7 Ornithology

7.1 Introduction

7.1.1 Background

This Chapter of the Environmental Impact Assessment Report (EIAR) evaluates the effects of the Development on the ornithology resource. This assessment was undertaken by Bird Surveyors Ltd (BSL). The Development description is provided in Chapter 2 of the EIAR. The assessment will consider the potential effects of the Development during the following development stages:

- Decommissioning of the Operational Barnesmore Windfarm (Initial Phase of the Development)
- Construction of the Development (likely to occur in tandem with the above phase)
- Operation of the Development
- Decommissioning of the Development (Final Phase)

The decommissioning of the Operational Barnesmore Windfarm and the construction of the Development are likely to occur partly in tandem. This represents a worst-case scenario for assessment purposes. Any effects arising as a result of the decommissioning of the Development are considered to be no greater than the effects arising when these two phases are combined. As a result, the final decommissioning phase has not been considered further in this assessment.

This Chapter of the EIAR is supported by the following figures, in **Volume III Figures**, and Technical Appendices, in **Volume IV Technical Appendices**:

- **Technical Appendix 7.1**: Ornithology Surveys 2017 - 2019
- **Technical Appendix 7.2**: Data Review
- **Technical Appendix 7.3**: Collision Risk Modelling (CRM)
- **Technical Appendix 7.4**: Operational Phase Bird Monitoring Plan
- **Technical Appendix 7.5**: Data Review (Confidential)

7.1.2 Statement of Authority

This ornithology assessment and chapter has been prepared by Dr Marc Ruddock, an ecologist and technical expert for Bird Surveyors Limited and a suitably qualified, competent, professional ornithologist with extensive experience of completing assessments. Bird Surveyors Limited are competent experts for the purposes of the preparation of this EIAR.

7.1.3 Legislation, Policy and Guidance

The following guidance, legislation and information sources have been considered in carrying out this assessment:

- EU Council Directive 2009/147/EC on the Conservation of Wild Birds (Birds Directive)
- Council Directive 92/43/EEC on the Conservation of Natural Habitats and of wild flora and fauna (the Habitats Directive)
- Irish Wildlife Acts 1976 to 2018
- The European Communities (Birds and Natural Habitats) Regulations 2011 (transposes EU Birds Directive2009/147/EC and EU Habitats Directive 2009/147/EC, 92/43/EC)
- The International Convention on Wetlands of International Importance 1971
- European Commission (2011). Wind energy development and Natura 2000. Guidance document
- European Commission (2002). Assessment of plans and projects significantly affecting Natura 2000 sites

This assessment has also been prepared with respect to the various planning policies and strategy guidance documents listed below:

- Planning and Development Acts 2000 - 2018
- Donegal County Council (2018). County Donegal Development Plan 2018-2024
- EPA (2017). Draft revised guidelines on the information to be contained in Environmental Impact Statements. Environmental Protection Agency.
- DoEHLG (2013). Guidelines for Planning Authorities and An Bord Pleanála on Carrying out Environmental Impact Assessment. Department of the Environment, Community and Local Government.

- EPA (2003). Advice notes on current practice (in the preparation of Environmental Impact Statements
- EPA (2002). Guidelines on the information to be contained in Environmental Impact Statements. Environmental Protection Agency (where relevant).
- NRA (2009). Guidelines for Assessment of Ecological Impacts of National Road Schemes (Revision 2). National Roads Authority.

In consideration of potential transboundary effects with the adjacent Northern Ireland additional information sources have been considered during this assessment including:

- The Conservation (Natural Habitats, etc.) Regulations 1995 (as amended) which transposes the Habitats Directive into law in Northern Ireland (the Conservation Regulations);
- The Wildlife (Northern Ireland) Order 1985 (as amended) (the Wildlife Order);
- The Wildlife & Natural Environment (Northern Ireland) Act 2011;
- Planning Policy Statement 2 (PPS 2) Planning & Nature Conservation;
- Planning Policy Statement 18 (PPS 18);
- JNCC (2012) UK Biodiversity Action Plan;
- Local Biodiversity Action Plans (www.biodiversityni.com);
- NIEA (2010). Wind Energy Development in Northern Ireland's Landscapes: Supplementary Planning Guidance to accompany Planning Policy Statement 18 'Renewable Energy'. NIEA Research and Development Series No 10/01, Belfast;
- DOE (2015). DOE Planning & Environment: Standing advice for planning officers and applicants seeking planning Permission for land which may impact on wild birds;

Where required a series of key additional reference and information sources have been considered during this assessment including:

- Percival (2003). Birds and wind farms in Ireland: A review of potential issues and impact assessment. Ecology Consulting.
- Percival (2001; 2003) Birds and windfarms: a review of potential issues and impact assessment. Ecology Consulting. 22pp
- McGuinness et al., (2015). Bird Sensitivity Mapping for Wind Energy Developments and Associated Infrastructure in the Republic of Ireland. Guidance Document. Birdwatch Ireland.
- Balmer et al. (2013). Bird Atlas 2007-11: The breeding and wintering birds of Britain and Ireland. British Trust for Ornithology;
- Pearce-Higgins et al., (2009). The distribution of breeding birds around upland wind farms. Journal of Applied Ecology 46: 1323-1331.
- Pearce-Higgins, et al., (2012). Greater impacts of wind farms on bird populations during construction than subsequent operation: results of a multi-site and multi-species analysis. Journal of Applied Ecology 49: 386–394.
- Colhoun & Cummins (2013). Birds of conservation concern in Ireland 2014 – 2019;
- CIEEM (2016) Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater and Coastal, 2nd edition;
- Eaton et al., (2015). Birds of Conservation Concern 4: the population status of birds in the UK, Channel Islands and Isle of Man;
- Ruddock & Reid (2010). Review of windfarms and their impact on biodiversity: Guidance for developments in Northern Ireland. Report by the Natural Heritage Research Partnership, Quercus for the Northern Ireland Environment Agency, Northern Ireland, UK;
- Tosh et al. (2014). A review of the impacts of wind energy developments on biodiversity. Report prepared by the Natural Heritage Research Partnership (NHRP) between Quercus, Queen's University Belfast and the Northern Ireland Environment Agency (NIEA) for the Research and Development Series No. 14/02;

In addition to the above, a series of other published literature and references are utilised and inserted throughout the text where relevant (**Section 7.11 References**). In the absence of specific ornithological survey guidance for Ireland, current best practice guidance from Scottish Natural Heritage (SNH; see **Section 11** for additional references) has been utilised where relevant particularly:

- SNH (2014). Guidance on repowering wind farms: bird survey requirements. November 2014. Scottish Natural Heritage;

- SNH (2015a). Good practice during wind farm construction. Scottish Natural Heritage. Version 3;
- SNH (2015b). Spatial planning for onshore wind turbines – natural heritage considerations. Scottish Natural Heritage;
- SNH (2016). Assessing Connectivity with Special Protection Areas (SPAs). Scottish Natural Heritage;
- SNH (2017). Recommended bird survey methods to inform impact assessment of onshore wind farms. Scottish Natural Heritage;
- SNH (2018a) Avoidance rate information & guidance note: Use of avoidance rates in the SNH wind farm collision risk model. Scottish Natural Heritage, Edinburgh, UK;
- SNH (2018b). Assessing the cumulative impact of inshore wind farms on birds. Scottish Natural Heritage; and
- SNH (2018c). Assessing significance of impacts from onshore windfarms on birds' out-with designated areas. Scottish Natural Heritage.

7.2 Assessment Methodology and Significance Criteria

The key issues for the assessment of potential ornithological effects relating to the Development are:

- Temporary effects arising from the initial decommissioning and construction phase;
- Permanent / direct effects; and
- Indirect (secondary) effects, including the displacement of species.

The footprint of the Development due to turbines, turbine blades, nacelles, towers and/or ancillary windfarm infrastructure (e.g. substation, Energy Storage Unit, power-lines, meteorological masts) for the initial decommissioning and construction and operational phases, has the potential to lead to three main effects on birds (SNH, 2018):

- Direct loss of breeding, wintering and/or foraging habitat;
- Direct mortality due to collision; and/or
- Displacement of birds as a result of increased disturbance and/or decreased suitability of breeding, wintering and/or foraging habitats.

For the purposes of this Chapter the details of the Development are as described in **Chapter 2: Development Description**.

Table 7.1: Consultation Responses

Consultee	Type and Date	Summary of Consultation Response	Response to Consultee
An Taisce	Email 14/06/2019	Particular consideration is required on flight paths of migratory birds, foraging and breeding areas for raptors, and cumulative impact with other existing and proposed wind farms	Flight paths of migratory (and all detected species) are provided in **Technical Appendix 7.1**. Foraging and breeding areas for raptors are provided in **Technical Appendix 7.1; Confidential Figures** Cumulative effects are reviewed in **this chapter of the EIAR,** in particular adjacent sites at Meenbog and Meenadreen
BirdWatch Ireland	Letter 12/06/2019	Consideration of Barnesmore Bog NHA; Lough Eske and Ardnamona Wood; Dunragh Loughs / Pettigoe Plateau Effects on habitats to be considered and also cumulatively with other windfarms, forestry, turf-cutting and over-grazing	Review of designated sites completed and considered in **this Chapter of the EIAR** and detailed in NIS Cumulative effects are reviewed in **this Chapter of the EIAR** in particular adjacent sites at Meenbog and Meenadreen

Consultee	Type and Date	Summary of Consultation Response	Response to Consultee
		EIA to consider potential direct and indirect impacts on waterbodies and water-ways including Lough Golagh, Lough Slug, Lough Atlieve, Lough Namaddy.	Potential direct / secondary effects on breeding, wintering and foraging species and habitats for priority species all reviewed and considered in **this Chapter of the EIAR.**
		Considers that region supports high numbers of bird species of conservation concern including Annex 1, red-listed, amber-listed species and previous BWI observations made on Meenbog and Carrickaduff. Specific concerns on potential negative effects on hen harrier, merlin, golden plover, red grouse, whooper swan, Greenland white-fronted goose and curlew.	Potential direct / secondary effects on breeding, wintering and foraging species and habitats for priority species all reviewed and considered in **this Chapter of the EIAR.**
		EIA and NIS to be accompanied by ornithological assessment in line with SNH (2017) guidance or other relevant species specific best practice survey guidelines	Further details on methods, timings and personnel presented and analysed in **this Chapter of the EIAR; Technical Appendix 7.1** and illustrated in Figures.
		Would like to see detailed assessment of the impact of the development on: • Breeding species including hen harrier, merlin, curlew, golden plover, sparrowhawk, kestrel, buzzard, raven, peregrine, ring ouzel, common sandpiper, snipe, red grouse and golden eagle • Wintering species including red grouse, snipe, golden plover, whooper swan, mute swan, mallard, teal, wigeon, Canada geese, red-throated diver, heron, sparrowhawk, goldeneye, tufted duck, moorhen, coot, greylag geese, buzzard, peregrine falcon, lesser black-backed gull, golden eagle, pale-bellied brent geese, raven, herring gull, little grebe, kestrel, white-tailed eagle, common gull, sanderling, merlin, greater black-backed gull.	Reviews and presentation of data for all key ornithological receptors to inform assessment all presented, mapped where required and analysed in **this Chapter of the EIAR; Technical Appendix 7.1; 7.2; 7.3.** Reviews and presentation of data for all key ornithological receptors to inform assessment are all presented, mapped where required and analysed in **this chapter of the EIAR; Technical Appendix 7.1; 7.2; 7.3.**

Consultee	Type and Date	Summary of Consultation Response	Response to Consultee
		Collision risk modelling	Details of collision risk presented in **this Chapter of the EIAR; Technical Appendix 7.3** and illustrated in associated Figures. Primary and secondary target species both considered.
		Specific request for assessment of wintering and breeding hen harrier in the context of the Blue Stack Mountains, Pettigoe Plateau and South Donegal regional breeding population	Reviews and presentation of data for all key ornithological receptors to inform assessment all presented, mapped where required and analysed in **this Chapter of the EIAR; Technical Appendix 7.1; 7.2 & 7.3.**
		Specific request for surveying of breeding curlew within the Site and the wider development area in context of the wider population collapse of the species	Reviews and presentation of data for all key ornithological receptors to inform assessment all presented, mapped where required and analysed in **this Chapter of the EIAR; Technical Appendix 7.1; 7.2 & 7.3**.
Development Applications Unit	Letter 25/07/2019	General scoping comments provided	General comments noted
		Requirement for ecological survey for habitats and species by suitably qualified persons at appropriate times of years with details of methodology and timings of surveys to be provided	Further details on methods, timings and personnel presented and analysed in **this Chapter of the EIAR; Technical Appendix 7.1** and illustrated in Figures.
		Assessment to cover construction, operation and if applicable restoration / decommissioning	Further details presented in **this Chapter of the EIAR; Technical Appendix 7.1; Confidential Figures**
		Specific reference to national biodiversity plans and any relevant county biodiversity plans. Losses of biodiversity such as woodland, scrub, and other habitat should be mitigated	Details of displacement and effects outlined in **this Chapter of the EIAR; Technical Appendix 7.1**. Negligible effects predicted compared to baseline (Operational Barnesmore Windfarm). The Habitat Management Plan (HMP) details restoration and management which will benefit range of species. Woodland and scrub less relevant at the locality Two years of survey completed 2017 – 2019 inclusive. Details of weather and survey conditions provided

Consultee	Type and Date	Summary of Consultation Response	Response to Consultee
		Hedgerows should be maintained as wildlife corridors and estimated losses calculated. Hedgerows and trees should not be removed during nesting season (1st March 31st August)	No proposed removal of hedgerows but identified the risks of disturbance during breeding season. Details of construction phasing and disturbance avoidance measures presented in **this Chapter of the EIAR**
		Bird surveys to follow best practice and if necessary modified for Ireland. Two years survey requirement with full details of methods, dates and times detailed. Hourly estimates of survey and weather conditions required	Further details on methods, timings and personnel presented and analysed in **this Chapter of the EIAR; Technical Appendix 7.1**) and illustrated in Figures. Two years of survey completed 2017 – 2019 inclusive. Details of weather and survey conditions provided
		Bird survey results to be referenced back to overall populations and dynamics.	Details of populations and likelihood of risk analysed and presented in **this Chapter of the EIAR**
		Requirement for consideration of seasonal bird migration routes as well as movements between roosting and feeding areas	Details of detections, flight paths and review of literature prepared in **this Chapter of the EIAR; Technical Appendix 7.1**; Figures as informatives
		EIAR requirements set out with particular relevance to Natura 2000 sites and provision of construction management plans. Cumulative and ex situ effects are to be considered on European sites up to 15km but that specific consideration of some species may be required beyond that distance	Review of designated sites completed up to and beyond 15 km in **Technical Appendix 7.1**; review of sensitivities of species including those outlined by NPWS and analysis presented in **this Chapter of the EIAR; Technical Appendix 7.1; Technical Appendix 7.3**; Outline Construction Environmental Management Plan (CEMP) details of CMS provided and established in **Technical Appendix 2.1.**
		Appropriate assessment to be considered through preparation of Natura Impact Statement (NIS) where relevant	Review of designated sites completed and considered in **this Chapter of the EIAR** and detailed in NIS **Technical Appendix 6.6.**
		Recognise importance of post construction monitoring and that this should not be implemented as mitigation. Post construction monitoring to include bird (and bat) fatality monitoring and the assessment of carcass removal by scavengers. A plan of action	Details of operational monitoring programme presented in **this Chapter of the EIAR**. Details of post construction fatality monitoring provided in **Technical Appendix 7.4.**

Consultee	Type and Date	Summary of Consultation Response	Response to Consultee
		should be agreed If significant mortality is detected Details provided on licences under Wildlife Acts and/or derogations and removal of vegetation to avoid 1st March to 31st August Recommends additional ecological survey immediately prior to commencement of construction to ensure no significant changes Various baseline data sources, consultees and references are provided	Any identified the risks of disturbance during breeding season are assessed in this Chapter of the EIAR and further detailed in CEMP Details of post construction fatality monitoring provided in **Technical Appendix 7.4** Data review completed in **Technical Appendix 7.1, 7.2 & 7.5**
DAERA Planning Response Team (NIEA - NED)	Scoping Opinion 30/09/2019	Likely effects arising in relation to planning regulations (NI) Likely effects arising to designated sites and important species including at: • Killeter Lakes and Bogs (ASSI) for bogs and hydrology • Within a hen harrier consultation zone • Near to Glendergan River / River Foyle & Tributaries ASSI and SAC related to hydrology Notes that area likely to support protected and priority species Requirement for review of designated sites / HRA	Review of data and analysis undertaken comparing baseline (Operational Barnesmore Windfarm) and the Development to inform **this Chapter of the EIAR and Technical Appendix 7.1 & 7.3** Review of designated sites completed in **Technical Appendix 7.1**; review of sensitivities of species including those outlined by NIEA and analysis presented in this Chapter of the EIAR**; Technical Appendix 7.1; Technical Appendix 7.3;** Potential effects on breeding, wintering and foraging habitats for priority species all reviewed and considered in this Chapter of the EIAR Review of designated sites completed and considered in **this Chapter of the EIAR** and **Technical Appendix 7.1** and detailed in NIS

Consultee	Type and Date	Summary of Consultation Response	Response to Consultee
		Standing advice information provided and most comments relates to habitat and/or hydrology Notes the requirement for appropriate protected / priority species surveys and pending findings a protected species management plan and/or an ornithological management and monitoring plan to include mitigations.	Potential effects of collision reviewed, analysed and considered in **this Chapter of the EIAR and Technical Appendix 7.3.** Potential effects of displacement reviewed, analysed and considered in **this Chapter of the EIAR** and **Technical Appendix 7.1 – 7.3**; HMP considered in context of ornithology based on layout and displacement / collision models and results which are presented in **Technical Appendix 7.1; 7.3** and **this Chapter of the EIAR.**
RSPB	Scoping Opinion 08/07/19	Recommendations on ES and data collection and surveys Do not hold any site specific data and defer to BWI and IRSG for same and also NIEA and NIRSG for raptor information. Hen harrier and merlin likely of special interest and also may be presence of curlew, snipe, red grouse and meadow pipit and to be considered during design stage Identifies potential data sources and request service including RSPB, NBN, BTO Identifies various expectations for ES including survey requirements and mitigation / enhancement options including: • Review of conservation designations • Connectivity to/from Natura 2000 sites • Habitat survey • Carbon calculation • Surveys to be undertaken at appropriate time of year, stated methods and reputable contractor including development Site and wider areas to assess direct / indirect effects	Response and details of rationale provided in methodology section **Technical Appendix 7.1** Data requests and information presented in **Technical Appendix 7.1** Potential effects on breeding, wintering and foraging habitats for priority species all reviewed and considered in **this Chapter of the EIAR** Data requests and information presented in **Technical Appendix 7.1** Review of designated sites completed in **Technical Appendix 7.1**; review of sensitivities of species including those outlined and analysis, details on methods, timings and personnel presented and information illustrated in Figures. Two years of survey completed 2017 – 2019 inclusive. Details of weather and survey conditions provided Potential direct / secondary effects on breeding, wintering and foraging habitats for priority species all reviewed and considered in **this Chapter of the EIAR and accompanying appendices**

Consultee	Type and Date	Summary of Consultation Response	Response to Consultee
		Surveys to include: • At least one full year of survey potentially more • CBC / B&S surveys Mar – Jul within 500 m • Winter B&S type surveys Oct – Mar within 500 m • Vantage point surveys to SNH guidance and targeting raptors using experience surveyors familiar with CRM • Migratory vantage point surveys to SNH guidance using surveyors experienced with swans / geese • Reference supplied for SNH survey guidance and various papers to quantify disturbance / displacement effects particularly for waders, hen harrier and buzzard • Cumulative effects with other nearby windfarms to be assessed Assessment to consider direct and indirect effect during construction, operation and decommissioning Review of assessment requirement and mitigation considerations (including habitat management; time restrictions on construction; details of Site plan, restoration of tracks after construction Advocates “no loss of biodiversity” and supports mitigation and/or enhancement on / off Site Monitoring should take place under a BACI approach and encouraged publication of results from the findings of the programme of monitoring	Displacement and disturbance review undertaken to consider mitigation; HMP proposed to reinstate and restore extensive areas of habitat which will benefit bird species; details of Construction Management Strategy provided in **this Chapter of the EIAR** and in **Outline CEMP** Potential direct / secondary effects on breeding, wintering and foraging habitats for priority species all reviewed and considered in **this Chapter of the EIAR.** There are negligible effects predicted from baseline (Operational Barnesmore Windfarm) to Development; in some incidences risk is reduced as a result of the Development. Details presented in **this Chapter of the EIAR** Potential direct / secondary effects on breeding, wintering and foraging habitats for priority species all reviewed and considered in **this Chapter of the EIAR** Potential effects of displacement reviewed, analysed and considered in **this Chapter of the EIAR and Technical Appendix 7.3**; including displacement modelling for key ornithological receptors HMP to provide mitigation for required Monitoring reviewed and discussed in **this Chapter of the EIAR**
NPWS	Meeting 25/07/2019	Review of ornithology findings and details prepared in minutes of meeting	Agreement reached on methods and approached and recorded in meeting minutes.

7.2.1 Scoping Responses and Consultations

This Chapter has been informed by appropriate consultation undertaken during the Environmental Impact Assessment (EIA) process; undertaken prior to planning application stage including a Scoping exercise which was completed in advance of EIAR preparation and in consultation with NPWS. Relevant Scoping responses and/or data were received from:

- An Taisce;
- Bird Watch Ireland;
- Development Applications Unit (DAU);
- DAERA;
- RSPB;

Key matters in the Scoping Opinion from consultees are reviewed here. The Scoping Opinion is provided in **Technical Appendix 1.3**. Consultation was received from the organisations shown in **Table 7.1** and are summarised here.

7.2.2 Methodology for the Assessment of Effects

The significance of the potential effects of the Development has been classified by professional consideration of the sensitivity of the receptor and the magnitude of the potential effect.

The assessment follows the requirements set out in the EIA Regulations and standardised guidance (CIEEM, 2018; **Chapter 1)** to focus on potentially significant effects and considers those arising from the footprint of Development due to turbines, turbine blades, nacelles, towers and/or ancillary windfarm infrastructure (e.g. sub-station, Energy Storage Unit, power-lines, meteorological masts) for the initial decommissioning and construction and operational phases. These are assessed in consideration of direct loss of breeding, wintering and/or foraging habitat; direct mortality due to collision; and/or displacement of birds as a result of increased disturbance and/or decreased suitability of breeding, wintering and/or foraging habitats.

The assessment considers that disturbance can take varying formats and occur over short or long temporal periods. The effects may be transient (e.g. short-term alteration in behaviour) or permanent (e.g. total displacement from the breeding or wintering locations) and that disturbance effects may be lower depending on the tolerance and/or experience and/or habituation of individuals or species (Ruddock & Whitfield, 2007; Whitfield et al., 2008) and habituation of several species has been observed at the Site.

The assessment considers that effects are likely to occur in phases; during the initial decommissioning and construction phase (which will occur simultaneously with the former) and during the operational phase. The initial decommissioning and construction phase will occur over a short temporal period (approximately 12 months) whilst the operational phase will occur over the operational life-time of the Development, which is assumed to be permanent. Cumulative effects can also occur temporally or spatially in combination with other nearby proposals.

Assessment of potential effects considered the relevant Survey Areas (**Figure 7.1 & 7.3**) which have been defined on the basis of the Site Boundary, rather than the Development footprint. These buffers allow an assessment of wider species connectivity in the area and to establish whether beyond the initial decommissioning and construction and the operational phases, footprint effects are likely within a wider zone of influence. However further assessment is undertaken of the turbine 500 m buffers and the infrastructure footprints for both the Operational Barnesmore Windfarm and the Development.

To establish effects of the Development, additional mapping and modelling analyses were undertaken of the baseline ornithology data (**Technical Appendix 7.1**) which includes comparative data between the existing Operational Barnesmore Windfarm infrastructure and turbines (baseline) compared to the Development infrastructure and turbines. Additional analyses were completed using the baseline data to review:

- Potential effects types;
- Potential effects on breeding birds;
- Potential effects on wintering birds;
- Potential effects of collision on birds;
- Potential effects by species; and
- Potential effects on designated sites and/or site features

Following the results from each survey and assessment of the baseline and sensitivity of the ornithological receptor (**Table 7.2**), the direct and/or indirect effects of the Development are analysed. This process considers the necessary mitigation measures and residual effects.

The assessment considers each of the potential effects of windfarms (SNH, 2018) and for each of these risks, the detailed knowledge of bird distribution and flight activity within and surrounding the Site has been utilised to predict the potential effects of the Development on birds and cumulatively in consideration with other projects (**Technical Appendix 1.2**) which is focussed on cumulative projects within 5 km of the Site (**Section 7.7**). Utilising the results from each survey and assessment of the baseline, the effects of the Development are analysed in isolation and in combination (with cumulative developments) and considered based on:

- Type (positive; neutral; negative);
- Extent (see **Section 7.2.2**);
- Magnitude (see **Table 7.3**);
- Duration (see **Section 7.2.2**);
- Reversibility (temporary, permanent, reversible, irreversible);
- Timing (hourly, daily, weekly, monthly, seasonally, annually); and
- Frequency (once, rarely, occasionally, frequently, constantly).

Effects will be reported according to EIA Regulations as either significant or not significant in the context of the sensitivity of the species (**Table 7.2**), the conservation status of bird species (Colhoun & Cummins, 2013) and population status and trends of each potentially affected species (**Tables 7.6 & 7.8**). If necessary, upon assessment of the effects of the Development, this process considers the necessary mitigation and / or enhancement measures together with any residual effects, as well as cumulative effects.

7.2.2.1 Geographical Extent

Following CIEEM (2018) and NRA (2009) the geographical extent of the receptors and effects are defined based on population status and trends of each species and/or assemblage utilising the following terms:

- International;
- National level (Ireland);
- Regional level (County);
- Local importance (Higher Value); and
- Local importance (Lower Value).

7.2.2.2 Duration of Effect

The duration of the effect is defined during the assessment based on:

- Short-term (initial decommissioning and construction phase); and
- Permanent but reversible (operational phase).

Where necessary EPA (2015) descriptions are utilised to include:

- Momentary – effects lasting from seconds to minutes;
- Brief – effects lasting less than a day;
- Temporary – effects lasting less than a year;
- Short-term – effects lasting one to seven years;
- Medium term – effects lasting seven to 15 years;
- Long term – effects lasting 15 to 60 years;
- Permanent – effects lasting over 60 years.

7.2.2.3 Sensitivity of Receptors

The sensitivity of the baseline conditions, including the importance of environmental features on or near to the Site or the sensitivity of potentially affected receptors, is assessed in line with best practice guidance, legislation, statutory designations and / or professional judgement. The framework for determining the sensitivity of receptors is detailed in **Table 7.2**.

Table 7.2: Framework for Determining Sensitivity of Receptors

Sensitivity of Receptor	Definition
Very High	The receptor has little or no ability to absorb change without fundamentally altering its present character, is of very high environmental value, or of international importance. In an ornithological context (Percival, 2003) this includes: Species that form the cited interest of an SPA and other statutory protected nature conservation areas (cited means mentioned in the citation text for the site as a species for which the site is designated).
High	The receptor has low ability to absorb change without fundamentally altering its present character, is of high environmental value, or of national importance. In an ornithological context (Percival, 2003) this includes: Species that contribute to the integrity of an SPA but which are not cited as species for which the site is designated. Ecologically sensitive species including the following: divers, common scoter, hen harrier, golden eagle, white-tailed eagle, curlew, red necked phalarope, roseate tern and chough. Species present in nationally important numbers (>1% of the Irish population)
Medium	The receptor has moderate capacity to absorb change without significantly altering its present character, has some environmental value, or is of regional importance. In an ornithological context (Percival, 2003) this includes: Species on Annex 1 of the EU Birds Directive. Species present in regionally important numbers (>1% regional (Donegal) population). Other species on the regional and/or national red list of Birds of Conservation Concern (Colhoun & Cummins, 2013)
Low	The receptor is tolerant of change without detriment to its character, is low environmental value, or local importance. In an ornithological context (Percival, 2003) this includes: Any other species of conservation interest, including species on regional and/or national amber list of Birds of Conservation Concern (Colhoun & Cummins, 2013)
Negligible	The receptor is resistant to change and is of little environmental value. In an ornithological context (Percival, 2003) this includes: Any other species of conservation interest, including species on regional and/or national green list of Birds of Conservation Concern (Colhoun & Cummins, 2013)

7.2.2.4 Magnitude of Effect

The magnitude of potential effects will be identified through consideration of the Development, the degree of change to baseline conditions predicted as a result of the Development, the duration, frequency and reversibility of an effect and professional judgement, best practice guidance and legislation.

The criteria for assessing the magnitude of an effect are presented in **Table 7.3**.

Table 7.3: Framework for Determining Magnitude of Effects

Magnitude of Effects	Definition
Very High	Total loss or very major alteration to key elements/ features of the baseline conditions such that the post development character/ composition/ attributes will be fundamentally changed and may be lost from the site altogether. Guide: < 20% of population / habitat remains
High	A fundamental change to the baseline condition of the asset, leading to total loss or major alteration of character. In an ornithological context (Percival, 2003) this includes: Major loss or major alteration to key elements/ features of the baseline (pre-development) conditions such that post development character/ composition/ attributes will be fundamentally changed. *Guide: 20-80% of population/ habitat lost*

Magnitude of Effects	Definition
Medium	A material, partial loss or alteration of character. In an ornithological context (Percival, 2003) this includes: Loss or alteration to one or more key elements/features of the baseline conditions such that post development character/composition/attributes of baseline will be partially changed. *Guide: 5-20% of population/ habitat lost*
Low	A slight, detectable, alteration of the baseline condition of the asset. In an ornithological context (Percival, 2003) this includes: Minor shift away from baseline conditions. Change arising from the loss/alteration will be discernible but underlying character/composition/attributes of baseline condition will be similar to pre-development circumstances/patterns. *Guide: 1-5% of population/ habitat lost*
Negligible	A barely distinguishable change from baseline conditions. In an ornithological context (Percival, 2003) this includes: Very slight change from baseline condition. Change barely distinguishable, approximating to the “no change” situation. *Guide: < 1% population/ habitat lost*

7.2.3 Significance of Effect

The sensitivity of the receptor and the magnitude of the predicted effects will be used as a guide, in addition to professional judgement, to predict the significance of the likely effects. **Table 7.4** summarises guideline criteria for assessing the significance of effects.

Table 7.4a: Framework for Assessment of the Significance of Effects (EIA Regs)

Magnitude of Effect	Sensitivity of Receptor				
	Very High	High	Medium	Low	Negligible
Very High	Major	Major	Major	Moderate	Moderate
High	Major	Major	Moderate	Moderate	Minor
Medium	Major	Moderate	Moderate	Minor	Negligible
Low	Moderate	Moderate	Minor	Negligible	Negligible
Negligible	Minor	Minor	Negligible	Negligible	Negligible

Table 7.4b: Framework for Assessment of the Significance of Effects (EPA)

Impact Magnitude	Definition
No change	No discernible change in the ecology of the affected feature
Imperceptible Effect	An effect capable of measurement but without significant consequences
Slight Effect	An effect which causes noticeable changes in the character of the environment without affecting its sensitivities
Moderate Effect	An effect that alters the character of the environment that is consistent with existing and emerging baseline trends
Significant Effect	An effect which, by its character, magnitude, duration or intensity significantly alters most of a sensitive aspect of the environment
Profound Effect	An effect which obliterates sensitive characteristics

Effects predicted to be of major or moderate significance are considered to be 'significant' in the context of the EIA Regulations, and are shaded in green in the above table.

7.2.4 Assessment Limitations

There were no significant limitations to the surveys, baseline data or constraints on the assessment. An extensive range of field surveys were undertaken during 2017 – 2019 with the Site Boundary and various associated and survey specific buffers (**Figure 7.1**). Some parts of the wider hinterland search areas within 2 km, 5 km, 10 km and 15 km (**Figure 7.3**; see **Technical Appendix 7.1** for descriptions) were not readily accessible but where possible these were observed from remote vantage point locations.

The Site Boundary was defined in 2019 revising the survey areas and the associated 500 m buffer was extended in 2019 (**Figure 7.7**) but these areas were within the 500 m and 800 m and 2 km Survey Areas of the survey area 2017 - 2019 and covered by the access track Survey Area (**Figures 7.46 – 7.60**) and therefore coverage was largely complete (**Figure 7.7**) for walkover surveys. The western part of the 500 m turbine buffer for Turbine 13 however extended marginally behind the 180 ° viewing arc of vantage point (VP 1). Some flights were readily detected there and no significant constraints are likely. The turbine location itself and rotor swept area were visible from that vantage point and there were not considered to be any significant constraints to species detection following the extension of the core survey area and since the 500 m turbine buffer of T13 has no proposed infrastructure.

7.3 Definition of Study Area

The ornithological Survey Area was digitally mapped in ArcGIS 10.5 and defined as the Site Boundary (hereafter Survey Area) buffered by 500 m (hereafter 500 m Survey Area) respectively for breeding and wintering bird surveys and vantage point surveys (**Figure 7.1**). This buffer was selected as research has shown the majority of wind turbine effects typically occur within 500 m (Pearce-Higgins *et al.,* 2009, McGuinness *et al.,* 2015; SNH, 2018; **Figure 7.1; Figure 7.2**). A 500 m buffer of the access track (Access Track Survey Area; **Figures 7.65 – 7.68**) was also utilised to assess the access track.

An 800 m buffer (hereafter 800 m Survey Area) defined the search area for curlew during breeding season surveys; as displacement effects on this species are considered up to 800 m (Pearce-Higgins *et al.,* 2009; **Figure 7.1**). The wider priority species survey area was defined as the 2 km buffer (hereafter 2 km Survey Area) to search for hen harrier and merlin nest locations and/or breeding territories or wintering locations of species considered vulnerable and/or priority species within Ireland or Northern Ireland (**Table 7.1**).

A wider search area up to 5 km (hereafter 5 km Survey Area) was utilised during priority species searches for eagles, swans and geese and hen harrier (**Figure 7.3**) and 10 km and 15 km (hereafter 10 km and 15 km Survey Areas respectively) were utilised during priority species searches for eagles, swans and geese and consideration of effects on designated sites.

Specific analysis and mapping of effects were conducted where necessary on the Operational Barnesmore Windfarm turbines and the Development turbines and associated 500 m and/or 800 m buffers.

7.3.1 Bird Surveys

The knowledge of the spatial and temporal occurrence of bird species within and surrounding the Site is essential to inform the likely effects of the Development. This Chapter is further supported by, and should be read in conjunction with **Technical Appendix 7.1, 7.2, 7.3** and the associated figures in **Volume III Figures.** The survey programme and assessment methods have been designed and reviewed throughout following regional and nationally recognised best practice guidance and published literature (**Section 7.1.3**). The methods utilised have four main aims:

- To provide baseline data on all extant ornithological features to establish the risk posed to birds due to the Development;
- To quantify the risk of collision with turbines to extant bird species flying through the Development area throughout the year;
- To identify locations of priority target species territories to establish risk posed due to Development; and
- To identify mitigation options and future monitoring needs, where required, upon assessment of disturbance and/or displacement and/or collision risk due to the Development

The key ornithological receptors are defined as species occurring within the zone of influence of the Development upon which likely significant effects are anticipated and assessed. The zone of influence for individual ornithological receptors refers to the area within which potential effects are anticipated and were assigned following best practice guidance and published literature.

The methodology for assessment followed a precautionary screening approach with regard to the identification of key ornithological receptors. Following a comprehensive desk study, initial site visits and consultation, a list of “Target species” likely to occur in the zone of influence for the Development was derived (**Table 7.1**). The target species list was derived from (i) SNH (2018a; b); (ii) Designated feature species of Special Protection Areas (SPA) within the zone of likely significant effects; (iii) Annex I of the Birds Directive; (iv) species protected under Schedule 4 of the Wildlife Acts 1976 – 2018; (v) species protected under Schedule 1 of the Northern Ireland Wildlife Order 1985 / WANE Act 2011; (vi) red and amber listed birds of Conservation Concern (Colhoun & Cummins, 2013; Eaton et al., 2014); and (vii) published and peer-reviewed scientific literature which identifies species or assemblage specific sensitivities or effects (e.g. Pearce-Higgins et al., 2009; 2012).

Following analysis of the collated bird survey data, it was possible to refine the list of target species to identify key ornithological receptors and associated sensitivities (see **Table 7.7**) and exclude species which were not recorded during the extensive surveys and those for which pathways for a potential significant effect could not be identified.

The survey scope of works has been designed utilising best practice guidance and scoping of the proposed survey works has been discussed and findings reviewed with NPWS (**Table 7.1**). The following field surveys were undertaken between 2017 and 2019:

- Breeding vantage point observation (March 2017 – August 2018) & (March 2018 – August 2018);
- Wintering vantage point observation (September 2017 – February 2018) & (September 2018 – March 2019);
- Spring migration vantage point observation (January 2018 – April 2018) & (January 2019 – April 2019);
- Autumn migration vantage point observation (September 2017 – November 2017) & (September 2018 – November 2018);
- Breeding walkover surveys (Brown & Shepherd + passerines) (March 2017 – July 2018 & March 2018 – July 2018); including;
- Prey species surveys (April 2017 - July 2018) & (April 2018 – July 2018);
- Woodland point counts (April 2017 – July 2017) & (April 2018 – July 2018);
- Wintering walkover surveys (September 2017 – February 2018) & (September 2018 – February 2019);
- Breeding priority species surveys (March 2017 – August 2018) & (March 2018 – August 2018); including
- Snipe surveys (May 2017) & (May 2018);
- Red grouse surveys (April 2017; August 2017) & (April 2018; August 2018);
- Wintering priority species surveys (September 2017 – February 2018) & (September 2018 – February 2019).

The surveys were undertaken by experienced field ornithologists. Full details of the survey methods, survey effort, and weather conditions are presented in **Technical Appendix 7.1** and a summary of key findings are recorded below:

7.3.1.1 Recorded Important and Protected Avian Species

- Desktop reviews were undertaken of published distributional data from a variety of published and specific requested data and designated sites in the area; three SPAs were recorded within 15 km from either operational or proposed turbines: Pettigoe Plateau SPA, Lough Derg SPA, Donegal Bay SPA and Lough Nillan Bog SPA.
- During vantage point surveys up to 18 target species were recorded which varied between years and some seasonal variation also recorded between breeding and wintering seasons. A similar range of target species were recorded during spring migration and autumn migration;
- Most frequently detected species from all vantage point surveys were raven, red grouse, golden plover, kestrel, snipe and cormorant although the detection frequency of all species varied by vantage point type, seasonally and between years, red-listed species recorded include curlew, golden eagle, golden plover, red grouse, white-tailed eagle and wigeon;
- The locations, flight paths and heights were recorded for target 1 species and utilised to inform CRM including for golden eagle, golden plover, peregrine falcon, white-tailed eagle flights recorded within the 500 m Survey Area during vantage point observations. Whooper swan were recorded within the turbine buffers but all flights were below collision risk heights;
- Additionally, secondary species were all mapped and buzzard, cormorant, heron and kestrel flights were mapped and reviewed in collision risk modelling.

- There were up to 38 species recorded during breeding walkover surveys within 500 m which varied between years of which four species were red-listed grey wagtail, golden plover, meadow pipit, red grouse and ring ouzel.
- There were a smaller number, up to 27 species, recorded during winter walkover surveys which varied between years of which five species were red-listed golden eagle, golden plover, meadow pipit, red grouse and white-tailed eagle;
- Priority species breeding locations confirmed that common sandpiper, kestrel, mallard, red grouse ring ouzel, and snipe were recorded within the 500 m Survey Area. In wider survey areas additional species curlew, golden plover, kestrel, merlin, peregrine, raven were all recorded breeding within the 2 km Survey Area.
- Between 2 km and 5 km buzzard, hen harrier and sparrowhawk were additionally recorded and up to 10 km additional species were recorded including cormorant, golden eagle, heron, herring gull, lesser black-backed gull, mute swan, red-throated diver, tufted duck, and whooper swan (non-breeding birds);
- A maximum of one curlew territory occurred within the 2 km Survey Area to the north of the Site but was beyond the 800 m disturbance zone from both the existing and proposed turbines with an additional territory identified more than 5 km away to the east;
- Golden plover were recorded also breeding to the north within 2 km Survey Area and an additional territory beyond the 5 km Survey Area;
- A pair of ring ouzel which occurred in both survey years including within 500 m of the Operational Barnesmore Windfarm, but the locations of the species changed between years;
- Nearest breeding hen harrier and merlin were recorded within the 5 km and 2 km Survey Areas respectively. Other successful breeding hen harrier and merlin locations were identified beyond the 2 km Survey Area to the west and south-west. Peregrine falcons were recorded within the 2 km Survey Area and successfully bred in both of the survey years.
- There were a number of red grouse and snipe recorded breeding in the Site and associated 500 m Survey Area, and the distribution and abundance of these varied between years of survey;
- Nearest breeding gulls and cormorants were recorded at Lough Eske, and Lough Derg with lesser black-backed gull and herring gull recorded at both of these waterbodies.
- Great northern diver were also recorded within the 10 km Survey Area on Lough Derg during the breeding season and Lough Eske over winter and off-shore (>20k km) at Donegal Bay. Red-throated diver were recorded at Pettigoe in one year of survey only and in Lough Eske (once) over the wintering season;
- Wintering priority species recorded within the 500 m Survey Area included cormorant, golden plover, red grouse, raven, ring ouzel, snipe and whooper swan;
- Wintering priority species were recorded more widely within the 2 km Survey Area included additional species Canada goose, golden eagle, kestrel and woodcock) whilst within the 5 km Survey Area including buzzard, heron, hen harrier, mallard, moorhen, mute swan, peregrine, sparrowhawk and white-tailed eagle were recorded
- Within the 10 km Survey Area other additional species occurred including common gull, coot, goosander, goldeneye, herring gull, lesser black-backed gull, little grebe, red-throated diver, teal, tufted duck, white-fronted goose and wigeon.
- Beyond the 10 km Survey Area a much more varied species range occurred particularly along Donegal Bay area which was examined. This included curlew, greater black-backed gull, light-bellied Brent geese, merlin, oystercatcher, redshank, sanderling and wigeon.
- A wide range of wintering, foraging and roosting areas were identified for swans and geese within 500 m to 15 km and beyond including within 500 m of the Operational Barnesmore Windfarm for whooper swan;
- The locations of breeding and/or wintering priority species frequently moved locations between survey years and there was considerable evidence of habituation to the Operational Barnesmore Windfarm including target species, golden plover, whooper swan, red grouse, snipe and common sandpiper and the distribution and abundance of these species too varied between years;
- Several goose species were recorded including light-bellied Brent goose, Canada goose, greylag goose, white-fronted goose and feral goose. There was some evidence of movements of geese along the Barnesmore Gap with both Canada goose and greylag detected moving through there. White-fronted goose were recorded at Pettigo, Lough Nillan and Lough Derg with between 3 – 15 birds recorded.
- Regularly occupied hen harrier winter roost areas were identified more than 2 km away from operational turbines but within the 5 km Survey Area and the maximum individual roost count was one bird and was used regularly each year over the winter survey period albeit at slight shifted locations. Several other suitable areas of roosting habitat occurred within the 2 km Survey Area but no hen harriers were observed and other roosts were identified approximately 5 – 10 km away from the Site Boundary and were recorded to have a maximum of one to two roosting harriers.

7.3.2 Annex I Bird Species

There were 10 Annex 1 species identified during bird surveys including golden plover, golden eagle, great northern diver, hen harrier, merlin, peregrine falcon, red-throated diver, white-fronted goose, white-tailed eagle and whooper swan.

Three of these species were listed on citation documents for SPAs within 15 km, namely golden plover; white-fronted goose and red-throated diver. Whooper swan are listed on the citation documents for Durnesh Lough SPA (but this is located nearly 20 km away from the Development and beyond connectivity distances for this species (5 km; SNH, 2016).

Table 7.5: Defining and screening Annex 1 key ornithological receptors and associated species sensitivity criteria and seasonal occurrence

Species	Sensitivity	Season	D	Direct effects	S	Secondary effects	D	Direct effects	S	Secondary effects	In / out
Golden plover	Medium	B/W	Yes	Breeding birds more than 1km away beyond disturbance distance but wintering birds within Development	Yes	Displacement may extend to 200 - 400 m for breeding birds. Wintering birds recorded within 200 m but appear habituated and utilising windfarm infrastructure including tracks and turbine bases	Yes	Flights recorded at collision height. Literature and on Site observation indicates habituation and low risk to collision	No	Displacement may extend to 200 - 400 m for breeding birds. Wintering birds appear habituated and utilising windfarm infrastructure including tracks and turbine bases	Yes
Golden eagle	High	B/W	No	More than >7 km away	Yes	Displacement from foraging range by disturbance	Yes	Flights recorded at collision height	Yes	Avoidance by 500 - 750 m; displacement from range by avoidance	Yes
Hen harrier	High	B/W	No	Breeding more than >1.5 km away; winter roost more than 4 km away	Yes	Displacement from foraging range by disturbance	No	No flights at collision risk height	Yes	Avoidance by 500 - 750 m; displacement from range by avoidance	Yes
White-tailed eagles	High	B/W	No	Non-breeding bird in area since returned to natal area	No	Widely ranging non-breeding bird. Unless established territory no likely effects	Yes	Flights recorded at collision height. Unless established territory no likely effects	No	Widely ranging non-breeding bird. Unless established territory no likely effects	Yes
White-fronted goose	High	W	No	More than 6 km away	No	No site usage recorded. Birds passing through on passage and/or wintering / foraging > 6km away	No	No flights recorded within 500 m	No	No risk of displacement since more than 6 km away. Avoidance distance is 600 m	No
Merlin	Medium	B/W	No	More than >1.5 km away	No	No site usage recorded. Birds passing through more than 500 m away	No	No flights at collision risk height or within 500 m	Yes	Displacement may extend to 200 - 400 m for breeding birds and none recorded within this distance band; Site within foraging range	Yes
Northern diver	Medium	B/W	No	More than 6 km away	No	No site usage recorded. Birds observed more than 6 km away. Disturbance may extend to 500 -750 m	No	No flights recorded within 500 m. No connectivity to identified sites	No	No site usage recorded. Birds observed more than 6 km away. Disturbance may extend to 500 - 750 m	No
Red-throated diver	Medium	B/W	No	More than 6 km away	No	No site usage recorded. Birds observed more than 6 km away	No	No flights recorded within 500 m. No connectivity to identified sites	No	No site usage recorded. Birds observed more than 6 km away. Disturbance may extend to 500 - 750 m	No
Peregrine	Medium	B/W	No	More than 1.5 km away	Yes	Displacement effects avoided by >500 - 750 m; disturbance within foraging range	Yes	Flights recorded at collision height	Yes	Avoidance by 500 - 750 m; displacement from range by avoidance	Yes
Whooper swan	Medium	W	Yes	Foraging, wintering and roosting within 560 - 600 m	Yes	Displacement may occur within 560 - 600 m; evidence of habituation on site to existing infrastructure	No	No flights at collision risk height	Yes	Disturbance may extend to 560 - 600 m; and some novel turbines may create barrier effect	Yes

Table 7.6: Population status of Annex 1 key ornithological receptors

Species	ROI (B)	ROI (W)	Donegal	Local (10km)	Local (2km)	Reference
Golden plover	150 (P)	80707 (I)	1395-3425	2 / 200-300	1 / 60	NPWS, 2012; iWebs 2018; Burke et al 2018; this study
Golden eagle	5-6 (P)	10-20 (I)	5-8	1	1	NPWS, 2012; IRSG; 2019; GET 2017; this study
Hen harrier	108-157 (P)	269-349 (I)	10-12	3-4	1-2	Ruddock et al 2016; NPWS 2012; this study
White-tailed eagles	10-12 (P)	20-24	10-12	0	0	NPWS, 2012; IRSG 2017; 2018 this study
White-fronted goose	-	9587	837-886	45-75	0	Fox et al., 2018; this study
Merlin	200-400 (P)	400-800 (I)	-	4	1-2	NPWS, 2012; Hardey et al., 2013; this study
Northern diver	-	1310	66-250	1-2	0	NPWS, 2012; this study
Red-throated diver	6-7 (P)	810	23-87	1	0	NPWS, 2012; Colhoun & Cummins 2013; this study
Peregrine	425 (P)	850 (I)	-	5-10	1-2	IRSG, 2017; this study
Whooper swan	<10 (P)	11586	499	c20 - 150	3-5	Crowe et al 2015; Colhoun & Cummins 2013; this study

7.3.2.1.1 Other Birds Identified as Key Ecological Receptors

Based on the red-listed species in Ireland (Colhoun & Cummins, 2013) and potential and/or published vulnerability to disturbance and/or displacement effects and/or proximity to the Development an additional suite of species was identified as potential ecological receptors. However, a number of these were screened out of formal assessment (**Table 7.7)** based on extant distances and/or likelihood of potentially significant effects.

Table 7.7: Defining and screening other key ornithological receptors and associated species sensitivity criteria and seasonal occurrence

Species	Sensitivity	Season	D	Direct effects	S	Secondary effects	D	Direct effects	S	Secondary effects	In / out
Curlew	High	B/W	No	More than >900 m away.	Yes	Displacement effects avoided by >620 - 800 m	No	No flights at collision risk height	Yes	Displacement avoided by >800 m	Yes
Red grouse	Medium	B/W	Yes	Within Development	Yes	May be displaced during construction in short-term	No	No flights at collision risk height	Yes	Displacement and territory modelling to be undertaken	Yes
Ring ouzel	Medium	B	No	More than 350 - 500m away	Yes	Breeding site not within Development and more than 350 - 500 m away but may be disturbed during construction	No	Not recorded during vantage point surveys and no flights at collision risk height during other surveys	No	Displacement not likely at this distance and proposed turbines are further away than existing turbines	Yes
Grey wagtail	Medium	B	Yes	Within development	Yes	Nesting in close proximity to existing infrastructure and tracks. Short-term displacement	No	No flights at collision risk height	No	Displacement may extend to 25 - 100 m	Yes

Species	Sensitivity	Season	D	Direct effects	S	Secondary effects	D	Direct effects	S	Secondary effects	In / out
						likely within 25 - 100 m					
Meadow pipit	Medium	B/W	Yes	Within development	Yes	Nesting in close proximity to existing infrastructure and tracks. Short-term displacement likely within 25 - 100 m	No	Not flight target species and flights not typically observed at collision risk height	Yes	Displacement may extend to 25 - 100 m	Yes
Goldeneye	Medium	B/W	No	More than 6 km away	No	No site usage recorded. Birds observed more than 6 km away.	No	No flights recorded within 500 m. No connectivity to identified sites	No	Displacement not likely at this distance	No
Herring gull	Medium	B/W	No	More than 5 km away	No	No site usage recorded. Birds observed more than 5 km away.	No	No flights recorded within 500 m. No connectivity to identified sites	No	Displacement not likely at this distance	No
Redshank	Medium	W	No	More than 14 km away	No	No site usage recorded. Birds observed more than 14 km away.	No	No flights recorded within 500 m. No connectivity to identified sites	No	Displacement not likely at this distance	No
Tufted duck	Medium	B/W	No	More than 6 km away	No	No site usage recorded. Birds observed more than 6 km away.	No	No flights recorded within 500 m. No connectivity to identified sites	No	Displacement not likely at this distance	No
Woodcock	Medium	W	No	More than 1.7 km away	No	No site usage recorded. Birds observed more than 6 km away.	No	No flights recorded within 500 m. No connectivity to identified sites	No	Displacement not likely at this distance	No
Wigeon	Medium	W	No	Recorded once on site; loafing on water and brief flight across lough	No	No significant site usage recorded	No	No flights at collision risk height	No	Displacement not since no regular occurrence on site	No
Cormorant	Low	B/W	Yes	Not nesting within the development but foraging within proximity to Development (lakes only)	Yes	Within Development (if lakes affected)	Yes	Flights recorded at collision height	No	No significant displacement effects considered likely but any long-term effects on water quality may influence foraging habitats	Yes
Common sandpiper	Low	B/W	Yes	Within Development		Nesting in close proximity to existing infrastructure and tracks. Short-term displacement likely within 25 - 100 m	No	No flights at collision risk height	No	Displacement may extend to 25 - 100 m; evidence of habituation to existing windfarm	Yes

Species	Sensitivity	Season	D	Direct effects	S	Secondary effects	D	Direct effects	S	Secondary effects	In / out
Heron	Low	B/W	Yes	Not nesting within the development but foraging within proximity to Development (lakes only)	Yes	Within Development (if lakes affected)	Yes	Flights recorded at collision height	No	No significant displacement effects considered likely but any long-term effects on water quality may influence foraging habitats	Yes
Kestrel	Low	B/W	No	More than 600 m away	Yes	May be displaced from foraging range during construction in short-term	Yes	Flights recorded at collision height	Yes	Displacement from foraging range; literature suggests no avoidance	Yes
Lesser black-backed gull	Low	B/W	No	More than 5 km away	No	No site usage recorded. Birds observed more than 5 km away.	No	No flights recorded within 500 m. No connectivity to identified sites		Displacement not likely at this distance	
Skylark	Low	B/W	Yes	Within Development	Yes	Nesting in close proximity to existing infrastructure and tracks. Short-term displacement likely within 25 - 100 m	No	Not target species and flights not typically observed at collision risk height	Yes	Displacement may extend to 25 - 100 m	Yes
Sparrowhawk	Low	B/W	No	Breeding more than 2 km away; wintering more than 3 km away	Yes	May be displaced from foraging range during construction in short-term	No	No flights at collision risk height	Yes	Site within foraging range	Yes
Snipe	Low	B/W	Yes	Within Development	Yes	Nesting in close proximity to existing infrastructure and tracks. Short-term displacement likely within 400m	No	No flights at collision risk height	Yes	Displacement and territory modelling to be undertaken	Yes
Buzzard	Low / negligible	B/W	No	More than 2.5 km away	Yes	May be displaced from foraging range during construction in short-term	No	No flights at collision risk height	Yes	Displacement by avoidance from foraging range	Yes
Raven	Low / negligible	B/W	No	More than 400 m away; winter roost >1km away	No	Evidence of habituation. May be displaced from foraging range during construction in short-term. No significant displacement effects considered likely	No	Evidence of avoidance behaviours and low sensitivity to turbines. CRM possible but not undertaken given low sensitivity of species and observed avoidance	No	Evidence of habituation. May be displaced from foraging range during construction in short-term. No significant displacement effects considered likely	No
BREEDING SMALL PASS RED (GL, MP)	Medium	B	Yes	Within Development	Yes	Nesting in close proximity to existing infrastructure and tracks. Short-term displacement likely within 25 - 100 m	No	Not flight target species and flights not typically observed at collision risk height	Yes	Displacement may extend to 25 - 100 m	Yes

Species	Sensitivity	Season	D	Direct effects	S	Secondary effects	D	Direct effects	S	Secondary effects	In / out
WINTERING SMALL PASS RED (MP)	Medium	W	Yes	Within Development	Yes	Wintering in close proximity to existing infrastructure and tracks. Short-term displacement likely within 25 - 100 m	No	Not flight target species and flights not typically observed at collision risk height	Yes	Displacement may extend to 25 - 100 m	Yes
BREEDING SMALL PASS AMBER (GC, GR, HM, LI, M., R., S., SC, SL, T. W.)	Low	B	Yes	Within Development	Yes	Nesting in close proximity to existing infrastructure and tracks. Short-term displacement likely within 25 - 100 m	No	Not flight target species and flights not typically observed at collision risk height	Yes	Displacement may extend to 25 - 100 m	Yes
WINTER SMALL PASS AMBER (GC, M., R., S., SC, SL)	Low	W	Yes	Within Development	Yes	Nesting in close proximity to existing infrastructure and tracks. Short-term displacement likely within 25 - 100 m	No	Not flight target species and flights not typically observed at collision risk height	Yes	Displacement may extend to 25 - 100 m	Yes
BREEDING SMALL PASS GREEN (B., BT, CH, CK, CT, HC, J., MA, SK, ST, WP, WR, WW)	Negligible	B	Yes	Within Development	Yes	Nesting in close proximity to existing infrastructure and tracks. Short-term displacement likely within 25 - 100 m	No	Not flight target species and flights not typically observed at collision risk height	Yes	Displacement may extend to 25 - 100 m	Yes
WINTERING SMALL PASS GREEN (BT, CH, FF, HC, JD, MA, RB, SB, ST, WR	Negligible	W	Yes	Within Development	Yes	Nesting in close proximity to existing infrastructure and tracks. Short-term displacement likely within 25 - 100 m	No	Not flight target species and flights not typically observed at collision risk height	Yes	Displacement may extend to 25 - 100 m	Yes

Table 7.8: Population status of other key ornithological receptors

Species	ROI (B)	ROI (W)	Donegal	Local (10km)	Local (2km)	Reference
Curlew	138 (P)	27830	8 / 1896-4395	1	1	NPWS, 2017; O'Donoghue et al 2017; iWebs 2018; this study
Red grouse	3800-4700 (I) (1708-2116 (P))	3800-4700	-	-	28-30	Cummins et al. 2010; NPWS, 2012; this study
Ring ouzel	14-24 (P)	14-24	-	-	1	NPWS, 2012; IRBBP, 2017; this study
Grey wagtail	53800-96150	-	-	-	1-3	Crowe et al., 2014; NPWS 2012; this study
Meadow pipit	1463310	-	-	-	556-884	Crowe et al., 2014; NPWS 2012; this study
Goldeneye	-	1940	137-319	-	0	NPWS, 2012; this study
Herring gull	2319	9734	420-2354	2-5 (P)	0	NPWS, 2012; this study
Redshank	500	19400	1890-3494	-	0	NPWS, 2012; this study
Tufted duck	606-808	20980	741-2241	-	0	NPWS, 2012; iWebs 2018; Burke et al 2018; this study
Woodcock	-	-	-	-	1	No information available; this study
Wigeon	-	56350	1454-4460	-	-	NPWS, 2012; iWebs 2018; Burke et al 2018; this study
Cormorant	4366	8720	148-803	-	1-3 (I)	NPWS, 2012; iWebs 2018; Burke et al 2018; this study
Common sandpiper	1848	-	2-4	5-10	3-4	NPWS, 2012; iWebs 2018; Burke et al 2018; this study
Heron	-	6080	72-187	16	2	NPWS, 2012; iWebs 2018; Burke et al 2018; this study
Kestrel	12100-21220	12100-21220	-	6-8	1-2	Crowe et al., 2014; NPWS 2012; this study
Lesser black-backed gull	2319	9734	61-196	6-7	0	NPWS, 2012; iWebs 2018; Burke et al 2018; this study
Skylark	218410-430880	218410-430880	-	-	26-129	Crowe et al., 2014; NPWS 2012; this study
Sparrowhawk	9100-14830	-	-	5-9	0	NPWS, 2012; this study
Snipe	4275	-	15-73	-	41-45	NPWS 2012; iWebs 2018; this study
Buzzard	1500	-	-	11-14	0	NPWS 2012; this study
Raven	38030-79940	-	-	5-12	2-4	Crowe et al., 2014; NPWS 2012; this study

7.3.3 General Bird Assemblage

Further analysis of the track and Survey Areas was undertaken (**Section 7.6.6.1; Figures 7.8 – 7.13; 7.27 – 7.32; 7.46 – 7.60**) to examine the composition and abundance of species likely to be directly and/or indirectly affected by the Development and compare these to the baseline (Operational Barnesmore Windfarm).

7.4 Site Description

The Site is an existing, operational windfarm which comprises 25 operational turbines (rated at 600kW each) which have been operational since 1997. The baseline includes the windfarm (turbine, tracks and control room) which is wholly owned by the windfarm operator (ScottishPower Renewables).

There is an extensive access track (circa 5-6 km) which runs west to east from the local road L-2595 including within the landownership to access the Site. The Operational Barnesmore Windfarm lands are comprised largely of open moorland (bog) habitat with a network of loughs and lakes and interspersed with drier hummocks and occasional rocky slopes and outcrops. The largest lough (Golagh) occurs centrally within the Site and is surrounded by turbines (**Figures 7.1 & 7.2**). Similar habitats occur within the 500m Survey Area which extends into Northern Ireland to the east and more extensive coniferous (largely Sitka spruce) forest plantation whereas to the west and north the buffer extends towards some more ridges, steep slopes, moorland and rock faces or outcrops towards the Barnesmore Gap.

Further moorland habitats and loughs occur within the landownership area alongside some evidence some mechanised peat (turf) extraction within the Barnesmore Bog NHA and evidence of historical drainage across several parts of the Site. There are overhead power-lines running through some parts of the Site and landownership areas and these appear to have brush-type bird perching diverters installed on the top cross-beams. Beyond the landownership more agriculturally improved and lowland habitats occur adjacent to the landownership on the southern and western side with some isolated coniferous blocks and strips to the west and north-west with larger crags and outcrops over Clogher Hill – Croaghmeen to the south. There are many more additional loughs within the wider landownership and associated 500m buffer including larger water-bodies at Lough Slug and Lough Atlieve.

7.5 The 'Do-Nothing' Impact

The baseline is the Operational Barnesmore Windfarm which has a planning consent that is not time limited therefore it can be expected to operate indefinitely, in a do nothing scenario it is likely that some of the environmental influences on site around peat extraction, under turbary rights, and areas being encroached by self-seeded conifers will continue.

7.6 Assessment of Potential Effects

7.6.1 Potential Effect Types

It is recognised that at a repowered Site that species may be habituated to existing turbines and infrastructure (SNH, 2014). Decommissioning and construction phase activities and operational activities presents three main risks to birds (Desholm, 2006; SNH, 2017); namely 1) direct mortality due to collision; (2) direct loss of breeding, wintering and/or foraging habitat, due to the footprint of Development; and 3) displacement of birds as a result of increased disturbance and/or loss of suitable habitat and barrier effects due to the avoidance of turbine arrays.

Displacement can occur in two ways i) displacement from breeding and/or wintering locations, and/or ii) displacement from foraging areas. These potential effects are not mutually exclusive and may interact with one another to increase or decrease the severity of the effect. For example, reduced occurrence of species caused by habitat loss may decrease collision risk (Pearce-Higgins et al., 2009). Similarly, the absence of avoidance response of specific species or individual birds may increase collision risk (Drewitt & Langston, 2006; McGuinness et al., 2015).

The initial decommissioning and construction phase will occur over a short temporal period (weeks – months) whilst the operational phase will occur over several years. Effects are most likely to arise where spatial and/or temporal interactions occur between nesting, foraging, wintering or roosting habitats and windfarm developments. The key considerations for birds and windfarms are direct mortality; direct or indirect effects of disturbance; loss or fragmentation of breeding, wintering or foraging habitats as well as barrier effects and such effects may be lower at a repowered Site particularly where habituation is evident.

7.6.3 Direct Mortality Effects

The mortality effects of windfarms on birds can be variable and may be affected by: season; topography; turbine metrics such as height, design and age; windfarm spatial arrangement; weather conditions; repowering; specific species' vulnerability or morphology; species' abundance and distribution; and the quality and quantity of surrounding habitats.

Poorly sited developments can result in extensive mortality e.g. Smóla (Norway). Site specific mortality may be elevated and may be additive or compensatory to other types of mortality such as persecution (e.g. shooting or poisoning), predation or other types of collisions (e.g. vehicles, towers, buildings, power-lines). However, population effects or dynamics may occur for poorly manoeuvrable, rare, long-lived, low productivity species and may have wider effects than at the site of the collision e.g. migrants.

The potential effects of repowering on mortality rates appears variable, since repowering (i.e. increasing the capacity) of older turbines may change the collision risk for birds (Stewart et al., 2007; Drewitt & Langston, 2008) but there may be no discrete relationship with turbine height and power output (MW) (Pearce-Higgins et al., 2009; 2012).

Collision risk and/or collisions are therefore a complex interaction between multiple species characteristics and occurrence, environmental, and wind turbine / windfarm factors (see Wilson et al., 2015). Windfarms may operate in combination with other mortality factors to exacerbate population declines, such as climate change effects, which may change over time given the increasing numbers of turbines nationally and globally in line with important renewable energy policy.

7.6.4 Potential Direct & Indirect Displacement Effects

Displacement from breeding, wintering or foraging areas can occur as a result of both direct and indirect effects at windfarms. This can occur through direct loss, perturbation or changes to habitats i.e. loss of nesting, foraging or roosting habitat or indirectly through behavioural avoidance due to disturbance (Langston & Pullan, 2003) and/or modification of the utility and quality of habitats (Arroyo et al., 2009). Indirect effects may also be due to behavioural avoidance by individual birds of turbines at or a wider 'barrier effect' at windfarm(s) level (de Lucas et al., 2004). This spatial avoidance may subsequently lead to localised population changes on abundance and/or distribution.

Displacement may not occur or its effects are negligible (Madders & Whitfield, 2006; Devereux et al., 2008; Douglas et al., 2011); it may have negative impacts (Pearce-Higgins et al., 2009); or effects may be complex interactions between site-specific and species-specific metrics (Drewitt & Langston, 2006; Pearce-Higgins et al., 2009; 2012; Garvin et al., 2011).

The direct habitat loss due to the footprint of the Development is a relatively small area of land with a wider behavioural effect likely at a greater distance through avoidance. Displacement is a spatial response i.e. avoidance of infrastructure by a specified distance (Whitfield et al., 2008) although this can be variable between species and individuals. Displacement exhibits considerable intra-specific variation and, where it occurs, may extend from 25 m to 1,000 m but that some species may not be affected (Douglas et al., 2011). Effects on some species may extend to a greater distance (see Ruddock & Whitfield, 2007; Whitfield et al., 2008).

Pearce-Higgins et al., (2009) found that there was no relationship with displacement and turbine size or power whilst Stewart et al., (2005) found that there does not seem to be an inter-relationship with abundance and turbine number. In this study only a weak relationship with power output was observed where lower (power) rated turbines had greater effects on bird abundance than higher rated turbines and that bird abundance was significantly affected by the life-span of the windfarm operation.

Some research indicates that some species may be affected (i.e. reduced occurrence and/or breeding density) up to 800 m away from turbines, tracks and/or windfarm infrastructure (Pearce-Higgins et al., 2009) with effects declining post-construction (Pearce-Higgins et al., 2012). There remains very little information on the long-term behavioural response of birds to windfarms (Stewart et al., 2007), although evidence is increasingly available (see Wilson et al., 2015; Fielding & Haworth, 2013; Sansom et al., 2016).

Some species may avoid windfarms between 100 m and 800 m and may be reduced in breeding density up to 500 m away from turbines (Pearce-Higgins et al., 2009) whilst other species are not significantly affected (Pearce-Higgins et al., 2009; Douglas et al., 2011; Pearce-Higgins et al., 2012) and foraging activity may be reduced within windfarms (Pearce-Higgins et al., 2009). Pearce-Higgins et al., (2012), found continued apparent negative impacts on waders, but re-iterated few impacts on red grouse and some species actually increased post- construction.

Displacement may affect breeding success in raptors (Bright et al., 2008; Carrete et al., 2009; Dahl et al., 2012) although several studies show no detectable effects (see Wilson et al., 2015). There is mixed evidence of habituation, with some reviews (Stewart et al., 2005) suggesting that effects will persist throughout the operational period. Others suggest this may vary between species (Marques et al., 2014) but few studies have demonstrated this empirically (see Madsen & Boertmann, 2008). Further research on habituation responses is desirable.

7.6.5 Potential Direct & Indirect Disturbance & Construction Effects

Perturbation caused by wind energy developments are primarily attributed to the construction phase (Garvin et al., 2011; Pearce-Higgins et al., 2012; Stevens et al., 2013; see **Chapter 2**) although some species (particularly seabirds, waders and raptors) may be impacted in the long-term (Nygard et al., 2010) with potential population effects. Other studies show that there are no detectable population level impacts (Devereaux et al., 2008; Pearce-Higgins et al., 2009; Fielding & Haworth, 2010; Douglas et al., 2011) although some species may be vulnerable to longer-term effects than others (Pearce-Higgins et al., 2012). The Operational Barnesmore Windfarm was constructed over 20 years ago and species may be habituated to the existing infrastructure and may have re-occupied areas the original construction although no detailed survey data is available for the Site. Novel construction activity may occur during the Development and may have disturbance effects for a temporary time period.

Disturbance is a key factor which can affect bird behaviour, physiology and spatial distribution (Ruddock & Whitfield, 2007; Tarjuelo et al., 2015). The distance at which a species responds (e.g. by flushing) indicates the sensitivity of the species to disturbance (Fernandez-Juricic et al., 2003). Spatial buffers and/or temporal cessation of works are usually prescribed to protect birds from disturbance (Rodgers & Schwikert, 2003).

For larger species the flushing distances and set-back distances are usually greater to protect them from human disturbance (Arroyo et al., 2006; Martinez-Abrain et al., 2010) but can be variable between species and individuals (Ruddock & Whitfield, 2007). Typically, smaller species will be affected by activities within 25 – 100 m indirectly (Ruddock & Whitfield, 2007) and/or directly by any associated footprint of actual land-take or removal of vegetation during decommissioning / construction activities. Pearce-Higgins et al. (2012) indicates that most breeding bird populations recover post-construction excluding large waders specifically snipe and curlew.

An important consideration when assessing the potential effects of the decommissioning/construction phases of the Development is the spatial extent of activities at any one time. All activities would not take place simultaneously over the whole Site. Rather they would be more restricted to smaller areas of activity at any particular time. Since suitable habitat typically exists nearby the effects of short-term displacement will be minimised as birds are able to move away from the source of the disturbance during decommissioning/construction activity. Additionally, some impacts are known to decline after these phases and therefore only temporary for some species (Pearce-Higgins et al., 2012).

7.6.6 Potential Ancillary Effects

Other windfarm infrastructure such roads and powerlines may cause effects for birds (Drewitt & Langston, 2008). This includes the facilitation of access to previously inaccessible areas via windfarm roads and tracks which may be used by recreational personnel and vehicles such as scramblers or motorbikes or turf extraction (see Ruddock et al., 2016) and access management is key to reducing any likely disturbance. There are a variety of users observed accessing the Site during baseline surveys.

Roads may increase fragmentation of habitats but may attract some species, e.g. novel linear features which harriers may utilise for foraging or snipe for feeding. Power-lines and any associated vegetation clearance may create fragmentation or barriers to movement (avoidance) and/or collision risks. Overhead power-lines and associated infrastructure (i.e. pylons or poles) may also act as perching locations for some species including nest predators such as corvids but can also cause electrocution. At the Operational Barnesmore Windfarm there are existing roads and power-lines to which birds may already be habituated

The main predicted effects during the operational phase on birds are from disturbance during maintenance operations which will be largely unchanged from baseline (**Chapter 2**), the avoidance and barrier effect of the turbines (i.e. causing displacement of flight activity; Drewitt & Langston, 2008 Masden et al., 2009) and direct mortality through collision. Therefore, all identified receptor species have been considered further in this Chapter for potential decommissioning/construction and/or operational effects.

7.6.7 Potential Effects on Bird Assemblage

7.6.7.1 Potential Effects on Breeding Bird Assemblage

To quantify potential direct differences of effects both the Operational Barnesmore Windfarm (baseline) and the Development layout i.e. footprint of turbines (including rotor swept area) and access roads were mapped in ArcGIS 10.5 and buffered by 25 m (Turbine and Infrastructure Buffer). This footprint was super-imposed upon the aggregated breeding bird locations to establish which species were co-incident with the Development and might therefore be directly affected. This analysis was also undertaken on the extant priority species locations to identify territories at risk of displacement for all years of survey (**Figure 7.46 – 7.60; 7.65 – 7.68**). Published literature was reviewed to establish which of the species recorded within 500 m may be vulnerable to displacement (**Figures 7.7 – 7.12; 7.20 – 7.22; 7.27 – 7.31; 7.46 – 7.58; Table 7.9**). There were up to 13 species recorded which varied between years and only two of which were red-listed (Colhoun & Cummins, 2013); meadow pipit and red grouse. Within the wider 500 m turbine buffers there were two additional red-listed species detected; grey wagtail, ring ouzel and golden plover which varied between years (**Figures 7.46 – 7.58**).

Table 7.9: Summary of breeding bird species within the existing and/or proposed Turbine and Infrastructure Buffer in 2017 and 2018

Species	2017EXISTING	2017PROPOSED	2018EXISTING	2018PROPOSED	Total
Cormorant	1	1			2
Common sandpiper			1	1	2
House martin			1	1	2

Species	2017EXISTING	2017PROPOSED	2018EXISTING	2018PROPOSED	Total
Meadow pipit	38	55	21	29	143
Red grouse	1	1			2
Raven	2	2			4
Skylark	3	6	1	2	12
Stonechat			1	1	2
Swallow		1			1
Snipe	1	1	2	2	6
Wheatear	1	1		1	3
Wren	1	1			2
Willow warbler				1	1
Total	48	69	27	38	182

Since the Development largely utilises the existing infrastructure, there is only a small difference in the predicted displacement or disturbance and territories between the existing and proposed Turbine and Infrastructure Buffers. Therefore, a marginally greater effect could arise due to the Development.

The Development may only directly affect a smaller sub-set of species and individuals, notably potential displacement or reduction in density of meadow pipits between eight (1.4%) and 17 (2%) territories and smaller numbers of other passerine species including skylark between 1 (3.8%) – 3 (2.3%) (**Technical Appendix 7.1**; see Pearce-Higgins et al., 2009) which produced similar differences in displacement estimates for meadow pipits (8 – 15) and may be variable between years (**Tables 7.9 & 7.10**).

Table 7.10 Predicted displacement of species (Pearce-Higgins et al., 2009) from within the 500 m buffer of existing and Development infrastructure for data 2017 – 2019.[1]

Year / Site	Species	Average % reduction (range)	Number (n) within 500 m	Average remaining (n)	Maximum remaining (n)	Minimum remaining (n)	Ave. loss (n)	Min loss (n)	Max. loss (n)
2017 Existing	Snipe	47.5 (8.1-67.7)	19 (1)	10.5	18.4	6.46	9.50	1.62	13.54
2017 Existing	Curlew	42.4 (3.4-72.8)	0	0.0	0.0	0.00	0.00	0.00	0.00
2017 Existing	Meadow pipit	14.7 (2.7-25.1)	484	412.9	470.9	362.52	71.15	13.07	121.48
2017 Existing	Wheatear	44.4 (4.9-65.2)	5	2.8	4.8	1.74	2.22	0.25	3.26
2017 Proposed	Snipe	47.5 (8.1-67.7)	23 (1)	12.6	22.1	7.75	11.40	1.94	16.25
2017 Proposed	Curlew	42.4 (3.4-72.8)	0	0.0	0.0	0.00	0.00	0.00	0.00
2017 Proposed	Meadow pipit	14.7 (2.7-25.1)	545	464.9	530.3	408.21	80.12	14.72	136.80
2017 Proposed	Wheatear	44.4 (4.9-65.2)	4	2.2	3.8	1.39	1.78	0.20	2.61

[1] Footnote to Table 7.10; n = number of territories; the displacement calculations are utilised to establish the average, minimum and maximum displacement values which provide an average, maximum and minimum remaining number of territories

Year / Site	Species	Average % reduction (range)	Number (n) within 500 m	Average remaining (n)	Maximum remaining (n)	Minimum remaining (n)	Ave. loss (n)	Min loss (n)	Max. loss (n)
2018 Existing	Snipe	47.5 (8.1-67.7)	28	14.7	25.7	9.04	13.30	2.27	18.96
2018 Existing	Curlew	42.4 (3.4-72.8)	0	0.0	0.0	0.00	0.00	0.00	0.00
2018 Existing	Meadow pipit	14.7 (2.7-25.1)	339	289.2	329.8	253.91	49.83	9.15	85.09
2018 Existing	Wheatear	44.4 (4.9-65.2)	1	0.6	1.0	0.35	0.44	0.05	0.65
2018 Proposed	Snipe	47.5 (8.1-67.7)	31	16.3	28.5	10.01	14.73	2.51	20.99
2018 Proposed	Curlew	42.4 (3.4-72.8)	0	0.0	0.0	0.00	0.00	0.00	0.00
2018 Proposed	Meadow pipit	14.7 (2.7-25.1)	371	316.5	361.0	277.88	54.54	10.02	93.12
2018 Proposed	Wheatear	44.4 (4.9-65.2)	1	0.6	1.0	0.35	0.44	0.05	0.65

For several of these species there is a negligible difference in the number of territories recorded between the existing and proposed infrastructure and therefore no significant effects are predicted. Differences, where they do occur, relate to a very small number of territory locations (typically 1-2 of extant species).

Modelling displacement within 500 m for meadow pipit (Pearce-Higgins et al., 2009) reveals that within years there was a localised low-medium magnitude of effect (1-5%) of difference between the maximum predicted displacements for existing (baseline) turbines compared to proposed turbines. Curlew, whilst modelled, were excluded from effects since no displacement could occur within 500 m.

The majority of key target breeding species (**Technical Appendix 7.1; Table 7.1**) which occurred within the vicinity and wider hinterland of the Development are avoided by appropriate buffers (**Figure 7.49 – 7.53**). Only one raptor, kestrel ccurred within 750 m (circa 650 m) of either the existing or the proposed turbines and infrastructure in one year only. Five species are recorded within 500 m of turbines, common sandpiper, mallard, red grouse, ring ouzel and snipe (**Table 7.11**). Curlew and golden eagle in particular are recorded closer to the existing turbines than the Development turbines in all years of survey (**Figures 7.54 – 7.58; 7.65 – 7.68**).

Table 7.11 Minimum distance of breeding priority species to nearest existing and/or proposed turbine

BTO	2017 Existing (m)	2017 Proposed (m)	Difference (m)	2018 Existing (m)	2018 Proposed (m)	Difference (m)
Buzzard	2868.0	2884.2	16.2	2510.7	2516.9	6.2
Cormorant				5491.4	5499.6	8.2
Common gull				13446.6	12730.7	-715.9
Common sandpiper	187.6	99.6	-88.0	51.3	22.2	-29.1
Curlew	989.6	991.1	1.5	1139.0	1141.0	2.0

BTO	2017 Existing (m)	2017 Proposed (m)	Difference (m)	2018 Existing (m)	2018 Proposed (m)	Difference (m)
Golden Eagle	7312.2	7513.7	201.5	7994.1	8169.4	175.4
Greater black-backed gull				8332.7	8088.4	-244.3
Goldeneye				6995.1	6908.1	-86.9
Golden plover	1032.5	1036.9	4.4	1461.2	1504.9	43.7
Heron				6049.1	6065.1	16.0
Herring gull	8546.2	8300.0	-246.1	5686.0	5499.4	-186.6
Hen harrier	2329.7	2333.5	3.9	2482.0	2487.0	5.0
Kestrel	646.2	665.4	19.2	1384.1	1462.1	78.0
Lesser black-backed gull	5975.8	5917.1	-58.7	6202.3	6128.1	-74.2
Mallard	501.0	385.6	-115.4	75.8	243.6	167.8
Merlin	1787.9	1795.6	7.7	3681.7	3693.7	12.0
Mute swan				6603.1	6605.9	2.8
Oystercatcher				15486.3	14718.4	-767.9
Light-bellied brent goose				20330.3	19445.7	-884.6
Peregrine	1736.5	1802.2	65.8	1736.5	1802.2	65.8
Red-throated diver	7623.6	6762.5	-861.1			0.0
Red grouse	56.2	137.9	81.7	60.5	83.6	23.1
Redshank				14288.2	13461.2	-827.0
Raven	1456.8	1204.0	-252.8	890.8	909.6	18.8
Ring ouzel	631.1	590.0	-41.1	364.9	366.9	2.1
Sparrowhawk	3981.5	3229.7	-751.8	2099.2	2347.4	248.2
Snipe	31.2	29.6	-1.6	60.7	73.9	13.3
Sanderling				20242.9	19350.6	-892.3
Tufted duck				5176.1	5063.9	-112.3
Whooper swan				5202.7	5173.3	-29.4

Snipe and red grouse territories occur within the existing Site, and both species were recorded to fledge young within the Operational Barnesmore Windfarm during surveys. Snipe occurred closest at 31 m – 61 m and away from existing turbines and between 30 m and 74 m from Development turbine locations. For all snipe recorded in most years of survey, the Development turbines are located, on average, closer (circa 37 m) to snipe territories than the existing turbines (**Table 7.11**). For snipe which occurred within the 500 m turbine buffers, the distances these were located away from turbines are similar on average, for the proposed turbines (222.2 m) to existing turbines (217.3 m, **Table 7.11**) i.e. average set-back (avoidance) distances is largely unchanged for snipe within 500 m of the proposed turbines.

Table 7.12 Distances (m) of snipe recorded in each year of survey to nearest existing and proposed turbines

Year	Existing turbines (all SN)	Existing turbines (SN within 500 m)	Proposed turbines (all SN)	Proposed turbines (SN within 500 m)
2017	1150.6 (35)	186.1 (19)	1162.6 (35)	226.2 (23)
2018	935.8 (45)	238.5 (28)	871.9 (45)	219.3 (31)
Average	1029.8 (80)	217.3 (47)	992.2 (80)	222.2 (54)

Modelling of displacement (Pearce-Higgins et al., 2009) for snipe (**Table 7.10**) finds that a difference in maximum displacement predictions between existing and proposed varied between years of 2017; 2.7 pairs; 2018: 2.0 pairs. Therefore, the potential displacement (effectively 2 to 3 pairs) or disturbance risks or effects that may arise due to the Development to snipe when compared to the baseline comprising the existing turbines and infrastructure. Snipe are shown to be habituated in the area but effects can be minimised subject to avoidance of disturbance factors during construction, and the implementation of habitat management.

The absence of curlew territories within 500 m indicates that no curlew will be displaced or reduced in density (Pearce-Higgins et al., 2009). Existing turbines (989 m - 1139 m) and/or proposed turbines (991 m – 1441 m) are all located more than 1 km from the nearest curlew territories in some years. Pearce-Higgins et al., (2009) provides a second displacement model for curlew within 1 km which estimates that 0.03 to 0.7 curlew may be displaced for both existing and/or proposed turbines. There is no difference between displacement predictions for either existing or proposed turbines, and no differential density reduction or displacement could occur (Pearce-Higgins et al., 2009; Whitfield et al., 2010). Therefore no significant displacement or disturbance risks, or effects predicted to arise to breeding curlew and the Development footprint lies out with the 800 m buffer for avoidance of any disturbance and/or displacement effects.

Most vulnerable to displacement or disturbance are the ground-nesting species, e.g., meadow pipit, skylark, red grouse, snipe, stonechat, wheatear and wren (**Figures 7.46 – 7.58**) but the distribution and abundance of these species varies between years (see also **Figures 7.46 – 7.58**). Less vulnerable to direct impacts are species including swallow, house martin and willow warbler are since they are more liable to be nesting in buildings, man-made structures and/or trees and/or hedgerows or scrub and often along vegetated edges associated with the existing tracks and infrastructure (**Figure 7.41 – 7.48**).

These locations can readily be protected from direct impacts during the initial decommissioning and construction phase by the protection of key breeding habitats and temporal restrictions on construction periods within the vicinity of such nests (**Section 7.9**). Several of the species territories recorded are associated with the lower altitude improved agricultural habitat mosaics near the Site entrance and existing hedgerows along roads, field margins and around buildings, all of which will be retained and/or reinstated (**Section 7.9; Technical Appendix 3.2**).

Most small passerines were recorded in grass / moorland pasture which contains meadow pipit and skylark and unusually some more common tree nesting species (such as chaffinch; hooded crow) were occasionally recorded out on the moorland areas, within areas of extant plantation and/or invasive, self-seeded conifers within the Site with an apparent reduced occurrence (displacement) of priority species such as meadow pipit and skylark, as self-seeded conifers are recorded along the eastern edge (see **Figure 7.46**).

7.6.7.2 Potential Effects on Wintering Bird Assemblage

The same analysis was completed on aggregated wintering bird species locations as outlined in **Section 7.6.6.1** and mapped for wintering bird survey data (**Figures 7.55, 7.57. 7.59; 7.60**).

During the winter few species are constrained to spatial locations and as such are much less vulnerable to displacement or disturbance than during the nesting season as they can readily move to alternative habitats. Red-listed species (Colhoun & Cummins, 2013) detected in the wider 500 m turbine buffers include golden plover, meadow pipit and red grouse. There were up to eight wintering bird species found within the existing and/or proposed Turbine and Infrastructure Buffers which varied between years (**Table 7.13; Figures 7.59 & 7.60**).

Table 7.13: Summary of wintering bird species within the existing and/or proposed Turbine and Infrastructure Buffers

Species	2017EXISTING	2017PROPOSED	2018EXISTING	2018PROPOSED	Total
Golden plover			1	1	2
Hooded crow				1	1
Meadow pipit	2	2	4	4	12
Red grouse	2	2	1	2	7
Snow bunting	2	2			4
Stonechat	1	1			2
Snipe	2	2	2	2	8
Wren	1	1			2

Species	2017EXISTING	2017PROPOSED	2018EXISTING	2018PROPOSED	Total
Total	10	10	8	10	

There were six target priority species during the winter namely cormorant, golden plover, raven, red grouse, ring ouzel, snipe and whooper swan recorded within the 500 m of existing turbines (**Figures 7.55, 7.57. 7.59; 7.60**). Small numbers of golden plover (up to circa 50 – 60 birds) were located in flight, foraging and roosting within the Site throughout the wintering season including in and around existing turbines. These birds were also frequently recorded roosting and foraging on the ground immediately adjacent to, and within the Operational Barnesmore Windfarm infrastructure, including at the edge and in the middle of existing windfarm tracks. Snipe were often located along existing ditches and drainage channels, and edges of existing windfarm tracks and hard-standing areas (**Figures 7.59 & 7.60**).

Research indicates a variable response of (breeding) golden plover (Sansom et al., 2016; Douglas et al., 2011) to windfarms. Red grouse and raven were recorded widely in the surveys and a whooper swan family group comprised of three to four birds (see **Section 7.6.7.9**) were regularly recorded roosting on loughs within and adjacent to the Operational Barnesmore Windfarm whilst cormorants were observed fishing on a number of the lakes and also both these species known to be commuting to / from the Site.

The footprint of decommissioning and construction therefore will only theoretically directly affect a sub-set of species and individuals. The locations can readily be protected from direct impacts during the decommissioning and construction phases by the protection of key habitats. Several of the species recorded are observed to be habituated to the Operational Barnesmore Windfarm and therefore long-term effects on these species are unlikely, whilst those in open habitats can readily relocate to alternative adjacent areas during the winter and species occurred at a range of distances from existing and proposed turbines which varied between years (**Table 7.14**).

Table 7.14 Minimum distance of wintering priority species to nearest existing and/or proposed turbine.

BTO	2017 Existing	2017 Proposed	Difference (m)	2018 Existing	2018 Proposed	Difference (m)
Brent goose				15731.6	14968.7	-762.9
Buzzard	3330.7	3343.0	12.2	3636.7	3645.3	8.7
Cormorant	5043.2	5039.8	-3.5	61.6	275.9	214.2
Canada goose	1783.7	1843.3	59.6	5678.7	5686.7	7.9
Common gull	13273.4	12545.6	-727.7	5129.1	5143.4	14.3
Coot	6401.7	6454.8	53.1			0.0
Curlew	15194.6	14407.0	-787.6	13446.4	12737.2	-709.2
Golden eagle	728.9	909.1	180.2	1488.7	1542.2	53.5
Greater black-backed gull	12987.9	12283.4	-704.5	13448.7	12601.0	-847.6
Goosander	6763.4	6627.0	-136.4	10031.9	9586.2	-445.7
Goldeneye	6390.1	5830.9	-559.2	6505.7	6632.6	126.9
Golden plover	667.2	710.9	43.7	120.2	552.7	432.5
Heron	2045.8	2041.8	-4.0	4740.9	3700.7	-1040.3

BTO	2017 Existing	2017 Proposed	Difference (m)	2018 Existing	2018 Proposed	Difference (m)
Herring gull	13005.7	12248.4	-757.3	8567.5	8128.4	-439.1
Hen harrier	4867.7	4873.9	6.2	5484.4	5491.6	7.2
Kestrel	3306.9	3344.5	37.6	1194.7	1328.4	133.7
Lesser black-backed gull	7366.3	7197.7	-168.6	5867.9	5811.5	-56.3
Little grebe			0.0	6349.0	6403.2	54.2
Mallard	3139.9	3105.6	-34.2	4786.8	3740.9	-1045.9
Moorhen	3834.2	3189.8	-644.5	4629.3	3983.9	-645.5
Merlin			0.0	12936.8	13097.9	161.1
Mute swan	4617.0	4631.5	14.5	5440.7	5462.5	21.8
Northern diver	6512.5	6514.6	2.1			0.0
Oystercatcher			0.0	15116.6	14392.2	-724.4
Light bellied brent goose	18864.8	17980.1	-884.7	14594.9	13849.1	-745.8
Peregrine			0.0	2259.7	2476.2	216.5
Red-throated diver	5998.4	6038.3	39.8	5998.4	6038.3	39.8
Red grouse	85.1	94.4	9.3	33.8	39.0	5.2
Redshank			0.0	14412.5	13578.3	-834.2
Raven	475.2	469.1	-6.1	844.4	114.1	-730.3
Ring ouzel			0.0	377.7	327.2	-50.4
Sparrowhawk	3262.3	2979.7	-282.6	3501.9	3515.1	13.1
Snipe	69.0	81.6	12.6	79.5	21.5	-57.9
Sanderling	16487.7	15719.5	-768.2	20549.9	19673.8	-876.1
Teal	5835.2	5695.9	-139.3	15021.0	14263.4	-757.6
Tufted duck	6407.0	6473.9	66.9	7061.8	7001.6	-60.2
White-tailed eagle	2342.7	2357.2	14.5	3514.7	2876.7	-638.0

BTO	2017 Existing	2017 Proposed	Difference (m)	2018 Existing	2018 Proposed	Difference (m)
White-fronted goose	7106.2	6317.4	-788.8	8529.5	7830.5	-699.0
Woodcock			0.0	1731.3	1745.5	14.2
Wigeon	6105.4	6113.5	8.1	6293.9	6303.5	9.6
Whooper swan	335.2	348.9	13.7	335.2	362.2	27.0
Hybrid / Feral goose	10080.1	10098.6	18.5	10269.9	10288.6	18.7
Total	69.0	81.6	12.6	33.8	21.5	-12.3

7.6.7.3 Potential Effects of Collision on Bird Assemblage

There was a maximum of 18 target species detected flying within the 500 m Survey Area during the breeding and/or wintering seasons, buzzard, cormorant, curlew, common sandpiper, golden eagle, golden plover, heron, kestrel, mallard, peregrine, red grouse, raven, sparrowhawk, snipe, teal, white-tailed eagle, wigeon, and whooper swan although the detection rates and occurrence varied between years. Some of the detected species were recorded breeding and/or wintering within 500 m of turbines or the wider hinterland of turbines and may therefore have a pathway to collision risk.

The key risk species for collision are identified for primary target species as the golden eagle, golden plover, peregrine, white-tailed eagle however, this risk varies spatially as well as temporally, i.e., between years and seasons (**Section 7.6.4; Technical Appendix 7.1; 7.3**). Whilst reviewing secondary species further information on the spatial occurrence (see **Figures 7.14 – 7.16 & 7.33 – 7.35**) and collision risk for secondary species buzzard, cormorant, heron and kestrel are provided to examine risks for these species.

7.6.7.4 Collision Risk Modelling (CRM)

The following section sets out collision models (SNH, 2014) and assessment findings for each bird receptor and concludes that the Development presents no significant risk of collision to ornithological receptors. There are no documented collisions recorded at the Operational Barnesmore windfarm, from weekly monitoring by operational staff, recording and reporting protocol operated by SPR since 2010). When considering the operational phase of the Development, an illustrative 30-year period has been used when considering the magnitude of collision estimates.

There were eight species which were recorded within the turbine 500 m buffers and at collision risk height namely, buzzard, cormorant, golden eagle, golden plover, heron, kestrel, peregrine and white-tailed eagle in at least one of the survey years. The individual (per) turbine collision risk estimates (Band et al., 2007) for all these species were <u>lower</u> for proposed turbine for all species (**Technical Appendix 7.3**; 2% to 7.1% lower risk; **Table 7.15**) compared to existing turbines and confirms that the reduction from 25 higher risk turbines to 13 lower risk turbines is a potential betterment (positive) effect of the repowering project in terms of collision risks for all species detected at collision risk height but collision risk at windfarm level varies between years and species (**Tables 7.16 & 7.17**).

Table 7.15 Summary of collision risk for risk species between existing and proposed turbine models

Species	Existing			Proposed			Change		
	Upwind %	Downwind %	Average %	Upwind %	Downwind %	Average %	Upwind change	Downwind change	Average change
Buzzard	14.4	8.3	11.3	10.13	4.76	7.45	-4.2	-3.5	-3.9
Cormorant	15.0	9.8	12.4	9.62	4.71	7.16	-5.4	-5.1	-5.2
Golden eagle	16.1	10.4	13.3	10.39	5.23	7.81	-5.7	-5.2	-5.5

Species	Existing			Proposed			Change		
	Upwind %	Downwind %	Average %	Upwind %	Downwind %	Average %	Upwind change	Downwind change	Average change
Golden plover	9.5	4.4	6.9	7.38	2.53	4.95	-2.1	-1.8	-2.0
Heron	20.2	14.0	17.1	12.71	7.23	9.97	-7.5	-6.7	-7.1
Kestrel	12.7	6.4	9.5	9.71	4.23	6.97	-3.0	-2.1	-2.6
Peregrine	12.4	6.5	9.5	9.13	3.86	6.50	-3.3	-2.7	-3.0
White-tailed eagle	18.7	12.4	15.5	12.04	6.57	9.30	-6.7	-5.8	-6.2

7.6.7.5 Collision Risk Modelling for Target Species

Information presented here was extracted and analysed for a number of primary target species which were observed to either utilise the Site and occurred within 500 m of turbines and occurred within collision risk height, namely golden eagle, golden plover, peregrine falcon and white-tailed eagle. It is also noted that all of the other primary species detected including whooper swan, curlew (and hen harrier) were all observed flying <20 m a.g.l. and/or were recorded beyond the 500 m turbine buffers and therefore there is no associated collision risk for these species and no further collision risk modelling was conducted on these species.

Information presented here was extracted and analysed for a number of secondary species which were observed to either regularly utilise the Site and occurred within 500 m of turbines and occurred within collision risk height, namely buzzard, cormorant, heron and kestrel. It is also noted that all of the other secondary species detected including mallard, red grouse, snipe, common sandpiper, sparrowhawk, teal and wigeon were either flying <20 m a.g.l. (Technical Appendix 7.1; 7.3) and therefore there is no associated collision risk for these species and no further collision risk modelling was conducted on these species.

Collision risk for primary target species varied between species and between years (**Table 7.16 & 7.17**) and further details are provided in **Technical Appendix 7.1 & 7.3**. There have been no collisions recorded for any species at the Operational Barnesmore Windfarm since monitoring protocol was implemented in 2010 and collision risk modelling predicts that the Development will reduce collision risk for all species modelled per turbine, it is concluded that the Development presents no significant effect in relation to collision risk.

Table 7.16 Summary of collision risk for 2017 – 2018 between existing and proposed turbines.

Species	Existing (one bird every)	Proposed (one bird every)	
Buzzard	NA	NA	years
Cormorant	47.3	50.6	years
Golden eagle	406.3	270.6	years
Golden plover	34.8 (84.2)*[2]	20.6 (49.9)*	years
Heron	NA	NA	years
Kestrel	10.0	7.2	years
Peregrine	345.7	314.2	years
White-tailed eagle	18.8	17.8	years

[2] * Indicates the collision risk estimate for models on wintering season only presence of golden plover

Table 7.17 Summary of collision risk for 2018 – 2019 between existing and proposed turbines.

Species	Existing (one bird every)	Proposed (one bird every)	
Buzzard	73.1	69.4	years
Cormorant	122.7	131.4	years
Golden eagle	NA	NA	years
Golden plover	19.3 (42.2)*	13.8 (30.2)*	years
Heron	129.0	137.2	years
Kestrel	52.5	44.3	years
Peregrine	NA	NA	years
White-tailed eagle	NA	NA	years

7.6.8 Potential Effects by Species

Through the extensive suite of surveys and field data aggregated for the Operational Barnesmore Windfarm and the Development (**Technical Appendix 7.1**) desktop reviews (**Technical Appendix 7.2**) and collision risk modelling (**Technical Appendix 7.3**) there are a number of primary and secondary ornithological receptors identified for assessment. Within the various assemblages these include waders (curlew, common sandpiper, golden plover, snipe) and red grouse; raptors (golden eagle, hen harrier, merlin, peregrine, buzzard, kestrel and white-tailed eagle); waterbirds & wildfowl (whooper swan, cormorant, heron and greylag goose) and small passerines (particularly meadow pipit, grey wagtail, skylark and ring ouzel) within the footprint of the Development) and for which the potential effects are reviewed and summarised here.

7.6.8.1 Potential Effects on Waders

Four wader species were identified during surveys that may be sensitive to disturbance and/or displacement to windfarm development.

7.6.8.2 Potential Effects on Golden Plover

Golden plover were recorded during breeding, wintering and migration seasons. The nearest breeding territory that was observed was 1 km – 1.4 km away whilst other breeding golden plover occur at > 7 km away (**Figures 7.20; 7.24; 7.39; 7.43**). Nearest breeding golden plover were located equidistant from both existing and proposed turbines (**Table 7.11**).

Breeding golden plover breeding season disturbance displacement effects may occur between 200 m and 400 m (Pearce-Higgins et al., 2009; Sansom et al., 2016). Since all breeding golden plover were located beyond this distance no direct effects will occur and no significant direct effects are predicted.

Wintering golden plover are located within the footprint of the Development. Direct effects may occur during the migration season and during winter. Displacement may occur in the order of 200 – 400 m whilst other research indicates a relative tolerance for disturbance and landscape changes for golden plover, (Pearce-Higgins et al., 2007) including to windfarms (Fielding & Haworth, 2010; 2015) with no long-term operational effects in some studies (Fielding & Haworth, 2013). Golden plover certainly show evidence of habituation at the Operational Barnesmore Windfarm and were regularly observed utilising the extant infrastructure including tracks and turbine hard-standings for roosting.

Published information, Douglas et al., (2011) found an increase in (breeding) golden plover at some windfarm sites, and analysis here suggests a neutral effect with low magnitude, potentially beneficial effect. The Site is of marginal suitability for breeding golden plover, and therefore the Development is considered more likely to have a negligible effect on golden plover.

Research on golden plover (breeding and wintering) indicates they appear to be tolerant of turbines (Fielding & Haworth, 2010; Douglas et al., 2011) and are recorded to routinely fly and breed within and through active windfarm locations. A negligible effect is therefore predicted for this species. Monitoring of this species will also in any event be undertaken as outlined in **Section 7.9 and Technical Appendix 7.4**.

No significant direct or secondary effect are considered likely during construction and/or operational phases. On a precautionary basis displacement from the areas utilised by golden plover may extend to 200 – 400 m temporarily during the construction phase during wintering / migration seasons whereas breeding activity was all beyond the potential zone of displacement. No significant direct disturbance and/or habitat loss effects are likely during construction and/or operational phases subject to the implementation of appropriate construction management.

Golden plover may be vulnerable to collision with turbines during the operational phase although turbine avoidance was observed on Site. Whilst plover were detected during both breeding and wintering season, the wintering flights were those primarily located within the core turbine areas and were spatially biased towards the eastern portion of the Site.

With no avoidance a maximum of 1.4 – 3.6 golden plover might collide annually during the operational and/or Development on the basis of current data, with recommended avoidance rate this is reduced to a negligible number of golden plover with one bird predicted to collide between 13 and 34 years at either the existing or proposed turbines which varies between years and season (**Technical Appendix 7.3**). This equates to a negligible amount of both the Irish national breeding population (150 pairs; Wilson et al., 2018) and wintering population (80,707 birds; Wilson et al., 2018).

The proposed turbines have a lower individual collision likelihood per turbine than the existing and the reduction of turbines in the eastern side from seven to three turbines will reduce per turbine collision risk in this region of preferred spatial usage within the Site. When only a wintering season model is selected collision risk rates drop to below zero birds (i.e. none) during a modelled 30-year period.

There are no significant effects predicted for golden plover since the species shows ready habituation to the existing turbines and tracks. Golden plover are classed as <u>medium sensitivity</u> by virtue of their occurrence on Annex 1 and as a red-listed species of conservation concern (**Table 7.1**). On the basis of observed habituation, breeding, wintering / migratory season presence, and relatively low sensitivity to disturbance as demonstrated in the literature the potential effects on golden plover are classified as having a <u>medium - low</u> magnitude of change locally and therefore moderate - slight significant effects (**Table 7.1**).

7.6.8.3 Potential Effects on Curlew

Whilst waders may be considered particularly vulnerable to displacement during decommissioning/construction activity including the curlew (and snipe) (Pearce-Higgins et al., 2009; 2012), the response of bird species is variable including curlew (Whitfield et al., 2010; Thomas, 1999; P. Whitfield, personal communication) and golden plover (Fielding & Haworth, 2010; Douglas et al., 2011) and any negative effects appear to decline post-construction (Pearce-Higgins et al., 2012).

During construction phases direct effects are avoided given the set-back distances of turbines from curlew (Section 7.7). Pearce-Higgins et al., (2012) effectively prescribes a 620 m – 800 m buffer around turbines for curlew, and all curlew territories are beyond 950 m, therefore it is predicted these territories will not be directly affect by construction on the basis of published information.

The nearest breeding territory that was observed was 990 m – 1.1 km away. Other breeding and wintering curlew occur at > 5 km (**Figures 7.20; 7.24; 7.39; 7.43**). Breeding or wintering curlew are not located within the footprint of the Development. Therefore no direct effects may occur. Nearest breeding curlew were located equidistant from both existing (989m – 1.14 km) and proposed turbines (991 m – 1.14 km). Therefore no differential displacement is likely to arise due to the repowered development.

Whilst waders may be considered particularly vulnerable to displacement during decommissioning/construction activity including the curlew (and snipe) (Pearce-Higgins et al., 2009; 2012), the response of bird species is variable including curlew (Whitfield et al., 2010; Thomas, 1999; P. Whitfield, personal communication) similar to golden plover (Fielding & Haworth, 2010; Douglas et al., 2011) and negative effects appear to decline post-construction (Pearce-Higgins et al., 2012).

Whitfield et al., (2010) in a long-term study found no evidence of a reduction in breeding success or immediate or gradual displacement of curlew. Individual curlew response varied between sites and there was no evidence of displacement even at 200 m and at some sites curlew actually moved closer to turbines during the post-construction period and routinely nested within 'tens of metres' from turbine bases.

During the operational phase it is recognised that curlew may be vulnerable to displacement by windfarms though the study by Pearce-Higgins et al., (2009) found evidence of displacement at the "large scale" (up to 800 m), it also found no significant evidence of displacement at the "fine scale" (up to 500 m). Thus, there is conflicting evidence whether curlew actually are displaced. Pearce-Higgins et al. (2012) re-enforces the likely potential impact on large waders (notably snipe and curlew), but indicates that other factors including whether displacement is considered a population "loss", long-term results and the effects mitigation and habitat management are not fully known.

During the operational phase any likely effects are avoided given the set-back distances of turbines from curlew. Based on Pearce-Higgins et al., (2009) there is no predicted loss or displacement of curlew at Barnesmore since they do not occur within 500 m, nor 800 m zones. The separation distance for curlew at both existing and proposed turbines are equivalent and therefore there is no difference between the Operational Barnesmore Windfarm and the Development.

Curlew that were recorded were typically flying at relatively low-level and occurred infrequently and some sightings recorded beyond the respective 500 m turbine buffers (**Technical Appendix 7.3; Figures 7.56 & 7.57**). Whilst breeding and roosting sites were recorded in the hinterland including within 2 km (in 2017 and 2018) but these were typically located beyond 1 km (see Pearce-Higgins et al., 2009) or more away from turbines.

There were no regular activity or spatial patterns observed for curlew utilising the existing and/or proposed windfarm Sites and flights observed appeared to use the valley down towards the N15. There was occasional usage of the Site by localised pairs which varied between years and season. Since breeding apparently failed in both years of survey, a higher level of activity may have been expected when feeding juveniles but activity through the Site was relatively low and low level (below risk height). There is no associated risk of displacement or direct impacts on curlew at the observed set-back distances (Pearce-Higgins et al., 2009).

There were no curlew flights recorded within potential collision risk height during the 2017 – 2019 surveys (**Table A7.3**). Therefore no collision could occur and no collision risk modelling has been undertaken. There have been no collisions recorded of this species at the Operational Barnesmore Windfarm and in conclusion the Development presents no significant risk to curlew from collision throughout the operational phase.

Curlew are classified as high sensitivity on the basis of the national declines in Ireland (Colhoun et al., 2015; O'Donoghue et al., 2019), its and red-listed status nationally and published sensitivity to windfarm development (e.g. Pearce-Higgins et al., 2009; 2012). The spatial set-back (>800 m) at Barnesmore from identified territories avoids risk of disturbance and displacement, and therefore there is negligible magnitude of change. No risk of collision is predicted and therefore the Development is considered to reduce potential effects on curlew, since the overall numbers of turbines are reduced (see also **Technical Appendix 2.1**).

No significant effects are predicted either from disturbance, displacement, or from collision since there is no predicted collision risk. Curlew will benefit from the management measures for golden plover and/or snipe as outlined in **Section 7.9 and Technical Appendix 7.4**.

7.6.8.4 Potential Effects on Common Sandpiper

Several (4 – 6 pairs) of common sandpiper territories were recorded at Barnesmore), along waterways and lough edges (**Figure 7.2**) and were clustered along the eastern parts of the Site including close to existing tracks and turbine bases (**Figures 7.20 – 7.25; 7.39**). A number of common sandpiper territories occur around the Site and within the Operational Barnesmore Windfarm footprint although the number and distribution of these changes slightly between years. This species therefore shows considerable habituation in relation to the Operational Barnesmore Windfarm with territories, including some successfully fledging young and occurring in close proximity to the existing turbines and tracks.

There is one common sandpiper territory recorded within both the existing and proposed Infrastructure Buffers in 2018 (**Table 7.9**). Between four and six territories have been recorded in the 500 m buffer of the existing turbines and/or proposed turbines. Others were recorded in the wider hinterland.

In both years of survey the same number of common sandpipers were recorded within the 500 m turbine buffers of existing and/or proposed turbines. Hence the maximum numbers of sandpiper territories that have the potential to be affected by the Development are consistent to the baseline.

The species occurred closest to proposed turbines in each year (99.6 m and 22 m) compared to existing turbines (187.6 m and 51.3 m) (**Tables 7.11; 7.14**). The risk of disturbance and/or displacement at these distances are elevated, but the species exhibits considerable evidence of habituation at the Site.

Given the close proximity of the species, construction activity may depress the population initially, and temporarily. As a wader, the species may be affected similar to other allied species such as snipe (see Section 7.6.9.5 Pearce-Higgins et al., 2009; 2012) but no explicit studies are published for the species. Pearce-Higgins et al. (2012) found continued negative impacts on waders and found some species actually increased post- construction. Construction may cause temporary disturbance and/or displacement. All common sandpiper flights were recorded at <20 m a.g.l. and thus vulnerability to collision is negligible.

As an amber-listed species common sandpiper are classified as low sensitivity and on the basis of published information which shows negligible magnitude of change on this species, the considerable inter-annual spatial and numerical variation and the closer spatial overlap with existing territories in both the Development and the Operational Barnesmore Windfarm the magnitude of change between baseline and the Development is therefore medium during the construction phase, leading to a slight significant effect which can be reduced to not significant subject to the best practice construction measures outlined within **Section 7.9** and Outline CEMP and particularly the protection of loughs / lough edges and water channels and tributaries where breeding territories were recorded. The effects are unlikely to persist throughout the operational phase given the evidence of habituation on the species.

7.6.8.5 Potential Effects on Snipe

Snipe may be vulnerable to displacement during windfarm development (Pearce-Higgins et al., 2009; 2012), however, it is recognised that the response of bird species is variable to windfarm development (Whitfield et al., 2010; Thomas, 1999; Fielding & Haworth, 2010; Douglas et al., 2011) and negative effects appear to decline post-construction (Pearce-Higgins et al., 2012). Snipe are considered the most potentially affected species at this location particularly temporarily during the construction phase.

Snipe may be reduced in density within 500 m of turbines although the effects decline beyond 400 m (Pearce-Higgins et al., 2009). Breeding snipe may be sensitive to displacement to windfarm development due to ground-nesting breeding strategy.

Snipe are defined as low sensitivity (**Table 7.2**) since the numbers recorded, 19 - 31 territories in the 500 m buffers of the existing and proposed turbines) comprise 0.2 - 0.4% of the national population (4275 pairs; NPWS, 2015) and since the species is amber-listed rather than red-listed.

There is a difference of between 2 – 3 territories; between survey years when comparing the numbers recorded relative to the Operational Barnesmore Windfarm and the Development. Therefore, the difference between theoretical displacements ranges between 7% and 22.5% (average 14%) of the local population within the 500 m Survey Area. This equates to a predominantly medium magnitude effect but ranging to high between years at the local (Site level only) in relation to displacement for this species although there is considerable evidence of habituation at the Site and populations are expected to recover post-construction.

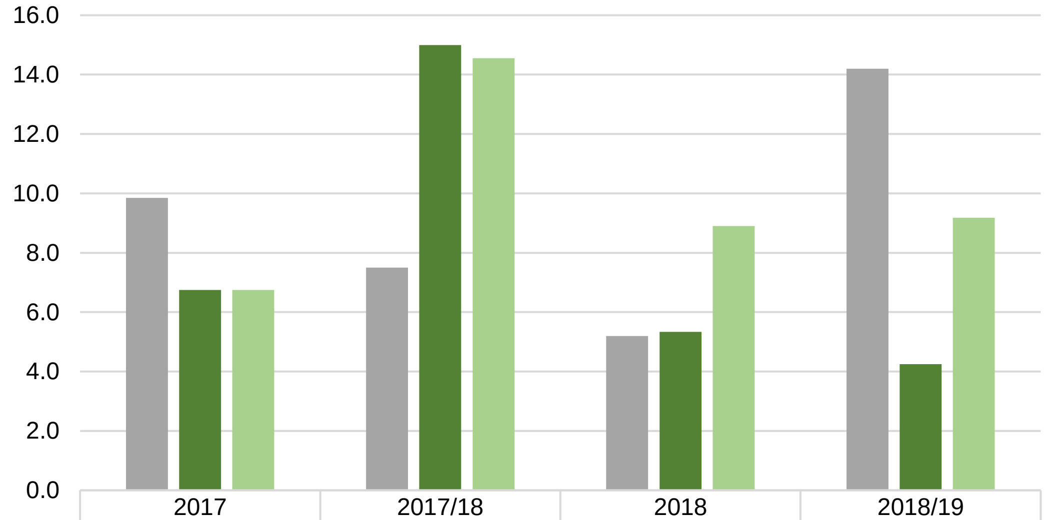
The baseline shows that there is considerable evidence of habituation of snipe within the Operational Barnesmore Windfarm and abundance and spatial distribution of snipe varied between years (**Technical Appendix 7.1**). There is also negligible difference between the average distances between years for snipe within 500 m turbine buffers (**Table 7.7**) and although differential displacement may occur habituation should be readily facilitated compared to the baseline given the negligible difference in average distances of existing versus proposed territories. Distributions of some species including snipe may also have been affected at a number of locations by turf cutting activities including within the NHA.

In the absence of long-term monitoring or ornithology survey data for the development phase of the Operational Barnesmore Windfarm, it is not possible to know the original baseline of the snipe population, although the original EIA noted “the common snipe was present in high numbers on the Site” nor the attenuation time before the species occurred / recolonised during the post-construction period. It is evident that snipe are utilising the existing Site, although some windfarm configuration changes are proposed, the snipe show significant evidence of habituation and would likely continue to utilise the Site. Snipe were frequently located during winter walkover, winter vantage point surveys and during wintering priority species searches within the 500 m turbine envelope, but these can more readily displace to other nearby habitats.

Since the average set-back distances are similar between the baseline and the Development, a negligible effect on displacement distance is predicted during the Development Operational phase, and given the larger spacing between fewer, larger turbines this also allows ready management of lands within the windfarm to mitigate for territorial displacement effect as habituation of this species, even within these distances has clearly been demonstrated within the existing Operational Barnesmore Windfarm.

Based on published literature of sensitivity during the phases associated with construction and decommissioning there is a medium to high magnitude of change effect with two (6%) or three (24%) difference in territories within 400 m (i.e. potential disturbance zone) between Operational Barnesmore Windfarm and the Development for a temporary time period (i.e. until construction is completed) in the absence of any mitigation via avoidance (**Section 7.7**). Since snipe are defined as low sensitivity species during the decommissioning/construction phases this results in a potential moderate to slight (minor) significant effect predicted for snipe and which are expected to recover post-construction with extensive evidence of habituation on Site the effect is reduced to medium-low magnitude during the operational phase.

Utilising minimum bounding geometry (MGB) to plot territorial boundaries for snipe locations between years within the 500 m Survey Area snipe were recorded to occur in breeding densities of approximately 5 – 10 ha / pair (see **Chart 7.1**), whilst in the existing turbine 500 m buffer this was 5 – 7 ha / pair and in the proposed turbine 500 m buffer this was 7 – 9 ha / pair and this varied over the wintering season. Snipe territories were less densely recorded in the proposed turbine area than the existing turbine area in 2018 and that winter 2018/19 whilst densities were similar in 2017 and 2017/18. The habitat management area proposed should thus facilitate the maximum number of territories likely to be displaced (n = 3). With a maximum of three territories predicted to be displaced, the habitat management areas are more than adequately sized to mitigate any potential displacement effects predicted for the decommissioning and construction phases



	2017	2017/18	2018	2018/19
Territory size (500 m)	9.9	7.5	5.2	14.2
Territory size (existing)	6.8	15.0	5.3	4.3
Territory size (proposed)	6.8	14.6	8.9	9.2

Chart 7.1 Snipe territory sizes at the Operational / proposed Barnesmore Windfarm.

The Draft Habitat Management Plan (**Technical Appendix 3.2)** proposes restoration of habitats and removal of self-seeded conifers, habitat management is proposed and includes extensive areas suited to snipe. The habitat management will have positive effects for snipe (**Section 7.9**), which are known habituate at this locality, with numbers and distribution varying between years within 400-500 m of existing turbines within the windfarm area. Habitat management / restoration will also help enable a rapid recovery post-construction for snipe and will further mitigate against displacement effects for two to three snipe territories and have additional benefits for golden plover and curlew.

7.6.8.6 Potential Effects on Red Grouse

Numerous red grouse territories were recorded at Barnesmore. Habitat quality varied across the Site (**Figure 7.2**) and in some areas a number of clusters of red grouse territories were observed (**Figure 7.22 & 7.58**). A number of red grouse territories occur around the Site and within the Operational Barnesmore Windfarm Turbine and Infrastructure Buffer although the number and distribution of these changes between years. This species therefore shows considerable habituation in relation to the Operational Barnesmore Windfarm with territories, including some successfully fledging young, occurring in close proximity to the existing turbines and tracks. Red grouse territories are further from proposed (137.9 m to 83.6 m) than existing turbines (56.2 m to 60.5 m) (**Table 7.1**).

Red grouse have been recorded to fledge a number of young in some years (maximum covey of nine birds recorded) thus birds appear productive at this Site although numbers varied considerably between years and it may be that influxes or effluxes of this species are occurring to / from the wider moorland areas to the north and/or west and the wider landownership. There is some evidence of gamebird and/or habitat management in the wider 2 km Survey Area to the north and perhaps some red grouse shooting may be occurring, this may explain the spatial variation between survey years (**Figures 7.20 – 7.25; 7.39**). Distributions of some species including red grouse may also have been affected at a number of locations by turf cutting activities including within the NHA.

Within the 500 m Survey Area between 23 and 20 territories have been recorded in the 500 m buffer of the existing turbines and more (24 to 19) were recorded in the proposed turbine 500 m buffer in the two years of surveys (**Figures 7.22 & 7.58**). The same maximum numbers of red grouse territories would be at risk since numbers of territories within the 500 m Survey Area and the 500 m buffers of the proposed turbines are similar to the baseline although this varies between years.

An additional maximum one territory occurred within 500 m of both the existing / proposed access track (**Figures 7.50 & 7.53**). Within the track footprint then in both years of survey there were similar numbers of red grouse within the existing and/or proposed track footprint and 25 m buffer 1 – 2 territories but in 2018 there was one additional territory in the proposed turbine / track buffer (**Figures 7.65 – 7.68**).

Red grouse do not appear to be affected by turbine development, (Pearce-Higgins et al., 2009; Douglas et al., 2011) although construction activity can temporarily depress the population initially (Pearce-Higgins et al., 2012). Published information suggests a neutral impact on this species, both Pearce-Higgins et al., (2009) and Douglas et al., (2011) indicate no effects of windfarms on red grouse. McGuiness et al., (2015) cite a 500 m sensitivity buffer for red grouse. All red grouse flights were recorded at <20 m a.g.l. and thus vulnerability to collision is negligible.

As a red-listed species, red grouse are classified as <u>medium sensitivity</u> and on the basis of published information which shows negligible magnitude of change on this species, the considerable inter-annual spatial and numerical variation and the similar maximum spatial overlap with existing red grouse territories in both the Development and the Operational Barnesmore Windfarm the magnitude of change is therefore <u>negligible</u> magnitude of change for red grouse in the re-powering of Barnesmore, leading to a negligible and not significant effect subject to the best practice construction measures outlined within the CMS in **Section 7.9.2** and in the Outline CEMP.

7.6.8.7 Potential Effects on Raptors

There was only one breeding raptor recorded within 750 m of the existing or proposed turbines kestrel (one year only). Merlin (1 pair), peregrine (1 pair) were recorded nesting within 2 km from turbines and hen harrier were just beyond 2 km. At Barnesmore and in the wider hinterland there were eight breeding raptor species which have been documented, namely golden eagle, hen harrier, merlin, peregrine, buzzard, kestrel, white-tailed eagle and sparrowhawk. The same species' assemblage was also recorded during the wintering seasons.

Winter roosting hen harriers were recorded within 5 km but none within the 2 km buffer. Golden eagle were breeding beyond 7 km away and were recorded utilising the Site and recorded widely during the wintering season also. The risk of any direct displacement from breeding or wintering locations is reviewed by species since all species are located beyond published and/or recognised set-back / buffer distances (Currie & Elliot, 1997; Ruddock & Whitfield et al., 2007; Whitfield et al., 2008). The white-tailed eagle was a non-breeding, non-territory holding bird which subsequently departed from the area and therefore extant risks are minimised.

7.6.8.8 Potential Effects on Buzzard

Buzzard are defined as low-negligible sensitivity at this locality since the species is green-listed, but exhibited high frequency of occurrence here and may be vulnerable to collision and/or displacement. Buzzards face the same generic risks to wind energy development that have been identified for other birds including behavioural avoidance; perturbation due to habitat modifications and mortality through collision. Buzzards were recorded foraging during the summer and the winter within the Study Areas and a number of identified territories are known nearby with closest pairs recorded at approximately 2.5 km.

Buzzards may be at collision risk (Orloff & Flannery, 1992; Smallwood et al., 2008; Garvin et al., 2011;) throughout the operational lifetime of the windfarm, however the per turbine risk at Barnesmore is shown through comparative modelling to reduce between existing and proposed turbines **(Table 7.15)** with low-negligible magnitude effects for the comparison between baseline and the Development. Buzzards have been recorded colliding with turbines, but flight activity may be reduced by up to 57.8% since they avoid windfarms (Pearce-Higgins et al., 2009) and collision risk therefore may be reduced. During the displacement modelling and research by Pearce-Higgins et al; foraging activity by buzzards was considered to be reduced within a windfarm (Pearce-Higgins et al., 2009) indicating avoidance of such facilities (**Figures 7.14 & 7.33**).

Based on Pearce-Higgins et al., (2009) there is a predicted average reduction of 41.4% of buzzard foraging activity and therefore the collision risk estimates are likely to be over-estimated since there is considerable evidence of avoidance in the published literature. The population of buzzards in the UK and Ireland has seen exponential growth particularly since the 1990s (Balmer et al., 2013) with a national population of circa 1,500 pairs (NPWS, 2015). There are up to two pairs recorded within 3 km representing 0.1% of the breeding population but all breeding sites are located more than 2 km away from existing / proposed turbines and there are negligible risks of direct impacts on the species.

Published research and evidence of close occurrence generally indicates a relatively low sensitivity to wind turbines, medium risk of collision and displacement effects and the observed information at this locality shows a relatively low level of flight occurrence and avoidance behaviour of the Operational Barnesmore Windfarm. There is also no spatial overlap of breeding locations (> 2 km away), which is greater than the published set-back distances for similar species, red kite (300-600 m; Ruddock & Whitfield, 2007) and low collision risk estimates given the large population of this species (**Technical Appendix 7.3**) in both the proposed windfarm and the Operational Barnesmore Windfarm.

The magnitude of change between baseline and the Development is therefore low-negligible for buzzard in regards to the collision risk estimates provided. There is a higher predicted risk of collision in the Development than for the existing Site indicating a potentially negative effect for the species, however overall collision and a medium to low magnitude of change is the worst-case scenario presented here. Therefore, a not significant effect is predicted for this species.

7.6.8.9 Potential Effects on Golden Eagle

Golden Eagles are defined as high sensitivity. The nearest breeding territory observed was 7.3 km – 8.2 km away whilst other breeding and wintering sightings occur at much closer proximity including a small number of flights recorded within the Site (**Figures 7.17 – 7.19; 7.36 – 7.38**). Breeding sites or wintering roost sites for golden eagles are not located within the footprint of the Development, therefore no direct effects may occur.

The Development (7.5 km – 8.1 km) will increase the distance to the nearest breeding golden eagle when compared to baseline (7.3 km – 7.9 km) which is greater than recommended set-back distances (750 m – 1.5 km; Currie & Elliot, 1997; Petty, 1998; Ruddock & Whitfield, 2007). These territories will be not be directly affected by construction / operational activities and no significant direct disturbance and/or habitat loss effects are likely.

Golden eagle core range is typically 2 – 3 km (McGrady et al., 2007), however flight connectivity may be 6 km, although may be up to 9 km (in the absence of neighbouring territories (SNH, 2017). Predicting Aquila Territory (PAT) modelling (McLeod et al., 2002) utilises the 6 km range. The pair of golden eagles west of the Operational Barnesmore Windfarm is beyond the 6 km range however, it is confirmed that the eagles observed over flying the Site are the same individuals (evidenced from wing-tags). The golden eagles were also observed mobbing a white-tailed eagle at the eastern edge of Barnesmore and towards Meenadreen which indicates the defence of territorial airspace over the Site (see **Figure 7.63**).

In Scotland, active eagle territories have been recorded within 3 – 3.5 km of operational windfarms and within 0.6 – 4.8 km from approved applications (Haworth & Fielding, 2010). This review identified that displacement may occur and that habitat management and supplementary feeding may confound the interpretation of the results. Madders & Whitfield (2006) cite golden eagles as having potentially the highest sensitivity to displacement by windfarms, with range use changing in a pair of resident Scottish eagles after a wind farm was constructed within the territory, although definitive conclusions on displacement and/or breeding success were confounded by a simultaneous habitat management plan in the territory (Walker et al. 2005; Fielding & Haworth, 2010). Other studies in USA, however, have not noted any displacement effects due to the operation of wind farms (Madders & Whitfield 2006; Bright et al., 2004).

Several reviews and recommendations for set-back distances (Currie & Elliot, 1997; Petty, 1998; Ruddock & Whitfield, 2007) in their reviews of golden eagle disturbance zones suggested buffers of 750 m– 1.5 km; 900 m – 1.1 km and 750 m – 1 km respectively and such metrics and set-back methods are frequently applied to windfarm developments (Obermeyer et al., 2011; Arnett & May, 2016). All golden eagle breeding and wintering sites recorded here are beyond 1 km from existing and/or proposed turbines. These studies show that individual responses may be highly variable and/or site specific (see Fielding & Haworth, 2010; Hedfors, 2014) and typically extend between 750 m and may extend up to 9 km although more typically up to 6 km.

There was a maximum of one pair of golden eagles which were located at two separate nesting locations within close proximity to one another. Other eagles are reported historically to the south-east (see **Technical Appendix 7.1**; M. Ruddock, personal observation) but none were recorded during this study. Donegal holds the entire national population of circa 5 – 6 pairs and the one pair within territorial range of the Site represents 17 - 20% of this population (IRSG, 2018; 2019).

Golden eagle occurrence can be predicted based on PAT modelling (McLeod *et al.,* 2002a, b; Walker *et al.,* 2005) however, using empirical field data (as recommended by Fielding & Haworth (2010) the foraging minimum bounding geometry (MBG) by joining all detected flight lines, points, nest sites and nearest roost sites for apparent individual pairs, were created to identify territorial zones for the eagles (**Figure 7.63**) The approximated observed composite territory size was (10,690 ha) for all years of study (12,212 ha in 2017 and 9,858 ha in 2018 respectively). No display activity was recorded over the Operational Barnesmore Windfarm area in any year of study although display activity was recorded to the west over the Barnesmore Gap. The suggested buffers (SNH, 2017) for golden eagles corresponds similarly to the observed range (**Figure 7.63**) although extended beyond the 6 km zone and similar to the 9 km zone.

This territory is derived from the golden eagle reintroduction project in Glenveagh, Co. Donegal, which commenced in 2001 (www.goldeneagle.ie). Thus any golden eagle territories which have established in this area have appeared after the construction of the existing windfarm (1997) and most likely not before 2005-2006 when golden eagles are typically old enough to breed. At least one of the eagles is an Irish bred bird, since 2007 when Irish chicks were first hatched, therefore the territory may be more recently established as a breeder given the lag in maturation for this species (Watson, 1997). The eagle productivity of the site was low (1 chick in each year) although golden eagles in Donegal are generally known to have poor productivity in recent years (IRSG, 2017; 2018; 2019).

It therefore confirms that birds have selected this area and are tolerant to the existing windfarm at this proximity to their core area, and/or avoided it by at least 7 km for nesting as indicated by the data although there are no suitable nesting crags within the Site. The golden eagles have selected to nest west of the Operational Barnesmore Windfarm due to the suitability and availability of a temporally available habitat and this has occurred since 2001 when the reintroduction of the species commenced. The eagle territory therefore has become established after the construction of the Operational Barnesmore Windfarm and thus they can be considered to be habituated to the Site.

Golden eagles may be vulnerable at windfarms and the surveys have established the extent and nature of risk e.g. flight routes and flying height. This is relevant due to the larger turbines proposed to which birds may not presently be habituated.

Sensitivity of golden eagles to windfarms within their core range may occur up to 2 - 3 km (Bright et al., 2008). Nesting and roosting records of this species were more than 2 km from the Site. There are potential pathways from the observed nesting (and roosting) sites to the Barnesmore windfarm since the Operational Barnesmore Windfarm and Development are within foraging range of the golden eagle (6 – 9 km; McGrady et al., 1997; McLeod et al., 2002; SNH, 2017) and within range (6 - 9 km) for considering connectivity to designated sites (SNH, 2016). Golden eagles are therefore within territorial range of the existing windfarm and/or the Development exhibiting foraging / commuting / territorial activity in close proximity to the Development and the Operational Barnesmore Windfarm and nesting / roosting in the wider hinterland.

During the operational phase avoidance may only extend to 750 m – 1 km from wind turbines (Ruddock & Whitfield, 2007). The proposed turbines cannot therefore cause displacement of golden eagles from these identified nesting sites, i.e. all studies indicate that disturbance and/or displacement may occur at a range of distances 500-1500 m and these are the buffers identified (Currie & Elliot, 1997; Petty, 1998; Ruddock & Whitfield, 2007; Whitfield et al., 2008) to minimise disturbance. Golden eagle nest sites are not presently known to occur within the 750 m – 1 km range of the existing or proposed turbines which is the recommended avoidance distance for this species (Ruddock & Whitfield, 2007). All identified eagle nest and/or roosts are located more than 1 km from turbines in field surveys.

The proportion of the regional population that may be influenced by the Development (1 pair; 16-20%) on a high sensitivity species. Via the iterative design process and specific movement of turbines away from the direction of the breeding site the Development has implemented a set-back greater than 7 km and as observed the likelihood of effect is low, since this is already an operational windfarm Site where a level of habituation has been demonstrated by this species. This reduces the effect of direct disturbance to low, and not significant, subject to decommissioning and construction activity being managed to ensure a disturbance-free zone during any breeding season, and assuming that the nests remain within the same positions, check surveys are proposed to be undertaken prior to decommissioning and construction commencing which will inform this process, see **Section 7.9**.

Golden eagles have selected to nest circa 7 km away from the existing turbines at this locality and are observed to be habituated to turbines and associated infrastructure. There are no significant direct disturbance / displacement risks, since proposed turbines are more than 7 km away and proposed turbines are marginally further away than existing turbine which is no nett difference from the baseline position. Subject to these measures outlined in no significant effects are predicted to arise due to direct disturbance. Similarly wintering sites occur beyond 2 km away from turbines, and no direct disturbance or displacement could occur. There appears to be no more than one pairs represented at the nearest roost sites with a maximum of 1 female; 1 male; 1 juvenile present at different times in the vicinity and, although some birds are unmarked, it appears likely the local breeding pair are remaining in the area throughout the winter period.

Displacement may occur where birds avoid areas around windfarms due to both infrastructure and loss of habitat. There remains a risk of displacement of foraging / range area for golden eagles and for collision during the operational lifetime of the windfarm since they are known to occur in the area. There is currently low-negligible risk of displacement of breeding locations during all phases to the eagle pair on the basis of the current >7 km set-back. No significant risk of collision for golden eagle is recorded (**Technical Appendix 7.3**) at the Development during the lifetime of the windfarm. This species is also known to nest in close proximity to active windfarms elsewhere (Fielding & Haworth, 2010; M. Ruddock, personal observation).

Fielding & Haworth (2010) indicates that displacement may occur during the operational phase (however this may be highly site specific and temporal / spatial avoidance of habitats is likely to occur during foraging. With the apparent relatively high numbers of grouse recorded during surveys at Barnesmore it is possible that golden eagles view the Barnesmore area as foraging ground, although no hunting flights were observed, and/or territorial airspace only. Hence on a precautionary basis the windfarm may therefore cause avoidance of portion of existing and potential foraging habitat for the golden eagle although the baseline usage and occurrence of foraging birds is relatively low at Barnesmore (**Technical Appendix 7.1**). Walker et al., (2005) suggested there may be 100% avoidance of the turbine area, although readily flew through spaces between turbines although sensitivity may to extend to 2 – 3 km (Bright et al., 2004) and disturbance at 75 0m – 1 km.

On a precautionary basis golden eagles may totally avoid an area of approximately 750 m around wind turbines (Ruddock & Whitfield, 2007) and effects may extend to 2.5 km (Bright et al., 2004). Taking a modelled spatial displacement / avoidance effect distance of 750 m from wind turbines results in a potential loss of habitat which may be available for foraging of up to 719 ha around the operational wind turbines and up to 865 ha around the proposed wind turbines which is a difference of 146 ha (1.2 – 1.5%) of potential eagle territory over which golden eagle activity may be reduced thereby further reducing collision risk between Baseline and the Development.

However, the 750 m zones only partially overlaps with the golden eagles range identified (**Figure 7.63**). In the existing turbines overlapped by 624 ha (2017) and 495 ha (2018) and the proposed turbines by 600 ha (2017) and 457 ha (2018) which is a difference of -24 ha or -38 ha. Therefore even incorporating maximum displacement / total avoidance at 750 m there is less of the range covered by turbines (since there is a considerable reduction in the number of turbines through repowering) and the repowering represents betterment in terms of potential displacement from range although this potentially influences the territory (> 5%) of the range and therefore can be categorised as a reduction (i.e. betterment) in the magnitude of displacement effect on the golden eagle territory. Whilst the territorial overlap is significantly reduced by repowering the maximum displacement is 20 ha (0.1 – 0.2% of range) around respective turbine layouts and can be categorised as a low magnitude of displacement effect on golden eagle territories.

Within the 2.5 km zone, results in a potential displacement zone foraging of up to 3,427 ha around the operational wind turbines and up to 3,842 ha around the proposed wind turbines which is a difference of 415 ha over which golden eagle activity may be reduced thereby further reducing collision risk between the operational (baseline) and Development. However, the 2.5 km zones only partially overlaps with the golden eagle range identified (**Figure 7.63**). The existing turbines overlapped by 1,928 ha (2017) and 1,400 (2018) and the proposed turbines by 1,864 ha (2017) and 1,342 ha (2018) which is a difference of -64 to -58 ha i.e. there is a similar reduction in the potential displacement. It is evident that eagles are not avoiding the windfarm at this scale (2.5 km) and since the territorial overlap is significantly reduced by repowering the maximum displacement is 415 ha (3.4 – 4.2% of range) around respective turbine layouts and can be categorised as a low magnitude displacement effect on golden eagle territories and is predicted to be negligible given observed habituation and usage of the Site as determined during field surveys, considerable set-back (>7 km) and reduction of overlap with the known eagle range.

Displacement modelling indicates that there is a smaller potential zone of influence on golden eagles in the Development compared to baseline. Since there are no significant predicted effects this difference does not require to be mitigated, however there is proposed restoration / and management which may provide additional enhancement for golden eagle territory quality as proposed for priority habitats via the Draft Habitat Management Plan In particular the removal of self-seeded conifers and restoration / remediation of parts of the bog will be beneficial to small passerines, red grouse, snipe and therefore directly beneficial to the potential food sources for golden eagles breeding and wintering in the area.

The data collected here indicates a small number of flights with activity and transits through the area within the Development 500 m buffer for golden eagles. Since flights of this species were at negligible risk of collision (i.e. one bird every >270 years; **Technical Appendix 7.3**) and golden eagles are present breeding and wintering in the wider area a negligible magnitude effect of collision is predicted based on published research and Site specific metrics including adequate set-back distances to nearby nest and/or roost sites.

Golden eagle may be vulnerable to collision with turbines during the operational phase. Turbine avoidance was observed on Site and some flights were recorded at high elevation over the Site. Flights were only recorded at risk of collision during one year of monitoring. Whilst eagles were detected during both breeding and wintering season, the flights were those primarily located outside of the core turbine areas and were spatially biased towards the western boundary and were not observed foraging within the Site itself.

With no avoidance a maximum of 0.2 – 0.4 golden eagle might be killed annually during the operational and/or Development on the basis of current data, with recommended avoidance rate (99%) this is reduced to a negligible number of golden eagle with one bird predicted to be killed between 406 and 270 years at either the existing or proposed turbines which varies between years with no observed collision risk in 2018 – 2019 when nesting was recorded marginally further away from the Site. This estimated collision risk equates to a negligible amount of both the County and national population (5-6 pairs).

The proposed turbines have a lower individual collision likelihood per turbine than the existing (**Technical Appendix 7.3**) and the reduction of turbines from 25 to 13 turbines will significantly reduce per turbine collision risk in this region of the Site.

The proposed turbines are further than minimum avoidance distances of disturbance / displacement effects (> 2km) for golden eagle and there are low magnitude effects of disturbance / displacement and negligible magnitude of effects of collision. Therefore, whilst slight effects are initially predicted on the golden eagles these are evidenced to be negligible given observed habituation and usage of the Site as determined during field surveys, considerable set-back (>7 km) and reduction of overlap with the known eagle range.

On the basis of published research which generally indicates a relatively low sensitivity to windfarms, low risk of collision and some displacement effects and the observed information at this locality which shows a relatively regular level of occurrence, no spatial overlap of both breeding or wintering locations, and low collision risk estimates in both the Development and the Operational Barnesmore Windfarm the magnitude of change between baseline and the Development is therefore assessed as having a slight (minor) to not significant effect. The effect is reduced wholly to not significant and further reduced by mitigation measures (**Section 7.9; Technical Appendix 3.2**) and since there is also a lower predicted territorial overlap and risk of collision for the Development turbines than for the operational turbines indicating a potentially positive effect for the species locally and at County / national level by repowering.

7.6.8.10 Potential Effects on Hen Harrier

Hen harrier are defined as high sensitivity at this locality since the species is listed on Annex I of the Birds Directive, amber-listed regionally and is red-listed nationally in the adjacent UK jurisdiction where some birds originated. The species may be sensitive to windfarm development due to the spatial overlap with windfarms and wintering or breeding habitats. Hen harriers may face the same generic risks to wind energy development that have been identified for other birds including behavioural avoidance; perturbation due to habitat modifications and mortality through collision. Hen harriers were recorded foraging relatively frequently during the summer and the winter (**Technical Appendix 7.1**) and a maximum of two pairs were recorded nesting and roosting at various localities during the study period within 2 – 5 km.

The pair located to the north failed at chick stage in 2017 and in the early breeding season in 2018 and may have been disturbed / displaced by extant shooting activity and there was considerable interaction with buzzards. The nearest pair to the east (>2 km in Northern Ireland) failed in 2017 and then re-laid a short distance to the north of the original site and fledged three young very late in the season. This pair then was not recorded to be present during 2018 and may have been disturbed / displaced by extant forestry activities. Other pairs including those which successfully fledged young were recorded toward Lough Derg and along the Northern Ireland border. The two nearest nest sites were recorded beyond 2 km of the existing and proposed turbines nesting in second rotation forest habitats and/or deep heather within forest clearings / rides.

Hen harriers were recorded foraging relatively infrequently during the summer and the winter and the nearest pair was recorded nesting during the study period just beyond 2 km. There is a relatively detailed quantity of research on hen harriers which are indicates the species is potentially sensitive to windfarm development (Percival, 2003; Pearce-Higgins et al., 2009) at up to 2 km (Bright et al., 2008; McGuiness et al., 2015) during both breeding and wintering seasons. The effects of windfarms have been considered a risk to hen harriers due to the spatial overlap with windfarms and wintering or breeding habitats (Haworth & Fielding, 2012).

The nearest breeding territory that was observed was 2.3 km away whilst other breeding and wintering hen harrier occur at >3.9 km and up to 19 km (**Figures 7.20; 7.24; 7.39; 7.43**). Breeding or wintering hen harrier are not located within the footprint of the Development. Therefore no direct effects may occur. Nearest breeding hen harrier were located equidistant (**Table 7.11**) from both existing (2.32 km – 2.48 km) and proposed turbines (2.33 km – 2.49 km) and therefore no differential disturbance / displacement may occur. Set-back distances of turbines from hen harrier of 500 - 750 m (Ruddock & Whitfield, 2007) are recommended and all territories are beyond this distance (> 2 km), therefore it is predicted these territories will not be directly affected by construction / decommissioning activities on the basis of this published information.

Harriers are considered to be at relatively low risk of collision and low-medium risk of displacement (Madders & Whitfield, 2006) with high (>99%) avoidance rates (Garvin et al., 2011; SNH, 2014; 2017) and will avoid wind turbines and considered to be less vulnerable to displacement. Madders & Whitfield (2006) reviewed several studies and found little evidence of large-scale displacement and ultimately suggested that foraging avoidance mostly extended to approximately 100 m although nest displacement was reported at 200 m to 300 m.

Hen harriers may be at lower risk of collision due to the majority of low elevation flights undertaken by the species which does not normally predispose them to flying within the rotor swept zone and high frequency of avoidance responses observed (Garvin et al., 2011). Wilson et al. (2015) suggested that collision risk may be affected by the proximity of the nest and during breeding displays, but that collision probability is generally low.

The key study examining displacement in hen harriers (Pearce-Higgins et al., 2009) found that avoidance extended to 250 m from turbines with reduced flight activity and that breeding density would consequently be reduced by 52.5% (range -1.2% to 74.2%). This study also found that risk exposure of hen harriers was unrelated to flying height and that there was no significant reduction in abundance affected by windfarm tracks or transmission lines although avoidance rates may be site specific. Haworth & Fielding, (2012) found that avoidance of 100 m to 250 m seems to be the consensus on minimum estimated avoidance for nesting and foraging (see also Madden & Porter, 2007; 10 m to 100 m).

Hen harrier been recorded nesting within 110 m – 500 m of windfarms and tracks (SPR, 2009; Robson, 2011; Forrest et al., 2011; McMillan, 2011) although may be displaced by 140 – 760 m (O'Donoghue et al., 2011) and nesting avoidance may only extend to 200 – 300 m (Madders & Whitfield, 2006; Robson, 2009). During windfarm construction, displacement has been suggested potentially to occur between 500 m to 1 km, depending on visibility (Madders 2004; Bright et al. 2006; Madden & Porter, 2007). Studies show that individual responses may be variable and/or site specific (see review in Wilson et al., 2015) and typically extend between 50 m and 1 km. Pearce-Higgins et al., (2009) indicates an average behavioural avoidance of 53% within 500 m which by inference would imply that there would be no avoidance at 950 m (i.e. circa 1 km). Several reviews and recommendations for set-back distances (Currie & Elliot, 1997; Petty, 1998; Ruddock & Whitfield, 2007) or disturbance zones suggested buffers of 500 – 600 m; 500 – 1000 m and 500 – 750 m respectively and such metrics are frequently applied to windfarm developments (Obermeyer et al., 2011). All hen harrier breeding and wintering sites recorded here are beyond 1 km from existing and/or proposed turbines.

Fernández-Bellon et al. (2015) examined proximity of turbines of breeding parameters of Irish hen harriers and found there were no statistically significant relationships between breeding parameters (nest success; brood size; productivity) and distance of the nest from the nearest wind turbine. However, a near significant result was recorded with lower nest success within 1 km of wind turbines. This concurs with similar maximum direct disturbance or indirect displacement distances recorded in other studies (Ruddock & Whitfield 2007; Pearce-Higgins et al., 2009).

There was a maximum of two pairs of hen harriers which were located at a variety of nesting locations. Three other territories were recorded between 5 km and 10 km in some years of survey but were not recorded foraging or utilising the windfarm area or any parts of the 2 km Survey Area. One to two pairs within range of the Site represents (10 - 20% of the regional population; 10 - 12 pairs for Bluestacks, Pettigoe and South Donegal; Ruddock et al., 2016) and 0.9 - 1.9% of the national population (108 – 157 pairs; Ruddock et al., 2016).

The foraging minimum bounding geometry (MBG) was created to identify territorial zones for each pair (**Figure 7.64**) based on detections during foraging, nesting and roosting observation. The approximated observed territory sizes were 2,066 ha (northern) and 2,005 ha (eastern) respectively. Both pairs were noted to display to the north and east of the closest site and no display activity was recorded over the Operational Barnesmore Windfarm area in any year of study.

The species is known to utilise second rotation (pre-thicket stage) plantation forests extensively in Northern Ireland (Wooton et al., 2018) and Ireland (Ruddock et al., 2016). The dynamics of forest clear-felling and planting will therefore strongly drive the pattern of spatial occurrence in forest nesting sites such as those recorded here in both Donegal and Tyrone. The hen harriers have selected nesting vegetation that is presently suitable and over-time these parcels will become unsuitable and hen harriers will be required to relocate to alternative nesting areas. The hen harriers have selected to nest in the wider hinterland of the Operational Barnesmore Windfarm due to the suitability and availability of a temporally available habitat.

Sensitivity of hen harriers to windfarms may occur up to 2 km (Bright et al., 2008; McGuinness et al., 2015). During the surveys; nesting and roosting records of this species were more than 2 km from the Site. There are potential pathways from the observed nesting (and roosting) since the Operational Barnesmore Windfarm and Development are within foraging range of the hen harrier (2-10 km; Arroyo et al., 2009; Irwin et al., 2012) and within range for considering connectivity to designated sites (SNH, 2016). Foraging behaviour of breeding pairs can be influenced by habitat changes at distances up to 2-3 km from the nest (Amar et al., 2004, Arroyo et al., 2009). Hen harriers are therefore within territorial range of the existing and/or Development displaying foraging activity in close proximity and nesting / roosting in the wider hinterland.

The Development cannot therefore cause displacement of hen harriers from these identified nesting sites, i.e. all studies indicate that disturbance and/or displacement may occur at a range of distances 500-1000 m (Madders, 2004; Bright et al., 2006; 2008). Reviews of the direct disturbance of hen harriers have identified buffers of 500-1000 m (Currie & Elliot, 1997; Petty, 1998; Ruddock & Whitfield, 2007; Whitfield et al., 2008) to minimise disturbance. All identified hen harrier nest and/or roosts are located more than 1 km from turbines in field surveys.

The proportion of the regional population that may are within the range of the Development (2 pairs; 10-20%; **Figure 7.64**) although it should be noted that via the design process the Development is > 1 km set-back (**Table 7.1**) and as observed, this is already an operational windfarm Site where a level of habituation has been demonstrated by these pairs. This reduces the effect of direct disturbance to low, and not significant, subject to decommissioning and construction activity being managed to ensure a disturbance-free zone during any breeding season, and assuming that the nests remain within the same positions, check surveys are proposed to be undertaken prior to decommissioning / construction commencing.

Since the proposed turbines are more than 2 km away and are marginally further away than existing there is no net difference from the baseline position. There are no significant effects predicted to arise due to direct disturbance and the species is further protected by the measures outlined in **Section 7.9.** Similarly roost sites occur beyond 2 km away from turbines, and no direct disturbance or displacement could occur. There appears to be no more than two pairs represented at the nearest roost sites with a maximum of 1 female; 2 males; 1 male / female present at different sites in the vicinity and, although birds are unmarked, it appears likely the local breeding pairs are remaining in the area throughout the winter period.

Displacement may occur where birds avoid areas around windfarms due to both infrastructure and loss of habitat. There remains a risk of displacement of foraging area for hen harriers (Pearce-Higgins et al., 2009) and for collision during the operational lifetime of the windfarm since they are known to occur in the area. There is currently low-negligible risk of displacement of breeding locations during all phases of decommissioning, construction or operation to either of these two pairs and on the basis of current data and retention of <1 km set-back and a CEMP; there is no risk of collision for hen harrier recorded (**Technical Appendix 7.3**) at the Development. This species is also known to nest in close proximity to active windfarms elsewhere.

Pearce-Higgins et al., (2009) indicated an average 53% avoidance at 500 m. Additional temporal avoidance of habitats is likely to occur during foraging. Pearce-Higgins et al., (2009) also suggested avoidance may be up to 78% of the foraging time utilised by hen harriers. The windfarm may therefore remove a portion of existing and potential foraging habitat for the hen harrier although the baseline usage and occurrence of foraging hen harriers is relatively low at Barnesmore (**Technical Appendix 7.1**). Foraging avoidance is likely to extend from a minimum of 100 m from wind turbines, extending to 250 m (Pearce-Higgins et al. 2009; Haworth & Fielding 2012).

There were no hen harrier flights recorded during breeding or wintering vantage point surveys within the 500 m buffer. However based on the sample of VPs in 2017 (360 hours) during 12 months (4,520 hours) and that 73 seconds of flight activity occurred (just beyond the 500 m buffer) and in 2018 (375 hours) during 13 months (4,892 hours) and that 18 seconds of flight activity occurred (just beyond the 500 m buffer) which, when considered on a precautionary basis and extrapolated equates to 15.3 minutes (2017-2018) to 3.9 minutes (2018 - 2019) per annum. The temporal displacement of hen harrier foraging activity then at 53% average may reduce activity to eight minutes (2017) to 2.0 minutes (2018) per annum. Since none occurred within 500 m of baseline (Operational Barnesmore Windfarm) and the Development both footprints may only displace the same amount of negligible flights activity of 2.0 to 8.0 minutes temporal displacement. Although Pearce-Higgins et al. (2009) recognise that -1.2% of temporal displacement may occur which equates to increased usage of the area and up to 74.2% which would be higher displacement (2.9 to 11.4 minutes). There is no quantifiable difference between baseline and the Development.

Pearce-Higgins et al. (2009) indicates that hen harriers will totally avoid an area of approximately 250 m around wind turbines. Taking a (minimal) modelled spatial displacement/avoidance effect distance of 250 m from wind turbines (as described in Pearce-Higgins et al., 2009) results in a potential loss of habitat which may be available for nesting or foraging, of up to 237 ha around the operational wind turbines and up to 257 ha around the proposed wind turbines which is a differential displacement of 20 ha. However, the 250 m zones only partially overlaps with the respective hen harrier territories identified (**Figure 7.64**). At the northern territory the existing turbines overlapped by 172 ha (8.3% of range) and the proposed turbines by 125 ha (6.1%) which is a difference of -47 ha, whilst the eastern territory was overlapped by 130 ha (existing; 6.5%) and 135 ha (proposed; 6.7%) which is 5 ha difference. Whilst the territorial overlap is significantly reduced by repowering the maximum displacement is 20 ha around respective turbine layouts and can be categorised as a low magnitude of displacement effect on hen harrier territories.

Within the 500 m zone, Pearce-Higgins et al. (2009) indicates up to 53% displacement of foraging activity results in a potential displacement zone foraging of up to 478 ha (53% of which is 253.3) around the operational wind turbines and up to 582 ha (53% of which is 308.5) around the proposed wind turbines which is a difference of 55.2 ha over which hen harrier foraging activity may be reduced thereby further reducing collision risk between baseline and the Development. However, the 500 m zones only partially overlaps with the respective hen harrier territories identified (**Figure 7.64**). At the northern territory the existing turbines overlapped by 289 ha (13.9%) and the proposed turbines by 254 ha (12.3%) which is a difference of -35 ha, whilst the eastern territory was overlapped by 213 ha (existing; 10.6%) and 226 ha (proposed; 11.3%) which is 13 ha difference.

There are for habitat remediation and restoration measures proposed as part of the habitat management plan within the windfarm which will benefit bird species, including prey species for the hen harrier and linear feature creation / retention to mitigate for any displacement of hen harrier foraging and/or indirect loss of prey species at this locality (**Section 7.9.3; HMP**). Foraging observations of hen harrier were noted along prey-rich features in the wider Site partially along the juxtaposition between lowland and upland habitat zones on the western side of the Site and the species frequently utilises linear features, scrub, hedgerow, drains, tracks and field boundaries for foraging.

The displacement modelling for total avoidance here therefore indicates that there is a slightly larger potential zone of influence on hen harriers (for one pair at least) in the Development compared to the baseline. This difference is proposed to be mitigated with compensation proposed for priority habitats via the Draft Habitat Management Plan. This habitat will be optimised (restored) such that it will be higher quality for foraging hen harrier should they occur during the operation of the Development. In particular the removal of self-seeded conifers and restoration of parts of the mountain and NHA will be beneficial to hen harriers breeding and wintering in the area.

The data collected here indicates a small number of annual flight activity and transits through the area but beyond the Development 500 m buffer for hen harriers. Since flights of this species were at negligible risk of collision (**Technical Appendix 7.3**) a negligible magnitude effect of collision is predicted based on published research and site specific metrics including adequate set-back distances to nearby nest and/or roost sites (**Technical Appendix 7.1**).

The proposed turbines are further than minimum avoidance distances of disturbance / displacement effects (> 2km) for hen harrier and there are low magnitude effects of disturbance / displacement and negligible magnitude of effects of collision. Therefore, moderate to slight (minor) significant effects are predicted on the hen harriers prior to implementation of habitat management measures to manage, create and restore habitats within the Site and avoid disturbance during the decommissioning and construction phases.

On the basis of published research which generally indicates a relatively low sensitivity to windfarms, low risk of collision and some displacement effects and the observed information at this locality which shows an occasional occurrence (**Technical Appendix 7.1**), no spatial overlap of both breeding (> 2 km away) or wintering locations (>4 km away), and low collision risk estimates (**Technical Appendix 7.3**) in both the Development and the Operational Barnesmore Windfarm the magnitude of change between baseline (Operational Barnesmore Windfarm) and proposed windfarm is therefore assessed as having an overall slight significant effect prior to mitigation for displacement only. The effect is reduced and not significant subject to appropriate mitigation measures (**Section 7.9.3; HMP**). There is also a lower predicted risk of collision for the Development turbines than for the operational turbines (**Technical Appendix 7.3**) indicating a potentially positive effect for the species locally and regionally by repowering and a reduction in the overlap with foraging range for at least one of the pairs.

7.6.8.11 Potential effects on Kestrel

Kestrel are defined as low sensitivity at this locality since the species is amber-listed. However, this species may be vulnerable to collision since research suggests they are frequently recorded as turbine casualties (Madders & Whitfield, 2006; SNH, 2014; 2017). Kestrel may be at collision risk throughout the operational lifetime of the windfarm with medium-low magnitude for negative effects, with most prevalent risk likely during the breeding season when activity was marginally higher.

There is a maximum of 1 – 2 pairs recorded within 2 km and 2 pairs recorded between 2 km and 5 km. These 1-2 pairs represent 0.008 – 0.02% of the Irish population (**Figures 7.20 – 7.25; 7.39; 7.42**). All breeding sites are located more than 600 m away from existing / proposed turbines and therefore there are negligible risks of direct impacts on the species.

Published research and evidence of close occurrence generally indicates a medium sensitivity to wind turbines, medium-low magnitude risk of displacement effects and the observed information at this locality shows a relatively frequent level of flight occurrence equates to a negligible effect during construction and decommissioning and a slight (minor) to not significant effect during the operational phase. There is also no spatial overlap of breeding locations (>600 m away), which is greater than published set-back distances for similar species, merlin (300-500 m; Ruddock & Whitfield, 2007) and medium-low collision risk estimates given the potential sensitivity of this species in both the Development and the Operational Barnesmore Windfarm (**Technical Appendix 7.3**).

The magnitude of change between baseline (Operational Barnesmore Windfarm) and Development is therefore medium-low for kestrel in the Development in regards to the collision risk estimates provided and their medium sensitivity to windfarms and vulnerability to collision. There is a higher predicted risk for collision in the proposed windfarm than for the operational Site indicating a potentially negative effect for the species by repowering affecting the local pair.

7.6.8.12 Potential effects on Merlin

Merlin are defined as medium sensitivity at this locality since the species is listed on Annex I of the Birds Directive and is amber-listed regionally (Colhoun & Cummins 2013). Merlin may face the same generic risks to wind energy development that have been identified for other birds including behavioural avoidance; perturbation due to habitat modifications and collision. Merlin were recorded foraging only once within the 500 m Study Areas during breeding bird surveys (**Technical Appendix 7.1**).

There is scant information available on effects of windfarms on merlin, although there are some records of turbine-mediated mortality (K. Duffy, personal communication; Hotker, 2006). Ruddock & Whitfield (2007) in that review noted a relative tolerance for some disturbance in this species and relative habituation to human activity in parts of the range (in the US) where urban nesting is frequently recorded although they are considered to be relatively sensitive to disturbance during the laying and egg-incubation stages.

A maximum of one pair of merlin occurs in the wider area which were recorded in different locations between years (1.7 km – 3.6 km) and were recorded elsewhere in the wider hinterland and beyond the zone of influence, which represents a maximum of 0.4% of the national population; 250 - 400 pairs; Hardey et al., 2013). The next nearest pair was recorded beyond 5 km from turbines. A negligible magnitude of effect is therefore predicted and no disturbance and/or displacement is predicted for construction and/or operational phases.

In Ireland, the species is rarely recorded nesting on the ground, and more frequently recorded nesting in other species' nests (predominantly corvid) at the edge of forest plantations i.e. tree nesting. This is confirmed at this Site, and nearby nests were located > 1.5 km away (and up to 15 km away) from the existing and/or proposed turbines.

There is little information available for merlin and the effects of windfarms. Merlin home range may be in the order of 6-7 km^2 (Sodhi & Oliphant, 1992) and connectivity to designated sites should be considered at up to 5 km (SNH, 2016). Published literature (Becker, 1984; Currie & Elliot, 1997; Ruddock & Whitfield, 2007) confirms that disturbance effects on merlin are unlikely beyond 200-500 m. The findings here indicate a negligible risk of displacement, based on predominantly > 1.5 km set-back distance in most years of survey and due to the negligible risk of collision since the species was only recorded in flight outside the 500 m turbine buffers and also at low level i.e. below collision risk height (**Technical Appendix 7.3**).

A range of buffers have been identified for merlin in order to avoid disturbance in the order of 200 m to 400 m (Currie & Elliot, 1997) and 300 m to 500 m (Ruddock & Whitfield, 2007) and this species occurs mostly beyond that distance here, therefore no disturbance or displacement is likely.

On the basis of published research which generally indicates a relatively low sensitivity to disturbance (<500 m) and the observed information at this locality which shows one pair in the wider area of the Operational Barnesmore Windfarm, a relatively low level of flight occurrence (**Technical Appendix 7.1**), limited spatial overlap of breeding locations (> 1 km away and variable between years), and no collision risk (**Technical Appendix 7.3**) results in a negligible magnitude of change between baseline and the Development, which results in a not significant effect for merlin. There is no predicted risk for collision in the Development or for the Operational Barnesmore Windfarm for merlin.

7.6.8.13 Potential Effects on Peregrine

Peregrine are defined as medium sensitivity at this locality since the species is listed on Annex I of the Birds Directive and are green-listed having recovered from previous historical declines. Peregrine were recorded foraging only infrequently during the summer and the winter within the Study Areas and identified territories are known nearby (1.7 km and up to 3.9 km) which have been occupied (intermittently) throughout the operational lifetime of the existing windfarm.

Proposed turbines are further away (1.8 km) than operational turbines from the closest peregrine nest (1.7 km) (**Table 7.11**). Peregrines have various sites in the wider area and locations were identified up to 19 km away. Peregrines are recorded to nest within 200-300 m of active wind turbines in Northern Ireland in similar upland habitats.

The buffer that is recommended for peregrines breeding during wind farm developments (typically multiple turbines in upland habitats) is 500 - 750 m. Ruddock & Whitfield, (2007, see also Whitfield et al., 2008) found recommended buffers or disturbance distance observations ranging from 8 m to 4,500 m. This study reports a mean distance of disturbance 199 m to 354 m although opinions ranged from 10 m to 750 m.

The distance at which human disturbance occurs will vary on a site-specific basis and also seasonally. Whitfield et al. (2008) recommends a buffer of 500 – 750 m during the breeding season. The upper limits found by Ruddock & Whitfield (2007) may be over-protective in pairs that are already habituated. The design of the Development has avoided any risks to disturbance and/or displacement of peregrine falcons at the locality by achieving more than 1.7 km set-back from turbines.

The published research and evidence of close occurrence generally indicates a relatively low sensitivity to wind turbines, and there is a negligible risk of collision and displacement effects and the observed information at this locality which shows a relatively low level of flight occurrence. There is also no spatial overlap of both breeding (>1.7 km away) or wintering locations (>2.2 km away), which is greater than published set-back distances (500-750 m; Ruddock & Whitfield, 2007).

Peregrines may be vulnerable to collision with turbines during the operational phase. With no avoidance a maximum of 0.1 – 0.2 peregrines might be killed annually during the operational and/or Development on the basis of current data, with recommended avoidance rate this is reduced to a negligible number of peregrines (**Technical Appendix 7.3**) with one bird predicted to be killed between 345 and 314 years at either the existing or proposed turbines which varies between years since no collision risk was recorded in the second year of surveys. This equates to a negligible amount of the peregrine population in Ireland (425 pairs).

The nearest pair are recorded to occur within the Barnesmore Bog NHA, however peregrines are known to nest in close proximity to turbines installed at quarry and moorland sites in Ireland (ranging from 25 m to 300 m; M. Ruddock, personal observation) and no displacement is predicted at Barnesmore since the ledges and/or breeding localities are unaffected by the Development. For peregrines there is considered to be a relatively low rate of collision likelihood (Madders & Whitfield, 2006) although a small number of peregrine-turbine collisions are documented within Europe including the Orkney Islands, Scotland (Meek et al., 1993; Ruddock & Reid, 2010; K. Duffy, personal communication). The ability for a population to tolerate extrinsic mortality factors is dependent on demographic parameters of the population being assessed; most notably productivity and survival rates (Ruddock et al., 2008; Whitfield et al., 2008; Fielding et al., 2009; Burke et al., 2015).

Any windfarm mediated causalities are comparatively low in relation to theoretical background or 'natural' mortality levels in peregrines. However, extrinsic mortality factors can be additive and post-construction monitoring of peregrines would be informative, particularly if peregrines are successful breeding in the wider area since young peregrines may be more prone to collision due to inexperience in flight and/or avoidance. Given the predicted value of mortality is of low proportional magnitude of the national population and to "natural" peregrine mortality, the overall impact of collision risk is considered negligible on the peregrine population.

Estimate for actual avoidance can be variable (Chamberlain et al., 2007) although the operational turbines have a lower theoretical risk of collision than the proposed turbines based on the proportion of flights within 500 m of the operational and/or proposed turbines and duration of time spent at risk height, this equates to mortality of only a negligible theoretical number of peregrines. Turbines at which mortality was recorded for peregrines (red kites and merlin) at Braes of Doune, Scotland were all independent of proximity to known nest sites (K. Duffy, personal communication). Therefore, it is not possible to predict which, if any, of the turbines may be a source of mortality. Theoretical collision risk for this species is negligible (**Technical Appendix 7.3**).

The magnitude of change between baseline and the Development is therefore negligible for peregrine. There is a higher predicted risk for collision in the Development than for the existing Site indicating a potentially negative effect for the species locally and regionally, however the mortality predictions are in the order of several hundred years and overall collision risk is low. Therefore, a not significant effect is predicted for this species. No significant direct or secondary effects are likely during construction and/or operational phases.

7.6.8.14 Potential Effects on Sparrowhawk

Sparrowhawk are defined as low sensitivity at this locality since the species is amber-listed. There is little information available on the impacts of windfarms on this species, but generally given the low altitude flights (typically <10 m a.g.l.) the likelihood of collision is negligible. At the Site, all nesting pairs identified were recorded at least 2 km from existing turbines. This species is dependent on mature conifer plantation for nesting at the present locality, which are subject to future clear-felling.

Flights were recorded for this species within 500m but there were negligible observed or theoretical risks of displacement or collision given the set-back distances recorded (>480 m) from existing turbines, and the low-level flights recorded, none of which were at collision risk height for either the existing or proposed turbines. There are two to three sparrowhawk pairs recorded within the 5 km Survey Area (**Technical Appendix 7.1**) which comprise 0.005 – 0.09% of the 9,100 pairs nationally (Crowe et al., 2014).

In summary, relatively low frequency of low altitude flights, generally indicates a relatively negligible sensitivity to wind turbines, with a negligible risk of collision and of displacement effects, and observed information at this locality shows a relatively low level of flight occurrence (**Technical Appendix 7.1**). There is also no spatial overlap of breeding locations (> 2 km away), which is greater than published set-back distances for the similar, albeit larger species, goshawk (300-500 m; Ruddock & Whitfield, 2007) and negligible collision risk estimates are predicted. Therefore, the magnitude of change between baseline and the Development is assessed to be negligible for sparrowhawk and not significant for this species.

7.6.8.15 Potential Effects on White-tailed Eagle

There were no fixed breeding and/ wintering locations for white-tailed eagle but a sub-adult eagle was seen widely ranging in the area during both years of survey in both winter and summer. This was a tagged bird fledged from Ireland in 2015 and recorded in Fermanagh and Donegal since 2016. The bird has since returned to the natal area (Lough Derg, Co. Clare / Tipperary) in 2019.

White-tailed eagle were recorded fishing at Lough Slug and the maintenance of water quality and protection of waterbodies from pollution and/or deterioration is critical for the protection of the aquatic resources including fish species. An Outline CEMP is included with the EIAR.

In the absence of a breeding and/or fixed wintering locality there are no likely direct effects from construction predicted. Should a territorial or regular wintering area become identified within 5 km to 13 km (SNH, 2016) in the future this can be considered further and any likely direct effects avoided utilising the set-back distances recommended by Ruddock & Whitfield (2007; 500 m - 750 m). No significant direct effects are likely during decommissioning and construction and/or operational phases.

White-tailed eagles are known to be sensitive to windfarm mediated collision (Dahl et al., 2012) and a number of eagles have been killed in Ireland due to turbine collisions (Fennelly, 2015). The white-tailed eagle was recorded at collision risk height and collision risk modelling was undertaken to examine the risk between Operational Barnesmore Windfarm and the Development.

Based on observational data, white-tailed may, theoretically be vulnerable to collision with turbines during the operational phase. With no avoidance a maximum of 1.07 – 1.12 eagles might be killed annually during the operational and/or Development on the basis of current data, with recommended avoidance rate this is reduced to a negligible number of eagles (**Technical Appendix 7.3**) with one bird predicted to be killed between 18.7 and 17.8 years at either the existing or proposed turbines which varies between years since no collision risk was recorded in the second year of surveys.

Since the population of white-tailed eagles is small in Ireland, 10-12 pairs (IRSG, 2018; 2019) mortality effects may be higher and it is possible that increased mortality caused by collisions at windfarms or increased levels of mortality could have a large influence on the small reintroduced population and could restrict population growth (Sansom et al., 2016; Whitfield et al., 2004b, Smart et al., 2010). This could slow the recovery of the species in Ireland if large numbers of collisions occurred, however in the context of Barnesmore since there are no established territories and/or wintering locations there are no likely significant effects that could occur. No significant direct effects are likely during construction and/or operational phases.

Therefore, the magnitude of change between baseline and the Development is assessed to be negligible for white-tailed, due to negligible vulnerability to collision, disturbance or displacement and the absence of extant breeding and/or wintering sites for the species. Therefore a not significant effect is predicted for this species.

7.6.8.16 Potential Effects on Swans & Geese

There were a range of goose and swan species detected during surveys including white-fronted goose, light bellied Brent goose, Canada goose, greylag goose, hybrid / feral goose, mute swan and whooper swan. Potentially significant effects were excluded for the majority of these species (**Table 7.5**) since they were not recorded within close proximity (>500m) and most species were more than 5 km away from the Operational Barnesmore Windfarm and/or the Development (**Tables 7.11; 7.14**).

The nearest wintering location for white-fronted geese (as citation species for nearby SPAs) observed was 7.3 km – 8.2 km away whilst other wintering sightings occur at much further away (**Figures 7.25; 7.26; 7.44; 7.45**). There were no breeding records of this species and no wintering geese were located within the footprint of the Development. Therefore no direct effects may occur. Any likely direct effects are avoided given the set-back distances of turbines from white-fronted goose since Langston & Pullan, (2003) recommend avoidance of circa 560 m for geese and McGuinness et al., (2015) recommends a 600 m sensitivity, and all white-fronted geese noted are considerably beyond this distance (> 7 km), therefore it is predicted these territories will be not be directly affected by construction.

7.6.8.17 Potential Effects on Whooper Swan

There is some potential disturbance and displacement risk to whooper swans, including roosting sites. While there was no collision risk on the basis of current field data, some potential effects on this Annex 1 species are possible. Whooper swans were recorded within 500 m of both existing and proposed turbines and also in the wider hinterland searches. In particular a number of roost sites were identified within and surrounding the Development at Lough Golagh and Lough Naleaghany. Whooper swans were recorded at 335 m from existing turbines in both 2017 and 2018 and at 349 m and 362 m from proposed turbines so marginally closer to the operational turbines (**Table 7.14**).

The swans utilising the Site were typically small family groups comprised of both adults and juveniles and appeared to use two main corridors for flight activity to / from other roosting / foraging sites along the east-west axis of both Lough Golagh and Lough Naleaghany. There were two apparent connected locations identified for the birds using the Site to the west and a foraging site > 10 km away (**Figures 7.25; 7.26; 7.44; 7.45**) and also other roost sites at Cullionboy located west of the windfarm. These small family parties appeared to utilise the Site during migration seasons in particular but swans were identified throughout the winter in the area. In some surveys swans were also recorded to utilise the loughs on Site throughout the day / night and did not depart or fly for several days at a time and foraged at edges of the loughs and/or loafed on the water for extended periods of time as well as roosting overnight and for extended sequential days.

The turbines are located within 600 m from the nearest known historical and identified wintering roost sites for whooper swans, which is within the published avoidance distances for swans and other wildfowl (Winkelman, 1985; Langston & Pullan, 2003; Fijn et al., 2012; McGuiness et al., 2015). Whilst there may be a risk of both collision and displacement of whooper swan at operational turbines (Rees, 2012) collision risk may be increased in poor visibility and at smaller turbines (Larsen & Clausen, 2002) and displacement at foraging sites may only extend to avoidance of 200 m – 400 m (Fijn et al., 2012) although one review suggests a maximum of 500 m – 600 m (Langston & Pullan, 2003) and indicative sensitivity in Ireland proposed at 600 m (McGuiness et al., 2015).

Flying swans were detected at distances of 180 m - 657 m to existing and 181 m – 198 m to proposed turbines but none of these flights were at risk of collision. There are potential displacement (barrier) effects due to novel turbines on the southern parts of the Site which were reviewed although the main commuting routes or foraging – roosting flyways were identified further away but within 5 km particularly along the Barnesmore Gap however it is clear that swans are habituated at the Operational Barnesmore Windfarm (<350 m) and design of the Development has incorporated specific wider spacing to avoid barrier effects of turbines (see **Section 7.6**) and individual screening of risk turbines.

In a detailed study of turbine avoidance by wintering pink-footed geese Larsen & Madsen (2000) suggest that 100-200 m was the avoidance distance for foraging geese and that over time they habituated (40-100 m) to the turbine presence (Madsen & Boertmann, 2008). The tolerance of turbines by Bewick's swans was also recorded to be a function of food supply and availability of supplementary food (Fijn et al., 2012) and that they actually moved closer to turbines later in the wintering periods.

Fijn et al., (2012) found that foraging Bewick's swans occurred on average 560 m from turbines (nine turbine windfarm with rotor swept height of 40 m - 140 m) but were recorded as close as 125 m. Since the nearest known roosts utilised by whooper swans and greylag (and other waterfowl), is currently >10 km from all turbines and the SPA is more than 10 km away for which some of these species are site features (**Figures 7.5; 7.20 – 7.26; 7.39**) therefore on the basis of majority of published tolerance information which ranges between 125 m and 600 m will result in lower risks of displacement since habituation is evident on Site.

Swans and geese, and particularly whooper swans are rarely reported as turbine collision victims (Fijn et al., 2012; Rees, 2012) and more often are recorded to collide with power-lines (Rees, 2006). It is likely that turbines in general will be avoided by all swans (see also Fijn et al., 2012) and most regularly swans are known to fly relatively low <10 m a.g.l. These data are confirmed by GPS satellite flight data which recorded flights at an average of 9 m a.g.l. over terrestrial habitats and 31 m a.g.l over aquatic habitats (Griffin et al., 2011).

The documented terrestrial flying heights are below the rotor swept height of the proposed turbines and migrating flights as detected during surveys were actually below rotor height (for both existing and proposed turbines) and the swan migration or foraging / commuting fly-ways identified during surveys recorded were <20 m a.g.l and/or outside the turbine envelopes(s) and/or more than 500 m away from the operational and/or proposed turbines and therefore no collision risks were detected. The small number of whooper swans were recorded that could be at theoretical risk of mortality if they passed through the proposed windfarm although the flights recorded here were >500 m from proposed turbines and/or above rotor height along the Barnesmore Gap which appears to act as a natural commuting corridor for swans (and geese).

It is concluded that there is a low potential risk of displacement for small numbers of whooper swans (3 – 5 birds; 0.4% of the Irish population and 1.0% of the Donegal (county) population) at the Development since swans, where they occurred, are within 560 m – 600 m (see Langston & Pullan, 2003) from the turbine although literature confirms that displacement is usually only temporary in wildfowl (Larsen & Madsen, 2000; Madsen & Boertmann, 2008; Fijn et al., 2012; see also Pearce-Higgins et al., 2012) and there is significant evidence of habituation behaviours at the Operational Barnesmore Windfarm.

It is concluded that there is negligible risk of collision from both the proposed turbines based on observed flying heights and flying trajectories and on the basis of published information larger turbines can actually reduce collision risk (Larsen & Clausen, 2002) when compared to smaller turbines which is the effective results of the Development and also when compared to those smaller turbines which occur in the wider vicinity (**Technical Appendix 2.1**). Overall then no significant impacts are predicted for the proposed turbines and appropriate set-backs are retained to any swans both historically and currently, however it is noted that some turbines are located at novel areas, but removal and/or marking of extant powerlines has been proposed to reduce risk of collision with wires and monitoring of potential barrier effects will be undertaken (see **Section 7.9**).

Whooper swans are classified as medium sensitivity species since they are on Annex I of the Birds Directive and are red-listed. On the basis of the set-back distances from wintering sites (<500 m) and potential flight pathways recorded during vantage point observations although there is no evidence of significant impacts in the literature whooper swan (nor for other swans or geese) there is a low-negligible risk of displacement and disturbance but negligible risk of collision, and therefore there is slight to not significant change in the magnitude of any decommissioning and construction and/or operational effects due to the Development. Therefore, a not significant effect is predicted for these species.

7.6.8.18 Potential Effects on Other Waterbirds

There were a number of waterfowl and waterbirds recorded within the wider hinterland and a small number recorded occasionally within the 500 m buffers (including mallard, teal and wigeon) the majority for which potential effects were scoped out (**Tables 7.5 & 7.7**) and two species in particular that were frequently recorded from vantage point surveys, and during wider walkover and priority species surveys within the Site, namely cormorant and heron.

7.6.8.19 Potential Effects on Cormorant

Cormorant are defined as low sensitivity at this locality since the species is amber-listed. There is little information available on the impacts of windfarms on this species, but generally given the low altitude flights (typically <10 m a.g.l.) the likelihood of collision is negligible. At the Site, there were no nesting pairs recorded however birds (mostly individuals) identified regularly utilising the loughs within and around the Site including Lough Golagh, Lough Naweelagh, Lough Nabrackboy and Lough Slug.

They were recorded a minimum of 60 m from existing turbines, and at least 275 m from proposed turbines, so set-back distances are further away for the Development although birds moved widely around each of the loughs and distances will change. This species is dependent on the waterbodies for foraging at the present locality, which are evidently relatively abundant food (fish) sources since cormorants routinely utilise these areas for foraging and have some regularly utilised flight paths and axes of access and departure to / from the Site.

Based on observational data, cormorants may, theoretically be vulnerable to collision with turbines during the operational phase. With no avoidance a maximum of 0.4 – 1.1 cormorants might be killed annually during the operational and/or Development on the basis of current data, with recommended avoidance rate this is reduced to a negligible number of cormorants with one bird predicted to be killed between 47.3 years / 50.6 years (2017-2018) and 122.7 years / 131.4 years (2018-2019) at either the existing or proposed turbines which is less risk of collision at the Development thereby representing a betterment for this species. There is also a lower predicted risk of collision for the Development turbines than for the operational turbines indicating a potentially positive effect for the species by repowering (**Technical Appendix 7.3**).

In summary, relatively low collision risks, generally indicates a relatively negligible sensitivity to wind turbines and habituation to the Operational Barnesmore Windfarm, with a negligible magnitude of collision and low risk of displacement effects, and observed information at this locality shows a regular flight occurrence (**Figures 7.14 & 7.33**). There is also no spatial overlap of breeding locations (> 5 km away). Spatial buffers and/or temporal cessation of works are usually prescribed to protect birds, including wader and wildfowl species, from disturbance (Hockin et al., 1992; Rodgers, 1993; Rodgers & Smith, 1995; 1997; Fernandez-Juricic *et al.,* 2001; Rodgers & Schwikert, 2002; 2003; Kirazli, 2015). From some of these published studies the response to disturbance in other similar waterbird species ranges from 50-175 m and buffers of (nests / colonies) have been prescribed between 90 and 250 m so temporary and/or long-term effects of disturbance are unlikely at Barnesmore.

Whilst no direct effects may be likely, secondary effects on the foraging resources may potentially be slight significant effects if water quality and/or fish species are affected on the Site. Effects on the hydrological resources at the Site are assessed in **Chapter 8: Hydrology and Hydrogeology** and mitigation and measures to protect these are detailed in the Outline CEMP document.

Therefore, the magnitude of change between baseline and the Development is assessed to be negligible and positive for cormorant, due to negligible vulnerability to collision, disturbance or displacement and provided the food resource in the on-site water bodies, is not significantly altered. Therefore, a not significant effect is predicted for this species.

7.6.8.20 Potential Effects on Heron

Grey heron are defined as negligible sensitivity at this locality since the species is green-listed (Colhoun & Cummins, 2013). There is little information available on the impacts of windfarms on this species, but generally given the low altitude flights (typically <10 m a.g.l.) the likelihood of collision is negligible. At the Site, there were no nesting pairs recorded however birds (mostly individuals) identified regularly utilising the loughs within and around the Site including Lough Golagh, Lough Naleaghany, Blind Lough and Lough Slug. Predominantly birds are recorded using Lough Golagh.

Birds were recorded within the 500 m of both proposed and operational turbines and birds moved widely around each of the loughs and flew to / from various shores and banks and flights were typically low level within the Site. This species is dependent on the waterbodies for foraging at the present locality, which are evidently relatively abundant food (fish) sources since herons routinely utilise these areas for foraging and have some regularly utilised flight paths and axes of access and departure to / from the Site.

Based on observational data, herons may, theoretically be vulnerable to collision with turbines during the operational phase and were recorded at risk height in only one year of survey. With no avoidance a maximum of 0.36 – 0.39 herons might be killed annually during the operational and/or Development on the basis of current data, with recommended avoidance rate this is reduced to a negligible number of cormorants with one bird predicted to be killed between 129 years and 137 years at the existing or proposed turbines respectively which is lesser risk of collision at the Development thereby representing a betterment for this species. There is also a lower predicted risk of collision for the Development turbines than for the operational turbines indicating a potentially positive effect for the species by repowering (**Technical Appendix 7.3**).

In summary, relatively low collision risks, generally indicates a relatively negligible sensitivity to wind turbines and habituation to the Operational Barnesmore Windfarm, with a negligible magnitude of collision and of low magnitude of displacement effects, and observed information at this locality shows a regular flight occurrence and habituation to the Operational Barnesmore Windfarm. There is also no spatial overlap of breeding or significant wintering locations (> 5 km away). Spatial buffers and/or temporal cessation of works are usually prescribed to protect birds, including wader and wildfowl species, from disturbance (Hockin et al., 1992; Rodgers, 1993; Rodgers & Smith, 1995; 1997; Fernandez-Juricic *et al.,* 2001; Rodgers & Schwikert, 2002; 2003; Kirazli, 2015). From some of these published studies the response to disturbance in other similar waterbird species ranges from 50-175 m and buffers of (nests / colonies) have been prescribed between 90 and 250 m so temporary and/or long-term direct effects of disturbance / displacement / collision are unlikely at Barnesmore.

Whilst no direct effects may be likely, secondary effects on the foraging resources may potentially be significant if water quality and/or fish species are affected on the Site. Effects on the hydrological resources at the Site are assessed in **Chapter 8: Hydrology and Hydrogeology** and mitigation and measures to protect these are detailed in the Outline CEMP document.

Therefore, the magnitude of change between baseline and the Development is assessed to be negligible for heron, due to negligible vulnerability to collision, disturbance or displacement and provided water management plan is implemented to protect the food resource for this species. Therefore, a not significant effect is predicted for this species.

7.6.8.21 Potential Effects on Small Passerines

There are a number of medium sensitivity (red-listed), low sensitivity (amber-listed) and negligible sensitivity (green-listed) species in the 500 m turbine area and/or footprint of the Development infrastructure. The majority of these do not occur in internationally, nationally, regionally significant population thresholds and there are only small differences in the footprint analysis between existing/proposed turbine and infrastructure buffers (**Section 7.6.1**). Two red-listed species were recorded namely meadow pipit and grey wagtail; the former occur extensively across the Site and the latter is restricted to 1 – 2 pairs near water edges and the extant control building for the Operational Barnesmore Windfarm. Significant baseline issues with turf-cutting related disturbance with small passerines were observed whereby areas which contained breeding birds during March and April were vacant by May when turf cutting activities typically commenced. Distributions of some species including small passerines may also have been affected at a number of locations by turf cutting activities including within the NHA.

Footprint analysis of breeding season data identified a small number of breeding territories within the Turbine and Infrastructure Buffer, which varied spatially between years (**Sections 7.6.1; 7.6.2**). These small number of territories may be directly disturbed and/or displaced but research also indicates that some species e.g. skylark and stonechat may actually increase during construction and that others may be more vulnerable to displacement wheatear and meadow pipit (Pearce-Higgins et al., 2012). Whilst one or two territories of some species (house martin, stonechat, swallow, wheatear, wren and willow warbler) were recorded in the footprint of the Development the two predominant species in the footprint were meadow pipit and skylarks. One corvid was also recorded (raven).

Footprint analysis of wintering data identified only a small number of passerines species (snow bunting, stonechat and wren) and one corvid (hooded crow) within the Turbine and Infrastructure Buffer, which varied spatially between years all of which can move away to other adjacent habitats during the winter.

There were three red-listed species recorded including meadow pipit, grey wagtail and ring ouzel. The former two do not occur in significant populations although there was a high abundance of meadow pipits locally but one species occurs of national significance (ring ouzel) with one pair recorded here representing (3.6%) of the Irish population (14 – 24 pairs; NPWS, 2015). Ring ouzel occur within 500 m of both proposed and existing turbines in one year of survey and were recorded at two separate breeding localities during surveys. One of these locations was within 400 m and in one year the ring ouzel were recorded closer to proposed turbines than existing turbines (590 m to 631 m) and in the second year of survey were further away from proposed turbines (367 m) than existing turbines (365 m) (**Table 7.11**). The species was also recorded in the spring of 2019 at a third (more distant) site beyond the 500 m buffer. Whilst this species is rare in Ireland it is evidently habituated to the Operational Barnesmore Windfarm and was also observed near the existing met mast during an additional survey for SPR.

As a smaller bird disturbance in ring ouzel is more likely to occur in the range of 100 – 300 m and particularly due to human presence although there may be significant variation in the sensitivity of individual birds to disturbance (Leyland, 2016). The birds were observed to defend an area from hooded crows and began mobbing behaviours of those corvids at approximately 150 m and therefore management of disturbance, particularly human activity, on the northern parts of the Site are critical to ensuring a disturbance free zone for ring ouzel and appropriate signage and awareness can increase nest success (Leyland, 2016). Predation and interaction with corvids (particularly hooded crows) may have caused failure in breeding in at least one year. Given the importance of this species nationally implementing a disturbance free-zone would be beneficial for ring ouzel to try and improve breeding success given their presence in three separate years. There are no likely direct or secondary effects on this species during construction and/or operation provided adequate set-back distances are retained and disturbance management measures are implemented during both construction and during operational phases.

Based on Pearce-Higgins et al., (2009) there is a predicted average loss of a small number of meadow pipit territories, although there were similar predictions for both the operational and proposed turbines (with 8-15 territories difference between years; although footprint analysis indicates similar potential displacement (8-17 territories) and thus the magnitude of change between baseline and the Development is low magnitude since this represents between 2.0% and 3.0% (**Table 7.3**) of local populations of birds in the area i.e. 556 - 844 meadow pipit territories recorded in the wider 500 m Survey Areas (**Section 7.6.1**).

No high or very high sensitivity species are likely to be affected during Development phases. Skylark are not considered to be significantly affected by displacement (Pearce-Higgins et al., 2009; 2012) but may be vulnerable to disturbance and the difference between existing and operational footprints is between one and three territories which represents 2.3 – 3.8% of the 26 - 129 territories recorded in the wider 500 m Survey Areas (**Section 7.6.1**) which is a low magnitude of effect.

Whilst there are a small number of medium sensitivity (red-listed), low sensitivity (amber-listed) and negligible sensitivity (green-listed) species in the wider 500 m Survey Area and footprint area none of these occur in internationally, nationally, regionally significant population thresholds and there are only small differences in the footprint analysis between existing/proposed turbine and infrastructure buffers (**Section 7.6.1**) which may cause direct disturbance and/or displacement during construction. Therefore a low magnitude, negative effect which equates to minor, and therefore not significant effect is predicted. This would reduce to negligible, and a not significant effect on the displacement of small passerines breeding locations provided adequate construction disturbance reduction measures are put in place (**Section 7.9**).

Table 7.18: Summary of Sensitivity, Extent, Magnitude, Duration and Significance of Effects Prior to Mitigation

Receptor	Sensitivity	Potential Effect	Receptor Importance	Magnitude of Effect	Duration of Effect	Significance of Effect
Decommissioning / Construction Phase						
Golden eagle	High	Disturbance Displacement	National / County National / County	Negligible (>750 m; >1.5 km) Negligible (>750 m; >1.5 km)	Short-term Short-term	Not significant Not significant
Hen harrier	High	Disturbance Displacement	National / County National / County	Negligible (>500 m; >750 m) Low (>500 m; >750 m)	Short-term Short-term	Not significant Slight (Minor)
Merlin	Medium	Disturbance Displacement	Local (Higher) Local (Higher)	Negligible (>500 m) Negligible (>500 m)	Short-term Short-term	Not significant Not significant
Peregrine	Medium	Disturbance Displacement	Local (Higher) Local (Higher)	Negligible (>500 m; >750 m) Negligible (>500 m; >750 m)	Short-term Short-term	Not significant Not significant
Buzzard	Low – Negligible	Disturbance Displacement	Local (Higher) Local (Higher)	Negligible (>500 m) Negligible (>500 m)	Short-term Short-term	Not significant Not significant
Kestrel	Low	Disturbance Displacement	Local (Higher) Local (Higher)	Negligible (>500 m) Negligible (>500 m)	Short-term Short-term	Not significant Not significant
Sparrowhawk	Low	Disturbance Displacement	Local (Higher)	Negligible (>500 m) Negligible (>500 m)	Short-term Short-term	Not significant Not significant

Receptor	Sensitivity	Potential Effect	Receptor Importance	Magnitude of Effect	Duration of Effect	Significance of Effect
			Local (Higher)			
White-tailed eagle	High	Disturbance Displacement	National National	Negligible (>500 m; >750 m) Negligible (>500 m; >750 m)	Short-term Short-term	Not significant Not significant
Common sandpiper	Low	Disturbance Displacement	Local (Higher) Local (Higher)	Medium (<50 - 100 m) Medium (<50 – 100 m; pollution of foraging resources)	Short-term Short-term	Slight (Minor) Slight (Minor)
Golden plover	Medium	Disturbance Displacement	Local (Higher) Local (Higher)	Low (> 400 m breeding; <400 wintering; evidence of habituation) Medium - Low (> 400 m breeding; <400 wintering; evidence of habituation)	Short-term Short-term	Slight Moderate – Slight (Minor)
Curlew	High	Disturbance Displacement	National / County National / County	Negligible (>800 m) Negligible (>800 m)	Short-term Short-term	Not significant Not significant
Snipe	Low	Disturbance Displacement	Local (Higher) Local (Higher)	High - Medium (<400 m; evidence of sensitivity in literature; evidence of habituation) High - Medium (<400 m; evidence of sensitivity in literature; evidence of habituation)	Short-term Short-term	Moderate – Slight (Minor) Moderate – Slight (Minor)
Red grouse	Medium	Disturbance Displacement	Local (Higher) Local (Higher)	Low (<500 m) Negligible (<500 m)	Short-term Short-term	Slight (Minor) Not significant
Whooper swan	Medium	Disturbance Displacement	County County	Low (<500 m wintering; evidence of habituation) Low (<500 m; wintering; evidence of habituation)	Short-term Short-term	Slight (Minor) Slight (Minor)
Cormorant	Low	Disturbance Displacement	Local (Higher) Local (Higher)	Low (<500 m; pollution of foraging resource) Low (<500 m; pollution of foraging resources)	Short-term Short-term	Slight (Minor) Slight (Minor)
Heron	Low	Disturbance Displacement	Local (Higher) Local (Higher)	Low (<500 m; pollution of foraging resource) Low (<500 m; pollution of foraging resources)	Short-term Short-term	Slight (Minor) Slight (Minor)

Receptor	Sensitivity	Potential Effect	Receptor Importance	Magnitude of Effect	Duration of Effect	Significance of Effect
Meadow pipit	Medium	Disturbance Displacement	Local (Higher) Local (Higher)	Low (small numbers may be disturbed) Low (small numbers may be displaced)	Short-term Short-term	Slight (Minor) Slight (Minor)
Skylark	Low	Disturbance Displacement	Local (Higher) Local (Higher)	Low (small numbers may be disturbed) Low (small numbers may be displaced)	Short-term Short-term	Slight (Minor) Slight (Minor)
Ring ouzel	Medium	Disturbance Displacement	National National	Low (<400 m; sensitive to disturbance) Low (<400 m; sensitive to displacement)	Short-term Short-term	Slight (Minor) Slight (Minor)
Small passerines	Medium / Low / Negligible	Disturbance Displacement	Local (Higher) Local (Higher)	Low - Negligible (small numbers may be disturbed) Low - Negligible (small numbers may be displaced)	Short-term Short-term	Slight (Minor) – Not Significant Slight (Minor) – Not Significant
Operational Phase						
Golden eagle	High	Displacement Collision	National / County National / County	Low (>750 m; >1.5km; within foraging range; reduced difference of displacement) Negligible (>750 m; 1.5km)	Permanent but reversible Permanent but reversible	Slight (Minor) Not significant
Hen harrier	High	Displacement Collision	National / County National / County	Low (>500 m; >750 m; within foraging range; 5 – 13 ha difference of displacement) Negligible (>500 m; >750 m; low altitude flights)	Permanent but reversible Permanent but reversible	Moderate – Slight (Minor) Not significant
Merlin	Medium	Displacement Collision	Local (Higher) Local (Higher)	Negligible (>500 m; low frequency of occurrence) Negligible (>500 m; low altitude flights)	Permanent but reversible Permanent but reversible	Not significant Not significant
Peregrine	Medium	Displacement Collision	Local (Higher) Local (Higher)	Negligible (>500 m; >750 m) Negligible (>500 m; >750 m)	Permanent but reversible Permanent but reversible	Not significant Not significant
Buzzard	Low – Negligible	Displacement	Local (Higher)	Low - Negligible (>500 m)	Permanent but reversible	Slight (Minor) – Not significant

Receptor	Sensitivity	Potential Effect	Receptor Importance	Magnitude of Effect	Duration of Effect	Significance of Effect
		Collision	Local (Higher)	Low - Negligible (>500 m)	Permanent but reversible	Slight (Minor) – Not significant
Kestrel	Low	Displacement	Local (Higher)	Negligible (>500 m)	Permanent but reversible	Not significant
		Collision	Local (Higher)	Medium – Low (>500 m; vulnerable to collision; higher risk at Development)	Permanent but reversible	Slight (Minor) – Not significant
Sparrowhawk	Low	Displacement	Local (Higher)	Negligible (>500 m)	Permanent but reversible	Not significant
		Collision	Local (Higher)	Negligible (>500 m; low altitude flights)	Permanent but reversible	Not significant
White-tailed eagle	High	Displacement	National	Negligible (non-breeding / non-territorial bird; no extant risk)	Permanent but reversible	Not significant
		Collision	National	Negligible (non-breeding / non-territorial bird; no extant risk)	Permanent but reversible	Not significant
Common sandpiper	Low	Displacement	Local (Higher)	Medium (<50 - 100 m; pollution of foraging resource)	Permanent but reversible	Slight (Minor)
		Collision	Local (Higher)	Negligible (<50 – 100 m; low altitude flights)	Permanent but reversible	Not significant
Golden plover	Medium	Displacement	Local (Higher)	Medium - low (<400 m; evidence of habituation)	Permanent but reversible	Moderate - Slight
		Collision	Local (Higher)	Negligible (evidence of habituation)	Permanent but reversible	Not significant
Curlew	High	Displacement	National / County	Negligible (>800 m)	Permanent but reversible	Not significant
		Collision	National / County	Negligible (>800 m; low altitude flights)	Permanent but reversible	Not significant
Snipe	Low	Displacement	Local (Higher)	High - Medium (evidence of habituation on site; difference in displacement predictions between operational and proposed windfarm)	Permanent but reversible	Moderate – Slight (Minor)
		Collision	Local (Higher)	Negligible (low altitude flights)	Permanent but reversible	Not significant
Red grouse	Medium	Displacement	Local (Higher)	Negligible (evidence of habituation on site; annual variation in population size; no evidence of sensitivity to windfarms	Permanent but reversible	Not significant
		Collision	Local (Higher)	Negligible (low altitude flights)	Permanent but reversible	Not significant

Receptor	Sensitivity	Potential Effect	Receptor Importance	Magnitude of Effect	Duration of Effect	Significance of Effect
Whooper swan	Medium	Displacement	County	Low-negligible (<500 m; evidence of habituation)	Permanent but reversible	Slight (Minor) – Not significant
		Collision	County	Negligible (<500 m; low altitude flights; evidence of habituation)	Permanent but reversible	Not significant
Cormorant	Low	Displacement	Local (Higher)	Low (<500 m; pollution of foraging resource)	Permanent but reversible	Slight (Minor)
		Collision	Local (Higher)	Negligible (<500 m; reduction of collision risk)	Permanent but reversible	Not significant
Heron	Low	Displacement	Local (Higher)	Low (<500 m; pollution of foraging resource)	Permanent but reversible	Slight (Minor)
		Collision	Local (Higher)	Negligible (<500 m; reduction of collision risk)	Permanent but reversible	Not significant
Meadow pipit	Medium	Displacement	Local (Higher)	Low (small numbers may be displaced)	Permanent but reversible	Slight (Minor)
		Collision	Local (Higher)	Negligible (no evidence of collision risk)	Permanent but reversible	Not significant
Skylark	Low	Displacement	Local (Higher)	Low (small numbers may be displaced; no evidence of sensitivity to windfarms)	Permanent but reversible	Slight (Minor)
		Collision	Local (Higher)	Negligible (no evidence of collision risk)	Permanent but reversible	Not significant
Ring ouzel	Medium	Displacement	National	Low (sensitive to disturbance)	Permanent but reversible	Slight (Minor)
		Collision	National	Negligible (low altitude flights)	Permanent but reversible	Not significant
Small passerines	Medium / Low / Negligible	Displacement	Local (Higher)	Low – Negligible (small numbers may be displaced)	Permanent but reversible	Slight (Minor) – Not significant
		Collision	Local (Higher)	Negligible (no evidence of collision risk)	Permanent but reversible	Not significant

7.6.8.22 Potential Effects on Designated Sites or Site Features

Within 15 km (as required by NPWS 2019; scoping response; **Table 7.1**) the key ornithological sites to be considered are Pettigoe Plateau SPA (5-6 km white-fronted goose; 1996), Lough Derg SPA (6-7 km; lesser black-backed gull; herring gull; 1995), Donegal Bay SPA (10-11 km; great northern diver, light-bellied brent goose, common scoter, sanderling and wintering waterbird assemblage; 2004), Lough Nillan Bog SPA (14-15 km; merlin, golden plover, white-fronted goose, dunlin; 1996) and Pettigoe Plateau SPA (NI) (14-15 km; golden plover, white-fronted goose; 1996). Four of these five SPA sites were designated just prior to the construction of the Operational Barnesmore Windfarm (1995 – 1996) whilst one was after the construction of the windfarm (2004).

The two SPA designated species which were identified to potentially be affected at Barnesmore are merlin and golden plover these are local birds rather than constituent parts of the respective SPAs. Since a range of other Annex 1 species were detected in the wider hinterland the detections, potential flight path connectivity and proximity were reviewed to /

from Barnesmore, namely red-throated diver, great northern diver, light-bellied brent goose, sanderling, herring gull, lesser black-backed gull and white-fronted goose and significant effects were excluded at the outset for these species. Common scoter and dunlin were not detected during surveys.

White-fronted goose were recorded from a range of sites more than 6.3 – 8.5 km away although nearest birds were closer to proposed turbines (**Tables 7.11 & 7.14**). Nearest birds were recorded at Lough Derg. SNH (2016) cites core range of 5 – 8 km between foraging and roost sites and thus Barnesmore is at the outer limit of this potential range. None were recorded on Site during walkover or vantage point surveys and no movement corridors were detected to / from the Site. Therefore, there is no significant identified pathway for significant effects on this species nor to / from designated sites.

Red-throated diver were recorded from sites more than 5.9 – 7.6 km away although nearest birds were closer to proposed turbines (**Tables 7.11 & 7.14**). Nearest birds were recorded at Lough Eske and Pettigoe. SNH (2016) cites core range of 8 – 13.5 km between foraging and nest sites and thus Barnesmore is within but at the outer limit of this potential range. None were recorded on Site during walkover or vantage point surveys and no movement corridors were detected to / from the Site. Therefore there is no significant identified pathway for significant effects on this species nor to / from designated sites.

Great northern diver were recorded from sites more than 6.5 km away although nearest birds were closer to proposed turbines (**Tables 7.11 & 7.14**). Nearest birds were recorded at Lough Eske (6.5 km), Lough Derg and off-shore at Donegal Bay (>20 km). SNH (2016) cites core range of (black-throated diver as 10 km and 8 – 13.5 km for red-throated diver) between foraging and nest sites and thus Barnesmore is within but at the outer limit of this potential range. None were recorded on Site during walkover or vantage point surveys and no movement corridors were detected to / from the Site. Therefore there is no significant identified pathway for significant effects on this species nor to / from designated sites.

Light-bellied Brent goose, were recorded from sites more than 13.8 – 18.8 km away although nearest birds were marginally closer to proposed turbines (**Tables 7.11 & 7.14**). Nearest birds were recorded at Donegal Bay. SNH (2016) cites core range of a range of goose species between foraging and roost sites between 5 km and 25 km and thus Barnesmore is within but at the outer limit of this potential range. Brent geese are coastal specialist with a much smaller foraging / roosting range and no suitable habitat occurs within Barnesmore for this species. None were recorded on Site during walkover or vantage point surveys and no movement corridors were detected to / from the Site. Therefore, there is no significant identified pathway for significant effects on this species nor to / from designated sites.

Similar to the Brent geese, sanderling were recorded from sites more than 15.7 – 20.5 km away although nearest birds were marginally closer to proposed turbines (**Tables 7.11 & 7.14**). Nearest birds were recorded at Donegal Bay. SNH (2016) cites core range of a range of wader species between foraging and / nest roost sites between 500 m and 11 km and thus Barnesmore is outside the limit of this potential range. Sanderling are coastal specialist with a much smaller foraging / roosting range and no suitable habitat occurs within Barnesmore for this species. None were recorded on Site during walkover or vantage point surveys and no movement corridors were detected to / from the Site. Therefore, there is no significant identified pathway for significant effects on this species nor to / from designated sites.

Herring gull and lesser black-backed gull, were recorded from sites more than 5.4 km away although nearest birds were marginally closer to proposed turbines (**Tables 7.11 & 7.14**. Nearest birds were recorded at Lough Eske and Lough Derg where breeding behaviours were observed in both years of survey and the birds were also recorded wintering more widely including at Lough Mourne and Donegal Bay. SNH (2016) do not cite core range of a range of gull species but the species is known to forage widely with a median maximum foraging distance of circa 22 km (Isaksson et al., 2016) or 20 – 30 km (Spelt et al., 2019) although both these studies show range is dependent on foraging habitat types. Thus Barnesmore is within the limit of this potential range. Despite this potential range neither of these species were recorded on Site during walkover or vantage point surveys and no movement corridors were detected to / from the Site. Therefore, there is no significant identified pathway for significant effects on this species nor to / from designated sites.

The five SPAs within 15 km cite additional secondary or assemblage species including merlin and hen harrier and Pettigoe Plateau both of which have been assessed here (**Section 7.6.7.22**) and no connectivity was found with individuals from these sites for either species. At Lough Derg SPA additional citation species includes common gull, Greenland white-fronted goose, tufted duck, mallard, goldeneye and greylag goose only mallard which were recorded within the Site although all these species were recorded within wider hinterland surveys. Potentially significant effects on these have been scoped out (**Tables 7.5 & 7.7**) from this assessment as no significant effects are likely. At Donegal Bay

SPA a range of secondary / assemblage species are included in the citation such as great northern diver, light-bellied brent goose, common scoter, sanderling, black-throated diver, red-throated diver, cormorant, shelduck, wigeon, mallard, long tailed duck, red-breasted merganser, oystercatcher, ringed plover, golden plover, lapwing, dunlin, bar-tailed godwit, curlew, redshank, greenshank, turnstone, black-headed gull, common gull. Curlew and golden plover were assessed for potential effects since they occurred in close proximity and whilst some of the other species were detected during wider hinterland surveys and were not recorded on Site during walkover or vantage point surveys and no movement corridors were detected to / from the Site. Therefore, there is no significant identified pathway for significant effects on these assemblage species nor to / from designated sites.

At Lough Nillan Bog SPA additional assemblage species were red-throated diver which were excluded from potential effects (**Tables 7.5 & 7.7**) since none of these were shown to have any connection to the SPA or via regular or significant flyways. At Pettigoe Plateau SPA (NI) additional assemblage species included hen harrier, merlin, dunlin, common tern, lapwing, curlew and snipe some of these species were recorded in the wider hinterland and some species were recorded on Site during walkover or vantage point surveys but no movement corridors were detected to / from the Site to these SPAs. Therefore, there is no significant identified pathway for significant effects on these assemblage species nor to / from designated sites.

At all of the nearest SPAs there are other consented and/or operational wind turbines in closer proximity than Barnesmore. At Lough Nillan Bog both Anarget I / II and Corkermore are operational whilst at Pettigoe Plateau the operational Meenadreen windfarm complex is located between Barnesmore Windfarm and the Dunragh / Pettigoe Plateau SPA and is spatially closer to Donegal Bay SPA.

Other Natura sites (SAC) within 5 km list secondary ornithology features at Croaghonagh Bog SAC (Greenland white-fronted goose, merlin, red grouse, curlew, kestrel) none of which were potentially affected or connected to the Barnesmore windfarm although hen harrier were recorded wintering on this Site which is the nearest identified roost site to the northern hen harrier pair which were also recorded over Barnesmore. Dunragh Loughs/Pettigo Plateau SAC cites additional secondary species merlin, golden plover, Greenland white-fronted goose, red-throated diver, red grouse for which some of these species were assessed but there is no significant identified pathway for significant effects on these assemblage species nor to / from designated sites.

It can be concluded, on the basis of objective scientific information, that the Development, individually or in combination with other plans or projects, will not adversely affect the integrity of any European designated site and there are no significant pathways for any of the primary species cited at these sites and therefore no significant effects are predicted. Detailed Natura Impact Statement and Appropriate Assessment (AA) Screening have been prepared to provide the competent authorities with the information necessary to complete an Appropriate Assessment for the Development in compliance with EU Directives.

Within 5 km there are nationally designated sites which cite secondary ornithological features at Barnesmore Bog NHA (peregrine falcon; red grouse; golden plover) and Killeter Forest and Bogs and Lakes ASSI (hen harrier, red grouse, Greenland white-fronted geese) respectively for which pathways to species have been identified. The peregrine falcon, red grouse and golden plover (breeding and wintering) considered in the assessment are all contained within the Barnesmore Bog NHA and mitigation / management of effects, where necessary, for these species have been implemented (**Section 7.9**). At Killeter Forest and Bogs and Lakes the eastern hen harrier territory, which is assessed here are contained within that ASSI designated site. Therefore, a transboundary connection is evident to the Barnesmore Site, which has been fully considered in the assessment (Section 7.6.8.10) and mitigated accordingly. No red grouse or Greenland white-fronted goose were detected from the Northern Ireland site. More widely, but within 5 km the Cashelnavean Bog NHA cites red grouse and snipe and the surveys here identified merlin within / in close proximity to this nationally designated site.

7.7 Potential Cumulative effects

All key ornithological receptors (**Tables 7.5 – 7.8**) are reviewed for cumulative effects; within 500 m, 800 m and 2 km Survey Areas and potential effects are considered. Hen harrier, golden eagle and whooper swan are further considered up to a 5 - 10 km Survey Area and in relation to the nearby SPAs and/or important known breeding / wintering areas (see SNH, 2012; SNH, 2016).

There are a number of operational, consented and proposed turbines in the wider landscape (**Technical Appendix 2.1**) with only two of these occurring within 2 – 5 km, namely Meendreen (comprised of two separate approvals) and Meenbog. The immediately adjacent windfarm (Meenadreen) which comprised four wind turbines but the more recently approved (2016) extension has a further 38 turbines installed which became operational during the survey period (2017 – 2018). Meenbog has been approved for 19 turbines in 2019 and judicial review proceedings were brought in relation to hen harrier.

The cumulative windfarms will have been consented after Barnesmore and completed a cumulative assessment with the Operational Barnesmore Windfarm and therefore the reduction in turbines in the landscape as proposed at Barnesmore will represent a lesser potential impact (betterment) than already assessed by those adjacent consented windfarms. The turbine locations from the adjacent Sites were plotted in order to consider any cumulative spatial overlap with ornithology receptors (**Figures 7.63; 7.64; 7.69 – 7.72**).

In relation to other wider hinterland developments these are not considered to have a potentially significant interaction effect on ornithology at Barnesmore. It is noted that several consented wind turbines occur closer to designated sites at Lough Nillan Bog (Anarget I / II; Corkermore), Pettigoe Plateau (Meenadreen) and Donegal Bay SPA. Meenadreen is located between Barnesmore Windfarm and the Dunragh / Pettigoe Plateau SPA. The Development creates no additional cumulative effects on either of the designated site species for the nearby SPAs.

Barnesmore has appropriately set-back and/or designed the layout to increase separation distances to key ornithological receptors. There are no spatial overlaps with the adjacent turbines within the 500 m turbine buffers although Meenadreen is immediately adjacent to the proposed turbine 500 m buffer and are located just beyond 500 m for the whooper swan roost site at Lough Naleaghany. There are no species recorded to be overlapped by more than one windfarm buffer at the two adjacent sites but in some years, other turbines immediately adjacent (which have been erected / consented after the Operational Barnesmore Windfarm) are spatially located closer to some species than either existing or proposed Barnesmore turbines including hen harrier, white-fronted goose, red-throated diver and great northern diver.

Meenbog surveys were conducted prior to and during 2017 and comprised a similar suite of surveys to those carried out at Barnesmore and detected a similar range of species and in some cases probably the same individuals during the 2017 surveys. The surveys noted golden plover, hen harrier, and golden eagle in particular and also confirmed the migratory swan / goose route along the Barnesmore Gap. One item of note in Meenbog is the detection of white-fronted goose (presumably on passage) at one of the loughs at Meenabrock which is located within the Barnesmore Site in January 2017. Whilst this species was not detected during the Barnesmore surveys on Site it is noted that the lakes may provide brief stop-over locations for species and similar to the whooper swans utilising the Site are apparently habituated to the Operational Barnesmore Windfarm if utilising these loughs within the Site. More buzzard and woodcock activity was apparent at Meenbog and may be due to the more heavily afforested landscape in the hinterland of that Site.

Breeding curlew and golden plover were located closer to Barnesmore than from Meenbog. In relation to Meenbog, that Site would appear to be closer to hen harrier breeding and winter roosting sites and occur within the hen harrier range of the pair located to the north and also to merlin, buzzard and sparrowhawk breeding locations and would appear likely to have effects on these species outlined the effects on these species. Any effects arising from the Development have been appropriately avoided and/or mitigated for Barnesmore and therefore no cumulative effects could arise.

At Meenadreen, surveys were reviewed from 2014 - 2015 which indicated the presence of several species of note including merlin (1 - 2 pairs), hen harrier (1 – 2 pairs within 5 km) and golden eagle and also reported the historical breeding of hen harriers at Pollawaddy which is located within / immediately adjacent to the Meenbog Site. Hen harriers were observed at Cullionboy and a range of sightings recorded within the Meenadreen Site. The golden eagle records may be consistent with an additional territory that was historically in the area to the south of Meenadreen (M. Ruddock, personal observation) and/or may be an extension of the Bluestacks golden eagle territory since Meenadreen vantage point locations covered a further extended area to the south compared to Barnesmore vantage point locations (see Fielding & Haworth, 2010).

More buzzard activity was apparent at Meenadreen and may be due to the more heavily afforested landscape in the hinterland of that Site. Whilst parts of the Meenadreen construction / Site complex were not accessed during surveys conducted here, there may have been a reduced occurrence of species recorded during the years of construction in that area although the spatial segregation with localised topography between these two Sites may act as a barrier to movements of birds between sites but no evidence of merlin were recorded during priority species observations in the hinterland near Meenadreen although these were located elsewhere. Whooper swans were however observed to cross over / near the Meenadreen Site en route to access roosting sites within the network of loughs at Barnesmore.

Barnesmore is located closer to the golden eagles breeding sites than the other two adjacent Sites Meenbog turbines overlap with the minimum golden eagle breeding range identified here (**Figure 7.63**) and may extend further over that Site if the sightings from their observations / vantage points were included. Similarly at Meenadreen their surveys indicate more widely used space by golden eagles than indicated in the range map identified here although it is recognised that ranging behaviour of birds may have changed since 2014 surveys were conducted at Meenadreen and the potential second pair of eagles to the south may have since disappeared to which their sightings may have related. The contraction of the Site footprint at the Development, via reduction of numbers of turbines within the development reveals that less area of the identified golden eagle range will be affected by displacement than at the Operational Barnesmore Windfarm.

For hen harrier there are other consented / operational turbines recorded closer to the identified hen harrier territories. Any individual or cumulative collision risk is reduced particularly by the reduction of hen harrier collision risk due to the Development (**Technical Appendix 7.3**) and habitat mitigation works proposed here. All turbines are located further away than best practice guidance and requisite set-backs (>750 m). Meenbog turbines overlap with the minimum hen harrier breeding range for the northern pair identified here (**Figure 7.64**) and may extend further over that Site if the sightings from their observations / vantage points were included. Meenbog has a separately proposed hen harrier management plan. The Development has a smaller overlap with that northern hen harrier territory than the Operational Barnesmore Windfarm and therefore potential effects are reduced at that territory and no cumulative effects could arise. Similarly at Meenadreen their surveys indicate more widely used space by hen harriers than indicated in the range map for the eastern pair although it is recognised that ranging behaviour of birds may have changed since 2014 surveys were conducted at Meenadreen. Barnesmore has proposed to implement habitat management which will be within the range of the hen harriers and mitigate any potential displacement effects for Barnesmore therefore no cumulative effects can arise.

Based on available cumulative data there is not considered to be any significant cumulative increased effect on snipe regionally. There are some local snipe territories predicted to be displaced at Barnesmore which have been mitigated appropriately and thereby eliminating any wider cumulative effects.

The Development has enacted appropriate set-back distances to known priority species or individuals including hen harrier, peregrine, golden eagle, curlew, golden plover, and other raptor territories and/or proposed the implementation of appropriate measures to reduce any potential direct or secondary effects to negligible. No significant cumulative direct or secondary effects are therefore predicted.

The reduction in the numbers of turbines, results in increases in spatial separation / set-back distances to some species including snipe and red grouse. There are fewer turbines proposed and collision risk for all species, per turbine, are actually lower with the repowered turbines, thereby reducing overall risk in the cumulative hinterland. The potential for any significant cumulative effects resulting from the addition of the Development are reduced.

In the absence of wider national cumulative impacts of windfarm developments data, and/or specific bird population thresholds of mortality there is currently considered to be no national, regional or local significant cumulative effect on any known breeding bird population. There are no other predicted cumulative effects for other species on basis of currently available data.

7.8 Potential Effects of Decommissioning Phase

As detailed in **Section 7.1.1** the decommissioning of the Operational Barnesmore Windfarm and the construction of the Development are likely to occur partly in tandem. This represents a worst-case scenario for assessment purposes. Any effects arising as a result of the decommissioning of the Development is considered to be no greater than the effects arising when these two phases are combined. As a result, the final decommissioning phase has not been considered further in this assessment.

7.9 Mitigation Measures

There are a number of significant effects predicted on ornithological features as a result of the Development, and therefore measures are proposed to mitigate these effects. Much of this mitigation will also have the benefit of further reducing a number of the other non-significant effects identified.

Moderate or moderate-minor, and therefore significant, effects are predicted on golden plover (disturbance); hen harrier (displacement), snipe (disturbance / displacement), meadow pipit / skylark (disturbance / displacement) and red grouse (disturbance) which may occur during construction / decommissioning phase and into the operational phase of the

Development. The Development has been designed to avoid and maximise distances to known and recorded nest sites and territories, and it should also be noted that habituation was observed locally, and several priority species were observed close to the Operational Barnesmore Windfarm over survey years.

Two key measures (**Section 7.9.1 – 7.9.3**) are proposed to mitigate these effects: (i) The implementation of a Construction Management Strategy (CMS) and (ii) the implementation of a Habitat Management Plan (HMP) to mitigate effects on Snipe, Hen Harrier and Golden Plover. There are no specific small passerine or red grouse mitigation measures proposed since the innate management measures proposed within the Habitat Management Plan are conducive to the recovery, expansion and support of these species.

There are no significant effects predicted on any European designated site or citation species, including SPAs which occur within 15 km. No mitigation is therefore required.

Avoidance measures have been embedded into the Development through its design and any minor effects are further avoided through the Construction Mitigation Strategy (**Section 7.8.1**). All other potential effects are assessed as minor or negligible, and not significant and therefore no mitigation is required.

Although no mitigation is required for Collison risk for any species and avoidance measures have been embedded in the Development design, SPR's carcass surveillance monitoring will be implemented throughout the operation of the Development (of all species) following the monitoring protocol outlined in **Technical Appendix 7.4**.

7.9.1.1 Mitigation by Avoidance

The baseline ornithological survey data (**Technical Appendix 7.1**) was utilised to inform design iterations of the Development where possible to implement set-back (avoidance) distances of turbines and infrastructure from ornithological receptors identified in each species specific assessment (**Section 7.4**). In the first instance the Development has sought to avoid significant effects by sensitive design of the windfarm layout. This included a variety of desktop iterations and risk matrices of the layout coupled with site meetings and ground-truthed reviews of all turbine locations. Each turbine location was reviewed in the context of ornithological receptors within the site and in particular the avoidance of barrier effects through wider spacing and movement of turbines particularly in / around the whooper swan wintering roost loughs and flight pathways to avoid potential significant effects.

The Development has reutilised and re-purposed extensive parts of the existing infrastructure and tracks / hard-standings and it is noted that, at the out-set that, several target species recorded breeding in the Site are noted to show considerable habituation in relation to tracks, infrastructure and the existing turbines.

7.9.2 Construction Management Strategy (CMS)

It is likely that the development footprint will be impacted by (i) pre-construction (site clearance) activities and (ii) decommissioning/construction activities. Birds are able to more readily move away from disturbance sources during the winter and from foraging habitats but less so when confined to a breeding site or nest site and thus disturbance effects may be lower over the winter period (September – February). In the first instance the Development has avoided high risk ornithological habitats and particularly since much of the Development follows the route of existing windfarm access tracks and footprint thereby minimising overall effects.

The Construction Management Strategy (CMS) will include the following measures:

- Where possible, enabling, decommissioning and construction works will take place between September and February outside of the bird breeding season to avoid disturbance or displacement of breeding birds;
- Key features and habitats that might be used by breeding birds will be checked by a qualified ornithologist prior to decommissioning/construction works commencing during the breeding season;
- Winter management around Lough Golagh and Lough Naleaghany particularly during autumn (October to December) when activity from whooper swans appeared more frequent.
- Creation of a disturbance free zone around the northern parts of the site for ring ouzel
- Activities undertaken during the bird breeding season (1st March to 31st August) may be allowed, subject to check surveys being undertaken, provided extant habitats are deemed unoccupied by breeding birds and/or extant species are proven to be non-breeding as determined by a qualified ornithologist under licence, where required from the National Parks & Wildlife Service (NPWS);

- The ornithologist will be appointed to oversee enabling works, site clearance, and to maintain on-going checks for nests along the route to avoid both disturbance and displacement and implement any nest specific mitigation measures required;
- If any nests are located, no works will be undertaken until the status of those nests are obtained and a clear written protocol is established for each nest including maps and distances to the proposed works;
- Where necessary, the mitigation protocol will consider the following options (i) spatial relocation of works if nests are located less than recommended buffer distances by agreement with NPWS (e.g. snipe 400 m; curlew 800 m; hen harrier 500 - 750 m;) or (ii) order to avoid disturbance and/or destruction nests will be monitored until nestlings have fledged and works will only be undertaken after fledging in the vicinity of the identified nests; (iii) any protocol or licences or other legislative requirements will be discussed with NPWS and agreed in writing before commencement of works;
- A map of indicative bird locations, nests and/or sensitive habitats, derived from this report and the any other pre-construction nest check or monitoring studies, will be provided before decommissioning/construction commences in a given area and supplied to contractors including relevant spatial buffers, where required;
- The ornithologist will advise the Applicant and all contractors of the indicative locations of significant bird species and habitats prior to the commencement of works. This will be done by the provision of maps and an induction talk on wildlife law and disturbance to birds.

With the implementation of the Construction Management Strategy the impact on breeding birds during decommissioning/construction works is reduced to negligible and therefore not significant.

7.9.3 Habitat Management Plan

A Habitat Management Plan (HMP) has been created in order to implement positive land management to mitigate any adverse impacts the Development may have had on priority habitats and ornithological receptors. The HMP proposes measures that will; off-set the difference between habitat displacement calculations for hen harrier in the proposed windfarm areas, encourage the rapid recovery of waders including snipe and golden plover post-decommissioning/ construction, off-set the difference between the displacement calculations for snipe in the proposed windfarm areas, provide improved habitat conditions for meadow pipit, skylark and red grouse across the site and off-set the small loss of peatland habitat from the Development. The details of management measures are set out in the Draft HMP and are briefly outlined below along with details of the rationale for each species:

- Restoration of the infrastructure from Operational Barnesmore Windfarm
- Planting of native woodland along riparian corridors
- Removal of self-seeded conifers across moorland habitat
- Blocking of historic drains to create wetter conditions to benefit both the peatland habitat and waders
- Prevention of peat cutting and restoration of peat cut areas

7.9.4 Snipe and Golden Plover Management and Rationale

Since there is a differential level of displacement predicted between the Operational Barnesmore Windfarm and the Development, habitat management measures that will benefit both snipe and golden plover will be undertaken as outlined below (detailed in Draft HMP). These measures include:

- Removal of self-seeded conifers from approximately 103 ha of open habitats (also beneficial for meadow pipit and skylark);
- Blocking of 1540 m of historic agricultural drains across 28.61 ha of peatland habitat to raise the water table and restore the peatland habitat in turn creating wetter areas and pools for snipe and golden plover.
- Monitoring of key Objectives to inform the success of the Aims outlined in the HMP including success of drain damming on re-wetting the peatland

7.9.5 Hen Harrier Management and Rationale

Since there are up to two pairs of hen harriers located within 2 km of the Development (despite noting the increased distances recorded between survey years) and there is a differential level of displacement predicted between the Operational Barnesmore Windfarm and the Development, habitat management measures that will benefit hen harrier are outlined below. These measures include:

- Removal of self-seeded conifers from approximately 103 ha of open habitat;

- Retention and maintenance of existing scrub and prey-rich habitat features within the Site Boundary where these are contiguous with the identified hen harrier territory boundaries (MCP) and linear foraging features that are used by hen harriers;
- Creation of 7.68 ha of linear foraging features using native trees and shrubs to increase habitat connectivity and foraging habitat.

7.10 Monitoring

The assessment has been undertaken on the basis of worst case/conservative assumptions, giving confidence in the level of effects assessed.

It is recognised that extensive reviews of historical monitoring (www.swbsg.org) and emergent research (Whitfield et al., in prep) has revealed the difficulties with assessing the nature and extent of change within post-construction monitoring works especially where small numbers of birds / territories occur i.e. small sample sizes. Furthermore, the difficulties associated with obtaining a matched / comparable control / reference site are difficult particularly likely to occur where the baseline is an operational windfarm (e.g. Barnesmore Operational Windfarm) alongside inter-annual variability (i.e. natural population variation) and extrinsic factors in defining the cause and effect associated with observed changes due to wind turbines / windfarms. As such there are no specific monitoring of bird populations proposed as any results are not likely to be meaningful.

The proposed habitat management and restoration measures for priority habitats and species will help maintain the hen harrier, snipe, golden plover, red grouse and small passerine populations and could also have potential beneficial effects on other species in the vicinity. It is hypothesised that the habituation observed in the Site during baseline will re-occur within a short temporal time frame post-construction (1-3 years). Monitoring of these habitat restoration measures will be implemented as per the HMP.

The project will also implement SPR's carcass surveillance programme whereby weekly site inspections include a search for carcasses on the turbine hardstandings and all dead/injured animals found are documented as part of the ISO14001 Environmental Management System. Any instance of a target species carcass being discovered will be reported to NPWS. All results are entered into a database for long-term analysis and can be made available to the regulator on request.

7.11 Residual Effects of the Development

It is proposed to quantify bird distribution and abundance post-construction to validate any residual effects of the construction mitigation strategy (**Section 7.9**). Based on site-specific evidence it is likely birds will continue to be habituated to the presence of the turbines and infrastructure. With mitigation measures employed, the impact on breeding and/or wintering birds is reduced to negligible and therefore not significant.

7.12 Summary of Significant Effects

It is predicted that any residual effects of the Development during the decommissioning/construction phases will be of negligible magnitude and temporary (i.e. until decommissioning and construction works are completed) on the breeding or wintering species within the Development area, construction footprint and 500 m buffer due to availability of other suitable habitats nearby and/or conservation status.

Prior to mitigation, from the primary field surveys and assessment there are considered to be negligible effects on extant bird species. However, some moderate effects are predicted for the construction phase on snipe, red grouse, common sandpiper, golden plover, whooper swan and meadow pipit and skylark. Snipe, whooper swan, common sandpiper, hen harrier, skylark and meadow pipit are also assessed as moderate - minor displacement effects during the operational phase. Following mitigation, these effects are assessed as being of negligible magnitude, and not significant.

Kestrel may be vulnerable to collision at the Barnesmore Site and so nest boxes will be installed to increase set-back distance for this species.

There are no raptors or other priority species that will be directly impacted by the Development subject to the implementation of disturbance management measures during construction / decommissioning. The majority of species are avoided by appropriate buffer distances to turbines. Specifically, the raptor and wader known breeding locations will not be directly affected by the Development subject to mitigation measures being implemented during these phases (**Section 7.9**) and habitat management to minimise long-term displacement effects.

Several species including red grouse, snipe, merlin, buzzard, sparrowhawk, peregrines and hen harriers have been recorded nesting within 50-300 m of existing turbines in Ireland including some of those at Barnesmore (M. Ruddock, personal observation) and two other SPR sites recently analysed in Northern Ireland (Corkey and Rigged Hill) thus no long-term implications are predicted following cessation of decommissioning/construction activities and given the observed set-back distances for priority species including any species associated with the nearby SPAs and nearby NHA / ASSI designations.

Specific measures to further reduce assessed displacement effects including management of habitats are proposed, which will benefit snipe, golden plover, small passerines and hen harrier, and set-back distances and seasonal and spatial restrictions on decommissioning/construction activity are also proposed. The proposed windfarm design has incorporated ornithological constraints, where possible, including avoidance of extant priority species and bird-habitats. Measures are proposed where adverse effects are predicted on the basis of published research and/or site specific evidence, this specifically includes construction management strategy, and snipe, golden plover and hen harrier management to avoid disturbance / displacement / collision risks to ornithological site features, which will be realised via the implementation of the measures set out within the Draft Habitat Management Plan. In order to further examine residual effects, if any, a comprehensive bird monitoring programme (**Section 7.9; Technical Appendix 7.4**) has been outlined.

Residual cumulative effects are assessed as being of negligible magnitude and not significant with the implementation of a CMS, supported by the HMP to support habituation and reduce effects of displacement. There are considered to be no significant effects of the Development on ornithology, subject to implementation of the measures and monitoring commitments outlined within this chapter, which can be secured via appropriately worded planning conditions. The summary of the effects detailed within this chapter are shown (**Table 7.18**) and included both the embedded and proposed measures set out in this chapter.

Table 7.19 Summary of Effects

Receptor	Potential Effect	Significance of Effect	Proposed Measures / Embedded Mitigation	Residual Effect (EPA, 2017)
Decommissioning / Construction Phase				
Golden eagle	Disturbance	Not significant	Avoidance by design (>750 m; >1.5 km) and CMS	Imperceptible
	Displacement	Not significant	Maintenance of set-back (>750 m; >1.5 km) and CMS	Imperceptible
Hen harrier	Disturbance	Not significant	Avoidance by design (>500 m; >750 m) and CMS	Imperceptible
	Displacement	Slight (Minor)	Maintenance of set-back (>500 m; >750 m) and CMS and HMP	Not significant
Merlin	Disturbance	Not significant	Avoidance by design (>500 m) and CMS	Imperceptible
	Displacement	Not significant	Maintenance of set-back (>500 m) and CMS	Imperceptible
Peregrine	Disturbance	Not significant	Avoidance by design (>500 m; >750m) and CMS	Imperceptible
	Displacement	Not significant	Maintenance of set-back (>500 m; >750 m) and CMS	Imperceptible
Buzzard	Disturbance	Not significant	Avoidance by design (>500 m) and CMS	Imperceptible
	Displacement	Not significant	Maintenance of set-back (>500 m) and CMS	Imperceptible

Receptor	Potential Effect	Significance of Effect	Proposed Measures / Embedded Mitigation	Residual Effect (EPA, 2017)
Kestrel	Disturbance Displacement	Not significant Not significant	Avoidance by design (>500 m) and CMS Maintenance of set-back (>500 m) and CMS	Imperceptible Imperceptible
Sparrowhawk	Disturbance Displacement	Not significant Not significant	Avoidance by design (>500 m) and CMS Maintenance of set-back (>500 m) and CMS	Imperceptible Imperceptible
White-tailed eagle	Disturbance Displacement	Not significant Not significant	Avoidance by design (>500 m; >750 m) and CMS (non-breeding bird) Maintenance of set-back (>500 m; > 750 m) and CMS (non-breeding bird)	Imperceptible Imperceptible
Common sandpiper	Disturbance Displacement	Slight (Minor) Slight (Minor)	Avoidance by CMS Avoidance by CMS and benefits via HMP and SWMP	Not significant Not significant
Golden plover	Disturbance Displacement	Slight Moderate – Slight (Minor)	Avoidance by CMS Avoidance by CMS and mitigation via HMP	Not significant; Slight – Not Significant
Curlew	Disturbance Displacement	Not significant Not significant	Avoidance by design (>800 m) and CMS Maintenance of set-back (>800 m) and CMS	Imperceptible Imperceptible
Snipe	Disturbance Displacement	Moderate – Slight (Minor) Moderate –Slight (Minor)	Avoidance by CMS Avoidance by CMS and mitigation via HMP	Slight – Not significant Slight – Not significant
Red grouse	Disturbance Displacement	Slight (Minor) Not significant	Avoidance by CMS Avoidance by CMS	Not significant Imperceptible
Whooper swan	Disturbance Displacement	Slight (Minor) Slight (Minor)	Avoidance by CMS Avoidance by CMS	Not significant Not significant
Cormorant	Disturbance	Slight (Minor)	Avoidance by CMS and mitigation via SWMP	Not significant

Receptor	Potential Effect	Significance of Effect	Proposed Measures / Embedded Mitigation	Residual Effect (EPA, 2017)
	Displacement	Slight (Minor)	Avoidance by CMS and mitigation via SWMP	Not significant
Heron	Disturbance Displacement	Slight (Minor) Slight (Minor)	Avoidance by CMS and mitigation via SWMP Avoidance by CMS and mitigation via SWMP	Not significant Not significant
Meadow pipit	Disturbance Displacement	Slight (Minor) Slight (Minor)	Avoidance by CMS Avoidance by CMS and via benefits via HMP	Not significant Not significant
Skylark	Disturbance Displacement	Slight (Minor) Slight (Minor)	Avoidance by CMS Avoidance by CMS and benefits via HMP	Not significant Not significant
Ring ouzel	Disturbance Displacement	Slight (Minor) Slight (Minor)	Avoidance by design (>350 m) and CMS (bespoke disturbance protection zone) Avoidance by design (>350 m) CMS(bespoke disturbance protection zone)	Not significant Not significant
Small passerines	Disturbance Displacement	Slight (Minor) – Not Significant Slight (Minor) – Not Significant	Avoidance by CMS Avoidance by CMS and benefits via HMP	Not significant - Imperceptible Not significant - Imperceptible
Operational Phase				
Golden eagle	Displacement Collision	Slight (Minor) Not significant	Avoidance by design (>750 m; >1.5 km; increased set-back and territory overlap; benefits via HMP) Avoidance by design (>750 m; 1.5 km); lower risk turbines	Not significant Imperceptible
Hen harrier	Displacement Collision	Moderate –Slight (Minor) Not significant	Avoidance by design (>500 m; >750 m) with mitigation via HMP Maintenance of set-back (>500 m; 750 m); lower risk turbines)	Slight – Not significant Imperceptible
Merlin	Displacement Collision	Not significant Not significant	Avoidance by design (>500 m); benefits via HMP	Imperceptible

Receptor	Potential Effect	Significance of Effect	Proposed Measures / Embedded Mitigation	Residual Effect (EPA, 2017)
			Maintenance of set-back (>500 m); low level flights – no risk of collision	Imperceptible; monitoring post-construction
Peregrine	Displacement Collision	Not significant Not significant	Avoidance by design (>500 m; >750 m); benefits via HMP Maintenance of set-back (>500 m; >750 m); lower risk turbines	Imperceptible Imperceptible; monitoring post-construction
Buzzard	Displacement Collision	Slight (Minor) – Not significant Slight (Minor) – Not significant	Avoidance by design (>500 m); avoidance behaviour likely Maintenance of set-back (>500 m); avoidance behaviour likely;; lower risk turbines	Not significant - Imperceptible Not significant – Imperceptible; monitoring post-construction
Kestrel	Displacement Collision	Not significant Slight (Minor) – Not significant	Avoidance by design (>500 m) Maintenance of set-back (>500 m); installation of nest boxes; lower risk turbines	Imperceptible Not significant – Imperceptible; monitoring post-construction
Sparrowhawk	Displacement Collision	Not significant Not significant	Avoidance by design (>500 m) Maintenance of set-back (>500 m); low level flights – no risk of collision	Imperceptible Imperceptible; monitoring post-construction
White-tailed eagle	Displacement Collision	Not significant Not significant	Avoidance by design (>500 m; >750 m); non-breeding / non-territorial bird; no extant risk Maintenance of set-back (>500 m; >750 m); non-breeding / non-territorial bird; no extant risk; lower risk turbines	Imperceptible Imperceptible; monitoring post-construction
Common sandpiper	Displacement Collision	Slight (Minor) Not significant	Avoidance by CMS and SWMP; benefits via HMP; habituation behaviour observed Habituation behaviour observed; low level flights – no risk of collision	Not significant Not significant; monitoring post-construction
Golden plover	Displacement Collision	Moderate – Slight (Minor) Not significant	Avoidance by CMS; mitigation by HMP; habituation behaviour observed; fewer turbines within range Habituation and avoidance behaviour observed; low risk species; lower risk turbines	Slight – Not significant Not significant; monitoring post-construction
Curlew	Displacement	Not significant	Avoidance by design (>800 m); benefits via HMP	Imperceptible

Receptor	Potential Effect	Significance of Effect	Proposed Measures / Embedded Mitigation	Residual Effect (EPA, 2017)
	Collision	Not significant	Maintenance of set-back >800 m; lower risk turbines	Imperceptible; monitoring post-construction
Snipe	Displacement Collision	Moderate – Slight (Minor) Not significant	Avoidance by CMS; disturbance management; mitigation by HMP; ; habituation behaviour observed Habituation behaviour observed; low level flights – no risk of collision	Slight – Not significant Not significant; monitoring post-construction
Red grouse	Displacement Collision	Not significant Not significant	Habituation behaviour observed; disturbance management; benefits via HMP Low level flights – no risk of collision	Imperceptible Not significant; monitoring post-construction
Whooper swan	Displacement Collision	Slight (Minor) – Not significant Not significant	Avoidance by CMS Low level flights – no risk of collision;	Not significant Not significant - Imperceptible; monitoring post-construction
Cormorant	Displacement Collision	Slight (Minor) Not significant	Avoidance by CMS and mitigation via SWMP; habituation behaviour observed Lower risk turbines; reduced collision risk	Not significant Imperceptible; monitoring post-construction
Heron	Displacement Collision	Slight (Minor) Not significant	Avoidance by CMS and mitigation via SWMP; habituation behaviour observed Lower risk turbines; reduced collision risk	Not significant Imperceptible; monitoring post-construction
Meadow pipit	Displacement Collision	Slight (Minor) Not significant	benefits via HMP; disturbance management Unlikely risks of collision	Not significant Not significant; monitoring post-construction
Skylark	Displacement Collision	Slight (Minor) Not significant	Benefits via HMP; disturbance management Unlikely risks of collision	Not significant Not significant; monitoring post-construction
Ring ouzel	Displacement Collision	Slight (Minor) Not significant	Avoidance by CMS; disturbance-free zone; (habituation behaviour observed Low level flights – no risk of collision	Not significant Not significant; monitoring post-construction

Receptor	Potential Effect	Significance of Effect	Proposed Measures / Embedded Mitigation	Residual Effect (EPA, 2017)
Small passerines	Displacement Collision	Slight (Minor) – Not significant Not significant	Avoidance by CMS; benefits via HMP; disturbance management Unlikely risks of collision	Not significant Not significant; monitoring post-construction

7.13 Statement of Significance

From the primary field surveys and assessment there are considered to be negligible magnitude and not significant effects on extant bird species, subject to the implementation of mitigation measures.

Some moderate and minor effects are predicted for some species, mainly due to decommissioning and construction activities on hen harrier, snipe, red grouse and small passerines and some displacement for hen harrier, snipe and small passerines during the operational phase compared to baseline and some collision risk for secondary species, which are nesting within the 2 km Survey Area. These predicted effects have been mitigated via specific measures to reduce likelihood and magnitude of effects including spatial and temporal construction management; management of habitats (as part of an HMP) which will benefit snipe, hen harrier and other small passerine species, and all priority species are spatially protected by appropriate set-back distances. In addition, various management and monitoring measures are outlined for implementation as part of the windfarm operational policies.

The Development design has incorporated ornithological constraints, where possible, including avoidance of extant priority species, and it is noted that several of the priority species in close proximity to the Operational Barnesmore Windfarm are present based on a temporally available habitat and several species have selected to nest / roost / forage in close proximity to the Operational Barnesmore Windfarm.

Further measures are outlined on the basis of published research, and best practice, to prevent nesting bird disturbance as required under wildlife legislation. In order to further test and examine residual effects, if any, there is a comprehensive monitoring programme which has been detailed.

Based on available cumulative data there is not considered to be any potential for significant cumulative effects to arise. The further measures proposed will ensure that there is no potential for cumulative effects resulting from the Development, in combination with the other sites considered.

Following implementation of proposed mitigation, and best practice measures, there are considered to be no significant negative effects of the Development on ornithology. The implementation of the measures outlined within this chapter, and the proposed monitoring recommendations can be secured via planning conditions.

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