kinveachy Forest SAC above (a).	(a) Three years of survey work has been completed at the site, the results of which are presented in **Technical Appendices 8.1 and 8.2 of the EIAR**. It is considered that an additional year of bird survey work will not substantially alter the existing baseline as reported or the assessment as presented in **Chapter 8 of the EIAR** and within this **FEI chapter**.
	3. Wider Countryside birds Due to shortfalls in the survey and assessment undertaken, we advise that there is insufficient information to assess the impacts of this proposal on Annex 1 birds in the wider countryside, in particular the Natural Heritage Zone (NHZ) 10 and national populations of white-tailed eagles. • **In relation to white-tailed eagle, we therefore object to this proposal until further information is provided to allow an accurate assessment of the collision risk to white-tailed eagles** (a). • **In relation to other Annex 1 birds in the wider countryside, we therefore advise that a further year of bird survey work is completed across the proposed development site following our guidance** (b). ***Further advice for white-tailed eagles*** The calculated annual collision rate for white-tailed eagle from this proposal is very high. It would seem likely that flights	(a) Further information is presented in **FEI Technical Appendix 8.1** and an amended assessment is provided within this **FEI chapter**. (b) Three years of survey work has been completed at the site, the results of which are presented in **Technical Appendices 8.1 and 8.2 of the EIAR**. It is considered that an additional year of bird survey work will not substantially alter the existing baseline as reported or the assessment as presented in **Chapter 8 of the EIAR** and within this **FEI chapter**. (c) Three years of survey work has been completed at the site, the results of which are presented in **Technical**

Consultee	Responses Relevant to Avian Ecology	Comment
	recorded are the adults from a nearby territory and their offspring, but the vantage point survey results do not indicate if the flights recorded were adult or juvenile birds. In addition, only one year of survey work has covered the south-eastern part of the site (our guidance recommends 2 years); contextual information from the Highland Raptor Study Group has not been obtained; and the timing of survey work over a limited temporal range means that collision rate could have been underestimated. **There is therefore insufficient information to assess the collision risk to white-tailed eagles** (c). There is evidence from Europe that white-tailed eagle territories with 3km of operating wind farms have lower occupancy and lower productivity than nests beyond this distance. It is unclear whether this is the result of collision mortality to adults, which are then replaced by new birds, resulting in these territories becoming 'sinks'. We are only aware of one pair of white-tailed eagle within NHZ10. **The proposed development could therefore reduce the range of the recovering white-tailed eagle population** (d). The predicted collision risk would also add significantly to a growing cumulative collision risk at a national level. Taking into account other recent wind farm applications, across Scotland the cumulative annual collision risk for white-tailed eagle is currently more than 14 birds per year. **This is likely to result in significant impacts on the growth rate of the national population of this re-introduced protected species, which will slow the rate of range expansion and hinder progress towards restoring its former range across Scotland** (e). We advise that in the first instance the applicants contact the Highland Raptor Study Group to request desk study information on any white-tailed eagle territories within 6km of the site as well as any available satellite tag data. If satellite tag data is available we recommend that a Kernel Density analysis is undertaken to identify the core areas of use of any territories. Although this will not provide a collision risk estimate it will help to indicate how much the proposed development site is used by white-tailed eagle and the requirement for further survey work. At this stage we advise that one further year of vantage point survey work is likely to be required across the whole of the proposed development site, with an additional year (i.e. two further years in total) covering the south-east part of the site in which turbines 1 to 8 are located (f). ***Further advice on Annex 1 birds in the wider countryside*** There is currently insufficient information to assess the potential impacts to Annex 1 birds in the wider countryside. This is due to the survey limitations listed in Technical Appendix 8.1 of the EIAR, notably the lack of survey coverage outside the red line application boundary which does not follow our guidance; shortfalls in the timing of breeding bird surveys within the wind farm site itself; because the eight turbines in the south-east section of the proposed development site have only been covered by one year of survey work (contrary to our guidance which recommends two years of survey work); and because the applicants do not appear to have accessed data held by the Highland Raptor Study Group which could have aided their assessment. The timing of vantage point surveys during the 2023 breeding season also provides limited temporal spread and may have underestimated flight activity. **Given the scale of the proposal and sensitivity of this site we consider that survey undertaken to date is inadequate to complete an**	**Appendices 8.1 and 8.2 of the EIAR**. It is considered that an additional year of bird survey work will not substantially alter the existing baseline as reported or the assessment as presented in **Chapter 8 of the EIAR** and within this **FEI chapter**. The results of consultation with the Highland Raptor Study Group is presented in **FEI Technical Appendix 8.1**. (d) Ornithological modelling (including Population Viability Analysis (PVA) was presented in **Technical Appendix 8.4 of the EIAR**, and an amended version is provided in **FEI Technical Appendix 8.1**. This included an assessment on the NHZ population based on collision risk assessed from the local satellite tagged birds which showed that without immigration the NHZ population would likely be maintained with the level of predicted cumulative collision risk (e) Ornithological modelling (including Population Viability Analysis (PVA) was presented in **Technical Appendix 8.4 of the EIAR**, and an amended version is provided in **FEI Technical Appendix 8.1**. (f) The results of the data consultation exercise are provided in **FEI Technical Appendix 8.1**, along with the results of the Kernel Density Analysis. Three years of survey work has been completed at the site, the results of which are presented in **Technical Appendices 8.1 and 8.2 of the EIAR**. It is considered that an additional year of bird survey work will not substantially alter the existing baseline as reported or the assessment as presented in **Chapter 8 of the EIAR** and within this **FEI chapter**. (g) The results of the data consultation exercise are provided in **FEI Technical Appendix 8.1**, along with the results of the Kernel Density Analysis. Three years of survey work has been completed at the site, the results of which are presented in **Technical Appendices 8.1 and 8.2 of the EIAR**. It is considered that an additional year of bird survey work will not substantially alter the existing baseline as reported or the assessment as presented in **Chapter 8 of the EIAR** and within this **FEI chapter**. (h) Three years of survey work has been completed at the site, the results of which are presented in **Technical Appendices 8.1 and 8.2 of the EIAR**.

Consultee	Responses Relevant to Avian Ecology	Comment
	assessment of the impacts to Annex 1 birds in the wider countryside (g). **For both of these issues,** we recommend that the applicants contact us to agree the scope of survey work required. Depending on the outcome of the initial results further survey and assessment may be required. Assessment of impacts will be required to consider the potential for collision risk, disturbance and displacement both from the proposed development on its own (including the proposed OHMBEP) and in combination with other developments (at the NHZ10 scale). Again, we recommend that the applicants contact us to agree the scope of this assessment. We will comment further once the additional information is available (h).	Further information is presented in **FEI Technical Appendix 8.1**. The assessment as presented in **Chapter 8 of the EIAR** has been updated to include the additional information as presented in **FEI Technical Appendix 8.1**, and the amended assessment is presented within this **FEI chapter**.

1.3 Methodology

Except as detailed below, the assessment methodology and criteria remain as detailed within the EIAR.

The one exception to this is in the collision risk modelling (CRM) undertaken. The results of the CRM as presented in the EIAR was undertaken following current guidance at the time of writing (NatureScot, 2000 and 2018). The model has been re-run in accordance with current guidance (NatureScot, 2024 and 2025).

1.3.1 Collision Risk Modelling

The Proposed Development consists of up to 26 turbines with a maximum blade tip height of 200m. The turbine parameters used for the model are presented in Tables 8.2 and 8.3. Modelling was carried out with a precautionary approach, where if decisions were being made about parameters, the approach was to take a precautionary but accurate approach.

Table 8.2: Turbine Parameters

Parameter	Dimensions	Unit
Number of Turbines	26	-
Baldes per Turbine	3	-
Hub Height	119	Metres
Rotor Radius	81	Metres
Maximum Chord	4.6	Metres
Pitch	15	Degrees
Mean Operational Rotor Speed		Revolutions per Minute
Proportion Operational	85	Percentage
Turbine Type		

Table 8.3: Blade Profile

f/R	c/C
0	0.575
0.05	0.575
0.1	0.702
0.15	0.86
0.2	1
0.25	0.947
0.3	0.899

f/R	c/C
0.35	0.851
0.4	0.804
0.45	0.756
0.5	0.708
0.55	0.66
0.6	0.613
0.65	0.565
0.7	0.517
0.75	0.47
0.8	0.422
0.85	0.374
0.9	0.327
0.95	0.279
1	0

Collision Risk Modelling (CRM) was carried out for both Golden eagle and White-tailed eagle (using satellite telemetry data), and for Golden eagle, Red kite *Milvus milvus* and White-tailed eagle (using flight activity data recorded over the Site during vantage point (VP) surveys between September 2020 and August 2022, and January 2023 to December 2023).

Flights included in the calculations were all those recorded within the viewsheds of the original vantage point (VP) locations (**Figure 3** of **EIAR Technical Appendix 8.1** refers), clipped to 500m around all the turbine locations. Incidental records[1] were not included.

A model (Forsythe *et al*., 1995) was used to calculate the daytime length as a function of latitude (57°17′1″N for the centre of the proposed Clune wind farm) and date (2023).

The Collision Risk Model

The general methodology used to predict collision risk for birds using the wind farm airspace is provided by NatureScot (NatureScot, 2024).

The model estimates the number of collisions through a process of five stages:

- **Stage A** uses bird survey data (in this case, satellite telemetry data and data from the original surveys) to establish the density of flying birds in the vicinity of the turbines (out to a distance of 500m), and the proportion flying at a risk height, between the lowest and highest points of the rotors (in this case, between 30 and 210m as turbine rotors are 38 – 200m);
- **Stage B** provides an estimate, based on the bird density and proportion at risk height, of the potential number of bird passages through rotors in the period in question;
- **Stage C** calculates the probability of collision during a single bird rotor transit;
- **Stage D** estimates the potential collision rate for a bird species, assuming current levels of bird use of the site, allowing for the proportion of time that turbines are not operational; and

[1] Standard record type means that the bird was observed during the duration of the vantage point watch and was within the viewshed of the VP (formed from a 180° arc centred on a predetermined view bearing out to a distance of 2km).

Incidental record type means that the bird was observed outwith the duration of the vantage point watch and / or was beyond the 2km limit.

- **Stage E** takes account of the proportion of birds likely to avoid the wind farm or its turbines, either because they have been displaced from the site or because they take evasive action or are attracted to the wind farm, e.g. in response to changing habitats.

Finally, **Stage F** requires uncertainty over time and space to be expressed through a range of confidence to give a best estimate for collision risk. Information to include should reflect:

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

In summary, the following steps were followed for this assessment:

- Digitise all flight lines and record relevant characteristics (including species, number of birds, start and finish time of flight, actual flight height (obtained from satellite telemetry data) and average flight height (obtained from original surveys) and time within each height band) in database;
- Calculate total bird activity for each species with sufficient flight activity to justify collision risk modelling;
- Calculate an 'areal bird density' which is the number of birds per unit area in flight at any height at a given point in time. The areal bird density is most usually expressed per square kilometre (km^2);
- With regards satellite telemetry data, calculate an 'occupancy rate' for each vantage point, defined as actual bird activity, i.e. time spent in the wind farm divided by the wind farm area, with flight activity clipped to 500m around all turbines;
- With regards flight activity data recorded over the Site from VP surveys, calculate an 'occupancy rate' for each vantage point, defined as the observed 'at risk' activity levels divided by total observation time and area observed, giving the occupancy per unit time and unit area for each VP, with flight activity clipped to 500m around all turbines;
- Average the occupancy rate across the VPs using an un-weighted mean approach;
- Apply the average occupancy rate to the wind farm development site, based on the Proposed Development area, risk volume and total turbine rotor volume, applying a factor to estimate the total time that the birds could theoretically be active during the year, based on an algorithm for calculating day length (Forsythe *et al*., 1995); thus determining the total predicted time spent by the individual species within air space that could be swept by turbine blades;
- Run the collision model with relevant turbine and ornithological parameters to calculate the theoretical probability of transits resulting in a collision assuming no avoiding action; and
- Multiply the number of transits by the collision rate, avoidance factor and operating parameters of the proposed wind farm to estimate the theoretical number of collisions per year.

Avoidance rates used were in accordance with NatureScot guidance (NatureScot, 2025).

The predicted mortality through collision is dependent on a number of variables, including flight activity within the turbine envelope, the species' physiology, nocturnal flight behaviour and flight velocity, weather conditions, the predicted avoidance rate, the number, rotational speed and

dimensions of the turbines, and the proportion of the time that the turbines are operational throughout the year.

The following assumptions were made for the various species:

- A daylight calculator was used to produce figures for the total daylight period at the Site;
- Biometric data (bird length and wingspan) for all species was obtained from the BTO webpage (Table 8.4); and
- All species were considered active during the day only.

Table 8.4 presents a summary of the model used for each species, biometric parameters, avoidance rates and the seasons during which the species was present on Site.

Table 8.4: Biometric Parameters used for CRM

Species	Bird Length (m)	Wingspan (m)	Bird Speed (m/s)	Avoidance Rate	Months Active	Daylight Hours	Nocturnal Hours	Total Hours	Activity Assumed Period	Flapping / Gliding
Golden eagle	0.82	2.12	11.9	0.990	All year	4504.20	0.00	4504.20	Daylight hours only	F
Red kite	0.63	1.85	12	0.990	All year	4504.20	0.00	4504.20	Daylight hours only	G
White-tailed eagle	0.8	2.2	13.6	0.95	All year	4504.20	0.00	4504.20	Daylight hours only	F

1.4 Baseline Conditions

The baseline remains the same as that reported within the EIAR. Additional information regarding the occurrence of White-tailed eagle over the Proposed Development as recorded by satellite tagged birds and data obtained from the Highland Raptor Study Group is included in Confidential Technical Appendix 8.1 of the FEI.

1.5 Mitigation Measures

In line with current Chartered Institute of Ecology and Environmental Management (CIEEM) guidelines (2022) and within the EIAR, the impact assessment in this FEI chapter is carried out in the presence of mitigation measures.

Mitigation measures as detailed in the EIAR remain the same.

1.6 Identification and Evaluation of Key Impacts

As the Kernel Density Analysis and subsequent amended Collision Risk Modelling (CRM) are related to an assessment of operational phase impacts only, only impacts at this phase are detailed here.

Assessment of impacts at both the construction and decommissioning phases remain as detailed within the EIAR.

1.6.1 Assessment of Operational Phase Impacts

The following impacts are considered for the operational phase:

- Disturbance / displacement (including barrier effects); and
- Additional mortality as a result of collision risk.

An updated impact assessment is provided for only Golden eagle, Red kite and White-tailed eagle, based on the results of the Kernel Density Analysis of satellite tagging data (applicable to Golden eagle and White-tailed eagle only), and an amended CRM (applicable for Golden eagle, Red kite and White-tailed eagle).

The biometric parameters used within the collision risk model (CRM) for those species listed above are provided in Table 8.5. A random CRM exercise was undertaken for both Golden eagle and White-tailed eagle (using satellite telemetry data), and for Golden eagle, Red kite and White-tailed eagle (using flight activity data recorded over the Site during vantage point (VP) surveys between September 2020 and August 2022, and January 2023 to December 2023).

Table 8.5: Biometric Parameters used for CRM

Species	Bird Length (m)	Wingspan (m)	Bird Speed (m/s)	Avoidance Rate	Months Active	Daylight Hours	Nocturnal Hours	Total Hours	Activity Assumed Period	Flapping / Gliding
Golden eagle	0.82	2.12	11.9	0.990	All year	4504.20	0.00	4504.20	Daylight hours only	F
Red kite	0.63	1.85	12	0.990	All year	4504.20	0.00	4504.20	Daylight hours only	G
White-tailed eagle	0.8	2.2	13.6	0.95	All year	4504.20	0.00	4504.20	Daylight hours only	F

Golden Eagle

This species has been observed transiting the Site below, at and above collision risk height. No breeding attempts were recorded during the field surveys.

A long term study at Benn an Tuirc Wind Farm (Walker, McGrady, McCluskie, Madders, & Mcleod, 2016) and Fielding and Haworth (2011) at Edinbane Wind Farm showed that Golden eagle will avoid the turbine array but there were no other detectable effects of the presence of a wind farm development in an eagle's range. Birds continued to hunt in proximity to the wind farm.

Golden Eagle Territory (GET) modelling has been carried out (**EIAR Technical Appendix 8.4**) which shows that the area which contains the turbines contains a mix of highly suitable / low suitable territory for Golden eagle. The central area of the turbine area is generally low suitability, but the south-east turbines are in an area of moderate to high suitability. This area is approximately 2.35km^2. There may be additional displacement around two other western turbines which sit on the edge of highly suitable habitat. Data from satellite tracked individual birds showed comparison with the GET model in that the central area of the array was less used. However there were some very localised areas of use on the fringes of the array which the GET model had not identified and one

'hot spot' of use within the array. The evidence from other studies suggests that access to most of the areas of higher activity would be retained, but the one hotspot within the array would likely be avoided once turbines are constructed. This would cause displacement and activity in that area would likely have to be accommodated elsewhere. However, year on year , use of this area was not consistent (**Figure 8.1.4** of **FEI Confidential Technical Appendix 8.1**).

At the same time, this would not be considered a significant impact given the large range of this species and the scale of the Proposed Development in an open environment with few other constraints. However, the impacts will be long term in duration.

Table 8.6 presents the overall annual collision risk for Golden eagle, number of years per collision, and the total number of collisions over the 40 year lifespan of the Proposed Development, and the contrast between the collision rate from the Kernel Density Analysis, that presented in **Chapter 8** and **Technical Appendix 8.1 of the EIAR** as calculated using previous guidance (NatureScot, 2000 and 2018), and the collision rate as calculated under current guidance (NatureScot, 2024, 2025).

Table 8.6: Collision Risk Modelling Results – Golden Eagle

Species	Avoidance Rate	Collisions per Year	Uncertainty (collisions per year)		Number of years per collision	Collisions over 40 years
			Lower range	Upper range		
From Kernel Density Analysis						
Golden eagle	0.990	0.044			22.73	1.76
From survey results from VP surveys as presented in Chapter 8 and Technical Appendix 8.1 of the EIAR (calculated using previous guidance (NatureScot, 2000 and 2018))						
Golden eagle	0.990	0.277			3.6	11.08
From survey results from VP surveys (calculated using current guidance (NatureScot, 2024 and 2025)						
Golden eagle	0.990	0.149	0.066	0.233	6.69	5.975

The results of the collision risk model are variable with the predicted loss of 1.76 birds over the 40-year lifetime of the Proposed Development using satellite telemetry data, and 6 birds using VP survey data with the model run using current guidance (NatureScot, 2024 and 2025). Both are significantly less than the predicted loss of 11 birds with the model run using previous guidance (NatureScot, 2000 and 2018). The collision risk data calculated using satellite telemetry data should be considered a subset of that calculated using flight activity data, as only a proportion of the eagle population is satellite tagged. It is indicative of the level of collision risk that would affect the local population of eagles.

Population Viability Modelling (PVA) (**FEI Technical Appendix 8.1**) was carried out using a stochastic model. For all models, regardless of whether collision risk was included or not, the population was found to decline. These models showed contradictory outcomes with the deterministic model (as presented in **Technical Appendix 8.4 of the EIAR**) showing increasing populations even after the additional mortality as a result of collision risk was included, while the stochastic model showed declines in all populations, even the baseline model. Both models represent a different approach to modelling; the deterministic model is usually too optimistic, in that it assumes there is no variation in the population, except as expressed in the means. The stochastic model allows for variation, but for smaller populations is more likely to decline to extinction because of that.

The current understanding of the Golden eagle population dynamics across the region show a recent improvement in the population within the central and southern Highlands. The 2015 population survey showed a large increase (Hayhow, Benn, Stevenson, Stirling-Aird, and Eaton, 2017) (possibly linked to increased scrutiny of illegal persecution in this area which may cause a reduction in its

occurrence). This may mean the stochastic model is too conservative or has not captured current population parameters correctly. Given that, and the fact that stochastic models can be too conservative with small populations, particularly when the population has strong population growth parameters (as demonstrated by the deterministic model), then it is likely that the stochastic model is overestimating the impact of the collision risk on the population.

At the same time, the collision risk estimates do not take account of displacement effects which are known to occur in this species. As such, the collision risk is likely to be substantially lower than the estimate, as birds will avoid the central turbine array and as such, the exposure to collision risk will be lower than in the collision modelling which does not account for that level of avoidance behaviour in the avoidance rate used.

Therefore it is considered that the collision risk is **unlikely to be significant** to this species, although there is some uncertainty around this.

Red Kite

There was evidence for breeding within the Site but generally in areas where disturbance would not occur. The probable territory is approximately 500m from any infrastructure; however it is likely to be further than this as the area the territory is located on (see **Figure 8.2.3** and **Figure 8.2.5** in **Technical Appendix 8.2: Confidential Annex of the EIAR**) had no suitable features for kite nesting; the actual nest location is therefore likely to be further from infrastructure given where the nearest suitable habitat for nesting is.

There is some suggestion that Red kites can be displaced from operational turbine arrays (Duffy and Urquhart, 2014), although kites in that long term study did continue to forage within the array and it was unclear if the reduced activity was a function of displacement or a change in activity in the area. Kites were reported as the victims of collision risk.

On a precautionary basis, it would be assumed that there would be some level of operational displacement by local birds. However while activity was observed within what would become the turbine array area, levels of activity were greater to the north of this area, which would remain available for foraging kite. As a result, the removal of the area of ground supporting the turbine array is considered **not significant**. Areas with higher levels of activity within the Site are still available for foraging. Confidence in this assessment is considered to be probable.

Table 8.7 presents the overall annual collision risk for Red kite, number of years per collision, and the total number of collisions over the 40 year lifespan of the Proposed Development, and the contrast between the collision rate as presented in **Chapter 8** and **Technical Appendix 8.1 of the EIAR** as calculated using previous guidance (NatureScot, 2000 and 2018), and the collision rate as calculated under current guidance (NatureScot, 2024, 2025).

The collision risk model using current guidance (NatureScot, 2024 and 2025) has predicted the loss of 12 birds over the 40 year lifetime of the Proposed Development, which is substantially less than the 27 birds predicted as lost (calculated using previous guidance (NatureScot, 2000 and 2018), and presented in **Chapter 8** and **Technical Appendix 8.1 of the EIAR**).

Even so, the predicted loss of 12 birds is a substantial level of mortality, so a PVA was undertaken to model the effects of this on the local Red kite populations. Details of this are provided in **Technical Appendix 8.1 of the FEI**.

This showed that the level of mortality would **not have a significant impact** on the population, which would continue to increase. Confidence in this assessment is considered near certain.

Previous research carried out in 2016 (Samson, Etheridge, Smart, and Roos, 2016) had suggested that the Highland Red kite population could be sensitive to additional mortality from collision risk due to the illegal persecution that the population was undergoing, which was restricting capacity to grow. However since 2016, the population has continued to grow and expand and as such, the robustness to additional mortality sources has increased.

Table 8.7: Collision Risk Modelling Results – Red Kite

Species	Avoidance Rate	Collisions per Year	Uncertainty (collisions per year)		Number of years per collision	Collisions over 40 years
			Lower range	Upper range		
From survey results from VP surveys as presented in Chapter 8 and Technical Appendix 8.1 of the EIAR (calculated using previous guidance (NatureScot, 2000 and 2018))						
Red kite	0.990	0.681			1.5	27.24
From survey results from VP surveys (calculated using current guidance (NatureScot, 2024 and 2025)						
Red kite	0.990	0.295	0.130	0.460	3.39	11.795

White-tailed Eagle

This species has been observed transiting the Site below, at and above collision risk height. No evidence of breeding was recorded within the Site but an active nest was recorded in 2023 in the buffer zone.

With regards displacement effects, given the design and scale of the Proposed Development, it is considered that there will be **no significant operational effects** on White-tailed eagle, given the large range of this species and the scale of the Proposed Development in an open environment with few other constraints. The satellite tracked birds showed a preference for moving through the area to the east of the Proposed Development. However, the impacts will be long term in duration.

Table 8.8 presents the overall annual collision risk for White-tailed eagle, number of years per collision, and the total number of collisions over the 40 year lifespan of the Proposed Development, and the contrast between the collision rate from the Kernel Density Analysis, that presented in **Chapter 8** and **Technical Appendix 8.1 of the EIAR** as calculated using previous guidance (NatureScot, 2000 and 2018), and the collision rate as calculated under current guidance (NatureScot, 2024, 2025).

The collision risk model using current guidance (NatureScot, 2024 and 2025) has predicted the loss of 13 birds over the 40 year lifetime of the Proposed Development (based on satellite telemetry data), or 11 birds (based on survey results from VP surveys and calculated using current guidance (NatureScot, 2024 and 2025)). Both results are substantially less than the 39 birds predicted as lost (calculated using previous guidance (NatureScot, 2000 and 2018), and presented in **Chapter 8** and **Technical Appendix 8.1 of the EIAR**).

Even so, the predicted loss of 13 birds (worst case scenario) is a substantial level of mortality, so a PVA was undertaken to model the effects of this on the White-tailed eagle population. Details of this are provided in **Technical Appendix 8.1 of the FEI**.

This showed that at the national level, the population growth is too strong to be impacted by the collision risk estimated for this species. The data from the satellite telemetry was also used on a local level PVA which despite the very small population size, suggested that the current population would continue to grow even with the levels of collision risk suggested by the tagged birds. This does not fully rule out local level effects, as the satellite tagged birds are a proportion of the local population but they are a significant part of it and given the strong population growth for the species, these would **not be considered significant**.

Table 8.8: Collision Risk Modelling Results – White-tailed Eagle

Species	Avoidance Rate	Collisions per Year	Uncertainty (collisions per year)		Number of years per collision	Collisions over 40 years
			Lower range	Upper range		
From Kernel Density Analysis						
White-tailed eagle	0.950	0.326			3.07	13.04
From survey results from VP surveys as presented in Chapter 8 and Technical Appendix 8.1 of the EIAR (calculated using previous guidance (NatureScot, 2000 and 2018))						
White-tailed eagle	0.950	0.97			1.0	38.8
From survey results from VP surveys (calculated using current guidance (NatureScot, 2024 and 2025)						
White-tailed eagle	0.950	0.258	0.114	0.402	3.88	10.322

1.7 Cumulative Effects

Cumulative impacts of wind farms on ornithological features may be categorised into two areas:

- Larger scale impacts of displacement and / or disturbance; and
- Increased mortality across a larger area due to collision risk.

Collision risk modelling is a broad-brush tool, the results of which provide an indication rather than a definitive risk calculation. Other factors such as disturbance and displacement, whether in the breeding season or winter, may carry as much weight, or more, in terms of realistic impacts.

The greatest theoretical risks of significant cumulative effects are on species of National or International importance from a high volume of wind farms being present in a relatively small area.

Current guidance suggests that the highest priority for cumulative impact assessment is for species that are declining and / or not in favourable conservation status, and that species of very high conservation importance or those vulnerable to wind farm developments should be targeted for cumulative assessments (NatureScot, 2012).

The context in which cumulative impacts are considered also depends upon the ecology of the species in question. For example, it may be appropriate to consider cumulative collision risk to geese associated with a SPA within the context of their wider foraging range.

For other receptors, such as breeding waders, it may be appropriate to consider the impacts on the local population in the context of any planned wind farms in the immediate vicinity which have the potential to cause additional displacement on a much more localised population.

Cumulative impact assessments are often complicated by limited availability of ornithological impact assessments for other wind farm developments. Where this information is available, survey periods and methods may differ between sites.

Furthermore, some wind farm developments may have been operational or in planning for many years, and thus data may no longer be valid due to age of data and / or changes in bird populations since the time of survey.

They may also have been assessed using different standards (for example, on older wind farm sites, collision risk avoidance rates may be different from those used currently and the EIA may not be explicit about what avoidance rate was used).

Furthermore, figures used to calculate cumulative collision risk generally do not take into account proposed mitigation or compensation. Therefore, it is reasonable to assume, where agreed with

NatureScot, that implementation of mitigation and compensation measures will reduce the overall impacts.

A search was carried out for wind farms with three or more turbines with tip heights greater than 50m[2] within NHZ 10 Central Highlands, and where appropriate within NHZ 7 Northern Highlands and NHZ 21 Moray Firth, out to a distance of 40km from the Site.

Table 8.9 shows the results of that search. Records of refusals more than two years old and projects which have been scoped more than five years ago have been omitted. Collision risk modelling data available is compared for the species (in this instance, Golden eagle, Red kite and White-tailed eagle) for which collision risk assessment has been made for the Proposed Development.

Table 8.9: Overview of Wind Farm Developments within 40km of the Site

Site Name	Distance (km) and Direction from nearest turbine	County	Status	No. of Turbines	NHZ	Species under assessment for which collision risk modelling is available
Kyllachy	~ 3km north	Highland	Scoping	11	10	
Glen Kyllachy	4.7km north-west	Highland	Operational	20	10	Golden eagle Red kite
Highland Wind Farm	~5km south-west	Highland	Application	19	10	Golden eagle White-tailed eagle
Farr	6.4km north-west	Highland	Operational	40	10	
Aberarder	11km west	Highland	Under Construction	12	10	Golden eagle
Dunmaglass	11.4km west	Highland	Operational	33	10	
Tom na Clach Extension	13.2km north-east	Highland	Approved	7	10	Golden eagle Red kite
Tom na Clach	13.4km north-east	Highland	Operational	13	10	Golden eagle Red kite
Moy	13.7km north	Highland	Operational	20	10	
Lethen	16.8km north-east	Highland	Application	17	10	Golden eagle Red kite
Corriegarth 2	19.2km south-west	Highland	Consented	16	10	Golden eagle Red kite White-tailed eagle
Corriegarth	19.7km south-west	Highland	Operational	23	10	Golden eagle
Balmore	23.4km north-east	Highland	Scoping	8	10	
Cairn Duhie Redesign	26.2km north-east	Highland	Application	16	10	
Cloiche	26.4km south-west	Highland	Consented	36	10	Golden eagle Red kite White-tailed eagle
Stronelairg	26.8km south-west	Highland	Operational	66	10	

[2] These parameters were selected because smaller developments are less likely to have quantitative data or may not even have an associated Environmental Statement or EIA Report.

Site Name	Distance (km) and Direction from nearest turbine	County	Status	No. of Turbines	NHZ	Species under assessment for which collision risk modelling is available
Ourack	29.3km north-east	Highland	Application	18	10	Golden eagle Red kite White-tailed eagle
Dell	29.8km south-west	Highland	Consented	14	10	Golden eagle
Dell Redesign	29.9km south-west	Highland	Scoping	9	10	Golden eagle
Berry Burn	33.9km north-east	Moray	Operational	29	10	
Hill of Glaschyle	34.3km north-east	Moray	Operational	12	10	
Berry Burn Extension	36.2km north-east	Moray	Approved	9	10	

Table 8.10 provides a summary of the results of the cumulative annual collision risks for Golden eaglem Red kite and White-tailed eagle only, incorporating the revised CRM results for Clune for these species only. Collision risk estimates were adjusted where avoidance rates had been changed subsequent to the rate being estimated. Figures are quoted to three decimal places and no values approximating to zero are actually zero values.

Table 8.10: Collision risk estimates for Golden eagle, Red kite, and White-tailed eagle assessed at the Proposed Development and for Wind Farms in NHZ 10

Wind Farm Status and Name	Golden eagle	Red kite	White-tailed eagle
Clune	0.149	0.295	0.258
	Operational		
Glen Kyllachy	0.044	0.484	
Tom na Clach	0.016	0.114	
Corriegarth	0.11		
	Under Construction		
Aberarder	0.11		
	Consented		
Corriegarth 2	0.093	0.222	0.312
Cloiche	0.1 (west) 0.08 (east)	0.01 (west) 0.07 (east)	0.14 (west) 0.03 (east)
Dell	0.029 (worst case scenario)		
	In Planning		
Highland	0.163		0.005
Tom na Clach Extension	0.012	0.115	
Ourack	0.14	0.025	0.055
Dell Redesign	0.199 (worst case scenario)		
	Refused		
Lethen	0.02	0.12	

Table 8.11 provides the cumulative annual estimates for the species considered. Numbers have been rounded to three decimal places where appropriate.

Table 8.11: Summary of Collision Risks in NHZ 10

Category	Golden eagle	Red kite	White-tailed eagle
	The Proposed Development		
Annual Collision Rate	0.149	0.295	0.258
Estimated no. of collisions over 40 years	5.975	11.795	10.322
	Operational, Under Construction and Consented Total		
Annual Collision Rate	0.582	0.9	0.482
Estimated no. of collisions over 40 years	23.28	36	19.28
	Operational, Under Construction, Consented and Proposed Development		
Annual Collision Rate	0.731	1.195	0.74
Estimated no. of collisions over 40 years	29.255	47.795	29.602
	In Planning		
Annual Collision Rate	0.514	0.14	0.06
Estimated no. of collisions over 40 years	20.56	5.6	2.4

1.7.1 Golden Eagle

The population estimate for NHZ 10 is estimated at 12 occupied breeding territories, and 43 and 0 occupied breeding territories respectively for NHZ 7 and 21, resulting in an estimate of 55 occupied breeding territories for the region (Wilson, 2015) .

More recent data from the Scottish Raptor Monitoring Scheme Annual Report 2023 (Peniche *et al*., 2025) has 12 occupied territories out of 17 checked in the Inverness-shire area in 2023.

Collision risks at the Proposed Development equate to approximately one collision every 6.7 years. Adding annual collision estimates of operational, wind farm developments under construction and approved wind farm developments to that of the Proposed Development yields an estimate of 0.7 birds every year.

PVA was carried out for the cumulative risk, and as with all other models (**FEI Technical Appendix 8.1**) the population declined. However, as with the assessment for risk associated with the Proposed Development solely, the cumulative collision risk estimate is an overestimate which does not take into account the behaviour response of Golden eagle to wind farm developments (Walker, McGrady, McCluskie, Madders, & Mcleod, 2016; Fielding and Haworth, 2011), and the displacement that results which would reduce considerably the actual operational collision risk.

Therefore, it is considered that the cumulative collision risk for this species does **not constitute a significant negative effect** on the regional population. Confidence in this assessment is considered probable.

1.7.2 Red Kite

The population estimate for Red kite for NHZ 10 is estimated at zero breeding pairs, and nine and 50 breeding pairs respectively for NHZ 7 and 21 (Wilson, 2015), resulting in an estimate of 59 breeding pairs for the region.

More recent data from the Scottish Raptor Monitoring Scheme Annual Report 2023 (Peniche *et al*., 2025) has 14 occupied territories out of 15 checked in the Inverness-shire area in 2023.

Collision risks at the Proposed Development equate to approximately one collision every 3.4 years. Adding annual collision estimates of operational, wind farm developments under construction and approved wind farm developments to that of the Proposed Development yields an estimate of approximately 1.2 birds every year.

PVA modelling for this species (**FEI Technical Appendix 8.1**) shows that this additional mortality can be absorbed by the regional population without any adverse effects. The population is growing and expanding too strongly for this level of mortality to reverse it. As such, cumulative collision risk is **not considered to be significant** and confidence in this assessment is near certain.

1.7.3 White-tailed Eagle

The population estimate for White-tailed eagle for NHZ 10 is estimated at zero territorial pairs, and one and zero territorial pairs respectively for NHZ 7 and 21 (Wilson, 2015). More recent data from the Scottish Raptor Monitoring Scheme Annual Report 2023 (Peniche *et al*., 2025) has one occupied territory out of one checked in the Inverness-shire area in 2023.

Collision risks at the Proposed Development equate to approximately 0.25 birds every year. Adding annual collision estimates of operational, wind farm developments under construction and approved wind farm developments to that of the Proposed Development yields an estimate of approximately 0.74 birds every year.

PVA modelling for this species (**FEI Technical Appendix 8.1**) has shown that despite the relatively high level of collision risk observed for this species, the population continued to grow. This reflects the buoyant state of the Scottish White-tailed eagle population, as demonstrated in Samson, Evans and Roos (2016), which indicated that the Scottish White-tailed eagle was in the period of rapid expansion following reintroduction.

Therefore, it is considered that the cumulative collision risk for this species does **not constitute a significant negative effect** on the regional population. Confidence in this assessment is considered near certain.

1.8 Summary of Residual Effects

The potential effects of the Proposed Development on ornithological receptors (specifically Golden eagle and White-tailed eagle) found within and in close vicinity to the Site have been assessed. Taking into account the successful implementation of the mitigation measures contained within the CEMP and HMP, there will be **no significant residual effects** in terms of the EIA Regulations (Table 8.5 refers).

Table 8.5: Summary of Residual Effects

Receptor	Evaluation	Operational Phase	
		Disturbance	Collision Risk
Golden eagle	Regional	Negligible – not significant	Minor – not significant
Red kite	County	Negligible – not significant	Minor – not significant
White-tailed eagle	Regional	Negligible – not significant	Minor – not significant

A summary of residual effects for both Golden eagle and White-tailed eagle during the Construction and Decommissioning Phases are not included in Table 8.5 as there is no change to that presented in Chapter 8 of the original EIA Report (RES, 2025).

1.9 Conclusions

Following a Kernel Density Analysis using satellite tagging data purchased from Natural Research for Golden eagle and the Royal Society for the Protection of Birds (RSPB) for White-tailed Eagle, a revised collision risk using current guidance (NatureScot, 2024 and 2025) was calculated for both species and Red kite for the Proposed Development. The resultant annual collision risk for all species was markedly less than that calculated following previous guidance (NatureScot, 2000 and 2018) and presented in **Chapter 8** and **Technical Appendix 8.1 of the EIAR** (RES, 2025).

An updated assessment of potential impacts and associated effects during the operational phase of the Proposed Development was then described.

The residual effects during the operational phase only was then assessed to establish if they would have significant effects on Golden eagle, Red kite and White-tailed eagle, and a cumulative assessment was carried out to identify any regional level impacts which could become significant as a result of the Proposed Development.

No significant residual effects were identified and it is therefore concluded that the Proposed Development can proceed without having an adverse effect on the ornithological receptors on and around the Proposed Development.

1.10 References

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