White Hill Wind Farm

Environmental Impact Assessment Report

Chapter 5: Biodiversity

White Hill Wind Limited

Galetech Energy Services
Clondargan, Stradone, Co. Cavan Ireland
Telephone +353 49 555 5050
www.galetechenergy.com

Contents

5.1 Introduction

5.1.1 Background and Objectives

Ecology Ireland Wildlife Consultants Ltd. was commissioned to undertake an ecological impact assessment of the proposed development to inform this Biodiversity chapter. This chapter assesses all aspects of ecology including ornithology.

This chapter provides an assessment of the likely and significant effects of the White Hill Wind Farm located in west County Carlow and east County Kilkenny and its associated ancillary developments on biodiversity and the ecology of the receiving environment.

The objectives of the assessment are to:-

- Produce a baseline study of the existing ecological environment in the vicinity of the proposed development;
- Identify likely positive and negative effects of the proposed development on biodiversity during the construction, operational and decommissioning phases of the development;
- Identify mitigation measures to avoid, remediate or reduce likely or significant negative effects; and,
- Assess likely or significant cumulative effects of the proposed development as a result of other developments.

5.1.2 Description of the Project

In summary, the project comprises the following main components as described in **Chapter 3**:-

- 7 no. wind turbines with an overall tip height of 185m, and all associated ancillary infrastructure;
- All associated and ancillary site development, excavation, construction, landscaping and reinstatement works, including the provision of site drainage infrastructure;
- Upgrades to the turbine component haul route; and,
- Construction of an electricity substation and installation of c. 15km of underground grid connection cable between the White Hill Wind Farm and the existing Kilkenny 110kV electricity substation.

The wind farm site traverses the administrative boundary between counties Carlow and Kilkenny; with 4 no. turbines located in Co. Carlow and 3 no. turbines within Co. Kilkenny. The electricity substation is located within Co. Carlow while the majority, c. 14km, of the underground electricity line is located in Co. Kilkenny. Off-site and secondary developments; including the forestry replant lands and candidate quarries which may supply construction materials; also form part of the project.

The turbine component haul route and associated upgrade works as described in **Chapter 3**. It is envisaged that the turbines will be transported from the Port of Waterford, through the counties of Kilkenny, Waterford, Carlow and Kildare to the project site. However, as the route follows motorway and national roads through counties Waterford and Kildare, it is assessed that there is no likelihood of effects on population & human health and, therefore, these areas have been screened out from further assessment.

A full description of the project is presented in **Chapter 3**.

5.1.3 Statement of Authority

Ecology Ireland Wildlife Consultants Ltd. (Ecology Ireland) is a leading independent ecological consultancy. The company was established by Dr. Gavin Fennessy in 2011 and has provided ecological advice, monitoring and reporting services to a large number of clients in the public and private sectors. Ecology Ireland and its key associates are highly experienced in the delivery of ecological impact assessments and have been involved in the successful delivery of planning permission for a number of the largest renewable energy and infrastructure projects in Ireland.

The following headings highlight a number of key project team members.

Dr. Gavin Fennessy

Dr. Gavin Fennessy (BSc PhD MCIEEM) is the Director & Principal Ecologist of Ecology Ireland Wildlife Consultants and a consultant ecologist with over 20-years of experience in environmental consultancy. Dr. Fennessy has contributed to and project managed numerous ecological impact assessment projects including EcIA, EIA, AA, SEA etc. Gavin is also an experienced expert witness having presented expert testimony at several An Bord Pleanála oral hearings. He has regularly contributed to B.Sc. Env. Sc. courses at UCC. Dr. Fennessy is an expert in wildlife hazard and collision risk and is the retained wildlife management expert of Dublin Airport Authority (2019 to present). Dr. Fennessy led the ecological impact assessment and associated ecology team on this project.

Tom O'Donnell

Tom O'Donnell is a Chartered Environmentalist and a full member of the Chartered Institute of Ecology and Environmental Management. He was awarded a BSc in Environmental and Earth System Science [Applied Ecology] from UCC in 2007 and an MSc in Ecological Assessment in 2009, both from UCC. He has gained significant experience in ecological assessment and environmental management over the last 13-years of professional employment. Tom has particular experience in terrestrial mammals surveys, bat surveys and conservation and bat call sonogram analysis using Kaleidoscope Pro. Tom led the mammal surveys of this project.

Rory Dalton

Rory Dalton (BSc) is a specialist aquatic ecologist with over 10-years of experience in consultancy. Rory is particularly skilled in riparian habitat and river morphology assessments and he has carried out full catchment level assessments of Otters and their prey. He has carried out numerous aquatic ecology surveys and is experienced in a wide range of specialist field techniques. He has experience in surveying fish and aquatic invertebrates as well as Otter and other mustelid species. Rory carried out the aquatic ecology assessment of this project.

Claire Deasy

Claire Deasy is an ecologist with almost 20-years of experience in ecological assessment. Her primary skills are in project management, surveying, data analysis and report writing. She has project managed numerous impact assessment projects with a particular focus on the ecological impacts of renewable energy projects (wind farms, solar, battery storage). Claire has wide range of ecological survey skills with particular expertise in botanical and habitat surveys. Claire has also contributed to the design and implementation of Habitat & Species Management Plans for EU protected species such as the Annex I Hen Harrier and Annex II Marsh Fritillary Butterfly. Claire undertook the habitat and botanical assessment of this project.

John Deasy

John is an independent ecological consultant with experience across a range of ecological disciplines including botanical and habitat surveys, bird surveys, mammal surveys and protected invertebrate surveys. He has almost 10-years of experience as a professional ecologist and has undertaken a range of botanical and habitat surveys including baseline surveys for renewable energy projects, shared-use greenways and domestic and commercial properties. These surveys have included non-native invasive species surveys, rare species surveys and evaluations of habitats listed on Annex I of the EU Habitats Directive. John holds a MSc. in Ecological Assessment and BSc. in Earth and Environmental Science from University College Cork and is a member of the Botanical Society of Britain and Ireland. John carried out various field surveys and contributed to the impact assessment of this project.

Michelle O'Neill

Michelle has over 12-years of experience working as an ecological consultant within the public and private sector on projects that include habitat and botanical surveys, breeding and winter bird surveys, mammal surveys, data analysis, assessment and report writing. She has a B.Sc. in Ecology and Diploma in Field Ecology. She also holds an NCVA in Computer Graphics. To date, she has completed habitat and botanical surveys for a range of projects as part of National Surveys, Ecological Monitoring, Ecological Impacts Assessments (EcIA/EIAR) and Appropriate Assessment (AA/NIS). She has a particular interest in botany and habitats and has worked on an Irish semi-natural grassland survey (2009-2012) and a habitat mapping project for the provision of a Teagasc pilot methodology for farmland habitat assessment of sustainability scheme. Michelle assisted in carrying out the botanical and habitat surveys of the project.

The avian field survey team was comprised of experienced ornithologists including Dr. Fennessy, Dr. Allan Mee, Mark Shorten, Aidan Duggan, Noel Lenihan, Luise Ní Dhonnabháin, Paul Troake, Barry O'Mahony, John Deasy, Paul Rowe, Éinne O'Cathasaigh, Gerard McGrath and Dr. Olivia Crowe.

An overview of survey effort is provided at **Annex 5.1** and surveys can be traced to surveyors by their initials.

Figure 5.1: Location of Wind Farm Site

Figure 5.2: Wind Farm Location and Grid Connection Route

5.2 Methodology

The methodology utilised to inform this assessment comprised field assessments and desktop review, which are described in the relevant sections below, taking due regard of guidelines relating to ecological assessments (e.g. EPA 2022, CIEEM 2018, 2019 & 2021). Surveys of the wind farm site, turbine component haul route, grid connection route and replant lands were carried out using established survey methodologies and according to current guidance documents.

The surveys and assessments have had due regard to national and local policies and the current conservation status of habitats and species recorded or likely to occur in the receiving environment.

5.2.1 Relevant Legislation & Guidelines

Guidelines relevant to the biodiversity assessment (surveys and assessments) are outlined in the corresponding sections below. Many of the key guidance documents are summarised in the Chartered Institute for Ecology and Environmental Management *Good Practice Guidelines for Habitats and Species* (CIEEM 2021). The *Guidelines on the information to be contained in Environmental Impact Assessment Reports* (EPA 2022) was also a key reference document in the preparation of this chapter.

5.2.2 Scoping & Consultation

As part of the early-stage environmental constraints analysis and scoping process undertaken to inform this assessment, a range of stakeholders relevant to biodiversity were consulted with. A list of all consultees is provided at **Table 1.3** (**Chapter 1**); while all responses received are provided at **Annex 1.8** (**Volume II**).

The consultation responses that provided dedicated comment in relation to biodiversity related issues included the correspondence with Carlow County Council, the Department of Agriculture, Food and the Marine and Kilkenny County Council. All matters raised were taken into account in the scoping of this chapter.

5.2.3 Designated Nature Conservation Sites

Designated nature conservation sites in the vicinity of the wind farm, including the wind turbines and associated infrastructure, as well as along the grid connection route and turbine component haul route were identified and considered as part of the ecological assessment. Geographical Information Systems (GIS) software was used to map and measure the distance from the application site boundary to nationally and European designated conservation sites.

The potential for likely significant effects on European designated Natura 2000 sites arising from the proposed project is fully assessed in the Appropriate Assessment Screening Report which is included with the Natura Impact Statement (NIS). The Screening Report identified that 2 no. Natura 2000 sites could be affected by the construction, operation or decommissioning of the project in the absence of mitigation measures. The NIS assesses whether the project could, on its own or in combination with other plans or projects, adversely affect the integrity of any of these Natura 2000 sites, with reference to their Conservation Objectives.

5.2.4 Field Assessment & Desktop Studies

Biodiversity field surveys were undertaken from 2019 to 2022 inclusive, with detailed survey schedules are available at **Annex 5.1**. A general biodiversity study area was implemented to encompass the extent of the wind farm site as illustrated at **Figure**

5.3. For certain surveys, including those along the grid connection route and turbine component haul route, ecological data (both desktop and field studies) was collected beyond this study area.

A desktop review of ecological data available for the study area was undertaken by consulting online databases to identify species of interest (*e.g.* rare, protected) previously recorded within the relevant national grid squares that overlap the study area; in this case a review was primarily undertaken of the S66 10km national grid square from the National Biodiversity Data Centre (NBDC) online database. The application boundary is encompassed in four 2km Grid Squares S66D, S66I, S66C and S57T and the biodiversity data available for these grid squares was fully interrogated. The grid connection route follows the road network and is contained in three 10km Grid Squares S66, S55 and S56. The data pertaining to those grid squares was also collated as part of this assessment.

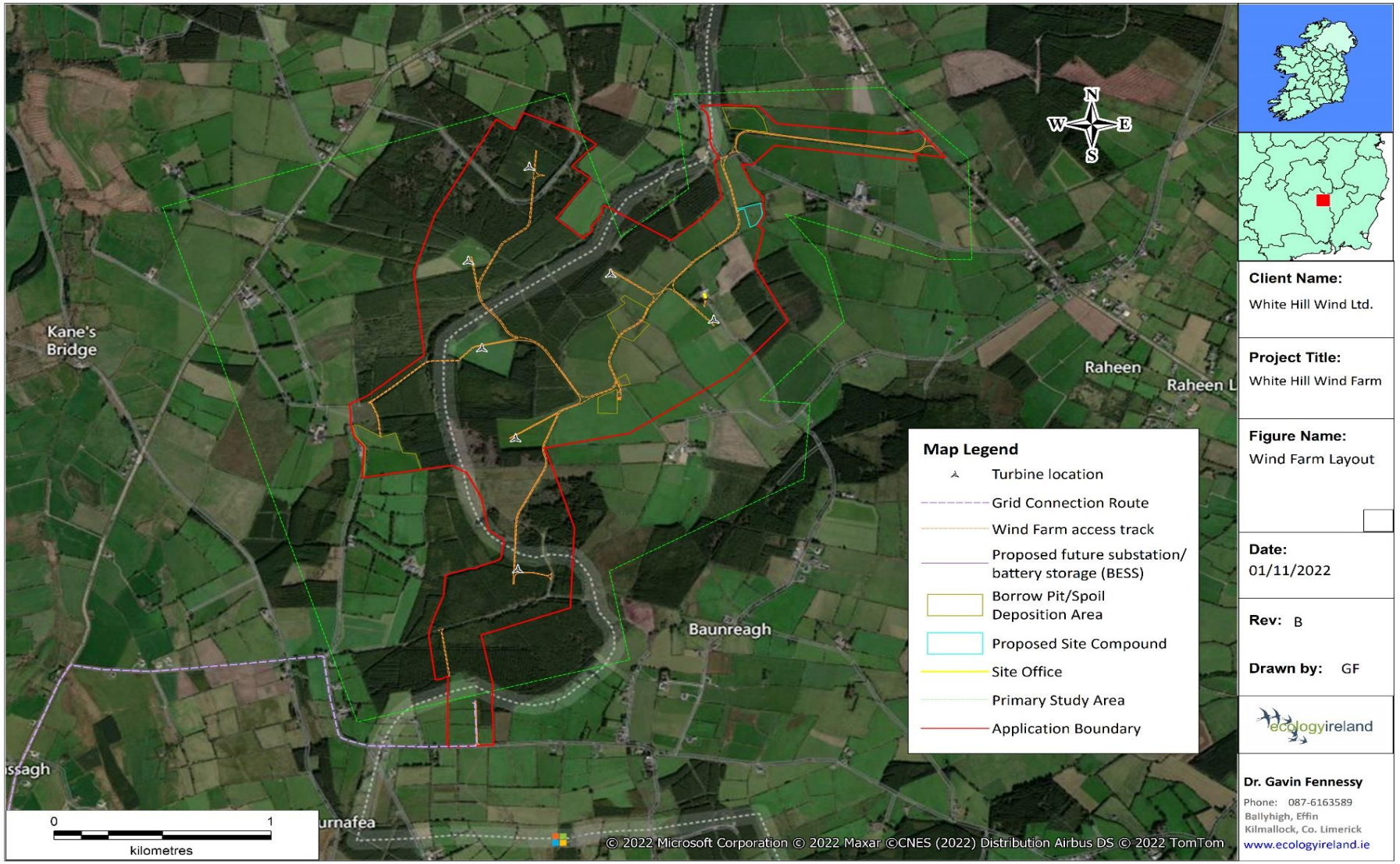

Figure 5.3: Wind Farm Layout with Study Area

5.2.4.1 Habitats and Flora

The habitat and flora survey involved undertaking a desktop review and a baseline field assessment of the habitats and flora within the study area. As part of the desktop study, a review of botanical data available for the project site was carried out to identify botanical species of conservation interest (e.g. rare, legally protected) and invasive species previously recorded within the relevant national grid squares that overlap the study site. In this case, a review was undertaken of the 10km grid square S66 and 2km grid squares which overlap the wind farm and grid connection route (S66C, S66I, S66D, S56U, S56W, S56X, S55R, S56T, S56U from the NBDC and BSBI online databases. The habitat and flora field assessment was carried out in accordance with best practice guidance (Smith *et al*. 2011). This involved a walkover of the study area where the dominant habitats present were mapped and classified according to Fossitt (2000) and where botanical species were identified and recorded according to dominant habitat type. The extents of habitats were recorded on a field map along with notes of the botanical species present and their relative abundance described using the DAFOR scale. In addition, observations of interest (e.g. invasive plant species, rare plants etc.) were recorded using GPS. The baseline walkover was undertaken between August and September 2021 within the general optimum botanical survey season when most plant species are growing (i.e. April to September inclusive; Smith *et al*. 2011). A survey of the western spoil deposition area was undertaken in June 2022.

Evaluation of the habitats present in terms of their biodiversity value was assessed using criteria amended after NRA 2009 and Nairn & Fossitt 2004 (see **Annex 5.2**). The correspondence of any habitats within the study area to those listed on Annex I of the EU Habitats Directive 92/43/EC was evaluated with reference to the European Commission (2013) and the National Parks & Wildlife Service (NPWS; 2013). The conservation status of habitats and flora was also considered in respect of the following: Irish Red List for Vascular Plants (Wyse Jackson *et al*. 2016); Irish Red List for Bryophytes (Lockhart *et al*. 2012), Flora Protection Order (1999 as amended 2015 & 2022); the EU Habitats Directive (92/43/EEC).

The haul route works locations were visited (August/September 2021 and August 2022) to record the presence/absence of any Third Schedule Invasive Plant species and any rare or protected plant species or protected or sensitive habitats. The grid connection route was driven (August/September 2021 and August 2022) to record the presence/absence of any Third Schedule Invasive Plant species at the road margin.

Habitats & Flora Desk Study

A desktop review was undertaken to collate and review available information, datasets and documentation sources pertaining to the flora and habitats of the study area. Records and information available from the following sources were reviewed:-

- National Biodiversity Data Centre (NBDC)[1];
- Botanical Society of Britain and Ireland (BSBI) dataset and distribution maps[2];
- NPWS Flora Protection Order (FPO) Bryophytes database;
- NPWS Article 17 Metadata and GIS Database Files
- Environmental Protection Agency (EPA) Rivers and Lakes dataset;

[1] NBDC database accessed 27/05/2021 & 06/11/2022

[2] BSBI data accessed 27/05/2021 & 06/11/2022

- Ancient and Long-established Woodland Inventory 2010 dataset;
- National Forestry Inventory and Planning System (FIPS, 1998);
- CORINE Landcover mapping layer (2012);
- OSI mapping - Discovery series at 1:50,000 scale; 6inch and 25inch historical mapping as available on Geohive OSI Mapviewer;
- Aerial Imagery- Google Earth, Bing;
- Geological Survey Ireland Mapviewer; and,
- Teagasc/EPA Soil Information System (SIS)Mapviewer

According to the GSI and EPA Mapviewers, the underlying bedrock is that of Westphalian shales and sandstones consisting of the Coolbaun Formation and the Swan Sandstone Member. A full description of the soil and underlying formations is provided at **Chapter 6** (Land & Soils).

Habitats

A review was undertaken of NPWS Article 17 datasets and other available datasets and reports to establish if there were existing records for any EU Annex I protected habitats or other ecologically sensitive habitats present within the proposed development site. The following datasets were consulted:-

- Article 17 datasets for Annex I habitats;
- Ancient and Long-established Woodland dataset (Perrin *et al*., 2010);
- National Survey of Native Woodlands (Perrin *et al*., 2008); and,
- Irish Semi-Natural Grassland Survey 2007-2012 (O'Neill *et al*., 2013).

The National Survey of native woodland 2003-2008 dataset (Perrin *et al*., 2008) did not record any native woodland within or adjacent to the study area. A review of the Ancient and Long-established Woodland Inventory (Perrin *et al*., 2010) found that there are no ancient or long-established woodlands within or adjacent to the project site. According to the Ancient and Long-established Woodland Inventory (2010), ancient woodland is defined as woodland stands which have been continuously wooded since 1660 and long-established woodland is defined as having been continuously wooded since 1830. The National Semi-natural grassland Survey dataset does not hold records for any semi-natural grassland habitats within or adjacent to the project site. According to the Article 17 Annex I Habitat mapping datasets, the study area does not contain or lie adjacent to any known Annex I habitat.

Historical aerial imagery and OSI historical mapping were also examined for evidence of land-use and semi-natural habitat types present within the study area in the past to provide information about potential remnant habitats onsite such as old woodland and wetlands. From a review of the historical aerial imagery (1995-2020) and historical OSI 6 inch and 25 Inch mapping dating back to the 1830's/1840's to 1913, the habitats within the project site have largely consisted of grassland field systems and hedgerows.

5.2.4.2 Birds

During scoping of the ornithological field surveys, it was recognised that the habitats present may support species for which additional specialist survey effort might be required. Based on the habitats present and the knowledge of the ornithological team, there was no likelihood of species such as breeding Red Grouse, *Lagopus lagopus hibernicus,* or breeding waders such as Lapwing, *Vanellus vanellus* to occur within the study area. Similarly, there are no recorded wintering roosts of Hen Harrier in the area (O'Donoghue, 2021). The lands within and surrounding the project site are dominated by improved agricultural grassland and commercial conifer plantation.

There are no lakes or waterbodies of size in the immediate hinterland of the wind farm site.

The wind farm site is also relatively distant from any designated Special Protection Areas (SPA) for birds. The closest of these, the River Nore SPA (004233) being located 13km from the nearest wind turbine, is designated for the protection of Kingfisher, *Alcedo atthis*. The next closest SPA is located c. 40km from the nearest wind turbine.

Avian field surveys at the site comprised multi-season vantage point surveys at the wind farm, breeding and winter season transect and point count surveys at the wind farm, and walked and driven surveys along the grid connection route. Survey design and extent was based on the professional knowledge of the project team and refined through the scoping and consultation process and with reference to a review of desktop information. Detailed survey methodologies are provided below.

In addition to the field surveys, a desktop study was also undertaken by consulting the National Biodiversity Data Centre (NBDC) online mapping database[3] to identify additional avian species historically recorded within the relevant national grid squares overlapping the biodiversity study area.

The conservation status of bird species was considered in respect of the Irish Wildlife Acts (1976 – 2012 as amended); Birds of Conservation Concern in Ireland (BoCCI) Red, Amber and Green lists (see Gilbert *et al*. 2021); and EU Birds Directive (2009/147/EC) Annex I list.

Vantage Point Survey

Standard vantage point (VP) field surveys were undertaken with due regard to NPWS VP methodology recommendations and guidance by Scottish Natural Heritage (SNH 2017). SNH 2017 guidelines recommend that breeding/winter season surveys for target bird species be completed as part of assessments of proposed wind farm sites, with typically 6-hours of coverage per month from each VP location per season, resulting in 36-hours of survey effort per VP in each survey season (SNH 2017). Vantage Point locations are illustrated at **Figure 5.4**.

Target species included raptors, waterbirds and waders.

Detailed flight line mapping was carried out for high conservation value species, such as Hen Harrier and any other Annex I species such as Peregrine Falcon *Falco peregrinus* and Golden Plover *Pluvialis apricaria*. A total of 6 no. vantage point locations were used for the VP surveys completed at the site between Autumn 2019 and Spring 2022. The VP surveys are outlined as follows (see **Annex 5.1** for survey schedules):-

- Summer/Breeding Season VP Surveys (March to August inclusive);
  - Summer 2020 (6 no. VPs, 36-hours survey effort);
  - Summer 2021 (6 no. VPs, 36-hours survey effort);
- Winter Season VP Surveys (October to March inclusive);
  - Winter 2019/2020 (6 no. VPs, 36-hours survey effort);
  - Winter 2020/2021 (6 no. VPs, 36-hours survey effort); and,
  - Winter 2021/2022 (6 no. VPs, 36-hours survey effort).

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

All bird species heard or seen during the VP watches were noted. Detailed field records were taken of target species (heard or seen) with as much of the following information recorded as possible:-

- Species and estimated number;
- Time first observed;
- Duration of observation;
- Estimated time on-site;
- Estimated time off-site (note that detailed records were made in relation to the study area so the time spend within/outside the wind farm site is estimated from the flight line and associated description);
- Flight-line drawn on a field map and numbered to link with associated field notes;
- Estimated flight height. Initial height estimate and any marked change noted during period of observation: <5m AGL (Close to ground) 5-25m AGL (Low Flight) 25-100m AGL (Medium Flight height) 0>100m AGL (High Flight Height); and,
- Any other observations of note (e.g. behaviour, association or interaction with other species, etc.).

Field surveys were undertaken using appropriate survey equipment as required (e.g. GPS units, binoculars, scope, notebooks, etc.) and during suitable weather conditions. All field observers communicated with two-way radios/mobile phones to allow co-ordination in the event that a noteworthy (i.e. Annex I) species was observed at or close to the site.

Dr. Gavin Fennessy has carried out Post-Doctoral research on collision risk and aircraft and has presented papers at a number of international conferences on wildlife hazard. He is critical of the reliance of Collision Risk Modelling (CRM), as set out in the SNH (2017) guidance, which is prevalent in the United Kingdom. The 'Band' model which is widely used in avian collision risk assessments for wind farms is not evidence based and the driver of the model ('avoidance rate') is generally derived without any observational data. The weaknesses inherent on a reliance on CRM are recognised (e.g. Madsen & Cook 2016) but the methodology is still widely used, albeit less so in Ireland than in the UK. Consequently, this assessment describes the occurrence and flight behaviour of the birds recorded at the wind farm site with a knowledge of the ecology and behaviour of the species.

Data are presented in this report as flightline observation tables with corresponding flightline maps. In addition, the proportion of time spent by target bird species on and off the site during the survey is calculated.

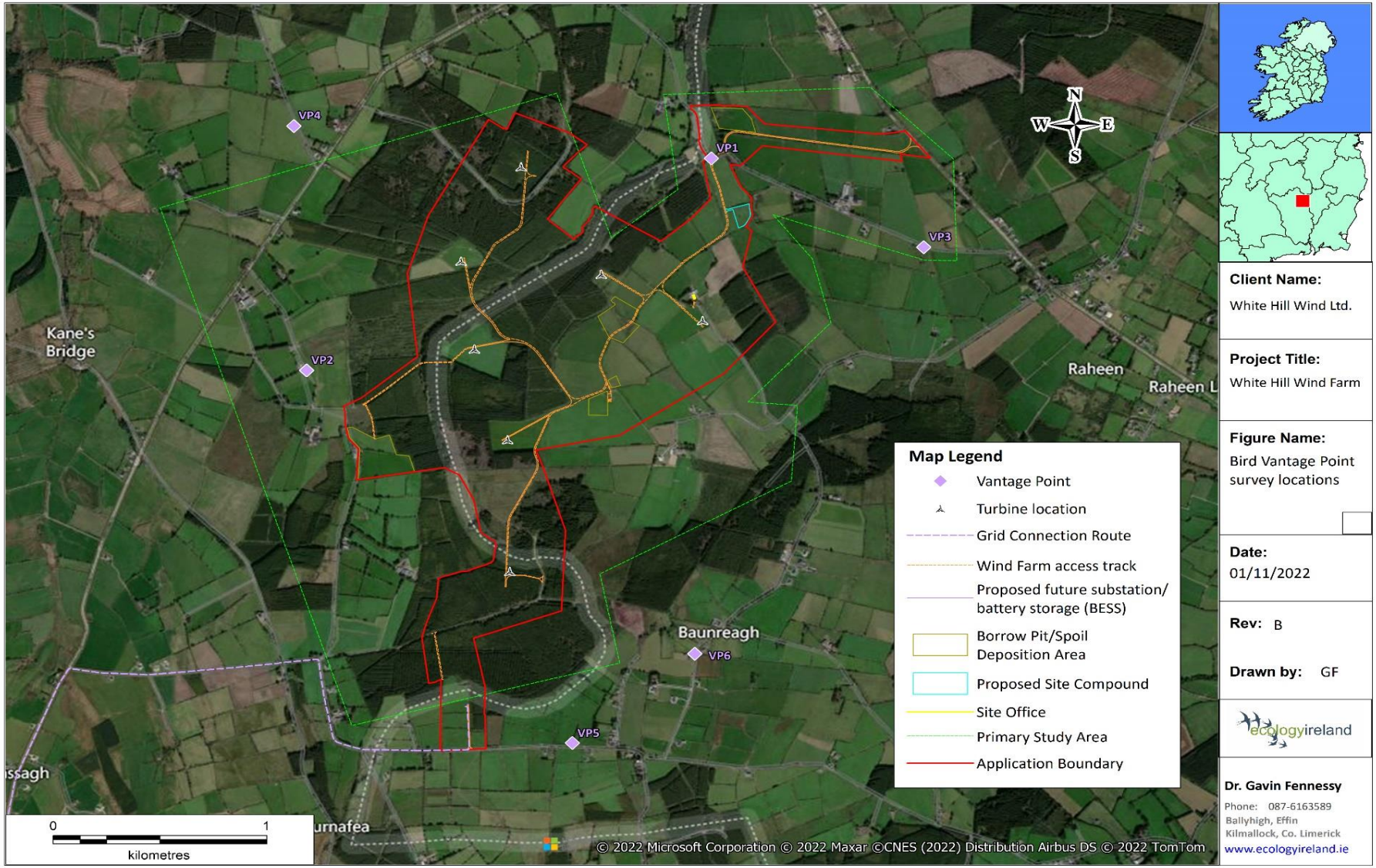

Figure 5.4: Location of Bird Survey Vantage Points (VPs)

General Bird Transect/Point Count Surveys

Standard general breeding and winter season bird transect and point count surveys (Bibby *et al.* 2000) were undertaken at the biodiversity study area as follows (**Figure 5.5**; with a total of 6 no. transects and 10 no. point counts used).

- Summer/Breeding Season General Bird Surveys (Early and Late Season);
  - Summer 2020 (6 no. transects, 10 no. point counts);
  - Summer 2021 (6 no. transects, 10 no. point counts);
- Winter Season General Bird Surveys;
  - Winter 2019/2020 (6 no. transects, 10 no. point counts);
  - Winter 2020/2021 (6 no. transects, 10 no. point counts); and,
  - Winter 2021/2022 (6 no. transects, 10 no. point counts).

Transects were c. 1km in length and located in open habitats, or existing tracks, while point-counts were of 5-minute duration and were located in closed/forestry habitats. These were established throughout the study area to survey the baseline general bird assemblage in the study area. The transects/point counts were surveyed on 2 no. occasions per breeding season (i.e. early and late periods of the nesting season) and on 2 no. occasions in each wintering season.

At each transect, all bird species encountered (seen or heard) within 100m of the observer were recorded and their abundance noted. Birds heard and seen during each point count were recorded, with the number of each species noted within 25m of the observer and beyond 25m from the observer.

Bird species occurring more than 100m from the observer during the survey transects or noted when walking between transects/point counts, or casually noted during other aspects of the biodiversity field study (e.g. VP surveys), were considered as 'additional' species for subsequent consideration. This approach allowed a comprehensive taxa list of the birds present at/near the study area to be generated.

Grid Connection Route Surveys

The route of the grid connection was driven on 2 no. occasions in each winter and breeding season with observations made of any bird species of interest in adjacent areas. Locations along the route which afforded views of the surrounding land were utilised to scan for species of interest. A casual record was kept of all birds seen or heard during these survey visits.

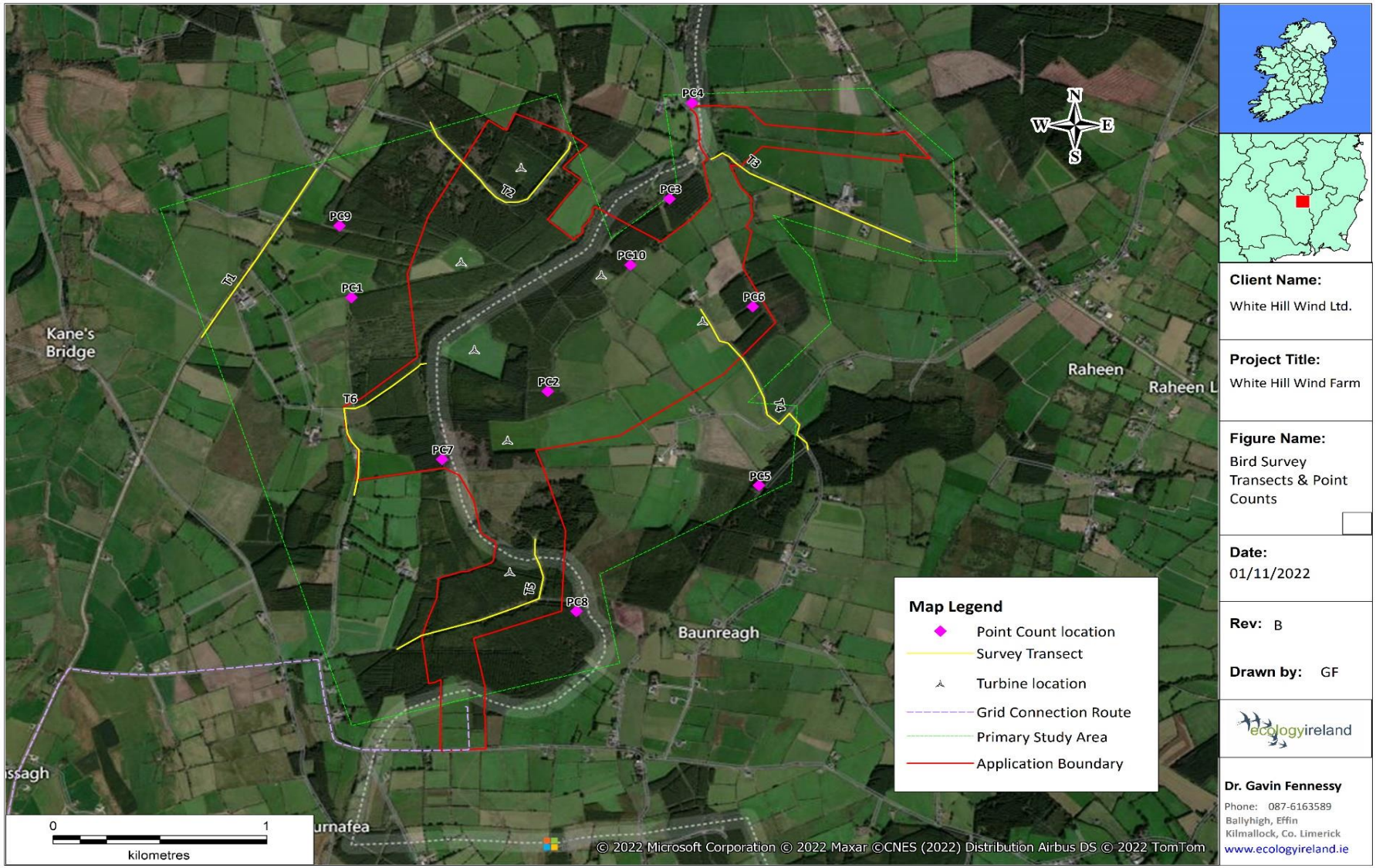

Figure 5.5: Bird Survey Transects and Point Counts.

5.2.4.3 Non-Volant Mammals

Non-volant mammal field surveys at the study area comprised walkovers and deployment of multiple wildlife trail cameras that were supplemented by casual records made in the course of other terrestrial field surveys (e.g. night-time bat surveys, VP surveys, etc.). Details of the dedicated schedule and trail camera deployment dates are provided at **Annex 5.1**, with trail camera locations shown at **Figure 5.6**.

A desktop study of non-volant mammal data was also undertaken by consulting the NBDC online mapping database to identify species historically recorded within the relevant national grid square(s) overlapping the biodiversity study area and grid connection route.

Walkover Surveys

Walkovers surveys were carried out to search for any evidence of non-volant mammals and particularly the resting places of these species (e.g. badger setts). During surveys, the footprint of the project was surveyed for signs of mammal activity. Surveys were undertaken in accordance with the National Roads Authority (NRA) (2009) *Ecological Surveying Techniques for Protected Flora and Fauna During the Planning of National Road Schemes* and the Joint Nature Conservation Committee (JNCC) (2004) *Common Standards Monitoring Guidance for Mammals*.

Dedicated mammal walkover surveys were carried out on 21 December 2021, 10 February 2022, 6 April 2022 and 1 June 2022. Any casual mammal sightings or signs observed during the course of other ecological surveys were also recorded.

During the walkovers, all sightings and signs of mammal species or signs of mammal activity (e.g. droppings, tracks, burrows, setts, holts etc.) were recorded using field notes and/or hand-held GPS units. Techniques used to identify mammal activity followed recognised guidelines (e.g. Clark 1988, Sutherland 1996, Bang & Dahlstrom 2004 and JNCC 2004).

The conservation status of mammal species was considered. The conservation status of mammals within Ireland and Europe is indicated by inclusion in one or more of the following: Irish Wildlife Acts (1976 - 2012); Red List of Terrestrial Mammals (Marnell et al. 2019); EU Habitats Directive. The evaluation of the site for mammals followed the criteria presented in Nairn & Fossitt (see **Annex 5.2**).

Wildlife Trail Cameras

Trail cameras were deployed at suitable locations on and adjacent to the wind farm site for longer term monitoring. These infra-red cameras take photographs and/or video when triggered by heat or motion and were deployed to record mammal activity within the study area.

In total, 5 no. trail cameras were erected at various dates between July 2021 and April 2022. The locations of trail camera deployment sites are illustrated at **Figure 5.6**. A trail camera was located at a Badger sett from 22 December 2021 to 4 April 2022, and the location is not disclosed in this report.

5.2.4.4 Bat Surveys

Bat surveys were carried out using a combination of daytime building and habitat suitability assessments and both active and passive bat detector surveys. Passive

detectors were deployed in the area from Spring 2021 up to Autumn 2021 (**Figure 5.6** & **Figure 5.7**).

Bat field surveys comprised active detector surveys and a passive detector study taking due regard to guidance from SNH (2019; subsequently revised as NatureScot 2021). Survey methodologies are described below. The conservation status of bats was considered in respect of the Irish Wildlife Acts (1976 - 2012 as amended); Red List of Terrestrial Mammals (Marnell *et al.* 2019); and EU Habitats Directive.

Available information on the known occurrence of bats, the suitability of the proposed development site at landscape level and historically recorded roosts was considered as part of the desktop survey. A data request for historic bat roost data was submitted to Bat Conservation Ireland.

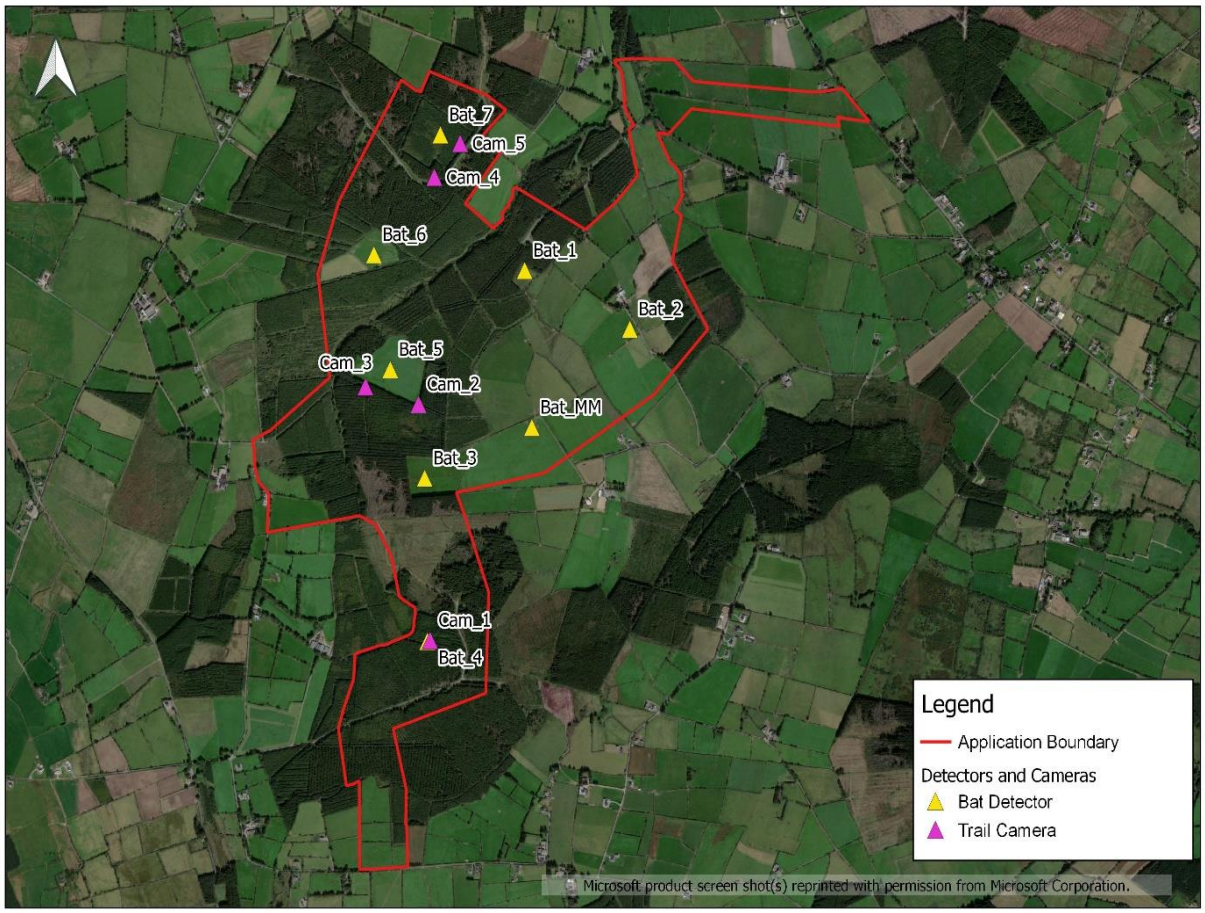

Figure 5.6: Trail Camera and Bat Detector Deployment Locations

Passive Detector Surveys

In order to inform an assessment of the likely effects of the project on bats, surveys were carried out to characterise the importance of the site for bats.

An ultrasonic detector survey was carried out at the wind farm site to record bat activity in the area from which information on species composition, relative abundance and landscape usage could be derived.

A multi-season passive detector survey was carried out from Spring 2021 to Autumn 2021 following SNH (2021) guidelines, with modifications for an Irish context. This saw the simultaneous deployment of 7 no. passive detectors at (or in the immediate

vicinity of) turbine locations. A detector was also deployed on a meteorological mast in Autumn 2021 where 1 no. microphone was placed at ground level and a second at approximately 50m above ground level.

The locations of detectors deployed is provided at **Table 5.1** below and illustrated at **Figure 5.6**. Details of the dates and weather conditions during bat detector deployment are summarised at **Annex 5.5**.

ID	Location (ITM)	
	ITM_Easting	ITM_Northing
Bat_1	661469	667063
Bat_2	661937	666819
Bat_3	661024	666201
Bat_4	661036	665526
Bat_5	660871	666652
Bat_6	660799	667128
Bat_7	661094	667624
Bat_MM	661501	666412

Table 5.1: Passive Bat Detector Deployment Locations (Spring 2021–Autumn 2021)

Wildlife Acoustic's SM4 full-spectrum bat detectors were deployed and detectors were set to record from 30-minutes before sunset until 30-minutes after sunrise. The detectors automatically adjust their start and finish times based on sunrise and sunset.

Species identification was aided by *post hoc* sonogram analysis using Wildlife Acoustics' Kaleidoscope Professional software (v. 5.4.8) and BTO's 'acoustic pipeline'.). The species identification of a subset of recordings was manually verified according to Russ (2012) and Middleton *et al*. (2014).

Individual bats of the same species cannot be distinguished by their echolocation alone and therefore 'bat registrations' are used as a measure of activity (Collins, 2016). A bat pass is defined as a recording of an individual species echolocation with a of maximum 15-seconds duration. All bat passes recorded in the course of this study follow these criteria, allowing for comparison between monitoring stations.

The survey locations are considered to provide good coverage of the project site. All wind turbines are proximal to a bat monitoring point; while the likelihood of design changes throughout the assessment process is acknowledged in NatureScot (2021). A technical issue with an individual recorder was experienced during the Spring 2021 recording period when the detector at turbine T3 failed to record. However, data was recorded for more than 10-suitable nights at other survey locations and it is assessed that an appropriate level of coverage was achieved overall.

Although commonly applied in Ireland, the NatureScot (2021) guidelines *Bats and Onshore Wind Turbines: Survey, Assessment and Mitigation* were written for a Scottish context. While survey effort and design for the subject project are carried out according to the guidelines, their precise implementation were adapted to an Irish context in the following ways:-

- NatureScot (2021) recommends the use of an online tool, 'Ecobat' to provide a measure of relative bat activity. The tool compares site specific inputted data to

a comparator database to provide an interpretation of the level of bat activity compared to other sites in Britain. The tool is not considered to be relevant in an Irish context (different range of species and differing ecology) and therefore interpretation of relative activity level at the project site versus other similar sites in Ireland relies on the expertise and experience of the authors; and,

- Assessment of vulnerability of bats to wind farms, including assessment of collision risk, generally follows the procedure outlined in SNH (2019) but with amendments to reflect the Irish species assemblage and the different relative abundance of individual species in an Irish context.

Figure 5.7: Passive Bat Detector Deployment Locations

Visual Assessment of Bat Roosting Features

NatureScot (2021) recommends surveys to identify key bat features such as maternity roosts or large hibernation or swarming sites. A study area extending '200m plus 1 no. rotor radius' from the 'proposed development' is recommended. In this instance the rotor radius of the wind turbines is 81m (diameter is 162m) and, per NatureScot, would require a study area of 281m. A conservative buffer of 300m to the site boundary has been applied.

Within this area, potential roosting features (PRFs) were initially identified by analysis of historic 6" mapping and aerial imagery followed by subsequent ground-truthing. Daytime visual assessments of potential bat roost features within and proximate to the wind farm site were carried out on 21 December 2021, 6 April 2022 and 7 April 2022. Features identified from the desk study predominantly consisted of buildings (see **Figure 5.8**) but other features including bridges, culverts and trees were also assessed.

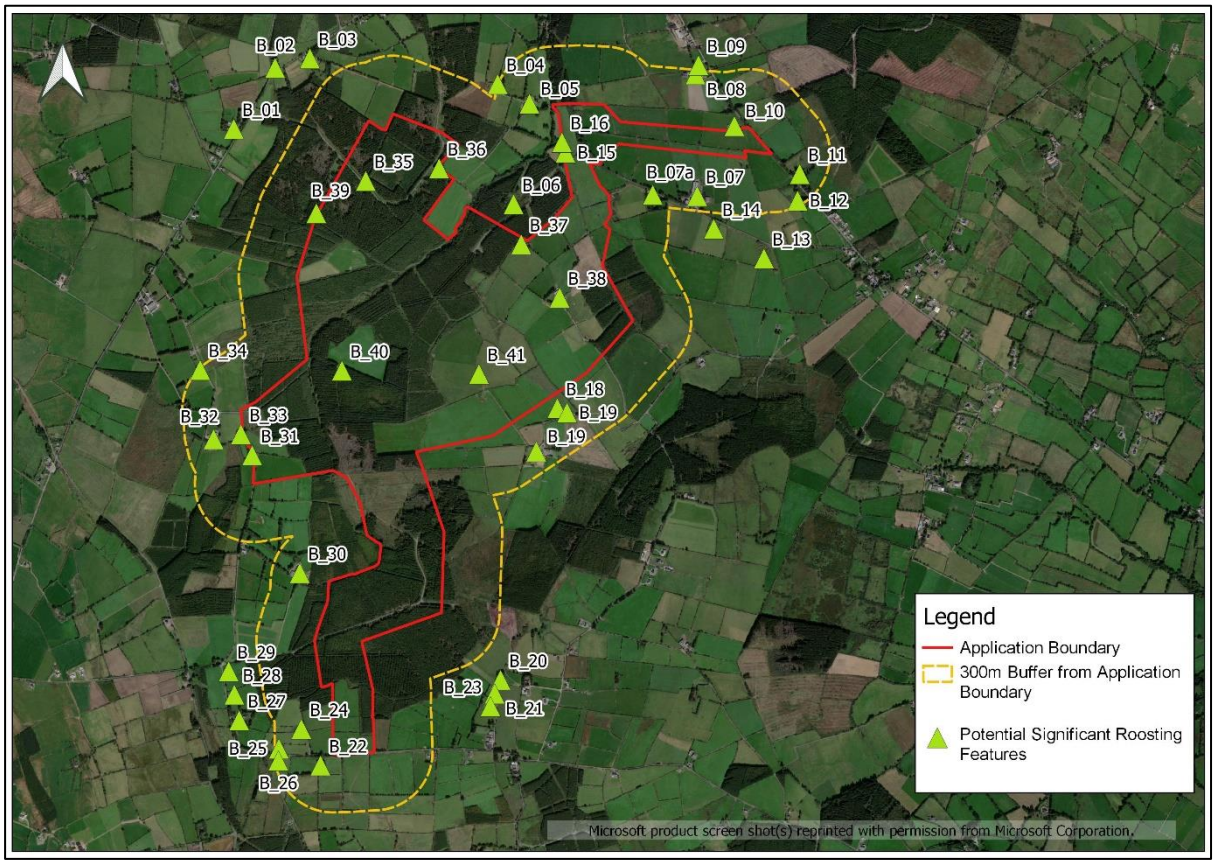

Figure 5.8: Potential Roost Features Survey Locations

Surveys and description of PRFs were carried out according to Collins (2016). PRFs are described according to the scheme shown in **Table 5.2** below.

Suitability	Description
Negligible	Negligible features which are likely to be used by roosting bats.
Low	A feature with one or more potential roost sites that could be used by individual bats opportunistically.
Moderate	Potential roost sites which do not provide appropriate conditions and / or suitable surrounding habitat to be used on a regular basis

Suitability	Description
	or by larger numbers of bats (i.e. unlikely to be suitable for maternity or hibernation).
High	A tree of sufficient size and age to contain PRFs but with none seen from the ground or features seen with only very limited roosting potential.

Table 5.2: Scheme for describing the potential suitability of features for bats

'Bat Surveys for Professional Ecologists: Good Practice Guidelines (3rd Edition)', Collins (2016).

Active Bat Surveys

Active bat surveys were used to complement the information gained from passive bat monitoring. The aim of the surveys was to identify any particular flightlines which may be apparent and to identify emergence behaviour which would indicate the presence of a roost. Active bat surveys were carried out at the wind farm site for at least 1.5-hours from dusk on 18 August 2021, 26 August 2021, 15 September 2021 and 1 June 2022. The locations of active survey tracks are illustrated at **Figure 5.9**, based on GPS units carried by the surveyors.

The survey on 1 June 2022 was a targeted emergence survey on a target structure (B38). This residence and farm building was identified as having moderate suitability to support significant numbers of roosting bats and full access for visual survey was not available. The survey was carried out following Collins (2016) guidelines in suitable weather conditions (temp: 15°C; wind F1; dry). The survey commenced at 21:30 and concluded at 23:15. Guide IR thermal imaging cameras were utilised as an aid to visual assessment during the surveys in accordance with best practice guidelines[4].

Active bat surveys were carried out along the grid connection route in order to assess the level of activity, species diversity and to identify any areas of relatively high activity. The surveys were carried out on the night of 24 August 2021. Existing tracks and roads were utilised for safety reasons.

Driven transects were carried out along the grid connection route following Roche *et al*. (2008) on 24 August 2021 in suitable weather conditions.

Active surveys utilised Wildlife Acoustic's EMT 2 Pro detectors to record bat echolocation, and these were subsequently analysed using Kaleidoscope software.

[4] https://cdn.bats.org.uk/uploads/pdf/Interim-guidance-note-on-NVAs-May-2022-FINAL.pdf?v=1653399882

Figure 5.9: Potential Roost Features Survey Locations

5.2.4.5 Aquatic Ecology Surveys

A desktop study was carried out to collate information available from previous studies relevant to the project site. A number of papers, documents and articles relevant to the project site as well as a range of online resources were utilised in accessing a variety of information including:-

- EPA website (www.epa.ie);
- NPWS website (www.npws.ie);
- OPW (www.opw.ie);
- National Biodiversity Data Centre website (www.biodiversityireland.ie);
- IFI website (www.fisheriesireland.ie);
- Water Matters website (www.catchments.ie/download/water-matters-say/);
- GSI website (www.gsi.ie); and,
- ViewrangerGPS.

Electronic resources were reviewed prior to fieldwork in order to get an overview of the project site and to inform how best to carry out the fieldwork in terms of on-site methods, health and safety issues, potential limitations and pitfalls, and the context of the site within the greater area. The online resources were again reviewed during the preparation of this chapter in order to assess the specifics on a variety of parameters and compile them, along with the findings of the field surveys, in order to attain an accurate appraisal of the project site.

Following the findings of the initial desktop study outlined above, a site walkover was carried out in line with relevant best practice guidelines (e.g. NRA 2005, NRA 2009). Stretches of Knocknabranagh & Knockbaun Stream & Coolcullen Stream within the

site were walked[5]. Similarly stretches of the Dinin River South, downstream of the project site, were walked where access was gained from bridges. The aim of the walkover was to assess the aquatic habitats, the riparian habitats, the physical and hydromorphological characteristics, to look for signs of species of interest, to identify issues pertaining to the aquatic environment and determine their causes and effects where possible.

The aquatic/fisheries habitats present were assessed in terms of their ecological value using criteria adapted from NRA 2009 and Nairn & Fossitt 2004. Aquatic habitat assessment was conducted in line with the methodology in the Environment Agency's *River Habitat Survey in Britain and Ireland Field Survey Guidance Manual 2003* (EA, 2003). Habitats of use to the various life stages of salmonids are assessed based on the information provided in *Trout and Salmon. Ecology, Conservation and Rehabilitation* (Crisp; 2000). Lamprey ammocoete[6] habitat quality as well as the suitability of adult spawning habitat is assessed based on the information provided in Maitland (2003) and Gardiner (2003).

Electrofishing Survey

3 no. sites were selected to be electrofished; 1 no. on the Coolcullen Stream, 1 no. on the Knocknabranagh & Knockbaun Stream, and 1 no. ~300m downstream of the confluence of both streams on the Coolcullen River (**Table 5.3**). Electrofishing followed the *WFD Electric fishing in wadable reaches* (CFB, 2008) methodology. Electrofishing was carried out over a measured distance which was determined on the day by the stream characteristics at each survey location. A minimum of 3 no. passes over each section was employed as a standard methodology to ensure capture of all fish present. Methodology for lampreys followed that of *Monitoring the River, Brook and Sea Lamprey, Lampetra fluviatilis, L. planeri and Petromyzon marinus* (Harvey & Cowx, 2003). Electrofishing for lamprey utilised pulsed fishing in suitable habitat. Full depletion was employed. Fish intercepted were stored in a container of river water, anaesthetised using clove oil and measured to the nearest millimetre (mm). Subsequent to this, the fish were allowed to recover in a container of well oxygenated river water. All fish were released alive without resulting in any damage or mortality.

Site Name	Location	Grid Reference (ITM)
Coolcullen Stream Site	Approximately 500m upstream of the confluence with the Knocknabranagh & Knockbaun Stream, in the vicinity of a proposed watercourse crossing.	E: 662039 N: 667298
Knocknabranagh & Knockbaun Stream Site	Approximately 50m upstream of the confluence with the Coolcullen Stream, as the stream leaves the drainage area of the wind farm.	E: 661818 N: 667676
Coolcullen River	At the bridge crossing of the L7122 local road, approximately 300m downstream from the confluence of the Coolcullen Stream and Knocknabranagh & Knockbaun Stream, as the river leaves the drainage area of the wind farm.	E: 661865 N: 667910

[5] Approximately 700m of the Coolcullen Stream and 1.2km of the Knocknabranagh & Knockbaun Stream were walked.

[6] The word ammocoete describes lamprey *spp* in their larval stage

Table 5.3: Electrofishing Sites

The findings of the electrofishing at each site were then combined with information gathered from the stream walkover (i.e. fisheries habitat assessment as well as other physical and hydromorphological characteristics including barriers to fish passage) in order to make a detailed fisheries assessment.

Biological Water Quality Analysis

Attaining a Q-value is the standard methodology of assessing the biological water quality of a watercourse in Ireland (**Table 5.4**). It is the biotic index utilised by EPA staff and sub-consultants to score watercourses as part of the Water Framework Directive and is an effective tool in determining the condition of aquatic environments. The method involves placing a kick-sample net (250mm width, 500µm mesh size) in a suitable riffle and kicking (vigorously disturbing) the riverbed for a standard duration of time (2-minutes). Aquatic invertebrates from the sample are then identified and classified according to their sensitivity to pollution; Groups A, B, C, D and E (where Group A are the most sensitive and group E are the most tolerant of pollution). As per Toner *et al*. 2005, relative numbers of each individual taxa are compiled and analysed such that each sampling site is then assigned a Q-value, a nationally recognised number that denotes water quality.

A number of survey sites were selected in order to carry out Q-value assessments. The sites were selected based on the footprint of the project in combination with the topography and hydrology of the area, as well as taking into account the project within the context of the greater catchment.

Q Value	WFD Status	Pollution Status	Condition
Q5 or Q4-5	High Status	Unpolluted	Satisfactory
Q4	Good Status	Unpolluted	Satisfactory
Q3-4	Moderate Status	Slightly polluted	Unsatisfactory
Q3 or Q2-3	Poor Status	Moderately polluted	Unsatisfactory
Q2, Q1-2 or Q1	Bad Status	Seriously polluted	Unsatisfactory

Table 5.4: Categories of Water Quality

Freshwater Pearl Mussel

Surveying for freshwater pearl mussel *Margaritifera margaritifera* (FPM) was carried out following the NPWS guidance *Margaritifera margaritifera Stage 1 and Stage 2 survey guidelines, Irish Wildlife Manuals, No. 12* (Anon, 2004). The watercourse reaches examined were subject to a presence/absence survey which involved wading in the river while viewing the substrate and looking for FPM with the aid of a bathyscope and with polarised sunglasses. The survey also involved checking for the presence of dead shells, particularly in depositing areas. Transect surveys were carried out, with the location of each recorded by GPS. Searches for FPM were also carried out when walking between transect locations when access and water depth allowed.

The river condition and habitat features at each survey stretch were noted. The potential for FPM to occur along each stretch was assessed with reference to *Conserving Natura 2000 Rivers Ecology Series No. 2 'Ecology of the Freshwater Pearl Mussel* (Skinner et al., 2003). The habitat was evaluated with reference to Environmental Quality Objectives (EQOs) as specified in Schedule 4 of the

'European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations', S.I. 296 of 2009 (see **Table 5.5** below).

Element	Objective	Notes
Filamentous algae (Macroalgae)	Absent or Trace (<5%)	Any filamentous algae should be wispy and ephemeral and never form mats.
Phytobenthos (Diatoms)	EQR 0.93	High status
Macrophytes - Rooted higher plants	Absent or Trace (<5%).	Rooted macrophytes should be absent or rare within the mussel habitat.
Siltation	No artificially elevated levels of siltation.	No plumes of silt when substratum is disturbed.

Table 5.5: Habitat Evaluation according to EQOs

The survey was carried out under licence (No. C218/2021) from NPWS and was led by accredited FPM surveyor Gerard Hayes with aquatic ecologist Rory Dalton. The wind farm and grid connection route are within a catchment listed in the NPWS *Margaritifera* Sensitive Areas Map. This catchment is identified as a 'Catchments of SAC populations listed in S.I. 296 of 2009'. The areas surveyed were selected on the basis of accessibility (incl. safety), proximity to the project site, watercourse size, and suitability within the receiving environment (**Table 5.6**).

Survey Reach Code	Location	No. of Transects	Length Surveyed
R1	D/S of L7122 Bridge to Phillips Bridge	20	1.2km
R2	Phillips bridge to Dinin Confluence	20	1.1km
R3	U/S of Coan Bridge	20	1.2km
R4	D/S of Uskerty Bridge	20	1km

Table 5.6: Sampling locations surveyed for Freshwater Pearl Mussel

5.2.4.6 Other Taxa

Other taxa (e.g. Lepidoptera, Odonata, Amphibians and reptiles) encountered during the field surveys were recorded for inclusion in this assessment. The historical occurrence of such species was also considered by consulting available desktop data sources.

The conservation status of such taxa was assessed by examining their inclusion in one or more of the following: Irish Wildlife Acts (1976 – 2012); Irish Red List for Butterfly (Regan *et al.* 2010; Irish Red List for Damselflies & Dragonflies (Nelson *et al.* 2011); Irish Red List for Amphibians, Reptiles & Freshwater Fish (King *et al.* 2011); Regional Red List of Irish Bees (Fitzpatrick *et al.* 2006); and the EU Habitats Directive.

Small areas of scrub in the study area, including within the wind farm site, where Devil's Bit Scabious *Succisa pratensis* the larval food plant of Marsh Fritillary *Euphydryas aurinia* were identified during habitat and botanical surveys were visited in late August 2021 to record the presence or absence of the protected butterfly species.

No specific Common Frog *Rana temporaria* surveys were considered necessary and frogs were recorded on casual basis when observed during site walkovers. There are relatively few areas of suitable breeding habitat within or proximate to the project site

and GIS and scoping surveys noted very few ponds or drains considered capable of supporting breeding frogs or Smooth Newts, *Lissotriton vulgaris*, based on criteria outlined in JNCC (2003). In addition, the design of the project avoids directly affecting areas of standing water within the project site.

5.2.4.7 Invasive Species

During the habitat and botanical walkover surveys, a search for non-native invasive species was undertaken. The survey focused on the identification of invasive species listed under the Third Schedule of the European Communities (Birds and Natural Habitats) Regulations 2011 (As Amended) (S.I. 477 of 2015).

5.2.4.8 Other Study Areas

Haul Route Works Locations

The haul route works locations were surveyed to identify the presence of any protected or important species (e.g. mammals or invasive plant species) that could be affected by the project.

The Black Bridge works location was also inspected as part of the aquatic surveys.

Grid Connection Route

As described in the preceding sections, the grid connection route was surveyed as part of the habitat, botanical and faunal surveys. A follow-up survey of the grid connection route was carried out in August 2022 to confirm the absence of Third Schedule species,

Replant Lands

The replant lands in Co. Monaghan were surveyed in March 2022 to identify the presence of important mammal or botanical species.

5.2.4.9 Evaluation Criteria for Ecological Assessment

Ecological evaluation of the study area for terrestrial biodiversity follows criteria amended after NRA (2009) and Nairn & Fossitt (2004; **Annex 5.2**).

5.2.5 Limitations to Assessment

The information contained in this chapter includes robust data which has been used to assess the likely significant effects of the proposed development on biodiversity. No substantial limitations were identified in terms of scale, scope or context in the preparation of this assessment.

The following minor survey and data analysis limitations were encountered and have been fully accounted for in the impact assessment:-

- Much of the field surveys were carried out during the COVID-19 pandemic. It presented certain challenges in terms of travel restrictions and difficulty in finding accommodation for surveyors travelling greater distances. Notwithstanding the logistical challenges encountered, it was possible to carry out all of the necessary survey work, at the optimal periods;
- Technical issues were identified with one of the bat detectors deployed during Spring 2021. Survey effort for other survey locations went above and beyond recommended levels and overall, it is considered that appropriate coverage was achieved

5.2.6 Impact Assessment

Ecological surveys for the project were undertaken following specific guidelines for habitats and species, as outlined in the preceding sections, and with reference to the relevant national legislation and policy. The importance of the habitats and species present is evaluated using the guidance document *Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal, and Marine* published by the Chartered Institute of Ecology and Environmental Management (CIEEM, 2018, updated 2019) and *Good Practice Guidance for Habitats and Species* (CIEEM 2021). This document outlines an accepted approach for the evaluation of potential impacts from such developments.

The description and evaluation of likely and residual effects arising from the project on the existing terrestrial biodiversity of the study area and surrounding area follows guidelines published by the EPA (2022) with reference to CIEEM (2018, 2019 and 2021).

5.2.6.1 Assessment of Cumulative Effects

Cumulative effects can result from individually insignificant, but collectively significant, actions occurring over a period of time or concentrated in a location (CIEEM, 2019). As such, these types of effects may be characterised as:-

- Additive/incremental – in which multiple activities/projects (each with potentially insignificant effects) add together to contribute to a significant effect due to their proximity in time and space (CIEEM, 2018, updated 2019); or,
- Associated/connected – where a development activity 'enables' another development activity e.g. phased development as part of separate planning applications. Associated developments may include different aspects of the project which may be authorised under different consent processes. It is important to assess the potential impacts of the 'project' as a whole and not ignore impacts that fall under a separate consent process (CIEEM, 2018, updated 2019).

5.3 Description of the Existing Environment

The following sections describe the results of the detailed desktop and field surveys that were undertaken to inform and ecological impact assessment of the proposed development.

5.3.1 Designated Conservation Sites

There are no nationally or European designated sites located within or immediately adjacent to the project site (**Figure 5.10**).

Table 5.7 shows the minimum distance between the project site and European and nationally designated conservation sites. The minimum distance from the closest of the proposed turbines is provided below. The search area has been set to a nominal 15km offset from the site boundary. This is an arbitrary distance typically used for illustrative purposes (e.g. DoEHLG 2009). The likelihood of effects upon more distant designated sites is also considered in the event that any likely significant effects are identified in relation to these distant sites during the assessment process. The Source-Pathway-Receptor model is used, along with a knowledge of the sensitive species and habitats for which sites are designated, to identify any likely significant effects which could arise as a result of the project.

Site Name	Site Code	Minimum Distance from Project Site (km)	Minimum Distance from nearest Turbine (km)
Natura 2000 Sites			
River Barrow & River Nore SAC	002162	0.0	1.7
River Nore SPA	004233	11.5	13.0
Lisbigney Bog SAC	000869	12.4	19.6
Nationally Designated Sites			
Mothel Church, Coolcullen pNHA	000408	1.6	1.9
Coan Bogs NHA	002382	2.1	4.7
Whitehall Quarries pNHA	000855	4.1	4.7
Cloghristick Wood pNHA	000806	7.1	8.3
Dunmore Cave pNHA	000401	9.4	10.1
Esker Pits pNHA	000832	10.0	10.6
Ballymoon Esker pNHA	000797	10.2	10.7
Dunmore Complex pNHA	001859	11.5	12.2
Newpark Marsh pNHA	000845	11.8	12.6
Lisbigney Bog pNHA	000869	12.4	19.6
Archersgrove pNHA	002051	12.6	13.5
River Nore/Abbeyleix Woods Complex pNHA	002076	13.3	16.7
Ardaloo Fen pNHA	000821	13.5	14.1
Lough Macask pNHA	001914	13.6	14.4
Clopook Wood pNHA	000860	14.1	23.2
Red Bog, Dungarvan pNHA	000857	14.3	15.2
Ballylynan pNHA	000846	14.4	20.7
Timahoe Esker pNHA	000421	14.6	24.6

Table 5.7: Distances to Designated Nature Conservation Sites

The small works area (carriageway strengthening) at Black Bridge on the L1835/L3037 is just upstream of the River Barrow and River Nore SAC (002162). The closest turbine location to this designated site is 1.7km distant. There are only 2 no. further Natura 2000 sites located within the 15km hinterland of the application site. River Nore SPA (004233) is situated 11.5km and Lisbigney Bog SAC (000869) is located 12.4km from the project. As described above, there are no other SPA sites located within 30km of the application site.

The qualifying and special conservation interests of the Natura 2000 sites located within 15km of the site are summarised in **Table 5.8**.

There are 17 no. pNHAs and one NHA located within 15km of the project **(Figure 5.11**). The closest of these sites is Mothel church, Coolcullen pNHA (000408) located 1.6km from the project and 1.9km from the nearest turbine location. Mothel Church is home

to a nursery colony of Natterer's bats (*Myotis nattereri*) which use the loft and bell tower of the church. Coan Bogs NHA (002382) is located to the north of the wind farm, over 2km from the application site. The only other nationally designated site located within 5km is Whitehall Quarries pNHA (000855), which is made up of two disused shale/slate quarries 5km west of Bagnelstown. The quarry tips and the floors of the old working areas now provide a rich variety of dry acidic habitats, which have been colonised to a greater or lesser extent by a variety of plants typical of such dry habitats such as Bilberry (*Vaccinium myrtillus*).

The Screening for Appropriate Assessment (AA) which accompanies the NIS details the aspects of the project which could in the absence of adequate mitigation lead to likely significant effects on designated Natura 2000 sites in the receiving environment. A NIS has been prepared in support of the AA process which further considers the potential for adverse impacts upon the designated sites and their qualifying interests which were identified at screening stage. Mitigation measures, including detailed construction management measures are presented which will be effective in avoiding ecological risks. It has been objectively concluded that the project will not adversely affect the integrity of any Natura 2000 site, and there is no reasonable scientific doubt in relation to this conclusion.

Site Name	Qualifying/Special Conservation Interests
River Barrow & River Nore SAC	• Estuaries [1130]; • Mudflats and sandflats not covered by seawater at low tide [1140]; • Reefs [1170]; • Salicornia and other annuals colonising mud and sand [1310]; • Atlantic salt meadows (Glauco-Puccinellietalia maritimae) [1330]; • Mediterranean salt meadows (Juncetalia maritimi) [1410]; • Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation [3260]; • European dry heaths [4030]; • Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels [6430]; • Petrifying springs with tufa formation (Cratoneurion) [7220]; • Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles [91A0]; • Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (Alno-Padion, Alnion incanae, Salicion albae) [91E0]; • *Vertigo moulinsiana* (Desmoulin's Whorl Snail) [1016]; • *Margaritifera margaritifera* (Freshwater Pearl Mussel) [1029]; • *Austropotamobius pallipes* (White-clawed Crayfish) [1092]; *Petromyzon marinus* (Sea Lamprey) [1095]; • *Lampetra planeri* (Brook Lamprey) [1096]; • *Lampetra fluviatilis* (River Lamprey) [1099];

	• *Alosa fallax fallax* (Twaite Shad) [1103]; • *Salmo salar* (Salmon) [1106]; • *Lutra lutra* (Otter) [1355]; • *Trichomanes speciosum* (Killarney Fern) [1421]; and, • *Margaritifera durrovensis* (Nore Pearl Mussel) [1990]
River Nore SPA	• Kingfisher (*Alcedo atthis*) [A229]
Lisbigney Bog SAC	• Calcareous fens with Cladium mariscus and species of the Caricion davallianae [7210]; and, • *Vertigo moulinsiana* (Desmoulin's Whorl Snail) [1016]

Table 5.8: Qualifying and Special Conservation Interests of Natura 2000 sites situated within 15km

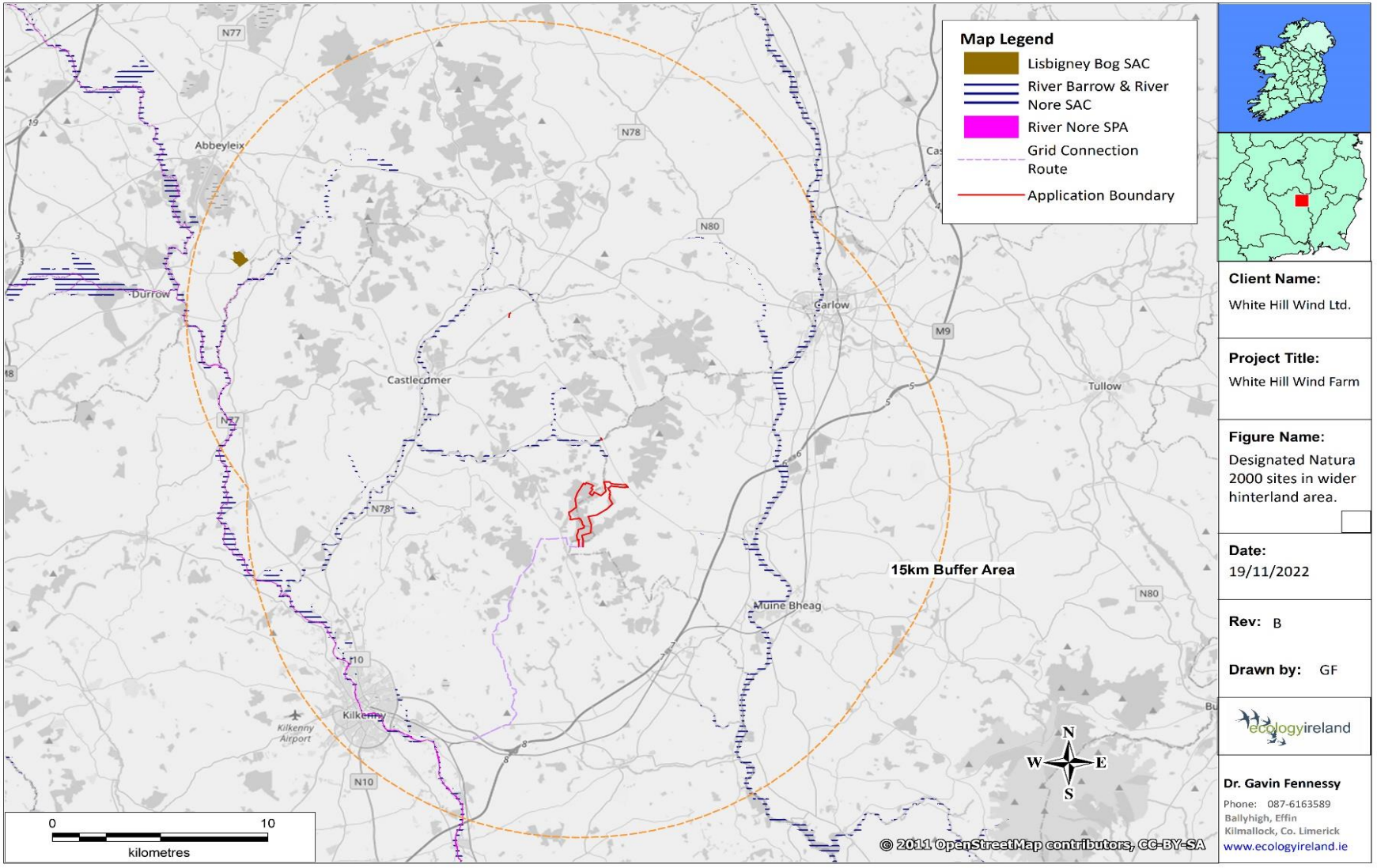

Figure 5.10: Map of Natura 2000 Sites within 15km

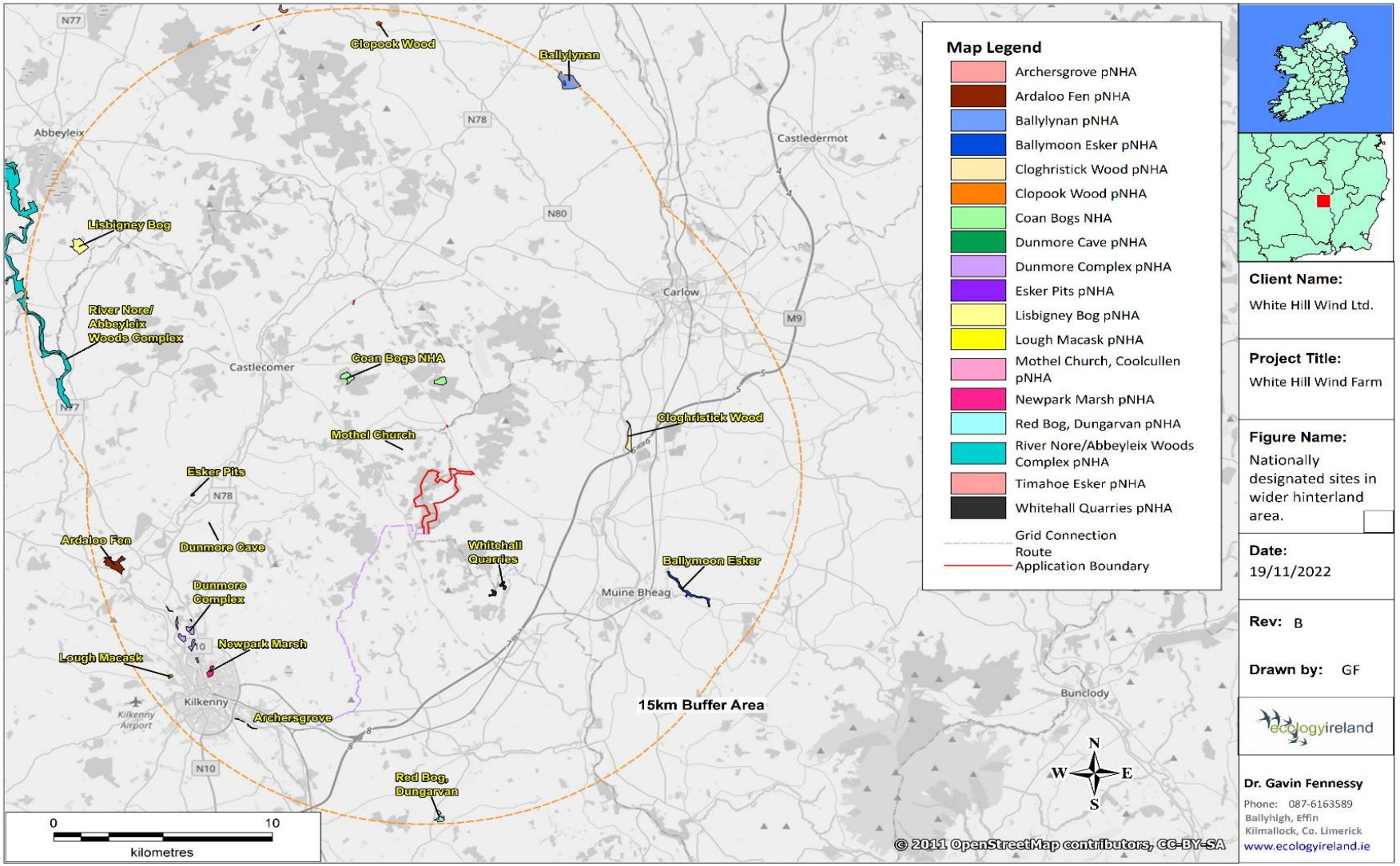

Figure 5.11: Nationally Designated Nature Conservation Sites within 15km

5.3.2 Habitats

A review was carried out of historical botanical records for the grid squares that overlap the project site. Three Red listed 'near threatened' species (Wyse-Jackson *et al.*, 2016) have historically been recorded within the grid squares that overlap the project site; *Veronica agrestis or* Green speedwell found on bare disturbed ground, the Dwarf mallow *Malva neglecta* found on dry, waste ground and Greater knapweed *Centaurea scabiosa* found on dry banks and pastures. These plants have been classified as near threatened due to a decline in their areas of occupancy (**Table 5.9**).

Common Name	Scientific Name	Flora Protection Order 2022	Red Data Book Category (Wyse-Jackson *et al.*, 2016)	Grid Square	Habitat
Green speedwell	*Veronica agrestis*	Not listed	Near threatened	S66	Found on bare, disturbed ground
Dwarf mallow	*Malva neglecta*	Not listed	Near threatened	S66	Waste places, dry habitats, sometimes at the base of a wall.
Greater knapweed	*Centaurea scabiosa*	Not listed	Near threatened	S66	Dry banks and pastures

Table 5.9: Rare or Protected Plant Species previously recorded from the S66 grid square (NBDC & BSBI databases)

5.3.2.1 Invasive Plant Species

The NBDC[7] database and BSBI database for grid squares overlapping the study area hold records for 13 no. non-native invasive plant species (see **Table 5.10** below) including 5 no. species listed under the Third Schedule Part I under Regulations 49 and 50 of the European Communities (Birds and Natural Habitats Regulations 2011) species comprising Japanese Knotweed *Fallopia japonica*, Giant Hogweed *Heracleum mantegazzianum*, Canadian waterweed *Elodea canadensis*, Water fern *Azolla filiculoides* and Indian Balsam *Impatiens glandulifera*. Regulation 49 of the Birds and Natural Habitats Regulations 2011 prohibits the planting, allowing or causing dispersal, and spreading of any plant listed in the Third Schedule. 5 no. of the non-native invasive species historically recorded are categorised as high Impact invasive species (Kelly *et al.*, 2013; NBDC dataset). The remaining species are categorised as medium risk and low risk and are not listed in the Third Schedule.

Common Name	Scientific Name	Listed in Third Schedule Part I * (Y/N)	Risk Rating (Kelly *et al.*, 2013) and/or NBDC Risk rating
Japanese Knotweed	*Reynoutria japonica*	Y	High
Travellers joy	*Clematis vitalba*	N	Medium
Cherry laurel	*Prunus laurocerasus*	N	High

[7] https://maps.biodiversityireland.ie/Map (accessed 06/11/2022)

Common Name	Scientific Name	Listed in Third Schedule Part I * (Y/N)	Risk Rating (Kelly *et al.*, 2013) and/or NBDC Risk rating
Montbretia	*Crocosmia pottsii* x *aurea* = *C.* x *crocosmiiflora*	N	Not classified
Sycamore	*Acer pseudoplatanus*	N	Medium
Buddleia	*Buddleja davidii*	N	Medium
Giant Hogweed	*Heracleum mantegazzianum*	Y	Low
Canadian Waterweed	*Elodea canadensis*	Y	High
Indian Balsam	*Impatiens glandulifera*	Y	High
Winter heliotrope	*Petasites pyrenaicus*	N	Low
Three cornered garlic	*Allium triquetrum*	N	Medum
Water Fern	*Azolla filiculoides*	Y	Medium
Narrow-leaved Ragwort	*Senecio inaequidens*	N	Medium

Table 5.10: Non-native Invasive Plant Species recorded from the S66 grid square (per NBDC & BSBI databases).

5.3.2.2 Habitats and Flora

No Annex I habitats listed under the EU Habitats Directive were recorded within the project site, study area, haul route works locations, or along the grid connection route. No botanical species protected under the Flora (Protection) Order 2022, listed in Annex II or IV of the EU Habitats Directive (92/43/EEC) were recorded. Furthermore, no Bryophytes protected under the Flora (Protection) Order 2022 are documented for the study area (Flora Protection Order Map Viewer NPWS).

The main habitats recorded within the study area are listed at **Table 5.11**. The habitat map of the wind farm site is detailed at **Figure 5.12**. The area in which the wind farm is to be located consists of an undulating rural landscape with a number of low-lying hills, small watercourses and scattered farm settlements. A high point of 296m OD occurs at Knocknabrannagh and Knockbaun townland in the centre of the wind farm site. The habitats within the study area reflect a landscape that has been the subject of considerable anthropogenic influence largely for agricultural land use and in more recent times for commercial forestry operations.

The dominant habitats are agricultural grassland. The improved agricultural grassland present in this area is intensively managed and is subject to ongoing fertilisation and drainage for dairy and beef cattle farming. The wind farm footprint will be primarily located on Conifer Plantation (WD4) or improved agricultural grassland (GA1) set out in large open fields, with smaller areas of spoil and bare ground (ED2) also present in the form of a network of farm access tracks. The development footprint will also be located on areas of higher value semi-natural grassland classified as Wet Grassland (GS4). The wet grassland where turbine T3 is located is an area which supports a relatively diverse species assemblage and a portion of this wet grassland habitat will be lost as a result of the direct footprint of the project.

Other types of semi-natural grassland recorded included Dry meadows and grassy verges (GS2) located along field margins and farm and forestry tracks. Field boundaries were comprised of treelines (WL2) and hedgerows (WL1) some of which are mature and long established and date back to the 1830's as evidenced in historic OSI 6-inch mapping. A number of eroding upland streams (FW1) traverse the study area, all of which are tributaries of the Dinin South which itself is a tributary of the River Nore. Both the Dinin South and River Nore form part of the River Barrow and River Nore SAC.

Fossitt Code	Habitat Type	Habitat Evaluation	Correspondence with Annex 1
GS2	Dry meadows and grassy verges	Local Importance (Lower value)	Lowland haymeadows (*Alopecurus pratensis, Sanguisorba officinalis)* 6510
GA1	Improved agricultural grassland	Local Importance (Lower value)	-
GS4	Wet Grassland	Local Importance (Higher value)	6410 Molinia meadows on caLCareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*)
WL1	Hedgerows	Local Importance (Higher value)	-
WL2	Treelines	Local Importance (Higher value)	-
WD1	Mixed broadleaved woodland	Local Importance (Higher value)	-
WS2	Immature woodland		-
WS5	Recently felled woodland		-
ED2	Spoil and bare ground	Negligible Importance	-
BL3	Buildings and artificial surfaces	Negligible Importance	-
BL1	Stonewalls and other stonework	Local Importance (Lower value)	-
FW1	Eroding/upland Rivers	Local Importance (Higher – International value)	Annex I habitat 'watercourses of plain to montane levels with *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation' (3260)
FW4	Drainage ditch	Local Importance (Higher value)	-

Table 5.11: Summary of Habitats (classified in accordance with Fossitt, 2000) within the Study Area, their respective evaluations as per NRA (2009) and their respective correspondence, if any, to EU Annex I Habitats

Within the wind farm development site the dominant habitats present are Conifer Plantation (WD4) and Improved agricultural grassland (GA1; **Figure 5.12**) and both are evaluated as being of Local Importance (Lower value).

Other habitats recorded within the wind farm site included hedgerows (WL1), Wet grassland (GS4), Dry meadows and grassy verges (GS2) Treelines (WL2) and Eroding upland streams (FW1) of Local Importance (Higher value). Drainage ditches (FW4), Stone walls and other stonework (BL1) and Amenity grasslands (GA2), Buildings and artificial surfaces (BL3) and Spoil and bare ground (ED2) were classified as being of Local Importance (Lower value).

The main habitats recorded within the wind farm study area are listed in **Table 5.11**. The habitat map of the proposed scheme is detailed in **Figure 5.12**.

Improved Agricultural Grassland (GA1)

Plate 5.1: Improved Agricultural Grassland (GA1)

One of the dominant habitats within the study area is Improved Agricultural Grassland (GA1) and the majority of the wind farm infrastructure is located within this habitat type. Improved Agricultural Grassland is intensively managed or highly modified grassland that has been reseeded is regularly fertilised and grazed and/or used for silage making. Species composition included abundant Perennial rye *Lolium perenne* grass and other occasional grass species including Yorkshire fog *Holcus lanatus*, Creeping bent *Agrostis stolonifera*, annual meadow grass *Poa annua* and Meadow foxtail *Alopecurus pratensis,* and Crested dogs-tail. Relative abundance of the different grass species varied in different fields depending on the grazing regime and level of grassland management. In some areas where there was more extensive cattle

grazing/less management, the Perennial rye grass did not dominate as much, instead a greater of mix of grass species were recorded with Perennial rye grass including frequently occurring Crested dogs-tail, Yorkshire fog, Meadow foxtail and Creeping bent. Broadleaved species within the improved grassland sward were comprised of frequent Dandelion *Taraxacum* spp and Common mouse ear *Cerastium fontanum* occasional Broad-leaved dock *Rumex obtusifolius*, Creeping buttercup *Ranunculus repens*, Meadow buttercup *Ranunculus acris*, pineapple weed *Matricaria discoidea* and Greater plantain *Plantago major*.

Improved Agricultural Grassland (GA1) is evaluated as being of Local Importance (Lower Value) due to its intensively managed nature albeit in less intensively managed fields the improved grassland did support a greater variety of botanical species.

Hedgerows (WL1)

Plate 5.2: Hedgerows (WL1)

Hedgerows are well established across the study area and formed the natural livestock proof boundaries along the agricultural grassland fields. Active management of the hedgerows was evident in many places and included cutting of hedgerows to c 2-3m high with some intermittent trees allowed to remain in places. This was particularly evident along farm tracks and public roads. Elsewhere the hedgerows have been allowed to grow and management was less intense, these hedgerows were generally 4-5m in height with trees such as Sycamore *Acer pseudoplatanus*, Ash *Fraxinus excelsior* and Whitethorn *Crataegus monogyna*. The shrub layer consisted of frequently occurring Bramble *Rubus fruticosus* agg. and Gorse *Ulex europaeus.* The quality of hedgerows and species composition within them varied across the study area; in places the hedgerows were species poor and gappy and in other areas hedgerows were mature and long established with a good variety of species which included ferns and bryophytes. A notably mature hedgerow was recorded along an existing farm track in the northeast of the study area leading to an

old farmstead. OSi mapping indicates that the hedgerow system and farmstead at this location; which are outside the direct footprint of the project; have been present for almost 200-years. The hedgerow leading to the farmstead consisted of a tall earthen bank which was covered in a dense bryophyte under-layer composed of abundant *Thuidium tamariscinum* moss. A good variety of ferns were also recorded and included frequently occurring Soft shield fern *Polystichum setiferum*, Male fern *Dryopteris filix-mas*, Broad buckler fern *Dryopteris dilatata* and Black spleenwort *Asplenium adiantum-nigrum*. Other herbaceous plants present included frequent Common dog violet *Viola riviniana*, Bugle *Ajuga reptans,* Red fescue *Festuca rubra,* Creeping bent and occasional Foxglove *Digitalis purpurea*, Bramble, Marsh bedstraw *Galium palustre*, Germander speedwell *Veronica chamaedrys*, Sweet vernal grass *Anthoxanthum odoratum*, Yorkshire fog *Holcus lanatus* and Cocksfoot *Dactylis glomerata*. The presence of woodland species component in the hedgerow is likely to be a result of the shading from nearby mature trees in the adjacent farmstead and from the adjacent Coniferous plantation which is c 15-20m in height.

In other areas, hedgerows were low and treeless and composed of abundant Billberry *Vaccinium myrtillus*. This plant is found mostly on acid heathland and damp mountainsides. Its presence in the hedgerow denotes the upland nature of the area and is likely a remnant population from when heath habitat was more common in the area prior to agricultural intensification and afforestation.

Hedgerows often form refuges for plant species which may have occurred more frequently in the landscape in the past. Woodland flora was well represented in the hedgerows across the study area along with heathland species such as *Vaccinium myrtilus* indicative of the upland nature of the area.

Hedgerow (WL1) habitat located within the study area is evaluated as being of Local Importance (Higher Value). While the hedgerow was highly managed or in poor condition in some places, many of the hedgerows were well established with a good species assemblage present. Hedgerows are important ecological corridors, providing habitat for insects (e.g. white tailed bumble bees were recorded entering and exiting hedgerows) and supports plants which provide food and shelter to pollinating insects, birds and other fauna and is as such beneficial to the local biodiversity.

Conifer Plantation (WD4)

Large blocks of commercial conifer plantations (WD4) of various age classes occur throughout the wind farm study area. The commercial conifer plantation consists predominately of 1st rotation plantations which are at various stages of maturity. The age classes present are dominated by blocks of mature and semi-mature closed canopy plantations (**Plate 5.3**). The conifer plantations present are typically species poor; dominated by regular, uniform stands of commercial timber tree species including Sitka Spruce *Picea sitchensis*. Along some of the conifer plantation edges, a narrow band of deciduous tree species such as Alder *Alnus glutinosa,* Beech *Fagus sylvatica* and Birches (*e.g.* Silver Birch *Betula pendula* and Downy Birch *B. pubescens*) have also been planted.

Plate 5.3: Conifer Plantation (WD4)

The conifer plantation ground flora is typically poor but includes occasional Common Bent *Agrostis capillaris*, Wood Sorrel *Oxalis acetosella* and mosses such as *Rhytidiadelphus squarrosus*, *Hypnum jutlandicum* and *Thuidium tamariscinum*. The ground flora can be mostly found along the plantation edges as; away from the edge towards the centre of the forest; the canopy closes in, light levels are much reduced and the ground layer consists predominately of a dense layer of dead and decaying conifer leaf litter. Narrow verges of semi-natural wet grassland (GS4; as described below) also persist along drainage channels adjacent to the conifer plantation.

Commercial conifer plantations are highly modified habitat types which are species poor and dominated by uniform stands of commercial timber species (e.g. Sitka Spruce) and, as such, are of Local importance (lower value).

Treelines (WL2)

Plate 5.4: Treelines (WL2)

Treeline habitat (WL2) occurred in places within the study area, albeit hedgerows were largely low growing. The main concentrations of treelines were recorded in the northeastern part of the wind farm site largely around farm settlements or along farm tracks and public roads.

Species assemblage consisted of frequently occurring mature Whitethorn, occasionally occurring Beech, Sycamore, Holly, Ash and rarely occurring Horse chestnut *Aesculus hippocastanum*. The shrub layer was composed of frequent Ivy, Bramble and Gorse with occasional Honeysuckle and Dog rose. Moss cover was high on the more shaded banks of the treeline habitats leading to the old farmstead in the northeast of the site and included species such as *Thuidium tamarascum*, *Polytrichum commune* and *Dircranium* spp. The broadleaved component consisted of frequently occurring Soft shield fern *Polystichum setiferum*, Male fern *Dryopteris filix-mas*, Broad buckler fern *Dryopteris dilatata* and Black spleenwort *Asplenium adiantum-nigrum*. Other herbaceous plants present included frequent Common dog violet *Viola riviniana*, Bugle *Ajuga reptans,* Red fescue *Festuca rubra,* Creeping bent and occasional Foxglove *Digitalis purpurea*, Bramble, Marsh bedstraw *Galium palustre*, Germander speedwell *Veronica chamaedrys*, Sweet vernal grass *Anthoxanthum odoratum*, Yorkshire fog *HoLCus lanatus* and Cocksfoot *Dactylis glomerata*.

Treelines are evaluated as Local Importance (Higher value). The treelines connect patches of woodland and/or scrub, forming an important network of connections between habitats. In addition, as with hedgerows, treelines also provide foraging,

shelter and commuting opportunities for a range of fauna including insects, bats and birds as well as nesting opportunities for birds.

Mixed Broadleaved Woodland (WD1)

Small fragments of mixed broadleaved woodland were found throughout the study area along the margins of conifer plantation, in the north of the wind farm site surrounding old farm sheds and to the northwest of the site along the Knocknabranagh & Knockbaun Stream. Species within the mixed broadleaved woodland largely consisted of frequent Grey willow, Ash, Alder and occasional Sycamore. Ground flora consisted of grasses such as frequent Yorkshire fog, Creeping bent and False oat grass with occasional Common rush, nettles and brambles.

The mixed broadleaved woodland, while limited in extent and fragmented in nature, is evaluated as Local Importance (Higher value) due to its value in supporting local biodiversity.

Recently Felled Woodland (WS5)

Recently felled woodland was located in the west of the wind farm site within the commercial conifer plantation. Rosebay willow herb was abundant where felling had occurred along with Common rush and False oat grass.

The recently felled woodland is evaluated as Local Importance (Lower value) due to its highly managed and disturbed nature.

Immature Woodland (WS2)

Immature woodland was located in the west of the wind farm site amongst the conifer plantation where the forestry crop had been felled and newly planted Sitka Spruce saplings had been planted. Ground flora consisted of frequent Rosebay Willowherb, Nettle and Bramble.

The immature woodland is evaluated as Local Importance (Lower value) due to the highly managed nature of the commercial forestry works.

Wet Grassland (GS4)

Plate 5.5: Wet Grassland (GS4)

Wet Grassland (GS4) is described as wet or waterlogged mineral or organic soils that are poorly-drained or, in some cases, subjected to seasonal or periodic flooding. On sloping ground, wet grassland is mainly confined to clay-rich gleys and loams, or organic soils that are wet but not waterlogged. In the study area, Wet Grassland (GS4) habitat type occurred largely in the north central and western part of the site where the Knockbrannagh and Knockbaun stream runs. Several man-made drains for agriculture and forestry have been cut along the perimeter of the fields in this area however the vegetation indicates that ground conditions are still moist. Many of the wet grassland fields appear to have been improved but are reverting to a more semi-improved wet grassland type due to the moist ground conditions. The habitat is composed of abundant Soft rush *Juncus effusus* and frequently occurring Creeping buttercup, White clover, Yorkshire fog, Crested dogs tail, Creeping bent, Common sorrel, Broad leaved Dock, Creeping bent. Occasionally occurring species included Sharp-flowered rush *Juncus acutiflorus*, Cuckoo flower *Cardamine pratensis*, Common mouse ear *Cerastium fontanum*, Meadow buttercup, Colstfoot *Tussilago farfara*, Sweet vernal grass, Selfheal *Prunella vulgaris*, Marsh thistle *Cirsium palustre* and Catsear *Hypochaeris radicata*.

Wet Grassland located at the site of the proposed turbine T3 had a higher ecological value than other wet grassland areas due to the diversity and abundance of species within the grassland sward. This area is approaching Annex I Molina meadows status with good representation of positive indicator species for this Annex I habitat. The grassland sward at the location of T3 included an abundance of wetland moss *Calliergonella cuspidata* (Pointed Spear-moss) within the ground layer. The grassland sward is composed of abundant Yorkshire Fog frequent Sharp-flowered rush, Tufted-hair grass *Deschampsia cespitosa*, Creeping bent, Red fescue and a number of sedges including Glaucus Sedge *Carex flacca*, Star sedge *Carex echinata*, Oval sedge *Carex leporina*. Occasional species included Sweet vernal grass, Tormentil

Potentilla erecta, Marsh thistle, Meadow buttercup, Common sorrel, Molina *Molinia caerula*. A wetter area within the same field contained frequently occurring Marsh cinquefoil *Comarum palustre* with occasional Marsh willowherb *Epilobium palustre,* Creeping buttercup, Tormentil, Star sedge, Oval Sedge Tufted-hair grass and Marsh speedwell. Clumps of immature willow *Salix cinerea* were also recorded rarely. A similar higher value type wet grassland was also recorded on either side of the Knocknabrannagh and Knockbaun stream in the northwest of the wind farm site.

Wet Grassland (GS4) habitat located within the study area is evaluated as being of Local Importance (Higher Value). It is locally important for biodiversity as much of the surrounding grasslands have been converted to improved agricultural grassland. Wet grasslands and the water features (drains, water filled hollows) within this habitat provide important habitat for amphibians and invertebrates, which in turn provide food for breeding birds and their chicks, as well as bat species. The field where turbine T3, and its associated crane hardstanding and access track; will be located is a wet grassland type that is considered of higher ecological value due to the greater variety and type of species present. The species recorded here were also positive indicators for the Annex I grassland Molinia Meadows or 6410 Molinia meadows on calcareous, peaty or clayey silt laden soils (*Molinion caeruleae*). A similar habitat of high value wet grassland is also present along both sides of the stream in the northwest of the site.

Dry Meadows and Grassy Verges (GS2)

Plate 5.6: Dry Meadows and Grassy Verges (GS2) habitat; Common Blue butterfly on Common knapweed

Dry meadows that are rarely fertilised or grazed and are mown only once or twice per annum and can be seen most commonly on grassy roadside verges. Within the study area, the habitat was recorded along the coniferous forestry tracks and margins of the farm tracks. Species included grasses such as the frequently occurring Cocksfoot, Yorkshire fog, False oat grass and broadleaved plants such as Common knapweed and occasional Common birds foot trefoil, Eyebright, Marsh thistle, Rosebay-Willowherb, White clover, Red Clover, Selfheal and Ragwort.

The Dry Meadows and Grassy Verge (GS2) habitat is evaluated as being of Local Importance (Higher Value) due to the range of flowering plant species present in this habitat which are beneficial to local invertebrates and, in turn, are important components which support local biodiversity.

Eroding Upland Rivers (FW1)

Plate 5.7: Eroding Upland River (FW1)

2 no. main streams flow through the study area; the Knocknabranagh & Knockbaun Stream and the Coolcullen Stream. The streams drain in a northerly direction and join together (Coolcullen River) before flowing into the River Dinin (South) which is itself a tributary of the River Nore and forms part of the River Barrow and River Nore SAC (002162). The streams are small in size, c. 1-3m wide, and shallow, c. 10-60cm of water.

In the north centre of the site between T5 and T6 where a crossing of the Knocknabranagh and Knockbaun Stream is located, the stream runs through coniferous forestry plantation. Tree planting has not taken place within 10m on either side resulting in a wet grassland type habitat on the banks of the stream at this location. The base of the stream here is composed of cobble gravel substrate. Instream flora was rare and included the aquatic moss *Fontinalis antipyretica* located on stones and rocks. Other plant species present on the stream banks included frequent Tufted hair grass, Yorkshire fog, Sharp-flowered rush, Soft rush with occasional Meadowsweet *Fillipendula ulmaria,* Tormentil, Marsh woundwort *Stachys palustris,* Bramble, Creeping buttercup and rarely occurring Lesser stitchwort *Stellaria graminea* and Bitter vetch *Lathyrus linifolius*. This stream bank vegetation is considered to be wet grassland of high ecological value due to the variety of species present.

Further east, the Coolcullen Stream runs through improved agricultural grassland. At this location, the instream flora was more plentiful with frequent Water cress, Floating sweet grass *Glyceria fluitans* Round leaved water crowfoot *Ranunculus omiophyllus* and occasional Water figwort Scrophularia *auriculata,* Hemlock water dropwort *Oenanthe crocata*. Bankside vegetation included frequent Yorkshire fog, Bramble, Meadowsweet, Soft rush, Gorse and Nettle *Urtica dioeca* with occasional Marsh woundwort and Angelica *Angelica sylvestris*. Cattle poaching and access to the Coolcullen Stream was evident in places. A ford is present in the north of the site where this stream crosses over a farm track.

The Upland Eroding River habitat is evaluated as being of Local Importance (Higher Value). While small in size, these linear aquatic and wetland habitats support specialist aquatic plant communities which enhance local biodiversity and function as eco-corridors. They also provide habitat to support amphibians and invertebrates, which in turn provide food for birds and their chicks as well as other fauna such as bat species. Eroding Upland Rivers can support habitat which corresponds to the EU Habitats Directive Annex I watercourses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation (3260); however the streams within the study area do not support this Annex I habitat type.

Drainage Ditch (FW4)

Plate 5.8: Drainage ditch (FW4)

A network of drainage ditches have been installed along the majority of the field boundaries across the study area as part of drainage measures for agricultural land improvements and for commercial afforestation. Many of the drains were dry and overgrown or had a muddy base with species assemblage composed of grasses such as the frequently occurring Yorkshire fog, Cocksfoot, Soft rush and Creeping buttercup with occasional Bramble, Rosebay willowherb, Marsh thistle, Tufted-hair grass, Aquatic ragwort and Nettle. In more moist drains, Round-leaved water crowfoot and Floating sweet grass were recorded.

The Drainage Ditch habitat is evaluated as being of Local Importance (Lower Value). While these habitats are valuable in supporting aquatic flora and fauna, they are routinely cleared and, due to the disturbed nature of the habitat, they are classified as being of local importance with lower ecological value.

Scrub (WS1)

Plate 5.9: Scrub (WS1)

Scrub is a habitat type dominated by at least 50% cover of shrubs, stunted trees or brambles. The canopy height is generally less than 5m, or 4m in the case of wetland areas. Scrub habitat was recorded within the study area near the site entrances in the northeast of the wind farm, along margins and firebreaks of coniferous forest plantation and within the proposed borrow pit to the northeast of the wind farm. Species recorded within the scrub habitat included frequently occurring Grey willow, Gorse, Bramble, Blackthorn and Hawthorn. Herbaceous species included frequently occurring Yorkshire fog, Marsh thistle, Nettle, Creeping bent, occasionally occurring Devils bit scabious *Succisa pratensis* and rarely occurring Broom *Cytisus scoparius.*

The Scrub habitat is evaluated as being of Local Importance (Lower Value) as it is limited in extent. However, scrub is an important breeding and foraging habitat for birds and other fauna and supporting local biodiversity in general and should be retained where possible.

Exposed Siliceous Rock (ER1)

A small area of exposed rock was recorded within a former quarry (now proposed as a borrow pit) in the northeast of the wind farm site. This area is now mostly overgrown, with Wet Grassland (GS4) and Scrub (WS1) habitat dominating. Mosses such as Pointed-spear moss *Calliergonella cuspidata* and *Fiscidians* spp. occasionally occurred. The lichen *Ochrolechia parella* was also growing on the rock face. Plant species colonising crevices in the rock face included Ox-eye daisy, Red fescue and Creeping bent grass.

Exposed Siliceous Rock is evaluated as being of Local Importance (Lower Value).

Plate 5.10: Exposed Siliceous Rock (ER1)

Spoil and Bare Ground (ED2)

The spoil and bare ground habitat (ED2) was largely located along the extensive network of farm and forestry tracks that are located throughout the study area. This bare ground area consisted of mud tracks or tracks with hardcore gravel laid along them. In places, the tracks had a strip of low growing vegetation running along the centre including frequent Yorkshire fog, Creeping bent, Annual meadow grass, Dandelion and Daisy. The majority of the access tracks present are regularly maintained/disturbed; and, due to the level of management and/or disturbance, there is little or no vegetation present on the main tracks. However, along track edges, which are subjected to less ongoing disturbance, vegetation has begun to recolonise in parts forming Dry Meadows and Grassy Verges (GS2) habitat type.

Plate 5.11: Spoil and bare ground (ED2) along existing forestry track

The Spoil and Bare Ground habitat present is a modified habitat type persisting as a result of resurfacing works and or ongoing maintenance (**Plate 5.11**). However, where vegetation has begun to re-establish (e.g. Recolonising Bare Ground (ED3)); along the centre and edge of tracks or in areas subject to lower disturbance levels; opportunities for wildflowers and plants of pollinator value to grow are introduced including occasionally occurring Common Knapweed, Common birds-foot trefoil, Pine-apple weed, Daisy and Colts-foot.

The Spoil and Bare Ground habitat is evaluated as being of Local importance (Lower value) ecological value.

Stone Walls and Other Stonework (BL1)

Plate 5.12: Stone Walls and Other Stonework (BL1)

This category incorporates stone walls and most other built stone structures in rural and urban situations, apart from intact buildings (Fossitt, 2000).

A number of stonewall house structures were clustered in the north of the study area at an old farmstead with an old dwelling and farm buildings. The structures here are stone built with corrugated rooves some of which have collapsed in some of the buildings. Plant species colonsing the old stone walls included frequent Ivy and Polypodium fern which was growing on the old wall tops in dense stands and occasional Bramble, Nettle, Herb Robert, Maiden-hair Spleenwort *Asplenium trichomanes* and the *Brachythecium* moss species. The yellow lichen *Xanthoria parietina* was also growing on the stone walls.

The stone walls and ruined buildings are evaluated as being of Local Importance (Higher Value) as the structures provide cover, shelter and potential nesting and foraging opportunities for a range of species including birds, bats and invertebrates.

Non-native Invasive Species

2 no. non-native invasive plant species (see **Table 5.12**), Sycamore *Acer pseudoplatanus* and *Montbretia* were recorded within the study area. Both of these species are classified as being of medium and low invasive species. With regards to Sycamore, there has been more recent discussion on whether Sycamore may now be considered as an archaeophyte here (i.e. ancient introductions; see Stolze & Monecke 2017.

Common Name	Scientific Name	Listed in Third Schedule Part I * (Y/N)	Risk Rating (Kelly *et al.*, 2013) and/or NBDC Risk rating
Sycamore	*Acer pseudoplatanus*	N	Medium
Montbretia	*Crocosmia x crocosmiiflora*	N	Low

Table 5.12: Non-native Invasive Species Recorded and their risk rating according to NBDC and Kelly *et al.*, (2013)

Habitats along the Grid Connection Route

Most of the circa 15km grid connection route follows public roads (*i.e.* buildings and artificial surfaces habitat (BL3) between the wind farm site and Kilkenny 110kV substation; with works to be undertaken within the paved surface.

Habitats present within the grid connection route or immediately adjacent to the works footprint include roads (BL3), roadside verges (i.e. dry meadow and grassy verge GS2) and stone walls and other stonework (BL1) (i.e. bridges), improved agricultural grassland (GA1), conifer plantation (WD4), Scrub (WS1), Arable crops (BC1), Mixed broadleaved woodland (WD1), hedgerows (WL1) and/or treelines (WL2) and residential properties (i.e. buildings and artificial surfaces (BL3), amenity grassland (GA2), and non-native shrubberies (WS3) etc.).

As the grid connection infrastructure will be buried within the paved surface, the habitats and plants adjoining the road will be undisturbed.

Horizontal Directional Drilling (HDD) will occur at 3 no. locations along the grid connection route. The HDD will be required to avoid trenching/excavations within bridging structures which traverse 2 no. unnamed local watercourses, and the Kilderry stream. Launch and receptor pits will be excavated at either side of the crossings to accommodate the drilling rig.

No Third Schedule non-native invasive species were recorded along the grid connection route when surveyed in June 2021. The 3 no. HDD crossing locations on and the works areas on the turbine component haul route were revisited in April, May and August 2022 as part of a baseline assessment of potential ecological constraints. No Third Schedule Invasive species were recorded at these sites.

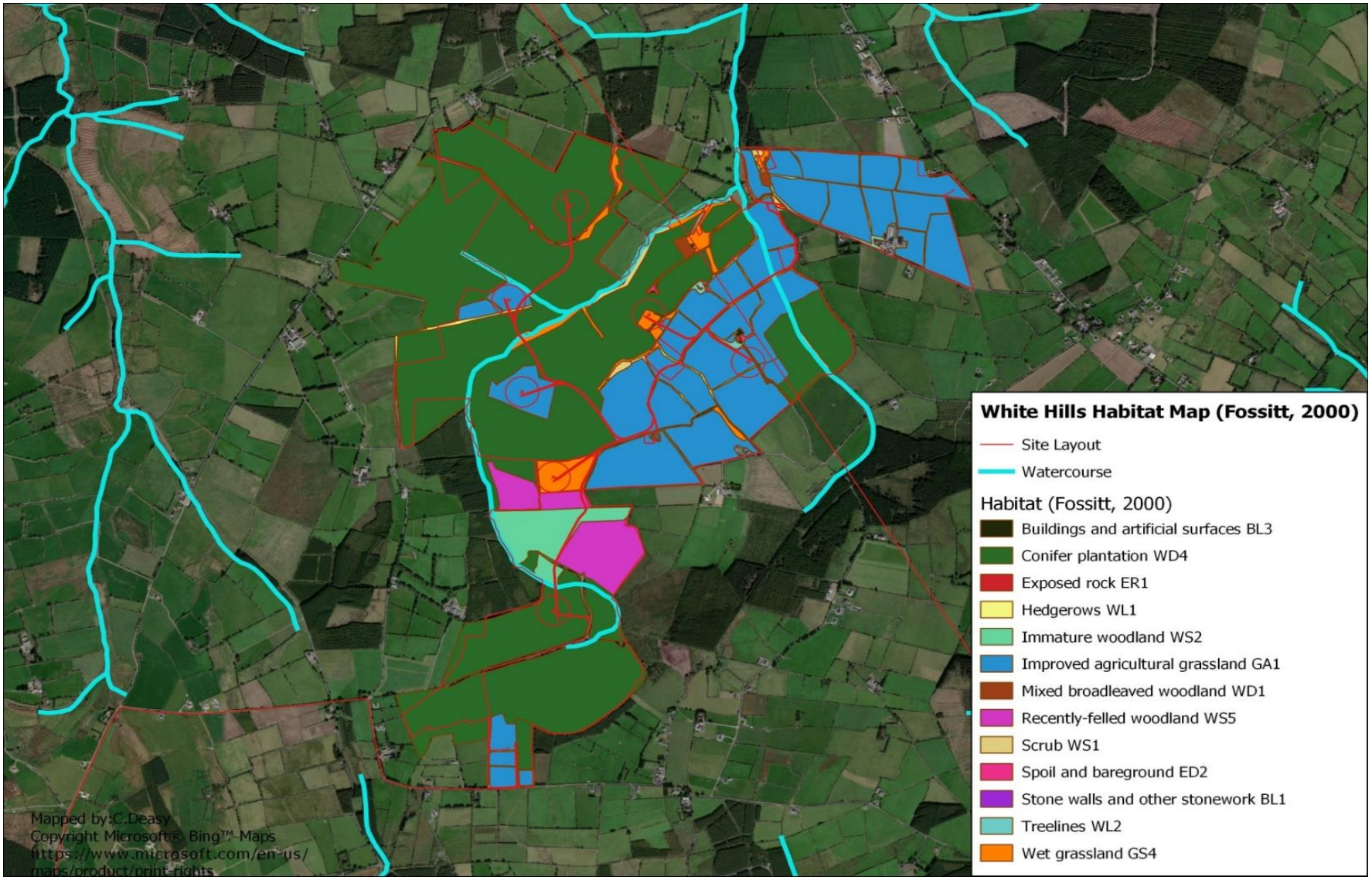

Figure 5.12: Habitat Map (Fossitt, 2000) of the Study Area

Replant Lands

The forestry replant lands were surveyed on 8 March 2022.

The dominant habitat present is improved agricultural grassland (GA1). Other habitats include, hedgerow (WL1), drainage ditches (FW4) and treelines (WL2).

Areas of GA1 contained species commonly found in this habitat type such as Ryegrasses (*Lolium* spp.) Clovers (*Trifolium* spp.) and Dandelions (*Taraxacum* spp.). WS1 occurs in mosaic with the GA1 habitats in the southern portion of the site, mostly dominated by Gorse (*Ulex europaeus*).

The hedgerows and treeline habitats were comprised of mostly native or naturalised species such as Ash, Hawthorn (*Crataegus mongyna*), Holly (*Ilex* aquifolum), Sycamore (*Acer pseudoplatanus*) and Beech (*Fagus sylvatica*), with understories of Ivy (*Helix hedera*) and Bramble (*Rubus fruticosus* agg.).

No evidence of burrows or resting places associated with protected mammal species (e.g. Badger Sett) was found. Frog Spawn was present in some ponding areas on site and in drainage ditches. No significant watercourses are present on site, and drainage is provided by man-made ditches within some field boundaries.

The replant lands are intensively managed at present. Areas of hedgerow (WL1) and treelines (WL2) support some local biodiversity, The site relatively intensively managed and contains some seminatural features which are common in a local context, the site overall is considered to be of local importance, lower value.

5.3.3 Birds

5.3.3.1 Vantage Point Surveys

3 no. winter and 2 no. breeding VP survey seasons were completed by March 2022. This provides a greater amount of seasonal coverage than the minimum 2-years of survey data recommended in the SNH Guidelines (SNH, 2017). For the 2020 and 2021 breeding and 2020/2021 and 2021/2022 winter survey season, the minimum recommended survey coverage of 36-hours observations per VP was achieved. In the first winter survey period, the observations began in November and 30-hours coverage per VP was achieved. **Annex 5.1** provides the details of the survey schedule and weather details for each of the survey visits.

Winter Season 2019/2020

A total of 118 no. flightlines of target bird species were recorded between November 2019 and March 2020 (**Annex 5.3**). **Table 5.13** summarises the cumulative total of time each species was observed within and outside of the application site.

5 no. species of raptor were recorded during this winter VP survey, with an additional species recorded and identified as a probable Goshawk, *Accipiter gentilis*. The bulk of the raptor sightings were Buzzard, *Buteo buteo* (44 no. flightlines) and Kestrel, *Falco tinnunculus* (42 no. flightlines). Sparrowhawk, *Accipiter nisus* (15 no. flightlines) was also fairly regularly recorded.

There were 2 no. sightings of 'Ringtail' (Female/Immature bird) Hen Harrier, *Circus cyaneus* during the VP watches. Both of these sightings were made on the 11 December 2019 and are likely to have involved the same bird. There was 1 no. additional sighting of a Ringtail made on 15 January 2020, as the observer made his way back to his vehicle from VP2 at the end of his watch. Hen Harriers, particularly female and juvenile birds, are highly mobile outside of the breeding season and may

be recorded in areas distant from preferred breeding and wintering habitats during this time of year (O'Donoghue 2021).

The only other raptor species recorded during the winter VPs in 2019/2020 was a single observation of Peregrine Falcon, *Falco peregrinus*.

Buzzards were frequently observed circling and soaring above the study area and this typical flight behaviour explains the duration of time the species was observed in flight over the application site (over 38-minutes) and outside of the wind farm site (over 77-minutes). Kestrels, were mostly observed hunting and commuting outside of the wind farm site with a relatively short time spent within the wind farm site (c. 5-minutes). Hen Harrier was only present within the wind farm site for a total of 1-minute and Peregrine Falcon did not occur within the application site during the winter VP watches in 2019/2020.

10 no. flightlines were observed for Golden Plover, *Pluvialis apricaria*, with the largest flock of this wintering wader observed being c. 300 no. birds, seen on 29 November 2019. Golden Plovers were observed circling and commuting widely across the areas under observation. Flocks were present in flight for over 50-minutes of total observation time, but only 2-minutes 10-seconds of this time was spent within the wind farm site.

The only other wading bird recorded was Snipe, *Gallinago gallinago*, with 1 no. flightline noted. This bird did not overfly the wind farm site. There was also 1 no. sighting of a Lesser Black-backed Gull, *Larus fuscus*, in flight; but the bird did not overfly the wind farm site.

Great Spotted Woodpecker, *Dendrocopus major*, a recent colonist, was recorded on several occasions and from several of the VP locations.

Winter Season 2019/2020 - 118 no. flightlines			
Species	**No. of flightlines**	**Duration On-site (s)**	**Duration Off-site (s)**
Raptors			
Buzzard	44	2305 [38min 25s]	4650 [1hr 17min 30s]
Kestrel	42	310 [5m 10s]	4785 [1hr 19min 45s]
Sparrowhawk	15	160 [2min 40s]	570 [9min 30s]
Hawk (possible Goshawk)	2	30 [30s]	110 [1min 50s]
Hen Harrier	2	60 [1min 0s]	60 [1min 0s]
Peregrine FaLCon	1	0	45 [45s]
Waders			
Golden Plover	10	130 [2min 10s]	2955 [49min 15s]
Snipe	1	0	70 [1min 10s]
Waterbirds			
Lesser Black-backed Gull	1	0	70 [1min 10s]

Table 5.13: Winter Season 2019/2020 Flightline Summary

The flightline descriptions are summarised at **Annex 5.3**. The associated flightline mapping is presented in **Annex 5.3** with each flightline marked with the corresponding Flightline ID from the tables provided.

The overall bird species recorded as casual observations by the VP observers during this winter period is summarised in **Table 5.14**.

Species	Species
Blackbird	Lesser Black-backed Gull
Blue Tit	Linnet
Bullfinch	Long-tailed Tit
Buzzard	Magpie
Chaffinch	Meadow Pipit
Coal Tit	Mistle Thrush
Collared Dove	Peregrine Falcon
Dunnock	Pheasant
Feral Pigeon	Pied Wagtail
Fieldfare	Raven
Goldcrest	Redwing
Golden Plover	Reed Bunting
Goldfinch	Robin
Great Spotted Woodpecker	Rook
Great Tit	Siskin
Greenfinch	Skylark
Grey Wagtail	Snipe
Hen Harrier	Song Thrush
Herring Gull	Sparrowhawk
Hooded Crow	Starling
House Sparrow	Stonechat
Jackdaw	Woodpigeon
Jay	Wren
Kestrel	

Table 5.14: Casual Bird Observations during Winter Season 2019/2020

Breeding Season 2020

A total of 142 no. flightlines of target bird species were recorded between March 2020 and August 2020 (**Annex 5.3**). **Table 5.15** summarises the cumulative total of time each species was observed within and outside of the wind farm site.

3 no. species of raptor were recorded during the breeding season VP survey. One species dominated the sightings with a total of 108 no. flightlines of Buzzard recorded during this period. Display flights, circling and soaring were commonly observed. Several individuals were present with observations of up to 3 no. birds flying together noted. Buzzard adults and young were recorded confirming local breeding pairs. Of the flightlines observed Buzzards were seen over the wind farm site for over 78-minutes cumulatively during the 2020 breeding season period. As can be inferred from the

flightlines, the bulk of the observations of Buzzards were of birds flying outside of the wind farm site (total time over 4-hours).

There were a small number of flightlines of Kestrel and Sparrowhawk noted during the 2020 breeding season (**Annex 5.3**). In total, Kestrel were present over the wind farm site for only 50-seconds and Sparrowhawk for 165-seconds.

There were 7 no. flightlines noted for Golden Plover. All of these observations were made in April 2020. Highly mobile flocks were recorded, with the largest flock noted being of 269 no. birds (**Annex 5.3**). A number of the flightlines crossed the wind farm site, with Golden Plovers spending a total of 14-minutes and 5-seconds over the site during the summer VP survey.

There were 2 no. sightings of commuting Curlew, *Numenius arquata*. Both were sightings of commuting single individuals, the first in May and the second in July 2020. The birds passed through the observation area but did not overfly the wind farm site (**Annex 5.3**).

Lesser Black-backed Gulls (4 no. flightlines) and Herring Gull (1 no. flightline) were observed with Lesser Black-backed Gulls recorded overflying the wind farm site (**Annex 5.3**). There were also several flightlines recorded of Grey Heron, *Ardea cinerea* during the 2020 breeding VP surveys. Grey Heron was recorded overflying the wind farm site for a total of 40-seconds during the 2020 breeding season observation period.

The associated flightline mapping for this period is presented in **Annex 5.3** with each flightline marked with the corresponding flightline ID from the corresponding table for this survey season also provided in **Annex 5.3**.

The overall bird species recorded as casual observations by the VP observers during this winter period is summarised in **Table 5.16**. The bird species recorded were typical of the farmland and conifer plantation habitats that dominate the local landscape. The common resident species were augmented by summer migrants including Cuckoo, *Cuculus canorus*, House Martin, *Delichon urbicum* and Swallow, *Hirundo rustica*.

Breeding Season 2020 - 142 no. flightlines			
Species	**No. of flightlines**	**Duration On-site (s)**	**Duration Off-site (s)**
Raptors			
Buzzard	108	4720 [1hr 18min 40s]	14625 [4hr 3min 35s]
Kestrel	8	50 [50s]	225 [3min 45s]
Sparrowhawk	8	165 [2min 45s]	285 [4min 45s]
Waders			
Golden Plover	7	845 [14min 5s]	400 [6min 40s]
Curlew	2	0	65 [1min 5s]
Waterbirds			
Lesser Black-backed Gull	4	225 [3min 45s]	425 [7min 5s]
Herring Gull	1	0	20 [20s]
Grey Heron	4	40 [40s]	165 [2min 45s]

Table 5.15: Breeding Season 2020 Flightline Summary

Species	Species
Blackbird	Lesser Black-backed Gull
Blackcap	Lesser Redpoll
Blue Tit	Linnet
Bullfinch	Magpie
Buzzard	Meadow Pipit
Chaffinch	Mistle Thrush
Chiffchaff	Pheasant
Coal Tit	Pied Wagtail
Collared Dove	Raven
Crossbill	Redwing
Cuckoo	Reed Bunting
Curlew	Robin
Dunnock	Rook
Feral Pigeon	Sand Martin
Fieldfare	Siskin
Goldcrest	Skylark
Golden Plover	Song Thrush
Goldfinch	Sparrowhawk
Great Tit	Starling
Grey Heron	Stock Dove
Grey Wagtail	Stonechat
Herring Gull	Swallow
Hooded Crow	Swift
House Martin	Tree Sparrow
House Sparrow	Whitethroat
Jackdaw	Willow Warbler
Jay	Woodpigeon
Kestrel	Wren

Table 5.16: Bird Observations during 2020 Breeding Season

Winter Season 2020/2021

A total of 186 no. flightlines of target bird species were recorded between October 2020 and March 2021. **Table 5.17** summarises the cumulative time each species was observed within and outside of the application site.

4 no. raptor species were recorded during this winter VP survey. All four species, Buzzard, Kestrel, Sparrowhawk and Peregrine Falcon had also been recorded at the site in the previous winter VP period. Consistent with the results of the previous winter,

2 no. species dominated the sightings, Buzzard (50 no. flightlines) and Kestrel (45 no. flightlines).

Sparrowhawk (23 no. flightlines) was recorded more often than in the previous winter period and display flight (courtship) was recorded on several occasions.

The only other raptor species recorded during the winter VPs in 2020/2021 was 2 no. observations of Peregrine Falcon, neither flightline over the wind farm site.

As in the previous winter period, Buzzards were recorded widely across the study area. Circling and soaring flights were common and interactions between multiple individuals was noted. Cumulatively, Buzzards were observed in flight for c. 83-minutes, with a little over 20-minutes of these observations made of birds within the wind farm site.

Kestrels were also observed frequently, although few flights crossed the wind farm site. This was also consistent with the previous winter's observations. Sparrowhawk spent a greater cumulative period flying within the wind farm site (over 9-minutes).

The most notable difference between the observations made in winter 2020/2021 and the previous winter period was the number of flightlines recorded of Golden Plover. Wintering flocks of Golden Plover are highly mobile and their numbers can fluctuate significantly inter-annually (e.g. Gillings & Fuller, 1999). Interestingly, the observations were concentrated in the early and late winter periods, with 34 no. of the flightlines recorded in the October-November VP watches and 18 no. of the flightlines observed in March 2021. No Golden Plover flightlines were recorded at the site in January or February 2021. This pattern of occasional occurrence is not unusual for this highly mobile, flocking species. In total, Golden Plovers were recorded for almost 10.5-hours, nearly 2-hours of which the birds were overflying the wind farm site.

There were 7 no. flightlines recorded of Snipe, with observations of small numbers of commuting birds most likely on passage migration, in October 2020. Cumulatively, these birds were only recorded overflying the wind farm site for 1-minute 35-seconds (**Annex 5.3**).

Flightlines were recorded of 2 no. waterbird species, Herring Gull (1 no. flightline) and Grey Heron (5 no. flightlines). The observations of both species were brief and Herring Gull did not overfly the wind farm site.

Winter Season 2020/2021 - 186 no. flightlines			
Species	**No. of flightlines**	**Duration On-site (s)**	**Duration Off-site (s)**
Raptors			
Buzzard	50	1,205 [20min 5s]	3,761 [1hr 2min 41s]
Kestrel	45	50 [50s]	4,650 [1hr 17min 30s]
Sparrowhawk	23	550 [9min 10s]	515 [8min 35s]
Peregrine FaLCon	2	0	100 [1min 40s]
Waders			
Golden Plover	53	7,100 [1hr 58min 20s]	30,265 [8hr 24min 25s]
Snipe	7	95 [1 min 35s]	300 [5min 0s]
Waterbirds			
Herring Gull	1	0	40 [40s]

Winter Season 2020/2021 - 186 no. flightlines			
Grey Heron	5	80 [1min 20s]	95 [1min 35s]

Table 5.17: Winter Season 2020/2021 Flightline Summary

The flightline descriptions are summarised in **Annex 5.3**. The associated flightline mapping for this season is also presented in **Annex 5.3** with each flightline marked with the corresponding flightline ID.

The overall bird species recorded as casual observations by the VP observers during this winter period is summarised in **Table 5.18**.

The species mix is again typical of the range of habitats present in the study area, with a variety of farmland and woodland birds represented. Winter migrant thrushes, Redwing, *Turdus iliacus* and Fieldfare, *Turdus viscivorus* were common and widespread at the wind farm site.

A less common passerine species, Tree Sparrow, *Passer montanus*, was recorded in several months from VP5 and VP6.

Species	Species
Blackbird	Linnet
Blue Tit	Long-tailed Tit
Bullfinch	Magpie
Buzzard	Meadow Pipit
Chaffinch	Mistle Thrush
Coal Tit	Peregrine Falcon
Collared Dove	Pheasant
Dunnock	Pied Wagtail
Feral Pigeon	Raven
Fieldfare	Redwing
Goldcrest	Reed Bunting
Golden Plover	Robin
Goldfinch	Rook
Great Spotted Woodpecker	Siskin
Great Tit	Skylark
Greenfinch	Snipe
Grey Heron	Song Thrush
Grey Wagtail	Sparrowhawk
Herring Gull	Starling
Hooded Crow	Stonechat
House Sparrow	Tree Sparrow
Jackdaw	Woodpigeon
Jay	Wren

Species	Species
Kestrel	Yellowhammer
Lesser Redpoll	

Table 5.18: Bird Observations during Winter Season 2020/2021

Breeding Season 2021

A total of 221 no. flightlines of target bird species were recorded between March 2021 and August 2021 (**Annex 5.3**). **Table 5.19** summarises the cumulative total of time each species was observed within and outside of the application site.

5 no. species of raptor were recorded during the breeding season VP survey. As in previous survey seasons at this site, Buzzard dominated the sightings with a total of 155 no. flightlines recorded during this period. Buzzard adults and young were recorded confirming local breeding pairs. Regular interactions between pairs of Buzzard were observed and circling and soaring birds were observed widely across the entire study area. Buzzards flightlines cumulatively accounted for over 76-minutes of flightline observations over the application site during the summer VP period. Buzzards were observed off-site for over 3.5-hours during these VP watches.

Kestrel was the next most frequently recorded target species in this breeding season period (21 no. flightlines). However, as in previous survey seasons, very little of the time when these birds were under observation was spent within the wind farm site (2-minutes 45-seconds).

A total of 14 no. flightlines were recorded for Sparrowhawk in this breeding season. It is likely that a pair bred locally based on the observations made during this breeding season. The cumulative duration spent overflying the site was under 5-minutes (**Table 5.19**).

The other 2 no. raptor species recorded during the 2021 breeding season VP surveys were Peregrine Falcon (1 no. flightline) and Hen Harrier (1 no. flightline). The sighting of Hen Harrier was of a Ringtail on the 13 August 2021. This is a time of year when Hen Harriers are post-breeding; and adults and young birds disperse from breeding grounds. In late summer, Hen Harrier are frequently recorded passing through areas where there is no resident breeding population (pers obs.).

The 4 no. flightlines noted for Golden Plover were all recorded early in the season, in March 2021. A number of the flightlines crossed the wind farm site, with Golden Plovers spending a total of 4-minutes 50-seconds over the site during the summer VP survey (**Table 5.19**).

Lesser Black-backed Gulls (21 no. flightlines) and Grey Heron (4 no. flightlines) were the other target species recorded during this summer period (**Table 5.19**; **Annex 5.3**). Commuting Lesser Black-backed Gulls were recorded during the May and June surveys. These Gulls frequently occur inland during the summer months, particularly associated with feeding opportunities in silage fields and during agricultural ploughing. Relatively small numbers of birds were recorded (largest flock comprised 9 no. birds).

The associated flightline mapping for this period is presented in **Annex 5.3** with each flightline marked with the corresponding flightline ID.

Breeding Season 2021 - 221 no. flightlines			
Species	**No. of flightlines**	**Duration On-site (s)**	**Duration Off-site (s)**
Raptors			
Buzzard	155	4,560 [1hr 16min 0s]	12,855 [3hr 34min 15s]
Kestrel	21	165 [2min 45s]	980 [16min 20s]
Sparrowhawk	14	280 [4min 40s]	560 [9min 20s]
Hen Harrier	1	45 [45s]	45 [45s]
Peregrine Falcon	1	0	30 [30s]
Waders			
Golden Plover	4	290 [4min 50s]	180 [3min 0s]
Waterbirds			
Lesser Black-backed Gull	21	455 [7min 35s]	815 [13min 35s]
Grey Heron	4	5 [5s]	170 [2min 50s]

Table 5.19: Breeding Season 2021 Flightline Summary

The overall bird species recorded as casual observations by the VP observers during this summer period is summarised in **Table 5.20**.

The species mix is typical of the range of habitats present in the study area, with a variety of farmland and woodland birds represented. The resident species were augmented by summer migrants including Sand Martin, *Riparia riparia* and Swift, *Apus apus*. Great Spotted Woodpecker were heard and seen regularly.

Species	Species
Blackbird	Lesser Redpoll
Blackcap	Linnet
Blue Tit	Long-tailed Tit
Bullfinch	Magpie
Buzzard	Meadow Pipit
Chaffinch	Mistle Thrush
Chiffchaff	Pheasant
Coal Tit	Pied Wagtail
Crossbill	Raven
Cuckoo	Redwing
Dunnock	Reed Bunting
Feral Pigeon	Robin
Fieldfare	Rook
Goldcrest	Sand Martin
Golden Plover	Siskin
Goldfinch	Skylark

Species	Species
Great Spotted Woodpecker	Song Thrush
Great Tit	Sparrowhawk
Greenfinch	Starling
Grey Heron	Stonechat
Grey Wagtail	Swallow
Hen Harrier	Swift
Hooded Crow	Tree Sparrow
House Martin	Whitethroat
House Sparrow	Willow Warbler
Jackdaw	Woodpigeon
Kestrel	Wren
Lesser Black-backed Gull	

Table 5.20: Bird Observations during 2021 Breeding Season

Winter Season 2021/2022

A total of 202 no. flightlines of target bird species were recorded between October 2021 and March 2022). **Table 5.21** summarises the cumulative time each species was observed within and outside of the application site.

4 no. raptor species were recorded during this winter VP survey, the same species that were recorded at the study area in the previous winter. In line with each of the previous two winter survey seasons, the flightline observations were dominated by 2 no. species, Buzzard (80 no. flightlines) and Kestrel (61 no. flightlines).

Sparrowhawk (27 no. flightlines) was recorded marginally more often than in the previous winter period. The only other raptor species recorded during the winter VPs in 2021/2022 was 2 no. observations of Peregrine Falcon (spending a cumulative total of 40-seconds within the wind farm site).

Buzzard flightlines totalled over 3-hours during this winter period. Of these observations, just over 47-minutes were spent within the wind farm site (**Annex 5.3**). Kestrels were frequently recorded, although in keeping with previous survey seasons, the bulk of the observations were of birds outside the wind farm site (**Annex 5.3**). However, of the 5 no. survey seasons, this was the period with the greatest cumulative amount of overflying of the wind farm site by both Kestrel (over 16-minutes) and Sparrowhawk (over 15-minutes).

In contrast to the previous winter period, there were few sightings of Golden Plover in the study area (5 no. flightlines) and none of the observed flights were across the wind farm site. No Golden Plover were present in December 2021 or February 2022 and there were only single observations made in November 2021 and January and March 2022.

There were relatively few sightings of Snipe (2 no. flightlines) and Lesser Black-backed Gulls (2 no. flightlines), with no flightlines across the wind farm site (**Annex 5.3**). 4 no. additional target waterbird species were observed. Of these, Grey Heron (13 no. flightlines) were cumulatively present over the site for 2-minutes. There were relatively

few and brief sightings of Little Egret, *Egretta garzetta* (2 no. flightlines), Mallard, *Anas platyrhynchos* (5 no. flightlines) and Teal, *Anas crecca* (2 no. flightlines).

Winter Season 2021/2022 – 202 no. flightlines			
Species	**No. of flightlines**	**Duration On-site (s)**	**Duration Off-site (s)**
Raptors			
Buzzard	80	2,845 [47min 25s]	8,150 [2hr 15min 50s]
Kestrel	61	995 [16min 35s]	6,945 [1hr 55min 45s]
Sparrowhawk	27	930 [15min 30s]	1,445 [24min 5s]
Peregrine FaLCon	2	40 [40s]	210 [3min 30s]
Waders			
Golden Plover	5	0	575 [9min 35s]
Snipe	3	0	50 [50s]
Waterbirds			
Lesser Black-backed Gull	2	0	275 [4min 35s]
Grey Heron	13	120 [2min 0s]	295 [4min 55s]
Little Egret	2	100 [1min 40s]	30 [30s]
Mallard	5	20 [20s]	105 [1min 45s]
Teal	2	5 [5s]	20 [20s]

Table 5.21: Winter Season 2021/2022 Flightline Summary

The flightline descriptions are summarised in **Annex 5.3**. The associated flightline mapping is presented in **Annex 5.3** with each flightline marked with the corresponding flightline ID.

The overall bird species recorded as casual observations by the VP observers during this winter period is summarised in **Table 5.22**.

The species mix is typical of the range of habitats present in the study area, with farmland and woodland birds well represented. Brambling, *Fringilla montifringilla*, is a wintering finch species, that was not recorded at the site in previous winter periods.

Species	Species
Blackbird	Little Egret
Blue Tit	Long-tailed Tit
Brambling	Magpie
Bullfinch	Mallard
Buzzard	Meadow Pipit
Chaffinch	Mistle Thrush
Coal Tit	Peregrine Falcon
Crossbill	Pheasant
Dunnock	Pied Wagtail
Feral Pigeon	Raven

Species	Species
Fieldfare	Redwing
Goldcrest	Reed Bunting
Golden Plover	Robin
Goldfinch	Rook
Great Spotted Woodpecker	Siskin
Great Tit	Skylark
Greenfinch	Snipe
Grey Heron	Song Thrush
Grey Wagtail	Sparrowhawk
Hooded Crow	Starling
House Sparrow	Stonechat
Jackdaw	Teal
Jay	Tree Sparrow
Kestrel	Whitethroat
Lesser Black-backed Gull	Woodpigeon
Lesser Redpoll	Wren
Linnet	

Table 5.22: Bird Observations during Winter Season 2021/2022

5.3.3.2 Transects and Point Count Surveys

Breeding and winter bird communities in the area were also recorded using standard belt transect and point count methodologies. The location of the transects and point counts is illustrated at Figure 5.5. Detailed results from the transects and point count surveys are presented at **Annex 5.4**.

A summary of the species recorded across the 5 no. survey seasons is provided in **Annex 5.4**. Overall, a total of 45 no. species were recorded in the breeding season period with 47 no. species recorded during the winter transects and point counts. Summary tables in **Annex 5.4** summarise the season in which each species was recorded as well as the current conservation status of the species in Ireland.

Winter Season 2019/2020

A total of 38 no. species were recorded across the 6 no. survey transects in Winter 2019/2020 (**Annex 5.4**). The peak counts observed for each species on each of the transects during the winter 2019/2020 survey walkovers is presented in the summary data table in **Annex 5.4**.

Golden Plover was recorded on Transect 1 and Transect 6, both observations being of flocks seen off-site at distance.

Annex 5.4 also presents the results of the Point Count surveys in the same period. A similar species assemblage was noted, with a total of 33 no. bird species recorded across the 10 no. Point Count locations.

Breeding Season 2020

A total of 36 no. species were recorded across the 6 no. survey transects in the 2020 breeding season (**Annex 5.4**). The peak counts observed for each species on the survey walkover is shown in the corresponding table in **Annex 5.4**.

Rook, *Corvus frugilegus*, was the most abundant species recorded. Great Spotted Woodpecker was recorded on Transect 2 and Transect 5.

Annex 5.4 also presents the results of the Point Count surveys in the same period. A similar species assemblage was noted, with a total of 35 no. bird species recorded across the 10 no. Point Count locations.

Winter Season 2020/2021

A total of 38 no. species were recorded across the 6 no. survey transects in Winter 2020/2021 (**Annex 5.4**). The peak counts observed for each species on the survey walkover is shown in the corresponding table in **Annex 5.4**.

Annex 5.4 also presents the results of the Point Count surveys in the same period. A similar species assemblage was noted, with a total of 36 no. bird species recorded across the 10 no. Point Count locations.

The species assemblage and diversity of species recorded was very similar to the previous winter season. Common resident species such as Robin, *Erithacus rubecula* and Wren, *Troglodytes troglodytes* and corvids, including Rook, Hooded Crow, *Corvus cornix*, Jackdaw, *Corvus monedula* and Magpie, *Pica pica* were frequently encountered. Woodland specialist, Jay, *Garrulus glandarius*, was also observed.

Breeding Season 2021

A total of 31 no. species were recorded across the 6 no. survey transects in the 2021 breeding season (**Annex 5.4**). The peak counts observed for each species on the survey walkover is shown in the corresponding table in **Annex 5.4**.

The species diversity recorded in the 2021 breeding season was marginally lower than in the previous breeding season. This was also reflected in the species diversity recording during the Point Count surveys in the same period (26 no. species).

Rooks were common and widespread during the breeding season surveys.

Winter Season 2021/2022

A total of 39 no. species were recorded across the 6 no. survey transects in Winter 2019/2020 (**Annex 5.4**). The peak counts observed for each species on the survey walkover is shown in the corresponding table in **Annex 5.4**.

Annex 5.4 presents the results of the Point Count surveys in the same period. A similar species assemblage was noted, with a total of 38 no. bird species recorded across the 10 no. Point Count locations.

The results of the winter transects and point count surveys were very consistent across the 3 no. survey years. Similar species diversity and abundance was recorded at the site.

Summary of Birds Recorded

A total of 59 no. bird species were recorded across the 5 no. seasons of breeding and wintering transect and point count surveys in this area. **Annex 5.4** summarises the results of these surveys with the seasons in which each species was present and the current conservation status of each species indicated.

A total of 45 no. bird species were recorded across the 2 no. breeding seasons, with a total of 47 no. species recorded across the 3 no. winter season surveys. 6 no. of the 59 no. species recorded are on the Red-list (Gilbert *et al*. 2021), as follows: Kestrel, Meadow Pipit, Grey Wagtail, Redwing, Golden Plover and Snipe. A further 14 no. species are currently Amber-listed, including Skylark, House Martin, Swallow, Willow Warbler, Starling, Spotted Flycatcher, Goldcrest, House Sparrow, Tree Sparrow, Greenfinch, Linnet, Mallard, Lesser Black-backed Gull and Herring Gull.

Other Species Recorded

There were 2 no. sightings of Barn Owl, *Tyto alba* in the vicinity of the site. The first was recorded on 15 January 2020 at ITM E660280 N664299 c. 0.5km south-southwest of the wind farm site and the second was of a casual sighting of a bird crossing the M9 on the evening of 22 April 2021 (ITM E666069 N661276), c. 6km southeast from the wind farm site. Barn Owls have been recorded in the area (NBDC) and several road-killed birds were reported from the M9 in 2020. Barn Owl is currently a Red-listed species.

Wintering Woodcock, *Scolopax rusticola*, were recorded at dusk near forestry edge at Baunreagh, c. 0.4km southeast of the wind farm site on 3 December 2021.

Bird Observations along the Grid Connection Route

There are very few waterbird sites in the vicinity of the grid connection route. The closest is Newpark Marsh to the north of Kilkenny City and a further 16 no. sites located within 20km of the route. The majority are sites where swans have been recorded along the River Barrow, substantially to the east of the grid connection route, between Goresbridge and Carlow town.

In winter 2019/2020, driven surveys of known Whooper Swan, *Cygnus cygnus* sites in the wider area recorded:-

- Between 12 no. and 37 no. Whooper Swans present during all surveys along the southern section of fields surveyed, c. 7km from the wind farm, along the River Barrow; and,
- Fields along the Oldleighlin River near Leighlinbridge, c. 6.5km from the wind farm were flooded during the December survey, and 2 no. Wigeon *Mareca penelope*, two Cormorants *Phalacrocorax carbo,* one Grey Heron, 140 no. Lapwing *Vanellus vanellus*, 2 no. Curlew and 40 no. Black-headed Gulls *Chroicocephalus ridibundus* were recorded.

Surveys along the grid connection route did not record the presence of any Whooper Swans during any of the driven surveys between 2019 and 2022. Sightings of raptors, waders and waterbird were uncommon during the surveys. The following were the most notable waterbird sightings recorded close to the route of the grid connection:-

- A flock of Lapwing *Vanellus vanellus* (21 no. birds) was recorded at Maddoxtown near the River Nore in January 2021, c. 13km from the wind farm;
- A flock of 35 no. Lapwing were observed overflying the M9 east of Clara, c. 8km from the wind farm, in November 2021;
- 11 no. Lesser Black-backed Gulls were recorded flying east in December 2020 at Clara GAA club, c. 8km from the wind farm; and,
- 2 no. Cormorants were recorded in flight, heading south at heights of >200m AGL in January 2021 at Kilbaylet Upper, c. 8.5km from the wind farm.

Incidental Bird Records from Replant Lands

A record was maintained of all birds casually seen or heard during the March 2022 visit to the replant lands. In all 13 no. species were recorded per **Table 5.23** below.

Rook was the most abundant species present with some nesting Rooks noted in the mature trees on site.

Species	Scientific Name
Blackbird	*Turdus merula*
Blue Tit	*Cyanistes caeruleus*
Chaffinch	*Fringilla coelebs*
Dunnock	*Prunella modularis*
House Sparrow	*Passer domesticus*
Jackdaw	*Corvus monedula*
Magpie	*Pica pica*
Redwing	*Turdus iliacus*
Robin	*Erithacus rubecula*
Rook	*Corvis frugilegus*
Starling	*Sturnus vulgaris*
Woodpigeon	*Columba palumbus*
Wren	*Troglodytes troglodytes*

Table 5.23: Bird species recorded during walkover of Replant Lands

Incidental Bird Records at Haul Route Works Locations

Very few bird species were recorded the haul route works locations. No birds were recorded nesting on or under Black Bridge. A pair of Mallard, *Anas platyrhnchos* were observed just downstream of the bridge on 5 August 2022. A small number of bird species were recorded as casual observations during visits to the N78/L1834 junction. Some Corvids were observed in the open field area, with Rook, *Corvus frugilegus* present on several occasions. Swallow, *Hirundo rustica*, was recorded flying over the field, flycatching. Other species observed or heard during visits to this location were Robin, *Erithacus rubecula*, Blackbird, *Turdus merula*, Wren, *Troglodytes troglodytes*, Goldfinch, *Carduelis carduelis*, Jackdaw, *Corvus monedula*, and Magpie, *Pica pica*.

5.3.4 Mammals

5.3.4.1 Desktop Survey

A relatively wide range of terrestrial mammals have previously been recorded in the 10km grid squares in which the proposed development site is located (S98, NBDC; **Table 5.24**).

Common Name	Scientific Name	Conservation Status*
American Mink	*Mustela vison*	Introduced species (non-native)
Badger	*Meles meles*	WA, LC
Brown Rat	*Rattus norvegicus*	Introduced species (non-native)
Eastern Grey Squirrel	*Sciurus carolinensis*	Introduced species (non-native)
Eurasian Red Squirrel	*Sciurus vulgaris*	WA, LC

Common Name	Scientific Name	Conservation Status*
European Rabbit	*Oryctolagus cuniculus*	Introduced species (non-native)
Greater White-toothed Shrew	*Crocidura russula*	Introduced species (non-native)
Irish Hare	*Lepus timidus hibernicus*	Annex V, WA, LC
Irish Stoat	*Mustela erminea hibernica*	WA, LC
Otter	*Lutra lutra*	Annex II/IV, WA, NT
Pine Marten	*Martes martes*	Annex V, WA, LC
Red Fox	*Vulpes vulpes*	LC
West European Hedgehog	*Erinaceus europaeus*	WA, LC
Wood Mouse	*Apodemus sylvaticus*	LC
Red Fox	*Vulpes vulpes*	LC

https://maps.biodiversityireland.ie/Map. Accessed 30/03/2022.

** Key: Annex status (EU Habitats Directive), WA (Protected under Wildlife Act 1976), LC – Least Concern, NT – Near Threatened (Marnell et al., 2019).*

Table 5.24: Terrestrial Mammals Previously Recorded in 10km Grid Square S66 (NBDC)

3 no. species of bats have been recorded in the 10km grid squares in which the wind farm site is located (S66, NBDC). These species and their conservation status are detailed at **Table 5.25** below.

Common Name	Scientific Name	Conservation Status*
Daubenton's Bat	*Myotis daubentonii*	Annex IV, WA
Common Pipistrelle	*Pipistrellus pipistrellus*	Annex IV, WA
Soprano Pipistrelle	*Pipistrellus pygmaeus*	Annex IV, WA

https://maps.biodiversityireland.ie/Map. Accessed 30/03/2022.

** Key: Annex status (EU Habitats Directive), WA (Protected under Wildlife Act 1976), LC – Least Concern, NT – Near Threatened (Marnell et al., 2019).*

Table 5.25: Bat Species Previously Recorded in 10km Grid Square S66 (NBDC)

A desktop study of available information on the bat potential of the local area was carried out prior to the field surveys, with particular attention given to the model of Bat Landscapes as available on the NBDC website. This model is based on the relative importance of landscape and habitat associations for bat species across Ireland (see Lundy *et al.* 2011).

The overall bat suitability index value (26) according to *Model of Bat Landscapes for Ireland* (Lundy *et al.* 2011) suggests the landscape in which the wind farm site is located is of 'low-to-moderate' suitability for bats in general. Species specific scores are provided in **Table 5.26**. The Annex II (EU Habitats Directive) listed bat species, Lesser Horseshoe Bat, is assigned a score of '1' as the wind farm site is outside the known range for this species.

Common Name	Scientific Name	Suitability Index
All bats	-	25.89
Soprano pipistrelle	*Pipistrellus pygmaeus*	34
Brown long-eared bat	*Plecotus auritus*	41
Common pipistrelle	*Pipistrellus pipistrellus*	44
Lesser horseshoe bat	*Rhinolophus hipposideros*	1
Leisler's bat	*Nyctalus leisleri*	32
Whiskered bat	*Myotis mystacinus*	30
Daubenton's bat	*Myotis daubentonii*	20
Nathusiius pipistrelle	*Pipistrellus nauthusii*	0
Natterer's bat	*Myotis nattererii*	31

Table 5.26: Suitability of the Study Area for Bat Species

Available bat records were provided by Bat Conservation Ireland (BCI) from their database of roosts locations and other bat records. These records are summarised in **Table 5.27** below and the location of records is shown in **Figure 5.13**. The relevant search area included a 10km radius from a central point within the wind farm site. Known roost locations in the target area as well as results from BCI Volunteer based surveys and records submitted by ecological consultants, were provided. Where roost locations occur in private dwellings, the location provided refers to the central point in the relevant 1km grid square.

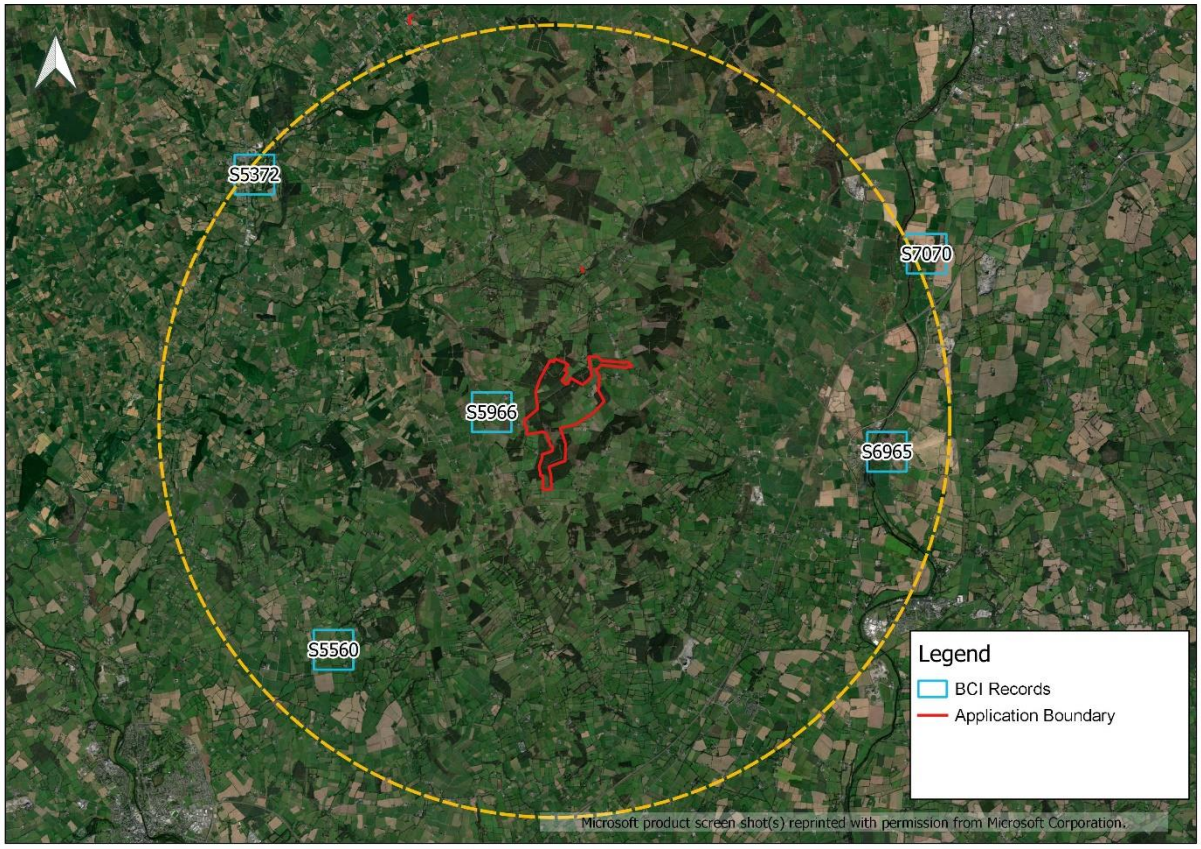

Figure 5.13: BCI Record Locations

Grid Reference (IG)	Address	Species
S5372	Mill Lane	Soprano Pipistrelle
S5560	Kilderry	Soprano Pipistrelle
S7070	Milford Bridge (ITM E669935 N670540)	Daubenton's Bat
S5966	Mothel	Natterer's Bat
S6965	Valerian Bridge, Leighlinbridge. (ITM E669035 N665441)	Daubenton's Bat

Table 5.27: BCI Records of Bat Roosts

5.3.4.2 Field Surveys

Non-volant Mammals

Dedicated walkover surveys of the project site were carried out to identify any available signs of non-volant mammal species encountered. Trail cameras were also deployed for passive monitoring of mammal activity.

A range of mammal signs were encountered and underground dwellings used by mammals were identified. A total of 6 no. non-volant mammal species were identified during the study (**Table 5.28**).

Common Name	Scientific Name	Conservation Status (Marnell 2019)
Badger	*Meles meles*	Least Concern
Eurasian rabbit	*Oryctolagus cuniculus*	Least Concern
Irish hare	*Lepus timidus subsp. hibernicus*	Least Concern
Pine marten	*Martes martes*	Least Concern
Red fox	*Vulpes vulpes*	Least Concern
Red Squirrel	*Sciurus vulgaris*	Least Concern

Table 5.28: Non-volant Mammals confirmed to be present at the Project Site

2 no. badger setts were identified and, in both cases, are outlier setts located proximal to access tracks to be constructed as part of the project. The locations of setts are not identified in this report, but images of the sett entrances are illustrated at **Plate 5.13**. These showed signs of occasional use and are typically located at a distance from the primary setts. They, like other secondary and tertiary setts, can be quiescent for prolonged periods and some are completely abandoned.

'Sett_A' is located within forestry on an old earth bank which was formerly a field boundary. The sett was classified as an outlier sett and consisted of a single entrance. It was monitored by a trail camera between 22 December 2021 and 4 April 2022 and low levels of badger activity took place during the monitoring period. A Badger was recorded entering and exiting the sett on the following dates:-

- 23 December 2021;
- 10 February 2022; and,
- 16 February 2022.

An internal wind farm road is proposed to be constructed within 20m of the sett entrance.

'Sett B' was located within an earth bank which divides 2 no. fields of improved agricultural grassland. It consists of a single entrance and no signs of significant excavation were present. The sett did not appear to be in frequent use and no signs of current activity were recorded. This burrow entrance is located on an elevated bank relatively close to a proposed access track (<10m).

The status of setts can change over time and it is possible that even long abandoned setts may be used by other mammals species or reoccupied by Badgers at some time in the future.

Signs of badger activity (tracks, feeding signs) were frequently encountered throughout the site and consisted of foraging signs (snuffle holes) and latrines. Badgers were recorded on trail cameras 'Cam_2' and 'Cam_5' (see **Figure 5.6**) regularly. Given the habitats present within the wind farm site, it is likely that this area, in particular, represents good foraging habitat for locally occurring badgers.

Similarly, Fox scat was found widely throughout the site. Foxes were regularly recorded on trail cameras.

Pine Marten were also detected at 3 no. camera trap locations (Cam_2, Cam_5 and on the camera at the outlier Badger sett). An adult Pine Marten was observed crossing the road near VP4 on 26 May 2021.

Red Squirrel were observed regularly at the outlier Badger sett. Irish hare was observed within the plantation forestry and was recorded by trail cameras 'Cam_1', 'Cam_2' and 'Cam_5. Rabbits (sightings, signs) were predominantly recorded on the lowland pasture habitats surrounding the wind farm site.

Sika Deer is likely occur at the site, at least occasionally. Other non-native deer species or hybrids may also be present in the study area. No evidence of native Red Deer was recorded.

Wood mouse, Brown rat and Pygmy and Greater White-toothed shrew are likely to occur throughout the site where suitable habitats and conditions for each individual species exist. The scrub, treelines and drier woodland habitats are suitable for shrews, Wood mouse and Brown rat. Each of these species are subject to seasonal fluctuations in population as the availability of food changes throughout the year. The treelines, as well as the edge of the woodland and scrub habitats are suitable for Irish stoat and hedgehog but neither of these species was recorded during the current surveys.

Examples of the mammal images captured by trail cameras at the proposed site are provided at **Plate 5.13** below.

Two Badgers grooming. Cam_2.	Pine Marten recorded at outlier sett 'Sett_A' (location not disclosed).
	
Red Fox. Cam_5.	Badger exiting outlier sett 'Sett_A' (location not disclosed).
	
Red Squirrel at outlier sett 'Sett_A' (location not disclosed).	Irish hare. Cam_1.

Plate 5.13: Sample Images captured by Trail Cameras

Non-volant Mammals along the Grid Connection Route

No breeding or resting places of protected non-volant mammal species were recorded along the grid connection route. Roadkilled Fox was recorded on the road margin at Feathallagh c. 7km southwest of the wind farm in August 2022. Given the length of the grid connection route, it is likely that a variety of non-volant mammal species occur in the vicinity of the route. However, as noted at **Section 5.3.5.6**, there was no sign of Otter (holts, spraint marking etc.) at the HDD locations. There is very limited likelihood of breeding or resting mammals along the edge of the public road network followed by the grid connection route.

Non-volant Mammals on the Haul Route

No sightings or signs of non-volant mammals were recorded at Black Bridge or at the N78/L1834 junction. No burrows or resting places of protected species were present.

Bat Surveys

The importance of the project site and its environs for bats was assessed through a number of ways. Daytime assessments of the suitability of the features present in the area for roosting bats was undertaken. Night-time ultrasonic detector surveys were carried also out at the wind farm site to record bat activity in the area from which information on species composition, relative abundance and landscape usage could be derived. Passive bat echolocation survey was carried out at 7 no. detector locations while active surveys were carried out at the wind farm site and along the grid connection route.

No significant roosts (e.g. maternity roosts or underground hibernation sites) were identified or are likely to occur within the wind farm site. During surveys to identify any potentially significant roosts which may be affected by the project, 2 no. minor roosts were discovered.

Passive Bat Surveys

Overall, a moderate level of activity was recorded at the site, and a moderate-to-high level of species diversity. The wind farm site contains limited roosting opportunities and high-quality foraging habitat. A total of 7 no. bat species were recorded (possibly 8 no. as Whiskered Bats and Brandt's Bats are indistinguishable through ultrasonic detection). Details of the dates and weather conditions during the passive detector deployments are shown in **Annex 5.5**.

The level of activity recorded at the site varies according to season, location and species. The results of passive bat monitoring are presented in **Table 5.29** below. A total of 19,818 individual bat 'registrations' were recorded during passive bat monitoring at wind turbine locations. Analysis of these registrations shows activity was highest in the Autumn survey period when an average of 83 no. registrations per detector per night were recorded. 70 no. registrations per detector per night were recorded in Summer while 53 no. registrations per detector per night were recorded in Spring. Activity is typically highest in Autumn when that year's young bats are on the wing, and bats are foraging in order to prepare for winter hibernation.

Leisler's Bat was the most commonly recorded species, and accounted for 45.3% of all registrations. Leisler's Bats are a relatively large and fast-flying species and have been recorded to have relatively large territories and to travel significant distances to reach preferred foraging habitats (Shiel *et al*. 1999). While strong habitat associations for the species have been difficult to identify in an Irish context, there is evidence to suggest a positive association with pasture and freshwater habitats (Roche *et al*., 2014). Given its characteristics and habitat composition, the project site is, therefore, likely to represent a sub-optimal foraging habitat for this species. Leisler's Bat is considered to be of relatively high risk of collision with wind turbine blades, due to their higher level of flight (SNH, 2019; NatureScot 2021).

Common Pipistrelle was the second most commonly recorded species and accounted for 41.9% of all registrations. Soprano Pipistrelle was the third most commonly recorded species and accounted for 7% of all registrations. These species are common and widespread in Ireland and utilise a variety of habitats. They were recorded during all 3 no. survey periods and are considered to be of relatively high risk of collision with wind turbine blades, due to their higher level of flight (NatureScot 2021).

Natterer's Bat (4.5%), Daubenton's Bat (0.7%), Brown Long-eared Bats (0.6%) and Whiskered Bat (0.1%) were all recorded relatively infrequently. Natterers Bats are

strongly associated with woodland and broadleaf woodland in particular (Roche *et al*., 2014) and the project site likely represents suitable, but suboptimal, foraging habitat for Natterer's Bat. Daubenton's Bats generally forage over waterbodies and therefore the project site likely represents a commuting habitat and suboptimal or occasional foraging habitat. Brown Long-eared Bats prefer to forage in woodland, hunting moths and other insects and can be under-recorded in ultrasonic detection survey due to their quiet calls.

No evidence of Lesser Horseshoe Bat was detected, and the site occurs outside the known range for the species. Some low frequency pipistrelle calls were recorded in the range of 42kHz to 45kHz, and Nathusius pipistrelle can echolocate within this range. While it cannot be ruled out that Nathusius pipistrelle may occur (at least occasionally), no pipistrelle calls with a peak frequency of less than 42kHz were detected, and therefore there is no conclusive evidence of the presence of Nathusius pipistrelle.

Monitoring location 'Bat_1' had the highest number of registrations recorded overall and accounted for 38% of all bat registrations recorded during the passive bat monitoring (**Figure 5.6**). 'Bat_4' accounted for 31.2%, 'Bat_2' accounted for 12.5% and Bat_3 for 8.2%. The remaining monitoring stations ('Bat 5', Bat_6 and 'Bat 7') each accounted for <5% of all registrations.

	Species	Bat_1	Bat_2	Bat_3	Bat_4	Bat_5	Bat_6	Bat_7
Spring 2021	Brown Long-eared bat	0.05882 [1]	0.05882 [1]	-	-	-	0.18 [2]	0.059 [1]
	Common Pipistrelle	20.88 [118]	2.588 [14]	-	8.9 [34]	0.47 [4]	12 [115]	0.18 [2]
	Daubenton's bat	0.9412 [5]		-	-	0.12 [1]	0.18 [1]	-
	Leisler's bat	97.88 [963]	9.765 [65]	-	110 [721]	15 [150]	12 [65]	6.1 [29]
	Natterer's bat	2.235 [9]	0.8824 [3]	-	-	0.47 [2]	1.6 [6]	-
	Soprano Pipistrelle	5.294 [33]	1.529 [10]	-	0.88 [6]	0.059 [1]	2 [18]	-
Summer 2021	Brown Long-eared bat	0.07692 [1]	0.07692 [1]	-	-	0.4615 [3]	0.3077 [1]	0.07692 [1]
	Common Pipistrelle	62.15 [412]	5.615 [41]	10.31 [83]	217.3 [731]	4 [8]	2.077 [8]	2.308 [7]
	Daubenton's bat	1 [6]	0.6154 [5]	0.2308 [1]	0.1538 [1]	0.3077 [2]	0.3077 [1]	0.07692 [1]
	Leisler's bat	81.85 [342]	13.31 [49]	0.6923 [5]	11 [59]	22 [38]	12.62 [98]	9.154 [20]
	Natterer's bat	5.231 [15]	0.5385 [6]	3.692 [9]	0.07692 [1]	0.6154 [2]	1.385 [5]	0.07692 [1]
	Soprano Pipistrelle	12.85 [81]	2.077 [15]	0.4615 [3]	0.3077 [2]	0.5385 [2]	0.2308 [1]	0.07692 [1]
	Whiskered bat	0.07692 [1]	-	-	0.3077 [2]	-	-	-
Autumn 2021	Brown Long-eared bat	1.625 [2]	2.143 [6]	1.143 [4]	1.857 [4]	0.7857 [4]	0.2857 [4]	0.2143 [2]
	Common Pipistrelle	160.3 [633]	23.79 [59]	32.71 [98]	44.93 [100]	4.786 [12]	0.2857 [2]	0.7143 [5]
	Daubenton's bat	2.667 [5]	0.9286 [2]	0.9286 [4]	0.7143 [3]	0.9286 [4]	0.1429 [1]	-
	Leisler's bat	34 [64]	105.6 [198]	21.71 [41]	17.5 [37]	9.929 [36]	0.2857 [1]	3.929 [10]
	Natterer's bat	4.3 [10]	6.143 [17]	34.93 [89]	0.3571 [1]	1.429 [3]	0.2857 [1]	
	Soprano Pipistrelle	38.54 [151]	16.07 [38]	8.214 [27]	7.857 [17]	2.929 [8]	0.2857 [1]	0.07143 [1]
	Whiskered bat	-	-	0.1429 [2]	0.8571 [3]	0.07143 [1]	0.07143 [1]	-

Note: Data is presented as "average [peak]" where average is the average number of registrations per night. Peak data represents the maximum number of nightly registrations from any night in the relevant recording period.

Table 5.29: Results of Passive Bat Monitoring

Monitoring at Height

An 80m meteorological mast was utilised to install a microphone at c. 50 meters above ground level during the Autumn 2021 bat detector surveys (the nights of the 18 August to 27 August inclusive). A second microphone was placed at ground level to allow direct comparison of activity levels at height versus at ground level. The survey location is shown as 'Bat_MM' in **Figure 5.6**.

During the 11-night survey period, 322 no. bat registrations were recorded at height, compared with 2140 no. at ground level. Leisler's Bat, Common Pipistrelle and Soprano Pipistrelle were recording at height with Leisler's Bat accounting for 92.7% of registrations. Common Pipistrelle accounted for 6.4% of registrations while Soprano Pipistrelle accounted for 1% registrations recorded at height. The results of the detailed analysis of bat calls from the microphone at height is shown in **Table 5.30** below.

At ground level, 80.4% of registrations recorded at ground level were identified as Leisler's Bat, followed by Common Pipistrelle (13%), Soprano Pipistrelle (4.5%) and Natterer's Bat (0.9%) with Daubenton's Bat, Whiskered Bat and Brown Long-eared Bat all recorded occasionally.

On the night of the 20 August 2021, no registrations were recorded at either ground level or at height, and analysis of available weather data shows relatively high wind speeds occurred on this night. On the 20 August 2021, activity across all detectors was suppressed within only 12 no. registrations recorded in total and no registrations recorded at Bat_5, Bat_6 or Bat_7.

It should be noted that only one monitoring point was available for survey at height, and this location occurs centrally within the wind farm site but at an elevated and relatively exposed location. Data gathered at this location should not be interpreted as applying throughout the study area as the habitat associations of bat species vary.

	Survey Night	Brown Long-eared Bat	Common Pipistrelle	Daubenton's Bat	Leisler's Bat	Natterer's Bat	Soprno Pipistrelle	Whiskered Bat	Total
Ground Level	18/08/2021	-	29	3	142	5	6	-	185
	19/08/2021	-	18	1	33	-	7	-	59
	20/08/2021	-	-	-	-	-	-	-	0
	21/08/2021	1	10	-	367	3	2	-	383
	22/08/2021	-	49	-	304	4	21	-	378
	23/08/2021	2	39	4	143	-	16	-	204
	24/08/2021	1	16	-	66	1	4	-	88
	25/08/2021	1	67	1	198	1	16	-	284
	26/08/2021	3	31	6	223	2	15	1	281
	27/08/2021	-	8	-	170	2	6	-	186
	Total	8	267	15	1,646	18	93	1	2,048
At Hei	18/08/2021	-	1	-	46	-	-	-	47

	Survey Night	Brown Long-eared Bat	Common Pipistrelle	Daubenton's Bat	Leisler's Bat	Natterer's Bat	Soprno Pipistrelle	Whiskered Bat	Total
	19/08/2021	-	1	-	14	-	-	-	15
	20/08/2021	-	-	-		-	-	-	0
	21/08/2021	-	1	-	57	-	-	-	58
	22/08/2021	-	1	-	34	-	1	-	36
	23/08/2021	-	7	-	32	-	1	-	40
	24/08/2021	-	4	-	7	-	-	-	11
	25/08/2021	-	3	-	24	-	-	-	27
	26/08/2021	-	2	-	48	-	-	-	50
	27/08/2021	-		-	28	-	1	-	29
	Total	0	20	0	290	0	3	0	313

Table 5.30: Results of Passive Bat Monitoring at Height

Due to the characteristics of the project along the grid connection route, haul route works locations and replant lands; no passive bat surveys were undertaken.

Active Bat Surveys

Active bat surveys were carried out for both the wind farm site and the grid connection route. The results of these investigations are presented separately below.

Active bat surveys were used to complement the information gained from passive bat monitoring at the wind farm site. The aim of the surveys was to identify any particular flightlines which may be apparent and to identify emergence behaviour which would indicate the presence of a roost.

The locations of registrations recorded during active bat surveys at the wind farm site are shown in **Figure 5.14**. No activity indicative of emergence from (or proximity to) an active roosting location was recorded during grid connection route surveys. While individual observations were made of bats in flight, no patterns of behaviour were noted which would suggest the presence of important or significant commuting routes.

The data derived from active surveys reflected the data derived from passive bat surveys in terms of species diversity and relative abundance.

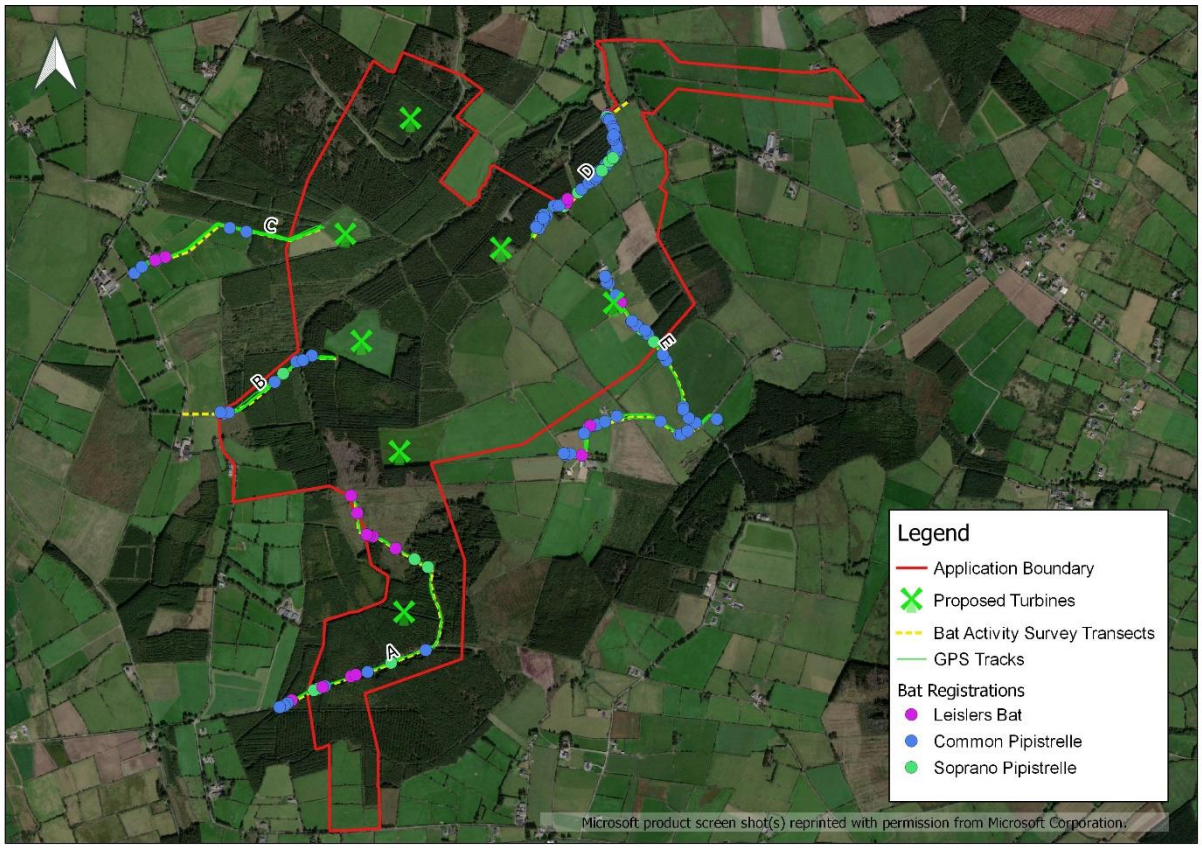

Figure 5.14: Results of Active Bat Surveys at Wind Farm Site

Active bat surveys were carried out on the proposed grid connection route in order to assess the relative abundance and species diversity of bats along the route.

The diversity of species recorded during active bat surveys along the grid connection route (**Figure 5.15**) was similar to the species diversity recorded on the wind farm site. For all species recorded along the grid connection route, the activity recorded was generally positively correlated with the presence of mature trees and large and structurally diverse hedgerows along the roadside.

Further assessment was carried out on potential roost features along and proximate to the grid connection route (see below).

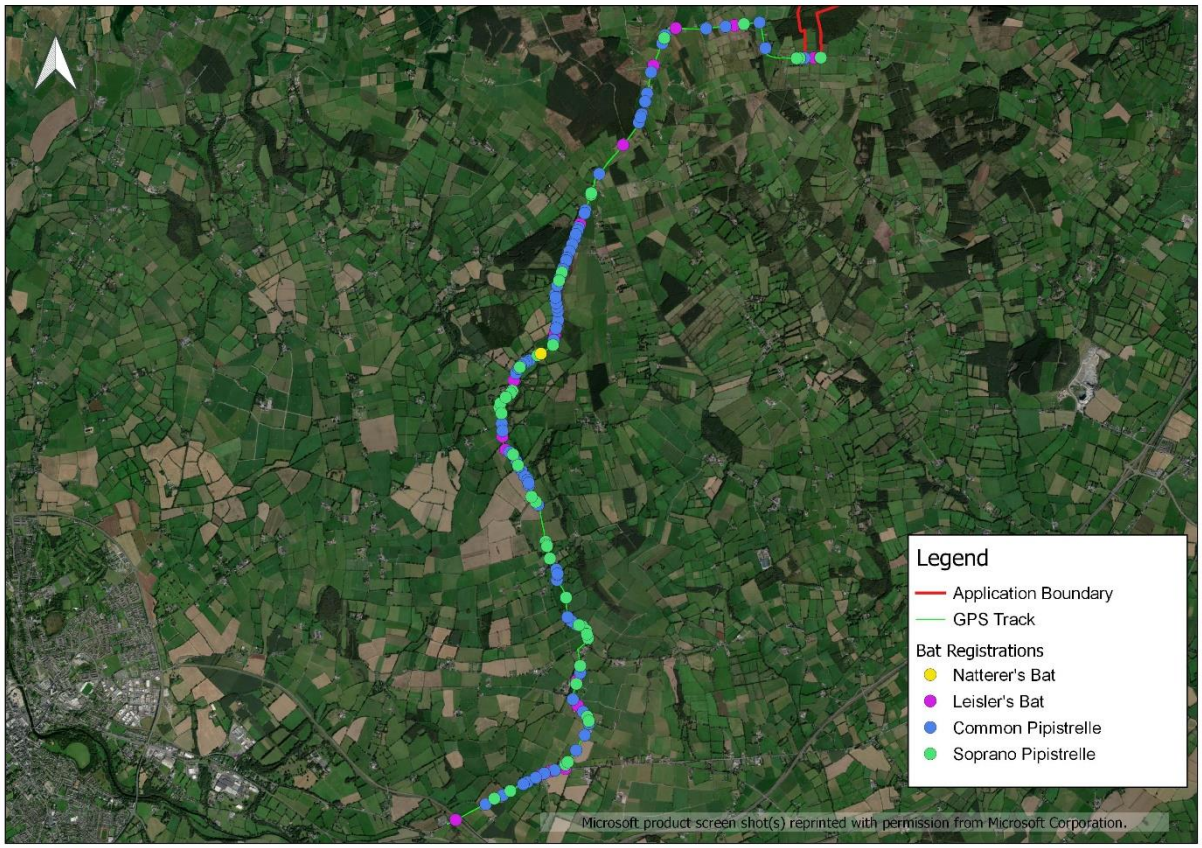

Figure 5.15: Results of Active Bat Surveys along the Grid Connection Route

Assessment of Potential Roosting Features (PRF)

Surveys were carried out to identify and investigate PRFs at the wind farm site and along the grid connection route. During these surveys, all structures which may potentially host roosting bats were inspected visually.

NatureScot 2021 recommends that key roosting features, which could support maternity roosts and significant hibernation and/or swarming sites, be identified in an area extending to 200m plus one rotor radius of the development boundary. As set out at **Section 5.2.4.4** above, roost surveys were carried out in an area extending c. 300m from the site boundary.

Visual surveys of potential significant bat roost features within at least 300m of the site boundary were carried out. Where any PRF had the potential to be directly or indirectly affected by the proposed works, visual surveys were undertaken to establish the suitability of the feature for roosting bats.

Targeted surveys were carried out to determine the presence of bats or PRFs where works may impact directly or indirectly on a PRF. Features with potential to accommodate a significant bat roost were initially identified through examination of OSi historic 6" black & white mapping, aerial imagery as well as site walkovers. Information on known mines and caves was identified through the examination of publicly available information produced by Geological Survey Ireland. Some of the historic features identified by historic mapping no longer exist.

A number of structures, primarily residences and associated outbuildings and agricultural buildings, were shown on OSi historic 6" mapping, OSi Discovery mapping or aerial imagery. The absence of other relevant structured was confirmed by ground

truthing. The structures considered are identified in **Figure 5.16** and summarised in **Table 5.31**, below.

EPA data regarding known locations of caves and historic mining operations was examined in order to identify the presence of any known underground features which could support a significant bat roost. No known underground sites are present within the project site.

Visual inspections were carried out on 28 July 2020, 30 June 2021 and 1 July 2021. Features inspected included bridges, buildings and trees.

Roosting was confirmed at the B_38 structure during the emergence survey on 1 June 2022. A single Soprano Pipistrelle was observed emerging from the gable at 22:06pm (see **Figure 5.16**; **Plate 5.14**). There was no evidence of any additional roosting at this location or the presence of a significant roost such as a maternity roost.

No key features likely to support significant roosts are present within the study area.

Ref.	Description	Suitability	Easting (ITM)	Northing (ITM)
B_05	Residence and farm buildings. Access not available.	N/A	661750	667939
B_06	4 no. buildings here, 3 no. of them derelict. 1 no. barn used for hay storage. All have high light ingress. 2 no. structures are low suitability. No potential for significant roosts	Low	661668	667421
B_07	Residence and metal/slate roofed outbuildings. No potential roosting features visible. Shed with grey metal roof underlain with plastic. No evidence of bat use.	Low	662616	667463
B_07 a	Occupied residence. Old farm building with several outbuildings.	Low	662387	667469
B_10	Occupied residence. Modern 2-storey construction. No evidence of roosting bats from external examination.	Low	662807	667824
B_11	Access not available.	N/A	663145	667576
B_12	Access not available.	N/A	663134	667439
B_15	Occupied single story residence with 2-outbuildings.	Low	661936	667687
B_16	Metal clad shed associated with B_15	Negligible	661918	667740
B_18	Occupied modern residence with poor connectivity to wider landscape. No potential roosting features were visible.	Low	661894	666367
B_19	Corrugated iron shed. Negligible potential to support roosting bats. In regularly use.	Negligible	661944	666345
B_22	Modern metal clad agricultural building.	Negligible	660672	664524
B_24	Occupied residence and detached garage in an exposed location. Gaps present around fascia and soffit and flashing around chimney.	Low	660573	664713

Ref.	Description	Suitability	Easting (ITM)	Northing (ITM)
	No evidence of bats in garage. Residence not accessible.			
B_25	Partly constructed residence and attached garage. Residence not accessible Evidence of occasional or night roosting by bats in garage, and DNA analysis of bat droppings in garage confirmed presence of Natterer's Bat and Brown Long-eared Bat. Birds nesting in garage (Jackdaw and Swallow) and light ingress reduce likelihood of significant roost being present here.	Confirmed	660458	664611
B_30	Derelict stone building with slate roof tiles. Significant light and wind ingress. Some parts of the ceilings have collapsed. Jackdaws nesting in attic space. No evidence of use by bats.	Moderate	660565	665517
B_31	Modern farm buildings. High Light ingress.	Negligible	660320	666124
B_32	Agricultural buildings. Over 800m from nearest turbine.	Low	660120	666207
B_33	Residential dwelling. Over 700m from nearest turbine.	Low	660261	666233
B_35	No longer exists.	N/A	660905	667541
B_36	No longer exists.	N/A	661284	667605
B_37	Cluster of stone buildings. 1 no. has new corrugated metal roof. All have some level of light ingress. No evidence of roosting and considered to have low roosting potential. No potential as a significant roost. May be used occasionally as a night roost.	Low	661708	667213
B_38	Residential and agricultural building with several agricultural buildings. Slate roofing. Trees surrounding. Emergence survey carried out and a single Soprano Pipistrelle bat emerged from soffit.	Confirmed	661906	666938
B_39	No longer exists.	N/A	660650	667374
B_40	No longer exists.	N/A	660782	666562
B_41	No longer exists.	N/A	661490	666545

Table 5.31: Description of Potential Roosting Features

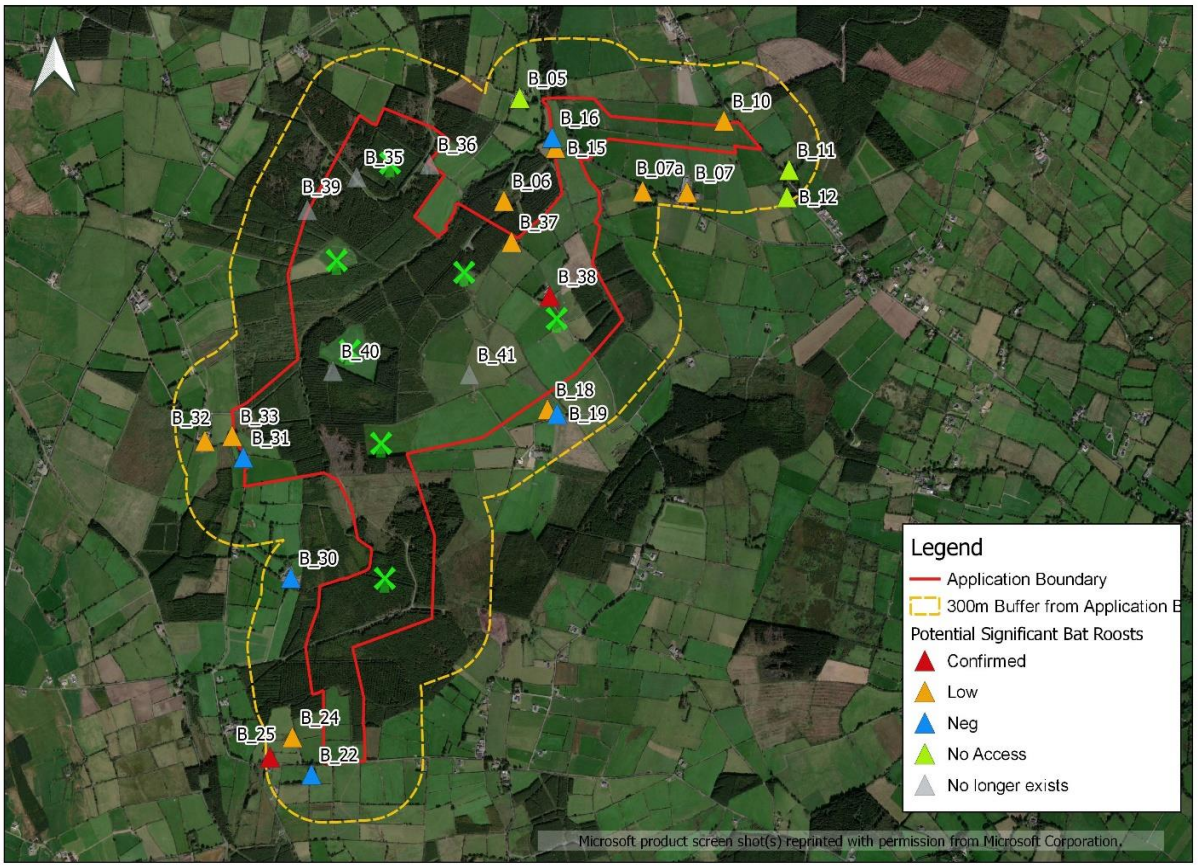

Figure 5.16: Locations of Potential Significant Roosting Features

Residence and Farm Building at B_38 during emergence survey.

Bat emergence (circled in red) at B_38 captured on thermal imaging camera.

Plate 5.14 Views of structure where bat emergence was confirmed.

No trees were identified in the study area which were considered to have any potential to support a significant bat roost.

Trees which may be directly or indirectly affected by the project were considered for their suitability for roosting bats. Trees within the study area are generally not suitable

for roosting by bats. 2 no. trees were identified with some suitability (i.e. above 'negligible' suitability) to be used by roosting bats; however, neither will be directly affected by the project (**Table 5.32**; **Figure 5.17**).

Ref.	Description	Species	Suitability	Easting (ITM)	Northing (ITM)
T_01	Mature Ash, minor ivy cover. Minor PRFs visible at height	Ash	Low	662134	667795
T_02	Multi stem ash. No evidence of PRFs. Moderate ivy cover.	Ash	Negligible	662619	667738

Table 5.32: Trees with Bat Roost Potential

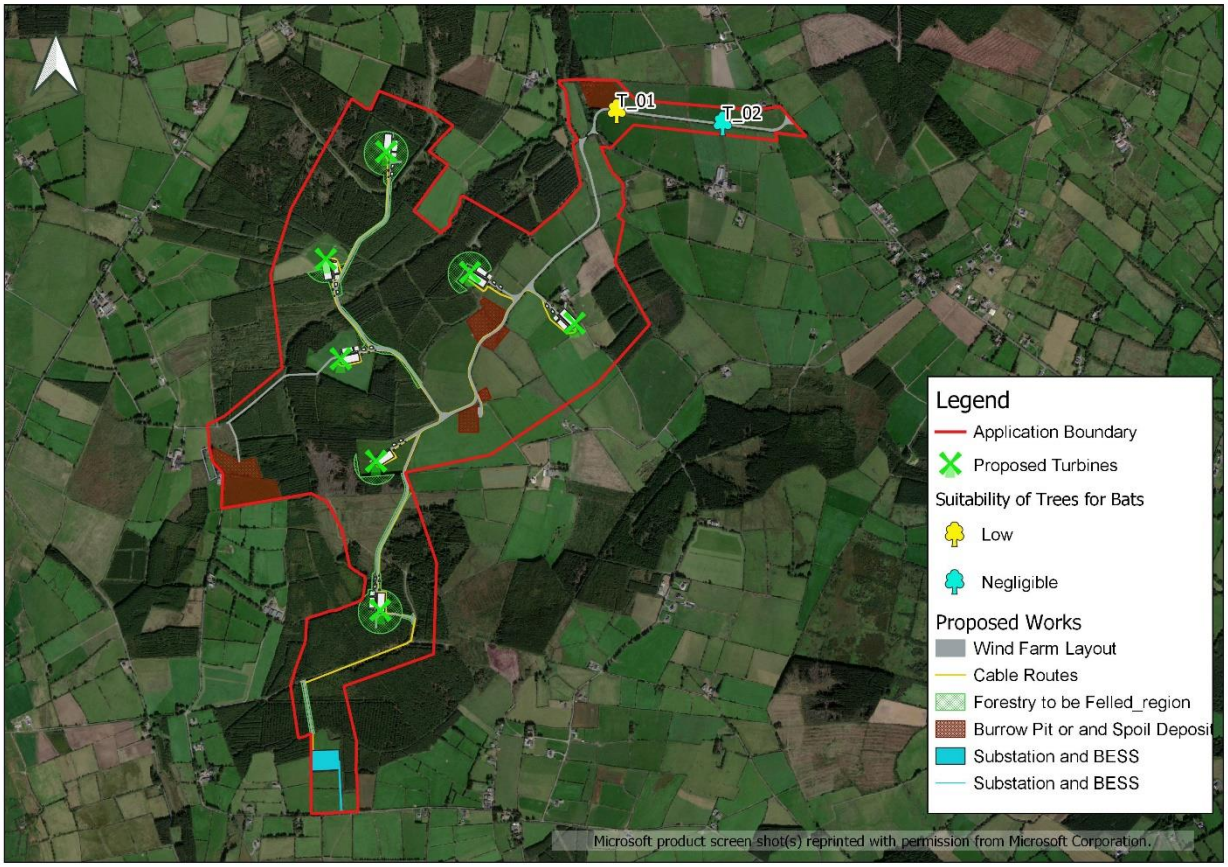

Figure 5.17: Locations of Trees with Bat Roost Potential

Visual survey and inspection of PRFs which may be directly or indirectly affected by the grid connection was carried out. The grid connection infrastructure will largely be within existing public roads and, therefore, the likelihood of effects occurring is generally low and relates only to construction works.

Locations where directional drilling may be required or where there is potential for interaction between existing structures and cable ducting works have been identified and these locations were surveyed to determine their suitability for roosting bats.

8 no. man-made structures were investigated which consisted of culverts and bridges. No trees with potential to be used by roosting bats which may be affected by the

proposed works were identified. Descriptions of the relevant PRFs is provided in **Table 5.33** below. Images of these PRFs are shown in **Plate 5.15**.

Ref.	Description	Suitability for roosting bats	Easting (ITM)	Northing (ITM)
Culvert 1 & 2	Plastic pipe.	Negligible	657837	656636
Culvert 3	No significant structure present.	Negligible	657484	658019
Bridge 1	Single culvert. Structure provides approx. 500mm above normal water level. Some minor PRFs present but lack of height reduced value to bats.	Low	657312	658685
Bridge 2	Structure provides little gap to normal water level.	Negligible	656828	660149
Bridge 3	Single arch stone structure, approx. 2m height. Some minor crevices present. No evidence of roosting bats.	Low	657115	660610
Culvert 4&5	No significant structure present.	Negligible	660358	664568

Table 5.33: Description of Potential Roosting Features along Grid Connection Route

Building at B_37

Building at B_30

	
Building at B_06	Interior of a building at B_06
	
Farm Building at B_38	Abandoned Residence at B_25
	
Inspection of Bridge 2.	Barrel of Bridge 1.

	
Tree T_02.	

Plate 5.15: Selection of the PRFs Inspected

Black Bridge was visually assessed for signs of its use by roosting bats (April 2022). There are some minor PRFs present, but no signs of roosting bats were recorded. The River Dinin (South) at Black Bridge is attractive for foraging bats. The works at the junction of the N78/L1834 will encompass areas of low hedgerow and open agricultural field. There are a small number of trees present, none of which were assessed as having appreciable roost potential for bats (April 2022).

5.3.5 Aquatic Ecology

5.3.5.1 Physical Characteristics and Fish Habitat

Coolcullen Stream

As the Coolcullen Stream passes through the project site, the characteristics of the riverine habitats are mainly shallow riffles and glides, suited to juvenile trout and salmon as rearing habitat. In the upper section, which drains the southeastern part of the project site, the stream runs through a conifer plantation; while, as the stream flows through the site, it flows mainly through farmland where riparian cover is mediocre to poor and is mostly grassy verge (GS2) with some riparian bramble scrub (WS1). The riverbed is coarse, consisting mainly of cobbles and large gravels, and is largely free of surface siltation except for within and immediately downstream of areas where cattle are poaching. There appears to have been some mechanical disturbance in the past, possibly the excavation of stream bed gravel for the building of roads, however, this happened many years ago and the stream has recovered well. The usual agricultural drainage schemes are in place and draining to the stream; however, for the most part, they are not actively maintained and are attenuating sediment and nutrients. Agriculture in the catchment is medium-to-low intensity, and this is benefiting the stream greatly in terms of water quality and invertebrate and fish assemblage.

In terms of fisheries habitats, there are some holding pools and spawning areas for adult trout. These are largely free of siltation and hence an oxygen rich intra-gravel zone is available for the development and refuge of eggs and alevins. Rearing areas for juvenile salmonids are plentiful, and this is reflected in the findings of the fish survey below. The stream is considered to be too small for spawning adult salmon. There is some reasonable eel habitat with submerged large stones and overhanging banks.

There is almost no stable optimal lamprey ammocoete habitat within this section of the watercourse; it is limited by the stream's high energy nature.

Plate 5.16: Coolcullen Stream as it leaves the Project Site (image captured during high water levels)

Knocknabranagh & Knockbaun Stream

The Knocknabranagh & Knockbaun Stream rises within the wind farm site where it begins as a mountain drain cutting through land which is mainly planted upon with sitka spruce. Generally, the spruce is blocking out light in a manner that prevents the growth of riparian vegetation and the stream mainly runs through pine needle clad plantation floor. This upper section is quite flat, and the stream has a low flow velocity and volume. Instream habitats are unvaried; generally a slow glide and the stream bed consists of a light dusting of sandy gravel on top of peaty material. There is very little spawning opportunity here, and the stream is likely to contain only very low numbers of trout and possibly eel. Additionally, the lack of light and riverbed substrate combine to produce a section of watercourse which exhibits low productivity in terms of macroinvertebrates.

The middle and lower stretches of the Knocknabranagh & Knockbaun Stream is in excellent condition hydromorphologically. It is an example of a high-quality mountain stream. There are riffles, pools and glides in optimal proportions, providing a good variety of habitats for juvenile salmonids and for resident adult brown trout. The stream is considered too small for spawning adult salmon. There is reasonable eel habitat with submerged large stones and overhanging banks. There is almost no stable optimal

lamprey ammocoete habitat within this section of the watercourse; it is limited by the stream's high energy nature and low fine sediment input.

Riparian vegetation in the middle and lower section is mainly overhanging rush and bramble often characteristic of these upland streams. In general, it is shallow set within its floodplain, which offers very good connectivity with the floodplain. Various wetland habitats border the stream throughout the stretch of stream draining the proposed development site. These exclude livestock from the watercourse while also attenuating nutrients and buffering the amplitude of floods and droughts. From the walkover survey, there is no evidence of any attempts at river channel modification on the main channel of the stream and no arterial drainage appears to have been carried out. The usual agricultural drainage schemes are in place; however, for the most part, they are not actively maintained and are attenuating sediment and nutrients. In summary, the traits described above combine to maintain this section of the watercourse in a highly natural state.

Plate 5.17: Knocknabranagh & Knockbaun Stream within the Project Site

5.3.5.2 Electrofishing Surveys

Figure 5.18: Electrofishing Sites

Coolcullen River

The Coolcullen River site was selected at the L7122 bridge crossing approximately 300m downstream of the confluence of the Coolcullen and Knocknabranagh & Knockbaun streams (**Figure 5.18**). The abiotic parameters at the sampling site are summarised in **Table 5.34**. Brown trout Salmo trutta, salmon *Salmo salar* and eel *Anguilla anguilla* were captured at this site. A single eel was captured and measured at 26.7cm A total of 43 no. trout and 7 no. salmon were caught within a 30m stretch of river accounting for 105m² of river which was electrofished. This equates to 0.41 trout/m² and 0.04 salmon/m². The average trout length was 6.24cm and the median was 5.8cm. The standard deviation for trout was 1.4 indicating that the age profile was quite limited. The average salmon length was 7cm and the median was 6.1cm. The standard deviation for salmon was 1.8 indicating that the age profile was varied. The age profile is shown in the graph below (**Figure 5.19**).

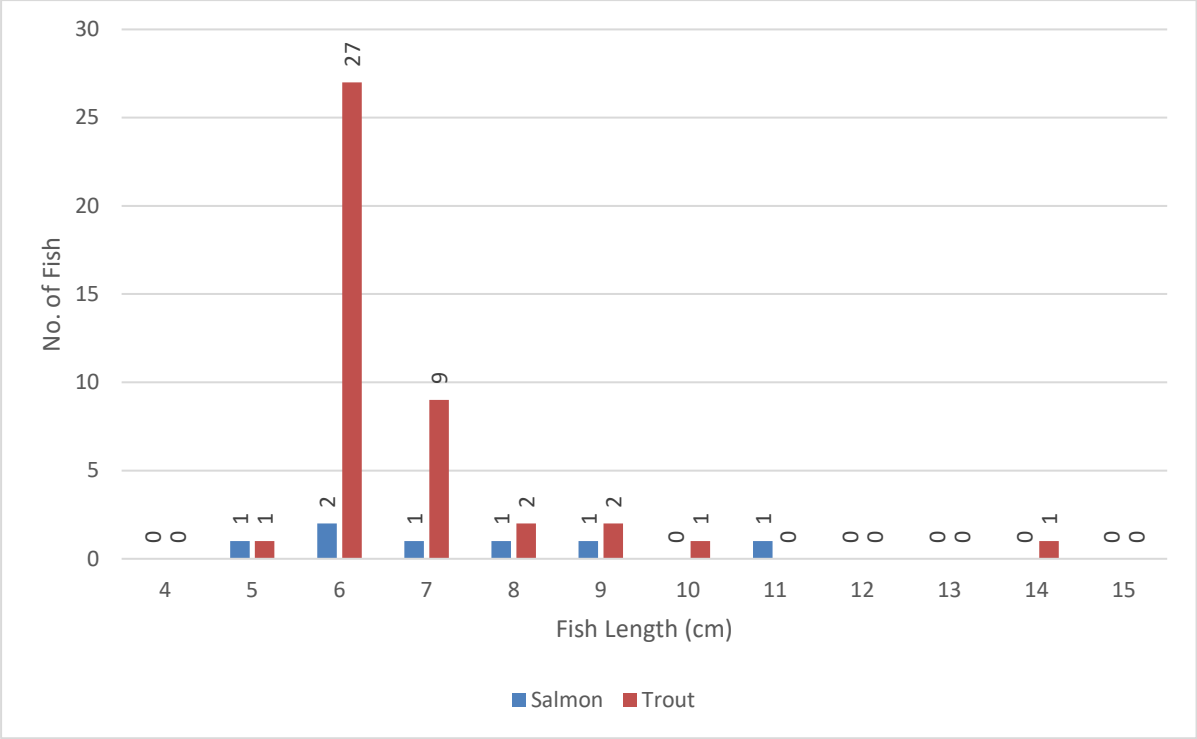

Figure 5.19: Age Profile of salmon and trout at Coolcullen River

Plate 5.18: Salmon (top row) and Trout (bottom row) captured at the Coolcullen River site

Coolcullen Stream

The electrofishing site on the Coolcullen Stream was selected 500m upstream of the confluence with the Knocknabranagh & Knockbaun Stream (**Figure 5.18**). The abiotic parameters at the sampling site are summarised in **Table 5.34**. Brown trout and salmon were captured at this site. A total of 37 no. trout and 4 no. salmon were caught within a 22m stretch of river accounting for 26.4m² of river which was electrofished. This equates to 1.4 trout/m² and 0.15 salmon/m². The average trout length was 6.4cm and the median was 6.51cm. The standard deviation for trout was 0.89 indicating that the age profile was quite limited. The average salmon length was 5.65cm and the median was 5.45cm. The standard deviation for salmon was 0.65 indicating that the age profile was very limited. The age profile is shown in the graph below (**Figure 5.20**).

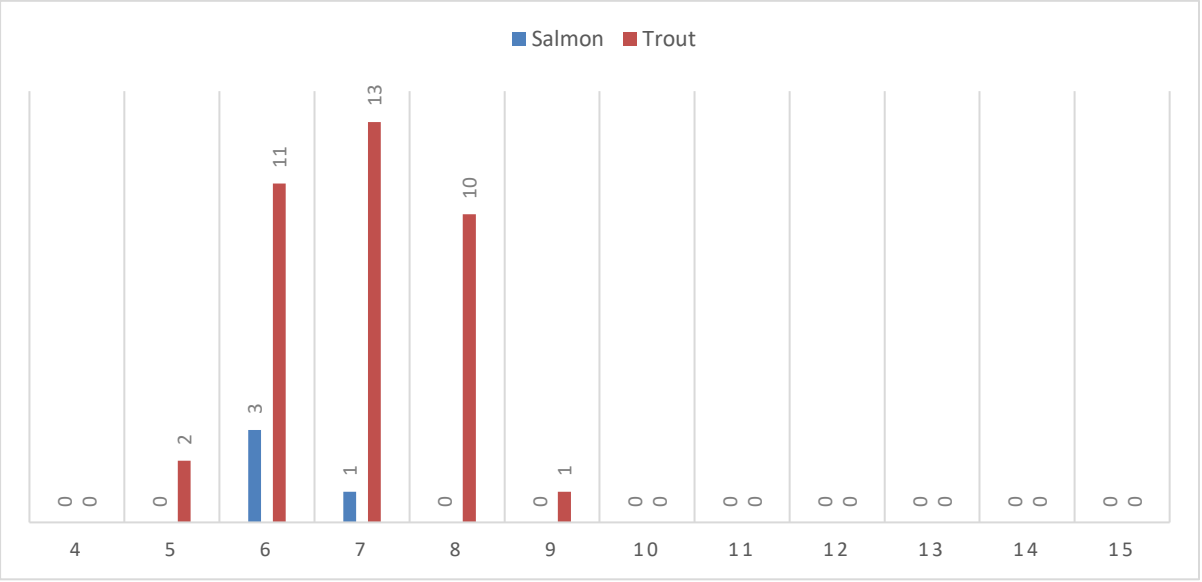

Figure 5.20: Age profile of salmon and trout at the Coolcullen Stream.

Knocknabranagh & Knockbaun Stream

The electrofishing site on the Knocknabranagh & Knockbaun Stream was selected 50m upstream of the confluence with the Coolcullen Stream (**Figure 5.18**). The abiotic parameters at the sampling site are summarised in Table 5.34. Brown trout and salmon were captured at this site. A total of 24 no. trout and 7 no. salmon were caught within a 20m stretch of river accounting for 24m² of river which was electrofished. This equates to 1 trout/m² and 0.29 salmon/m². The average trout length was 10cm and the median was 9cm. The standard deviation for trout was 4.42 indicating that the age profile was varied. The average salmon length was 5.6cm and the median was 5.6cm. The standard deviation for salmon was 0.38 indicating that the age profile was very limited. The age profile is shown in the graph below (**Figure 5.21**).

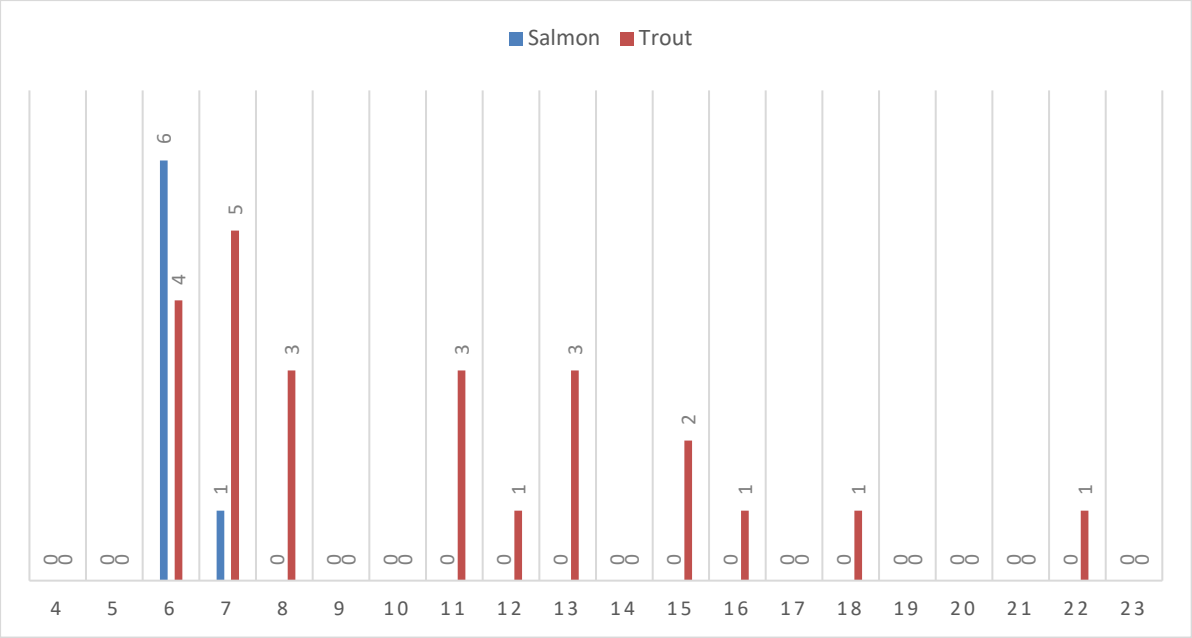

Figure 5.21: Age profile of salmon and trout at the Knocknabranagh & Knockbaun Stream.

Parameter	Coolcullen River Site	Coolcullen Stream Site	Knocknabranagh & Knockbaun Stream Site
Length fished	30	22	20
Time Fished (mins)	10	5	5
Width (m)	3.5	1.2	1.2
Mean depth (cm)	4	4	5
Maximum depth (cm)	15	20	55
Bed rock (%)	95	-	-
Boulder (%)	-	15	10
Cobble (%)	-	55	50
Gravel(%)	5	25	30
Sand (%)	-	5	10
Silt (%)	-	-	-
Siltation (clean/slight/moderate/heavy/not visible)	Slight	Slight	None
Plume (heavy/moderate/slight/none)	None	Slight	Slight
Riffle (%)	60	50	15
Pool (%)	10	40	80
Glide (%)	30	10	2

Parameter	Coolcullen River Site	Coolcullen Stream Site	Knocknabranagh & Knockbaun Stream Site
Plant cover (%)	20	10	15

Table 5.34: Sampling Site Descriptions – Abiotic Parameters.

11 no. sites were surveyed in the Dinin River catchment during July and August 2017 by IFI[8]. 6 no. fish species were recorded overall in the Dinin River catchment comprising brown trout (9 no. sites) salmon (9 no. sites), European eel (1 no. site), minnow (4 no. sites), stone loach (10 no. sites), three-spined stickleback (4 no. sites). Interestingly, no lamprey species were captured. Brown trout and salmon were the most abundant species captured. 4 no. age classes for brown trout (0+, 1+, 2+ and 3+) were present, with 0+ the most abundant cohort. 2 no. age classes for salmon (0+ and 1+) were present, with 0+ again the most abundant cohort. European eel were captured at Site 11, only.

Sites 5, 6, 7 and 8 were within the River Dinin (South) catchment. 4 no. species were captured within this catchment comprising brown trout (3 no. sites) salmon (3 no. sites), minnow (1 no. site), stone loach (3 no. sites). Site 5 was on the Coolcullen River at Phillips Bridge, approximately 1.2km downstream of the project site. The highest density of salmon captured during that was at Site 5 on the Coolcullen River, with approximately equal numbers of trout and salmon captured. Site 6, which was the Dinin South main channel, had similar ratios of trout and salmon. This is in stark contrast to the ratio of trout and salmon captured during the current electrofishing survey, where there were approximately 5 no. trout for each salmon captured on average across all 3 no. sites, and approximately 6 no. trout for each salmon captured at the Coolcullen River Lower Site which is just 1km upstream of the 2017 Site 5 at Phillips Bridge.

The likely reason for this, which was identified during the site walkover, and has also been identified by the Nore Suir River Trust[9], is a fish passage issue at Coan Bridge, approximately 4km downstream of the project site. The apron of Coan Bridge is completely impassable to fish as it is a multi-tiered shallow laminar flow with no plunge pool on each tier to give migrating fish a break and to give them the depth needed to leap to the next tier. Therefore, passage at Coan Bridge depends completely on the fish pass, which is a Denil style fish pass.

The Denil fish pass does not create a series of separate pools, like many other fish pass designs, instead it uses a series of symmetrical, closely-spaced, upstream-sloping, U-shaped baffles. These baffles turn the flow upon itself at the base of the baffle and create a low velocity zone that fish use to ascend. However, at Coan Bridge, the cavities created by the U-shaped baffles have been filled in with mobile river gravel, and the fish pass has become a shallow riffle. Additionally, at the head of the fish pass, there was a gravel bar deposit and a number of boulders which were directing the flow away from the fish pass and diverting the necessary flow volumes to attract migrating fish to the base of the fish pass. Although this is not a total barrier to fish passage, it is certainly a partial barrier. Full functionality of this fish pass would require

[8] http://wfdfish.ie/wp-content/uploads/2019/03/SERBD_Dinin_2017.pdf

[9] http://www.noresuirrivertrust.org/files/norebarriermigrationstudyver1_3.pdf

maintenance or a design upgrade but would open up 10+km of excellent spawning habitat and 30+km of excellent rearing habitat for salmon within the Nore Catchment.

Plate 5.19: Fish Pass and Bridge Apron at Coan Bridge

5.3.5.3 Biological Water Quality Analysis

A total of 4 no. biological water quality sample sites were selected; one on the Coolcullen Stream, 2 no. on the Knocknabranagh & Knockbaun Stream, and 1 no. downstream of the confluence of the 2 no. on the Coolcullen River at Phillips Bridge (**Figure 5.22**). A further 3 no. biological water quality sample sites were selected along the grid connection route and are discussed below. The Coolcullen Stream had a Q-Value of Q4-5; this was measured 100m upstream of the confluence with the Knocknabranagh & Knockbaun Stream. The Knocknabranagh & Knockbaun Stream had a Q rating of Q4-5 at the upper site immediately downstream of the watercourse crossing between turbines T5 and T6, and Q4 at the lower sampling site which was 70m upstream of the confluence with the Coolcullen Stream. The Coolcullen River scored Q4 at Phillips Bridge; this score was considered to be at the upper side of the Q4 strata, close to the boundary with Q4-5.

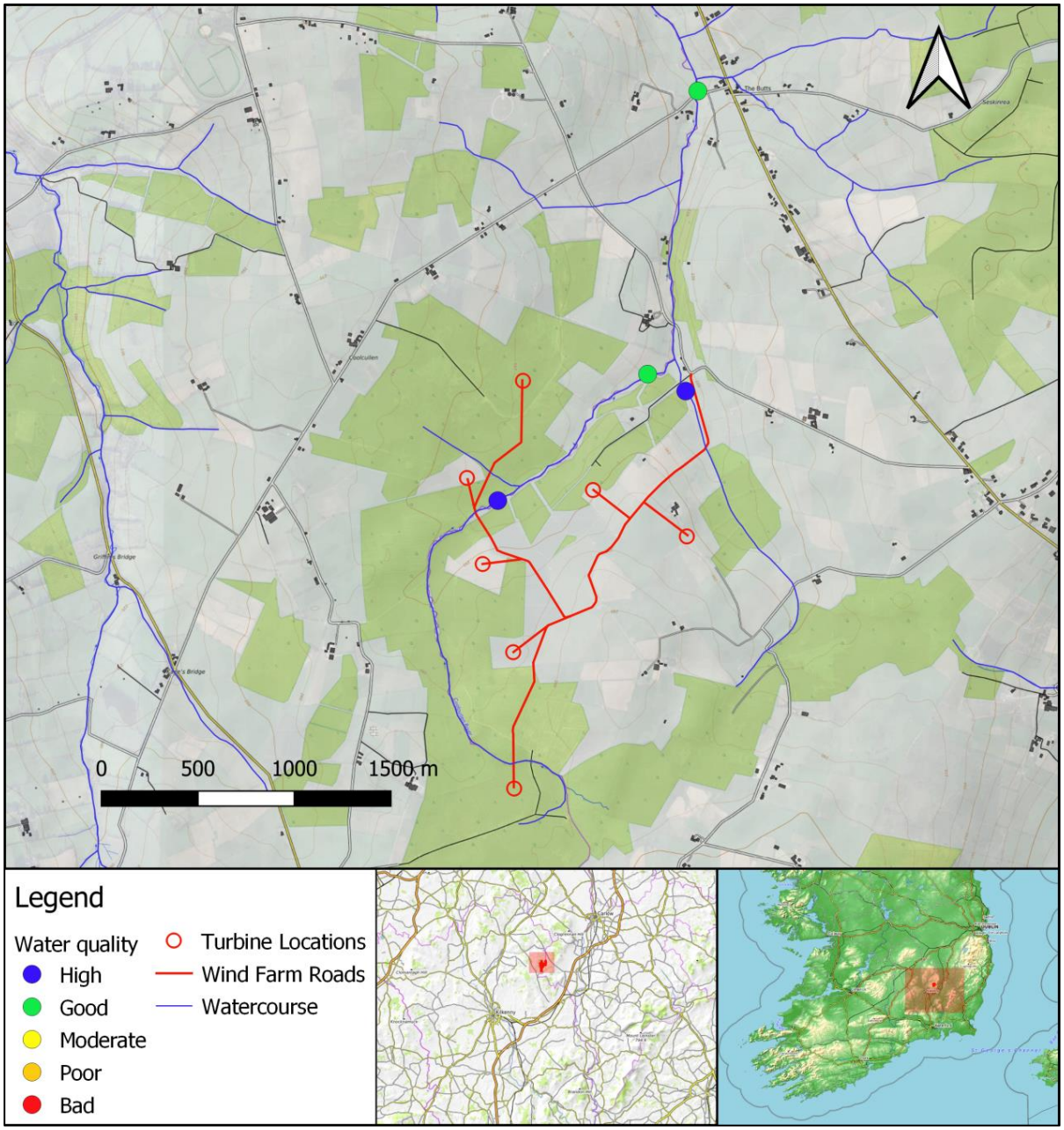

Figure 5.22: Biological Water Quality Analysis within and downstream of the Wind Farm

In terms of the rest of the South Dinin subcatchment, there are 2 no. national water quality monitoring stations; 1 no. upstream of the confluence with the Coolcullen River and therefore not hydrologically connected to the project site, and one 300m upstream of the confluence with the North Dinin subcatchment (**Figure 5.23**). Both of these have scored Q4 in the most recent round of water quality sampling in the area in 2019. Both sites have remained relatively stable around Q4 since the mid-late 1980's, each occasionally scoring Q3-4 or Q4-5 before returning to Q4 in the following round of sampling. Downstream from this, along the length of the Dinin Main Channel[10], there

[10] The Dinin Main Channel is the length of channel between the confluence of the Dinin South and Dinin North at the upstream end, and the point at which the Dinin flows into the Nore; a stretch of approximately 11km.

are 2 no. national water quality monitoring stations. One of these is at Lisnafunshion, approximately 200m downstream of the confluence between the Dinin North and South subcatchments, and the other is at Dinin Bridge on the N77, c. 1.2km upstream from the confluence with the Nore. Both of these stations have attained a Q-Value of Q3-4 in the latest two rounds of sampling, and they have been alternating between Q3-4 and Q4 for the since the mid-1980s. In summary, water quality deteriorates as the river flows downstream, this is a typical trait of Irish rivers as the farming intensity and human habitation increase from the uplands to the lowlands.

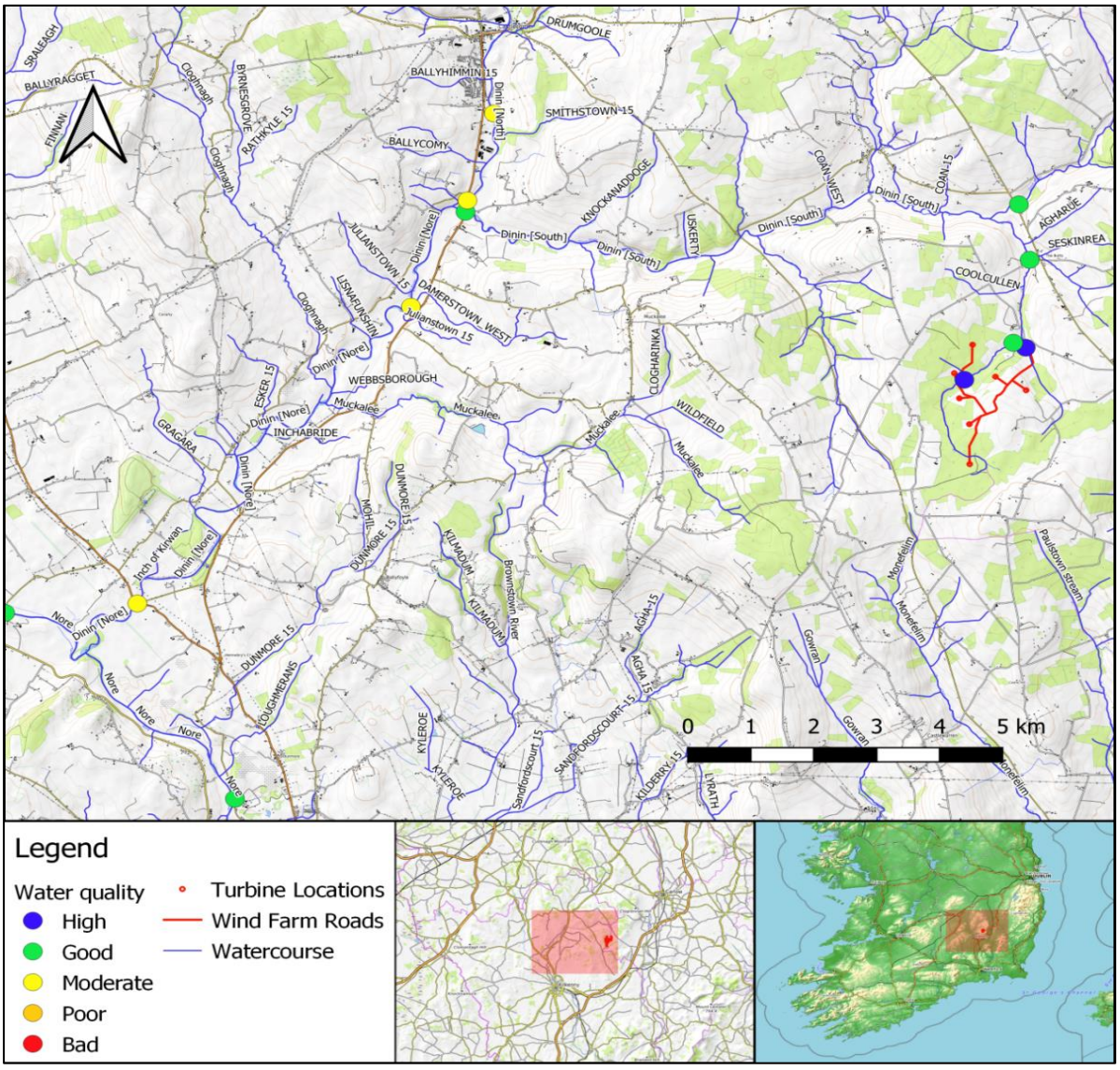

Figure 5.23: Biological Water Quality within the Dinin Catchment

5.3.5.4 Freshwater Pearl Mussel

A total of 4 no. 'reaches' were surveyed for freshwater pearl mussel (FPM; **Figure 5.24**). 20 no. cross-river transects were carried out at each reach, giving a total of 80 no. transects completed within a total of c. 4.5km of channel length, which represents a significant proportion of the South Dinin watercourse downstream of the project site. The Coolcullen and Knocknabranagh & Knockbaunstreams were assessed to be too small to support a population of FPM, and so no transects were carried out within them.

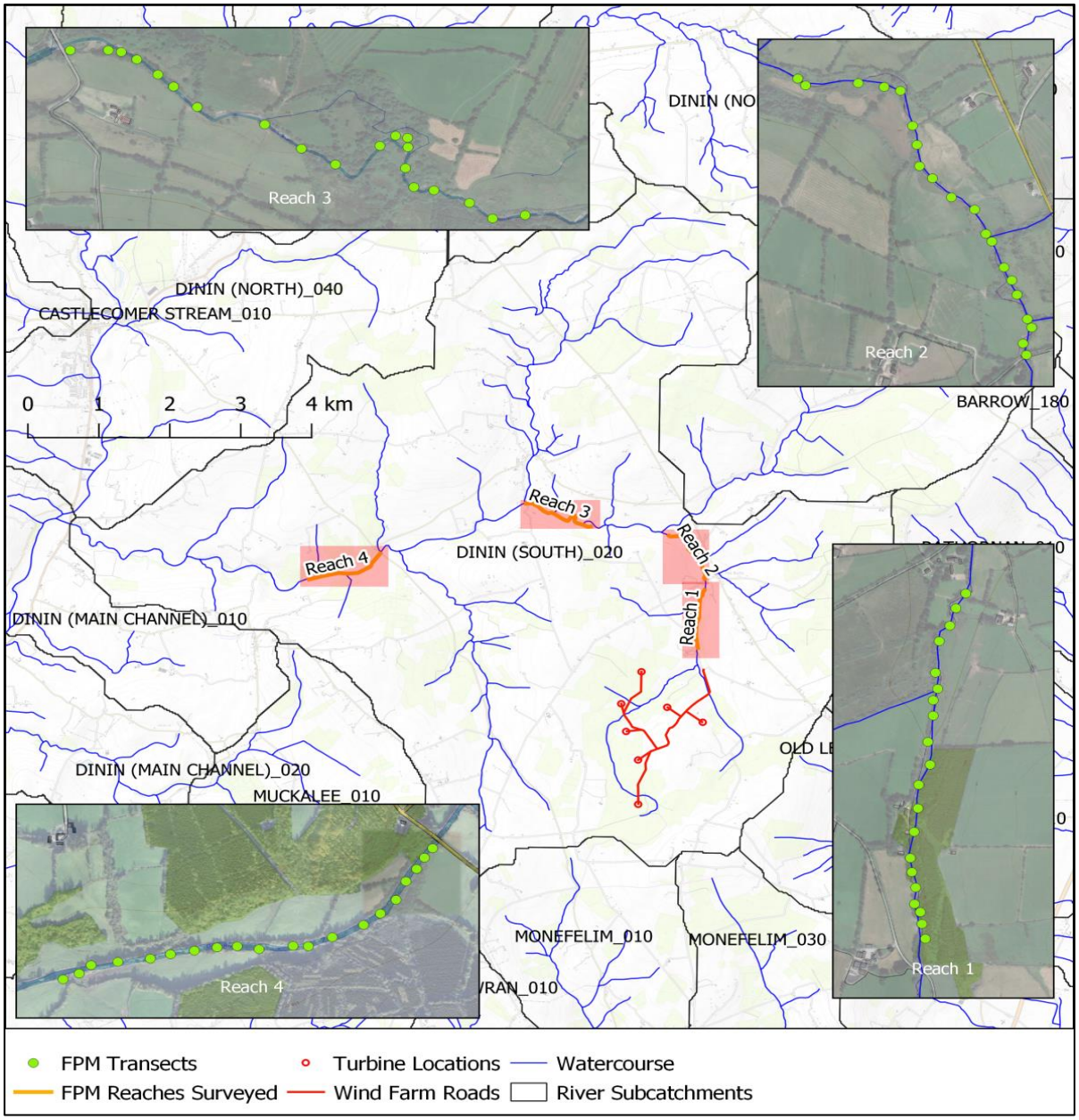

Figure 5.24: FMP Survey Reaches

No FPM were observed during the survey. The stretches examined were deemed representative of the river as a whole and a variety of microhabitats were surveyed (e.g. clean substrates in riffle, glide and pool under partial and full shade). No evidence of FPM in the form of shells were recorded during the field investigations, despite extensive searches on deposits at the leeward side of bends.

The NBDC have no records of FPM in the Dinin Catchment[11]. The underlying bedrock is classified as 'Westphalian shale, sandstone, siltstone & coal' according to the GSI Bedrock Geology database. According to the GSI rock unit groups (1:100,000 resolution), approximately half of the catchment of the Dinin South is Westphalian and Namurian Sandstone, and the rest is Westphalian Shale. Using criteria in Anon (2004), the Dinin South is classified as a moderate priority river for FPM, i.e. 'rivers with no prior

[11] https://maps.biodiversityireland.ie/Species/123483

records but with either igneous or sandstone bedrock underlying at least one third of their length; rivers flowing from lakes.'

Although the water chemistry is suitable for FPM, some of the physical parameters appear to render the stretch of watercourse surveyed unsuitable, particularly the presence of excessive mobile gravels and the highly erosive nature of the watercourse. Downstream of the confluence of the Coolcullen and Knocknabranagh & Knockbaun streams, signs of erosion are plentiful and, in places, severe. Banks of freshly exposed soil and subsoil are a common feature of the river corridor, as are man-made attempts to remediate such erosion. Large embankments of deposited gravels are very common, with many instances of evidence to suggest that the gravels become mobile on a regular basis[12]. *Ecology of the Freshwater Pearl Mussel* (Skinner *et al*., 2003) states on multiple occasions that good riverbed stability is an important parameter for the presence of FPM, and only a small proportion of the watercourse was found to be stable during the FPM survey. Additionally, Skinner *et al*. (2003) claim that gradient could affect mussel distribution indirectly by determining the stability of the substrata, and that an intermediate gradient range of 0.8–3 m/km was preferred. The stretch of watercourse surveyed downstream of the project site has a gradient ranging from 8m/km to 20m/km, while the Coolcullen and Knocknabranagh & Knockbaun streams within the wind farm site have a gradient of over 20m/km. Anon (2004) suggests that the watercourse should be 200m altitude or below. The entire Coolcullen and Knocknabranagh & Knockbaun streams channels as well as much of Reach 1 is above 200m altitude. These physical and hydromorphological traits of the watercourse suggest that the stretch of watercourse surveyed may not be suitable for FPM.

In the *Conservation Objectives* document for the River Barrow and River Nore SAC (NPWS, 2011) it states that "*The status of the freshwater pearl mussel (Margaritifera margaritifera) as a qualifying Annex II species for the River Barrow and River Nore SAC is currently under review. The outcome of this review will determine whether a site-specific conservation objective is set for this species.*" This document provides no additional detail as to the presence or whereabouts of this species within the Barrow/Nore Catchments. As previously stated, the NBDC has no records of FPM within the Dinin Catchment.

There are records of FPM within the Nore Catchment (NBDC, 2022) and they are records of *Margaritifera durrovensis*, the Nore freshwater pearl mussel, a species only known to the Nore River. The population stretches from Poorman's Bridge (ITM E640642 N685937) to Lismaine Bridge (ITM E644141 N666041), with most of the population found between Poorman's Bridge and the Avonmore Creamery above Ballyragget (ITM E643941 N672240; NPWS, 2011). This stretch of river (>15km west of the wind farm site) is entirely upstream of the confluence with the Dinin River and, therefore, this population is not hydrologically connected with the project.

5.3.5.5 Watercourse Crossings at Wind Farm

Stream Crossing No.1

[12] E.g. river gravel freshly deposited in tractor ruts at crossings, or on top of vegetation which was still alive and green underneath.

This proposed crossing of the Coolcullen Stream (located proximate to the temporary construction compound) is at the site where the electrofishing along this stream was carried out. It is approximately 500m upstream of the confluence with the Knocknabranagh & Knockbaun Stream. The riverine habitats are mainly shallow riffles and glides. The riverbed is coarse, consisting mainly of cobbles and large gravels, and is largely free of surface siltation. Riparian cover is mediocre to poor and is mostly grassy verge (GS2) with some riparian bramble scrub (WS1), and cattle have access to the river at a number of places. The hydromorphology appears to have been somewhat affected by mechanical means (likely gravel extraction) in the past. The crossing site is suited to juvenile trout and salmon as rearing habitat. There is no suitable lamprey ammocoete habitat; while some marginally suitable eel habitat is present. It is proposed to place a suitably sized box culvert at this crossing.

Stream Crossing No.2

This proposed crossing of the Knocknabranagh & Knockbaun Stream (between turbines T5 and T6) is approximately 1.4km upstream of the confluence with the Coolcullen Stream. This stretch of the western stream is in excellent condition hydromorphologically. It is an example of a high-quality mountain stream. There are riffles, pools and glides in optimal proportions, providing a good variety of habitats for juvenile salmonids and for resident adult brown trout. The stream is considered too small for spawning adult salmon. There is reasonable eel habitat with submerged large stones and overhanging banks. There is almost no stable optimal lamprey ammocoete habitat within this section of the watercourse; it is limited by the stream's high energy nature and low fine sediment input. It is proposed to place a suitably sized box culvert at this crossing.

Stream Crossing No.3

This proposed crossing is of a small first order tributary of the Knocknabranagh & Knockbaun Stream (located between turbines T6 and T7). This watercourse is present on OSI mapping, however, it is essentially a drainage ditch with a steady flow. It has been modified by straightening and most likely deepening, and is part of an extensive drainage network, some of which was created as part of the conifer plantation through which it flows. This stream crossing site most likely contains a small population of juvenile salmonids and may contain some eel. There is no lamprey ammocoete habitat. It is proposed to place a suitably sized box culvert at this crossing.

Stream Crossing No.4

This crossing is of the upper reaches of the Knocknabranagh & Knockbaun Stream (between turbines T3 and T4). At the crossing, the stream is a mountain drain cutting through 1-2m of surrounding terrain which is planted upon with sitka spruce. The spruce is blocking out light in a manner that prevents the growth of riparian vegetation. This section of stream is quite flat, and the stream has a low flow velocity and volume. Instream habitat is an unvaried slow glide, and the stream bed consists of a light dusting of sandy gravel on top of peat. There is very little spawning opportunity here, and the stream is likely to contain only very low numbers of trout and possibly eel.

Stream Crossing No.5

This crossing is of the Knocknabranagh & Knockbaun Stream, between turbine T5 and the western spoil deposition area, where an existing forestry/agricultural track crosses the stream at a shallow water crossing. Apart from the existing road crossing, this

stretch of stream is in excellent condition hydromorphologically, providing a good variety of habitats for juvenile salmonids and for resident adult brown trout. There is no lamprey habitat at the crossing. It is proposed to place a bottomless culvert here without modifying the riverbed.

5.3.5.6 Watercourse Crossings along Grid Connection Route

The cable route crosses a number of water features along it's c. 15km length. Three of these are to be crossed using HDD, as the deck of the bridge does not have sufficient depth capacity to allow for a trench to carry the cable through. Others have sufficient bridge deck depth capacity and the cable trench will simply be continued through the bridge deck. In total, only 4 no. crossings are made across water features of ecological interest; the 3 no. crossings using HDD and 1 no. trench crossing. Other water features are drainage ditches with either low flow or no flow under normal conditions

HDD1 and 2 cross the Lyrath Stream. HDD2 crosses in the townland of Feathallagh where the stream is a 1st order stream of moderate steepness. It consists of quite mobile gravels which interact with instream woody debris to create diverse instream habitats. The stream is in good condition hydromorphologically and does not appear to have been subject to major mechanical disturbance. A biological water quality sample was taken here and afforded the watercourse a score of Q3-4.

HDD1 crosses in townland of Kilmagar approximately 1.6km downstream of HDD2. The stream is still quite small here and is a 2nd order stream. At this point, the stream is a low gradient stream, more typical of lowlands, and is erosionally/depositionally neutral. There was, however, at the time of surveying, rolling mounds of coarse sand/fine gravel migrating at a steady rate downstream. This unusual phenomenon was attributed to severe and extensive earthworks c. 700m upstream of the site, where a field of ~2 hectares bordering the stream was being drained including extensive instream and riparian excavation and realignment of the stream. Attaining the Q-value at the lower site produced large plumes of silt which had no doubt been exacerbated by the recent upstream works; however, it is thought that this section of stream has pre-existing background levels of siltation due to the presence of tillage farming, some of which extends to the brow of the riverbank. The stream was given a score of Q2-3 at this site. This stream is suitable for trout and eel and may contain a resident population of brook lamprey in its lower reaches.

HDD3 and 1 no. of the trench crossings cross the Kilderry_15 stream, both in the townland of Ballysallagh/Feathallagh. Both crossings are in close proximity to one another. The stream is a fast-flowing, highly erosive upland stream which experiences large amplitude spate floods as evidenced by the features of erosion and general hydromorphological condition of the stream. The catchment is steep, and land use is mainly upland farming. This section of the Kilderry_15 stream is suitable for juvenile trout and may contain small populations of eel. The high energy nature of the stream in this section ensures that there is no accumulation of the silt beds necessary for the presence of lamprey. The apron of the bridge under which HDD3 is crossing, and another feature immediately downstream, are likely to be impassable to fish, meaning that upstream of this, any fish population is extremely vulnerable to pollution events and/or drought events as re-population would not be possible. The wooded nature of the river corridor is offering excellent shading. The watercourse was given a score of Q4 (upper boundary).

Aquatic Ecology at Haul Route Works Locations

The works on Black Bridge will not require any in-stream works or interference with any natural features on the riparian corridor. The stream crossing was visited and no signs of Otter were recorded at or near this bridge crossing.

The proposed works on the junction of the N78/L1234 are not in proximity to any watercourse.

Aquatic Ecology at Replant Lands

The replant lands are dominated by agricultural grassland and there is no significant watercourse located within the site. The lands are located within the Fane subcatchment (SC-010). The County (Water) River is located c. 200m to the south of these lands. EPA Q-Ratings from upstream and at Wallace's Bridge taken in 1997 recorded a 'Poor' (Q3) biological water quality status. However, the most recently available data from another station, upstream of Wallace's Bridge and close to the replant lands recorded a Q4 (Good) biological water quality in 2020. This stretch of river also achieved a moderate WFD status (2013-2018; www.epa.ie).

5.3.6 Other Taxa

A desktop review of the other taxa that have been recorded in the grid squares in which the project site is located was carried out. **Table 5.35** presents the Invertebrate fauna that have been recorded in the 2km Grid Squares which encompass the project site.

Gooden's Nomad Bee, *Nomada goodeniana* is an endangered species that has historically been recorded in Grid Square S66C. This species is most frequently recorded in the east and southeast of the country (**Figure 5.25**).

Common Name	Scientific Name	Grid Square Recorded	Conservation Status	Species group
7-spot Ladybird	Coccinella septempunctata	S66I	Least concern	Coleoptera
Cherry Fruit Moth	*Argyresthia pruniella*	S66C	Least concern	Lepidoptera
Comma	*Polygonia c album*	S66D	Least concern	Lepidoptera
Common Carder Bee	*Bombus (Thorabombus) pascuorum*	S66D	Least concern	Hymenopteran
Dingy Skipper	*Erynnis tages*	S66C, S66I	Threatened Species: Near threatened	Lepidoptera
Garden Tiger	*Arctia caja*	S66C	Least concern	Lepidoptera
German Wasp	*Vespula paravespula germanica*	S66C	Least concern	Hymenopteran
Gooden's Nomad Bee	*Nomada goodeniana*	S66C	Threatened Species: Endangered	Hymenopteran

Common Name	Scientific Name	Grid Square Recorded	Conservation Status	Species group
Green veined White	*Pieris napi*	S66C, S66I	Least concern	Lepidoptera
Large White	*Pieris brassicae*	S66I	Least concern	Lepidoptera
Meadow Brown	*Maniola jurtina*	S66C	Least concern	Lepidoptera
Orange tip	*Anthocharis cardamines*	S66D, S66C, S66I	Least concern	Lepidoptera
Peacock	*Inachis io*	S66I	Least concern	Lepidoptera
Red necked Footman	*Atolmis rubricollis*	S66C	Least concern	Lepidoptera
Ringlet	*Aphantopus hyperantus*	S66C	Least concern	Lepidoptera
Silver Y	*Autographa gamma*	S66I	Least concern	Lepidoptera
Small Garden Bumble Bee	*Bombus (Megabombus) hortorum*	S66D	Least concern	Hymenopteran
Small Tortoiseshell	*Aglais urticae*	S66I	Least concern	Lepidoptera
Small White	*Pieris rapae*	S66I	Least concern	Lepidoptera
White Ermine	*Spilosoma lubricipeda*	S66I	Least concern	Lepidoptera
Wood White	*Leptidea sp.*	S66C	Not threatened	Lepidoptera

Table 5.35: Terrestrial invertebrate species recorded in the 2km Grid Squares

Marsh Fritillary has been recorded from Grid Square S56, but there have been no records from S66. Common Frog, *Rana temporaria* and Smooth Newt, *Lissitron vulgaris*, have both been recorded in the 10km Grid Square in which the wind farm will be located. Smooth Newt has been recorded at Baurnafea (c. 1km southwest of the wind farm site) in 2018 and they have also been recorded from near Bagenelstown.

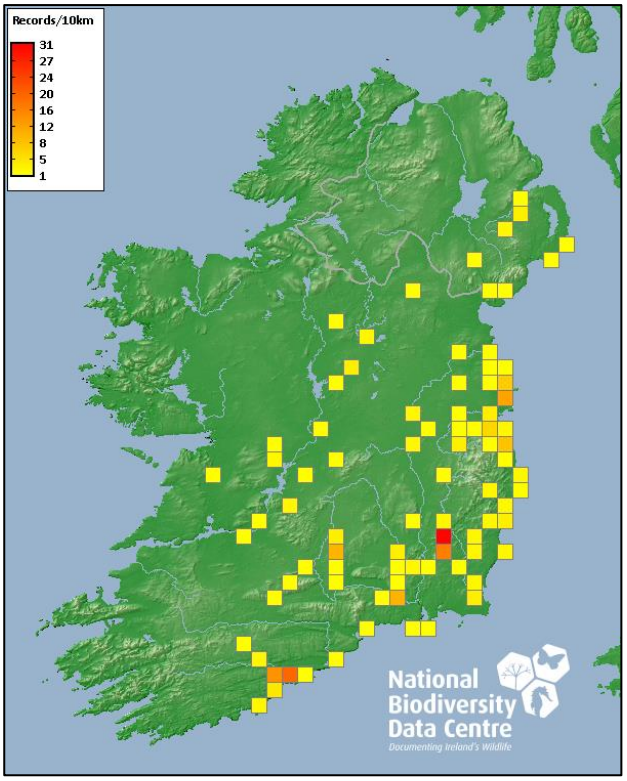

Figure 5.25: Distribution of Gooden's Nomad Bee (National Biodiversity Data Centre, Ireland)

5.3.6.1 Casual Records

Common Frog was recorded on several occasions during VP surveys in each survey season. Smooth Newt was not recorded but it is likely to occur in small areas of suitable habitat. Common Frog was recorded in wet grassland habitat in the study area during the botanical and habitat surveys. No breeding signs were recorded and there are limited features within the study area for breeding frogs.

Surveys in late August 2021 for evidence of larval webs in areas with Devil's Bit Scabious did not record the presence of any Marsh Fritillary in the study area. Neither were any adult Marsh Fritillary observed on the wing during the various field surveys.

Other species recorded as casual observations made during field visits are presented in **Table 5.36**.

Common Name	Scientific Name
Common Carder Bee	*Bombus pascuorum*
Green-veined White	*Pieris napi*
Large Red-tailed Bumblebee	*Bombus (Melanobombus) lapidarius*
Large White	*Pieris brassicae*
Meadow Brown	*Maniola jurtina*
Pale Straw Pearl	*Udea lutealis*
Peacock	*Aglais io*
Pied Hoverfly	*Scaeva pyrasti*

Common Name	Scientific Name
Red Admiral	*Vanessa atalanta*
Ringlet	*Aphantopus hyperantus*
Silver Y	*Autographa gamma*
Small Copper	*Lycaena phlaeas*
Small Tortoiseshell	*Aglais urticae*
Small White	*Pieris rapae*
White-tailed Bumblebee	*Bombus lucorum*

Table 5.36: Other Species Recorded as Casual Observations

5.4 Description of Likely Effects

5.4.1 Designated Sites

A constraints led design approach was taken to siting of the principal features of the project to avoid areas of high sensitivity for key habitats and species occurring or likely to occur at the project site. The potential impacts on the Natura 2000 sites and their qualifying interests are considered in detail in the NIS that accompanies the planning application.

The Source-Pathway-Receptor (SPR) model was used in evaluating the potential for effects arising from the project affecting designated sites and their conservation objectives. Construction, operational and decommissioning phase effects were assessed. The likely Zone of Influence (ZoI) for different activities and protected habitats and species ranges in temporal and spatial scale. In most cases, proximity to the project site is a major factor in determining the potential for effects. However, key considerations such as the hydrological connectivity between the project site and the designated site and the distribution and ecology of the qualifying interests are also taken into account. For illustrative purposes, a nominal distance of 15km from the project site is used when displaying the location of designated sites in the wider hinterland. As appropriate, potential impacts on designated sites at greater distances are also considered and potential pathways for such impacts are evaluated.

There are three Natura 2000 sites located within 15km of the project site. These are:-

- River Barrow & River Nore SAC (002162);
- River Nore SPA (004233); and,
- Lisbigney Bog SAC (000869).

While a number of the qualifying interests of the River Barrow & River Nore SAC (see **Table 5.8** above) are located either upstream of the site, or in areas so distantly downstream (e.g. Estuaries, Saltmarsh habitats) that there is no likelihood of impact, there are other Qis that could potentially be impacted. Apart from the works to facilitate turbine delivery at Black Bridge, the construction works will not be carried out in close proximity to the SAC (the nearest turbine is located c. 1.7km overland). No signs of Otter were recorded at the wind farm site or at any of the watercourse crossings for the grid connection route or haul route works locations. Given the limited nature of the works on Black Bridge it is unlikely that there will be any significant disturbance or displacement effects on faunal QIs as a result of the project.

It is assessed that in the absence of appropriate mitigation, significant effects could occur in relation to the River Barrow & River Nore SAC. The significant effects identified are those associated with surface water run-off and contamination of watercourses linked to the SAC.

The River Nore SPA is designated for the protection of Kingfisher [A229]. It is located c. 11.5km over-land from the project site. It is in excess of 15km downstream of the project site. Kingfishers hold linear territories along the riparian corridor of from <1km to several kilometres in length (BWPi). Surveys on Irish river systems indicate they favour rivers with availability of vertical nesting banks of 1-2m in height (Cummins *et al*. 2010). The small streams that drain the wind farm sites are unattractive for nesting Kingfishers and would represent sub-optimal foraging habitat for this largely sedentary species. Given the distances involved between the project site and the SPA, there is no likelihood of any direct impacts arising on Kingfisher. However, given that there is a hydrological link, albeit distant, there is some potential, in the absence of adequate mitigation for impact upon the habitat and prey abundance within the SPA.

Lisbigney Bog SAC is located 12.4km from the project site. It is designated for the conservation of Calcareous fens with Cladium mariscus and species of the Caricion davallianae [7210] and *Vertigo moulinsiana* (Desmoulin's Whorl Snail) [1016]. This site is located upstream of the project site and there is no potential for direct or indirect effects on this site arising from the project.

Full details of the assessment undertaken are provided in the NIS.

There are also a number of nationally designated sites (NHA and pNHA) in the wider area. There are 17 no. pNHAs and 1 no. NHA located within 15km of the project site (**Figure 5.11**).

The closest of these sites is Mothel church, Coolcullen pNHA (000408) located 1.6km from the project site and 1.9km from the nearest turbine location. Mothel Church is home to a nursery colony of Natterer's bats (*Myotis nattereri*) which use the loft and bell tower of the church. While Natterer's Bat was recorded widely at the site it made up a small proportion of the registered bat calls (<4.5%) and the habitats present at the wind farm site are considered suitable, but sub-optimal, for foraging Natterer's Bat. Monitoring at height, during the summer period did not record any calls of the species near the met mast location.

Coan Bogs NHA (002382) and Whitehall Quarries pNHA (000855) are the only other nationally designated sites located within 5km of the project site. Neither are designated for faunal interests and no pathway for likely significant effects upon these sites was identified. None of the other more distant sites that do not share a European designation (e.g. River Nore/Abbeyleix Woods Complex pNHA) will be affected by the project.

Construction Phase

As the project is not located within any designated site for nature conservation, direct effects will not occur. Indirect effects during the construction phase relate to the risk of a deterioration in water quality which could adversely affect the breeding or foraging activities of qualifying interests of SPA, SACs and features of interest of NHAs, and pNHAs; while disturbance/displacement effects could also arise due to construction activities.

Surface Water Runoff

General enabling and construction works are likely to mobilise sediment and other contaminants through run-off. Tree felling, excavations, creation of new access tracks and upgrade of existing tracks, construction of turbine hardstanding areas, stream crossings and all other new hard surfaces are likely to contribute to the increase in runoff.

Likely sources of sediment laden water include:-

- Standing water in excavations could contain an increased concentration of suspended solids as a result of the disturbance of the underlying soils;
- Access tracks passing close to watercourses could allow the migration of silt laden runoff into watercourses;
- Silt carried on the wheels of vehicles leaving the project site could be carried onto the public road;
- A blockage in the drainage infrastructure could allow a breakout of silt laden runoff to reach adjacent watercourses or streams;
- Runoff from borrow pits or spoil deposition areas could be silt laden, with the risk of draining into receiving watercourses;
- Overland flow entering excavations could increase the quantity of surface water to be treated for sediment removal;
- Tree felling and vegetation clearance could lead to an increase in sediment and nutrients in the surface water runoff, particularly if the brash is left in place in the riparian buffer zones;
- Inappropriate management of excavations could lead to loss of suspended solids to surface waters;
- Inappropriate management of the excavated material could lead to loss of suspended solids to surface waters;
- Surface water inflows and minor groundwater seepages may occur in turbine base excavations. Pumped water from the excavations will most likely contain suspended solids; and,
- During watercourse crossings and enabling works near watercourses there is a potential to release suspended solids into the watercourse. Works leading to erosion of the riverbanks/bed could result in the release of suspended solids.

Release of hydrocarbons

- Refuelling activities could result in fuel spillages which could pollute ground and surface water;
- Fuel spill/leaks from storage tanks within the temporary construction compound for plant machinery. Fuel spills/ leaks could result in a deterioration of downstream water quality; and,
- Tree felling process require trafficking of heavy machinery which can lead to pollution of watercourses due to spillage of fuels and hydrocarbons.

Release of Cement-Based Products

Cement-based products should uncontrolled discharges or inappropriate management of cementitious materials occur, could lead to contamination of receiving surface waters and groundwaters.

Spread of Invasive Non-native Species

While no Third Schedule non-native species were recorded within the project site, it is possible that such species could be present by the time construction works commence, or that machinery and imported material could act as a vector for introducing or dispersing non-native invasive species within the proposed project working areas (including intersecting watercourses) and to adjacent lands/watercourses.

Disturbance/Displacement

The project site is not located proximate to any SPA where any direct effects upon avian species are assessed as likely to occur. The likelihood of ex-situ effects occurring on such species is also unlikely based on the nature and scale of the project, the habitats present and the bird assemblage recorded using the site across a number of years.

No signs of Otters were recorded at the watercourse crossings, including at Black Bridge. It is possible however, that in the absence of mitigation that some disturbance and displacement of faunal qualifying interests (particularly Otter) could occur as a result of the construction activity.

Habitat Loss

There will be no direct habitat loss of any habitat associated with the designated Natura 2000 sites in the wider receiving environment.

Operational Phase

As the project site is not located within designated nature conservation site, no direct effects will occur. Once operational, no significant change would be anticipated in relation to the volume or quality of run-off from the site.

The grid connection route will be undergrounded and therefore there will be no risk of operational phase impacts arising in relation to the cable connection.

Indirect effects such as those related to collision risk to qualifying interests and features of interest to European and nationally designated sites are assessed below.

Collision Risk

During the operational phase, there is the potential for collision of birds and bats with turbine towers, blades (moving or stationary) and/or associated infrastructure; and that the wind turbines could act as a barrier to dispersal and movement of birds and bats.

The project site is not located close to any European nature conservation site designated for bird or bat qualifying interests. Mothel Church, Coolcullen pNHA (designated for a maternity Natterer's Bat colony) is located 1.9km from the nearest turbine and, therefore, theoretically within the zone of influence for bats dispersing to feed from this roost site. However, as described above, there was little evidence of the wind farm site being an important foraging area or on a regular commuting route for Natterer's Bats.

The likelihood of collision mortality with such species is assessed elsewhere within this chapter and within the NIS as relevant. It is assessed that collision mortality will not affect the conservation objectives of Natura 2000 sites within the Zone of Influence. Similarly, based on the detailed survey data, there is no reason to indicate that the

project will adversely affect the Natterer's Bat population through collision mortality at the operational stage.

Decommissioning Phase

Risks associated with the decommissioning phase are likely to be similar in nature, although less pronounced, both spatially and temporally, than those associated with the construction phase. Therefore, the risks to designated sites and their features of interest or qualifying interests are chiefly related to effects on water quality from run off of sediment and other pollutants and also to increased disturbance associated with the movement of plant and personnel. These activities may also increase the risk of the spread of Invasive Plant species.

Summary

The NIS assesses the potential effects of all of the phases of the project on the designated European sites and their conservation objectives. There is a lack of credible pathway to mediate impacts upon many of the nationally and European designated sites in the wider hinterland of the project. However, there are a number of sites in the receiving environment, most notably those hydrologically linked with the application site, that could potentially be impacted by the project.

The construction phase is identified as requiring the greatest degree of active environmental control. However, commensurate measures for control of run-off during the operational and decommissioning phases of the project will need to be applied to ensure that the identified risks are adequately addressed. In the absence of appropriate mitigation, there is a likelihood of significant adverse effects on designated sites, including the River Barrow and River Nore SAC in the short-term, associated with the construction phase.

5.4.2 Habitats

5.4.2.1 Construction Phase

No Annex I habitats listed under the EU Habitats Directive are present within the study area (including the haul route works locations). Also, no botanical species protected under the Flora (Protection) Order 2022, listed in the EU Habitats Directive, or listed as flora of conservation concern in Ireland were recorded within the study area. The main habitats which will be directly impacted by the proposed development works footprint include improved agricultural grassland (GA1) and Conifer plantation (WD4) which are of Local importance (Lower value). Other habitats which will be directly impacted include Hedgerows (WL1), Treelines (WL2) Wet grassland (GS4), Dry meadows and grassy verges (GS2) and Scrub (which are considered to be of Local importance (Higher value) and Exposed rock Local importance (Lower value).

Approximately 0.5km of existing agricultural tracks (*i.e.* Spoil and bare ground (ED2)), Local importance (Lower value), will be upgraded to accommodate the proposed development site access.

Eroding upland river (FW1) habitat and flora associated with aquatic habitats in the study area and downstream could be adversely affected by the project through indirect hydrological/water quality effects such as nutrient release, siltation and/or contaminated run-off arising from the development works footprint. These watercourses are connected to the River Dinin which forms part of the EU Designated sites, the River Barrow & River Nore SAC and the River Nore SPA. The River Barrow & River Nore SAC is located immediately downstream of Black Bridge on the Dinin

(South) although it is 1.7km from the nearest turbine (over land). The River Nore SPA is 13km from the nearest turbine (over land) but in excess of 26km downstream when measured along the river network.

Other habitats present such as Recently felled woodland (WS5), Immature Woodland (WS2), Stonewalls and other stonework (BL1) of Local importance (Lower to Higher Value) are outside the project footprint and as such will be maintained as is and not directly affected.

The wind farm site extends to an area of c. 290ha; however the direct footprint (i.e. loss of habitat) of the wind farm infrastructure is small in comparison. The actual permanent land take is limited to the area of the turbine bases, crane hardstandings, the new and existing access tracks, the meteorological mast base and the electricity substation, which collectively account for circa 9ha). This is c. 3% of the total area of the wind farm site. Furthermore, the wind farm will be largely confined to the existing improved agricultural grassland (GA1) and Conifer plantation (WD4) and existing access tracks (i.e. buildings and artificial surfaces (BL3)) of Local importance (Lower value). The permanent loss of sections of such habitats, which are of Local importance (Lower value), will lead to a neutral-imperceptible impact on existing semi-natural habitats and flora species at the site and surrounding locality. It is also noted that the forestry plantation cleared to facilitate the wind farm development will be replaced elsewhere.

Small areas of relatively high quality and diverse wet grassland (GS4) will be permanently removed at the location of turbines T1 and T3 and their associated infrastructure. The wet grassland is a semi-natural habitat that is of Local Importance (Higher value). This represents a significant negative impact in the local context on this semi-natural grassland habitat type which is becoming increasingly scarce in the surrounding intensively managed landscape. The wet grassland surrounding the infrastructure at these locations (i.e. outside of the project footprint) may be damaged by inappropriate trafficking during the construction phase. Furthermore, the installation of drainage associated with the is also likely to alter the hydrology of the Wet Grassland habitat. This could result in the drying out of the area leading to a permanent habitat modification and could in the absence of mitigation be a significant negative effect at the immediate local scale in the absence of mitigation. Such an effect is likely to be localised to the area immediately drained by such infrastructure and would not affect other areas of similar habitat.

Sections of hedgerow (WL1) and treeline (WL2) habitat will also be permanently removed to accommodate the construction of wind farm infrastructure. No Annex I habitats or rare of protected plant species were present in these areas. The removal of these sections of hedgerow (WL1) and treeline (WL2) is assessed as likely to have a significant local negative impact on this habitat as it is a permanent loss of a habitat type that is of Local Importance (higher value). However, the extent of vegetation removal has, by design, been minimised and no vegetation will be unnecessarily removed. As part of the reinstatement process; all trees felled and hedgerow removed in the construction of wind farm infrastructure will be replaced elsewhere within the project site, particularly along arterial access tracks.

In the absence of any mitigation to protect existing trees during the construction phase, it is likely that trees in hedgerows and treelines may be damaged by construction activity. This could arise from damage to roots of trees if they remain unprotected and are within the works areas. Additionally, there is a likelihood of

machinery strike damaging tree limbs. In a worst-case scenario, the damage inflicted on the trees, hedgerows and treeline habitats would result in their degradation and removal from the lands. The effect of this would be permanent and are likely to be significant negative at the highly localised scale in the absence of appropriate mitigation.

Eroding/upland streams (FW1) and an extensive network of forestry and agricultural drainage ditches (FW4) have been installed across the study area and form a hydrological link between the study area and aquatic habitats in the wider locality including the EU designated site the River Barrow and River Nore SAC. There is, therefore, a pathway for adverse indirect hydrological/water quality effects such as nutrient release, siltation and/or contaminated run-off arising from the project site. This is assessed as likely to result in a moderate, negative and short-term effect in the local context.

Overall, effects on habitats and flora are assessed as likely to be significant negative short term at a local to European level.

5.4.2.2 Operational Phase

The likely operational phase effects are largely related to the turbine activity and to a lesser extent to the maintenance of the site infrastructure. Following the completion of the construction phase and the recolonisation of disturbed ground, there will be no additional removal of habitat during the operational phase. As a result, there is no likelihood of direct adverse effects on habitat and flora arising from the operational phase of the development.

While site traffic will be greatly reduced during the operational phase in comparison to the construction phase, habitat damage may occur from inappropriate trafficking for maintenance works during the operational phase. This is particularly so in areas of sensitive wet grassland in proximity to turbines T1 and T3; and effects are assessed as slight negative in the local context.

Maintenance activities may also give rise to discharges of silt, hydrocarbons and other chemicals into watercourses. In the absence of appropriate controls, there is a risk of leakages of oils, fuels and other hydrocarbons from plant & machinery, turbine transformers and the electricity substation. However, it should be noted that during the operational phase, only small quantities of hydrocarbons will be present. Notwithstanding this, there remains a slight negative risk of adverse effects on terrestrial and aquatic habitats, and flora.

As outlined in previous sections, the project will result in the replacement of the vegetated surface with less permeable surfaces within the wind farm (e.g. hardstands, access tracks etc.) which may result in an increase in the proportion and velocity of surface water run-off reaching the surface water drainage network and receiving watercourses. During storm rainfall events, additional run-off coupled with increased velocity of flow could increase hydraulic loading, resulting in erosion of watercourses. This could lead to adverse effects on aquatic habitats and flora, most notably through sedimentation of instream habitats through increased erosion rates.

It is assessed that the likely operational phase effects on habitats and flora are slight-negative, short-term and in the local context, in the absence of mitigation.

5.4.2.3 Decommissioning Phase

The likelihood of effects during decommissioning are similar in nature, if not in scope, to those assessed for the construction phase. All decommissioning works will be governed by the same requirements to control habitat loss and damage, run-off and pollution to watercourses as have been implemented during the construction phase.

In the absence of mitigation, the likely effects of the decommissioning phase on habitats and flora are assessed to be slight negative short term at a local level. The nature of the decommissioning works is unlikely to result in any significant effects on rare or protected habitats or botanical species in the wider area. In the absence of appropriate mitigation, invasive plant species may be spread during the decommissioning works.

5.4.2.4 Non-native Invasive Species

Construction works within the project site may disturb stands of invasive plants and/or soils contaminated with invasive plant material and cause them to spread onsite. In addition to lands within the project site, there is an identified risk of invasive plant species being spread onto neighbouring lands and onto public roads and other locations. Construction works could, therefore, result in the spread of invasive plant species both *in-situ* and *ex-situ*. The most common means by which these species can be spread are:-

- Site and vegetation clearance, mowing, hedge-cutting or other landscaping activities;
- Spread of seeds or plant fragments during the movement or transport of soil;
- Spread of seeds or plant fragments through the local surface water and drainage network;
- Contamination of vehicles or equipment with seeds or plant fragments which are then transported to other areas; and,
- Importation of soil from off-site sources contaminated with invasive species plant material.

A watercourse can act as a pathway allowing the transit of invasive species resulting in the indirect habitat loss/damage to downstream habitats in the wider area including designated nature conservation sites that are present e.g. River Barrow & River Nore SAC. Run-off from traffic, deposition of spoil from the wheels of vehicles or accidental spillage of soil from the trailers may result in the inadvertent spread of invasive plant species to nearby aquatic habitats downstream.

Machinery, equipment and material (including soil) which may be transported onto the site for construction may also lead to the introduction of further invasive species to the site with potential to displace local natural biodiversity. Given the location of the project site with hydrological connections to an EU designated site(s), the effect of the spread of non-native invasive plant species could lead to a significant negative effect at the local to European level.

5.4.2.5 Grid Connection

It is assessed that adverse effects on habitats & flora arising from the installation of grid connection infrastructure could only arise during the construction phase; however, it should be noted that the grid connection will be predominately placed within the carriageway of public roads; with only short section of infrastructure placed off-road which are assessed to be of low ecological value. No Annex I habitats, rare,

protected, or Third Schedule Invasive species were recorded along the grid connection route. The effects of the grid connection on habitats are assessed to be likely, non-significant neutral, localised in extent and temporary in nature.

5.4.2.6 Replant Lands

The replant lands are not located within or adjacent to any designated conservation site and is not located within any particularly sensitive habitats. The site is currently in use as improved agricultural grassland (GA1), a habitat of generally low ecological importance. The afforestation of the site will see the loss of GA1 habitat of low local value, which is a habitat that is abundant locally and nationally.

The replanting and ongoing management of lands (e.g. thinning, spraying, felling) may also result in adverse effects on watercourses and aquatic habitats due to the completion of ground works and the risk of accidental release of silt, sediment or other pollutants. However, in this case, the areas to be planted are not within the immediate vicinity of any notable water features; although the lands are drained by artificial ditches within field boundaries. It is likely that in the absence of appropriate mitigation that there will be non-significant negative and highly localised short-term effects on habitats associated with the planting and early establishment phase. As the forestry matures, the effect on the local habitat are likely to be neutral non-significant and highly localised in the medium to long-term.

5.4.3 Birds

5.4.3.1 Construction Phase

There are a number of likely construction phase effects of wind farms on birds, including habitat loss or degradation and disturbance. The likely significance of each of these effects at the project site and associated elements (e.g. grid connection route, replant lands and haul route works locations) is discussed below. An overall assessment of the likely effect of the project, as a whole, on the local avian community is also presented. The study area is not situated proximate to any Special Protection Area. The closest SPA is the River Nore SPA situated 11.4km overland from the application boundary (13km from the nearest turbine). This site is designated for the conservation of a single species, Kingfisher. Likely effects on the conservation objectives of this SPA are assessed in detail in the NIS. There is no likelihood of direct effects on the SPA but, in the absence of adequate mitigation, there is a likelihood of effects on water quality and prey availability of Kingfisher associated with run-off of contaminants to connected watercourses. Even in the 'worst case scenario' (without mitigation), such effects are likely to be significant negative but temporary in nature. Measures to avoid adverse effects on sensitive aquatic habitats and species will also be effective in minimising the risk to the SPA. Given the large distances involved and the dilution and dispersal effects that this will imbue, the actual risks of significant effects on Kingfishers in the River Nore SPA are limited. However, a precautionary approach has been adopted and likely effects on the SPA are fully assessed in the NIS.

The bird community recorded by the multi-seasonal surveys at this site reflects the nature of the dominant habitats present. The mix of agricultural grassland and conifer plantation present is represented by the dominance of typical farmland and woodland birds recorded at the site. Species diversity was relatively consistent between winter and breeding seasons, although there was significant interannual variation in the occurrence and pattern of usage of the site by key target species. The

breeding seasons flightlines were dominated by Buzzard and there were a number of breeding pairs present in this area. Adult and juvenile Buzzards were frequently recorded on the wing during the summer months and at least 1 no. Buzzard was observed on-site for over an hour in each of the breeding season VP survey periods. Buzzard flightlines also tended to dominate the winter seasons, although to a lesser extent. Kestrels were recorded in each of the survey seasons, although the time spent on-site was far more limited than Buzzard in all of the survey seasons. In several seasons, the cumulative total of the time Kestrels were observed on-site was substantially less than 10-minutes (<6-minutes in 4 no. of the 5 no. survey seasons). In the winter of 2021/2022, Kestrels were recorded over the wind farm site for a cumulative total of 16-minutes 35-seconds. As can be visually appreciated in the corresponding flightlines (**Annex 5.3**) Kestrels were far more frequently observed in areas outside the wind farm site.

The only other raptor species regularly observed on-site across the survey period was Sparrowhawk. Similar to the observations of Kestrels in this area, the cumulative time Sparrowhawks were observed in flight over the application site was less than 10-minutes in 4 no. of the 5 no. survey seasons. In the winter of 2021/2022, Sparrowhawk was observed on-site for a cumulative total of 15-minutes 30-seconds.

There were infrequent sightings of Hen Harrier (3 no. sightings in total, seen in only winter survey seasons; on-site for less than 2-minutes across entire 5 no. seasons) and Peregrine Falcon. Peregrine Falcon was rarely observed and was recorded for a maximum of 40-seconds over the wind farm site in any survey season. There were several sightings of a probable Goshawk at the site during the winter of 2019/2020. The bird was not seen during subsequent visits and is likely to have been a vagrant. A small number of Goshawks have bred in Ireland, but sightings of vagrant birds are reasonably frequent. It is probable that occasional escapes of captive bred birds also contribute to the sightings of this species in Ireland.

The pattern of occurrence and abundance of wintering flocks of Golden Plover varied significantly interannually. In the winter of 2019/2020, relatively large flocks of up to 300 no. birds were observed from time to time (10 no. flightlines), although very occasionally occurring over the site. In all, Golden Plovers were present on site for a cumulative total of a little over 2-minutes during that winter period. In the following winter (2020/2021), sightings of Golden Plover were far more frequent (53 no. flightlines) and these sightings were highly concentrated in the early and late parts of the winter season. In total, Golden Plovers were recorded on site for a cumulative total of almost 2-hours during the winter VPs. Golden Plovers were observed outside of the wind farm site for a total of almost 8.5-hours during that winter. In strong contrast, in the final winter season there were only 5 no. observations of Golden Plover and none of these were of birds within the wind farm site. Golden Plovers were not observed foraging or at rest (i.e. on the ground) within the site.

There were occasional sightings of other waterbirds and waders during the VP surveys. These were infrequent with a few sightings of Lesser Black-backed Gull and Grey Heron in several of the survey seasons. There was a handful of other sightings of waterbirds with flightlines observed of Little Egret, Mallard and Teal in a single survey season (Winter 2021/2022).

Of key consideration in terms of this assessment are effects on the target species observed to occur at the wind farm site, particularly those species of elevated conservation importance that were observed on a regular basis; namely Golden

Plover and Kestrel. A number of other Annex I avian species have been recorded on, or in the vicinity of, the study area on a very infrequent basis during the intensive field surveys e.g. Peregrine Falcon, Little Egret and Hen Harrier. The study area is not considered to be of any particular ecological significance for these species as they do not regularly occur in this area.

Habitat Loss or Change

The construction activity and loss of habitat around the project footprint is likely to disturb and displace birds that occur in the immediate vicinity of these works. The movement of plant and personnel during construction is likely, in the absence of mitigation to see significant, albeit highly localised, negative impacts on the overall bird community present at the wind farm site. The duration of such effects is likely to range from short-term (e.g. disturbance effects associated with site traffic) to long-term (e.g. those that result from habitat loss and are associated with the ongoing disturbance/displacement effects of the operational wind farm). The extent to which individual species are susceptible to such effects depends, to a large extent, on their individual ecology.

Direct habitat loss or change is inevitable in the development of any project, especially when the development of access tracks, turbines, crane hardstandings and other associated construction is considered. This can result in reduced feeding, nesting and roosting opportunities for birds.

Direct habitat loss due to the development of wind farms tends to be relatively small (Drewitt & Langston 2006). In this instance, the permanent land take is largely limited to the area of the turbine bases, crane hardstandings, site entrances & access tracks, and the electricity substation, with minor construction at the meteorological mast, temporary construction compound and borrow pits (to be reinstated and re-vegetated). The grid connection infrastructure cable will be undergrounded and, as it will be located within the paved carriageway of public roads, will involve relatively little habitat disturbance or permanent habitat loss. Accordingly, the grid connection infrastructure is not assessed as likely to negatively affect the bird community occurring along this route.

As described earlier, the wind farm footprint is dominated by conifer plantation (WD4) and improved agricultural grassland (GA1). The general breeding and wintering bird community present at and in the vicinity of the site, as described by the flightline and walkover surveys, is typical of the range of habitats present. A total of 59 no. bird species were recorded during dedicated breeding and winter surveys (transects and point counts) with most species common locally and nationally. 6 no. of the 59 no. species recorded are currently on the Red-list (Gilbert *et al*. 2021); namely Kestrel, Meadow Pipit, Grey Wagtail, Redwing, Golden Plover and Snipe.

Kestrel, Meadow Pipit and Grey Wagtail were recorded in the study area throughout the survey years. Snipe was only recorded in the area during the winter period and did not appear to breed locally. Redwing and Golden Plover were observed as winter migrants with some observations of Golden Plover persisting into April during the pre-migration staging period.

Of these, Kestrel was not confirmed to be breeding within the wind farm site and was seen for little time on-site during the breeding seasons. In the latest iteration of the BoCI, Kestrel jumped from Green-listed to Red-listed having shown significant declines in breeding population in Ireland in recent years. The species is believed to have been

impacted by changes in land use and in farming practices which may have affected their prey availability, while it is possible that secondary poisoning has taken its toll.

The habitat loss/change associated with the project is assessed as likely to have little impact on the occurrence of Kestrel in this area. There will be a relatively small loss of foraging and nesting habitat for the species. Kestrels were observed in areas outside the wind farm site to a considerably greater extent than they were present on-site. The likely effects on the occurrence of the species at the wind farm site during the construction stage are, therefore, neutral imperceptible.

Meadow Pipit remains a common and widespread species in Ireland and was also Green-listed until recent iterations of the BoCCI list. It has observed declines in population believed to be associated with the 2 no. consecutive harsh winters 2009/2010 and 2010/2011. There is evidence that the population is recovering (CBS indices; Birdwatch Ireland) in the intervening years.

Meadow Pipit are often associated with upland areas and less-improved agricultural grassland. It is likely that the loss of some areas of wet grassland in the footprint of the project will see localised disturbance and displacement of Meadow Pipit. It is likely that this will result in a slight negative effect on Meadow Pipit.

Grey Wagtail is a species that nests and feeds along river corridors. It too has suffered significant declines in breeding population in recent decades. In the absence of adequate mitigation, construction related effects on water quality could affect the habitats of importance to Grey Wagtail in the local area. Such effects would be likely to have a significant but highly localised negative impact on the species in the short-term.

Redwing is a winter visitor and does not breed in Ireland. While relatively common in Ireland over the winter months, the species has shown a global decline in population in recent decades. It forms flocks that are highly mobile and feed on a wide range invertebrate, fruits and berries. It is likely that the habitat loss/change associated with construction will have a localised non-significant negative effect on the occurrence of the species within the wind farm site.

Snipe were not frequently observed at the site. The extent of suitable habitat for the species present within the wind farm footprint is relatively limited. Small areas of wet-grassland which will be lost at the site are attractive for the species. However, there was little evidence from either the VP surveys or from the intensive walkover studies (transects and point counts) that there was any regular usage of the site by more than a small number of individuals. The species did not breed in the area. The habitat loss/change is assessed as likely to have a neutral imperceptible effect on Snipe in this area.

Golden Plover were regularly recorded in the study area although, as already highlighted, there was a significant amount of observed interannual variation in the numbers of birds and their pattern of occurrence in this area. Golden Plover, when present, were observed from early winter up until April (when they are considered likely to be commuting between wintering and breeding areas). The study area is not within the known breeding range of Golden Plover, where the breeding population is largely restricted to northwest Ireland (and where significant population decline and range contraction has occurred, Balmer *et al*. 2013). In winter, a large influx of Golden Plover of the *altifrons* race (a separate population to the Irish breeding birds) arrive from breeding sites in Iceland (Wernham *et al*. 2002) and recent evidence confirms

that the wintering numbers of Golden Plover in Ireland, which are in excess of 150,000, are relatively stable (Balmer *et al*. 2013, Boland & Crowe, 2012).

Golden Plover was the most commonly recorded wading bird during the winter VP studies. The number of flightlines ranged from 5 no. (in winter 2021/2022) to 53 no. (in winter 2020/2021) and flock size ranged from single individuals to c. 400 birds. The flocks were highly mobile and observed over a wide area, recorded for considerably longer on areas outside of the wind farm site than within. The species did not appear to rest, or forage within the site. There is no indication that any of the habitats present within the wind farm site are of importance to the locally observed Golden Plover. The species is flocking during the winter months and is observed widely across inland counties. Wintering Golden Plovers are attracted to winter cereals, stubbles, fallow grassland and to closed-grazed pastures (EU 2009). It should be noted that, in this case, likely effects relate to the large and stable wintering Golden Plover population and not to the declining and range-contracting Irish breeding population. It is likely that, based on the evidence from the field studies in this area, that the loss and change of habitat at the wind farm during the construction phase will have neutral imperceptible to slight negative effect; and not significant; on the usage of the site by wintering Golden Plover.

Other high conservation value species recorded in the area, such as Peregrine Falcon and Hen Harrier were so infrequently observed over the wind farm site that the likely effect of habitat loss and change at the wind farm site will be neutral imperceptible.

Buzzard and, to a lesser extent, Sparrowhawk were regularly recorded in the area. Both of these raptor species are currently Green-listed. The loss/change of habitats on site associated with the construction of the wind farm is assessed as likely to result in a marginal local decrease in potential nesting and foraging habitats; however, effects on the species are assessed as likely to be local slight neutral in the short term.

General bird surveys have established that the study area is used by a diversity of breeding and wintering species typical of the range of habitats present in the study area (i.e. conifer plantation and agricultural grassland). It is not assessed as likely that there will be any significant reduction of breeding species diversity within the project site as a result of vegetation clearance and construction activities to facilitate the construction of the project. The introduction of open spaces or 'edge-effect' into a previously closed forestry canopy can, in fact, increase the abundance of some species and could benefit the overall species diversity of the plantation (Fuller 2003).

Disturbance/Displacement

Wind farms can cause disturbance to the bird community through displacement due to construction activities, increased human presence and noise. Studies on bird displacement due to disturbance have yielded somewhat inconsistent and inconclusive results (Langston & Pullan 2004, Drewitt & Langston 2006, Kingsley & Whittam 2005). These studies have indicated that the scale of disturbance varies greatly between and within species (*loc cit*., Langston & Pullan, 2003). Disturbance effects can result in reduced numbers of birds within a particular distance from a source of disturbance.

As described above, a range of raptors, waterbirds and waders were recorded in the study area. In addition, a diversity of passerine species typical of the dominant habitats present were recorded. The wind farm is dominated by managed habitats and lacks the upland features typical of many Irish onshore wind farms. In terms of the

key target species under consideration here (i.e. principally raptors, waterbirds and waders), few were observed with any regularity spending prolonged periods within the wind farm site. Buzzard was the target species that was recorded most frequently on-site over most of the survey seasons. Several pairs of Buzzards were believed to have bred locally and adults and young were observed within the study area. However, Buzzards were observed far more frequently and for much longer cumulative durations in areas outside of the wind farm site. Buzzard abundance and distribution has increased dramatically in Ireland in recent decades. The species has rapidly increased its breeding range in Ireland and is now one of the most common raptors in the country. Buzzards typically nest in the canopy of trees and, in the absence of mitigation, disturbance and displacement of breeding pairs may occur during the construction phase, either as a result of the loss of nesting habitat or by direct displacement. Similar displacement could occur for species including Sparrowhawk, which is suspected to have bred locally. Kestrels, were infrequently recorded in the study area during the summer months and no breeding was recorded in the area. There is some suitable habitat present and, therefore, there could be some displacement/disturbance of nesting Kestrel and Sparrowhawk during the construction phase.

Waterbirds and waders observed in the study area included occasional sightings of Grey Heron and gull species. The Grey Heron flights were associated with birds commuting between foraging sites on watercourses. No breeding evidence was recorded within the wind farm site. Gulls were occasionally recorded and these were largely observations of birds commuting across the site. A small number of records of Snipe were recorded, including some birds that were likely on passage migration. Similarly, there were a handful of sightings of additional species such as Little Egret, Mallard and Teal, all recorded in the final winter VP season. The pattern of occurrence of these species and their usage of the site does not indicate any strong association with the site. It is likely, given the pattern of these observations, that there would be a neutral imperceptible effect on these species as a result of construction phase disturbance.

Golden Plovers were frequently observed in the study area, albeit the pattern of occurrence varied greatly from winter to winter. The lands within the wind farm did not appear to be used to any extent by foraging or roosting birds. The observations tended to be of large and mobile flocks that spend prolonged periods of time in flight, across large areas, occasionally overflying the site. The birds spent relatively little of the observed time on-site and in winter 2021/2022 were not observed on-site at all during the course of the VP surveys. The general construction activity may result in some disturbance/displacement effects on this wintering/migrating species. However, if birds are displaced from the wind farm site, there is a significant amount of similar open habitat in the immediate environs of the wind farm site and these highly-mobile flocks are likely to utilise these lands instead. Given the presence of suitable alternative habitat in the wider area, the construction phase is assessed as likely to have a temporary slight negative effect.

Birds associated with the plantation habitat will be the most affected group as this is the nesting habitat which will be subject to the greatest local loss. However, any areas within or close to construction activity may see some disturbance and displacement effects on the local bird community. Displacement and disturbance will have a lesser effect on the local bird population if alternative habitats with sufficient carrying capacity are widely available in the surrounding landscape (Kingsley & Whittam

2005). There is a significant amount of similar conifer plantation and open agricultural habitats in the hinterland of the project and this will avoid displacement beyond the immediate environs of the site. In the absence of appropriate mitigation, the removal of vegetation could affect nesting and roosting birds and habitats of importance for the general bird community at the site. It is likely that the loss of habitat and construction related disturbance will have a slight negative and highly localised impact on general bird populations at the wind farm site.

The grid connection infrastructure will be undergrounded predominately within public roads. The grid connection route does not pass through any areas identified as being of ecological importance for the Annex I species under consideration. Given the short duration of the installation works, the location of the works areas within already-disturbed environments (i.e. public roads) and the absence of any important bird habitats directly along the route, the installation of the grid connection is expected to have a negligible disturbance impact on avifauna.

In the absence of appropriate mitigation, the works to facilitate access along the turbine component haul route could disturb and displace nesting and roosting birds. Such impacts are assessed as likely to be minor, temporary and localised in nature.

5.4.3.2 Operational Phase

Operational phase impacts on birds can be related to disturbance, displacement or collision effects.

Disturbance/Displacement

Wind farms can cause disturbance to the bird community through displacement related to increased human presence (e.g. post construction maintenance), turbine presence and turbine noise. As mentioned previously, the literature on bird displacement due to wind farm disturbance has provided somewhat inconsistent and inconclusive results (Langston & Pullan 2003 & 2004, Drewitt & Langston 2006, Kingsley & Whittam 2005). These studies have indicated that the scale of disturbance varies greatly between and within species (*loc. cit.*). Disturbance effects depend on a range of issues including seasonal bird use, diurnal bird use, location, availability of alternative habitats, bird life cycle, flock size, habituation and turbine and wind farm specifications (*loc. cit.*).

Wind farms can also cause displacement of birds by creating a barrier effect to migration or local flight paths, which could result in disruption of ecological links between feeding, breeding and roosting areas (e.g. Drewitt & Langston 2006, Kingsley & Whittam 2005). In Ireland, this issue is more likely to occur with migrating wildfowl populations (Percival, 2003); however, no such species were recorded at the study area during the 5 no. seasons of VP surveys.

Published research on disturbance and displacement effects of wind farms on birds (e.g. Pearce-Higgins *et al*. 2012) has reported significant declines in the population densities of certain species at wind farm sites from pre- to post-construction and there are indications from other research that the presence of turbines may result in lower nest success for certain species (e.g. Hen Harrier). However, this effect was only evident for nest sites located within 1km of wind turbines (Fernández-Bellon *et al*. 2015).

In terms of the key target species under consideration here (i.e. Golden Plover, Peregrine Falcon, Hen Harrier and Kestrel), no nest sites or breeding activity was recorded at the study area during the 5 no. seasons of VP surveys and walkover

transects and point counts. A number of green-listed raptor species, notably Buzzard and Sparrowhawk, are believed to have bred within the wind farm site and wider study area. Both species are regularly recorded at operational wind farms in Ireland (G. Fennessy pers obs.) with the availability of suitable foraging and nesting resources likely to dictate the ongoing presence of these species. While some highly localised disturbance/displacement effects around operational turbines may occur, it is assessed as unlikely that there would be a significant change in the pattern of usage of the subject site by such species during the operational phase.

Recorded activity levels of all target species (apart from Golden Plover which will be discussed below) were also generally low in the study area in both the breeding and winter seasons, with no regular flight paths or areas of high importance identified within the study area. The main habitats affect by the project will be conifer plantation and agricultural grassland, which are not of particular ecological value for these target species. While a number of sections of open wet grassland habitat will be impacted, the extent of habitat loss in these areas is relatively small and are not located along any regular flight paths or areas of preferential use by the target species under consideration here.

Likely operational phase disturbance/displacement effects on Hen Harrier and Peregrine Falcon as a consequence of the project are assessed to be neutral and non-significant.

Golden Plovers were recorded in the study area each winter. On the basis of the surveys undertaken, it is assessed that they did not feed or roost within the wind farm site. The presence of wind turbines may result in disturbance/displacement effects on this wintering/migrating species. As described previously, the wintering population which occurs at the study area is large and stable as compared to the breeding population, which is declining and is restricted in range to northwest Ireland. The species is regularly recorded at and in the vicinity of operational wind farms elsewhere in Ireland during the winter months (G. Fennessy pers obs.).

Indeed, while there is some evidence that Golden Plover can initially be displaced from the area immediately around an active turbine (Pearce Higgins *et al*. 2009), a subsequent study by the same author has reported that, following the construction period, populations may become habituated to operational wind farms (Pearce Higgins *et al*. 2012). Post construction monitoring at 15 no. upland windfarms showed no significant decline in Golden Plover numbers (Pearce Higgins *et al*. 2012). Similarly, there was no decline in Golden Plover populations recorded during 3-years of post-construction surveys at one UK windfarm site (Douglas *et al*. 2011). It is assessed as likely that Golden Plover will continue to occur in this area during the operational phase of the project; and that no significant disturbance/displacement effects on the Golden Plover population are likely to occur. Likely operational phase disturbance/displacement effects on Golden Plover are, therefore, assessed to be slight negative in the short to longer-term.

All other bird species recorded at the wind farm are not regarded as being particularly sensitive to disturbance/displacement and/or barrier to movement arising from wind farm development (Langston & Pullan 2003 & 2004, Percival, 2003 and Stewart *et al.* 2004). The extensive bird surveys did not record evidence of significant movements of birds across the wind farm site that would be susceptible to barrier effects.

Collision

Bird mortality or injury at wind farms can occur through collision with rotors, towers, nacelles, cables, power lines and meteorological masts (Drewitt & Langston, 2006, Kingsley & Whittam, 2005). While most wind farm collision studies indicate low levels of bird mortality per turbine, these levels may be significant for some bird species populations such as those with a low annual productivity, slow maturity and in cases of very large wind farms with large numbers of turbines (Langston & Pullan 2003, Drewitt & Langston, 2006). This scenario has occurred on a number of inappropriately located wind farms such as those at Altamount Pass in California and Tarifa in Spain (*loc cit*., Percival, 2003). It should be noted that the Altamount Pass wind turbines were only of c. 30m in height and the rotor envelope is therefore not comparable to the current wind farm layout. In contrast the subject wind turbines will have a blade tip height of 185m, a hub height of 104m and a rotor diameter 162m.

Collisions with wind turbines are most likely to occur where birds fly regularly at turbine blade height and do not demonstrate an effective avoidance response. Certain species, it has been postulated, show less effective avoidance of turbines and are at an increased collision risk as a result. In general, large/heavy species such as swans/geese are more susceptible to collision mortality as they are less manoeuvrable than raptors such as Hen Harrier. No flightlines of protected wildfowl species such as Whooper Swan or Greenland White-fronted Goose were recorded in the study area during the VP surveys and there is no evidence that the site is located on regular commuting or migration route for any such bird species.

In reality, the scientific evidence on collision mortality of birds with wind turbines is scant. Real-world studies on bird avoidance behaviour and the predictive ability of standard collision risk models is highly questionable (Madsen & Cook 2016). However, there is no doubt that collision mortalities occur at wind farms and that these generally occur when birds are struck by a blade. For this to occur at the project site, the birds would need to be flying at elevations of 23-185m above ground level.

The overflying rate of the project site by most target bird species, (with Golden Plover being the exception), was found to be consistently low throughout the 5 no. season survey period. The likely collision risk for such target species (e.g. Hen Harrier, Peregrine Falcon) at the wind farm is therefore extremely low. The likely effects on such species as a result of collision, across the operational lifetime of the project, is slight neutral.

Kestrel, due to its hunting behaviour (hovering) is believed to be at an increased risk of collision when compared with some other raptor species. Kestrel was observed in flight at rotor swept height within the project site for an average cumulative total of an of less than 4-minutes 20-seconds across the 5 no. survey seasons. This represents a very small proportion of the observation period (typically 36-hours observation period per season). Due to the infrequent occurrence on site, particularly at rotor swept height and the lack of evidence of locally breeding birds, the likelihood of collision mortality is assessed to be slight to moderate negative.

Golden Plover activity was found to be highly variable from winter to winter. In the winter of 2020/2021 Golden Plovers were observed on site at rotor swept height for c. 1-hour 47-minutes. However, there were no Golden Plovers recorded on site whatsoever in the following winter period. Flight heights were typically <100m, although ranged as high as 200m on occasion and as such a large proportion of flightlines took place within the rotor swept height. However, Golden Plover are highly mobile and are considered to have an avoidance rate of 98% (SNH 2018), making them less susceptible to turbine collision. This supposition is supported by post

construction monitoring at 15 no. upland wind farms (Pearce Higgins *et al*. 2012) and also during 3-years of post-construction surveys at 1 no. UK wind farm site (Douglas *et al*. 2011) where no decline in Golden Plover populations were recorded. It should also be noted that much of the Golden Plover activity recorded during the VP surveys of the study area occurred outside of the wind farm site and as such these flightlines would not be at risk of collision with turbines. Pearce Higgins *et al*. (2012) produced a detailed analysis of the observed effects at wind farm and control sites to examine any significant impacts on the abundance of key bird species using these sites. They found little evidence for differences in population trends between operational wind farms and reference sites which, they state, implies that any increase in mortality through collision with operating turbines, or other changes associated with wind farm operation, has little effect on local populations. In the same paper, they also state that there is little evidence for consistent post-construction population declines in any species using wind farm sites. Given the regular occurrence of Golden Plover within the study area and the potential for large flocks of this species to fly within the rotor swept area (for the range of tower heights and blade lengths under consideration), there is some potential for turbine collision to occur at the wind farm site. The available research shows that Golden Plover are relatively adept at navigating around operational turbines, however, and collision fatalities are unlikely to have any measurable effect on the local wintering Golden Plover population (Pearce Higgins *et al*. 2012). The likelihood of collision effects on the local Golden Plover population as is therefore assessed to be non-significant negative and localised in the short to longer-term.

The grid connection infrastructure will be installed underground and will not pose any collision risk to avian species.

5.4.3.3 Decommissioning Phase

The decommissioning phase involves dismantling and removal of infrastructure and generally will involve far less intrusive work than at construction stage. There will be some limited potential for surface water run-off which could affect bird species that feed and nest along the local watercourses. The extent and duration of the works are unlikely to cause significant disturbance or displacement effects on any avian species. In the absence of appropriate mitigation, the likely effects on avian species are assessed to be temporary, slight-negative and localised.

5.4.3.4 Replant Lands

The afforestation of the lands is unlikely to significantly affect the avian species diversity in the local area. The planting and subsequent management and harvesting operations would see a marginal increase in sources of disturbance for breeding and roosting birds. On the other hand, forested areas may provide breeding, foraging and roosting habitat for a variety of bird species. Overall, the likely effect on bird populations arising from the temporary planting phase is non-significant neutral and highly localised. As the forestry matures, it is likely that there will be a localised slight positive effect on bird species diversity and abundance in the medium to long-term.

5.4.4 Mammals

5.4.4.1 Non-volant Mammals

Construction Phase

The primary effect of wind farm development on non-volant mammals typically arises through the loss of habitat as a result of construction. In the case of this project, the habitat to be lost predominately comprises intensive agricultural grassland and commercial forestry, each of which are of limited ecological value.

Access tracks will occur in close proximity to 'outlier' badger setts at 2 no. locations. Outlier badger setts may be occupied sporadically or seasonally, and use of individual outlier setts varies according to location and the badger group involved. Being an outlier sett, it is unlikely to be used by badgers for breeding purposes. In the absence of precautions, direct disturbance could occur to these burrow systems with 'Sett_B' within 10m of an access track but on the opposite side of the soil bank. There is less likelihood of significant direct effects on 'Sett_A' given a separation distance of c. 20m to the construction footprint.

For both 'Sett_A' and 'Sett_B', there is a likelihood of indirect disturbance effects from noise and vibration and ongoing human presence. Such disturbance may cause disruption of normal activity or displacement of badgers locally. The badger outlier setts are assessed to be of 'Local Importance (higher value)' (following NRA, 2009).

The likelihood of site traffic leading to a risk of road casualties of Badgers and other mammals has also been assessed. The bulk of construction traffic and movement of machinery and personnel will occur during daylight hours and the site speed limits will be imposed. Therefore, there is no risk of significant fatalities of non-volant mammals on site roads.

During the construction phase of the development, disturbance of fauna occurring on/near the wind farm is likely. This disturbance will be temporary in duration. The overall level of non-volant mammal activity at the wind farm site was found to be moderate. In the event that some mammals are displaced through disturbance or direct loss of habitat, there are extensive areas of similar habitat in the vicinity of the site and affected or disturbed individuals may move into the surrounding areas. Given the relatively small footprint of the development, any displacement or disturbance that may occur is likely to be highly localised, both temporally and spatially. It is assessed that the permanent loss of agricultural grassland and commercial forestry is unlikely to adversely affect the local mammal community.

Some disturbance effects on non-volant mammal species during the construction phase are likely to occur due to the construction of the grid connection infrastructure and completion of the haul route works. No signs of mammals including Otter and Badger were recorded during surveys of bridge/culvert sites along the grid connection route and no underground dwellings were present in these areas; while no evidence of mammals was identified at the haul route works locations.

In addition, mammals associated with aquatic habitats (e.g. Otter) in the wider area could be subject to adverse effects from siltation, run-off and fuel spills. No evidence of the presence of Otter was recorded on the watercourses at the wind farm site or those crossed by access tracks and along the grid connection route. It is likely that Otters occur locally, at least on occasion, and there is a likelihood, in the absence of appropriate mitigation, for adverse effects on the species.

The likely construction phase effects on the non-volant mammal community present is assessed to be non-significant, localised, short-term to temporary, negative.

Operational Phase

There is a very limited likelihood of operational phase effects on the local mammal community. The level of human and vehicular disturbance will not be significantly higher than that experienced currently. Mammals will use the access tracks to commute to and from feeding areas and there is some potential for increased interaction between humans and locally occurring mammals.

It is assessed that the presence of the project will not present as a barrier to the movement of Badgers, Foxes and other mammals through the site.

Any edible or putrescible wastes generated by visitors to the site (e.g. at the electricity substation) is likely to attract mammalian scavengers. Such effects are amenable to mitigation as described in the mitigation measures outlined below.

In the absence of mitigation, the likely operational phase effects on non-volant mammals are assessed to be long-term, neutral imperceptible and highly localised in nature.

Decommissioning Phase

Similar to the construction phase, there is a likelihood of disturbance and displacement effects on mammals; however, effects are assessed to be of a reduced magnitude and significance. In the absence of mitigation, effects on mammals are assessed as likely to be non-significant negative, localised and temporary to short-term in nature.

Replant Lands

The replant lands are dominated by habitats of low importance to breeding or resting mammals. The grassland may provide foraging habitat for species that are believed to occur locally e.g. Badger. However, there is a substantial amount of similar habitat in the surrounding area. In the short to longer-term as the woodland matures, it would provide some suitable habitat for woodland species and generalists. It is likely that the effect on non-volant mammals would be neutral imperceptible in the short to longer term.

5.4.4.2 Bats

Construction Phase

Wind energy developments present 4 no. likely risks to bats (NatureScot, 2021):-

- Collision mortality, barotrauma and other injuries;
- Loss or damage to commuting and foraging habitat;
- Loss of, or damage to, roosts; and,
- Displacement of individuals or populations.

For each of these risks, the detailed knowledge of bat distribution and activity within the study area gained during the current assessment is used to predict the likely effects of the project on bats. Several bat species were noted in the vicinity of the wind farm site and grid connection route, all of which are legally protected under the Irish Wildlife Acts (1976 as amended) and listed on the EU Habitats Directive.

Given the ecological context of the site and general lack of optimal roosting opportunities, the project site is rated as 'low value, locally important' for bats. Pasture based agriculture will continue in undeveloped areas of the site post-construction, and the effect of the loss of intensive pasture to foraging bats is likely to be

insignificant. Construction phase activities will also result in the loss of commercial forestry as well as small areas of hedgerow and treeline habitats, and the effect of this loss will be to reduce foraging and commuting habitat locally. This is likely to disturb or displace bats that forage at the site or commute through the site. While hedgerows and treelines are common features in the wider landscape, the loss of commuting habits (albeit only short lengths) will displace some bats in the immediate locality of works and marginally reduce habitat connectivity locally. It should be noted that in the context of wind farm developments, it is preferrable to reduce habitat connectivity in the immediate locality of turbines to reduce the potential for collision and barotrauma to occur.

1 no. bat roost was confirmed within the wind farm site and this contained a single Soprano Pipistrelle bat on the night of survey. No works are proposed which will affect this structure. Bat activity recorded was moderate overall. While it is assessed that there is no likelihood of a significant bat roost occurring within the relevant distance of the project (per NatureScot, 2021), it is likely that individual bats or small groups of bats may roost in trees or existing structures at least occasionally and mitigation measures will be applied to minimise the effects on bats. No ideal tree roosts locations were noted and the suitability of the available trees for roosting bats is assessed to be 'negligible' or 'low'.

Construction phase lighting may attract certain bat species and displace others and floodlighting can be a significant source of disturbance for all nocturnal mammal species. However, this effect will be temporary in nature and localised to areas around the site compound. Night-time lighting will be limited in extent (both static lighting, and vehicle headlights) as standard construction works will be carried out mostly during daylight hours.

Construction related run-off or degradation of aquatic habitats through hydrological links could lead to a deterioration of the feeding resource for bats associated with aquatic habitats in the wider area. However, the design of the project has ensured that there will generally be no construction activity within 50m of watercourses, except where unavoidable.

The likely effects on bats are, therefore, assessed to be localised, temporary to short-term, and slight negative.

Operational Phase

Habitat loss experienced during the construction phase (described above) will continue to persist through the operational phase; however, all hedgerow lost during construction will be replaced elsewhere on site. The operation of the wind farm at this site is likely to result in disturbance to commuting and foraging bats. Bat activity at the site was variable, with periods of moderate-to-high activity occurring for some species. Decreased connectivity resulting from removal of commuting features likely to be used by many bat species (e.g. hedgerows and treelines) will persist during the operational phase, but decreased connectivity to proposed turbine locations is desirable in terms of reducing risk of fatality or injury as a result of contact with rotating turbine blades. Collision risk is discussed further below.

There is little or no published evidence available on prevalence of bat fatalities at wind farms in an Irish context. Where fatalities have been monitored at wind farms in the USA, most losses have been related to periods of migration (www.nationalwind.org).

Both direct collision with turbine blades and barotrauma resulting from close contact with blades have been reported as an issue for bats at wind farms (e.g. Cryan *et al*., 2009). The susceptibility of bat species likely to be at risk of effects from wind turbines is partly associated with the likelihood of different species flying at rotor blade height. In an Irish context, Leisler's Bat is considered to have a somewhat greater mortality risk at wind farms than the other species recorded on (or adjacent to) the site, as this species is a relatively large and high-flying species. Leisler's Bats typically do not follow landscape features such as treelines or woodland edges when foraging.

A general assessment of vulnerability of bat populations to collision with wind turbines, based on best available scientific information, is provided below. This adapts, for use in an Irish context, a collision risk scheme provided in NatureScot (2021). NatureScot (2021) provides a generic assessment of bat collision risk for UK species based on species behaviour and flight categorisation as well as evidence of casualty rates in the UK and Europe. This bat species collision risk assessment is considered to represent best available information for use in an Irish context.

This species collision risk categorisation is used in combination with relative abundance to indicate the likely vulnerability of bat populations. Relative abundance for Irish species was determined in accordance with a scheme for rarity of bat species provided in Wray *et al*. (2010) in combination with best available population data provided in recent Article 17 reports (NPWS, 2019). The limitations in terms of Irish bat population data is acknowledged in the latter report. The collision risk estimation scheme for Irish bat species is presented in **Table 5.37** below.

Relative Abundance	Collision-Risk		
	Low	Medium	High
Common (100,000 plus)			Common Pipistrelle Soprano Pipistrelle
Rarer (10,000 – 100,000)	Daubenton's Bat Brown Long-eared Bat Lesser Horse-shoe Bat		Leisler's Bat
Rarest (under 10,000)	Natterer's Bat Whiskered Bat		Nathusius Pipistrelle

Population vulnerability: yellow = low, orange = medium, red = high.

Table 5.37: Estimation of Irish Bat species' Population Vulnerability

In determining the project specific risk to bats, NatureScot (2019) recommends a two-stage process as follows:-

- Stage 1: Indicatively assess site risk based on consideration of habitat present and development related features (i.e. number of turbines, size of turbines and proximity to other wind farms); and,
- Stage 2: Overall assessment of risk for high collision-risk species, considering bat activity results and the relative vulnerability of species.

Initially, an assessment of the general site risk based on habitats present was carried out following the scheme presented in NatureScot (2021). Some moderate suitability bat roosts are present near the wind farm site and the site presents foraging habitat

which is well connected to good roosting and foraging habitats in the hinterland. Therefore, a habitat risk of 'Moderate' is applied.

The project is 'Medium' in scale (under 10 no. turbines although with relatively large turbines, and with one other operational wind energy developments within 10km). Based on the above initial site risk assessment, the project is considered to be 'Medium Risk' to bats and a site risk score of 3 is applicable.

The next stage of the process is applicable to 'high collision-risk' species only and utilises information on the activity level recorded on site in each monitoring period. This assessment is intended to identify projects which are of greatest concern in terms of bat collision risk. The following high collision-risk species have been recorded at the current site:-

- Leisler's Bat;
- Common Pipistrelle; and,
- Soprano Pipistrelle.

A species-specific indication of risk is provided below for each of these species (**Table 5.38**).

Overall activity level for Leisler's Bat in the context of the project is assessed to be 'moderate to high'. Leisler's Bat activity was generally highest in the summer period but a high peak of activity occurred at 'Bat_1' in Spring 2021 (963 no. registrations).

Common Pipistrelle is a common and widespread species in Ireland and is assessed to be a high-collision risk species due to foraging ecology and flight characteristics. Common Pipistrelles were the most regularly recorded species across the site. Overall activity levels for Common Pipistrelles are assessed to be moderate'. Common Pipistrelle activity was highest in the Summer and considerably lower in Spring. Common Pipistrelle activity was highest in the Autumn period and peaks of activity occurred at the 'Bat_1' monitoring location.

Soprano Pipistrelle is a common and widespread species in Ireland and is assessed to be a high-collision risk species due to their foraging ecology and flight characteristics. Soprano Pipistrelles were recorded during surveys across the site. Soprano Pipistrelle activity was highest in the autumn period and peaks of activity occurred at the 'Bat_1' monitoring location.

	Species	Site Risk Level	Activity Category	Overall Assessment
Spring 2021	Leisler's Bat	3	Moderate to High (4)	12
	Common Pipistrelle	3	Low to Moderate (2)	6
	Soprano Pipistrelle	3	Low (2)	6
Summer 2021	Leisler's Bat	3	Moderate (3)	9
	Common Pipistrelle	3	Moderate (3)	9
	Soprano Pipistrelle	3	Low to Moderate (2)	6
Autumn 2021	Leisler's Bat	3	Moderate (3)	9
	Common Pipistrelle	3	Moderate (3)	9
	Soprano Pipistrelle	3	Moderate (3)	9

Overall collision risk assessment: Low (0- 4; green), medium (5 - 12; amber), high (15 - 25; red) (following SNH, 2019).

Table 5.38: Overall Collision Risk Assessment of Bat Species

The overall risk-assessment procedure indicates the project is of medium risk for all relevant bat species in all seasons. While activity levels of the above species varied between survey locations (corresponding to turbine locations), it is not possible to determine with certainty the different levels of collision risk presented by individual turbines. While some turbines showed higher levels of bat activity in several seasons than other turbine locations, the NatureScot (2021) methodology involves recording activity from near ground-level. The clearance of vegetation for turbulence reasons and to provide bat buffer zones around the operational turbines would also be expected to change the occurrence and pattern of activity of bat species in the immediate vicinity of the turbines. The purpose of integrating the bat buffer zones into the design of the wind farm layout is to reduce the likelihood of collision related mortality with bats.

The primary measure employed to avoid collision and barotrauma in bats relates to the design of the project to avoid, insofar as possible, features utilised by foraging/commuting bats. As recommended by SNH (2019), a 50m separation distance from habitat features used by bats and the blade tips of wind turbines must be maintained as the minimum bat feature buffer. Buffers are provided as the distance from turbine towers to the feature, with the separation distance being dependent on feature heights in relation to turbine dimensions. A buffer area was implemented which took account of the turbine dimensions and the approximate height of the vegetation that occurs in the vicinity of the turbine locations. This buffer area was calculated based on the formula presented in NatureScot (2021):-

$$Buffer\ distance = \sqrt{(50 + bl)^2 - (hh - fh)^2}$$

(where bl = blade length, hh = hub height, fh = feature height (all in meters))

Applying the dimensions of the proposed turbines and a feature height of 20m, yields a buffer distance of c. 100m. All forestry/hedgerows/treelines within 100m of a wind turbine will, therefore, be removed and, as appropriate, replaced on-site of elsewhere.

As per NatureScot (2021) guidance there is no requirement to complete an Overall Risk Assessment for low-risk species. The low-risk species that were recorded were Brown Long-eared Bat, Natterer's Bat, Whiskered Bat and Daubenton's Bat. Overall activity levels were generally low for the above species and by virtue of their low vulnerability to wind energy developments, no significant collision related risk is likely. No other significant impacts are likely to occur on bats during the operations phase of the proposed wind farm.

In the absence of mitigation, the overall effects on bats during the operational phase is assessed as likely to be slight negative and localised in the long-term.

In addition to the buffer zones, operational mitigation is proposed to further minimise the risk of collision fatalities and bats at this site.

Decommissioning Phase

Similar to the construction phase, there is a low likelihood of disturbance and displacement on bats from activities associated with the decommissioning phase of

the project. However, any such effects are likely to be imperceptible negative, localised and temporary in nature.

Grid Connection

The laying of the grid connection is unlikely to have any significant effects on bats.

Replant Lands

The replant lands are dominated by improved agricultural grassland, a habitat of low ecological value for bats. Disturbance or removal of hedgerow or trees to facilitate planting could result in a loss of breeding/resting and foraging habitat for bats. If a roost was affected, this is assessed as likely to have moderate to significant negative local effects on bats in the short-term. However, on the basis of surveys undertaken, there is no evidence to suggest that any PRFs would be affected by the afforestation and such effects are assessed as unlikely and amenable to mitigation.

In the short to longer-term as the woodland matures, it will provide some suitable habitat for foraging and commuting bats. It is likely that the effect on bats will be neutral imperceptible in the short to longer term.

5.4.5 Aquatic Ecology

There are several mechanisms by which construction projects can negatively impact upon the aquatic environment. By and large, the likely effects associated with wind farm developments are related to the construction phase, with significantly lesser risks associated with the operational and eventual decommissioning phases of the project. The chief mechanisms for negative impacts to arise relate to the following occurrences.

Input of Silt

As well as directly affecting fish through their gills, this has the medium/long term effect of settling on the riverbed smothering coarse patches of sediment with fine particles, and depleting oxygen levels within the sediment by reducing through-flow within the sediment. It may also cause direct mortality of eggs and early life stages of various fish. The deterioration of the riverbed in this manner has a detrimental effect on the macroinvertebrate assemblage, which also has a knock-on effect on fish. The likelihood of influx to the watercourse increases dramatically with rain, particularly heavy rain. Slope, ground porosity and vegetated cover are also significant factors governing the input of sediment to a watercourse.

Input of Nutrients

Excessive nutrients drive up productivity within a watercourse. Excessive plant and algal growth is caused by input of the plant nutrients nitrogen and phosphorus. In the presence of excessive growth of organic matter, ambient dissolved oxygen (DO) levels fall whilst the biochemical oxygen demand (BOD) rises (a measurement of the rate of oxygen usage by aerobic organisms). The preceding sentences are a brief overview of nutrient input, however in reality it is a complex science of parameters, drivers, knock-on effects and feedback systems that combine and deplete the oxygen levels in the watercourse. This can have a significant effect on fish life, as well as many species of invertebrates, often changing the species assemblage of the ecosystem itself.

Input of Cement

The introduction of cement to an aquatic environment can change the chemistry of the water (particularly pH and dissolved oxygen) as well as adding suspended solids, and as such has the potential to cause significant negative impacts on the stream. The significance and duration of the chemical effect is dependent on parameters such as quantity spilled, dilution rates, speed if remediation etc. However, an individual event could lead to a significant medium-term impact. Concrete spills can cause fish kills and can be detrimental to the macroinvertebrate community. The resultant reduction in water quality and its bio-indicators is in violation of the Water Framework Directive (2000/60/EC).

Input of Hydrocarbons and other chemicals

Spillage of hydrocarbons and other chemicals into the aquatic environment, depending on its character and magnitude, has the potential to cause significant effects of varying extents and durations. The spill can cause biotic mortality in a number/combination of ways, through physiochemical reactions (pH, DO, COD etc) or through direct toxicity.

Hydromorphological Changes

Hydromorphological changes can result from direct mechanical disturbance of the river, or significant changes within the catchment. Examples of direct mechanical disturbance include re-alignment of the channel, disturbance of connectivity to the flood plain, river crossings etc. Examples of significant changes within the catchment include large scale poorly designed drainage systems, drainage of wetlands, replacement of the vegetated surface with less permeable surfaces; all of which can change the magnitude of flood events as well as the erosion-deposition regime within the main channel.

5.4.5.1 Construction Phase

There are several aspects of the construction phase of the project which could, in the absence of adequate controls, affect the local aquatic ecosystem. The principal mechanisms involve the mobilisation of sediment and pollutants during the vegetation clearance, earthworks and construction of wind farm infrastructure. The sensitive aquatic ecosystems and species include fish and macroinvertebrates.

Clear Felling

Approximately 15ha of conifer plantation are to be removed to make way for the turbine bases, crane hardstandings, and other ancillary infrastructure. The main issues pertaining to watercourses during clear felling are potential sediment and nutrient release. Sediment can be released during vegetation clearance mainly due to a combination of the removal of canopy combined with the tracking of heavy machinery over unvegetated/exposed ground. Nutrients may also be released as a result of decomposing brash, in combination with nutrients released from changes in soil structure and stability.

Clear felling is part of the current land usage, with or without the project, in line with current timber industry practices.

Earthworks

There will be significant earthworks onsite during the construction of the project. Excavation, storage and movement of soil, sub-soil and rock will be carried out for the provision of the various infrastructure. It is likely, in the absence of adequate controls, that silt, hydrocarbons and other chemicals could be released to watercourses, as

well as inducing hydromorphological change in watercourses. As described at **Section 5.4.5** above, the runoff of sediment to watercourses can adversely affect the aquatic ecosystem, impacting on fish and their habitats. Salmonids are sensitive to increased sediment loading and marked increases in runoff of silt could result in changes in the distribution and abundance of macroinvertebrates and fish in areas impacted by uncontrolled silt and sediment mobilisation.

Although there currently exists some access tracks within the site which will be upgraded, the majority of the access tracks will be newly created. The passage of machinery on these gravel tracks, particularly heavy machinery, can also cause release of sediment into watercourses. There are a number of processes through which this can happen including wear and break-down of surface gravels, degradation of tracks due to a combination of weight and vibration, damage to roadside drainage, and importation of sediment on wheels and tracks. This is also likely, in the absence of adequate mitigation, to input hydrocarbons to watercourses.

In the absence of adequate environmental controls, run off during construction is likely to result in moderate to significant negative effects on aquatic ecosystems in the temporary to short-term. The extent of this effect would be dependent on the nature and volume of the mobilised silt and the watercourses to which this material discharged. In general, runoff will disperse and settle-out depending on the particle size and flow conditions in the watercourse. In this instance, given the characteristics of the watercourses present, it is likely that silt will settle out locally in areas downstream of the site, although fine sediments may disperse further along the hydrologically connected watercourses.

Dewatering and Pouring of Concrete

Excavations may require dewatering due to water table issues, or heavy rain. This water is usually laden with suspended solids and the suction associated with the pumping may increase the level of suspended solids further. The pouring of foundations will involve conveying and handling concrete onsite. This is brought in bulk in concrete trucks, which will typically require washing-out after they have emptied their loads. This may, in the absence of adequate controls, introduce silt and cement to aquatic environments. Cementitious run-off can cause fish kills and can be detrimental to the macroinvertebrate community. In the absence of adequate environmental controls, there is a likelihood of moderate to significant negative effects on aquatic ecosystems, including salmonids, in the temporary to short-term.

Chemical Spillage

The operation and maintenance of the machinery onsite involves the use of hydrocarbon derivatives such as diesel, hydraulic fluid (including brake fluid) and various lubricants. Common causes for spillage include burst hose pipes, leaking tanks, spillage during refill/maintenance, incidents at the holding tanks. This may, in the absence of adequate controls, result in the introduction of pollutants to aquatic environments. This would likely result in some moderate to significant negative short-term impacts on fish and sensitive macroivertebrate species.

Wind Farm Watercourse Crossings

The effects caused by bridge crossings depend largely on their design and the nature of the river itself. Poorly designed bridges can block fish passage, genetically isolating resident fish species and making them vulnerable to becoming absent following severe drought/pollution events, as well as blocking access to much needed

spawning and rearing habitat for anadromous species. Generally, the bridging of smaller watercourses and drainage ditches is less impactful than bridging rivers, and clear span bridges are generally the preferred option as they negate the majority of the issues regarding fish passage and construction stage pollution. Advice on the appropriate design of watercourse crossings has been integrated into the project from an early design stage and the stream crossings on the wind farm are unlikely to result in the blocking of, or impediments to, the movement of aquatic species. The individual stream crossings and associated culvert design is described in **Section 5.3.5.5**.

Any works in or near watercourses may temporarily cause disturbance to the immediate aquatic species and habitats. In the absence of appropriate environmental control, it could also inadvertently result in increased run-off or discharge of potential pollutants with a similar effects to those described above for in respect of earthworks. In the absence of adequate mitigation, runoff during installation of the stream crossings is likely to result in moderate to significant negative local effects on aquatic ecosystems in the short-term.

The works on the haul route at Black Bridge will not require any in-stream works. This existing watercourse crossing is directly upstream of the River Barrow and River Nore SAC. At Black Bridge, it is estimated that 11m^3 of road cuttings will be removed, and disposed of at an approved facility, in preparation for strengthening works (the emplacement of concrete) over the bridge archway. The works will be carried out over a short time period and are not assessed as likely to result in the discharge of significant volumes of pollutants into the River Dinin. However, given the sensitivity of the location, proximate to the SAC, it will be necessary to fully mitigate any likelihood of pollution, no matter how remote these may be. Given the proximity to the sensitive aquatic ecosystem; it is concluded that, without adequate environmental controls, there is some potential for mobilisation of contaminants, including cementitious material, during the bridge strengthening work. The likely effect of the run-off of contaminants to the watercourse, given the relatively small scale of the works and the volumes of material to be used, would result in a significant temporary negative impact on local fish and sensitive macroinvertebrate species with such effects moderating to imperceptible further downstream of the works location. The risks identified are highly amenable to mitigation.

Grid Connection Watercourse Crossings

The installation of an underground grid connection cable may affect local watercourses. Due to the characteristics of the road network, the grid connection infrastructure will be predominately located within the confines of the road carriageway and not within any roadside verge. As described at **Section 3.5.3.2** (**Chapter 3**), Horizontal Directional Drilling (HDD) will occur at 3 no. locations along the grid connection route. The HDD will be required to avoid trenching/excavations within bridging structures which traverse 2 no. unnamed local watercourses, and the Kilderry stream. Launch and receptor pits will be excavated at either side of the crossings to accommodate the drilling rig. The bore will be at a depth of 3m below the bridging structures

In the absence of adequate environmental controls, these HDD crossings could result in run-off to watercourses and/or breakout of lubricants during the HDD process. The likelihood of such effects is remote given that HDD is a well proven method for crossing watercourses and is preferred to engineering solutions that involve direct in-stream

works. In the absence of appropriate mitigation, slight to moderate local temporary negative effects are assessed as likely to occur.

Replant Lands

The replanting of lands may affect watercourses. The main issue pertaining to aquatic ecology is the release of sediments to watercourses during the planting and ongoing management of this land. However, as described at **Section 5.3.5.6** above, there are no major watercourses at the replant site and the County (Water) River is located several hundred metres from these lands. In this context, it is assessed that there is no significant likelihood of negative effects on aquatic ecosystems.

5.4.5.2 Operational Phase

The likelihood of effects on aquatic ecology during the operational phase is very limited. It is assessed that there is a negligible likelihood of significant negative effects on aquatic ecosystems and species arising during the operational stage.

5.4.5.3 Decommissioning Phase

The likelihood of effects on the local aquatic ecology during the decommissioning phase is similar in nature, if not in scope, to those assessed for the construction phase. In the absence of appropriate environmental controls, there is a likelihood of run off of silt and other contaminants to watercourses. In this scenario, there is a likelihood of slight to moderate, temporary to short-term, local negative effects on the aquatic species.

All decommissioning works will be governed by the same requirements to control habitat loss and damage, run-off or potential pollution to watercourses as have been implemented during the construction phase.

5.4.6 Other Taxa

No other taxa of conservation concern were found in the study area. A number of other taxa were noted within and adjacent to the wind farm site and along the grid connection route, none of which are of conservation concern in Ireland at present. Common Frog is listed on Annex V of the EU Habitats Directive and is also legally protected by the Irish Wildlife Acts (1976 – 2012 as amended) along with Common Lizard.

5.4.6.1 Construction Phase

The construction phase could lead to habitat loss or disturbance of other taxa likely to be present such as Common Frog, Common Lizard and Smooth Newt. As mentioned previously, the wind farm footprint is dominated by conifer plantation (WD4) as well as agricultural grassland (predominately GA1).

There were no observations of Marsh Fritillary from the study area. There are a number of contemporary records of adult Marsh Fritillary on the wing from June 2021 (NBDC). These records were of adult butterflies from areas northeast of the wind farm site at Seskinrea and Red Bog (June 2021; NBDC). Historical records exist of Marsh Fritillary from S56 (through which the grid route traverses) and from S57 in which the works on the haul route are located.

While a variety of invertebrate fauna, including Lepidoptera species were observed, there was no area noted with suitability for breeding Dragonflies and Damselflies.

The remaining other taxa species recorded in the study area are not currently of conservation concern in Ireland. Frogs occur widely at the site and are likely to breed in pools, drains etc. across the site. Access track construction and upgrading and construction of hardstanding areas and turbine bases could reduce the amount of suitable breeding habitat for Frogs at the site. The footprint of the project is small, however, and the main habitats present are modified and not of high ecological value for Frogs and other taxa in general. The design of the project has avoided, insofar as possible, areas close to watercourses.

In the absence of appropriate mitigation, the construction of the project is assessed as likely to result in temporary slight negative localised effects on habitats of importance for other taxa.

The installation of the grid connection will involve relatively little habitat disturbance or permanent habitat loss – the grid cable will be laid predominately within the carriageway of public roads. With the application of standard environmental controls, the installation works are unlikely negatively affect other protected fauna occurring along the route.

5.4.6.2 Operational Phase

No significant effects are predicted on other taxa during the operational phase of the project.

5.4.6.3 Decommissioning Phase

Significant effects on other taxa as a result of the movement of plant and personnel during the decommissioning process are unlikely. All decommissioning works will be governed by the same requirements to control habitat loss and damage, run-off or pollution to watercourses as have been implemented during the construction phase.

Replant Lands

No significant effects are likely in relation to the diversity or abundance of other taxa at the replant lands. These lands are dominated by improved agricultural grassland (GA1) with no significant water features present.

5.4.7 Cumulative Effects

The project as a whole has been assessed with other existing, permitted and proposed developments in the wider vicinity of the project site to evaluate the likelihood of significant effects on biodiversity which, when combined, may result in effects which are cumulatively significant.

The project as a whole has been assessed with other existing, permitted and proposed developments in the wider vicinity of the project site (see **Table 1.4**, **Chapter 1**) to evaluate the likelihood of significant effects on biodiversity which, when combined, may result in effects which are cumulatively significant.

The majority of consent applications pertain to one-off residential dwelling or farm buildings/structures along the local and regional roads. The scale of these applications will not have an effect on the designated sites in the wider receiving environment and therefore as stated in the accompanying NIS, there is no potential for significant in-combination/cumulative effects with the proposed development arising from such developments.

Given the nature of the subject project and the species that are most likely to be subject to cumulative and in-combination effects from other projects in the wider

area, developments such as other wind farms are highlighted as those of key relevance to the assessment of likely construction and operational phase effects. Accordingly, effects upon bird species through cumulative loss of habitat, displacement effects, collision mortality and barrier impacts; in addition to cumulative effects surface water quality; have been assessed.

The Seskin Wind Farm is located c. 2km northeast of the White Hill Wind Farm. At the time of writing, the design and layout of the Seskin Wind Farm remains subject to change; however, during consultation between the respective developers, current turbine coordinates and specifications have been provided. The site of the Seskin Wind Farm is dominated by commercial conifer plantation; some of which is likely to be lost to accommodate the construction and operation of the project. However, due to the abundance of this habitat type within the local and wider landscape, cumulative effects are not assessed as likely. The Seskin Wind Farm is also located within the same surface water sub-catchment as the subject project. Therefore, cumulative effects on aquatic habitats and species may, in the absence of appropriate environmental controls, arise.

The Freneystown Wind Farm is located c. 4.5km southwest of the subject project. At the time of writing, the design and layout of the Freneystown Wind Farm remains subject to change; however, during consultation between the respective developers, current turbine coordinates and specifications have been provided. No cumulative effects on sensitive habitats, aquatic habitats and species are likely to occur due to separation distance and given that the Freneystown is largely located within a different surface water sub-catchment.

The Bilboa Wind farm is located c. 4.5km northeast of the subject project. The wind farm site is located in an area dominated by conifer plantation over peatland. The wind farm site drains largely to the Nore catchment and partially to the Barrow. Due to separation distance, the findings of the assessments in the preceding sections, the measures described at **Section 5.5** below, and the measures set out in respect of the Bilboa Wind Farm; there is no likelihood of significant cumulative effects arising on designated sites, habitats, birds, mammals, and aquatic species.

The Pinewoods Wind Farm is located c. 20km northwest of the subject project. Given the findings of the EIAR and NIS in respect of that project, the mitigation measures to be implemented, the findings of the assessments in the preceding sections, the measures described at **Section 5.5** below, and the measures set out in respect of the Pinewoods Wind Farm; there is no likelihood of significant cumulative effects arising on designated sites, habitats, birds, mammals, and aquatic species.

The closest operational wind farm is located at Gortahile in Co Laois; c. 5.5km to the northeast. It is located in an upland area with a high proportion of mature forestry cover. No other operational wind farms are located within 10km of the subject project. Other more distant wind farms such as the Kilbranish Wind Farm and Greenoge Wind Farm in Co. Carlow and Foyle Wind Farm and Lisdowney Wind Farm in Co. Kilkenny are relatively distant from the proposed wind farm.

We are also aware of proposed wind farm developments at Ballynalacken, Co. Kilkenny, and Coolglass, Co. Laois; each of which are located in excess of 15km from the subject project.

Given the spatial arrangement of the respective wind farms and the intervening separation distances, it is assessed that there is no likelihood of cumulative collision risk

on avian or bat species; while there is no likelihood of a cumulative barrier effect on birds. There is some potential for cumulative disturbance and displacement effects; however, significant cumulative or in combination effects are highly unlikely.

No other projects were identified which are assessed as likely to act cumulatively on the local ecology (habitats and species) to result in significant adverse effects.

5.5 Mitigation Measures

From the outset, an iterative process of constraints led design was employed for the project whereby independent ecological expertise was utilised at an early design stage in identifying the constraints and designing the site layout to take account of these constraints. The siting of the turbines and associated infrastructure was informed by the environmental constraints.

The mitigation measures described below are designed to address and minimise the effects of the project.

5.5.1 Construction Phase

Mitigation to minimise the risk of adverse impacts upon designated sites and their conservation objectives are those chiefly relating to the environmental controls on works near watercourses and measures to minimise the risk of run-off to watercourses hydrologically connected to downstream Natura 2000 sites.

The measures required to avoid adverse construction phase effects on the designated sites potentially affected by the project (i.e. those hydrologically connected downstream) largely overlap with the commitments in relation to the protection of water quality. However, measures to ensure no disturbance and displacement occurs of Otter, or other aquatic/semi-aquatic species are also proposed. These measures are specifically detailed in the NIS.

The following sections detail the overall mitigation commitments to address the likely effects identified on the receiving environment as a result of the project. A suitably qualified Ecological Clerk of Works (ECoW) will be employed to oversee the full and proper implementation of the ecological mitigation strategy throughout the construction and commissioning of the project.

5.5.1.1 Habitats

The following mitigation measures are proposed in respect of the likely effects of the project on habitat and flora:-

- There will be no removal/clearance of habitats, or movement of construction machinery outside of the development works area/footprint during the construction phase, where the works area/footprint will be clearly marked;
- Existing hedgerows and trees to be retained at/near the site will be protected in line with current guidelines (*e.g.* NRA 2006). Measures to protect trees will include the installation of tree protection barriers around the root protection zones of retained trees. Where essential works are required within the root protection zones, ground protection (such as a cellweb membrane) will be installed following consultation with a qualified and experience arborist and/or engineer, to minimise risks of damage to roots;
- The construction of the project will be undertaken in accordance with the detailed Construction Environmental Management Plan (CEMP) to be prepared prior to construction; and,
- Detailed surface water management measures have been incorporated into

the proposed wind farm design to reduce the likelihood of significant effects on water quality, including downstream designated sites. Furthermore, a self-imposed buffer from natural watercourses (apart from the stream crossings) has been employed during the design layout so as to avoid sensitive hydrological features. All general/sanitary waste generated at the site during construction will be appropriately managed prior to removal off site by licenced contractors with no disposal of waste to nearby water features.

Hedgerow Establishment and Tree Planting

Overall, it is assessed that the loss of native trees and hedgerows is small in scale and the effect of its loss will be reduced through the planting of new native hedgerows and treelines. New hedgerows will be created, away from turbines to avoid attracting bats to these areas and existing hedgerows are to be retained and enhanced where possible with gaps to be restored as necessary with native hedgerow mix:-

- Native hedgerow whips to be planted consisting of White thorn *Crataegus monogyna,* Black thorn *Prunus spinose,* Guelder rose *Viburnum opulus,* Holly *Ilex aquifolium,* Hazel *Corylus avellana,* Spindle *Euonymus europeus,* Dog rose *Rosa canina;* and,
- Native woodland trees to be planted and will include Oak *Quercus robur,* Alder *Alnus glutinosa,* Holly *Ilex aquifolium,* Apple *Malus sylvestris,* Hazel *Corylus avellana,* Downy birch *Betula pubescens,* Willow e.g. *Salix cinerea/aurita* and Scots pine *Pinus sylvestris.*

The plant species selected also align with the All-Ireland Pollinator Plan Guidelines for Wind Farms (NBDC, 2021) which will support local pollinator species such as butterflies, bumble bees and solitary bees.

Invasive Plant Species

Prior to the commencement of vegetation clearance activity, a survey by an appropriately experienced ecologist will be carried out to confirm that no Third Schedule Plant species are present within the project site, including along the grid connection route and replant lands. If present, the full extent(s) of the invasive plant species will be mapped. The appointed contractor(s) will prepare and implement an Invasive Species Management Plan (ISMP) for the works with the input from a suitably qualified ecologist.

The ISMP, if required, will be clearly communicated to all site staff and will be adhered to fully under the supervision of the ECoW. The control of some species may require the use of herbicides, which can pose a risk to human health, to non-target plants or to wildlife. In order to ensure the safety of herbicide applicators and of other public users of the site, a qualified and experienced contractor will be employed to carry out all work. The contractor will refer to and implement the following, which provides detailed recommendations for the control of invasive species and noxious weeds: Chapter 7 and Appendix 3 of the TII Publication *The Management of Noxious Weeds and Non-Native Invasive Plant Species on National Roads* (NRA, 2008).

Maintaining site hygiene at all times in an area where invasive non-native species are present is essential to prevent further spread. The following site hygiene measures will be implemented onsite during the construction and/or for maintenance works during the operational stage where applicable:-

- Fence off the infested areas prior to and during construction works where possible in order to avoid spreading seeds or plant fragments around or off the construction site;
- Clearly identify and mark out infested areas. Erect signs to inform Contractors of the risk;
- Avoid if possible using machinery with tracks in infested areas;
- Clearly identify and mark out areas where contaminated soil is to be stockpiled on site and cannot be within 75m of any watercourse or within a flood zone;
- If soil is imported to the site for landscaping, infilling or embankments, the contractor will gain documentation from suppliers stating that it is free from invasive species;
- Ensure all site users are aware of measures to be taken and alert them to the presence of the Invasive Species Management Plan; and,
- Erection of adequate site hygiene signage in relation to the management of non-native invasive material as appropriate.

5.5.1.2 Birds

- Construction operations will largely take place during the hours of daylight to minimise disturbances to roosting birds or any active crepuscular/nocturnal bird species;
- A Toolbox Talk will be prepared and incorporated as part of the construction phase site induction. A wildlife register will be maintained by the environmental site staff during the construction phase. Site staff will be encouraged to report any bird sightings of note made during the construction phase and this information will be logged by the environmental site staff. The site manager will continue to maintain a wildlife register throughout the operational phase;
- All lighting systems, at the electricity substation and compound, will be designed to minimise nuisance through light spillage. Shielded, downward directed lighting will be used wherever possible and all non-essential lighting will be switched off during the hours of darkness;
- All edible and putrescible wastes will be stored and disposed of in an appropriate manner. Similarly, all construction materials will be stored and stockpiled at prescribed locations and all waste materials will be disposed of to licensed facilities;
- Mitigation measures outlined in this EIAR to minimise and prevent the likely effects on aquatic habitats and species will be fully implemented. In addition, tree felling will be undertaken in accordance with the specifications set out in the Forest Service Forestry and Water Quality Guidelines (2000) and Forest Harvesting and Environmental Guidelines (2000), to ensure a tree clearance method that reduces the potential for sediment and nutrient runoff;
- Tree-felling and removal of mature vegetation will be undertaken outside of the bird breeding season (1 March – 1 August). Hedgerows and mature trees will be retained insofar as possible;
- To avoid effects on nesting birds, the works on the grid connection route will be carried outside of the bird breeding season where possible. If works on the grid connection route are to be carried out during the bird breeding season, the areas where works are to be carried out will be checked immediately prior to such works by a suitably qualified ecologist to ensure that no protected species are present. No works will proceed in areas identified to have nesting birds until an appropriately qualified and experienced ECoW is appointed to monitor the

construction activity and implementation of the environmental and ecological mitigation measures;
- Standard VP monitoring in accordance with the *Survey Methods for Use in Assessing the Impacts of Onshore Wind farms on Bird Communities* (Scottish Natural Heritage 2017) will be carried out during the construction phase by experienced ecologists. A VP survey will be carried out between mid-March and mid-August. If construction activity extends into the winter period (October-March) a winter VP survey will be carried out to monitor the occurrence of waders, wildfowl and raptors. The survey shall cover the development footprint and all areas within 500m of the works; and,
- A total of 30 no. bird nest boxes (woodcrete and/or recycled plastic) will be erected within the wind farm site during the construction phase with the selection of boxes and suitable deployment locations decided by a suitably qualified ecologist.

5.5.1.3 Mammals

- A pre-construction mammal survey will be carried out immediately prior to the commencement of vegetation clearance. All areas where vegetation and built features will be removed will be first checked for evidence of the presence of roosting bats;
- All watercourse crossings will be surveyed prior to the commencement of work to identify any resting or breeding sites of protected mammal species;
- An ecologist will supervise/check areas where tree-felling and vegetation removal will occur prior to and during construction. This will ensure that any site-specific issues in relation to wildlife will be highlighted and appropriate mitigation measures (e.g., NRA/TII guidelines) are applied;
- The outlier Badger setts recorded in vicinity of access tracks will be surveyed and activity confirmed ahead of any works, including vegetation clearance. NatureScot (2017) advises employing a minimum exclusion zone of 30m from active sett entrances to construction works, which is in line with NRA (2006) for non-breeding season works, although under these guidelines this increases to 50m of active setts during the breeding season (December to June inclusive), with no blasting or pile driving within 150m of active setts. A suitably experienced ecologist will assess the evidence of activity at these outlier setts and, if appropriate, discuss the need for derogation licence with the NPWS. The ecologist will advise on appropriate actions to ensure that the risk of disturbance to badgers is minimised;
- If any breeding or resting sites of protected mammal species are located at any stage in the construction phase, no works will continue until such time as the ECoW advises and/or any required derogation licences are in place;
- Mitigation measures outlined in this EIAR to minimise and prevent likely effects on aquatic habitats and species will be fully implemented. In addition, tree felling will be undertaken in accordance with the specifications set out in the Forest Service Forestry and Water Quality Guidelines (2000) and Forest Harvesting and Environmental Guidelines (2000), to ensure a tree clearance method that reduces the potential for sediment and nutrient runoff;
- Construction operations will largely take place during the hours of daylight to minimise disturbances to nocturnal mammal species;
- All lighting systems will be designed to minimise nuisance through light spillage. Shielded, downward directed lighting will be used wherever possible and all non-essential lighting will be switched off during the hours of darkness;

- All edible and putrescible wastes will be stored and disposed of in an appropriate manner;
- Any sightings of mammals on-site will be logged on the wildlife register. This includes any fatalities recorded during construction phase; and,
- A total of 30-bat boxes (woodcrete and/or recycled plastic) will be erected at suitable locations in the area, with the type of boxes and the deployment locations selected by a suitably qualified ecologist.

5.5.1.4 Aquatic Ecology

The creation of a buffer zone around watercourses is one of the most important mitigations for a wind energy project in terms of aquatic ecology. Many of the water features associated with the site, such as drainage ditches, are dry during certain seasons/weather. Except for specific points, such as stream crossings, a 50m buffer around watercourses will be observed within which works will be limited and will require the installation of appropriate measures

The other major mitigation to prevent the potential impacts to the ecology of watercourses, is the design and implementation of a highly functional site drainage system, or Surface Water Management System, with integrated silt management and flow attenuation management. For this project, a bespoke drainage system taking into account parameters such as rainfall rates, gradient, area, etc was designed.

Measures integrated into the drainage system will include silt traps, settlement ponds[13], check dams, silt fences, separated clean/dirty water drains and vegetated swales. Crucially, the site drainage system will not outflow to the existing drainage network directly, but will discharge, via settlement ponds and vegetated swales, to numerous buffered overland outfalls which will promote percolation and vegetation filtration. The large number of these outfalls across the site are intended to keep volumes at each outfall low thus ensuring high filtration efficiency and low erosion rates. The following are mitigations specific to the ecology of watercourses:-

- The input of silt will be managed using a range of techniques integrated into the design of the Surface Water Management System including Altmuller and Dettmer settlement ponds, check dams, silt fences, vegetated swales and buffered overland outfalls;
- The input of nutrients, the main source being clear felling, will also be managed using aspects of the site drainage system, particularly the vegetated swales and the overland outflows. Clear felling, in line with current timber industry practices, is part of the current land usage and the proposed drainage design will improve outfall from this existing practice;
- The input of cement to watercourses will be mitigated onsite. Where concrete is delivered to the wind farm site, only the chute will be cleaned onsite. Chute cleaning water is to be isolated in temporary lined wash-out pits. No discharge of cement contaminated water to the construction phase drainage system or directly to any artificial drain or watercourse will be allowed;
- The input of hydrocarbons and other chemicals to watercourses will be mitigated against onsite. All plant will be inspected and certified to ensure they are leak free and in good working order prior to use on the wind farm site. On-

[13] Settlement ponds will be as described in Altmuller & Dettmer; a design element that has been proven to work, both in the short and long term, and have clearly demonstrated results in terms of habitat improvement and FPM population dynamics. They also provide excellent spawning and larval habitat for frogs and newts.

site re-fuelling of machinery will be carried out using a mobile double skinned fuel bowser. The fuel bowser will be re-filled off site and will be towed/driven around the wind farm site to where machinery are located. Any chemical storage areas will be bunded appropriately for the fuel storage volume. An emergency plan for the construction phase to deal with accidental spillages will be contained within the CEMP. Spill kits will be available to deal with accidental spillages. In a worst-case scenario, if there is an incident onsite, the site drainage system does not discharge directly to any watercourse, thus insulating watercourses from such an event;

- Hydromorphological changes to watercourses, brought about by changes within the catchment, will be mitigated to a large extent by the use of settlement ponds and check dams to attenuate water, as well as vegetation swales and overland outfalls to promote percolation. As such, hydromorphological changes within watercourses are not expected as a result of the project;
- A Water Quality Monitoring Plan be put in place and will provide for an inspection and maintenance plan for the site drainage system. Regular inspections of all installed drainage systems will be undertaken, especially after heavy rainfall, to check for blockages, and ensure there is no build-up of standing water in parts of the systems where it is not intended;
- Any excess build-up of silt levels at dams, the settlement ponds, or any other drainage features that may decrease the effectiveness of the drainage feature, will be removed. This will be given careful consideration by the ECoW. During the construction phase field testing, sampling and analysis of a range of parameters with relevant regulatory limits and EQSs will be undertaken for each primary watercourse at the wind farm site. Monitoring shall be carried out following heavy rainfall events and during 95th percentile low flow rates (the flow which is surpassed 95% of the time) as this is the stage when pressures and threats are highest on aquatic biota;
- Stream crossings will primarily use box culverts for stream crossings 1, 2, 3 and 4, while a bottomless culvert is proposed for crossing 5. All small drains to be crossed within the site will be piped. The design and installation of these crossings will follow the guidelines set out in "*National Roads Authority National Roads Authority. (2005). Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes*":-
  - In terms of the box culverts, the key measure is that culverts should be installed so that the bottom (invert) is at least 500mm below the grade line of the natural stream bed and that the culvert should be 'drowned out[14]'; this negates issues with fish passage. The open-bottom culvert is essentially a span bridge and the installation of it has no potential to cause fish passage issues. In terms of the piping of drains onsite, the pipes will be level, or close to level, and will be set below water level (drowned out) to ensure fish passage. In terms of ensuring water quality during the construction/installation of these stream crossings, each crossing will be site specific and the particulars will be agreed onsite between the engineers, the ECoW and IFI, however a number of basic principles will be used. Firstly, for the piped drain crossings, if sufficient depth of water is present in the drain, it may be best to drop the pipe into place and backfill. If excavation is required to get levels, it may be best to

[14] Meaning that meaning that the culvert sits well below low water levels rather than perched above it

dam the drain with sandbags if flow is sufficiently low to permit this approach, or otherwise to dam the drain and overpump. Pipes in dry drains will be installed making sure to keep the slope at grade. For the culverts, a stretch of river will be electrofished before being dammed at both ends and overpumped; this will contain dirty water within the working cell while the excavation is taking place to attain the depth for the culvert. For the installation of the bottomless culvert it is likely that a temporary dam-and-flume will be put in place to allow for the infilling behind the abutments without water quality issues;

- All instream works will be carried out in the months of July, August and September to avoid the salmonid spawning season and to avoid the times when the young of the year are at their most vulnerable;
- In terms of directional drilling, the works, including launch and receiver pits, will be carried out outside 20m from each watercourse. This is the buffer zone width recommended by IFI. The drilling process shall be constantly monitored to detect any possible breakout or leaking of bentonite into the surrounding geology; this is gauged by observation and by monitoring pumping rates and pressures. Monitoring by an ecologist/environmental engineer will be required during directional drilling works. IFI and NPWS will be notified of the works in advance; and,
- In terms of crossing within the bridge deck, critical elements with respect to aquatic ecology include for the placement of a sealed silt fence at both sides of the bridge crossing point and to a minimum of 10m upstream and downstream of each crossing on both sides of the road to divert water and runoff from the road into silt traps at each corner of the road. The size and design of these silt traps will vary and be suited to local conditions. The silt traps and sealed silt fence will be installed prior to any construction works commencing at the bridge crossing. An ecologist/environmental engineer will again be monitoring for the duration of the works.

5.5.1.5 Other Taxa

- Areas where soil or water is to be stored (e.g. settlement ponds) will be checked regularly throughout the construction phase for the presence of Frogs (and spawn) and other protected aquatic and semi-aquatic fauna. If protected species are present, the environmental staff will translocate these, if possible (under licence if applicable). The same measure will be applied for any drains or areas of standing water forded by construction machinery. These areas will be checked on an ongoing basis by the ECoW and any areas with breeding frogs, spawn or tadpoles will be mapped and if possible fenced off temporarily to allow Frogs to metamorphose. If such areas cannot be avoided by site traffic the environmental staff will translocate the frogs (adults/young) under licence if applicable;
- An updated survey for adult Marsh Fritillary, *Euphydras aurinia*, will be carried out in the year of construction (May/June) ideally before construction commences. Locations with Devil's Bit Scabious within the site (along the edge of existing access tracks) will be checked in September/October for the presence of larval webs. Marsh Fritillary butterfly is the only Irish insect listed under Annex II of the EU Habitats Directive. In the event that larval webs are recorded within the works area, mitigation measures will follow best practice guidelines as outlined in the '*Ecological Surveying Techniques for Protected Flora and Fauna during the Planning of National Road Schemes*' (NRA, 2008);

- If other taxa such as other species of Lepidoptera, Common Viviparous Lizard etc. are recorded within or adjacent to the wind farm, or the haul route works locations or grid connection route, these sightings will be logged on the wildlife register; and,
- Any sightings of rare or protected invertebrates, amphibians etc. made in the course of operational phase monitoring will be recorded and if appropriate this information will be submitted to the National Biodiversity Data Centre.

5.5.2 Operational Phase

The requirements for operational phase monitoring and mitigation are substantially fewer than for the construction phase. Given the findings of the above assessments, operational phase measures are predominately related to birds and bats, as follows:-

- Bird activity will be monitored for 3-years post construction by a suitably qualified ecologist. Standard breeding bird surveys will be carried out (transects and point counts) and winter VP surveys will be undertaken with reference to standard methodology (e.g. SNH, 2017, Gilbert *et al*. 2011). Annual reports will be prepared and submitted to the Planning Authority (Authorities) as required;
  - Monthly fatality searches will be carried out around the turbine bases for the first 3 no. years of operation, with a minimum of half of the winter season searches using trained cadaver dogs (minimum 3 no. cadaver dog searches);
  - All feather spots and bird (and bat) carcasses will be photographed and logged and an annual fatality search report will be prepared and submitted to the Planning Authority (Authorities). Any fatalities noted by site staff or maintenance crews will be logged on the wildlife register and this register will be made available to the ecologist carrying out the monitoring program;
- Bird and bat boxes will be checked and maintained annually for the first 3-years of operation by a suitably qualified ecologist. Any boxes requiring maintenance or replacement will be identified and removed/replaced under the supervision of an ecologist;
- As a precautionary mitigation measure, in addition to the creation of buffers between the proposed turbines and surrounding vegetation (discussed above) reduced rotation speed will be implemented when turbines are idling. Automatic 'feathering' of idling blades will be implemented (through SCADA) to reduce rotation speed of blades to below 2rpm while idling. Feathering blades has been shown to be effective in reducing fatality rates of bats by up to 50% and does not result in a significant loss of energy output (NatureScot 2021). No additional control measures to avoid/reduce collision related bat fatalities are considered warranted in this instance; and,
- Monitoring of the bat activity at the wind farm during the operational phase is recommended, based on the NatureScot 2021 guidelines, as several bat species were recorded within and adjacent the project site. Under these guidelines and EUROBATS (Rodrigues *et al*., 2008) guidelines, it is recommended that monitoring of bats be implemented for at least 3-years once the wind farm is operational. Surveys will be conducted from March/April to October/November inclusive, during temperate weather conditions (i.e. air temperatures not lower than 10°C, calm, dry and overcast conditions). This monitoring will include detector surveys of bat activity near all turbines and the continuing status of any nearby potential roosts. Passive detector(s) will be deployed at several locations, a number of these close to turbines and others remote from turbine locations, within the wind farm site during the summer/autumn months. These deployment locations will be

the same used in the pre-construction bat monitoring. An annual report of operational phase bat activity will be prepared and submitted for the attention of the Planning Authority (Authorities) as required:-

- Over the first three years of operation a combination of data will be collected from:-
  - bat activity monitoring (seasonal deployment of static bat detectors) including continuous monitoring at height (if feasible);
  - fatality search around turbines;
  - recording of weather data including wind speed and direction, air temperature, precipitation and barometric pressure;
- At the end of the first year of operation, the bat activity data will be reviewed by a suitably qualified and experienced ecologist and, if deemed necessary, a curtailment strategy will be implemented. It is anticipated that the clearance of vegetation to create bat buffers will limit bat activity in the vicinity of turbines and will be effective in reducing the potential for collision risk. However, as acknowledged in NatureScot (2021) it is difficult to predict how bat behaviour will change post-construction. Therefore, further mitigation informed by post-construction monitoring may be required. One such option is smart curtailment, whereby turbines identified in high-risk locations by post-construction monitoring are feathered to run at < 2rpm, while optimal flight conditions for bats occurs;
  - Any requirement for smart curtailment, and the parameters that would influence it, will be guided by the comprehensive post-construction monitoring methodology, which will clarify the bat usage of the site at turbine locations post-construction and identify the likely relationship with temporal and weather parameters, and any potential collision fatalities; and,
  - The need for, and implementation of, a smart curtailment strategy will be reviewed by a bat specialist at the end of the second and third years of operation taking into account the accumulated survey data.

As detailed in the SWMP, following the completion of construction and the re-vegetation of disturbed ground, the generation of 'dirty' water runoff will be significantly diminished. It is important to reiterate that areas of hardstanding will be impermeable and the majority of incident rainfall will percolate naturally to ground. The following aquatic ecology protection measures will also be implemented:-

- Infiltration interceptor drains will be retained for the duration of the project to ensure that up-slope ('clean') runoff is directed away from site infrastructure and managed in an appropriate manner;
- Swales and check dams (i.e. for the management of 'dirty' water) shall be retained for the duration of the project. The swales, having become vegetated, and check dams will act as a filtration feature for the low volume of surface water runoff arising and will be sufficient to ensure the avoidance of any deleterious matter being discharged to downstream watercourses. Accordingly, it is proposed that the silt/settlement ponds and lagoon-type sediment ponds will be decommissioned 1-year following the completion of construction. This period will ensure that the swales have become sufficiently vegetated to filter any silt/sediment which may arise;
- Interceptor drains will be installed up-gradient of all infrastructure to collect clean surface runoff, in order to minimise the amount of runoff reaching areas where suspended sediment could become entrained. It will then be directed

to areas where it can be re-distributed over the ground by means of a level spreader;
- Swales/roadside drains will be used to collect runoff from access tracks, turbine hardstanding areas and substation compound areas which may contain entrained suspended sediment, and channel it to settlement ponds for sediment settling;
- Transverse drains ('grips') will be constructed, where appropriate, in the surface layer of access tracks to divert any runoff into swales/track side drains;
- Check dams will be used along sections of access tracks drains to intercept silts at source. Check dams will be constructed from a 40mm non-friable crushed rock or similar;
- Swales and check dams will buffer volumes of runoff discharging from the drainage system during periods of high rainfall, by retaining water until the storm hydrograph has receded, thus reducing the hydraulic loading to watercourses; and,
- Settlement ponds will be designed in accordance the greenfield runoff rate requirements; and,
- Imported rock for construction purposes and road surfacing will be strong, well graded limestone which will be resistant to erosion and have a low likelihood to generate fines in hardstand runoff. The operation of the underground grid connection will not result in any likely hydrological or water quality effects and therefore do not require mitigation measures.

Mitigation measures relating to oils and fuels are as follows:-

- Fuels stored on site will be minimised. Any storage areas will be bunded appropriately for the fuel storage volume for the time period of the construction;
- The substation transformer and oil storage tanks will be located in a concrete bund, impervious to rainwater ingress, capable of holding 110% of the stored oil volume;
- Turbine transformers will be located within the turbines, and any leaks will be fully contained within the turbine thus eliminating any pathway for leakages to affect land and soil;
- Maintenance vehicles will be regularly inspected for leaks and fitness for purpose; and
- An emergency plan for the operational phase to deal with accidental spillages will be contained within an Operational-Phase Environmental Management Plan. Spill kits will be available to deal with accidental spillages.

5.5.3 Decommissioning Phase

Decommissioning works will be governed by the same requirements to control run-off or pollution to watercourses as have been implemented during the construction phase, as follows:-

- A decommissioning phase environmental management plan will be prepared in advance of the works. This will include all appropriate surface water and spoil management commitments;
- The site compound will need to conform to the construction phase mitigation measures including those related to lighting design and proper treatment of edible and putrescible wastes; and,
- Following reinstatement, the site will be monitored by a suitably qualified ecologist for a 2-year period to determine the progress of revegetation and if

necessary to introduce supplementary planting with native species. A reassessment of the site will be carried out at the end of Year-1 to assess the site's progression over the previous year and to take photographic evidence of the site vegetation status, drainage management and general site appearance.

5.6 Residual Effects

The mitigation measures described for the proposed White Hill Wind Farm development have been designed to minimise the impact of the development, from the construction of the wind farm infrastructure including the UGL and turbine delivery, through the operational phase and onto decommissioning. The constraints led design approach followed has been effective in identifying and insofar as possible avoiding potential risks of impacts to the receiving environment. The mitigation measures set out in the EIAR are comprehensive and backed by a detailed planning phase CMP.

5.6.1 Construction Phase

5.6.1.1 Designated Sites

Taking cognisance of measures incorporated into the project design and mitigation measures to avoid effects which are considered in the preceding sections, it is concluded that the construction of the project will not have any residual adverse effect on the integrity of any designated site. With the implementation of the recommended mitigation measures, the project will not contribute to in-combination effects with other projects and activities including agriculture and silviculture on designated sites.

5.6.1.2 Habitats & Botanical Species

The construction phase will result in the loss of areas of habitat of some local value. With the implementation of the mitigation strategy, the residual effect of the construction phase is assessed to be non-significant negative in the short-term and highly localised.

5.6.1.3 Birds

With the application of the recommended mitigation measures during the construction phase, the residual effects on birds are assessed as likely to be non-significant negative, short-term and highly localised.

5.6.1.4 Bats

With the implementation of the recommended mitigation measures during the construction phase, the residual effects on bats are assessed as likely to be non-significant negative, short-term and highly localised.

5.6.1.5 Non-volant mammals

With the application of the recommended mitigation measures during the construction phase, the residual effects on non-volant mammals are assessed as likely to be non-significant to imperceptible negative, short-term and highly localised.

5.6.1.6 Aquatic Ecology

With the implementation of the recommended mitigation and environmental controls, the residual effects of the construction phase are assessed as likely to be neutral imperceptible, temporary and localised.

5.6.1.7 Other Taxa

The residual impacts of the construction phase on other taxa are assessed as likely to be non-significant neutral, localised and temporary in nature.

5.6.2 Operational Phase

5.6.2.1 Designated Sites

The NIS concludes that the operation of the project will not have any residual adverse effect on the integrity of any Natura 2000 sites including the River Barrow & River Nore SAC and the River Nore SPA. There is no likelihood of any residual impacts on nationally designated sites as a result of the operation of the wind farm.

5.6.2.2 Habitats & Botanical Species

With the implementation of the mitigation strategy, the residual effect on habitats and botanical species is assessed to be imperceptible neutral and highly localised.

5.6.2.3 Birds

With the implementation of the mitigation strategy, the residual effect on birds is assessed to be imperceptible negative and highly localised.

5.6.2.4 Bats

With the application of the recommended mitigation measures, the residual effects on bats are assessed as likely to be imperceptible negative and highly localised.

5.6.2.5 Non-volant mammals

With the implementation of the mitigation strategy, the residual effect on non-volant mammals is assessed to be imperceptible neutral and highly localised.

5.6.2.6 Aquatic Ecology

With the implementation of the mitigation strategy, the residual effect on aquatic species is assessed to be neutral imperceptible and localised.

5.6.2.7 Other Taxa

The residual effects on other taxa are assessed as likely to be neutral imperceptible and localised.

5.6.3 Decommissioning Phase

5.6.3.1 Designated Sites

The NIS concludes that the decommissioning of the project will not have any residual adverse effect on the integrity of any Natura 2000 sites including the River Barrow & River Nore SAC and the River Nore SPA. Similarly, there will be no significant residual effects on any nationally designated wildlife conservation sites.

5.6.3.2 Habitats & Botanical Species

With the implementation of the mitigation strategy, the residual effect on habitats and botanical species is assessed as likely to be non-significant neutral and highly localised.

5.6.3.3 Birds

With the implementation of the mitigation strategy, the residual effect on birds is assessed as likely to be neutral imperceptible and highly localised.

5.6.3.4 Bats

With the application of the mitigation strategy, the residual effect on bats is assessed as likely to be neutral imperceptible and highly localised.

5.6.3.5 Non-volant mammals

With the implementation of the mitigation strategy, the residual effect on non-volant mammals is assessed as likely to be imperceptible neutral and highly localised.

5.6.3.6 Aquatic Ecology

With the implementation of the mitigation strategy, the residual effect on aquatic ecology is assessed as likely to be neutral imperceptible and localised.

5.6.3.7 Other Taxa

The residual effects on other taxa are assessed as likely to be neutral imperceptible and localised.

5.7 Conclusion

This ecological impact assessment has fully assessed the likelihood of adverse effects of all aspects of the project on the species and habitats in the receiving environment. Overall, it is assessed that the detailed monitoring and mitigation commitments will be effective in ensuring that there are no significant residual effects on biodiversity arising from the construction, operation or decommissioning of the project.

Separately, a NIS has fully assessed the potential impacts of all aspects of the project, on its own and in combination with other projects and plans, on designated Natura 2000 sites in the wider receiving environment. The NIS concludes that the implementation of environmental control measures means, in light of best scientific knowledge, that there will be no significant effects, either individually or in combination with other plans or projects, adversely affecting the conservation interests, conservation objectives or integrity of the River Barrow & River Nore SAC and the River Nore SPA or any other Natura 2000 sites.

References

Balmer, D.E., Gillings, S., Caffrey, B.J., Swann, R.L., Downie, I.S. & Fuller, R.J. 2013. *Bird Atlas 2007-11: the breeding and wintering birds of Britain and Ireland*. BTO Books, Thetford.

Bang, P. & Dahlstrom, P. 2004. *Animal Tracks and Signs. Oxford University Press*, Oxford.

Bibby, C. J., Burgess, N. D., Hill, D. A. & Mustoe, S. H. 2000. *Bird Census Techniques (2nd Edition)*. Academic Press, London.

Boland, H. & Crowe, O. 2012. *Irish Wetland Bird Survey: waterbird status and distribution 2001/02–2008/09*. BirdWatch Ireland, Kilcoole, Co. Wicklow.

BWPi 2008. *Birds of the Western Palearctic*. DVD published by BirdGuides UK.

CIEEM 2018. *Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine*. Chartered Institute of Ecology and Environmental Management, Winchester.

CIEEM 2019. *Guidelines for Ecological Impact Assessment (EcIA)*.

CIEEM 2021. *Good Practice Guidance for Habitats and Species*. Version 3. Chartered Institute of Ecology and Environmental Management, Winchester.

Clark, M. 1988. *Badgers*. Whittet Books, London.

Collins J. (Ed.). 2016. *Bat Surveys for Professional Ecologists: Good Practice Guidelines (3rd Edition)*. The Bat Conservation Trust, London.

Cummins, S., Fisher J., McKeever R.G., McNaghten, L. & Crowe, O. 2010. *Assessment of the distribution and abundance of Kingfisher Alcedo atthis and other riparian birds on six SAC river systems in Ireland*. Report for NPWS.

DoEHLG 2009. *Appropriate Assessment of Plans & Projects - Guidance for Planning Authorities*.

Drewitt, A.L. & Langston, R.H.W. 2006. *Assessing the impacts of wind farms on birds. In Wind, Fire and Water: Renewable Energy and Birds*. Proceedings of the BOU Conference, University of Leicester, 1–3 April 2005. Ibis 148 (suppl. 1): 29–42.

EPA 2022. *Guidelines on the information to be contained in Environmental Impact Assessment Reports*. EPA, Johnstown Castle, Wexford.

EU 2009. Golden Plover. *EU Management Plan 2009-2011. Technical Report - 2009 – 034*.

Fernández-Bellon D., Irwin S., Wilson M and O'Halloran J. 2015. *Reproductive output of Hen Harriers Circus cyaneus in relation to wind turbine proximity*. Irish Birds 10: 143–150.

Fitzpatrick, U., Murray, T.E., Byrne, A., Paxton, R.J. & Brown, M.J.F. 2006. *The Regional Red List of Irish Bees*. Queens University Belfast, Northern Ireland.

Fossitt, J. 2000. *A Guide to Habitats in Ireland*. Heritage Council

Gilbert, G., Stanbury A. and Lewis, L. 2021. *Birds of Conservation Concern in Ireland 4: 2020–2026*. Irish Birds 43: 1–22.

Gillings, S & Fuller, R.J. 1999. *Winter ecology of Golden Plovers and Lapwings: a review and consideration of extensive survey methods*. BTO Research Report 224.

JNCC. 2004, *Common Standards Monitoring Guidance for Terrestrial Mammals, Version August 2004*, ISSN 1743-8160.

Kelly, J., O'Flynn, C., and Maguire, C. (2013). *Risk analysis and prioritisation for invasive and nonnative species in Ireland and Northern Ireland*. A report prepared for the Northern Ireland Environment Agency and National Parks and Wildlife Service as part of Invasive Species Ireland.

King, J.L., Marnell, F., Kingston, N., Rosell, R., Boylan, P., Caffrey, J.M., FitzPatrick, Ú., Gargan, P.G., Kelly, F.L., O'Grady, M.F., Poole, R., Roche, W.K. & Cassidy, D. 2011. *Ireland Red List No. 5: Amphibians, Reptiles & Freshwater Fish*. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland.

Kingsley, A., Whittam, B., 2005. *Wind Turbines and Birds: A Background Review for Environmental Assessment*. Draft May 12 2005. Canadian Wildlife Service, Gatineau, Quebec, p. 81.

Langston, R.H.W., Pullan, J.D., 2003. *Windfarms and Birds: An analysis of the effects of windfarms on birds, and guidance on environmental assessment criteria and site selection issues*. In: Secretariat Memorandum of the Standing Committee, Convention on the conservation of European wildlife and natural habitats. BirdLife International, RSPB, Strasbourg. pp. 1–58.

Langston, R.H.W. & Pullan, J.D. 2004. *Effects of wind farms on birds*. Nature and Environment No. 139. Council of Europe Publishing, Strausberg.

Lockhart, N., Hodgetts, N. & Holyoak, D. 2012. *Ireland Red List No.8: Bryophytes*. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland.

Lundy, M.G., Aughney, T., Montgomery, W.I., & Roche, N. 2011. *Landscape conservation for Irish bats & species specific roosting characteristics*. Bat Conservation Ireland.

Madsen, E. A. & Cook, A.S.C.P 2016. *Avian collision risk models for wind energy impact assessment*. Environmental Impact Assessment Review 56:43-49. https://doi.org/10.1016/j.eiar.2015.09.001.

Maitland, P.S. 2003. *Ecology of the River, Brook and Sea Lamprey. Conserving Natura 2000 Rivers Ecology Series No. 5.* English Nature, Peterborough.

Marnell, F., Looney, D. & Lawton, C. (2019) *Ireland Red List No. 12: Terrestrial Mammals*. National Parks and Wildlife Service, Department of the Culture, Heritage and the Gaeltacht, Dublin, Ireland.

Middleton, N., Froud, A., French, K. 2014. *Social Calls of the Bats of Britain and Ireland*. Pelagic Publishing. Exeter, UK.

Nairn, R. and Fossitt, J. 2004. *The ecological impacts of roads and an approach to their assessment for National Road Schemes*. In: Davenport, J. and Davenport, J.L.

(eds.) *The Effects of Human Transport on Ecosystems: Cars and Planes, Boats and Trains*. 98-114. Dublin: Royal Irish Academy.

NatureScot 2017. Protected species advice for developers: Badger. Available at: https://www.nature.scot/sites/default/files/2017-10/A2293028%20-%20Species%20Planning%20Advice%20Project%20- %20Badger.pdf

NatureScot 2021. *Bats and onshore wind turbines - survey, assessment and mitigation*. nature.scot/doc/bats-and-onshore-wind-turbines-survey-assessment-and-mitigation

Nelson, B., Ronayne, C. & Thompson, R. 2011. *Ireland Red List No.6: Damselflies & Dragonflies (Odonata)*. National Parks and Wildlife Service, Department of the Environment, Heritage and Local Government, Dublin, Ireland.

NRA 2005. *Guidelines for the Crossing of Watercourses during the construction of National Road Schemes*.

NRA 2006. *Environmental Impact Assessment and Construction Guidelines*.

NRA 2008. *Guidelines on The Management of Noxious Weeds and Non-Native Invasive Plant Species on National Roads*.

NRA 2008. *Ecological Surveying Techniques for Protected Flora and Fauna during the Planning of National Road Schemes*.

NRA 2009. *Guidelines for Assessment of Ecological Impacts of National Roads Schemes*.

O'Donoghue. 2021. *Hen Harrier Circus cyaneus Ecology and Conservation during the Non-Breeding Season in Ireland, Bird Study*.

O'Neill, F.H., Martin, J.R., Devaney, F.M. & Perrin, P.M. 2013. *The Irish Semi-natural Grasslands Survey 2007-2012*. Report submitted to the National Parks and Wildlife Service, Dublin.

Pearce Higgins, J. W., Stephen, L., Douse, A. and Langston, R. H. W. 2012. *Greater impacts of wind farms on bird populations during construction than subsequent operation: results of a multi-site and multi-species analysis*. Journal of Applied Ecology, 49: 386–394. doi: 10.1111/j.1365-2664.2012.02110.x

Pearce-Higgins, J.W., Stephen, L., Langston, R.H.W., Bainbridge, I.P. & Bullman, R. 2009. *The distribution of breeding birds around upland wind farms*. Journal of Applied Ecology, 46, 1323–1331.

Percival, S. M., 2003. Birds and wind farms in Ireland: a review of potential issues and impact assessment. Report to S.E.I.

Perrin, P.M., Barron, S.J., Roche, J.R. & O'Hanrahan, B. 2010. *Guidelines for a national survey and conservation assessment of upland vegetation and habitats in Ireland*. Version 1.0. Irish Wildlife Manuals, No. 48. National Parks & Wildlife Service, Dublin.

Perrin, P., Martin, J., Barron, S., O'Neill, F., McNutt, K. & Delaney, A. 2008. *National Survey of Native Woodlands, 2003-2008*. Unpublished report to the National Parks and Wildlife Service, Dublin.

Regan, E.C., Nelson, B., Aldwell, B., Bertrand, C., Bond, K., Harding, J., Nash, D., Nixon, D., & Wilson, C.J. 2010. *Ireland Red List No. 4 – Butterflies*. National Parks and Wildlife Service, Department of the Environment, Heritage and Local Government, Ireland.

Reynolds, C.S. 1998. *The state of freshwater ecology*. Freshwater Biology, 39: 741-753. https://doi.org/10.1046/j.1365-2427.1998.00315.x

Roche, N., Langton, S., and Aughney, T. 2009. *The Car Based Bat Monitoring Scheme for Ireland: Synthesis report 2003-2008*. Irish Wildlife Manuals, No. 39. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland.

Roche, N., Aughney, T., Marnell, F. & Lundy, M. (2014). *Irish Bats in the 21st Century*. Bat Conservation Ireland, Cavan, Ireland.

Rodrigues, L., Bach, L., Dubourg-Savage, M.-J., Goodwin, J. & Harbusch, C. 2008. *Guidelines for consideration of bats in wind farm projects*. Bonn: UNEP/EUROBATS.

Russ, J. 2012. *British Bat Calls: A Guide to Species Identification*. Pelagic Publishing, Exeter.

Shiel CB, Shiel RE, Fairley JS 1999. *Seasonal changes in the foraging behaviour of Leisler's bats (Nyctalus leisleri) in Ireland as revealed by radio-telemetry*. J Zool (Lond) 249:347–358

Skinner, A., Young, M. and Hastie, L. 2003. *Ecology of the Freshwater Pearl Mussel. Conserving Natura 2000 Rivers Ecology Series No. 2* English Nature, Peterborough.

SNH (Scottish Natural Heritage) 2017. *Recommended bird survey methods to inform impact assessment of onshore wind farms*.

SNH (Scottish Natural Heritage). 2019. *Bats and Onshore Wind Turbines: Survey, Assessment and Mitigation*. Version January 2019.

Stolze, S. & Monecke T. 2017. *Holocene history of 'non-native' trees in Ireland*. Review of Palaeobotany and Palynology, Vol. 244, 347-355.

Sutherland W.J (Ed.). 1996. *Ecological Census Techniques, a Handbook*. Cambridge, UK.

Wernham C.V., Toms M.P., Marchant J.H., Clark J.A., Siriwardena G.M. & Baillie S.R. 2002. *The migration atlas: movements of the birds of Britain and Ireland*. Poyser, London.

Whitfield, D.P. & Madders, M. 2006. *A review of the impacts of wind farms on hen harriers Circus cyaneus and an estimation of collision avoidance rates. Natural Research Information Note 1 (revised)*. Natural Research Ltd, Banchory, UK.

Wyse Jackson, M., FitzPatrick, Ú., Cole, E., Jebb, M., McFerran, D., Sheehy Skeffington, M. & Wright, M. 2016. *Ireland Red List No. 10: Vascular Plants*. National Parks and Wildlife Service, Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs, Dublin, Ireland.