7 ORNITHOLOGY

7.1 INTRODUCTION

This chapter describes the Avian Ecology of the Carrownagowan Wind Farm project, which includes the development, as set out and described in Chapters 1, 2 (refer to **Section 2.3** for a description of the characteristics of the project) and 3 of this EIAR, and assesses the likely significant effects the project may have on avian receptors. Where potential effects are identified, mitigation measures have been developed.

The assessment of the effect of the project on avian ecology is part of the overall Biodiversity assessment in the EIAR and has been presented here as a separate chapter.

7.1.1 Scope of assessment

This chapter assesses the potential impacts and effects of the project on birds and their habitats with particular reference to species of ornithological importance. These include bird species with National and International protection under the Wildlife Acts 1979 as amended, and the EU Birds Directive 2009/147/EC. Bird species of ornithological importance occurring or likely to occur within the zone of influence (ZOI) of the project that could potentially be affected were classified as Avian Key Ecological Receptors.

This assessment is based on best practice guidance, published literature, professional judgement and on ornithological surveys completed at the study area over four consecutive years, between winter 2016/17, and summer 2020. These include:

- 2016-17 Winter Bird Survey
- 2017 Breeding Bird Survey
- 2017-18 Winter Bird Survey
- 2018 Breeding Bird Survey
- 2018-19 Winter Bird Survey
- 2019 Breeding Bird Survey
- 2019-20 Hen harrier roost survey
- 2020 Hen harrier breeding survey

The supporting **Appendices 7-1, 7-2** and **7-4** include all the data from the ornithological surveys completed at the study area between the winter of 2016-17 and summer of 2019. **Appendix 7-3** contains the Collision Risk Assessment (CRA) which describes the Collision Risk Modelling undertaken for this project. The chapter should be read in conjunction with the supporting appendices.

The assessment of the project site began with a desk study of available avian published data on sites designated for nature conservation, other ecologically sensitive sites, habitats and species of interest in the vicinity of the project. A review of OSI mapping, online environmental web-mappers, aerial imagery and ortho-photography was also undertaken. The baseline information obtained from the desk study was the first stage in defining a ZOI of the project.

Following the desk studies, a review was carried out of the comprehensive ornithological surveys completed at the project site. The ornithological surveys undertaken provided vital baseline information regarding the existing avian ecology of the study area. The surveys completed informed

on the avian species using the area, and the suitability of the habitats present and extending away from the site.

This chapter quantifies any potential effects relating to the Avian Key Ecological Receptors and identifies any measures required to avoid, reduce and mitigate likely significant effects. Identification of effects and prescribed mitigation has been derived following a collaborative approach working with a multi-disciplinary team including site ornithologists, ecologists, and project engineers. The results of the ornithological surveys have been utilised to inform the design of the project, thereby minimising potential effects on avian ecology, sensitive habitats, and species of conservation interest.

The information provided in this EIAR chapter, accurately and comprehensively describes the baseline ornithological environment, provides an accurate prediction of the likely significant effects on the avian ecology of the project, prescribes mitigation where necessary, and, describes the residual effects on avian ecology.

The assessment of the effects of the project designated sites of national importance for nature conservation including Natural Heritage Areas (NHAs) and proposed NHAs have been assessed in the main Biodiversity chapter, Chapter 6, while the sites of ornithological interest have been assessed in **Section 7.4.2**. The implications of the project alone and in-combination with other plans and projects, on the integrity of the European Sites including Special Areas of Conservation (SACs) and Special Protected Areas (SPAs) in view of their conservation objectives has been assessed in the Natura Impact Statement (NIS) prepared for the project. The NIS concluded that the proposed project will not adversely affect the integrity of any of the European sites concerned.

7.1.2 Description of Project

The Carrownagowan Wind Farm is located within forested lands on the northern slopes of Slieve Bernagh Mountain, approximately 4km northeast of the village of Broadford, and 7km north-west of Killaloe, in Co. Clare. The site boundary includes a total land area of c.750ha which principally consists of commercial conifer plantation of various rotations, with sections of bogland, cutover bog, and grasslands in unplanted areas within the site. The forestry operations have modified the overall site, which would have supported peatland habitats prior to planting.

The project comprises of:

- 19 No. Wind Turbines (blade tip height up to 169m) with transformers;
- 19 No. Wind Turbine foundations and Hardstand areas;
- 1 No. Permanent Meteorological Mast (100m height) and associated hardstand areas;
- 1 No. Substation (110kV) including associated ancillary buildings (electrical building including control, switchgear and metering rooms, and the operational building including welfare facilities, workshop and office);
- Underground electrical collection and SCADA system linking each wind turbine to the on-site project substation;
- Upgraded Site Access;
- New and upgraded internal site service roads (8.4km of existing tracks to be upgraded and 11.4km of new service roads to be constructed);
- Provision of an on-site Visitor cabin.
- Underground cable for connection to National Electricity Grid;
- Construction of new roadways and localised widening along turbine delivery route;

- Temporary construction site compounds and mobile welfare units;
- 3 No. Borrow pits to be used as a source of stone material during construction and for storage of excess excavated peat materials;
- 3 No. Peat-spoil deposition areas (at borrow pit locations);
- Associated surface water management systems;
- Conifer felling to accommodate wind farm infrastructure;
- Underground 110kV cable for connection to National Electricity Grid between the proposed wind farm substation and to the existing ESB owned 110kV substation at Ardnacrusha Power Station;
- Off-site replacement forestry at three sites, (Ballard, Co Wicklow; Cooraclare, Co. Clare; and Trillackacurry, Co. Longford)

The developer is seeking a 30 year planning period. The proposal is described in full in Chapters 2 and 3 of this EIAR. From here on, the above is described as the project.

The project is illustrated **Figure 7-1** and **Figure 7-2** below.

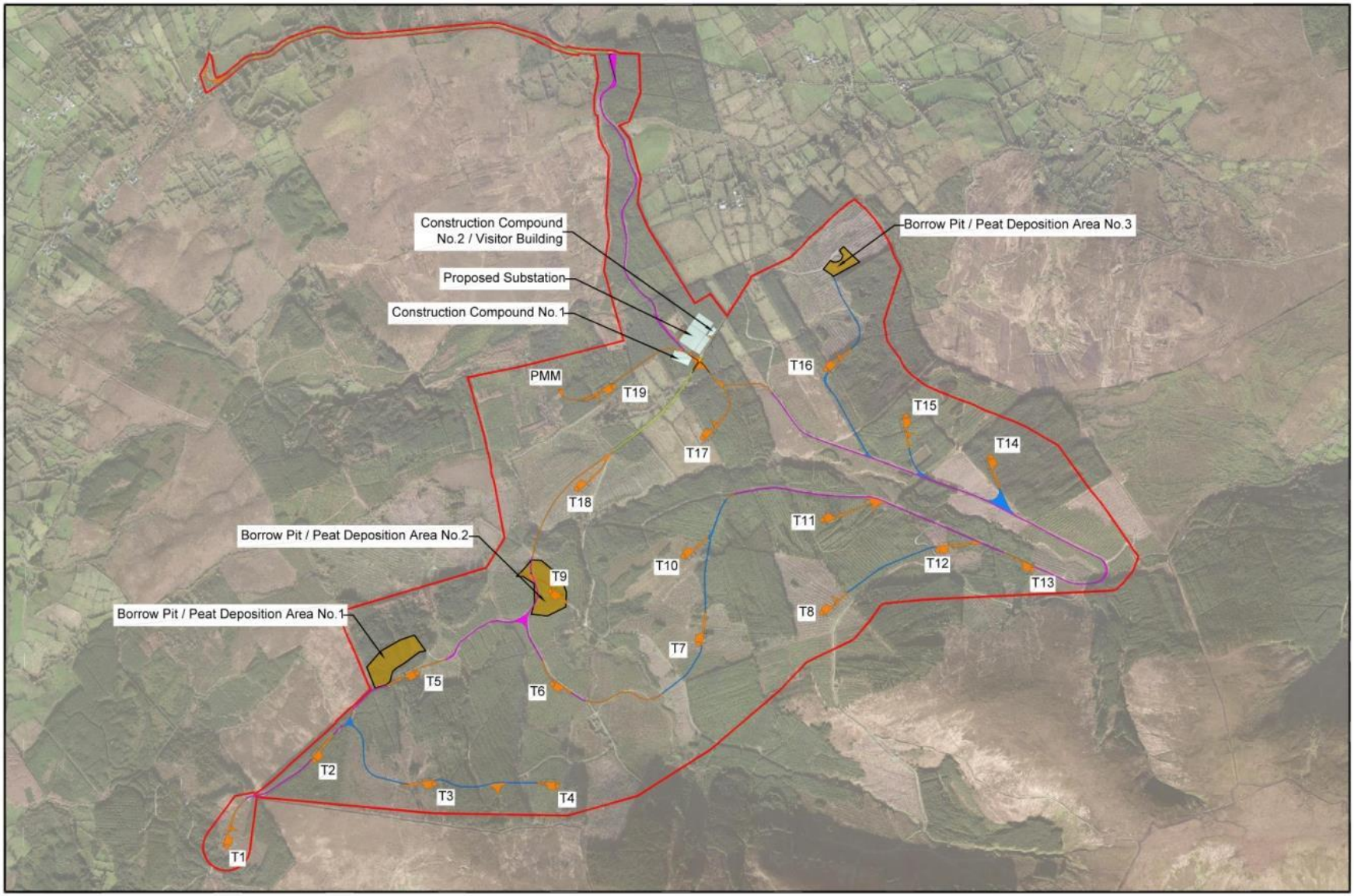

Figure 7-1. Carrownagowan Wind Farm

Figure 7-2. Underground Grid Connection

7.1.3 Legislative Context

The EIAR has been prepared in accordance with the requirements of the 2011 EIA Directive as amended by EIA Directive 2014/52/EU.

The following include the most important legislative requirements relevant to habitats and fauna in Ireland:

- Irish Wildlife Acts 1976 as Amended
- The European Communities (Birds and Natural Habitats) Regulations 2011 (transposes EU Birds Directive 2009/147/EC and EU Habitats Directive 2009/147/EC, 92/43/EC)
- The International Convention on Wetlands of International Importance 1971

This chapter has been prepared with respect to the following guidance documents:

- Environmental Protection Agency (2017). Draft revised guidelines on the information to be contained in Environmental Impact Statements. Environmental Protection Agency;
- Guidelines for Ecological Impact Assessment in the UK and Ireland - Terrestrial, Freshwater, Coastal and Marine (IEEM, 2019);
- National Roads Authority (2009). Guidelines for Assessment of Ecological Impacts of National Road Schemes (Revision 2) NRA;
- The Irish Wind Energy Association, Best Practice Guidelines for The Irish Wind Energy Industry, 2012;
- National Biodiversity Action Plan 2017 – 2021.

7.1.4 Consultation

Consultation was undertaken with the relevant statutory and non-statutory organisations as part of the EIAR scoping to inform the assessment. Full details can be found in **Appendix 1-3** of the EIAR.

- National Parks and Wildlife Service;
- BirdWatch Ireland;
- Irish Raptor Study Group;
- An Taisce;
- Irish Wildlife Trust.

7.1.4.1 Pre-planning Meeting with NPWS

A pre planning application meeting was held with the NPWS on the 12th February at the Coillte Office in Galway. The discussion included biodiversity at the site, water quality and the use of the site and surrounds by the hen harrier. There was also a discussion on the use of native planting along the site roads to improve diversity of species on the site.

7.1.5 Statement of Authority

This Ornithology Chapter was prepared by Caoimhin O'Neill (BSc), Senior Ecologist at Malachy Walsh and Partners. Caoimhin has over seven years' experience in ecological impact assessment. He has completed numerous ecological assessments for a variety of projects, including wind farm proposals. He is an experienced field ecologist with considerable bird survey work experience. John Murphy was a contributing author to this Chapter. Mr. John Murphy is lead ornithologist with Malachy Walsh and Partners. He has been a bird watcher for 40 years and has worked professionally as a bird and ecology surveyor since 1982. He was involved in bird survey design and his knowledge of bird behaviour and

bird activity in the area has also informed the assessment. The report has been reviewed by Monica Kane, Senior Ecologist with Malachy Walsh and Partners with 15 years' experience working in the area of ecological impact assessment.

Bird survey work was undertaken by McCarthy Keville O'Sullivan (MKO) and Malachy Walsh and Partners. Summaries of ornithologists that completed the ornithological surveys at the study area are available in **Appendix 7-1 and Appendix 7-2**.

7.2 METHODOLOGY

7.2.1 Desk Study

A comprehensive desk study was completed to search for relevant information on species of conservation concern which may potentially use of the study area. This assessment included a thorough review of the available ornithological data from the following sources, including:

- National Parks and Wildlife Service (NPWS);
- National Biodiversity Data Centre (NBDC) (online) including requested records from the NPWS Rare and Protected Species Database;
- Irish Wetland Bird Survey I-WeBS;
- Bird Atlases: (Sharrock, 1976; Lack, 1986; Gibbons et al., 1993; Balmer et al., 2013);
- Birds of Conservation Concern (BoCCI) in Ireland 2014-2019 (Colhoun & Cummins, 2013);
- Environmental Impact Statements from relevant projects in the region, including wind farms;
- McGuinness, D., Muldoon, C., Tierney, N., Cummins, S., Murray, A., Egan, S. & Crowe, O. (2015). Bird Sensitivity Mapping for Wind Energy and Associated Infrastructure in the Republic of Ireland. Guidance Document. Birdwatch Ireland.

The following literature and guidance were reviewed and informed the survey design, and the assessment:

- Scottish Natural Heritage (May 2014, revised version). Recommended Bird Survey Methods to Inform Impact Assessment on Onshore Wind farms;
- Scottish Natural Heritage (2017). Recommended Bird Survey Methods to Inform Impact Assessment on Onshore Wind farms;
- Scottish Natural Heritage (June 2016, Version 3). Assessing Connectivity with Special Protection areas (SPAs);
- Scottish Natural Heritage (2012). Assessing the Cumulative Impact of Onshore Wind Energy;
- Scottish Natural Heritage (2006). Assessing Significance of Impacts from Onshore Wind farms on Birds Outwith Designated Sites;
- Scottish Natural Heritage (2018). Avoidance rate information & guidance note: Use of avoidance rates in the SNH wind farm collision risk model. Scottish Natural Heritage, Edinburgh, UK. http://www.snh.gov.uk/docs/B721137.pdf;
- Scottish Natural Heritage (2000). Wind farms and birds: calculating a theoretical collision risk assuming no avoidance action;
- Percival (2003) Birds and Wind farms in Ireland: A review of potential issues and impact assessment.

7.2.2 Identification of Target Species

This section of the assessment describes the criteria used for the selection of Target Species for the surveys completed at the Carrownagowan wind farm study area. Target species are typically those

species which are afforded a higher level of protection, or which are considered to be more sensitive to potential impacts from wind farm projects by virtue of their behaviour.

The results of the desk-top study were used to identify bird species which were considered potentially to occur within the survey area. Following the comprehensive desk study, initial site visits, and stakeholder consultations, a list of Target Species potentially occurring within the ZOI of the project was developed. Of these, Target Species were identified and formed the main focus of the bird surveys.

The Target Species list for Carrownagowan wind farm site included;

- Annex I of the EU Birds Directive;
- Species protected under the fourth schedule of the Wildlife Acts 1976-2012 (buzzards, eagles, falcons, harriers, hawks, kites, osprey, owls);
- Red-listed birds of Conservation Concern (Colhoun and Cummins, 2013);
- Species of Special Conservation Interests (SCIs) of nearby Special Protection Areas (SPA) within the likely ZOI;
- Bird species that are susceptible to impacts from this type of project.

The Target Species list from surveys completed can be viewed in **Appendix 7-1** and **7-2**.

Bird species identified as Target Species during desk studies, and not recorded during the comprehensive surveys completed were excluded, and species where no identified pathways for effects were excluded from the assessment.

7.2.2.1 Zone of Influence

The Zone of Influence (ZOI) is the likely area over which the project could have potential impacts on given avian Key Ecological Receptors (KERs).

The ZOI for individual avian KERs refers to the zone within which potential effects are anticipated. For this chapter the ZOIs were assigned following best available guidance (SNH 2016 and McGuinness et.al 2015).

For bird species the ZOI over which significant impacts may occur will differ for different avian KERs, depending on any pathway, and range of species occurring. The desk study included a review of ecological information that was relevant to the project, focusing on a 15km buffer around the project.

As part of this assessment, the Scottish Natural Heritage, Guidance Document 'Assessing Connectivity with Special Protection Areas' (2016) was consulted. This provides guidance with regard to the identification of connectivity between wind farm projects and Special Protection Areas (SPA). The guidance document takes into account the distances Species of Special Conservation Interest (SCIs) may commute beyond the SPAs site boundary, and includes information such as dispersal and foraging ranges of birds of SCI which are encountered when assessing projects.

The methods for defining the ZOI is summarised as follows:

- The nature, size and location of the project were considered;
- Identification of sensitive species, using the area, within range of the project;
- Identification of important areas for birds within the site, and extending away from the site;
- The sensitivities of the relevant avian KERs were considered;

- Identification of potential effect pathways, including disturbance, displacement and collision impacts.

Significant impacts are deemed to be those impacts resulting in a likely change in conservation status of an avian KER. The potential sources of impacts include excavations, and vegetation clearance, noise, and physical presence of humans, and the wind farm and turbine structures themselves. The potential pathways include, disturbance to breeding sites and foraging sites. Species with an unfavourable conservation status are more sensitive to the effects of certain impacts. Avian KERs sensitive to the potential impacts associated with wind farm projects are more likely to be impacted.

This assessment utilised a precautionary approach when assessing the connectivity with a designated site, i.e. sites that were not designated for bird species but may be used by Target Species were also considered.

7.2.3 Field Surveys

Based on the available information and the habitats and features present on site, the site specific ornithological surveys were developed.

McCarthy Keville O'Sullivan (MKO) was appointed to carry out ornithological survey works by Coillte in Autumn 2016.

Field surveys were undertaken to gather detailed information on bird distribution and flight activity within the area, in order to predict the potential effects of the project on birds. The most suitable survey locations were established by MKO through site reconnaissance and viewshed analysis. Two years of surveys were completed between October 2016 and September 2018.

The survey period is inclusive of the following ornithological surveys;

- Winter 2016/2017
- Breeding 2017
- Winter 2017/18
- Breeding 2018

Malachy Walsh and Partners (MWP) were appointed by Coillte to complete an additional year of surveys, following methodologies completed over the previous two years. These surveys were commissioned to confirm, and compare the results of the two previous years of survey, and describe any changes of the bird activity at the site, if any. The focus of the latter surveys in winter 2019/20 and summer 2020 were solely on hen harrier.

The survey period is inclusive of the following ornithological surveys;

- Winter 2018/19
- Breeding 2019
- Winter 2019/20
- Breeding 2020

Full details of methodologies and survey results can be viewed in **Appendix 7-1, Appendix 7-2 and Appendix 7-4** while the results of the hen harrier breeding survey in 2020 is presented below in **Section 7.3.3.1**.

7.2.3.1 Vantage Point (VP) Surveys

Vantage point (VP) surveys were undertaken in accordance with SNH (2014-2017) guidance. Eight vantage points were selected. Eight vantage points were selected for the original 2 year study (2016-2018) by MKO (refer to **Appendix 7-1**). Each vantage point was watched for a period of six hours, per monthly site visit. The selected eight vantage point locations surveyed were continued during winter 2018-19 (October-March, 2018) and the 2019 breeding survey period (April-September, 2019) by MWP (refer to **Appendix 7-2**). Vantage point locations are illustrated in **Figure 7-3** below.

7.2.3.1.1 Viewshed Analysis of VP Locations

Viewshed analysis was undertaken for each VP location to determine visual coverage of the survey area (taken to encompass the site and the flight activity survey area). Viewsheds were set to observer height of 2m showing a view of everything over 25m height. Viewsheds encompassed a 2km radius with 180^0 view. Each viewshed was then cropped to an 180^0 arc showing the direction of view. Viewshed analysis determined that, based on the VP locations selected, visual coverage of approximately 81% of the survey area was achieved. **Figure 7-4** below illustrates the viewshed coverage from all VP locations. Viewshed mapping showing the coverage from each VP can be viewed in **Appendix 7-1** and **Appendix 7-2**.

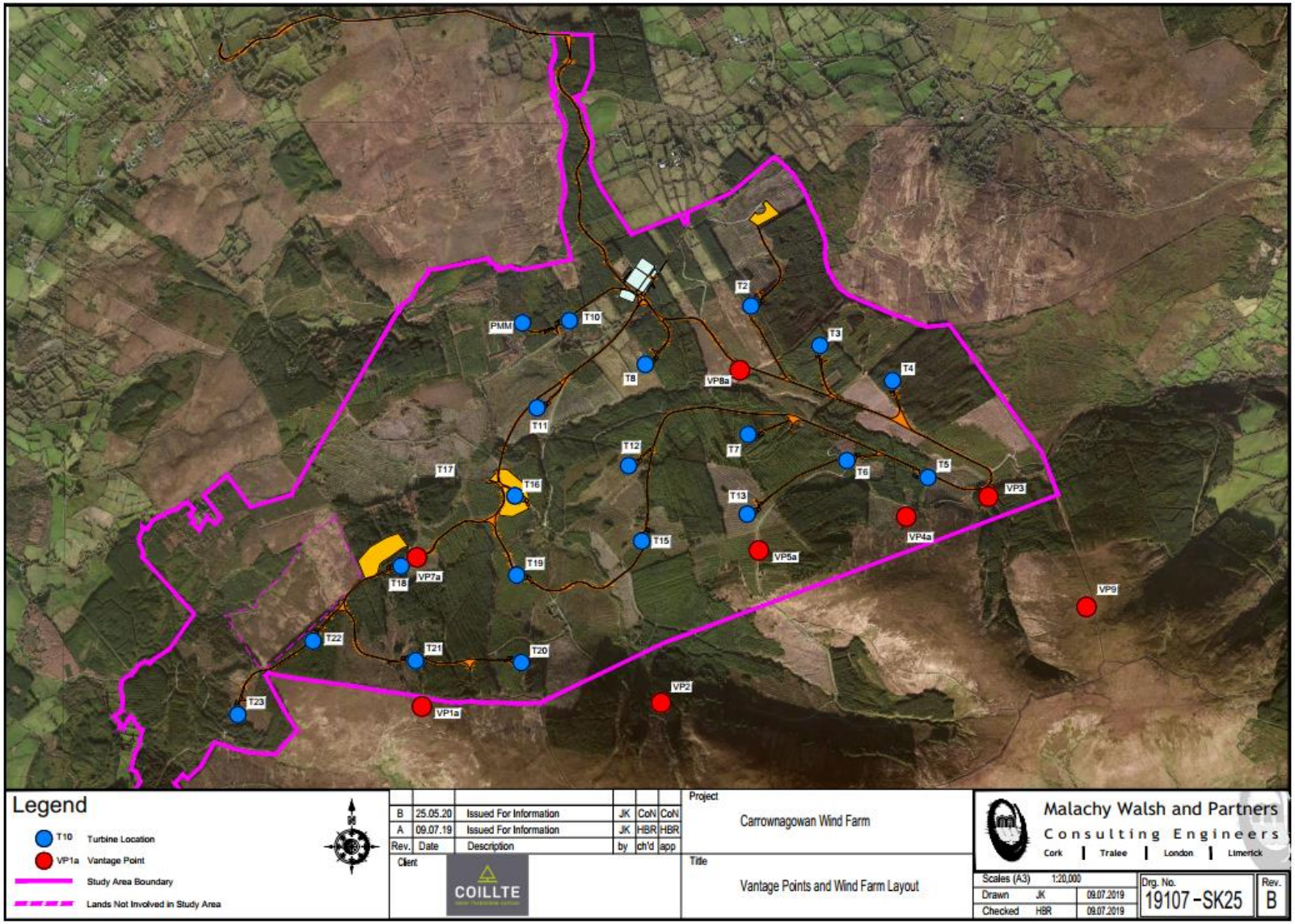

Figure 7-3. Vantage point locations

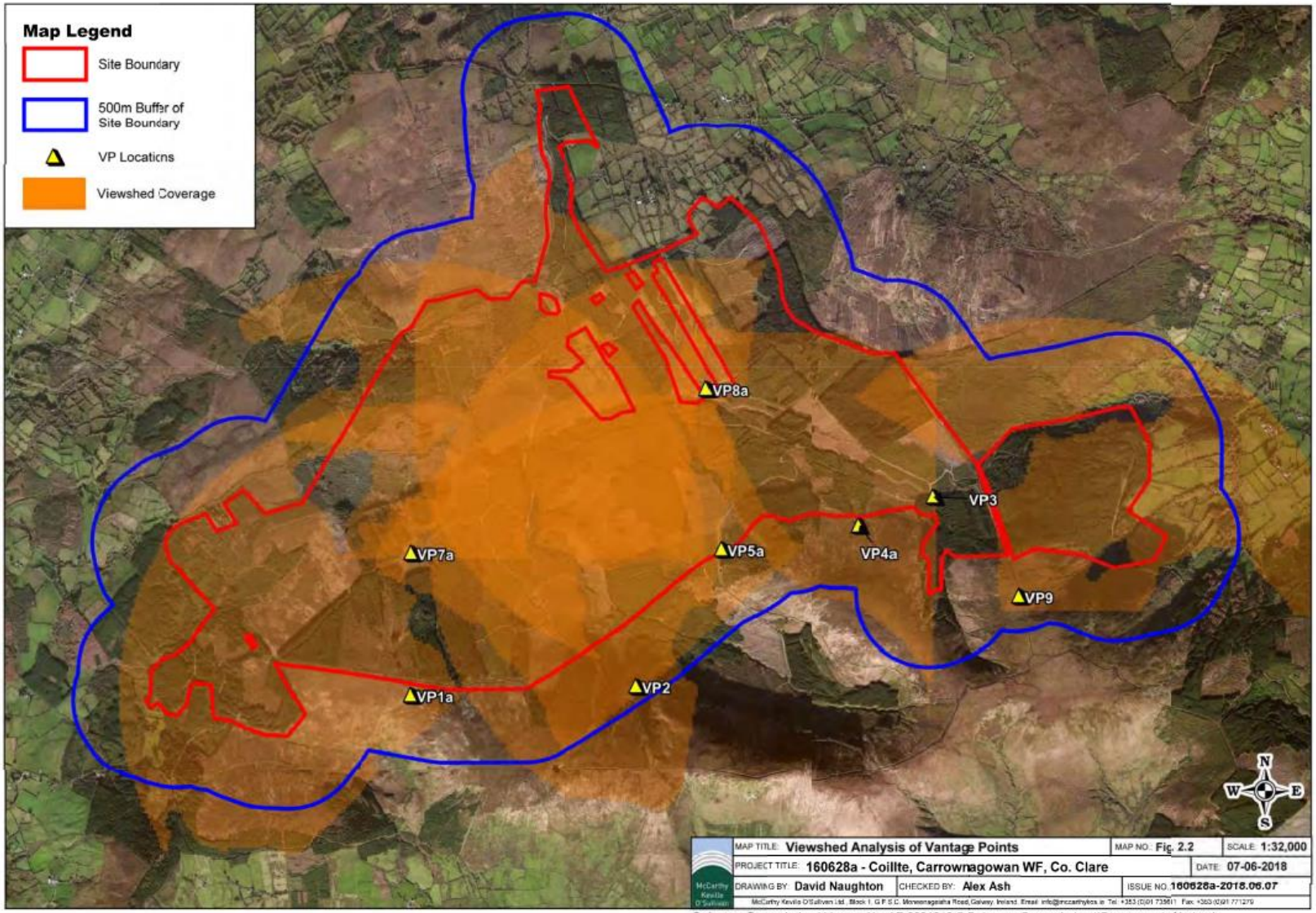

Figure 7-4. View-shed coverage

7.2.3.1.2 Flight Data Recording

Data on bird observations and flight activity was collected by scanning an arc of 180° and a 2km radius by an observer at each fixed location for six hours per month. The timing of vantage point surveys was modified to the avian ecology of the target species present at the study area, and included morning, day and evening surveys. In this manner, an even spread of survey effort was achieved throughout daylight hours and across the survey seasons.

Flight activity was divided into distinct height bands. The flight bands were chosen in relation to the dimensions of likely turbine models for the site and the resulting potential collision height. Bands are split into 0-10m, 10-25m, 25m-175m and 175m+. The surveys design used the precautionary approach, a 25-175m was used as potential collision height (PCH) (Actual PCH = 31m-169m) in collision risk modelling.

Details on vantage point watch surveys are presented in **Appendix 7-1, and Appendix 7-2**. This includes full details of dates, times, survey locations, survey duration and weather conditions for each survey.

7.2.3.2 Hen Harrier Roost Survey

Potential hen harrier roost sites within 2km of the study area were surveyed for the presence of hen harrier during winter seasons. Survey work was undertaken using methods described by Hardey et al. (2013) and the 'Irish Hen Harrier Winter Roost Survey' (unpublished document coordinated by members of NPWS). Surveys were carried out during non-breeding seasons (Oct 2016 – Mar 2017, Oct 2017 – Mar 2018, Oct 2018 – Mar 2019). Survey effort, including details of survey duration and weather condition, is presented in **Appendix 7-1 and Appendix 7-2.** A winter roost survey was also completed between October 2019 and March 2020 by MWP (refer to **Appendix 7-4**).

Hen harrier roost survey locations are illustrated in **Figure 7-5** below. Hen harrier roost survey locations for the 2019/20 survey are presented in **Appendix 7-4**.

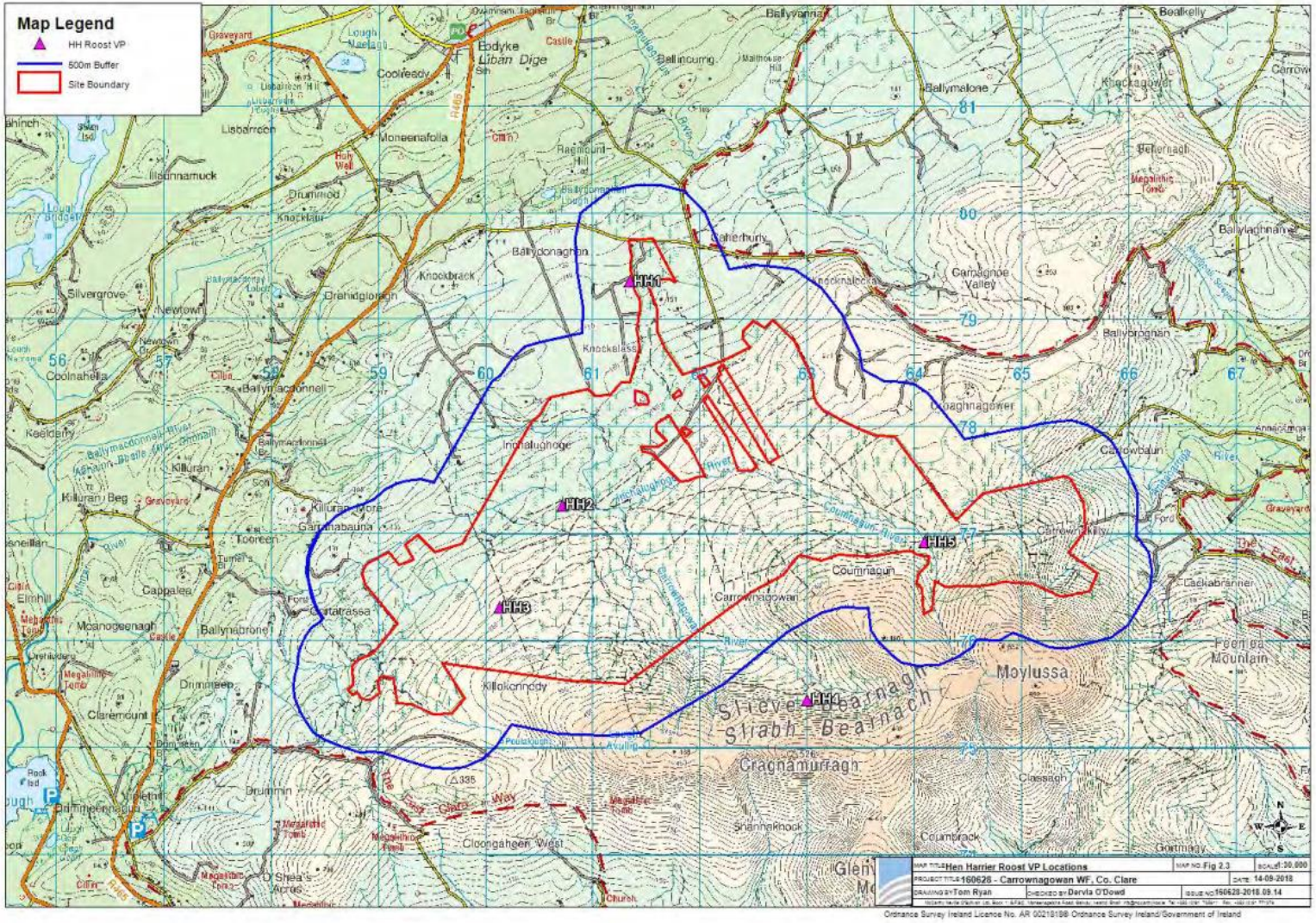

Figure 7-5. Hen harrier roost survey points

7.2.3.3 Red Grouse Survey

Red grouse surveys were undertaken during March 2017, March 2018, and March 2019. The methodology was derived from that described in Bibby et al. (2000) and the survey methods for the most recent national Red Grouse survey (2006/2007 to 2007/2008) coordinated by BirdWatch Ireland and submitted to the NPWS (Murray et al., 2013). The survey area extended 500m beyond the site boundary, where access allowed. The survey consisted of tape luring transects.

Survey effort, including transect routes, details of survey duration and weather condition, is presented in **Appendix 7-1** and **Appendix 7-2.**

The surveys were carried out under NPWS License Number 025/2017, 021/2018, and 030/2019 respectively.

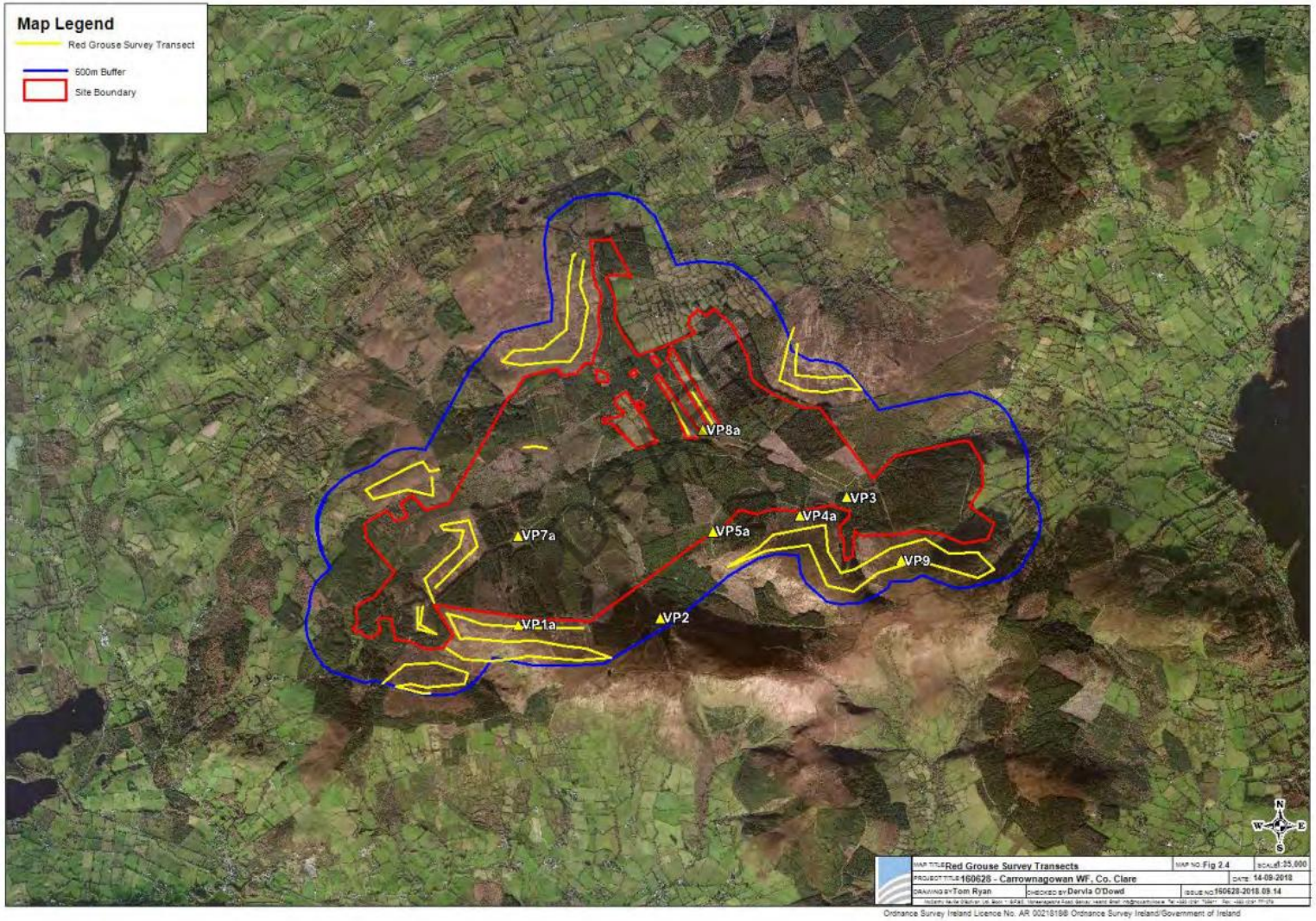

Figure 7-6. Red grouse transect routes

7.2.3.4 Wetland Surveys

Wetland sites within 10km of the study area were surveyed for waterbird populations (i.e. waders, waterfowl, gulls, grebes and rails). The survey area extended to 10km as greenland white-fronted geese was identified as a potential target species within the wider surroundings of the project mainly and Lough O'Grady. The core foraging range from winter night roosts for this species is 8km as outlined by SNH (SNH 2016). The extensive surveys were completed to provide information on wetland waterbirds extending away from the project site. Count methodology was in line with survey methodology guidelines issued by SNH (2014) and BirdWatch Ireland (2015). Monthly counts were undertaken at each of the wetland sites to cover the winter seasons. Counts were conducted during daylight hours (ideally at dawn or before dusk) from suitable vantage points at the wetland sites.

Survey locations are illustrated in **Figure 7-7** below. Survey effort and results are presented in **Appendix 7-1 and Appendix 7-2.**

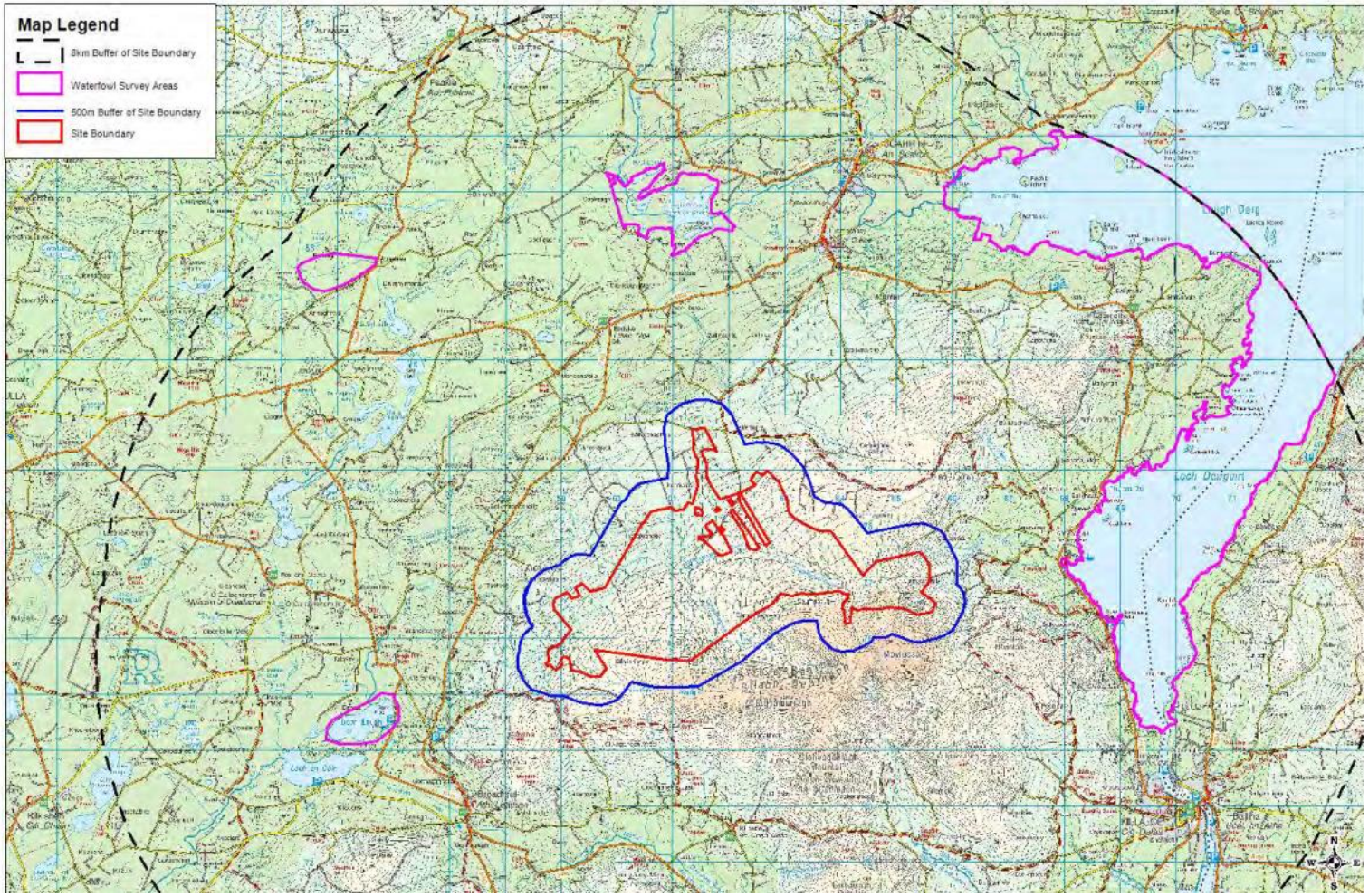

Figure 7-7. Wetland survey area

7.2.3.5 Distribution and Abundance Surveys

Distribution and abundance surveys were carried out to record numbers and distributions of wintering, breeding and migrant birds using the site that might be affected either directly or indirectly by the proposal (e.g. habitat loss, displacement effects).

7.2.3.5.1 Winter Walkover Survey

Winter transect surveys were conducted to determine the presence of bird species of conservation concern within the area of potential suitable habitat within the study area. The survey area extended 500m outside the project site boundary, as per SNH guidance (SNH, 2014, 2017).

Transect routes were devised to ensure coverage of different habitat complexes within the study area. The methodology was broadly based on methods described in Bibby et al. (2000). Target species were raptors, waterbirds, gulls and ground birds of conservation interest. Along with target species, all additional species observed were recorded to inform the evaluation of supporting habitat.

Walkover surveys were carried out during the months of October, December, January and March for the 2016/2017 and 2017/2018 winter periods, with the site being visited twice per month for this survey. Refer to **Figure 7-9**.

The 2018/19 walkover surveys were undertaken in the months of October, December and March.

Survey effort, including details of survey duration and weather condition, and results is presented in **Appendix 7-1 and 7-2**.

7.2.3.5.2 Breeding Walkover Survey

Breeding walkover surveys were undertaken during both breeding seasons to detect the presence of breeding birds on site. The survey area extended to 500m outside the site boundary as specified by SNH (2014, 2017). Refer to **Figure 7-8**. Upland bog areas were surveyed using the adapted Brown and Shepherd method, as described by Gilbert et al (1998). This survey method is primarily used to detect the presence of breeding waders, such as curlew, golden plover, snipe and lapwing. However, this survey method was adapted to include the recording of breeding territories of all target species.

Breeding walkover surveys were carried out during the months of April, May, June and July for the 2017 and 2018 breeding season. All (accessible) areas of the site were visited once per month for these surveys. Survey effort including details of survey duration and weather conditions can be found in **Appendix 7-1**, and surveys completed in 2019 can be viewed in **Appendix 7-2**.

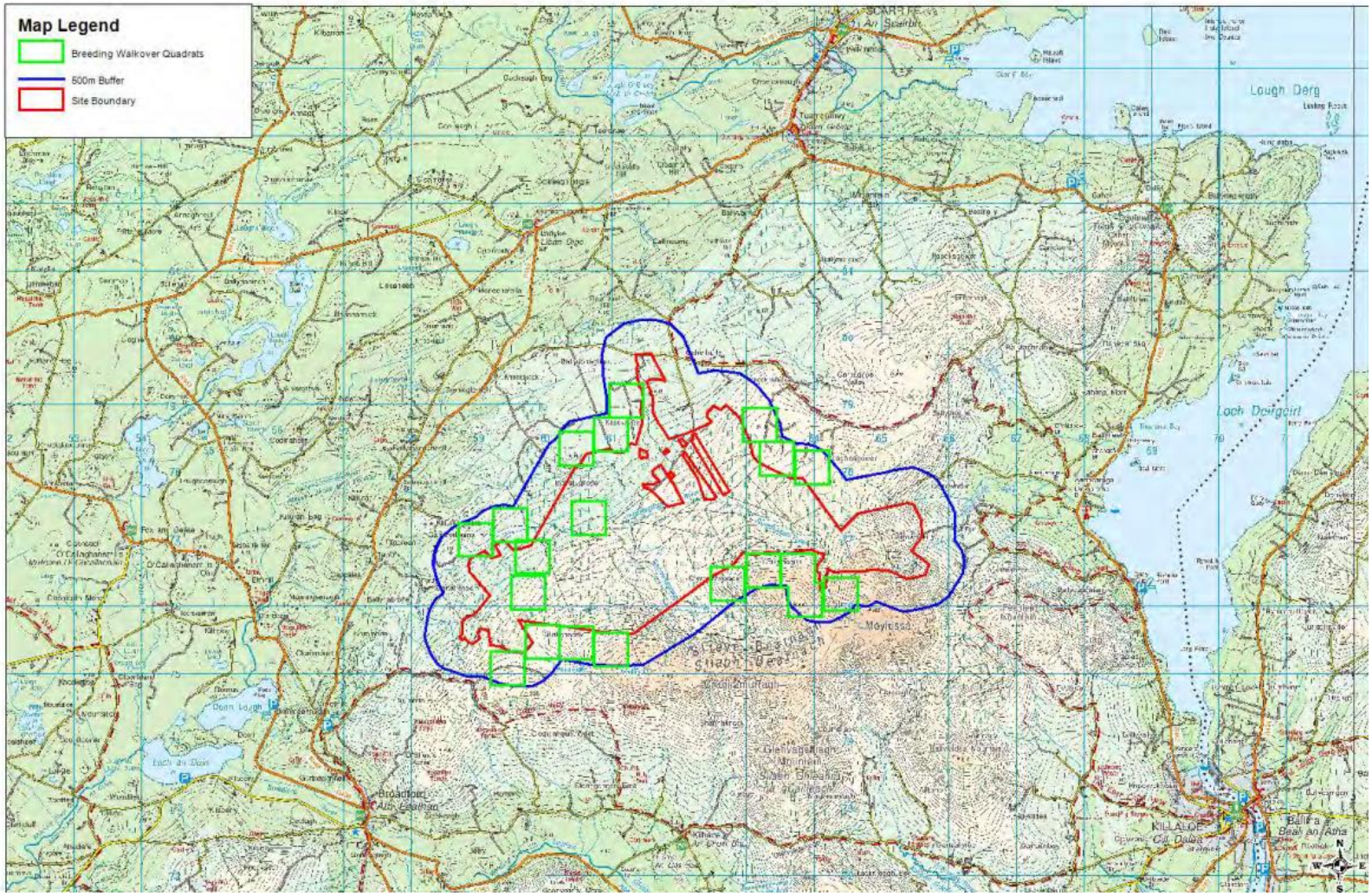

Figure 7-8. Breeding Walkover Survey Quadrats

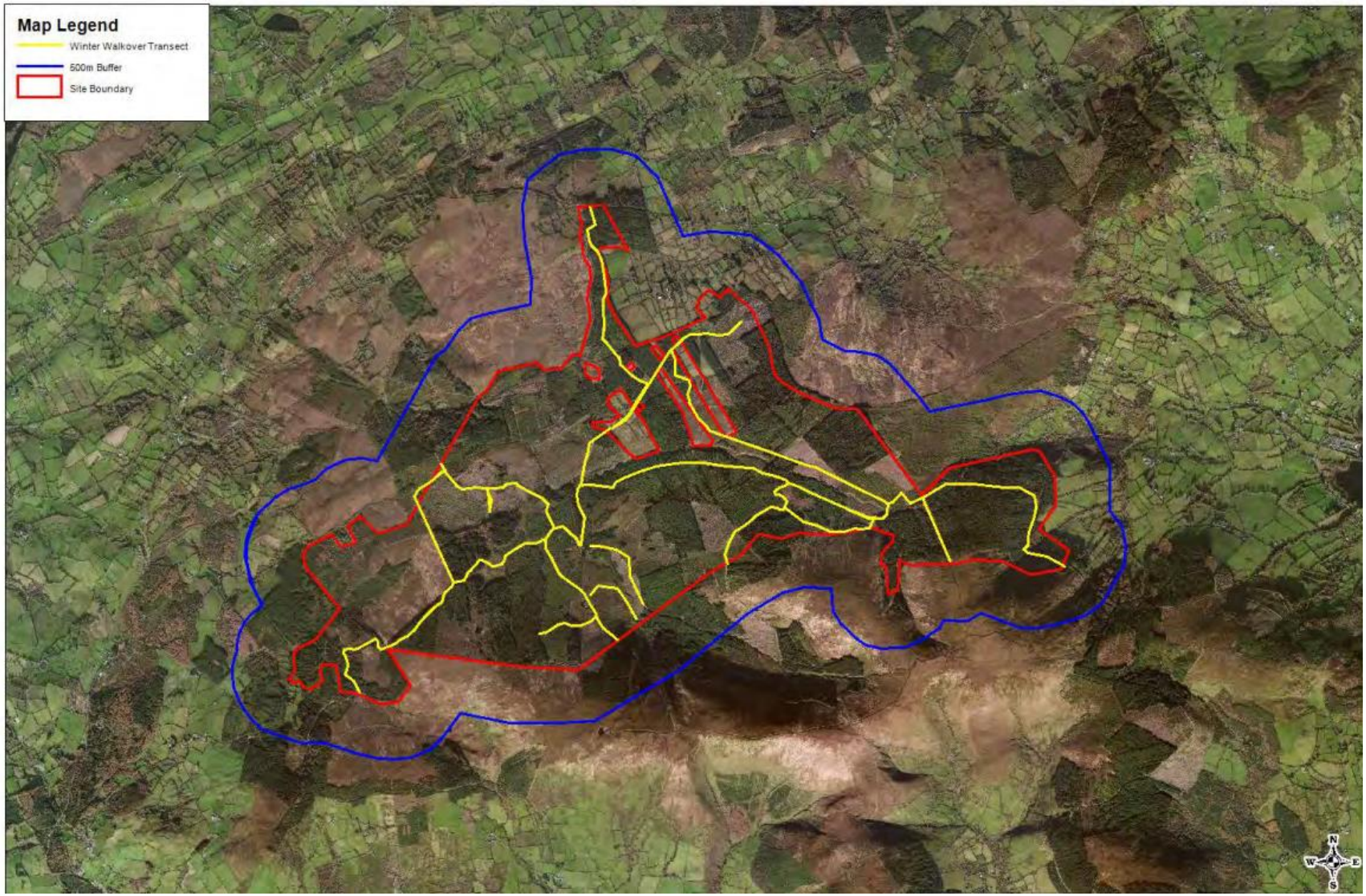

Figure 7-9. Winter walkover transect routes

7.2.3.6 Breeding Raptor Survey

Breeding raptor surveys (i.e. birds of prey and owls) were conducted within the study area and extending away from the site. The survey area extended 2km beyond the site boundary. The aim of these surveys was to identify attempted or successful breeding attempts by raptor pairs and inform on their territories within the study area. Methodologies were based on Hardey et al. (2013).

SNH (2017) describes that breeding raptor surveys should be undertaken onsite and to a radius of 2km from the project site boundary for a duration of two years. A key target species at this site included hen harrier; draft Irish guidelines for survey this species recommend surveying an area covering a 5km radius from the outer most turbines (Wilson et al 2015). This approach was adopted, i.e. breeding raptor surveys were undertaken onsite and to a 5km radius from the project boundary. This approach was in line with SNH (2017) and Irish guidelines for breeding hen harrier surveying at wind farm sites (Wilson et al, 2015).

7.2.3.6.1 Merlin Survey

Breeding raptor surveys (including merlin) were conducted over breeding season of 2019 to survey for early season signs of breeding activity, and cover recently fledged birds.

Searches along selected routes, and survey areas were conducted looking for signs of merlin within and around the site. Signs searched for included plucking posts, remains of prey, pellets and regularly utilised perches (see **Figure 7-11** below).

The methodologies used and results can be viewed in **Appendix 7- 2.**

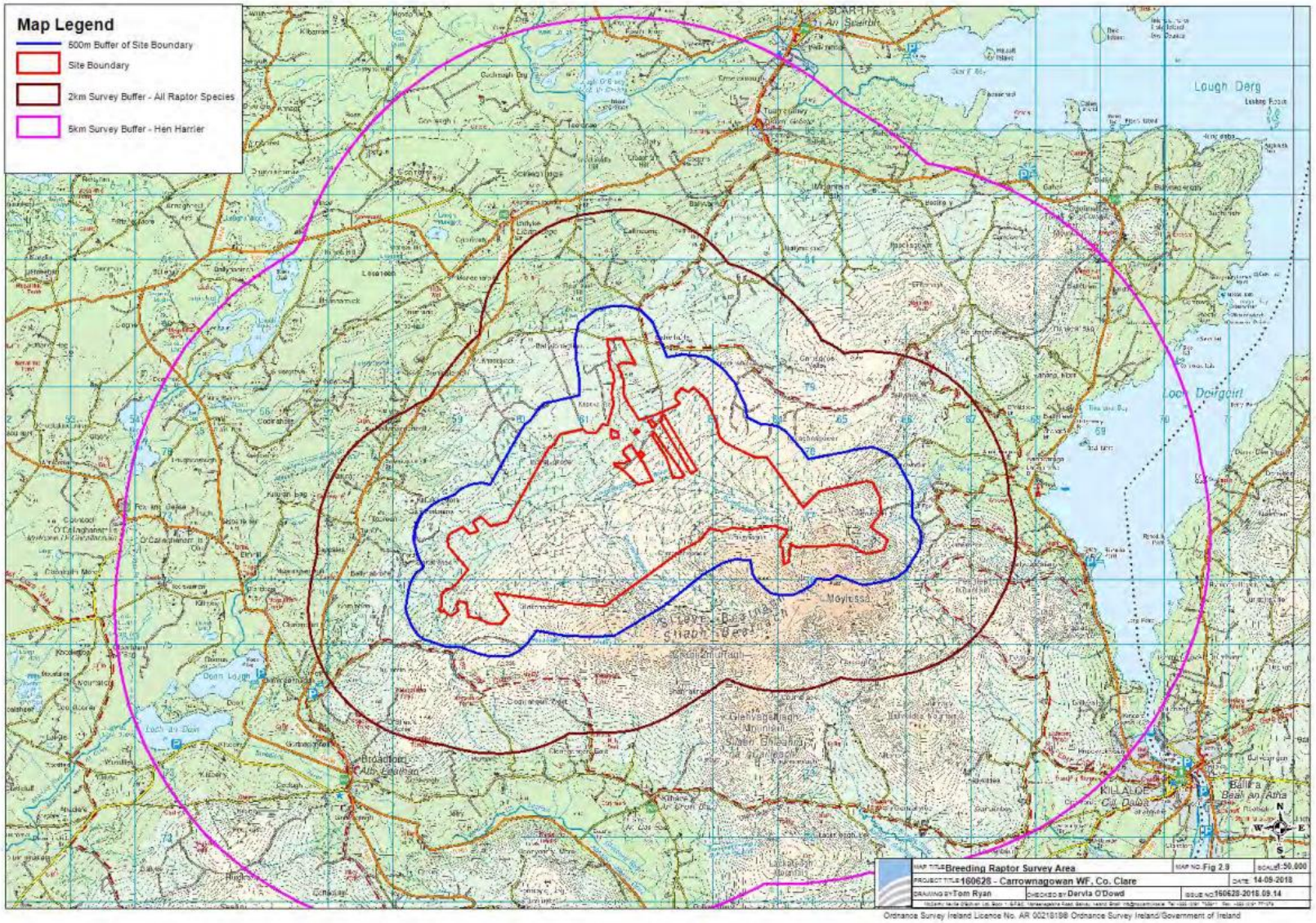

Figure 7-10. Breeding raptor survey area

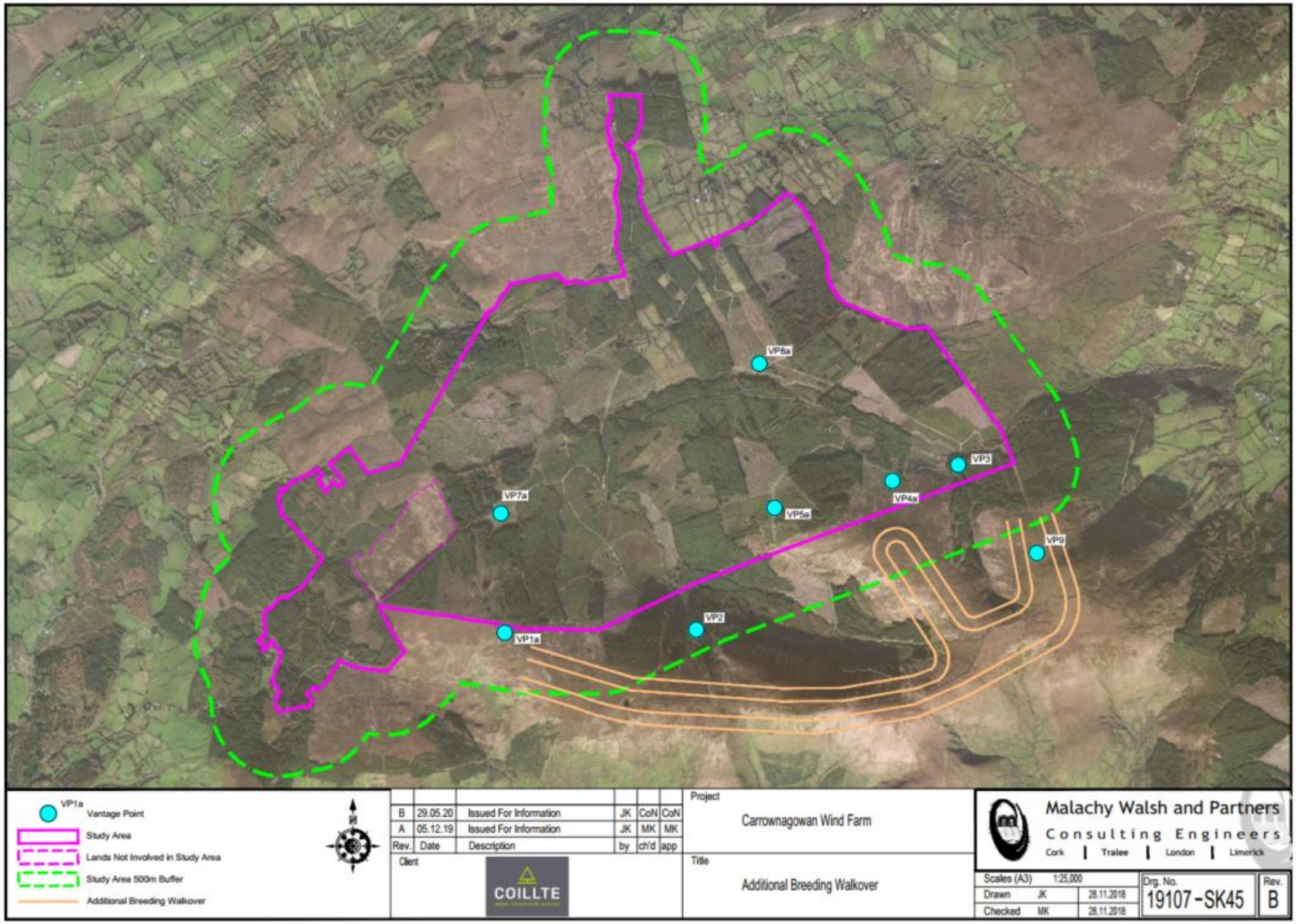

Figure 7-11. Breeding Raptor to south of site

7.2.3.7 Woodcock and Nightjar surveys

Targeted nocturnal woodcock and nightjar transects were undertaken during the breeding season of 2019.

The methodologies used and results can be viewed in **Appendix 7- 2**.

7.2.3.8 Hen Harrier Breeding Survey 2020

A targeted hen harrier breeding survey was undertaken between the months of May, June, July and August 2020 to determine the distribution and use of the site and general area by birds. Survey work was undertaken with regard to Hardey et al. (2013). The aim of the survey work was to record and map evidence of breeding hen harrier, locate active nests, and record activity, behaviour, feeding rates at nests and breeding success. A combination of vantage points (VP), which ranged from 1-4 hours in duration depending on hen harrier breeding activity, and transects were used to locate and monitor nesting activity. Survey work was undertaken by ornithologist and raptor expert, Allan Mee.

7.2.4 Identification and Evaluation of Avian Key Ecological Receptors

Avian Key Ecological Receptors refers to important bird species that should be subject to detailed assessment. Such species will be those that are considered to be important and potentially affected by the project. The identification and evaluation of avian Key Ecological Receptors (KERs) is based on the results of the desk-top study and field surveys and occurrence within the ZOI, legal status, conservation status, the NRA evaluation approach (NRA, 2009b), and professional judgement, the results of which are presented in **Section 7.3.5**.

Key ecological receptors are referred to by NRA (2009b) as those ecological features which are evaluated as Locally Important (higher value) or higher and are likely to be impacted significantly by the proposed development. Features that were evaluated as being of Local Importance (higher value) and higher in this study were selected as avian KERs and then the impact significance on each of these features was assessed.

7.2.5 Impact Assessment Methodology and Ornithological Evaluation Criteria

7.2.5.1 Potential Effects Associated with Project

As described in SNH Guidance (2017), wind farms present three main potential risks to birds (Drewitt & Langston 2006, 2008; Band et al. 2007) most notably target species. These include;

- Direct habitat loss through construction of wind farm infrastructure.
- Indirect effects such as displacement; if birds avoid the wind farm and its surrounding area due to turbine construction and operation. Displacement due to disturbance during the construction and operational phase may occur. Displacement may also include barrier effects in which birds are deterred from using normal routes to feeding or roosting grounds.
- Direct effect of mortality caused by collisions turbine blades and other infrastructure.

The potential impacts are assessed against parameters as set out in NRA 2009 Guidance, in addition to guidance produced by the EPA, 'Guidelines on the information to be contained in Environmental Impact Assessment Reports' (EPA, 2017), and IEEM Guidelines For Ecological Impact Assessment in the UK and Ireland (CIEEM, 2019).

7.2.5.2 Determining sensitivity, magnitude and significance of effects

Evaluating the sensitivity of birds follows the guidance set out in Percival (2003). Percival's methodology is considered alongside the other literature relating to the effects of wind farms on birds as reviewed in Whitfield and Madders (2006) and Drewitt and Langston (2006). This methodology has been used to assess the sensitivity of a species to the project type, the magnitude of the effect, and the significance of the potential impact.

A number of factors are used to determine this sensitivity:

- Whether the species is on Annex I of the EC Birds Directive;
- Whether the species is particularly ecologically sensitive – this includes large birds of prey and rare breeding birds (including divers, common scoter, hen harrier, golden eagle, red-necked phalarope, roseate tern and chough);
- Whether the site contains species at nationally important numbers (>1% of Irish population);
- Whether the site contains species at regionally important numbers (>1% of regional population, with the region usually taken as the county);
- Whether the species is subject to special conservation measures, such as red or amber species on the BirdWatch Ireland's (Colhoun and Cummins, 2013) list of Birds of Conservation Concern (BoCCI).

The sensitivities are evaluated using the criteria set out in **Table 7-1** below.

Table 7-1. Evaluation of Sensitivity for Birds (Percival 2003)

Sensitivity	Determining Factor
Very High	Species that form the cited interest of SPAs and other statutorily protected nature conservation areas. Cited means mentioned in the citation text for the site as a species for which the site is designated.
High	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, rednecked phalarope, roseate tern and chough. Species present in nationally important numbers (>1% Irish population).
Medium	Species on Annex 1 of the EC Birds Directive. Species present in regionally important numbers (>1% regional (county) population). Other species on BirdWatch Ireland's red list of Birds of Conservation Concern.
Low	Any other species of conservation interest, including species on BirdWatch Ireland's amber list of Birds of Conservation Concern not covered above.

In order to assess any potential impacts identified, the magnitude of any possible effects on the species is determined.

Once the species or populations of species in the study area have been evaluated in terms of their sensitivity, the next step is to determine the magnitude of the possible effects that may occur. The significance of any one impact is a product of the sensitivity of the receptor, the magnitude of the impact and the probability of that impact occurring.

The determination of the magnitude of the effects is shown in **Table 7-2** below.

Table 7-2. Determining the magnitude of possible effects (Percival, 2003)

Magnitude	Description
Very High	Total loss or very major alteration to key elements, features of the baseline conditions such that the post project character, composition, attributes will be fundamentally changed and may be lost from the site altogether. *Guide: <20% of local population-habitat remains.*
High	Major loss or major alteration to key elements, features of the baseline (pre-construction) conditions such that post project character, composition, attributes will be fundamentally changed *Guide: 20-80% of local population-habitat lost*
Medium	Loss or alteration to one or more key elements, or features of the baseline conditions such that post project character, composition, attributes of baseline will be partially changed. *Guide: 5-20% of local population-habitat lost*
Low	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-project circumstances, patterns. *Guide: 1-5% of local population-habitat lost*
Negligible	Very slight change from baseline condition. Change barely distinguishable, approximating to the "no change" situation. *Guide:<1% of local population-habitat lost*

The significance of the impacts is determined based on **Table 7-3** below, including published literature of potential impacts wind farms pose on bird species. The methodology allows this by cross-tabulating the sensitivity of the species, and the magnitude of the effects, to give a prediction of the significance of each potential impact.

Table 7-3. Determination of significance (Percival, 2003)

Significance		Sensitivity			
		Very high	**High**	**Medium**	**Low**
Magnitude	**Very high**	Very high	Very high	High	Medium
	High	Very high	Very high	Medium	Low
	Medium	Very high	High	Low	Very Low
	Low	Medium	Low	Low	Very Low
	Negligible	Low	Very low	Very Low	Very Low

7.2.5.3 Impact Assessment EPA Criteria (2017)

EPA (2017) impact assessment criteria are described below.

The criteria for assessing significance of effects are described in **Table 7-4** below.

Table 7-4. Criteria for assessing impact significance based on CIEEM (2019) and EPA (2017)

Parameter	Description
Direction (Quality)	Positive: A change which improves the quality of the environment (for example, by increasing species diversity; or the improving reproductive capacity of an ecosystem, or by removing nuisances or improving amenities).
	Neutral: No impacts or impact that are imperceptible, within normal bounds of variation or within the margin of forecasting error.

Parameter	Description	
	Negative: A change which reduces the quality of the environment (for example, lessening species diversity or diminishing the reproductive capacity of an ecosystem; or damaging health or property or by causing nuisance).	
Magnitude	Imperceptible	An effect capable of measurement but without significant consequences.
	Not significant	An effect which causes noticeable changes in the character of the environment but without significant consequences.
	Slight	An effect which causes noticeable changes in the character of the environment without affecting its sensitivities.
	Moderate	An effect that alters the character of the environment in a manner that is consistent with existing and emerging baseline trends.
	Significant	An effect which, by its character, magnitude, duration or intensity alters a sensitive aspect of the environment.
	Very Significant	An effect which, by its character, magnitude, duration or intensity significantly alters most of a sensitive aspect of the environment.
	Profound	An effect which obliterates sensitive characteristics
Extent	The area over which an impact occurs.	
Duration	• 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 1 to 7 years • Medium term – effects lasting 7 to 15 years • Long term – effects lasting 15 to 60 years • Permanent – effects lasting over 60 years	
Reversibility	Irreversible impacts: permanent changes from which recovery is not possible within a reasonable time scale or for which there is no reasonable chance of action being taken to reverse it. Reversible impact: temporary changes in which spontaneous recovery is possible or for which effective mitigation (avoidance/cancellation/reduction of effect) or compensation (offset/recompense/offer benefit) is possible.	
Frequency and timing	Frequency – How often the effect will occur. (once, rarely, occasionally, frequently, constantly – or hourly, daily, weekly, monthly, annually)	

7.2.6 Statement on Limitations and Difficulties Encountered

As the site is situated in upland area, the weather conditions during winter periods may on occasion be unsuitable for ornithological surveys. However, the weather was monitored, and surveys were scheduled around poor weather conditions.

No significant limitations have been identified.

7.3 EXISTING ENVIRONMENT

7.3.1 Site Description

The site is located approximately 4km northeast of the village of Broadford, Co. Clare. The site is situated in an upland area (approx. 200-420m OD), on the north-western slopes of the Slieve Bernagh Mountains. The site covers an area of c.750 hectares, which principally consists of commercial conifer plantation (of various rotations). Sections of upland blanket bog (PB2), raised bog (PB1), cutover bog (PB4), and wet heath (HH3) occur in unplanted areas between large forestry blocks. The peatland habitats occurring have been damaged by on-going forestry operations at the site. A number of areas of wet grassland (GS4) occur, which are reverting from previous agricultural improvement.

In the wider landscape, Lough Derg lies to the east of Slieve Bernagh and agricultural land extends away from the lower slopes to the far north and west and hilly terrain to the south.

A number of field areas of wet grassland (GS4) occur, reverting back from improvement for agriculture. The site is drained by a number of first and second order streams (FW1), in the upper reaches of the catchment area. The site is drained largely by the Owengarney River. The eastern extent of the project site is drained by the Annacarriga River. Within the Carrownagowan wind farm site, the conifer plantation sometimes extends to the margins of the rivers and streams draining the site.

The site is accessed via the L-8221 local road to the north (BL3), which extends into a network of existing access tracks (BL3) within the wind farm site. Extending away from the wind farm site, bogland, heathland and conifer plantation dominate the immediately surroundings, with agricultural grassland dominating beyond this.

The grid route, which is 22.4km in length, runs underground from the proposed Carrownagowan wind farm 110kV substation to the existing ESB owned 110kV substation at Ardnacrusha. The grid connection exits the southern end of the site, using existing conifer access track (BL3), and access track installed in agricultural grassland (GA1). The route uses the network of Local and Regional roads (BL3), bounded by hedgerow (WL1), treeline (WL2), and improved grassland (GA1), generally in a southern direction, connecting to the Ardnacrusha hydroelectric station.

7.3.2 Desk Study Results

7.3.2.1 Designated Sites

Designated sites for nature conservation within the ZOI of the project were identified.

Special Protected Areas

SPA sites were originally designated under Directive 79/409/EEC, The Directive on the Conservation of Wild Birds ('The Birds Directive'), and are now protected as Natura 2000 Sites under the EU 'Habitats Directive'. There are four SPA sites within ZOI of project.

Special Areas of Conservation

SAC sites are protected under the European Union (EU) 'Habitats Directive' (92/43/EEC), as implemented in Ireland by the European Communities (Natural Habitats) Regulations, 1997. There are ten SAC sites within the ZOI of the project.

International Convention on Wetlands of International Importance 1971

The Convention on Wetlands, also known as the Ramsar Convention, is an intergovernmental treaty which aims to conserve and protect wetlands and their resources around the world. The desk-top review concluded that there are no Ramsar sites within 15km of the site boundary.

Natural Heritage Areas

Sites of National Importance in the Republic of Ireland are termed, Natural Heritage Areas (NHA) and Natural Heritage Areas (pNHA). While the Wildlife (Amendment) Act 2000 has been passed into law, pNHAs will not have legal protection until the consultative process with landowners has been completed; this process is currently ongoing. There are seven NHA sites, and thirteen pNHA sites located within 15km of the site.

Table 7-5 below lists the designated sites within the ZOI of the project.

Table 7-5. Designated sites

Designated Site	Distance from designated site to location of nearest turbine-Grid Connection	Feature of Interest
SPA Sites		
Lough Derg (Shannon) SPA (004058)	c. 4.2km to east of T13 c. 7.6km to east of Grid Connection	– Cormorant (*Phalacrocorax carbo*) [A017] – Tufted Duck (*Aythya fuligula*) [A061] – Goldeneye (*Bucephala clangula*) [A067] – Common Tern (*Sterna hirundo*) [A193] – Wetland and Waterbirds [A999]
Slieve Aughty Mountains SPA (004168)	c. 8.0km to north of T9 c. 9km to north of Grid Connection	– Hen Harrier (*Circus cyaneus*) [A082] – Merlin (*Falco columbarius*) [A098]
River Shannon and River Fergus Estuaries SPA (004077)	c.18.7km to south of T1 c. 4.8km to south of Sub Station and Grid Connection	– Cormorant (*Phalacrocorax carbo*) [A017] – Whooper Swan (*Cygnus cygnus*) [A038] – Light-bellied Brent Goose (*Branta bernicla hrota*) [A046] – Shelduck (*Tadorna tadorna*) [A048] – Wigeon (*Anas penelope*) [A050] – Teal (*Anas crecca*) [A052] – Pintail (*Anas acuta*) [A054] – Shoveler (*Anas clypeata*) [A056] – Scaup (*Aythya marila*) [A062] – Ringed Plover (*Charadrius hiaticula*) [A137] – Golden Plover (*Pluvialis apricaria*) [A140] – Grey Plover (*Pluvialis squatarola*) [A141] – Lapwing (*Vanellus vanellus*) [A142] – Knot (*Calidris canutus*) [A143] – Dunlin (*Calidris alpina*) [A149] – Black-tailed Godwit (*Limosa limosa*) [A156] – Bar-tailed Godwit (*Limosa lapponica*) [A157] – Curlew (*Numenius arquata*) [A160] – Redshank (*Tringa totanus*) [A162] – Greenshank (*Tringa nebularia*) [A164] – Black-headed Gull (*Chroicocephalus ridibundus*) [A179] – Wetland and Waterbirds [A999]
Slievefelim to Silvermines Mountains SPA (004165)	c. 16.7km to southeast of T13 c. 13.2km to east of Grid Connection	– Hen Harrier (*Circus cyaneus*) [A082]
pNHA Sites		

Lough Derg (000011)	c. 4.3km to east of T13	– Wetland and Waterbirds
Lough O'Grady (001019)	c. 4.9km to north of T9 c. 7.7km to north of Grid Connection	– The main interest of this site is as a waterfowl site, especially for Greenland white-fronted geese, however, there are no recent records for the species. There is also a good diversity of habitats ranging from open water to wet grassland and marsh and wet woodland and scrub.
Lough Cullaunyheeda (001017)	c. 10km to west T1 c. 10km to west of Grid Connection	– Waterfowl site with nationally important numbers of diving duck. A good diversity of habitats ranging from open water to wet grassland, marsh, cutover bog and wet woodland.
Fergus Estuary and Inner Shannon (002048)	c. 17.9km to south of T1 c. 3.9km to south of Grid Connection	– Wetlands & Waterbirds
Inner Shannon Estuary- South (000435)	c. 20km to south c. 5.3km to south of Grid Connection	– Wetlands & Waterbirds

7.3.2.2 BirdWatch Ireland (Bird Sensitivity Tool)

A Bird Sensitivity Mapping Tool for wind energy projects was developed by BirdWatch Ireland and provides a measured spatial indication of where protected birds are likely to be sensitive to wind energy projects. The tool can be accessed on the National Biodiversity Data Centre Website[1] and is accompanied by a guidance document (McGuiness et al. (2015). The criteria for estimating a zone of sensitivity (i.e. 'low', 'medium', 'high' and 'highest') is based on a review of the behavioural, ecological and distributional data available for each species.

The majority of the wind farm site is situated within an area identified as a ''Low Sensitivity Zone'' (All birds; 19, and hen harrier 19). ''Moderate'' sensitivity zones are located towards the eastern part of the site (All Birds: 34.1 and hen harrier 19, Red Grouse 15.1). There are no 'Highest' sensitivity areas within a 20km radius of the current wind farm site boundary.

7.3.2.3 Breeding and Winter Bird Atlas (2007-2011)

The majority of the wind farm site occurs within hectad R67 (10km grid square), the most westerly part of the site occurs within R57. The southern part of the grid connection is situated within hectads R66 and R56. The grid connection will be undergrounded and confined to the public road network.

Table 7-6. Records of target bird species from the Bird Atlas 2007-11 (Balmer et al., 2013)

Species	Winter Atlas 07-11 Hectad R57/R67	Breeding Atlas 07-11 Hectad R57/R67	Conservation Status
Hen harrier	Present	Probable	Annex I EU Birds Directive, SCI of SPA within Zone of Influence
Peregrine falcon	Absent	Probable	Annex I EU Birds Directive
Corncrake	Absent	Present	Annex I EU Birds Directive, BOCCI Red Listed
Whooper swan	Present	Absent	Annex I EU Birds Directive
Golden plover	Present	Absent	Annex I EU Birds Directive, BOCCI Red

[1] https://maps.biodiversityireland.ie/Map

			Listed
Dunlin	Present	Absent	Annex I EU Birds Directive
Lapwing	Present	Absent	BOCCI Red Listed
Curlew	Present	Absent	BOCCI Red Listed
Redshank	Present	Absent	BOCCI Red Listed
Goldeneye	Present	Present	BOCCI Red Listed, SCI of SPA within Zone of Influence
Tufted duck	Present	Probable	BOCCI Red Listed, SCI of SPA within Zone of Influence
Pochard	Present	Absent	BOCCI Red Listed
Shoveler	Present	Absent	BOCCI Red Listed
Black-headed gull	Present	Present	BOCCI Red Listed
Herring gull	Absent	Present	BOCCI Red Listed
Woodcock	Present	Absent	BOCCI Red Listed
Red grouse	Present	Probable	BOCCI Red Listed
Kingfisher	Present	Probable	Annex I EU Birds Directive
Common tern	Absent	Confirmed	Annex I EU Birds Directive, SCI of SPA within Zone of Influence
Grey wagtail	Present	Confirmed	BOCCI Red Listed
Meadow pipit	Present	Confirmed	BOCCI Red Listed

7.3.2.4 Irish Wetland Bird Survey (IWeBS)

The Irish Wetland Bird Survey (I-WeBS) is a monitoring scheme for wintering waterbirds in Ireland which is run jointly by BirdWatch Ireland (BWI) and the National Parks and Wildlife Service (NPWS). The Carrownagowan wind farm site is not covered by an IWeBS site. There are three I-WeBS sites listed within the ZOI, as follows:

- Lough O'Grady (OH013)
- Scariff Area (OHS20); Subsite OH601
- Lough Derg (OJ008); Subsites OH553; OJ014; OJ013

Table following tables (**Table 7-7** through to **Table 7-9**) summarises the IWeBS data for each of the sites.

Table 7-7. Lough O'Grady IWeBS summary data (OH013)

Species	1% National	1% International	2007/08	2008/09	2009/10	2015/16	Mean
Mute swan	90		3	2	2	2	2
Whooper swan	150	270	32	10			
Greylag goose	50	980			2		
Wigeon	630	15000	120	100	110	56	56
Teal	340	5000				40	40
Mallard	290	20000	30	10	42		
Tufted duck	310	12000			4		
Goldeneye	60	11500			4		
Little grebe	20	4000	3				
Great crested grebe	40	3500	2	7	5	3	3

Species	1% National	1% International	2007/08	2008/09	2009/10	2015/16	Mean
Cormorant	120	1200	9	6	8	3	3
Grey heron	25	2700	2	3	4	3	3
Coot	220	17500			2		
Golden plover	1200	9300	100*	40	30	40*	
Lapwing	1100	20000	100*	100	115	26	26
Snipe		20000	1*		1		
Curlew	350	8400	30	1	6	62	62
Greenshank	20	2300				15	15
Black-headed gull		20000			25	23	23
Common gull		16400		25			

Table 7-8. Scarriff Bay IWeBS Summary Data (OHS20)

Species	1% National	1% International	2007/08	2009/10	2015/16	Mean
Mute swan	90				33	33
Whooper swan	150	270	47	30	23	23
Greylag goose	50	980			44	44
Tufted duck	310	12000			12	12
Lapwing	1100	20000	30	90		
Curlew	350	8400	20			

Table 7-9. Lough Derg IWeBS Summary Data (OJ008)

Species	1% National	1% International	2010/11	2011/12	2013/14	2014/15	2015/16	Mean
Mute swan	90		209	101	171	79	62	103
Whooper swan	150	270	116	13	55	46	23	34
Greylag goose	50	980	30	48	46	20	48	40
Shelduck	120	3000						
Wigeon	630	15000	102	176		20	2	66
Gadwall	20	600	7	8		2		5
Teal	340	5000	122	72	15	64	2	38
Mallard	290	20000	298	261	66	96	78	125
Pintail	20	600	14	10				10
Shoveler	30	400	7	89				89
Pochard	160	3000	112	90	22	7		40
Tufted duck	310	12000	1976	1785	1196	932	339	1063
Scaup	65	3100	5	21				21
Long-tailed duck		17250	2					
Goldeneye	60	11500	64	23	14	6	13	14
Black-throated diver		3750				1		1

Species	1% National	1% International	2010/ 11	2011/ 12	2013/ 14	2014/ 15	2015/ 16	Mean
Great northern diver	20	50		1				1
Little grebe	20	4000	88	24	32	18	18	23
Great crested grebe	40	3500	171	41	41	61	22	41
Cormorant	120	1200	149	62	116	153	163	124
Little egret	20	1300			1			1
Grey heron	25	2700	8	4	3	4	3	4
Water rail			7	1	2			2
Moorhen		20000	17	13	9	8		10
Coot	220	17500	1348	857	286	296	70	377
Golden plover	1200	9300	200		339		47	193
Lapwing	1100	20000	891	738	1037	426	76	569
Snipe		20000	5	6	8	5		6
Curlew	350	8400	72		38		15	26
Greenshank	20	2300					2	2
Black-headed gull		20000	758	271	275	511	65	280
Common gull		16400	1*		4			4
Lesser black-backed gull		5500	7	3	3	1		2
Herring gull		10200		1	1	1		1
Great black-backed gull		4200	2	8	4	2		5
Kingfisher			2	1	1	1		1

7.3.2.5 The 2015 National Survey of Breeding Hen Harrier in Ireland

The 2015 National Hen Harrier Survey (Ruddock et al., 2016) was consulted to determine the proximity of known hen harrier breeding sites within relevant 10km hectads. The following records were reported from the relevant 10km hectads, within 5km of the Carrownagowan wind farm site:

- R57 – Possible Breeding in 2015;
- R67 – Confirmed Breeding in 2015, Confirmed Breeding in 2010;
- R77 – Confirmed Breeding in 2015, Possible Breeding in 2005 (hectads partially covers Lough Derg, and lands to the east of Lough Derg, to the east of the project).

The southern extremity of the Slieve Aughty Mountains SPA (004168) is situated approximately 8.0km to the north of T9. Within the Slieve Aughty SPA, since the 2000 national hen harrier survey period, and 2015 survey period, there has been a reduction in breeding pairs of almost 50%. The first national hen harrier survey (1998-2000) recorded between 15 and 23 pairs in the Slieve Aughty Mountains. In 2015 this SPA held 8-14 breeding pairs of hen harrier. This equates to 8.9% of the national population and 20.3% of the SPA network population (Ruddock et al., 2016).

The Slieve Aughty SPA site synopsis describes high pressures include forestry operations within this SPA site[2]. Forestry is the main threat to hen harrier in Ireland. The extent and temporary availability of forest habitat is clearly the main influence acting on the hen harrier, affecting the long term distribution, abundance and viability of the population (IRSG, 2016).

The Slievefelim to Silvermines Mountains SPA (004165) is situated approximately 16.7km to southeast of T13. The number of recorded breeding pairs within this SPA has possibly doubled between 2005 and 2015, where five (confirmed and possible) hen harrier territories were recorded in 2005, with ten (confirmed and possible) hen harrier territories recorded in 2015.

Considering the apparent population decline from the Slieve Aughty Mountains SPA within the same timeframe as the Slievefelim to Silvermines Mountains SPA has recorded an apparent increase, the concept of redistribution of breeding pairs from the Slieve Aughty Mountains SPA to the Slievefelim to Silvermines Mountains SPA, is a potential reason for the apparent reduction (Ruddock, 2016).

During surveys completed in the Slieve Aughty Mountains SPA in 2019, there were six confirmed territories recorded, and one possible territorial pair. Four of the six confirmed pairs were successful in fledging a total of seven young[3]. This is a further reduction from 2015. During surveys completed in the Slievefelim to Silvermines Mountains SPA in 2019 there were seven confirmed pairs and one possible pair recorded and an additional successful pair recorded outside the SPA boundary. Of the seven pairs in the SPA, only one nest was successful fledging just one chick.

Table 7-10. Numbers of confirmed and possible hen harrier territories within the boundaries of each of the six breeding hen harrier SPAs

SPA Site		2005 Survey	2010 Survey	2015 Survey	Change/Estimates From 2005-2015
Slieve Aughty Mountains SPA (004168)	confirmed	24	15	8	-48.1%
	possible	3	8	6	
Slievefelim to Silvermines Mountains SPA(004165)	confirmed	4	6	4	+100%
	possible	1	6	6	

7.3.2.6 Non-designated Regional Zone for Hen Harrier

During consultations with NPWS, it was highlighted that the Carrownagown wind farm site lies within a Non-Designated Regional Zone for hen harrier, based on the 2015 National Hen Harrier Survey, namely the Slieve Bernagh-Keeper-Hill Regional Area. During the 2015 regional population estimates the Keeper-Hill area was not included in the Slieve Bernagh-Keeper-Hill Regional Area (Ruddock et al. 2016).

In 2016, the NPWS prepared an unpublished *post hoc* analysis report of the 2015 hen harrier survey which identified a range of relatively important yet non-SPA designated areas for breeding hen harriers.

The regional population estimates for the Slieve Bernagh-Keeper-Hill Regional Area, during the 2015 National Survey of Breeding Hen Harrier in Ireland, was estimated at 5-7 breeding pairs. This Regional

[2] https://www.npws.ie/sites/default/files/protected-sites/natura2000/NF004168.pdf
[3] http://www.henharrierproject.ie/HHP_HH_Monitoring_2019.pdf

Area has increased since all previous surveys (by up to 250%) and the area appears to have increased mainly since 2010 to a maximum of seven breeding pairs, however this may, in part, be due to increased survey effort (Ruddock et al., 2016).

The Slieve Bernagh-Keeper-Hill Regional Area population estimates are shown in the following table.

Table 7-11. Slieve Bernagh to Keeper Hill Regional Population Estimates

Total pairs 1998 - 2000	Total pairs 2005	Total pairs 2010	Total pairs 2015
1	1-2	2	5-7

7.3.2.7 NPWS Rare and Protected Species Dataset

A data request was made to the NPWS regarding records from the Rare and Protected Species Database. The following provides the records obtained from the NPWS (27th June 2019, and 19th November 2019) regarding rare and protected bird species.

7.3.2.7.1 Hen Harrier

NPWS hold a number of possible and confirmed breeding pair records within 5km of the Carrownagowan wind farm site.

Due to the confidentiality of these records exact locations could not be published.

0-3km from centroid:

- 2015: 2 confirmed and 1 possible breeding sites
- 2010: 1 confirmed breeding site and 2 additional sightings
- 2005: 10 sightings

3-5km from centroid:

- 2010: 1 sighting

7.3.2.7.2 Peregrine Falcon

NPWS have records of two active peregrine falcon breeding sites recorded in the 2017 National survey, for the study area (within 5km of the site).

7.3.2.7.3 Red Grouse

NPWS have a number of separate breeding sites for red grouse for the study area (within 5km). Territories were occupied in both 2007 and 2008.

7.3.2.7.4 Greenland White-fronted Geese

NPWS provided historic Greenland white-fronted geese records for the area. This species was recorded at ten separate locations between the winters of 1982/83 and 2000/2001. The vast majority of all of the observations occurred between the early 1980s and early 1990s. Seven of the ten locations were from Lough O'Grady over three kilometres north of the site. Geese were recorded at Ballymalone, over 2km to the northeast of the site during the winter of 1983/1984. Approximately, 5km to the northeast of the site, there was also a record at Scarriff from the same year. The final record was over the 4.5km to the south of the site at Kilcolman bog during the same winter in 1983/1984. However, the species has not been recorded from Kilcolman bog for a long time and it is highly probable they no longer use the site.

7.3.2.8 Birdwatch Ireland Consultation

A data request was made to Bird Watch Ireland (BWI) for specific bird data records within the relevant 10km hectads of the Carrownagowan wind farm site. BWI responded on the 11th of June 2018. BWI advised consulting with the most recent 2007-2011 Bird Atlas dataset through the NBDC website (see **Section 7.3.2.3**).

7.3.3 Field Survey Results

A comprehensive list of bird species recorded during ornithological surveys undertaken at the study area is provided in **Appendix 7-1** and **Appendix 7-**2.

The Target Species listed below included species recorded during ornithological surveys completed at the study area, and species identified during the desk study that may be potentially within the ZOI of the project.

- **Raptors**
  - Hen Harrier
  - Peregrine
  - Merlin
  - Sparrowhawk
  - Kestrel
  - Buzzard
  - White-tailed eagle
- **Waders**
  - Golden plover
  - Dunlin
  - Curlew
  - Common redshank
  - Lapwing
  - Woodcock
- **Swans**
  - Whooper swan
  - Mute Swan
- **Game birds**
  - Red Grouse
- **Gulls**
  - Herring gull
  - Lesser Black-backed gull
- **Ducks**
  - Tufted duck
  - Goldeneye
  - Common pochard
  - Shoveler
  - Wigeon
- **Shore birds and Water birds**
  - Cormorant
  - Little egret
  - Common tern
- **Passerines**

- Including, kingfisher, meadow pipit, and grey wagtail

The following sections summarise sightings of Target Species recorded during vantage point and other surveys over the survey period. Survey results and mapping for each Target Species are included in **Appendix 7-1** (surveys completed between winter 2016/17 and summer 2018), and **Appendix 7-2** (winter 2018/19 and summer 2019), including:

- Results of vantage point surveys (summary of the monthly distribution of flight activity recorded for the target species during the vantage point watches);
- List of identified breeding territories during Brown & Shephard surveys;
- Summary of monthly distribution of breeding raptor survey results;
- Summary of red grouse survey results;
- Summary of waterfowl survey observations for relevant target species;
- Summary of observations for target species during vantage point watches.

The results of the hen harrier winter roost survey completed in winter 2019/20 is presented in **Appendix 7-4** while the results of the hen harrier breeding survey in 2020 is presented in the following section.

7.3.3.1 Hen Harrier (Circus cyaneus)

During vantage point surveys conducted between the winter of 2016/17, through to the breeding season of 2018, hen harrier was observed in flight on 124 occasions during the entire two year survey period. Of these observations, fifty three of the flights occurred at potential collision height (PCH).

During vantage point surveys conducted between winter 2018/19 and the summer of 2019, there was a total of 69 hen harrier observations during the one year survey period. Of these, 20 observations were at PCH.

Four breeding territories[4] of hen harrier were identified during the 2017 breeding season. Of these, three breeding territories were within the bird survey area and one was between 2km and 5km of the bird survey area. A breeding attempt (nesting) was made within the study area, however this attempt was unsuccessful, and there were no observations of the pair in the area in July or subsequent months. A second breeding pair was recorded between 2km - 5km to the south of the study area in the 2017 breeding season. This pair produced at least one fledged chick, but it is believed that this chick did not survive for long outside of the nest, due to the lack of activity observed following the initial observation in July 2017. In summary, there was no successful breeding recorded in the summer of 2017. The nest sites recorded within the study area were all situated within young forestry. Predation is considered to have been a factor in both (failed) breeding attempts in 2017.

During the 2018 breeding season two breeding territories were identified. One territory was recorded within the study area (outside the wind farm boundary). A nest was confirmed in this location and four chicks were successfully hatched. The other was in the same area as the confirmed breeding site from 2017, between 2km and 5km to the south, however, no nest was located, and the breeding attempt was deemed to be unsuccessful.

[4] A territory is defined as any area of occupied by apparently breeding hen harriers (Ruddock, 2016)

Two breeding territories were identified within the study area during the breeding season of 2019, with no confirmed nest site identified. However, a juvenile bird was observed at the study area in July 2019, indicating local possible breeding.

During the 2020 hen harrier breeding survey, three active hen harrier nests were located with all three of the nest sites outside of the wind farm site boundary. While one nest failed, two of the nests successfully hatched, however these nests also ultimately failed, the likely cause being nest predation by buzzard and fox.

Table 7-12. Summary of hen harrier breeding activity between summer 2017 and 2020

Breeding year	Summary of breeding activity
2017	- 4No. breeding territories within the study area of which there were two failed nest attempts. One of these four territories was at a remove of 2-5km from the study area.
2018	- 2No. breeding territories within the study area of which one was successful with four chicks fledged.
2019	- 2No. breeding territories within the study area and though no nest site was identified, one incidental record of a juvenile bird indicates possible local breeding.
2020	- 3No. breeding territories within the study area of which all failed.

The results of the breeding season surveys completed, suggest that the study area and wider surroundings are important for breeding hen harrier. The results of the field surveys indicate similar with desk study results and data requests obtained from NPWS.

7.3.3.2 Hen Harrier Roost Survey Results

Hen harrier was observed on five occasions during hen harrier roost surveys over the winter periods of 2016/17 and 2017/18. Two of these observations were made during the same survey on the 23rd March 2017. One was of a male travelling over an area of forestry, while the other observation was of a female, recorded as likely going into roost in an area of heather to the west of the site boundary. The remaining three observations were confined to February and March 2018.

There was no evidence of roosting hen harrier between October 2018 and March 2019.

A hen harrier roost survey completed during the winter 2019/20 did not identify hen harrier roosting at the study area.

The results outlined above would indicate that during time of survey the study area was not used by hen harrier in significant numbers during the winter survey periods. Results of the 2016/17 winter period and the 2017/18 winter period would suggest the observations were of breeding birds returning to the study area.

7.3.3.3 Peregrine (Falco peregrinus)

During vantage point surveys completed between winter 2016/17 and summer 2018, peregrine falcon was observed in flight on three occasions over the entire two-year period. Two of these observations were at potential collision height (PCH). One of the observations was of a pair of peregrine in a courtship display flight on the 21st March 2018 (towards the southern end of the study area, within 2km of the site boundary). The two remaining observed flights over this survey period were made in December 2017 and February 2018 related to a single bird travelling and hunting respectively.

There was one observation of Peregrine outside the site boundary from VP 1A in February 2019. The bird was first heard calling overhead before flying into view from the north at 60-80m. As it flew south southeast to south to southwest following the crest of the hill its flight height undulated from 3m to 30m. It flew to the southwest out of sight.

A peregrine falcon breeding territory was identified during breeding raptor surveys in 2017, and again 2018. This territory is located just over 2km away from the site boundary. While peregrine activity at this location showed signs of territorial behaviour during both breeding seasons, however there was no breeding activity detected in either year.

The survey results are in line with results of the NPWS data request, which had records of two active peregrine falcon breeding within 5km of the project.

7.3.3.4 Merlin (Falco columbarius)

This species was observed on two occasions between winter 2016/17, and summer 2018. The observations were in April, 2017 and May, 2017. Both observations were of a single bird, in low flight, below potential collision height (PCH). Both of the observations of Merlin made from VP1A.

An adult male Merlin was observed in February 2018, where it flew into view from the north, outside the site boundary, at 1m in height passing through clear fell. The bird flew over the west side of the hill south of VP 1A. It picked up speed and flew southwest up and over the next hill at 3-10m height and off out of sight. In July 2019 an adult female was observed flying outside the site boundary from VP 1A flying southwards at 10m above the heather. The bird was lost from view after 3 seconds as it flew south behind the ridge.

The desk study did not identify any documented records of merlin in the area.

It is acknowledged the difficulties in surveying merlin, and this has been considered in the assessment.

7.3.3.5 Sparrowhawk (Accipiter nisus)

During vantage point surveys completed between winter 2016/17 and summer 2018, this species was observed in flight on forty-nine occasions throughout the entire survey period. Four of these flights were at PCH. Observations were dispersed throughout the study period. Most flights were of individual birds either commuting or hunting. Breeding activity was also recorded during vantage point surveys in the breeding season of 2018, with fledged chicks and adults carrying prey observed on a few occasions at the study area.

Thirteen sparrowhawk flight paths were recorded at the study area in both the winter season of 2018/19 and breeding season 2018 at the study area (inside and outside the site boundary). Most of the observations were from VP1A. Flying and hunting were the predominant activities recorded by individual birds. Both male and female sparrowhawks were recorded in the survey area. There were four flight paths recorded during the breeding season.

Eight territories of sparrowhawk were observed for this species during the summers of 2017 and 2018. Breeding was confirmed in 2017 at SH01, towards the south western part of the site where an adult female was observed carrying prey towards a nesting area. During the 2018 breeding season an active nest and fledged young were observed on site at SH06 towards the south centre part of the site. Begging young were also heard from a VP survey at SH08, just to the north of the site boundary, confirming successful breeding at this area also.

During 2019 breeding bird surveys one territory for sparrowhawk was identified towards the east centre of the site.

7.3.3.6 Kestrel (Falco. tinnunculus)

During vantage point surveys completed between winter 2016/17 and summer 2018, this species was observed in flight on 144 occasions throughout the entire survey period. Sixty six of these were at PCH.

There were a total of 43 flight paths between winter 2018/19 and summer 2019 survey period. The majority observed during the breeding season. Kestrel was observed from all VPs in the survey area, but most frequently from VP3 towards the east of the study area, within the site boundary. Flight paths were predominantly of individual hunting or flying birds with the flight heights ranging from 10-50m.

During the breeding seasons of 2017 and 2018, nine territories were recorded for this species during the survey period. Two of these territories (K05 and K06) (see **Appendix 7-1**) are located over 2km away from the site boundary, and are therefore not considered to be of significance to the project. The remaining territories are located towards the periphery of the site boundary, around the site. In 2018 breeding was confirmed within the study area at K07 (to the south of the site) where adults were observed carrying prey towards a nesting area. One fledged chick was also observed in July. A juvenile bird was also observed during a VP survey in 2017, confirming breeding in the wider area of the site boundary. Other territories were identified via the presence of adult pairs on several separate occasions during the breeding season, however no further confirmed breeding activity was detected.

In July 2019, 6 Kestrels were observed together from VP 2. They comprised a male and a female with 4 juveniles. The birds were recorded south of the VP, outside the site boundary and were observed hunting and flying in this area.

7.3.3.7 Buzzard (Buteo buteo)

During vantage point surveys completed between winter 2016/17, and summer 2018, this species was observed in flight on 23 occasions throughout the survey period. Sixteen of which were at potential collision height (PCH). Most flights were observed during the breeding season period with birds typically recorded as hunting or soaring.

During vantage point surveys completed between winter 2018/19 and summer 2019 buzzards were again most active during the breeding survey period, where 18 out of the 19 flight paths were recorded between April and September 2019. Between one and three birds were recorded hunting, flying, soaring and circling over all habitat types. Most observations of buzzard were from VP2. In June 2019, an adult and a juvenile were recorded together from VP7 where they were observed hunting over heather moorland.

Two breeding territories were recorded for this species during the 2017 breeding season. During the 2018 breeding season, two breeding territories were again identified, broadly located in the same areas as 2017, towards the periphery of the site. These territories were identified by the observation of territorial displays and calls of adult birds. No breeding attempt was observed, however breeding activity was recorded at BZ03 (approximately 2km to the southwest of the site boundary) in 2018 where fresh nesting material was observed.

During the 2019 breeding season breeding season, a single breeding territory was observed.

7.3.3.8 Woodcock (Scolopax rusticola)

During vantage point surveys completed between winter 2016/17 and summer 2018, this species was recorded in flight on seven occasions. All flights were below PCH. Other evidence of this species during the survey period was of a bird calling, which was not observed in flight.

Woodcock was recorded on three occasions during vantage point surveys completed between winter 2018/19 and summer of 2019. Breeding activity was recorded at two locations near VP3 and VP4A. On the 5th June 2019, a male woodcock was observed roding and flying over forestry to the north of VP 4A, inside the site. On the 7th June, 2 separate observations were made where a male bird, observed roding outside the site from VP3, 15 minutes later a bird was observed flying over forestry within the site from the same location.

Targeted nocturnal woodcock surveys were undertaken in June and August 2019. During the June transect surveys, a woodcock was observed in an area south of VP7A and north of VP1A at 22.00. The bird was roding and circling several times before being disturbed by a Kestrel. A second woodcock was observed roding to the north north-west of the original location at 22.22. A third woodcock was flushed from an access track to the north-west of VP4A and flew east at 23.30.

7.3.3.9 Golden Plover (Pluvialis apricaria)

During vantage point surveys completed between winter 2016/17 and summer 2018, this species was observed in flight on 21 occasions during the 2016-2018 survey period. Six of which were at potential collision height (PCH). Many of the observed flights occurred during the migration period for this species (October and March). Numbers ranged from a single bird to a flock of 450 birds. The majority of the observations were outside the site boundary, c.850m to the southeast of the site. A map showing the results of the vantage point surveys is provided in **Appendix 7-1**.

There were a total of 10 observations during vantage point surveys completed between winter 2018/19, and summer 2019. Six of these were at PCH. Observations were made predominantly from VP9A during the winter and early spring. Activity was concentrated c.850m south-east outside the site boundary and associated mostly with heath, bog and scrub habitats in this area at Moylussa. Flocks size varied from 4-450 birds flying. Of the 10 flight paths recorded, one was within the site boundary. This corresponds to the flock of 450 birds which were commuting over the study area at a height greater than 200m on the 5th December 2018. This observation was made from VP9A, where the birds were observed flying northwards over the south eastern extremity of the site. On the 8th November 2018, 65 birds were observed from VP9A on the ground in heather moorland just over 500m to the south east of the site boundary.

Golden plover was not observed within the site boundary during winter walkover surveys completed at the site (between winter 2016/17, and winter 2018/19). Nor was there any evidence of breeding activity recorded over the three breeding seasons.

Golden plover was observed on twelve occasions during winter waterfowl surveys throughout the study period (winter 2016/17 through to winter 2017/18). The species was observed on Lough Derg but also on different areas of wet grassland within the eight-kilometre site hinterland. Flock sizes ranged from twenty-two to one hundred and ninety-eight birds.

During waterfowl distribution surveys conducted in 2018/19 golden plover was observed on one occasion. On the 8th March 2019 nine birds were observed at Core Bog, approximately 4.5km to the northeast of the site boundary.

The project site is well outside the known breeding range of golden plover.

7.3.3.10 Red Grouse (Lagopus lagopus hibernicus)

Slieve Bernagh is a known for the occurrence of red grouse. This species was recorded on 100 occasions during vantage point surveys completed between winter 2016/17 through to breeding season of 2018. Nineteen of these observations related to observed flight activity, and all were below PCH. Eighty one of the records were of calling birds with no visual observations. Numbers ranged from one to two birds.

Twenty five observations of this species were made during dedicated red grouse surveys in March of 2017 and 2018. The majority of these observations were birds responding to the tape lure. Confirmed breeding territories were detected during breeding walkover surveys in 2017 and 2018 where incubating adults and juvenile birds were recorded. Breeding activity was primarily located to the south of the site, within 500m of the site boundary, in heather dominated blanked bog habitat which is favoured by this species when breeding.

A total of 7 locations were surveyed under NPWS licence 30/2019. Red grouse was recorded at 1 of the 7 locations during these licenced surveys; two birds were recorded in February 2019 to the south of VP1, outside the site boundary, but within 500m. Red grouse droppings were recorded in the same month to the west of VP7A, to the west of the site boundary.

In a response to a data request, National Parks and Wildlife Services have confirmed a single breeding territory which was recorded in 2007/08. This territory is approximately 500m south of the study area.

Refer to **Appendix 7-1 and Appendix 7-2** for maps showing survey locations, and the areas where Red grouse were recorded during NPWS licensed surveys.

7.3.3.11 Cormorant (Phalacrocorax carbo)

During vantage point surveys completed between winter 2016/17, this species was recorded only once during the entire survey period on the 27th of March 2018. The flight was recorded at over 175m in height, and was of an individual bird travelling in a southerly direction.

During vantage point surveys completed between winter 2018/19, one cormorant was recorded from VP5A in March. The bird was observed flying at 60-80m commuting through the site boundary, from the south-west to the north-east of the VP.

These were the only observations within the proximity of the wind farm.

Cormorant was observed on 371 occasions during winter waterfowl surveys (Winter 2016/17, and 2017/18) on various lakes including Lough Derg (approximately 4.3km to east of T13). Flock sizes ranged from one to 65 birds.

During winter waterfowl surveys (Winter 2018/19), Cormorant was observed at Clonea Lough (approximately 8.4km to the west/southwest of T1), Kilgory Lakes (approximately 5.8km to the west/northwest of T1), and Core Bog (approximately 6km to the north/northwest of T9). Numbers ranged from 1 bird at Core Bog, to 8 birds at Clonlea Lough.

7.3.3.12 Passerines

The assemblage of species recorded over the three survey years, are typical for the habitats present in upland area.

Red listed species recorded during breeding and winter bird surveys undertaken at the study area included meadow pipit and grey wagtail. Meadow pipits were confirmed to be breeding within the study area, and probable breeding of grey wagtail was recorded.

7.3.3.13 Waterfowl-Wetland Survey Results

The following species were recorded during wetland surveys undertaken between winter 2016/17 and Winter 2018/19:

- Whooper swan (Annex I)
- Herring Gull (BoCCI red-listed)
- Lesser Black-backed Gull (SCI species for Lough Derg SPA)
- Little Egret (Annex I)
- Kingfisher (Annex I)
- Tufted Duck (Red Listed, SCI species for Lough Derg SPA)
- Goldeneye (Red Listed, SCI species for Lough Derg SPA)
- Black-headed Gull (Red Listed)
- Curlew (BoCCI red-listed)
- Wigeon (BoCCI red-listed)
- Lapwing (BoCCI red-listed)
- Shoveler (BoCCI red-listed)

The wetland surveys undertaken did not identify any regular flight paths or usage of the project by a number of target species. Of the species listed above, lesser black back gull, and herring gull were observed on one occasion commuting over the site, across the three consecutive years of ornithological surveys completed at the study area. Of the remaining species listed above, there was no evidence of these species within the project, or within the proximity of the wind farm site. No regular flight paths, or migratory routes of the species listed above were identified. Therefore, due to the aforementioned, the project will not result in habitat loss, or disturbance, displacement (including barrier effect), or collision impacts on the species listed above, and these will not be considered further in this assessment.

7.3.4 Habitats Present and Usage by Birds

The species and relative abundances recorded are typical for upland sites, and the habitats available for birds. The type and nature of the upland habitats, in the site and wider locality, has been significantly modified by plantation forestry and this accounts for the occurrence of (specialist) species including redpoll, crossbill and siskin. Hen harrier and merlin may benefit from temporal availability of breeding sites and foraging habitat in conifer plantation, but for these and for other species extensive open moorland is essential habitat.

While conifer plantation may have created new bird habitats for species such as hen harrier, there are more serious implications in terms of the extent of upland moorland lost to natural upland species using these habitat types, such as red grouse, and hen harrier. Moreover, forest habitat and to some extent agriculture may encourage predator numbers to an unbalanced level, particularly fox, pine marten, hooded crow and raven, affecting vulnerable ground-residing species such as hen harrier and red grouse (Thompson et al. 1988).

7.3.5 Identification and Evaluation of Avian Key Ecological Receptors

The following table (**Table 7-12**) carries out an identification and evaluation of Avian Key Ecological Receptors (KERs), and rationale for inclusion, or exclusion based on criteria set out in **Section 7.2.4 above**.

Table 7-13. Evaluation of Avian Key Ecological Receptors (KERs) and selection Criteria, and rationale for inclusion or exclusion

Species	Conservation Status	Description and occurrence	NRA Evaluation	KER (Yes/No)	Rational for Inclusion-Exclusion
Hen harrier	Annex I, EU Birds Directive BoCCI Amber List Wildlife Act SCI of Slieve Aughty SPA	Estimated National Breeding population of estimated of 108-157 pairs (Ruddock et al., 2016). Estimated National wintering population estimated between 269-349 individuals (NPWS Article 12[5]). Estimated 7 breeding pairs in Slieve Bernagh (Ruddock et al., 2016)	**National-International Importance** **Breeding**	**Yes**	Annex I Species Conservation Status Recorded in Breeding Atlas hectads <u>Breeding</u> The project is located outside the core foraging range (2km) of the Slieve Aughty SPA population at 8km to north of T9. Hen harriers have been recorded breeding within the study area, with an estimated three breeding pair within 5km of the project site. The results of the field surveys are in line with desk study and NPWS data request results. The site is situated with the Slieve Bernagh non designated area for hen harrier, while has an estimated 7 breeding pair (Ruddock et al., 2016). The local breeding population birds equals c.2.5% of the National breeding population. A single breeding pair in Ireland is considered of International Importance as per NRA criteria. <u>Wintering</u> It is considered that the birds recorded during the winter periods are early breeding birds returning to the site. Winter observations were of individual birds and communal roosts were not recorded. There was no evidence of a winter roost on site or in the wider area. Numbers of significance as per NRA criteria were not recorded.
Peregrine	Annex I, EU Birds Directive BoCCI Green List Wildlife Act	Estimated National breeding population of peregrine: 425 breeding pairs (National Breeding Peregrine Survey 2017 (IRSG 2018)).	**County Importance** **Breeding & Winter**	**Yes**	Annex I Species Conservation Status Recorded in Breeding Atlas hectads <u>Breeding and Winter</u> The evidence of the three years of surveys completed at the study indicates that the project site is little used by this species. A number of flight-lines

[5] Ireland's bird species' status and trends for the period 2008-2012

		Recorded within hectad R67 as probable breeding During surveys at the study area a breeding territory was identified c.2km away.			were recorded towards the periphery of the site. No optimal breeding habitat is present within, and adjacent the site. The confirmed breeding activity is located 2km away. The peregrine falcon population occurring have been assessed as County Importance.
Merlin	Annex I, EU Birds Directive BoCCI Amber List Wildlife Act SCI of Slieve Aughty SPA	Estimated National breeding population of 100-200 pairs breeding (NPWS Article 12). Numbers increase in winter with an influx of Icelandic birds. Slieve Aughty Mountains SPA c. 8.0km to north of T9. c. 9km to north of Grid Connection	**County Importance** **Breeding & Winter**	**Yes**	Annex I Species Conservation Status The project site is outside the core foraging range (5km) of birds protected within SPA. There were only four observations of this species over the three years of survey completed at the study area. Three of the observations coincided with breeding season. No evidence of breeding or roosting activity recorded during surveys. Using the precautionary principle, the population of merlin occurring have been assessed as County Importance.
Sparrowhawk	BoCCI Amber List Wildlife Act	Estimated National breeding population of individuals equals: Min: 9,100 Max: 14,830 (NPWS Article 12).	**Local Importance (Higher Value)** **Breeding & Winter**	**Yes**	Conservation Status Recorded in Breeding Atlas hectads The evidence of the three years of surveys completed at the study indicates that that this species is a regular user of the site. Over the three years of vantage point survey this species was observed on fifty three occasions at the study area. This species is amber listed in Ireland. The population of sparrowhawk recorded across the seasons is evaluated as Local Importance (Higher Value) on the basis of a resident, regularly occurring population assessed to be important in the local context.
Kestrel	BoCCI Amber List Wildlife Act	Estimated National breeding population of individuals equals; Min: 12,100 Max: 21,220	**Local Importance (Higher Value)** **Breeding &Winter**	**Yes**	Conservation Status Recorded in Breeding Atlas hectads The evidence of the three years of surveys completed at the study indicates that that this species is a regular user of the site. Over the three years of vantage point survey this species was observed on 144 occasions during

		(NPWS Article 12)			vantage points surveys completed between winter 2016/17, and Summer 2018, and on 43 occasions during vantage point surveys between winter 2018/19, and summer of 2019. This species is amber listed in Ireland. The population of kestrel recorded across the seasons is evaluated as Local Importance (Higher Value) on the basis of a resident, regularly occurring population assessed to be important in the local context.
Buzzard	BoCCI Green list Wildlife Act	National population of breeding pairs estimated at 1,500 (NPWS Article 12)	**Local Importance (Higher Value)** **Breeding**	**Yes**	Green Listed Recorded in Breeding Atlas hectads During summer 2017, and summer 2018, buzzard was recorded 23 times during Vantage Point surveys and four territories were identified through breeding and territorial behaviour during breeding raptor surveys (summer 2017 and 2018). During vantage point surveys completed between winter 2018/19, and summer 2019, buzzards were most active during the breeding survey period, where 18 out of the 19 flight paths were recorded between April and September 2019. The birds recorded during the breeding season are likely to be associated with a breeding population from the wider area and were assigned Local Importance (Higher Value).
Woodcock	BoCCI Red list during the breeding season	No population is data available for woodcock in Ireland.	**Local Importance (Higher Value)** **Breeding & Winter**	**Yes**	Red Listed Conservation Status Recorded in Breeding Atlas hectads During vantage point surveys completed between winter 2016/17, and summer 2018, this species was recorded in flight on seven occasions at the study area. Woodcock was recorded on three occasions during vantage point surveys completed between winter 2018/19, and summer of 2019. Results of breeding bird surveys indicate that woodcock are breeding in small numbers at the study area. The low numbers of sightings during breeding walkover surveys and the overall low numbers recorded throughout the study period indicate that the study area does not support a large population of this species. The population recorded has been

					evaluated as Local Importance (Higher Value), based on a regular occurring breeding population that is assessed as important in the local context.
Red Grouse	BoCCI Red list Wildlife Act.	Estimated National breeding population of pairs equals; Min: 1,708 Max: 2,116 (NPWS Article 12)	**County Importance Breeding & Winter**	**Yes**	Red listed Conservation Status Recorded in Breeding Atlas hectads Data request, National Parks and Wildlife Services have confirmed a single breeding territory which was recorded in 2007/08. This territory is approximately 500m south of the study area. Confirmed breeding territories were detected during breeding walkover surveys in 2017, 2018 and 2019, outside the site, to the south. Resident population to south of site has been evaluated as County Importance.
Golden Plover	Annex I, EU Birds Directive BoCCI Red List Wildlife Act	Estimated National Wintering Population is 99,870 (NPWS Article 12 Report) Estimated National breeding population is 134-156 pairs (NPWS Article 12)	**County Importance Winter**	**Yes**	Conservation Status During ornithological surveys completed at the study area between winter 2016/17 and summer 2018, this species this species was observed on 21 occasions. Many of the observed flights occurred during the migration period for this species (October and March). Numbers ranged from a single bird to a flock of 450 birds. Activity was concentrated to the south-east outside the site boundary and associated mostly with heath, bog and scrub habitats in this area. There are no breeding records of this species in the hectads that cover the site, and the project site is outside the current and historical breeding range for this species. Breeding bird surveys completed at the site do not indicate that this species was breeding at the study area. Nationally important numbers were not recorded at the site, which would correspond to c.800 birds, or 1% of the National Wintering population. IWEBS counts for the area include mean counts of 193 for Lough Derg, and a mean count of 40 for Lough O'Grady. Estimated golden plover wintering population of 11,221 have been recorded for the Shannon-Fergus Estuary (Lewis et al. 2016). The flock of 450 birds has been evaluated as County Importance.

Cormorant	Annex I, EU Birds Directive BoCCI Amber List SCI for Lough Derg SPA Wildlife Act	Estimated National wintering population of 8,720. Estimated National breeding population is 4,366 pairs (NPWS Article 12)	**Local Importance (Lower Value)**	**No**	During the three year study period this species was observed twice during vantage point surveys; consisting of individual birds flying above potential collision risk (PCH). The project site is dominated by conifer plantation, which is not considered suitable for breeding or foraging cormorant. Therefore, this species cannot be considered to be dependent on the habitats of the site. Observations during wetland surveys more than 5km away. Wetlands at a remove from site Important for this species. The site is not considered to be associated with a regular commuting route for this species. Numbers of ecological significance as per NRA criteria were not recorded over the site.
Passerines, including Meadow pipit Grey wagtail	BoCCI Red list Wildlife Act		**Local Importance (Higher Value)**	**Yes**	Red listed species Significant effects are not anticipated as a result of the project. As described in SNH guidance (2017), it is generally considered that passerine species are not significantly impacted by wind farm projects. Resident breeding population of meadow pipit were recorded at the study area. Evaluated as local importance higher value as resident, or regular population occurring.

7.3.6 Determining the Sensitivity of Avian Key Ecological Receptors (KERs)

This evaluation follows the guidance set out for the assessment of birds as outlined in Percival (2003). The criteria is outlined in **Section 7.2.5.2** above.

Species of High Sensitivity

Consideration of the survey data against **Table 7-1** above indicates that one High sensitivity species has been recorded, namely:

- Hen Harrier

Species of Medium Sensitivity

Consideration of the survey data against **Table 7-1** above indicates that five species of Medium Sensitivity has been recorded, including:

- Peregrine
- Merlin
- Golden plover
- Red grouse
- Woodcock

Species of Low Sensitivity

Consideration of the survey data against **Table 7-1**, above, indicates that the remaining avian KERs identified are classified as Low Sensitivity species. These are:

- Sparrowhawk
- Kestrel
- Buzzard
- Passerines, including meadow pipit, and grey wagtail

7.4 LIKELY SIGNIFICANT EFFECTS

7.4.1 Phases of the Project

The key phases of the project as relevant to the evaluation of ecological impacts will consist of the construction phase, operational phase and decommissioning phase.

7.4.1.1 Construction Phase

The following are the main activities that could potentially cause significant effects on the avian Key Ecological Receptors (KERs):

- Site clearance, including the felling of forestry at the locations of turbines and substation location to facilitate construction and associated habitat loss effects on birds;
- The use of heavy machinery and construction activity particularly that associated with earthworks and excavations within the 'works area' during construction activities and associated disturbance and displacement effects on birds.

7.4.1.2 Operational Phase

The operational phase of the project will include the following key activities, which could potentially cause significant effects on the avian KERs:

- Collision impacts from rotating blades of operating turbines within the wind farm envelope;
- Disturbance and displacement and/or barrier impacts from operation turbines, and maintenance of turbines.

7.4.1.3 Decommissioning Phase

The decommissioning phase of the project will include the following key activities that could potentially cause significant effects on the avian KERs:

- The activity of decommissioning machinery and associated personnel may result in disturbance impacts for local bird species.

7.4.2 Designated Sites

7.4.2.1 European Sites

The project is not located within the boundaries of any European or Nationally designated sites. Therefore there will be no direct habitat loss within any designated site as a result of the project.

With regard to European Sites, a screening for Appropriate Assessment was prepared in compliance with Article 6(3) of the Habitats Directive. As part of this assessment, the potential for the project to have an effect on any Natura 2000 site (alone, or in combination with other plans and projects), in the ZOI was considered.

The screening for Appropriate Assessment concluded:

''It cannot be excluded beyond reasonable scientific doubt, in view of best scientific knowledge on the basis of objective information and in light of the conservation objectives of the relevant European sites, that the project, individually or in combination with other plans and projects, would have a significant effect on the following European Sites':

- Slieve Bernagh SAC, 002312
- Slieve Aughty Mountains SPA (004168)"

For this reason, the project must be subject to Appropriate Assessment and potential effects on the European sites have been assessed in the Natura Impact Statement (NIS), which has been prepared for the project**.** Slieve Bernagh SAC lies adjacent to the wind farm site boundary to the north and south while the Slieve Aughty Mountains SPA lies 8km north of the proposed wind farm.

The NIS concluded:

''It can be excluded, on the basis of objective scientific information, that the project, individually or in combination with other plans or projects, will not affect the integrity of any European Site''.

The assessment and findings contained in the NIS will be used by the competent authority to complete the Appropriate Assessment for the project.

Lough Derg pNHA, the Fergus Estuary and Inner Shannon pNHA, and Inner Shannon Estuary-South pNHA, are broadly covered, within European sites, and therefore have been assessed in the Appropriate Assessment screening prepared for the project, which concluded that the project will not adversely affect the integrity of European sites in view of the sites conservation objectives. Therefore, it is reasonable to conclude that the integrity of Lough Derg pNHA, which spatially coincides with Lough Derg (Shannon) SPA, the Fergus Estuary and Inner Shannon pNHA and Inner Shannon Estuary-South pNHA, which coincide with the River Shannon and River Fergus Estuaries SPA and the Lower River Shannon SAC, will not be adversely affected by the project.

The main interest of the Lough O'Grady pNHA, which lies 5km north of T9, is waterfowl, especially for Greenland White-fronted Geese. There were no observations of this species within, or in the proximity of the project site and thus the ornithological interest of this site will not be significantly affected by the project. Lough Cullaunyheeda pNHA lies 10km west of T1 and its main ornithological interest is waterfowl with the site supporting nationally important numbers of diving duck. There were no observations of this species within, or in the proximity of the project site and thus the ornithological interest of this site will not be significantly affected by the project. The potential for indirect effects as a result of poor water quality impacts are assessed in the main Biodiversity chapter, **Chapter 6**, of the EIAR.

7.4.3 Do-Nothing Effects

The Carrownagowan site is situated commercial forestry plantation, with different stages of the rotation cycle. If the Carrownagowan Wind Farm does not go ahead, it is likely that the current land-use will remain the same.

The potential for hen harrier to use the Carrownagowan Forestry site is directly correlated to Coillte's forestry management of the site. Forestry plantations in their initial years, prior to closed canopy, have potential to support breeding and foraging hen harrier. Therefore as forestry matures, and is felled, there is potential for ongoing loss, and creation of suitable habitat for hen harrier.

Since pre-thicket forestry is considered to have potential as hen harrier foraging habitat and closed canopy forestry is considered poor harrier foraging habitat, the areas of good foraging potential forestry that may be less likely to be used by foraging hen harrier will vary over the years due to the maturation and cycling of forestry plantation blocks. The forestry management plan has been reviewed from year 2020-2055, which would coincide with the lifetime of the proposal described in

this report. It is considered that subject to normal management practices, the forestry plantation occurring will be suitable for nesting hen harrier between 3-9 years after planting, and forestry will be suitable for foraging hen harriers between 3-15 years after planting.

The forestry under Coillte management within 5km[6] of the site boundary equals 2,627ha. The following table **(Table 7-13)** estimates the total areas of potentially suitable habitat for hen harrier within the current wind farm site boundary, and the Coillte managed forestry within 5km radius between years 2020-2055.

[6] In Irwin et al., 2012, it was reported that 89% of birds forage within 5km of the nest.

Table 7-14. Potentially suitable habitat available for hen harrier within Coillte Forestry

	Study Year	Suitable habitat within site boundary	% of suitable habitat within site boundary	Suitable habitat within Coillte managed forestry 5km radius	% of suitable habitat within Coillte managed forestry within 5km radius
Nesting habitat (3-9 years)	2020-2022	167.76	24.52	379.69	14.42
Foraging habitat (3-15 years)	2020-2022	289.95	42.39	638.24	24.28
Nesting habitat (3-9 years)	2025	133.81	19.0	559.20	21.28
Foraging habitat (3-15 years)	2025	241.81	34.4	845.55	32.18
Nesting habitat (3-9 years)	2030	54.09	7.7	269.64	10.26
Foraging habitat (3-15 years)	2030	182.17	25.9	767.56	29.21
Nesting habitat (3-9 years)	2035	79.66	11.3	276.50	10.52
Foraging habitat (3-15 years)	2035	171.02	24.3	724.58	27.58
Nesting habitat (3-9 years)	2040	89.44	12.7	256.50	9.76
Foraging habitat (3-15 years)	2040	121.72	17.3	427.65	16.27
Nesting habitat (3-9 years)	2045	64.18	9.1	119.38	4.54
Foraging habitat (3-15 years)	2045	144.34	20.5	446.58	16.99
Nesting habitat (3-9 years)	2050	118.69	16.9	251.82	9.58
Foraging habitat (3-15 years)	2050	169.82	24.16	400.68	15.25
Nesting habitat (3-9 years)	2055	142.19	20.20	304.23	11.58
Foraging habitat (3-15 years)	2055	270.77	38.52	530.94	20.21

The analysis of the future forest management for the site, describes a reduction of forestry habitat potentially available for nesting and foraging hen harrier to year 2045, and year 2040 respectively, then increases close to baseline levels by year 2055. Currently (year 2020) 24.52% of the forestry within the site boundary is available for nesting hen harrier, and 41.42% of the forestry is potentially available for foraging hen harrier. Over the lifetime of the project, the percentage of forestry habitat within the site boundary potentially available for nesting hen harrier reduces to 9% by year 2045 then increases to 20.2% by year 2055. Over the lifetime of the project, the percentage of forestry habitat within the site boundary potentially available for foraging hen harrier reduces to 17.3% by year 2040, then increases to 38.52% by year 2055.

The forestry under Coillte management within 5km of the site boundary equals 2,627ha. Of the 2,627ha of forestry, 379ha (14.42%), is currently potentially available for nesting hen harrier, and 638ha (24.28%) is currently available for foraging hen harrier. The forestry currently available for nesting hen harrier within 5km of the site boundary remains relatively stable between years 2025-2055, initially increasing to 4.54% by year 2045, then gradually increasing to c.20% by 2055.

7.5 ASSESSMENT OF LIKELY SIGNIFICANT EFFECTS

In order to assess the significance of potential impacts on the avian KERs, an appraisal as to the magnitude of any such impact on these species is necessary. Percival (2003) details an assessment methodology to determine the significance of an impact based on the product of the sensitivity of the receptor and the magnitude of the effect.

The sensitivity of a species is defined by Percival (2003) as its ecological importance and nature conservation interest at the site.

The significance of any one impact is a product of the sensitivity of the receptor, the magnitude of the impact and the probability of that impact occurring. The assessment of significance in the following sections follows this methodology, as outlined in Percival (2003) (refer to **Section 7.2.5.2** above for details).

Criteria for assessing impact significance based on CIEEM (2019) and EPA (2017) guidance has also been used in the assessment of likely significant effects (see **Table 7-4** above).

It must be noted that the identification of a risk does not represent a prediction either that it will occur, or that it will create or cause significant impact.

7.5.1 Hen Harrier (Breeding)

7.5.1.1 Habitat Loss during Construction

Hen harriers are ground nesting birds that breed in moorland, young conifer plantations and other upland habitats (Wilson et al., 2009, Wilson et al., 2010). Pre-thicket conifer plantation (first and second rotation) may be used by breeding hen harriers (i.e. first rotation up to 12 years old and second rotation plantations aged between 3 – 9 years inclusive). Irwin et al. (2012) states that foraging harriers appear to avoid forest stands less than 3 years and greater than 15 years of age.

The grid connection is confined to public roads and will not require hedgerow clearance. The haul route leading up to the site will require the loss of 2.3km of hedgerow clearance adjacent to public road, including the clearance of sections of woodland extending to roadside margins.

The following table describes the habitat loss as a result of the project.

Table 7-15. Habitat loss

Habitat Type	Total area (ha) within wind farm red line boundary	Habitat loss area (ha) wind farm site
Conifer plantation (WD4) WD1 (Mixed) broadleaved woodland, & Recently felled woodland (WS5)	684.18	67.66
Wet heath and wet grassland mosaic (HH3) & (GS4)	6.00	0.17
Cutover bog (PB4)	8.27	0.90
Wet grassland (GS4)	11.13	0.18
Built area and artificial surfaces (BL3)	8.15	3.7

In total c.684ha of forestry (of various rotations) occurs within the red line site boundary of the project. Of this, 167.76ha (24.52% within the site boundary) will be available for nesting hen harrier and 289.95ha (42.39%) will be available for foraging hen harrier between 2020 and 2022. The construction phase of the project will require the loss of c.67.66ha of forestry, of which 18.18ha would be potentially available for nesting hen harrier, and 31.87 would be available for foraging hen harrier in this period.

During the construction phase of the project, habitat loss of forestry plantation accounts for c.10% of the forestry within the wind farm red line site boundary. Of the 67.66 hectares that will be felled, 18.18ha of potentially suitable nesting hen harrier habitat will be lost, with 149.58ha (21.86%) of potentially suitable hen harrier nesting habitat remaining. Therefore the construction phase of the project will result in a reduction of c.11% of the potentially suitable nesting habitat within the redline boundary of the site.

During the construction phase of the project 31.87ha of potentially suitable hen harrier foraging habitat will be lost, with 258.08ha (37.73%) of potentially suitable habitat remaining. This represents a reduction of 11% in potentially suitable foraging habitat within the redline boundary of the site.

The forestry under Coillte management within 5km of the site boundary equals 2,627ha. Of the 2,627ha of forestry, 379ha (14.42%), will be potentially available for nesting hen harrier, and 638ha (24.28%) will be available for foraging hen harrier during the construction phase between 2020 and 2022. This habitat will not be affected by the wind farm project and will be available for foraging and nesting hen harrier together with the private forestry and open peatland habitats within 5km of the wind farm.

From the analysis of the forest management plan for the site, including the Coillte forestry extending away from the site as well as private forestry and available peatland habitats, it is considered that the loss of potentially suitable nesting and foraging habitat during the construction phase is not significant.

An iterative approach to project design was adopted so that the most suitable traditional habitats for breeding and foraging hen harrier will not be developed. The turbine T1 will require loss of 0.9ha of cutover bog, and T8 will require the loss of 0.31ha of wet grassland (reverting from improvement). However, it is considered that this habitat loss is not significant, given the availability of often more suitable, and traditional hen harrier habitat adjacent, and extending away from the site, including the bogland protected within the Slieve Bernagh SAC extending away from the site.

Any loss of currently suitable forestry habitat owing to the project will not be significantly above that which would occur and does occur as a result of the forestry operations at the project site. The areas

around the project site, including the Slieve Bernagh Bog SAC, will continue to provide suitable foraging and breeding habitats in heather and rough grassland. The design of the project has taken cognisance of, and has avoided the most suitable, and traditional foraging and breeding habitats within and adjacent to the site, while maintaining connectivity with the Slieve Bernagh Bog SAC (002312), and the wider area, which offers vast areas of suitable hen harrier habitat around the project site.

The sensitivity of hen harrier is considered **High**. The magnitude of the habitat loss effect is assessed as **Low**. Using the evaluation criteria in **Table 7-3** above, the significance of the habitat loss effect as a result of the construction of the project on hen harrier is assessed as **Low**. Using EPA (2017) criteria, it is considered the habitat loss described will result in a **Long-term, Slight Negative effect** on hen harrier.

7.5.1.2 Displacement and Barrier Effects (Construction)

Displacement of birds may occur due to effective loss of habitat while barrier effects occur where the wind farm creates an obstacle to regular movements to and from breeding or foraging grounds. Both displacement and barrier effects manifest themselves as a reduction in the number of birds in flight within the wind farm (Humphreys *et al*., 2015).

Foraging and commuting birds may temporarily avoid construction areas owing to the noise and increased activity. The design of the project was driven by a process of mitigation by avoidance as well as a principle of using existing infrastructure to the maximum possible extent. The Carrownagowan wind farm site is a large site that covers an area of c.749.69ha within the site boundary. The construction phase of the project will be phased, concentrating activity within the site to certain areas, and construction activities at any one time. This will allow hen harriers to use other available suitable areas.

Potentially, pre-thicket forestry within the area may be temporarily avoided by foraging hen harrier during the construction phase; however the most valuable traditional nesting habitats have been excluded from the wind farm site, and will be excluded from the works during the construction phase. Of the nest sites identified between 2017 and 2020, just one, the 2017 failed nest, was within the current wind farm planning boundary, approximately 0.4km from the nearest proposed turbine. The 2018 successful nest site was outside of the proposed wind farm site boundary, over 0.6km from the nearest proposed turbine. There were no confirmed nests identified within the site boundary in 2019. There were 3 confirmed failed nest sites outside of the proposed wind farm site boundary in 2020, the nearest being approximately 0.5km from the nearest proposed turbine.

There will be a slight loss of foraging area through disturbance during the construction phase from a zone around the wind turbines, however the percentage of suitable hen harrier habitat is not considered significant, in the context of the overall site and that available in the surrounds.

An assessment of the effects of a wind farm on a population of breeding hen harriers reported regular flights at close proximity to turbine bases (Madden & Porter 2007). This report also describes that, although reductions in flight activity around turbines were observed during the construction phase, the activity of bird populations quickly returned to pre-construction levels once construction was complete.

During the construction phase, hen harrier monitoring at Coollegrean Wind farm, in north Kerry, hen harriers were observed foraging and commuting in the proximity of construction activities by

ecologists for MWP. This was noted on the 24th June 2016, where an adult male was observed using the conifer edge associated with the turbulence felling for turbine T5. The bird foraged low (2-5m) around the construction activities at a distance c.50m from the turbine base, where excavators and a number of site personnel were involved in construction activities. Again on the 29th July, 2016 a ringtail bird (juvenile or adult female) was observed commuting, and foraging in a southern direction following the main wind farm spine road, and at the location of T4, while construction activities were ongoing at this general location. The birds did not veer away from the locations where construction operations were being carried out, although during the latter observation the bird did gain height slightly.

Monitoring during the construction phase completed at one wind farm in the United States and at two wind farm projects in Scotland found no significant decrease in the use of sites during construction by Northern harriers and hen harriers, respectively (Johnson et al., 2000, Haworth Conservation, 2013, cited in Wilson et al, 2015). Construction phase disturbance on nesting birds has been estimated at 500m, with some disruption extending up to 1km along sight line views (Madders, 2004). However, Bright et al. (2006) suggests that displacement can occur up to 500m around construction sites, and Forrest et al., (2011) described a successful breeding pair of hen harrier within 110m of construction activities, where exclusion zones were installed to decrease levels of disturbance.

It must be noted that existing activities at the site, and in the do nothing scenario, include forestry felling and planting operations, and upgrading of roads throughout the site. Furthermore, there is ample often more suitable breeding and foraging habitat in the wider area, including the bogland within and outside the Slieve Bernagh SAC, and sections of forestry, with various rotations extending away from the site.

However, it is possible that hen harriers may breed within 500m of a turbine during the construction phase, and could potentially be disturbed by construction activities of the wind farm. Pre-construction, and construction phase monitoring programme is recommended, and where required, appropriate, recognised exclusion zones will be in place for the duration of the construction phase of the project. Additionally, it is that the forestry felling required, and any vegetation clearance will be completed outside the bird breeding season.

The sensitivity of hen harrier is considered **High**. Without mitigations in place, the magnitude of the effect is assessed as **Medium**. Using the evaluation criteria in **Table 7-3** above, the significance of the disturbance and/or subsequent displacement effects during the construction phase are considered **High**. Using the EPA (2017) criteria, the disturbance, and or displacement effects are considered a **Short-term, Significant Negative** effect on breeding hen harrier during the construction phase.

7.5.1.3 Displacement and Barrier Effects (Operation)

Displacement of foraging and flight behaviour has been recorded close to wind turbines in Britain (100m for foraging and 250m for flight) (Madders & Whitfield, 2006, Whitfield & Madders, 2006 Pearce-Higgins et al. 2009 (cited in Wilson et al 2015)). Pearce-Higgins et al. (2009) describes a reduction of 52.5% in hen harrier flight activity within 500m of the turbine array. The study found that hen harriers showed significant turbine avoidance out to at least 250m from the turbines. A study undertaken in the United States describes similar results for northern harriers, with a drop off in recorded flight activity of over 50% within the wind farm (Garvin et al., 2011), although a second study describes more frequent flights of northern harriers within 50m of turbines (Thelander et al., 2003).

Findings of at least eight studies of hen harrier displacement effects in the USA and continental Europe, using several study designs, were included in a review of wind farm impacts on hen harriers.

The review found that only one study documented good evidence of displacement and concluded that although further studies are highly desirable, if displacement of foraging occurs, then it will likely be limited to within 100m of wind turbines, if it occurs at all. The review concluded that foraging hen harriers have a low sensitivity to disturbance at operational wind farms (Whitfield & Madders 2006b).

A study was carried out by Madden and Porter (2007), at a wind farm site in east County Galway, to determine the usage of hen harrier at the site. This wind farm, situated within the Slieve Aughties Mountains, consists of 71 turbines, which required mass clearance of closed canopy forestry, with one significant area of upland blanket bog, with varying disturbance to the east, adjacent to the site. The distances between the turbines ranged from 159m to 260m apart. Prior to the construction phase (2004), the bogland to the east of the site was used by foraging hen harrier, likely by nesting pairs within 2km of the site. Post construction surveys (2006 and 2007) at this site indicated the continued use of the bogland to the east by Hen harrier, with observations of birds passing between turbines, or along turbine lines, with no sudden or unusual movements that would indicate alarm, or sudden hesitation. The results of the operational phase monitoring indicated that the birds readily used the wind farm site during the first year of operational phase monitoring, and did not require a significant amount of time to habituate to the operational turbines. In summary, the study found that hen harriers continued to hunt over the area following construction of the wind farm, often passing within 50m of turbines. Both foraging and transient birds were observed.

A recent study in Ireland investigating hen harrier breeding success in relation to distance from wind turbines recorded no significant differences in breeding success as a result of turbine proximity. Lower nest success rates and productivity were observed within 1km of operating wind turbines, however, these results were not statistically significant (Wilson et al, 2015 and Fernández-Bellon et al. 2015). Before-after monitoring of four wind farm sites in Scotland found no effects on breeding numbers or distances of nests to turbines (Forrest et al., 2011, Robson, 2012, Haworth Conservation, 2013, cited in Wilson et al, 2015).

At Paul's Hill Wind Farm in Scotland post-construction hen harrier monitoring of flight activity results, when compared with the baseline studies, indicated while there was a greater degree of flight variability that the core flight activity remained the same. There was no evidence of changes in nesting locations due to wind farms and no evidence of reduction in the number of breeding pairs[7].

The Athea Wind Farm in west Co. Limerick has been monitored by specialist bird surveyors prior to, during and post construction. The civil works associated with the construction of the wind farm were completed in March of 2013. When compared with the baseline studies, the operational phase monitoring results indicate that the post construction usage of the wind farm site by foraging hen harrier is similar to usage during the years prior to construction (Katherine Kelleher, pers. comm., 2016).

During operational phase surveys at Cordal Wind Farm in northeast County Kerry, situated in an upland commercial conifer plantation, with stands of bogland within and extending away from the site, a breeding pair successfully bred within 350m of an operating turbine, with two fledglings recorded. During year 1 of operational phase hen harrier monitoring conducted at the Cordal Wind Farm and Coollegrean Wind Farm (2019 breeding season) the male hen harrier was regularly observed

[7] http://www.snh.gov.uk/docs/A694304.pdf

foraging and commuting at a distance of c.20-50m from the operating turbines (Davey Farrar, pers. comm., 2020).

Based on these observations, and studies from elsewhere (Whitfield & Madders 2006b, Madden & Porter 2007, Wilson et al 2015.), it is anticipated hen harriers will continue to use the Carrownagowan wind farm site, with some slight degree of turbine avoidance shown by hunting birds, and breeding birds. It must be noted that the hen harrier using the area have been subjected to existing forestry operations that have been ongoing in the area for decades, though the nearby SAC surrounding the site offers more suitable habitat.

As stated earlier in this section, Pearce-Higgins et al. (2009) describes a reduction of 52.5% in hen harrier flight activity within 500m of the turbine array and a significant turbine avoidance out to at least 250m from the turbine. In contrast to the proposed wind farm under consideration here all wind farms selected as part of the Pearce-Higgins study were located within unenclosed upland habitats (moorland, rough grassland or blanket bog). The study also excluded areas of forest and felled forest. The Carrownagowan wind farm site is dominated by forest and felled forest, which may affect the direct applicability of the Pearce-Higgins study. Within the site boundary and 5km[8] of the project on average approximately 600ha of the 2,627ha of Coillte forestry will be available as pre-thicket forest per year for foraging hen harrier over the lifetime of the project (refer to **Table 7-14**, above). A similar amount of private forestry would be available within 5km of the site boundary while the area of permanently available open peatlands, a more traditional hen harrier habitat surrounding the project site that is used by foraging hen harriers within the Slieve Bernagh to Keeper Hill region[9], was also estimated. It was estimated that the total available foraging habitat over the lifetime of the wind farm between the site boundary and extending out to 5km would be 3,345ha as presented in the table below.

A data request was made to the DAFM requesting forestry data on the private forestry in the area. The total area of private forestry holding within 5km of the site boundary equals 1,871.6ha. Of this on average 280ha will be available for foraging hen harrier over the lifetime of the project. Furthermore, more suitable, and more traditional hen harrier habitat immediately surrounds the project site, which includes the Slieve Bernagh Bog SAC (c.1,974ha) that is used by foraging hen harriers within the Slieve Bernagh to Keeper Hill region[10].

Over the lifetime of the wind farm on average 203ha of forestry and 118ha of open peatland would be available for foraging hen harrier within a 500m radius of turbines within the wind farm site boundary. Therefore, assuming a 52.5% reduction in flight activity this would be reduced by 169ha and that there is no further suitable habitat available within the site boundary, this would represent an effective loss of approximately 5% within the total area encompassing the site boundary and the extent beyond out to 5km. It is noted that the 95% confidence interval ranges from -1.2-74.2% indicating the true displacement value could lies somewhere between 0ha, which would be negligible, to 238ha, which would represent an effective loss of foraging habitat of 0% to 7.1%.

This would indicate that the magnitude of the potential displacement effect would be Low.

[8] In Irwin et al., 2012, it was reported that 89% of birds forage within 5km of the nest.
[9] https://www.npws.ie/sites/default/files/protected-sites/synopsis/SY002312.pdf
[10] https://www.npws.ie/sites/default/files/protected-sites/synopsis/SY002312.pdf

Table 7-16. Available foraging habitat over the 30 year lifetime of the wind farm within 5km of the wind farm site boundary

Landcover	Available foraging habitat
Coillte forestry	591.95
Private forestry	547.36
Moors and heathlands (corine)[11]	805.79
Bogs (corine)	1,400.32
Total	3,345.42

The sensitivity of hen harrier is considered **High**. During the operational phase of the project, the magnitude of the effect is considered **Low**. Using the evaluation criteria in **Table 7-3 above**, the significance of the displacement, and or barrier effect as a result of the operational phase the project on hen harrier using the study area is considered **Low**. Using the EPA (2017) criteria, the displacement barrier effect on hen harrier using the study area, is considered a **Long-term**, **Slight to Moderate Negative** effect.

7.5.1.4 Effects on Passerines and Hen harrier Prey Availability

Hen harrier prey items varies across seasons and habitats present and is comprised mainly of small rodents and passerine birds (Baines and Richardson, 2013). Hen harriers prey on a very wide range of bird species such as Meadow Pipits and Skylarks (Dobson et al., 2009). In Ireland small mammals, birds, amphibians and reptiles are all included in the diet of hen harriers during the breeding season. Land management which affects the availability of prey may ultimately impact on hen harrier numbers.

The results of a study at 12 wind farm sites and 12 control sites in Ireland found that total bird densities were lower at wind farm sites, than at control sites, with more reductions closer to turbines (Fernández-Bellon et al. 2019). That study found that forest species were significantly lower within 100m of turbines than at greater distances, as a result of habitat alteration, and installation of wind farm infrastructure. The densities of species such as meadow pipit were lower on large wind farm sites.

Significant effects on populations of passerines are not anticipated given the nature of the habitats within the development footprint, the location of the turbines (mainly in conifer plantation), and the assemblage of bird species recorded during surveys. In addition, SNH guidance (2017) describes, that passerine species are not significantly impacted by wind farms. Species such as meadow pipit and grey wagtail, are ground nesting birds that preferentially select undisturbed areas for breeding. This behaviour precludes the use of intensively managed habitats or locations exposed to high levels of disturbance such as those present within and adjacent the footprint of the project.

As a group passerine species have historically adapted to, and co-existed with, the increased mechanisation in farming and the literature indicates that it is the loss and alteration of breeding habitats associated with the intensification in agriculture is resulting in the significant cause of adverse impacts rather than changing farm technologies such as increased mechanisation. Some disturbance to breeding passerines could be expected if construction work takes place in the breeding season. Potentially, this could be of Low significance at the site as the turbines are widely spaced apart (at least 470m) and there is ample foraging habitat throughout the overall site, and in the greater area.

[11] Calculations for moor and heathlands, and bog, based on CORINE landcover data

The project has for the most part avoided the unplanted areas at the site, and these will remain for the lifetime of the project. The development has included the use of existing site infrastructure where possible. Considering the ecological resources available and the habitats present at the footprint of the project and in the surrounding area, using the criteria outlined in **Table 7-3**, above, the magnitude of potential disturbance, and displacement impacts is considered to be **Low-Negligible** for passerine species. Using the Percival (2003) evaluation criteria, it is plausible to predict that the significance of the change in habitat as a result of the construction of the wind farm on passerine species is considered **Very Low**.

A study completed in Northern Ireland showed that three species, (meadow pipit, skylark and starling) made up 74% of hen harrier diet (Scott 2005). All three of these species were recorded at the Carrownagowan study area during the breeding bird surveys, and meadow pipits were frequently recorded breeding within the bogland habitats extending away from the site.

There is evidence that suggests that breeding passerines are not significantly impacted by the presence of wind turbines. For example, a German study found no effect on numbers or spatial distribution of skylarks within 1km of turbines (Langston and Pullan 2004).

The sensitivity of hen harrier is considered **High**. During the construction and operational phase development, the magnitude of the effect relating to the use of the site by hen harrier prey, and the subsequent availability of hen harrier prey, is considered **Negligible**. Using the evaluation criteria in **Table 7-3** above, the significance of the effect as a result of the construction and operational phases of the project on prey items for hen harrier using the study area is assessed as **Very Low**. Using the EPA (2017) criteria, the effects of the project on the availability of prey for hen harrier, are considered a **Long-term, Slight Negative to Imperceptible Effect**.

7.5.1.5 Collision Risk during Operation

The population level consequences of predicted collision risks can be assessed by considering the additional mortality that would be caused, relative to background mortality rates in the population, where a threshold level of 1% increase in annual mortality is used to establish whether the predicted collision impact will be negligible or not (Percival, 2003). A negligible magnitude impact would be predicted if the collision mortality was to represent an increase of less than 1% on the background mortality rate.

A collision risk model has been undertaken and full details are provided in **Appendix 7-3**.

The collision risk has been calculated at a rate of 0.056 collisions per year, or 1.65 birds over the 30 year lifetime of the wind farm. This corresponds to a 2% increase in the background mortality rate of the local population and a 0.1% increase in the background mortality rate of the national population. Therefore the magnitude of the collision effect is considered Low. The National breeding population of hen harrier is estimated at between 108-157 pairs and the local population is estimated at eight birds. The increase in annual mortality at a Local Level is considered to be Low and at National level is predicted to be Negligible.

It must be noted that as a result of the assumptions and the limitations collision risk modelling presents, the estimated predicted collisions should only be considered indicative and never definitive, and are used solely as a comparative tool rather than an accurate indicator of mortality risk. The CRM describes what could potentially happen, and leans towards the worst case scenario with regard to any predicted collision risk.

Direct mortality of hen harriers resulting from collision with turbines has been recorded in some studies (Whitfield & Madders, 2006a, Scott & McHaffie, 2008) (cited in Wilson et al, 2015), however records of hen harrier mortality due to the installation of wind farms in both published and grey literature, are rare (Wilson et al 2015). In Ireland between 2007 and 2019, six wind bird turbine strike incidents were recorded and included hen harrier among other species in the 13 year period (O'Donoghue *et al*., 2020).

Hen harriers are well-known to fly mainly at very low elevations as they search the ground for prey at slow speed (e.g. Watson 1977). Flights at higher elevation usually occur when birds are not hunting, such as when returning to a nest with prey, during display flights, or when simply flying from one place to another (Whitfield and Madders 2006a). For example, at Arecleoch wind farm in south-west Scotland, 80% of flights were below 10m above ground level. Similarly, at Spireslack wind farm in Lanarkshire only 3% of flight observations were at 20-110m, and at the nearby Hagshaw Hill extension only 3% of harrier flights were at 10- 100m, with even less activity above these height bands (Whitfield and Madders 2006a). Foraging hen harriers at several sites in Argyll in Scotland also spent very little time flying higher than 5m above ground (Madders 1997).

While most of the studies reported low flight heights for hen harrier (below rotor sweep), however this is not always the case, with high percentages of flight time spent within the rotor sweep (Dick 2011, *cited in Ferdandez report*).

A review of hen harrier collision risk studies included data on collision fatalities from at least 10 wind farms (nine in USA & one in Spain) where hen harriers (or Northern Harrier as the species is known in North America) occurred. Hen harrier deaths were recorded at three sites, with only a single study, involving searches over 7,500 turbine-years, recording more than one casualty, while there were no collision victims recorded at seven sites (Whitfield & Madders 2006b). Documented mortality was not positively related to hen harrier activity, since the wind farms with recorded deaths were those with the lowest recorded levels of hen harrier activity. Overall, the review concluded that hen harriers do not appear to be susceptible to colliding with turbine blades and that collision mortality should rarely be a serious concern (Whitfield & Madders 2006b). Although, it is noted, that no comparable work has been published for Ireland, but a similar result would be expected.

A paper discussing hen harrier usage of an operational wind farm in County Galway described several occasions where hen harriers passed within 50m of operational turbines (Madden & Porter 2007). Most of the sightings involved birds foraging within 10m of the ground. In addition, hen harriers have been seen hunting below 10m in height, within 20m-100m of operating turbines at existing wind farms in County Kerry and Cork.

There is some evidence from Northern Ireland to suggest that risks of collisions with turbines may be increased during conditions of poor visibility such as hill fog (Scott & McHaffie 2008). Juvenile hen harriers may potentially be most at risk of collision with wind turbines immediately following fledging. Young birds are dependent on the adults for food for 2 or 3 weeks following fledging and would remain in the immediate vicinity of the nest during this time. Newly fledged birds are quite clumsy and unskilled in the air, but they become fairly proficient at flying within a week of fledging (Watson 1977). Once independent of the parent birds, juveniles would disperse away from the breeding territory.

However, a recent study, carried out by the School of Biological, Earth & Environmental Sciences at University College Cork, on the interactions between hen harriers and wind turbines has shown that the majority, 82.8%, of hen harrier flight time was below the reach of turbine blades, with only 11.8%

occurring within potential rotor sweep height. Using this data, a collision risk score of 0.031 and 0.099 bird deaths per breeding season due to collision was calculated (Wilson et al., 2015). Previous works have also shown hen harriers to demonstrate avoidance behaviour close to individual wind turbines which has been estimated at 99% (Whitfield & Madders, 2006).

A study carried out by Wilson et al., (2015) has found that fledglings less than five weeks old spent 99.1% of their observed flight time below 25m which may suggest that immediately after fledging the juvenile bird is at a lower risk than adults. Using conservative estimates, collision risk analysis from that study revealed that, over the lifetime of a typical wind farm in Ireland (25 years), the number of hen harrier deaths resulting from collisions with wind turbines is estimated to be in the range of 0.8 to 2.5 birds. These findings demonstrate that hen harriers are at low risk of collision with wind farm infrastructure as a result of their typically low flight height and known avoidance behaviour.

Furthermore, juvenile hen harriers become fairly proficient at flying within a week of fledging (Watson 1977). Once independent of the parent birds, juveniles disperse away from the breeding territory within 2-3 weeks, or even days, of fledging. Therefore the highest risk of collision will occur within a narrow timeframe annually.

The sensitivity of hen harrier is considered **High**. During the operational phase of the project, the magnitude of the collision effect is considered **Low**. Using the evaluation criteria in **Table 7-3 above**, the significance of the effect as a result of the operational phase the project on hen harrier using the study area is considered **Low**. Using the EPA (2017) criteria, the displacement, barrier effect on hen harrier using the study area, is considered a **Long-term**, **Slight Negative** effect.

7.5.2 Peregrine (Breeding and Winter)

7.5.2.1 Habitat Loss (Construction Phase)

The results of the three consecutive years of survey indicate that the site is little used by this species. This species was not observed breeding within the project site. The habitats within the site do not provide optimal breeding habitat for this species. The observations during VP surveys were of birds commuting and foraging along the site boundary, over the bogland towards the southern end of the Carrownagowan wind farm site. The turbines are mainly situated on conifer plantation, a habitat which this species was not observed on during VP surveys at the site. Furthermore, there is an abundance of this habitat type in the greater area.

The sensitivity of peregrine is considered **Medium**. The magnitude of the effect is assessed as **Low**. Using the evaluation criteria in **Table 7-3**, above, the significance of the change in habitat as a result of the construction of the wind farm on peregrine is considered **Low**. Using EPA (2017 criteria), it is considered the habitat loss described will result in a **Long-term, Slight Negative** effect on peregrine falcon.

7.5.2.2 Displacement and Barrier Effects (Construction)

The core foraging range of breeding Peregrine is 2km (SNH 2016). During the ornithological surveys completed at the site between 2016/19, there was no peregrine breeding or roosting activity observed within, or adjacent to the project site. The results of VP surveys indicate that this species does not regularly commute, or forage over the site. The breeding territories for this species are located over 2km away from the project. As described in Ruddock and Whitfield (2007)[12] disturbance distances for

[12] M. Ruddock & D.P. Whitfield (2007) A Review of Disturbance Distances in Selected Bird Species. Scottish Natural Heritage.

this species range from between 500m-750m. Furthermore, a literature review suggests that nesting peregrines are more susceptible to disturbance impacts from above their nests.

The sensitivity of peregrine is considered **Medium**. The magnitude of displacement and barrier effects as a result of the project (construction) is considered **Low** - **Negligible**. Using the evaluation criteria in **Table 7-3** above, it is plausible to predict that the significance of the displacement and barrier effect is considered **Low – Very Low.**

The significance of the effect according with EPA (2017) guidance is considered to be a **Short-term Slight Negative** effect during the construction phase.

7.5.2.3 Displacement and Barrier Effects (Operation)

For the duration of the operational phase of the wind farm, this species are expected to continue to preferentially select the foraging and breeding habitats, of equivalent or higher value, available in the wider geographical area rather than any of the habitat types present within the footprint of the project.

The sensitivity of Peregrine is considered **Medium**. The magnitude of potential effect is considered to be **Low** - **Negligible** for peregrine. Using the evaluation criteria in **Table 7-3**, above, it is plausible to predict that the significance of the change in habitat as a result of the operational phase of the wind farm on peregrine is considered **Low - Very Low.**

Using EPA (2017) criteria, the effect of the habitat loss as a result of the project on peregrine is considered a **Long-term, Slight Negative Effect.**

7.5.2.4 Collision Risk during Operation

The results of the three years of survey indicate that this species does not regularly commute, or forage over the site. The habitat present, are not optimal nesting peregrine.

A collision risk assessment has been completed for this species (see **Appendix 7-3**). The collision risk for this species is calculated at zero collisions per year.

The sensitivity of peregrine is considered **Medium.** The magnitude of the effect is considered to be **Negligible** at a local to National level. Using the evaluation criteria in **Table 7-3** above, the significance of the effect as a result of the operational phase of the project on peregrine is **Very Low**. Using EPA (2017) criteria, the collision effect as a result of the project on peregrine, is considered a **Long-term**, **Slight** to **Imperceptible Negative** effect.

7.5.3 Merlin (Breeding and Winter)

7.5.3.1 Habitat Loss (Construction Phase and Operational Phase)

Merlin was observed at the Carrownagowan wind farm study area, on four occasions during the three consecutive years of surveys completed at the study area. The results of the surveys completed at the study area, indicate that the site is little used by this species. The loss of foraging habitat for this species is minimal, as conifer plantation is not optimal foraging habitat for this species. While merlin is known to occasionally use woodland for breeding, there are vast areas of bogland, and more optimal suitable breeding extending away from the site. In addition, the conifer plantation that will be lost constitutes a small proportion of the total project area and the availability of conifer plantation within and outside the site.

For the duration of the wind farm construction phase, and operational phase this species is expected to continue to preferentially select the foraging and breeding habitats, of equivalent or higher value, available in the wider geographical area, rather than any of the habitat types present within the footprint of the project.

The sensitivity of merlin is considered **Medium**. The magnitude of the effect is assessed as **Negligible**. Using the evaluation criteria in **Table 7-3**, above, the significance of the change in habitat as a result of the construction of the project on merlin is assessed as **Very Low.**

Using EPA (2017) criteria, the effect of the habitat loss as a result of the project on merlin is assessed as a **Long-term, Imperceptible Negative** effect.

7.5.3.2 Displacement and Barrier Effects (Construction and Operation)

Disturbance due to construction works can result in effective habitat loss through displacement. This effect will be short term in nature for the duration of the construction phase.

The results of the ornithological surveys indicate that the habitats present within the footprint of the project are rarely used by merlin. Disturbance during construction phase is unlikely to discourage flight activity or foraging in the vicinity of the project particularly given the low levels of activity recorded. Given the short-term duration of the construction works, and the availability of suitable habitats in the surroundings, the magnitude of the Effect is assessed as Low.

There is limited potential for disturbance, or displacement effects associated with avoidance of operating turbines at the project site. The upper most limit for Merlin disturbance suggested in the literature is 500m (Ruddock and Whitfield 2007). All flight activity of merlin, was of birds flying low, below rotor blade height, which is typical flight behaviour for this species. Therefore a barrier effect is not likely to occur.

During the operational phase of the wind farm significant displacement and barrier effects are not expected, mainly due to the low levels of activity recorded. Post construction, extensive suitable foraging and breeding habitat will remain, as there is an abundance of suitable habitat extending away from the site. During the operational phase of the wind farm, this species is expected to continue to preferentially select the higher value foraging and breeding habitats available in the wider geographical area rather than any of the habitat types within the footprint of the proposal.

The sensitivity of Merlin is considered **Medium**. During the construction and operational phase of the project, the magnitude of the effect is considered **Negligible**. Using the evaluation criteria in **Table 7-3 above**, the significance of the effect as a result of the construction and operational phases the wind farm on merlin is considered **Very Low**.

Using EPA (2017) criteria, the effect as a result of the project on merlin is assessed as a **Long-term, Imperceptible Negative Effect**.

7.5.3.3 Collision Risk during Operation

With regard to Merlin only four observations of this species were recorded during the entire survey period (three consecutive years of survey between winter 2016/17, and summer of 2019). Merlin is nimble in flight, with prey caught by surprise attack from a low gliding flight, close to the ground.

During the three years of VP survey completed at the study area there was no flight activity of merlin recorded within the potential collision risk zone. While collision risk modelling could not be carried

out for this species, this does not mean that the collision risk cannot be assessed, but instead it means that the collision risk, within the accuracy levels available to the assessment, is zero.

Survey data indicates that there is, currently, no significant use made by this species of the habitats within the footprint of the wind farm, or the overall study area. For the duration of the operational phase of the project, this species is expected to continue to preferentially select the foraging and breeding habitats, of equivalent or higher value, available in the wider geographical area rather than any of the habitat types present within the footprint of the wind farm.

The sensitivity of Merlin is considered **Medium**. The magnitude of the effect considered to be **Negligible**. Using the evaluation criteria in **Table 7-3**, above, the significance of the effect as a result of the operational phase of the project on merlin is **Very Low**. Using EPA (2017) criteria, the effect as a result of the project on merlin, is considered a **Neutral effect.**

7.5.4 Golden Plover (Wintering)

7.5.4.1 Habitat Loss (Construction Phase)

As the project footprint is dominated by conifer plantation, the habitat loss for this species is minimal. The conifer plantation does not provide suitable foraging, roosting, or breeding habitat for this species. In addition during walkover surveys within the site boundary, this species was not observed on the sections of bogland habitats occurring within the site boundary.

The sensitivity of golden plover is considered **Medium**. Considering the low ecological value of the habitats present at the footprint of the wind farm site in conjunction with the criteria outlined in **Table 7-2**, above, the magnitude of the potential effect on this species is considered to be **Negligible**. Using the evaluation criteria in **Table 7-3**, above, the significance of the change in habitat as a result of the construction of the project on golden plover is considered **Very low**.

Using EPA (2017) criteria, the effect as a result of the project on Golden Plover, is considered a **Neutral Effect**.

7.5.4.2 Displacement and Barrier (Construction)

McGuinness et al (2015), describes the zone of sensitivity for golden plover as 800m during the breeding season only. The result of the three breeding surveys completed, did not find evidence of breeding golden plover using the Carrownagowan wind farm site.

During VP surveys completed over the three years of survey at the study area golden plover were seen on the ground on very few occasions. All these observations were c.850m to the southeast of T13. It is possible that the birds use this area to feed, or roost while passing through. This habitat is readily available extending away from the site. A study carried out by Pearce-Higgins et al. (2012) demonstrated that during the construction phase golden plover (including winter) showed no change or less certain reactions, during the construction phase of wind farms. In addition the conifer plantation that occurs between the southern part of the site and the turbines offer a noise buffer between the works areas and the bogland to the south.

It must be noted that a certain amount of activity already exists at the site including forestry felling, plant, and upgrade of internal roads. Disturbance during construction phase is unlikely to discourage flight activity over the site, in the vicinity of the project particularly given the low levels of activity recorded, and the existing levels of activity present at the site.

The sensitivity of golden plover is considered **Medium**. The magnitude of the effect during the construction phase is considered **Low**. Using the evaluation criteria in **Table 7-3**, above, the significance of the effect as a result of the construction phase of the project on golden plover is **Very Low**. Using EPA (2017) above the effect is considered **Short-term Slight Negative - Imperceptible Effect**.

7.5.4.3 Displacement and Barrier Effects (Operation)

A study completed by Pearce-Higgins et al. (2009) found reduced use of habitat surrounding operating turbines, to within 200m of the turbine base. A review of 29 other studies suggests golden plover will approach wind turbines to an average distance of 175m in non-breeding season (Hötker et al. 2006). Furthermore, post-construction monitoring at 15 upland wind farms showed no significant decline in golden plover populations post construction (Pearce-Higgins et al. 2012). As discussed, over the three years of surveys completed at the study area, a number of golden plover observations were made, mainly c.850m to the south, and southeast of the site as there is no suitable feeding habitat within the site itself. Should any potential displacement effect occur, it is not considered significant, as there are extensive areas of suitable habitat in the wider area.

The results of the extensive surveys completed at the site over three consecutive years, indicate that this species do not regularly fly over the site, or land within the site and therefore significant displacement barrier effects is not anticipated.

The sensitivity of golden plover is considered **Medium**. The magnitude of the effect during the operational phase is assessed as **Low**. Using the evaluation criteria in **Table 7-3** above, the significance of the effect as a result of the operational phase of the project on golden plover is **Very Low**. Using EPA (2017) above the effect is assessed **Long-term Slight Negative to Imperceptible** effect.

7.5.4.4 Collison Risk during Operation

During the study period golden plover were observed on twenty-one occasions flying over the site. Observed flights are most likely to comprise birds passing through the site as there is limited suitable wintering habitat present within the site boundary. Golden plover exhibits a very high level of site fidelity, or faithfulness, and flocks return to traditional areas each year (Wernham et al.2002, cited in EC, 2009). The three years of survey did not record golden plover usage within the site, or large populations of golden plover traditional over-wintering or feeding areas within the project site.

Percival (2003), states that in Ireland, waterfowl and seabirds are mostly at risk when they occur in high concentrations. The infrequent of observations and the relatively low numbers of golden plover observations indicate that there is no regular passage of this species over the site.

McGuinness et.al (2015), describes that collision risk for waders is generally deemed to be low, due to a relatively low, cursory flight path, coupled with high flight manoeuvrability. A review of pan-European collision assessments revealed much lower golden plover collision records than other species, however, it must be noted that this was not controlled; for survey effort or corpse recovery rates (Hötker et al. 2006).

A Collision Risk Assessment has been completed and can be viewed in **Appendix 7-2**.

The collision risk has been calculated at a rate of 3.98 collisions per year, or 109.73 birds over the 30 year lifetime of the wind farm. The golden plover wintering population of Shannon-Fergus Estuary is

estimated at 11,221 (Lewis et al, 2016[13]). Annual mortality of golden plover has been calculated at 27% per annum (www.bto.org). The annual increase in the collision estimates of 3.98 per year corresponds to an absolute increase of 0.04% in annual mortality of the Shannon-Fergus Estuary population. Therefore the predicted collision risk is **Negligible** in the context of the Shannon-Fergus Estuary population.

The predicted 0.8 per year, or the 24 collisions over the lifetime of the wind farm figure may be somewhat unreliable due to the unrecorded nocturnal flight activity of the species excluded from the Collision Risk Model (CRM). Additionally, the plover observations sometimes involved large flocks, of up to 450 individuals, that circled over fields for extended periods of time leading to extremely high values of bird-seconds spent at PCH (potential collision height). Based on the results of the CRM the increase in background mortality would be 0.003% locally.

The sensitivity of golden plover is considered **Medium**. The magnitude of the effect is assessed as **Negligible**. Using the evaluation criteria in **Table 7-3 above**, the significance of the effect as a result of the operational phase of the project on golden plover is **Very Low**.

Using EPA (2017) criteria, the effect is assessed **Long-term Slight Negative Effect.**

7.5.5 Red grouse (Breeding and Winter)

7.5.5.1 Habitat Loss (Construction)

Given the specific habitat requirements of this ground nesting species and given that the footprint of the project is dominated by conifer plantation, in addition to the availability of more suitable habitat in the surrounding area, significant habitat loss effects are not expected.

The sensitivity of red grouse is considered **Medium**. Using the precautionary principle, the magnitude of the effect is assessed as **Negligible**. Using the evaluation criteria in **Table 7-3** above, the significance of the effect as a result of the construction phase of the project on red grouse is assessed as **Very Low.** Using EPA (2017) criteria, the effect is considered **a Long-term Imperceptible Negative Effect**.

7.5.5.2 Displacement and Barrier Effect (Construction)

The locations of the red grouse breeding sites identified during bird surveys completed at the site are located outside the site boundary. The closest breeding site located approximately 380m away. While some suitable sub optimal breeding and foraging areas occur within the overall site boundary, the footprint of the project is mainly on conifer plantation.

During the construction phase of the project, it is unlikely that foraging and breeding red grouse attempts will occur within the site boundary, as the birds will continue to select the more suitable areas of habitat, located outside the site boundary, mainly to the south and west of the site. The construction activities will be buffered by the conifer plantation occurring, between the bogland to the south. In addition, it must be noted that a certain amount of noise levels occurs at the site, including the forestry operations.

The sensitivity of red grouse is considered **Medium**. The magnitude of the effect is considered to be **Low** for red grouse. Using the evaluation criteria in **Table 7-3** above the significance of the effect

[13] Review and Assessment of Waterbird Data from the Shannon-Fergus Estuary. Prepared by Lesley Lewis, Brian Burke & Olivia Crowe (2016)

during the construction phase of the project on red grouse is considered **Low**. Using EPA (2017) criteria, the effect is considered **Short-term Slight Negative Effects**.

7.5.5.3 Displacement and Barrier Effect (Operation)

A study undertaken by Douglas et.al (2011) found no significant changes in the relationships between the occurrence of red grouse, and turbines, or access track proximity. This study also did not find any evidence of the re-distribution of red grouse in response to wind farm operations.

The occurrence of red grouse near wind energy access routes in a Scottish case study was found to be higher than in the surrounding moor (Pearce-Higgins et al. 2009). Additionally, Pearce-Higgins et al. (2012) found populations of red grouse recovered within one year after disturbance caused by construction of wind farms.

Once the construction phase ceases, ceases it is considered that the red grouse using the study area will continue to do so.

A further potential operational disturbance effect could be disruption to important flightlines (barrier effect). All flight activity of red grouse was of birds flying low, below rotor blade height, which is typical flight behaviour for this species. In addition, no regular important flight routes have been identified within the site boundary of the project. Therefore a barrier effect is not likely to occur.

The sensitivity of red grouse is considered **Medium.** The magnitude of the effect is considered to be **Negligible**. Using the evaluation criteria in **Table 7-3** above, the significance of the effect during the operational phase of the project is assessed as **Very Low**. Using EPA (2017) criteria, the effect is assessed as **Neutral**.

7.5.5.4 Collision Risk during Operation

Where red grouse occur, they fly infrequently, and when they do, they habitually keep low to the ground, below the height of turbine blades. A study carried out by Pearce Higgins et al. (2012) on the impacts of wind farms on bird populations occurring through collisions, habitat loss, avoidance, and barrier effects, disturbance displacement or exclusion, e.g. from breeding grounds or foraging areas, showed results that red grouse did not show any significant responses to wind turbines.

During the extensive three years of surveys at the study area, red grouse were not recorded within the rotor sweep of the turbines. No flight activity was recorded within the potential collision risk zone. While the collision risk modelling exercise could not be undertaken, this does not mean that the collision risk cannot be assessed, but instead it means that the collision risk, within the available VP survey results available to the assessment, is at zero.

The sensitivity of red grouse is considered **Medium.** The magnitude of the effect is assessed as **Negligible**. Using the evaluation criteria in **Table 7-3** above, the significance of the effect as a result of the operational phase of the project on red grouse is **Very Low**. Using EPA (2017) criteria, the effect is assessed as **Neutral**.

7.5.6 Woodcock (Breeding & Winter)

7.5.6.1 Habitat Loss (Construction Phase)

Within the wind farm site, the habitat loss will be mainly of conifer plantation of various stages of rotation.

The felling of forestry required as part of the project may temporarily reduce the distribution and availability of daytime roosting and breeding sites. However, significant areas of forestry with potential roosting sites will remain within the site and surrounding area. There are substantial areas of suitable breeding and foraging habitat available within the site, and the surrounding, and wider area. Substantial areas of undisturbed suitable foraging habitat will remain at the site. In addition, it must be noted that the site occurs in a commercial conifer plantation and whether the project proceeds or not, the conifer operations will continue at the site.

The conifer felling required for the project will be carried out prior to the breeding season. This will avoid significant impacts to breeding woodcock.

As discussed, the direct habitat loss of potential breeding and roosting habitat will be minimal with significant areas of conifer plantation remaining within the site boundary, and extending away from the site.

The sensitivity of woodcock is assessed as **Medium**. The magnitude of the effect, is assessed as **Negligible**. Using the evaluation criteria in **Table 7-3** above, the significance of the effect as a result of the construction phase on woodcock is considered **Very Low**. Using EPA (2017) criteria, the effect is considered a **Long-term Negligible Negative Effect**.

7.5.6.2 Displacement and Barrier Effect (Construction)

It can be assumed that some temporary displacement may occur for woodcock. However, the results of the extensive surveys undertaken at the site indicate that the project site is not used in significant numbers of this species. As discussed, there is ample foraging, breeding and roosting habitat within and extending away from the site. Given the extent of suitable habitat within the site, in the wider area, in addition to the crepuscular nature, and nocturnal habitat of the species, significant displacement of this during the construction phase is not anticipated.

The sensitivity of woodcock is assessed as **Medium**. The magnitude of the effect is assessed as **Negligible**. Using the evaluation criteria in **Table 7-3** above, the significance of the effect as a result of the construction phase on woodcock is considered **Very Low**. Using EPA (2017) criteria, the effect is considered a **Short-term Slight Negative Effect**.

7.5.6.3 Displacement and Barrier Effect (Operation)

Dorka et al., (2014) suggests that that wind turbines could potentially result in significant displacement effects on woodcock. However, this has been disputed (Schmal, 2015), and (Straub et al 2015).

Following the construction phase, extensive foraging and breeding habitat will remain within and extending away from the site. Disturbance during the operational phase of the project is unlikely to discourage birds passing through the site, nor foraging and any breeding activity at the location of the project.

The sensitivity of woodcock is assessed as **Medium**. The magnitude of the effect is assessed as **Low**. Using **Table 7-3** above, the significance of the effect is assessed as **Low**. Using EPA (2017) criteria, the effect is considered a **Long-term, Slight Negative Effect.**

7.5.6.4 Collision Risk during Collision

This species was not recorded flying at the potential collision risk zone during the extensive vantage point surveys completed over three consecutive years of surveys at the site. While the collision risk

modelling exercise could not be undertaken, this does not mean that the collision risk cannot be assessed.

As discussed previously, the results of survey work undertaken, indicates that the site does not support large numbers of woodcock. However, it must be noted that the observations of woodcock may be somewhat underestimated, as flight activity for this species is predominantly crepuscular in nature while the VP survey are largely diurnal.

However, where woodcock were recorded in flight, they were observed at just above the canopy level. Generally roding woodcock, fly just above canopy level, which is below the rotor swept area of the Carrownagowan wind farm turbines.

The sensitivity of woodcock is considered **Medium**. Using the precautionary principle, the magnitude of the effect considered to be **Low**. Using the evaluation criteria in **Table 7-3** above, the significance of the effect as a result of the operational phase of the project on woodcock is **Low**. Using EPA (2017) criteria, the collision risk is assessed as a **Long term Slight to Imperceptible Negative** effect.

7.5.7 Sparrowhawk (Breeding & Winter)

7.5.7.1 Habitat Loss (Construction Phase)

Within the wind farm site, the habitat loss will be mainly of conifer plantation of various stages of rotation.

While the felling of forestry may potentially, temporarily reduce the distribution and availability of suitable trees to provide potential nest sites, significant areas of forestry edge, suitable for breeding will remain. The loss of any breeding or foraging habitat at the study area for this species is considered minimal, as there is an abundance of similar habitat, and sometimes more optimal habitat extending away from the site, in the wider area, including hedgerows, bounding agricultural grassland.

The Sensitivity of sparrowhawk is considered **Low.** The magnitude of the effect is assessed as **Negligible**. Using the evaluation criteria in **Table 7-3** above, the significance of the effect as a result of the construction phase of the project on sparrowhawk is considered **Very Low**. Using EPA (2017) criteria, the effect is assessed as a **Long-term Imperceptible Negative Effect**.

7.5.7.2 Displacement and Barrier Effects (Construction)

The construction phase of the project may temporarily result in some disturbance, or displacement for sparrowhawk. However any displacement impacts are not considered significant given the availability of similar and suitable breeding and foraging habitat within and surrounding the site. Existing activities at the site include forestry operations, including felling, and thinning of forestry. Overall, disturbance during construction phase of the project is unlikely to discourage sparrowhawk flight activity, foraging or breeding in the proximity of the project site.

The sensitivity of sparrowhawk is considered **Low.** The magnitude of the effect is assessed as **Low**. Using **Table 7-3** above the significance of the effect is considered **Very Low**. Using EPA (2017) criteria, the effect is assessed as a **Short-term Imperceptible Negative Effect**.

7.5.7.3 Displacement and Barrier Effects (Operation)

With regard to raptors and operational phase wind farms, Whitfield and Madders (2006a) suggest that most studies do not detect any significant displacement of raptor species by operating wind turbines.

Previous analysis for raptors have generally found only low levels of turbine avoidance (Hötker 2006; Hötker et al. 2006), with some raptor species such as sparrowhawk, known to continue foraging activity close to turbines (Pearce Higgins et.al 2009b). In addition, extensive areas of suitable foraging habitat will remain post construction.

Disturbance from operation is unlikely to significantly discourage breeding attempts and sparrowhawk are expected to continue to habituate to the project site during the operational phase of the project. The widespread distribution of sparrowhawk limits the potential for ecologically significant effects.

The sensitivity of sparrowhawk is considered **Low.** The magnitude of the effect is assessed as **Low**. Using **Table 7-3** above the significance of the effect is considered **Very Low**. Using EPA (2017) criteria, the effect is assessed as a **Long-term Imperceptible Negative Effect**.

7.5.7.4 Collision Risk during Collision

This species utilises hedgerows or other cover to surprise its prey, which is usually small birds. In addition this species is a master of flying in woodland where it can fly through small gaps in branches pursuit of its prey, displaying great agility. While no avoidance rate is published for sparrowhawk the rate for Goshawk, which is of the same genus, is 98%.

A collision risk assessment has been completed for this species (see **Appendix 7-2**). The collision risk for this species is calculated at 0.004 collisions per year, or 0.12 collisions over the lifetime of the wind fram. Collision risk is predicted to be very low with no collisions predicted during the 30 year operational lifetime of the project.

Based on the agility of the bird, the widespread distribution, calculations, and documented avoidance rates (95% average for all raptors), it is considered that the wind farm will not result in significant collision effects on sparrowhawk.

A Collision Risk Assessment has been completed and can be viewed in **Appendix 7-3**.

The collision risk has been calculated at a rate of 0.003 collisions per year, or 0.08 birds over the 30 year lifetime of the wind farm. Therefore the predicted collision risk is **Negligible** at any geographical scale.

The sensitivity of sparrowhawk is considered **Low.** The magnitude of the effect is considered to be **Negligible**. Using the evaluation criteria in **Table 7-3** above, the significance of the effect as a result of the operational phase of the project on sparrowhawk is considered **Very Low**. Using EPA (2017) criteria, the effect is assessed as a **Long-term Imperceptible Negative Effect**.

7.5.8 Kestrel (Breeding and Winter)

7.5.8.1 Habitat Loss (Construction Phase)

The project will result in the loss of 67.66ha of conifer plantation. Within the wind farm site, the habitat loss will be mainly confined to conifer plantation of various stages of rotation.

While the felling of forestry may potentially, temporarily reduce the distribution and availability of suitable trees to provide potential nest sites, significant areas of forestry edge, suitable for breeding will remain within and in the wider area. Significant areas of forestry with potential foraging areas, and more open areas will remain within the site and surrounding areas. There are substantial areas of suitable breeding and foraging habitat available within the site, and surrounding the site and the wider

area. The loss of foraging habitat for this species will be minimal, with sufficient suitable habitat plenty in wider area.

The sensitivity of Kestrel is assessed as **Low.** The magnitude of the effect is assessed as **Negligible**. Using the evaluation criteria in **Table 7-3** above, the significance of the effect as a result of the construction phase of the project on kestrel is assessed as **Very Low**. Using EPA (2017) criteria, the effect is assessed as a **Long-term Imperceptible Negative Effect**.

7.5.8.2 Displacement and Barrier Effects (Construction)

The construction phase of the project may temporarily result in some disturbance, or displacement for kestrel. However any displacement impacts are not considered significant given the availability of similar and suitable breeding and foraging habitat within and surrounding the site. Existing activities at the site include forestry operations, including felling, and thinning of forestry. Overall, disturbance during construction phase of the project is unlikely to discourage kestrel flight activity, foraging or breeding in the proximity of the project.

The sensitivity of kestrel is assessed as **Low.** The magnitude of the effect is assessed as **Low**. Using **Table 7-3** above the significance of the effect is assessed as **Very Low**. Using EPA (2017) criteria, the effect is assessed as **Short-term Imperceptible Negative Effects**.

7.5.8.3 Displacement and Barrier Effects (Operation)

Extensive areas of suitable foraging and breeding habitat will remain post construction and there is an abundance of suitable habitat within the site, and in the surrounding area.

With regard to raptors and operational phase wind farms, Whitfield and Madders (2006a) suggests that most studies do not detect any significant displacement of raptor species by operating wind turbines.

Previous analysis for raptors have generally found only low levels of turbine avoidance (Hötker 2006; Hötker et al. 2006), with some raptor species such as kestrel, known to continue foraging activity close to turbines (Pearce Higgins et.al 2009b).

Disturbance from operation is unlikely to significantly discourage breeding attempts and kestrels are expected to continue to habituate to the project site during the operational phase. The widespread distribution of Kestrel limits the potential for ecologically significant effects.

The sensitivity of kestrel is assessed as **Low.** The magnitude of the effect is assessed as **Low**. Using **Table 7-3** above the significance of the effect is assessed as **Very Low**. Using EPA (2017) criteria, the effect is assessed as a **Long-term Imperceptible Negative Effect**.

7.5.8.4 Collision Risk during Operation

A collision risk assessment has been completed for this species (see **Appendix 7-3**).

The collision risk has been calculated at a rate of 0.365 collisions per year, or 11 birds over the 30 year lifetime of the project. The annual increase in background mortality for the local population is estimated to be 2% and for the national population is estimated to be 0.01%. The magnitude of the effect at a local level is assessed as Medium for this common and widely distributed raptor in Ireland. The National population of kestrel is estimated at between 12,100, and 21,220 individuals. The increase in annual mortality of the National population is predicted as Negligible (0.01%).

The baseline conditions will be partially changed at a local level, and will be barely distinguishable at a National level.

It must be noted that the predicted collision risk for Kestrel is potentially unreliable, as a high proportion of the recorded flight activity involved hovering birds, so the mean flight speed used in the CRM may not be representative of the mean flight speed of the birds recorded during the VP surveys.

Based on the conservation status, widespread distribution, agility of the bird, calculations, and documented avoidance rates, it is considered that the project will not result in significant collision effects on kestrel.

The sensitivity of Kestrel is considered **Low.** The magnitude of the effect is considered to be **Medium** at a local level. Using the evaluation criteria in **Table 7-3** above, the significance of the effect as a result of the operational phase of the project on kestrel is considered **Low - Very Low**. Using EPA (2017) criteria, the effect is assessed as a **Long-term Slight – Imperceptible Negative Effect**.

7.5.9 Buzzard (Breeding and Winter)

7.5.9.1 Habitat Loss (Construction Phase)

The project is dominated by conifer plantation, which does not provide optimal breeding, or foraging habitat for this species. The felling of trees may temporarily reduce the distribution and availability of trees that are of sufficient age, to provide potential breeding sites. However significant areas of forestry edge, that may be suitable for breeding buzzard will remain, within the site, and there is an abundance of similar habitat in the wider area.

Based on the conservation status of this species, the low numbers recorded on site (over three consecutive years), the wide-ranging nature of the species and the availability of suitable habitats in the surroundings (i.e. conifer plantation, scrub, bogland, heathland, and grassland), the habitat loss required for the project is not significant.

The sensitivity of buzzard is assessed as **Low.** The magnitude of the effect is assessed as **Low – Negligible**. Using the evaluation criteria in **Table 7-3** above, the significance of the effect as a result of the construction phase of the project buzzard is assessed as **Very Low**. Using EPA (2017) criteria, the effect is assessed as a **Long-term Imperceptible Negative Effect**.

7.5.9.2 Displacement and or Barrier Effects (Construction)

Over the three years of survey, no nest sites were located within the site.

The construction phase of the project may temporarily result in some disturbance, and or displacement for buzzard. However any displacement impacts are not considered significant given the availability of similar and suitable breeding and foraging habitat within and surrounding the site. Existing activities at the site include forestry operations, including felling, and thinning of forestry. Overall, disturbance during construction phase is unlikely to discourage buzzard flight activity, foraging or breeding activity in the proximity of the project.

Given the short-term duration of construction works, the relatively low number of observations and the availability of similar, and often more suitable habitats in the wider area, it is considered that the disturbance and displacement impacts will not be significant.

The sensitivity of buzzard is assessed as **Low.** The magnitude of the impact is assessed as **Low**. Using the evaluation criteria in **Table 7-3** above, the significance of the effect as a result of the construction

phase of the project on buzzard is assessed as **Very Low**. Using EPA (2017) criteria, the effect is assessed as a **Short-term Imperceptible Negative Effects**.

7.5.9.3 Displacement and or Barrier Effects (Operation)

There is limited potential for disturbance displacement effects associated with avoidance of operating turbines at the project site. Buzzards have been shown to habituate to operating turbines (Hötker, H., Thomsen, K. M., & Köster, H., 2006). However, breeding activity is suggested to be reduced within 500m of operating turbines (Pearce-Higgins et al 2009). Among the birds species identified for avoidance of wind farms, buzzards showed a decrease in breeding density of 15-53%. However, during surveys completed in 2017 and 2018 no nest sites were confirmed within the site, or the habitat immediately fringing the site. In addition, extensive areas of suitable nesting and foraging habitat exist in the wider area (outside 500m), and will remain following the construction phase of the project.

Given the low numbers recorded, the conservation status of this species, and the abundance of suitable habitats in the wider area, the effects associated with disturbance, and or displacement and barrier effect are considered low.

The sensitivity of buzzard is considered **Low** and the magnitude is **Low**. Using the evaluation criteria in **Table 7-3** above, the significance of the effect as a result of the operational of the project on buzzard is considered **Very Low**. Using EPA (2017) criteria, the effect is assessed as a **Long-term Slight – Imperceptible Negative Effect**.

7.5.9.4 Collision Risk during Collision

A collision risk assessment has been completed for this species (see **Appendix 7-3**).

The collision risk has been calculated at a rate of 0.12 collisions per year, or 3.5 birds over the 30 year lifetime of the project. The local population of buzzard is estimated at 12 birds (pres.comm. Clare BWI). Annual mortality of buzzard has been calculated at 0.19 per annum (www.bto.org). The annual increase in the predicted collisions of 0.12 per year corresponds to an absolute increase of 1.0% in annual mortality of the local population of buzzard. The magnitude of the effect at a local level is assessed as Medium for this common and widely distributed raptor in Ireland. The National population of buzzard is estimated at between 1,500 individuals. The absolute increase in annual mortality of the National population is predicted as **Negligible**.

Based on the conservation status, widespread distribution, calculations, and documented avoidance rates (98%), it is considered that the project will not result in significant collision effects on buzzard.

The sensitivity of buzzard is considered **Low**. The magnitude of the effect is assessed as **Medium** at a local level, and **Negligible** at a National level. Using the evaluation criteria in **Table 7-3** above, the significance of the effect as a result of the operational phase of the project on buzzard is considered **Very Low**. Using EPA (2017) criteria, the effect is assessed as a **Long-term Slight – Imperceptible Negative Effect**.

7.5.10 Summary of Likely Significant Effects of the Wind Farm

The following table presents a summary of the likely significant construction and operational effects of the wind farm on the key ecological receptors (KER) identified above in **Section 7.8.1 to 7.8.9**.

Table 7-17. Summary of construction impact characterisation for avian Key Ecological Receptors (KERs) based on Percival (2003) and EPA (2017)

KER & BoCCI status[14]	Potential impacts	Duration and Magnitude of potential impact[15]	Frequency and reversibility	Magnitude and Significance of effect[16]
Hen harrier (breeding)	Habitat loss during construction	Long-term Slight Negative	Predicted to occur during construction phase[17]. Reversible in the case of conifer plantation, irreversible for peatland habitats.	The magnitude of effect is assessed as Low. **High** sensitivity species + **Low** Impact = **Low** significance. No likely significant effects at a local or county level are predicted.
	Displacement and barrier effects during construction	Short-term Significant Negative	Predicted to occur during construction phase. Reversible, as noise and disturbance levels reduce post construction.	The magnitude of effect is assessed as Low. **High** sensitivity species + **Medium** Impact = **High** significance. Likely significant effects at a local level are predicted.
	Displacement and barrier effects during operation	Long-term Slight to Moderate Negative	Predicted to occur during 30 year lifetime of wind farm. Reversible after wind farm decommissioning.	The magnitude of effect is assessed as Low. **High** sensitivity species + **Low** Impact = **Low** significance. No likely significant effects at a local or county level are predicted.
	Disturbance to prey availability	Long-term Slight to Imperceptible Negative	Predicted to occur during 30 year lifetime of wind farm. Reversible after wind farm decommissioning.	The magnitude of effect is assessed as Low. **High** sensitivity species + **Negligible** Impact = **Very Low** significance. No likely significant effects at a local or county level are predicted.
	Collision risk during operation	Long-term Slight to Imperceptible Negative	Predicted to occur during 30 year lifetime of wind farm.	The magnitude of effect is assessed as Low. **High** sensitivity species + **Low** Impact = **Low** significance.

[14] BoCCI status indicated by colour
[15] Significance of potential impact based on EPA (2017)
[16] Magnitude and Significance of potential impact based on Percival (2003)
[17] It is envisaged that the project will have an 18 month construction period followed by a 4-6 month commissioning period.

			Reversible after wind farm decommissioning.	No likely significant effects at a local or national level are predicted
Peregrine (breeding and winter)	Habitat loss during construction	Long-term Slight Negative	Predicted to occur during construction phase. Reversible in the case of conifer plantation, irreversible for peatland habitats.	The magnitude of effect is assessed as Low. **Medium** sensitivity species + **Low** Impact = **Low** significance. No likely significant effects at a local or national level are predicted
	Displacement and barrier effects during construction	Short-term Slight Negative	Predicted to occur during construction phase. Reversible, as noise and disturbance levels reduce post construction.	The magnitude of effect is assessed as Low. **Medium** sensitivity species + **Low - Negligible** Impact = **Low – Very Low** significance. No likely significant effects at a local or national level are predicted
	Displacement and barrier effects during operation	Long-term Slight Negative	Predicted to occur during 30 year lifetime of wind farm. Reversible after wind farm decommissioning.	The magnitude of effect is assessed as Low. **Medium** sensitivity species + **Low - Negligible** Impact = **Low – Very Low** significance. No likely significant effects at a local or national level are predicted
	Collision risk during operation	Long-term Slight to Imperceptible Negative	Predicted to occur during 30 year lifetime of wind farm. Reversible after wind farm decommissioning.	The magnitude of effect is assessed as Low. **Medium** sensitivity species + **Negligible** Impact = **Very Low** significance. No likely significant effects at a local or national level are predicted
Merlin (breeding and winter)	Habitat loss during construction	Long-term Imperceptible Negative	Predicted to occur during construction phase. Reversible in the case of conifer plantation, irreversible for peatland habitats.	The magnitude of effect is assessed as Low. **Medium** sensitivity species + **Negligible** Impact = **Very Low** significance. No likely significant effects at a local or national level are predicted
	Displacement and barrier effects during construction and operation	Long-term Imperceptible Negative	Predicted to occur during construction phase.	The magnitude of effect is assessed as Low.

			Predicted to occur during 30 year lifetime of wind farm. Reversible, as noise and disturbance levels reduce post construction. Reversible after wind farm decommissioning.	**Medium** sensitivity species + **Negligible** Impact = **Very Low** significance. No likely significant effects at a local or national level are predicted
	Collision risk during operation	Long-term Imperceptible Negative to Neutral	Predicted to occur during 30 year lifetime of wind farm. Reversible after wind farm decommissioning.	The magnitude of effect is assessed as Low. **Medium** sensitivity species + **Negligible** Impact = **Very Low** significance. No likely significant effects at a local or national level are predicted
Golden plover (winter)	Habitat loss during construction	Neutral	Predicted to occur during construction phase. Reversible, as noise and disturbance levels reduce post construction.	The magnitude of effect is assessed as Low. **Medium** sensitivity species + **Negligible** Impact = **Very Low** significance. No likely significant effects at a local or national level are predicted
	Displacement and barrier effects during construction	Short-term Slight to Imperceptible Negative	Predicted to occur during construction phase. Reversible, as noise and disturbance levels reduce post construction.	The magnitude of effect is assessed as Low. **Medium** sensitivity species + **Low** Impact = **Low** significance. No likely significant effects at a local or national level are predicted
	Displacement and barrier effects during operation	Long-term Slight to Imperceptible Negative	Predicted to occur during 30 year lifetime of wind farm. Reversible after wind farm decommissioning.	The magnitude of effect is assessed as Low. **Medium** sensitivity species + **Low** Impact = **Low** significance. No likely significant effects at a local or national level are predicted
	Collision risk during operation	Long-term Slight Negative	Predicted to occur during 30 year lifetime of wind farm. Reversible after wind farm decommissioning.	The magnitude of effect is assessed as Low. **Medium** sensitivity species + **Negligible** Impact = **Very Low** significance. No likely significant effects at a local or national level are predicted

Red grouse (breeding and winter)	Habitat loss during construction	Long-term Slight to Imperceptible Negative	Predicted to occur during construction phase. Reversible in the case of conifer plantation, irreversible for peatland habitats.	The magnitude of effect is assessed as Low. **Medium** sensitivity species + **Negligible** Impact = **Very Low** significance. No likely significant effects at a local or national level are predicted
	Displacement and barrier effects during construction	Short-term Slight to Imperceptible Negative	Predicted to occur during construction phase. Reversible, as noise and disturbance levels reduce post construction.	The magnitude of effect is assessed as Low. **Medium** sensitivity species + **Low** Impact = **Low** significance. No likely significant effects at a local or national level are predicted
	Displacement and barrier effects during operation	Neutral	Predicted to occur during 30 year lifetime of wind farm. Reversible after wind farm decommissioning.	The magnitude of effect is assessed as Low. **Medium** sensitivity species + **Negligible** Impact = **Very low** significance. No likely significant effects at a local or national level are predicted
	Collision risk during operation	Neutral	Predicted to occur during 30 year lifetime of wind farm. Reversible after wind farm decommissioning.	The magnitude of effect is assessed as Low. **Medium** sensitivity species + **Negligible** Impact = **Very low** significance. No likely significant effects at a local or national level are predicted
Woodcock (breeding and winter)	Habitat loss during construction	Long-term Negligible Negative	Predicted to occur during construction phase. Reversible in the case of conifer plantation, irreversible for peatland habitats.	The magnitude of effect is assessed as Low. **Medium** sensitivity species + **Negligible** Impact = **Very low** significance. No likely significant effects at a local or national level are predicted
	Displacement and barrier effects during construction	Short-term Slight Negative	Predicted to occur during construction phase. Reversible, as noise and disturbance levels reduce post construction.	The magnitude of effect is assessed as Low. **Medium** sensitivity species + **Negligible** Impact = **Very low** significance. No likely significant effects at a local or national level are predicted

	Displacement and barrier effects during operation	Long-term Slight Negative	Predicted to occur during 30 year lifetime of wind farm. Reversible after wind farm decommissioning.	The magnitude of effect is assessed as Low. **Medium** sensitivity species + **Low** Impact = **Low** significance. No likely significant effects at a local or national level are predicted
	Collision risk during operation	Long-term to Imperceptible Negative	Predicted to occur during 30 year lifetime of wind farm. Reversible after wind farm decommissioning.	The magnitude of effect is assessed as Low. **Medium** sensitivity species + **Low** Impact = **Low** significance. No likely significant effects at a local or national level are predicted
Sparrowhawk (breeding and winter)	Habitat loss during construction	Long-term Imperceptible Negative	Predicted to occur during construction phase. Reversible in the case of conifer plantation, irreversible for peatland habitats.	The magnitude of effect is assessed as Low. **Low** sensitivity species + **Negligible** Impact = **Very Low** significance. No likely significant effects at a local or national level are predicted
	Displacement and barrier effects during construction	Short-term Imperceptible Negative	Predicted to occur during construction phase. Reversible, as noise and disturbance levels reduce post construction.	The magnitude of effect is assessed as Low. **Low** sensitivity species + **Low** Impact = **Very Low** significance. No likely significant effects at a local or national level are predicted
	Displacement and barrier effects during operation	Long-term Imperceptible Negative	Predicted to occur during 30 year lifetime of wind farm. Reversible after wind farm decommissioning.	The magnitude of effect is assessed as Low. **Low** sensitivity species + **Low** Impact = **Very Low** significance. No likely significant effects at a local or national level are predicted
	Collision risk during operation	Long-term Imperceptible Negative	Predicted to occur during 30 year lifetime of wind farm. Reversible after wind farm decommissioning.	The magnitude of effect is assessed as Low. **Low** sensitivity species + **Negligible** Impact = **Very Low** significance. No likely significant effects at a local or national level are predicted

Kestrel (breeding and winter)	Habitat loss during construction	Long-term Imperceptible Negative	Predicted to occur during construction phase. Reversible in the case of conifer plantation, irreversible for peatland habitats.	The magnitude of effect is assessed as Low. **Low** sensitivity species + **Negligible** Impact = **Very Low** significance. No likely significant effects at a local or national level are predicted
	Displacement and barrier effects during construction	Short-term Imperceptible Negative	Predicted to occur during construction phase. Reversible, as noise and disturbance levels reduce post construction.	The magnitude of effect is assessed as Low. **Low** sensitivity species + **Low** Impact = **Very Low** significance. No likely significant effects at a local or national level are predicted
	Displacement and barrier effects during operation	Long-term Imperceptible Negative	Predicted to occur during 30 year lifetime of wind farm. Reversible after wind farm decommissioning.	The magnitude of effect is assessed as Low. **Low** sensitivity species + **Low** Impact = **Very Low** significance. No likely significant effects at a local or national level are predicted
	Collision risk during operation	Long-term Slight to Imperceptible Negative	Predicted to occur during 30 year lifetime of wind farm. Reversible after wind farm decommissioning.	The magnitude of effect is assessed as Low. **Low** sensitivity species + **Medium** Impact = **Low** - **Very Low** significance. No likely significant effects at a local or national level are predicted
Buzzard (breeding and winter)	Habitat loss during construction	Long-term Imperceptible Negative	Predicted to occur during construction phase. Reversible in the case of conifer plantation, irreversible for peatland habitats.	The magnitude of effect is assessed as Low. **Low** sensitivity species + **Negligible** Impact = **Very Low** significance. No likely significant effects at a local or national level are predicted
	Displacement and barrier effects during construction	Short-term Imperceptible Negative	Predicted to occur during construction phase.	The magnitude of effect is assessed as Low. **Low** sensitivity species + **Low** Impact = **Very Low** significance. No likely significant effects at a local or national level are predicted

			Reversible, as noise and disturbance levels reduce post construction.	
	Displacement and barrier effects during operation	Long-term Slight to Imperceptible Negative	Predicted to occur during 30 year lifetime of wind farm. Reversible after wind farm decommissioning.	The magnitude of effect is assessed as Low. **Low** sensitivity species + **Low** Impact = **Very Low** significance. No likely significant effects at a local or national level are predicted
	Collision risk during operation	Long-term Slight to Imperceptible Negative	Predicted to occur during 30 year lifetime of wind farm. Reversible after wind farm decommissioning.	The magnitude of effect is assessed as Low. **Low** sensitivity species + **Medium** Impact = **Very Low** significance. No likely significant effects at a local or national level are predicted

7.5.11 Grid Connection – Effects on all avian Key Ecological Receptors

7.5.11.1 Habitat Loss Construction Phase and Operational Phase

The grid connection has been carefully positioned to ensure there will be no significant loss of habitats that would be considered of high ecological value for avian Key Ecological Receptors (KERs) considered in this assessment. The grid connection will follow existing road, and will connect to the existing substation at Ardnacrusha. No hedgerow clearance is required. The installation of the grid connection will result in temporary disturbance of already altered habitats, rather than habitat loss as such. Therefore the grid route, and connection to the existing substation will not result in significant habitat loss for avian KERs identified.

Using EPA (2017) criteria, the effect is assessed as a **Neutral**.

7.5.11.2 Disturbance and Displacement Construction and Operational Phase

The only potential for significant disturbance, and or displacement impacts would be during the construction phase. The grid connection route has been selected to utilise existing built infrastructure for the majority of its length (i.e. cables to be laid within public roads). Cables will be laid underground to avoid significant effects on roadside verges and disturbance to nesting birds. No hedgerow clearance is required.

Using EPA (2017) criteria, the construction phase effect is assessed as a **Short-term Slight Negative Effect**.

7.5.11.3 Collision Risk during Operation

The grid connection will be installed underground, therefore avoiding collision impacts with overhead lines.

7.5.12 Decommissioning Effects on all avian Key Ecological Receptors

If the Carrownagowan Wind Farm is to be decommissioned, there is potential that, during the decommissioning phase of the wind farm, disturbance of nesting or wintering birds by human activity, construction activity and the operation of machinery could occur. It is considered that the decommissioning operations of the Carrownagowan Wind Farm will be of a significantly lesser magnitude and scale compared to a construction phase of a wind farm, as activities such as road construction, and turbine installation will not be required.

Prior to wind turbine removal, due consideration would be given to any potential impacts arising from the decommissioning operations. Some of the potential issues could include:

- Temporary disturbance, and or displacement;
- Potential disturbance to wintering, and breeding species such as hen harriers, by the presence of machinery, and personnel on-site;
- Time of year and time-scale (to be outside sensitive periods, including breeding season);
- It is likely that access tracks may remain in use for the benefit of the landowner.

The decommissioning phase of the project could result in disturbance to local bird species using the site. Bird species may be disturbed by the noise and physical presence activities of personnel and machinery during decommissioning works. Bird species may also become temporarily displaced during decommissioning activities. Disturbance may result in displacement of birds from an area which can

result in effective habitat loss or a reduction in the quality of the habitat, thereby leading to a reduction in bird density locally (Pearce-Higgins, 2009).

Underground cables will be cut back and left underground. The cables will not be removed if the Environmental Assessment of the decommissioning operation demonstrates that this would do more harm than leaving them in situ. The assessment will be carried out closer to the time to take into account environmental changes over the project life.

Hardstand areas will be remediated to match the existing landscape thus requiring restoration or reforestation. Access roads will be left for use by the landowner. The current view is that the disturbance associated with the removal and disposal of the material would be more deleterious than leaving them in place.

Prior to the decommissioning work, a comprehensive reinstatement proposal, including the implementation of a program that details the removal of structures and landscaping, will be submitted to the relevant competent for approval.

To avoid potential impacts on nesting birds, decommissioning activities will be timed to avoid the main period of sensitivity for breeding birds (March 1st to August 31st).

The removal of turbines from the site will potentially result in direct positive effects associated with the return of semi-natural habitat to areas which previously contained site infrastructure. Overall, it is considered that decommissioning activities will result in **Permanent Slight Positive Effects** of **Low** Significance.

Using EPA (2017) criteria, disturbance, and or displacement effects during the decommissioning phase are expected to be **Temporar**y to **Short-term** in duration, and is therefore considered as **Not Significant**.

7.6 RISK OF MAJOR ACCIDENTS AND DISASTERS

Wind farms are not generally associated with major accidents and disasters, and there are no major risks regarding this on local bird populations in the area.

7.7 CUMULATIVE EFFECTS

According to the Scottish Natural Heritage, 'the cumulative effect of a set of project is the combined effect of all the projects, taken together' (SNH, 2005).

All of the potential effects of the wind farm identified above (direct habitat loss, disturbance, displacement, barrier and collision risk) have the potential to contribute to the cumulative ornithological impacts, so all have been considered in this cumulative ornithological assessment.

7.7.1 Land Management

The commercial forestry in the area would potentially be the main potential for cumulative impacts, on avian KERs, in that the s site is situated within a commercial forestry site. The main potential for impacts are habitat loss of potentially suitable foraging and nesting habitat for bird species, including the hen harrier using the area, and disturbance and displacement impacts.

During the construction phase, forestry operations will cease. Therefore during the construction phase of the project this will not result in significant disturbance, and or displacement impacts on hen harrier in-combination with forestry operations, such as felling and harvesting.

Cumulative displacement effects can occur as a result in habitat loss and could potentially occur where numbers are limited by availability of resources (foraging and nesting), resulting in increased competition among bird species (King et al., 2009). Each of these was considered with regard to the avian KERs.

Baseline conditions at the site will not be significantly altered should the wind farm become operational. The site will continue to be managed for forestry, which will create temporal and spatial changes in hen harrier use, as is what is likely to have been ongoing, since the introduction of forestry to the region. Large commuting corridors will be maintained between turbines, and in the landscape in the greater area, which will ensure on-going connectivity with the wider landscape. The analysis of the forest management plan for the site it can be seen that the potential suitable foraging and nesting habitat available for nesting and foraging hen harrier remains relatively stable over the lifetime of the wind farm (2025-2055), with no significant reduction, and will remain available for the population of hen harrier using the area.

The project will not result in significant cumulative habitat loss of the bogland habitats in the area, as the project has avoided more natural habitats for species such as foraging hen harrier, and will be allowed to remain over the lifetime of the wind farm.

The project has avoided the sections of unplanted bogland habitats within the site boundary. Therefore, the project will not result in significant cumulative habitat loss of bogland occurring in-combination with the existing peat harvesting in the area. It is unlikely that peat harvesting and agriculture will have much of an influence on baseline conditions because the surrounding sections of Slieve Bernagh Bog SAC will continue to be managed for nature conservation and restrictions for these activities will apply. Therefore the more suitable and natural habitats will remain for species such as hen harrier, and red grouse.

The main potential for disturbance displacement impacts, in combination with peat harvesting and agricultural activities in the area, would be during the breeding season, while construction activities are being carried out, moreover for species such as harrier. However, if hen harriers are observed breeding, an exclusion zone will be put in place to avoid disturbance, and displacement impacts. In

addition, the operational phase hen harrier monitoring will inform on any hen harrier nesting locations, and these areas could be avoided during felling operations at the Coillte forestry site.

It can be concluded, that the project will not result in significant cumulative habitat loss, disturbance, and displacement impacts on avian KERs, in combination with forestry, peat harvesting, and agriculture in the area.

7.7.2 Other Wind Farms

The potential negative cumulative effects of wind turbines on birds include barrier effects that can be caused by a number of wind farms occurring at a geographical location (Drewitt & Langston, 2006). Multiple wind farms in an area can have a cumulative impact of collision mortality, depending on the scale and distance between projects and also the bird species that occur in an area. Mortality from collision is associated with very high numbers of turbines and densities of birds.

There is currently one operating wind farm, and one permitted wind farm within a 15 kilometre radius of the project site. **Table 7-15** below describes the wind farms within 15km of the project. Bunkimalta Windfram, is permitted, currently in planning and review. This wind farm is situated c.20km to the east, and has been included as it is situated in the proximity of Keeper Hill.

Table 7-18. Other wind farms in the region

Name	Status	Number of turbines
Sonnagh Old	Existing	9
Derrybrien	Existing	71
Curraghgruaige	Existing	3
Templederry	Existing	2
Knockastanna	Existing	4
Vistakon	Existing	1
Castlewaller	Permitted	16
Bunkimalta	Permitted	16

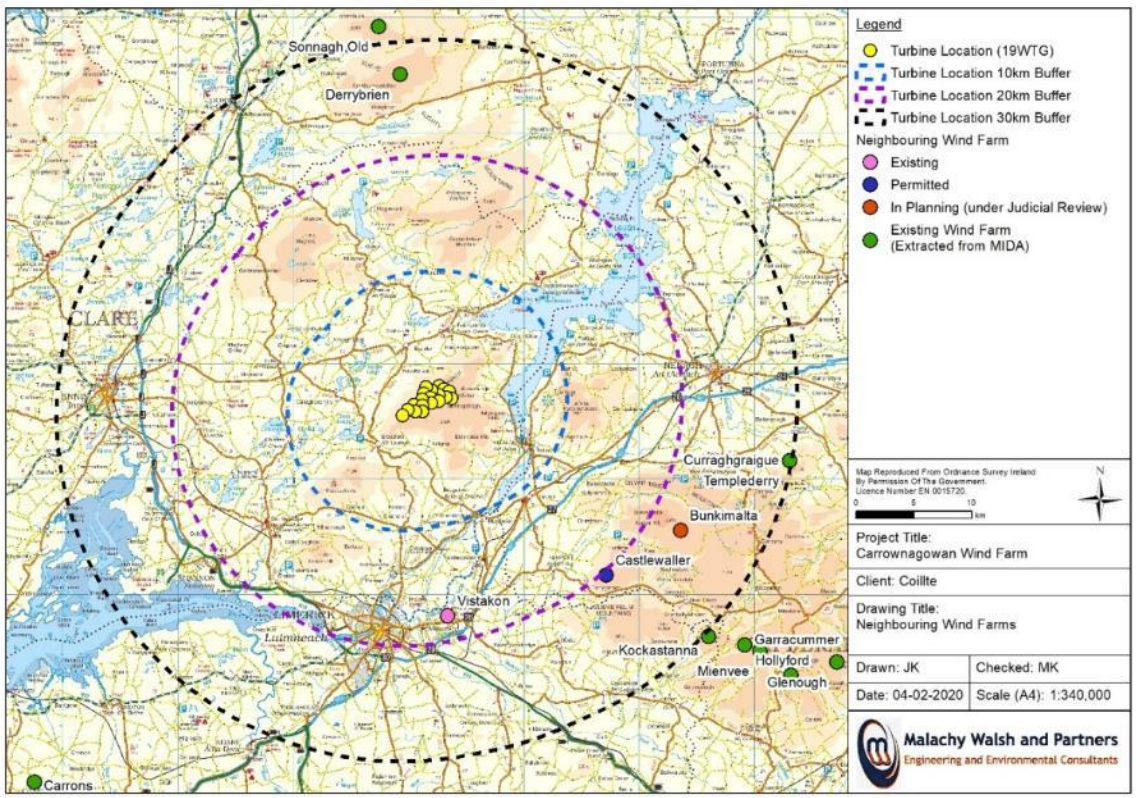

Figure 7-12. Wind farm developments within 30km of the proposed Carrownagowan wind farm

The project and other wind farms in the region are separated by vast areas of agricultural grassland, and the River Shannon and built areas. Due to the separation distance of over 20km it is unlikely that the project and other wind farms in the region will result in cumulative habitat loss impacts on the hen harrier population of the Slieve Bernagh to Keeper Hill Area, or other avian KERs identified.

The largest concentration of wind farms occur to the south east within the Slievefelim to Silvermines Mountains SPA. This SPA, or part of it, bounds the southern extent of the Slieve Bernagh - Keeper Hill Regionally Important Area for hen harrier. While the Keeper Hill birds were not, included in the Slieve Bernagh – Keeper Hill Area during the 2015 National Hen Harrier Breeding Survey, the site extends to it (Ruddock et al., 2016). The most recent National Hen Harrier Survey indicates that the hen harrier population within the Slieve Bernagh to Keeper Hill area has increased between 2000, and 2015, and particularly since 2010 to a maximum of seven breeding pair (Ruddock et al., 2016). While the increases may be due in part due to increased survey effort, these results suggest that the hen harrier population in the Slieve Bernagh – Keeper Hill Area have not been significantly displaced from the area, or subjected to collision impacts owing to operational wind farms commissioned in that time frame, and have maintained, and likely increased in population in the presence of a number of turbines. This is backed up by similar results recorded within the Slievefelim to Silvermines Mountains SPA, which has also increased in estimated breeding pairs between 2005 and 2015.

All works along the public road network will be carried out under a road opening licence and agreed with the local authorities to ensure there are no conflicts with other proposals at that time.

It is that any vegetation clearance required will not be carried out during the bird breeding season (March-August inclusive). Compliance with good working practices and environment quality standards during the construction phase of the road widening works, and along the grid connection, will ensure

that significant direct or indirect impacts will not ensue. Therefore significant cumulative or in-combination effect on the Key Ecological Receptors identified, are not expected.

Therefore, due to the aforementioned, it can be concluded that the project will not result in significant cumulative effects on avian Key Ecological Receptors identified, in-combination with other wind farms in the region.

7.8 MITIGATION

7.8.1 Mitigation by Design

Consultation between the design team (Project Manager, Project Engineers, Project Ecologists/Ornithologists) and the developer was conducted on an ongoing basis during the design phase, in order to formulate a project design which would avoid, by design and at source, any construction activities, and minimise habitat loss for bird species, such as hen harrier. As a consequence, all aspects of the project, including layout adopted avoidance by design approach. An example of this avoidance by design approach includes, the footprint of the project is located on the least ecologically sensitive areas found during the site investigations in order to minimise potential impacts. The turbines are mainly located in the existing forestry at the site.

The project design has included the following to reduce the potential for significant effects on avian receptors, including:

- Avoidance with recognised buffers installed at identified successful hen harrier nest sites.
- Avoidance of bogland habitats (turbine arrays and wind farm infrastructures located away from the better quality, and natural foraging and nesting habitat for species such as hen harrier;
- To avoid a potential barrier effect on birds, the turbines have been positioned at distances greater than 500m apart as per recommendations in Percival (2001);
- Hard-standing areas have been designed to the minimum size necessary to support the turbine model selected;
- The grid connection route has been selected to utilise built infrastructure for the entire length (i.e. cables to be laid within public roads). Cables will be laid underground to avoid effects on roadside hedgerows and disturbance to nesting birds;
- Construction of access roads and areas of hard standing will be kept to a minimum to reduce habitat loss as much as possible;
- Direct habitat loss will be minimised by upgrading existing access tracks, where possible.

7.8.2 Mitigation by Management during the Construction Phase

7.8.2.1 Project Ecologist (Construction Phase)

It is recommended that a Project Ecologist with appropriate expertise and recognised long-term ornithological experience will conduct pre construction, and construction phase bird surveys at the site, including the monitoring of hen harrier.

7.8.2.2 Pre-Construction Avian Monitoring

Where construction work is required in the breeding season, a survey for Hen Harrier nests within 500m of planned activities will be conducted by a suitably experienced Ornithologist/Ecologist in February, March and April, prior to any construction work being carried out.

If a hen harrier nest is discovered within 500m of planned construction work, heavy duty construction activities within 500m from the nest site will be excluded during the hen harrier breeding season (April to August) to allow for successful breeding. Hen harrier activity at any such nest will also be monitored throughout the breeding season.

7.8.2.3 Construction Phase Avian Monitoring

The construction phase of the project will likely be spread across the summer and winter survey periods. Vantage Point surveys will be carried out as outlined in **Section 7.2.3** above.

If it is the case that a hen harrier nest is detected within 500m of the permitted construction works or within the general location of the wind farm site, the following will be carried out;

- The Project Ecologist will immediately notify NPWS;
- The location of the nest will be treated as an Ecological Sensitive Area, and will be kept from the public domain;
- All high impact, and heavy construction works will be suspended within 500m of any hen harrier breeding nest site;
- Management measures for the protection of any hen harrier breeding site at the site will be discussed, and agreed with NPWS;
- Following the implementation of management measures, an exclusion zone will be installed and enforced throughout the construction phase of the project;
- The Project Ecologist will monitor the Ecological Sensitive Area, and will liaise with NPWS to ensure all mitigations measures agreed with NPWS are fully implemented.

7.8.2.4 General Construction Mitigation Measures

The following lists general construction mitigation measures:

- The felling of forestry will take place outside the breeding season (March to August, inclusive).
- Any vegetation clearance required, including the cut back, and any clearance of hedgerows, and scrub will take place outside the breeding season (April to August, inclusive).
- Where possible, construction will take place outside the breeding season (April to July, inclusive) to minimise disturbance, and or displacement to breeding birds.
- Where it is not possible to restrict construction work in this way, work will commence prior to the breeding season, to ensure that any incubating birds or birds with young are not displaced by work commencing during, or within the breeding season.
- Off-road vehicle activity will be minimised. Habitat disturbance to birds will be limited by controlling the movement of plant, and site vehicles during the construction and operational phases of the wind farm. Plant, and other site vehicles will not encroach onto habitats beyond the project footprint and, with the exception of maintenance works on the site drainage and settlement ponds, will not enter the bogland habitats.
- All plant and equipment will conform with the Construction Plant and Equipment Permissible Noise Levels Regulations 1996 (SI 359/1996) and other relevant legislation.
- Plant and equipment will be turned off when not in use, with no unnecessary revving.
- Plant washed regularly and inspected to prevent invasive species such as Japanese knotweed from entering the site.

7.8.2.5 Ecological Clerk of Works (ECoW)

An Ecological Clerk of Works (ECoW) will be appointed for the construction phase of the project. Duties will include:

- Deliver Tool Box Talks, informing on-site personnel of the ornithological and ecological sensitivities within the project site;
- Liaise with Project Ornithologist, discussing issues that may arise;

- Provide guidance to contractors to ensure site is compliant with legislation;
- Liaising with NPWS, Local Authorities, other consenting authorities and other relevant bodies with regular updates in relation to construction progress.

7.8.2.6 Measures for Avoidance of Sensitive Habitats and Habitat Loss

The following measures will be undertaken to avoid directly or indirectly affecting habitats with value for birds outside of the construction footprint:

- There shall be no encroachment onto bogland habitat excluded from the project;
- Direct habitat loss will be minimised by upgrading existing access tracks, where possible;
- Depositing of excavated material on existing areas of heather or bog will not be permitted;
- Exclusion Zones will be installed to ensure the works do not advance past already altered habitat. Habitat degradation will be limited by controlling the movement of construction vehicles and machinery within the exclusion zones. Construction vehicles and machinery will not encroach onto habitats beyond the project footprint and will be required to travel via the constructed roads when moving between works areas. To emphasise this requirement, the boundaries of the footprint of the project will be fenced off with post and wire. The Environmental Manager-ECoW will also monitor vehicle movements.

7.8.2.7 Measures for Avoidance of Disturbance to Breeding and Roosting Birds

The following measures will be undertaken:

- Vegetation removal, including hedgerows and trees will be conducted outside of the restricted period (March 1st to 31st of August), to prevent disturbance to breeding birds;
- Site maintenance visits should be minimised and unnecessary onsite human activity will be minimised, especially between April and August;
- In the unlikely event that protected bird species are found actively using the site for breeding and or roosting in the proximity of works during the construction phase, works will cease in this area immediately, and the area will be cordoned off until advice is sought from the Project Ornithologist.

7.8.2.8 Site Reinstatement Measures

The following measures will be undertaken:

- Where hedgerow removal will be required, the equivalent, or like for like will be replanted, with species local to the area;
- Where there is the requirement to remove stands of scrub, the equivalent will be replanted;
- Where re-vegetation, is slow, reseeding will be carried out with suitable species native to the area.

7.8.2.9 CEMP

A Construction and Environmental Management Plan (CEMP) has been prepared. The finalised CEMP will be in place prior to the start of the construction phase and will incorporate the mitigation measures described above as well as other mitigation measures described in the EIAR together with any relevant planning conditions. Construction Best Practice measures which form part of the design of the project are included in **Appendix 3-1** of the EIAR.

7.8.3 Habitat Improvement Lands for Hen Harrier

It is proposed to provide foraging and potentially suitable nesting habitat for hen harrier over the lifetime of the wind farm through the ecological improvement of existing areas of conifer plantation and the rehabilitation of peatland habitats. Two areas for habitat improvement have been identified and are described below in the context of the rationale for selection and the desired ecological objectives and outcomes of the prescribed improvement actions.

The aim of the habitat enhancement is to identify forestry plots occurring on peatland that could be reverted to suitable open moorland by permanent deforestation.

For both areas, the objective is to rehabilitate the blanket bog and heath habitats to provide suitable habitat for hen harrier prey such as meadow pipit, skylark and small mammals. The main objective of the rehabilitation measures is to restore conditions to allow blanket bog and wet heath vegetation to recover in felled areas depending on localised site conditions (slope, peat depth, drainage, forestry modifications) and, by doing so, provide foraging habitat for hen harrier, improve connectivity with adjacent open peatland habitat protect and enhance the adjacent bog by improving hydrological conditions within the habitat improvement areas. The rehabilitation of lowland blanket bog from afforested areas will also prevent further drying out of adjacent peatland along the edges of the conifer stand and result in a better water quality outcome than continuing forestry operations. Raising of the water table and removal of trees will improve the site for amphibians.

These areas have been selected on the basis of their potential suitability for foraging hen harrier, availability to the applicant for the provision of hen harrier improvement lands, and proximity to Slieve Bernagh SAC and open peatland habitat, and the proximity to a previously successful hen harrier nesting area. The lands within the SAC surrounding these parcels of land provide suitable foraging open peatland habitat to the south, west and north/northeast and are also proximal to the forestry to the east, a portion of which comprises pre-thicket habitat, which is also considered as foraging hen harrier habitat (refer to **Figure 13 and 14**). The proposed permanent felling of this forestry will increase the amount of contiguous open habitat available to foraging hen harrier and potential for suitable nesting habitat.

There are two parcels of land proposed to the northwest of the proposed wind farm site and these are referred to below as “Habitat Improvement – Area A” and “Habitat Improvement – Area B”, which lies to the south of the former. Refer to the following figures.

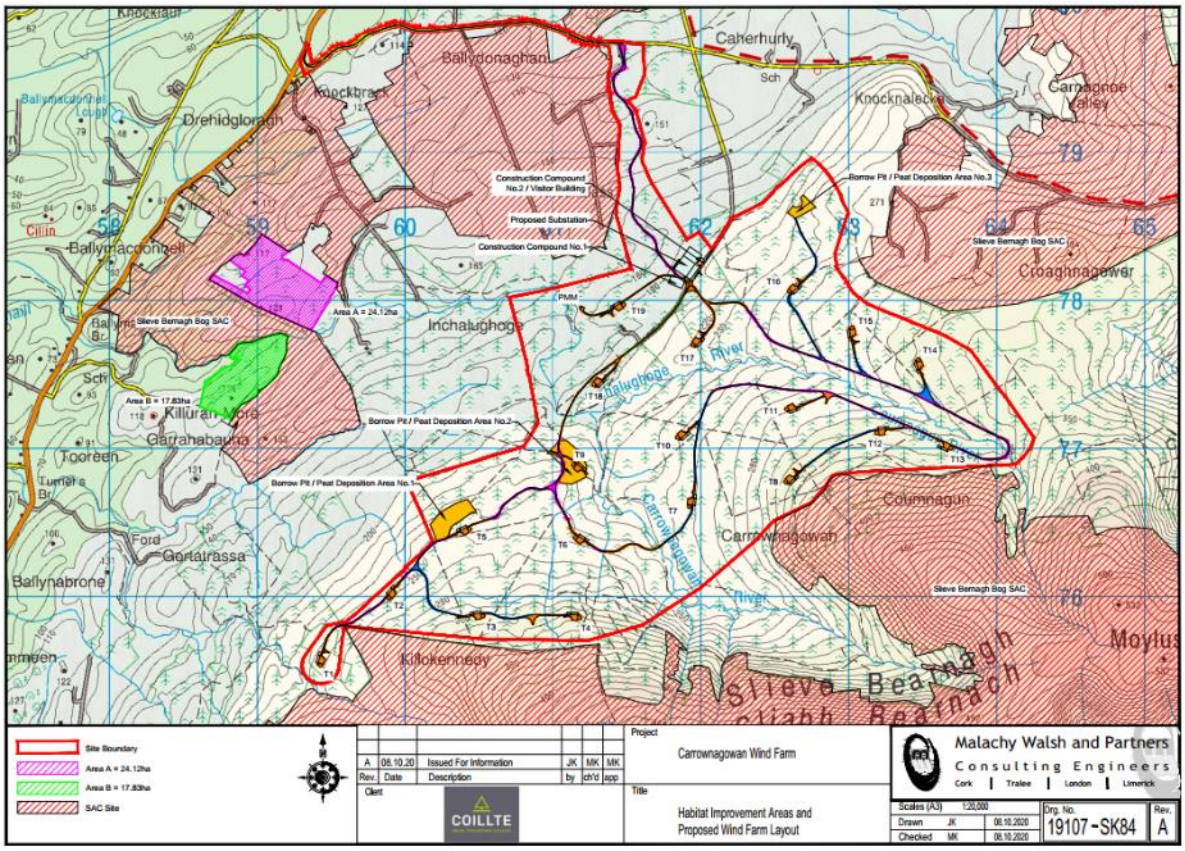

Figure 13. Habitat improvement areas shown in geographic context of proposed wind farm

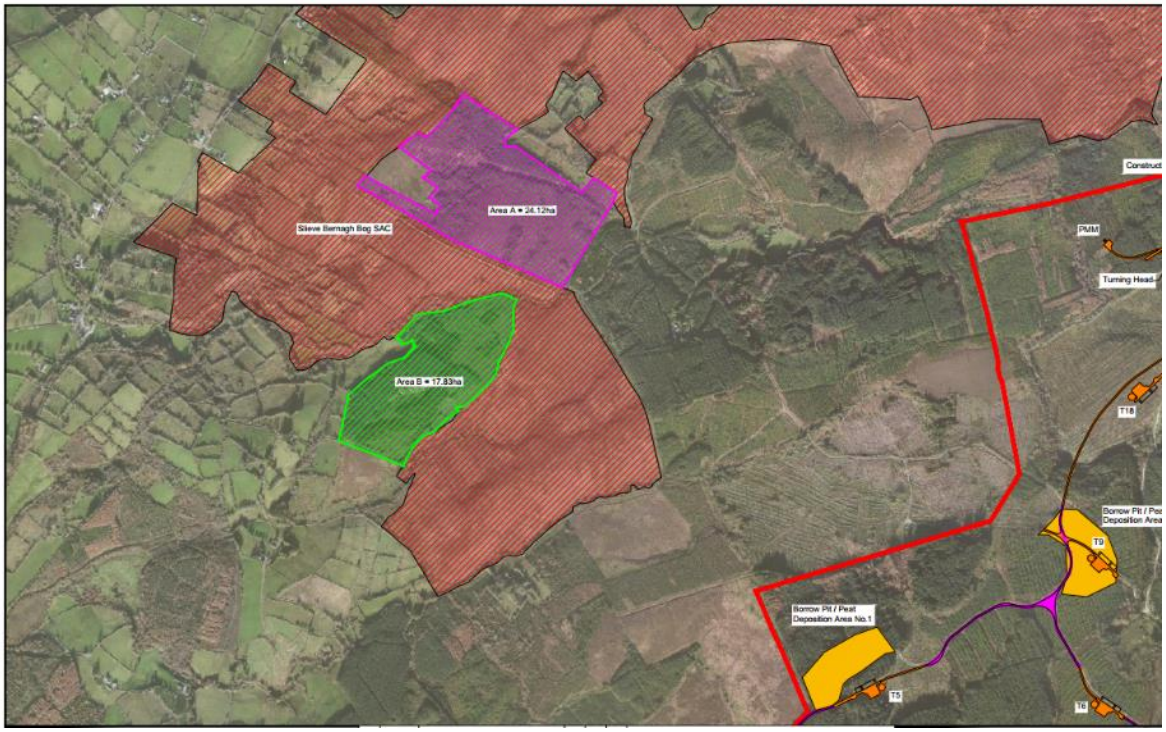

Figure 14. Area A and Area B and Slieve Bernagh SAC on OSI aerial photography

7.8.3.1 Habitat Improvement – Area A

This parcel of land lies in the townland of Ballymacdonnell, lies approximately 1.7km northwest of the nearest turbine and comprises 24.12ha. The site is surrounded on almost 3 sides by the Slieve Bernagh Bog SAC and can be described as protruding into the SAC. The site itself is almost entirely planted with conifer trees since c. 1992 on what would have been blanket bog. Approximately half of the parcel comprises mature conifer plantation while the remainder and in particular the area to the south comprises small isolated stands of mature trees interspersed among stunted trees. It is likely that the ground conditions here were overly wet and unsuitable for conifer tree growth and the trees never prospered. While the bog is not intact given the presence of forestry drains, this area still supports elements of peatland vegetation.

7.8.3.2 Habitat Improvement – Area B

This parcel of land lies in the townland of Killuran More, lies approximately 1.7km northwest of the nearest turbine and comprises 17.83ha. The site is surrounded to the north, east and south by Slieve Bernagh Bog SAC. The site itself is almost entirely planted with conifer trees planted between 1990 and 1993 on what would have been blanket bog and probably other peatland habitats. Approximately two thirds of the parcel comprises mature conifer plantation while some patches to the east comprise stunted trees. It is likely that the ground conditions here were unsuitable for conifer tree growth and the trees never prospered. Patches of this plantation also display stunted growth indicating that the ground blanket bog flora layer is still somewhat intact.

7.8.3.3 Prescribed Management and Monitoring Actions

The prescribed improvement actions for both Area A and Area B are described here below:

1. Trees will be permanently harvested during the construction phase of the wind farm and to maintain fallow (unplanted) for the lifetime of the wind farm.
2. Trees will be felled outside the bird breeding season.
3. Trees will be cut below the lowest whorl of branches and as close to the ground as possible so that the stump is flush with ground level, and where this is not possible all low branches will be removed to prevent future regeneration.
4. Trees will be felled manually on deeper peat and will be removed using a winch. Brash will be used to protect the ground from rutting leading to erosion, sedimentation loss and to create brash mats during the period of tree felling. These are an essential component of the harvesting system, where wheeled or tracked harvesting machines are used, which aid machine floatation and travel and significantly reduce the risk of soil damage. Excess brash and trees will be removed off site where practically feasible to minimise nutrient leaching to the soil.
5. Hand-pulling of conifer seedlings will be required post-felling.

It is also proposed to block selected drains to rewet parts of the bog to encourage the return of blanket bog flora. The water table will be deliberately raised on site through damming forest interceptor drains after felling to encourage the reestablishment of blanket bog and wet heath vegetation and recreate a more natural hydrology. Selected drains will be blocked / dammed with peat or interlocking plastic piles or straw bales to reduce the rate of water run-off from the site and to trap any sediment released by operations. This measure will also help increase the water table and overtime drains will become infilled with *Sphagnum* mosses and other bog and heath vegetation.

All habitat improvement work will be required to be carried out under the supervision of a suitably qualified and experienced ecologist.

The process of blanket bog and wet heath establishment will be monitored by setting up a number of permanent vegetation monitoring quadrats, including quadrats within blocked drains. These will be surveyed during years 1, 2, 3, 5, 10, 15, 20, 25 and 30. The survey outcomes will be reviewed during these years by a suitably qualified and experienced ecologist to assess the status of the habitats at the site and whether any adjustment of the ecological management is necessary.

Drains that are blocked and/or infilled will be monitored regularly. This will include vegetation monitoring, as described, and also monitoring of the integrity of the dams in order to allow for early detection of any potential problems with dam failure and/or erosion. These will be monitored monthly for the first 6 months, and bi-annually thereafter.

Appropriate hen harrier, passerine and small mammal surveys will be conducted in Areas A and B to determine the usage of the site by hen harrier and the abundance and availability of suitable hen harrier prey. This will be done on an annual basis for the lifetime of the wind farm.

7.8.3.4 Ecological Outcomes

In terms of ecological outcomes for hen harrier, the measures will:

- Provide habitat for meadow pipit, the preferred prey of hen harrier, as well as skylark and small mammals.
- Improve connectivity between existing open peatland areas within the Slieve Bernagh SAC between the townlands of Drummod to the north and Ballymacdonnell to the south with the rehabilitation of Area A and by doing so increase the amount of contiguous open habitat available to foraging hen harrier.
- Improve connectivity between existing open peatland areas within the Slieve Bernagh SAC between the townlands of Ballymacdonnell to the north and Killuran More to the south with the rehabilitation of Area B and by doing so increase the amount of contiguous open habitat available to foraging hen harrier.

7.8.4 Operational Phase Mitigation and Monitoring

7.8.4.1 Disturbance and Habitat Protection Measures

During the operational phase of the project, displacement, and or disturbance impacts, and habitat degradation will be limited by controlling the movement of maintenance vehicles; maintenance vehicles will not encroach onto habitats beyond the project footprint.

7.8.4.2 Project Ecologist (Operational Phase)

7.8.4.3 Operational Phase Avian Monitoring

Bird surveys will continue during the operational phase and will be carried out by an ecologist with appropriate expertise and recognised long-term ornithological experience. The timing and extent of bird surveys will be agreed with NPWS.

A detailed Operational Avian Monitoring Programme will be prepared for the operational phase of the project. The monitoring programme at a minimum will include:

- Breeding Surveys (with particular focus on hen harrier);
- Winter Bird Surveys;
- Hen Harrier Roost Surveys;
- Targeted bird collision surveys (corpse searches).

Whether the project proceeds or not, the forestry operations will continue at the site. If the project proceeds, it is that any future felling timed for breeding season, will include pre-felling monitoring for breeding hen harrier. This monitoring can coincide with the operational phase monitoring described in the previous section. Operational phase monitoring can inform on any hen harrier breeding activity at the overall forestry site.

Consultations will remain ongoing with NPWS throughout the operational phase of the project to report on monitoring.

7.8.5 Decommissioning Phase

If it is decided to decommission the wind farm at the end of its operational life of 30 years, a comprehensive reinstatement proposal, including the implementation of a program that details the removal of all structures and landscaping, will be submitted to Clare County Council, and NPWS for approval prior to the decommissioning work.

An environmental assessment will be undertaken at that time to ascertain whether or not it would be more or less environmentally damaging to remove or keep in place the underground cables and access tracks. All elements of the decommissioning works will be agreed with Clare County Council beforehand and there will be a consent requirement for the timing of decommissioning works.

The Carrownagowan Wind Farm will be in operation for 30 years. If the wind farm will be decommissioned after this period, mitigation measures will be carried out using appropriate to Best Practice at the time. Prior to the decommission phase of the wind farm the following will be carried out:

- Decommissioning operations should be carried out outside the main bird breeding season (March to August) as much as possible;
- Where decommissioning operations are required in the breeding season, a survey for hen harrier nests within 500m of planned activities will be conducted by a suitably experienced ornithologist, in late March and April, prior to any operations being carried out;
- If a hen harrier nest is discovered within 500m of planned decommissioning works, heavy duty activities within 500m from the nest site will be excluded during the hen harrier breeding season (April to August). Hen harrier activity at any such nest will also be monitored throughout the breeding season (all done in consultations with NPWS);
- Off-road vehicle activity will be avoided or minimised. Habitat disturbance to birds will be limited by controlling the movement of plant and vehicles during the operational phase, and decommissioning phase of the wind farm. Plant and vehicles will not encroach onto habitats beyond the footprint and, with the exception of maintenance works on the site drainage and settlement ponds, will not enter the surrounding bogland habitat.

7.9 RESIDUAL IMPACTS

Residual impacts are impacts that remain, once mitigation has been implemented or, impacts that cannot be mitigated.

Pre-construction and construction monitoring for hen harrier will enable the identification of any nesting birds within 500m of construction work and allow for the protection of breeding hen harrier from disturbance effects during the construction phase. This mitigation measure will ensure that breeding hen harrier should they occur in proximity to the construction works will not be significantly disturbed.

While the operational displacement effects of the proposed wind farm on hen harrier are not considered to be significant, the provision of 42ha of lands supporting peatland habitat for foraging hen harrier outside of the site and in proximity to a previously successful nesting area will reduce the predicted operational displacement effect of the wind farm.

With the avoidance measures (mitigation by design), and best practice in place (mitigation by management), and provided all mitigation measures are implemented in full, and remain effective throughout the construction phase, operational phase, and decommissioning phase of the project, significant residual effects on avian Key Ecological Receptors are not expected.

7.10 CONCLUSION

- No significant effects are predicted on birds due to habitat loss, or habitat alteration during the construction or operational or decommissioning phases of the project.
- No significant effects are predicted on birds due to disturbance, displacement, and barrier effects during the construction or operational or decommissioning phases of the project.
- The project will not result in significant collision effects on bird species.
- The project will not result in cumulative impacts in combination with forestry, peat harvesting, agriculture, and other wind farms, in the area.
- The Carrownagowan Wind Farm will not result in any significant residual effects on any of the avian Key Ecological Receptors either alone, or cumulatively, in combination with other projects.

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