

## **Technical Appendix 8: Ornithology**

**TA 8.1: Ornithology Appendix**

**TA 8.2: Collision Risk Analysis**



## **Technical Appendix 8.1: Ornithology Appendix**



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**Artfield Forest Wind Farm**

**Technical Appendix 8.1: Ornithological Appendix**



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## 1 INTRODUCTION

1.1.1 This Appendix has been prepared to accompany **Chapter 8: Ornithology** of the Artfield Forest Wind Farm (the Proposed Development) Environmental Impact Assessment (EIA) Report.

1.1.2 It presents detailed methodologies and results of ornithology desk studies and field surveys to inform the design and assessment of the Proposed Development.

1.1.3 It should be read with reference to the following Figures, which are included within **Volume 3a** of the EIA Report:

- **Figure 8.1:** Ornithological Statutory Designated Sites;
- **Figure 8.2:** Desk Study;
- **Figure 8.3:** Vantage Point (VP) Survey Plan;
- **Figure 8.4:** Breeding Bird Survey Plan;
- **Figure 8.5a:** VP Flight Activity Target Species Results (Raptors);
- **Figure 8.5b:** VP Flight Activity Target Species Results (Non-Raptors);
- **Figure 8.6:** VP Flight Activity Target Species Results at Collision Risk Height;
- **Figure 8.7:** Moorland Breeding Bird Survey (MBBS) Results; and
- **Figure 8a:** Confidential Annex 1/Schedule 1 Breeding Raptor and Owl Results<sup>1</sup>.

1.1.4 Only common bird species names are referred to within the main text of this Technical Appendix. **Annex 1** provides a summary of all bird species referred to herein, within **Chapter 8: Ornithology** of the EIA Report and all other associated Appendices and Figures. Both common and species names together with a summary of their conservation status as relevant is provided.

1.1.5 Collision mortality risk analysis is provided separately in **Technical Appendix 8.2**.

1.1.6 Information pertaining to the locations of sensitive breeding bird species and which are considered confidential is provided in **Confidential Figure 8.A in Volume 5**. Such information will not be made publically available, but will be provided to the Scottish Government and NatureScot.

### 1.2 Site Overview

1.2.1 The Site is located approximately 8km northwest of Kirkcowan, 15km west of Newton Stewart, Dumfries and Galloway, Scotland. The habitats comprise a mix of commercially managed coniferous forestry and rough grazing pastures. The Site also supports areas of recently felled and replanted woodland together with compartments of mixed plantation woodland.

1.2.2 Several watercourses intersect the Site, which primarily drain into the Tarf Water river. The Mulniegarroch Burn / Purgatory Burn forms part of the Sites north western boundary.

1.2.3 The eastern extent of the Site holds previous planning consent for the Gass Wind Farm, comprising nine wind turbines and associated infrastructure (Dumfries and Galloway Council Planning Reference

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<sup>1</sup> The confidential figure sits in Volume 5: Confidential Documents.

14/P/1/0674). Reference is made in this report to the Environmental Impact Assessment undertaken for that application<sup>2</sup>.

### 1.3 Key Guidance

1.3.1 Ornithology survey methodologies and subsequent interpretation of results has made reference to the following key industry standard guidance produced by NatureScot (formerly Scottish Natural Heritage (SNH)):

- Brown, A.F. & Shepherd, K.B. (1993). A method for censusing upland breeding waders. *Bird Study* 40, 189-195.
- SNH (2017). *Recommended bird survey methods to inform impact assessment of onshore wind farms*. Version 2. March 2017.
- Hardey, J., Crick, H., Wernham, C., Riley, H., Etheridge, B. & Thompson, D. (2013). *Raptors: a field guide to survey and monitoring*. Third Edition. The Stationary Office, Edinburgh.
- Gilbert, G., Gibbons, D.W. & Evans, J. (1998). *Bird monitoring methods*. A manual of techniques for key UK species. RSPB, Sandy, Bedfordshire.
- Eaton, M., Aebischer, N., Brown, A., Hearn, R., Lock, L., Musgrove A., Noble, D., Stroud, D. & Gregory, R. (2015). *Birds of conservation concern 4: the population status of birds in the UK, Channel Islands and Isle of Man*. British Birds, 108, pp. 708-746.
- SNH (2000). *Windfarms and Birds - Calculating a theoretical collision risk assuming no avoiding action*. SNH Guidance Note. Available at <http://www.snh.gov.uk/docs/C205425.pdf>.
- SNH (2018). *Assessing significance of impacts from onshore wind farm outwith designated areas*. Guidance. Version 2 – February 2018.
- SNH (2016). *Assessing connectivity with Special Protection Areas (SPAs)*. Guidance. Version 3 – June 2016.

### 1.4 Target Species

1.4.1 Target species for survey and recording were identified through desk study and consultation with NatureScot (See **Chapter 8: Ornithology** of EIA Report), on the basis of their known or likely presence, their likely sensitivity to the proposed scheme and those which are afforded a higher level of legislative protection, which is in accordance with current NatureScot guidance (SNH, 2017 and 2018).

1.4.2 Primarily, target species included those species listed on/as:

- Those listed on Annex 1 of the EC Birds Directive (2009/147/EC);
- Those listed on Schedule 1 of the Wildlife and Countryside Act 1981 (Amendment) (Scotland) Regulations 2001;
- Black grouse;
- Nightjar; and,

- Wetland birds, including geese, duck, waders and waterfowl.

1.4.3 This has ensured inclusion of qualifying interests of designated sites for nature conservation (**Table 2.2**) and target species that should be in the development of onshore wind farms in Scotland, as per guidance (SNH, 2017).

## 2 DESK STUDY

### 2.1 Methodology

2.1.1 In accordance with guidance (SNH, 2017), a desk study was undertaken to ascertain an overview of likely bird populations and designated sites in proximity to the Proposed Development, in order to identify possible target species to inform the requirements for survey.

2.1.2 The desk study comprised a review of sources summarised in **Table 2.1**.

2.1.3 Additional peer reviewed literature and industry guidance, has also been reviewed and is referred to where relevant.

**Table 2.1: Desk study key sources and information sought.**

Key Source	Information Sought	Search Area
Sitelink <sup>3</sup>	Statutory designated sites for nature conservation with qualifying ornithological interests.	Within 10km of the Site boundary, extended to 20km for internationally designated sites with migratory geese qualifying interests ( <b>Figure 8.1 of the EIA Report</b> ).
Royal Society for Protection of Birds (RSPB)	Existing ornithological records.	6km from the approximate Site Centre (NX 24580 67523) ( <b>Figure 8.2 of the EIA Report</b> ).
Dumfries and Galloway Raptor Study Group (DGRSG)	Existing records of scarce breeding and roosting raptors and owls.	6km from central grid reference within Site (NX 24580 67523), extended to 10km for eagles ( <b>Figure 8.2 of the EIA Report</b> ).
South West Scotland Environmental Information Centre (SWSEIC)	Existing ornithological records and non-statutory designated sites with ornithological interest.	Within 5km of the Site boundary, extended to 10km for Annex 1 <sup>4</sup> and Schedule 1 <sup>5</sup> bird records ( <b>Figure 8.2 of the EIA Report</b> ).
Gass Wind Farm Environmental Statement (ES) Chapter 8	Existing ornithological records from baseline surveys.	Study areas are shown on Figures 8.1 and 8.2 of the ES.
Kilgallioch Extension Wind Farm EIS Report Chapter 9	Existing ornithological records from baseline surveys.	Study areas are shown on Figures 9.1 and 9.2 of the ES.

<sup>3</sup> <https://sitelink.nature.scot/home>.

<sup>4</sup> Species listed on Annex 1 of the Directive 2009/147/EC (the 'Birds Directive')

<sup>5</sup> Species listed on Schedule 1 of the Wildlife and Countryside Act 1981 (as amended).

<sup>2</sup> Sgurr Energy 2014 14\_P\_1\_0674 Environmental Statement Vol. 2 Appendix 7A phase 1 Habitat and NVC Survey, and Drawing no. 162183-003 Figure 7.5 NVC Results.

## 2.2 Results

### Statutory Designated Sites for Nature Conservation

- 2.2.1 This section should be read with reference to **Figure 8.1 of the EIA Report**.
- 2.2.2 A review of Sitelink identifies that the Site does not form part of any statutory designated site for nature conservation with qualifying ornithological interests.
- 2.2.3 **Table 2.2** summarises statutory designated sites with ornithological features of interest located within 10km of the Site boundary, extended to 20km for internationally designated sites with migratory goose interests.
- 2.2.4 Distances specified within **Table 2.2** are taken from the Site boundary to the designation boundary at its nearest point.

**Table 2.2: Designated sites for nature conservation.**

SPA – Special Protection Area; SSSI – Site of Special Scientific Interest.

Designated Site	Distance / Orientation	Ornithological Qualifying Interests
Derskelpin Moss SSSI	5.6km, south east	<ul style="list-style-type: none"> <li>Dunlin (breeding);</li> <li>Breeding bird assemblage, incl. teal, tufted duck, common sandpiper, redshank, oystercatcher, golden plover and black grouse; and,</li> <li>Foraging hen harrier, merlin and short-eared owl.</li> </ul>
Glen App and Galloway Moors SPA	6.2km, west	<ul style="list-style-type: none"> <li>Hen harrier (breeding).</li> </ul>
Glen App and Galloway Moors SSSI	6.2km, west	<ul style="list-style-type: none"> <li>Hen harrier (breeding).</li> </ul>
Loch of Inch and Torrs Warren SPA	10 km, south west	<ul style="list-style-type: none"> <li>Greenland white-fronted goose (non-breeding); and,</li> <li>Hen harrier (non-breeding).</li> </ul>
Loch of Inch and Torrs Warren Ramsar Site	10km, south west	<ul style="list-style-type: none"> <li>Greenland white-fronted goose (non-breeding).</li> </ul>

### Existing Ornithological Records

- 2.2.5 This section provides a summary of existing ornithological records identified through desk study sources. Only records of 'Priority Species for assessment when considering the development of onshore wind farms in Scotland' and 'Species with restricted ranges' as listed within Annex 1 of guidance (SNH, 2018)<sup>6</sup> are considered in detail.
- 2.2.6 The consideration of existing records are also limited to those reported within the last 10 years (since 2009), so the most up to date (and thus relevant to the Proposed Development) records are regarded.

<sup>6</sup> SNH (2018) *Assessing significance of impacts from onshore wind farms outwith designated sites. Guidance. Version 2 – February 2018.*

### RSPB

- 2.2.7 In consultation, the RSPB held only records of nightjar for the search area.
- 2.2.8 These comprised four records of likely breeding nightjar, with the nearest recorded located approximately 2.6km east of the Site. Full details for all nightjar records returned from RSPB are provided in **Annex 2** and illustrated on **Figure 8.2 of the EIA Report**.

### DGRSG

- 2.2.9 In consultation with the DGRSG, no records were provided for the search area.

### SWSEIC

- 2.2.10 SWSEIC returned records of 12 species from within 5km of the Site (extended to 10km for Annex 1 and Schedule 1 species).
- 2.2.11 This included black grouse, pink-footed goose, hen harrier, peregrine falcon and osprey. Full details returned from SWSEIC are provided in **Annex 2** and illustrated on **Figure 8.2 of the EIA Report**.

### Gass Wind Farm EIA Documentation

- 2.2.12 A summary of the surveys undertaken to support the Gass Wind Farm ES Chapter are presented in **Table 2.3**.

**Table 2.3: Survey summary which supported the Gass Wind Farm.**

Survey type	Dates	Results
Moorland breeding bird survey	Apr-Jul 2012, Apr-Jul 2013	<ul style="list-style-type: none"> <li>Lapwing (1 territory) and snipe (1 territory).</li> </ul>
Breeding Annex 1/Schedule 1 raptor and owl searches	Mar-Jul 2013	<ul style="list-style-type: none"> <li>No breeding species.</li> </ul>
Vantage Point (VP) flight activity surveys	Apr 2012 – Sept 2013	<ul style="list-style-type: none"> <li>Pink-footed goose (6 flights) and lapwing (3 flights).</li> </ul>
Black Grouse Surveys	Mar-Apr 2013	<ul style="list-style-type: none"> <li>No black grouse leks.</li> </ul>
Winter Walkover Surveys	Oct 2012, Feb 2013	<ul style="list-style-type: none"> <li>No wintering geese or swans.</li> </ul>

### Kilgallioch Extension Wind Farm EIA Documentation

- 2.2.13 A summary of the surveys undertaken to support the Kilgallioch Extension Wind Farm are presented in **Table 2.4**.

**Table 2.4: Survey summary which supported the Kilgallioch Extension Wind Farm.**

Survey type	Dates	Results
Moorland breeding bird survey	Apr-Aug 2018	<ul style="list-style-type: none"> <li>Snipe (2 territories, probable).</li> </ul>
Breeding Annex 1/Schedule 1 raptor and owl searches	Mar-Jul 2018, Feb-Jul 2019	<ul style="list-style-type: none"> <li>Barn owl nest site recorded in both years but no definitive evidence of breeding.</li> </ul>
Vantage Point (VP) flight activity surveys	Apr 2018-Aug 2019	<ul style="list-style-type: none"> <li>Pink-footed goose (1 flight), greylag goose (2 flights), hen harrier (16 flights), goshawk (1 flight), red kite (2 flights), merlin (1 flight), peregrine falcon (2 flights) and short-eared owl (2 flights).</li> </ul>



Survey type	Dates	Results
Black Grouse Surveys	Apr 2014, Apr-May 2015	<ul style="list-style-type: none"> <li>No black grouse leks.</li> </ul>
Winter Walkover Surveys	Sept 2018-Mar 2019	<ul style="list-style-type: none"> <li>Small flock of whooper swans in Nov-Dec 2018 at Loch Eldrig.</li> </ul>
Hen harrier roost searches	Sept 2018-Feb 2019	<ul style="list-style-type: none"> <li>Three areas for roost sites comprising 2-4 birds.</li> </ul>

### 3 FIELD SURVEYS

3.1.1 Field survey effort and methodologies were agreed with NatureScot prior to commencement (see **Chapter 8 of the EIA report Volume 2**, Table 8.1 and **Annex 6**). Detailed knowledge of bird populations, distributions and flight activity in order to assess the potential effects of the Proposed Development upon ornithological features, has been derived from field surveys undertaken between 2018 and 2019.

3.1.2 Field surveyor knowledge and experience of bird habitat associations at comparable sites has also informed and guided survey effort over the course of surveys.

#### 3.2 Field Survey Personnel

3.2.1 All field surveys have been completed by experienced and professional ornithologists named in **Annex 3**; all of whom are all fully conversant in recognised bird survey methodologies for proposed wind turbine developments.

#### 3.3 Methodologies

3.3.1 The following ornithology field surveys were completed:

- Vantage Point (VP) flight activity surveys (April 2018 – August 2019);
- Moorland breeding bird survey (MBBS) (2018 and 2019);
- Breeding Annex 1/Schedule 1 raptor and owl searches (2018 and 2019);
- Breeding woodland grouse searches (2018); and,
- Nightjar survey (2018).

3.3.2 All surveys were undertaken in accordance with recommendations outlined within current guidance (SNH, 2017), and as agreed through consultation with NatureScot. Full details of consultations are provided within Chapter 8: 'Ornithology' of the EIA Report.

##### **VP Flight Activity Surveys**

3.3.3 VP flight activity surveys were undertaken between April 2018 and August 2019, providing coverage of two consecutive breeding seasons (April to August) and one non-breeding season (September to March).

##### **VP Locations and Viewsheds**

3.3.4 Three vantage points were used between April 2018 and March 2019 to provide maximum coverage of the VP Study Area required in accordance with current guidance (SNH, 2017); defined as a 500m

buffer around outermost Proposed Development turbine locations as illustrated in **Figure 8.3 of the EIA Report**.

3.3.5 In March 2019 the Proposed Development within the Site was extended to the north and a fourth VP was required to sufficiently cover that additional area. A fourth VP was added and surveyed between April 2018 and August 2019. The methodology was agreed with NatureScot and detailed within Table 8.1 Chapter 8: Ornithology and provided in **Annex 6**.

3.3.6 All VP locations are presented within **Table 3.1** and illustrated in **Figure 8.3 of the EIA Report**.

3.3.7 Ground-thruthed modelled areas of visibility within the 2km viewsheds from each VP location are further detailed are also illustrated in **Figure 8.3 of the EIA Report**.

**Table 3.1: VP locations.**

VP	Grid reference	Radius (m)
1	NX 25373 65649	2000
2	NX 23414 66558	2000
3	NX 22523 68728	2000
4	NX 22978 67785	2000

##### **VP Survey Effort**

3.3.8 The total survey effort (hours) completed at each VP between April 2018 and August 2019 is summarised in **Table 3.2**. Full details of all survey times, field surveyors used and weather conditions are presented in **Annex 3**.

3.3.9 The total VP survey effort completed in 2018 at each VP was 78 hours. In 2019, an additional VP was added to account for a shift of the maximum developable area to the north. This approach was discussed and agreed with NatureScot by email on 5<sup>th</sup> August 2019 (Table 8.1 Chapter 8: Ornithology, and **Annex 6**).

3.3.10 Survey effort during the breeding and non-breeding season met, or exceeded, the 36 hours recommended per VP (in accordance with current guidance ((SNH, 2017))).

3.3.11 Survey times were dispersed throughout the day and were also completed in a range of weather conditions, but always conducive to survey and safe access.

3.3.12 In accordance with current guidance (SNH, 2017), flight lines were mapped for all target species passing through the VP survey area. Details of species, number of birds, flight height in bands (at, below or above collision risk height), duration and direction were noted on standardised recording forms and field plans.

3.3.13 The following height bands (HT) were used in the field to record target species activity at, below or above collision risk height for subsequent use in the calculation of collision mortality risks. Height bands used in the field were based on a proposed turbine height of up to 149.9m at the time of survey. The Proposed Development includes for turbines up to 180m tip and therefore height band HT2 and HT3 incorporate the rotor sweep:

- HT1 <20m;
- HT2 20-150m; and,

- HT3 >150m.

**Table 3.2: VP flight activity survey effort summary (hours).**

VP	2018									2019			Total
	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	
1	12	6	6	6	6	6	6	6	6	6	6	6	78
2	12	6	6	6	6	6	6	6	6	6	6	6	78
3	12	6	6	6	6	6	6	6	6	6	6	6	78
VP	2019						Total						
	Apr	May	Jun	Jul	Aug								
1	5	10	9	6	6		36						
2	6	9	9	6	6		36						
3	0	15	9	6	6		36						
4	0	15	9	6	6		36						

#### Secondary Species

3.3.14 Secondary species were also noted in approximately fifteen minute summary intervals, with the number of birds present and general behaviour recorded in order to build an overall picture of activity. Fifteen minute periods were considered appropriate to ensure surveyors were fully alert to target species activity, which took priority during survey.

3.3.15 Secondary species are defined here as commoner raptors (e.g. buzzard, kestrel and sparrowhawk), all gulls, raven, feral species and mallard, along with any large concentrations of Schedule 1 or Red-listed<sup>7</sup> passerines as recorded during survey.

#### Moorland Breeding Bird Surveys

3.3.16 Moorland breeding bird surveys (MBBSs) were undertaken in 2018 and 2019.

3.3.17 The MBBS Study Area comprised coverage of the Site, extended to include accessible areas of open habitats within 500m as shown in **Figure 8.4 of the EIA Report** and in accordance with current guidance (SNH, 2017).

3.3.18 The methodology employed followed the Brown and Shepherd (1993)<sup>8</sup> method for censusing upland breeding waders, based upon the recommendations set out in Calladine *et al.* (2009)<sup>9</sup> as per current guidance (SNH, 2017). The methodology is suitable for moorland and open country species including, waders, skuas, gulls and some wildfowl species however, incidental observations of any raptors, owls or notable passerines (i.e. Schedule 1 and BoCC red-listed) may also be recorded.

3.3.19 A series of four staggered visits were completed between April and July 2018 (Year 1), and three staggered visits in between May and July 2019 (Year 2) (See limitations).

<sup>7</sup> Eaton *et al* (2015). Birds of Conservation Concern (BoCC).

<sup>8</sup> Brown, A.F. & Shepherd, K.B. (1993). A method for censusing upland breeding waders. *Bird Study*, 40, 189-195.

<sup>9</sup> Calladine, J., Garner, G., Wernham, C. & Thiel, A. (2009). The influence of survey frequency on population estimates of moorland breeding birds. *Bird Study*, 56 (3), 381-388.

3.3.20 During each survey visit a pre-determined route was walked through the survey area, with all birds seen or heard, and their behaviours (e.g. displaying, carrying food etc.) were mapped in the field.

3.3.21 All surveys were undertaken during daylight hours and in fine conditions conducive to survey. Survey effort in 2018 (Year 1) and 2019 (Year 2) is summarised in **Table 3.3**. Full details of all survey times, field surveyors used and weather conditions are presented in **Annex 3**. Given the size of the MBBS Study Area, survey visits were typically undertaken by a small team of surveyors and/or over consecutive days.

**Table 3.3: MBBS effort.**

2018 (Year 1)			
Visit	Date	Start Time (24hrs)	Finish Time (24hrs)
1	27/04/2018	08:10	14:15
2	10/05/2018	07:10	12:55
3	22/06/2018 & 23/06/2018	10:40 10:30	16:50 15:45
4	07/07/2018 & 08/07/2018	09:30 09:30	15:00 15:25
2019 (Year 2)			
Visit	Date	Start Time (24hrs)	Finish Time (24hrs)
1	23/05/2019 & 24/05/2019	11:15 11:10	17:50 16:55
2	12/06/2019 & 13/06/2019	10:15 11:15	16:29 17:10
3	05/07/2019	09:00	15:15

#### Breeding Annex 1/Schedule 1 Raptor and Owl Searches

3.3.22 Searches for Annex 1/Schedule 1 breeding raptor and owls were undertaken between April and July 2018 (Year 1) and May and July 2019 with reference to species-specific methodologies outlined in Hardey *et al.* (2013)<sup>10</sup>.

3.3.23 A series of search visits were made, staggered across the core breeding season, between April/May and July.

3.3.24 Survey effort is summarised in **Table 3.4**. Full details of all survey times, field surveyors used and weather conditions are presented in **Annex 3**.

3.3.25 The breeding raptor and owl Study Area comprised coverage of the Site and, where access allowed, areas out to 2km as shown in **Figure 8.4 of the EIA Report**, in accordance with current guidance (SNH, 2017).

<sup>10</sup> Hardey, J., Crick, H., Wernham, C., Riley, H., Etheridge, B. and Thompson, D. (2013). *Raptors: a field guide to survey and monitoring. 3rd Edition*. The Stationery Office, Edinburgh.

3.3.26 Search effort and search areas were also informed through a review of desk study records. The potential presence of golden eagle was discounted through desk study and therefore the Study Area did not extend to 6km.

**Table 3.4: Breeding raptor and owl search effort summary.**

Year 1			
Visit	Date	Start Time (24hrs)	Finish Time (24hrs)
1	18/04/2018	14:20	20:35
2	25/04/2018	09:20	15:35
3	08/05/2018	16:55	20:05
4	22/05/2018	10:15	16:15
5	28/06/2018	11:00	17:30
6	24/07/2018	09:20	15:20
7	27/07/2018	09:20	15:30
Year 2			
Visit	Date	Start Time (24hrs)	Finish Time (24hrs)
1	25/05/2019	10:00	14:30
2	26/05/2019	11:30	18:30
3	19/06/2019	10:00	16:05
4	22/06/2019	09:15	15:15
5	24/07/2019	12:00	18:00

#### Breeding Nightjar Survey

3.3.27 A nightjar survey was carried out with reference to species-specific methodologies outlined in Gilbert *et al.* (1998)<sup>11</sup>, and comprised two survey visits, in June 2018 (one dawn and one dusk survey), during favourable weather conditions.

3.3.28 The nightjar survey area comprised all suitable habitat (including clear-fell and regenerating plantation) within the Site and out to 500m (where access allowed) as shown in **Figure 8.4 of the EIA Report**.

3.3.29 Surveys were undertaken along a pre-determined transect through the Study Area, stopping at listening points adjacent to suitable breeding habitats, where singing (churring) males were listened for.

3.3.30 Survey effort is summarised in **Table 3.5**. Full details of all survey times, field surveyors used and weather conditions are presented in **Annex 3**.

**Table 3.5: Nightjar survey effort summary.**

Visit	Date	Start Time (24hrs)	Finish Time (24hrs)
1	28/06/2018	22:30	00:00

<sup>11</sup> Gilbert, G., Gibbons, D.W. & Evans, J. (1998). *Bird Monitoring Methods*. RSPB, Sandy.

Visit	Date	Start Time (24hrs)	Finish Time (24hrs)
2	29/06/2018	03:00	04:30

#### Breeding Black Grouse Searches

3.3.31 In accordance with current guidance (SNH, 2017), searches for lekking black grouse were undertaken in 2018, and consisted of a preparatory visit to check for habitat suitability for, followed by two surveys to search for lekking breeding black grouse, between late-April and mid-May.

3.3.32 The breeding black grouse Study Area comprised all suitable habitats (e.g. open moorland, woodland edges and tracks) within, and out to 1.5km, of the Site where access allowed, as shown in **Figure 8.4 of the EIA Report**, in accordance with current guidance (SNH, 2017).

3.3.33 Survey effort is summarised in **Table 3.6**. Full details of all survey times, field surveyors used and weather conditions are presented in **Annex 3**.

3.3.34 Search effort and survey areas have been informed by desk study records and through consultation with NatureScot.

**Table 3.6: Black grouse effort summary.**

Visit	Date	Start Time (24hrs)	Finish Time (24hrs)
1	19/04/2018	05:00	06:40
2	26/04/2018	04:45	07:45
3	09/05/2018	04:20	07:20

## 3.4 Results

### VP Flight Activity Surveys

#### Target Species

3.4.1 Target Species flight activity recorded during the VP survey period (April 2018 to August 2019) from all VPs combined is summarised in **Table 3.7**.

3.4.2 The total number of all flights, total number of birds recorded and the total time spent in each height band (HT) (in seconds), from all VP locations combined is presented. This includes some flights which were detected outside of the VP study area (500m turbine buffer) and which are not at-risk to collision. Flights recorded within the 'at risk' window are presented in **Table 3.8**.

3.4.3 Detailed flight records are presented in **Annex 4**, which also indicates the total flight time for each species below, at and above the typical turbine rotor swept path. Flight lines for each species over the entire survey period are illustrated in **Figures 8.5a – 8.5b of the EIA Report**.

**Table 3.7: Target species flight activity summary (all flights).**

Species	Total No. of Flights	Total No. of Birds	Total Flight Time (secs) <sup>12</sup>
Greylag goose	1	1	70
Goosander	1	4	464
Grey heron	4	5	314
Hen harrier	5	5	508
Goshawk	8	8	528
Golden plover	1	2	70
Merlin	3	3	50
Peregrine falcon	1	1	126

**Table 3.8: 'At Risk' Target species flight activity summary.**

Species	Total No. of Flights	Total No. of Birds	Total Flight Time (secs) <sup>12</sup>
Greylag goose	1	1	70
Goosander	1	4	116
Grey heron	3	3	169
Hen harrier	4	4	250
Goshawk	7	7	485
Golden plover	1	1	35
Peregrine falcon	1	1	126

Secondary Species

3.4.4 Relatively low levels of activity of the following secondary species were also recorded:

- Mallard;
- Sparrowhawk;
- Buzzard;
- Black-headed gull;
- Great black-backed gull.
- Common gull;
- Lesser black-backed gull
- Herring gull;
- Kestrel; and,

- Raven.

Collision Risk Mortality

3.4.5 Where sufficient "at collision risk" flight activity data has allowed, collision risk mortality as a result of birds colliding with rotor blades has been assessed using the SNH Collision Risk Models (CRMs) as detailed in Band *et al.* (2007).

3.4.6 Full details are provided in **Technical Appendix 8.2.**

**Moorland Breeding Bird Surveys**

3.4.7 Surveys in 2018 and 2019 recorded only a small number of breeding wader and waterfowl territories, consisting of snipe and mallard as summarised in **Table 3.9** and illustrated in **Figure 8.7 of the EIA Report**. Territories were primarily recorded in areas of open habitat on the periphery of the Site.

3.4.8 Much of the habitats within the MBBS Study Area, primarily comprised closed canopy coniferous woodlands, unsuitable for breeding species of open country.

3.4.9 A small number of common crossbill breeding territories were also recorded in suitable woodland habitat within the Study Area in 2018 and 2019. The species is likely to breed widely within suitable habitats of the Site.

**Table 3.9: Target species breeding territories.**

Species	No. of territories within the MBBS Survey Area	
	2018	2019
Snipe	2	1
Mallard	0	1

**Breeding Annex 1/ Schedule 1 Raptor and Owl Searches**

3.4.10 A single goshawk was recorded displaying over the Study Area during surveys in May 2018 (**EIAR Volume 3a: Figure 8.7**). No further observations of the species were made during further search effort in 2018 and 2019 and no nesting locations were confirmed. Observations of flight activity in April 2018 during VP flight activity surveys, did however suggest breeding was likely to have taken place by a single pair, with the nest range likely extending into the Site.

3.4.11 A barn owl nest site was located in the Study Area, to the north of the Site in 2018 (**Confidential Figure 8A of Volume 5**).

3.4.12 A long-eared owl breeding territory was also recorded within the Study Area during a MBBS survey, in 2019 in plantation woodland in the eastern periphery of the Site. A bird was heard calling several times, but no definitive nesting location was identified.

3.4.13 A summary of Annex 1/Schedule breeding raptor and owl territories recorded during searches is provided in **Table 3.10**.

3.4.14 No breeding Annex 1/ Schedule 1 raptor and owl territories were identified during surveys in 2019.

3.4.15 The indicative locations of breeding territories based on the breeding Annex 1/ Schedule 1 raptor and owl searches are provided in **Figure 8A of Volume 5**.

<sup>12</sup> Total time multiplied by the number of birds.

**Table 3.10: Target species breeding territories.**

Species	No. of territories within the breeding raptor and owl Study Area	
	2018	2019
Goshawk	1	0
Barn owl	1	0

**Breeding Nightjar Survey**

3.4.16 During survey in 2018, no nightjar were recorded in the Study Area, and the species is considered to be absent.

**Breeding Black Grouse Searches**

3.4.17 During the searches in 2018, no black grouse were recorded in the Study Area, and the species is considered to be absent.

**Field Survey Limitations**

3.4.18 All habitats within the Site were accessible. The wider Study Areas used for the MBBS (500m), Annex 1/ Schedule 1 Breeding Raptor and Owl Searches (2km), Breeding Black Grouse Searches (1.5km) and Breeding Nightjar Survey (500m) were surveyed from suitable locations within the Site or public rights of way (PRoWs), scanning the Study Areas with the use of optics (telescope and binoculars).

3.4.19 Given the good visibility across the survey area from the PRoWs this is not considered a limitation to the results obtained.

3.4.20 Plantation woodland habitats within the survey area were surveyed by traversing tracks and clearings rather than walking directly through dense plantation habitat, due to logistical and health and safety considerations. The survey area was appropriately covered from the accessible tracks and clearings and this is not therefore considered a limitation to the results obtained.

3.4.21 VP flight activity surveys commenced after a short period of “settling in”, to ensure any potential disturbance to target species present within each viewshed had reasonably passed and surveyors were alert to survey following a traverse to each VP location.

3.4.22 Surveyors were stationary until the completion of watches at the VP locations and (when the VP surveys were carried out simultaneously) were in contact to ensure flight lines of target species where they were recorded, were not duplicated.

3.4.23 During 2019 only three out of four MBBS surveys were completed. In recognition of the species present and extensive baseline information available from historic surveys and nearby development, this is not considered to represent a limitation to the baseline.

3.4.24 During April 2019 VP surveys, a reduced number of hours were undertaken at VP1, VP3 and VP4 but the deficit in VP hours was redressed in May and June 2019. Given a high number of surveys at these VPs were done in early May 2019 this is not considered to represent a limitation to the baseline.

3.4.25 The Proposed Development layout was extended in 2019 and therefore Study Areas were accordingly increased to cover this area. This is not considered a limitation as the majority of the Site was covered by the surveys in two years, with the extension area covered in by one year of surveys (agreed with NatureScot, **Annex 6**).

3.4.26 Given the extension to the Proposed Development layout to the north-west VP4 was set up in April 2019 to provide coverage of this area. A total of 36 hours were undertaken at VP4 from early May to August 2019. Only two flight of target species (one hen harrier and one goshawk) were recorded during the entire 36 hour survey period at VP4. Given the low activity of target species from VP4 during the breeding season, and the low number of target species flights during the non-breeding season at VPs 1-3, the lack of data for VP4 during the non-breeding season is not considered a limitation.

3.4.27 Overall no limitations to the survey data in establishing an accurate reflection of the levels of target species activity within adopted Study Areas, and particularly the Site, are identified.

## ANNEX 1 – BIRD SPECIES SUMMARY

**Table A1-1** provides a list of bird species referred to within **Chapter 8: Ornithology** of the EIA Report. Both common and species names are presented along with a summary of each species conservation status using the following abbreviations:

- Annex 1 - species listed on Annex 1 of the Birds Directive (2009/147/EC);
- Schedule 1, 1A, A1 - species listed on Schedule 1, Schedule 1A or Schedule A1 of the Wildlife and Countryside Act (1981, as amended);
- BoCC - BoCCs as listed by leading bird conservation organisations in the UK, including the RSPB and BTO. Red and Amber categories are given (Eaton *et al.*, 2015)<sup>13</sup>;
- SBL - species listed on the Scottish Biodiversity List; and,
- LBAP – species listed as a priority species for Dumfries and Galloway Local Biodiversity Action Plan.

**Table A1-1: Summary of bird species.**

Common Name	Species Name	Conservation Status
Whooper swan	<i>Cygnus cygnus</i>	Annex 1, Schedule 1, SBL, BoCC – Amber, LBAP
Pink-footed goose	<i>Anser brachyrhynchus</i>	BoCC – Amber
Greenland white-fronted goose	<i>Anser albifrons</i>	Annex 1, SBL, BoCC – Red, LBAP
Greylag goose	<i>Anser anser</i>	BoCC – Amber
Teal	<i>Anas crecca</i>	BoCC – Amber
Mallard	<i>Anas platyrhynchos</i>	BoCC – Amber
Tufted duck	<i>Aythya fuligula</i>	-
Goldeneye	<i>Bucephala clangula</i>	BoCC – Amber
Goosander	<i>Mergus merganser</i>	-
Black grouse	<i>Tetrao tetrix</i>	SBL, BoCC – Red, LBAP
Grey heron	<i>Ardea cinerea</i>	-
Red kite	<i>Milvus milvus</i>	Annex 1, Schedule 1, Schedule 1A, SBL, BoCC – Amber, LBAP
Hen harrier	<i>Circus cyaneus</i>	Annex 1, Schedule 1, Schedule 1A, SBL, BoCC – Red, LBAP

<sup>13</sup> Eaton M.A, Aebischer, N.J, Brown, A.F., Hearn, R.D., Lock, L., Musgrove, A.J., Noble, D.G., Stroud, D.A. & Gregory, R.D. (2015) Birds of Conservation Concern 4: the population status of birds in the United Kingdom, Channel Islands and Isle of Man. *British Birds*, 108, 708–746.

Common Name	Species Name	Conservation Status
Goshawk	<i>Accipiter gentilis</i>	Schedule 1
Sparrowhawk	<i>Accipiter nisus</i>	-
Buzzard	<i>Buteo buteo</i>	-
Osprey	<i>Pandion haliaetus</i>	Annex 1, Schedule 1, SBL, BoCC – Amber, LBAP
Oystercatcher	<i>Haematopus ostralegus</i>	BoCC – Amber
Golden plover	<i>Pluvialis apricaria</i>	Annex 1, SBL, LBAP
Lapwing	<i>Vanellus vanellus</i>	SBL, BoCC – Red, LBAP
Dunlin	<i>Calidris alpina</i>	SBL, BoCC – Amber, LBAP
Common sandpiper	<i>Actitis hypoleucos</i>	BoCC – Amber
Redshank	<i>Tringa totanus</i>	BoCC – Amber
Woodcock	<i>Scolopax rusticola</i>	SBL, BoCC – Amber, LBAP
Snipe	<i>Gallinago gallinago</i>	BoCC – Amber
Black-headed gull	<i>Chroicocephalus ridibundus</i>	SBL, BoCC – Amber, LBAP
Great black-backed gull	<i>Larus marinus</i>	BoCC – Amber
Lesser black-backed gull	<i>Larus fuscus</i>	BoCC – Amber
Common gull	<i>Larus canus</i>	BoCC – Amber
Herring gull	<i>Larus argentatus</i>	SBL, BoCC – Red, LBAP
Barn owl	<i>Tyto alba</i>	Schedule 1, SBL, LBAP
Long-eared owl	<i>Asio otus</i>	-
Short-eared owl	<i>Asio flammeus</i>	Annex 1, SBL, BoCC – Amber, LBAP
Nightjar	<i>Caprimulgus europaeus</i>	SBL, BoCC- Amber, LBAP
Kestrel	<i>Falco tinnunculus</i>	SBL, BoCC – Amber
Merlin	<i>Falco columbarius</i>	Annex 1, Schedule 1, SBL, BoCC – Red, LBAP
Peregrine falcon	<i>Falco peregrinus</i>	Annex 1, Schedule 1, SBL, LBAP
Raven	<i>Corvus corax</i>	-
Common crossbill	<i>Loxia curvirostra</i>	Schedule 1

## ANNEX 2 – EXISTING ORNITHOLOGICAL RECORDS

**Table A2-1** provides a summary of existing ornithological records returned by RSPB within at least a 6km radius from a centre grid reference within the Site. Only records from within the last 10 years are regarded (since 2009). Only species regarded as target species are included within **Table A2-1**.

**Table A2-1: Summary of existing ornithological records (RSPB)**

Species	No. of Records	Date Range	Summary
Nightjar	4	2016 and 2018	All probable or possible breeders.

**Table A2-2** provides a summary of existing ornithological records returned by SWSEIC within at least 5km of the Site (extended to 10km for Annex 1 and Schedule 1 species). Only records from within the last 10 years are regarded (since 2009). Only species regarded as target species are included within **Table A2-2**.

**Table A2-2: Summary of existing ornithological records (SWSEIC)**

Species	No. of Records	Date Range	Summary
Greylag goose	3	2011, 2013-14	A peak of 30 geese.
Pink-footed goose	1	2014	1 bird at Loch Ronald in May.
Goldeneye	1	2016	1 bird in January at Loch Heron.
Woodcock	1	2010	3 birds.
Whooper swan	2	2009 and 2016	A group of two and four in January in both years.
Black grouse	1	2011	1 male in September (non-lek).
Nightjar	1	2016	Unsexed bird in mid-August.
Red kite	1	2014	1 bird in April.
Hen harrier	1	2015	1 female in March.
Osprey	1	2014	1 bird in May at Loch Ronald chased by corvid.
Peregrine falcon	1	2009	1 in January.
Common crossbill	1	2013	3 birds in February.

### ANNEX 3 – ORNITHOLOGY FIELD SURVEY EFFORT

The following codes are used to record weather conditions within Tables A3-1 to A3-5:

Wind Speed	Rain	Cloud Cover
Calm	None	0 Out of 8
Light air	Drizzle/mist	1
Light breeze	Light showers	2 <b>Frost</b>
Gentle breeze	Heavy showers	3 None
Moderate breeze	Heavy rain	4 Ground
Fresh breeze		5 All day
Strong breeze	<b>Visibility</b>	6
Moderate gale	Poor	7 <b>Snow</b>
Fresh gale	<1km	8 None
Strong gale	>1km	9 On site
Whole gale		10 High ground
Storm	<b>Cloud Height</b>	11
	<150m	0
<b>Wind Direction</b>	150-500m	1
16 point compass	>500m	2

The following field surveys carried out the ornithology surveys: Mr A. McNab (AJM), Mr G. Palmer (GP), Mr P. Carroll (PC), Mr T. Bowman (TB), Mr P. Howard (PH), Dr C. Bonnington (CB), MR A. Hutt (AH), Mr G. Taylor (GT), Mr R. Irvine (RI), Mr R. Shand (RS), Mr A. Denton (AD), Mr N Bostock (NB) and Mr D. Haywood (DH).

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**Table A3-1: VP flight activity survey effort (April 2018 – August 2019).**

Date	VP	Surveyor	Start Time	Finish Time	VP Hours	Wind Speed	Wind Direction	Rain	Cloud Cover	Cloud Height	Visibility	Frost	Snow
17/04/2018	3	AJM	16:45	19:45	3	5/5/5	S/S/S	0/0/0	7/7/7	2/2/2	2/2/2	0/0/0	0/0/0
17/04/2018	1	PC	17:00	20:00	3	5/5/5	S/S/S	0/0/0	7/7/7	2/2/1	2/2/2	0/0/0	0/0/0
24/04/2018	1	AH	15:00	18:00	3	5/5-4/5-4	SW/SW/SW	0/0/0	8/8/8	2/2/2	2/2/2	0/0/0	0/0/0
24/04/2018	3	RI	15:20	18:20	3	5/5-6/4	SW/SW/SW	0/0/1	8/8/7	1/1/1	2/2/2	0/0/0	0/0/0
24/04/2018	2	GT	15:30	18:30	3	4/4/4	SW/SW/SW	0/0/2	8/8/8	2/2/2	2/2/2	0/0/0	0/0/0
26/04/2018	2	AJM	07:50	10:50	3	0/1/0	WSW/WSW/WSW	0/1/0	8/8/7	2/2/2	2/2/2	0/0/0	0/0/0
26/04/2018	2	AJM	11:20	14:20	3	4/4/3	WSW/WSW/WNW	3/0/0	6/6/5	2/2/2	2/2/2	0/0/0	0/0/0
27/04/2018	1	AJM	04:50	07:50	3	1/1/1	WNW/NW/NW	0/0/0	1/1/1	2/2/2	2/2/2	1/1/1	0/0/0
27/04/2018	3	PC	05:10	08:10	3	1/1/1	NW/NW/NW	0/0/0	2/2/2	2/2/2	2/2/2	1/1/0	0/0/0
29/04/2018	3	RI	08:55	11:55	3	3/2/3	ENE/ENE/E	0/0/0	1/1/2	2/2/2	2/2/2	0/0/0	0/0/0
29/04/2018	1	AH	09:15	12:15	3	2/1/0-1	NE/NE/NE	0/0/0	1/2/4	2/2/2	2/2/2	0/0/0	0/0/0
29/04/2018	2	GT	09:15	12:15	3	3/2/1	SE/SE/E	0/0/0	2/2/3	2/2/2	2/2/2	0/0/0	0/0/0
09/05/2018	1	PC	07:50	10:50	3	2/3/3	S/S/SSE	0/0/0	8/8/8	2/2/2	2/2/2	0/0/0	0/0/0
09/05/2018	2	AJM	07:50	10:50	3	3/3/3	S/S/SSE	0/0/0	8/8/8	1/1/2	2/2/2	0/0/0	0/0/0
09/05/2018	1	PC	11:20	14:20	3	4/4/4	SSE/S/S	0/2/4	8/8/8	2/2/2	2/2/2	0/0/0	0/0/0
09/05/2018	2	AJM	11:20	14:20	3	4/4/4	SSE/S/S	0/2/4	8/8/8	2/2/2	2/2/2	0/0/0	0/0/0
22/05/2018	3	RS	10:30	13:30	3	3/3/1	E/E/S	0/0/0	3/3/6	2/2/2	2/2/2	0/0/0	0/0/0
22/05/2018	3	RS	14:00	17:00	3	2/2/2	SSW/SW/SW	0/0/0	5/3/2	2/2/2	2/2/2	0/0/0	0/0/0
13/06/2018	3	RI	15:30	17:30	2	5/5	SW/SW	1/2	8/8	1/1	1/1	0/0	0/0
13/06/2018	2	GT	15:45	17:45	2	4/5	SW/SW	3/3	8/8	0/0	1/0	0/0	0/0
21/06/2018	2	GT	14:55	16:55	2	5/5	NW/NW	0/0	0/0	2/2	2/2	0/0	0/0
21/06/2018	3	RI	15:00	17:00	2	5/5	NW/NW	0/0	4/1	2/2	2/2	0/0	0/0
21/06/2018	2	GT	17:25	19:25	2	5/5	NW/NW	0/0	0/0	2/2	2/2	0/0	0/0
21/06/2018	3	RI	17:30	19:30	2	5/5	NW/NW	0/0	1/1	2/2	2/2	0/0	0/0
22/06/2018	1	RI	07:30	10:30	3	4/4/5	NW/NW/NW	0/0/0	1/2/2	2/2/2	2/2/2	0/0/0	0/0/0
23/06/2018	1	RI	07:20	10:20	3	2/3/3	W/W/NW	0/0/0	6/8/5	2/2/2	2/2/2	0/0/0	0/0/0
07/07/2018	3	RI	06:20	09:20	3	1/1/2	NW/NW/NW	0/0/0	8/7/5	2/2/2	2/2/2	0/0/0	0/0/0
08/07/2018	3	RI	06:15	09:15	3	1/1/2	NW/NW/NW	0/0/0	8/8/8	2/2/2	2/2/2	0/0/0	0/0/0

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Date	VP	Surveyor	Start Time	Finish Time	VP Hours	Wind Speed	Wind Direction	Rain	Cloud Cover	Cloud Height	Visibility	Frost	Snow
23/07/2018	1	PC	08:30	11:30	3	2/3/3	SSW/SSW/SSW	0/0/0	6/6/4	2/2/2	2/2/2	0/0/0	0/0/0
23/07/2018	2	AJM	08:35	11:35	3	3/3/3	SSW/SSW/SSW	0/0/0	5/4/4	2/2/2	2/2/2	0/0/0	0/0/0
23/07/2018	1	PC	12:00	15:00	3	3/3/3	SSW/SSW/SSW	0/0/0	6/6/7	2/2/2	2/2/2	0/0/0	0/0/0
23/07/2018	2	AJM	12:05	13:05	3	3/3/3	SSW/SSW/SSW	0/0/0	6/7/7	2/2/1	2/2/2	0/0/0	0/0/0
23/08/2018	2	AJM	11:05	14:05	3	3/3/2	SW/SSW/W	2/2/3	8/8/8	2/2/2	2/2/2	0/0/0	0/0/0
23/08/2018	1	RS	11:10	14:10	3	2/2/1	SW/W/W	3/4/0	8/8/4	1/1/2	2/2/2	0/0/0	0/0/0
23/08/2018	3	PC	11:25	14:25	3	3/3/3	SSW/SW/W	1/3/0	8/8/7	1/1/2	2/2/2	0/0/0	0/0/0
23/08/2018	2	AJM	14:35	17:35	3	3/3/4	W/W/WNW	0/2/0	6/6/3	2/2/2	2/2/2	0/0/0	0/0/0
23/08/2018	1	RS	14:40	17:40	3	1/2/2	W/W/W	3/3/0	4/3/2	2/2/2	2/2/2	0/0/0	0/0/0
23/08/2018	3	PC	14:55	17:55	3	3/4/3	W/WNW/WNW	3/3/0	7/4/4	2/2/2	2/2/2	0/0/0	0/0/0
26/09/2018	2	AJM	10:05	13:05	3	3/3/3	SW/SW/SW	1/0/0	8/8/8	0/1/1	1/2/2	0/0/0	0/0/0
26/09/2018	1	RS	10:10	13:10	3	2/2/2	SW/SW/SW	1/0/0	8/8/8	1/2/2	1/2/2	0/0/0	0/0/0
26/09/2018	3	PC	10:25	13:25	3	3/4/3	SSW/SSW/SSW	1/0/0	8/8/8	1/2/2	1/2/2	0/0/0	0/0/0
26/09/2018	2	AJM	13:35	16:35	3	2/3/4	WSW/WSW/W	0/0/0	8/7/6	2/2/2	2/2/2	0/0/0	0/0/0
26/09/2018	1	RS	13:40	16:40	3	2/2/2	SW/SW/SW	0/0/0	8/7/6	2/2/2	2/2/2	0/0/0	0/0/0
26/09/2018	3	PC	13:55	16:55	3	3/3/4	SW/SW/SW	0/0/0	8/7/7	2/2/2	2/2/2	0/0/0	0/0/0
18/10/2018	3	AD	10:30	13:30	3	1/1/1	SW/S/S	0/0/0	4/4/6	2/2/2	2/2/2	0/0/0	0/0/0
18/10/2018	2	RI	10:45	13:45	3	2/1/3	SE/SSE/E	0/0/0	5/4/6	2/2/2	2/2/2	0/0/0	0/0/0
18/10/2018	3	AD	14:00	17:00	3	1/1/1	SW/SW/SW	0/0/0	6/4/4	2/2/2	2/2/2	0/0/0	0/0/0
18/10/2018	2	RI	14:15	17:15	3	2/2/2	SSW/SSW/SSW	0/0/0	6/4/4	2/2/2	2/2/2	0/0/0	0/0/0
23/10/2018	1	AD	10:15	13:15	3	5/4/4	WNW/WNW/WNW	1/1/1	8/8/8	1/2/2	2/2/2	0/0/0	0/0/0
23/10/2018	1	AD	13:45	16:45	3	4/5/4	NW/WNW/WNW	1/1/1	8/8/8	2/2/2	2/2/2	0/0/0	0/0/0
15/11/2018	2	AD	10:10	13:10	3	4/4/4	SW/SW/WSW	2/0/0	8/6/6	2/2/2	2/2/2	0/0/0	0/0/0
15/11/2018	2	AD	13:40	16:40	3	4/5/4	SW/WSW/SW	0/0/0	8/7/8	2/2/2	2/1/2	0/0/0	0/0/0
20/11/2018	1	AD	10:00	13:00	3	2/3/3	NE/NE/NE	0/0/2	5/6/6	2/2/2	2/2/2	0/0/0	0/0/0
20/11/2018	3	PC	10:00	13:00	3	4/4/3	ENE/ENE/ENE	0/0/2	7/7/7	2/2/2	2/2/2	0/0/0	0/0/0
20/11/2018	1	AD	13:30	16:30	3	3/3/3	NE/ENE/NE	2/0/2	7/7/5	2/2/2	2/2/2	0/0/0	0/0/0
20/11/2018	3	PC	13:30	16:30	3	3/3/3	ENE/ENE/ENE	0/0/2	7/7/7	2/2/2	2/2/2	0/0/0	0/0/0
07/12/2018	2	AD	07:50	10:50	3	5/5/5	SSW/SW/SW	0/0/0	4/5/5	2/2/2	2/2/2	0/0/0	0/0/0

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Date	VP	Surveyor	Start Time	Finish Time	VP Hours	Wind Speed	Wind Direction	Rain	Cloud Cover	Cloud Height	Visibility	Frost	Snow
07/12/2018	2	AD	11:20	14:20	3	5/5/5	S/SW/SW	0/0/0	6/4/4	2/2/2	2/2/2	0/0/0	0/0/0
20/12/2018	1	AJM	09:30	12:30	3	3/3/3	SW/SW/SW	3/0/2	7/7/8	2/2/2	2/2/2	0/0/0	0/0/0
20/12/2018	3	PC	09:40	12:40	3	3/3/4	SW/SW/SW	2/2/2	7/7/7	2/2/2	2/2/2	0/0/0	0/0/0
20/12/2018	1	AJM	13:00	16:00	3	3/3/3	SW/SW/SW	2/0/0	8/7/6	2/2/2	2/2/2	0/0/0	0/0/0
20/12/2018	3	PC	13:10	16:10	3	4/4/4	SW/SW/SW	2/2/0	7/7/7	2/2/2	2/2/2	0/0/0	0/0/0
23/01/2019	3	TB	10:00	13:00	3	0/1/1	0/SE/S	0/0/2	4/7/7	2/2/2	2/2/2	1/0/0	1/1/1
23/01/2019	1	PC	10:05	13:05	3	1/0/1	WNW/-/SSW	0/0/0	2/6/7	2/2/2	2/2/2	1/1/0	1/1/1
23/01/2019	3	TB	13:30	16:30	3	1/0/1	S/0/E	2/2/2	8/8/8	2/1/2	2/2/2	0/0/0	1/1/1
23/01/2019	1	PC	13:35	16:35	3	1/1/1	SSW/SSW/SW	2/1/0	8/8/8	2/2/2	2/2/2	0/0/0	1/1/1
29/01/2019	2	TB	10:00	13:00	3	1/3/4	SW/W/NW	0/0/2	8/8/8	1/1/1	2/2/2	0/0/0	2/2/2
29/01/2019	2	TB	13:30	16:30	3	2/3/3	W/W/W	2/0/2	8/4/6	1/2/2	2/2/2	0/0/0	2/2/2
13/02/2019	1	PH	09:25	12:25	3	5/5/5	SSW/SSW/SSW	0/0/0	8/8/8	1/2/2	2/2/2	0/0/0	0/0/0
13/02/2019	3	TB	09:30	12:30	3	4/4/3	S/S/S	0/0/0	8/8/8	1/1/1	2/2/2	0/0/0	0/0/0
13/02/2019	1	PH	12:55	15:55	3	5/5/5	SSW/SSW/SSW	0/0/0	6/7/7	2/2/2	2/2/2	0/0/0	0/0/0
13/02/2019	3	TB	13:00	16:00	3	4/4/5	SW/SW/S	0/0/0	8/8/8	1/1/1	2/2/2	0/0/0	0/0/0
26/02/2019	2	TB	10:20	13:20	3	1/1/2	SE/SE/SE	0/0/0	0/0/0	0/0/0	2/2/2	0/0/0	0/0/0
26/02/2019	2	TB	13:50	16:50	3	2/1/1	SE/SE/SE	0/0/0	0/0/0	0/0/0	2/2/2	0/0/0	0/0/0
12/03/2019	3	PH	09:55	12:55	3	4/5/5	WSW/WSW/WSW	0/0/0	7/6/6	2/2/2	2/2/2	0/0/0	0/0/0
12/03/2019	1	TB	10:00	13:00	3	3/3/3	SW/SW/SW	0/0/0	7/5/5	2/2/2	2/2/2	0/0/0	0/0/0
12/03/2019	3	PH	13:25	16:25	3	5/5/4	SW/SW/SW	0/0/0	5/7/7	2/2/2	2/2/2	0/0/0	0/0/0
12/03/2019	1	TB	13:30	16:30	3	4/3/3	SW/SW/SW	0/0/0	3/6/8	2/2/2	2/2/2	0/0/0	0/0/0
21/03/2019	2	TB	09:55	09:55	3	3/2/3	SSW/SSW/SW	0/0/0	8/8/8	1/1/1	2/2/2	0/0/0	0/0/0
21/03/2019	2	TB	10:25	13:25	3	2/3/3	SW/SW/SSW	0/0/0	8/8/8	1/1/1	2/2/2	0/0/0	0/0/0
29/04/2019	1	CB	14:55	17:55	3	3/3/2	S/S/S	0/0/0	4/3/2	2/2/2	2/2/2	0/0/0	0/0/0
29/04/2019	1	CB	18:25	20:25	2	2/2	S/S	0/0	1/1	2/2	2/2	0/0	0/0
30/04/2019	2	CB	08:30	11:30	3	4/4/4	S/S/S	1/0/1	8/8/8	2/2/2	1/2/2	0/0/0	0/0/0
30/04/2019	2	CB	12:00	15:00	3	4/4/4	S/S/S	1/1/1	8/8/8	2/2/2	2/2/2	0/0/0	0/0/0
01/05/2019	3	CB	08:45	11:45	3	2/2/1	S/S/S	1/1/0	8/8/8	0/0/1	0/0/2	0/0/0	0/0/0
01/05/2019	3	CB	12:15	15:15	3	0/3/2	NA/S/S	0/0/0	6/7/6	2/2/2	2/2/2	0/0/0	0/0/0

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Date	VP	Surveyor	Start Time	Finish Time	VP Hours	Wind Speed	Wind Direction	Rain	Cloud Cover	Cloud Height	Visibility	Frost	Snow
01/05/2019	1	CB	16:23	17:23	1	2	S	0	6	2	2	0	0
02/05/2019	4	CB	07:32	10:32	3	3/3/3	W/W/W	0/0/0	8/8/7	2/2/2	2/2/2	0/0/0	0/0/0
02/05/2019	4	CB	11:02	14:02	3	4/4/4	W/W/W	1/0/0	8/7/7	2/2/2	2/2/2	0/0/0	0/0/0
22/05/2019	1	NB	13:00	16:00	3	4/4/4	WNW/WNW/NW	0/0/0	2/1/1	2/2/2	2/2/2	0/0/0	0/0/0
22/05/2019	3	RI	13:15	16:15	3	3/3/3	NW/NW/NW	0/0/0	1/2/2	2/2/2	2/2/2	0/0/0	0/0/0
22/05/2019	1	NB	16:30	19:30	3	5/4/4	NW/NW/WNW	0/0/0	1/1/1	2/2/2	2/2/2	0/0/0	0/0/0
22/05/2019	3	RI	16:45	19:45	3	3/4/3	WNW/NW/NW	0/0/0	3/2/2	2/2/2	2/2/2	0/0/0	0/0/0
23/05/2019	2	RI	07:55	10:55	3	1/2/2	NW/WNW/W	0/0/0	1/2/3	2/2/2	2/2/2	0/0/0	0/0/0
23/05/2019	4	NB	08:12	11:12	3	3/3/4	WNW/WNW/NW	0/0/0	1/1/1	2/2/2	2/2/2	0/0/0	0/0/0
24/05/2019	2	RI	08:00	11:00	3	3/3/3	NW/NW/NW	0/0/0	7/6/7	2/2/2	2/2/2	0/0/0	0/0/0
24/05/2019	4	NB	08:25	11:25	3	5/4/4	NW/NW/NW	0/0/0	7/7/7	2/2/2	2/2/2	0/0/0	0/0/0
25/05/2019	3	NB	06:55	09:55	3	1/2/2	NW/NW/NW	0/0/0	8/8/8	2/2/2	2/2/2	0/0/0	0/0/0
25/05/2019	1	RI	07:00	10:00	3	1/1/2	NW/WNW/W	0/0/0	8/8/8	2/2/2	2/2/2	0/0/0	0/0/0
26/05/2019	4	NB	14:30	17:30	3	4/4/4	WNW/WNW/WNW	0/0/0	4/4/4	2/2/2	2/2/2	0/0/0	0/0/0
26/05/2019	2	RI	16:40	19:40	3	4/4/4	WNW/WNW/WNW	0/0/0	6/3/2	2/2/2	2/2/2	0/0/0	0/0/0
12/06/2019	2	RI	16:15	19:15	3	4/4/6	NE/NE/NE	0/0/0	8/8/8	2/2/2	2/2/2	0/0/0	0/0/0
12/06/2019	4	NB	16:30	19:30	3	5/5/6	ENE/NNE/NNE	0/0/0	8/8/8	2/2/2	2/2/2	0/0/0	0/0/0
15/06/2019	1	DH	11:00	14:00	3	2/3/4	SE/SE/SE	1/0/0	7/8/8	1/1/1	2/2/2	0/0/0	0/0/0
15/06/2019	3	NB	11:20	14:20	3	4/5/5	SSW/SE/SE	0/0/2	8/8/8	1/2/1	2/2/1	0/0/0	0/0/0
15/06/2019	1	DH	14:00	17:00	3	3/3/3	S/S/SW	1/0/0	8/8/8	1/1/1	2/2/2	0/0/0	0/0/0
15/06/2019	3	NB	14:50	17:50	3	4/4/4	SE/SSE/SSW	2/1/2	2/1/0	1/1/2	2/1/2	0/0/0	0/0/0
16/06/2019	4	NB	10:20	13:20	3	4/4/4	SSW/S/S	0/0/0	6/6/6	2/2/2	2/2/2	0/0/0	0/0/0
16/06/2019	4	NB	13:50	16:50	3	4/3/3	S/S/S	2/2/0	8/8/7	2/1/2	2/2/2	0/0/0	0/0/0
16/06/2019	2	RI	18:15	21:15	3	4/5/5	SE/SSE/SSE	0/0/2	7/7/8	2/2/1	2/2/2	0/0/0	0/0/0
17/06/2019	2	NB	06:10	09:10	3	5/5/5	SSW/SSW/SSW	0/0/0	7/8/8	2/1/1	2/2/2	0/0/0	0/0/0
17/06/2019	1	NB	11:10	14:10	3	5/5/5	SSW/SSW/SSW	0/0/0	6/5/6	2/2/2	2/2/2	0/0/0	0/0/0
17/06/2019	3	NB	14:40	17:40	3	5/3/3	SSW/SSW/SSW	0/2/3	6/8/8	2/1/1	2/2/2	0/0/0	0/0/0
03/07/2019	2	RI	10:10	13:10	3	2/3/3/	NW/NW/NW	0/0/0	6/7/5	2/2/2	2/2/2	0/0/0	0/0/0
03/07/2019	4	TB	10:25	13:25	3	2/2/2	N/N/NW	0/0/0	7/6/6	2/2/2	2/2/2	0/0/0	0/0/0

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Date	VP	Surveyor	Start Time	Finish Time	VP Hours	Wind Speed	Wind Direction	Rain	Cloud Cover	Cloud Height	Visibility	Frost	Snow
03/07/2019	2	RI	13:40	16:40	3	3/4/4	NW/NNW/NNW	0/0/0/	5/6/7	2/2/2	2/2/2	0/0/0	0/0/0
03/07/2019	4	TB	13:55	16:55	3	2/2/2	NW/NW/NW	0/0/0	6/7/7	2/2/2	2/2/2	0/0/0	0/0/0
09/07/2019	1	AJM	12:30	15:30	3	2/2/2	W/W/W	1/1/2	8/8/8	1/1/1	2/2/2	0/0/0	0/0/0
09/07/2019	3	RI	12:45	15:45	3	3/3/3	SW/SW/SW	0/1/3	8/8/6	1/1/1	2/2/2	0/0/0	0/0/0
17/07/2019	1	NB	07:00	10:00	3	1/2/2	S/S/SSW	0/0/2	8/8/8	1/1/1	2/2/2	0/0/0	0/0/0
17/07/2019	3	NB	10:40	13:40	3	4/4/3	SSW/SSW/SSW	2/2/2	8/8/8	1/1/1	2/1/2	0/0/0	0/0/0
14/08/2019	1	AJM	12:25	15:25	3	2/2/2	SE/SE/SE	2/2/2	8/8/8	1/1/1	1/2/1	0/0/0	0/0/0
14/08/2019	3	TB	12:45	15:45	3	2/2/2	SE/SE/SE	2/1/1	8/8/8	1/1/1	1/1/1	0/0/0	0/0/0
14/08/2019	1	AJM	15:55	18:55	3	2/2/2	SE/SE/SE	2/0/0	8/8/8	1/1/1	2/2/2	0/0/0	0/0/0
14/08/2019	3	TB	16:15	19:15	3	2/1/2	SE/S/S	2/1/0	8/8/8	1/1/1	2/2/2	0/0/0	0/0/0
28/08/2019	2	PC	13:00	16:00	3	4/4/4	WNW/NNW/NNW	0/0/0	8/7/6	2/2/2	2/2/2	0/0/0	0/0/0
28/08/2019	4	AJM	13:15	16:15	3	4/4/4	W/NNW/NNW	0/0/0	8/7/6	2/2/2	2/2/2	0/0/0	0/0/0
28/08/2019	2	PC	16:30	19:30	3	3/3/3	W/SW/SW	0/0/0	5/6/4	2/2/2	2/2/2	0/0/0	0/0/0
28/08/2019	4	AJM	16:45	19:45	3	4/3/2	W/SW/SW	0/0/0	5/4/3	2/2/2	2/2/2	0/0/0	0/0/0

**Table A3-2: MBBS effort.**

When only one value is given this was the weather condition for the whole survey period.

Date	Surveyor	Start Time	Finish Time	Wind Speed	Wind Direction	Rain	Cloud Cover	Cloud Height	Visibility	Frost/ Snow
27/04/2018	PC	08:15	13:30	1/1/1/2/2/2	NW/N/NE/N/N	0/0/0/0/0/0/0	2/4/4/5/6/6	2/2/2/2/2/2/2	2/2/2/2/2/2	0
27/04/2018	AJM	08:10	14:15	1/1/1/2/2/2	NW/NW/NW/NNW/NNW	0/0/0/0/0/0/0	1/1/1/3/5/3	2/2/2/2/2/2/2	2/2/2/2/2/2	0
10/05/2018	AJM	07:10	12:55	2/2/3/3/3/2	SW/SW/SW/W/SW/SW	0/0/0/0/0/0/0	2/3/5/5/6/6	2/2/2/2/2/2/2	2/2/2/2/2/2	0
10/05/2018	PC	07:10	12:05	2/3/3/3/3/3	SW/WSW/W/W/WSW	0/0/0/0/0	2/4/5/4/6	2/2/2/2/2/2/2	2/2/2/2/2/2	0
22/06/2018	RI	10:40	16:50	4/5/4/4/4/4	NW/NW/NW/NNW/NNW	0/0/0/0/0/0	4/5/3/1/1/2	2/2/2/2/2/2/2	2/2/2/2/2/2	0
23/06/2018	RI	10:30	15:45	4/4/5/4/3/3	W/NW/NNW/NNW/NNW	0/0/0/0/0/0	7/6/4/6/4/	2/2/2/2/2/2/2	2/2/2/2/2/2	0
07/07/2018	RI	09:30	15:00	1/1/1/2/2/2	NW/SE/SE/S/S/SW	0/0/0/0/0/0	5/2/2/4/6/	2/2/2/2/2/2/2	2/2/2/2/2/2	0

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Date	Surveyor	Start Time	Finish Time	Wind Speed	Wind Direction	Rain	Cloud Cover	Cloud Height	Visibility	Frost/Snow
08/07/2018	RI	09:30	15:25	2/2/2/3/3/3	NW/NW/NW/NW/NW/NW	0/0/0/0/0/0	7/8/6/5/5/5	2/2/2/2/2/2	2/2/2/2/2/2	0
23/05/2019	RI	11:00	16:35	3/3/3/2/2/3	WNW/W/NW/NW/WNW/WNW	0/0/0/0/0/0	3/2/2/1/1/0	2/2/2/2/2/2	2/2/2/2/2/2	0
23/05/2019	NB	11:15	17:50	4/3/3/3/3/3/3	NW	0/0/0/0/0/0/0	1/1/1/1/1/1/1	2/2/2/2/2/2/2	2/2/2/2/2/2	0
24/05/2019	RI	11:10	16:15	3/3/3/2/2/3	NW/NW/NW/NW/NW/NW	0/0/0/0/0/0	7/7/6/6/5/5	2/2/2/2/2/2	2/2/2/2/2/2	0
24/05/2019	NB	11:35	16:55	4/4/3/3/3/3	NW/NW/NW/NW/NW/NW	0/0/0/0/0/0	6/4/7/7/4/4	2/2/2/2/2/2	2/2/2/2/2/2	0
12/06/2019	RI	10:15	16:05	3/3/3/3/4/4	NNE/NNE/NNE/NNE/N/N	0/0/0/0/0/0	8/8/8/8/8/8	2/2/2/2/2/2	2/2/2/2/2/2	0
12/06/2019	NB	10:35	16:29	2/4/4/4/4/4/5	N/N/NE/NE/ENE/ENE	0/0/0/0/0/0	8/8/8/8/8/8/8	1/2/2/2/2/2	2/2/2/2/2/2	0
13/06/2019	RI	11:15	16:40	2/1/1/2/2/2/2/2	NNE/S/S/SSW/S/SW	0/0/0/0/0/0	6/6/8/8/8/8/8	2/2/2/2/2/2	2/2/2/2/2/2	0
13/06/2019	NB	11:30	17:10	1/2/2/2/2/2/2/3	WNW	0/0/0/0/0/0	8/8/8/8/8/8/8	1/2/2/2/2/2	2/2/2/2/2/2	0
05/07/2019	RI	09:15	15:00	3/3/3/3/2	WNW/NW/NW/W/W	1/1/0/1/1	8/8/7/8/8	1/2/2/2/2/2	2/2/2/2/2/2	0
05/07/2019	TB	09:10	14:20	2/2/2/2/2/2/2	W/W/W/W/W/W/W	1/0/0/1/1/1	8/8/7/8/8/8	2/2/2/2/2/2	2/2/2/2/2/2	0
05/07/2019	AJM	09:00	14:35	2/2/1/1/1/2	W/W/W/W/W/W/W	2/2/0/0/2/2/2	8/7/7/8/8/8/8	1/2/2/2/2/2	2/2/2/2/2/2	0
05/07/2019	DH	09:30	15:15	3/2/2/2/3/2	WNW/WNW/W/WWSW/W/W/WNW	1/0/0/1/1/1/0	8/7/7/8/8/8/8	1/2/2/2/2/1/2	1/2/2/2/2/2	0

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**Table A3-3 Annex 1/Schedule 1 Breeding raptor and owl search effort.**

When only one value is given this was the weather condition for the whole survey period.

Date	Surveyor	Start Time	Finish Time	Wind Speed	Wind Direction	Rain	Cloud Cover	Cloud Height	Visibility	Frost/Snow
18/04/2018	PC	14:20	20:20	4/4/4/4/4/4	SSE/SSE/SE/SE/SE/SE	0/0/0/0/0/0	7/7/7/5/7/7	2/2/2/2/2/2	2/2/2/2/2/2	0
18/04/2018	AJM	14:30	20:35	3/3/3/3/3/4	S/S/S/SE/SE/SE	0/0/0/0/0/0	8/6/5/5/5/6	1/2/2/2/2/2	2/2/2/2/2/2	0
25/04/2018	AJM	09:20	15:35	3/3/3/3/3/3	WSW	0/0/0/0/0/0	6/7/6/6/5/7	2/2/2/2/2/2	2/2/2/2/2/2	0
25/04/2018	PC	09:20	15:20	3/3/3/3/3/3	SW/SW/SW/SW/SSW/SSW	0/0/0/0/0/0	8/7/6/6/7/7	2/2/2/2/2/2	2/2/2/2/2/2	0
08/05/2018	AJM	16:55	20:05	4/4/3/3	NW/NW/NW/NW	2/0/0/0	7/4/4/4	2/2/2/2	2/2/2/2	0
08/05/2018	PC	16:55	19:55	3/3/3	NNW/NNW/NNW	1/0/0	7/4/4	2/2/2	2/2/2	0
22/05/2018	PC	10:15	16:15	3/3/3/2/2/2	E/E/SE/SSE/SW/SW	0/0/0/0/0/0	5/7/4/6/7/6	2/2/2/2/2/2	2/2/2/2/2/2	0
28/06/2018	RI	11:30	17:30	2/2/3/3/3/3	NW/NW/NW/NW/NW/NW	0/0/0/0/0/0	1/1/1/2/2/2	2/2/2/2/2/2	2/2/2/2/2/2	0
28/06/2018	GT	11:00	17:00	1/1/1/1/1/1	SW/SW/SW/SW/SW/SW	0/0/0/0/0/0	0/0/0/0/0/0	0/0/0/0/0/0	2/2/2/2/2/2	0
24/07/2018	PC	09:20	15:20	2/2/2/2/2/2	W/W/W/W/SW/WWSW	0/0/0/0/0/0	7/8/8/7/7/7	2/2/2/2/2/2	2/2/2/2/2/2	0
27/07/2018	AJM	09:20	15:30	2/2/2/2/2/2	W/W/WWSW/SW/SW/SW	0/0/0/0/0/0	8/8/7/7/7/7	2/2/2/2/2/2	2/2/2/2/2/2	0
25/05/2019	RI	10:15	14:30	2/2/2/2/2	W/W.SW/SW/SW	0/2/2/1/1	8/8/8/8/8	2/2/2/1/0	2/2/2/2/0	0
25/05/2019	NB	10:00	14:30	2/2/1/2	NW/WNW/W/W/SW/SW	2/2/1/1	8/8/8/8	2/2/1/1	2/2/2/1	0
26/05/2019	RI	11:35	16:20	3/4/4/4/4	WNW	0/1/0/0/0	8/8/8/8/8	2/2/1/1/1	2/2/2/2/2	0
26/05/2019	NB	11:30	14:30	4/3/4	WSW/W/WNW	0/1/0	8/8/7	1/1/2	2/2/2	0
26/05/2019	NB	17:32	18:30	4	WNW	0	7	2	2	0
19/06/2019	AH	10:00	16:00	4/4/3	SW/SW/SW	0/0/0	4/4/6	2/2/2	2/2/2	0
19/06/2019	AH	10:00	16:00	3/3/3	SW/SW/SW	0/0/0	6/6/6	2/2/2	2/2/2	0
19/06/2019	RI	10:05	13:05	3/3/3	SSW/SSW/SW	0/0/0	4/4/6	2/2/2	2/2/2	0
19/06/2019	RI	13:05	16:05	3/3/3	SW/SW/SW	0/0/0	7/7/6	2/2/2	2/2/2	0
22/06/2019	RI	09:15	12:15	3/3/3	S/S/S	0/0/0	4/8/8	2/2/2	2/2/2	0
22/06/2019	RI	12:15	15:15	3/3/3	S/S/S	0/0/0	7/6/4	2/2/2	2/2/2	0
24/07/2019	TB	12:00	18:00	3/3/2/2/3/2	S/S/S/S/S/S	0/0/0/0/0/0	8/8/7/3/3/4	1/1/2/2/2/2	1/1/2/2/2/2	0
24/07/2019	GP	12:00	18:00	3/3/2/2/2/2	S/S/S/S/S/S	0/0/0/0/0/0	8/7/7/5/5/5	1/2/2/2/2/2	1/2/2/2/2/2	0

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**Table A3-4 Nightjar survey effort.**

Date	Surveyor	Start Time	Finish Time	VP Hours	Wind Speed	Wind Direction	Rain	Cloud Cover	Cloud Height	Visibility	Frost	Snow
28/06/2018	GT & RI	22:30	00:00	1.5	1/1	SW/SW	0/0	0/0	0/0	0/0	0/0	0/0
29/06/2018	GT & RI	03:00	04:30	1.5	1/1	SW/SW	0/0	0/0	0/0	0/0	0/0	0/0

**Table A3-5 Black grouse search effort.**

Date	Surveyor	Start Time	Finish Time	Wind Speed	Wind Direction	Rain	Cloud Cover	Cloud Height	Visibility	Frost	Snow
19/04/2018	PC	05:00	06:30	3/3	SSE/SSE	0/0	8/8	1/0	1/1	0/0	0/0
19/04/2018	AJM	05:05	06:40	3/3	SSW/SSW	0/0	8/8	1/0	1/1	0/0	0/0
26/04/2018	AJM	04:45	07:45	3/3/3	WSW/WSW/WSW	0/0/0	5/7/7	2/2/2	2/2/2	0/0/0	0/0/0
26/04/2018	PC	04:45	07:45	3/3/3	W/SW/SW	0/0/0	7/7/7	2/2/2	2/2/2	0/0/0	0/0/0
06/05/2018	AJM	14:20	07:20	2/3/3	S/S/S	0/0/0	8/8/8	1/1/0	1/1/1	0/0/0	0/0/0
09/05/2018	PC	04:20	07:20	2/1/2	SE/SSE/SSE	0/0/0	8/8/8	1/1/1	1/1/1	0/0/0	0/0/0

## ANNEX 4 – VP FLIGHT ACTIVITY SURVEY: TARGET SPECIES FLIGHTS

**Table A4-1** presents details of target species flight lines recorded during VP flight activity surveys between April 2018 and August 2019. The species, number of birds, total flight duration (no. of birds multiplied by duration) and duration spent at each height band (HT) is presented. Note that the flights in **Table A4-1** refer to all target species flights recorded, and not just those flights included in the CRM.

**Table A4-1: Target species flights (April 2018 to August 2019).**

Date	VP	Species	No. of birds	Start Time (24h)	Duration (s)	HT1 (s)	HT2 (s)	HT3 (s)	Notes
17/04/2018	3	Hen harrier	1	18:39	75	0	75	0	-
17/04/2018	1	Goshawk	1	19:32	85	0	85	0	Adult male hunting.
17/04/2018	1	Goshawk	1	19:33	26	0	26	0	Adult male hunting.
09/05/2018	1	Peregrine	1	11:23	126	0	105	21	-
07/07/2018	3	Grey heron	2	07:47	140	60	80	0	-
18/10/2018	2	Golden plover	2	13:28	70	0	70	0	Direct flight.
20/12/2018	1	Goshawk	1	10:37	35	0	35	0	-
13/02/2019	1	Goshawk	1	10:18	8	8	0	0	-
13/02/2019	1	Hen harrier	1	11:21	26	26	0	0	-
26/02/2019	2	Hen harrier	1	11:35	150	135	15	0	-
26/02/2019	2	Hen harrier	1	13:05	142	97	45	0	-
12/03/2019	3	Merlin	1	14:06	9	9	0	0	-
12/03/2019	1	Goshawk	1	16:18	220	0	220	0	-
29/04/2019	1	Merlin	1	15:06	20	20	0	0	Mobbed by meadow pipits.
29/04/2019	1	Goshawk	1	18:35	39	0	0	39	Lost behind trees.
29/04/2019	1	Grey heron	1	19:10	44	0	44	0	Looked to land by river.
29/04/2019	1	Grey heron	1	19:19	85	0	0	85	Lost behind trees.
29/04/2019	1	Merlin	1	20:18	21	21	0	0	Mobbed by bird, possibly perched & then took off.
01/05/2019	3	Goosander	4	13:30	464	0	464	0	Dropping at end of flight, following river to coast.
24/05/2019	4	Goshawk	1	10:31	45	15	30	0	Adult male perched or landed, went into western conifers onsite.
25/05/2019	1	Greylag	1	08:57	70	0	0	70	Flying south fast over VP.

Date	VP	Species	No. of birds	Start Time (24h)	Duration (s)	HT1 (s)	HT2 (s)	HT3 (s)	Notes
15/06/2019	1	Goshawk	1	13:53	75	30	45	0	Female flew east cross centre of site.
17/06/2019	2	Grey heron	1	08:50	45	0	45	0	-
28/08/2019	4	Hen harrier	1	18:47	115	0	0	115	Ring tail (juvenile).

## ANNEX 5 – CUMULATIVE DEVELOPMENTS WITHIN NHZ 19

**Table A5-1: . Cumulative Wind Farm Developments identified within NHZ 19 (Western Southern Uplands and Inner Solway)**

Development	Number of Turbines
<b>Operational / Under Construction</b>	
Hagshaw Hill	26
Windy Standard	36
Hare Hill	20
Artfield Fell	15
Minsca	16
Dalswinton	15
Wether Hill	14
Hagshaw Hill Extension	20
Whiteside Hill	13
Harestanes/ Forest of Ae	68
Clyde	152
Nutberry	6
Dungavel Hill	13
Bankend Rig	11
Carscreugh	18
Arecleoch	60
Barlockhart	4
Artfield Hill Extension	7
Glenchamber	11
Sanquhar	9
Andershaw	11
Minnygap	10
Dersalloch	23
Plascow	3
Hare Hill Extension	35
Auchrobert	12
Galawhistle	22
Airies Farm	14
Brockloch Rig	30
Blackcraig	23
Glen App and Loch Ree	11
Afton	25
<b>Consented</b>	
Kilgallioch	96

Development	Number of Turbines
Knockman Hill	5
Kype Muir	26
Penbreck	6
Solwaybank	15
Middle Muir	15
Poniel	3
Magheughan Rig	6
Kennoxhead	19
Gass	9
Barlockfort Moor Extension	4
Bankend Rig Extension	3
Crookedstane	4
Lion Hill	4
Cumberhead Hill	11
Sandy Knowe	24
Stranoch	24
Kype Muir Extension	15
South Kyle	50
Benbrack	18
Windy Rig	12
Chirmorie	21
Lethans	22
Douglas West	13
Penbreck	3
Lorg	15
Pencloe Forest	21
<b>Application/ Appealed</b>	
Fell	9
Shepherd's Rig	19
Margree	15
Glentaggart	5
Twentyshilling Hill	9
Enoch Hill	19
Wether Hill Extension	11
Quatans Hill	19
Glenmuckloch Farm	8
Harryburn	17
Overhill Wind Farm	10
North Lowther	30

Development	Number of Turbines
Cornharrow	11
Windy Standard III	20
Glenshimmeroch	10
Troston Loch	14
Polquhairn	9

## ANNEX 6 – NATURESCOT SURVEY METHODOLOGY CORRESPONDANCE

**From:** John Gibson [<mailto:John.Gibson@nature.scot>]  
**Sent:** 05 August 2019 16:20  
**To:** Stacey Whiteley  
**Cc:** Howard Fearn; 'Tom Walker'  
**Subject:** Proposed Artfield Wind Farm

Hi Stacey,

I've now read through the Artfield Wind Farm – Scope of Ornithological and Ecological survey work.

Based on previous survey work and surveys proposed/underway for 2019 we are content that the proposed approach to baseline ornithological and ecological information gathering and ornithological target species will be sufficient to inform and support any future planning application. While the VP survey work 2018/19 did not cover the full extent of the site, given results of previous surveys of flight activity and those proposed/underway for 2019 we are not overly concerned that this should hold up any planning application.

If you need anything else just get in touch.

Regards,

John

**John Gibson | Operations Officer**

Scottish Natural Heritage | Holmpark Industrial Estate | New Galloway Road | Newton Stewart | DG8 6BF | t:  
01671 404700 Dualchas Nàdair na h-Alba | Raon Gnìomhachais Phàirc an Tuilm | Rathad Ghall-Ghàidhealaibh  
Nuaidh | Baile Ùr Nan Stiùbhartach DG8 6BF nature.scot – Connecting People and Nature in Scotland -  
@nature\_scot

[From: Stacey Whiteley \[<mailto:Stacey.Whiteley@scotland.nhs.uk>\]](mailto:Stacey.Whiteley@scotland.nhs.uk)

## **Technical Appendix 8.2: Collision Risk Analysis**





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**Artfield Forest Wind Farm**

**Technical Appendix 8.2: Collision Risk Analysis**



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# 1 INTRODUCTION

- 1.1.1 This appendix has been prepared to accompany **Chapter 8: Ornithology** of the Artfield Forest Wind Farm (the "Proposed Development") Environmental Impact Assessment (EIA) Report (EIAR).
- 1.1.2 It presents the details and results of Collision Risk Analysis, completed to inform the assessment of the Proposed Development.
- 1.1.3 Only common bird species names are referred to within this Appendix. **Technical Appendix 8.1** of the EIAR provides a summary of all bird species referred to herein. Both common and species names, together with a summary of their conservation status as relevant is provided.

# 2 METHOD

- 2.1.1 The Band collision risk model (CRM) (Band *et al.*, 2007<sup>1</sup>) has been used to estimate the collision mortality risk to target species. The Band model calculates collision mortality risks in three stages
- Stage 1: the estimation of the number of birds passing through the rotor swept volume of the wind farm, based on observed VP flight activity data;
  - Stage 2: the estimation of collision likelihood i.e. the probability of a bird flying through a rotor being hit, based on bird and wind farm parameters and whereby all collisions are assumed to be fatal. This provides an estimate of how many fatal collisions would occur, in theory, should birds take no avoiding action; and,
  - After multiplying State 1 and Stage 2 an avoidance factor is then applied i.e. whereby it is assumed birds take action to avoid collision.

## 2.2 Wind Farm Characteristics

- 2.2.1 Wind farm characteristics are summarised in **Table A2.1** and have been based upon a candidate turbine of the Vestas V150-4.2MW, with an approximate hub height of 105m and rotor diameter of 150m. Where any uncertainty exists regarding turbine parameters, best available or worst-case figures have been included.
- 2.2.2 For the purposes of analysis, the flight risk volume (Vw) is based on a buffer constructed with a radius of 500m around the outer proposed turbine locations, with a height at least equal to the rotor diameter.

**Table 2.1: Wind farm characteristics.**

Parameter	Value	Unit
Size of wind farm (500m turbine buffer)	483.8	Hectares (ha)
No. of rotors	12	-
No. of blades	3	-
Height to tip	180	Meters (m)
Hub height	105	Meters (m)

<sup>1</sup> Band, W., Madders, M. and Whitfield, D.P., (2007). Developing Field and Analytical Methods to Assess Avian Collision Risk at Wind Farms.

Parameter	Value	Unit
Rotor diameter	150	Meters (m)
Rotor radius	75	Meters (m)
Max. chord	4.2	Meters (m)
Pitch	15	Degrees (°)
Rotation period <sup>2</sup>	6	Seconds (s)
Downtime	15	Percentage (%)

## 2.3 Viewsheds

- 2.3.1 Flight activity data for use in CRMs has been obtained from a total of four Vantage Point (VP) locations (VP1, 2, 3 and 4), utilised during baseline VP flight activity surveys between April 2018 and August 2019.
- 2.3.2 Visible areas within the viewshed for each VP were estimated in GIS (Pitney Bowes MapInfo 2019.2), using an observer height of 1.5m (i.e. seated) and a 20m vertical offset above the ground surface. Viewsheds were constructed based on a 2km viewing radius and a 180°viewing arc. Details of the visible areas (ha) within the viewsheds for each VP location and within the wind farm (500m turbine buffer), are summarised in **Table A2.2**.
- 2.3.3 For the purposes of the calculation of collision mortality risks, to account for viewshed overlap and the undertaking of simultaneous watches from VPs where this occurred, viewshed visible areas have been corrected to remove overlapping areas of viewsheds.
- 2.3.4 Any flights seen from the VP and survey effort within the overlapping areas have however been retained for the purposes of a conservative approach.

**Table 2.2: VP observational effort.**

VP	Total Visible Area (ha)	Visible Area within Wind Farm (ha)	Corrected Visible Area within Wind Farm (ha)
VP1	527.2	34.82	34.82
VP2	497.3	175.20	138.6
VP3	590.3	266.20	108.4
VP4	499.9	238.10	163.6

## 2.4 'At-risk' Flight Activity

- 2.4.1 An 'at-risk' flight is identified as one which is visible from the VP and which passes into the wind farm area (500m turbine buffer), with at least part of its flight recorded between 30m and 150m comprising Height Band (HT) HT2 and HT3 utilised during baseline VP flight activity surveys.

<sup>2</sup> Based on a speed range of 4.9 – 12.0 rpm (<http://www.chubut.gov.ar/portal/wp-organismos/ambiente/wp-content/uploads/sites/8/2018/04/Anexo-4-0067-7060-V00GENspecs.pdf>) and a conservative operating speed estimate derived as 20% of the maximum speed.



**Year 1 Non-breeding Season**

VP	No. of Flights	No. of Birds	At Risk Duration in seconds
1	0	0	0
2	2	2	16.24
3	0	0	0
<b>Totals</b>	<b>2</b>	<b>2</b>	<b>16.24</b>

VP	Watch data			Flying time (s)	Flying time hahr-1	Weighted flying time ha hr <sup>-1</sup>	
	Area (ha)	Time (hrs)	HaHr	Risk height	Risk height	Weighting	Risk height
1	34.8	42	1462.44	0.00	0.0000000000	0.123554042	0.0000000000
2	138.6	42	5821.20	16.24	0.0000007751	0.491803279	0.000000381
3	108.4	42	4552.80	0.00	0.0000000000	0.384642680	0.0000000000
<b>Totals</b>	<b>281.80</b>	<b>126</b>	<b>11836.44</b>	<b>16.24</b>	<b>0.0000007751</b>	<b>1.0000000000</b>	<b>0.0000003812</b>

Mean activity hr <sup>-1</sup> in wind farm			WIND FARM DATA	
Risk height	0.00018	0.0024%	Wind farm area (ha)	483.8

<b>Potentially Active Hours</b>	2168.4 <sup>8</sup>	(September 2018 – March 2019)		
<b>Downtime</b>	15%			<b>D</b>
<b>Vw =</b>	725700000			<b>L + d</b>
<b>Vr =</b>	992429	<b>No. Turbines</b>	12	
<b>Vr/Vw =</b>	0.0013675			
<b>Speed =</b>	12			
<b>Vw Occupancy =</b>	0.3999	1439.6		
<b>Vr Occupancy =</b>	0.0005	2.0		
<b>Transit time =</b>	0.3900			
<b>Transits =</b>	5.048			
<b>Collision probability =</b>	0.058			

<b>Collisions with no avoidance</b>	0.293
<b>Collisions with 99% avoidance</b>	0.003
<b>Collisions with 99% avoidance &amp; downtime</b>	0.002
<b>30 year mortality</b>	0.088
<b>30 year mortality with 15% downtime</b>	0.075
<b>Years for 1 death</b>	401.82

**Year 2 Breeding Season**

VP	No. of Flights	No. of Birds	At Risk Duration in seconds
1	0	0	0
2	0	0	0
3	0	0	0
4	1	1	38.11
<b>Totals</b>	<b>1</b>	<b>1</b>	<b>38.11</b>

VP	Watch data			Flying time (s)	Flying time hahr-1	Weighted flying time ha hr <sup>-1</sup>	
	Area (ha)	Time (hrs)	HaHr	Risk height	Risk height	Weighting	Risk height
1	34.8	36.0	1253.52	0.00	0.0000000000	0.078173409	0.0000000000
2	138.6	36.0	4989.60	0.00	0.0000000000	0.311166988	0.0000000000
3	108.4	36.0	3902.40	0.00	0.0000000000	0.243365812	0.0000000000
4	163.6	36.0	5889.60	38.11	0.0000017976	0.367293790	0.000000660
<b>Totals</b>	<b>445.4</b>	<b>144.0</b>	<b>16035.12</b>	<b>38.11</b>	<b>0.0000017976</b>	<b>1.0000000000</b>	<b>0.0000006603</b>

Mean activity hr <sup>-1</sup> in wind farm			WIND FARM DATA	
Risk height	0.00032	0.0319%	Wind farm area (ha)	483.80

<b>Potentially Active Hours</b>	2327.7 <sup>9</sup>	(April 2019 – August 2019)		
<b>Downtime</b>	15			<b>D</b>
<b>Vw =</b>	725700000			<b>L + d</b>
<b>Vr =</b>	992429	<b>No. Turbines</b>	12	
<b>Vr/Vw =</b>	0.0013675			
<b>Speed =</b>	12			
<b>Vw Occupancy =</b>	0.7435	2676.8		
<b>Vr Occupancy =</b>	0.0010	3.7		
<b>Transit time =</b>	0.3900			
<b>Transits =</b>	9.386			
<b>Collision probability =</b>	0.058			

<b>Collisions with no avoidance</b>	0.544
<b>Collisions with 99% avoidance</b>	0.005
<b>Collisions with 99% avoidance &amp; downtime</b>	0.005
<b>30 year mortality</b>	0.163
<b>30 year mortality with 15% downtime</b>	0.139
<b>Years for 1 death</b>	216.10

<sup>8</sup> Potentially active hours calculated from the sum of day lengths between 1<sup>st</sup> September and 31<sup>st</sup> March (excl. 28<sup>th</sup> February).

<sup>9</sup> Potentially active hours calculated from the sum of day lengths between 1<sup>st</sup> April and 31<sup>st</sup> August.

**Collision Mortality Risk Summary – Hen Harrier**

Season	Annual Seasonal Mortality	30 Year Seasonal Mortality
Year 1 Breeding Season (2018)	0.000	0.000
Year 1 Non-breeding Season (2018-19)	0.002	0.075
Year 2 Breeding Season (2019)	0.005	0.139