

# 8 Ornithology

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# 8 Ornithology

## 8.1 Executive Summary

- 8.1.1 This chapter provides an assessment of the potential effects associated with the Proposed Development on ornithological features present.
- 8.1.2 Field surveys were conducted in accordance with Scottish Natural Heritage (SNH) consultation advice and relevant guidance during the 2018 breeding season in order to determine the current breeding assemblage within the study area. Ornithological surveys have regularly taken place for wind farm projects within, and in the immediate vicinity of the Proposed Development site over the last 15 years and as a result, a number of adjacent projects' survey areas have at least in part overlapped spatially with the site. The assessment therefore utilises relevant data recorded for local wind farm sites as well as the 2018 survey results.
- 8.1.3 In general, the bird assemblage recorded in 2018 corresponded with results of surveys undertaken for other wind farm projects in the local area, with few target species sensitive to wind farm development present within the site. Ornithological features taken forward to the assessment included those recorded during historic surveys within the 2 km study area that may have been absent during the 2018 breeding season. These comprised: wildfowl (whooper swan, pink-footed goose and greylag goose), goshawk, black grouse, lapwing, curlew and golden plover. No designated sites are considered likely to be affected by the Proposed Development.
- 8.1.4 The ornithological assessment identified habitat loss and disturbance during the construction and decommissioning phases, and displacement, collision risk and lighting effects during the operational phase, as potential impacts. Unmitigated effects from construction, operation and decommissioning activities on all Important Ornithological Features (IOFs) were assessed as being at worst minor adverse and not significant in the context of the EIA Regulations.
- 8.1.5 A cumulative assessment was undertaken and it was concluded that no further mitigation is required for the Proposed Development, and all cumulative effects are not significant.

## 8.2 Introduction

- 8.2.1 This chapter considers the potential effects on ornithology associated with the construction, operation and decommissioning of the Proposed Development. The specific objectives of the chapter are to:
- describe the ornithological baseline;
  - describe the assessment methodology and significance criteria used in completing the assessment;
  - describe the potential unmitigated effects of predicted impacts (direct or indirect) on Important Ornithological Features (IOFs);
  - describe the mitigation measures proposed to address likely significant effects; and
  - assess the residual effects remaining following the implementation of mitigation, including cumulatively with other wind farm projects.
- 8.2.2 This chapter is supported by Appendix 8.1: Ornithology, which contains the following Annexes:
- Annex A – Ornithological legal protection;
  - Annex B – Ornithological survey methodologies;
  - Annex C – Ornithological survey effort and general information;

- Annex D – Ornithological survey results;
- Annex E – Review of the effects of artificial light on birds in relation to deployment of obstruction lighting on turbines; and
- Annex F – Supplementary desk study information.

8.2.3 This chapter is supported by the following figures:

- Figure 8.1 Ornithological Designated Sites within 20 km;
- Figure 8.2 Wind Farm Projects within 2 km;
- Figure 8.3 Site Boundaries and Study Areas;
- Figure 8.4 2018 Vantage Point and Viewshed;
- Figure 8.5 Flight Activity Results: 2018 Breeding Season;
- Figure 8.6 Wader Activity: 2018;
- Figure 8.7 Raptor Activity: 2018; and
- Figure 8.8 Black Grouse Historic Records.

## 8.3 Legislation, Policy and Guidelines

### ***Legislation***

8.3.1 Relevant European legislation and guidance documents have been reviewed and taken into account as part of this ornithological assessment. Of particular relevance are the following European legislation:

- Directive 2009/147/EC on the Conservation of Wild Birds ('Birds Directive');
- Directive 92/43/EEC on Conservation of Natural Habitats and of Wild Fauna and Flora (as amended) ('Habitats Directive'); and
- Environmental Impact Assessment Directive 2014/52/EU.

8.3.2 The following national legislation is considered as part of the ornithology assessment:

- The Wildlife and Countryside Act 1981 (as amended);
- The Conservation (Natural Habitats &c.) Regulations 1994 (as amended) (The Habitats Regulations);
- The Nature Conservation (Scotland) Act 2004 (as amended); and
- The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017.

### ***Planning Policy***

8.3.3 Chapter 5 sets out the planning policy framework that is relevant to the EIA. The policies set out include those from the South Lanarkshire Local Development Plan 2015. This section also considers the relevant aspects of Scottish Planning Policy, Planning Advice Notes and other relevant guidance. Of relevance to the ornithology assessment presented within this chapter, regard has been had to the following policies:

- *UK Post-2010 Biodiversity Framework (2012);*
- *Scottish Biodiversity Strategy: It's in Your Hands (2004)/2020 Challenge for Scotland's Biodiversity (2013);* and

- Scottish Government (2017). *Planning Advice Note 1/2013-Environmental Impact Assessment*, Revision 1.0.

### Guidance

8.3.4 Cognisance has been made of the following guidance:

- Eaton M.A., Aebischer N.J., Brown A.F., Hearn R.D., Lock L., Musgrove A.J., Noble D.G., Stroud D.A. and 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;
- European Commission (2010). Natura 2000 Guidance Document 'Wind Energy Developments and Natura 2000'. European Commission, Brussels;
- Scottish Natural Heritage (SNH) (2000). *Windfarms and birds: calculating a theoretical collision risk assuming no avoidance action*. SNH Guidance Note;
- SNH (2016a). *Assessing connectivity with Special Protection Areas (SPAs)*. Version 3;
- SNH (2016b). *Environmental Statements and Annexes of Environmentally Sensitive Bird Information; Guidance for Developers, Consultants and Consultees* Version 2;
- SNH (2017) *Recommended Bird Survey Methods to inform impact assessment of Onshore Windfarms*.
- SNH (2018a). *Assessing significance of impacts from onshore windfarms on birds out with designated areas*. Version 2
- SNH (2018b). *Assessing the cumulative impacts of onshore wind farms on birds*. SNH Guidance Note;
- SNH (2018c). *Environmental Impact Assessment Handbook – Version 5: Guidance for competent authorities, consultation bodies, and others involved in the Environmental Impact Assessment process in Scotland*; and
- SERAD (Scottish Executive Rural Affairs Department) (2000). *Habitats and Birds Directives, Nature Conservation; Implementation in Scotland of EC Directives on the Conservation of Natural Habitats and of Wild Flora and Fauna and the Conservation of Wild Birds (“the Habitats and Birds Directives”)*. Revised Guidance Updating Scottish Office Circular No 6/1995.

## 8.4 Consultation

8.4.1 During the pre-application EIA process, SNH provided comment relating to the Ornithology Scoping Report for the Proposed Development (MacArthur Green, 2018), and specifically the collection of baseline ornithology data which would be used to inform this assessment. A summary of the SNH response and how it was addressed in this Chapter is presented in Table 8.1.

**Table 8.1 – Key issues**

Consultee	Summary of key issues	Where addressed in chapter
SNH 27 April 2018	“[SNH] can confirm that the approach to ornithological surveying set out in the report you provided should provide a sufficient basis for assessing the potential impacts.”	The methods and data sources considered for obtaining sufficient information to allow a robust assessment of the Proposed Development are presented in Section 8.5 and in detail in Appendix 8.1.

Consultee	Summary of key issues	Where addressed in chapter
SNH 31 January 2019	Given the separation distance between the Proposed Development site and the SPA, in line with our Guidance on Assessing Connectivity with Special Protection Areas (SPAs) (June 2016) the Proposed Development would be situated out with the core foraging range for hen harrier, golden plover, peregrine and short-eared owl. However, the Proposed Development site would be situated within the core foraging range for merlin, which is the area in which we would consider there may be connectivity between the development site and the qualifying interests of the SPA.	Baseline survey results in 2018 and historic surveys for other local wind farm projects within 2 km (Section 8.6) have not recorded breeding merlin, and the species appears to be only present rarely. Consideration of potential effects within an EIA context, and a Habitats Regulations Appraisal (HRA) context on the SPA population are presented in Section 8.7.
	Regarding the ornithology interests of the Muirkirk Uplands Site of Special Scientific Interest (SSSI), we reserve full judgement on potential effects until we have considered the full ornithology survey results.	Consideration of potential effects on the SSSI are presented in Section 8.7.
	We do not consider that the proposal will have a negative impact on the interests of North Lowther SSSI.	Noted. Consideration of potential effects on the SSSI are presented in Section 8.7.

## 8.5 Assessment Methodology and Significance Criteria

8.5.1 This chapter takes an appropriate and topic-specific approach to assessment of the Proposed Development within the parameters identified in Chapter 3: Proposed Development. This chapter provides a worst-case assessment of the Proposed Development for ornithology and presents sufficient information for consultees and the decision makers to comment on and determine the application within the parameters of the Proposed Development.

### ***Site status and context***

8.5.2 The site currently comprises an area of mainly low conservation value mature conifer plantation (refer to Chapter 7: Ecology for further details). It is surrounded by open rough grazing moorland and historical opencast mine workings (Dalquhandy being directly to the north), as well as operational wind farms, the closest being Hagshaw Hill and Extension, and Galawhistle, directly to the south and south-west.

### ***Scope of Surveys***

- 8.5.3 Consultation was undertaken with SNH to reach agreement on the scope of ornithological surveys required to inform the assessment (Table 8.1).
- 8.5.4 As summarised in MacArthur Green (2018), ornithological surveys have regularly taken place for wind farm projects in the immediate vicinity of the site over the last 15 years, as well as ongoing monitoring for the Hagshaw Hill Extension Wind Farm. As a result, a number of adjacent sites' survey areas have overlapped spatially with the Proposed Development site (Figure 8.2). As a result, it is considered that the ornithological baseline conditions within the development site are well known.
- 8.5.5 It was therefore agreed with SNH (Table 8.1) that one breeding season of additional survey effort is sufficient to allow a robust characterisation of the baseline ornithological assemblage and usage of the site and surrounding area, when used in combination with the substantial information collated for other nearby projects.

### ***Study Area***

- 8.5.6 The assessment focused on the site and appropriate buffer areas, as recommended by SNH (2017) guidance (see Appendix 8.1 for further details).
- 8.5.7 The specific study areas associated with this assessment are as follows:
- ornithological designated sites: within 20 km of the site (Figure 8.1);
  - scarce breeding birds (raptors, owls and black grouse): 2 km buffer around the site (Figure 8.3);
  - black grouse: 1.5 km buffer around the site (Figure 8.3);
  - breeding birds (waders): within suitable upland habitat (non-forested), up to 500 m from the site (Figure 8.3);
  - flight activity (collision risk): within the turbine area a 500 m buffer of the outermost turbine locations; and
  - cumulative effects: projects within the appropriate Natural Heritage Zone (NHZ) (Figure 8.2).

### ***Information and Data Sources***

#### **Desk Study**

- 8.5.8 The desk study used the following source for information on designated sites:
- SNH Sitelink (<http://gateway.snh.gov.uk/sitelink/index.jsp>).
- 8.5.9 The desk study also gathered ornithological information that was available within Environmental Statements, EIA reports and associated Technical Appendices in the public domain relating to applications of the following local wind farm projects (see Figure 8.2). Table 8.2 outlines the timeline of baseline ornithology surveys carried out for these projects:
- Hagshaw Hill Extension Wind Farm (HH): April 2003 to July 2004;
  - Nutberry Wind Farm (NU): April 2004 to March 2006;
  - Galawhistle Wind Farm (GA): September 2007 to August 2009;
  - Dalquhandy Wind Farm (DQ): November 2011 to November 2012; and April to July 2017 (for revised application);
  - Cumberhead (Nutberry Extension) Wind Farm (CU): May 2013 to August 2014;

- Douglas West Wind Farm (DW): September 2014 to September 2015. Includes a report 'Final Breeding Raptor Survey Report 2015 of the Proposed Douglas West & Dalquhandy DP Renewable Energy Project' (DES, 2015) which contains historic breeding raptor information provided by the South Strathclyde Raptor Study Group (SSRSG); and
- Repowered Hagshaw Hill Wind Farm (RHH): March to August 2018.

8.5.10 In addition, the desk study used information relating to the following proposed local wind farm project which was not taken forward for development:

- Douglas West Community Wind Farm (DWCW): November 2009 to November 2010 and a scoping visit was also carried out at the DWCW site in September 2009. The site boundary for this project largely overlapped with the Douglas West Wind Farm.

**Table 8.2 – Timeline of baseline ornithology surveys undertaken for nearby wind farm sites**

Wind farm	Year (2003 to 2017)															
	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18
HH							Operational Monitoring									
HU																
GA																
DWCW																
DQ																
GU																
DW																
RHH																

ornithology data was collected at these wind farms during breeding and non-breeding seasons. Each wind farm covered some or all of the following survey types:

- flight activity surveys (summer vantage point watches and autumn migration vantage point watches);
- scarce breeding bird surveys (walkover surveys for raptors and any other species listed in Schedule 1 of the Wildlife and Countryside Act 1981);
- black grouse surveys; and
- upland breeding bird surveys (waders and any other species of conservation concern).

**Field Surveys**

8.5.12 Ornithological fieldwork commenced in March 2018 and was completed in August 2018, and comprised the surveys detailed below (see Appendix 8.1, Annexes B and C for further details).

Scarce breeding bird surveys:

8.5.13 Monthly surveys from April to August 2018 for breeding raptors and any other species listed in Schedule 1 of the Wildlife and Countryside Act 1981 took place within the site and a survey area buffer of a minimum of 2 km, following survey methodologies from Hardey *et al.* (2013) and Gilbert *et al.* (1998).

Black grouse surveys:

8.5.14 Black grouse surveys took place within the site boundary and a survey area buffer of a minimum of 1.5 km in 2018 in April and May 2018, following survey methodology from Gilbert *et al.* (1998).

Flight activity surveys:

- 8.5.15 It was agreed with SNH (Table 8.1) that flight activity (vantage point) surveys were not required due of the following reasons:
- Considerable information exists from previous flight surveys for nearby wind farm projects, which have survey areas that either overlap with the Proposed Development site, or are close by; and
  - The mature conifer plantation that comprises the majority of the site is likely to be of low habitat quality for target species such as breeding raptors or waders. Activity levels over the site are therefore likely to be very low.
- 8.5.16 The following wind farm projects have carried out flight activity surveys where viewsheds have at least in part overlapped with the Proposed Development site (see Appendix 2 of MacArthur Green (2018) for details of vantage point locations and associated viewsheds):
- Cumberhead Wind Farm (2013-14): VP 1 and VP 3 have combined coverage of around 80% of the Proposed Development site.
  - Douglas West & Dalquhandy DP Renewable Energy Project (2014-15) and Douglas West Community Wind Farm (2009-10): VP 3 and VP 1 (2009-10 only) have a combined coverage of around 75% of the Proposed Development site.
  - Dalquhandy Wind Farm (2011-12): VP 1 has coverage of up to 25% of the Proposed Development site.
  - Hagshaw Hill Extension Wind Farm (2003-04).
- 8.5.17 In addition, flight activity surveys from a single vantage point in 2018 for the Repowered Hagshaw Hill Wind Farm project covered the area directly to the south of the Proposed Development site (Figure 8.4).

Upland breeding bird surveys:

- 8.5.18 The conifer plantation habitat within the site is unsuitable for upland breeding birds such as waders, and so no surveys were undertaken in 2018. To the south of the site, for the Repowered Hagshaw Hill Wind Farm project, upland breeding bird surveys in 2018 focussed on recording breeding waders and any other species of conservation concern found within the site and a 500 m buffer (i.e. overlapping with the south of the Proposed Development site), following survey methodology from Brown & Shepherd (1993).

***Assessment of Potential Effect Significance***

- 8.5.19 This section defines the methods used to assess the significance of effects through the process of an evaluation of sensitivity of feature (a combination of nature conservation importance (nature conservation importance) and conservation status) and magnitude of impact for each likely impact. The assessment focuses on a 'worst-case' Proposed Development as described below.
- 8.5.20 The evaluation for wider-countryside interests (not relating to Natura 2000 sites covered by the Habitats Regulations Appraisal (HRA) process) involves the following process:
- identifying the potential impacts associated with the Proposed Development;
  - considering the likelihood of occurrence of potential impacts where appropriate;
  - defining the nature conservation importance and Conservation status of the bird populations present to establish level of sensitivity;
  - establishing the magnitude of the likely impact (both spatial and temporal);

- based on the above information, making a judgement as to whether or not the resultant unmitigated effect is significant with respect to the EIA Regulations;
- if a potential effect is determined to be significant, suggesting measures to mitigate or compensate the effect where required;
- considering opportunities for enhancement where appropriate; and
- confirming residual effects after mitigation or enhancement are considered.

#### Sensitivity of Feature

8.5.21 Determination of the level of sensitivity of a feature is based on a combination of the feature's nature conservation importance and conservation status.

8.5.22 There are three levels of nature conservation importance as detailed in Table 8.3.

**Table 8.3 – Determining factors of a feature's Nature Conservation Importance**

Importance	Description
High	Populations receiving protection by an SPA, proposed SPA, Ramsar Site, SSSI or which would otherwise qualify under selection guidelines.  Species present in nationally important numbers (>1% national breeding or wintering population).
Medium	The presence of species listed in Annex 1 of the Birds Directive (but population does not meet the designation criteria under selection guidelines).  The presence of breeding species listed on Schedule 1 of the Wildlife and Countryside Act 1981 (as amended).  The presence of rare breeding species noted on the latest Birds of Conservation Concern (BoCC) Red list (Eaton <i>et al.</i> 2015).  Regularly occurring migratory species, which are either rare or vulnerable, or warrant special consideration on account of the proximity of migration routes, or breeding, moulting, wintering or staging areas in relation to the Proposed Development.  Species present in regionally important numbers (>1% regional breeding population).
Low	All other species' populations not covered by the above categories.

8.5.23 IOFs to be assessed were taken to be those species of high and medium nature conservation importance.

8.5.24 As defined by SNH (2018a), the conservation status of a species is "*the sum of the influences acting on it which may affect its long-term distribution and abundance, within the geographical area of interest*". Conservation status is considered by SNH (2018a) to be 'favourable' under the following circumstances:

- "*population dynamics indicate that the species is maintaining itself on a long-term basis as a viable component of its habitats;*
- *the natural range of the species is not being reduced, nor is likely to be reduced for the foreseeable future; and*

- *there is (and probably will continue to be) a sufficiently large habitat to maintain its population on a long-term basis”.*

8.5.25 SNH (2018a) recommends that *“the concept of favourable conservation status of a species should be applied at the level of its Scottish population, to determine whether an impact is sufficiently significant to be of concern. An adverse impact on a species at a regional scale (within Scotland) may adversely affect its national conservation status”.* Thus, *“An impact should therefore be judged as of concern where it would adversely affect the existing favourable conservation status of a species or prevent a species from recovering to favourable conservation status, in Scotland.”*

8.5.26 In the case of non-designated sites in Scotland, the relevant regional scale for breeding species is considered to be the appropriate NHZ which the site falls within. The Proposed Development is at the edge of NHZ 17 West Central Belt and adjacent to NHZ 19 Western Southern Uplands & Inner Solway (Figure 8.1). However, as the upland habitats and topography of the site are more similar to those of NHZ 19 rather than NHZ 17, effects were assessed based on NHZ 19 species’ populations.

8.5.27 For wintering or migratory species, the national UK population or flyway population is considered to be the relevant scale for determining effects on the conservation status, and this approach is applied here.

**Magnitude of Impact**

8.5.28 An impact is defined as a change of a particular magnitude to the abundance and/or distribution of a population as a result of the Proposed Development. Effects can be adverse, neutral or favourable.

8.5.29 In determining the magnitude of impacts, the resilience of a population to recover from temporary adverse conditions is considered in respect of each potentially affected population.

8.5.30 The sensitivity of individual species to disturbance during relevant behaviours is considered when determining spatial and temporal magnitude of effect and is assessed using guidance described by Bright *et al.* (2006), Hill *et al.* (1997) and Ruddock and Whitfield (2007).

8.5.31 Impacts are judged in terms of magnitude in space and time. There are five levels of spatial and temporal impact magnitude as detailed in Table 8.4 and Table 8.5 respectively.

**Table 8.4 – Spatial magnitude of impact**

<b>Spatial magnitude</b>	<b>Description</b>
Very High	Total/near total loss of a bird population due to mortality or displacement. Total/near total loss of productivity in a bird population due to disturbance. Guide: >80 % of population lost or increase in additive mortality.
High	Major reduction in the status or productivity of a bird population due to mortality or displacement or disturbance. Guide: 21-80 % of population lost or increase in additive mortality.
Medium	Partial reduction in the status or productivity of a bird population due to mortality or displacement or disturbance. Guide: 6-20 % of population lost, or increase in additive mortality.
Low	Small but discernible reduction in the status or productivity of a bird population due to mortality or displacement or disturbance. Guide: 1-5 % of population lost or increase in additive mortality.

Spatial magnitude	Description
Negligible	Very slight reduction in the status or productivity of a bird population due to mortality or displacement or disturbance. Reduction barely discernible, approximating to the “no change” situation.  Guide: < 1 % of population lost or increase in additive mortality.

**Table 8.5 – Temporal magnitude of Impact**

Temporal magnitude	Description
Permanent	Effects continuing indefinitely beyond the span of one human generation (taken as approximately 25-30 years), except where there is likely to be substantial improvement after this period. Where this is the case, Long-Term may be more appropriate.
Long-term	Approximately 15 - 25 years or longer (see above).
Medium-term	Approximately 5 – 15 years.
Short-term	Up to approximately 5 years.
Negligible	<12 months.

**Potential Cumulative Effects**

- 8.5.32 The *Cumulative Assessment* section (Section 8.10) presents information about the potential cumulative effects of the Proposed Development combined with other operational, consented or proposed wind farm projects.
- 8.5.33 SNH (2018b) has provided guidance on assessing the cumulative effects on birds. This assessment follows the principles set out in that guidance.
- 8.5.34 Cumulative effects may include cumulative disturbance-displacement, collision mortality, habitat loss or barrier effects. Some cumulative impacts, such as collision risk, may be summed quantitatively, but according to SNH (2018b) “*In practice, however, some effects such as disturbance or barrier effects may need considerable additional research work to assess impacts quantitatively. A more qualitative process may have to be applied until quantitative information becomes available for developments in the area, e.g. from post-construction monitoring or research*”.
- 8.5.35 The main projects likely to cause similar effects on ornithological features are other operational wind farms, or those under construction, consented, or in the planning process within NHZ 19 (Table 8.6).
- 8.5.36 Wind farm projects at scoping stage have generally been scoped out of the cumulative assessment because they usually do not have sufficient information on potential effects to be included, as the baseline survey period is ongoing, or results have not been published.
- 8.5.37 As requested by SNH during consultation, the Repowered Hagshaw Hill Wind Farm and revised schemes for the Cumberhead and Dalquhandy Wind Farms are presently at application stage and given their proximity to the Proposed Development site have been included in the assessment.

- 8.5.38 Cumberhead Wind Farm has been approved for 11 turbines but an application has recently been submitted for Cumberhead Wind Farm for a re-design of 14, larger turbines. An application was submitted in December 2018 seeking consent to replace the existing 26 turbines at Hagshaw Hill Wind Farm (excluding Hagshaw Hill Extension) with 14 new, larger turbines. A Section 42 application for larger turbines and a slightly amended layout at Dalquhandy was also submitted in December 2018.
- 8.5.39 Projects that have been refused or withdrawn have been scoped out of the cumulative assessment.
- 8.5.40 Small projects with three or fewer turbines have also been scoped out from the cumulative assessment as often these projects are not subject to the same level of detail of ornithological assessment, and so there are no directly comparable data. Because of the small scale of such projects, effects are likely to be negligible on the IOFs assessed here. Other small-scale renewable projects such as micro hydro schemes have also been scoped out for similar reasons. Table 8.6 identifies the wind farm projects that have been considered in the cumulative assessment.

**Table 8.6 – NHZ 19 Wind farm Projects Included in the Cumulative Assessment (Ordered by Project Status)**

Project	Status	Number of turbines	Source of information
<b>Installed wind farm projects</b>			
Airies	Installed	14	ES chapter
Andershaw	Installed	14	ES chapter
Arecleoch	Installed	60	No info available
Artfield Fell	Installed	15	Non-Technical Summary (NTS)
Auchrobert	Installed	12	No info available
Balmurrie Fell (Artfield Fell Extension)	Installed	7	NTS
Bankend Rig	Installed	11	Breeding and Wintering Bird Report 2010-11; Kennoxhead SEI cumulative assessment
Barlockhart Moor Wind Farm	Installed	4	From Barlockhart Moor Wind Farm Extension ES
Blackcraig	Installed	23	ES chapter
Carscreugh	Installed	18	ES chapter
Clyde	Installed	152	ES chapter
Dalswinton (Pennyland Moor)	Installed	15	ES chapter
Dersalloch	Installed	23	ES chapter, 2006 and 2012 addendum
Dungavel	Installed	13	ES chapter
Galawhistle	Installed	22	ES chapter

<b>Project</b>	<b>Status</b>	<b>Number of turbines</b>	<b>Source of information</b>
Glen App	Installed	11	ES chapter
Glenchamber	Installed	11	From Barlockhart Moor Wind Farm Extension ES
Hagshaw Hill Wind Farm	Installed	26	No info available
Hagshaw Hill Extension	Installed	20	ES chapter
Hare Hill Phase 1	Installed	20	No info available
Kilgallioch	Installed	96	ES chapter and addendum
Mark Hill	Installed	28	NTS
Middle Muir	Installed	15	ES chapter
Minnycap	Installed	10	No info available
Nutberry	Installed	6	ES chapter
Wether Hill	Installed	14	ES chapter
Windy Standard	Installed	36	Windy Standard Extension ES
<b>Approved wind farm projects</b>			
Afton	Approved	27	Variation ES, NTS
Bankend Rig Extension	Approved	3	ES chapter
Benbrack	Approved	18	ES chapter
Chirmorie	Approved	21	ES Chapter
Crookedstane	Approved	4	ES chapter
Cumberhead	Approved	11	ES chapter
Dalquhandy	Approved	15	ES chapter
Douglas West	Approved	13	ES chapter
Dungavel Hill	Approved	13	ES chapter
Gass	Approved	9	ES chapter
Glenmuckloch	Approved	8	ES chapter
Harestanes	Approved	68	ES chapter
Kennoxhead	Approved	19	ES chapter
Knockman Hill	Approved	5	Environmental Report
Kype Muir	Approved	26	ES chapter
Kype Muir Extension	Approved	18	ES chapter
Lion Hill	Approved	4	ES chapter

Project	Status	Number of turbines	Source of information
Mochrum Fell	Approved	8	ES chapter
Over Hill	Approved	11	ES chapter
Penbreck	Approved	9	ES chapter
Plascow Wind Cluster	Approved	3	Environmental Report
Sandy Knowe	Approved	24	ES chapter
Sanquhar Community Windfarm	Approved	9	SEI chapter
South Kyle	Approved	50	ES chapter
Whiteside Hill	Approved	10	No info available
Windy Standard Extension (Brockloch Rigg Windfarm Limited)	Approved	30	ES chapter
<b>Application wind farm projects</b>			
Annabaglish	Application (appeal)	14	ES chapter
Ashmark Hill	Application	7	ES chapter
Auchencrosh	Application	Unknown	No info available
Balunton	Application	9	ES chapter
Barlockhart Moor Extension	Application	4	ES chapter
Broken Cross	Application	7	ES chapter
Cumberhead (revised application recently submitted for a re-design and more, larger turbines)	Application	14	Original ES and revised EIA report chapter
Dalquhandy (revised application on approved project to increase turbine heights)	Application	15	Original ES chapter
Enoch Hill	Application	16	ES chapter
Garleffan	Application (appeal)	6	ES chapter and SEI
Glentaggart	Application	5	ES chapter
Hare Hill Phase 2	Installed	35	ES chapter
Harestanes Extension	Application	7	ES chapter
Knockendurrick	Application	7	ES chapter
Kype Muir Extension	Application	15	ES chapter

Project	Status	Number of turbines	Source of information
Lethans	Application	22	ES chapter
Lorg	Application	15	ES chapter
Magheuchan Rig	Application	12	ES chapter and SEI
Margree	Application	25	ES chapter
Pencloe	Application	19	ES chapter
Polquhairn	Approved	9	ES chapter
Red Moss Hotel & Truck Stop	Application	19	No info available
Repowered Hagshaw Hill	Application	14	EIA Report
Stranoch 2	Application	24	ES chapter and addendum
Tormywheel Extension	Application	4	ES chapter
Twentyshilling Hill	Application	9	ES chapter
Ulzieside	Application	12	No info available
Wether Hill Extension	Application	11	ES chapter
Windy Rig	Application	12	SEI chapter

#### Statement of Significance

8.5.41 The potential significance of the effect was determined through a standard method of assessment based on professional judgement, considering both sensitivity and magnitude of change as detailed in Table 8.7. Major and moderate effects are considered significant in the context of the EIA Regulations.

**Table 8.7 – Significance criteria**

Significance	Description
Major	Significant effect, as the effect is likely to result in a permanent/ long term and very high/ high extent significant adverse effect on the integrity of the feature.
Moderate	Significant effect, as the effect is likely to result in a medium term and high / medium extent partially significant adverse effect on the integrity of the feature.
Minor	The effect is likely to adversely affect the feature at an insignificant level by virtue of its limited duration and/or extent, but there will probably be no effect on its integrity. This is not a significant effect.
Negligible	No material effect. This is not a significant effect.

### **Requirements for Mitigation**

8.5.42 Mitigation will be required if the *Assessment of Potential Effects* Section 8.7 determines that there is an unmitigated moderate adverse or major adverse and therefore significant effect on any IOF identified in this chapter.

8.5.43 Even without any significant effects on IOFs, general mitigation will be applied in the form of a Breeding Bird Protection Plan (BBPP) to ensure legal compliance that disruption to nesting birds and any disturbance to Schedule 1 breeding birds during the construction period is avoided.

### **Assessment of Residual Effect Significance**

8.5.44 If a potential effect is determined to be significant, suggested measures to mitigate the effect to a non-significant level will be considered and the revised significance of residual effects after mitigation will be assessed.

### **Limitations to Assessment**

8.5.45 There can often be varying degrees of uncertainty over the sensitivity of features or magnitude of impacts as a result of limited information. A precautionary approach is therefore adopted for the assessment where the response of a population to an effect is uncertain.

8.5.46 The following potential limitations to assessment have been identified:

- Baseline surveys did not cover the non-breeding season, meaning that data gaps were filled by the data collected for other local wind farm projects over the past 15 years. As the site is primarily comprised of commercial conifer plantation, ornithological interest is likely to be low during the non-breeding season, and this was consistent with results in the local area. As agreed with SNH (Table 8.1), the baseline dataset is considered sufficient to assess non-breeding season impacts.
- Although only a single year of surveys was undertaken, inter-annual variation can be determined using the data collected from other wind farm sites in the local area as agreed with SNH (Table 8.1).

## **8.6 Baseline Conditions**

### **Designated Sites**

8.6.1 There are no statutory nature conservation designations with an ornithological interest within the site. Table 8.8 details the designated sites located within 20 km of the Proposed Development that have ornithological interests. It should be noted that the two SSSIs are coincidental in extent with the Muirkirk and North Lowther Uplands SPA.

**Table 8.8 – Designated Sites within 20 km of the Proposed Development**

<b>Name</b>	<b>Distance</b>	<b>Qualifying interests</b>	<b>Status</b>
Muirkirk and North Lowther Uplands SPA	6.4 km	Hen harrier ( <i>Circus cyaneus</i> ), breeding	Unfavourable Declining
		Short-eared owl ( <i>Asio flammeus</i> ), breeding	Favourable Maintained
		Peregrine ( <i>Falco peregrinus</i> )	Unfavourable No Change
		Golden plover ( <i>Pluvialis apricaria</i> ), breeding	Favourable Maintained

Name	Distance	Qualifying interests	Status
		Merlin ( <i>Falco columbarius</i> ), breeding	Unfavourable No Change
		Hen harrier ( <i>Circus cyaneus</i> ), non-breeding	Unfavourable Declining
Muirkirk Uplands SSSI	6.4 km	Hen harrier ( <i>Circus cyaneus</i> ), breeding	Favourable Maintained
		Short-eared owl ( <i>Asio flammeus</i> ), breeding	Favourable Maintained
		Hen harrier ( <i>Circus cyaneus</i> ), non-breeding	Unfavourable Declining
		Breeding bird assemblage	Favourable Maintained
North Lowther Uplands SSSI	9.4 km	Hen harrier ( <i>Circus cyaneus</i> ), breeding	Unfavourable No Change
		Breeding bird assemblage	Unfavourable Declining

### ***Birds Recorded During Desk and Field Surveys***

8.6.2 The following paragraphs summarise the results of target species recorded during the 2018 field surveys (March to August 2018) and of the desk study that included the local wind farm projects within a 2 km study area of the Proposed Development site (surveys from 2003 to 2018). Full details of the results of 2018 surveys can be found within Appendix 8.1 and Figures 8.5 to 8.7.

#### **Bird Assemblage within the Local Area**

8.6.3 Table 8.9 summarises the results of baseline surveys within the local area over the long-term period, and states whether each target species recorded was found to be present (P) or whether there was no evidence (NE) recorded during surveys, or in the cases where information was not available (-).

8.6.4 Over the period of surveys, Table 8.9 shows that the species assemblage has remained relatively similar between years, as well as across different sites. In general, the local area including the Proposed Development site is of limited importance for most target species, with few breeding records of raptors and low levels of site usage by foraging raptors. A similar variety of wader species do breed within most sites, although the habitat within the Proposed Development site is unsuitable. Whooper swan, pink-footed goose and greylag goose were the only target wildfowl species regularly recorded, mainly in flight, and birds utilise the waterbody within the Dalquhandy Wind Farm site as a roosting location.

**Table 8.9 – Summary of Desk-based Findings for Target Species (Raptors, Waders and Wildfowl) at Nearby Wind Farm Projects**

Species	Conservation status and legal protection	RHH	HH	NU	GA	DWCW	DQ	CU	DW
<b>Wildfowl</b>									
Pink-footed goose	BoCC Amber-listed, Annex II (Part B), Schedule 2	NE	NE	P	P	P	P	P	P
Greylag goose	BoCC Amber-listed, Annex II (Part B), Schedule 2	NE	NE	P	P	P	P	P	P
Whooper swan	BoCC Amber-listed, Annex II (Part B), Schedule 2	NE	NE	NE	P	P	P	P	P
<b>Raptors and Owls</b>									
Goshawk	BoCC Green-listed, Schedule 1	NE	NE	NE	NE	NE	NE	P	P
Hen harrier	BoCC Red-listed, Annex I, Schedule 1	NE	P	P	P	P	P	P	P
Merlin	BoCC Red-listed, Annex I, Schedule 1	NE	P	P	P	P	P	P	P
Osprey	BoCC Amber-listed, Annex 1, Schedule 1	P	NE	P	P	P	P	NE	P
Peregrine	BoCC Green-listed, Annex 1, Schedule 1	P	P	P	P	P	P	P	P
Red kite	BoCC Green-listed, Annex 1, Schedule 1	NE	NE	P	P	NE	NE	NE	P
Barn owl	BoCC Green-listed, Schedule 1	NE	P	NE	P	NE	NE	NE	P
Short-eared owl	BoCC Amber-listed, Annex 1	NE	NE	P	P	NE	P	P	P
<b>Waders</b>									
Common sandpiper	BoCC Amber-listed	P	NE	NE	P	P	P	P	P

Species	Conservation status and legal protection	RHH	HH	NU	GA	DWCW	DQ	CU	DW
Curlew	BoCC Red-listed; sensitive to wind farms (SNH, 2018c)	P	P	P	P	P	P	P	P
Golden plover	BoCC Green-listed, Annex 1	P	P	P	P	P	P	P	P
Green sandpiper	BoCC Amber-listed, Schedule 1	NE	NE	NE	P	NE	NE	NE	NE
Lapwing	BoCC Red-listed	P	-	P	P	P	P	P	P
Oystercatcher	BoCC Amber-listed	P	-	P	P	P	P	P	P
Redshank	BoCC Amber-listed	NE	NE	NE	NE	P	P	P	P
Ringed plover	BoCC Red-listed	P	-	NE	P	P	P	P	P
Snipe	BoCC Amber-listed	P	-	P	P	P	P	P	P
<b>Other Target Species</b>									
Black grouse	BoCC Red-listed, sensitive to wind farms (SNH, 2018c).	NE	P	P	P	P	NE	NE	P
Herring gull	BoCC Red-listed	P	-	-	P	P	P	P	-

### **Wildfowl**

- 8.6.5 No wildfowl were recorded during baseline surveys in 2018, however whooper swan, pink-footed goose and greylag goose have been recorded within the 2 km study area.
- 8.6.6 During baseline surveys for Dalquhandy in 2011-12, whooper swans were frequently observed utilising the waterbodies to the north. Six flights, totalling 74 birds were observed during flight activity surveys. In 2014-15, small numbers of whooper swans (2-3 birds) were recorded using the waterbody within the Douglas West site.
- 8.6.7 Large numbers of pink-footed geese were recorded at Dalquhandy during autumn 2012. A peak flock of 2,400 birds was recorded in October 2012 flying over the site before settling down onto large water bodies to roost. Birds remained on the Dalquhandy site in significant numbers until late October before numbers started to decline throughout November 2012. In total, 32 flights were recorded between September 2011 and November 2012. One third of all flights observed involved flocks of birds greater than a thousand individuals. The Dalquhandy SEI assessment suggested that observed activity during early autumn 2012 may indicate that the Dalquhandy site is being utilised as a staging post for the regional population of pink-footed goose as they migrate, particularly in autumn and early winter. This is consistent with records for the Douglas West project in 2014-15. In October 2014, approximately 1,500 pink-footed geese were observed leaving a probable roost site around waterbodies to the north of the Proposed Development site.
- 8.6.8 A total of 26 greylag geese flights were recorded between July and November 2011 at Dalquhandy. Flock size was generally small, ranging up to nine birds, suggesting birds were part of a resident breeding population. Up to 185 birds were recorded roosting within the Dalquhandy site. A single pair bred on one of the small ponds outside of the Proposed Development site's 500 m buffer. In 2014-15, small numbers of greylag geese were recorded utilising the waterbody within the centre of the Douglas West site on isolated occasions. Migrating greylag geese were recorded regularly during the winter of 2014-15, and birds which belong to the local non-migratory (non-Icelandic) population were also present throughout the 2015 breeding season. A breeding attempt was suspected somewhere to the north-east of the Douglas West site.

### **Black grouse**

- 8.6.9 The 2018 black grouse surveys did not record any lek locations within 1.5 km of the Proposed Development site. Black grouse leks have been recorded during baseline surveys for the following wind farm sites surrounding the Proposed Development (see Figure 8.8 for summary):
- Hagshaw Hill Extension: a total of 4-6 males (plus two females) were recorded lekking at four lek sites in 2003-04, located with 500 m to 1 km south of the Proposed Development site.
  - one lek was recorded within 750 m south of the Proposed Development site as part of surveys for the DWCW project in 2010; and
  - a single lekking male was recorded around 500 m south of the Proposed Development site, as part of the Douglas West baseline surveys in 2015.
- 8.6.10 Lekking black grouse have also been recorded at other local project sites, although over 1.5 km from the Proposed Development: two lek sites were at the Nutberry site in 2004 and three lek sites were recorded at the Galawhistle site in 2008 and 2009. No black grouse leks were recorded for the Cumberhead site in 2013 and 2014, with only a few intermittent sightings of lone birds recorded in any given survey year. No evidence of black grouse was recorded within the Dalquhandy site.

### **Goshawk**

- 8.6.11 In 2018, goshawk was not recorded within 2 km of the Proposed Development site.

- 8.6.12 Goshawk was confirmed as breeding in Cumberhead Forest within the Cumberhead survey area in 2013 (location unknown) and this species was considered probably breeding within the Cumberhead survey area during the 2014 breeding raptor survey.
- 8.6.13 Goshawk was recorded flying to the west of the Proposed Development site in 2015, but no breeding activity was observed (Douglas West surveys). SSRSG reported that goshawk had very probably bred in the 2 km buffer surrounding the Douglas West site or nearby during the preceding five years (2010 – 2015), particularly in the Long Plantation to the east/south-east of the Douglas West site but the species was not recorded on a regular basis. Goshawk was the only Schedule 1 raptor that SSRSG held a breeding record of within the Douglas West site and the 2 km boundary (DES, 2015).

#### **Peregrine**

- 8.6.14 In 2018, two sightings of peregrine (first sighting an individual and second sighting two birds together) were recorded flying over the Hagshaw Hill site in April and May, but there was no evidence of breeding activity within the 2 km study area.
- 8.6.15 SSRSG reported occasional sightings of peregrine at the Douglas West site and in the 2 km buffer zone of the Douglas West site, although no breeding records (DES, 2015).
- 8.6.16 There were no peregrine nest sites recorded within 2 km of the DWCW site in 2010. Peregrine presence was recorded within 2 km of the Cumberhead site in 2013 and 2014; although no nest sites or evidence of nesting peregrine was recorded, a potentially suitable peregrine nest site was identified close to the Cumberhead site (location not provided), but there are no records to suggest occupation.

#### **Hen harrier**

- 8.6.17 In 2018, hen harrier was not recorded within 2 km of the Proposed Development site.
- 8.6.18 Hen harriers have been recorded flying within 2 km of the local wind farm sites surrounding the site, but no breeding activity has been recorded. SSRSG reported regular sightings of hen harrier at the Douglas West site and in the 2 km buffer zone of the Douglas West site, although no breeding records (DES, 2015).
- 8.6.19 SSRSG identified that hen harrier has historically bred at distances of around 4 km and 7-8 km from the DWCW site (DES, 2015). Two female hen harriers were recorded through the DWCW site during a scoping visit in September 2009 and a male was recorded in July 2010 hunting between Arkney Hill and the edge of the former opencast site at a time when birds breeding locally (>4 km from the DWCW site) still had young in the nest (DES, 2015).

#### **Merlin**

- 8.6.20 In 2018, there were no merlins recorded in the Proposed Development site.
- 8.6.21 Merlins have been recorded infrequently foraging over the local wind farm sites, but no breeding activity has been recorded.
- 8.6.22 SSRSG has reported occasional sightings of merlin at the Douglas West site and in the 2 km buffer zone of the Douglas West site, although no breeding records (DES, 2015). SSRSG has also reported possible nesting merlin 4 km from the DWCW site (DES, 2015).

#### **Osprey**

- 8.6.23 One osprey flew over the Hagshaw Hill site in 2018, but there was no evidence of breeding activity within the 2 km survey area.
- 8.6.24 No evidence of osprey breeding activity was recorded in any survey for the wind farm sites surrounding the Proposed Development site.

- 8.6.25 Two ospreys were recorded flying once over the DWCW site during the breeding season in April 2010. SSRSG reported successful nesting osprey breeding at 15 km to the south-east of the DWCW site prior to the scoping survey for that project in September 2009 (DES, 2015).
- 8.6.26 Two osprey flights were recorded for the Dalquhandy site, one in July 2011 and another one in August 2012. These single individuals were likely to be migrating birds as the Dalquhandy site is not considered to offer any value to osprey.
- 8.6.27 Two single observations of osprey were recorded flying over the Douglas West site in 2014 and 2015. SSRSG have reported occasional sightings of osprey at the Douglas West site and in the 2 km buffer zone of the Douglas West site, although no breeding records (DES, 2015).
- 8.6.28 No evidence of osprey was recorded in either the breeding or non-breeding season at any other wind farm sites surrounding the site.

**Barn owl**

- 8.6.29 The 2018 surveys did not record barn owl within 2 km of the Proposed Development site.
- 8.6.30 There has been some evidence of barn owl breeding activity reported for proposed wind farm sites surrounding the Proposed Development site. In 2003/2004, barn owl was recorded breeding in valley sites within 2 km, but as barn owls hunt mostly in valley bottoms it is unlikely that birds will utilise the higher ground within the site. Barn owl breeding was confirmed at one location within the Galawhistle site in 2008 and 2009 and a second pair bred close to the Galawhistle access track in 2009 and probably 2008; these birds may have been within 1.5 km of the Proposed Development, albeit with Galawhistle turbines now constructed on the hill separating the two locations.
- 8.6.31 No evidence of barn owl breeding activity was reported at any other wind farm sites surrounding the Proposed Development.

**Short-eared owl**

- 8.6.32 The 2018 surveys did not record short-eared owl within 2 km of the Proposed Development.
- 8.6.33 Short-eared owl were recorded during surveys for Dalquhandy and Cumberhead, although there was no evidence of breeding behaviour.
- 8.6.34 There was no evidence of breeding attempts by short-eared owl in 2004 or 2005 at the Nutberry site, although observed flight activity and behaviour in suitable nesting habitat indicated that one pair might have bred in suitable habitat within 2 km of the Nutberry site boundary in 2004.
- 8.6.35 SSRSG has reported occasional sightings of short-eared owl at the Douglas West site and in the 2 km buffer zone of the Douglas West site, although no breeding records (DES, 2015). SSRSG has also reported that short-eared owl may nest 4 km away from the DWCW site (DES, 2015)

**Other Raptors**

- 8.6.36 In addition to the above target species, there were sightings of buzzard, kestrel and tawny owl (secondary species) during the 2018 surveys.
- 8.6.37 One short golden eagle flight was recorded at the Galawhistle site in June 2008, but this species was not recorded at any other site.
- 8.6.38 Red kite was recorded flying over the Nutberry site in 2004, the Galawhistle site between 2007 and 2009 and the Douglas West site between 2014 and 2015, although no breeding evidence of this species was recorded. SSRSG has reported occasional sightings of red kite at the Douglas West site and in the 2 km buffer zone of the Douglas West site, although no breeding records (DES, 2015). SSRGS is aware of increasing red kite activity in the general area of Douglas West throughout the year, but it had no records of breeding prior to the DWCW surveys in 2009 and 2010. The nearest known red kite breeding site to the DWCW site is 6 km away to the north (DES, 2015).

## **Waders**

### Curlew

- 8.6.39 In 2018, one possible curlew breeding territory was recorded within 500 m to the north of the Proposed Development site. A further territory was likely to have been present within 1 km to the south.
- 8.6.40 Curlew are known to breed in the local area around the site and this species has been recorded at all proposed wind farm sites within 2 km, including: five pairs at the Hagshaw Hill site in 2003/2004; five pairs in 2004/2005 at the Nutberry site; two to three pairs within the Galawhistle site in 2008 and 2009; six pairs bred on the DWCW site in 2010; three pairs bred or attempted to breed within the Dalquhandy site in 2012, with one pair in 2017; six confirmed breeding territories were recorded in 2013 and one territory was recorded in 2014 at the Cumberhead site; and a total of five occupied territories were recorded for the Douglas West site in 2015.

### Golden plover

- 8.6.41 Two golden plover flocks were recorded flying through the Proposed Development site during spring migration in April 2018, but they did not breed in the area.
- 8.6.42 Flocks of golden plover have been recorded flying through the majority of proposed wind farm sites surrounding the Proposed Development site during the non-breeding season, although breeding was not recorded. The most frequent activity for golden plover in the local area was at Cumberhead Wind Farm between September 2012 and February 2014, when 11 flocks (one to 200 individuals per flight) were recorded. A flock of 180 birds was recorded in October 2014 at Douglas West, but the species was absent on all other survey dates for that project in 2014 to 2015.
- 8.6.43 In the Nutberry ES, flocks of golden plover were recorded feeding in fields around Birkenhead in 2005 which were around 3 km north-east of the proposed Nutberry Wind Farm turbines. Baseline surveys for the Galawhistle ES also produced some evidence that golden plovers occasionally forage within that survey area; between September 2007 and August 2009, golden plovers were recorded flying within the Galawhistle Wind Farm site and occasionally heard calling 500 m north of the site during the flight activity surveys.
- 8.6.44 In the Dalquhandy SEI, golden plovers were recorded during the non-breeding season preferentially roosting on the island in a water body within 1 km to the north of the Proposed Development site. The majority of flights were observed adjacent to the large water bodies within the survey area.

### Lapwing

- 8.6.45 In 2018, two lapwings flew through the Proposed Development site in May, but they did not breed in the area. A flock of 74 individuals was observed at a waterbody outside of the 500 m study area to the north within Dalquhandy in mid-August.
- 8.6.46 Small numbers of lapwing are known to breed in the local area. The following proposed wind farm sites around the site have recorded breeding lapwing: two pairs recorded for the Galawhistle site in 2008 and 2009; one pair bred in 2010 at the DWCW site; nine pairs bred at the Dalquhandy site in 2012 (although only one pair in 2017); and 2-3 pairs bred at the Douglas West site in 2015 (two territories within 500 m of the Proposed Development site).
- 8.6.47 At Nutberry and Cumberhead, small numbers of lapwing were recorded as present, but breeding activity was not recorded.

### Oystercatcher

- 8.6.48 In 2018, a small number of oystercatchers were recorded within 1 km of the Proposed Development site, but they did not breed in the area.

8.6.49 Breeding oystercatcher have been recorded at proposed wind farm sites surrounding the site including: five pairs in 2008 and 11 pairs in 2009 for the Galawhistle site; two pairs for the DWCW site in 2010; two pairs for the Dalquhandy site in 2012 (one in 2017); and three pairs for the Douglas West site in 2015.

8.6.50 Oystercatcher were recorded as present but not breeding at the Nutberry site (2006) and Cumberhead site (2013/2014).

#### Ringed plover

8.6.51 In 2018, a ringed plover was recorded in May within 500 m to the north of the Proposed Development site, but it is not known to have bred in the area.

8.6.52 Small numbers of breeding ringed plover have been recorded at proposed wind farm sites surrounding the site including: three pairs in 2008 and four pairs in 2009 at the Galawhistle site; four pairs at the DWCW site in 2010; five pairs at the Dalquhandy site in 2012 (but none in 2017); and two pairs at the Douglas West site in 2015.

8.6.53 Ringed plover was present but not breeding at the Cumberhead site in 2014.

#### Snipe

8.6.54 In 2018, one possible snipe territory was recorded within 500 m to the north of the Proposed Development site.

8.6.55 Snipe are known to breed in the local area. The following proposed wind farm sites around the site all recorded breeding snipe: four pairs in 2004 and two pairs in 2005 at the Nutberry site; six pairs at the Galawhistle site in 2008 and 2009; six pairs at the DWCW site in 2010; five pairs at the Dalquhandy site in 2012 (7-9 pairs in 2017); one probable and three possible territories at the Cumberhead site in 2014; and 13 territories at the Douglas West site in 2015.

## 8.7 Assessment of Potential Effects

8.7.1 The assessment of potential effects is based on the project description outlined in Chapter 3. In relation to describing impacts on ornithological features, the relevant specifications used to determine the 'worst-case' Proposed Development involves:

- 13 turbines with a tip height of 200 m, a hub height of 122.5 m, a blade length of 76 m and a rotor diameter of 155 m. Each turbine will have a typical generating capacity of around 6 MW.
- Forest within the site will be felled as part of the Wind Farm Felling Plan (refer to Figure 16.3) and turbines will be key-holed within the forestry block and any new forestry will not be planted within these areas.
- The construction period will last for up to 12 months, comprising a construction programme as described in Chapter 3. The associated infrastructure will include: site access, access tracks, crane hardstanding, underground cabling, on-site substation and maintenance building, energy storage compound, temporary construction compound, laydown area, concrete batching plant, potential excavations/borrow workings and two permanent meteorological masts.

### ***Scoped-in/out Important Ornithological Features***

#### **Designated Sites**

8.7.2 Based on listed SPA qualifying interests (Table 8.8), distance from the site (>5 km), and foraging ranges of SPA qualifying interests during the breeding season (Pendlebury *et al.* 2011; SNH, 2016), it is concluded that there is no likely connectivity for any qualifying feature of the Muirkirk and

North Lowther Uplands SPA, or the component North Lowther Uplands SSSI and Muirkirk Uplands SSSI, with the exception of merlin (as per SNH comment in Table 8.1).

8.7.3 There are no records of breeding merlin within around 4 km from the site, and whilst phased forest felling within the site may provide more suitable habitat for merlin, replanting soon after would mean that areas may only be suitable for a relatively short timeframe prior to thicket closure. It is therefore considered that connectivity between the site and the SPA population is very unlikely.

8.7.4 It can thus be reasonably concluded that the Proposed Development will not have a significant effect on the SPA & SSSIs, or indeed any other designated site. As such, any further assessment under the EIA or HRA process is not required, as no likely significant effects are predicted.

**Target Species**

8.7.5 The scoping-in of target species to assess as IOFs is based on information gathered during 2018 baseline surveys as well as from surveys undertaken for other local wind farm projects which provide a longer-term dataset of the likely bird assemblage within the site and surrounding area.

8.7.6 SNH’s (2018a) guidance on assessing effects of wind farms on birds identifies 22 species that are widespread across Scotland which utilise habitats or have flight behaviours that may be adversely affected by a wind farm. The initial scoping-in stage therefore considers which of these species have been recorded within or around the site, as confirmed through survey results and desk studies outlined above.

8.7.7 Of these 22 species, 16 have been observed within the site and local area (Table 8.10).

8.7.8 The second stage of the scoping-in process is to determine which of these species have been recorded in numbers that may be of importance – i.e. the study area, or the airspace above the study area, is of some value to the species, and the wider NHZ population. This has been determined by the following method:

- Wildfowl: species recorded either utilising the site or wider 2 km study area, or regularly recorded in flight above the study area;
- Raptors: Schedule 1/Annex I species potentially breeding within 2 km study area, or regularly found in flight above, or in proximity to the site; and
- Waders: species found breeding in proximity to the site (nominally within 500 m), or regularly recorded in non-breeding flocks above the study area.

**Table 8.10 – Scoped-in/out Target Species**

Target Species	Summary of Activity within 2 km Study Area	Scoped In / Out
Whooper swan	Overflying most wind farm sites, waterbodies at DQ used, within 500 m of site.	In
Pink-footed goose	Overflying most sites, up to 2,400 birds roosting at DQ, within 500 m of site.	In
Greylag goose	Not recorded in 2018. Overflying most sites, up to 185 birds roosting within DQ, within 500 m of site.	In
Red kite	Not recorded in 2018. Occasional flight at DW, GA, NU.	Out
Hen harrier	Not recorded in 2018. Recorded at all other sites in flight, foraging, sometimes regularly. No breeding within 2 km study area.	Out

Target Species	Summary of Activity within 2 km Study Area	Scoped In / Out
Goshawk	Not recorded in 2018. Possible breeder within 2 km, occasional flights recorded in suitable habitat within study area.	In
Golden eagle	Not recorded in 2018. Single non-breeding flight at GA.	Out
Osprey	One record in 2018. Occasional flights at most sites, no nesting or foraging records.	Out
Merlin	Not recorded in 2018. Infrequently recorded at all sites. No breeding evidence	Out
Peregrine	Infrequently to regularly recorded at all sites, but no breeding evidence. Study area may form part of wider territory.	Out
Black grouse	No records in 2018. Lekking activity recorded historically within 1.5 km of site, with Hagshaw Hill Wind Farm black grouse management area adjacent to the site.	In
Golden plover	Non-breeding flocks regularly recorded in 2 km study area, and within 500 m of site. Some roosting and feeding activity in study area. Two flocks (total 154 birds) recorded in 2018.	In
Lapwing	Found breeding within some sites, including within 500 m of site at DW. Single flight recorded in 2018, with migratory flock at DQ.	In
Curlew	Found breeding within some sites, including within 500 m of site at DW. Nine flights recorded in 2018 to south of site.	In
Herring gull	Likely to be present within most sites, but no breeding recorded. Single flight recorded in 2018.	Out
Short-eared owl	Not recorded in 2018. Infrequently recorded at all sites, no breeding evidence within 2 km study area.	Out

8.7.9 From this process, a total of eight species, determined to be of medium nature conservation importance (Table 8.3) are considered to be the IOFs (Table 8.11). These are: **whooper swan, pink-footed goose, greylag goose, goshawk, black grouse, golden plover, lapwing and curlew.**

**Table 8.11 – Nature Conservation Importance of IOFs**

Feature	Nature conservation importance	Reason
Whooper swan	Medium	Schedule 1, Annex I, EU Birds Directive Migratory Species
Pink-footed goose	Medium	EU Birds Directive Migratory Species
Greylag goose	Medium	EU Birds Directive Migratory Species
Goshawk	Medium	Schedule 1
Black grouse	Medium	BoCC Red-listed; key feature of Hagshaw Hill HMP

Feature	Nature conservation importance	Reason
Golden plover	Medium	Annex I
Lapwing	Medium	BoCC Red-listed
Curlew	Medium	BoCC Red-listed

8.7.10 In addition, it is necessary to consider the species' conservation status when assessing the likely effects. Relevant conservation status information for the 'scoped in' IOFs is detailed within Table 8.12 based on the following BoCC status in Eaton *et al.* (2015):

- HD: Historical decline in breeding populations. Species judged to have declined severely between 1800 and 1995;
- BR = Breeding rarity. Species qualified as rare breeders if the UK breeding population was <300 pairs.
- WL = non-breeding localisation. Species were considered localised if more than 50% of the UK population was found at ten or fewer sites in the non-breeding season.
- WI = non-breeding international importance. Species were considered of international importance if the UK holds at least 20% of the European population in the non-breeding season.
- BDp = Breeding Population Decline. Severe decline in the UK breeding population size, of >50 %, over 25 years (BDp1) or the entire period used for assessments since the first BoCC review, starting in 1969 ("longer-term") (BDp2);
- BDMr: Breeding range decline. Moderate decline (>25% but <50%) between 1988–91 and 2007–11 (BDMr1) or 1968–71 and 2007–11 (BDMr2); and
- BDMp = Breeding Population Decline. Moderate decline in the UK breeding population size, of more than 25%, over 25 years (BDMp1) or the entire period used for assessments since the first BoCC review, starting in 1969 ("longer-term") (BDMp2).

**Table 8.12 – Conservation Status of Scoped In IOFs**

Species	Conservation Status Information	Conservation Status
Whooper swan	BoCC Amber List (BR, WL)	The GB whooper swan population is around 11,000 individuals (Musgrove <i>et al.</i> 2011). According to Hayhow <i>et al.</i> (2017) there has been an increase over a ten-year period (2004/05 to 2014/15) of 17%. The estimated peak abundance within NHZ 19, drawn from several surveys, was given as 1,188 individuals by Wilson <i>et al.</i> (2015), which was the second highest NHZ total. Surveys identified highest peak numbers in early winter, with a gradual decline from December to April. Both the national and NHZ populations are considered to be in favourable conservation status.
Pink-footed	BoCC Amber List (WL, WI)	The GB pink-footed goose population is around 360,000 individuals (Musgrove <i>et al.</i> 2011). According to Hayhow <i>et al.</i> (2017) there has been an increase over a ten-year period (2004/05 to 2014/15) of 51%.

Species	Conservation Status Information	Conservation Status
goose		The estimated peak abundance within NHZ 19, over a five-year period, was given as 34,621 individuals by Wilson <i>et al.</i> (2015). Pink-footed goose numbers over the winter within NHZ 19 were maintained at relatively stable levels. Both the national and NHZ populations are considered to be in favourable conservation status.
Greylag goose	BoCC Amber List (WL, WI)	<p>The Icelandic greylag goose population that winters in Britain is estimated to be around 85,000 individuals (Musgrove <i>et al.</i> 2011). According to Hayhow <i>et al.</i> (2017) there has been an increase over a ten-year period (2004/05 to 2014/15) of 9%.</p> <p>Combined results from 2008 and 2009 suggest that the Scottish summering greylag goose population is around 47,405 (range 44,059–51,763) individuals (Mitchell <i>et al.</i> 2011).</p> <p>The NHZ population is unknown, but 760 individuals were recorded in autumn 2016 in the Clyde area, for the national annual census (Mitchell &amp; Brides, 2017). Both the national and NHZ populations are considered to be in favourable conservation status.</p>
Goshawk	BoCC Green List	There are an estimated 400 pairs in Britain (Musgrove <i>et al.</i> 2013). The NHZ19 population was estimated by Wilson <i>et al.</i> (2015) to be 31 (range 17-41) pairs in 2013. The goshawk population appears to be expanding in range in Scotland (Forrester <i>et al.</i> 2007) and as the species is BoCC Green-listed, the national and regional/NHZ populations are likely to be in favourable conservation status.
Black grouse	BoCC Red List (HD, BDp1, BDp2, BDMr2)	<p>Black grouse is Red-listed due to a historical decline in the UK, without substantial recent recovery. It also qualifies due to a severe decline in the UK breeding population size of &gt;50% over 25 years.</p> <p>Breeding numbers in the UK declined by 80% between 1991 and 2004. Sim <i>et al.</i> (2008) estimated there to be 5,078 male black grouse in the UK in 2005, with approximately two-thirds of these occurring in Scotland. However, Forrester <i>et al.</i> (2007) estimate that in Scotland there are around 3,550 to 5,750 lekking males, representing about 71% of the British population. In Scotland the breeding range is contracting and numbers are declining, though the rate of decline varies regionally, being high in south western Scotland (-49%). Evidence suggests that the national and regional populations are in unfavourable conservation status.</p> <p>The NHZ 19 (Western Southern Uplands and Solway) population was estimated by Wilson <i>et al.</i> (2015) to be 121 (range 71-168) displaying males.</p>
Lapwing	BoCC Red List	The national lapwing population was estimated to be 130,000 pairs in 2009 (BTO BirdFacts) and the Scottish population is estimated to be

Species	Conservation Status Information	Conservation Status
	(BDp1, BDp2)	<p>between 71,500 and 105,600 pairs (Forrester <i>et al.</i> 2007).</p> <p>The BTO BirdTrends programme has reported a national decline by 43% across the UK, and 57% in Scotland between 1995 and 2014. The BTO's map of change in relative density between 1994-96 and 2007-09 indicates that decreases have been strongest in lowland regions and the south and that some increase may have occurred in some upland and northern regions of Britain. The NHZ trend is unknown but the regional and national populations are likely to be in unfavourable conservation status.</p>
Curlew	BoCC Red List (BDMp1, BDp2)	<p>The most recent national curlew population estimate recorded 68,000 pairs in 2009 (Massimino <i>et al.</i> 2017) and there has been a significant continued decline across Scotland, including in the south west. The recent inclusion of the species on the BoCC Red-list suggests that the national and NHZ/regional populations are in unfavourable conservation status.</p> <p>The NHZ 19 population was estimated to be 4,284 (3,851-4,717) pairs in 2005 (Wilson <i>et al.</i> 2015).</p>
Golden plover	BoCC Green List	<p>The UK golden plover breeding population is estimated to be 38,400-59,400 pairs (Musgrove <i>et al.</i> 2013), although Forrester <i>et al.</i> (2007) give a Scottish breeding population estimate of 15,000 pairs, stating that this represents 80% of the British breeding population.</p> <p>The spring passage population of golden plover in Scotland was estimated by Forrester <i>et al.</i> (2007) to be 10,000-30,000 individuals. BirdFacts estimated the UK winter population to be 400,000 individuals in 2006/07.</p> <p>The NHZ 19 breeding population was estimated by Wilson <i>et al.</i> (2015) to be 778 (range 716-839) pairs in 2005.</p> <p>The BTO BirdTrends website (Massimino <i>et al.</i> 2017) states that the national population is in probable decline, and this is likely to reflect the regional/NHZ population.</p>

## Construction

### Potential Effects

- 8.7.11 The main potential impacts of construction activities across the site are the displacement and disruption of breeding, foraging or roosting birds as a result of noise and general disturbance over a short-term period (either the duration of a particular construction activity within working hours, or the duration of the whole construction period).
- 8.7.12 Impacts on breeding birds would be confined to areas in the locality of temporary construction compounds, turbines, tracks and other infrastructure. Few attempts have been made to quantify the impacts of disturbance of birds due to activities of this type, and much of the available information is inconsistent. However, as a broad generalisation, larger bird species such as

raptors, or those that feed in flocks in the open tend to be more susceptible to disturbance than small birds living in structurally complex habitats (such as woodland, scrub and hedgerow) (Hill *et al.* 1997).

- 8.7.13 Direct habitat loss would also occur due to the Proposed Development's construction, which would be both temporary (e.g. construction compounds) and longer term (access tracks and turbines). This has the potential to impact on breeding or foraging individuals.

Wildfowl

- 8.7.14 Impact: wildfowl using the site or wider study area may be displaced during construction, either by disturbance or direct habitat loss.

- 8.7.15 Sensitivity: as migratory species of European importance, but unconnected to a designated site, whooper swan, pink-footed goose and greylag goose are classified as medium nature conservation importance. The national and NHZ 19 populations are considered to be in favourable conservation status and the three species' sensitivity is therefore medium-low.

- 8.7.16 Magnitude of Impact: wildfowl were recorded in flight within the 2 km study area and using the waterbodies to the north of the site at Dalquhandy during winter periods. Some of these waterbodies, including the large pond at NS791330, are within the 500 m buffer of the site boundary and so disturbance is a potential risk requiring further investigation.

- 8.7.17 Madsen (1985) measured the impact of roads and landscape features on field utilisation of pink-footed geese in autumn and spring. The disturbance distance of roads with higher traffic volume (>20 cars per day) was around 500 m in autumn, although roads with 0–10 cars per day also had a depressing effect on utilisation. In a recent review, Olsson (2018) found that although there are large variations in responses among species, individual populations, seasons, sources and levels of disturbance, disturbance effects on geese have been observed at distances up to 500 m (see for example, Vickery and Gill, 1999, Jensen *et al.*, 2017). Evidence therefore suggests it is possible that construction activities associated with the Proposed Development could result in the disturbance of roosting geese.

- 8.7.18 Up to 2,400 pink-footed geese have been recorded using the waterbodies as an autumn roost site, which equates to around 7 % of the NHZ 19 winter population, and around 0.7 % of the national population. Although pink-footed geese are only present in numbers that reach significance for a short period in autumn, the roost site may still be of importance to the conservation status of the NHZ 19 and national population if it is an important staging location for migratory birds. The loss of a roost site may impact on the fitness, and potentially the survival rates of the population. As the roost site has only been used intermittently, it is likely that alternative roost sites would be available if disturbance were to occur, and although this may result in costs to fitness due to increased flight times, it is not anticipated that survival rates would be affected at a population level. As such, a low spatial and short-term magnitude of impact is predicted on pink-footed goose, in relation to the NHZ 19 population. In this regard, it is noted that planning permission has already been granted for a wind farm to be constructed on the Dalquhandy site itself, with construction works much closer to the waterbody in question.

- 8.7.19 During baseline surveys for Dalquhandy, whooper swans were frequently observed utilising the waterbodies to the north. Six flights, totalling 74 birds were also recorded during flight activity surveys. In 2014-15, small numbers of whooper swans (2-3 birds) were recorded using the waterbody within the Douglas West site. It is therefore possible that relatively small numbers of whooper swans may be subject to disturbance due to construction activities within the site during the winter period. However, it is considered that associated reductions in fitness is unlikely to reach significance within the context of the survival rates of the NHZ 19 population (1,188 individuals). As such, a low spatial and short-term magnitude of impact is predicted on whooper swan, in relation to the NHZ 19 population.

- 8.7.20 A total of 26 greylag geese flights were recorded at Dalquhandy between July 2011 and November 2012. Flock size was generally small, ranging up to nine birds, suggesting birds were part of a resident breeding population. In 2014-15, small numbers of greylag goose were recorded utilising

the waterbody within the centre of the Douglas West site on isolated occasions. If it is considered that up to nine greylag geese intermittently use the ponds in the local area, this would likely represent less than 1 % of the NHZ population (assuming it to be over the 760 individuals recorded at one site in the local area). As such, a low spatial and short-term magnitude of impact is predicted on greylag goose, in relation to the NHZ 19 population.

- 8.7.21 Significance of Effect: the unmitigated effects on the NHZ 19 populations of pink-footed goose, whooper swan and greylag goose are classified as **minor** adverse and not significant in the context of the EIA Regulations.

Goshawk

- 8.7.22 Impact: breeding or foraging goshawks may be displaced from the site during construction, either by disturbance or direct habitat loss.

- 8.7.23 Sensitivity: as a Schedule 1 listed species unconnected to a designated site, goshawk is classified as medium nature conservation importance. The national and NHZ 19 populations are considered to be in favourable conservation status and the species' sensitivity in the context of this site is therefore Medium-Low.

- 8.7.24 Magnitude of Impact: there is potentially at least one goshawk territory currently within the 2 km study area, although to date no breeding evidence has been recorded, and level of activity within the site appears to be low, with no records during 2018 surveys. Nevertheless, Cumberhead Forest provides suitable habitat for breeding. This area of forest is subject to ongoing forest harvesting activities and so any breeding birds are likely to be accustomed to a regular amount of localised activities that would be of a reasonably similar nature to those associated with wind farm construction, including keyholing activities.

- 8.7.25 Forestry Commission Scotland (2006) has recommended a safe working distance of up to 450 m for forestry activities around a goshawk nest, with Ruddock & Whitfield (2007) concluding that birds may be affected up to 500 m from disturbance source. As such, depending on the location of future territories, and the extent of planned felling activities, one territory may be affected by construction activities over the short-term. However, due to the size of Cumberhead Forest it is considered unlikely that a territory would be lost from the NHZ population, but rather any pair would be more likely to relocate at sufficient distance from disturbance sources. As such a negligible spatial and short-term temporal magnitude of impact is predicted on the NHZ 19 goshawk population (31 pairs).

- 8.7.26 Significance of Effect: The unmitigated effect on breeding goshawk from construction is classified as **negligible** and is therefore not significant in the context of the EIA Regulations.

Black Grouse

- 8.7.27 Impact: lekking or foraging black grouse may be displaced from the site during construction, either by disturbance or direct habitat loss.

- 8.7.28 Sensitivity: due to its Red-list conservation status (Eaton *et al.* 2015) and sensitivity to wind farms, the species is classified as medium nature conservation importance. The NHZ and national populations are likely to be of unfavourable conservation status and the species' sensitivity in the context of this site is therefore medium-high.

- 8.7.29 Magnitude of Impact: no infrastructure is planned to overlap with any lekking location, and in general the mature plantation habitat within the site is unsuitable for the species.

- 8.7.30 According to an expert review by Ruddock and Whitfield (2007) leks may be actively disturbed at 300 to 500 m from a disturbance source. Black grouse were not recorded during surveys within 1.5 km of the site in 2018, although previous survey results have shown that a single male lek was present in 2015, around 300 m south of the site boundary and proposed construction compound, laydown area and substation (Figure 8.8). Historic lek sites were recorded in a similar area to this lek site. Numbers seem to have however declined from two males in 2010 to single males in recent years and it is possible that no lekking males are now present in the local area.

- 8.7.31 The site is adjacent to 12 ha of land used as part of the Hagshaw Hill Wind Farm Extension Black Grouse Management Plan (Figure 8.8). The aim of this Plan is to enhance the habitat for black grouse outwith Hagshaw Hill Extension Wind Farm area in an effort to maintain lekking black grouse numbers from baseline levels of 4-6 males recorded in 2003. In the management area, the management prescriptions include: increased abundance of cottongrass; exclusion of grazing for dwarf shrub regeneration; bracken treatment; and fence marking to reduce the possibility of black grouse collisions. Native tree and shrub planting has also taken place further south along the Robshill Burn.
- 8.7.32 There is no evidence that black grouse currently utilise the site or the adjacent black grouse management area, but for the purposes of this assessment, a worst-case situation would be to assume that it is utilised by two lekking males last recorded in 2010, and they would be disturbed throughout the duration of construction activity associated with any turbines or other infrastructure within 500 m.
- 8.7.33 Unmitigated, the possible temporary loss of two lekking males would represent around 1.6 % of the NHZ 19 population (121 males), although may also contribute to increased fragmentation of habitat for movements of birds between lek sites further afield. The magnitude of construction impacts on the current NHZ 19 black grouse population is therefore considered to be low spatial, and short-term temporal.
- 8.7.34 Significance of Effect: the unmitigated effect from construction is classified as **minor** adverse and is therefore not significant in the context of the EIA Regulations.

Lapwing and Curlew

- 8.7.35 Impact: breeding lapwings and curlews may be displaced from the site during construction, either by disturbance or direct habitat loss.
- 8.7.36 Sensitivity: as Red-listed (Eaton *et al.* 2015) species sensitive to wind farm development, lapwing and curlew are classified as being of medium nature conservation importance. The national and NHZ 19 populations are considered to be in unfavourable conservation status and the species' sensitivities are medium-high.
- 8.7.37 Magnitude of Impact: the Proposed Development site does not provide suitable habitat for lapwing or curlew, and so no direct habitat loss from construction of infrastructure is predicted. In the 2018 breeding bird surveys, curlews were recorded over 500 m from the site in open moorland in areas to the south, in particular at lower altitudes around Longhouse Hill and 1 km west of Windrow Wood (Figure 8.6). No lapwing were recorded within the 500 m study area.
- 8.7.38 Surveys conducted for Dalquhandy in 2012 recorded nine pairs of lapwings, and three pairs of curlews within that site. In 2017, only single curlew and lapwing pairs were present. Surveys for Douglas West recorded 2-3 lapwing territories, and 1-2 curlew territories within 500 m of the Proposed Development site.
- 8.7.39 As a precaution, it is therefore considered possible that during the construction period, the lapwing and curlew populations within around 500 m of the Proposed Development site may be reduced by up to 2-3 pairs, based on results from adjacent Douglas West surveys in 2015. Within an NHZ 19 population context, this level of temporary loss is considered to be of negligible spatial and short-term temporal magnitude for both IOFs.
- 8.7.40 Significance of Effect: the unmitigated effect on lapwing and curlew from construction is classified as **minor** adverse and is therefore not significant in the context of the EIA Regulations.

Golden Plover

- 8.7.41 Impact: breeding or non-breeding golden plovers may be displaced from the site during construction, either by disturbance or direct habitat loss.
- 8.7.42 Sensitivity: golden plover is an Annex I listed species, and the national and NHZ 19 populations are likely to be in unfavourable conservation status. The species' sensitivity is medium-high.

- 8.7.43 Magnitude of Impact: there were no breeding golden plover recorded during the 2018 baseline period. No breeding evidence was recorded at Dalquandy, or at Douglas West.
- 8.7.44 On the 23 April 2018, two spring passage golden plover flocks were recorded in flight to the south of the site, but there was no indication that habitats within or adjacent to the site were suitable or used by birds for roosting or feeding during this period. Baseline surveys for Dalquandy in 2011-2012 recorded golden plover potentially roosting at a waterbody around 1 km to the north of the Proposed Development site. Flocks were regularly recorded in flight in proximity to waterbodies, but did not venture close to Cumberhead Forest. A single flock was recorded during the non-breeding season at Douglas West.
- 8.7.45 There would be no direct habitat loss for golden plover because plantation forest within the Proposed Development site is unsuitable for the species. The immediate surrounds are also unlikely to be regularly used by non-breeding golden plovers as waders are known to avoid forest edge habitats (e.g. Wilson *et al.* 2014, who recorded suppressed numbers within 700 m of forestry). Construction disturbance to non-breeding birds is therefore unlikely to be significant in terms of impacts on individual fitness or survival.
- 8.7.46 The impact of construction on the national passage golden plover population would result in an impact of negligible spatial and short-term temporal magnitude.
- 8.7.47 Significance of Effect: the unmitigated effect from construction on golden plover is classified as **minor** adverse and is not significant in the context of the EIA Regulations.

### ***Operation***

- 8.7.48 The following operational impacts are assessed in this section:
- displacement of birds around operational turbines;
  - collisions with turbines; and
  - increased lighting associated with operational turbines.

#### **Potential Effects: Displacement**

- 8.7.49 The displacement of nesting, foraging or roosting birds from the site has the potential to extend beyond the construction phase, as described above, and to occur during the operational phase.
- 8.7.50 Displacement away from operational turbines has been found to occur in a number of individual wind farm studies, although the effects vary considerably between sites and species. Considering a range of breeding bird species but predominantly waders and passerines at upland wind farms, Pearce-Higgins *et al.* (2012) showed that there were no displacement effects on any bird species from wind farms during the operational phase other than those that had already occurred during construction, and for some species, the effects during construction were reversed during operation with numbers returning to pre-construction numbers.
- 8.7.51 It is recognised that disturbance may occur due to maintenance or recreational activities throughout the operational phase, although since these are likely to be of shorter duration and smaller extent than construction activities, effects would be lower than those predicted for construction effects.
- 8.7.52 Pearce-Higgins *et al.* (2009) observed certain species experience localised population increases with proximity to wind farm infrastructure, so while some birds may be displaced locally, others may benefit from the introduction of new structures into the habitat, or some other consequence of construction. This finding was further supported by Pearce-Higgins *et al.* (2012) who reported significant increases in breeding numbers of skylarks and stonechats at wind farms.

#### Wildfowl

- 8.7.53 Impact: roosting wildfowl may be at risk of displacement from habitat around turbines or other infrastructure, thereby impacting on individual fitness or survival rates.

- 8.7.54 Sensitivity: medium-low.
- 8.7.55 Magnitude of Impact: in a review of impacts of wind farms on swans and geese, Rees (2012) reported on previous studies that attempted to record displacement effects, mainly those feeding around turbines. Within, it was reported that at a Dutch wind farm study, pooled data for white-fronted geese, bean geese and barnacle geese suggested birds were displaced to feeding areas 200–400 m from a wind farm site post-construction. A German study of bean goose and white-fronted goose recorded displacement up to 500 m. In general, for all swan and geese species studied, displacement distances of feeding birds at wintering sites ranged from 100 m to a maximum of 600 m. Separately, Larsen and Madsen (2000) found that the avoidance distance of feeding pink-footed geese around a wind farm was up to 200 m, and in a follow-up study, Madsen and Boertmann (2008) reported that birds at this wind farm were subsequently found within 100 m. Based on this, and other studies referenced where goose avoidance distances around turbines have reduced over time, the authors suggested that geese may behaviourally adapt to changing landscapes created by wind farms.
- 8.7.56 Wildfowl were recorded using the waterbodies to the north of the Proposed Development site at Dalquhandy during winter periods. All of these waterbodies, including the large waterbody at NS 791330 which has been used by whooper swan, pink-footed goose and greylag goose, are over 1 km from the closest proposed turbine location within the Proposed Development site, and so are likely to be at distances that would allow birds to be undisturbed by the presence of operational turbines.
- 8.7.57 Small numbers of greylag goose and whooper swan (2-3 birds) were recorded utilising the waterbody within the centre of the Douglas West site, which is around 200 m east of the Proposed Development access route. During the operational period, wildfowl are likely to be able to continue to roost at this location without disruption, with maintenance vehicle access to the site unlikely to affect birds.
- 8.7.58 A continuation of roosting at all waterbodies for all wildfowl species is considered to be the most likely outcome, and so a negligible spatial and long-term temporal magnitude is predicted.
- 8.7.59 Significance of Effect: the unmitigated effect from operational displacement on wildfowl is classified as **minor** adverse and is not significant in the context of the EIA Regulations.
- Goshawk
- 8.7.60 Impact: nesting or foraging goshawks may be at risk of displacement from habitat around turbines or other infrastructure, thereby impacting on breeding success, productivity or survival rates.
- 8.7.61 Sensitivity: medium-low.
- 8.7.62 Magnitude of Impact: survey data collected for wind farm projects in the local area indicate that the site may overlap with a goshawk breeding territory, despite no records in 2018. Inter-annual variation in numbers and distribution is likely to occur each year as a result of ongoing commercial forestry activities within and surrounding Cumberhead Forest.
- 8.7.63 As a predominantly woodland species, it is unlikely that goshawks would be subject to extensive displacement around operational turbines compared to some open moorland species for example. Some localised loss of foraging or nesting habitat in close proximity to operational turbines may occur, but this is unlikely to result in a significant effect on the viability of any territory, with sufficient woodland habitat still likely to exist in the wider area. Keyholing may result in increased forest edge habitat, which may increase foraging opportunities. The impact of displacement on the goshawk NHZ 19 population is considered to result in an impact of negligible spatial and long-term temporal magnitude.
- 8.7.64 Significance of Effect: with the NHZ 19 and national populations of goshawk likely to be in favourable conservation status, the unmitigated effect from operational displacement is classified as **negligible** and is not significant in the context of the EIA Regulations.

### Black Grouse

- 8.7.65 Impact: black grouse is recognised as a species which is potentially sensitive to the presence of wind farms (e.g. SNH, 2018a), and wind farm operation may cause some displacement of breeding and foraging black grouse from areas close to turbines and other infrastructure.
- 8.7.66 Sensitivity: medium-high.
- 8.7.67 Magnitude of Impact: historically a small lek existed within 500 m of the site boundary, south of the Hagshaw Hill Extension Black Grouse Management Area (Figure 8.8). Although no birds were recorded in 2018, due to the presence of operational turbines some potentially suitable lekking, foraging or breeding habitat may remain unused, should birds be present in the local area in future years.
- 8.7.68 Evidence presented from Austria has suggested that leks may be adversely affected by wind farms, although it is not clear what the exact causes may be: potentially a combination of turbine noise, maintenance activities or collisions (Zieler and Grünsachner-Berger, 2009). At the operational Griffin Wind Farm, early indications are that there were no obvious effects of the turbines on the closest lek which was located approximately 500-600 m from a turbine (Ross, 2012). At Berry Burn Wind Farm, the closest active leks to turbines recorded during the operational period were 240 m away in 2014, and 175 m away in 2016 (with a second 280 m away) (MacArthur Green, 2018).
- 8.7.69 On balance, sufficient historic lekking habitat to the south of the site, which is outside of potential displacement range, is likely to remain available for black grouse. In addition, the native tree and shrub planting associated with the adjacent Douglas West habitat management plans will provide further suitable habitat. It is uncertain whether birds would be displaced from the Hagshaw Hill Extension Black Grouse Management Area during the operational period, but with key-holing of turbines within forestry, and replanting after felling is planned in 2021-25, it is likely that sufficient screening would mean that the habitat would still be used. Indeed, any black grouse present on site would be to some extent tolerant of wind turbines due to the presence of the existing Hagshaw Hill and Extension Wind Farms.
- 8.7.70 Although the likelihood of occurrence is low, as a worst-case, out of an NHZ 19 population of 121 males, displacement effects on up to two males may result in an impact of low spatial and long-term temporal magnitude.
- 8.7.71 Significance of Effect: the effect on black grouse is classified as **minor** adverse and is not significant in the context of the EIA Regulations.

### Lapwing and Curlew

- 8.7.72 Impact: nesting or foraging lapwing and curlew may be at risk of displacement from habitat around turbines or other infrastructure, thereby impacting breeding success, productivity or survival rates.
- 8.7.73 Sensitivity: medium-high.
- 8.7.74 Magnitude of Impact: data from 2018 and historic surveys indicate that around 2-3 pairs each of curlew and lapwing may breed within approximately 500-750 m of the Proposed Development site boundary, although over 1 km from a proposed turbine location. The study by Wilson *et al.* (2014) on the impacts of forest edge effects on wader breeding suggests that it is unlikely that birds would attempt to nest in close proximity to the site, even in the absence of the Proposed Development. No wader breeding activity for example, was recorded close to forestry during surveys in 2018, although curlew were present further south. Thus, although it is possible that birds may show some additional small-scale displacement from current nesting areas due to the presence of operational turbines in addition to existing forestry, additional impacts are likely to be of negligible spatial and long-term temporal magnitude within the NHZ 19 populations' context.
- 8.7.75 Significance of Effect: the unmitigated effect from operational displacement on the NHZ 19 lapwing and curlew populations is classified as **minor** adverse and not significant in the context of the EIA Regulations.

Golden Plover

8.7.76 Impact: foraging golden plover may be at risk of displacement from habitat around turbines or other infrastructure, thereby impacting on productivity or survival rates.

8.7.77 Sensitivity: medium-high.

8.7.78 Magnitude of Impact: breeding golden plover were not recorded during the 2018 baseline surveys, and the species does not breed in the 2 km study area. Two spring passage golden plover flocks were recorded to the south of the site, in 2018, and golden plover were recorded potentially roosting at a waterbody around 1 km to the north of the Proposed Development site in 2011-12. No birds were recorded in proximity to Cumberhead Forest during baseline surveys and it is therefore considered unlikely that any birds would be displaced by the Proposed Development. The magnitude of impact is therefore considered to be negligible spatial and long-term temporal.

8.7.79 Significance of Effect: the unmitigated effect on the national/flyway golden plover population from operational displacement is classified as **minor** adverse and is not significant in the context of the EIA Regulations.

**Potential Effects: Collision Risk**

8.7.80 To meet the SNH (2017) guidelines, potential collision risk for the site has been assessed through the combination of a desk-based study assessing bird data from similar wind farm sites surrounding the Proposed Development site, providing data from 2003 to 2018.

2018 Flight Activity Surveys

8.7.81 Flight activity surveys were undertaken to help inform the Repowered Hagshaw Hill Wind Farm project, with a single vantage point being used, approximately 3 km south of the Proposed Development site, covering open moorland to the south of the operational Hagshaw Hill Wind Farm site. Although this covers different habitat from the Proposed Development site, it provides a broad indication of the species assemblage present, and level of flight activity within the local area during the breeding season.

8.7.82 A summary of all target species recorded during the 2018 breeding season is presented in Table 8.13. In general, it shows that there are low numbers of species present in the local area to the south of the site, and low activity rates. The most numerous species, curlew, had flight activity concentrated around breeding territories.

**Table 8.13 – Flight activity survey summary recorded for Repowered Hagshaw Hill Wind Farm project: March to August 2018**

Species	Total flights recorded	Total individuals recorded	Total bird seconds (duration x no. birds)
Curlew	9	13	729
Golden plover	2	154	34,144
Herring gull	1	1	28
Lapwing	1	2	50
Osprey	1	1	90
Oystercatcher	1	1	32

Other Wind Farm Projects – Collision Risk Modelling Results

8.7.83 A summary of collision risk modelling results for IOFs at other wind farm projects surrounding the site (2003 – 2018) is presented in Table 8.14.

**Table 8.14 – Collision rates predicted for local wind farm projects (“-“= not recorded at risk)**

Species	RHH	DW	DWCW	CU	DQ	GA	NU
Whooper swan	-	-	-	0.016	-	-	-
Pink-footed goose	-	0.254	0.000	0.025	0.90 (99% avoidance)	0.85 (99% avoidance)	-
Greylag goose	-	0.198	0.0007	0.013	0.06 (99% avoidance)	0.41 (99% avoidance)	-
Goshawk	-	-	-	0.007	-	-	-
Black grouse	-	0.000	0.000	-	-	-	-
Lapwing	0.000	0.028	0.003	-	0.638*	0.017	-
Curlew	0.000	0.110	0.064	0.013	0.190*	0.291	0.178 (95% avoidance)
Golden plover	5.934 (3.391 for new turbines)	0.000	0.000	0.628	14.02*	0.048	0.162 (95% avoidance)

\* revised Section 42 application collision rate

Wildfowl

8.7.84 Impact: wildfowl flying above the site may be subject to a collision risk with turbines, thereby increasing the mortality rate of the population above background levels.

8.7.85 Sensitivity: medium-high.

8.7.86 Magnitude of Impact: whooper swan, pink-footed goose and greylag goose have been recorded in flight during the majority of other local project surveys, although during the adjacent Dalquhandy Wind Farm baseline surveys whooper swan (up to 15 birds), pink-footed goose (up to 2,400 roosting birds), and greylag goose (up to 185 roosting birds) were also recorded utilising the pools within the adjacent part of the former Dalquhandy Opencast Site. The Dalquhandy ES figures show that most flights are to and from the north and do not cross the Proposed Development site.

8.7.87 From Table 8.15, the largest predicted annual collision rate at the recommended 99.8 % avoidance rate was at Douglas West (0.254), which equates to one collision every four years. Other projects have lower collision rates when values are converted to the 99.8 % avoidance rate. Much lower annual collision rates were predicted for whooper swan (at Cumberhead only) and greylag goose (up to one every 12 years when converted to a 99.8 % avoidance rate).

8.7.88 Flight activity rates and therefore collision rates associated with the Proposed Development are likely to be comparable with the range of rates recorded at other local project sites. Less than one collision every four years is predicted for any species, which is considered to be of negligible

magnitude in relation to the respective national populations, for example when put into the wider context of goose shooting bag numbers each year across the UK and Iceland.

- 8.7.89 Significance of Effect: the effect is classified as **negligible** and is therefore not significant in the context of the EIA Regulations.

Goshawk

- 8.7.90 Impact: goshawk flying within the site may be subject to a collision risk with turbines or other infrastructure, thereby increasing the mortality rate of the population above background levels.

- 8.7.91 Sensitivity: medium-low.

- 8.7.92 Magnitude of Impact: goshawk flights were recorded during baseline surveys for Cumberhead Wind Farm in 2013 and 2014, likely associated with a breeding territory. Predicted collision rate was low (one every c.147 years). Goshawks were seen occasionally at Nutberry, although no breeding evidence was observed, and no collision risk modelling was undertaken. No other local wind farm project is likely to have suitable forestry habitat for the species, hence the lack of collision modelling.

- 8.7.93 Goshawks are in general likely to fly below turbine rotor heights when hunting within and adjacent to forestry and fly at risk heights mainly when displaying around nest sites. With no nesting recorded within the Proposed Development site, collision risk is likely to be very low. As such, a negligible spatial and long-term temporal magnitude of impact is predicted.

- 8.7.94 Significance of Effect: with the regional population likely to be in favourable conservation status, the overall effect on the NHZ 19 goshawk population is assessed as **negligible** and not significant in the context of the EIA Regulations.

Black Grouse

- 8.7.95 Impact: black grouse flying within the site may be subject to a collision risk with turbines or other infrastructure, thereby increasing the mortality rate of the population above background levels.

- 8.7.96 Sensitivity: medium-high.

- 8.7.97 Magnitude of Impact: no black grouse were recorded in 2018, and no collision risk modelling was conducted for any other local wind farm project, due to the low number of, or lack of at-risk flights. In general, black grouse fly at low altitudes below rotor height although they are known to be at risk of colliding with structures close to ground level, such as fences and wires; deer fencing has proved to be a particular hazard for this species. Zeiler and Grünschachner-Berger (2009) reported cases of black grouse mortality resulting from collisions with various structures close to ground level and reports strong declines in black grouse numbers in local populations in areas where three wind farms were constructed in the Alpine zone in Austria.

- 8.7.98 There is a potential risk to black grouse from any structures such as fences and railings of the steps associated with turbines. However, based on the lack of suitable habitat within the site, and the proposed key-holing of turbines within forestry, the likelihood of this occurring is considered to be very low.

- 8.7.99 The magnitude of impact of collision with turbine infrastructure on black grouse is considered to be negligible spatial and long-term temporal on the NHZ 19 black grouse population.

- 8.7.100 Significance of Effect: the effect on black grouse is classified as **negligible** and is not significant in the context of the EIA Regulations.

Lapwing and Curlew

- 8.7.101 Impact: lapwing and curlew flying within the site may be subject to a collision risk with turbines or other infrastructure, thereby increasing the mortality rate of the population above background levels.

- 8.7.102 Sensitivity: medium-high.

- 8.7.103 Magnitude of Impact: curlew was recorded during the 2018 breeding season and distribution was largely associated with breeding territories to the south of the site. The 2018 baseline data for the Repowered Hagshaw Hill Wind Farm project predicted a breeding curlew collision rate of zero because all flights recorded within the CRAA occurred in survey height bands 0-40 m, which is below lower rotor tip height (45 m). At nearby wind farm sites, including those more suitable for curlew than the Proposed Development site, predicted collision rates were no more than one every 3-5 years (at a 98 % avoidance rate), and with the Proposed Development site comprising unsuitable habitat, collision rates are likely to be much lower.
- 8.7.104 Only one lapwing flight event (two birds) was recorded during surveys in 2018, and predicted collision rates were very low at all other local wind farm sites, despite breeding pairs found within some of them. With the Proposed Development comprising unsuitable habitat for the species, collision rates are likely to be very low.
- 8.7.105 Overall, collision risk for lapwing and curlew associated with the Proposed Development is considered to be of negligible spatial and long-term temporal magnitude.
- 8.7.106 Significance of Effect: despite the unfavourable status of the NHZ 19 lapwing and curlew populations, the overall effect is considered to be **minor** adverse and not significant in the context of the EIA Regulations.
- Golden Plover
- 8.7.107 Impact: golden plover flying within the site may be subject to a collision risk with turbines or other infrastructure, thereby increasing the annual mortality rate of the population above background levels.
- 8.7.108 Sensitivity: medium-high.
- 8.7.109 Magnitude of Impact: two flocks of golden plover (one flock of 44 individuals and another of 110 individuals) were recorded in April 2018 during the baseline surveys for Repowered Hagshaw Hill Wind Farm project, although these birds did not remain to breed in the study area. The species was considered to be present during the spring migration period only (for modelling purposes, taken to be from 1 March to 30 April), and a per-turbine collision rate of 0.424 collisions per year, scaled up from eight to 14 turbines resulted in an overall collision rate of 5.934 per year.
- 8.7.110 Other wind farm sites surrounding the Proposed Development have predicted golden plover collisions (Table 8.15), but none of these sites have recorded breeding evidence, backing up the assertion that birds are present on migration only. The Dalquhandy site (tip height increase submitted in December 2018) predicted the highest collision rate for non-breeding golden plover (14.02 per year).
- 8.7.111 At Dalquhandy, golden plover flights were frequently recorded, closely associated with waterbodies to the north of the Proposed Development site. Very few of these flights however appeared to occur within around 500 m of Cumberhead Forest, with the Proposed Development site being of unsuitable habitat for the species. Although there is a risk that non-breeding flocks will occasionally fly over the Proposed Development site at rotor height, collision rates are likely to be as similarly low as most of the other local wind farm projects.
- 8.7.112 The spring passage population of golden plover in Scotland was estimated by Forrester *et al.* (2007) to be 10,000-30,000 individuals. The additional mortality due to collisions associated with the Proposed Development is considered to be of negligible spatial and long-term temporal magnitude within the context of the passage population.
- 8.7.113 Significance of Effect: the overall effect on golden plover is assessed as **minor** adverse and not significant in the context of the EIA Regulations.

### **Potential Effects: Lighting**

- 8.7.114 There are potential lighting impacts on birds where turbines have a rotor tip height over 150 m as these turbines would need to be lit in accordance with Article 222 of the UK Air Navigation Order (ANO) (in line with current guidance from the Civil Aviation Authority (CAA, 2016).

#### All IOFs

- 8.7.115 Impact: impacts on IOFs might arise as a consequence of deployment of obstruction lighting on turbines over 150 m to blade tip. Once installed on-site, the Proposed Development turbines T01, T02, T07, T08 and T13 would need to be lit with medium intensity (2000 candela) steady red aviation warning lights, mounted on the nacelle of the turbines and 32 candela steady red aviation lights (likely to be 3) on the towers of the same turbines, indicating the blade length. Lighting could have two effects on IOFs: birds may be attracted and thereby placed at higher risk of collisions, or they may avoid the lights with a consequent displacement impact.
- 8.7.116 Sensitivity: medium-low for wildfowl and goshawk, and medium-high for black grouse and waders.
- 8.7.117 Magnitude of Impact: Annex F of Appendix 8.1 provides a literature review on the potential impacts of artificial lighting on birds. For breeding birds, there are no studies or observations reporting clear examples of any seasonal activities of birds being affected by exposure to artificial light. The review concluded that there is very little, if any, impact of artificial light on photoperiod responses (e.g. daily period of time birds are active, or breeding or migratory cues) of wild birds.
- 8.7.118 It is widely recognised that nocturnal migrant birds are attracted to artificial light while migrating, and historical reports of collisions associated with structures such as lighthouses or oil rigs suggest that risks are highest during periods of poor visibility and high winds. Watson *et al.* (2016) conclude that artificial lighting changes behaviour of nocturnal migrant birds, either by changing their flight paths to pass over lit areas, by flying at lower altitudes over lit areas, by increasing their call rates over lit areas, or by remaining longer over lit areas.
- 8.7.119 The evidence provided in the literature review indicates that lights on turbines may increase numbers of nocturnal migrant birds that collide, particularly if lights are steady rather than flashing. Obstruction lighting on turbines however appears to be several orders of magnitude less effective than the light from lighthouses and lightships in attracting nocturnal migrant birds.
- 8.7.120 Regarding potential displacement around turbines, Day *et al.* (2017) reported that migrating eiders showed higher avoidance at night of an oil-production facility in Alaska when it was illuminated with a hazing light system. However, this seems to be a rare example of birds being displaced by artificial lights, and there seem to be more examples of birds using artificial lights to their benefit, such as the use by shorebirds of artificial lights to allow them to feed visually at night.
- 8.7.121 Based on the literature review, it is considered that there is little evidence in the scientific literature to indicate that any of the IOFs would be significantly impacted either negatively or positively by lighting requirements, particularly at a relatively small project such as the Proposed Development.
- 8.7.122 Significance of Effect: in conclusion, the magnitude of impact on IOFs associated with lighting is predicted to be negligible spatial and long-term temporal, and **minor** adverse and not significant in the context of the EIA Regulations.

### **Decommissioning**

- 8.7.123 Decommissioning effects for the Proposed Development are difficult to predict with any confidence because of the long timeframe until their occurrence (30 years). Decommissioning impacts are considered for the purpose of this chapter to be similar to those of construction effects in nature but are likely to be of shorter duration. The significance of effects predicted in the *Construction Effects* section are therefore considered appropriately precautionary for assessing decommissioning effects on IOFs.

## 8.8 Mitigation

- 8.8.1 No significant effects were predicted for any IOF, and therefore no specific mitigation is required.
- 8.8.2 A BBPP would be set up as standard to avoid the destruction or disturbance of any nest site, and with species-specific temporal and spatial restrictions around construction works should any active nest be located.
- 8.8.3 Pre-construction breeding bird surveys would be undertaken by a suitably qualified ornithologist as part of the BBPP to determine whether any breeding activity is taking place within potential species-specific disturbance zones of any proposed infrastructure (assumed to be 500 m for Schedule 1 raptors and 750 m for black grouse). If breeding (or lekking in the case of black grouse) does occur within a potential disturbance zone, all construction works would be halted immediately and a disturbance risk assessment would be prepared. The risk assessment would consider the likelihood and possible implications of the associated construction activities on the breeding attempt and set out necessary measures to ensure that no disturbance occurs. The proposed mitigation measures, and if required, the exact distance of any disturbance-free zone would be agreed with SNH, within which any construction activity that is considered to be potentially disturbing would be prohibited in that area until chicks are fledged (or the core lekking period of March to May has passed in the case of black grouse).

## 8.9 Residual Effects

- 8.9.1 As there is no mitigation required, the level of significance and therefore residual effects are unchanged for all IOFs (**negligible** or **minor** adverse, not significant).

## 8.10 Cumulative Assessment

- 8.10.1 The assessment of ornithological effects associated with the Proposed Development alone predicted unmitigated non-significant effects for every IOF, due to the low suitability of habitat within the site, lack of breeding records, and the low activity levels of IOFs recorded during baseline surveys. It is therefore considered that the magnitude of impacts of the Proposed Development on IOFs would contribute very little to the overall cumulative effect for each potential impact at an NHZ 19 level. An NHZ-level cumulative assessment is therefore not considered necessary. The Proposed Development may however somewhat affect IOFs at a local level, and so a qualitative cumulative assessment of the potential effects of local wind farm projects shown in Table 8.15, on local IOF populations, is considered more relevant. This will also be put within a NHZ 19 context.

**Table 8.15 – Other Projects Considered Within the Cumulative Impact Assessment**

Project	Status	Number of Turbines
Douglas West	Consented	13
Dalquhandy (revised application)	Revised Application	15 (15)
Hagshaw Hill (Repowering scheme)	Operational (Application)	26 (14)
Hagshaw Hill Extension	Operational	20
Cumberhead (revised application)	Consented (Application)	11 (14)
Nutberry	Operational	6
Galawhistle	Operational	22 (20 in South Lanarkshire)

- 8.10.2 The cumulative assessment has been limited to disturbance-displacement and collision risk, with negligible effects predicted for habitat loss or lighting effects associated with the Proposed Development.

## **Wildfowl**

### **Cumulative Disturbance-displacement**

- 8.10.3 Pink-footed goose, whooper swan and greylag goose were recorded on occasion using the waterbodies within the neighbouring Dalquhandy Wind Farm site for roosting purposes, with small numbers of greylag geese using the waterbody within the Douglas West site on occasion. If all local wind farm projects became operational, it is possible that birds would cease to use these areas for roosting purposes, and so a staging location during autumn migration could be lost. The waterbodies on the Dalquhandy site are a legacy of the mining operations and subsequent restoration measures, and so it is unlikely that the site is an established site for geese to use each year, and baseline results from each project suggests that utilisation has been intermittent. At Cumberhead, a small number of greylag geese, part of the local feral population, were recorded using the open ground to the north, which is also considered to be a stopover roost for a winter passage population of pink-footed goose. There were no predicted disturbance-displacement impacts on these species in the project's Environmental Statement however.
- 8.10.4 With the cluster of local wind farms that may become operational in future years comes a risk that the area may prove to be a barrier to movements of geese. However, most flights recorded at Dalquhandy were to and from the north of the local wind farms, and so this flightpath should remain unimpeded. Results from other local projects show that the area does not appear to be an important part of a daily commuting route, and that most flights are long-distance, migratory in nature. These flights are often at heights above turbine rotor heights, and even if not, the increase in flight distance and duration incurred will be negligible compared to the overall distance required to travel.
- 8.10.5 The overall cumulative disturbance-displacement effect on the local wildfowl populations is assessed as **minor** adverse, and therefore not significant in the context of the EIA Regulations. This is because of the intermittent site usage, suggesting that alternative roost sites are available, and also the remaining possibility that roost sites would continue to be available, with closest turbines at sufficient distances away to minimise displacement risks. A non-significant cumulative effect at an NHZ 19 population level due to the effects associated with these local projects is also predicted.

### **Cumulative Collision Risk**

- 8.10.6 Whooper swan, pink-footed goose and greylag goose were recorded flying over the local project sites, albeit on a relatively infrequent basis. Nevertheless, collision modelling was undertaken for some of the local wind farm projects, resulting in a cumulative collision rate of less than one bird per year for each species, as reported above. This is likely to still be the case when considering risks associated with the Proposed Development. When considering the peak counts of roosting pink-footed goose on nearby Dalquhandy ponds (2,400 pink-footed geese and 185 greylag geese), this represents negligible increases in mortality to the local population, and therefore consequently the national/flyway populations, particularly when taken within the context of the British Association for Shooting & Conservation (BASC) recommend bag limits (per hunter per day) of two greylag and five pink-footed goose (Crabtree *et al.* 2010). The overall cumulative collision risk effect on the local wildfowl populations is assessed as **negligible** at all levels, and therefore not significant in the context of the EIA Regulations.

## **Goshawk**

### **Cumulative Disturbance-displacement**

- 8.10.7 Suitable forested habitat exists within Cumberhead and Nutberry sites for at least one goshawk territory and depending on the extent of felling associated with these projects and the Proposed Development, a territory may become unviable. Much suitable habitat would however still exist within Cumberhead Forest, and so goshawks may be able to relocate, similar to what may happen as a result of commercial forestry activities in the absence of any wind farms. The overall cumulative disturbance-displacement effect on the local goshawk population is therefore assessed

as **minor** adverse, and therefore not significant in the context of the EIA Regulations. A non-significant cumulative effect at an NHZ 19 population level due to the effects associated with these local projects is also predicted.

#### **Cumulative Collision Risk**

- 8.10.8 A collision risk may exist for goshawk at Cumberhead and Nutberry wind farms, although this is likely to be low unless a nest site is located close to turbines. The predicted collision rate at Cumberhead was 0.007, or one every c.142 years, and cumulative rates are unlikely to reach significance, even at a local level. The overall cumulative collision risk effect on goshawk is assessed as **negligible** on the local population, and therefore not significant in the context of the EIA Regulations. A non-significant cumulative effect at an NHZ 19 population level due to the effects associated with these local projects is also predicted.

#### **Black Grouse**

##### **Cumulative Disturbance-displacement**

- 8.10.9 Although the wider local area has hosted up to four lek sites in the past, black grouse numbers appear to have declined over the last 15 years. A historic lek site within 500 m to 1 km south of the Proposed Development site formed one of the four lek sites identified by Zisman *et al.* (2009) in 2003 and 2004 that were within around 2 km from the site. A total of 4-6 males (plus two females) were recorded lekking at these sites in 2003-04. During 2010 black grouse surveys for the DWCW project, two males were recorded at the historic lek to the south, in an approximately similar location to that in 2015 for the Douglas West project, when only one male was present. No males were recorded in 2018 during surveys for the Proposed Development and the Repowered Hagshaw Hill Wind Farm project.
- 8.10.10 Black grouse may still be present in the local area, albeit it is not clear whether the reduction they have undergone is due to the presence of operational wind farms or based on wider species' population trends. Nevertheless, if all local wind farm projects become operational at the same time, a return to former numbers would become less likely, although habitat management for black grouse at the Hagshaw Hill Extension and Douglas West sites may help maintain a small local population.
- 8.10.11 Habitat within the Proposed Development site is however generally unsuitable for black grouse, and so birds are unlikely to be affected by displacement from within the site during operation, with the possible exception of around the substation location at the south eastern site boundary. During construction, mitigation measures as part of the BBPP (described above) would avoid impacts on any black grouse present in the local area.
- 8.10.12 Despite habitat management in the local area, a worst-case **moderate** adverse cumulative effect is predicted on the local population (assuming all projects become operational), which is potentially significant within the context of the EIA Regulations, however, this situation would likely arise in any event in the absence of the Proposed Development which does not have suitable habitat for black grouse.
- 8.10.13 Within an NHZ 19 population level context, wind farm project sites frequently overlap with black grouse habitat, and it is possible that habitat loss and fragmentation may result from the cumulative presence of wind farm developments. At a number of sites where black grouse have been present, habitat management measures have however been planned to provide improved conditions for black grouse away from turbines, which is intended to at least in part offset any losses. Taking into consideration habitat management measures in relation to potential effects on black grouse within NHZ 19, and the low likelihood that all projects would become operational, a **minor** adverse cumulative effect on the NHZ 19 black grouse population is predicted.

#### **Cumulative Collision Risk**

- 8.10.14 Although a collision risk for black grouse does exist due to turbines and associated infrastructure, the likelihood of this occurring within the local area is very low due to the small numbers of

individuals present. If the Hagshaw Hill Wind Farm Repowering scheme is consented, and replaces the original Hagshaw Hill Wind Farm, collision risk is likely to be even lower, because of fewer, larger turbines replacing old ones, and which would have increased lower rotor tip heights at around 40 m. Black grouse flights would therefore generally occur well below rotor height.

- 8.10.15 The overall cumulative collision risk effect on black grouse is assessed as **negligible** on the local population, and therefore not significant in the context of the EIA Regulations. The cumulative collision risk on the NHZ 19 population is also likely to be reflective of the local situation, i.e. not significant, because of the low collision risks associated with the species.

### ***Lapwing and Curlew***

#### **Cumulative Disturbance-displacement**

- 8.10.16 Curlew and lapwing were recorded breeding within most local wind farm sites where suitable open habitats are present. A small number of breeding pairs may be affected by displacement due to the construction and operation of wind farms, although in some cases, e.g. Douglas West, habitat management measures may help offset such losses of habitat. As described above, the Proposed Development site is of unsuitable habitat for waders, and with forest edge effects likely already displacing birds from near to the Proposed Development site boundary, no further effects above the baseline situation are likely. At a local population level for both curlew and lapwing, overall residual cumulative effects are considered to be of no more than a low spatial and long-term temporal magnitude.
- 8.10.17 A **minor** adverse cumulative effect on the local populations is therefore predicted for both species, which is not significant within the context of the EIA Regulations. Both wader species are regularly found during baseline surveys and are potentially sensitive to disturbance-displacement due to wind farms within NHZ 19. However, the contribution of the Proposed Development to any effects would be negligible, if not zero.

#### **Cumulative Collision Risk**

- 8.10.18 Low collision rates were predicted for curlew and lapwing at local wind farm projects, and cumulatively the associated additional annual mortality is unlikely to be significant above a local level, despite both species' populations being in unfavourable condition. The Proposed Development would likely contribute a zero, or negligible magnitude to cumulative collision rates, with the site being of unsuitable habitat.
- 8.10.19 A **minor** adverse cumulative effect on the local populations is therefore predicted for both species, which is not significant within the context of the EIA Regulations. A significant cumulative collision risk may exist for the NHZ 19 populations in a worst-case scenario. However, the Proposed Development would contribute either zero, or negligible amounts to this.

### ***Golden Plover***

#### **Cumulative Disturbance-displacement**

- 8.10.20 Sansom *et al.* (2016) have shown information to suggest that breeding golden plovers may be affected up to 400 m away from operational turbines. No golden plovers were recorded breeding within the local area, but some habitat suitable for roosting or feeding may become unavailable due to displacement effects around turbines and other infrastructure. Presence of golden plover during the non-breeding season was irregular during baseline surveys however, which suggests that the local area is only used by birds moving between sites, or on spring passage. The Proposed Development site is of unsuitable habitat, and as with other wader species, edge effects of forestry are likely to already preclude birds from using adjacent habitats. It is unlikely that the Proposed Development would contribute a measurable amount to the cumulative effect.
- 8.10.21 Overall, the residual cumulative effect on the local golden plover population from operational displacement is classified as **minor** adverse and is not significant in the context of the EIA Regulations. This is also likely to be the level of significance for the contribution of wind farm

projects within NHZ 19 when scaled up to the relevant population (national/Scottish wintering or migrating populations).

### **Cumulative Collision Risk**

- 8.10.22 A local cumulative annual collision rate of around 20 birds is predicted, mainly due to the frequent flight activity in proximity to the larger turbines as part of the revised application for Dalquhandy (around 14 collisions per year, Table 8.14). In addition, two non-breeding flocks recorded in April 2018 during surveys for the Repowered Hagshaw Hill Wind Farm scheme contributed the majority of the remaining predicted collision rate. The larger flock comprised 110 birds. At other sites, flocks of up to 200 individuals were recorded.
- 8.10.23 As no breeding birds are present, the passage golden plover population is considered relevant for determining level of effect. The spring passage population of golden plover in Scotland was estimated by Forrester *et al.* (2007) to be 10,000-30,000 individuals. The additional mortality due to collisions (excluding any associated with the Proposed Development) would be an increase over the baseline mortality rate (0.27, BTO BirdFacts) by up to 0.7 %. This is considered to be of low spatial and long-term temporal magnitude. As reported in the collision risk assessment for the Proposed Development alone, few golden plover flights recorded during baseline surveys for Dalquhandy and the Repowered Hagshaw Hill Wind Farm scheme were close to the Proposed Development site, which, unlike these other two project sites, comprises unsuitable habitat. The contribution of the Proposed Development towards the cumulative collision rate would likely be very small, with birds evidently avoiding forested areas.
- 8.10.24 A **minor** adverse cumulative effect is therefore predicted, which is not significant within the context of the EIA Regulations. The Proposed Development's contribution to this would be negligible.

### **Mitigation**

- 8.10.25 A potentially significant cumulative effect was predicted for the local black grouse population as a result of displacement due to wind farm developments. Although the Proposed Development site is unsuitable habitat for black grouse, to minimise the possibility of any contribution that the Proposed Development could make to this cumulative displacement effect, native woodland will be planted around the substation located close to the Hagshaw Hill Black Grouse Management Area, to provide screening from human disturbance, lighting and noise, and potentially provide some suitable habitat for black grouse (refer Chapter 16 Forestry).

### **Residual Cumulative Effects**

- 8.10.26 The provision of screening and/or potentially suitable habitat due to native woodland planting around the Proposed Development substation is predicted to lessen the likelihood of losses to the local population and any potential impact on the objectives of the adjacent Hagshaw Hill Black Grouse Management Plan as a result of the Proposed Development.
- 8.10.27 Overall, a **minor** adverse and not significant residual cumulative effect on the local population is predicted when taking this mitigation into account, along with the other committed black grouse mitigation measures at other local wind farms, and the low likelihood that all projects would become fully operational. At an NHZ 19 level, the residual significance is predicted to remain **minor** adverse.

## **8.11 Summary**

- 8.11.1 This chapter has assessed the potential effects associated with the construction, operation and decommissioning of the Proposed Development on birds.
- 8.11.2 The compilation of baseline information for the ornithological assessment consisted of a desk-based assessment and one season of field surveys in accordance with SNH (2017) guidance. The desk-based assessment included bird monitoring data recorded for seven wind farm developments surrounding the site (providing data from 2003 to 2017). Baseline surveys in 2018

collected breeding bird data for the site, plus flight activity data for an area to the south of Hagshaw Hill Wind Farm.

- 8.11.3 IOFs identified from the baseline assessment were wildfowl (whooper swan, pink-footed goose, greylag goose), goshawk, black grouse, curlew, lapwing and golden plover.
- 8.11.4 Impacts from unmitigated construction and decommissioning activities were assessed as not significant in the context of the EIA Regulations. A BBPP and pre-construction surveys would be set up as standard to avoid the destruction or disturbance of any nest site, with species-specific temporal and spatial restrictions around construction works.
- 8.11.5 During the operational period, effects were also assessed as not significant in the context of the EIA Regulations.
- 8.11.6 A cumulative assessment was undertaken, and it was concluded that except for black grouse, no further mitigation is required for the Proposed Development, and all cumulative construction and operational effects are not significant, particularly when taking into account proposed mitigation and enhancement for other wind farm projects within NHZ 19. For black grouse, screening by native woodland planting, as well as replanting of conifers, has been proposed to reduce the residual risk of displacement to the local population, from moderate adverse to minor adverse and not significant.

**Table 8.16 – Summary Table**

Description of Effect	Significance of Potential Effect		Mitigation Measure	Significance of Residual Effect	
	Significance	Beneficial/ Adverse		Significance	Beneficial/ Adverse
<b>During Construction / Decommissioning</b>					
Whooper swan	Minor (Not significant)	Adverse	None required	Minor	Adverse
Pink-footed goose	Minor (Not significant)	Adverse	None required	Minor	Adverse
Greylag goose	Minor (Not significant)	Adverse	None required	Minor	Adverse
Goshawk	Negligible (Not significant)	Adverse	BBPP and pre-construction surveys. Spatial and temporal restrictions of construction activity if required.	Negligible	Adverse
Black grouse	Minor (Not significant)	Adverse		Minor	Adverse
Lapwing	Minor (Not significant)	Adverse		Minor	Adverse
Curlew	Minor (Not significant)	Adverse		Minor	Adverse
Golden plover	Minor (Not significant)	Adverse		Minor	Adverse
<b>During Operation: Displacement</b>					
Whooper swan	Minor (Not significant)	Adverse	None required	Minor	Adverse
Pink-footed goose	Minor (Not significant)	Adverse	None required	Minor	Adverse
Greylag goose	Minor (Not significant)	Adverse	None required	Minor	Adverse
Goshawk	Negligible (Not significant)	Adverse	None required	Negligible	Adverse
Black grouse	Minor (Not significant)	Adverse	None required	Minor	Adverse
Lapwing	Minor (Not significant)	Adverse	None required	Minor	Adverse
Curlew	Minor (Not significant)	Adverse	None required	Minor	Adverse
Golden plover	Minor (Not significant)	Adverse	None required	Minor	Adverse
<b>During Operation: Collision Risk</b>					
Whooper swan	Negligible (Not significant)	Adverse	None required	Negligible	Adverse

Description of Effect	Significance of Potential Effect		Mitigation Measure	Significance of Residual Effect	
	Significance	Beneficial/ Adverse		Significance	Beneficial/ Adverse
Pink-footed goose	Negligible (Not significant)	Adverse	None required	Negligible	Adverse
Greylag goose	Negligible (Not significant)	Adverse	None required	Negligible	Adverse
Goshawk	Negligible (Not significant)	Adverse	None required	Negligible	Adverse
Black grouse	Negligible (Not significant)	Adverse	None required	Negligible	Adverse
Lapwing	Minor (Not significant)	Adverse	None required	Minor	Adverse
Curlew	Minor (Not significant)	Adverse	None required	Minor	Adverse
Golden plover	Minor (Not significant)	Adverse	None required	Minor	Adverse
<b>During Operation: Lighting Effects</b>					
All IOFs	Minor (Not significant)	Adverse	None required	Minor	Adverse
<b>Cumulative Effects</b>					
Whooper swan	Minor (Not significant)	Adverse	No further mitigation required	Minor	Adverse
Pink-footed goose	Minor (Not significant)	Adverse	No further mitigation required	Minor	Adverse
Greylag goose	Minor (Not significant)	Adverse	No further mitigation required	Minor	Adverse
Goshawk	Minor (Not significant)	Adverse	No further mitigation required	Minor	Adverse
Black grouse	Moderate (Significant)	Adverse	Screening of substation by native woodland planting	Minor	Adverse
Lapwing	Minor (Not significant)	Adverse	No further mitigation required	Minor	Adverse
Curlew	Minor (Not significant)	Adverse	No further mitigation required	Minor	Adverse
Golden plover	Minor (Not significant)	Adverse	No further mitigation required	Minor	Adverse

## 8.12 References

- Band, W., Madders, M. and Whitfield, D.P. (2007). *Developing field and analytical methods to assess avian collision risk at Windfarms*. In: de Lucas, M., Janss, G.F.E. and Ferrer, M. (eds.) *Birds and Windfarms: Risk Assessment and Mitigation*. Pp. 259-275. Quercus, Madrid.
- Bright, J. A., Langston, R. H. W., Bullman, R., Evans, R. J., Gardner, S., Pearce-Higgins, J. & Wilson, E. (2006). *Bird Sensitivity Map to provide locational guidance for onshore Windfarms in Scotland*. Royal Society for the Protection of Birds.
- Brown, A. F. and Shepherd, K. B. (1993) *A method for censusing upland breeding waders*. *Bird Study*, 40: 189-195.
- CAA (Civil Aviation Authority) 2016. *The Air Navigation Order 2016 and Regulations*. Available at: [https://publicapps.caa.co.uk/docs/33/CAP393\\_E5A3\\_MAR2018\(p\).pdf](https://publicapps.caa.co.uk/docs/33/CAP393_E5A3_MAR2018(p).pdf).
- Day, R.H., Prichard, A.K., Rose, J.R., Streever, B. and Swem, T. 2017. *Effects of a hazing-light system on migration and collision avoidance of eiders at an artificial oil-production island, Arctic Alaska*. *Arctic*, 70, 13-24.
- DES (Dunnock Environmental Services) 2015. *Final Breeding Raptor Survey Report 2015 of the Proposed Douglas West & Dalquhandy DP Renewable Energy Project*.
- Drewitt, A.L. & Langston, R.H.W. 2006. *Assessing the impacts of Windfarms on birds*. In *Wind, Fire and Water: Renewable Energy and Birds*. Proceedings of the BOU Conference, University of Leicester, 1–3 April 2005. *Ibis* 148 (suppl. 1): 29–42.
- Eaton MA, Aebischer NJ, Brown AF, Hearn RD, Lock L, Musgrove AJ, Noble DG, Stroud DA and Gregory RD (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
- European Commission (2010). *Natura 2000 Guidance Document 'Wind Energy Developments and Natura 2000*. European Commission, Brussels. Available at: [http://ec.europa.eu/environment/nature/natura2000/management/docs/Wind\\_farms.pdf](http://ec.europa.eu/environment/nature/natura2000/management/docs/Wind_farms.pdf)
- European Commission (2016a). *Directive 2009/147/EC on the Conservation of Wild Birds*. Available at: [http://ec.europa.eu/environment/nature/legislation/birdsdirective/index\\_en.htm](http://ec.europa.eu/environment/nature/legislation/birdsdirective/index_en.htm).
- European Commission (2016b). *Directive 92/43/EEC on Conservation of Natural Habitats and of Wild Fauna and Flora*. Available at: [http://ec.europa.eu/environment/nature/legislation/habitatsdirective/index\\_en.htm](http://ec.europa.eu/environment/nature/legislation/habitatsdirective/index_en.htm)
- European Commission (2016c). *Environmental Impact Assessment Directive 2014/52/EU*. Available at: <http://ec.europa.eu/environment/eia/eia-legalcontext.htm>
- Forrester, R.W., Andrews, I.J., McInerny, C.J. et al. (eds). 2007. *The Birds of Scotland*. The Scottish Ornithologists Club, Aberlady
- Gilbert, G., Gibbons, D.W. & Evans, J. (1998) *Bird Monitoring Methods*. RSPB, Sandy.
- Gill, J.P., Townsley, M. and Mudge, G.P. (1996). *Review of the impacts of Windfarms and other aerial structures upon birds*. *SNH Review* 21: 68pp.
- Hardey, J., Crick, H., Wernham, C., Riley, H., Etheridge, B. & Thompson, D. (2009; updated 2013) *Raptors: a field guide for surveys and monitoring (2nd and 3rd editions)*. The Stationery Office, Edinburgh.

Hayhow DB, Ausden MA, Bradbury RB, Burnell D, Copeland AI, Crick HQP, Eaton MA, Frost T, Grice PV, Hall C, Harris SJ, Morecroft MD, Noble DG, Pearce-Higgins JW, Watts O, Williams JM, *The state of the UK's birds 2017*. The RSPB, BTO, WWT, DAERA, JNCC, NE and NRW, Sandy, Bedfordshire.

Hill, D.A., D. Hockin, D. Price, G. Tucker, R. Morris, and J. Treweek. (1997). *Bird disturbance: improving the quality of disturbance research*. Journal of Applied Ecology 34:275-288.

JNCC (Joint Nature Conservation Committee) 2012. *The UK Biodiversity Action Plan (BAP) and UK Post-2010 Biodiversity Framework*. Available at: [http://jncc.defra.gov.uk/pdf/UK\\_Post2010\\_Bio-Fwork.pdf](http://jncc.defra.gov.uk/pdf/UK_Post2010_Bio-Fwork.pdf)

Larsen JK, Madsen J (2000) *Effects of turbines and other physical elements on field utilization by pink-footed geese (Anser brachyrhynchus): a landscape perspective*. Landsc Ecol 15:755–764.

Madsen, J. & Boertmann, D. *Landscape Ecol* (2008) 23: 1007. <https://doi.org/10.1007/s10980-008-9269-9>

Masden, E. A., Haydon, D. T., Fox., A.D. and Furness, R.W. (2010) *Barriers to movement: Modelling energetic costs of avoiding marine wind farms amongst breeding seabirds*. Marine Pollution Bulletin, Vol. 60, issue 7: 1085-1091.

Massimino, D., Woodward, I.D., Hammond, M.J., Harris, S.J., Leech, D.I., Noble, D.G., Walker, R.H., Barimore, C., Dadam, D., Eglington, S.M., Marchant, J.H., Sullivan, M.J.P., Baillie, S.R. & Robinson, R.A. (2017). *BirdTrends 2017: trends in numbers, breeding success and survival for UK breeding birds*. Research Report 704. BTO, Thetford. Available at: [www.bto.org/birdtrends](http://www.bto.org/birdtrends)

Mitchell, C., Griffin, L., Trinder, M., Newth, J. & Urquhart, C. (2011) *The status and distribution of summering Greylag Geese Anser anser in Scotland, 2008–09*, *Bird Study*, 58:3, 338-348, DOI: 10.1080/00063657.2011.585629

Mitchell, C. & K. Brides. 2017. *Status and distribution of Icelandic-breeding geese: results of the 2016 international census*. Wildfowl & Wetlands Trust Report, Slimbridge. 19pp.

Musgrove, A., Aebischer, N., Eaton, M., Hearn, H., Newson, S., Noble, D., Parsons, M., Risely, K. and Stroud, D. (2013). *Population estimates of birds in Great Britain and the United Kingdom*. British Birds 106, pp. 64 –10

Pearce-Higgins, J.W., Stephen, L., Douse, A. and Langston, R.H.W. (2012). *Greater impacts of Windfarms on bird populations during construction than subsequent operation: results of a multi-site and multi-species analysis*. Journal of Applied Ecology 49: 386-394.

Pendlebury, C., Zisman, S., Walls, R., Sweeney, J., McLoughlin, E., Robinson, C., Turner, L. & Loughrey, J. (2011). *Literature review to assess bird species connectivity to Special Protection Areas*. Scottish Natural Heritage Commissioned Report No. 390.

Rees, E. (2012). *Impacts of wind farms on swans and geese: A review*. Wildfowl. 62. 37–72.

Ruddock, M. & Whitfield, D. P. (2007). *A Review of Disturbance Distances in Selected Bird Species*, A report from Natural Research (Projects) Ltd to Scottish Natural Heritage.

Sansom, A., Pearce-Higgins, J. W. and Douglas, D. J. T. (2016), *Negative impact of wind energy development on a breeding shorebird assessed with a BACI study design*. Ibis, 158: 541–555. doi:10.1111/ibi.12364

SERAD (Scottish Executive Rural Affairs Department) (2000). *Habitats and Birds Directives, Nature Conservation; Implementation in Scotland of EC Directives on the Conservation of Natural Habitats and of Wild Flora and Fauna and the Conservation of Wild Birds ("the Habitats and Birds*

*Directives*”). Revised Guidance Updating Scottish Office Circular No 6/1995. Available at: [http://jncc.defra.gov.uk/pdf/HDir\\_Rpt.pdf](http://jncc.defra.gov.uk/pdf/HDir_Rpt.pdf).

Scottish Government (2004). *The Nature Conservation (Scotland) Act 2004* (as amended). Available at: <https://www.legislation.gov.uk/asp/2004/6/contents>.

Scottish Government (2012). *The Conservation (Natural Habitats &c.) Regulations 1994 (as amended) (The Habitats Regulations)*. Available at: <https://www.legislation.gov.uk/ssi/2012/228/contents/made>.

Scottish Government (2014). *The Wildlife and Countryside Act 1981 (as amended)*. Available at: <https://www.gov.scot/Topics/Environment/Wildlife-Habitats/InvasiveSpecies/legislation>.

Scottish Government (2017). *The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017*. Available at: <http://www.legislation.gov.uk/ssi/2017/101/contents/made>.

Scottish Natural Heritage (2000). *Windfarms and birds: calculating a theoretical collision risk assuming no avoidance action*. SNH Guidance Note. Available at: <https://www.nature.scot/windfarms-and-birds-calculating-theoretical-collision-risk-assuming-no-avoiding-action>.

Scottish Natural Heritage (2012). *Assessing the Cumulative Impact of Onshore Wind Energy Developments*. Available at: <https://www.nature.scot/sites/default/files/2017-09/A675503%20-%20Assessing%20the%20cumulative%20impact%20of%20onshore%20wind%20energy%20developments.pdf>.

Scottish Natural Heritage (2014a). *Recommended bird survey methods to inform impact assessment of onshore wind farms*. Available at: <https://www.nature.scot/recommended-bird-survey-methods-inform-impact-assessment-onshore-windfarms>.

Scottish Natural Heritage (2014b). *Repowering onshore wind farms: bird survey requirements*. Available at: <https://www.nature.scot/sites/default/files/2017-09/Guidance%20note%20-%20Repowering%20onshore%20wind%20farms%20-%20bird%20survey%20requirements.pdf>.

Scottish Natural Heritage (2016a). *Assessing connectivity with Special Protection Areas (SPAs). Version 3*. Available at: <https://www.nature.scot/sites/default/files/2017-06/A2015314%20-%20Assessing%20connectivity%20with%20special%20protection%20areas%20-June%202016.pdf>.

Scottish Natural Heritage (2016b). *Environmental Statements and Annexes of Environmentally Sensitive Bird Information; Guidance for Developers, Consultants and Consultees* Version 2. Available at: <https://www.nature.scot/sites/default/files/2017-10/A2097001%20-%20Environmental%20Statements%20and%20Annexes%20of%20Environmentally%20Sensitive%20Bird%20Information%20-%20September%202016.pdf>

Scottish Natural Heritage (2018a). *Assessing the cumulative impacts of onshore wind farms on birds*. SNH Guidance Note. Available at: <https://www.nature.scot/guidance-assessing-cumulative-impacts-onshore-wind-farms-birds>

Scottish Natural Heritage (2018b). *Assessing the impact of repowered wind farms on nature, consultation draft*. Available at: <https://www.nature.scot/sites/default/files/2018-06/Guidance%20-%20Assessing%20the%20impact%20of%20repowered%20wind%20farms%20on%20nature%20-%20consultation%20draft%20-%20June%202018.pdf>

Scottish Natural Heritage (2018c). *Assessing significance of impacts from onshore windfarms on birds outwith designated areas*. Version 2. Available at:

<https://www.nature.scot/sites/default/files/2018-02/Guidance%20-%20Assessing%20the%20significance%20of%20impacts%20on%20bird%20populations%20from%20onshore%20wind%20farms%20that%20do%20not%20affect%20protected%20areas.pdf>.

Scottish Natural Heritage (2018d). *Environmental Impact Assessment Handbook* – Version 5: Guidance for competent authorities, consultation bodies, and others involved in the Environmental Impact Assessment process in Scotland. Available at: <https://www.nature.scot/sites/default/files/2018-05/Publication%202018%20-%20Environmental%20Impact%20Assessment%20Handbook%20V5.pdf>.

Watson, M.J., Wilson, D.R. and Mennill, D.J. 2016. *Anthropogenic light is associated with increased vocal activity by nocturnally migrating birds*. *Condor*, 118, 338-344.

Wilson, J.D., Anderson, R., Bailey, S., Chetcuti, J., Cowie, N.R., Hancock, M.H., Quine, C.P., Russell, N., Stephen, L. and Thompson, D.B.A. (2014). *Modelling edge effects of mature forest plantations on peatland waders informs landscape-scale conservation*. *Journal of Applied Ecology* Vol 51. pp204-213.

Wilson, M., Fernández-Bellon, D., Irwin, S. and O’Halloran, J. (2015). *The interactions between Hen Harriers and turbines*. Windharrier Final Project Report. School of Biological, Earth & Environmental Sciences, University College Cork, Ireland.

Wilson, M. W., Austin, G. E., Gillings S. and Wernham, C. V. (2015). *Natural Heritage Zone Bird Population Estimates*. SWBSG Commissioned report number SWBSG\_1504. pp72. Available from: [www.swbsg.org](http://www.swbsg.org)

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