DERRYADD WIND FARM

ENVIRONMENTAL IMPACT ASSESSMENT REPORT (EIAR)

VOLUME II

EIAR Main Report

January 2019

TOBIN CONSULTING ENGINEERS

Patrick J. Tobin & Co. Ltd.

REPORT

PROJECT: Derryadd Wind Farm, Environmental Impact Assessment Report (EIAR)

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DOCUMENT AMENDMENT RECORD

Client: Bord na Móna Powergen Ltd.

Project: Derryadd Wind Farm

Title: Derryadd Wind Farm EIAR

PROJECT NUMBER: 10325				DOCUMENT REF: 10325-01			
Rev A	EIAR	LL	Jan '19	ST	Jan '19	DG	Jan '19
Revision	**Description & Rationale**	**Originated**	**Date**	**Checked**	**Date**	**Authorised**	**Date**
TOBIN Consulting Engineers							

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1 INTRODUCTION

1.1 BACKGROUND TO ENVIRONMENTAL IMPACT ASSESSMENT (EIA) AND STRATEGIC INFRASTRUCTURE DEVELOPMENT (SID)

Environmental Impact Assessment (EIA) is the process that examines the potential environmental effects of a proposed development. Where potential significant effects are identified, appropriate measures for the prevention and/or mitigation of impacts are prescribed. The EIA process consists of the preparation of an Environmental Impact Assessment Report, the carrying out of consultations, the examination by the competent authority of the information presented in the environmental impact assessment report and any supplementary information provided, followed by the reasoned conclusion by the competent authority on the significant effects of the project on the environment arising from the examination of the information presented. An Environmental Impact Assessment Report (EIAR) is a statement of the effects, if any, that the proposed development would have on the environment and is used to inform the EIA process. This EIAR has been prepared by Tobin Consulting Engineers on behalf of Bord na Móna Powergen Ltd.

The proposed Derryadd Wind Farm development is subject to the EIA process as it falls under '*Category 3 (i) of the Fifth Schedule Part II of the Planning and Development Regulations, 2001 (SI No 600 of 2001)*' which sets out a comprehensive list of project types and development thresholds where relevant, which are subject to EIA for the purposes of the Regulations. The proposed development is subject to the EIA process as the regulations stipulate that '*Installations for the harnessing of wind power for energy production (wind farms) with more than 5 turbines or having a total output greater than 5 megawatts*', requires an EIAR. This report has also taken cognisance of the new EIA Directive 2014/52/EU.

In addition, the application meets the Strategic Infrastructure Development (SID) threshold for wind energy set out in the Seventh Schedule (Class 1) of the Planning and Development Act 2000, as amended i.e. the project will consist of a wind farm with an expected total output greater than 50 Megawatts (an output of approximately 96 Megawatts is anticipated). Therefore, the Planning Application and this EIAR is being submitted directly to An Bord Pleanála as an SID project in accordance with Section 37E of the Planning and Development Act 2000, as amended. An Bord Pleanála determined that this approach is required, as detailed in correspondence dated 25/05/18, included in Appendix 1.1.

1.2 PLANNING APPLICATION

Bord na Móna Powergen Ltd. (a subsidiary of Bord na Móna Plc and hereafter referred to as Bord na Móna) intends to apply to An Bord Pleanála for planning permission to develop a wind farm and all associated infrastructure at the Derryaroge, Derryadd, Derryshannoge and Lough Bannow substantially cutaway bogs within the Mountdillon peat production bog group in County Longford,

The proposed wind farm site is located within the townlands of Cloonkeel, Ballynakill, Cloonbearla, Cloonbrock, Derryaroge, Mount Davys, Rappareehill, Cloonfore, Cloonfiugh, Barnacor(Ed Rathcline), Grillagh (Moydow By), Derryad (Moydow By), Annaghbeg, Annaghmore, Derryart, Derryoghil, Ards, Corralough, Cloontamore, Derrygeel, Cloontabeg, Kilmakinlan, Derrynaskea, Derryshannoge, Derraghan More, Coolnahinch (Moydow By), Derryglogher, Mosstown (Rathcline By), Corlea and Derraghan Beg. The site is approximately 2km east, at the nearest point, from Lanesborough, County Longford. Longford Town is approximately 9km north east of the proposed wind farm location.

For the purposes of this EIAR and planning application, the proposed development is referred to as the Derryadd Wind Farm. The 'red line' boundary indicates the planning application boundary, while the 'blue line boundary' indicates the Bord na Móna landownership boundary for the Mountdillon Bog Group (See Figure 1.1- Regional Site Location Map).

1.3 THE APPLICANT

The applicant for the proposed Derryadd Wind Farm development is Bord na Móna Powergen Ltd., a subsidiary of Bord na Móna plc. Bord na Móna is a publicly owned company, originally established in 1946 to develop and manage some of Ireland's extensive peat resources on an industrial scale, in accordance with government policy at the time.

In 2011, Bord na Móna published a 'Strategic Framework for The Future Use of Peatlands'. The strategy establishes a framework for the on-going assessment of the company's approximately 80,000 hectares (ha) total land bank and provides for the formulation of appropriate strategies, policies and actions. The development of wind energy as an after use for cutaway peatlands is clearly indicated in this strategy. On page 39 of the 2011 strategy document, indicative zones of potential in the midlands area are outlined on a map. The map indicates that the Mountdillon bog group has wind energy development potential.

To date, Bord na Móna has a number of commissioned wind farms that are supplying energy to the National Grid including Bellacorick Wind Farm in County Mayo, Mountlucas Wind Farm in County Offaly, Bruckana Wind Farm, situated on the borders of counties Tipperary, Kilkenny and Laois, and Sliabh

Bawn Wind Farm in County Roscommon (developed as a joint venture with Coillte). In addition, Bord na Móna has recently commenced construction of Oweninny Wind Farm, County Mayo in a joint venture with ESB and, was awarded a Grant of Planning Permission for Cloncreen Wind Farm, County Offaly (May 2017).

Bord na Móna Powergen also manages and operates a number of thermal and renewable energy assets, including Edenderry Power Plant (a peat/biomass generating unit), Cushaling peaking plant and the Drehid landfill gas facility.

1.4 THE NEED FOR THE PROPOSED DEVELOPMENT

As noted above, the development of wind energy as an after use for cutaway peatlands is specifically identified in the Bord na Móna, 'Strategic Framework for The Future Use of Peatlands'.

When considering the need for this wind farm development, and wind energy as an energy source in general, it is important to place its development in an international, national and local policy context from the perspectives of environment, energy and planning. Chapter 4, section 4.4 *Planning and Development Policy Context* outlines the legislative mechanisms and requirements from a global to local level, which have been formulated to support the generation of energy from renewable sources and reduce the dependency on fossil fuels.

The assessment in Chapter 4 of this EIAR ("Policy, Planning and Development Context") demonstrates that the proposed wind farm development is consistent with the current energy and planning policy context, which seeks to increase the share of electricity generation from renewable sources and locate wind energy developments in suitable locations, thereby minimising any environmental impacts.

1.5 SITE LOCATION AND BACKGROUND

The proposed development, (See Figures 1.1 and 1.2) is located within the Mountdillon peat production bog group in Co. Longford. The development site has an area of approximately 1908 hectares.

The site is approximately 12km long in the northwest/southeast direction and is approximately 4km wide in an east/west direction. The site lies between the towns and villages of Lanesborough, Derraghan, Keenagh and Killashee while the main urban centre in the region, Longford Town, is 9km to the northeast from its nearest point. Derryaroge Bog to the north is adjacent to the River Shannon and Lough Bannow Bog is immediately to the west of the Royal Canal which runs in a north south direction.

The land use/activities on the site are a mixture of active peat extraction, peat extraction works (administration offices, machinery maintenance and storage, stores, canteen), bare cutaway peat, re-vegetation of bare peat, and two existing wind monitoring masts on Derryaroge Bog and Lough Bannow Bog. These works form part of the Bord na Móna Mountdillon peat production facility in County Longford.

The surrounding landscape is a mixture of forestry, agricultural land and cutover/cutaway peatland. The landscape is predominately flat. The most significant features in the surrounding landscape are 'Bawn Mountain', which is located approximately 8km to the east of Lough Bannow Bog and Sliabh Bawn, which is located 8km to the north west of the site.

The significant energy infrastructure that exists in the local area is Lough Ree Power located to the west of Derryaroge Bog, and its associated grid infrastructure in the form of 110 kV pylons network (in particular the Lanesborough/Richmond and Lanesborough/Mullingar lines). Sliabh Bawn Wind Farm in County Roscommon is located approximately 8km northwest of the proposed development. There is also an EPA-licenced ash repository (Lough Ree Ash Repository Licence No. P0610-03,) used for disposal of ash from Lough Ree power plant located to the west of the site.

At a greater distance from the site is the Skrine Wind Farm, located approximately 19km to the south-west of proposed development and the Roosky Wind Farm, located approximately 14.5km to the north of the proposed development.

There are also a number of Bord na Móna rail lines that pass through the bogs facilitating the transportation of milled peat and ash.

The proposed development is located predominately in a preferred location for wind energy development as outlined in the Longford County Development Plan 2015 – 2021, subsection 5.5.2.1 -Wind Energy.

1.6 SUMMARY OF THE PROJECT DESCRIPTION

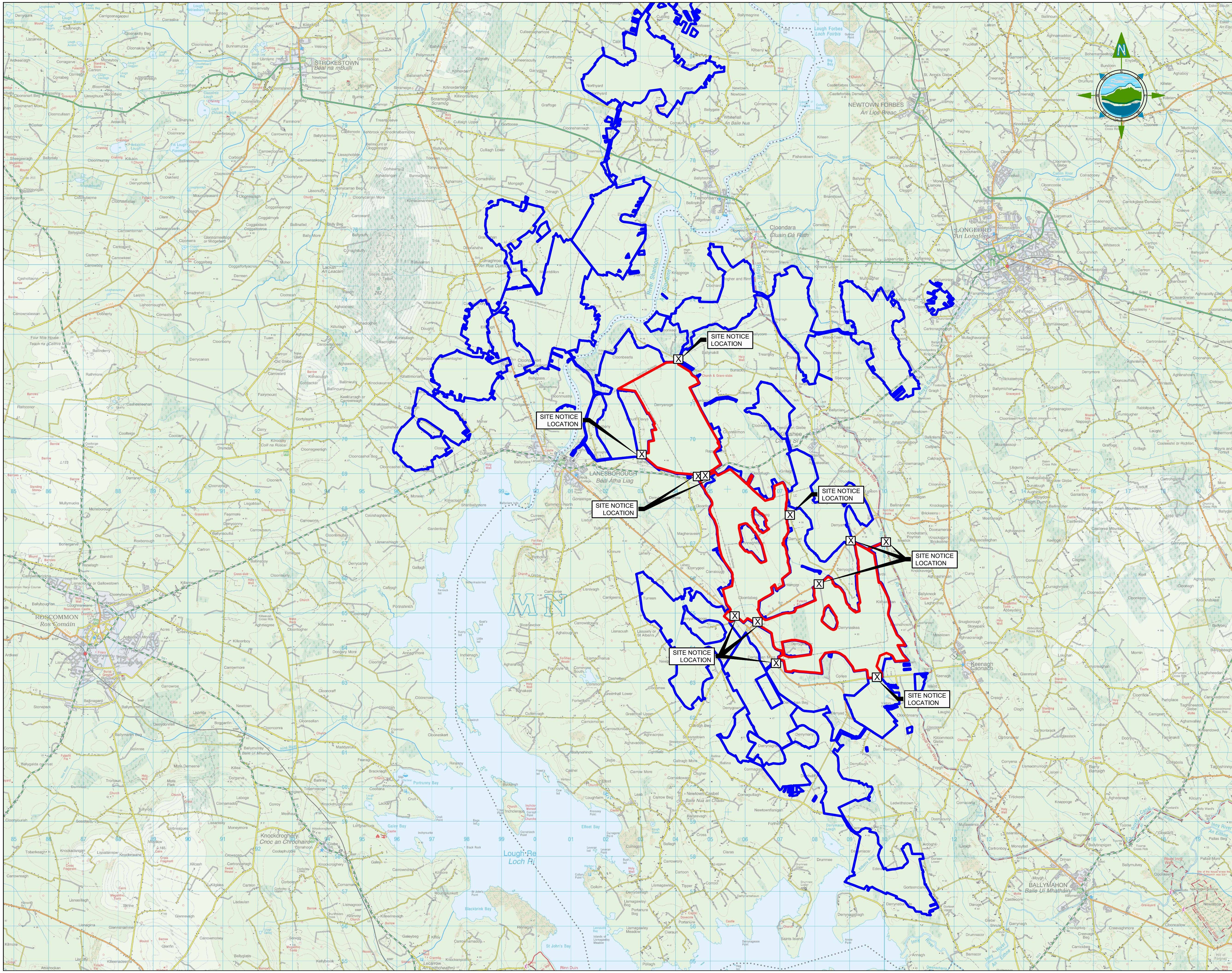
The proposed development comprises the construction of 24 no. wind turbines and ancillary works. The turbines will have a maximum blade tip height of 185m above the top of the foundation level and will be accessible from internal access routes within the Bord na Móna site. Bord na Móna Powergen Limited intends to apply for a ten-year planning permission for the following:

- 24 no. wind turbines with an overall blade tip height of up to 185m and all associated hard-standing areas;
- 5 no. borrow pits;
- 3 No. permanent Anemometry Masts up to a height of 120m;

- Provision of new internal site access roads (permanent and temporary), passing bays, amenity cycleways, car parking and associated drainage;
- 1 no. 110kV electrical substation, including battery storage, which will be constructed at one of two proposed locations on site: either Option A in Cloonfore townland or Option B in Derraghan More townland. The electrical substation will have 2 no. control buildings, associated electrical plant and equipment, battery storage containers and a wastewater holding tank;
- 5 no. temporary construction compounds, in the townlands of Cloonfore, Cloontabeg, Derraghan More, and Rappareehill (2 no.);
- All associated underground electrical and communications cabling connecting the wind turbines to the proposed substation at either Option A in Cloonfore or Option B in Derraghan More;
- All works associated with the connection of the proposed wind farm to the national electricity grid, which will be either to the existing Lanesborough/Richmond 110 kV line via overhead line (Option A) or to the existing Lanesborough/Mullingar 110 kV line via an underground or overhead line (Option B);
- Removal of existing meteorological masts;
- New access junctions, improvements and temporary modifications to existing public road infrastructure to facilitate delivery of abnormal loads and construction access, including locations on the N6, N61, N63, R392, R398, L11554, L1136 roads, access onto the local road in the townland of Cloonkeel, access onto the local road in the townland of Mount Davys and amenity access from the Royal Canal Tow Path (off the L5239);
- All related site works and ancillary development; and
- A 10-year planning permission and 30-year operational life from the date of commissioning of the entire wind farm.

A full description of the proposed development is provided in Chapter 2 – *Description of the Proposed Development.*

The application includes two potential substation locations - Option A in Cloonfore townland or Option B in Derraghan More townland - and associated grid connection options. The proposed wind farm connection to the national electricity grid will be either to the existing Lanesborough/Richmond 110kV line via overhead line to Option A, or to the existing Lanesborough/Mullingar 110kV line via an underground cable or overhead line to Option B. All new build transmission connection infrastructure for this proposed development is contained within the development site, aside from a short section of underground cabling along the R392. A detailed description of the grid connection can be found in Chapter 2, Section 2.4.8, Grid Connection.



GENERAL LEGEND

PLANNING APPLICATION BOUNDARY

PART OF LAND OWNERS PROPERTY FOLIO

SITE NOTICE LOCATION

NOTES:

1. DRAWINGS FOR PLANNING PURPOSES ONLY.
2. FIGURED DIMENSIONS ONLY TO BE TAKEN FROM THIS DRAWING.
3. GRID REFERENCES TO IRISH NATIONAL GRID.
4. ALL LEVELS SHOWN RELATE TO ORDNANCE SURVEY DATUM AT MALIN HEAD

OSI 1:50,000 Discovery Series Sheet No's: 1828, 1826, 1824, 2028, 2026, & 2024.

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1000m 0 1000m 2000m 3000m

Rev	Date	Description	By	Chkd.
A	Jan. '19	PLANNING ISSUE	MN	ST

Client: BORD NA MÓNA Naturally Driven

Project: DERRYADD WIND FARM

Title: REGIONAL SITE LOCATION MAP

Scale @ A3: 1:100,000

Prepared by: M. Nolan | Checked: S. Tinnelly | Date: January 2019

Project Director: D. Grehan

Drawing Status: Planning

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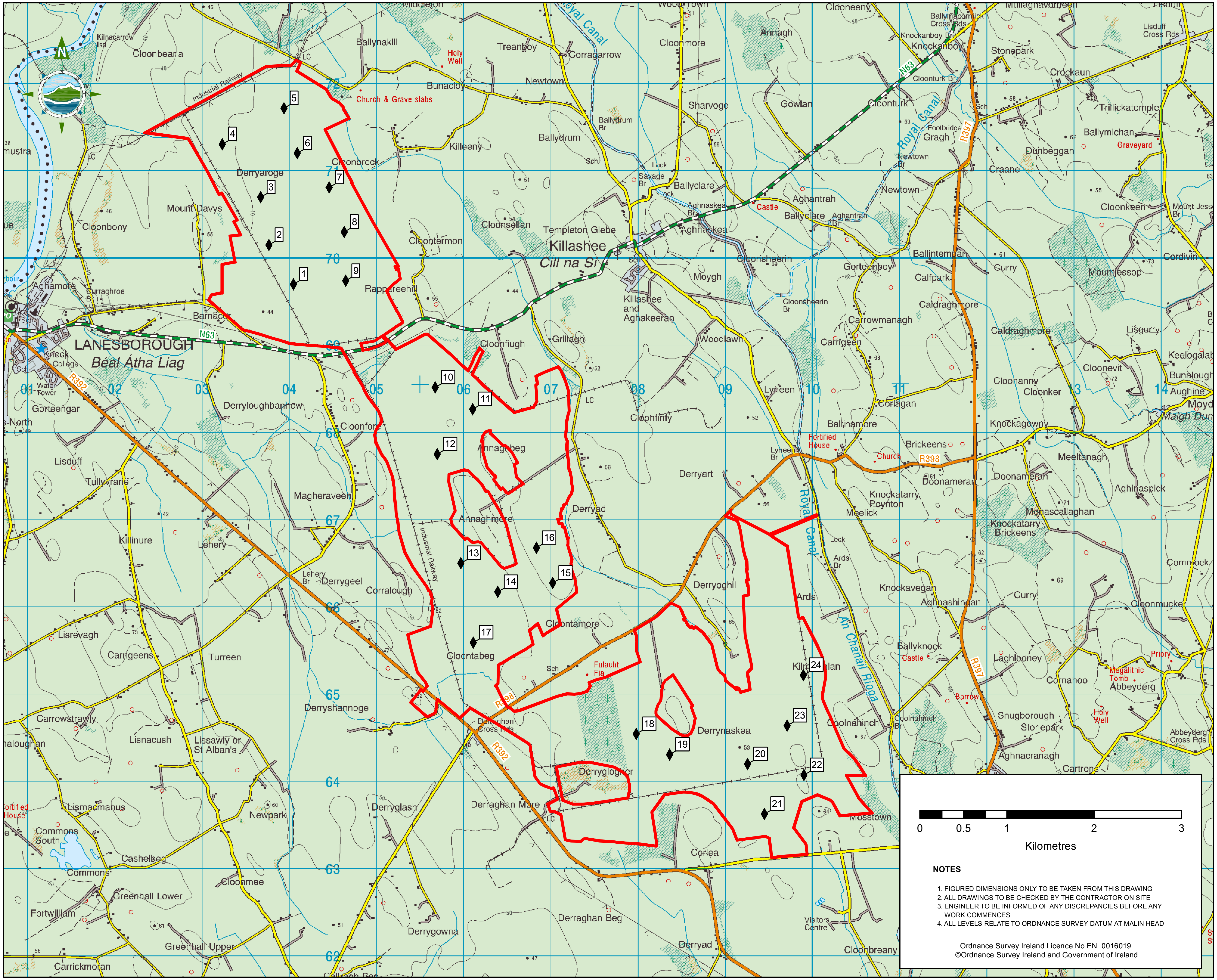
Drawing No.: Figure 1.1

Revision: A



NOTES

1. FIGURED DIMENSIONS ONLY TO BE TAKEN FROM THIS DRAWING
2. ALL DRAWINGS TO BE CHECKED BY THE CONTRACTOR ON SITE
3. ENGINEER TO BE INFORMED OF ANY DISCREPANCIES BEFORE ANY WORK COMMENCES
4. ALL LEVELS RELATE TO ORDNANCE SURVEY DATUM AT MALIN HEAD

Legend

- Planning Application Boundary
- ◆ Proposed Turbine Locations

Issue	Date	Description	By	Chkd.
A	Jan 2019	Final Issue	FH	ST

Client: BORD NA MÓNA — Naturally Driven

Project: DERRYADD WIND FARM

Title: Proposed Wind Turbine Locations

Scale @ A3: 1:40,000

Prepared by: F. Healy | Checked: S. Tinnelly | Date: January 2019

Project Director: D. Grehan

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Figure 1.2

Issue: A

1.7 LEGISLATIVE CONTEXT

As described in Section 1.1, the proposed development is subject to EIA and to the requirements set out in the provisions of:

- Part X of the Planning and Development Act 2000 (as amended by the Planning and Development (Amendment) Act 2010 (No. 30 of 2010), s. 54, (S.I. No. 405 of 2010);
- The European Union (Environmental Impact Assessment) (Planning and Development) Regulations 2014 (S.I. No. 543 of 2014) Reg. 2;
- The European Union (Environmental Impact Assessment and Habitats) Regulations 2011 (S.I. No. 473 of 2011) Reg. 6;
- The European Union (Environmental Impact Assessment) (Planning and Development Act, 2000) Regulations 2012 (S.I. No. 419 of 2012) Reg. 2(c);
- The European Communities (Environmental Impact Assessment) (Amendment) Regulations 2006 (S.I. No. 659 of 2006) Regulations 2 and 4; and
- The European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018 (S.I. No. 296 of 2018).

The following EIA guidelines have been taken into consideration in the preparation of this EIAR

- "Guidelines on the Information to be contained in Environmental Impact Statements" (EPA, 2002);
- "Advice Notes on Current Practice in the Preparation of Environmental Impact Statements" (EPA, 2003);
- "Draft Guidelines on the Information to be contained in Environmental Impact Statements" (EPA, September 2015);
- "Draft Advice Notes on Preparing Environmental Impact Statements" (EPA, September 2015); and
- Draft Guidelines on the information to be contained in Environmental Impact Assessment Reports (EPA, August 2017).

In addition to the Regulations and Guidelines above, this EIAR has been prepared with cognisance to the *"Wind Energy Development Guidelines for Planning Authorities (2006)"*, the proposed draft revisions to these guidelines (December 2013), and the Preferred Draft Approach to these guidelines as announced by the Government in June 2017.

A Natura Impact Statement (NIS) has also been prepared for the proposed development. The purpose of the NIS is to inform An Bord Pleanála in its undertaking of an 'Appropriate Assessment' of the proposal, as required under Article 6(3) of the EU Habitats Directive (92/43/EC). This is an assessment of the potential for significant or adverse effects resulting from the project, both individually and in combination with other activities, plans and projects, on European Site(s) as designated under the EU Habitats Directive and the conservation objectives for their qualifying species and habitats. The NIS is accompanied by a standalone Appropriate Assessment Screening report.

1.8 OVERVIEW OF THE EIAR

1.8.1 Information within the EIAR

The minimum information that must be contained in an EIAR is specified in Part X of the Planning and Development Act, 2000 and Schedule 6 of the Planning and Development Regulations, 2001 (as amended by S.I. No. 296 of 2018). The structure and content of this EIA Report fully complies with the legislative requirements as set out in "*Part X of the Planning and Development Act, 2000*", "*Part 10 of the Planning and Development Regulations, 2001*" (as amended by S.I. 296 of 2018) and the environmental guidelines detailed in Section 1.6 above.

The EIAR contains information on the scale and nature of the proposed development, a description of the existing environment, impact assessment of the proposed development, mitigation measures to reduce or negate potential effects on the receiving environment and residual effects (if relevant).

The overall EIAR is arranged in three volumes, as follows:

Volume I:	Non-Technical Summary (NTS);
Volume II:	Environmental Impact Assessment Report (EIAR); and
Volume III:	Appendices.

Volume I: Non-Technical Summary

This document provides an overview and summary of the EIAR using non-technical terminology. It is a standalone document and should offer a clear and concise summary of the existing environment, characteristics of the development and mitigation measures for the development.

Volume II: Environmental Impact Assessment Report

To allow for ease of presentation and consistency when considering the various elements of the environment, a systematic structure will be adopted for the main body of the report. This structure is known as a '*Grouped Format*'. The structure is used for each particular environmental aspect, as provided below.

Chapter 1 – Introduction: this chapter of the EIAR provides an introduction and a brief background to the project and the legislative requirements under which the document is prepared. It describes the EIA consultation and scoping procedures, the structure of the EIAR, the study team and contributors to the EIAR.

Chapter 2 – Description of the Proposed Development: provides a detailed description of the proposed development, which includes details of the site layout and infrastructure. It details the construction procedures and the materials required, the operational and maintenance phases, in addition to the decommissioning and rehabilitation procedures.

Chapter 3 – Reasonable Alternatives: provides a description of the alternatives considered.

Chapter 4 – Policy, Planning and Development Context: provides details of the policy and planning context of the proposed development on an international, national, regional and local level.

Chapter 5 to Chapter 17 inclusive deal with the following aspects:

- Chapter 5 - Population and Human Health;
- Chapter 6 - Biodiversity;
- Chapter 7 - Land, Soils and Geology;
- Chapter 8 - Hydrology and Hydrogeology;
- Chapter 9 - Landscape and Visual;
- Chapter 10 - Material Assets - Shadow Flicker*;
- Chapter 11 - Material Assets - Telecommunications, Aviation and EMF*;
- Chapter 12 - Air Quality and Climate;
- Chapter 13 - Noise and Vibration;
- Chapter 14 - Traffic and Transport;
- Chapter 15 - Archaeology, Architectural and Cultural Heritage;
- Chapter 16 - Interaction of the Foregoing; and
- Chapter 17 - Matrix of Mitigation Measures.

*Note: Chapter 10 (Material Assets - Shadow Flicker) and Chapter 11 (Material Assets - Telecommunications, Aviation and EMF) of this Environmental Impact Assessment Report (EIAR) can be classified as "Material Assets" and, as such, are often presented together within one chapter of an EIAR. However, for the purposes of clarity and a detailed assessment of each parameter, each topic is presented separately within this EIAR.

Each of the environmental aspect chapters have been prepared using the following headings:

- Introduction;
- Methodology;
- Existing Environment;
- Potential Impacts;
- Mitigation Measures (Chapter 17 provides a summary of the mitigation measures identified throughout the EIAR); and
- Residual Impacts.

Introduction

This section includes the background to the assessment.

Methodology

This section will describe the study methodology employed in carrying out the assessment.

Existing Environment

In describing the existing environment, an assessment is made of the context into which the proposed development will be located. This takes account of any other proposed and existing developments in the vicinity.

Potential Impacts

This section allows for a description of the specific direct, indirect and cumulative effects, which the proposed development may have. This is done with reference to the existing environment and characteristics of the proposed development, while also referring to the magnitude, duration, consequences and significance of the proposed development during the construction, operational and decommissioning phases.

Mitigation Measures

This includes a description of any remedial, or mitigation measures that are either practicable or reasonable having regard to the potential effects. It will also outline, where relevant, monitoring proposals to be carried out should consent be granted in order to demonstrate that the project in practice conforms to the predictions made.

Residual Impacts

This section will describe the degree of environmental change that will occur after the proposed mitigation measures have taken effect.

Volume III: Appendices

All supporting documentation and references, referred to in the EIAR (Volume II) are included in this volume (with the exception of photomontages).

1.8.2 Description of Likely Significant Effects

As stated in the "Draft Guidelines on the Information to be contained in Environmental Impact Assessment Reports' (EPA, August 2017), an assessment of the likely significant effects of a proposed development is a statutory requirement of the EIAR process. The criteria for the presentation of the characteristics of potential significant effects are described with reference to the magnitude, spatial extent, nature, complexity, probability, duration, frequency, reversibility, cumulative effect and transboundary nature (if applicable) of the effect.

The classification and description of effects in this EIAR follows the terms provided in Table 3.3 of the Draft EPA Guidelines referenced above (and duplicated in Table 1.1 below for information purposes).

According to the Guidelines, the relevant terms listed in the table below can be used to consistently describe specific effects but all categories of terms do not need to be used for every effect.

The use of standardised terms for the classification of effects ensures that the EIAR employs a systematic approach, which can be replicated across all disciplines covered in the EIAR. The consistent application of terminology throughout the EIAR facilitates the assessment of the proposed development on the receiving environment.

Table 1.1: Descriptions of Effects (as per Table 3.3 of the August 2017 Draft Guidelines on the information to be contained in Environmental Impact Assessment Reports).

Quality of Effects It is important to inform the non-specialist reader whether an effect is positive, negative or neutral	**Positive Effects** A change which improves the quality of the environment (for example, by increasing species diversity; or the improving reproductive capacity of an ecosystem, or by removing nuisances or improving amenities).
	Neutral Effects No effects or effects that are imperceptible, within normal bounds of variation or within the margin of forecasting error.
	Negative/adverse Effects A change which reduces the quality of the environment (for example, lessening species diversity or diminishing the reproductive capacity of an ecosystem; or damaging health or property or by causing nuisance).
Describing the Significance of Effects ''Significance' is a concept that can have different meanings for different topics – in the absence of specific definitions for different topics the following definitions may be useful (also see *Determining Significance* below.).	**Imperceptible** An effect capable of measurement but without significant consequences.
	Not significant An effect which causes noticeable changes in the character of the environment but without significant consequences.
	Slight Effects An effect which causes noticeable changes in the character of the environment without affecting its sensitivities.
	Moderate Effects An effect that alters the character of the environment in a manner that is consistent with existing and emerging baseline trends.
	Significant Effects An effect which, by its character, magnitude, duration or intensity alters a sensitive aspect of the environment.
	Very Significant An effect which, by its character, magnitude, duration or intensity significantly alters most of a sensitive aspect of the environment.
	Profound Effects An effect which obliterates sensitive characteristics
	Extent

Describing the Extent and Context of Effects Context can affect the perception of significance. It is important to establish if the effect is unique or, perhaps, commonly or increasingly experienced.	Describe the size of the area, the number of sites, and the proportion of a population affected by an effect.
	Context Describe whether the extent, duration, or frequency will conform or contrast with established (baseline) conditions (is it the biggest, longest effect ever?)
Describing the Probability of Effects Descriptions of effects should establish how likely it is that the predicted effects will occur – so that the CA can take a view of the balance of risk over advantage when making a decision.	**Likely Effects** The effects that can reasonably be expected to occur because of the planned project if all mitigation measures are properly implemented.
	Unlikely Effects The effects that can reasonably be expected not to occur because of the planned project if all mitigation measures are properly implemented.
Describing the Duration and Frequency of Effects 'Duration' is a concept that can have different meanings for different topics – in the absence of specific definitions for different topics the following definitions may be useful.	**Momentary Effects** Effects lasting from seconds to minutes
	Brief Effects Effects lasting less than a day
	Temporary Effects Effects lasting less than a year
	Short-term Effects Effects lasting one to seven years
	Medium-term Effects Effects lasting seven to fifteen years
	Long-term Effects Effects lasting fifteen to sixty years
	Permanent Effects Effects lasting over sixty years
	Reversible Effects Effects that can be undone, for example through remediation or restoration
	Frequency of Effects Describe how often the effect will occur. (once, rarely, occasionally, frequently, constantly – or hourly, daily, weekly, monthly, annually)

1.9 STUDY TEAM AND CONTRIBUTORS TO THE EIAR

TOBIN Consulting Engineers have been engaged by Bord na Móna to coordinate and prepare the EIAR for the proposed development. The relevant inputs of the various contributors and lead members of the Study Team are listed in Tables 1.2 and 1.3 below.

Table 1.2: List of Companies/Consultants Involved in the Preparation of the EIAR

Team	Inputs
TOBIN Consulting Engineers	Project Direction and Management, Scoping and Consultation, Preparation of EIAR, AA Screening, Natura Impact Statement, EIAR Sections: • Introduction • Description of Proposed Development • Reasonable Alternatives • Population and Human Health • Biodiversity • Lands, Soil and Geology, Site Investigations • Hydrology and Hydrogeology • Material Assets -Shadow Flicker • Air Quality and Climate • Interaction of the Foregoing
Bord na Móna	Reasonable Alternatives and Design
Stephen Dowds Associates	Policy, Planning and Development Context
Gavin & Doherty Geo Solutions	Lands, Soil and Geology, Site Investigations
Pager Power	Material Assets - Shadow Flicker Modelling/ Technical Assessment
AWN Consulting	Noise and Vibration
Compliance Engineering Ireland (CEI)	Material Assets -Telecommunications, Aviation and EMF
Macro Works	Landscape and Visual Impact
Through Time Ltd. (previously known as Arch Ltd.)	Archaeology and Cultural Heritage
Corporate Health Ireland	Human Health
Bat Eco. Services	Bat Analysis (Biodiversity)
Dr. Maria Long	Whorl Snail Survey (Biodiversity)

Team	Inputs
Tom Gittings, Independent Consultant	Collison Risk Modelling (Biodiversity)
Alan Lipscombe Traffic and Transport Consultants Ltd.	Traffic and Transport

Table 1.3: List of Key Personnel involved in the Preparation of the EIAR

Field of Expertise	Company	Contact Name	Qualifications	No. of Years Experience
Project Direction and Management, Scoping and Consultation, Preparation of EIAR, AA Screening, Natura Impact Statement, EIAR Sections: • Introduction • Description of Proposed Development • Reasonable Alternatives • Population and Human Health • Biodiversity • Lands, Soil and Geology, Site Investigations • Hydrology and Hydrogeology • Material Assets -Shadow Flicker • Air Quality and Climate • Interaction of the Foregoing	**TOBIN Consulting Engineers**	Damien Grehan	Honours Degree in Engineering (1992), UCD Masters' Degree in Engineering Science (1994), UCD Chartered Engineer	24
	TOBIN Consulting Engineers	Siobhán Tinnelly	Postgraduate Diploma in Management, Irish Management Institute (IMI), 2017 MSc. Applied Hydrogeology, University of Newcastle-upon-Tyne, 2013 Post Graduate Diploma in Environmental Engineering, Trinity College Dublin, 2004 B.A. (Mod) Natural Sciences (Env. Science), Trinity College Dublin, 1996-2000 Professional Geologists, P.Geo. Institute of Geologists of Ireland (IGI)	18
	TOBIN Consulting Engineers	Allison Austin	B.A Geography (University of Liverpool, 2003) M.Sc Environmental Resource Management (University College Dublin, 2004) Post Grad. Cert. in Biological Recording and Species Identification (University of Birmingham, 2008) Certificate in Renewable Energy (Dundalk IT, 2012)	10

	TOBIN Consulting Engineers	Padraig Cregg	B.Sc Zoology (National University of Ireland, Galway, 2007) M.Sc Evolutionary and Behavioural Ecology (University of Exeter, 2008)	10
	TOBIN Consulting Engineers	Laura Kennedy	B.Sc., Zoology (University College Cork) M.Sc., Environmental Science (Trinity College Dublin)	8
	TOBIN Consulting Engineers	John Dillon	BSc in Environmental Science (2001), NUIG MSc and Diploma in Environmental Engineering (2003), Imperial College London Professional Geologist (PGeo)	15
	TOBIN Consulting Engineers	Robert Hunt	BEng (Hons) in Civil Engineering MSc in Environmental Engineering Associate Certificate in Environmental Management	8
	TOBIN Consulting Engineers	Michael Nolan	City & Guilds in Computer Aided Design, Griffith College Dublin 2001	15
	TOBIN Consulting Engineers	Fergal Healy	MSc in Resource Management and Sustainability, National University of Ireland, Galway/University of Limerick, 2016 B.A in History and Geography, National University of Ireland, Galway, 2011 CPD Cert (10 ECTS Credits) in Geographical Information Systems, Dublin Institute of Technology	2

Planning	**Stephen Dowds Associates**	Stephen Dowds	BA in Geography, Trinity College Dublin MRUP in Urban Planning, UCD Member of Irish Planning Institute (MIPI)	36
Lands, Soil and Geology, Site Investigations	**Gavin and Doherty Geo Solutions**	Paul Quigley	BEng (Hons) in Civil Engineering Chartered Engineer with 20 years' experience in civil engineering and is a UK Registered Ground Engineering Adviser.	20
		Laura Burke	BEng - Civil Engineering (NUI Galway) MSc Engineering Geology and DIC (Diploma Imperial College) (Imperial College London) MIEI and CEng (Chartered Engineer) Engineers Ireland	7
Material Assets -Shadow Flicker (Modelling/Technical Assessment)	**Pager Power**	Kai Frolic	MPhys, first class honours, University of Surrey (2008). Member of the Institute of Physics (MIsntP)	10
Noise and Vibration	**AWN Consulting**	Dermot Blunnie	BEng (Hons) Sound Engineering (University of South Wales, 2007), Post Graduate Diploma Acoustics and Noise Control (Institute of Acoustics, 2010), MSc Applied Acoustics (University of Derby, 2013)	10
Material Assets - Telecommunications, Aviation and EMF	**Compliance Engineering Ireland (CEI)**	Seamus O' Leary	BE (Electronic), C.Dip.AF, C.Eng. FIEI Chartered Engineer and Fellow of Engineers Ireland.	28

Landscape and Visual Impact	**Macro Works**	Richard Barker	Principal Landscape Architect at Macro Works Ltd. Masters Degree in Landscape Architecture (2003), Post Graduate Diploma in Forestry (1996), BA Environmental Studies (1995), Corporate Member of the Irish Landscape Institute	20
Archaeology and Cultural Heritage	**Through Time Ltd.**	Fiona Rooney	Bachelor of Arts degree in Archaeology and Geography, University College Cork.	20
		Martin Fitzpatrick	Bachelor of Arts degree in Archaeology and History, National University of Ireland, Galway Master of Arts degree in Archaeology, National University of Ireland, Galway	20
Human Health	**Corporate Health Ireland**	Dr. Martin Hogan	MB BCh UCC 1987 FFOM RCPI 2000 (Fellow of the Faculty of Occupational Medicine) FRCPI RCPI 2008 (Fellow of the Royal College of Physicians of Ireland)	31
Bat Analysis (Biodiversity)	**Bat Eco. Services**	Dr. Tina Aughney	Doctorate of Philosophy in Environmental Science Bachelor of Science 2.1 honours degree in Environmental Science	18
Collison Risk Modelling (Biodiversity)	**Independent Consultant**	Dr. Tom Gittings	BSc Ecology, University of East Anglia 1988 PhD Zoology, University College Cork 1994	23

Whorl Snail (Vertigo sp.) Survey	**Independent Consultant**	Dr. Maria P. Long	BSc (Zoology) University College Cork (1999) MSc (Ecosystem Conservation and Landscape Management) NUI Galway (2001) PhD (Ecology) Trinity College Dublin (2011)	18
Traffic and Transport	**Alan Lipscombe Traffic and Transport Consultants Ltd.**	Alan Lipscombe	BEng Hons in Transportation Engineering, Napier University, Edinburgh, 1989	29

1.10 SCOPING AND CONSULTATION

1.10.1 Consultation with Planning Authorities during 2016, 2017 and 2018

The scoping and statutory consultation process undertaken as part of the EIAR for the proposed development was carried out in accordance with the aforementioned EPA Guidelines in addition to the Department of Environment Heritage and Local Government's Wind Energy Development Guidelines (2006) and IWEA Best Practice Guidelines (2012).

Bord na Móna and TOBIN Consulting Engineers met with the following Planning Authorities on the dates below to discuss the scope of the application for planning permission:

- Pre-planning SID meeting with An Bord Pleanála: 17/11/16;
- Pre-planning meeting with Longford County Council 29/11/16;
- Pre-planning meeting with Roscommon County Council 19/01/17;
- Pre-planning meeting with Longford County Council (No. 2): 23/05/17;
- Pre-planning SID meeting with An Bord Pleanála (No. 2): 29/05/17;
- Pre-planning meeting with Longford County Council (No. 3): 14/03/18; and
- Pre-planning SID meeting with An Bord Pleanála (No. 3): 17/05/18.

All comments from each of the Planning Authorities have been taken into consideration in the preparation of this EIAR.

A "Scoping Report" was prepared in August 2016 and submitted to the bodies listed in Table 1.4 below in September 2016, for review and comment. This report was accompanied by a Consultation Cover Letter introducing the project and the project team. The Scoping Report and correspondence is included in Appendix 1.2. Further consultation documentation was issued in April 2017 and April 2018. This consultation documentation reflected changes to the number and location of turbines. This documentation is included in Appendix 1.1.

1.10.2 Traffic and Transport Consultation

Longford County Council

TOBIN team attended initial meetings with Longford County Council on the 29th of May 2016 with a second consultation meeting on the 23rd of May 2017 with a representative from the Longford County Council Roads Department. The TOBIN traffic and transport specialist scoped the project with the Longford County Council Roads Engineer in April and May of 2017. Traffic count locations, proposed junction visibilities and locations were clarified with Longford County Council. Ongoing liaison with Longford County Council continued in June 2017. An update meeting was held in March 2018.

Roscommon County Council

A meeting took place between Roscommon County Council and TOBIN representatives on the 19th of January 2017 to discuss the haul routes. Roscommon County Council stated that they had no objections to the drawings of the haul of the abnormal loads (i.e. turbine blades).

The traffic and transport specialist from TOBIN spoke to a representative from Roscommon County Council (phone call on the 22nd of February 2017). TOBIN were advised that the team should engage with the Motorway Maintenance Contractors, Colas Roadbridge.

Westmeath County Council

The TOBIN traffic and transport specialist consulted with the Westmeath Area Engineer on the 22nd of February 2017. The project and the proposed haul route were outlined to the Westmeath Area Engineer. It was recommended to contact Colas Roadbridge, the Motorway Maintenance Contractors.

Other Consultation

On advisement from Roscommon and Westmeath County Councils, TOBIN liaised with Motorway Maintenance Contractors, Colas Roadbridge, in relation to the haul of abnormal loads at the N6/N63 Junction. Liaison between TOBIN and Colas Roadbridge was undertaken in February and July 2017. A request for a preliminary advanced works report to facilitate the abnormal loads on the haul route was requested. The Colas “Advanced Works Report” was issued on the 29th of June 2017 (Appendix 14.1).

A letter was issued from TOBIN to TII on the 8th of September 2016 in regard to the EIS Scoping relating to the proposed Derryadd Wind Farm. A response was received from TII on the 14th of October 2016. Please refer to Table 1.4 below for response.

1.10.3 Environmental Consultation (to inform the EIAR) undertaken between 2016-2018

Table 1.4 below summarises the consultation undertaken during 2016-2018 in the preparation of this EIAR.

Table 1.4: Summary of the EIAR Pre-Planning Consultation undertaken during 2016-2018 for Derryadd Wind Farm

Department	Date of Consultation Correspondence	Date of Response	Response Points (Includes direct quotations from correspondence received)	Comment/Response to issue raised
Dept of Arts, Heritage, Regional, Rural and Gaeltacht Affairs **Contact:** Michael Murphy	8th September 2016	14th October 2016	• Outlined below are the nature conservation recommendations of The National Parks & Wildlife Service (NPWS) of the Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs. It is noted that the location of the proposed development (*wind farm*) is situated in a location likely to impact on protected species and habitats. E.g.: Breeding Curlew, Buzzard, Cuck coo Woodpeckers, Hen Harrier, Barn Owl Vertigo snail and Pine Marten • The Department considers that the information submitted does not allay concerns in relation to the location of the wind turbines within the large area outlined on the map provided. In principle there are no objections to the development, but the exact locations of each turbine would need to be addressed to avoid areas of conservation interest. I.e. areas of intact hedgerows, mature trees, foraging areas, streams, fens, cut-over bog, intact bog remnants. This information would allow a full assessment of the impact of the turbines in this area. • Therefore, it is not possible to adequately assess the impact of the proposed development accordingly, prior to making any decision; it is recommended that the applicant be requested to provide additional information to address the concerns outlined above.	On the 7th of June 2018 Tobin Consulting Engineers and Bord na Móna staff met with Susan Moles, NPWS Conservation Ranger for County Longford. The consultation meeting provided NPWS with the opportunity to raise any concerns that they may have relating to the proposed development, to discuss the survey approach and to provide data/ local knowledge that would facilitate a better assessment of potential impacts of the proposed development on flora and fauna locally. Further details can be found in Chapter 6, Biodiversity, Section 6.2.2 (Table 6.1)
	27th April 2017	April/May 2017	• No further comments on updates sent	
	9/10th April 2018	April 2018	• No further comments on updates sent	

Dept of Agriculture Food and Marine **Contact:** Liz McDonnell	8th September 2016	28th September 2016	• Any damage to landscape features during construction phase should be repaired to retain ecological value. • When upgrading drainage systems, it is important that the study takes into account potential impact on neighbouring agricultural lands.	Recommendations from the Dept. of Agriculture, Food and Marine were incorporated into the mitigation measures included in Chapter 6, Biodiversity, Section 6.5.
	27th April 2017	April 2017	• No further comments on updates sent	
	9/10th April 2018	April 2018	• No further comments on updates sent	
Fáilte Ireland **Contact:** Yvonne Jackson	8th September 2016	26th September 2016	**Predicted impact:** • Describe the location, type, significance, magnitude/extent of the tourism activities or assets that are likely to be affected. • Describe how the new development will affect the balance between long-established and new dwellers in an area and its effect on the cultural or linguistic distinctiveness of an area. • Describe how changes in patterns of employment, land use and economic activity arising from the proposed development will affect tourism, for example, illustrating how a new industrial development will diversify local employment opportunities thereby reducing the area's unsustainable over-reliance on seasonal tourism. • Describe the consequences of change, referring to indirect, secondary and cumulative impacts on tourism; Examples can include describing how the new development may lead to a reduced assimilative capacity for traffic or water during the peak of the tourism season or how new urbanism combined with existing patterns of tourism may lead to unsustainable levels of pedestrian traffic through a sensitive habitat. • Describe the potential for interaction between changes induced in tourism and other uses that may affect the environment – for instance increasing new tourism-related housing affecting water resources or structures. • Describe the worst case for tourism if all mitigation measures fail.	Section 5.2 of the EIAR focuses on Population including the current land use of the development site and the activities occurring there, population, employment, tourism, visitor attractions and activities and the community gain. Sections 5.2.2.4 and 5.2.2.5 detail current tourism, visitor attractions and amenities. The predicted effects, including on tourism, are considered in section 5.2.3 of the EIAR. No specific mitigation measures in relation to tourism are required as the predicted effects are expected to be positive. The potential effects of other environmental aspects associated with the proposed development which may be human related such as Water (Chapter 8) and Traffic (Chapter 14) are discussed in the relevant chapters of the EIAR.
	27th April 2017	April 2017	• No comments received on update.	

	9/10th April 2018	April 2018	• Acknowledged receipt of update by phone, no comments received to date.	
Department of Communications, Climate action & Environment/ Geological Survey Ireland Contact: Sophie Préteseille	8th September 2016	27th September 2016	**Datasets and viewers** • Soils & Geology, Geotechnics and Ground Stability" and "Hydrology, Hydrogeology and Water Quality" chapters, maps and datasets are currently available for viewing and/or download on the Geological Survey website under "Online Mapping"- direct link: www.gsi.ie/mapping.htm with the "Spatial Resources Viewer": http://dcenr.maps.arcgis.com/apps/MapSeries/?appid=a30af518e87a4c0ab2fbde2aaac3c228 • Datasets (bedrock, karst, groundwater vulnerability, wells, boreholes, etc.) can be downloaded from: http://www.dccae.gov.ie/natural-resources/en-ie/Geological-Survey-of-Ireland/Pages/Data-Downloads.aspx **Specific Data** • The "Groundwater Wells" dataset is available from the above-mentioned download site. There are no well data within the perimeter of the proposed wind farm, but a few exist on the edge. • Concerning County Geological Sites (CGS), the audit of geological heritage sites for Co. Longford was carried out in 2015 and the shapefile can be downloaded from the Geological Survey website at: http://www.gsi.ie/Programmes/Heritage+and+Planning/County+Geological+Sites+Audits/Longford.htm There is currently no CGS within the perimeter of the proposed wind farm. The closest CGS is the "Corlea Trackway" that was discovered during the peat extraction phase by Bord na Móna, and now with a visitor centre. The CGS description is attached and the site is not recommended for NHA designation. Due to the nature, history and location of the site, no impact is anticipated from the proposed wind farm development on the CGS. • There are no landslide records within the perimeter of the proposed wind farm. Please note that the dedicated viewer	As recommended by the Geological Survey Ireland, we confirm that bedrock, karst and boreholes information and also information on soils, subsoils and minerals, was obtained from Geological Survey of Ireland (GSI) datasets (see section 7.2.3, 7.3.2 to 7.3.10 and figures 7.2 to 7.9) Wells and vulnerability have been considered. Please see Chapter 8, Section 8.3. We confirm that the database has been considered - Corlea track is referred to in 7.3.6 and shown on Figures 7.6 and 7.7 We confirm that Landslides database is considered and data from it is referred to in 7.3.12 and on Figures 7.10 and 7.11. See section 7.3.15 – we note some data obtained from the site investigation but consider it is not particularly conclusive *"Some joints in the limestone bedrock have been described as open (0.5 to 2.5 mm wide) and moderately wide (10 - 100 mm wide) indicating some minor dissolution at*

			http://spatial.dcenr.gov.ie/GeologicalSurvey/LandslidesViewer/index.html is being upgraded and should be live in the autumn. • As the Geological Survey karst dataset is far from comprehensive due to important data gaps, we would welcome complementary data collected during the EIA; data which would be added to the national database. • At a later stage, we would much appreciate a copy of reports detailing any site investigations carried out. The data would be added to the Geological Survey national database of site investigation boreholes, implemented to provide a better service to the civil engineering sector. Data can be sent to Beatriz Mozo, Land Mapping Unit, at beatriz.mozo@gsi.ie, 01-678 2795.	*joints. The drilling did not encounter any significant karstic features such as voids*." The applicant is willing to share site investigation data with the Geological Survey.
	27th April 2017		• Email response 19th May 2017. No additional comments to be made to those in September 2016.	
	9/10th April 2018		• No additional comment.	
Irish Peatland Conservation Council **Contact:** Tadhg Ó Corcora	8th September 2016	3rd October 2016	• The proposed development site is made up principally of cutaway bog habitat. Irish Peatland Conservation Council are aware that will be a number of intact remnants where cutting and in fact drainage will not have occurred. These must be properly assessed and screened out for any adverse impacts that may occur during the construction of the wind turbines and critically of all associated works such as roads and drainage networks. A detailed map of such remnants within the site in the context of turbine and associate works location to be included in the final EIS in order for these to be independently assessed. **Lough Bawn pNHA** • Your document notes the presence of Lough Bawn pNHA within the southern boundary. IPCC liaised with Bord na Móna who provided a map detailing the location of the pNHA in relation to the proposed development area. This site must be given careful consideration as it is known from its site synopsis to be a small and fragile site. The proposed development should not result in any degradation to this protected site. In fact, as the	All recommendations and comments from the Irish Peatland Conservation Council were considered in the preparation of the EIAR. In particular, the recommendations have been incorporated into Section 6.5 of Chapter 6, Biodiversity and also Chapter 7 Lands, Soil and Geology. Peat stability is considered in Chapter 7 Land, Soils and Geology. Water Quality is addressed in Chapter 8 Hydrology and Hydrogeology. Interconnectivity between hydrogeological, hydrological and ecological features have been considered in Chapters 6, 7 and 8 (Hydrology and Hydrogeology) of this EIAR.

			development of a wind farm effectively constitutes the production of an after-use rehabilitation plan for the site conservation works should be considered which will aid in the preservation of the pNHA and boost its conservation status, a goal of the National Peatlands Strategy and imperative to Ireland's commitments to conserve peatland habitat. **Lough Bannow pNHA** • Lough Bannow pNHA supports a variety of habitats, as noted to include open water, swamp and reed fringe. These habitats are particularly sensitive to any change in water quality and run off from such a significant development poses a threat. All precautions must be met to ensure no degradation occurs on the site as a result of this development. **Lough Ree SAC** • Your scoping document recognises the fact that Lough Ree SAC/SPA is approximately 540m away from the site. IPCC would like for the EIS to assess any potential watercourses linking the proposed development site to Lough Ree SAC which could be adversely affected by any change in water quality that might result from large scale construction. We would also highlight that in the addition to the birds referenced as qualifying interests for Lough Ree SPA the SAC site synopsis lists large number of curlew (178) which were overwintering on the site. Given the curlew is a species under significant threat in Ireland and some of these birds are likely native breeders these need to be properly assessed and the adequate set back distances put in place.	Potential impacts on archaeological features have been considered in detail in Chapter 15, Cultural Heritage. All recommendations and comments from the Irish Peatland Conservation Council were considered in the preparation of the EIAR. In particular, the recommendations have been incorporated into Section 6.5 of Chapter 6, Biodiversity and also Chapter 7 Lands, Soil and Geology. Significant bird surveys have been carried out in the area of the proposed development and are detailed in Appendix 6 of the EIAR. Interconnectivity between hydrogeological, hydrological and ecological features have been considered in Chapters 6, 7 and 8 (Hydrology and Hydrogeology) of this EIAR.
	27th April 2017	16th May 2017	• The IPCC are not inherently opposed to the construction of wind farms. We acknowledge Ireland's need to change from using poisonous fossil fuels to a fully sustainable energy network, but, any proposed development should only be given planning permission subject to a stringent desire to do the construction works and after-use rehabilitation and monitoring using ecologically safe and sound scientific methods and best practice.	

			Intact Raised Bog Habitat: • Through a desktop study, the IPCC have identified a number of intact raised bog remnants that we would be very concerned about both within and on the boundary of the wind farm. Ireland has an international obligation to protect ANNEX I habitats under the Habitats Directive transposed into Irish law in 1997 of which raised bog is a priority. **Within the Boundary:** • Lough Bawn pNHA is located at Grid Reference N 10300 64000. This is an internationally important site that is within the boundary of the proposed wind farm. The IPCC would like to point out that this site is known to be sensitive and has already suffered from a reduced water level. As this is a designated site it is imperative that it must be protected from development, drainage and nutrient enrichment. Conservation management of this area should be a priority and any development given planning permission must also deliver a rehabilitation plan. This is an opportunity to boost Ireland's conservation status which is a vitally important goal of the National Peatlands Strategy. • At Grid Reference N 02695 71489 there is raised bog remnant which needs to be assessed for potential damage arising from drainage and other detrimental effects caused by construction and improper or non-existent after-use rehabilitation. This area must have an eco-hydrological survey undertaken as it contains ANNEX I habitats (7110 and 7120). These are priority habitats and if left to degrade would work against Ireland and our aim for sustainable energy production. This would be a wise use of degraded peatlands and would increase Ireland's peatland conservation status. **Outside the Boundary:** • Clontamore Bog (Grid Ref. N 08039 65995), while on the perimeter of the proposed site, should be examined and	Potential impacts on archaeological features have been considered in detail in Chapter 15, Cultural Heritage. All recommendations and comments from the Irish Peatland Conservation Council were considered in the preparation of the EIAR. In particular, the recommendations have been incorporated into Section 6.5 of Chapter 6, Biodiversity and also Chapter 7 Lands, Soil and Geology.

			have a management plan initiated. The road (R398) may be used during the construction phase and the increased traffic may cause subsidence and pollution. The IPCC would also like to know if there will be peat stability and hydrology tests carried out to ensure that any problems will be foreseen prior to construction relating to this remnant. I would also like to point out that Wetland Surveys Ireland has not yet conducted a survey for this site and this should be completed before any construction is underway by the developer.	A project specific Peat Management Plan and a Peat Stability Risk Assessment Report has been prepared for the project and are included in Appendix 7.3 and 7.4 of the EIAR.
			• Lehery Bog (Grid Ref. N 07887 65369) is an intact raised bog remnant that has been earmarked for a habitat survey by Wetland Surveys Ireland, which has not yet been conducted. The IPCC would like this to be carried out by the developer before any construction works to ensure that any habitats important nationally and internationally are properly recorded and taken into account alongside peat stability and hydrology studies. This is to ensure that this remnant is not destroyed during construction and any possible after effects arising from the construction are properly mitigated.	
			• At Grid References N 07182 65965 and N 05219 70174 there are remnants of raised bogs which may be affected by the construction of Wind Turbine No. 20 and 11 respectively. The IPCC would like these areas to be studied for possible issues regarding peat stability and hydrology. If these remnants are destroyed or drained it could become a carbon source rather than a carbon sink. We would like to know what management procedures will be incorporated into the development to ensure that these habitats, which are outside the boundary of the proposed wind farm, will not be destroyed.	All recommendations and comments from the Irish Peatland Conservation Council were considered in the preparation of the EIAR. In particular, the recommendations have been incorporated into Section 6.5 of Chapter 6, Biodiversity and also Chapter 7 Lands, Soil and Geology. A project specific Peat Management Plan and a Peat Stability Risk Assessment
			• Ballynakill South is a wetland area located at Grid Reference	

			N 04492 72136. This has not yet been surveyed by Wetland Surveys Ireland and is very close to Turbine No. 6. The IPCC would like a habitat survey to be undertaken by the developer along with peat stability and hydrology tests both in the site and within the wind farm boundary. This is to ensure that the proposed wind farm development will not adversely affect any national or internationally important species and habitats. • In relation to turbines 6, 11 and 20 IPCC suggest these should be excluded from the proposed developed due to their proximity of raised bog habitat and its associated habitat and avifauna. • Corlea Bog (Grid Ref. N 10220 62657) is a nationally important peatland habitat that has had rehabilitation measures put in place to rewet and preserve archaeological information and internationally important habitat. The IPCC would like to know what management techniques the proposed Derryadd wind farm will use to ensure that this important site does not suffer any detrimental effects from the construction of the turbines and/or drainage of the surrounding area. As this is a tourist attraction, there is also the visual impact on this unique site. **Archaeology** • Peatlands in Ireland hold a great deal of cultural and ancestral history, preserved in the anaerobic conditions. The proposed Derryadd Wind Farm boundary contains up to 100 recorded National Monuments. Ireland has international obligations under the European Convention on the Protection of the Archaeological Heritage, ratified by Ireland in 1997. Article 1 of this convention states that Ireland must “protect the archaeological heritage as a source of the European collective memory and as an instrument for historical and scientific study”. The IPCC would like to know if	Report has been prepared for the project and are included in Appendix 7.3 and 7.4 of the EIAR. Interconnectivity between hydrogeological, hydrological and ecological features have been considered in Chapters 6, 7 and 8 (Hydrology and Hydrogeology) of this EIAR. Potential impacts on archaeological features have been considered in detail in Chapter 15, Cultural Heritage.

			there will be scientific supervision from an independent body that will evaluate the proposed wind farm area for its archaeological importance. The IPCC could not support the development before a full archaeological survey is undertaken and the necessary precautions and mitigations are in place to ensure that no loss of archaeological information and cultural history happens. We are particularly concerned about the proximity of Turbines No's 9, 14 and 22 to National Monuments and suggest these be omitted from the proposal in the interests of protecting the complex archaeological heritage of the site. In relation to best practice, we need clarification as to whether the methods being used to conserve the Corlea Iron Age Trackway - rewetting - will be used to protect the significant archaeology of this site. **Water Framework Directive Status of Rivers** • In accordance with the Water Framework Directive, Ireland's rivers, lakes, groundwater and coastal regions must be scientifically deemed to be of "good ecological status". Notably in the area of the proposed wind farm the Kilnacarrow. Further correspondence to clarify how these matters will be assessed in the planning application has been acknowledged.	
	9/10th April 2018	April 2018	• No comments received on update	
Longford County Council **Contact:** Louise Kiernan	8th September 2016	14th October 2016	• Section 4.5 Tourism and Annex 6 of the Longford County Development Plan 2015-2021 in relation to the potential impact on the Mid-Shannon Wilderness Park. • Section 6.1.1 Landscape Character Assessment., Section 5.5.2 Renewable Energy Sources., 5.5.2.1 Wind Energy. • In particular attention is drawn to WD4 and the need to consider the application in terms of visual impact, predicted noise levels, design, impact of associated site works, construction, proximity to dwellings, interference with	All recommendations and comments from Longford County Council (based on correspondence and/or meetings with the project team) were considered in the preparation of this EIAR. A number of meetings took place with Longford County Council, as detailed in Section 1.10 above. All recommendations

			navigation, television and communication signals (in this regard proximity to Abbeyshrule Airstrip should be considered), impact on environmental designations, decommissioning, sensitivity of locations of folklore, mythology and religious significance, location relative to water bodies, future extension proposals. • In addition to the aforementioned the cumulative impact of the proposed development in conjunction with existing, permitted or future planned windfarms should be considered. This should also consider the transboundary impact in different local authority areas. • Wind Energy – Guidelines for Planning Authorities (DoEHLG) or any relevant updates. • Appendix 5 – Areas of Wind potential. • Reference to the relevant sections in relation to the Midland Regional Planning Guidelines in terms of peatland areas and renewable energy. • In terms of the field studies to be conducted, care should be taken that these are in the appropriate ecological season. • Any visual impact assessment should take account of the varying seasons and associated foliage changes. • Phone call from Planner Donal Murtagh on 4th October 2016 to inform us that the Mid-Shannon Wilderness Park should be included in our considerations. This project neither includes nor excludes a Wind Farm but can be incorporated into any development on the Bog.	provided to the proposed development project team were noted during these meetings and incorporated into the project design and environmental assessment. The Longford County Development Plan was consulted, and the project was designed with consideration for the objectives of the plan. All surveys were undertaken, where possible, in the appropriate ecological season. Bord na Móna are currently working with local communities and authorities regarding the development of the Corlea Archaeological and Biodiversity Project and the Mid Shannon Wilderness Park. *"As Bord na Móna completes its rehabilitation work on the bogs it may be possible for existing local communities, and Longford County Council to take responsibility for portions of the cutaway bogs. This will not conflict with any future intention of Bord na Móna and its potential future use of the bogs. The amenity use of the rehabilitated bogs can be compatible with any future use for the bogs such as renewable energy*
Contact: Rita Connaughton	27th April 2017	May 2017	• The Longford County Development Plan Annex 6 introduces a proposal to develop a Mid Shannon Wilderness Park. The Mid Shannon Wilderness Park covers a large area of land from Lough Ree through to the Royal Canal and includes the Rivers Shannon, Inny and Camlin. Some work in realising this is about to commence on the site of the Corlea track way and its subsequent connection to the Royal Canal. The proposed wind farm is set wholly within this proposed Mid Shannon Wilderness Park and to the North of the Corlea project. As such all proposed developments must be cognisant of the policies and objectives relating to the Mid Shannon Wilderness Park.	

			• Section 5.5.2 deals with Renewable Energy Sources and as such the policy therein should form part of the early planning consultation process. • Section 5.5.2.1 deals specifically with Wind Energy within a Longford context and contains four specific policies. They are as follows ▪ WD 1: Developments for wind farms will be encouraged to locate in those areas identified as having wind potential within the County, as defined on the Map contained in Appendix 5. ▪ WD 2: Proposals for large scale industrial wind farm developments shall be directed to areas of cutaway bogs subject to the following; 1. Dependent on the completion of an investigation demonstrating suitability of the areas, 2. The preparation of revised Wind Energy Development Guidelines and the Renewable Energy Export Policy and Development Framework 3. Compliance with the necessary environmental assessments ▪ WD4: In assessing an application for a wind farm the following shall be taken into consideration: - ▪ <u>Visual impact</u> - Both on site and over extensive areas. Applications may be required to include photo or video montages - taken from a variety of locations after discussion with the Planning Authority. Site cross sections showing existing and proposed ground levels in relation to all structures on site are required.	*projects"*[1] such as the proposed Derryadd Wind Farm. The Longford County Development Plan was consulted and the project was designed with consideration for the objectives of the plan. All recommendations and comments from Longford County Council (based on correspondence and/or meetings with the

[1] Longford County Development Plan, 2015-2021

			Ideally, they should be sited against a backdrop of a hill or elevated area. Non-linear type layouts are favourable. Windfarms should not be intervisible from one another. ▪ <u>Predicted Noise Levels</u> - Developments must ensure that noise levels will not be intrusive in relation to background noise at the nearest dwelling. Blades, of single speed must rotate in the same direction. Monitoring noise levels at selected locations generally for the first year of operation of the wind farm will be a condition of planning permission. Manufacturer's certification of noise emissions will be required at application stage. ▪ <u>Design</u> - Solid towers should be used throughout the windfarm, which should be of the same height and colour. Advertising material including the manufacturer's name or logo will not be permitted on the wind turbine. ▪ <u>Impact of associated site works</u> - Including access roads, substations, grid connections, fencing etc. Details of proposed grid connections are required at application stage. Consideration should be given to the potential landscape impacts in the context of grid connections taking into account technical feasibility and economic viability, particularly in environmentally sensitive locations. Access roads shall be un-surfaced and follow natural contours of the site. Fencing will not be permitted on any part of the site except normal livestock fencing when the land is part of an operating agricultural holding. ▪ <u>Construction</u> - A detailed phased programme for the construction together with estimates of traffic generation is required at application stage. Consideration will be given to the potential damage to	project team) were considered in the preparation of this EIAR. The Longford County Development Plan was also consulted and the project was designed and assessed with consideration for the objectives of the plan.

			roads during the construction phase. In some cases, access routes may be restricted by planning condition. ▪ Proximity to Dwellings - Wind turbines should generally not be located within 500m of any dwelling, but this may vary from site to site. ▪ Interference with navigation, television and communication signals – A communications booster may also be required or some other technical solution. Air and sea navigation authorities may be consulted for their comments on proposed wind farm developments. ▪ Impact on Environmental Designations - Amenity areas, Sensitive landscapes, views and prospects, Designated Tourist Areas, Natural Heritage Areas, Special Protection Areas, Special Areas of Conservation, Archaeological site, biodiversity, protected structures, national monuments etc. Wind farm developments should not be located within 100 metres of ancient monuments. The impact on migratory birds, in particular, will be assessed in consultation with the Irish Wildbird Conservancy (BirdWatch Ireland). ▪ Decommissioning - Proposals for restoration of the site after removal of the turbines should be included with an application. Adequate financial security will be required by planning condition. ▪ Sensitivity of locations of folklore, mythology and religious significance to these developments - Evidence of consultation with local community groups is an important element of planning for such a project. Developers will also be required to assess their proposals for the impact of shadow flicker on	All recommendations and comments from Longford County Council (based on correspondence and/or meetings with the project team) were considered in the preparation of this EIAR. The Longford County Development Plan was also consulted and the project was designed and assessed with consideration for the objectives of the plan.

			dwellings and this information should accompany the planning application. ▪ Location relative to water bodies - Wind farm developments should not be located within 150m of lakes or rivers. • Applicants are advised to outline future extension proposals if known. It should be noted that temporary permissions for an anemometer is without prejudice to any subsequent application for a wind farm. Where appropriate, the Planning Authority may request additional information in determining an application for a wind farm development, including detailed information similar to that required as part of an Environmental Impact Assessment (EIA). • Section 6 of the Development Plan deals with Environment, Heritage and Amenities • The whole chapter is important and refers to conservation and protection of the environment, green infrastructure, landscape character assessment, water quality, protection of archaeological, natural and built heritage and natural and recreational amenities, particular regard should be had to Section 6.2.2.7 Inland Lakes and Waterways and the Policies ILW1 to ILW17 relating to the protection of Longford's Inland Waterways. • The Local Economic and Community Plan ▪ The LECP should also be taken into consideration in relation to the economic and community development of the County.	All recommendations and comments from Longford County Council (based on correspondence and/or meetings with the project team) were considered in the preparation of this EIAR. The Longford County Development Plan was also consulted and the project was designed and assessed with consideration for the objectives of the plan.
		March 2018	• A further project update meeting was held with Longford County Council Planners.	

	9/10th April 2018	April 2018	• No response to date.	
Transport Infrastructure Ireland **Contact:** Michael McCormack	8th September 2016	14th October 2016	• Transport Infrastructure Ireland (TII) wishes to advise that it is not in a position to engage directly with planning applicants in respect to proposed developments. TII will endeavour to consider and respond to planning applications referred to it given its status and duties as a statutory consultee under the Planning Acts. The approach to be adopted by TII in making such submissions or comments will seek to uphold official policy and guidelines as outlined in the Spatial Planning and National Roads Guidelines for Planning Authorities [Department of Environment, Community & Local Government, 2012 (DoECLG)]. Regard should also be had to other relevant guidance available at www.TII.ie. • The Authority notes the proposed site extents extend to the north and south of the N63, national secondary road, at a location on the network that is subject to a general l00kph speed limit. In such circumstances, the developer/applicant should be aware that official policy concerning access to national roads seeks to avoid the creation of additional access points from new development or the generation of increased traffic from existing accesses (i.e. non-public road access) to national roads, to which speed limits greater than 50kph apply. The developer should have regard, *inter alia,* to the following; • Consultations should be had with the relevant Local Authority/Roads Design Office with regard to locations of existing and future national road schemes; • TII would be specifically concerned as to potential significant impacts the development would have on the national road network (and junctions with national roads) in the proximity of the proposed development, i.e. N63; • The developer should assess visual impacts from existing national roads; • The developer should have regard to any Environmental Impact Statement and all conditions and/or modifications	All recommendations and comments from Transport Infrastructure Ireland were considered in the preparation of this EIAR. In particular, the recommendations are incorporated into Chapter 14, Traffic and Transport. A number of meetings took place with the relevant authorities, as detailed in Section 1.10.2 above. All recommendations provided to the proposed development project team were noted during these meetings and incorporated into the project design and environmental assessment.

			imposed by An Bord Pleanála regarding road schemes in the area. The developer should in particular have regard to any potential cumulative impacts; • The developer, in conducting Environmental Impact Assessment, should have regard to TII Publications; • The developer, in conducting Environmental Impact Assessment, should have regard to TII's Environmental Assessment and Construction Guidelines, including the *Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes* (National Roads Authority, 2006); • The EIS should consider the Environmental Noise Regulations 2006 (51 140 of 2006) and, in particular, how the development will affect future action plans by the relevant competent authority. The developer may need to consider the incorporation of noise barriers to reduce noise impacts (see *Guidelines for the Treatment of Noise and Vibration in National Road Schemes* (Pt Rev., National Roads Authority, 2004)); • It would be important that, where appropriate, subject to meeting the appropriate thresholds and criteria and having regard to best practice, a Traffic and Transport Assessment be carried out in accordance with relevant guidelines, noting traffic volumes attending the site and traffic routes to/from the site with reference to impacts on the national road network and junctions of lower category roads with national roads. The Authority's Traffic and Transport Assessment Guidelines (2014) should be referred to in relation to proposed development with potential impacts on the national road network. The scheme promoter is also advised to have regard to Section 2.2 of the TII TIA Guidelines which addresses requirements for sub-threshold TIA; • The designers are asked to consult TII Publications to determine whether a Road Safety Audit is required; • In the interests of maintaining the safety and standard of the national road network, the EIS should identify the	All recommendations and comments from Transport Infrastructure Ireland were considered in the preparation of this EIAR. In particular, the recommendations are incorporated into Chapter 14, Traffic and Transport. A number of meetings took place with the relevant authorities, as detailed in Section 1.10.2 above. All recommendations provided to the proposed development project team were noted during these meetings and incorporated into the project design and environmental assessment. All relevant publications were reviewed to inform the traffic impact assessment for the proposed development.

			methods/techniques proposed for any works traversing/in proximity to the national road network. • In relation to haul route identification, the applicant/developer should clearly identify haul routes proposed and fully assess the network to be traversed. Separate structure approvals/permits and other licenses may be required in connection with the proposed haul route and all structures on the haul route should be checked by the applicant/developer to confirm their capacity to accommodate any abnormal load proposed; • In relation to cabling and potential connection routing, the scheme promoter should note locations of existing and future national road schemes and develop proposals to safeguard proposed road schemes and in the context of existing national roads, should be aware that separate approvals may be required for works traversing the national road network. The Authority requests referral of any agreements between the local authority and the scheme promoter related to national roads.	
	27th April 2017	May 2017	• Similar response to above received	
	9/10th April 2018	April 2018		
Roscommon County Council – Planning Environment and Roads	8th September 2016		• Please see section 1.10.2, Traffic and Transport Consultation for consultation details.	Please see section 1.10.2, Traffic and Transport Consultation for consultation details.
	27th April 2017			
	9/10th April 2018			
Inland Fisheries Ireland	8th September 2016		• No response.	-
	27th April 2017	2nd May 2017	• Email from Inland Fisheries confirming receipt of letter in the Dublin office. They do not deal with Co. Longford but have forwarded the letter to Catherine Kerins, the environmental officer for the upper Shannon region. She will make a response in relation to the development. No further response.	
	9/10th April 2018		• No response.	
An Taisce	8th September 2016			-

	27th April 2017		• No response.	
	9/10th April 2018			
Teagasc	8th September 2016		• No response.	-
	27th April 2017			
	9/10th April 2018			
The Heritage Council	8th September 2016		• No response.	-
	27th April 2017			
	9/10th April 2018			
Irish Raptor Study Group	8th September 2016		• No response.	-
	27th April 2017			
	9/10th April 2018			
Waterways Ireland	8th September 2016		• No response.	-
	27th April 2017			
	9/10th April 2018			
Environmental Protection Agency	8th September 2016		• No response.	-
	27th April 2017			
	9/10th April 2018			
Health and Safety Authority	8th September 2016		• No response.	-
	27th April 2017			
	9/10th April 2018			
Sustainable Energy Authority of Ireland	8th September 2016		• No response.	-
	27th April 2017			
	9/10th April 2018			
Irish Wildlife Trust	8th September 2016		• No response.	-
	27th April 2017			
	9/10th April 2018			
HSE West	8th September 2016		• No response.	-
	27th April 2017			
	9/10th April 2018			
ISPCA	8th September 2016		• No response.	-
	27th April 2017	19th May 2017	The ISPCA state they only became aware of the proposed development and this is the first letter they received in regard to the development. They met with Sean Creedon and Karina Dennigan of Bord na Mona on Wednesday 3rd of May who gave an overview of the development. Notification of the proposed development was advertised in the local press some time ago,	All recommendations and comments from the ISPCA were considered in the preparation of this EIAR.

			but the ISPCA was not aware of it. At the meeting with Bord na Mona, I raised the ISPCA's concerns that we were not notified directly about the proposed development at an earlier juncture. The ISPCA supports the development of renewable energy and we are concerned about the impact of climate change on the environment. We also recognise that the Irish government has targets to achieve in terms of renewable energy in relation to various protocols. However, we do have concerns about the proposed Derryadd Windfarm due to the close proximity of three turbines to the ISPCA's property at Derryglogher, the closest of which will be situated just 650m from the centre of our land. Whilst we understand that an ecological impact survey has been carried out and will be included in the proposal, which I believe is to be submitted in September, we are concerned about the impact of the turbines on the animals being rehabilitated at our centre. These include up to 40 equines all of which have been seized or surrendered to ISPCA Inspectors as a result of being cruelly treated or neglected. Many have come from very poor conditions and are already nervous and stressed. Some may also be immuno-suppressed as a result of their condition. I am aware of the body of research into the impacts of wind turbines on birds, bats and terrestrial wild mammals, but there is a paucity of research into the impacts of wind turbines on domesticated animals, livestock and equines. Although there is no direct evidence of negative impacts of wind turbines on this group of animals, lack of evidence of any impact is not evidence of a lack of impact. It is possible that equines would become habituated to the noise of the turbines over time, but more research is required on the impacts of turbines on vulnerable groups of animals such as the nervous / stressed equines cared for at the ISPCA centre in Derryglogher. The ISPCA at this stage must remain cautious and our default position is that unless there is sufficient evidence to show that there will be no, or negligible negative effects on our equines, we will remain opposed to the siting of the three turbines planned for the immediate vicinity.	In particular, the recommendations were examined during the preparation of Chapter 5, Population and Human Health, Section 5.3.2. All recommendations and comments from the ISPCA were considered in the preparation of this EIAR. In particular, the recommendations were examined during the preparation of Chapter 5, Population and Human Health, Section 5.3.2.

			The ISPCA has not had sufficient time to conduct a complete review of the literature surrounding the impact of noise pollution from wind turbines. However, the British Horse Society has recommended that: "The potential effect of turbines on horses should be considered on any route used by them – this includes bridleways, byways, roads and permissive routes – and on businesses where horses are kept or trained." We entrust that sufficient consideration will be given to the impact of the proposal on the equines in our care. In the absence of information on the impact on vulnerable animals, we would like to suggest that Bord na Mona commission independent research into this issue. In the absence of such research, the ISPCA will oppose the proposal and in the event that the proposal is successful will be seeking to have the three closest turbines relocated on removed from the proposal completely.	
	9/10th April 2018		No response. However, a project update meeting was held between the ISPCA CEO (Dr. Andrew Kelly) and Sean Creedon, Bord na Móna on April 11th 2018.	All recommendations and comments from the ISPCA were considered in the preparation of this EIAR. In particular, the recommendations were examined during the preparation of Chapter 5, Population and Human Health, Section 5.3.2.
Bat Conservation Ireland	8th September 2016 27th April 2017 9/10th April 2018		No response.	-
Commission for Regulation of Utilities	8th September 2016	12th September 2016	Acknowledgement of receipt of letter.	-
	27th April 2017 9/10th April 2017			
Midlands Energy Agency	8th September 2016 27th April 2017 9/10th April 2018		No response.	-
The Office of Public Works	27th April 2017 9/10th April 2018		No response.	-
Birdwatch Ireland	8th September 2016 27th April 2017		No response.	-

	9/10th April 2018			
Department of Transport Tourism and Sport	8th September 2016		See TII	-
	27th April 2017			
	9/10th April 2018			
The National Parks and Wildlife Service	8th September 2016		See Dept of Arts, Heritage, Regional, Rural and Gaeltacht Affairs	-
	27th April 2017			
	9/10th April 2018			

In addition to the consultation detailed above, a specific consultation exercise was undertaken between 2016 and 2018 with the main Telecommunications and Aviation companies operating in the region of the proposed Derryadd Wind Farm development.

Following the provision of the proposed wind farm site boundary details and the initial draft proposal for the wind farm in 2016, the majority of the telecommunications/aviation operators responded by stating that they had no objection to the proposed development as it poses no threat to current microwave links in the area of the project.

In 2017, a similar consultation process was undertaken that was informed by responses from the consultees. When the final turbine positions were communicated to the operators in 2018, a number of operators who had no objections in 2016 and 2017 did not respond to the latest set of turbine co-ordinates. In addition to that engagement, detailed consultation was undertaken with a number of operators including ESB Telecoms and 2RN, as recorded in the table below. A summary of the overall telecommunications/aviation operator consultations is included in Table 1.5 below and is further detailed in Chapter 11 of this EIAR, "Material Assets -*Telecommunications, Aviation and EMF*".

Table 1.5: Summary of Telecommunication Consultations undertaken in the preparation of the EIAR (2016-2018)

	Summary of Consultations		
	Company /Individual contacted/data supplied – Maps and turbine details	**Date of most recent contact (A number of rounds of consultation took place between 2016-2018)**	**Summary result and response**
1	Shannon Airport/Paul Hennessy	19/07/2016	No issue, consult with the IAA in future. No response in 2018.
2	Dublin Airport/Cork Airport/ Nigel Somerfield	22/02/2016	No issue in 2016, no more communication required please.
3	Galway Airport/Donal Porter (caretaker), Alan Farrell - Galway Co Council	27/03/2018	No issue as airport not operational.
4	Knock Airport/John McCarthy /Tomas Grimes	27/03/2018	No issue
5	Sligo Airport /Joe Corcoran/ Kevin Traynor (Operations Manager)	27/03/2018	No issue

	Summary of Consultations		
	Company /Individual contacted/data supplied – Maps and turbine details	**Date of most recent contact (A number of rounds of consultation took place between 2016-2018)**	**Summary result and response**
6	Donegal Airport (Brendan O Baoill ATC Manager)	27/03/2018	No issue
7	City of Derry Airport	27/03/2018	No issue
8	Belfast International Airport	27/03/2018	No issue
9	Belfast City Airport	27/03/2018	No response in 2018
10	Irish Aviation Authority/ Deirdre Forrest/ John Hughes & Audrey Rafferty	27/03/2018, 1/4/2018, 12/4/18,	In 2018 response was that: (1) agree an aeronautical obstacle warning light scheme for the wind farm development (2) provide as-constructed coordinates in WGS84 format together with ground and tip height elevations at each wind turbine location (3) notify the Authority of intention to commence crane operations with a minimum of 30 days prior notification of their erection.
11	Department of Defence/Eilish Keating	27/03/2018, 12/04/18	No issue, their views are that: 1. Single turbines or turbines delineating corners of a windfarm should be illuminated by high intensity obstacle strobe lights (Red). 2. Obstruction lighting elsewhere in a windfarm will be of a pattern that will allow the hazard to be identified and avoided by aircraft in flight. 3. Obstruction lights used should be incandescent or of a type visible to Night Vision Equipment. Obstruction

	Summary of Consultations		
	Company /Individual contacted/data supplied – Maps and turbine details	**Date of most recent contact (A number of rounds of consultation took place between 2016-2018)**	**Summary result and response**
			lighting fitted to obstacles must emit light at the near Infra-Red (IR) range of the electromagnetic spectrum specifically at or near 850nanometres (nm) of wavelength. Light intensity to be of similar value to that emitted in the visible spectrum of light. Obstruction lights used should be incandescent or of a type visible to Night Vision Equipment.
12	Abbeyshrule Aerodrome // various clubs	27/03/2018	Owner stated verbally that there is no issue as it is so far away. Requested lights and signs on any HV power lines from the site. No response in 2018.
13	Trim Airfield // Vincent Savage/Michelle Dore/ Pat Murphy	27/03/2018	No response to date.
14	Towercom/David Enright/ Gavin Hickey / Declan Drummond	27/03/2018	No issue for Towercom
15	Eir mobile Formerly Meteor and Mosaic/ John Bagnall/ Brendan O Flaherty	27/03/2018, 27/3/2018	Turbine #10 was only 58m from a link in 2017. On 1/5/2018 John Bagnall responded that the turbine is now positioned in a good place in relation to their network. No issue for their network.
16	Eir/Thomas Sheridan	27/03/2018	No issue for the Eir microwave radio network in 2018.

	Summary of Consultations		
	Company /Individual contacted/data supplied – Maps and turbine details	**Date of most recent contact (A number of rounds of consultation took place between 2016-2018)**	**Summary result and response**
17	Airspeed/Gareth Rennicks/Christian Walls/maps/ Ger Boyce, Peter O Brien	27/03/2018, 27/4/2018	No issue for Airspeed in 2017. Peter O Brien stated on 30/4/18 that there is no issue of concern for their radio circuits.
18	Netshare /Vodafone / Gavin Byrne	27/03/2018, 27/4/2018	There is no impact on the Vodafone network. They have no objection. In 2018 Gavin Byrne responded again that Vodafone has no issue.
19	Tetra Ireland/ Thomas Barry	27/03/2018	No issue for Tetra in 2018.
20	Imagine / Equiendo - Ronnie O Neil / Michael O Donovan	27/03/2018	No issue for Imagine in 2018.
21	BT / Padraig Condon	30/03/2018	No issue for BT.
22	Three (02 legacy) / Gerry Callan	27/03/2018	No issue for Three and the O2 legacy network.
23	Virgin media / UPC / Cathal O Donnell/ Liam Allister	27/03/2018	No issue for Virgin media in 2017 and 2018.
24	Garda Síochána	27/03/2018	No response to scoping report but they had advised on 27/6/2016 that the Gardaí and Tetra had no issue. Email data sent again to Michael McDonnell on 27/3/2018 and 11/5/2018. No response in 2018.
25	ESB Telecoms Services / Donal Hasslam/ Wilson Dalikeni / Derek Jones / Paul McDonagh	27/03/2018	Highlighted potential problems for the ESB. Radio circuits from Ardagh site to control & monitor their 38kV sites maybe interfered with. Their consultants JRC advised engagement with ESB about micrositing turbine T16. They requested that BnM supply them the absolute exact details of this turbine, dimensions and position (this detail

	Summary of Consultations		
	Company /Individual contacted/data supplied – Maps and turbine details	**Date of most recent contact (A number of rounds of consultation took place between 2016-2018)**	**Summary result and response**
			was provided). They proposed that a microsite restriction should be agreed limiting movement to 25m in the sector 266 to 360 to 85 East of Irish Grid North (EIGN). The applicant confirmed the final proposed location for T16 with JRC and ESB and confirmed that that there is no proposal to microsite the turbine at this location. Bord na Móna will continue to liaise with JRC and the ESB as the project develops.
26	ESB Telecoms Ltd / Peter Byrne	27/03/2018, 27/4/2018,30/4/18	No issue for any operators on their sites in 2018.
27	02/Three (Mosaic) / Gerry Callan	27/03/2018	No issue for the 02 legacy network / Three / H3G reported from Mosaic.
28	BAI / Roger Woods	27/03/2018	No issue expected.
29	RTE /2RN / Colin Kennedy/Johnny Evans	27/03/2018	No issue. Protocol must be signed pre-construction and television and radio services remediated if interfered with.
30	Digiweb (Viatel / smart telecom) / Hugh Logue & Donal McEneaney	27/03/2018, 27/4/2018	No issue for Viatel in 2018.
31	Sigma / Brian Kearney / Jimmy Nolan	27/03/2018	No issue for Sigma to earlier proposals. No response to final turbine positions. No reply in 2018 to any contacts.
32	Magnet / Ailish O Connor & James Canty	27/03/2018, 27/4/2018, 11/5/18	No interference expected to earlier proposals. On 17/5/2018 Magnet stated that they expect no interference.

	Summary of Consultations		
	Company /Individual contacted/data supplied – Maps and turbine details	**Date of most recent contact (A number of rounds of consultation took place between 2016-2018)**	**Summary result and response**
33	Longford Fire Station / Declan Kilcline	27/03/2018, 27/4/2018	No issue but designer should plan for emergency services having access to site and plan for response to fire event. No responses in 2018 to further consultations
34	National Ambulance Service / Niamh Murphy and Pat McCreanor	27/03/2018	He noted that Niamh Murphy responded on 16/6/2016 to say that they had no issue and that she would have run it by him at that time. In 2018 he referred it on to Telent Technology services Ltd, who have responded below. No issue.
35	RNLI / Carl MacGowan.	27/03/2018, 27/4/2018	No interference expected in 2018.
36	Coastguard / Gerry Smullen	27/03/2018	No issue in 2018.
37	Camp West & (WRCC) / Seamus Murphy/Sean Brady / Richard Sheehan	27/03/2018	No interference expected. No response to final turbine positions submitted in 2018.
38	Eastern Regional Control Centre (ERCC) / Richard Sheehan	27/03/2018	No interference expected. No response to final turbine positions submitted in 2018.
39	Northern Sound Longford / John Carrigy / Trevor Galvin	27/03/2018	No issue with the planned development but they reserve the right to complain in the future if any interference is found upon construction.
40	Shannonside / Trevor Galvin	27/03/2018	No issue but they reserve the right to complain if problems arise. No concerns with this in relation to our microwave links. No issue anticipated with VHF Band II but reserve the right to seek

	Summary of Consultations		
	Company /Individual contacted/data supplied – Maps and turbine details	**Date of most recent contact (A number of rounds of consultation took place between 2016-2018)**	**Summary result and response**
			remediation if any issues arise during or after construction.
41	iradio Athlone / Jonathan Duane / Leigh Doyle	27/03/2018, 27/4/2018	No response to Scoping report to date in 2018.
42	Ripplecom/ Denis Herlihy, Piotr Zurek	27/03/2018	On 16/5/2018 Piotr replied that the final turbine positions will have no impact on their point to point links (red lines on their map) but might block the line of sight to some residential customers. Turbine 4 – Customer 64, Customer 104 Turbine 7 – Customer 65, Customer 1106622 Turbine 10 - Customer 107
43	EOBO Ltd (Bbnet) / Barry O Halloran	27/03/2018	No issue for Bbnet in 2018
44	Onwave Broadband, (Now Europasat as it took over Onwave)	27/03/2018	No response to Scoping report to date
45	Premier Broadband / web form	27/03/2018	No issue for Premier broadband in 2017. No response in 2018

	Summary of Consultations		
	Company /Individual contacted/data supplied – Maps and turbine details	**Date of most recent contact (A number of rounds of consultation took place between 2016-2018)**	**Summary result and response**
46	Eurona Arden broadband / web mail	27/03/2018	Paul Curran stated in 2016 that Eurona operate a wireless Transmitter on Slieve Bawn and have customers in Lanesborough area. They need to be kept updated on developments in case of interference to customers. Barry Wilson replied on 11/5/2018 that in his opinion this development will have no bearing on their current or planned operations. Further updates can be sent to Barry Wilson.
47	Pure Telecom /Shane Flood	27/03/2018	In 2016 -No issue – their services are carried on Eir network so refer to Eir
48	Qsat / Sarah Herman	27/03/2018	No response needed, no issue for them in 2016.
49	Europasat /webform	27/03/2018	Responded on 12/10/2016 to ticket 633796 raised on 10/10/2016, that no interference is expected.
50	Carnsore broadband	27/03/2018	No interference expected in 2017. No response in 2018.
51	Host Ireland / David Goss	27/03/2018	Shane Bunyan has confirmed on 15/2/2017 that no interference is expected. No response in 2018.
52	Westnet / Paul Cunnane	27/03/2018	No issue in 2017. No response in 2018.
53	Fastcom / Eamon Fowley / Ronan O Hart	27/03/2018	No issue for them in 2018.
54	Telent /Pat McGrath	03/04/2018	No issue for Telent or for services they provide to the HSE Ambulance services.

	Summary of Consultations		
	Company /Individual contacted/data supplied – Maps and turbine details	**Date of most recent contact (A number of rounds of consultation took place between 2016-2018)**	**Summary result and response**
55	Communications Corp Group	27/04/2018	Keith McInerney called on 14/5/2018 and said that as far as he is aware they have no links in the area except for those operated for them by 2rn, so he has no objection. He would like to be kept informed of any developments.

1.10.4 Public Consultation

1.10.4.1 Public Consultation Events

The primary form of engagement with local communities was in the form of "Public Consultation Events" which were held in the local area and are detailed below.

Two Public Consultation Events, providing information on the proposed project, were held in January 2016 and in September 2016. The sessions in January 2016 were to introduce the project to the local community, while the sessions in September 2016 was to represent the proposed layout to the local community. Both events were held at four locations near the proposed site, namely at Keenagh, Killashee, Newtowncashel and Lanesborough. The total attendance in January 2016 was approximately 250 people and the total attendance in September 2016 was approximately 170 people. Ahead of each Public Consultation Phase advertisements were placed in three local newspapers. An information note was included in the Local Notes sections for the various Parishes in the Longford Leader and four parish newsletters to inform the public of the events. Notices were also broadcast on the local radio at a frequency of three times per day for three days in January 2016 and five days in September 2016. In September 2016, notification letters were posted to residences within 2km of the proposed development boundary and also sent to a further 1,300 residences outside of the 2km development boundary area through An Post Ad Mailer System.

At the public consultation events in January 2016, details of the proposed location of the Derryadd Wind Farm development were provided. In September 2016, details of the proposed development (including location maps, distance bands from residences and photomontages) were available for public examination. Members of the public were invited to submit comments, concerns and opinions regarding the proposed development to a member of staff, by means of a Feedback Box provided at each venue, or subsequently by email via a dedicated project email address. Some of the primary issues raised by attendees were in relation to potential landscape and visual impact, proximity of turbines to houses, Community Benefits, Amenities and noise. These issues are addressed in Chapter 9 "Landscape and Visual Impact", Chapter 5 "Population and Human Health" and Chapter 13 "Noise and Vibration" of this EIAR document. Specific comments and responses were directed to the relevant specialist for consideration as part of their assessment.

1.10.4.2 Community Engagement Forum

In addition to the above public engagement in relation to the proposed wind farm, a Community Engagement Forum was established which was chaired by an Independent Chairperson and comprised members of the local community. This forum facilitated ongoing discussions with local residents and provided the opportunity to discuss any queries in relation to the proposed development.

Since its inaugural meeting in November 2016, a number of Forum meetings were held during which representatives of Bord na Móna updated the community members on the progress of the Derryadd Wind Farm project, presented draft turbine layout iterations for review and clarified design details. Specialist speakers also attended some of the meetings to discuss topics identified by the residents.

Events carried out as part of this process included the following:

- 11 Forum meetings – commenced 01/11/16, most recent meeting 16/11/17;
- One meeting with representatives from Bord na Móna Peat Energy Limited on the 13/04/17 to discuss existing site Boundary Management Issues;
- One facilitated Forum visit to Mountlucas Wind Farm – 06/05/17 to meet with residents around that wind farm; and
- One project clinic to enable other members of the community to meet the project team and discuss the draft turbine layout design– 25/05/17.

1.10.4.3 Additional Public Consultation/Community Engagement Events

In addition to the community engagement outlined above, a number of further events/communications took place as follows:

- 2 organised tours of Mountlucas Wind Farm which took place on 07/05/16 and 12/07/16 and were attended by 28 people and 13 people, respectively;
- 6 individual tours of Mountlucas Wind Farm during 2016 which were attended by13 people in total;
- 6 requested House-to-House Visits during the period from July 2017 to May 2018;
- Approximately 120 queries received via emails, post, phone and via the Community Liaison Officer (CLO);
- All residences within 2km of the site were sent the following information by post:
  - Map and Project Brochure - 01/10/16
  - A Revised layout– 01/04/17
  - A letter of invitation to the Public Clinic – 01/05/17;
- A dedicated CLO was appointed for the project in May 2017 and carried out three rounds of visits to more than 300 houses within 2km of the site providing information as follows:
  - 01/08/17-Summer Newsletter
  - 01/10/17-Planning timeline update
  - 01/02/18 – Revised layout;

- A Project Website was developed for the project. This website, https://www.derryaddwindfarm.ie/ went live on June 7th 2017;
- One meeting with four local Development Associations to discuss the proposed project and amenity trails and connectivity (13/03/2018); and
- One meeting with representatives of the No to Derryadd Wind Farm Community Group (12/12/18).

A full description of the Public Consultation undertaken for the Derryadd Wind Farm project is outlined in the *'Community Report for the Derryadd Windfarm'* in Appendix 1.3.

1.11 ASSUMPTIONS AND LIMITATIONS OF ASSESSMENT

Assumptions specific to certain environmental aspects are discussed in the relevant chapters of the EIAR. General Assumptions that have been made during preparation of the EIAR are set out below:

- The principal land uses in the vicinity of the Derryadd Wind Farm remain as they were at the time of this EIAR preparation. In undertaking cumulative assessments, cases where planning permissions have been granted by the Local Authorities or An Bord Pleanála, (e.g. Sliabh Bawn and Skrine Wind Farms) have been assumed to be in place in line with the duration specified in the grant of permission for each development.
- Information provided by third parties, including publicly available information and databases, is correct at the time of publication.

Limitations specific to certain environmental aspects are discussed in the relevant chapters of the EIAR. General limitations associated with this EIAR are outlined below:

- Baseline conditions and assessments are assumed to be accurate at the time of the physical surveys but may be subject to change, due to the nature of the surrounding environment and surrounding activities.
- The assessment of cumulative effects from built or consented developments is partially reliant on the availability of information provided by relevant third parties. An Bord Pleanála and Local Authority public planning registers were reviewed as part of the impact assessment. None of the individual specialists have highlighted any limitations that are considered significant.

1.12 LIST OF PLANNING DRAWINGS

The following list of Planning Drawings accompany the Planning Application for Derryadd Wind Farm and are referenced within this EIAR.

DERRYADD WIND FARM – PLANNING DRAWINGS January 2019	
10325-2000	Regional Site Location Map
10325-2001	Site Location Map – Sheet 1 of 4
10325-2002	Site Location Map – Sheet 2 of 4
10325-2003	Site Location Map – Sheet 3 of 4
10325-2004	Site Location Map – Sheet 4 of 4
10325-2005	Site Master Plan
10325-2006	Site Layout Plan – Sheet 1 of 7
10325-2007	Site Layout Plan – Sheet 2 of 7
10325-2008	Site Layout Plan – Sheet 3 of 7
10325-2009	Site Layout Plan – Sheet 4 of 7
10325-2010	Site Layout Plan – Sheet 5 of 7
10325-2011	Site Layout Plan – Sheet 6 of 7
10325-2012	Site Layout Plan – Sheet 7 of 7
10325-2013	Proposed Substation Plan – Overhead Line Option A \ B
10325-2014	Proposed Substation Plan – Underground Cable Option B
10325-2015	Proposed Substation Elevations – Overhead Line Option A \ B
10325-2016	Proposed Substation Elevations – Underground Cable Option B
10325-2017	Proposed Customer Control Building – Plan, Elevations & Section
10325-2018	Proposed Eirgrid Control Building – Plan, Elevations & Section
10325-2019	Typical 110Kv Structure Details
10325-2020	Proposed Temporary Site Compound & Elevations
10325-2021	Typical Turbine Hardstand Layout
10325-2022	Typical Turbine Details
10325-2023	Typical Road Construction Details
10325-2024	Typical Surface Water Settlement Pond Plan & Sections
10325-2025	Typical Culvert Details
10325-2026	Typical Battery Energy Storage System (BESS) Details
10325-2027	Typical Trench Bedding Details
10325-2028	Typical Met Mast Details
10325-2029	Typical Fencing Details

10325-2030	Typical Cable Joint Bay Details
10325-2031	Proposed Self Contained Temporary Wheelwash System Typical Details
10325-2041	Amenity Car Park Locations and Layout
10325-2042	Vehicular Traffic Entrance details & Visibility Sightlines – Sheet 1 of 2
10325-2043	Vehicular Traffic Entrance details & Visibility Sightlines – Sheet 2 of 2
10325-2044	Pedestrian and Cyclist Entrance details & Safety Management Systems
10325-2060	Typical Borrow Pit A Plan & Sections

2 DESCRIPTION OF THE PROPOSED DEVELOPMENT

2.1 INTRODUCTION

2.1.1 The Proposed Site

The proposed development, known as Derryadd Wind Farm (See Figures 1.1 and 1.2) is located within part of the Mountdillon peat production bog group in Co. Longford.

The proposed wind farm site is located within the townlands of Cloonkeel, Ballynakill, Cloonbearla, Cloonbrock, Derryaroge, Mount Davys, Rappareehill, Cloonfore, Cloonfiugh, Barnacor(Ed Rathcline), Grillagh (Moydow By), Derryad (Moydow By), Annaghbeg, Annaghmore, Derryart, Derryoghil, Ards, Corralough, Cloontamore, Derrygeel, Cloontabeg, Kilmakinlan, Derrynaskea, Derryshannoge, Derraghan More, Coolnahinch (Moydow By), Derryglogher, Mosstown (Rathcline By), Corlea and Derraghan Beg, Lanesborough, Co. Longford.

The land use/activities on the site are a mixture of active peat extraction, peat extraction works (administration offices, machinery maintenance and storage, stores, canteen), bare cutaway peat, re-vegetation of bare peat, and two existing wind monitoring masts on Derryaroge Bog and Lough Bannow Bog. These works, aside from the wind monitoring masts, form part of the Bord na Móna Mountdillon peat production facility in County Longford.

The proposed development is approximately 12km long in the northwest/southeast direction and is approximately 4km wide in an east/west direction. The site lies between the towns and villages of Lanesborough, Derraghan, Keenagh and Killashee while the main urban centre in the region is Longford Town. The site is approximately 2km east of Lanesborough, County Longford. Longford Town is approximately 9km north east of the wind farm location. The site has an area of approximately 1900 hectares and mainly lies directly to the east of the R392 which runs from Lanesborough in the north to Ballymahon in the south. Derryaroge Bog to the north is adjacent to the River Shannon and Lough Bannow Bog is immediately to the west of the Royal Canal which runs in a north south direction. Lough Ree is located approximately 5km to the west of Derryadd Bog.

The surrounding landscape is a mixture of forestry, agricultural land and cutaway peatland. The landscape is predominately flat. The most significant features in the surrounding landscape are ‘Bawn Mountain’ which is located approximately 8km to the east of Lough Bannow Bog and Sliabh Bawn located 8km to the northwest of the proposed development.

The significant energy infrastructure that exists in the local area is Lough Ree Power located to the west of Derryaroge Bog, and its associated grid infrastructure in the form of 110 kV pylons network (in particular the Lanesborough/Richmond and Lanesborough/Mullingar lines). Sliabh Bawn Wind Farm in County Roscommon is located approximately 8km northwest of the proposed development. The proposed development is in a suitable area for wind energy development as outlined in the Longford County Development Plan 2015 – 2021.

There are also a number of Bord na Móna rail lines that pass through the bogs facilitating the transportation of milled peat and ash.

At a greater distance from the site is the Skrine Wind Farm, located approximately 19km to the south-west of proposed development and the Roosky Wind Farm, located approximately 14.5km to the north of the proposed development.

In addition, the recently permitted refurbishment of the Cloon-Lanesboro 110 kV overhead line (Planning Re, 18/139, Longford Co. Co.) includes a proposal to refurbish the existing overhead line located primarily in Counties Galway and Roscommon, with 120m of the line located in County Longford, in the vicinity of Lanesborough substation.

2.1.2 The Proposed Development

The proposed development comprises the construction of 24 no. wind turbines and ancillary works. The turbines will have a maximum blade tip height of 185m above the top of the foundation level and will be accessible from internal access routes within the Bord na Móna site.

Bord na Móna intends to apply for a ten-year planning permission for the following:

- 24 no. wind turbines with an overall blade tip height of up to 185m and all associated hard-standing areas;
- 5 no. borrow pits;
- 3 No. permanent Anemometry Masts up to a height of 120m;
- Provision of new internal site access roads (permanent and temporary), passing bays, amenity cycleways, car parking and associated drainage;
- 1 no. 110kV electrical substation, including battery storage, which will be constructed at one of two proposed locations on site: either Option A in Cloonfore townland or Option B in Derraghan More townland. The electrical substation will have 2 no. control buildings,

associated electrical plant and equipment, battery storage containers and a wastewater holding tank;

- 5 no. temporary construction compounds, in the townlands of Cloonfore, Cloontabeg, Derraghan More, and Rappareehill (2 no.);
- All associated underground electrical and communications cabling connecting the wind turbines to the proposed substation at either Option A in Cloonfore or Option B in Derraghan More;
- All works associated with the connection of the proposed wind farm to the national electricity grid, which will be either to the existing Lanesborough/Richmond 110 kV line via overhead line (Option A) or to the existing Lanesborough/Mullingar 110 kV line via an underground or overhead line (Option B);
- Removal of existing meteorological masts;
- New access junctions, improvements and temporary modifications to existing public road infrastructure to facilitate delivery of abnormal loads and construction access, including locations on the N6, N61, N63, R392, R398, L11554, L1136 roads, access onto the local road in the townland of Cloonkeel, access onto the local road in the townland of Mount Davys and amenity access from the Royal Canal Tow Path (off the L5239);
- All related site works and ancillary development; and
- A 10-year planning permission and 30-year operational life from the date of commissioning of the entire wind farm.

All elements of the proposed project as listed above, including grid connection and any works required on public roads to accommodate turbine delivery, have been considered and are addressed as part of this EIAR.

The application includes two substation location options (Option A and Option B) and associated grid connections. Both options and their associated grid connections have been assessed in this EIAR, however, only one substation and associated grid connection will ultimately be constructed. The proposed wind farm will connect to the grid via either 110 kV overhead line or underground cable. The proposed connection methodology for Option A is overhead only. Both underground and overhead options are presented for Option B. All new build transmission connection infrastructure for this proposed development is contained within the development site aside from a short section of underground cable along the R392. If the connection is by overhead line the new build of transmission line will be less than 1km.

The connection of either substation will involve the insertion of two new lattice towers into an existing ESB Transmission line. Should the connection option of overhead line be chosen then 500m to 1km of new transmission line will be built from the new towers to the new station and back. Should the connection be underground cable, the length will be approximately 0.75km to allow the cable route to cross the public road, follow the public road edge, enter Bord na Móna lands and proceed to the proposed substation. Further details of the connection arrangement options are outlined in section 2.4.7 Grid Connection below.

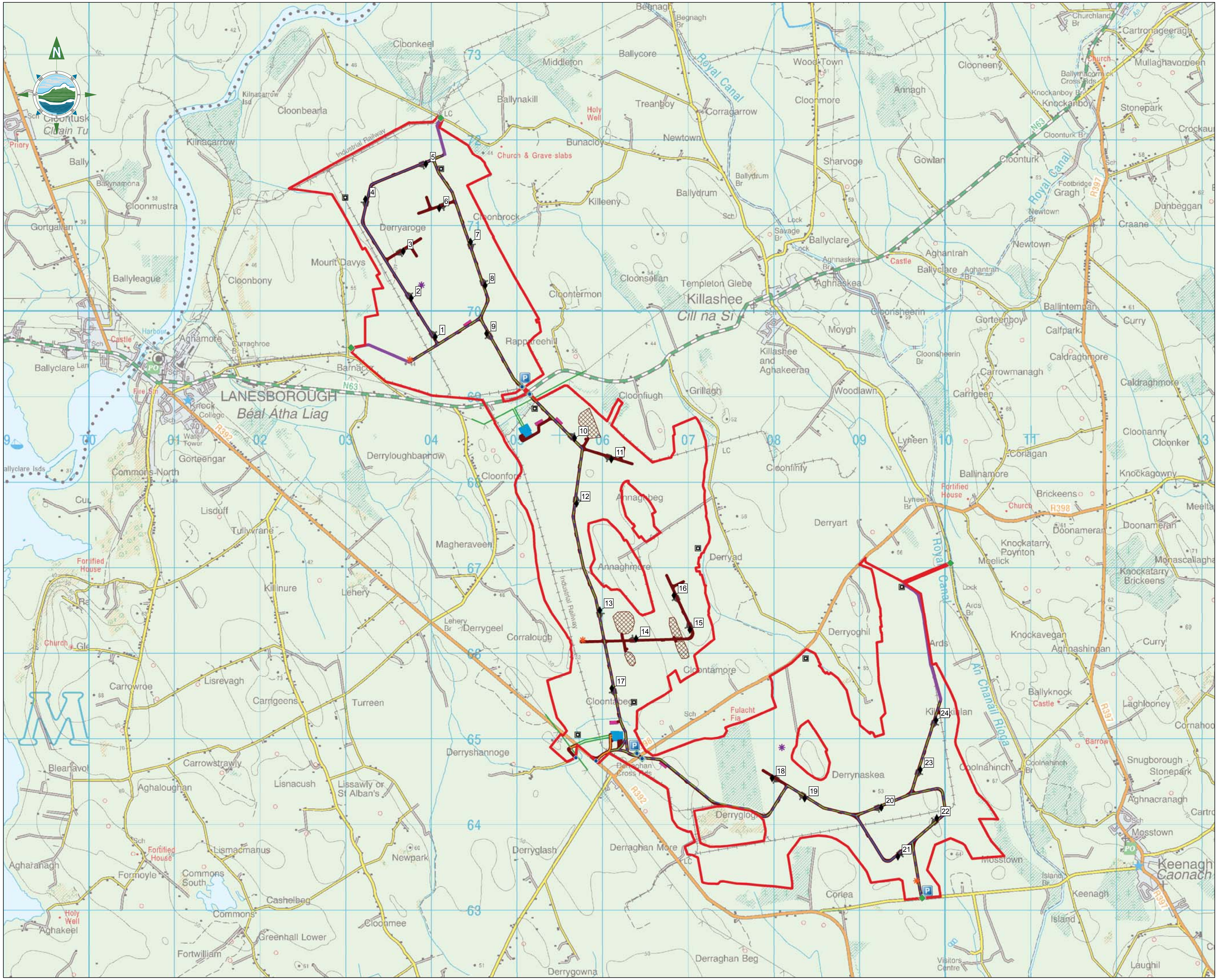
2.2 COMMUNITY BENEFIT PROPOSAL

Bord na Móna presently operate two wind farm community gain schemes at its wind farms in Mountlucas and Bruckana. These schemes were established in 2014 thanks to the help and cooperation of the communities surrounding the wind farms. The Community Gain Schemes for Bruckana and Mountlucas Wind Farms were set up on the basis of community involvement and public consultation. The Community gain scheme consists of a fixed level of funding (based on the installed capacity of the wind farm) that is made available each calendar year for community led projects in the local area. During 2017 and 2018, a ‘near neighbour’ scheme was established for residents in the vicinity of the Bruckana and Mountlucas wind farms. The near neighbour schemes offer electricity bill payers living within a prescribed distance of a wind turbine an annual contribution towards their electricity usage. In addition to the electricity contribution payment, the Scheme will also offer participants a contribution towards the completion of energy measures on the property and/or education support. A detailed description of the Community Benefit proposal is outlined in the ‘Community Report for the Derryadd Windfarm’ in Appendix 1.3.

2.3 DEVELOPMENT LAYOUT

The design layout of the proposed wind farm development provides for 24 wind turbines and has been designed to minimise the potential environmental effects of the wind farm, while at the same time maximising the energy yield of the wind resource passing over the site.

The overall layout of the proposed development is shown in Figure 2.1. This figure shows the proposed locations of the wind turbines, hardstanding areas, passing bays, electrical substation (Option A and Option B), borrow pits, anemometry masts, temporary construction compounds, internal roads layout, the main site entrances and proposed amenity paths. Detailed site layout drawings of the proposed development are included as Appendix 2.1 of this report and are also detailed in the Planning Drawings that accompany this application (as listed in Chapter 1).



Legend

- Planning Application Boundary
- Proposed Substation Options
- Borrow Pit Locations
- Turbine Hardstand
- Temporary Construction Compounds
- Amenity Car Park
- Proposed Turbine Locations
- Proposed Met Mast Locations
- Existing Met Mast Locations
- Construction & Operational Traffic Access
- Amenity Access
- Existing Surface Water Pumps
- Underground Cables
- Overhead Line
- Road Layout
- Cycleway / Walkway Only
- Cycleway
- Walkway

0 200 400 800 1,200 1,600
Metres

Issue	Date	Description	By	Chkd.
A	Jan. 2019	Final Issue	MN	ST

Client:

BORD NA MÓNA
Naturally Driven

Project:

DERRYADD WIND FARM

Title:

SITE LAYOUT PLAN

Scale @ A1: 1:20,000

Prepared by:	Checked:	Date:
M. Nolan	S. Tinnelly	January 2019

Project Director: D. Grehan

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Issue: A

Figure 2.1

2.4 DEVELOPMENT COMPONENTS

2.4.1 Wind Turbines

2.4.1.1 Turbine Locations

The location of individual turbines is influenced by a range of design constraints. These constraints are established in advance of the design modelling of the turbine layout and have a significant impact on the output from the layout modelling. The key constraints that were established prior to the development of the final turbine layout are as follows:

- Setback distance to Dwellings of 750m (A four times tip height setback distance (rounded up to 750m));
- 100m from ancient monuments;
- 150m from rivers and lakes;
- Telecomms link plus a buffer of a size requested by the relevant telecomms providers;
- 100m buffer from boundary of Lough Bawn NHA; and
- 2 rotor diameter setback from the boundary of the site.

Significant sections of existing bog units were constrained out during the design iterations. These included:

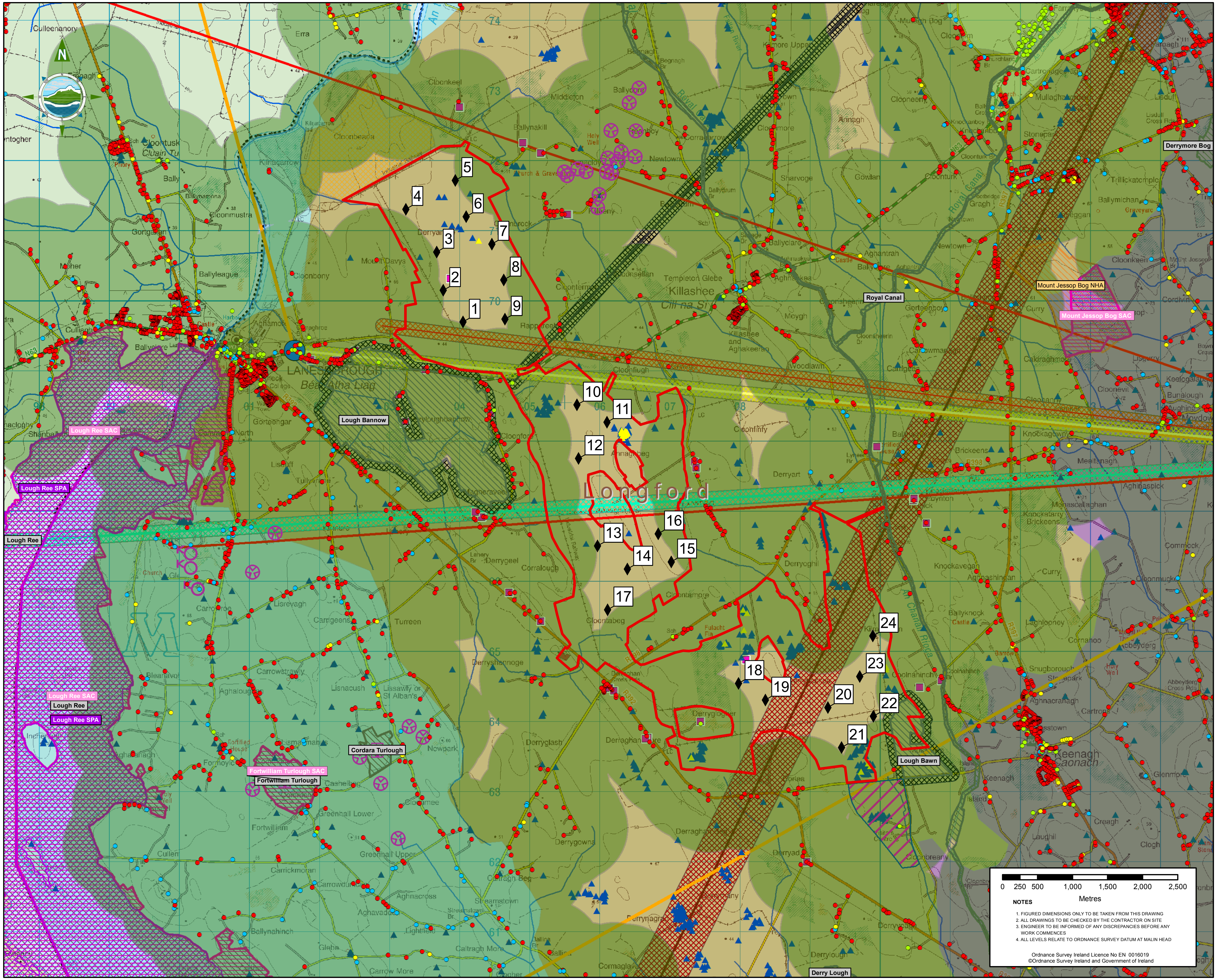
- Cloonbony Bog located to the west of Derryaroge Bog;
- The northern section of Derryaroge Bog (north of the existing rail line); and
- The Derryaroge mineral island (setback buffer of 30m applied to the mineral island).

The proposed wind turbine layout has been optimised using wind farm design software (a combination of WAsP, WindPro Computational Fluid Dynamics and WindFarmer) to optimise the energy yield from the site, while maintaining sufficient distances between the proposed turbines to ensure turbulence and wake effects do not compromise turbine performance.

The Grid Reference co-ordinates of the proposed turbine locations are listed in Table 2.1 below. The top of the foundation levels are also listed in Table 2.1 below.

Table 2.1: Turbine Location Details

Turbine ID	Easting's (m)	Northing's (m)	Top of Foundation level (m)
1	204045	269699	40.5
2	203765	270151	40.7
3	203671	270697	43.7
4	203229	271306	39.3
5	203936	271719	40.4
6	204091	271202	39.5
7	204457	270810	40.1
8	204628	270299	40.7
9	204644	269739	40.4
10	205672	268516	49.1
11	206100	268268	45.4
12	205694	267752	42.3
13	205967	266503	42.2
14	206391	266174	44.8
15	207018	266275	44.1
16	206832	266677	46.2
17	206108	265592	45.9
18	207978	264543	55.0
19	208360	264306	52.2
20	209253	264198	50.0
21	209448	263627	52.2
22	209902	264073	57.5
23	209709	264641	54.6
24	209894	265219	54.4



Legend

- Study Area
- River
- Proposed Substation option
- Proposed Turbine Location
- Archaeological Sites
- Archaeological Sites - Not scheduled to be included in revised list of Recorded Monuments
- Planning Applications Jan 2011 - December 2018

Buildings

- Commercial & Residential
- Commercial
- Residential
- Unknown
- 750m Buffer from sensitive receptors

Ecological

- Special Area of Conservation
- Special Protected Area
- Natural Heritage Areas
- Proposed Natural Heritage Areas
- Ornithological constraints
- Recommended 100m protective buffer/pNHAs
- Habitats of High Ecological Value (WS1,WN7,PB1,HH1/PF2/WS1,FW2/FW4, FL1/FL2,GS1,WN2,PF3)
- Habitats of Medium/High Ecological Value
- Bog Remnant

Karst Features

- Borehole
- Swallow Hole
- Enclosed Depression
- Turlough
- Spring

Landscape Character

- Central Corridor
- Open Agricultural
- Peatlands
- Shannon Basin / Lough Ree

Geology

- Longford County Geological Sites

Telecommunications

- RTE Link
- Meteor Mosaic Link
- BnM Airspeed Link
- Eir Link
- Netshare Link
- 3 / O2 Link
- Ripplecom Links (Red Line) - Licensed
- ESB point

Issue	Date	Description	By	Chkd.
A	Jan. 2019	Final Issue	MN	ST

Client: BORD NA MÓNA
Naturally Driven

Project:
DERRYADD WIND FARM

Title:
OVERALL CONSTRAINTS MAP

Scale @ A3: 1:50,000

Prepared by: M. Nolan
Checked: S. Tinnelly
Date: January 2019

Project Director: D. Grehan

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Issue: A

Figure 2.2

2.4.1.2 Wind Turbine Specifications

The exact rating and design of the proposed turbine will be subject to a competitive procurement process that will only commence if the project receives consent. The proposed turbine will be detailed by the turbine manufacturer on award of the contract. However, the proposed Derryadd Wind Farm turbines will be the typical three bladed, horizontal axis type with general specifications as follows:

- Maximum height envelope of 185m; and
- Installed capacities of approximately 4MW per turbine resulting in an estimated 96MW in total for the wind farm.

The proposed wind turbines will have a maximum top of foundation to blade tip height of up to 185 metres. Within this maximum turbine-size envelope, various configurations of hub height, rotor diameter and ground to blade tip height may be used.

The exact make and model of the turbine will be dictated by a competitive tender process, but it will not exceed the maximum size envelope set out above. Modern wind turbines from the main turbine manufacturers have evolved to share a common appearance and other major characteristics with only minor cosmetic differences differentiating one from another.

A typical turbine begins generating electricity at wind speeds of 2.5 to 3.5m/s with optimum power generation at wind speeds of approximately 12 to 20m/s. Turbines usually shut down at wind speeds greater than 25m/s in order to protect themselves from excessive wear. Modern turbines typically turn at 9 to 18 revolutions per minute (rpm) depending on wind speed and type of turbine. The entire nacelle and rotor are designed to swing around, or 'yaw', in order to face the prevailing wind. A wind vane located on the nacelle of the turbine controls the yaw mechanism. Rotors of all 24 No. turbines will rotate in the same direction. A control unit is located at the base of the turbine and an internal ladder leads up to the nacelle where the shaft, gearbox and generator are located.

When operating, the rotational energy of the blades is utilised to drive the wind turbine generator. The generated power is in the form of low voltage and connected via low voltage cables to the wind turbine transformer. This transformer steps up the generated low voltage to medium voltage which supports a reduction of electrical losses when transmitting power over large distances. The medium voltage from the wind turbine transformers connects to the proposed on-site substation which again will be stepped up to high voltage for connection to the transmission system.

For the purposes of this EIAR, various types and sizes of wind turbines (up to 185m tip height above top of foundation) have been considered in the relevant sections of the EIAR to assess the worst-case scenario. Turbine design parameters have a bearing on the assessment of shadow flicker, noise, visual impact, traffic and transport and ecology (specifically birds), as addressed elsewhere in this EIAR. In each EIAR section that requires the consideration of turbine parameters as part of the impact assessment, the turbine design parameters that have been used in the impact assessment have been specified.

At the turbine selection stage of the project, new turbine models or variations of currently existing models may be available that were not on the market at the pre-planning and EIAR preparation stage, that would better suit the site and fit within the proposed size envelope. Should this circumstance arise, the specific parameters of the new turbines will be assessed for their compliance with the criteria set out and considered in this EIAR, and any conditions that may be attached to any grant of planning permission that might issue.

A drawing of the maximum size envelope of the proposed wind turbine is shown in Planning Drawing 10325-2022.

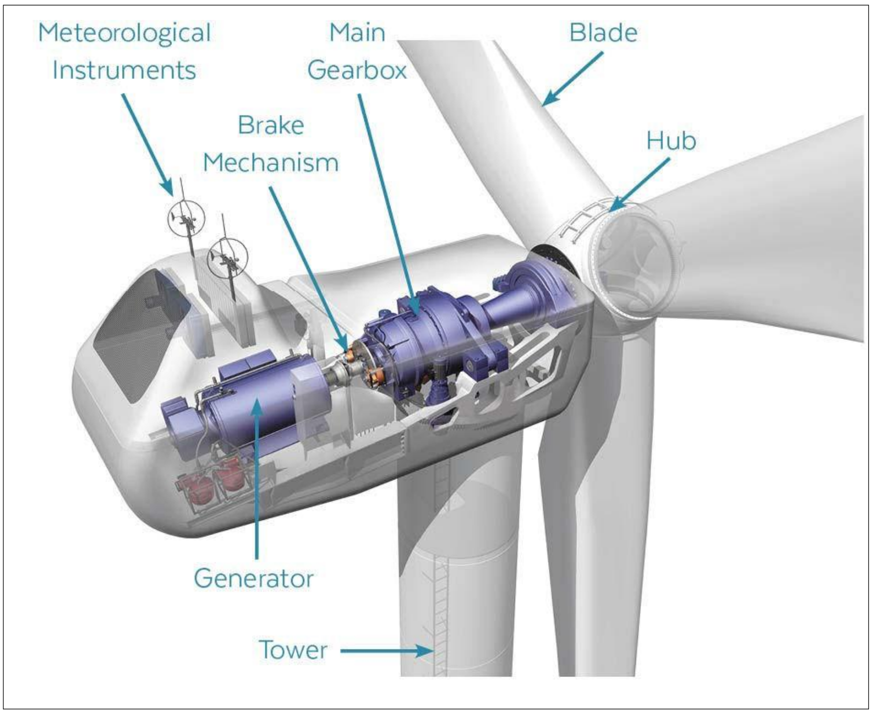


Figure 2.3: Turbine nacelle and hub components

2.4.1.3 Turbine Tower

The turbine tower is typically a conical steel tube with triple paint finish. Modern tower design also provides for the use of concrete sections. Towers generally comprise a steel ring at the base of the tower which is assembled on top of the concrete foundations using locally supplied concrete and then pre-stressed. The tower is typically delivered to site in three to six sections. The first section is bolted to the steel base, which is cast into the concrete foundation. The base of the tower is typically around 4m in diameter, tapering to approximately 2m where it is attached to the nacelle. The tower is accessed by a galvanised steel hatch door, which will be kept locked except during maintenance. The nacelle is typically 4m in width and varies in length depending on the final hub height.

2.4.1.4 Turbine Blades

The blades of modern turbines are generally made of fibreglass or carbon fibre reinforced polyester and are aerodynamically shaped to improve efficiency and lower noise production.

2.4.1.5 Turbine Foundations

Construction of the turbine bases will require excavation of the surrounding soil or peat from the foundation and crane hardstanding area to founding level with access being provided from adjacent tracks at or near the surrounding ground level. The soil or peat will be replaced with granular fill where required.

Each wind turbine will require a reinforced concrete (RC) foundation comprising a base slab bearing onto rock or other competent substrata with a central upstand to support the tower. The foundations for each turbine will be designed by the appointed Civil Designer. Typically, these bases are 24m in diameter with detailed foundation design being dictated by the local ground conditions.

Each wind turbine is secured to a reinforced concrete foundation that is installed below the finished ground surface. The size of the foundation will be dictated by the turbine manufacturer, and the final turbine selection will be the subject of a competitive tender process. Different turbine manufacturers use different shaped turbines foundations, ranging from circular to hexagonal and square, depending on the requirements of the final turbine supplier. The turbine foundation transmits any load on the wind turbine into the ground. After the foundation level of each turbine has been formed using piling methods or on competent strata, the bottom section of the turbine tower or “can” is levelled (Plate 2.1 below). Reinforcing steel is then built up around and through the can (Plate 2.2 below), and the outside of the foundation is shuttered with demountable formwork to allow the pouring of concrete.

Plate 2.1:Levelled turbine tower “can”   Plate 2.2: Steel reinforcement being added

2.4.1.6 Hardstands

Hardstand areas consisting of levelled and compacted hardcore are required around each turbine base to facilitate access, turbine assembly and turbine erection. The hard-standing areas are typically used to accommodate cranes used in the assembly and erection of the turbine, offloading and storage of turbine components, and generally provide a safe, level working area around each turbine position. The hard-standing areas are extended to cover the turbine foundations once the turbine foundation is in place. The size, arrangement and positioning of hard standing areas are dictated by turbine suppliers. The turbine hardstanding areas are shown on Planning Drawing 10325-2021 and shown on the site layout drawings included with the Planning Application. The hard-standing area is intended to accommodate a crane during turbine assembly and erection. The hard-standing areas shown on the detailed layout drawings are indicative of the sizes required, but the extent of the required areas at each turbine location may be optimised on-site depending on topography, position of the site access road, the proposed turbine position and the turbine supplier’s requirements. Preliminary designs shown represent a worst case based on typical designs. The EIAR utilises this worst case when determine the quality, significance, extent and duration of potential impacts.

2.4.1.7 Assembly Area

Unbound, levelled assembly areas will be located on either side of each hard-standing area as shown on Planning Drawing 10325-2021. These assembly areas are required for offloading turbine blades, tower sections and hub from trucks until such time as they are ready to be lifted into position by cranes.

2.4.1.8 Turbine Colour

The turbines are multi-ply coated to protect against corrosion. It is proposed that the turbines would be of an off-white or light grey colour to blend into the sky background. This minimises visual impact as recommended by the following guidelines on wind energy development:

- Department of the Environment, Heritage and Local Government (DoEHLG) – "*Wind Farm Development – Guidelines for Planning Authorities*" (2006);
- "The Influence of Colour on the Aesthetics of Wind Turbine Generators" – ETSU W/14/005333/00/2000.

2.4.1.9 Power Output

The proposed wind turbines have an assumed rated electrical power output of 4 MW. This may vary as a result of the final turbine type, power output modelling and turbine development over the period leading up to construction. For the purposes of this EIAR, a rated output of 4MW has been used to calculate the power output of the proposed wind farm, which would result in an estimated installed capacity of 96 MW.

Based on the above, the proposed wind farm has the potential to produce up to 243,878 MWh (Megawatt hours) of electricity per year, based on the following calculation:
A x B x C = Megawatt Hours of electricity produced per year
where:

- A = …… The number of hours in a year: 8,760 hours
- B = …… The capacity factor, which takes into account the intermittent nature of the wind, the availability of wind turbines and array losses etc:29%
- C = …… Rated output of the wind farm: 96 MW

The capacity factor of a wind farm takes into account the intermittency of the wind and is based on average wind speeds. A load factor of 29% is used here, based on the average figure for Ireland (average load factor for 2010-2016 is 28.66% rounded up to 29% for calculation purposes), as referenced by the Sustainable Energy Authority of Ireland *'"Energy in Ireland 1990-2016 Report", Nov. 2017)'*.

The 243,878 MWh of electricity produced by the proposed wind farm would be sufficient to supply the equivalent of 58,066 Irish households with electricity per year. This is based on the Commission for Energy Regulation (CER) decision paper concerning typical domestic consumption values for electricity customers published in March 2017. This decision paper updates the recommended typical annual household electricity consumption figure to 4,200 kWh.

2.4.2 Site Roads

The proposed development site will be accessed via the N63, R392, R398 and L11554 roads. Internal site roads will be constructed as part of the initial phase of the construction of the wind farm. Material will either be imported into the site or won from the proposed borrow pits within the site to provide the required base of the internal roads. The internal roads will be a mixture of permanent (construction/operational and amenity) roads, temporary (construction only) roads and amenity pathways/cycleways (permanent).

New roadways will have a running width of approximately 6 metres (6.5m including shoulders), with wider section at corners and on the approaches to turbine locations. The proposed new roadways incorporate passing bays to allow traffic to pass easily while traveling around the site. Peat/soil excavated as part of the construction of the internal roads will be sidecast, bermed and profiled on either side of the trackway.

All new roadways will be constructed with a 2.5% camber to aid drainage and surface water runoff. Typical Road Construction Details are included in Planning Drawing 10325-2023.

2.4.3 Borrow Pits

There are five potential borrow pit locations which have been identified to produce excavated material to provide fill material for roads (permanent, temporary, amenity), passing bays, hardstands, upfill to foundations and temporary compounds. The borrow pits are located towards the centre of Derryadd Bog and are at advantageous locations with regards to the hauling of materials within the site. It is anticipated that the borrow pits will be excavated as required.

Approximate volumes of materials available on site are summarised in Table 2.2. The estimates are based upon specific dimensions so as to provide a safe working zone and to minimise land take.

Table 2.2: Borrow Pit Summary

Borrow Pit	Surface Area (m^2)	Material composition
Borrow pit 17-1	52,700	Rock
Borrow pit 17-3	36,300	Granular fill / Rock
Borrow pit 17-4N	22,500	Granular fill
Borrow pit 17-4S	21,700	Granular fill
Borrow pit 17-5	13,700	Rock

The total approximate volume of potentially usable material is 958,100m^3, including a 1.3 factor for bulking (Caterpillar, 2017). Where excavations extend into competent rock, they are likely to require very heavy ripping or blasting methods to extract the stronger rock. The depth of competent rock varies across each borrow pit.

Given the volumes of material available from these borrow pits, it is possible that they will fulfil a significant portion of the material requirements for the project. The use of on-site borrow pits will reduce the environmental effect of other aspects of the development such as by reducing the need to transport material to the site.

Post-construction, the borrow pit area will be partially backfilled with overburden and excavated material from elsewhere on the site and permanently secured. The temporary access roads to the borrow pits will be removed. Berms will be erected around the area to prevent access as necessary. Appropriate health and safety signage will also be erected on the berms and at locations around the borrow pit.

2.4.4 Electricity Substation

It is proposed to construct one 110 kV substation within the site, at one of two locations (Option A or Option B) as shown on Planning Drawing 10325-2005. The layouts of the proposed Substation Options are shown on Planning Drawings 10325-2013 and 10325-2014. The construction and electrical components of the substations will be to EirGrid specifications. Further details regarding the connection between the substation options and the national electricity grid are provided in Section 2.4.8. The footprint of the proposed substation is the same for both options, i.e. approximately 142 metres in length by approximately 120 metres. The substation footprint will include two control buildings (refer to Section 2.4.6) and electrical apparatus necessary to facilitate the generated power from the wind turbines to export onto the transmission system.

2.4.5 Battery Storage

Provision has been made as part of this submission for a battery energy storage system. This includes 8 no. containerised modules with dimensions equal to that of standardised 40 ft. shipping containers (13.7 m x 2.4 m x 2.8 m). The containerised modules will be similar in appearance to shipping containers and shall be mounted on concrete foundations. Based on existing technology each of the container could have a storage capacity of 2MW.

The proposed system includes use of lithium-ion batteries connected to inverter systems which convert the stored energy from direct current (DC) to alternating current (AC). The converted AC power is connected to step up transformers feeding a common busbar located within the Independent Power Producer (IPP) substation control building.

Detailed design of the proposed battery energy storage system will be carried out following a competitive procurement process of the battery technology supplier. It is expected the procured plant will be designed in accordance with latest international and industry standards as well as local regulation requirements.

2.4.6 Substation Control Buildings

Two substation control buildings will be located within whichever substation compound is constructed. Control Building 1 (Asset Owner Control Building) will measure approximately 25 metres by 15 metres and approximately 6.6 metres in height. Control Building 2 (IPP Control Building) will measure approximately 16 metres by 12 metres and approximately 6.4 metres in height. Layout drawings of the control buildings are shown on Planning Drawings 10325-2017 and -2018.

The wind farm control buildings will include welfare facilities for the staff that will work on the proposed wind farm during the operational phase of the project. Toilet facilities will be installed with a low-flush cistern and low-flow wash basin. Due to the specific nature of the proposed development there will be a very small water requirement for occasional toilet flushing and hand washing and therefore the water requirement of the proposed development is small. It is proposed to install a groundwater well adjacent to the substation in accordance with the Institute of Geologists Ireland, *Guide for Drilling Wells for Private Water Supplies* (IGI, 2007). The well will be flush to the ground and covered with a standard manhole. A pump house is not currently required as an in-well pump will direct water to a water tank within the roof space of the control building (subject to final design).

It is proposed to manage wastewater from the staff welfare facilities in the control buildings by means of a sealed storage tank, with all wastewater being tankered off-site by a permitted waste collector to a wastewater treatment plant. It is not proposed to treat wastewater on-site, and therefore the EPA's *'Code of Practice: Wastewater Treatment and Disposal Systems Serving Single Houses'* (EPA, 2009) does not apply. Similarly, the EPA's manual on *'Treatment Systems for Small Communities, Business, Leisure Centres and Hotels'* (EPA, 1999) also does not apply, as it too deals with scenarios where it is proposed to treat wastewater on-site.

Such a proposal for managing the wastewater arising on site has become standard practice on wind farm sites, which are often proposed in areas where finding the necessary percolation requirements for on-site treatment would be challenging and has been accepted by numerous Planning Authorities and An Bord Pleanála as an acceptable proposal. The proposed wastewater storage tank will be fitted with an automated alarm system that will provide sufficient notice that the tank requires emptying. Full details of the proposed tank alarm system will be submitted to the Planning Authority in advance of any works commencing on-site. The wastewater storage tank alarm will be integrated with the on-site electrical equipment for alarm notification that will be monitored remotely 24 hours a day, 7 days per week. Only waste collectors holding valid waste collection permits under the Waste Management (Collection Permit) Regulations, 2007 (as amended), will be employed to transport wastewater away from the site. When the final destination of the materials is known following the appointment of a permitted contractor, this information will be submitted to the Planning Authority if necessary.

2.4.7 Underground Cabling

Each turbine will be connected to the on-site proposed substation (either Option A or Option B) via underground MV cables. Fibre-optic cables will also connect each wind turbine to the wind turbine control system located within the IPP Control Building. The electrical and fibre-optic cables running from the turbines to the substation compound will be run in cable ducts approximately 1.2 metres below the ground surface alongside the proposed wind farm internal roadways.

2.4.8 Grid Connection

A connection between the proposed development site and the national electricity grid will be necessary to export electricity from the proposed wind farm. As outlined in Section 2.4.4, there are two options for the substation location and consequently there are two associated grid connection options as follows:

- Substation Option A will connect to the national electricity grid via overhead line to the existing Lanesborough/Richmond 110 kV line; or
- Substation Option B will connect to the national grid via either an underground cable or overhead line to the existing Lanesborough/ Mullingar 110 kV line.

All new build transmission infrastructure required for the proposed development is contained within the development site.

2.4.8.1 Overhead Line Connections

The overhead line connection between Substation Option A and the existing Lanesborough/ Richmond 110kV line will require approximately 480m of new 110 kV transmission line (240m distance from the substation to the existing overhead line) and the installation of 6 new lattice towers/wooden polesets.

The overhead line connection option to Substation Option B will require approximately 1,000m of new 110 kV transmission line (500m from the substation to the existing overhead line) and 8 new lattice towers/wooden polesets.

On completion of the final design of the overhead line connection options, some of the structures that do not experience a line angle change could be replaced with wooden polesets. For this reason, the construction methodology for wooden polesets is also included in Section 2.9 of this chapter.

The proposed lattice towers will all be located within the proposed development site. Each tower can have a footprint of up to approximately 70m^2 and an overall height of up to 20m. They will be lattice steel structures with cross-arms which can extend over the base footprint and internal bracing.

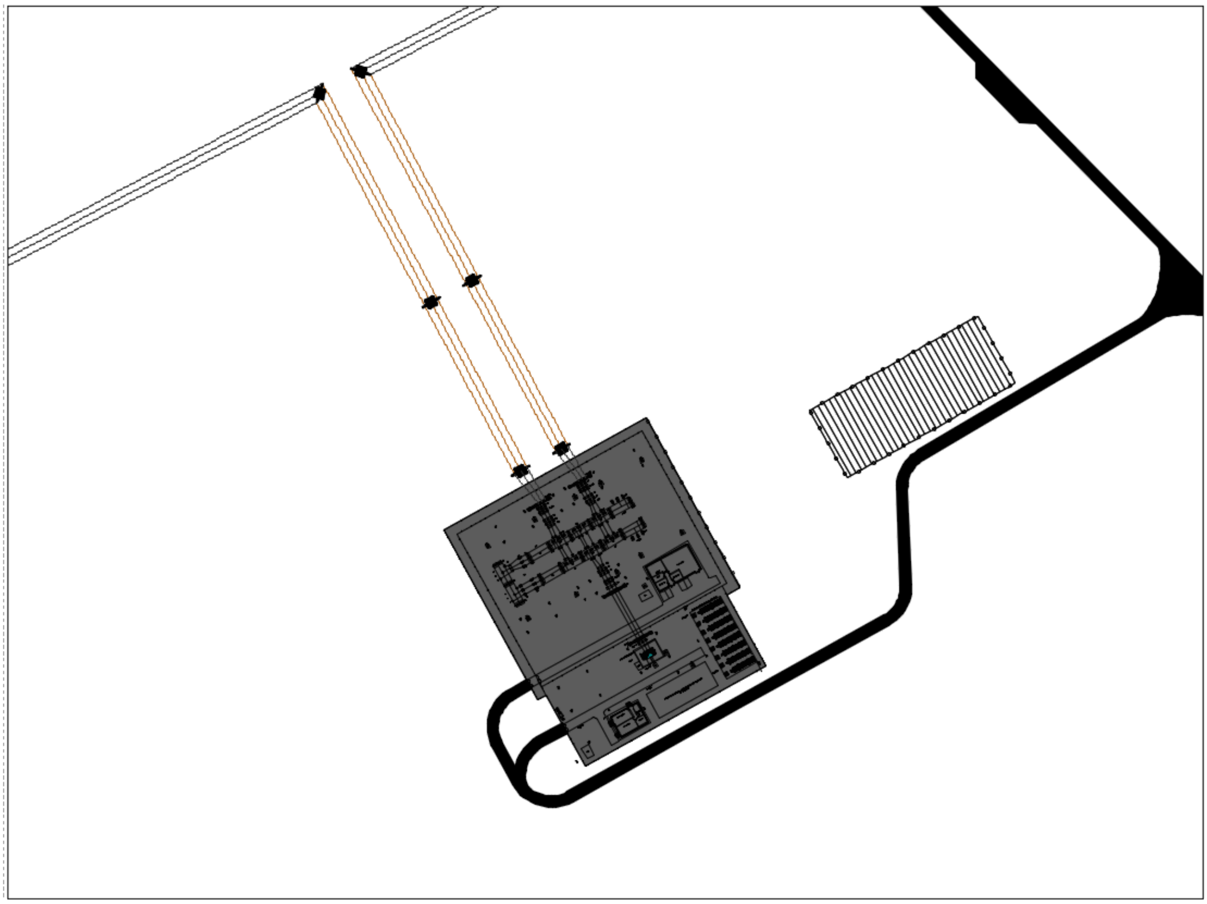


Figure 2.4: Grid Connection for Option A (overhead line in brown), "zoom-in" image from Planning Drawings.

The Grid Connection for Option A (overhead line) is shown on Planning Drawings 10325-2005 and 10325-2007, with a "zoom -in" image included in Figure 2.4 above.

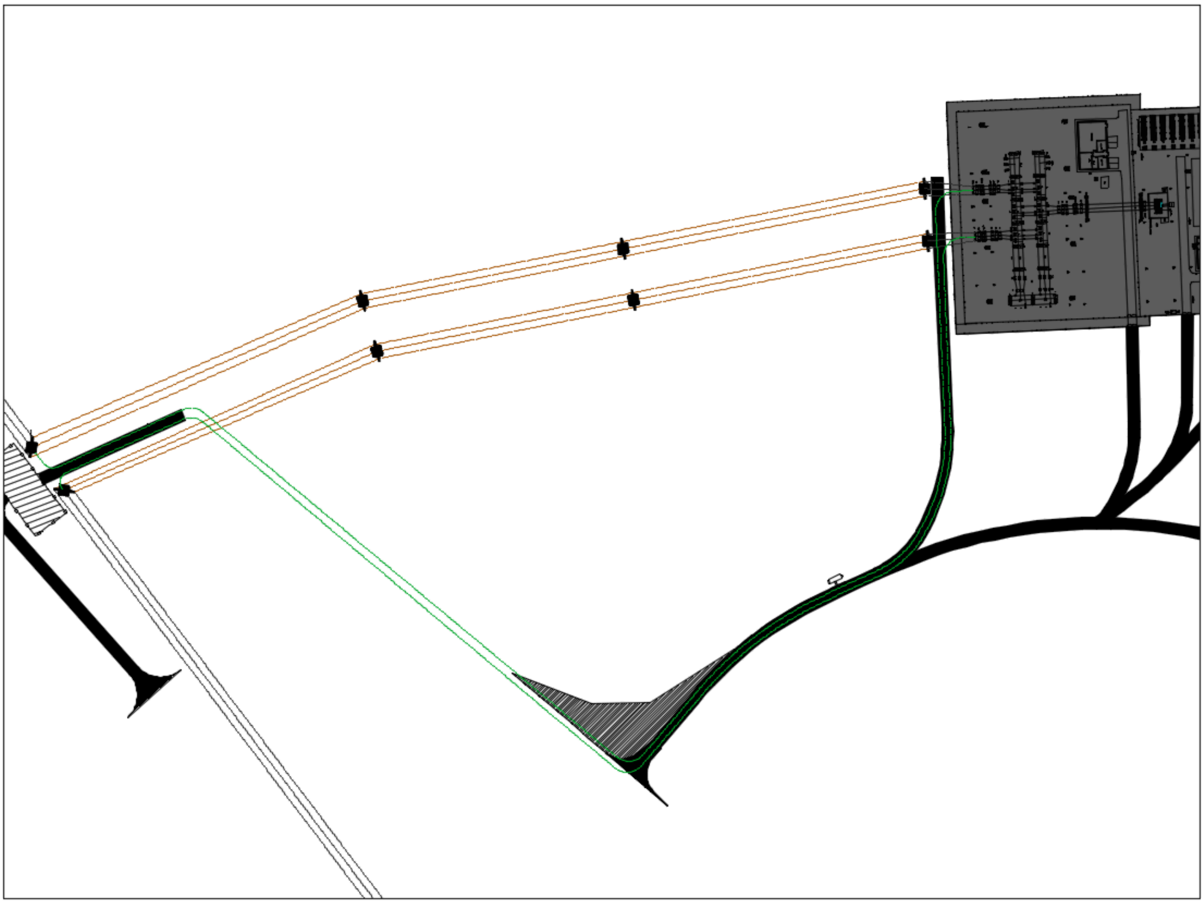


Figure 2.5: Grid Connection for Option B (underground cable (green) and overhead line (brown)), "zoom-in" image from Planning Drawings.

The Grid Connection(s) for Option B is shown on Planning Drawings 10325-2005 and 10325-2011, with a "zoom -in" image included in Figure 2.5 above.

2.4.8.2 Underground Cable Connection

Should an underground cable option be selected for the connection between Substation Option B and the Lanesborough/Mullingar 110 kV line, it is intended that the connection will follow the available road network and will require approximately 750m of transmission cable from the substation to the existing overhead line).

The cables will be laid in trenches as per ESB Networks Specification (Planning Drawing 10325-2027, Typical Trench Bedding Details and Section 2.8.4.3).

If the connection is by underground cable, two Line Cable Interface Masts (LCIM) will be inserted into one of the existing 110 kV lines as shown on Planning Drawing 10325-2005 and 10325- 2011.

LCIMs are used where a high-voltage underground cable connects to an overhead line and comprises of a mast and associated equipment.

The proposed LCIMs are within the proposed development site. Each mast has a footprint of approximately 70m^2 and an overall height of up to 20m. They will be lattice steel structures with cross-arms which can extend over the base footprint and internal bracing and are very similar in size and character to the masts proposed for the overhead line options in section 2.4.8.1 (refer to Planning Drawing 10325-2019 above).

2.4.9 Rural (Local) Electricity Supply

As part of the development, a rural/local supply will be required as a back-up power supply to the proposed substations for light, heat and power purposes. There are two MV local supplies adjacent to the development location which could be utilised, these include the Lanesboro – Ballymahon MV supply (nearest to Substation Option B) and the Derryaroge - Aghamore MV supply (nearest to Substation Option A). The rural/local supply will be designed and constructed by ESB Networks. The exact source of supply is to be confirmed, however, the supply will enter the site by either MV overhead line or MV cable. The rural/local supply will have an associated step-down transformer (i.e. MV to LV) and will enter the substation building by underground cable and terminate onto the control building AC distribution board.

2.4.10 Anemometry Masts

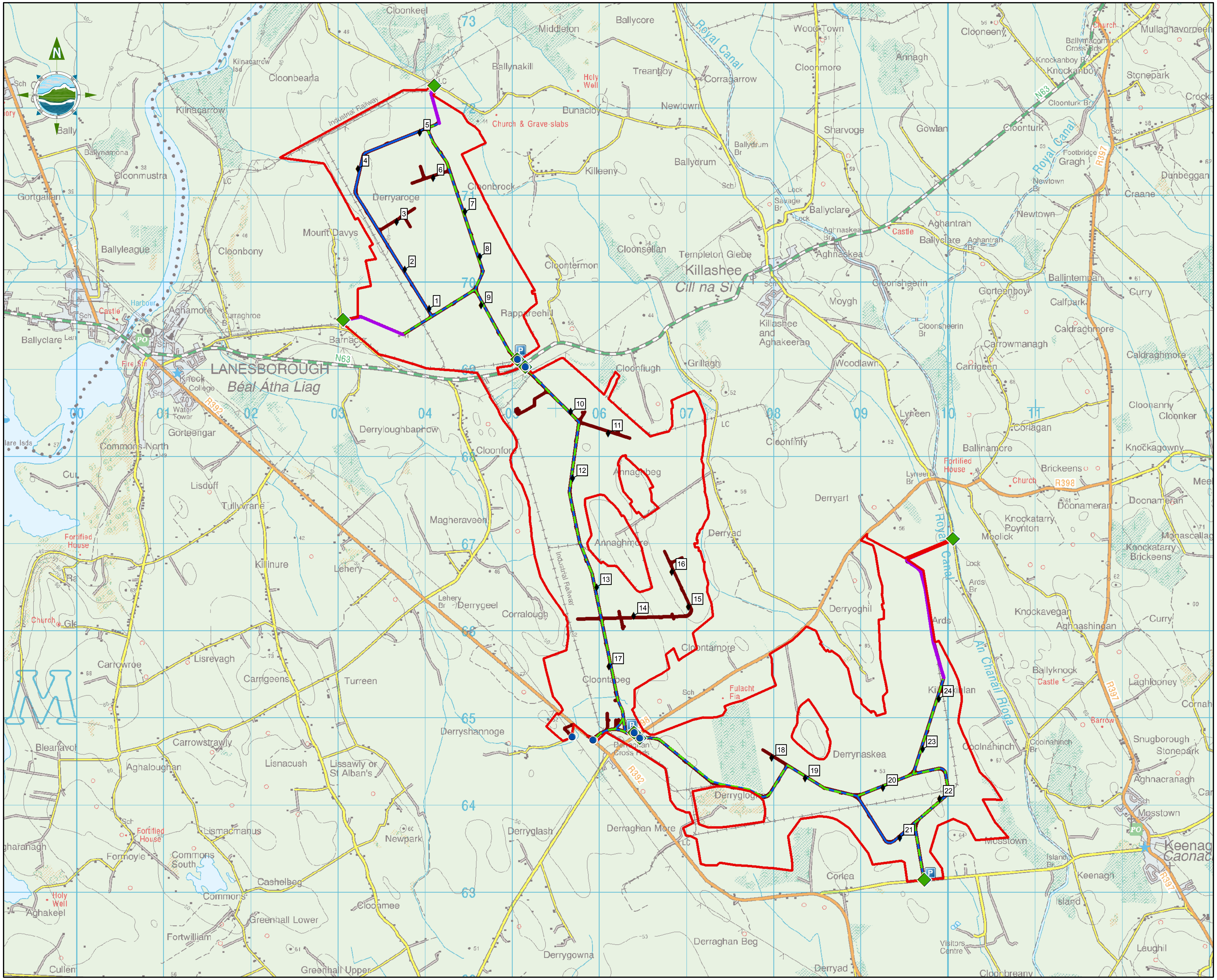
Three permanent anemometry masts are proposed as part of the proposed development. The anemometry masts will be equipped with wind monitoring equipment at various heights. The masts will be located as shown on the site layout drawing in Figure 2.1. Each mast will be a slender, free-standing lattice structure up to 120 metres in height, as shown in Planning Drawing 10325-2028.

The masts will be constructed on a hardstanding area sufficiently large to accommodate the crane that will be used to erect the mast, adjacent to an existing track.

2.4.11 Amenity Cycleway/Carparks

A total of approximately 30kms of amenity access (including pathways and cycleways) will be provided as part of the construction of the proposed development. The amenity cycleway will be mainly located on the proposed internal road network that will service the wind farm. These pathways/cycleways will have a gravel/crushed stone finish surface. Figure 2.1 -Site Layout Plan outlines the final configuration of the internal roads with the cycleway included in the layout plan. In addition, there will be approximately 6.5km of dedicated amenity cycleway proposed to provide access points into the site from Lanesborough, the Royal Canal and the Corlea Trackway. The configuration of the dedicated amenity cycleway is also outlined in Figure 2.1 -Site Layout Plan and is comparable to sections of the cycleway provided along the Royal Canal. The amenity access points to the site are discussed in the Amenity Plan in Appendix 2.3 and are illustrated in Figure 2.6 – Construction/Operational and Amenity Access Location Map.

In addition to the amenity cycleway, three new car parks will be provided. These car parks will be located at the southern boundary of Derryaroge Bog adjacent to the existing access point, at the southern end of Derryadd Bog (also adjacent to an existing access point) and at the southern end of Lough Bannow Bog (north of the Corlea centre and opposite the Corlea walkway). Drawing 10325-2041 illustrates the configuration of the proposed car parks, including an overall total capacity for 15 vehicles and suitable signage at each location.



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Legend

- Planning Application Boundary
- Amenity Car Park
- Proposed Turbine Locations
- Construction & Operational Traffic Access
- Amenity Access
- Road Layout
- Cycleway / Walkway Only
- Cycleway
- Walkway

0 200 400 800 1,200 1,600
Metres

Issue	Date	Description	By	Chkd.
A	Jan. 2019	Final Issue	MN	ST

Client:
BORD NA MÓNA
Naturally Driven

Project:
DERRYADD WIND FARM

Title:
CONSTRUCTION / OPERATIONAL & AMENITY ACCESS LOCATION MAP

Scale @ A3: 1:40,000

Prepared by: M. Nolan
Checked: S. Tinnelly
Date: January 2019

Project Director: D. Grehan

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e-mail: info@tobin.ie
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Figure 2.6

Issue: A

2.5 ACCESS AND TRANSPORTATION

2.5.1 Construction/Operational Site Entrances

There will be a total of six wind farm entrances used to transport materials and equipment to the site. All are existing entrances with the exception of the proposed large component and construction entrance that will be located on the Lanesborough to Ballymahon road (R392) to the west of the proposed substation (Option B) and an entrance into the Derryshannoge Bog to be located along a local road (L11554) that accesses the R392 north of Derraghan Village. The existing entrances that have been identified for the wind farm and are used presently for the machinery involved in the current peat harvesting activities are the following:

- Existing entrance to the Southern part of Derryaroge Bog, off the N63;
- Existing entrance to the Northern part of Derryadd Bog, off the N63;
- Existing entrance to the Southern part of Derryadd Bog, off the R398; and
- Existing entrance to the Northern part of Lough Bannow Bog, off the R398.

The main entrance for the proposed development is located along the R392 Ballymahon to Lanesborough road. This entrance will be the main construction entrance to the site and will facilitate both materials delivery to the site (stone, steel and concrete) as well as large oversize components such as turbine blades, tower sections and substation components. The Derryshannoge access will be used for the grid connection works only (associated with Substation Option B) and as such will have a comparably low level of traffic and associated material deliveries.

2.5.2 Amenity Site Entrances

As discussed above, the amenity access points to the site are discussed in the Amenity Plan in Appendix 2.3 and are illustrated in Figure 2.6 – Commercial and Amenity Access Location Map.

2.5.3 Turbine and Construction Materials Transport Routes

Turbine and Construction materials will be restricted to the following routes:

- Construction materials coming west from Longford along the N63 accessing the site through the southern entrance to Derryaroge and the northern entrance to Derryadd;
- Construction materials coming from Lanesborough access the site either along the N63, R392 or R398 and the site entrances along those roads; and
- Turbine and oversized loads access the site from Lanesborough going south along the R392 accessing the site through the entrance on that road.

- Construction materials from Ballymahon going north to the site along the R392 accessing the site at the entrance along this road to Derryadd or the entrances along the R398 to Derryadd or Lough Bannow;
- A limited amount of construction materials such as steel, stone and concrete will access the Derryshannoge Bog using the L11554 entrance. These materials will either be transported north from Ballymahon or south from Lanesborough along the R392.

2.5.4 Traffic Management

As described in Chapter 14, Traffic and Transport, the successful completion of this project will require significant co-ordination and planning and a comprehensive set of mitigation measures will be put in place before and during the construction stage of the project in order to minimise the effects of the additional traffic generated by the proposed development. The traffic management plan proposed for the Derryadd Wind Farm is included in the CEMP, in Appendix 2.2.

2.6 SURFACE WATER MANAGEMENT

2.6.1 Existing Site Drainage

The surface of the cutover bog is drained by a network of parallel northwest-southeast generally orientated field drains that are typically spaced every 15 - 20m. The field drains are approximately 0.5 - 1.5m deep and in most areas they intercept the mineral subsoil underlying the peat. These field drains mostly feed into larger surface water drains which drain the main catchments across the three bog formations. The surface water drains are primarily in a northwest-southeast orientation but there are a number of shorter cross drains which intersect the small field drains. There are also a number of pump stations located at low points in the larger drains to direct the surface water to the outfall locations and boundary drains. There are various outfalls on the bog boundaries which comprise mainly pumped outfalls but also some areas of gravity drainage. Surface water draining/pumped from the site is routed via settlement ponds (in accordance with the IPC licence requirements) prior to discharge into off-site drainage channels, streams and rivers which ultimately flow into the River Shannon.

2.6.2 Preliminary Drainage Design Concept

The surface water drainage system utilises sustainable drainage devices and methods where appropriate. The drainage layout for the operational stage of the proposed development has been designed to collect surface water run-off from roads, crane pads and hardstanding areas and is dispersed across the cutaway peatlands and will ultimately be assimilated into the existing drainage network within the boundary of the proposed development. A typical detail of the proposed settlement ponds is shown on Planning Drawing 10325-2024. Run-off arising from the development will discharge into settlement ponds specifically constructed for managing surface water from the wind farm. Once treated in the settlement pond the treated surface water will then be allowed to spread across the adjacent cutaway peatland. This treated water will then move into the existing bog drainage network at appropriate greenfield run-off rates. Any treated surface water from the wind farm that finds its way into the existing drainage system will then be captured in the existing system of silt ponds before final discharge to the receiving watercourse. There will be no direct discharges from the wind farm to any existing natural watercourse.

During the construction phase, all run-off from construction areas will be controlled and treated to reduce suspended solids concentration prior to being discharged into the existing drainage network. A number of temporary peat settlement ponds will be established during the construction phase along roadways and in areas of high construction activity to minimise silt laden run-off entering the drainage network. Those not required permanently shall be reinstated upon completion of the main construction works.

As discussed above, it is proposed to limit the rate of outflow from the development area through a variety of measures, which can be classified as sustainable drainage measures. Permanent ponds are proposed for management of run-off from the proposed development areas. Additional ponds will be provided during the construction stage, as required, to accommodate the additional levels of sediments anticipated during this stage. The proposed locations of the permanent and temporary settlement ponds are shown on Planning Drawings 10325-2005 to 2012, with details shown on Drawing 10325-2024.

Subject to potential planning conditions and prior to commencement of construction activity, this drainage design (including construction specific measures) will be reviewed by the appointed Contractor as part of the review of the Construction Environmental Management Plan (CEMP), Appendix 2.2.

A Surface Water Management Plan (SWMP) has been prepared and is included as Appendix 8.4 of the EIAR. The purpose of this plan is to ensure that all site works are conducted in an environmentally responsible manner so as to minimise any adverse impacts from the proposed development on surface water quality. The plan will incorporate the following specific objectives:

- Provide overall surface water management principles and guidelines for the construction phase of the Derryadd Wind Farm project;
- Address erosion, sedimentation and water quality issues; and

- Present measures and management practices for the prevention and/or mitigation of potential downstream impacts.

During the operational phase of the project, the management of surface water will be carried out in accordance with the proposed design and associated management features such as silt fences and silt ponds. The design of the wind farm has been developed following a detailed examination of the existing drainage system currently used to drain the bogs as part of the peat harvesting process. The drainage design ensures that any surface water arising from the proposed wind farm during operation will be contained and treated to ensure it can be dispersed out from the proposed development without any significant impact on existing activities or licences.

The decommissioning phase will not require any significant works that will impact on the drainage network.

The protection of water quality and prevention of pollution events requires a sustained and concentrated input from the Contractor with regard to the provision and maintenance of sediment control structures. The drainage system, as it is designed, does not impact on the existing drainage regime on site.

2.6.2.1 Silt control

Silt control measures e.g. silt bags, will be implemented as required during the construction process. Dewatering silt bags allow the flow of water through them while trapping any silt or sediment suspended in the water. The silt bags provide a passive non-mechanical method of removing silt from silt-laden water collected from works areas within a construction site. Silt bags are easily disposed by a licensed waste contractor.

Figure 2.7: Examples of Proprietary Silt Control Measure

In specific locations, silt fences will be installed as an additional water protection measure around existing watercourses, particularly where works are proposed within the 50-metre buffer zone of a stream.

2.6.3 Culverts

Culverts will be required where site roads, crane pads and turbine pads cross main bog drainage networks. Indicative locations of the culverts are shown on Planning Drawings 10325-2005 – 2012.

Precast concrete culverts of minimum 300mm in diameter shall be provided, a typical detail of which is shown on Planning Drawing 10325-2025. The proposed culverts and any diversion of the existing main drainage network across the site are specified in the site layout Planning Drawings 10325-2005 – 2012.

2.7 CONSTRUCTION MANAGEMENT

2.7.1 Construction Timing

Approximately 100-120 persons will be employed during the peak construction period and it is estimated that the construction phase will take approximately 24 - 30 months from starting onsite to completion of commissioning of the turbines. All vegetation clearance that is required during construction works must commence outside the breeding birds season, which runs from the 1st of March to the 31st of August.

The hours of construction activity will be limited to avoid unsociable hours where possible. Construction operations shall generally be restricted to between 7:00hrs and 19:00hrs weekdays and between 7:00hrs and 13:00hrs on Saturdays. However, to ensure that optimal use is made of good weather period or at critical periods within the programme (i.e. concrete pours) or to accommodate delivery of large turbine component along public routes it could be necessary on occasion to work outside of these hours. Any such out of hours working will be agreed in advance with the local Planning Authority.

2.7.2 Construction Sequencing

The construction phase can be broken down into three main phases:

1) civil engineering works: approximately 18 months;
2) electrical works: approximately 18 months (will commence shortly after the civil works and will then run in parallel); and
3) turbine erection and commissioning: approximately 9 months.

The main tasks under each phase are outlined below.

Civil Engineering Works

- Create new entrance(s) and hardcore existing entrances (where required).
- Construct new site roads (permanent and temporary), drainage ditches and culverts
- Construct temporary roads and open borrow pits.
- Clear and hardcore area for temporary site offices. Install same.
- Construct remaining new roads, hard-standings and crane pads.
- Construct substation and associated drainage ditches and culverts.
- Construct remaining new roads, hard-standings and crane pads.
- Construct one of the two Substation Options (A or B) and the associated substation control buildings and groundworks for the substation compounds.
- Construct electrical apparatus bases/plinths and bund for transformer.
- Excavate/pile as required for turbine bases. Store soil/peat locally for backfilling and re-use. Place blinding concrete to turbine bases using either a piled solution or on competent strata. Fix reinforcing steel and anchorage system for tower section. Construct shuttering. Fix any ducts etc. to be cast in. Pour concrete bases. Cure concrete. Remove shutters after 1-2 days.

- Install meteorological mast(s).
- Install electrical ducting and cables.

Electrical Works

- Install external electrical equipment at substation.
- Install transformer at substation compound.
- Erect stock proof and palisade fencing around substation area.
- Install internal collector network and communication cabling.
- Construct grid connection.

Turbine Erection and Commissioning

- Backfill tower foundations and cover with suitable material.
- Erect towers, nacelles and blades.
- Complete electrical installation.
- Grid connection.
- Commission and test turbines.
- Complete site works and reinstate site.
- Remove temporary site offices. Provide any gates, landscaping, signs etc. which may be required.

The phasing and scheduling of the main construction task items are outlined in Figure 2.8, where January 2021 has been selected as an arbitrary start date for construction activities.

ID	Task Name	Task Description	Q1 2021 Jan-Mar	Q2 Apr-Jun	Q3 Jul-Sept	Q4 Oct-Dec	Q1 2022 Jan-Mar	Q2 Apr-Jun	Q3 Jul
1	**Site Health and Safety**								
2	**Site Compounds**	Site compounds, site access, fencing, gates							
3	**Site Roads**	Excavation/upgrade roads, install drainage measures, install culvert, install water protection measures, open borrow pits							
4	**Turbine Hardstands**	Excavate base, construct hardstanding areas							
5	**Turbine Foundations**	Fix steel, erect shuttering, concrete pour							
6	**Substation Construction & Electrical Works**	Construct substation, underground cabling between turbines, export cabling							
7	**Backfilling & Landscaping**								
8	**Turbine Delivery and Erection**								
9	**Substation Commissioning**								
10	**Turbine Commissioning**								

Figure 2.8: Indicative Construction Schedule

2.8 CONSTRUCTION METHODOLOGIES

2.8.1 Temporary Compounds, Hardstands, Material Storage Areas and Site Offices

At the commencement of the construction phase, five temporary compound areas will be constructed to provide office space, welfare facilities, hardstands for storing materials and hazardous materials.

The site accommodation is likely to consist of temporary porta-cabins constructed on a granular platform. The peat/topsoil will be stripped where hardstands or development is proposed. The hardstandings shall be constructed to heights of 0.5 or 1.0m above existing ground level based on the various extents of potential surface water flooding across the site.

Ground investigation in the form of peat probing and trial pitting has been carried out along the proposed turbine and hardstanding locations to inform the depth of excavation and upfill required. Preliminary volume calculations provide a rough estimation of fill required for the hardstands.

This is estimated as 960,600m^3 of compacted material which is equivalent to 1,252,150m^3 of un-compacted material including for bulking during transportation. It is likely that much of this material volume will be obtained from onsite borrow pits. Any volumes of materials required from quarries will only be sourced from quarries which are within a reasonable proximity of the site.

2.8.2 Turbine Foundations

Foundations for wind turbines may be of the gravity, rock anchored or piled type. Trial pitting and/or windrow sampling has been carried out at each of the turbine base locations. The geotechnical investigations to date indicate that the majority of the foundations at the proposed Derryadd wind farm will be piled. Piling depths will depend on site conditions. These will be established by detailed post-consent geotechnical investigations. Pre-construction final design will be carried out. Additional geotechnical investigations will be undertaken at each turbine location with associated sampling and laboratory testing.

Each of the turbines to be erected on site will have a reinforced concrete base. Overburden will be stripped off the foundation area to a suitable formation using a 360º excavator and will be placed across the site as close to the excavation as practical. A five-metre-wide working area will be required around each turbine base, with the sides of the excavated areas sloped sufficiently to ensure that slippage does not occur. Material excavated to create the working area will be stored locally for later reuse in backfilling the working area around the turbine foundation. The excavated material will be surrounded by silt fences to ensure sediment-laden run-off does not occur.

The formation material will be approved by the Site Engineer as meeting the turbine manufacturer's requirements. In the case of gravity foundations, if the formation level is reached at a depth greater than the depth of the foundation, the ground level will have to be raised with clause 804 hardcore material and or lean mix concrete, compacted in 240 millimetres (mm) layers, with sufficient compacted effort (i.e. compacted with seven passes using 12 tonne roller). Drainage measures will be installed to protect the formation by forming an interceptor drain around the perimeter of the base which will outfall out at the lowest point level with the spreader or settlement pond. In the case of piled foundations, the piling of concrete piles to the required depth will be carried out. The piles will most likely be constructed by coring and inserting a steel sleeve which will be filled with reinforced concrete prior to sleeve removal. Where piling is carried out soil/peat will be excavated with the provision of a surrounding work area to allow placing of shuttering etc.

An embankment approximately 600mm high will be constructed around the perimeter of each turbine base where required and a fence or berm will be erected to prevent construction traffic from driving into the excavated hole and also to demarcate the working area. All necessary health and safety signage will be erected to warn of deep excavations etc. Access to and from excavated bases will be formed by excavating a pedestrian walkway to a standard 1:12 grade (appropriate for designated walking routes and recreational trails).

There will be a minimum of 100 mm of blinding concrete laid on the formation material positioned using concrete skip and 360° excavator to protect ground formation and to give a safe working platform.

A 360° excavator with suitable approved lifting equipment will be used to unload reinforcing steel to required areas. The bottom matt of steel will be fixed prior to the tower cans, if used, being lifted into position. Steel cans, if used, will be lifted into position using a crane and approved lifting appliances and reinforcing steel will be positioned around cans in accordance with the turbine suppliers' requirements. The can will be levelled using the jacks at the base of the can. The top flange of the can will be checked to ensure it is level using an automatic optical level. The remaining reinforcing steel will then be fixed and earthing material attached. The level of can will be checked again prior to, and during the concrete pour. Alternative approaches such as the use of a foundation anchorage system will also be considered. The detailed design and exact dimensions will be determined once a turbine manufacturer has been selected following a competitive procurement process.
Formwork to concrete bases will be propped/supported sufficiently so as to prevent failure. Concrete for bases will be poured using a concrete pump. After a period of time when the concrete has set sufficiently, the top surface of the concrete surface is to be finished with a power float.

Once the base has sufficient curing time it will be filled with suitable fill up to existing ground level. The working area around the perimeter of the foundation will be backfilled with suitable material.

2.8.3 Site Roads and Crane Pad Areas

Site roads will be constructed to each turbine base and at each base a crane hard standing will be constructed to the turbine manufacturer's specifications. Tracked excavators will carry out excavation for roads with appropriate equipment attached. Material excavated to create the working area will be stored locally for later reuse in backfilling the working area around the turbine foundation. Any surplus excavated material will be sidecast, profiled and bermed as close to the excavation areas as practical as set out in the Peat Management Plan. A two to three-metre-wide working area will be required around each hard-standing area, with the sides of the excavated areas sloped sufficiently to ensure that slippage does not occur.

When the formation layer has been reached, stone from the on-site borrow pits or local quarries shall be placed to form the road foundation. In the event of large clay deposits being encountered in sections of road, a geotextile layer will be required at sub base level. The sub grade will be compacted with the use of a roller or other approved compaction method. The final top layer of unbound material will not be provided until all turbine bases have been poured. This prevents damage to the wearing course due to stone and concrete trucks movements. All roads will be maintained for the duration of the project.

2.8.4 Grid Connection Option(s)

As stated above, the proposed wind farm will connect to the existing national grid via either of two substation location options (Option A and Option B) and associated grid connections. Both options and their associated grid connections have been assessed in this EIAR. However, only one substation and associated grid connection will ultimately be constructed. The proposed wind farm will connect to the grid via either 110 kV overhead line or underground cable.

2.8.4.1 Substation Option A

Substation Option A is situated in the townland of Cloonfore. The proposed connection methodology for Option A is an overhead line. The expected distance of new build overhead transmission line for this option is approximately 480m. The details of the overhead line construction follow in section 2.8.4.4 below.

2.8.4.2 Substation Option B

Substation Option B is situated in the townland of Derraghan More. Both underground and overhead options are presented for Option B. Should the overhead line be the preferred connection method, the expected length of new build overhead transmission line for this option is approximately 1km and the details of the overhead line construction follow in section 2.8.4.4 below. Should an underground cable be the preferred option, approximately 1.5km of 110 kV underground cable will need to be installed as per section 2.8.4.3 below (750m distance from the substation to the existing overhead line).

Both substation option designs include for the construction and placement of battery storage units. The proposed construction of the battery storage area will include development of civil works for siting the battery storage units and associated ancillary equipment. The battery units and ancillary equipment will be crane lifted and affixed into their final positions. Once fixed into position, all electrical connections will made off and commissioned prior to entering into service.

2.8.4.3 110 kV Underground Cables

The number and layout of cables is an important consideration in the design of the site. Minimum safety distances and angles etc. must always be maintained. This has been a fundamental consideration in determining the final location of the station buildings and the Line Interface Cable Masts.

The cables will be installed primarily within the site as indicated on the planning application drawings with the exception of where they will be laid in a short section of the public roadway. It should be noted that works within the public road will be subject to further consents/agreements with Longford County Council for example a Road Opening Licence etc. as appropriate.

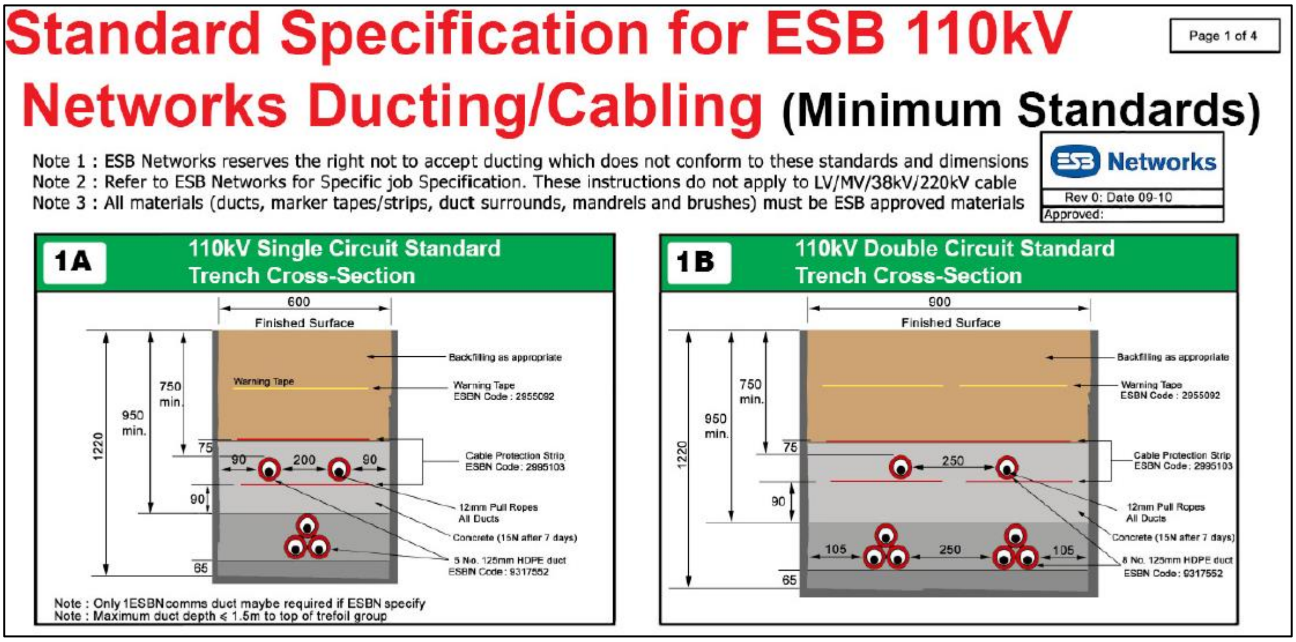


Figure 2.9: Figure from ESB Networks 110 kV cable installation specifications (www.esbnetworks.ie)

All cables will be laid in underground ducts and/or culverts. Ducts will be installed by open trenching. The typical sequence of operations for installing ducts in trenches is to strip off the ground material and top soil/peat. A trench is then formed to the required depth and width. The ducts are generally laid on a bed of lean mix concrete and surrounded with lean mix concrete. The small amount of surplus soil/peat will be used for local restoration and landscaping. Where the public road is excavated, or contaminants are found the material will be removed from site and disposed at an appropriately licenced facility.

The underground cable required to facilitate the grid connection will be laid beneath the surface of the site and/or public road using the following methodology:

- The area where excavations are planned will be surveyed, prior to the commencement of works, with a cable locating tool and all existing underground services will be identified.
- A trench will be opened using an excavator to accommodate the formation required as per the agreed ESB Networks standards and specifications or any updated versions.
- The excavated material will be cast to the side to be reused as backfilling material where appropriate.
- The trench will be surfaced as per the road surface specifications of the national or local public road or the wind farm road as appropriate.
- Cable joint pits are typically located at approximately 500m intervals, each joint pit will be approximately 2.5m x 6m in size with a communications chamber and an earth link box in close proximity to the joint pit. The detail of which can be seen on Planning Drawing 10325-

2030 and is typically located off road and adjacent to the public road and accessible for cable pulling and future maintenance.

Two cable interface masts will need to be inserted into the existing Overhead Line to facilitate the connection of the underground cables. The construction of these masts would generally follow the same process as detailed in section 2.8.4.4.2 for the installation of angle masts.

2.8.4.4 Grid Connection Overhead Line Option

The methodology for construction of a short section of overhead line will involve the following:

- Insertion of two angle masts in the existing overhead line;
- Construction of two end masts near the proposed station;
- Construction of additional angle masts where the route from the existing line to the station changes direction; and
- Construction of intermediate towers/polesets as necessary to achieve the design clearance of the line from the ground.

Whether an end mast, angle mast or cable interface mast is required the process of installation is generally as follows.

2.8.4.4.1 <u>Angle Mast Foundation</u>

The area to be excavated will be checked for existing underground services, an excavator will be utilised to excavate each of the four foundation bases (one for each mast leg) to the required dimensions and formation level, approximately 3m x 3m x 3m in depth. When each leg is excavated the formation levels (depths) are checked by the Site Engineer/Site Manager.

Excavated material will be stored on bog mats as necessary for future backfilling.

During any dewatering activities, a water filtration system will be utilised to control the amount of sediment in surface water runoff.

When the excavation has been completed and checked, the Contractor will fix the necessary steel reinforcement in the foundation base.

Any water in the excavation is pumped out prior to any concrete being poured into the foundation. Concrete trucks shall be brought as close as possible to the excavation to pour directly into the excavation. In the event of this not being possible, concrete shall be transported in 6 Tonne dumpers with covered skips and fitted with concrete chutes. The concrete is then poured into the excavation from formation level to a level approximately 1.5m below ground level.

Once the new blocks have been poured, the remaining part of the foundation, the shear block or neck is then formed. The shear block or neck refers to the concrete that is placed around the steel legs of the angle mast to protect them below ground level. Shuttering and steel reinforcement are required to form the concrete neck. Once the shuttering is complete the concrete may be poured and the foundation completed.

The remainder of the excavations are backfilled one leg at a time with the material previously excavated. The backfill is placed and compacted in layers ensuring that the turve layer is carefully placed on top. Any surplus spoil will be cast or placed to the side and landscaped/profiled to match the surrounding terrain. Waste will be removed from site for disposal by a licensed waste Contractor.

Once the mast base is completed and fully cured it is ready to receive the mast body. When the base construction crew leave site, they shall ensure to remove all surplus materials from the site including all unused excavated fill.

2.8.4.4.2 Angle Mast Assembly and Erection

The Mast will be assembled on the ground beside the foundation. A mobile crane will be used to erect the angle mast on the formed and cured foundations. Crane size and weight is generally dependent upon the size and weight of the angle mast in question. The mast erection procedure can often be completed in various sections (lifts) where the weight of the differing components deems it required. Mast sections are assembled on the ground and lifted into place. It is expected that in this case the mast will be erected in a single lift. Wheeled cranes may be used with access on stoned or bog mat access tracks.

Plate 2.3: Angle Mast erection by mobile crane

2.8.4.4.3 <u>Poleset Erection</u>

Polesets are framed on the ground adjacent to the required location.

Each pole should be buried to the depth specified on the design sheet. The minimum buried depth shall not be less than 2.3 metres. The Contractor should use a "1.5 foot" (0.45m) bucket to dig the hole and ensure that the hole is excavated to minimum size and not allowed to get excessively large. The hole should be carefully backfilled in small layers which should be compressed with the bucket to ensure good shear strength.

All polesets are to be installed with sleepers fitted, unless otherwise stated. For rock foundations, sleepering of poles is unnecessary. Refer to Planning Drawing 10325-2019 for details of the proposed polesets.

2.8.4.5 Stringing of Conductors:

Stringing of overhead lines refers to the installation of phase conductors and shieldwires where required on the supporting poleset or tower structures. The stringing will be completed in the straight sections and between the angle mast positions. To facilitate the pulling of the conductor through the structure location pulleys (stringing wheels) are attached to each structure. The conductor is kept clear of all obstacles along the straight by applying sufficient tension.

Once the conductor has been pulled into position, one end of the straight is terminated on the appropriate tension fittings and insulator assemblies. The free end of the straight is then placed in temporary clamps called "come-alongs" which take the conductor tension and the conductor is then cut from the puller-tensioner and the connection to the insulators and structures is completed.

2.9 ENVIRONMENTAL MANAGEMENT

2.9.1 Construction Phase Monitoring and Oversight

The requirement for a Construction and Environmental Management Plan (CEMP) to be prepared in advance of any construction works commencing on any wind farm site and submitted for agreement to the Planning Authority is now well-established.

A CEMP has been prepared for the proposed development and is included in Appendix 2.2. It is intended that the CEMP would be updated prior to the commencement of the construction of the wind farm, to ensure that all mitigation measures, conditions and or alterations to the EIAR and application documents that may emerge during the course of the planning process are included. Following the update, the CEMP will be submitted to the Planning Authority for written approval.

The CEMP also includes a Traffic Management Plan.

The construction contractor will be responsible for implementing the mitigation measures specified in the EIAR and CEMP and for communicating the requirements with all staff on-site. Their implementation of the mitigation measures will be overseen by the supervising Ecological Clerk of Works (ECoW), ecologists, archaeologists and/or geotechnical engineers, as appropriate.

2.9.2 Surface Water Monitoring during Construction

The surface water drainage system will require regular inspection during construction works and during operations to ensure that it is working optimally. Where issues arise, the works should be stopped immediately and the source of potential impacts on the surface water quality investigated.

Records of all maintenance and monitoring activities associated with the construction site will be retained by the Contractor on-site.

2.9.3 Concrete Deliveries

Only ready-mixed concrete will be used during the construction phase, with all concrete being delivered from local batching plants in sealed concrete delivery trucks. The use of ready-mixed concrete deliveries will eliminate any potential environmental risks of on-site batching. When concrete is delivered to site, only the chute of the delivery truck will be cleaned, using the smallest volume of water necessary, before leaving the site. Concrete trucks will be washed out fully at the batching plant, where facilities are already in place.

The small volume of water that will be generated from washing of the concrete lorry's chute will be directed into a temporary lined impermeable containment area, or a concrete wash unit. This type of unit catches the solid concrete and filters and holds wash liquid for pH adjustment and further solids separation. The residual liquids and solids can be disposed of off-site at an appropriate waste facility. Where temporary lined impermeable containment areas are used, such containment areas are excavated and lined with an impermeable membrane.

The areas are generally covered when not in use to prevent infill of rainwater. In periods of dry weather, the areas can be uncovered to allow much of the water to be lost to evaporation. At the end of the concrete pours, any of the remaining liquid contents is tankered off-site. Any solid contents that will have been cleaned down from the chute will have solidified and can be broken up and disposed of along with other construction waste.

Due to the volume of concrete required for each turbine foundation, and the requirement for the concrete pours to be continuous, deliveries are often carried out outside normal working hours in order to limit the traffic impact on other road users, particularly peak period school and work commuter traffic. Such activities are limited to the day of turbine foundation concrete pours, which are complete in a single day per turbine.

The risks of pollution arising from concrete deliveries will be further reduced by the following:

- Concrete trucks will not be washed out on the site but will be directed back to their batching plant for washout other than the delivery chutes.
- Site roads will be constructed to a high standard to allow transport of the turbine components around the site, and hence, concrete delivery trucks will be able to access all areas where the concrete will be needed. No concrete will be transported around the site in open trailers or dumpers so as to avoid spillage while in transport. All concrete used in the construction of turbine bases will be pumped directly into the shuttered formwork from the delivery truck. If this is not practical, the concrete will be pumped from the delivery truck

into a hydraulic concrete pump or into the bucket of an excavator, which will transfer the concrete to the location where it is needed.

- The arrangements for concrete deliveries to the site will be discussed with suppliers before work starts, agreeing routes, prohibiting on-site full washout and discussing emergency procedures.
- Clearly visible signage will be placed in prominent locations close to concrete pour areas specifically stating washout of concrete lorries is not permitted on the site.

2.9.3.1 Concrete Pouring

Because of the scale of the main concrete pours that will be required to construct the proposed wind farm, the main pours will be planned weeks in advance, and refined in the days leading up to the pour. Special procedures will be adopted in advance of and during all concrete pours to minimise the risk of pollution. These may include:

- Using weather forecasting to assist in planning large concrete pours and avoiding large pours where prolonged periods of heavy rain is forecast.
- Restricting concrete pumps and machine buckets from slewing over watercourses while placing concrete.
- Ensuring that excavations are sufficiently dewatered before concreting begins and that dewatering continues while concrete sets.
- Ensuring that covers are available for freshly placed concrete to avoid the surface washing away in heavy rain.
- Disposing of surplus concrete after completion of a pour will be off-site.

2.9.4 Refuelling

Wherever possible, vehicles will be refuelled off-site. This will be the case for regular, road-going vehicles. However, for construction machinery that will be based on-site continuously, a limited amount of fuel will have to be stored on site.

On-site refuelling of machinery will be carried out using a mobile double skinned fuel bowser. The fuel bowser, a double-axle custom-built refuelling trailer, will be re-filled off site or at the contractors site compound and will be towed around the site by a 4x4 jeep to where machinery is located. It is not practical for all vehicles to travel back to a single refuelling point, given the size of the cranes, excavators, etc. that will be used during the construction of the proposed wind farm. The 4x4 jeep will also carry fuel absorbent material and pads in the event of any accidental spillages. The fuel bowser will be parked on a level area in the construction compound when not in use.

Only designated trained and competent operatives will be authorised to refuel plant on site. Mobile measures such as drip trays and fuel absorbent mats will be used during all refuelling operations.

2.9.5 Road Construction

2.9.5.1 Permanent roads, including Amenity Roads (founded/floating)

The construction methodology for excavated roads, is summarised as follows:

- Interceptor drains should be installed upslope of the access road alignment to divert any surface water away from the construction area.
- Excavation of roads shall be to the line and level given in the detailed design requirements. Excavation should take place to a competent stratum beneath the peat (as agreed with the site designer).
- All excavated peat shall be placed/spread, profiled and placed alongside the excavations.
- Side slopes of the excavations will be battered as the excavation progresses.
- The surface of the excavated road will be developed using granular fill. The depth will vary based on the depth of peat and on the designer requirements.
- A layer of geogrid/geotextile may be required at the surface of the competent stratum (to be confirmed by the designer).
- A final unbound surface layer shall be placed over the excavated road, as per design requirements, to provide a road profile and graded to accommodate wind turbine construction and delivery traffic.
- An additional 50mm surface of quarry dust will be placed over the roads selected for use as amenity access roads.

The construction methodology for permanent floating roads, is summarised as follows:

- Permanent floating roads will be 6.0m wide and will be developed using CL804 surface on a CL803 or CL6F2 base.
- The floating road surface will be placed on suitable biaxial geogrid/geotextile, if required, and will be designed to accommodate local ground conditions.

Typical sections of a new permanent road are shown on Planning Drawing 10325-2023. Where required, the road widths will be increased to form the indicated passing bays.

2.9.5.2 Temporary Floating Roads

The construction methodology for temporary roads, is summarised as follows:

- Temporary floating roads will be 6.0m wide and will be developed using CL804 surface on a CL803 or CL6F2 base;
- The floating road surface will be placed on suitable biaxial geogrid/geotextile, if required, and will be designed to accommodate local ground conditions;
- Interceptor drains should be installed upslope of the access road alignment to divert any surface water away from the construction area; and
- Road construction should be carried out in sections of approximately 50m lengths.

Typical sections of a new temporary floating road are shown on Planning Drawing 10325-2023.

2.9.6 Dust Suppression

In periods of extended dry weather, dust suppression may be necessary along haul roads and around the borrow pit area(s) to ensure dust does not cause a nuisance. If necessary, water will be taken from stilling ponds in the site's drainage system and will be pumped into a bowser or water spreader to dampen down haul roads and site compounds to prevent the generation of dust. Silty or oily water will not be used for dust suppression, because this would transfer the pollutants to the haul roads and generate polluted runoff or more dust. Water bowser movements will be carefully monitored, as the application of too much water may lead to increased runoff.

2.9.7 Vehicle Washing

Wheels or vehicle underbodies are often washed before leaving sites to prevent the build-up of mud on public (and site) roads. Site roads will be already formed using on-site materials before other road-going trucks begin to make regular or frequent deliveries to the site (e.g. with steel or concrete). The site roads will be well finished with compacted hardcore, and so the public road-going vehicles will not be travelling over soft or muddy ground where they might pick up mud or dirt.

However, in the interest of best practice and to avoid the potential for the transfer of alien invasive plant species into the site, it is proposed to install a self-contained wheelwash system at the project site. Planning Drawing 10325-2031 includes typical details of a proposed self-contained wheelwash system which will be installed as part of the construction phase of works. The wheelwash will be located at the construction and delivery entrance of the site, off the R392, as shown on Planning Drawings 10325-2005 and 10325- 2011.

A road sweeper will be available if any section of the surrounding public roads becomes soiled by vehicles associated with the proposed development.

2.10 HEALTH AND SAFETY

The proposed Derryadd Wind Farm will be designed, constructed, operated and decommissioned in accordance with all relevant Health and Safety Legislation, including:

- Safety, Health and Welfare at Work Acts 2005 to 2014;
- Safety, Health and Welfare at Work (General Application) Regulations;
- Safety, Health and Welfare at Work (Construction) Regulations 2013; and
- Safety, Health and Welfare at Work (Work at Height) Regulations 2006.

Aspects of the development that will present health and safety issues include:

- Health and safety aspects of construction activities;
- General construction site safety (e.g. slip/trip, moving vehicles etc);
- On site traffic safety (during construction and operational phases) associated with high road embankments;
- Traffic safety during the transport of oversized loads to the site;
- Lifting of heavy loads overhead using cranes;
- Working at heights; and
- Working with electricity during commissioning.

2.10.1 Construction Phase

A Health and Safety Plan covering all aspects of the construction process will address the Health and Safety requirements in detail. This will be prepared on a preliminary basis at the procurement stage and developed further at construction stage.

All hazards will be identified, and risks assessed. Where elimination of the risk is not feasible, appropriate mitigation and/or control measures will be established. The contractor will be obliged under the construction contract and current health and safety legislation to adequately provide for all hazards and risks associated with the construction phase of the project. Safepass registration cards are required for all construction, delivery and security staff. Construction operatives will hold a valid Construction Skills Certificate Scheme card where required. The developer is required to ensure a competent contractor is appointed to carry out the construction works. The contractor will be responsible for the implementation of procedures outlined in the Safety and Health Plan. Public safety will be addressed by restricting site access during construction. Appropriate warning signs will be posted, directing all visitors to the site manager.

The scale and scope of the project requires that a Project Supervisor Design Process (PSDP) and Project Supervisor Construction Stage (PSCS) are required to be appointed in accordance with the provisions of the Safety, Health and Welfare at Work (Construction) Regulations. These roles have been performed by Tobin Consulting Engineers up to the end of the planning stage of the project.

The PSDP appointed for the construction stage shall be required to perform his/her duties as prescribed in the Safety, Health and Welfare at Work (Construction) Regulations. These duties include (but are not limited to):

- Identify hazards arising from the design or from the technical, organisational, planning or time related aspects of the project;
- Where possible, eliminate the hazards or reduce the risks;
- Communicate necessary control measures, design assumptions or remaining risks to the PSCS so they can be dealt with in the Safety and Health Plan;
- Ensure that the work of designers is coordinated to ensure safety;
- Organise co-operation between designers;
- Prepare a written Safety and Health Plan;
- Prepare a safety file for the completed structure and give it to the client; and
- Notify the Authority and the client of non-compliance with any written directions issued.

The PSCS appointed for the construction stage shall be required to perform his/her duties as prescribed in the Safety, Health and Welfare at Work (Construction) Regulations. These duties include (but are not limited to):

- Development of the Safety and Health Plan for the construction stage with updating where required as work progresses;
- Compile and develop safety file information
- Reporting of accidents / incidents;
- Weekly site meeting with PSCS;
- Coordinate arrangements for checking the implementation of safe working procedures. Ensure that the following are being carried out:
- Induction of all site staff including any new staff enlisted for the project from time to time;
- Toolbox talks as necessary;
- Maintenance of a file which lists personnel on site, their name, nationality, current Safe Pass number, current Construction Skills Certification Scheme (CSCS) card (where relevant) and induction date;
- report on site activities to include but not limited to information on accidents and incidents, disciplinary action taken and PPE compliance;

- Monitor the compliance of contractors and others and take corrective action where necessary; and
- Notify the Authority and the client of non-compliance with any written directions issued.

2.10.2 Operational Phase

Similar to the construction phase of the project, it is not anticipated that the operational phase of the wind farm will cause a significant negative impact on agricultural and commercial activities outside the development footprint and this will continue throughout the lifetime of the development.

It is not anticipated that the operation of the wind farm will present a danger to the public and livestock. Rigorous safety checks are conducted on the turbines during design, construction, commissioning and operation to ensure the risks posed to staff, landowners and general public are negligible.

Access to the turbines is through a door at the base of the structure, which will be locked at all times outside maintenance visits.

Signs will be erected at suitable locations such as, amenity access points and carparks, setting out the conditions of public access under the relevant legislation and providing normal hours (and out of hours) contact details. Staff associated with the project will conduct frequent visits, which will include inspections to establish whether any signs have been defaced, removed or are becoming hidden by vegetation or foliage, with prompt action taken as necessary.

Signs will also be erected at suitable locations across the site as required for the ease and safety of operation of the wind farm. These signs include:

- Buried cable route markers at 50m (maximum) intervals and change of cable route direction;
- Directions to relevant turbines at junctions;
- “No access to Unauthorised Personnel” at appropriate locations;
- Speed limits signs at site entrance and junctions;
- “Warning these Premises are alarmed” at appropriate locations;
- “Danger HV” at appropriate locations;
- “Warning – Keep clear of structures during electrical storms, high winds or ice conditions” at site entrance;
- “No unauthorised vehicles beyond this point” at specific site entrances; and
- Other operational signage required as per site-specific hazards.

An operational phase Health and Safety Plan will be developed to fully address identified Health and Safety issues associated with the operation of the site and providing for access for emergency services at all times.

The components of a wind turbine are designed to last up to 30 years and are equipped with a number of safety devices to ensure safe operation during their lifetime. During the operation of the wind farm regular maintenance of the turbines will be carried out by the turbine manufacturer or appointed service company. A project or task specific Health and Safety Plan will be developed for these works in accordance with the site's health and safety requirements.

2.11 WIND FARM OPERATION

The proposed wind farm development is expected to have a lifespan of 30 years. During this period, on a day-to-day basis, the wind turbines will operate automatically, responding by means of anemometry equipment and control systems to changes in wind speed and direction.

The wind turbines will be connected together, and data relayed from the wind turbines to a control centre. Each turbine will also be monitored off-site by the wind turbine supplier or Operations and Maintenance (O&M) service provider. The monitoring of turbine output, performance, wind speeds, and responses to any key alarms will be monitored at a control centre 24-hours per day.

Each turbine would be subject to a routine maintenance programme involving a number of checks and changing of consumables, including oil changes. In addition, there will be a requirement for unscheduled maintenance, which could vary between resetting alarms to major component changes requiring a crane. Typically, maintenance traffic will consist of four-wheel drive vehicles or vans. The electricity substations components and site tracks will also require periodic maintenance in accordance with appropriate operation maintenance plans, procedures and health and safety plans.

Once operational, the wind farm will support 6 – 8 long term, high quality technical jobs in operation and maintenance as well as a number of jobs in ancillary functions.

2.12 WIND FARM DECOMMISSIONING

As stated previously the wind turbines proposed as part of the proposed development are expected to have a lifespan of 30 years. Following the end of their useful life, the wind turbines may be replaced with a new set of machines, subject to planning permission being obtained, or the site may be decommissioned fully, with the exception of the electricity substation.

Upon decommissioning of the proposed wind farm, the wind turbines would be disassembled in reverse order to how they were erected. All above ground turbine components would be separated and removed off-site for recycling. Turbine foundations would remain in place underground and would be covered with earth and allowed to revegetate or reseed as appropriate. Leaving the turbine foundations in-situ is considered a more environmentally prudent option, as to remove that volume of reinforced concrete from the ground could result in potentially significant environment nuisances such as noise, dust and/or vibration. The majority of the site roadways will be in use for additional purposes to the operation of the wind farm (such as a mature amenity and recreational use) by the time the decommissioning of the project is to be considered, and therefore it will be more appropriate to leave the site roads in situ for future use. If it were to be confirmed that the roads were not required in the future for any other useful purpose, they could be removed.

The on-site substation will not be removed at the end of the useful life of the wind farm project as it will form part of the national electricity network. Therefore, the substation will be retained as a permanent structure and will not be decommissioned.

3 REASONABLE ALTERNATIVES

3.1 INTRODUCTION

In 2014, EIA Directive 2011/92/EU was amended by Directive 2014/52/EU and Article 5, relating to the preparation of an Environmental Impact Assessment Report (EIAR) by the developer, to state the following should be included regarding alternatives:

“a description of the reasonable alternatives studied by the developer, which are relevant to the project and its specific characteristics, and an indication of the main reasons for the option chosen, taking into account the effects of the project on the environment” (Article 5(1)(d)).

This is further reinforced in Annex IV which refers to the information to be included in an EIAR (as per Article 5(1)) and states the following:

“2. A description of the reasonable alternatives (for example in terms of project design, technology, location, size and scale) studied by the developer, which are relevant to the proposed project and its specific characteristics, and an indication of the main reasons for selecting the chosen option, including a comparison of the environmental effects.”

In the European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018 (S.I. No. 296 of 2018) Article 97 which contains the revised Schedule 6 – information to be contained in EIAR outlines in article 2 (b) that:

“(b) a description of the reasonable alternatives (for example in terms of project design, technology, location, size and scale) studies by the person or persons who prepared the EIAR, which are relevant to the proposed development and its specific characteristics, and an indication of the main reasons for selecting the chosen option, including a comparison of environmental effects:”

This chapter will examine the alternatives as required above.

3.2 METHODOLOGY

3.2.1 Standards and Guidance Documents

The following documents and guidance were reviewed in the preparation of this chapter:

- Draft Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (EPA, 2017);
- Environmental Impact Assessment of Projects - Guidance on the preparation of the Environmental Impact Assessment Report (European Union, 2017);
- Transposition of 2014 EIA Directive (2014/52/EU) in the Land Use Planning and EPA Licencing Systems (DoHPCLG, 2017);
- Directive 2014/52/EU of the European Parliament and of the Council of 16 April 2014 amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment; and
- Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment (Department of Housing, Planning and Local Government, 2018).

Consideration was also given to the following as part of the literature review:

- Draft Advice Notes for Preparing Environmental Impact Statements (EPA, 2015);
- Draft Revised Guidelines on the information to be contained in Environmental Impact Statements (EPA, 2015);
- Advice Notes on Current Practice (in the preparation of Environmental Impact Statements) (EPA, 2003); and
- Guidelines on the information to be contained in Environmental Impact Statements (EPA, 2002).

3.2.2 Approach

There is limited European and national guidance on what constitutes a ‘reasonable alternative’. It is noteworthy that the aforementioned EU Guidance Document (EU, 2017) states that reasonable alternatives *“must be relevant to the proposed project and its specific characteristics, and resources should only be spent assessing these alternatives”.*

It also states that “the selection of alternatives is limited in terms of feasibility. On the one hand, an alternative should not be ruled out simply because it would cause inconvenience or cost to the Developer. At the same time, if an alternative is very expensive or technically or legally difficult, it would be unreasonable to consider it to be a feasible alternative”.

There is also limited guidance on the level of detail to be provided. However, the current Draft EPA Guidelines (EPA, 2017) state that *"It is generally sufficient to provide a broad description of each main alternative and the key issues associated with each, showing how environmental considerations were taken into account is deciding on the selected option."*

3.2.3 Structure of the Chapter

The Draft 2017 EPA guidance suggest alternatives be considered under the following headings:

- 'Do Nothing' Alternative;
- Alternative Locations;
- Alternative Layouts;
- Alternative Design;
- Alternative Processes;
- Alternative Mitigation Measures; and
- Consultation about the consideration of the alternatives.

Each of these is addressed in the following sections.

When considering a wind farm development, given the intrinsic link between layout and design, the two will be considered together in this chapter.

3.3 ALTERNATIVES CONSIDERED

3.3.1 'Do-Nothing' Alternative

An alternative to developing a wind farm at the proposed development site would be to leave the site as it is, once peat extraction ceases. The date of cessation of peat extraction is primarily dependent on the continued use of milled peat as a fuel in the Lanesborough Power station. Peat extraction has already ceased on parts of the site and will reduce on an increasing area year on year. When peat extraction ceases, a Site Rehabilitation Plan will be implemented in accordance with the IPC licence requirements, to encourage re-vegetation of bare peat areas, with targeted active management being used to enhance re-vegetation and the creation of small wetland areas (if required).

In implementing the 'Do-Nothing' alternative, however, the opportunity to capture a significant part of County Longford's renewable energy resource would be lost, as would the opportunity to contribute to meeting Government and EU targets for the production and consumption of electricity from renewable resources and the reduction of greenhouse gas emissions. The opportunity to generate local employment, a development contribution, rates and investment would also be lost. Also, the proposed amenity access points and associated carparks would not be constructed as part of the rehabilitation and, therefore, this recreational opportunity would be lost as well as the proposed connectivity with Lanesborough, the Royal Canal and Corlea Trackway. On the basis of the positive environmental effects arising from the project, the do–nothing scenario was not the chosen option.

3.3.2 Alternative Locations

Bord na Móna owns circa 80,000 hectares of land, primarily in the midlands of Ireland. An assessment of potential future uses of this landbank was published by Bord na Móna in 2011 in a document entitled *'Strategic Framework for the Future Use of Peatlands'*. This report clearly identified the potential for the development of renewable energy (in particular Wind Energy) and other developments on Bord na Móna lands.

The Project Ireland 2040 National Planning Framework identifies a range of Key future planning and development and place-making policy priorities for the Eastern and Midland Region that includes

'Harnessing the potential of the region in renewable energy terms across the technological spectrum from wind and solar to biomass and, where applicable, wave energy, focusing in particular on the extensive tracts of publicly owned peat extraction areas in order to enable a managed transition of the local economies of such areas in gaining the economic benefits of greener energy.'

Consequently, when considering suitable locations for the proposed development, the assessment was confined to lands within the Bord na Móna landholding only as these lands have been identified in a regional context as being suitable for this type of development. An examination of sites outside of the landholding was not included as part of the process.

The assessment carried out for the determination of a suitable location for the proposed development was a two-stage process. The first stage comprised the identification of a number of candidate sites while the second phase comprised a site-specific assessment. Each of these stages are described in the following sections.

3.3.2.1 Selection of Candidate Sites

In order to identify candidate sites i.e. sites considered suitable for wind energy development, Bord na Móna conducted a technical review of lands which are either cut away or will be cut away before 2030. This involved Desk Studies and On-Site Surveys of the landbank. Known constraints were then applied across the landbank. The constraints applied were derived from various industry and regulatory guidelines (such as IWEA Best Practice Guidance 2012 and the Wind Energy Planning Guidelines 2006), available Geographical Information Systems (GIS) datasets and on-site surveys (carried out as part of the peat extraction activity), and included the following:

- Planning Policy Context;
- Proximity to Sensitive Receptors;
- Peat Depths;
- Consistent suitable wind speeds;
- Proximity to the national electricity grid; and
- Proximity to Designated sites/Environmental Sensitivities.

This methodology was used to generate a list of potential sites for further consideration. Over twenty sites were identified as having a higher potential for wind energy development and were then brought forward for the site-specific assessment, as detailed overleaf.

A review of the Offer Process Application Information that is provided on the publicly available EirGrid website indicates a total of 21 Bord na Móna sites that are in the application process for grid connection. These sites are outlined in Table 3.1 below:

Table 3.1: Bord na Móna Grid Connection Applications (January 2016)

Bord na Móna Grid Connection Applications – January 2016	
Littleton	Ballybeg
Derryadd	Clorhane 2
Ballydermot 1	Leamonoghan
Clongawny	Derryarkin
Lisclogher	Ballydermot 3
Timahoe 2	Garryhinch
Clorhane 1	Timahoe 1
Derryaghan	Derryarogue
Coolnamona	Leamonoghan
Ballydermot 2	Derryarkin
Drinagh	

3.3.2.2 Site-specific Assessments

The site-specific assessments were conducted by the Bord na Móna Powergen wind energy development team with input from other in-house experts where required e.g. the Bord na Móna Works Management, Central Engineering, Construction, Ecology and Land and Property teams. The aim of the site-specific assessments was to gauge the sites with the best potential to deliver a successful wind farm project by the early to mid-part of the next decade, i.e. 2020 - 2025. The ultimate end goal was to select a project to bring forward, for which preliminary engineering designs and a planning application could be prepared.

For the site-specific assessment of the candidate sites, a number of criteria were chosen which not only covered the broad range of issues which can arise in wind farm development, but also allowed for direct comparison of the candidate sites to each other to determine their relative suitability for wind farm development. The site-specific selection criteria and outline of basis for assessment for each criterion are listed in Table 3.2.

Table 3.2 Site-specific Selection Criteria

Criterion	Basis for Assessment
Grid Access/Capacity	Grid Access/Capacity means potential of the National Grid to accommodate future projects on the network. The proximity of the project to suitable grid nodes (i.e. those with spare capacity) should facilitate the selection of a project for a viable grid connection offer.
County Development Plans and Zoning	County Development Plans typically indicate the areas of a county which are deemed preferred, open to consideration and not suitable for wind farm development. Bord na Móna has committed not to develop wind farms in areas deemed unsuitable for wind farm development.
Proximity to Houses	Refers to how close turbines are to residences.
Wind Resource Assessment	The available wind resource (i.e. wind speed) directly relates to the potential electrical output available from the site.
Environmental Sensitivity	Environmental Sensitivity is the ecological sensitivity of the site based on proximity to sensitive areas within or around the site.
Landscape Capacity/ Cumulative Impact	Depends on the landscape's capacity to absorb wind farm developments.
Aviation	Airspace control and use to be considered.

Criterion	Basis for Assessment
Land Use	Internal Bord na Móna consideration relating to the residual peat depth, peat harvesting plans, and alternative uses of each bog.
Communications Infrastructure	Telecoms masts and signals in the vicinity and across the sites to be considered.
Flood Plain Analysis	Flood Plain Analysis assesses the wind farm's location in terms of historical flooding data.
Supporting Infrastructure	Sites with better road access require less modifications or upgrade to the local infrastructure to facilitate construction or delivery of turbine components to site.

A weighted score was awarded to each site under each criterion. Higher weightings were given to key criteria such as environmental sensitivity, Grid access/capacity, County development plans/zoning and proximity to houses. The scores for each site were totalled following the assessment to determine the most suitable site for the proposed wind energy development.

3.3.2.3 Site Selection Results

Following the site-specific assessment process carried out in late 2015, the site proposed for the Derryadd Wind Farm Development emerged as the preferred location. A summary of the findings under each criteria is provided in Table 3.3.

Table 3.3: Summary of the key findings with respect to the site chosen for the proposed development site

Criterion	Proposed Development Site
Grid Access/Capacity	The proposed development site scored well in terms of proximity to existing grid infrastructure and also in terms of available grid capacity at the relevant nodes. Close proximity of gird infrastructure has a positive environmental effect arising from the reduction in the construction impact on soils/geology and surface water.
County Development Plans and Zoning	The proposed development complies with the policies of the Regional Planning Guidelines and the Longford County Development Plan 2015 – 2021. It is predominantly located in a preferred area for such development.

Criterion	Proposed Development Site
Proximity to Houses	In general. Bord Na Móna sites are surrounded by low density rural housing, and most sites have a relatively large proportion of their land area free from proximity issues. The proposed development site is a long narrow site and a larger proportion of the land area has proximity issues. However, given the extent of the lands it was considered that the setback distance requirements (as indicated in Wind Energy Development Guidelines 2006) could be met at this location.
Wind Resource Assessment	The mean Wind Atlas wind speed was calculated per site and the wind speed for the proposed development site was considered sufficient in the context of the efficiency and nature of modern day turbine technology.
Environmental Sensitivity	There are no sites designated under the EU Habitats Directive (SACs) and EU Birds Directive (SPAs) located within the footprint of the proposed development. The nearest European designated site is Lough Ree SPA/SAC approximately 2km to the west (as described in the AA Screening Report). The closest nationally designated site is Lough Bawn pNHA which is located adjacent to the site to the south-east. On-site habitat mapping completed by the Bord na Móna Ecology team provided information on areas of biodiversity interest within the site. However, given the extent of lands available it was considered that none of these areas would be significantly impacted by the proposed development.
Landscape Capacity/ Cumulative Impact	Currently there are no wind farm developments existing or with planning in County Longford. The closest wind farm development to the proposed development site is Sliabh Bawn Wind Farm. The boundary of the wind farm is located approximately 8km to the north west in County Roscommon. Further details are included in Chapter 9, Landscape and Visual Impact.
Aviation	The proposed development site does not lie under airspace designated a Military Operational Area (MOA) or restricted for military use. The site is not used for low flight training purposes or does not lie under a helicopter transit or Emergency Aeromedical Service (EAS) route.

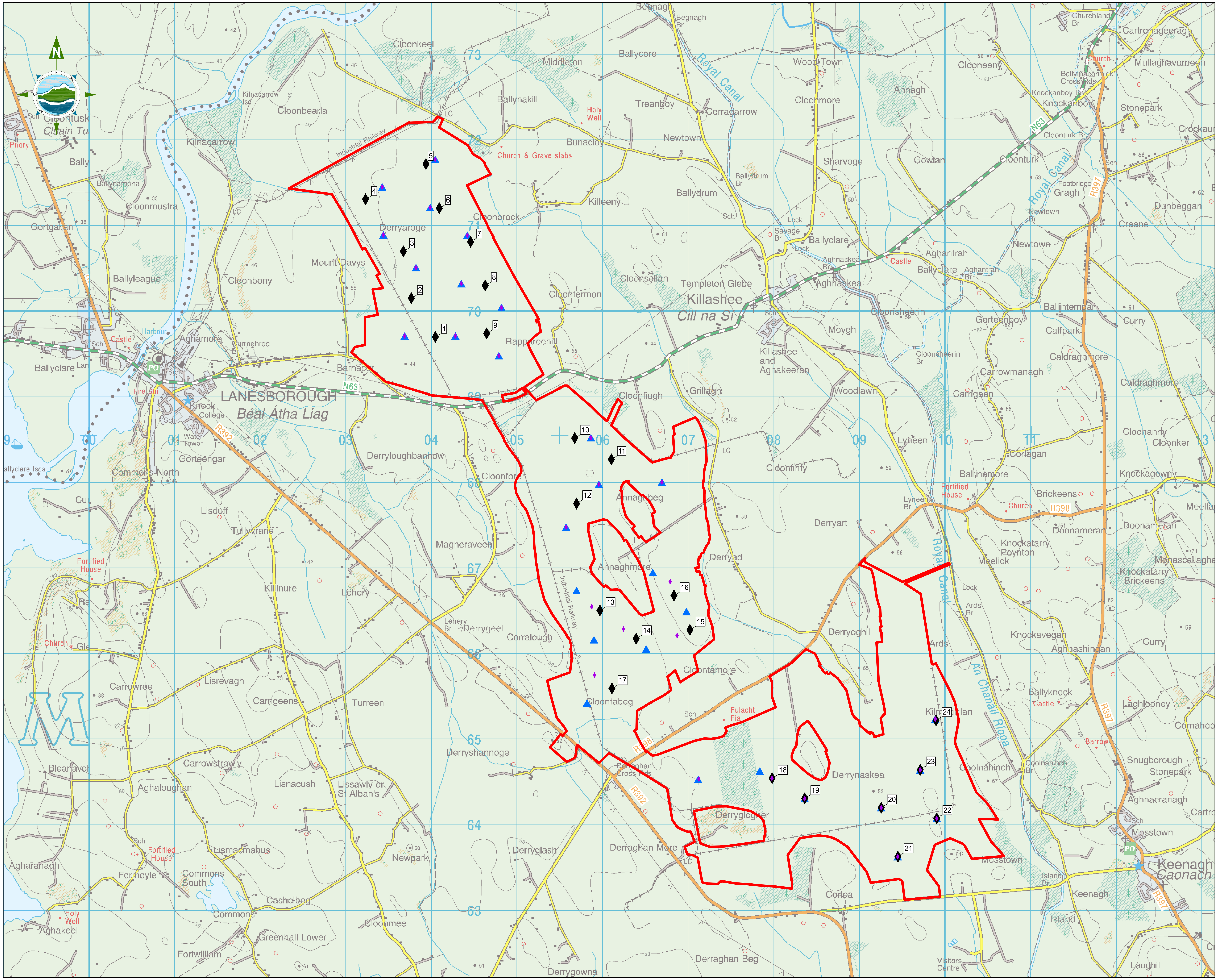
Criterion	Proposed Development Site
Land Use	While peat extraction still continues within the Mountdillon Bog Group it was not considered to be a constraint to the proposed development given the timelines involved.
Communications Infrastructure	There are a number of radio communication links in the vicinity of the proposed development however only a small number encroach on the boundary of the proposed wind farm. As this criterion does not impact project viability it was considered that any potential issues could be overcome by engineered solutions if required. (i.e. wind farm layout design or additional telecom relay masts).
Flood Plain Analysis	The Mountdillon Bog Group as a whole did not score well in terms of flooding due to historic flooding events, however, it was considered that this criterion would not impact project viability as significant areas within the group do not experience large scale flooding events. Any such issues will be overcome by avoiding those areas prone to flooding or through engineered solutions where necessary.
Supporting Infrastructure	The proposed development site scored well in terms of proximity to existing road infrastructure in terms of ease of delivery of turbine components. As outlined previously it also scored well in terms of proximity to grid infrastructure.

The criteria outlined in Table 3.2 can be regarded as either a constraint to the proposed development or a facilitator for the proposed development. For example, the level of flooding at the site may reduce the available ‘buildable ‘area or the lack of flooding may highlight the suitability of the site. The environmental effect of significant flooding may arise due to a requirement for deeper and more extensive drainage leading to potential downstream surface water impacts. In the case of Bord na Móna lands the existing onsite drainage is a facilitator to the project as surface water is already managed in accordance with the EPA administrated IPC licence. It is noteworthy that the process described in the preceding paragraphs is not a one-off process for ranking the candidate sites in terms of their suitability for wind energy developments. The site selection process is revisited in its entirety for each individual project selection and the criteria updated to take account of any changes that have occurred (i.e. policy, legislative, environmental etc.) since the previous site selection process was conducted.

3.3.3 Alternative Layouts / Design

During the EIAR stage, the study area (as outlined in the Biodiversity chapter, Chapter 6) was surveyed in detail to establish the baseline environment. All site constraints were identified and updated as further detailed assessment was undertaken. The locations of county roads, streams, residential dwellings, landowner boundaries, telecommunication links, ecologically sensitive areas, areas of deep subsoil and peat depositions, archaeological sites and visually sensitive areas were noted. Separation distances to identified constraints were determined using a Geographical Information System (GIS) (refer to Figure 2.2, Chapter 2, Description of the Proposed Development for the Derryadd Wind Farm Constraints Map).

The site layout design stage considered the size, number and positioning of turbines and layout of associated site infrastructure i.e. internal roads, temporary construction compounds, met masts, substations, borrow pits etc. Alternatives considered for each of these elements are documented in the following sections. It was an iterative process comprising input from the design team, environmental specialists, internal and external stakeholders. As an iterative process, environmental effects were reduced or eliminated through changes to the design, where possible. The alternative designs considered for the Derryadd Wind Farm are illustrated in Figure 3.1 and Figure 3.2, herein.



Legend

- Planning Application Area
- Proposed Turbine Locations 2018 (24)
- Proposed Turbine Locations 2017 (28)
- Proposed Turbine Locations 2016 (29)

0 200 400 800 1,200 1,600
Metres

Issue	Date	Description	By	Chkd.
A	Jan. 2019	Final Issue	MN	ST

Client:

BORD NA MÓNA
Naturally Driven

Project:

DERRYADD WIND FARM

Title:

SITE LAYOUT
DESIGN HISTORY MAP
TURBINE LOCATIONS

Scale @ A1: 1:20,000

Prepared by: M. Nolan
Checked: S. Tinnelly
Date: November 2018

Project Director: D. Grehan

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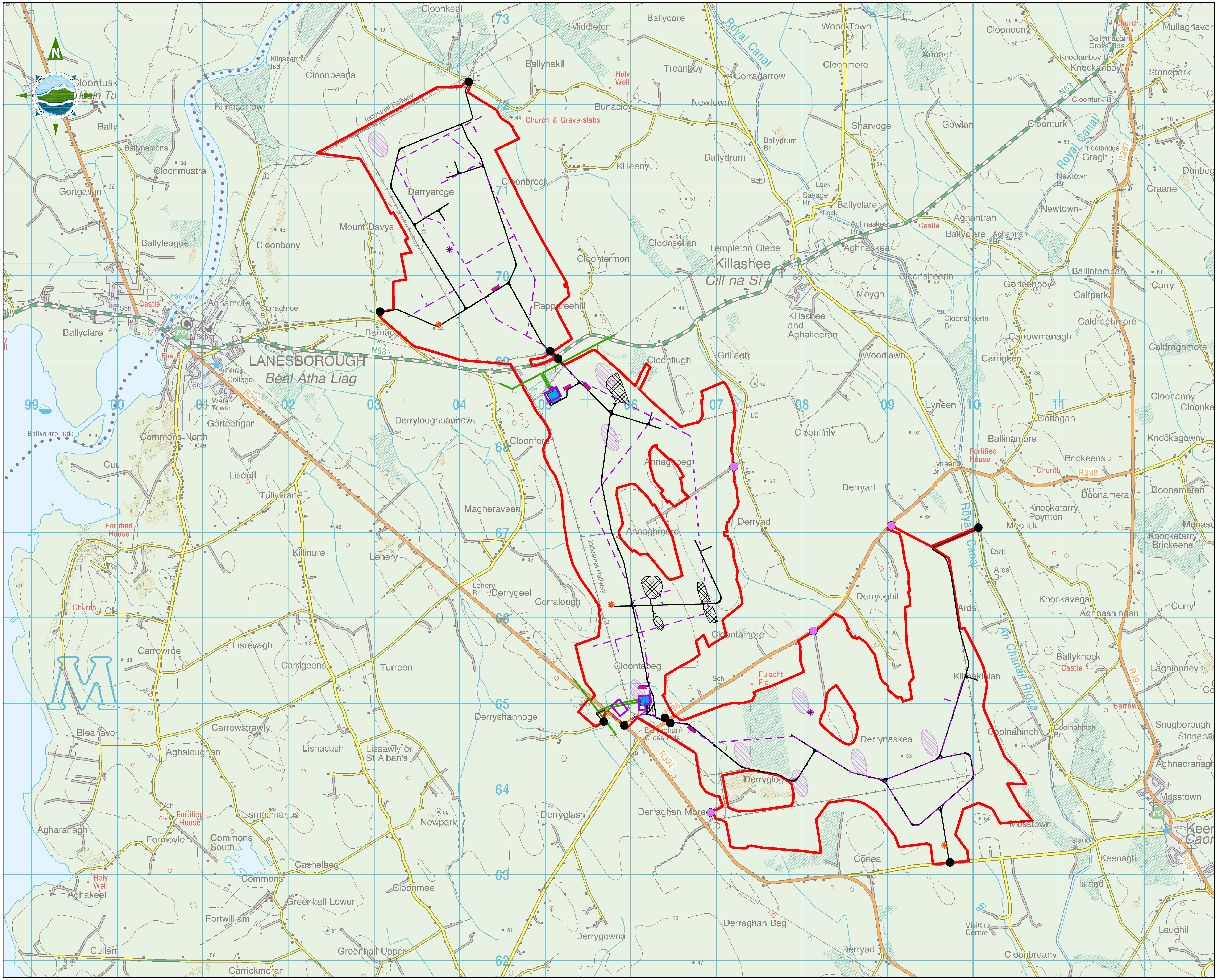
Figure 3.1

Issue: A



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Legend

- Planning Application Area

2018 Infrastructure (Current 24 Turbine Layout)

- Proposed Internal Roads 2018
- Borrow Pit Locations 2018
- Proposed Substation Options 2018

2017 Infrastructure (28 Turbine Layout)

- Proposed Internal Roads 2017
- Potential Borrow Pits 2017
- Proposed Substation Options 2017

Constant / New Infrastructure (No changes)

- Overhead Line
- UG Cables
- Temporary Construction Compounds
- Proposed Met Mast Locations
- Existing Met Mast Locations
- Proposed Site Access Location
- Considered Site Access Location

0 200 400 800 1,200 1,600
Metres

Issue	Date	Description	By	Chkd.
A	Jan. 2019	Final Issue	MN	ST

Client:
BORD NA MÓNA
Naturally Driven

Project:

DERRYADD WIND FARM

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Figure 3.2

Issue: A

3.3.3.1 Turbine Layouts

As outlined previously, constraints/facilitators (outlined in Table 3.3 and detailed in the Constraints Map, Figure 2.2, Chapter 2) to wind farm development and turbine placement were identified and surveyed in detail as part of the EIAR process.

The final proposed turbine layout takes account of all significant site constraints and the distances to be maintained between turbines and from houses (includes existing and daft guidance), roads, etc. The layout is based on the results of all site investigations and environmental assessments that have been carried out since 2014 and during the development of the EIAR. As information regarding the site of the proposed development was compiled and assessed, the number of turbines, the size of turbines and the proposed layout were revised and amended to take account of the physical constraints of the site and the requirement for buffer zones and other areas which were not favourable for turbine location.

The selection of turbine number, size and layout has also had regard to wind-take, noise and shadow flicker impacts and the separation distance to be maintained between turbines. The EIAR and wind farm design process was an iterative process, where findings at each stage of the assessment were used to further refine the design, always with the intention of minimising the potential for environmental impacts. The development of the final proposed wind farm layout has resulted from feedback from the assessments carried out during preparation of this EIAR, statutory consultation and information supplied from an extensive Public Consultation process with local communities (2016 – 2018) in the vicinity of the proposed site.

The various considerations that were taken into account include:

- Turbine proximity to dwellings;
- Turbine size
- Noise and shadow flicker guidelines;
- Distance from archaeological sites to turbine locations;
- Distance from sensitive habitats to turbine locations;
- Distance from water bodies to turbine locations;
- Turbine spacing;
- Avoidance of any interference with telecommunications systems;
- Visibility of the proposed development in the landscape;
- Distance from the site boundary to turbine locations; and
- Proximity of met masts to dwellings

Consideration was also given to relevant guidance, namely the Wind Energy Development Guidelines (DoEHLG, 2006), Best Practice Guidelines for the Irish Wind Energy Industry (IWEA, 2012); Draft Guidelines on the information to be contained in Environmental Impact Assessment Reports (EPA, 2017) and guidelines and recommendations from the relevant local authority's county development plans and wind energy strategies.

The initial constraints study identified a significant viable area within the proposed development site, in which a potential turbine layout was developed. This turbine layout was then refined a number of times following feedback from the project team during detailed site investigations and from consultees, including public consultation. These iterations resulted in the number of turbines reducing from 29 in the initial design, to 28 in the interim layout and down to 24 in the current layout (as shown in Figure 3.1). The adjustments through each layout iteration resulted in a reduction in the number of turbines, and also placement changes to turbines to ensure sufficient distances were maintained from sensitive receptors and constraints, and to maintain the required separation distances between turbines. The positive environmental effects of the reduction of the number of turbines include the following : a decrease in the amount of materials used in the construction of the wind farm (stone, concrete, steel) and associated traffic movements, a reduction in the length of the internal road network and the disturbance and movement of peat within the site, a reduction in the potential disturbance and collision risk for those species using the site, a decrease in the overall impact on the habitats within the site and a reduction in the level of potential visual impact . On this basis, the 24 turbine layout was the chosen option.

3.3.3.2 Alternative Turbine Configurations

The proposed wind farm will have an estimated power output of approximately 96 Megawatts (MW). Having regard to the available wind resource and the selected power output for the proposed wind farm, it is proposed to install 24 No. turbines at the site using wind turbines in the *circa* 4 MW range. Such a wind farm could also be achieved on the proposed site by using smaller turbines (for example 2 MW machines). However, this would necessitate the installation of 48 No. turbines to achieve the same site output.

Furthermore, the use of smaller turbines would be a less efficient use of the wind resource available having regard to the nature of the site. A larger number of smaller turbines would result in the wind farm occupying a greater footprint within the site, with a larger amount of supporting infrastructure being required (i.e. roads, internal collector cables etc.) and increasing the potential for negative environmental effects to occur. The proposed number of turbines takes account of all site constraints and the distances to be maintained between turbines and features such as roads and houses, while maximising the wind energy potential of the site. The 24-turbine layout selected for the site has the smallest development footprint of the other alternatives considered, while still achieving the required output than would be achievable using different turbine sizes.

The turbine model to be installed on the site will be the subject of a competitive tendering process. The maximum height of the turbines that will be selected for construction on the site will not exceed 185m when measured from top of foundation level to highest blade tip position. For the purposes of the EIAR, the worst-case scenario of turbines within this size envelope has been assessed (e.g. tallest turbine within defined range has been assessed for visual impact, loudest for noise, longest rotor for shadow flicker and blade transport, etc.). The EIAR therefore provides a robust assessment of the turbines that could be considered within the overall development description. The use of alternative significantly smaller turbines would not be appropriate as they would fail to make the most efficient use of the wind resource passing over the site. Furthermore, the increased use of materials, excavation and movement of peat and increase in visual impact associated with a larger number of smaller turbines would result in a higher level of negative environmental effects than the chosen option.

3.3.3.3 Site Entrances

Arising from the existing peat extraction activity, there are a significant number of entrances to the site, as shown in Figure 3.2 (and Figure 2.6, Chapter 2). The main site footprint comprises of three bog areas within the Bord na Móna Mountdillon Group of Bogs, namely Derryaroge, Derryadd and Lough Bannow Bogs (and a small section of Derryshannoge Bog).

There are four entrance points to Derryaroge Bog that were identified. They are a mixture of machine and rail entrances. All four were considered as part of the design process. The final design identified two of the entrances to be used as amenity access points and a third entrance to be used for amenity access, construction and operation of the proposed wind farm. The amenity only entrances are located on the western boundary of the site (onto the Mount Davys access road) and on the eastern boundary of the site accessing the local road at Ballynakill. The proposed combined amenity/construction/operation entrance is located on the N63. Utilisation of this entrance for construction activities reduces the potential impact of this type of traffic on the local roads around this part of the site. The other entrances were considered for this use but the existing N63 entrance was deemed to be the optimal choice as it is an existing entrance with good sightlines requiring the minimum of upgrade for use and therefore minimal environmental effects. A fourth entrance along the existing rail line to the west of the site was also considered as both an amenity and a construction/operation entrance. This option was not chosen due to the potential impact on third party lands and the nature of the local road in that area.

There are five existing entrances to Derryadd Bog. Two are located along the N63, one is located on the southern boundary along the R398 and two are located on the eastern side of the bog along a local road. The existing entrances are used for the trafficking of either peat extraction machinery, local access to third party lands, rail traffic or traffic associated with the Mountdillon works. One of the entrances along the N63 was chosen as an amenity/construction/operation entrance. This entrance is located directly across from the existing southern entrance to Derryaroge Bog. The existing entrance to Mountdillon Works located to the west of this entrance was not chosen in order to reduce the amount of interaction between the works traffic and the wind farm traffic particularly during the construction phase. The existing southern entrance along the R398 was also chosen as an amenity/construction/operation entrance. This entrance facilitates connectivity between Derryadd Bog and Lough Bannow Bog. The existing entrances to the east of the bog were not chosen to reduce the potential impact of construction, amenity and operation traffic on the local road. A new entrance is proposed to facilitate the delivery of oversize components to the site. The new entrance is proposed to access the site from the R392 on the western side of Derryadd Bog. Alternatives that were considered for the large component entrance included existing entrances to the site along the N63 between Derryaroge and Derryadd and an existing entrance to Lough Bannow along the R392 to the south of Derraghan cross. The entrances along the N63 were not chosen for large turbine component delivery due to the potential effect on buildings within Lanesborough to facilitate access onto the N63. The existing entrance along the R392 at Lough Bannow was not chosen for a number of reasons. It is the access entrance to the national headquarters of the ISPCA. It is located to the south of Derryaghan settlement and therefore large turbine components would have to pass through the settlement. The new entrance location is in close proximity to Substation Option B and would, therefore, provide easy access to the substation should this option be constructed.

There are five active and one inactive existing entrances to Lough Bannow Bog. There are three active entrances located along the R398 on the northern boundary of the bog. There is one inactive entrance on the eastern side of the bog that connects the bog to the towpath along the Royal Canal. There is a single active entrance on the southern boundary of the bog that accesses a local road north of the Corlea Trackway Visitor’s Centre. There is an existing active site entrance along the R392 that also accesses the ISPCA headquarters. Following assessment, two existing entrances (one active and one inactive) were chosen as amenity specific access points. These access points are onto the Royal Canal and the local road close to the Corlea Trackway Visitor Centre. Both of these locations will provide excellent connectivity between the site and these existing tourism/amenity attractions. The amenity/construction/operation entrance chosen was along the R398 directly across from the southern entrance to Derryadd. Construction traffic will spend a minimum amount of time on the local road network as it moves from one bog unit to the next. The existing entrance on the western side was not chosen in order to minimise any interaction between construction or operation traffic and traffic that are accessing the ISPCA along the access road.

Finally, access to the 110 kV overhead line on Derryshannoge Bog will be through an existing junction along the R392 and along a short section of the L11554 local road. A new entrance onto the R392 was considered. However, as access is required for a short period of time during the construction phase and for maintenance during the operational phase, the existing access to this location was considered to be sufficient and to represent the lowest potential negative environmental effect option.

3.3.3.4 Internal Access Roads

The development of the wind farm will require the construction of internal access roads on-site. Access roads are required to allow plant and machinery access to the turbine locations, transport of turbines and construction materials to each of the turbine locations and also to allow service vehicles traverse the site during the operational phase. Such tracks must be of a gradient and width sufficient to allow safe movement of equipment and vehicles.

Access road layout and design is also an iterative process. The initial layout was designed to minimise construction of new roads by following the existing access tracks where possible and linking turbine locations via the most direct route, avoiding environmental (higher value habitat) and archaeological constraints.

The initial design was further developed by applying the required vehicle turning radii. The road layout was modified with each revision of the turbine layout. Passing bays were designed for selected locations along the internal roads. These bays were located in specific areas to ensure minimum environmental effect by locating the passing bays away from higher value habitat and also in a configuration that facilitates the design of the amenity pathways/cycleways.

Finally, amenity paths were added linking the overall development to the public access points around the site. Further information is provided in Section 3.3.3.7.

3.3.3.5 Substation Locations and Grid Connection

The planning application provides for two potential substation locations and associated grid connection options (Option A and Option B). All reasonable potential grid connection solutions were examined during the design phase. For example, a potential underground grid connection route was considered before substation location and design was completed. This additional solution consisted of an underground cable connection from the site to the existing substation located adjacent to the Lough Ree Power station. This option did not progress to the design stage as it was considered that such a solution would require trench excavations over a significant distance and also interaction with third party landowners to establish way leaves. It is considered that this option would have had a higher potential for negative environmental effect. The chosen options represent the minimum disturbance to the area and consequently the lowest environmental impact. If consented and based on anticipated EirGrid post planning system studies and subsequent grid connection offer, only one substation and associated grid connection will ultimately be constructed, as described in Chapter 2, Description of the Proposed Development.

The proposed wind farm will connect to the grid via a short section of overhead line or via underground cable through Bord na Móna lands and along the curtilage of the public road. Final design of the grid connection will be subject to receiving consent for a grid connection offer and the nature of the offer arising from EirGrid post planning system studies.

3.3.3.6 Borrow Pits

The use of onsite borrow pits, if available, would represent an efficient use of existing onsite resources and would also significantly reduce the need to transport large volumes of construction materials along the surrounding public road network to the site.

Consequently, a review of potential borrow pit locations was carried out in consultation with internal Bord na Móna personnel with input from field studies and external geotechnical experts who were familiar with the site. Existing GIS data was also considered, namely aerial photography and peat depths etc.

Arising from this process, nine initial potential borrow pit locations were identified (See Figure 3.2). An assessment of each location was carried out having regard to existing site constraints (habitat value, on site drainage, proximity to the proposed internal road network), and proximity to sensitive receptors was also considered (local residents, ISPCA,). Site investigation work provided further information on potential borrow pit locations, and a specific Borrow Pit Assessment was subsequently carried out to determine the optimum locations. Analysis of the results of this assessment identified five suitable borrow pit locations and also determined the volume and suitability of the resource available. The five locations chosen are considered to have minimal impact on the existing drainage, sensitive habitats and fauna within the site and minimal impact on sensitive receptors adjacent to the site. The assessment of these five locations has been included for consideration in this EIAR.

3.3.3.7 Proposed Derryadd Wind Farm Amenity Plan

The Amenity Plan for the proposed development was prepared by a specialist consultant (Deirdre Black & Associates) in consultation with the project design team and relevant stakeholders, in particular, Longford County Council and the local community. The full plan is discussed in Chapter 2 and appended in Appendix 2.3.

The objective of the Plan is to open up the peatland landscape to local communities by developing a network of walking and cycling routes through the proposed development site, using the proposed site access roads and dedicated amenity pathways/cycleways. This would connect settlements and form local connections to the wider greenway and blueway network. In this context, alternatives considered were the following:

- Access Points; and
- Internal walking/cycling loops.

3.3.3.7.1 <u>Access Points</u>

An assessment of existing and proposed amenity facilities in the wider local area, in particular walking and cycling networks, was carried out. These networks were mapped and the proposed site location and internal road network overlain. From this, a number of potential access points, where the internal road network could be extended to connect with the surrounding road network and offsite amenities, was determined. Following this process, a review of the proposed access points was carried out in conjunction with the design team and relevant stakeholders. Onsite constraints (i.e. ground conditions, peat depths, and environmental parameters (including habitat sensitivity) and offsite constraints (i.e. local access to connectivity points) identified during the EIAR baseline assessment process were superimposed onto the proposed amenity plan and the most suitable access points were determined. From this process, a total of ten access points were selected. An additional four access points were identified but not chosen in the final design.

3.3.3.7.2 <u>Internal Loops</u>

Following an analysis of the proposed wind farm layout and an appraisal of the wider amenity and tourism context, consideration was given to whether linear or looped connections through the site would be most suitable for walking and cycling.

Following consultation with the design team and relevant stakeholders it was determined that in light of the broader greenway/blueway context, loops are more likely to be regularly used by local residents rather than longer distance linear connections whereas visitors to the area may prefer point to point linear paths. Therefore, it was decided to utilise a mixture of looped facilities that were connected to each other and longer linear paths connecting specific locations such as Lanesborough to Corlea trackway so that users could opt to do shorter or longer walks/cycles as desired.

In total, three loops were proposed - the Derryaroge Loop, the Lough Bannow Loop and the Corlea/Lough Bannow/Royal Canal/Keenagh Loop.

3.3.4 Alternative Processes

3.3.4.1 Alternative Land-Uses

As peat production ceases over the coming years, Bord na Móna will be presented with the opportunity to allow or facilitate new landscapes to develop. Research work, mainly in the form of demonstration projects, has been ongoing since the 1970's. The research and demonstration projects informed the understanding of the nature of industrial peatlands and facilitated the development of a knowledge base that has been built up over decades. The alternative uses that have been examined over that timeframe include renewable energy (in particular, wind energy), biomass, coniferous forestry, horticulture, grassland, cereal growing, growth of cranberries and blueberries, biodiversity/ecosystem services and amenity/tourism related after uses.

Wind farm development on Bord na Móna lands commenced in 1992 with the construction and operation of the Bellacorick Wind Farm, Co. Mayo. Since then two additional wind farms were constructed and became fully operational in 2015 at Bruckana and Mountlucas. Construction has also commenced on a fourth wind farm at Oweninny in County Mayo and planning consent has been secured for a fifth at Cloncreen, Co. Offaly. This alternative use of cutaway peatlands has been clearly demonstrated to be successful and have a low level of environmental effects.

Short rotation forestry trials carried out in the 1970's directly on cutaway bog, without intrusive conversion of the growing medium, did not survive and died out within a few years. Further trials in 2005 on well prepared cutaway failed to provide the necessary yield to make the growing of willow biomass viable. The yield was less than 20% of the yield attainable on good arable land.

Afforestation was initially envisaged as the most favourable commercial option for the after-use of post-production peatlands. Trials on this particular use date back to 1955. The initial trials were favourable; however, the growing performance was poor. In 1996, the BOGFOR research programme was set up by a group of organisations that included Bord na Móna, Collite, the COFORD Council for Forest Research and Development and University College Dublin. Arising from this research, a further 10 trial sites have been developed in the last 15 years. None of the sites have demonstrated 100% the required commercial success. A further trial using a bedding plough was established in 2010. Trials of this type of after use are ongoing. The trials have not progressed sufficiently to provide conclusive results.

Horticultural trials were carried out at Lullymore during the 1960's up to the 1970's. A range of field vegetables were successfully grown during the trials. However, it was not possible to replicate the success of the trial at other locations. The specific peat type at Lullymore had particular characteristics and the research did not transfer to other demonstration sites.

The techniques for the conversion of cutaway bogland to grassland was developed during the 1970's and 1980's. A total of 1,500 hectares of cutaway was successfully converted and subsequently sold to the private sector. The ability to convert cutaway to grassland requires specific conditions and it is estimated that a small percentage of cutaway (10%) would be suitable for this use. Furthermore, due to the level of cost associated with this type of conversion, the economic circumstances are presently not favourable.

Cereal growing was also examined. However due to the specific mixture of macro and micro nutrients required at certain stages of its growth, this option did not prove successful.

Cranberries and Blueberries both require acidic media for their growth and were therefore trialled on deep acidic peat. Despite the successful establishment of cranberries, the necessary weather conditions to promote the development of fruit did not prevail and are not typical of the midland region. Neither plants are considered as a viable option.

The potential Biodiversity and Ecosystem Services that may arise from the careful management of rehabilitated cutaway peatlands has been recognised in the development of the 2010-2015 Bord na Móna Biodiversity Action Plan and the more recent Biodiversity Action Plan 2016-2021. Bord na Móna has rehabilitated close to 12,000 hectares of the company's boglands which amounts to over fifteen percent of its total landholding to date. As part of that work, the company has actively restored over 1,000 hectares of raised bog since 2009 and aims to increase this figure in the next six years.

The flagship project that demonstrates the amenity and tourism potential of cutaway peat lands is Lough Boora Parklands in Co. Offaly (http://www.loughboora.com/). The parklands include a range of tourism and amenity activities, including walking and cycling trails, fishing and angling amenities and opportunities for bird watching. The amenity use of the Mountlucas Wind Farm in conjunction with the production of renewable electricity illustrates that the after use of cutaway peatlands may comprise more than one use and may also facilitate additional developments.

In addition to the alternative land uses listed above, Bord na Móna is also exploring the potential for the development of an aquaculture project on cutaway peatlands and also the potential to site solar farms within those areas that are post peat production. In April 2017, Bord na Móna and ESB publicly announced a joint venture to develop 500MW of solar energy on cutaway peatlands. The selection of a solar farm site requires a solar development specific set of constraints/facilitators to be examined. The first location selected for potential development is the Timahoe North Bog located in Co. Kildare.

However, notwithstanding the range of uses considered and explored by Bord na Móna over its lands, the proposal to develop a wind farm at Derryadd has been identified as the most appropriate and sustainable use of the cutaway bog at the proposed site.

Over the coming decades, increasingly greater areas of the Bord na Móna land bank will come out of peat production and be available for alternative land uses. Bord na Móna's *'Strategic Framework for the Future Use of Peatlands'* (2011) sets out a strategic framework for the consideration of future potential uses of cutaway peatlands. The document is available to view at www.bordnamona.ie and is currently being updated to take account of policy change since its publication.

3.3.4.2 Alternative Sources of Energy

Currently, most of Ireland's energy is produced using fossil fuels such as gas, oil, coal and peat. The large-scale use of carbon intensive fossil fuel releases large quantities of carbon dioxide (CO_2) and other pollutants into the atmosphere, which contribute to the process of climate change and other detrimental health and environmental effects.

When considering wind energy as an energy source, it is important to place its development in an international, national and local policy context from the perspectives of environment, energy and planning. Numerous legislative mechanisms and requirements from a global to local level have been formulated to support the generation of energy from renewable sources and reduce the dependency on fossil fuels and these are discussed in further detail within Chapter 4 Policy, Planning and Development Context.

At a national level, in December 2015 the Government published an Energy White Paper, entitled *'Ireland's Transition to a Low Carbon Energy Future 2015 – 2030'*. It is set firmly in the Global and European context, which has put energy security and climate change among the most urgent international challenges. This paper sets out the Government's Energy Policy from now until 2030. The three core objectives (the 'three energy pillars') are sustainability, security of supply and competitiveness. The target is that GHG emissions will be reduced by 80% to 95% below 1990 levels by 2050 and to zero or below by 2100. This will be achieved by a range of measures including changes of behaviour, greater efficiency, use of renewable indigenous resources etc. Large scale wind energy projects continue to be seen as providing a significant contribution to achieving this target. The proposed wind farm will help in the delivery of growth in the renewable energy sector, by delivering approximately 96MW of capacity.

The primary alternative is to continue to generate electricity using finite, fossil fuel resources beyond 2030. This will further contribute to greenhouse gas and other emissions and hinder Ireland in its commitment to meet its target to increase electricity production from renewable sources and to reduce greenhouse gas emissions.

Bord na Móna is continuing to diversify its portfolio of renewable energy assets as it transitions from the harvesting and combustion of peat. This transition is evident across the land bank and will progress with the potential development of additional wind farms, solar farms, increased use of Biomass in the co-firing with peat, landfill gas, Biogas and battery storage. A key input to ensuring a successful and sustainable transition is the selection of the correct technology for the correct site.

With respect to the listed technologies for production of renewable energy, the reasons why the use of wind energy technology on this particular site produces the lowest level of environmental effects are as follows:

- Large scale solar farms require a significantly higher footprint than wind farms to produce the equivalent level of electricity. This technology can therefore have a greater impact on sensitive habitats. In the context of the Derryadd site, the use of wind energy technology reduces the potential environmental effects with respect to this particular aspect.
- Co-firing of peat and biomass is an activity that is proposed to utilise the existing peat fired power stations. The alternative for Derryadd would be the construction of a new peat/biomass power station. This would result in additional environmental effects above the activity of the existing power stations.
- Landfill gas production is only possible through colocation with an existing municipal landfill. Therefore, this is not an option for Derryadd.
- Biogas production facilities generally have a relatively small footprint and tend to be located adjacent to the national gas network to facilitate gas injection. Utilisation of this site for this purpose is possible and it could form an additional use of the site. The Derryadd site has a number of benefits such as its relative remoteness in comparison to the surrounding agricultural land, it is a single connected land bank and it is a brownfield site. If the site was not used for wind energy production then another less suitable (less remote, disconnected

and greenfield) site may be required in order to meet the required renewable electricity targets for 2030 that would result in a higher level of environmental effects.

- Battery storage technology is not a renewable electricity generation technology. It is a complementary technology and is proposed as a storage element of the project.

Bord na Móna lands by their relatively remote nature can facilitate large scale developments such as wind farms. As previously outlined, a detailed constraints/facilitators analysis has been carried out that demonstrates that the Derryadd site is a highly suitable location for the deployment of wind energy.

3.3.5 Alternative Mitigation Measures

The mitigation measures proposed in relation to the elements of the project are detailed in the chapters to follow and are also summarised in Chapter 17 - Matrix of Mitigation Measures. The mitigation measures proposed are considered to be proven and best practice. The level of mitigation proposed is determined to be proportionate to the potential impact. On this basis, the chosen mitigation measures are those that are considered to have the least environmental effects.

3.3.6 Consultation about the consideration of the alternatives

Details of the consultations held in respect of the proposed development are listed in Chapter 1, Section 1.10. All meetings, public consultations and submissions received to date have been reviewed and incorporated into the design and layout process, as appropriate.

3.4 CONCLUSIONS

Renewable energy resources include wind, solar, water (hydropower, wave and tidal), heat (geothermal) and biomass (wood, waste) energy. These sources are constantly replenished through the cycles of nature, unlike fossil fuels, which are finite resources that are becoming increasingly scarce and expensive to extract. Renewable energy resources offer sustainable alternatives to our dependency on fossil fuels as well as a means of reducing greenhouse gas emissions and opportunities to reduce our reliance on imported fuels. These resources are abundantly available in Ireland, yet only a fraction has been tapped so far (Sustainable Energy Authority of Ireland (SEAI) website, www.seai.ie).

A gradual shift towards increasing our use of renewable energy resources would result in:

- Reduced carbon dioxide emissions;
- Secure and stable energy for the long-term;
- Reduced reliance on fuel imports; and

- Investment and employment in our indigenous renewable energy projects; often in rural and underdeveloped areas.

When weighed against all of the alternatives and constraints/facilitators outlined in this chapter, the proposed Derryadd Wind Farm site has been found to be a highly suitable location for a wind farm site with regard to a number of criteria including wind speed, environmental effects, distance from dwellings and landscape character. The location is particularly appropriate with regard to the foregoing and with regard to ease of access, proximity to the grid connection and strategic renewable energy zoning.

4 POLICY, PLANNING AND DEVELOPMENT CONTEXT

4.1 INTRODUCTION

This chapter assesses the planning history, the planning and development context and the planning need of the proposed Derryadd Wind Farm development. This chapter includes a review of relevant international, national and local policy documentation, legislation, strategies and plans.

This assessment demonstrates that the proposed wind farm development is consistent with the current energy and planning policy context, which seeks to increase the share of electricity generation from renewable sources and locate wind energy developments in suitable locations, thereby minimising any environmental impacts. This assessment also demonstrates that there is a clear 'need' for this type of development in a national and regional context.

The proposed 24 wind turbine development will be located on four bogs within the Mountdillon Group of peat production bogs, namely Derryaroge, Derryadd, Derryshannoge (part of) and Lough Bannow cutaway bogs which are located in south County Longford, as shown on Figure 1.1. The site has a total area of approximately 1,900 hectares and is located in an area which lies between the towns and villages of Lanesborough, Derraghan, Keenagh, and Killashee. The surrounding landscape is a mixture of forestry, agricultural land and cutaway peatland, and is predominately flat. The Royal Canal and Lough Ree are located to the east and west respectively, and the River Shannon passes the northern boundary of the proposed development site.

The site on which the proposed development will be located is cutover peatland that is currently being used for peat extraction by Bord na Móna to predominantly provide fuel for the nearby Lough Ree Power Station at Lanesborough. Refer to Figure 1.1 for Site Location Map. A full description of the proposed development is provided in Chapter 2 – Description of the *Proposed Development.*

The proposed wind farm will constitute a significant addition to Ireland's overall renewable energy generating capacity and will also provide a generating capacity of renewable energy in the area. Due to the scale of the proposal, the project is of strategic economic and social importance to the Region and the State. The capital investment required for a project of the scale proposed will represent a significant economic contribution to the Region and the State as a whole. The project will assist in meeting national renewable energy targets and will also result in significant reductions in carbon emissions from electricity generation and reduce the reliance on imported fossil fuels, and will assist in the transition from the dependency on fossil fuels to energy generation from renewable sources.

There are 264 wind farms in the Republic of Ireland (IWEA, 2019[2]). In 2017, wind energy comprised 26.1% of the fuel mix for electricity generation (www.eirgridgroup.com). Installed capacity was 3,424 MW at the end of May 2018. A record 2826 MW of electricity was produced by wind on 12/1/18 (IWEA). The use of renewables in electricity generation in Ireland reduced our CO_2 emissions by 2.6 million tonnes in 2014 (Government White Paper: Ireland's Transition to a Low Carbon Energy Future 2015-2030).

The 'All Island Generation Capacity Statement 2017-2026' assumes that government targets on production of electricity from renewable resources will largely be achieved from wind energy. It notes that installed capacity of wind generation has grown from 145 MW at the end of 2002 to over 2,600 MW at the time of writing of that report. The 2017 estimates provided by IWEA indicate that almost 536 MW were installed in 2017. It is estimated that wind capacity will grow to between 3,900 and 4,300 MW by 2020.

4.2 PLANNING LEGISLATION

The 7th Schedule of the Planning and Development Act 2000 (as amended) sets out classes of development which, following consultation with An Bord Pleanála, may be considered to constitute Strategic Infrastructure Development (SID) under Section 37A of that Act. Class 1 of the 7th Schedule includes the following:

An installation for the harnessing of wind power for energy production (a wind farm) with more than 25 turbines or having a total output greater than 50 megawatts.

In view of the fact that the development proposed fits into this category, consultations were held with the Board under Section 37B of the Act and the Board issued a determination that the development does constitute Strategic Infrastructure for the purposes of Section 37A. A copy of the Board's determination is included in Appendix 1.1. The planning application for the proposed development, which this EIAR will accompany, will be made to An Bord Pleanála under Section 37E of that Act.

4.3 PLANNING HISTORY OF THE EXISTING SITE

There have been a number of previous planning applications on the proposed development site, including:

- **Register reference 08/623** - a grant of planning permission (dated 20/03/09) for a wind monitoring mast at Derryaroge. This permission was for a period of five years.

[2] https://www.iwea.com/about-wind/facts-stats

- **Register reference 14/35** - a grant of planning permission (dated 6/05/14) for retention of a wind monitoring mast at Derryaroge. This refers to the same mast as permitted under 08/623. This revised permission was granted for a period of 10 years.
- **Register reference 15/86** – a grant of planning permission (dated 25/08/15) for a wind monitoring mast at Derrynaskea (Lough Bannow Bog). This permission was granted for a period of five years.

4.3.1 History of neighbouring wind farm developments

Planning permission Roscommon County Council register reference 10/507 (Appeal Ref. 20.239743) – a grant of planning permission issued to Coillte Teo. on 27/3/2012 for a development comprising 20 turbines at Sliabh Bawn, Strokestown, County Roscommon. The planning permission has a life of 10 years with a permission for the wind farm for a period of 25 years from the date of commissioning. The site is located about 8km to the NW of the current site. This wind farm has been constructed and is operational since March 2017.

Planning permission Roscommon County Council register reference 04/103 (Appeal Ref. 20.208733) – a grant of planning permission issued to Provento Ireland PLC on 19/1/2005 for a development comprising 2 no. turbines at Skrine, Athleague. The turbines have a stated 64m hub height and 70m blade diameter. An extension of time was granted to Gaelectric on this planning permission, extending it until 18/1/2010. This site is nearly 20km to the SW of the current site. This wind farm has been constructed.

Planning permission Roscommon County Council register reference 17/2255 and 13/3005 - an application for development of a wind farm with 2 No. Wind Turbines with a tip height of up to 170 metres, at Ballaghaderreen, County Roscommon (Roosky Wind Farm). This wind farm is located approximately 14.5km to the north of the proposed development.

4.3.2 Other Recent Planning Permissions in Vicinity of Site

In order to determine if there are any significant proposed developments in the vicinity of the site that might be impacted upon by the proposed wind farm, all recent planning applications in the vicinity of the site have been monitored and reviewed. This provides information with regard to potential as well as existing receptors in the vicinity of the site as well as information concerning potential cumulative impacts on the environment. The most significant of these are outlined below:

Planning permission Longford County Council register reference 18/35– a grant of planning permission issued to Harmony Solar on 15/08/2018 for a ten year permission for a solar farm on a site of approximately 51.38 hectares consisting of the following: up to 216,000 m^2 of solar photo-voltaic panels on ground mounted steel frames to accommodate between 35MW to 50MW of electrical capacity; substation and control room and associated hard standing; 14 no. inverter/transformer stations; underground power and communication cables & ducts; boundary security fence; CCTV cameras; upgraded internal access tracks; new internal access tracks and associated drainage infrastructure; provision of passing areas on lands adjacent to the L-11261 local road; access will be via the L-11261 local road through the upgrade of an existing agricultural entrance and at the existing entrance to Middleton House; and temporary construction compounds and all associated site services & works at the townlands of Middleton, Ballycore, Treanboy and Newtown, near the village of Killashee, Co. Longford.

Planning permission Longford County Council register reference 18/146 – a grant of planning for development on the 26/08/18 at a site comprising lands within the property of the former Atlantic Mills factory. The development will comprise the construction of a solar farm with an export capacity of approximately 4MW comprising photovoltaic panels on ground mounted frames, with associated infrastructure including a switch gear control room (to be developed at 1 of 2 location options on site - no additional works proposed to the existing substation on site as part of this application), ducting and electrical cabling, internal access roads, fencing and all associated site development works at Fisherstown, Clondra, Co. Longford.

Planning permission Longford County Council register reference 18/139 - (Cloon – Lanesboro 110 kV Overhead Line) - a grant of planning issued for development on the 21/08/18 at the site of the existing Cloon to Lanesboro 110 kV Overhead Line, approximately 65 kilometres long. Approximately 37km of the existing circuit is located within the functional area of Galway County Council with approximately 27km located in County Roscommon and approximately 120 metres located in County Longford. The refurbishment works within County Longford will be undertaken at structure EM365, located within the Lanesboro Substation in the townland of Aghamore (Rathcline By). The development will consist of the refurbishment of the Cloon – Lanesboro 110 kV Overhead Line which will primarily include: replacement of a large proportion of existing structures, the breaking out and reconstruction of the concrete foundation and shear blocks at the majority of end/angle mast structures, painting of mast structures, replacement of insulators, crossarms, stays and/or fittings on existing structures; and the fitting of bird flight diverters and stay guards. No additional structures are proposed along the existing circuit. Any replacement structures will be constructed at, or immediately adjacent to the existing structures they will replace and will be of a generally similar height and appearance.

The remaining key permissions identified concern dwelling houses, domestic extensions, farm buildings, septic tanks, a mobile phone mast etc. and are listed in Appendix 4.1.

4.4 PLANNING AND DEVELOPMENT POLICY CONTEXT

When considering wind as an energy source, it is important to place its development in an international, national and local policy context from the perspectives of environment, energy and planning. This section outlines the legislative mechanisms and requirements from a global to local level, which have been formulated to support the generation of energy from renewable sources and reduce the dependency on fossil fuels.

4.4.1 UN Global Policy Context

It is now accepted in the scientific community that human activities and our use of fossil fuels are contributing to climate change. Most of the energy we use to heat our homes, for electricity and transport come from fossil fuels such as oil, gas and coal. As a result, levels of greenhouse gases (GHGs) in the atmosphere have increased markedly and our energy usage has steadily increased.

The Intergovernmental Panel on Climate Change (IPCC) indicates that from 2000-2010, greenhouse gases increased on average by 2.2% per annum. Without additional efforts to reduce greenhouse gas emissions, mean surface temperature increases in 2100 are forecast to be between 3.7°C to 4.8°C compared to pre-industrial levels. (IPCC WGIII AR5, published in April 2014.) It states: "*Human influence on the climate system is clear, and recent anthropogenic emissions of greenhouse gases are the highest in history. Recent climate changes have had widespread impacts on human and natural systems*." It concludes that global warming is undeniable and that human behaviour is a significant cause. Long term impacts include impacts from storm surges, sea-level rise, flooding, periods of extreme heat, extreme weather events, impacts on food and water security and loss of ecosystems and biodiversity.

The *United Nations Framework Convention on Climate Change* (UNFCCC) set out a series of targets through the Kyoto Protocol, which was agreed in 1997. Subsequently, the UNFCCC has agreed to restrict the average global temperature increase to less than 2°C compared to pre-industrial levels.

The 21st Conference of the Parties to the UNFCCC (COP 21), took place in Paris in 2015. The Parties aimed to agree a new legally binding agreement on climate change. For Ireland, this includes a reduction of at least 40% in domestic GHG emissions by 2030 compared to 1990.

The 2018 UN Climate Change Conference took place in Katowice between the 2nd and 14th of December 2018. This reached an agreement on the implementation of what had previously been agreed in Paris.

This includes how governments will measure, report on and verify their emissions-cutting efforts which are intended to strengthen delivery of what had been agreed. A further conference is planned this year (2019) in Chile.

4.4.2 European Legislative and Policy Context

The EU adopted the 2020 Climate and Energy Package by the European Council in December 2008. The objectives of the package include:

- Reduce GHG emissions by at least 20% compared to 1990 levels.
- Reduce primary energy consumption by 20% compared with projected levels.
- Achieve a 20% level of EU energy consumption from renewable sources.

The Renewables Directive (EU Directive 2009/28/EC) introduced legally binding targets on Member States for the consumption of renewable energy (from electricity, heating and cooling, and transport) by 2020. This included the overall, legally binding target of 16% of Irish energy requirements from renewable sources by 2020.

The European Council agreed on a 2030 climate and energy policy framework for the EU (2030 Framework for Climate and Energy, 2014.). The Council endorsed a binding EU wide target of a reduction in GHG emissions of at least 40% by 2030, compared to 1990 levels. The Framework aims to move the economy and energy system of the European Union towards a low-carbon economy.

Definitive new limits for greenhouse gas emissions for each Member State are to be proposed. Emphasis is also placed on energy efficiency. A target to increase renewable energy at EU level to at least 27% of the energy consumption of the EU by 2030 is included. Arising from a statement on the 14th of June 2018 the European commission has agreed to increase the target and sets a new, binding, renewable energy target for the EU for 2030 of 32%, including a review clause by 2023 for an upward revision of the EU level target.

In October 2009, Member States committed to reduce EU greenhouse gas emissions by 80 – 95% below 1990 levels by 2050. The European Commission published its Communication on an Energy Roadmap 2050 in December 2011. Such reductions will require EU energy production to become almost carbon free. The Roadmap analyses scenarios through which the consequences of decarbonising the EU energy system are assessed. Under all scenarios, there will be a significant increase required in renewable energy deployment in Europe.

EUROPE 2020: A European strategy for smart, sustainable and inclusive growth

This Communication from the European Commission addresses the issues of sustainable development in the European Union in the light of recent economic challenges. Sustainability is at the heart of this document. This includes the need for the production of clean energy and reduction of greenhouse gas emissions. It notes the savings that this will deliver in terms of reduced oil and gas imports. Objectives include limiting greenhouse gas emissions by 20% or even 30%, providing 20% of energy needs from renewables and increasing energy efficiency by 20% (all compared to 1990 levels). Ireland's objectives are a 20% reduction in non-ETS (Emissions Trading System) emissions by 2020 and a further reduction by 2030 (both relative to 2005 levels) with 40% of electricity from renewable energy resources. Ireland's non-ETS emissions targets are a 20% reduction in emissions by 2020 and a further reduction by 2030 (both relative to 2005 levels). (see *White Paper: Ireland's Transition to a Low Carbon Energy Future 2015-2030, Paragraph 61*).

4.4.3 National Policy

Renewable Electricity Policy and Development Framework

The government is in the process of preparing the *Renewable Electricity Policy and Development Framework.* This document is currently subject to a process of Strategic Environmental Assessment. It will set out policy to facilitate large scale, onshore, renewable electricity developments, work toward a low carbon future, enhance security of supply and facilitate competitiveness. It will identify strategic areas in Ireland for renewable electricity generation. It will provide planning guidance for assessing such proposals, supplementing the guidance contained in the existing Wind Energy Development Guidelines for Planning Authorities, 2006; (see *Draft Renewable Electricity Policy and Development Framework: Draft Strategic Environmental Assessment Scoping Report, 2016*). The main draft document has not yet been published.

Climate Action and Low Carbon Development Act 2015

The Climate Action and Low Carbon Development Act was passed in 2015. Under this act, the government shall adopt a national mitigation plan, and a national adaptation framework with a view to achieving a low carbon, climate resilient and environmentally sustainable economy by the end of the year 2050. The government will also establish, and has done so, a Climate Change Advisory Council which shall advise and make recommendations on the national mitigation plan and national adaptation framework.

Strategy for Renewable Energy 2012-2020

This document was produced by the Department of Communications, Energy and Natural Resources in 2012. It makes renewable energy central to the development of energy policy in Ireland. It noted that there is potential for export of renewable energy as Ireland's renewable resources significantly exceed demand. It sets out a number of strategic goals which includes an increase in renewable electricity from onshore and offshore wind farms for both the domestic and the export market. It supports the target of achieving 40% renewable electricity generation.

National Renewable Energy Action Plan to 2020

This document was submitted to the EU to set out the detailed schemes and policies which will guide Ireland's development of renewable energy resources in order to meet its targets of 2020 under European Directive 2009/28/EC. It notes the target of 40% of electricity generation from renewable sources by 2020. This is mainly from onshore wind generation. This would be achieved by the receipt of grid connection offers for 3,900MW of renewable generation over 18 months from December 2009 if subsequently built out by 2020.

National Policy Position on Climate Action and Low Carbon Development (2014)

In 2014, the Government adopted the National Policy Position on Climate Action and Low Carbon Development. It seeks an aggregate reduction in carbon dioxide (CO_2) emissions of at least 80% (compared to 1990 levels) by 2050 across the electricity generation, built environment and transport sectors as well as an approach to carbon neutrality in the agriculture and land-use sector, including forestry, which does not compromise capacity for sustainable food production.

White Paper- Ireland's Transition to a Low Carbon Energy Future 2015-2030

The White Paper sets out to guide the Government's Energy Policy from now until 2030. The three core objectives (the 'three energy pillars') are sustainability, security of supply and competitiveness. The target is that GHG emissions will be reduced by 80% to 95% below 1990 levels by 2050 and to zero or below by 2100. This will be achieved by a range of measures including changes of behaviour, greater efficiency, use of renewable indigenous resources etc.

It is the Government's target to increase the share of final energy consumption made up of renewable energy sources to 16% by 2020; this includes a target of 40% in the case of electricity supply.

More specifically, by 2030, the government will have achieved a range of objectives including:

- the highest possible level of energy efficiency;
- be a leader in renewable energy deployment;
- the energy system will be part of a single, physically interconnected EU internal energy market;
- a marked reduction in reliance on fossil fuels, with energy related GHG emissions falling in line with agreed targets;

- created sustainable jobs through the development and deployment of the new approaches and technologies required for the transition including through the exploitation of indigenous energy resources;
- the energy system will have the infrastructure necessary to provide the services needed; and
- robust public and stakeholder engagement in energy policy, and effective community consultation on energy infrastructure developments.

There will be a move to lower emissions fuels with a lower reliance on fossil fuels and increasing the use of electricity and bioenergy to heat homes and fuel transport.

The exploitation of "*Ireland's abundant, diverse and indigenous renewable energy resources is a defining element of this energy policy*" (Section 5.3). The achievements to date have come mainly from onshore wind energy and from biomass. Onshore wind was responsible for 81% of renewable energy electricity in 2014.

> *The 2020 target of 40% RES-E is likely to require a total of 3,500-4,000 MW of onshore renewables generation capacity, compared to the 2,500 MW available at end December 2014, of which wind generation accounted for 2,200MW. To achieve our target, the average rate of build of onshore wind generation will need to increase to up to 260 MW per year. The current rate of build is about 170 MW per year.* (Paragraph 129).

There will continue to be an important role for large scale wind energy projects (paragraph 130). Significant potential of off-shore wind energy is also noted.

National Mitigation Plan July 2017

This first National Mitigation Plan contains measures to reduce the dependence of the Irish economy on carbon emitting energy sources. The document is to be continually updated. Under the Climate Action and Low Carbon Development Act 2015, each National Mitigation Plan must specify the policy measures that Government consider are required to manage greenhouse gas emissions and the removal of emissions at a level that is appropriate for furthering the national transition objective set out in the Act. This work is necessarily ongoing and envisages the Government adopting appropriate mitigation options so as to achieve progressive emissions reductions.

Chapter 3 of the document addresses the electricity generation sector. Between now and 2050, the sector is to move from a fossil fuel-based electricity system to a low carbon power system. This includes increased levels of renewable generation." *Our electricity system will be one where onshore wind remains a key part of Ireland's generation portfolio out to 2030. Assuming more cost competitive technologies do* *not emerge in this decade, this is likely to remain the position beyond 2030 and possibly out to 2050*." (Section 3.1).

Department of Communications Climate Action and Environment: Renewable Electricity Support Scheme (RESS)

A new RESS was developed by the government in July 2018. Unlike previous schemes, renewable projects seeking support will compete against one another. This is intended to maximise financial benefits arising from falling technology costs. The new RESS is also intended to support increased community participation in wind farm projects and to facilitate an expansion of renewable electricity up to 55% by 2030.

Department of Environment Heritage and Local Government Planning Guidelines for Wind Energy (June 2006)

These Guidelines offer advice to planning authorities on planning for wind energy through the development plan process and in determining applications for planning permission. The guidelines are also intended to ensure a consistency of approach throughout the country in the identification of suitable locations for wind energy projects and in the treatment of planning applications for wind energy developments.

Relevant points include:

- Visual impact is among the more important considerations and advice is given on spatial extent, spacing, cumulative effect, layout and height. There is an emphasis on the distinctiveness of landscapes and their sensitivity to absorbing different types of development;
- Environmental considerations such as the impact on habitats and birds and the need for habitat management. It is noted that designation of an area of natural and cultural heritage does not in itself preclude development, unless it is judged to be such that it would impact on the integrity of such sites and their natural heritage interests;
- The need for information on the underlying geology of the area including a geotechnical assessment of bedrock and slope stability and the risk of bog burst or landslide. Geological consultants should be employed to ensure that sufficient information is submitted;
- Impacts on human beings such as noise and shadow flicker.

Landscape character types have been selected in these guidelines and flat peatland has been identified as one particular landscape type.

These guidelines have been considered in the preparation of this EIAR.

It is noted that the Department of Housing, Planning, Community and Local Government (DoHPCLG) (formerly the Department of Environment, Housing and Local Government (DOEHLG) is currently conducting a targeted review of the 2006 Wind Energy Development Guidelines in relation to noise, proximity and shadow flicker. At the time of writing of this report, neither the final guidelines nor a draft are available.

It has been announced by the Government that "*a preferred draft approach"* has been agreed on the review. This includes:

- More stringent noise limits, in tandem with the introduction of a new robust noise monitoring regime in relation to wind farms;
- A setback of 4 times the turbine tip height between a wind turbine and the curtilage of a residential property, subject to a mandatory minimum setback distance of 500 metres;
- Elimination of shadow flicker;
- New requirements concerning engagement with local communities along with the provision of community benefit measures; and
- Undergrounding of grid connection, except where ground conditions prevent it.

Consequently, this EIAR follows all existing and issued guidelines relevant to Wind Farm development, including the current 2006 DoECLG guidelines, and considers the above listed key aspects of the Preferred Draft Approach.

The government has issued Planning Circular Letter PL 5/2017 and the *"Interim Guidelines for Planning Authorities on Statutory Plans, Renewable Energy and Climate Change July 2017*". Local Authorities shall, in preparing development plans, acknowledge and document national policy on renewable energy and indicate how the plan will contribute to realising overall national targets on renewable energy (particularly in any proposal to introduce or vary a mandatory setback distance or distances for wind turbines).

Code of Practice for Wind Energy Development in Ireland, Department of Communications, Climate Action and Environment (Dec 2016)

This code of practice addresses issues concerning engagement with the local community and community benefit. It is intended to ensure that wind energy development in Ireland is undertaken in observance with the best industry practices, and with the full engagement of communities around the country. The code of practice informed both the design and execution of the communication program for the Derryadd Wind Farm.

Best Practice Guidelines for the Wind Energy Industry (IWEA, 2012)

These guidelines were published in April 2012 as a best practice guide for wind energy developments, replacing the 2008 and 1994 publications of the same title. In the 2012 publication, there is a much greater emphasis on the environmental and community aspects of development, reflecting increased awareness and the need for a higher level of scoping and wider consultation. It is intended as a '*reference document'* to complement the DoHPCLG's (formerly DoEHLG) own guidelines and its main purpose is to encourage '*responsible and sensitive wind farm development*' that takes into consideration the concerns of local communities, planners and other interested parties. The emphasis is on responsible and sustainable design and environmental practices, external stakeholder relations and good community engagement practices. Issues addressed include:

- Feasibility Study Guidelines;
- Planning and Environmental Legislation;
- Environmental Impact Assessment;
- Wind Farm layout;
- Health and Safety/Construction and Operation; and
- Community Engagement.

The 2012 Irish Wind Energy Association (IWEA) Guidelines were considered in the preparation of this EIAR, with special attention focused on the Environmental Impact Assessment chapters that advise on the impacts of wind farm development (i.e. noise, shadow flicker, ecology, geology, visual and landscape, cultural heritage, hydrology, etc.).

Good Neighbour – IWEA Best Practice Principles in Community Engagement & Community Commitment (IWEA, March 2013)

'*Good Neighbour – IWEA Best Practice Principles in Community Engagement & Community Commitment'* was published by the IWEA in March 2013 as an extension to the IWEA Best Practice in Wind Farm Development (March 2012). The guidelines support the provision of financial contributions by wind farm operators to local communities and have sought to formulate best practice principles for the provision of a community commitment and engagement.

This proposed wind farm development is in line with objectives of community engagement and commitment.

Project Ireland 2040 - National Planning Framework

The National Planning Framework was published by the Department of Housing, Planning and Local Government in February of 2018. The National Planning Framework (NPF) is the Government's high-level strategic plan for shaping the future growth and development of Ireland out to the year 2040. The framework identifies a development and place making policy priority for the eastern and midlands region that states:

"Harnessing the potential of the region in renewable energy terms across the technological spectrum from wind and solar to biomass and, where applicable, wave energy, focusing in particular on the extensive tracts of publicly owned peat extraction areas in order to enable a
managed transition of the local economies of such areas in gaining the economic benefits of greener energy."

Furthermore National Policy Objective 55 of the NPF states:
"Promote renewable energy use and generation at appropriate locations within the built and natural environment to meet national objectives towards achieving a low carbon economy by 2050."

Government Policy on Sustainable Development

'*Sustainable Development – A Strategy for Ireland'* was published by the Department of the Environment in 1997. The principal purpose of the strategy was to provide a sustainable framework in which all future developments should be placed. This policy document promoted the development of renewable energy sources, including maximising the efficiency of energy generation as well as the use of renewable resources. It also sought to minimise greenhouse gas emissions and other forms of pollution in terms of both cleaner energy generation and more sustainable energy consumption.

The document *'Making Ireland's Development Sustainable'* was produced by the Department of the Environment, Heritage and Local Government (DoEHLG) for the Johannesburg World Summit on Sustainable Development held in 2002. The report examined progress made in the ten years since the Rio de Janeiro Earth Summit. It assessed the challenge faced and set out policies and actions to meet that challenge. It concluded that a high quality environment was essential for economic progress and for sustainable development generally.

In 2012, the Government published *'Our Sustainable Future: A Framework for Sustainable Development for Ireland'*. This document updates the earlier '*Making Ireland's Development Sustainable'* (2002). This sets out government policies which seek to incorporate sustainable development principles into all areas of government decision making. One of the key challenges addressed is the production of clean energy and addressing the related issues of climate change. It notes targets to reduce greenhouse gas emissions and the challenges faced in achieving such targets.

The proposed development is in line with this strategy, as it will produce energy from a renewable source. This will help minimise greenhouse gas emissions and other forms of pollution produced by traditional fossil fuel based energy sources.

4.4.4 Midland Regional Planning Guidelines, 2010-2022/draft Regional Spatial and Economic Strategy (RSES)

The regional structure of government has been recently altered. Longford was in the Midland Region which took in Counties Longford, Westmeath, Laois and Offaly. Under the Local Government Reform Act of 2014, the county now comes within the ambit of the larger Midland and Eastern Regional Assembly. A new Regional Spatial and Economic Strategy (RSES) has been drafted for this region but is not yet complete.

Previously, the old Midland Regional Authority produced the Regional Planning Guidelines for the Midland Region 2010-2022. Pending the adoption of the new RSES for the new Midland and Eastern Region, these guidelines remain in force. They note the government's target to achieve 40% of electricity from renewable sources. The guidelines recognise the potential for the region to harness renewable energy development arising from the presence of the cutaway bogs.

The guidelines state that the cutaways have potential to 'accommodate large scale energy production in the form of wind farms and bioenergy'. The guidelines also state in section 3.3.4.6:
'Worked out peatland areas, offer potential for renewable energy installations including wind energy. With a strong history of energy production and an extensive electricity transmission network in place, the potential exists for a smooth transition to renewable energy from fossil fuels.'

Furthermore the guidelines also identify that the region has substantial capacity for the development of wind farms (Section 5.8).

4.4.5 Longford County Development Plan 2015 - 2021

The proposed wind farm will be located within County Longford. The relevant development plan is the Longford County Development Plan 2015-2021 (LCDP).

Section 4.5 Tourism states the following as part of policy TOU2:

'*The development of the bogs for amenity purposes will not exclude them for other purposes such as the generation of renewable energy including wind generation. It is envisaged that these types of activities can be mutually inclusive and developed in an integrated way.'*

The proposed development which includes the integration of both wind energy production and amenity is directly in line with this policy statement.

Section 5.5 of the LCDP deals with Energy and Communications. The council recognises the need to adopt more sustainable forms of energy production. It states that:

> *"the need to adopt a more sustainable approach to energy production is acknowledged by the Planning Authority. A favourable approach will be taken towards applications for renewable energy developments provided they are environmentally sustainable and are in accordance with general planning criteria."* (Section 5.5.2).

It is the Council's intention to prepare, where resources permit, a Renewable Energy Strategy for the County to support the development of renewable energy production. (Policy RE1). To date no such plan has been prepared.

Certain criteria are listed in the development plan for the assessment of potential sites for the development of alternative energy sources. These are:

– *Significant wind energy potential*
– *Accessibility to the national grid*
– *Suitability of the site having regard to land uses*
– *Measures to minimise impact on other development* (Policy RE 2).

Appropriate Assessment will be required "for all proposed renewable energy projects," (Policy RE6). The LCDP notes a proposed National Peatland Strategy and states that, when it is adopted, it shall implement it (Policy RE7). This document has now been adopted and published (2015) by the Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs. It addresses the issue of wind farms and states:

> *"The consideration of wind farm development on peatlands as distinct from non-peatland areas needs to take account of additional matters including, inter alia, the potential impact of site development works on fisheries habitat including river and streams; the management of extracted peat and prevention of the potential hazard of bog flows and peat failures and risks that might result from same..* (Section 5.6.5)

The LCDP notes the potential of the county for wind energy development and the need for same. The council will generally look favourably on such developments.

> *In general the Council will look favourably on the development of wind farms and the harnessing of wind energy in a manner that is consistent with proper planning and sustainable development of the County.* (Section 5.5.2.1)

Areas where such development will be encouraged are identified in Appendix 5 (see extract below, Figure 4.1).

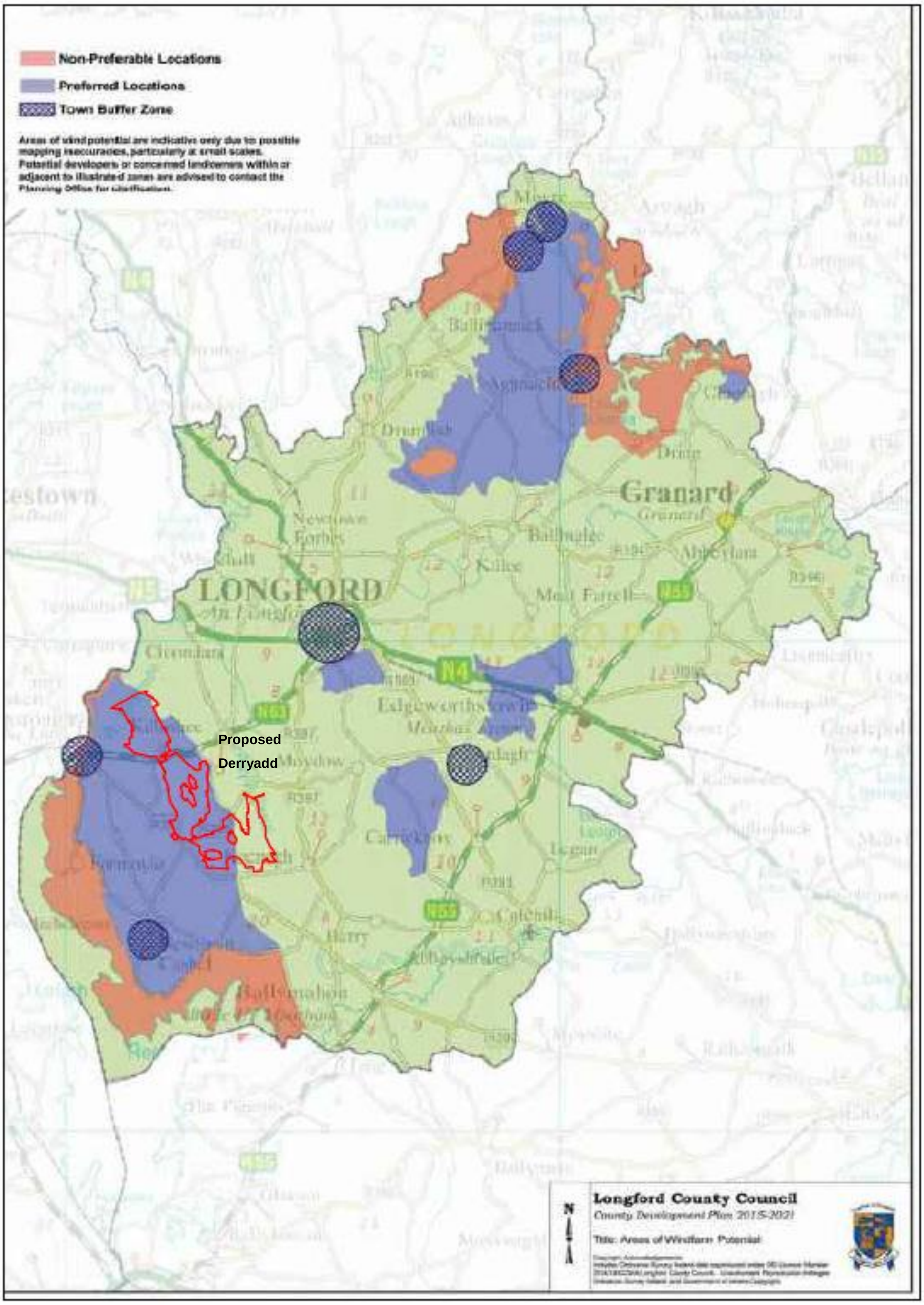


Figure 4.1: Areas of Wind Farm Potential, LCDP, Appendix 5

Policies for wind farm development include the following:

> *Developments for wind farms will be encouraged to locate in those areas identified as having wind potential within the County, as defined on the Map contained in Appendix 5.* (Policy WD 1)
>
> *Proposals for large scale industrial wind farm developments shall be directed to areas of cutaway bogs subject to the following;*
>
> - *Dependent on the completion of an investigation demonstrating suitability of the areas,*
> - *The preparation of revised Wind Energy Development Guidelines and the Renewable Energy Export Policy and Development Framework*
> - *Compliance with the necessary environmental assessments WD 2:* (Policy WD 2).

Policy WD4 sets out in considerable detail the range of factors to be considered in the assessment of planning applications for wind farms. This refers specifically to issues of visual impact, noise, design, impact of associated site works, impact of construction activities, proximity to dwellings, impact on telecommunications, impact on ecologically designated sites, decommissioning, impact on areas of folklore significance etc., proximity to water bodies. It is requested that proposals for extensions should be mentioned, if known.

Annex 6 of the LCDP concerns the proposed Mid Shannon Wilderness Park. There are no precise boundaries provided of this Park but a generalised map (Map No. 3) of the area under consideration does include the area of the current planning application site. The Park is intended to build on a number of existing amenities which occur in this area in close proximity – lakes, rivers etc. – as well as "*future rehabilitated Bord na Móna bogs*". This is intended to happen in conjunction with future uses of the bogs such as renewable energy:

> *It is now proposed for existing local communities and Longford County Council to partner with Bord na Móna and collaborate in developing new amenity uses for the cutaway bogs. This will not conflict with any future intention of Bord na Móna and its potential future use of the bogs. The amenity use of the rehabilitated bogs can be compatible with any future use for the bogs such as renewable energy projects*. (Section 1.2).

The Council has adopted Variation No. 3 of the CDP which notes the Government's White Paper 'Ireland's Transition to a Low Carbon Energy Future 2015-2030'.

4.4.6 Adjoining County Development Plans

The Roscommon County Development Plan 2014-2020 recognises government policy on the need for renewable energy and notes government targets in this regard (Section 4.6). Wind energy is seen as an important part of this and also has the capacity to generate local employment. The Plan seeks to encourage the development of wind energy in suitable locations and to achieve a balance between responding to Government Policy on renewable energy and enabling the County's energy resources to be harnessed (Section 3.4.3). Regard should be had to the Wind Energy Planning Guidelines 2006.

The Westmeath County Development Plan 2014-2020 notes the need to expand the use of renewable energy sources as a means of fighting global warming and climate change and notes government targets in this regard (Chapter 10). It seeks the development of wind energy sources in the county within the context of proper planning and sustainable development. It notes the suitability of worked out bogs for such projects. Amendments were made to preferred areas within the county in Variation No. 1 of the Plan.

The Leitrim County Development Plan 2015-2021 contains an objective to maximise the use of renewable energy in the county (Section 2.4). The need for a reliable electricity supply is noted (Section 3.11.4) as well as the role of wind farms in reducing reliance on carbon emitting fuels (Section 3.11.5). These must be in accordance with national and regional guidance.

4.5 PLANNING NEED FOR THE PROPOSED DEVELOPMENT

Section 4.3.3 of this chapter outlines the national policy that clearly drives the need for this type of development. Of particular relevance is the Energy white paper – Ireland's Transition to a low Carbon Energy Future. This outlines the renewable energy target of 16% by 2020 of which 40% of electricity production is to come from renewable sources. The Project Ireland 2040 - National Planning Framework specifically identifies the development of renewable electricity projects (in particular wind) within the '*extensive tracts of publically owned peat extraction areas*'.

On a regional scale, the draft RSES specifically identifies worked out peatland areas for potential wind energy development and recognises the substantial capacity within the region for their development. On a local level, the Longford County Development Plan recognises that proposed amenity use of BNM cutaway peatlands is compatible with renewable energy projects.

It should be noted that there is a considerable economic benefit to the development of wind farms nationally and specifically at Derryadd. In the national context, Pöyry published a report in March 2014 titled 'The Value of Wind Energy to Ireland'. The report stated that the sector could support 22,510 jobs in the construction stage and double the amount of existing jobs in the operational phase by 2030. It also projected an investment of €4.8 billion in the time period from 2020 to 2030. Specifically, in the case of Derryadd, approximately 100-120 jobs will be supported during the construction phase and between 6-8 jobs during the operational phase. The construction of the wind farm would have a capital cost in the region of 100 million euro and an estimated 20 to 30 million euro of the total cost relating to site works which will require the services of local contractors and suppliers. The proposed wind farm also creates an opportunity to generate real tangible benefits for the local community who may not have a direct involvement in the project. The estimated direct benefit to the local community arising from the combined community benefit and near neighbour schemes is a total of approximately 8.1 million euro over a 30 year period. Furthermore, significant annual rate payments will be made to Longford County council during the operation of the wind farm. These payments will be directed to the provision of public services within Co. Longford. These services include provisions such as road upkeep, fire services, environmental protection, street lighting, footpath maintenance etc. along with other community and cultural support initiatives.

4.6 CONCLUSION

The proposed Derryadd Wind Farm development will produce energy from indigenous, renewable resources. As such, it will contribute towards international, EU, national, regional and local policy regarding the reduction of dependence on fossil fuels, increased reliance on renewable energy and reducing emissions of GHGs.

It will contribute towards national policies to increase wind electricity generation capacity in the country and assist in the exploitation of Ireland's renewable energy resources. It will also contribute to meeting the EU's challenging target of 32% renewable energy by 2030.

In addition, the proposed development is aligned with the objectives of the current Regional Planning Guidelines for the Midland Region 2010-2022 and the draft Regional Spatial and Economic Strategy (RSES) for the new Midland and Eastern Region i.e. the recognition of the potential for the region to harness renewable energy development (in the form of wind farms and bioenergy) arising from the presence of the cutaway bogs.

At a local level, the proposed development is in line with and supports the policies of the Longford CDP and is predominantly located in a preferred area for such development as identified in the Longford County Development Plan 2015-2021. The proposed development will conform to all of the requirements of the planning and design guidelines for wind farms as set out in the LCDP 2015-2021.

5 POPULATION AND HUMAN HEALTH

5.1 INTRODUCTION

This chapter examines the existing environment and addresses the potential effects on population and human health arising from the proposed development.

Section 5.2 of the Chapter will focus on Population including the current land use of the development site and the activities occurring there, population, employment, tourism, visitor attractions and activities and the community gain. It will assess the potential effects, if any, arising from the proposed development. The second part of this chapter (Section 5.3) will specifically deal with the potential effects on human health associated with the proposed development. This will include a human health risk assessment which is the process to estimate the nature and probability of adverse health effects in humans as a result of the proposed development. Following assessment of the potential effects, mitigation measures will be proposed to mitigate any potential negative effects arising from the proposed development.

The potential effects of other environmental aspects associated with the proposed development which may be human related such as Water (Chapter 8), Landscape and Visual Impact (Chapter 9), Material Assets - Shadow Flicker (Chapter 10), Air Quality (Chapter 12), Noise and Vibration (Chapter 13), and Traffic and Transport (Chapter 14) are discussed in the relevant chapters of this EIAR.

5.1.1 Statement of Authority

Section 5.2 (Population) of this chapter has been completed by Mrs. Allison Murphy (BA, MSc) of TOBIN Consulting Engineers who has over 13 years' experience in environmental consultancy. Allison is appropriately experienced and capable of undertaking this assessment having completed numerous population assessments for a range of infrastructure projects in Ireland including energy developments. Section 5.3 (Human Health) has been completed by Dr. Martin Hogan FRCPI FFOMI, Consultant Occupational and Environmental Physician (who works for and on behalf of CHI (Cork)) for Bord na Móna. Dr. Hogan has over 20 years' experience is assessing possible impacts to health in environmental impact assessments.

5.2 POPULATION

5.2.1 Methodology

A desktop study and a site visit were carried out in order to examine relevant information pertaining to population. The following information sources and references were also used to compile this chapter:

- British Horse Society 'Wind Turbine experiences – 2012 Survey Results' (September 2013);
- British Horse Society 'Wind Turbines and Horses - Guidance for Planners and Developers' (August 2015);
- Climate Change 'The impact of wind turbines on house prices in Scotland' (October 2016);
- EPA Guidelines – 'Information to be contained in Environmental Impact Statements', (2002);
- EPA 'Advice Notes on Current Practice in the Preparation of Environmental Impact Statements' (September 2003);
- EPA 'Draft Guidelines on the information to be contained in Environmental Impact Assessment Reports' (August 2017);
- Central Statistics Office (CSO) information;
- Dept. of Communications, Climate Action and Environment 'Code of Practice for Wind Energy Development in Ireland' (2017);
- Fáilte Ireland 'Guidelines on the treatment of tourism in an Environmental Impact Statement' (2011);
- Fáilte Ireland Information in relation to tourism amenity in conjunction with websites of relevant tourism sites and amenities for the area;
- IWEA 'Best Practice Guidelines for the Irish Wind Energy Industry' (2012);
- IWEA 'Best Practice Principles in Community Engagement and Community Commitment' (2013);
- IWEA "An Enterprising Wind": An economic analysis of the job creation potential of the wind sector in Ireland (2014);
- Longford County Council 'County Longford Tourism Statement of Strategy and Work Programme 2017-2022';
- Longford County Development Plan 2015-2021;
- OSI mapping and Aerial Photography to identify land use and possible amenity sites;
- Poyry 'Value of Wind Energy to Ireland' (2014);
- RenewableUK 'The effect of wind farms on house prices' (March 2014); and
- Roscommon County Development Plan 2014-2020.

Fáilte Ireland tourist literature for Longford was examined in relation to tourism amenity in conjunction with the websites of relevant tourism sites and amenities in the area. County Longford is one of nine counties forming Ireland's Hidden Heartlands. The branding of the region by Fáilte Ireland as Ireland's Hidden Heartlands aims to attract tourists "active in nature" and encourages them to explore the region's natural assets such as the River Shannon and its walking trails, boating, fishing, greenways and woodlands. In addition, Ordnance Survey maps were used to identify land use and possible amenity and tourist sites that may be located in proximity to the proposed wind farm development.

A consultation letter was sent to Fáilte Ireland and a response was received on the 26th September 2016 (refer to Chapter 1 of this EIAR and Appendix 1.1). This response included a copy of the Fáilte Ireland 'Guidelines on the treatment of tourism in an Environmental Impact Statement'. This consultation response has been considered in this assessment.

The effects of the proposed development on the human environment are analysed in compliance with the requirements of the draft "Guidelines on the Information to be contained in Environmental Impact Assessment Reports" (EPA, 2017) and the terminology referenced therein has been used to describe impacts where they occur.

5.2.2 Existing Environment

5.2.2.1 Land Use

The proposed wind farm development will be located on four bogs within the Mountdillon peat production group, on Derryaroge, Derryadd, Derryshannoge, and Lough Bannow cutaway bogs which are in south County Longford. The site has a total area of approximately 1,900 hectares. These bogs are located between the towns and villages of Lanesborough, Derraghan, Keenagh, Killashee, and the River Shannon. The River Shannon forms the county border with Roscommon.

The current land use and activities on the site are a mixture of active peat extraction and associated works such as maintenance of machinery, a staff canteen, stores etc., bare cutaway peat, re-vegetation of bare peat, and existing wind monitoring masts on Derryaroge Bog and Lough Bannow Bog. There are also a number of Bord na Móna rail lines that pass through the bogs facilitating the transportation of milled peat and ash.

The surrounding landscape is a mixture of forestry, agricultural land and cutaway peatland. It is predominately flat. There are a number of scattered domestic dwellings and farm buildings surrounding the study area, along with some linear settlement on the N63 and local roads. Details are provided in Figure 5.1.

The proposed development application provides for 1 no. 110 kV electrical substation, which will be constructed within the ownership boundary of Bord na Móna, at one of two proposed locations on site: either Option A in Cloonfore townland or Option B in Derraghan More townland. The electrical substation will have 2 no. control buildings, a battery storage compound, associated electrical plant and equipment and a wastewater holding tank. The proposed wind farm will connect to the grid either via a 110 kV overhead line or underground cable. All new build transmission infrastructure for the proposed development will be contained within the development site aside from a short section of underground cable along the R392.

5.2.2.2 Population

To understand an area its population must be examined. This section outlines population change in the study area over the period 2006-2016 and is based on census information obtained from the Central Statistics Office (CSO). The proposed development will be located within the jurisdiction of Longford County Council. Table 5.1 details the population change in the study area between 2006-2016.

Table 5.1: Population Change 2006-2016

	2006	2011	2016	% Change
State	4,239,848	4,588,252	4,761,865	11%
Longford	34,391	39,000	40,873	16%
Killashee (ED)	284	432	437	35%
Rathcline (ED)	1289	1428	1,443	11%
Mountdavis (ED)	204	250	252	19%
Kilcommock (ED)	595	953	1,062	44%
Ledwithstown (ED)	285	356	363	21%
Cashel East (ED)	312	323	302	-3%

Source: Central Statistics Office (CSO) May 2017

Table 5.1 illustrates that from 2006 to 2016 the population has increased in the area as a whole with the exception of Cashel East.

In addition to planning application searches (from 2016 to January 2019), a detailed house survey (ground truthing survey) was undertaken on the 15th and 16th of June 2016 by TOBIN Consulting Engineers. Figure 5.1 presents all buildings that are present within 2km of the proposed turbines.

Table 5.2 below outlines the types of building present within 2km of the proposed turbines. A total of 298 buildings were identified within 2km of the turbines. The closest confirmed dwellings to a turbine are located in excess of 750m from the nearest turbines.

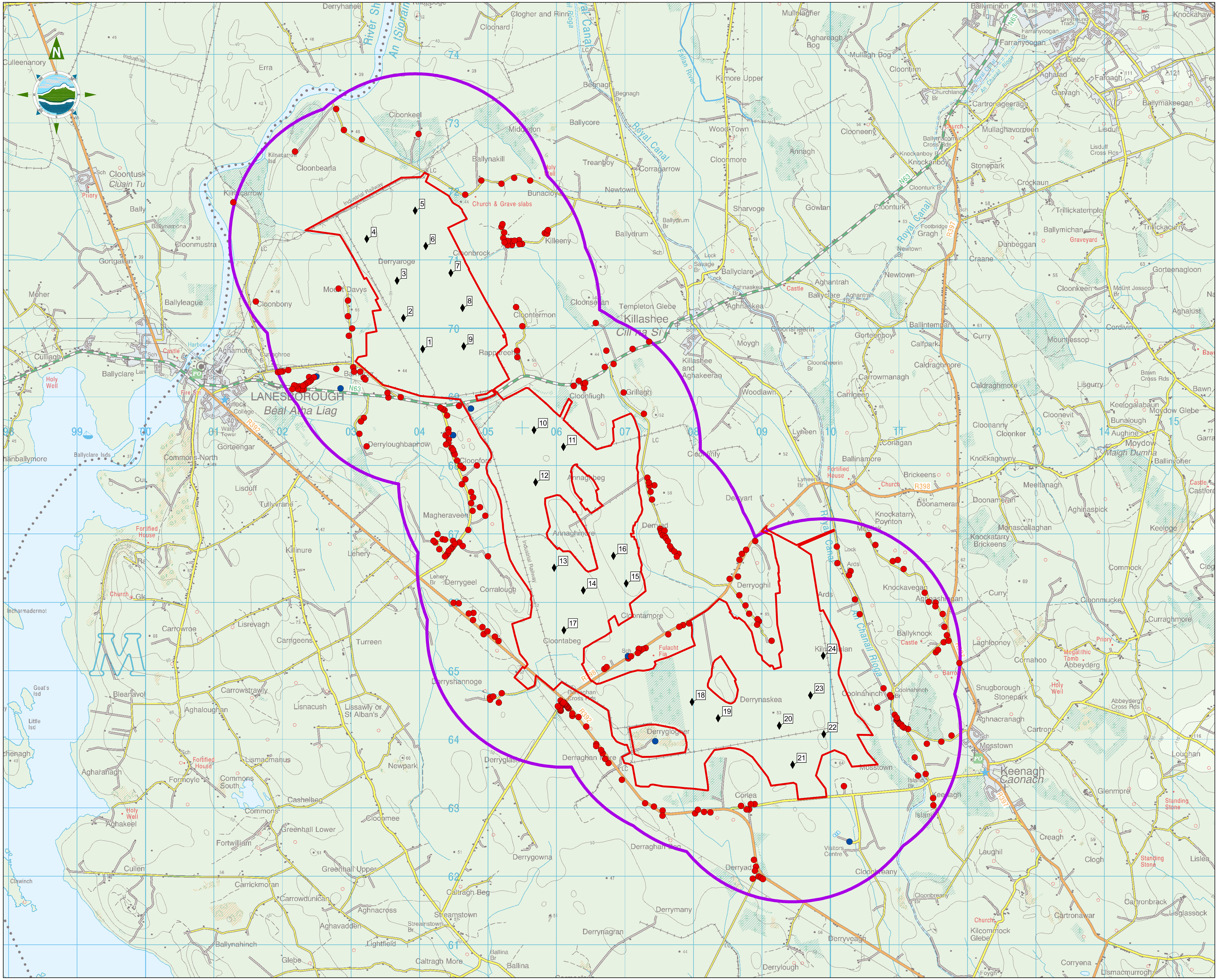
Table 5.2: Buildings within 2km of the Turbine Locations

No. of Buildings	Total within 2km of Turbines
Residential	291
Commercial	7

Source: Geodirectory data and project house survey

The potential effects on these buildings are considered within the relevant chapters of this EIAR (Noise and Vibration (Chapter 13), Material Assets - Shadow Flicker (Chapter 10), Traffic and Transport (Chapter 14) etc.).

Communication with all residences within a 2km area of the boundary of the site occurred as part of public engagement for this project. This included forum meetings, public clinics and house to house visits to inform the local population and the general public about the project. Further details on this engagement are set out in Chapter 1 of this EIAR and the Community Report in Appendix 1.3.



Legend

- Planning Application Boundary
- Proposed Turbine Locations
- 2km Turbine Buffer

Dwellings

- Commercial
- Residential

Dwelling Type	Count
Residential	291
Commercial	7
Total:	298

0 250 500 1,000 1,500 2,000
Metres

Issue	Date	Description	By	Chkd.
A	Jan 2019	Final Issue	MN	ST

Client:
BORD NA MÓNA
Naturally Driven

Project:
DERRYADD WIND FARM

Title:
DWELLINGS & SENSITIVE RECEPTORS IN VICINITY OF PROPOSED WIND FARM

Scale @ A1: 1:25,000

Prepared by: M. Nolan
Checked: S. Tinnelly
Date: January 2019

Project Director: D. Grehan

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Figure 5.1
Issue: A

5.2.2.3 Employment

Employment is an important indicator of the economic standing of an area. This section examines employment status and unemployment levels in the region of the proposed development. The Labour Force Survey undertaken by the CSO provides details of unemployment on a regional level. As Longford is located in the Midland Region, data for this region is used to illustrate unemployment in the area.

Table 5.3 illustrates the findings from the most recent Labour Force Survey (Q3 2018) published by the CSO. The unemployment rate is the number of unemployed persons expressed as a percentage of the total labour force. The unemployment rate for the State in Q3 2018 was 6.0% while the unemployment rate for the Midlands Region was 7.1% thereby indicating that the level of unemployment in the Midlands Region was higher than the State in general.

The participation rate is the number of persons available to the labour force (i.e. persons over 15 years old to 74 years old either working or looking for work) expressed as a percentage of the total population. In Q3 2018 the participation rate in the State was 62.6% compared with 58.8% in the Midlands Region.

Table 5.3: Labour Force Survey (Q3 2018)

	Unemployment Rate (persons aged 15-74)	Participation Rate
State	6.0%	62.6%
Midlands Region	7.1%	58.8%

Source: CSO, 21st November 2018

The CSO also publishes figures relating to the Live Register. These figures are not strictly a measure of unemployment as they include persons who are legitimately working part-time and signing on part-time. However, they can be used to provide an overall trend within an area.

Table 5.4: Live Register

	October 2017	October 2018	% Increase
State	236,492	199,247	-15.7%
Midlands Region	19,132	15,678	-18.0%

Source: CSO 21st November 2018

The figures in Table 5.4 above show that over the period October 2017 – October 2018, there was a 15.7% decrease in the number of persons on the live register in the State as a whole and an 18.0% decrease in the number of persons on the live register in the Midlands Region. Despite a decrease in live register figures the overall trend indicates a need for further employment in the Midlands Region including County Longford.

Section 4.2, of the Longford County Development Plan 2015-2021 entitled *Industry, Commercial and Business Development* sets out the following relevant key aims with regards to employment for the county:

- “To promote the renewable energy sector in the County to generate business and employment”.
- “To promote sustainability and the use of ‘clean technology’ in existing and proposed industrial developments, including the use of alternative and renewable energy sources and the promotion of developments located within walking/cycling proximity of larger residential areas. To establish strong inter-regional partnerships which have the potential to create opportunities for enterprise and employment in the Midland Region through expanding on linkages with the border and west regions”.
- “To work with Bord na Móna, ESB and Coillte to identify opportunities for enterprise and job creation”.

This highlights the real potential for further employment opportunities to be gained from the energy sector in Longford from developments such as the proposed Derryadd Wind Farm.

5.2.2.4 Tourism

The National Tourism Development Authority (Fáilte Ireland) periodically collates statistics on overseas visitors to Ireland and to individual counties. Longford is situated in the Midlands Tourist Region.

The most recent set of annual statistics for the study area are for the year 2017[3], and are included in Table 5.5 below.

Table 5.5: Overseas Tourism 2017

	Britain (000s)	Europe (000s)	N. America (000s)	Other (000s)	Total Overseas (000s)
No. of Visitors to Ireland	3,445	3,256	1,715	607	9,023
Midlands	91	75	40	11	218

[3] Tourism Facts 2017 (Failte Ireland, July 2018)

Source: Fáilte Ireland published July 2018

Of the overseas visitors to Ireland, 4,721,000 people were on holiday, 2,615,000 people were visiting friends and relatives, 1,294,000 people were on business and 394,000 people recorded as other. It is of note that 25% of those coming to Ireland to visit friends and family were born in Ireland.

Fáilte Ireland overseas visitor figures from 2017 show that Longford was the least visited county in Ireland with just 24,000 tourists. Those numbers are however expected to rise following the launch of a new tourism brand 'Ireland's Hidden Heartlands' and Ireland's first Centre Parc Resort opening in Longford in 2019.

The Department of Environment and Local Heritage (DoEHLG), '*Wind Energy Development Guidelines'* (2006), state that '*the effect of wind energy development on tourism and recreational activities must be assessed*'. These Guidelines also state that *'Wind Energy developments are not incompatible with tourism and leisure interests, but care needs to be taken to ensure that insensitively sited wind energy developments do not impact negatively on tourism potential'* (Ref Section 3.9).

The Sustainable Energy Ireland (SEI) publication, '*Attitudes towards the development of wind farms in Ireland'* (2003), found that those with direct experience of wind farms in their locality do not in general consider that they have had any adverse impact on the scenic beauty of the area, on wildlife in the area, or on tourism. It also finds that it may be possible to do more to exploit the positive tourist potential of wind farms in attracting the ever larger numbers of environmentally aware visitors to the locality.

Fáilte Ireland, in association with the Northern Ireland Tourist Board (NITB), surveyed both domestic and overseas holidaymakers to Ireland to determine their attitudes to wind farms in 2007. The survey drew on many aspects of the original SEI survey and the purpose of the survey was to assess whether or not the development of wind farms would impact on the enjoyment of the Irish scenery by holidaymakers.

In this survey Fáilte Ireland recognises that while there is a generally positive disposition among tourists towards wind farm development in Ireland, it is important also to take into account the views of the one in seven tourists who are negatively disposed towards wind farms. The challenge lies in striking a balance between the maintenance of landscape character and scenery as a tourism asset and facilitating the development of further wind farms to ensure Ireland meets with greenhouse gas reduction targets.

Visitors were asked whether they were favourable or unfavourable towards the construction of wind farms on certain landscapes of interest. The results found that there was greater relative negativity expressed about potential wind farms on coastal landscapes (one third) and Mountain or Farmland (one quarter respectively). On the other hand less than one in twenty were negatively disposed to the construction on bog land or urban industrial land.

It is the view of Fáilte Ireland that National Parks and areas of national scenic importance should be avoided for wind farm development. However, the survey results suggest that in other landscapes, the development of wind farms can have a positive impact in terms of the visitor's perception of the Irish landscape and of Ireland's commitment to renewable energy (Fáilte Ireland, 2008).

In 2012 Millward Browne Landsdowne, on behalf of Fáilte Ireland, repeated this 2007 research with both domestic and overseas visitors. This research found that *"in 2012 there is a greater perception that wind farms have a positive impact on the Irish landscape compared to 2007. Wind farms are seen almost on a par with housing in terms of visitor acceptance levels, and well ahead of other developments such as pylons or mobile phone masts which are generally not welcomed by the majority."* The 2012 research also found that the most widely held view is that wind farms will not impact on a visitor's likelihood to visit the area again, with a slightly greater majority saying that this would have a positive rather than a negative impact. With regards to wind farm location, the highest support in 2012 was for wind farm development to be in urban/industrial areas (55% favourable, 15% unfavourable, 30% neither) and bogland (51% favourable, 22% unfavourable and 26% neither).

The potential effect on tourism as a result of the proposed development is considered in section 5.2.3 below. The landscape and visual impact from a tourism perspective are assessed in Chapter 9 of this EIAR.

5.2.2.5 Visitor attractions and activities

Fáilte Ireland identifies the top fee paying and free attractions in Ireland each year. None of these attractions are located in proximity to the proposed development. Of the top 10 listed fee paying attractions in 2017, five are located in County Dublin and one each is located in Counties Clare Meath, Galway, Kerry and Wicklow.

The Longford County Development Plan 2015-2021 highlights several flagship tourist attractions for County Longford. The Corlea Trackway Centre is once such attraction and is located 3km from Keenagh Village and approximately 750m south of the study area boundary. The Corlea Archaeological Settlement and Biodiversity Project complements the existing facilities at the centre and provides further educational and interpretation of the area's history, archaeology and biodiversity. There is also a link at the Corlea Trackway Centre to the adjoining Royal Canal. This can facilitate boating, walking and cycling visitors coming from Dublin and travelling to the West via Longford and the Shannon to visit the Corlea Trackway Visitor Centre.

The Mid Shannon Wilderness Park is also listed as a flagship tourist attraction within the Longford County Development Plan 2015-2021. The development of a Mid Shannon Wilderness Park in Longford will combine existing natural amenity areas including Lough Ree, the Rivers Shannon, Inny and Camlin, the Royal Canal, Newcastle Wood and other forests and the future rehabilitated Bord na Móna bogs.

Bord na Móna are currently working with local communities and authorities regarding the development of the Corlea Archaeological and Biodiversity Project and the Mid Shannon Wilderness Park. *"As Bord na Móna completes its rehabilitation work on the bogs it may be possible for existing local communities, and Longford County Council to take responsibility for portions of the cutaway bogs. This will not conflict with any future intention of Bord na Móna and its potential future use of the bogs. The amenity use of the rehabilitated bogs can be compatible with any future use for the bogs such as renewable energy projects"*[4] such as the proposed Derryadd Wind Farm.

The Longford County Development Plan 2015-2021 notes that the Corlea Trackway Visitor Centre and Corlea Archaeological and Biodiversity Project, coupled with the Royal Canal Walking/Cycling Route and the Mid Shannon Wilderness Park, will provide the various communities and villages of South Longford with amenity facilities and infrastructure. It will also encourage visitors to the area especially of the walking and cycling variety. This will help the area to build a more sustainable ecotourism base which will in turn provide economic benefits to the area.

The Mid Shannon Tourist Trail also goes through part of the study area, following the local road network. The proposed wind farm development would be visible to tourists following this route.

Lough Ree is a major lake on the River Shannon. Lough Ree and the River Shannon are popular for fishing and boating and there are local walks around parts of the shoreline. The northern end of Lough Ree is approximately 5km from the northwestern portion of the proposed development site and the eastern shores of the Lough remain between approximately 5 and 8km from the site as it wraps around it to the south. The River Shannon runs approximately 2km to the northwest of the site before it passes through Lanesborough having meandered into the study area from the north. Inchcleraun, or Quaker Island as it is otherwise known, is an island in the middle of Lough Ree that is home to the ruins of St Diarmaid's Monastery (a National Monument). Inchcleraun is approximately 9km to the southwest of the

[4] Longford County Development Plan, 2015-2021

proposed development site. There are also the ruins of an Augustinian Monastery on Saints Island in Lough Ree, which lies approximately 8km to the south of the site.

Other notable heritage attractions in the area include Abbeyderg Monastery near the settlement of Keenagh, which is approximately 3.5km east of the site.

Also of note with regards to attracting visitors to County Longford is the planned Center Parcs ‘Longford Forest’ resort located 5km from Ballymahon (approximately 12km southeast of the proposed Derryadd Wind Farm site boundary). This will be Centre Parcs only Irish resort, a flagship project to be operational in summer 2019 which has the potential to have a significant impact on the tourism landscape in the whole midlands region. The Center Parcs Longford Forest resort will be one of the largest single tourism investments ever made in Ireland, and as such will raise the profile of County Longford in terms of future tourism promotional and marketing campaigns.

The effects of the proposed Derryadd Wind Farm on the above visitor attractions are considered in section 5.2.3 below and Chapter 9 (Landscape and Visual Impact Assessment) of this EIAR.

Walking and Cycling Routes

The Longford County Development Plan 2015-2021 includes the following policies in relation to walking and cycling routes and public rights of way:

- *“Facilitate the provision of cycleways and footpaths, particularly in conjunction with new housing developments. The Council shall also promote the potential development of long distance walking routes, particularly those with historical and cultural associations and links to other routes in adjacent counties”* (Ref Policy- PED 3).

- *“It is the policy of the Council to protect, enhance and improve existing public rights of way where appropriate and where resources permit. The Council will also investigate the provision of additional rights of way, where appropriate through agreement with existing landowners and through the development management process”*(Ref Policy - ILW 6).

- *“It is the policy of the Council to protect existing rights of way and investigate further provision particularly in relation to access to the Royal Canal and the County’s lakes, rivers and forests and areas of historical, archaeological, architectural, recreational and cultural importance. To this end, the Council shall investigate the compilation of a register of rights of way within the County including mapping of same”* (Ref Policy- AM 6).

- *"It is policy of the Council to pursue the redevelopment of the towpath of the Royal Canal for pedestrian/cycle use, providing linkages with Longford Town to the River Shannon in Clondra and to the towns of Kenagh, Ballymahon and Abbeyshrule and to link with the National Cycle Network at Mullingar via established cycle routes in Westmeath".* (Ref Policy PED 8).

- *The Council shall encourage and promote the investigation and use of the potential of the Canal towpaths for the provision of designated walking and cycle routes and wildlife corridors for recreational, amenity and educational purposes and the promotion of links with any further designated walking, cycling and wildlife routes existing or proposed throughout the County. This should be carried out in the context of an important resource for the population of the County and with a view towards the promotion of sustainable tourism projects in County Longford"* (Ref Policy ILW 10).

Longford – Clondra Royal Canal Trackway

The Longford-Clondra trackway was opened in June 2014 and provides a 16km off-road cycling and walking route along the Royal Canal towpath. There are also proposals to link Dublin to Mullingar and Longford Town to the Shannon via the Royal Canal as walking/ cycling routes. This would provide a major and important off road National walking/cycling route across the County which will have major tourism benefits for Longford.

No known public rights of way or cycling routes will be severed by or are located in proximity to the proposed development.

The effects of the proposed development on walking and cycling routes is considered in section 5.2.3. below.

Angling

County Longford has a number of renowned angling destinations. The Longford County Development Plan 2015-2021 includes the following policy in relation to angling:

- *"The Council will support the development of angling tourism initiatives throughout the County, building on the amenity and recreational potential of the angling sector. In this regard the Council shall facilitate the development and upgrading of angler access, stands, car parks and their associated facilities, in accordance and consultation with relevant management strategies, key stakeholders and bodies including Inland Fisheries Ireland. Where appropriate the Council shall promote an inter-regional approach in this regard, in association with Leitrim, Roscommon,* *Westmeath and Offaly in order to enhance the mid and north Shannon tourism area"* (Ref Policy TOU 8).

- *"The Council shall continue to engage with Inland Fisheries Ireland with regard to the enhancement of the angling tourism product and the development of associated infrastructure"….* (Ref Policy TOU 23).

The effects of the proposed development on angling is considered in section 5.2.3. below.

Golf Courses

Golf is a popular activity for both tourists and locals. There are no golf courses in proximity to the proposed development. The County Longford Golf Club is located east of Longford Town (i.e. >10km from the study area).

The effects of the proposed development on golf courses is considered in section 5.2.3. below.

Equestrian Activities

The ISPCA National Animal Centre at Derryglogher lies approximately 750m to the west of turbine 18 and 950m to the west of turbine 19 within Lough Bannow bog. Lockside Farm and Stables (approximately 1.5km) and Mosstown Stables (approximately 1km) are both located south east of the study area near Keenagh in County Longford. The Roscommon Equestrian Centre is located approximately 10km to the west of the proposed development in Kilrooskey near Lough Ree on the River Shannon.

The potential effects of the proposed development on equestrian activities is considered in section 5.2.3. below.

5.2.2.6 Community Gain

As described in Chapter 2 of this EIAR, the proposed development has several potential community economic gains including the creation of local jobs, increased local expenditure by staff and contractors (e.g. accommodation and sustenance) and additional employment regionally through the supply of materials and services. In addition, the payment of a development contribution to Longford County Council and annual rates will provide benefits to the local community through refurbishment and upgrading of roads, carparks, sewers, waste water facilities, drains or watermains, community facilities, open spaces, landscaping etc.

A range of other local benefits will be provided to the area through the annual Community Gain Scheme. This fund aims to provide financial assistance to local groups and not-for-profit organisations in the area for projects around the proposed development. It is a criterion of this scheme that the qualifying projects are to benefit the local community.

Bord na Móna Powergen also proposes to operate a Near Neighbour Scheme which will mean that local residences (within a set distance of a turbine) will benefit from an annual contribution towards their electricity usage. In addition to the electricity contribution these residents will also be offered a contribution towards the completion of energy measures on the property and/or education support.

The proposed development has the potential to 'open up' the site for public use by allowing for walking/cycling routes through the site to connect to neighbouring villages and form part of the Royal Canal Greenway. Initial public consultations regarding this have proven positive with suggestions from members of the public to link the site with the Corlea Trackway Centre and Royal Canal. It is Bord na Móna Powergen's intention to continue to engage with the community to further gain ideas for potential amenity plans for the proposed development site. The proposed development will see over 30km of permanent roads put in place that will be used by the public for walking, cycling, running etc.

5.2.3 Potential Impacts (Population)

5.2.3.1 Potential Effects - Construction

Land Use

The proposed wind farm development will be located on four bogs within a site of approximately 1900 hectares. Existing entry points / access roads for Bord na Móna machinery and a railway line are present in parts of these bogs. During the construction phase Bord na Móna will continue active peat extraction in the surrounding bog areas where resources are available and therefore activities (i.e. machinery on the bog) will be appear similar to present day. During the construction phase relatively small areas of peat extraction fields, cutover/cutaway peat and revegetated cutaway peat will be formed into internal roads, hardstanding areas, turbine bases and borrow pits (temporary). Construction works for the wind farm development will be visible in some areas (refer to Chapter 9) as the land use changes. As the development and infrastructure is constructed, the land use will change and some existing habitats will be lost (refer to Chapter 6). The change to land use during the construction phase will have an imperceptible negative indirect effect on the local population and construction works will be short term in nature, expecting to take between 24-30 months.

Population

There may potentially be an increase in visitors (i.e. construction workers etc.) staying in temporary accommodation in the area and adding value to the local economy. This would be a positive direct effect as a result of the proposed development being constructed. During the construction phase of the development, the main potential indirect effects on dwelling houses and the local population will include increased traffic levels, noise and visual effects. These effects are assessed in detail in the relevant chapters of this EIAR. The construction phase of the proposed development will likely have a slight negative effect on the local population and will be short term is nature (24-30 months).

Economic

The proposed development will create or support employment at local and national levels both directly and indirectly. It is anticipated that the wind farm will have the following effects locally:

- Development activities such as site monitoring, site investigations, legal fees, consultancy studies for the environmental assessment report, etc;
- Spending locally by surveyors, engineers and scientists; and
- Accommodation and sustenance may be required in the locality for those workers on site.

Approximately 100-120 persons will be directly employed during the peak construction period. The area will also experience a benefit from secondary investment associated with increased visitors and spend within the area. Construction materials such as stone will be sourced on site and locally where feasible and concrete will be sourced locally. Throughout the construction period plant and equipment and associated operatives will be sourced locally where practicable. During construction, additional indirect employment will be created in the region through the supply of services and materials to the wind farm. Therefore, the construction phase of the proposed development will have a short-term slight positive effect on employment in the local area and Midlands Region through the creation of new jobs and support of existing jobs and services. The construction of the wind farm will have an estimated capital cost in the region of 100 million euro and an estimated 20 to 30 million euro of the total cost will relate to site works which will require the services of local contractors and suppliers.

The 'Value of Wind Energy to Ireland' (Poyry, 2014) report states that *"the wind industry would make a valuable contribution to the Irish economy by meeting the 2020 renewable target and provide a good platform for continued growth during the 2020s compounding the benefit to the economy."* It also states that wind farm developments in Ireland, such as the proposed development, have the potential to support 12,390 jobs (person-years) during construction to deliver the 2020 renewable target; a further 10,120 jobs (person-years) would be supported during construction through to 2030. Wind growth is expected to support €3.5 billion of direct investment to 2020, 1.2% of total Irish investment, and an additional €4.8

billion to 2030. In this case the economic effects to Ireland from expanding the wind farm industry are positive, direct and long-term.

The findings in the report "An Enterprising Wind": An economic analysis of the job creation potential of the wind sector in Ireland (IWEA, 2014), also suggest that "a major programme of investment in wind could have a sizable positive effect on the labour market, resulting in substantial growth in employment. It would add noticeably to the GDP and produce a significant improvement in Debt/ GDP ratio by 2020".

Tourism and Amenities

The proposed wind farm development site is not currently open to the public and there are no tourist attractions or amenities (including walking/cycling trails, angling facilities, golf courses or equestrian activities) on site. This will remain the case during the construction phase and therefore have a neutral effect.

5.2.3.2 Potential Effects - Operation

Land Use

The land use will change to accommodate the proposed Derryadd Wind Farm development. The proposed development will also see approximately 30km of permanent roads put in place as the land is opened up for use by the public for walking, cycling, running etc. This will be a positive moderate permanent direct effect to the land use.

Property Values

Whether or not wind farms have any effect on property values has been debated for many years. In the UK a study was commissioned on 'The effect of wind farms on house prices[5]' and was carried out by the Centre of Economics and Business Research (Cebr). The key findings of the study were:

- Overall the analysis found that country-wide property market drives local house prices, not the presence or absence of wind farms.
- The econometric analysis established that construction of wind farms at the sites examined across England and Wales has not had a detectable negative impact on house price growth within a 5km radius of the sites.

[5] 'The effect of wind farms on house prices' (RenewableUK, March 2014)

In 2016 a research project estimating the 'The impact of wind turbines on house prices in Scotland'[6] was completed. It was based on analysis of over 500,000 property sales in Scotland between 1990 and 2014. The key findings of the project were:

- No evidence of a consistent negative effect on house prices: Most results either show no significant effect on the change in price of properties within 2km or 3km, or find the effect to be positive.
- Results vary across areas: The results vary across different regions of Scotland.

Although there have been no similar studies carried out in Ireland regarding the effects of wind farms and property prices, it is a reasonable assumption based on available published studies that the operation of a wind farm at the proposed location would not significantly impact on property values in the area.

Population

The proposed development has been designed to ensure that there are no undue or adverse effects on the local or wider population. For the operational phase of the project, the main potential indirect effects include noise, shadow flicker, electromagnetic interference and visual effects. These effects are assessed in detail in the relevant chapters of this EIAR along with the inclusion of recommended mitigation measures to offset identified adverse effects where necessary.

The proposed development is not expected to affect local population numbers but it may help attract tourists and temporary visitors to the area as the site is opened up for public access and linked to other attractions in the region. This would have a slight positive permanent effect to the area.

Economic

Local expenditure from operational activities will include employment (estimated as between 6 – 8 people), ongoing purchases of local materials, services and equipment as necessary. The project will improve conditions for socio-economic growth by improving the power supply capacity and infrastructure in the local region. This has the potential to make the area more attractive to inward investment, further aiding rural development. While the direct effects from the proposed development locally will be limited, positive economic effects will be felt elsewhere in the area due to the substantial initial investment and ongoing generation of electricity. The energy generated will feed directly into the electricity transmission system, providing a sustainable source and an increasingly competitive, low impact, energy supply to the

[6] 'The impact of wind turbines on house prices in Scotland' (Climate Change, October 2016)

county's domestic and industrial consumers. This is a significant, positive permanent direct effect for electricity consumers.

Tourism and Amenities

The proposed development includes for the provision of amenity infrastructure in the form of cycle and walkways throughout the windfarm development site to connect with neighbouring villages and form part of the Royal Canal Greenway. On completion there will be approximately 30km of roads and amenity paths available for public use. Bord na Móna is committed to developing the area following the construction phase, similar to the Mountlucas Wind Farm development, for the benefit of the local communities. At the site there is potential for organised exercise activities such as a weekly Park Run or installing outdoor exercise equipment. This is a positive permanent direct effect for the area and local people.

In addition, Bord na Móna will continue to work with local communities and authorities regarding the development of the Corlea Archaeological and Biodiversity Project and the Mid Shannon Wilderness Park and these projects can be progressed in conjunction with the proposed development. This has potential to have a positive, permanent indirect effect for the area and tourists.

The Mid Shannon Tourist Trail also goes through part of the study area, following the local road network. The amenity elements of the proposed wind farm will link to this trail potentially enhancing its appeal for tourists. This has potential to have a positive permanent direct effect for the area and tourists.

Equestrian Activities

The ISPCA National Animal Centre at Derryglogher is the closest equestrian centre and lies 750m to the west of turbines 18 and 950m to the west of turbine 19 within Lough Bannow bog. Some horses can be fearful of turbines while others are undisturbed. It has also been reported that some horses can walk past turbines calmly, while on other occasions the same horse can have an adverse reaction for no apparent reason[7]. The British Horse Society notes that the noise and visual stimulus (e.g. the movement of blades or shadows cast by the blades) from operating turbines could potentially cause disturbance to horses on equestrian routes. There are currently no equestrian routes on site and if none are developed a neutral effect is expected. The UK Countryside Agency proposes that a distance of four times the blade tip height be recommended for national trails and promoted equestrian routes on the basis that these are likely to be used by horses unfamiliar with turbines[8].

[7] British Horse Society (2015) Wind Turbine Guidance for Planners and Developers.

[8] British Horse Society (2012) Wind Turbines experiences - 2012 Survey Results.

The British Horse Society recommends a “minimum separation distance of 200m or three times blade tip height (whichever is greater) will be required between a turbine and any route used by horses or a business with horses”[9]. The location of the closest turbine (Turbine 18) is approximately 780m from the ISPCA National Animal Centre reception building. Based on the distance of the nearest turbine from the ISPCA National Animal Centre, the effect on the horses is not likely to be significant. As Lockside Farm and Stables, Mosstown Stables and The Roscommon Equestrian Centre are located at greater distances, no adverse effects from the proposed wind farm are expected.

Energy and Climate Change

The proposed wind farm development when operational will provide energy from a renewable resource and will not contribute to air pollution. In turn the wind farm will help reduce CO_2 and other greenhouse gas emissions by providing an alternative to the generation of energy through the burning of fossil fuels and will aid in achieving Irelands targets for renewable energy. Table 5.6 below shows the total predicted carbon savings over the lifetime of the windfarm. Further details of the carbon savings can be found in Chapter 12, Air Quality and Climate.

Table 5.6: Predicted Carbon Savings

Windfarm Lifetime Savings	**(t CO_2)**	**Payback (yrs)**
Against SEM mid-merit	4,847,989	1.06
Against EU FFC	4,289,933	1.19
Against 'Demand Following' CCGT	2,570,066	1.99

The proposed development will lead to increased security of energy supply in Ireland and provide diversity in our energy supply. When operational, the wind farm will generate enough electricity to supply the needs of approximately 58,066 homes.[10] The proposed development will have positive long-term direct effect for Ireland.

[9] British Horse Society (2015) Wind Turbine Guidance for Planners and Developers.

[10] Over 58,066 homes 96MW grid capacity, based on wind farm capacity factor of 29, and an annual average domestic energy consumption of 4,200kWh/y (Sustainable Energy Authority of Ireland, “Energy in Ireland 1990-2016” (Nov 2017) and CER Report, 2017)

Community Benefit

In addition to the positive economic and amenity effects detailed above, the payment of a development contribution to Longford County Council and annual rates will provide benefits to the local community through refurbishment and upgrading of roads, carparks, sewers, waste water facilities, drains or watermains, community facilities, open spaces, landscaping etc. This will have a local slight, positive long-term indirect effect on the population.

The annual fund of the Community Gain Scheme will be related to the total installed MW of the wind farm and the arising MW/hr output. This scheme will have a local positive long-term effect for the community groups and projects involved.

An element of the Near Neighbour Scheme will see local residences (within a set distance of a turbine) benefit from an annual contribution towards their electricity usage and will result in a positive long-term effect for these residences.

5.2.3.3 Decommissioning Phase

Only the above ground components of the wind farm will be removed off site during the decommissioning phase with the internal site road network remaining. When the decommissioning phase is occurring this site and internal road network will be well established for recreational and amenity uses. It can be expected that the decommissioning phase will cause some noise and traffic disturbance to the local population and amenity uses on this site. It may also require the temporary closure of certain areas of the site for health and safety purposes as the turbines are being dismantled and removed but these areas will be re-opened to the public as soon as possible. These direct effects are likely to be non-significant, temporary and short term in duration. The decommissioning phase may have a slight positive effect with regards to the economy and jobs as more workers will be needed to undertake the decommissioning works on site and the recycling process further afield. This direct positive effect will be short term and temporary in nature lasting the duration of the decommissioning phase.

5.2.3.4 Cumulative Effects

In terms of population, the proposed development is not expected to contribute to any significant, negative cumulative effects on other existing developments in the vicinity. The opening of the bog for public access and linkages to surrounding attractions could assist with boosting tourism and visitor numbers to the area and Longford County which would be a positive long term cumulative effect.

5.3 HUMAN HEALTH

This assessment has been prepared in accordance with the relevant guidelines produced by the Environmental Protection Agency (EPA) as detailed in 5.3.1 below. The Human Health section has been completed by Dr. Martin Hogan FRCPI FFOMI, Consultant Occupational and Environmental Physician (who works for and on behalf of CHI (Cork)) for Bord na Móna. Dr. Hogan has over 20 years' experience is assessing possible impacts to health in environmental impact assessments.

Data has been collected primarily through a review of relevant documents listed in Section 5.3.1, information gathered through the extensive public consultation detailed in Chapter 1, and mapping provided by the project design team. An overview, including the findings of a literature review (Appendix 5.1), on the potential impacts of the proposed wind farm on human health has also been carried out and is detailed in Section 5.3.3.1 of this EIAR.

Aspects examined in this section of the chapter primarily relate to impacts from the proposed development on socio-economic activities and on local community health. These two themes are discussed primarily in this chapter but may be referred to in other chapters where appropriate.

5.3.1 Methodology

This section sets out the methodology that was used in order to assess the impact of the proposed development on human health.

5.3.1.1 Relevant Guidelines

This assessment has been prepared having regard to the following guidelines:

Draft Advice Notes for Preparing Environmental Impact Statements (EPA, 2015);

Draft Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (EPA, 2017);

Night time Noise Guidelines for Europe (World Health Organisation (WHO), 2009);

Health Impact Assessment Resource and Tool Compilation (US EPA, 2016);

Guidelines for Community Noise (WHO,1999);

Health in Environmental Impact Assessment - A Primer for a Proportionate Approach (IEMA, 2017);

Health Impact Assessment (Institute of Public Health Ireland, 2009);

Air Quality Standards Regulations 2011 (S.I. No. 180 of 2011);

Air Quality Guidelines (WHO, 2005);

British Standard (BS) 5228-1:2009+A1:2014 – Code of Practice for Noise and Vibration Control on Construction and Open Sites Part 1: Noise;

Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4) (EPA, 2016); and

WHO Environmental Noise Guidelines for the European Region 2018.

Guidance on the methodology for assessing human health in EIA

The 2014 amendment to the 2011 EIA Directive (2014/52/EU) directs that "Population and Human Health" be assessed in an Environmental Impact Assessment Report. However, no specific additional guidance on the meaning of the term Human Health has been issued in the context of Directive 2014/52/EU. In addition, no specific guidance on the assessment of human health in the context of EIAR has been issued to date.

The 2017 draft EPA guidelines on the information to be contained in Environmental Impact Assessment Reports states that

"*While no specific guidance on the meaning of the term Human Health has been issued in the context of Directive 2014/52/EU, the same term was used in 3.3.6 the SEA Directive (2001/42/EC)*. *The Commission's SEA Implementation Guidance* states '*The notion of human health should be considered in the context of the other issues mentioned in paragraph (f)'*".. (Paragraph (f) (of Annex I of the SEA Directive) lists the environmental factors including soils, water, landscape, air etc.).

The 2017 draft EPA guidelines also states that the above health assessment approach is *"consistent with the approach set out in the 2002 EPA Guidelines where health was considered through assessment of the environmental pathways through which it could be affected, such as air, water or soil, viz*:

"*The evaluation of effects on these pathways is carried out by reference to accepted standards (usually international) of safety in dose, exposure or risk. These standards are in turn based upon medical and scientific investigation of the direct effects on health of the individual substance, effect or risk. This practice of reliance upon limits, doses and thresholds for environmental pathways, such as air, water or soil, provides robust and reliable health protectors [protection criteria] for analysis relating to the environment"*.

The 2017 draft EPA guidelines also note that in an EIAR, "*the assessment of impacts on population & human health should refer to the assessments of those factors under which human health effects might occur, as addressed elsewhere in the EIAR e.g. under the environmental factors of air, water, soil etc"* and that *"assessment of other health & safety issues are carried out under other EU Directives, as relevant. These may include reports prepared under the Integrated Pollution Prevention and Control, Industrial Emissions, Waste Framework, Landfill, Strategic Environmental Assessment, Seveso III,* *Floods or Nuclear Safety Directives. In keeping with the requirement of the amended Directive, an EIAR should take account of the results of such assessments without duplicating them*".

The Institute for Environmental Management and Assessment (IEMA) in the UK issued a discussion document in 2017 (IEMA, 2017), which it describes as a primer for discussion on what a proportionate assessment of the impacts on health should be in EIA. It is a useful document when considering what can and should be assessed in the context of EIA. Regard has been given to the general approach advocated in this document when compiling this chapter.

One of the messages in the IEMA document in terms of assessing health in EIA, is that there should be a greater emphasis on health outcomes, (that is the potential effects on human health), rather than simply the health determinants, (that is the agents or emissions which could have the potential to have health effects). The IEMA document noted that in EIA, there has previously been a strong focus on just the agents or emission levels (e.g. dust) rather than focussing on the effects of these agents/emission levels on human health. This change in emphasis does not mean a complete change in practice. For example, measurement and modelling of dust levels continues to be an essential part of the health assessment.

The IEMA document notes that "*public health is defined as the science and art of promoting and protecting health and well-being, preventing ill-health and prolonging life through the organised efforts of society and has three domains of practice: health protection, health improvement and improving services*". The IEMA document suggests that these three domains should be considered in the assessment of health in EIA. Examples of health protection issues to be considered could include issues such as chemicals, radiation, health hazards, emergency response and infectious diseases whilst health improvement issues could include lifestyles, inequalities, housing, community and employment. Examples of improving services issues could include service planning, equity and efficiencies.

The World Health Organization (WHO) defined health in its broader sense in its 1948 constitution as "*a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity"*. Therefore, whilst the EPA guidance is useful in terms of health protection, for a more holistic assessment as per the IEMA document, it is also worthwhile to look at broader health effects in terms of opportunities for improvement of health and for improvement of access to services. While it is important to do this, it is also important not to attribute every conceivable event as being a health effect. To further rely on the WHO definition, a health effect would be something that would have a material impact on somebody's physical, mental and social well-being, be that positive or negative.

Therefore, *health protection, health improvement and improving services* are all considered in this chapter of the EIA Report. The methodology for assessing health protection is considered further below.

Health Impact Assessment and Environmental Impact Assessment

The IEMA (IEMA, 2017) document notes that Health Impact Assessment (HIA) and EIA are separate processes and that whilst a HIA can inform EIA practice in relation to human health, a HIA alone will not necessarily meet the EIA human health requirement. HIA is not routinely carried out for major infrastructure schemes in Ireland.

Guidance (IPHI, 2009) was issued by the Institute of Public Health in Ireland in 2009. There are however considerable difficulties in performing a HIA as outlined by the Institute of Public Health for infrastructural projects such as the proposed development. Not least of these is the difficulty of getting baseline health data. It is quite difficult due to patient confidentiality and other reasons to accurately determine levels of even relatively common medical conditions in a relatively defined population that might be affected by a project. Qualitative and quantitative baseline health data is a vitally important part of the appraisal section of the HIA. In the absence of an accurate baseline it is very difficult to assess qualitative and quantitative changes that might occur. One could use more generalised data that might exist for larger areas such as a city or county, but these would be at most an estimate of the local baseline and not accurate enough to allow for meaningful interpretation.

The IEMA document notes that the WHO (WHO, 2014) provides an overview of health in different types of impact assessment and presents the WHO perspective on the relationship of HIA to other types of impact assessment as follows:

"The health sector, by crafting and promoting HIA, can be regarded as contributing to fragmentation among impact assessments. Given the value of impact assessments from a societal perspective, this is a risk not to be taken lightly ... The need … and justification for separate HIA cannot automatically be derived from the universally accepted significance of health; rather, it should be demonstrated whether and how HIA offers a comparative advantage in terms of societal benefits …
Health issues can, and need to, be included [in impact assessment] irrespective of levels of integration. At the same time, from a civic society perspective, it would be unacceptable for HIA to weaken other impact assessments. A prudent attitude suggests optimizing the coverage of health along all three avenues:

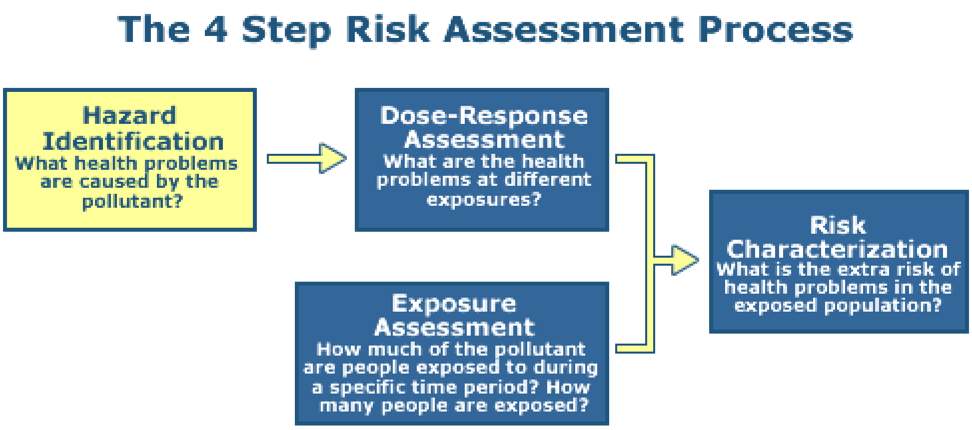
- *better consideration of health in existing impact assessments other than HIA;*
- *dedicated HIA; and*
- *integrated forms of impact assessment"*

It is clear therefore that even the WHO does not support a stand-alone HIA unless it could be demonstrated to be of advantage over the EIA Report. It is for these reasons that this health assessment is part of the EIA Report and there is no stand-alone HIA.

The HIA is defined as a combination of procedures, methods and tools that systematically judges the potential, and sometimes unintended, effects of a policy, plan, programme or project on both the health of a population and the distribution of those effects within the population, whilst the health assessment in the context of EIA focuses the attention of the assessment on likely significant effects, i.e. on effects that are deemed likely to occur and, if they were to occur, would be expected to be significant (as per the requirements of the EIA Directive). Conducting an HIA will not necessarily meet the EIA population and human health requirement.

5.3.1.2 Health Protection

The assessment of human health for the proposed development, in terms of health protection, follows the approach set out in the EPA Guidelines and in the Commission's SEA Implementation Guidance. It is also similar in nature to the US EPA Guidance. Human Health protection is considered through the assessment of the environmental factors (pathways) through which health could be affected such as air, noise, water and soils. The US EPA guidance includes a four step approach which is represented graphically below.



The potential noise, air, soils and water impacts which could affect human health were identified (Hazard Identification), the scale of these potential impacts (Dose-Response Assessment) and their duration (Exposure Assessment) were assessed and the significance of the potential impact on human health determined (Risk Characterisation). This assessment involved a review of the relevant chapters of this EIAR and the identification of potential impacts (described further below in Section 5.3.3).

When using a recognised Health Based Standard, the dose-response assessment is actually included in the standard. In other words, the authorities or expert committees which recommended the level of the standard will have taken into account the health problems at the different exposure levels and set the level within the standard to prevent these problems from occurring.

5.3.1.3 Significance Criteria for rating Health Impacts

There is a difficulty in assigning levels of significance to human health impacts. In medicine, as in all science, the concept of statistical significance is used. This involves attaching a value to significance, often expressed as a percentage level of confidence in the data. Confidence measures of 95% or even 99% are often used to measure levels of certainty or changes that are not due to chance alone.

This is a valid approach for the study of the impacts on a *population*, but does not absolutely exclude a response on an *individual*. However, it is difficult to assign levels of significance to individual human health impacts without detailed information about that individual. Thus, the significance of health effects is assessed on a group or community basis rather than on an individual basis. There is such a variability in human response that one could never identify all possible individual effects and so, in accordance with the guidance referred to above, it is considered to be more appropriate to assess the significance of health effects at a population level. The significance criteria for the assessment of the health of communities are, therefore, as outlined in Table 5.7 below.

Table 5.7: Criteria Used in the Assessment of Community Human Health Protection Impacts

Impact Level	Significance Criteria
Imperceptible	No significant human health impacts are apparent
Slight	A small impact on individual reported symptoms but no change in health status can be attributed to the proposed windfarm
Moderate	A moderate impact on health status of an individual but no change in morbidity or mortality can be attributed to the proposed windfarm
Significant	The proposed windfarm has the potential to impact on individual health status with an associated change in morbidity
Very Significant	The proposed windfarm has the potential to impact on the health status of groups of people

Profound	The proposed windfarm has the potential to impact on the health status of communities

Asthma can be used as an example when using these criteria:

- An Imperceptible impact would be one with no measurable effect on asthma.
- A Slight impact might be a temporary increase in symptoms in an individual but no change in the severity of the underlying condition or treatment required.
- A Moderate impact might be an individual increasing their use of inhalers attributable to the proposed development but no change in underlying condition and no effect on the vast majority of asthmatics.
- A Significant effect might be an individual becoming asthmatic or an individual's asthma becoming measurably more severe as a result of the proposed development.
- A Very significant effect might be a group of individuals becoming asthmatic or their asthma becoming measurably more severe as a result of the proposed development.
- A Profound effect might be a measurable increase in the incidence or severity of asthma in a community as a result of the proposed development.

5.3.2 Baseline Environment/Community Profile

Evidence shows that different communities have varying susceptibilities to health impacts both positive and negative as a result of social and demographic structure, behaviour and relative economic circumstance.

Whilst specific health data for individuals in the vicinity of the proposed windfarm is confidential and difficult to establish, as has been detailed in the methodology section above, a community profile has been used to establish a baseline and identify unequal distributions in existing factors such as deprivation or burden of poor health, in order that changes in community exposure to certain health pathways and their degree of impact on the population or community can be assessed.

A group made up of the Health Services Executive, Lenus and the Irish Health Repository have published health profiles for all the Local Authorities areas in Ireland.

There are separate health profiles available for all local authority areas. The most recent profiles published relate to 2015 (Lenus, 2015) and have been used to establish a community health profile for the proposed windfarm.

The key facts in the Health Profile relating to County Longford are:

- It is the 4th most deprived local authority area nationally, with 88% of its population either below average affluence or disadvantaged.
- It has a high percentage of those with no formal or primary education 19.3% (national average 15.2%), unemployment of 24.7% (national 19.0%), and households which are Local Authority rented 13.6% (national average 7.8%).
- The Traveller population of 1.9% is above the national rate of 0.7%.
- The birth rate to females under 20 years of age of 17.1% is above the national average of 12.3%.
- Cancer incidence is either average or below average for all cancers and the main causes of cancer except for male prostate cancer which is above the national average.
- Mortality rates for all deaths and the main causes of death are average or below the national average except for respiratory deaths.

It is important to realise when viewing these figures that they relate to the entire administrative area which is County Longford. They are based on the then census population of 39,000 (2011). While we can take these figures as being correct, they do not necessarily accurately reflect the health profile of smaller areas which are close to the proposed development. The map of deprivation included in the profile shows the area in the vicinity of the proposed development to be marginally above and below the national average. It is therefore neither particularly affluent nor particularly deprived. There are nevertheless areas of deprivation where the statistics above, simply do not apply. As outlined previously, it is not possible to get reliable baseline information on small scale populations. The data above, qualified in this manner, nevertheless does give a valuable insight into the general area.

As mentioned it is not possible to identify every vulnerable individual. However, every human community contains vulnerable individuals. Be those the old, the very young or because they have conditions which may make them more susceptible. Examples are as diverse as humans themselves but include asthma, autism, those with psychological illness to name but a few. It is important to point out that Health Standards are set for the vulnerable and not for the robust.

5.3.3 Potential Impacts (Human Health)

5.3.3.1 Overview

When performing an assessment of the potential for health effects from a large scale infrastructural project it is important to conduct a review of all relevant literature on the subject. It is also important to assess the quality of any information reviewed. In general, studies which are published in peer-reviewed journals are the most authoritative. Peer-reviewed means that only those with reasonable scientific substance which meets the scientific criteria of experts in the field are published. Even within peer-reviewed journals there are different qualities of studies. A prospective cohort study is often the gold standard. It is not possible to study all effects with this method so sometimes other methods such as a case-control study which may be retrospective are the best available. In general the principles remain the same.

More information on interpretation of scientific literature can be found on the Sense about Science website, www.senseaboutscience.org. This is an independent campaigning charity that challenges the misrepresentation of science and evidence in public life. It advocates openness and honesty about research findings, and works to ensure the public interest in sound science and evidence is recognised in public discussion and policymaking.

It is important to realise that not all publications even in peer reviewed journals are of equal quality. Studies which are merely based on questionnaires or other reporting of symptoms are of less value but may be useful in identifying areas for further study particularly if they are linked with scientific measurements such as exposure data.

Occasionally opinion is published, without necessarily strong backup, to stimulate discussion but of course it has only the value of the scientific evidence behind it.

With wide use of the Internet there are also a multitude of other sources of information with varying degrees of unreliability.

When performing a literature review often the first thing one looks for are literature reviews of the subject if available performed by reputable independent bodies.

This is a subject on which there is clearly a lot of opinion available on the internet with wide ranging and often contradictory information. What follows is a description of some of the available material and an analysis of its scientific robustness.

In this review the sources of the relevant opinions and their scientific reliability are described.

5.3.3.2 "Wind Turbine Syndrome"

This term first appeared in 2009, when a New York Paediatrician, Dr. Nina Pierpont (Pierpont, 2009), self-published a pamphlet she called *Wind Turbine Syndrome: A Report on a Natural Experiment.* Her "natural experiment" was to speak on the telephone with 23 people who answered her advertisement asking if they lived near a wind turbine and if they ever felt sick. Fifteen of them of them said they had family members who would probably answer the question posed in the affirmative. Based on these personal assessments, Dr Pierpont claimed science “proved” her belief that wind turbines cause a vast array of maladies. This would not be what could be defined as a reliable scientific study and it more closely resembled a relatively unscientific Opinion Poll. In other words using the logic stated above this was not published in a peer-reviewed journal, and is indeed unlikely to be because of the relatively unscientific nature of its methods. Therefore, any conclusions it might infer must be treated with considerable doubt.

Interestingly, if the term "Wind Turbine Syndrome" is entered into Pubmed, (accessed 29th November 2018) there are only eight references, none of which state that there was any evidence of such a “Syndrome”.

“Wind Turbine Syndrome” therefore is not an accepted medical term. There have been reports however of some non-specific symptoms which have been tentatively linked by some people to living near wind turbines. When the key words “Wind Turbine Health” are input into Pubmed (accessed on 29 November 2018) 107 articles were found. This is significantly more than a similar search in 2016 and 27 more than the same search undertaken in March 2018. This is still a modest number but it is clear some medics/academics have studied this topic. Most of these have concentrated on the potential impacts of the sound/ infrasound of the turbines including a recent article by Jeffrey *and Krogh* which is addressed below. Most of these have subsequently been robustly criticised for lacking scientific methodology.

A review of the existing literature on wind turbines was performed in 2011 by Knopper (Knopper, 2011). The results of this study were stated as follows:

> *“Conclusions of the peer reviewed literature differ in some ways from those in the popular literature. In peer reviewed studies wind turbine annoyance has been statistically associated with noise but found to be more strongly related to visual impact, attitude to wind turbines and sensitivity to noise. To date, no peer reviewed articles demonstrate a direct causal link between people living in proximity to modern wind turbines, the noise they emit and resulting physiological health effects. If anything, reported health effects are likely attributed to a number of environmental stressors that result in an annoyed/stressed state in a segment of the population. In the popular literature, self-reported health outcomes are related to distance from turbines and the claim is made that infrasound is the causative factor for the reported effects, even though sound pressure levels are not measured.”*

The National Health and Medical Research Council of Australia did a “Quick review of the potential health effects of Wind Turbines” in 2010, which concluded:

"This review of the available evidence, including journal articles, surveys, literature reviews and government reports, supports the statement that: There are no direct pathological effects from wind farms and that any potential impact on humans can be minimised by following existing planning guidelines."

Professor Simon Chapman (Chapman, 2012) writing in the New Scientist in October 2012 pointed out that, if wind turbines did cause medical problems, we would expect to find a relationship between prevalence of the syndrome and populations living near wind farms. But we do not. In fact, he stated that it is almost the case that the opposite is true. The people who should be most affected are those who live on the land where the wind turbines are actually located but this is not described in the literature.

In short, the locations of wind turbines and the locations of people suffering from them show little or no statistical relationship.

In December 2013, the National Health and Medical Research Council in Australia published its Systemic Review (Merlin, 2015) which was performed by the University of Adelaide. This was an extremely thorough follow on to the "Quick Review" referred to above. It was completely independent with no relationship to either Wind Farms or objectors. This is probably the most in-depth review of this matter ever performed anywhere in the world. It looked extensively at all the reported effects and systematically looked at all the evidence. It concluded: "*The evidence considered does not support the conclusion that wind turbines have direct adverse effects on human health, as the criteria for causation have not been fulfilled".* This is very reassuring because of its independence, its thoroughness and the fact that it is current.

There was a commentary published in the BMJ (Hanning, 2008) on 8th March 2012 by Hanning and Evans. This was not an evidence-based study but merely an opinion piece. This occurs from time to time in medical literature but it should not be viewed as necessarily authoritative but a stimulant for discussion. Often it is the discussion that ensues which is of more interest.

The aforementioned Prof Chapman (Chapman, BMJ 2012;344:e3366, 2008) responded, in a letter published in a subsequent issue of the BMJ.

He stated:
"Hanning and Evans, two writers who declare histories of anti-windfarm activity, say that "a large body of evidence" now exists that wind turbines disturb sleep and impair health within permissible distances from housing. They are correct in saying that a large body of relevant evidence exists, but wildly incorrect in their interpretation of its conclusions. I have located no less than 17 reviews of the evidence on whether

wind turbines and infrasound cause health problems, nearly all which satisfy the fully "independent" provenance being called for. Predictably, none are referenced in the editorial.

As will be seen, all of these reviews make strong statements that the evidence is very poor that wind turbines in themselves cause problems. What these reviews conclude is that:

- *A small minority of exposed people claim to be adversely affected by wind turbines.*
- *Negative attitudes to wind turbines are more predictive of reported adverse health effects and annoyance than are objective measures of actual exposure.*
- *Being able to see wind turbines is similarly predictive of annoyance.*
- *Deriving income from hosting wind turbines on one's land may have a "protective effect" against annoyance and health symptoms."*

In addition, a critical review of the Scientific Literature (McCunney, 2014) published in 2014 by McCunney in the JOEM concluded:

1) Infrasound sound near wind turbines does not exceed audibility thresholds.

(2) Epidemiological studies have shown associations between living near wind turbines and annoyance.

(3) Infrasound and low-frequency sound do not present unique health risks.

(4) Annoyance seems more strongly related to individual characteristics than noise from turbines.

In conclusion there appears little evidence of the so-called *Wind Turbine Syndrome* and so significant health effects in this regard are not foreseeable.

5.3.3.3 Noise Induced Hearing Loss

During the construction and operational phases of the proposed development, environmental noise levels sufficient to cause noise induced hearing loss will not occur. Therefore, as concluded in Chapter 13, Noise and Vibration, there is no risk of noise induced hearing loss due to noise from environmental exposure as a result of the proposed development.

5.3.3.4 Sleep Disturbance

In 2009, the WHO issued "Night Noise Guidelines for Europe". This explores the impacts of night time noise. It stated that in two European countries studied (Switzerland and The Netherlands), almost 50% of the population are exposed to night time noise in excess of 45dB L_{night}. It quotes some impacts at quite low night time levels and proposed an ideal noise level of 40dB L_{night} outside residences. This however is a yearly average. It does accept that this is essentially unachievable and suggests an interim value of 45dB L_{night} outside, again a yearly average. This is the current Guideline.

The Department of Environment, Heritage and Local Government's Wind Energy Development Guidelines (2006) states that:

"A fixed limit of 43dB(A) will protect sleep inside properties during the night."

This is a somewhat stricter guideline than the current WHO figure and approximately equates to the proposed "Ideal" WHO Limit of 40dB as a yearly average as the noise will vary with different wind speeds and directions. Interestingly, the Wind Energy Development Guidelines also state, *"In general, noise is unlikely to be a significant problem where the distance from the nearest turbine to any noise sensitive property is more than 500 metres."* This guideline is, of course, relevant to the proposed Wind Farm, where the shortest distance from a turbine to a residence is in excess of 750m.

In addition, as detailed in the Noise Chapter (Chapter 13), the predicted day-time noise levels at a worst-case distance of 200m from the construction works are calculated to be 52 dB LAeq,T. As these works will progress along the grid connection route, the worst-case predicted impacts will reduce. It is envisioned that they would be at the closest position to the nearest NSL for no more than 2 to 3 days.

In 2018 a major WHO review by Basner and McGuire (Basner, 2018) on Environmental Noise was published in March 2018. While it mainly concentrated on road, rail and aircraft noise it did briefly discuss Wind Turbine noise. It concluded the following:

"The results of the six identified studies that measured self-reported sleep disturbance are consistent, four of the studies found an association between wind turbine noise levels and increased sleep disturbance. However the evidence that wind turbine noise affects sleep is still limited. This finding is supported by other recent reviews on wind turbine noise and sleep disturbance. Three of the studies referred to noise specifically in the questions which could have led to a bias in the results. Also while the results from four out of the six studies suggest that sleep disturbance due to wind turbine may occur when noise levels are above 40 or 45 dBA, for two of the studies less than ten percent of the participants were exposed to these higher noise levels. Therefore, it is difficult to make conclusions on populations exposed to these higher levels. In addition, noise levels were calculated using different methods and different noise metrics were reported in the studies."

Whilst this has been published since the Department's Guidelines referred to above it is strong evidence that the guidelines are appropriate.

In October 2018, the WHO (WHO, Environemntal Noise Guidelines for the European Region, 2018) issued a full Environmental Noise Guidelines for the European Region. They were a development from the publication above. They do give specific guidelines in relation to wind turbine noise. It did, however, make interesting observations. It stated:

“For the relationship between wind turbine noise and prevalence of hypertension, three cross-sectional studies were identified, with a total of 1830 participants (van den Berg et al., 2008; Pedersen, 2011; Pedersen & Larsman, 2008; Pedersen & Persson Waye, 2004; 2007). The number of cases was not reported. All studies found a positive association between exposure to wind turbine noise and the prevalence of hypertension, but none was statistically significant. The lowest levels in studies were either <30 or <32.5 Lden. No meta-analysis was performed, since too many parameters were unknown and/or unclear. Due to very serious risk of bias and imprecision in the results, this evidence was rated very low quality.

The same studies also looked at exposure to wind turbine noise and self-reported cardiovascular disease, but none found an association. No evidence was available for other measures of cardiovascular disease. As a result, only evidence rated very low quality was available for no considerable effect of audible noise (greater than 20 Hz) from wind turbines or wind farms on self-reported cardiovascular disease They state that for average noise exposure the conditionally recommend reducing noise levels produced by wind turbines below 45 dB L den as wind turbine noise about this level is associated with adverse health effects.”

In relation to annoyance it stated:

“*Two publications containing descriptions of four individual studies were retrieved (Janssen et al., 2011; Kuwano et al., 2014). All four studies used measurements in the vicinity of the respondents’ addresses; the noise exposure metrics used in the three original studies (Pedersen, 2011; Pedersen & Persson Waye, 2004; 2007) included in Janssen et al. (2011) were recalculated into Lden. The noise levels in the studies ranged from 29 dB to 56 dB. Different scales were used to assess annoyance, with slightly different definitions of “highly annoyed” and explicit reference to outdoor annoyance in the data used for the Janssen et al. (2011) curve. Construction of the ERFs provided in the two publications differed and they were therefore not further combined in a meta-analysis. …. The 10% criterion for % Highly Annoyed (HA) is reached at around 45 dB Lden (where the two curves coincide). There was a wide variability in %HA between studies, with a range of 3–13%HA at 42.5 dB and 0–32%HA at 47.5 dB. The %HA in the sample is comparatively high.*

Further statistical analyses of annoyance yield evidence rated low quality for an association between wind turbine noise and %HA when comparing an exposure at 42.5 dB and 47.5 dB, with a mean difference in %HA of 4.5 (indoors) and 6.4 (outdoors). There is also evidence rated moderate quality for a correlation between individual noise exposure and annoyance raw scores (r = 0.28). given the relatively low noise levels. There is evidence rated low quality for an association between wind turbine noise and annoyance, but this mainly applies to the association between wind turbine noise and annoyance and not to the shape of the quantitative relationship."

In relation to sleep, it stated:

"*Six cross-sectional studies on wind turbine noise and self-reported sleep disturbance were identified (Bakker et al., 2012; Kuwano et al., 2014; Michaud, 2015; Pawlaczyk-Luszczynska et al., 2014; Pedersen & Persson Waye, 2004; 2007). Noise levels were calculated using different methods, and different noise metrics were reported. Three of the studies asked how noise affects sleep; the other three evaluated the effect of wind turbine noise on sleep using questions that explicitly referred to noise.*

The risk of bias was assessed as high for all six studies, as effects on sleep were measured by self-reported data. There were a limited number of subjects at higher exposure levels. A meta-analysis was conducted for five of the six studies, based on the OR for high sleep disturbance for a 10 dB increase in outdoor predicted sound pressure level. The pooled OR was 1.60 (95% CI: 0.86–2.94). The evidence was rated low quality."

Therefore, it made no recommendation for average night time noise exposure of wind turbines. It is stated the quality of evidence of night time exposure to wind turbine noise is too low to allow for recommendation.

This is the most recent and authoritative guideline regards to human health effects with the guideline of 45 dB L_{den} which is a measure taking into account day, evening and night exposure.

A recent article by Brauner (Brauner, 2018) showed no link between wind turbine noise and a risk of myocardial infarction.

Another article by Poulsen (Poulsen, 2018) also showed no link between wind turbines and adverse pregnancy outcomes.

5.3.3.5 Infra-sound

Infra-sound is sound below the audible human frequency. This is normally taken as being 20 Hz or less. Our ears cannot respond to this but sometimes it can be associated with vibration and is sometimes an

issue discussed with for example large tunnelling projects. Infra-sound is of course also an everyday event with everyday sources.
Many of the people who cite human health problems with wind turbines relate these to infrasound. These are often quite vague but include nausea, disturbance of sleep, tinnitus or ringing the ear as well as others. Several people have even postulated methods why something which we cannot hear, and that the ear is not designed to respond to, can nevertheless have adverse effects. One person who has most expressed concerns about this is Alec Salt of the Washington University School of Medicine. Another is Marianna Alves Pereira.

Many of the postulated methods are barely biologically plausible and no dose response relationship has been demonstrated. In other words if there was an effect one would expect this at higher intensities or volumes of infra-sound. Even though it cannot be heard, infrasound can be measured using sound metres.

In this regard, there is a very interesting publication from the South Australian EPA (Evans, 2013) published in 2013 entitled *Infrasound levels near wind farms and in other environments.* In this the authors objectively measured infrasound in a number of the different environments including urban and rural and interestingly in houses adjacent to windfarms and those further away. Among its conclusions were that:

"Infrasound levels of between 60 and 70dB(G) commonly occur in the urban environment."

The publication goes on to say that:
"Noise generated by people and associated activities within a space was one of the most significant contributors to measured infrasound levels, with measured infrasound levels typically 10 to 15dB(G) higher when a space was occupied. Infrasound levels up to approximately 70dB(G) were measured in occupied spaces."

When discussing the specific locations that were tested it stated:
"At two locations, the EPA offices and an office with a low frequency noise complaint, building air conditioning systems were identified as significant sources of infrasound. These locations exhibited some of the highest levels of infrasound measured during the study."

For rural environments they concluded, that while infrasound levels were lower than urban areas, that interestingly:
"Infrasound levels at houses adjacent to wind farms are no higher than those at houses located a considerable distance from wind farms."

Another is a relatively recent publication from Germany the Ministry of the Environment in the Federal State of Baden Wuerttemberg (Ratzel, 2016). It states in conclusion:

"Infrasound is caused by a large number of different natural and technical sources. It is an everyday part of our environment that can be found everywhere. Wind turbines make no considerable contribution to it. The infrasound levels generated by them lie clearly below the limits of human perception. There is no scientifically proven evidence of adverse effects in this level range.

The measurement results of wind turbines also show no acoustic abnormalities for the frequency range of audible sound. Wind turbines can thus be assessed like other installations according to the specifications of the TA Lärm (noise prevention regulations). It can be concluded that, given the respective compliance with legal and professional technical requirements for planning and approval, harmful effects of noise from wind turbines cannot be deduced."

The overall inference therefore is that infrasound related to windfarms can be discounted. It is lower than people would normally be exposed to in urban environments and that windfarms in general are not a significant source of infrasound with traffic (Noise and Vibration, Chapter 13) and indeed ordinary human activity being far more relevant.

Therefore, there will be no significant adverse effect on human health as a result of infrasound.

5.3.3.6 Electromagnetic Interference (EMI)

Electromagnetic compatibility (EMC) is the branch of electrical sciences which studies the unintentional generation, propagation and reception of electromagnetic (EM) energy with reference to the unwanted effects that such energy may induce. Emissions, such as electromagnetic fields (EMF) are related to the unwanted generation of EM energy.

The WHO (WHO, Electromagnetic fields and public health, 2007) guidance states that EMF is sometimes cited for potential health effects. Concerns expressed in the past include: childhood leukaemia, brain tumours and other cancers. Laboratory experiments have provided no reliable evidence that EMF are capable of producing cancer, nor do human epidemiological studies suggest that they cause cancer in general.

Some non-cancerous adverse health effects are claimed to be associated with power frequency EMF. These include: miscarriages, reproductive and developmental abnormalities, depression and suicide, allergy and neurological disease. However, the Health Promotion Agency in the UK stated, in November

2007, that *"there is little scientific evidence to support these claims and the current body of evidence does not show that exposure to EMF below guideline levels presents a human health hazard"*.

Electric fields are created by differences in voltage: the higher the voltage, the stronger the resultant field. Magnetic fields are created when electric current flows: the greater the current, the stronger the magnetic field. An electric field will exist even when there is no current flowing. If current does flow, the strength of the magnetic field will vary with power consumption but the electric field strength will be constant.

Electric Fields and Magnetic Fields occur not just related to transformers and power cables but indeed even more so to every day electrical items. The proposed substation will be located at one of two proposed locations on the site itself, well away from any residence with no possible EMF impact. The distance from the nearest sensitive receptor to Substation Location Option A is in excess of 450 metres. The distance from the nearest sensitive receptor to Substation Location Option B is in excess of 350 metres. To place these distances in context the distance to the nearest sensitive receptor from the existing substation for Lanesborough power station is in excess of 125 metres. Further information on this is available in the EirGrid publication entitled "*EMF and you*", included in Appendix 5.2.

The aforementioned Australian study (Merlin, 2015) (*"Infrasound levels near wind farms and in other environments*") when referencing electromagnetic radiation concluded:

"There is no direct evidence on whether there is an association between electromagnetic radiation produced by wind farms and health outcomes.

Extremely low-frequency electromagnetic radiation is the only potentially important electromagnetic emission from wind turbines.

Limited evidence suggests that the level of extremely low-frequency electromagnetic radiation close to wind farms is less than average levels measured inside and outside Australian suburban homes.

There is no consistent evidence of human health effects from exposure to extremely low-frequency electromagnetic radiation at much higher levels than is present near wind farms."

For these reasons, the assessment is that there will be no significant human health effects as a result of electromagnetic radiation.

5.3.3.7 Air Quality/ Dust Emissions

All construction of the turbines will take place several hundred metres from the nearest residence (the nearest residences are located in excess 760m from a turbine). Construction dust by its nature is heavy and disperses over a confined area as it falls to ground. The exact nature of the dust depends on the nature of the soil being excavated and the construction materials used.

Mitigation measures, in terms of dust control, on the construction site with sound construction methods will minimise any effects and these are outlined in Chapter 2, Description of the Proposed Development and Chapter 12, Air Quality and Climate. While in a construction project of this scale it is inevitable that there will be occasional dust generation, this is likely to be very localised in place and time. As detailed in Chapter 12, Air Quality and Climate, it is extremely unlikely that the construction activities will result in air quality standards being exceeded over any significant period of time in the environment outside the construction site. It can, therefore, be stated with confidence that there will be no significant human health effects arising from emissions to air including dust generation.

Indeed, by replacing fossil fuel burning power generation stations, one can expect a positive overall impact on Air Quality in the country as a whole as a results of the proposed development as compared to a Do Nothing scenario.

5.3.3.8 Shadow Flicker

Shadow flicker effect is something which, for the vast majority of people, is a minor annoyance but nothing more. However, concerns have been raised that in some people with photosensitive epilepsy it could trigger a seizure.

Even with these sensitive persons, it is only a proportion of those with epilepsy who may be vulnerable. The overall number is estimated as 1 in 4000 of the population would be photosensitive to such an extent that the potential flashing lights could trigger an epileptic seizure. For the vast majority of weather conditions and times of the day, there can be no flicker. This is clearly detailed in Chapter 10, Material Assets - Shadow Flicker.

Firstly, it only happens during the confluence of the following conditions namely, when the wind is blowing, at certain times of the day, at certain times of the year with certain angles of the sun, when cloud is not present and would only pose even a potential risk for a tiny proportion of the day.

Here again the aforementioned Australian study (Merlin, 2015) has something interesting to say and states the following:

"The Environment Protection and Heritage Council of Australia (EPHC; 2010) notes that the risk of seizures from modern wind turbines is negligible, given that less than 0.5% of the population are subject to epilepsy at any point in time and, of this proportion, 5% are vulnerable to strobe lighting (light flashes). In the majority of circumstances (>95% of the time), the frequency threshold for individuals susceptible to strobe lighting is >8 Hz, with the remainder affected by frequencies >2.5 Hz. The EPHC estimates that the probability of conventional horizontal-axis wind turbines causing an epileptic seizure for an individual experiencing shadow flicker is <1 in 10 million in the general population."

The risk of shadow flicker triggering an epileptic seizure therefore, even without the shutdown mechanisms, is deemed to be less than one in 10 million.

In fact, with technological advances, where individual turbines will be automatically shutdown in conditions that might cause shadow flicker, it will be significantly curtailed and this is the case in this project.

Shadow Flicker has been extensively covered in Chapter 10 of this EIAR. The conclusion of that chapter state that there will be no residual shadow flicker impacts associated with the proposed development following the implementation of the mitigation measures outlined in Section 10.4 of Chapter 10. The applicant is committed to mitigation that will ensure that any residual effects are within the acceptable limits.

With the proposed mitigation measures in place, there will be no discernible shadow flicker and, therefore, no adverse health effects. We can therefore predict that there will be no significant adverse human health effects as a result of shadow flicker.

5.3.3.9 Psychological Effects

In the planning process, potential adverse effects on psychological health are often mentioned, for example, anxiety and stress experienced by those who may be worried about noise, flicker or other issues.

The community may also experience annoyance arising from increased traffic or noise from the temporary impacts of the construction phase.

For virtually every proposal for any development there are concerns about potential significant adverse effects on a person's overall psychological well-being. This is somewhat a more difficult matter to assess as there are no direct measurements one can use. While one can give great detail in predicting for example noise emissions one cannot use the same scientific certainty in predicting psychological impacts. It is not possible to use a standards-based approach for example.

There are various degrees of psychological impact and these can be both positive and negative. There can be a positive impact, whereby people may look forward to a better employment opportunities. There can also be adverse effects of varying degrees. At the lower end of this impact might be annoyance where somebody is annoyed by for example, the visual impact. This is not a medical impact as such. If someone develops a psychological illness such as anxiety or depression this would be a medical impact.

While we cannot model matters which may affect psychological well-being as we could do with for example noise or vibration, we can however look at experience from other windfarms to determine if significant psychological impacts are described in relation to windfarms. If they were for example one would expect to find evidence of increased levels of depression or anxiety in the vicinity of other windfarms. There is no evidence of such findings in the peer-reviewed literature. It would be remarkable if such effects were occurring and not been recorded in the literature, so the only reasonable conclusion is that there are no such effects.

No significant adverse human health effects on psychological health are predicted as a result of the proposed windfarm.

5.3.3.10 Noise and Vibration

Noise

The potential for the proposed development to give rise to noise impacts is extensively covered in Chapter 13, Noise and Vibration.

The Chapter concluded that during the construction phase of the project there will be some effect on nearby noise sensitive properties due to noise emissions and vibration from site traffic and other activities .However, given that the construction phase of the development is temporary in nature and the distances between the main construction works and nearby noise sensitive properties, it is expected that the various noise sources will not be excessively intrusive. The predicted impact is assessed as being a temporary slight negative impact and therefore no adverse health impacts are predicted. The chapter also concluded that the cumulative predicted noise levels associated with the proposed development will be within best practice noise criteria curves recommended in Irish guidance '*Wind Energy Development Guidelines 2006*'. It is not considered that a significant effect is associated with the development.

While noise levels at low wind speeds will increase due to the proposed development, the predicted levels will remain low, albeit a new source of noise will be introduced into the soundscape.

The predicted operational noise effects are assessed as slight over the long term and as it has been demonstrated that the relevant national guidance in relation to noise associated with wind turbines can be satisfied, the predicted effect associated with the operational turbines is long term and not significant.

We can be confident, therefore, that there will be no significant adverse effect from noise on human health.

<u>Vibration</u>
The potential for the proposed development to give rise to vibration impacts is also extensively covered in Chapter 13, Noise and Vibration.

The chapter stated that levels of vibration generated as a result of the operation of wind turbine units fall off rapidly with distance away from the units. Typically, at a distance of 100m from a 1 MW turbine unit the level of vibration associated with a turbine is the order of 10-5 mm/s (as detailed in the Noise and Vibration Chapter, Chapter 13). This level of vibration is significantly below any thresholds where either cosmetic or structural damage could be caused to a building as outlined in the relevant section of this document. Indeed it assesses the impact as imperceptible. The level of vibration is such that it will not be felt by human beings located even in the nearest residences. As vibration is felt most readily when human beings are lying down or seated we can also conclude it will not be felt by people who are standing, walking or cycling through the area.

From all of this it is clear, therefore, that there will be no significant adverse health impacts from vibration.

5.3.3.11 Potential Health Benefits

Apart from the socioeconomic benefits already described there are significant environmental benefits to the proposed development. Renewable energy has many advantages from a health perspective. Burning fossil fuels releases many pollutants including particles, oxides of nitrogen, Sulphur Dioxide and many others. Replacing fossil fuels with renewable wind energy will have benefits for the environment and of course global warming improvements. As global warming is one of the greatest threats to human health on a global scale. Any contribution towards decreased reliance on fossil fuel has potential benefit to health and well-being on a global scale.

5.3.3.12 Health Improvement

Projects that have the potential to have both direct and indirect effects including environmental benefits, protect the population from public health dangers as well as support regeneration, reduce unemployment and improve socio-economic circumstance, could contribute to improving the health and wellbeing of communities.

The assessment of human health for the proposed wind farm, in terms of health improvement, includes an assessment on how the proposed scheme would impact on the socio-economics of the community.

Energy is a necessity for both residential and economic development in a modern economy.

The proposed windfarm has the potential to provide opportunities for health improvements by providing employment and renewable energy for residential and economic development. There is the potential not only for employment in the construction and operation of the windfarm but also to attract other employment to utilise the renewable energy. Data centres are an obvious example.

Employment and income are among the most significant determinants of long-term health. Many epidemiological studies consistently show that better health outcomes are associated with higher socio-economic status and better residential conditions. For example, a recent study by Schultz (WM, 2018) showed a direct relationship between poorer socioeconomic conditions and adverse outcomes from cardiovascular disease.

Consequently, poor economic circumstances can influence health throughout life, where communities subject to socio-economic deprivation or poor housing are more likely to suffer from morbidity, injury, mental anxiety, depression and tend to suffer from higher rates of premature death than those less deprived. Some of the most reliable methods to improve health within a community is to raise its socio-economic status.

Projects that have the potential to reduce unemployment and improve socio-economic circumstance, do contribute to improving the health and wellbeing of socio-economically deprived communities.

In social health terms, economic development also brings the opportunity for reducing inequities in society. Long-term unemployment for example is detrimental to the individual, family and society. It has potential to transfer across generations so that families where the head of household is long term unemployed are themselves far more likely to become or stay unemployed. This has potential to create and sustain social inequities. The economic development opportunities provided by the proposed windfarm development have the potential to allow new and better quality housing, to create more employment and reduce the risk of long-term unemployment. This in turn can lead to greater opportunities for equity in society.

There will be improved opportunities if the roads within the old bog area are opened to the public as is proposed. The potential to exercise brings with it health benefits, both psychological and physical.

The conclusion, therefore, is that the operational windfarm will have a positive effect on human health in relation to health improvement.

5.3.3.13 General amenity

The key criterion in relation to general amenity is community wellbeing, including social sustainability. Direct effects on communities due, for example, to loss of community facilities such as amenity space, natural areas or opportunities to interact with others, can impact on community wellbeing or community interaction. Indirect effects may result from changes in environmental quality, for instance, from noise or visual intrusion and are cross-referenced where applicable within the relevant chapters of the EIAR. Impact levels (Descriptions of Effects) are defined in Table 1.1 of Chapter 1 of this EIAR.

The proposed Derryadd Wind Farm will give rise to a range of benefits at a local level. It will ensure the continuity of enterprise and employment on the Derryadd Wind Farm site well beyond the peat harvesting phase. Construction is expected to extend over a 24-30 month period, with up to 100 – 120 workers employed on the project at peak. Once in operation, the wind farm will support 6 – 8 long term, high quality technical jobs in operation and maintenance as well as a number of jobs in ancillary functions. Substantial rates will be paid to Longford County Council when the development becomes operational. In addition, there is approximately 30km of an internal road and amenity paths proposed for the site which will be available for public use. This will be a valuable public amenity adding to amenities already available in the surrounding area. It will make available opportunities to exercise in a safe environment. This has the potential to positively benefit human health for those who utilise this.

The conclusion here is that the proposed windfarm will have a significant positive effect with regards human health in relation to general amenity.

5.4 DO NOTHING EFFECTS

All components of the baseline are constantly changing due to a combination of natural and human processes. When predicting likely direct and indirect effects, it is important to remember that there are two baseline environments available for comparison: the existing baseline environment and the future baseline environment without the implementation of the proposed development but considering natural changes only.

In the case of no development occurring, the positive effects detailed in section 5.2.3 and 5.3.3.11 to 5.3.3.13above would not occur. Likewise, the transient effects, such as noise or dust detailed during the construction phase would also be avoided.

If the development did not go ahead, the proposed development site will remain within the Mountdillon Peat Production Group as areas of active peat extraction, bare cutaway peat and re-vegetating bare peat cutaway bog, which given its unavailability to the general public, will have a neutral effect on the local population, tourism and amenity. Current activities on the bogs are likely to decrease and eventually cease as peat sources diminish or the demand for peat ceases. This would have a negative effect on employment and spending in the area.

The duration of continued peat production at the site will vary across the site. The proposed development site consists of three cutaway bogs which have significantly depleted peat reserves, and apart from relatively small localised areas, peat harvesting operations will be substantially reduced on each of the bogs over time.

5.5 MITIGATION MEASURES (POPULATION AND HUMAN HEALTH)

The land use at the proposed Derryadd Wind Farm will change from its current land use but no mitigation measures are required from a population perspective. The population numbers of the area are not expected to change as a result of the proposed development and, therefore, no mitigation measures are required in this respect.

From an economic perspective, the proposed development will provide employment opportunities to the local community during the construction phase, and ongoing sustainable income for the maintenance and operation team and the developer involved. It will also support employment in the wider region through the purchase of supplies and materials. As the expected result is positive, no mitigation measures are required.

The proposed development area will be opened for public access including the construction of walkways and cycleways. Outdoor exercise equipment or activities such as a weekly park run may be operated from the site. Further consultation will take place with the local population concerning how best to utilise the site once the wind farm is operational. It is also proposed to link the area with neighbouring tourist attractions bringing more visitors to the area and Longford County. As results regarding tourism and amenity are expected to be positive no mitigation measures are required.

Annual rates paid by the developer will contribute significant funds to Longford County Council, which will be used to improve the services available to the people of the county. As the result is positive no mitigation measures are required.

The establishment of a community gain scheme will support community projects within the locality of the proposed development. As the result is positive no mitigation measures are required.

The proposed development will be developed in a manner such that the effect on population and human health is minimised.

Where required, mitigation measures for other environmental aspects associated with the proposed development which may be human related such as Water (Chapter 8), Landscape and Visual Impact (Chapter 9), Material Assets - Shadow Flicker (Chapter 10), Air Quality and Climate (Chapter 12), Noise and Vibration (Chapter 13), and Traffic and Transport (Chapter 14) are discussed in the relevant chapters of this EIAR.

5.6 RESIDUAL IMPACTS

The proposed wind farm development will provide energy from a renewable resource and help to achieve national energy and climate change policies. This is a direct positive residual effect for Ireland.

In terms of population the residual effects are expected to be positive particularly in terms of local economy, tourism and amenity. The proposed Derryadd Wind Farm is unlikely to have any significant negative effects on the local or broader population following the implementation of the mitigation measures prescribed in the relevant chapters of the EIAR.

The establishment of a Community Gain Scheme is considered to be a positive effect for the local community in general. This in turn would have a positive effect on the individuals living in this community and a positive effect on their individual psychological health.

There is currently no credible evidence to link wind turbines to adverse health impacts. Any community will have vulnerable individuals. When limits are set be it for noise or dust it is to protect the most vulnerable rather than the robust, as long as the limits are met individuals and communities are protected.

The predicted emissions are within these standards and so we can be confident that there will be no significant adverse effects on health, even amongst the vulnerable.

It is important to remember that all the studied areas referred to above and in the references in Section 5.7 below will have included such vulnerable individuals. There is no evidence of increased risk to these groups from windfarms. Therefore, there will be no significant adverse effects on human health.

Overall, we can be confident that there will be no significant adverse human health effects on the population and there are some health benefits from the proposed development.

5.7 REFERENCES

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6 BIODIVERSITY

6.1 INTRODUCTION

This chapter presents a Biodiversity Impact Assessment of the proposed development and should be read in conjunction with the site layout plans and Chapter 2: Description of the Proposed Development. Details of the assessment methodology, existing site conditions are presented, potential impacts are assessed, and mitigation measures are recommended, where required.

The objectives of the ecological evaluation included:

- obtain baseline ecological data at the proposed development site;
- determine the ecological value of the identified ecological receptors;
- assess the potential impacts, including direct, indirect and secondary impacts which result from the proposed works both during construction, operation and decommissioning;
- recommend mitigation measures to avoid and reduce impacts; and
- identify any residual impacts post mitigation and restoration measures.

The potential impacts of the proposed development on European sites (sites designated as Special Areas of Conservation (SACs) or Special Protection Areas (SPAs) that form part of the Natura 2000 network) in the surrounding area have been evaluated. This appraisal is presented separately in the form of a Natura Impact Statement (NIS) (which accompanies the Planning Application documentation).

The proposed wind farm is located approximately 3km east of Lanesborough, Co. Longford, 4km west of Kilashee, Co. Longford and 8km to the north of Newtowncashel Co. Longford. The wind farm is located on the Moundillon group of peat extraction bogs, Co. Longford. A full description of the proposed development is provided in Chapter 2: Description of the Proposed Development.

This chapter has considered detailed information available from previous studies in the area and other data sources for this landholding, including habitat data and protected fauna (see Section 6.4.3).

6.1.1 Statement of Authority

This biodiversity chapter has been completed by Mr. Padraig Cregg (B.Sc. Zoology: National University of Ireland Galway, M.Sc. Evolutionary and Behavioural Ecology: University of Exeter) Senior Ornithologist in conjunction with the ecology team of TOBIN Consulting Engineers. In addition to the ecology team of TOBIN, Dr. Tom Gittings undertook the collision risk analysis and reporting for birds, Dr. Tina Aughney (licenced bat specialist) carried out bat surveys and wrote the bat report, Alan Booth (Marsh fritillary) and

Dr. Maria Long (molluscan specialist) completed the survey and reporting for protected species of butterfly and whorl snails.

Mr. Padraig Cregg has 6 years' experience working in both the UK and Ireland in designing, executing and managing ornithological assessments in the renewable energy industry. This experience covers a range of areas including project management and co-ordination, Environmental Impact Assessment, and ecological and ornithological assessments. His work experience to date has also involved working on major infrastructure projects, carrying out both the design and execution of bird surveys. Padraig has extensive experience in designing surveys to capture the seasonal change in avian communities at a site (with particular reference to Annex 1 species of the EU Birds Directive and Red Listed Species of Conservation Concern in Ireland). The author is appropriately experienced and capable of undertaking this assessment having worked on over 30 wind farm projects in both the UK (Scotland) and Ireland.

Ms. Laura Kennedy is a Senior Ecologist and Project Manager with TOBIN Consulting Engineers. She is a qualified and experienced environmental consultant with ten years' post-graduate experience in environmental sciences and environmental consultancy in Canada and Ireland. Laura has prepared and delivered Planning and Environmental Consideration reports, Technical Data reports, Environmental Assessments, Permit Applications, Environmental Effects Monitoring reports and Appropriate Assessment reporting for renewable energy projects, pipeline projects, and mining projects in Canada and Ireland. Laura has a strong technical background as an aquatic ecologist and has extensive field experience in biological and chemical water quality assessment. She has also collected hydrology and meteorology data, conducted wildlife surveys (bird and nest surveys, amphibian surveys), and carried out fish habitat assessments, which has included electrofishing, minnow trapping and fish identification.

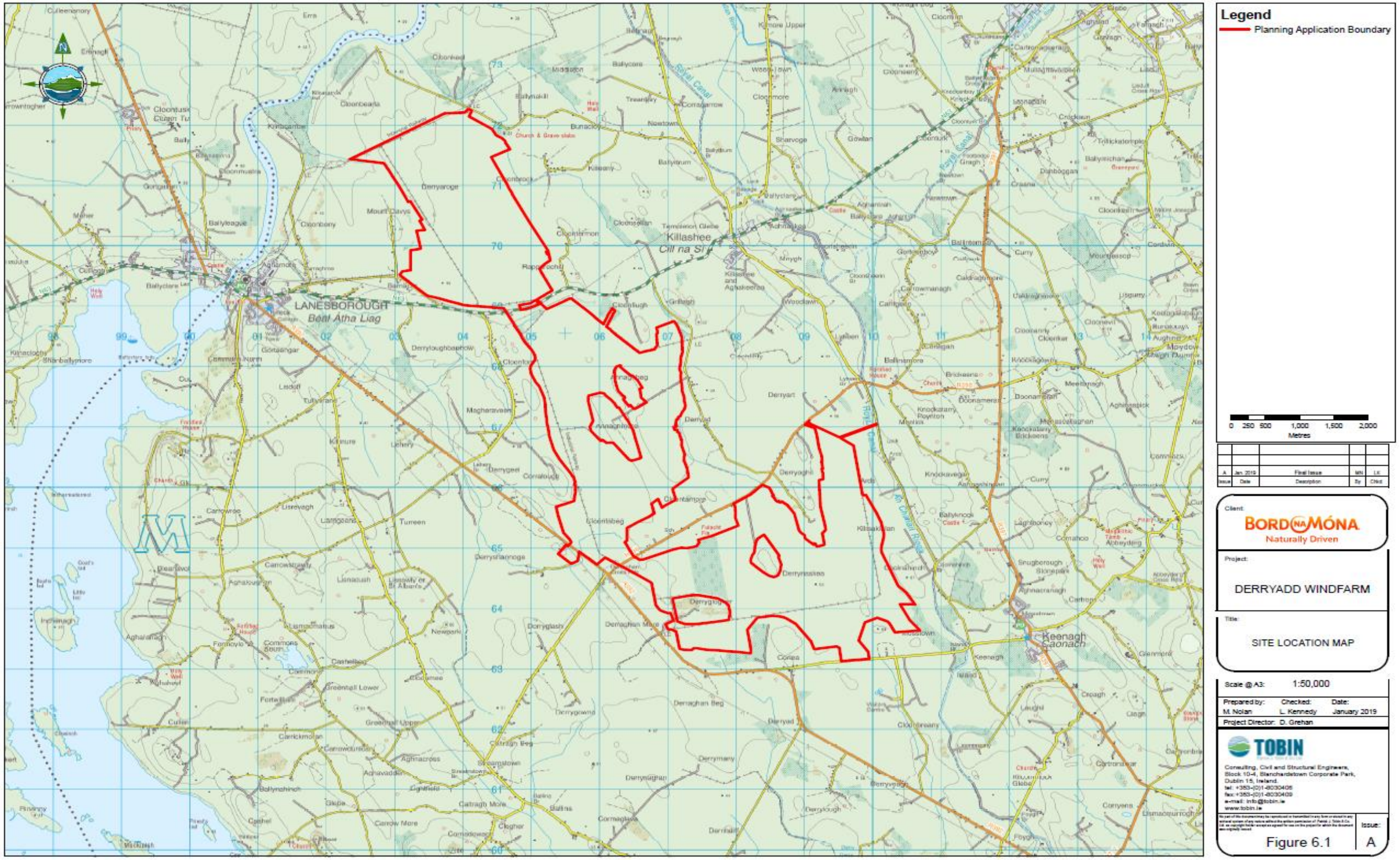
Dr. Aughney is a consultant ecologist specialising in bat and bat ecology. She holds a Ph.D. in Agri-Environmental Policy and Entomology. After finishing her research, she branched into the area of bats and has worked as a Bat Specialist since 2000. She has undertaken extensive training and survey work for all Irish bat species completing courses in Ireland and the UK. She has undertaken extensive survey work in relation to large development projects including motorway road schemes, wind farm projects, renovation works and monitoring programmes. She is on the Heritage Council Bat Panel.

Dr. Maria Long is an ecologist with exceptionally broad experience gained across a number of sectors (university, self-employed, consultancy, public sector, ENGO). She has successfully run a business as a self-employed ecologist since 2002, repeatedly winning competitive tenders, and has lectured part-time since during her PhD. She is highly experienced in botany, invertebrate survey, ecological monitoring, habitat mapping and management, conservation assessments and rare species mapping, monitoring and management. She is an expert on land molluscs, and has worked on Vertigo and other rare species extensively in both Ireland and Northern Ireland since 2006. She has provided advice and input to government agencies both north and south, and was lead author and lead ecologist on the recent four-year monitoring project for Vertigo species in Ireland (Long and Brophy 2017[11]).

Dr. Gittings is an ecological consultant specialising in avian ecology. He holds a Ph.D. in Zoology and is a member of the Chartered Institute of Ecology and Environmental Management. He has 21 years' experience in professional consultancy work and research. He has a wide range of experience of ecological assessments of wind farms and have been involved in 27 wind farm projects. These have included sites with breeding and wintering Hen Harriers, sites with wintering Whooper Swans and sites with migratory waterbirds. He has also provided scoping advice and peer review services for several wind farm projects. He also has a wide range of other ornithological experience.

[11] Long, M.P. & Brophy, J.T. (2017) Monitoring of sites and habitat for three Annex II species of whorl snail (Vertigo). Volume 1: Final Report. Irish Wildlife Manuals, No. XX. National Parks and Wildlife Service, Department of the Culture, Heritage and the Gaeltacht, Ireland.

Figure 6.1: Onsite bog groups, from north to south: Derryarogue, Derryadd, and Lough Bannow bogs



6.1.2 *Phases of the Development*

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

6.1.2.1 Construction Phase

The following key activities, that could potentially cause significant effects on the environment, will be undertaken during the construction phase and therefore need to be given due consideration in the evaluation of ecological impacts:

- Site clearance and any drainage requirements at turbine locations and substation location to facilitate construction;
- Access routes to be used by machinery during construction;
- The use of heavy machinery and associated disturbance within the 'works area 'during construction;
- The excavation of borrow pits;
- The excavation of soils/peat for the installation of turbines, substation base and associated hard standing areas and any associated drainage requirements;
- The use of concrete and other potentially harmful substances at each works area; and
- Management, storage and reuse of excavated material during the construction.

6.1.2.2 Operation Phase

The operation phase of the development will include the following key activities, which could potentially cause significant effects on the environment, and will therefore need to be considered in the evaluation of ecological impacts:

- Rotating blades of operating turbines within the wind farm envelop; and
- Maintenance of turbines throughout the lifetime of the proposed development.

6.1.2.3 Decommissioning phase

The decommissioning phase of the development will include the following key activities, that could potentially cause significant effects on the environment, and will therefore need to be given due consideration in the evaluation of ecological impacts:

- The activity of decommissioning machinery and associated personnel may result in disturbance impacts for local wildlife; and
- Decommissioning activities could potentially result in the release of sediment laden water or pollutants into local watercourses.

6.2 STUDY AREA

As discussed in Chapter 2, the proposed development includes 24 No. wind turbines on a number of peat extraction bog sites approximately 12km long and 4km wide. The study area for the Biodiversity Assessment comprised the proposed development site and the wider surrounding hinterland.

6.3 ZONE OF INFLUENCE

The Zone of Influence (ZoI) is the likely area over which the proposed development could have potential impacts on a given receptor. The ZoI was first assessed in a desk study review of ecological information that was pertinent to the proposed development, focusing on a 15km buffer around the proposed development. The ZoI over which significant impacts may occur will differ for different key ecological receptors, depending on the pathway. Significant impacts are deemed to be those impacts resulting in a likely change in conservation status of a key ecological receptor. According to the National Roads Authority (NRA) guidelines (NRA 2009[12]), key ecological receptors will be features of sufficient value to be material in the decision-making process for which potential impacts are likely. According to the NRA Guidelines, key ecological receptors are therefore defined as features of Local (Higher Value), County, National, or International Importance.

The first step in determining the ZoI is to analyse the characteristics of the proposed development and identify the range of ZoI using the source-pathway-receptor conceptual model. The mechanism for defining the ZoI is summarised as follows:

- The nature, size and location of the proposed development were considered;
- The sensitivities of the relevant ecological receptors were considered; and
- The potential impact sources and pathways were identified.

The ZoI for the various ecological receptors for which the proposed development could have potential impacts are outlined in Table 6.1.

[12] National Roads Authority (NRA; now known as Transport Infrastructure Ireland) (2009). Ecological Surveying Techniques for Protected Flora and Fauna during the Planning of National Road Schemes. Available from http://www.tii.ie/technical-services/environment/planning/Ecological-Surveying-Techniques-for-Protected-Flora-and-Fauna-during-the-Planning-of-National-Road-Schemes.pdf

Table 6.1: Zone of Influence Informing the Assessment

Ecological Feature		Potential Source(s) of Effect from Proposed Development	Potential Effect Pathways	ZoI (metres from proposed development site)	Rationale
Habitats and Flora	Terrestrial habitats or plant species	Vegetation clearance, infrastructure sites, access routes	Habitat Loss	0m (i.e. within proposed development site)	Only habitat loss in footprint of the proposed development would pose risk of significant effect.
	Surface water dependent habitats or plant species	Instream/riparian zone works	Habitat Loss	0m (i.e. within proposed development site)	Only habitat loss in footprint of the proposed development would pose risk of significant effect.
	Ground-water dependent habitats/species	Earthworks, infrastructure sites, access routes	Interference with groundwater supply or quality	100m	The potential ZoI of the proposed development with respect to hydrogeological impact pathways has been defined based upon detailed hydrogeological investigations and advice of the design team's hydrogeologists. Based on the site investigation data and the topography of the site there is no hydrogeological link to Groundwater Dependent Terrestrial Ecosystems (GWDTE) including; Cordara Turlough, Fortwilliam Turlough, Lough Ree or Lough Bawn.

Ecological Feature		Potential Source(s) of Effect from Proposed Development	Potential Effect Pathways	ZoI (metres from proposed development site)	Rationale
Mammals	Mammal crossing points	Earthworks, infrastructure sites, access routes	Altered or decreased routes for commuting	100m upstream and downstream of watercourses from works	Radius within which surveys recommended to detect otter crossing points in the UK Design Manual for Roads and Bridges (Highways Agency 2001[13]).
	Breeding or resting sites	Vegetation clearance, earthworks, instream works	Disturbance to breeding sites	150m	Human presence effects to otter assessed within 150m in accordance with guidance on road construction-related disturbance of underground sites from the National Roads Authority (NRA 2006[14]).
Birds	Breeding birds (highly sensitive species)	Vegetation clearance, noise and physical human presence	Disturbance to breeding sites	ZoI will vary with species and type of impact: relevant factors include conservation status, sensitivity to disturbance and species core foraging distance, e.g. core foraging distance of Hen Harrier is 2km (SNH 2016)[59].	Species with an unfavourable conservation status are more sensitive to the effects of certain impacts. Receptors sensitive to the potential impacts associated with this type of development are more likely to be impacted.

[13] Highways Agency (2001). BD 21/01 – Design Manual for Roads and Bridges Volume 3, Section 4, Part 3 – The Assessment of Highway Bridges And Structures.

[14] National Roads Authority (NRA; now known as Transport Infrastructure Ireland) (2006c). Guidelines for the Treatment of Otters Prior to the Construction of National Road Schemes. National Roads Authority: Ireland. Available from http://www.tii.ie/tii-library/environment/construction-guidelines/Guidelines-for-the-Treatment-of-Otters-prior-to-the-Construction-of-National-Road-Schemes.pdf.

Ecological Feature		Potential Source(s) of Effect from Proposed Development	Potential Effect Pathways	ZoI (metres from proposed development site)	Rationale
	Breeding birds (less sensitive species)	Vegetation clearance, noise and physical human presence	Noise and human presence causing disturbance to breeding sites	ZoI will vary with species and type of impact: relevant factors include conservation status, sensitivity to impact and species core foraging distance, e.g. core foraging distance of Hen Harrier is 2km (SNH 2016)[59].	Species that utilises habitats found within the proposed development site are more likely to be encountered. Nearby Special Protection Areas (SPAs) that contain mobile special conservation interest species may find supporting habitat within the proposed development site.
	Wintering birds	Noise and physical human presence, construction works in wetland habitats	Noise and human presence causing disturbance to feeding and roosting sites	ZoI will vary with species and type of impact: relevant factors include conservation status, sensitivity to impact and species core foraging distance, e.g. core foraging distance of Whooper Swan is 5km (SNH 2016)[59].	
Invertebrates	Butterflies, dragonflies, damselflies, beetles, bees, etc.	Vegetation clearance	Direct injury or loss of habitat	0m (i.e. within proposed development site)	Only habitat loss within the proposed development will pose risk of significant effects on invertebrates.
Aquatic Species	In freshwater habitats	Instream/riparian zone works	Mortality/habitat loss	0m (i.e. within proposed development site)	Habitat loss or mortality impacts can only occur within the footprint of the works.

6.4 METHODOLOGY

The ecological appraisal included three main elements to inform the baseline ecological assessment. These included consultation with key stakeholders (Section 6.4.2), a desktop ecological evaluation (Section 6.4.3), and field surveys (Section 6.4.4). The approach and methodology followed have regard to the guidance documents listed in Section 6.4.1.

6.4.1 Legislation, Polices and Guidance

The following legislation has been considered in this chapter, where relevant:

- European Communities (Birds and Natural Habitats) Regulations 2011 S.I. 477 of 2011 (as amended). With particular reference to the Third Schedule of the European Communities Regulations 2011 (S.I. 477 of 2011) which deals with invasive species;
- The EIA Directive 2011/92/EU as amended by Directive 2014/52/EU;
- European Union (EU) (Environmental Impact Assessment and Habitats) (No. 2) Regulations 2015. [S.I. No. 320/2015];
- Environmental Liabilities Directive (2004/35/EC);
- The Habitats Directive (92/43/EEC) (as amended);
- The Birds Directive (2009/147/EC) (as amended);
- The EU Water Framework Directive (2000/60/EC);
- The Wildlife Acts 1976 to 2012;
- The Flora (Protection) Order 2015 S.I. 356;
- Relevant fisheries legislation up to and including the Inland Fisheries Acts 1959-2010, (as amended);
- Objectives relevant to ecology and biodiversity in the latest County Development Plans of the relevant Counties potentially impacted by the proposed development, specifically Co. Longford;
- Bird species of medium and high conservation concern listed in the publication Birds of Conservation Concern in Ireland (BoCCI) 2014 – 2019;
- Relevant policies in Actions for Biodiversity 2011-2016, Ireland's 2nd National Biodiversity Plan produced by the Department of Arts, Heritage and the Gaeltacht in 2011 (now the Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs); and
- Ireland's National Biodiversity Group and Biodiversity Forum are currently working on the Actions for Draft 3rd National Biodiversity Action Plan 2017 – 2021, v2.0.

The potential for effects on nature conservation interests was assessed, taking into consideration the habitats and species that are likely to be affected by the proposed development. This approach included consideration (as appropriate) of the following guidance documents:

- Scottish Natural Heritage (SNH) (2000). Wind Farms and Birds: Calculating a Theoretical Collision Risk Assuming no Avoidance Action;
- SNH (2006). Assessing Significance of Impacts from Onshore Wind Farms on Birds Outwith Designated Areas;
- SNH (2009). Monitoring the Impact of Onshore Wind Farms on Birds;
- SNH (2010). Avoidance Rates Information and Guidance Note: Use of Avoidance Rates in the SNH Wind Farm Collision Risk Model;
- SNH (2012). Assessing the Cumulative Impact of Onshore Wind Energy Developments;
- SNH (2014). Recommended Bird Survey Methods to Inform Impact Assessment of Onshore Wind Farms;
- SNH (2016). Assessing Connectivity with Special Protection Areas (SPAs);
- Fossitt (2000). A Guide to Habitats in Ireland. The Heritage Council;
- Environmental Protection Agency (EPA) (2002). Guidelines on the information to be contained in Environmental Impact Statements;
- EPA (2017). Guidelines on the information to be contained in Environmental Impact Assessment Reports. Draft, August 2017;
- Chartered Institute of Ecology and Environmental Management (CIEEM) (2016). Guidelines for Ecological Impact Assessment in the UK and Ireland;
- National Roads Authority (NRA) (2005). Guidelines for the Crossing of Watercourses During the Construction of National Road Schemes;
- NRA (2006a). Guidelines for Assessment of Ecological Impacts of National Road Schemes (Revision 1, National Roads Authority);
- NRA (2006b). Guidelines for the Treatment of Otters prior to the Construction of National Roads Schemes. National Roads Authority, Dublin;
- NRA (2009a). Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes;
- NRA (2009b). Ecological Surveying Techniques for Protected Flora and Fauna during the Planning of National Road Schemes;
- NRA (2009c). Guidelines for Assessment of Ecological Impacts of National Road Schemes. (Revision 2, National Roads Authority);
- Smith, G. F., O'Donoghue, P., O'Hora, K., & Delaney, E. (2011). Best practice guidance for habitat survey and mapping. *Ireland's Heritage Council: Kilkenny, Ireland*.

- NRA (2010). Guidelines on the Management of Noxious Weeds and Non-Native Plan Species on National Roads;
- Murray A. (2003). Draft Methodology for a National Hedgerow Survey. Unpublished document for Network for Nature;
- Longford County Development Plan 2015 – 2021;
- Bord na Móna (2016). Biodiversity Action Plan 2016-2021;
- Murray A. (2003). Draft Methodology for a National Hedgerow Survey. Unpublished document for Network for Nature;
- Fitter, R., & Fitter, A. (1984). Collins guide to the grasses, sedges, rushes and ferns of Britain and northern Europe. William Collins Sons & Co. Ltd;
- Parnell, J., Curtis, T., & Cullen, E. (2012). Webbs An Irish Flora. Cork University Press; Hayden, T. J., & Harrington, R. (2000). Exploring Irish Mammals. Town House;
- Mc Guinness, S., Muldoon, C., Tierney, N., Cummins, S., Murray, A., Egan, S. & Crowe, O. (2015). Bird Sensitivity Mapping for Wind Energy Developments and Associated Infrastructure in the Republic of Ireland;
- Bang, P., Dahlstrøm, P., & Walters, M. (2001). Animal tracks and signs. Oxford university press;
- Sterry P., Cleave A. & Read R. (2016). British Butterflies and Moths (Collins Complete Guides); and
- Dijkstra K.D.B. & Lewington R. (2006). Field Guide to the Dragonflies of Britain and Europe. Bloomsbury Publishing.

6.4.2 Consultation

Consultation with various state agencies and environmental Non-Governmental Organisations (NGO's) was undertaken between September 2016 and April 2018 to inform the Environmental Impact Assessment Report (EIAR). All project consultation is detailed in Chapter 1 of the EIAR. Consultees were informed of updates to the site layout, as appropriate. Consultation letters were sent (September 2016, April/ May 2017 and April 2018) to the following key parties relevant to this chapter:

- An Bord Pleanála;
- Longford County Council;
- National Parks and Wildlife Service;
- BirdWatch Ireland;
- Irish Raptor Group Study Group;
- Inland Fisheries Ireland;
- Bat Conservation Ireland;
- Irish Wildlife Trust;

- Irish Peatland Conservation Council; and
- Heritage Council.

Table 6.2: Summarises of the Key Consultee Responses

Consultation Response	EIAR Section
National Parks and Wildlife Service (NPWS) noted that the proposed development is situated in a location likely to impact on protected species, e.g. Breeding Curlew, Buzzard, Cuckoo, [Great Spotted] Woodpecker, Hen Harrier and Barn Owl.	Flora and fauna are discussed in EIAR Section 6.5
Irish Peatland Conservation Council highlighted the significant threat which Curlews face in Ireland. They pointed to the likelihood that some of the wintering Curlew from Lough Ree SPA/ SAC are native breeders which need to be properly assessed. Where breeding is found they emphasise the need to put in place adequate set back distances.	Flora and fauna are discussed in EIAR Section 6.5
Meetings were conducted with An Bord Pleanála (ABP) on three occasions: in 2016, 2017 and 2018, see Chapter 1 for further details, ABP emphasised the need to ensure that connectivity of the site is considered in detail as it relates to ecology. The outcome of the meetings was a survey approach which took into account the potential for ornithological connectivity to exist between local designated sites and the proposed development. There was reference made to a possible hydrological connection between the proposed development and Fortwilliam Turlough SAC. Additionally, ABP emphasised the need to consult with NPWS.	Flora and fauna are discussed in EIAR Section 6.5
On the 29th of November 2016 Longford County Council noted that Mount Jessop is now a Candidate Special Area of Conservation (cSAC). Further consultation meetings were held with Longford County Council in 2017 and March 2018, as detailed in Chapter 1.	European sites are discussed in detail in the NIS
On the 7th of June 2018 TOBIN Consulting Engineers and Bord na Móna staff met with Susan Moles, NPWS Conservation Ranger for County Longford. The consultation meeting provided NPWS with the opportunity to raise any concerns that they may have relating to the proposed development, to discuss the survey approach and to provide data/ local knowledge that would facilitate a better assessment of potential impacts of the proposed development on flora and fauna locally. Key species discussed included; a potential Curlew breeding site to the south of the site and at Lough Bawn pNHA, a Hen Harrier roost at Derrymacar to the south of the site, a Peregrine Falcon nest to the south-east of the site, breeding Curlew present on a number of islands on Lough Ree (Inchenagh and Clawinch), a Greenland White-fronted Goose roost on Inchcleraun island Lough Ree, Whooper Swan were noted to occasionally forage on site and the presence of an internationally important population of Desmoulin's Whorl Snail *(Vertigo moulinsiana)* in the Royal Canal adjacent to the site.	Flora and fauna are discussed in EIAR Section 6.5
On the 11th of July 2018, NPWS followed up with a letter of nature conservation observations. Additional areas of discussion arising from this letter included: the requirement to assess impacts on local designated sites, Barn Owl reported in the Mosstown areas, Long-eared Owl breeding locally, bat surveys are required at the site and an impact study of otters and [common] frog.	Flora and fauna are discussed in EIAR Section 6.5. European sites are discussed in detail in the NIS.

6.4.3 *Desk Study*

The ecological desk study for this project included the following steps:

- Identification of key ecological receptors and all sites designated for nature conservation within the ZoI of the proposed development (please refer to Section 6.3 of this chapter and the NIS which accompanies the Planning Application documentation). Rationale for establishing the ZoI included inter alia distance from the site, e.g. the core foraging range of Whooper Swan is 5km.;
- A review of all National Parks and Wildlife Service (NPWS) site synopses for designated sites within the ZoI of the proposed development;
- A species list for the proposed development study area was generated using the National Biodiversity Data Centre biodiversity maps (NBDC; www.biodiversityireland.ie) in order to determine if any rare or protected species have been recorded in this area and the likelihood of any such species being present at the proposed development site. A species list for 10km grid square N06, N07 and N16 (i.e. the hectads in which the study area overlaps with, which contain information of ecological records from a wide range of scientific sources readily accessible to the public from the NBDC) was also generated to determine if any rare or protected species occur in the wider Longford area;
- A review of Ordnance Survey maps and aerial photography in order to determine the broad habitats that occur within the study area and thus typical bird communities;
- A review of relevant ecological reports, and rehabilitation plans previously completed for the study area; and
- BWI bird sensitivity data.

6.4.3.1 Survey Rationale

The surveys were designed following the consideration of the consultation responses, the findings of the desk study, a review of the key methodologies and published guidelines and based on typical flora and fauna communities likely to be found within the habitats of the study area. Bird survey methodology was peer reviewed by Aniar Ecology (in May 2016) following the winter bird surveys carried out in 2014/2015 and recommendations on the survey approach were made (see Appendix 6.2 of the EIAR for further details).

6.4.3.2 Identification of Target Species – Ornithology

The standard guidance for carrying out ornithological surveys at a proposed wind farm site is the Scottish Natural Heritage (SNH) (2014) '*Recommended bird survey methods to inform impact assessment of onshore wind farms*'. Within this document it is stated that *'the location and scale of the proposal and* *sensitivity of the bird interest present will determine the target species and the duration of the survey period'*.

Target species are the subject of the assessment and are a key factor in understanding survey requirements. Target species in general are those species which are afforded a higher level of legal protection due to their unfavourable conservation status and/ or those species whose behaviour makes them more susceptible to impacts from wind farms. Species groups which fall into this category include raptors (particularly soaring birds of prey), water birds (including migratory waterfowl) gulls and waders[15]. A species which was not highlighted for special consideration during the desk study can become the target of the assessment following field surveys. Ultimately the results of field surveys dictate the target of the assessment.

Species which do not fall under the above criteria but are of local importance may also need to be considered. These species are termed secondary species. The recording of target species observations is prioritised over secondary species. In general, it is considered that passerines[16] are little impacted by wind farms, as per SNH (2014).

6.4.3.3 Viewshed analysis

A viewshed analysis was undertaken (using ArcGIS 10.4.1) for the seven[17] vantage points used to survey Derryaroge, Derryadd and Lough Bannow bogs from October 2014 to April 2016. A second analysis was conducted for the eleven vantage points post the contraction of the site. A further view shed analysis was undertaken for the twelve vantage points used for the survey period October 2016 to March 2017 (see Appendix 6.9). The SNH (2014) guidance document recommends undertaking Vantage Point (VP) surveys such that the view shed encompasses the wind farm envelope and a 500m radius beyond the outermost turbines. The lowest swept area for operating turbines at the site is predicted to be 40m above ground level. The results of the four viewshed analysis are presented below:

- 11 No. Vantage points (April - September 2016 and April - September 2017): 100% view shed coverage of proposed turbine locations and 94% viewshed coverage to 500m beyond the outermost turbines (Figure 1, Appendix 6.9);

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[15] Powlesland, R. G. (2009). Impacts of wind farms on birds: a review. *Science for conservation*, (289).

[16] Passerines (perching birds) are typically small birds of the order Passeriformes, whose behaviour is thought to make them less susceptible to impacts from wind farm.

[17] Seven of the original fifteen vantage points had view sheds which included the three bogs (Derryarogue, Derryadd and Lough Bannow) which make up the current onsite area.

- 7 No. Vantage points – a subset of the total of 15 (October 2014 – March 2016): 100% view shed coverage of proposed turbine locations and 92.5% viewshed coverage to 500m beyond the outermost turbines (Figure 2, Appendix 6.9);
- 11 No. Vantage points (April 2017 – September 2017): 100% view shed coverage of proposed turbine locations and 94% viewshed coverage to 500m beyond the outermost turbines (Figure 3, Appendix 6.9); and
- 12 No. Vantage points (October 2016 – March 2017 and October 2017 – March 2018): 100% view shed coverage of proposed turbine locations and 94.9% viewshed coverage to 500m beyond the outermost turbines (Figure 4, Appendix 6.9).

The high levels of view shed coverage of the proposed development site is considered to be as a consequence of the flat topography found locally and given a lowest swept area by operation turbines of 40m.

6.4.3.4 Limitations

The information contained in this chapter of the EIAR included robust data with which the likely impacts as a result of the proposed development were assessed. Where relevant, residual impacts are described in detail. No significant limitations were identified in terms of scale, scope or context in the preparation of the Biodiversity chapter of this EIAR.

6.4.4 Field Surveys

Field surveys were undertaken by skilled and appropriately experienced ecologists (see Section 6.1.1) between the periods October 2014 to October 2018. The data collected was robust and allowed TOBIN to draw accurate, definitive and coherent conclusions on the possible impacts of the proposed development at Derryadd on ecological receptors.

During these surveys, areas of scientific and/ or conservation interest in the vicinity of the proposed development were investigated. Relevant survey reports are included as appendices (refer to Appendix 6.1, 6.3, 6.6, 6.7 and 6.8) and the main findings are summarised in Section 6.5. Further details of the survey methodology are presented in the subsequent paragraphs.

Table 6.3: Survey Works and Periods Conducted

Survey Period	Personnel*	Surveys Conducted
October 2014 – March 2015	John Murphy (Senior Ecologist/Ornithologist), Caroline Hurley (Senior Ecologist), Austin Cooney (Ornithologist), Caroline Lalor (Ecologist), Hazel Tough (Ecologist) and Caoimhin O'Neill (Ecologist) of Malachy Walsh and Partners Engineering and Environmental Consultants.	Birds: Monthly vantage point (VP) surveys[18], 6 hours per VP per month. Winter transects survey, 2 visits, one early (November) and one late (March) visit.
April – August 2015		Birds: Monthly vantage point (VP) surveys, 6 hours per VP per month. Breeding birds transect survey, 2 visits, one early (May) and one late (July) visit.
September 2015 – March 2016		Birds: Monthly vantage point (VP) surveys, 6 hours per VP per month. Winter transects survey, 2 visits, one early (November) and one late (March) visit.
April – September 2016	Jessica Quinn (Ecologist/ Ornithologist), Allison Austin (Senior Ecologist), Christopher Walsh (Ecologist), Alan Booth (Ecologist), Kevin Delahunty (Ecologist), Brian Arneill (Independent Ornithologist), Nick Duff (Independent Ornithologist) and Austin Cooney (Independent Ornithologist) of TOBIN Consulting Engineers.	Birds: Monthly vantage point (VP) surveys, 6 hours per VP per month. Breeding bird transect surveys two visits March-July. Woodcock survey two visits, both in June. Monthly I-WeBS[19] of water bodies in the hinterland of the site (April - September).
June –November 2016	Dr. Tina Aughney (Senior Ecologist) of Bat Eco Services.	Bats: Anemometer Survey, SM2 Rotational Survey, walking transects and driving transects.
8th of September 2016	Daireann McDonnell (Senior Ecologist), Laura Kennedy (Senior Ecologist), Jessica Quinn (Ecologist/ Ornithologist), and Christopher Walsh (Ecologist) of TOBIN Consulting Engineers	Multidisciplinary ecological walkover survey: Surveyors noted habitats encountered and any signs of protected species at the turbine locations.
October 2016 – March 2017	John Murphy (Senior Ecologist/Ornithologist), Caroline Hurley (Senior Ecologist), Austin Cooney (Ornithologist), Caroline Lalor (Ecologist), Hazel Tough (Ecologist)	Birds: Monthly vantage point (VP) surveys, 6 hours per VP per month. I-WeBS of water bodies in the hinterland of the site.

[18] At proposed wind farm sites vantage point surveys are typically used to evaluate the flight activity of a given location.

[19] Irish Wetland Bird Surveys

Survey Period	Personnel*	Surveys Conducted
	and Caoimhin O'Neill (Ecologist) of Malachy Walsh and Partners Engineering and Environmental Consultants.	
18th of April 2017	Padraig Cregg (Senior Ecologist) of TOBIN Consulting Engineers	Following the relocation of several turbines, these new locations were surveyed for habitats encountered and any signs of protected species.
April - September 2017	John Hehir (Assistant Ornithologist), Patrick Manley (Assistant Ornithologist) and Sean Ronayne (Assistant Ornithologist) of McCarthy Keville O'Sullivan Planning and Environmental Consultants.	Birds: Monthly vantage point (VP) surveys, 6 hours per VP per month, breeding walkover survey (3 visits, April - June), breeding raptor survey (4 visits, April - July) Woodcock survey (3 visits in June) and I-WeBS of water bodies in the hinterland of the site (August and September).
October 2017 – March 2018	Alan Booth (Ecologist), Shane Cully (Ornithologist) and Kevin Delahunty (Ecologist).of TOBIN Consulting Engineers	Birds: Monthly vantage point (VP) surveys, 6 hours per VP per month. I-WeBS of water bodies in the hinterland of the site, Hen Harrier Roost Surveys, Transect surveys
9th, 10th and 12th of April 2018	Joanne Allen Hamilton (Senior Ecologist) of TOBIN Consulting Engineers	Following the relocation of several turbines and internal roads, all infrastructure was surveyed for habitats encountered and any signs of protected species.
17th and 18th of June 2018	Dr. Tina Aughney (Senior Ecologist) of Bat Eco Services.	Bats: Anemometer Survey, SM2 Rotational Survey, walking transects and driving transects.
May - July 2018	Padraig Cregg (Senior Ecologist) and Kevin Delahunty (Ecologist) of TOBIN Consulting Engineers	Birds: Species specific Curlew and Woodcock surveys. These surveys were undertaken in areas where these species were previously recorded, Curlew survey (4 visits) and Woodcock survey (3 visits).

Survey Period	Personnel*	Surveys Conducted
October 2018	Alan Booth (Ecologist) and Kilian Murphy (Ecologist) of TOBIN Consulting Engineers	Marsh Fritillary survey. This survey was undertaken in areas of suitable habitat. The optimal survey period is usually from April to September (adults surveys in the early season and caterpillar surveys in the late season); however, favourable weather conditions over the summer of 2018 allowed the survey period to be extended into early October.
October 2018	Dr. Maria Long (Ecologist)	*Vertigo moulinsiana* survey. This survey was undertaken in potential *V. moulinsiana* habitat.

6.4.4.1 Habitats

A multi-disciplinary walkover survey following the methodology outlined by the NRA (2009) was undertaken at proposed turbine locates including all hardstand areas, borrow pits, proposed met mast locations, substation locations, grid connection routes and internal haul roads. Multi-disciplinary walkover surveys were undertaken on three occasions: September 2016, April 2017 and April 2018. These visual surveys were deemed to be adequate to assess habitats of low ecological interest (following methodology outlined in Smith *et al*. 2011[20]). These surveys aimed to record the habitats, flora and fauna present within the survey area as described in the following paragraphs.

Surveys were undertaken of all semi-natural habitats encountered including the collection of data on dominant vegetation, qualitative consideration of plant species diversity, presence of non-native invasive plant species, presence of protected flora, vegetation structure, topography, drainage, disturbance and management. The data was recorded, and the habitats encountered during site visits were classified in accordance with Fossitt (2000)[21] and where appropriate, reference was made to the interpretation manual of EU Habitats as appropriate, specific surveys of hedgerows and treelines were undertaken with a view to assessing their importance based on species composition, structure and management. Although hedgerows were not commonly encountered at the site the methodology used during the survey of hedgerows broadly followed those proposed by Murray (2003)[22]. Walkover surveys along watercourses in the vicinity of the proposed development were also undertaken. Watercourse characteristics including bankside vegetation, substrate, and flow rate were recorded. An evaluation was made on the suitability of the habitat for aquatic species of conservation concern.

Species identification and nomenclature followed Parnell and Curtis (2012)[23] for higher plants, Watson (1981)[24] for bryophytes and Fitter *et al.* (1984)[25] for grasses and sedges.

Following the completion of desktop analysis and field surveys, habitat maps of the proposed turbine locations, hard stand areas, proposed met mast locations, substation locations, grid connection routes and internal roads were prepared according to the methodology outlined in Smith *et al.* (2011). The habitat maps detail habitats and habitat complexes recorded within this area. The mapping takes account of

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[20] Smith, G. F., O'Donoghue, P., O'Hora, K., & Delaney, E. (2011). Best practice guidance for habitat survey and mapping. The Heritage Council: Ireland.
[21] Fossitt, J. A. (2000). A guide to habitats in Ireland. Heritage Council/Chomhairle Oidhreachta.
[22] Murray, A. (2003). Draft Methodology for a National Hedgerow Survey. Unpublished Networks for Nature Document

[23] Parnell, J., Curtis, T., & Cullen, E. (2012). Webbs An Irish Flora. Cork University Press.
[24] Watson, E. V. (1981). *British Mosses and Liverworts: An Introductory Work*. Cambridge University Press.
[25] Fitter, R., & Fitter, A. (1984). *Collins* guide *to the grasses, sedges, rushes and ferns of Britain and northern Europe*. William Collins Sons & Co. Ltd.

whether the habitat determination was made by detailed field survey, visual field inspection from a distance or from remote sensing techniques as recommended by Smith *et al.* (2011).

In addition to habitat surveys, fauna surveys were conducted to assess usage of the areas by birds and mammals (and is discussed in the following sections). Considering the characteristics of the habitats present and the nature of the proposed development, it was considered unnecessary to carry out evaluations of more specialised groups such as invertebrate species (with the exception of Marsh Fritillary and Whorl Snail; see Appendix 6.7 and 6.8, respectively for further details) although incidental records of Lepidoptera (Butterflies and Moths) as per Sterry (2016)[26] and Odonata (Dragonflies and Damselflies) as per Dijkstra *et al*. (2006)[27] were made.

6.4.4.2 Birds

6.4.4.2.1 <u>Vantage Point Surveys</u>

Vantage point surveys aim to quantify the level of flight activity and its distribution over the survey area. The primary purpose of the survey is to provide data to inform the collision risk model, which makes predictions of mortality, from collisions with turbines. Vantage points are fixed locations, which are strategically positioned to provide a maximum view shed of the survey area from a minimum number of locations. The surveyed area should include the entire wind farm envelope where turbines may be positioned and should extend to a 500m radius from the outermost turbines. The view shed of a given vantage point should extend to a distance of no greater than 2km and include an arc of no greater than 180 degrees, as per SNH (2014)[28]. The number of vantage points used reduced from fifteen to eleven with the contraction of the study area in April 2016. Seven of the original fifteen vantage points had view sheds which included the three bogs (Derryaroge, Derryadd and Lough Bannow) which make up the current onsite area. The remaining eight vantage points provide good supplementary information, but they will not contribute directly to the collision risk analysis. All calendar months in which target species were present were surveyed. A DTM terrain model was used by TOBIN to assist with the selection of vantage point locations. The following vantage points were used during the course of surveying at the proposed development:

- October 2014 to April 2016: 7 No. vantage points;
- Breeding season 2016: 11 No. vantage points;
- Winter season 2016/ 17: 12 No. vantage points;

[26] Sterry, P. (2016). Collins Complete Guide to British Butterflies and Moths. Published by HaperCollins.

[27] Dijkstra, K.D.B., Bechly, G., Bybee, S.M., Dow, R.A., Dumont, H.J., Fleck, G., Garrison, R.W., Hämäläinen, M., Kalkman, V.J., Karube, H. and May, M.L. (2013). The classification and diversity of dragonflies and damselflies (Odonata). *Zootaxa*, *3703*(1), 36-45.

[28] Scottish Natural Heritage (SNH) (2014). Recommended bird survey methods to inform impact assessment of onshore wind farms. SNH Guidance. Scottish Natural Heritage, Battleby. Available from http://www.snh.gov.uk/docs/C278917.pdf.

- Breeding season 2017: 11 No. vantage points; and
- Winter season 2017/ 18: 12 No. vantage points.

Vantage points were selected to ensure a view shed of all potential turbine locations, given the lowest swept area of turbines at the time of the survey, i.e. the predicted lowest swept area of turbines has increased as the technology has changed since the outset of surveying in 2014. The location of each vantage point is mapped in Figure 6.2 below.

The vantage point methodology followed guidelines issued by the SNH (2014)[28]. The minimum requirement of 36 hours per vantage point per season (breeding and non-breeding) was achieved, with the exception of VP11 during the 2016 breeding season, i.e. this VP was surveyed for 33 hours[29]. The timing of watches was tailored to the ecology of the target species present on site, including dawn, day and dusk surveys. Field information recorded included; dates, vantage point location, weather, survey start and end time, species observed, time of observation, number of individuals per observation, height of flight, duration of flight, reference number to flight line. All flight lines of target species were mapped on field sheets. Behavioural observations were also recorded.

Birds which use the airspace around turbines are susceptible to collision with operating turbines. The swept area of the rotor blade is the area in which a collision is theoretically possible. Potential collision height (PCH) is therefore defined as the area of space occupied by the turbine rotors. Potential collision height will vary between wind farms and with the specification of the manufacturer. At Derryadd PCH was considered to be within the height band of 55-185m[30] above ground level. In general, three height bands were used by surveyors to characterise flight height; below PCH, at PCH and above PCH (see Appendix 6.5 for further details).

6.4.4.2.2 <u>Transect Surveys</u>

A transect survey follows a defined liner route through a specific area. To achieve maximum coverage of suitable habitat, several routes were needed. At the outset, 28 No. transects were used however this reduced 21 No. with the contraction of the study area. These transects covered a large and representative portion of the survey area. Where access allowed, all areas of suitable habitat were surveyed on site and to a 500m radius from the planning/ development boundary, as per SNH (2014)[28]. The location of each transect is mapped in Figure 6.2. The transect surveys were walked at a standard speed. Notes on aural and visual registrations of bird species were recorded during field surveys. Visual registrations were

[29] A minimum of 36 hours was surveyed at all vantage points (VP) with the exception of VP11 during the 2016 breeding season. A total of 33 hours was achieved at this location, with the omitted 3 hours of survey time conducted at the nearby VP9 in error.

[30] This height is based on predictions of turbine tub heights and rotor blade lengths.

recorded with the aid of binoculars (e.g. 8 x 42) and if necessary, with the aid of a telescope (e.g. 20-45 x 60 Scope). Particular emphasis was paid to waders in areas of bare peat and other target species.

The transect survey methodology followed that of Countryside Bird Survey (CBS) Manual[31]. Two surveys were carried out per season (i.e. winter/ non-breeding or breeding season). Breeding season surveys were conducted between March and July. This is the recommended period for conducting breeding bird surveys[31]. Birds present were recorded by sight and song/ call. For all species, every effort was made to minimise disturbance risks that might be caused by the human intrusion associated with undertaking the survey. The surveyor regularly stopped to allow rapid detection of species presence, such as displaying birds and to take appropriate avoidance measures.

Where access allowed and in addition to the CBS, a reduced visit Brown and Shepherd (1993)[32] survey methodology was employed in suitable habitat for breeding waders. Brown and Shepherd (1993) methods are suitable for surveying many upland and open country species. Suitable breeding habitat for waders includes wetlands and bogs including wet grassland, marsh, fens, river valleys, raised bog, degraded raised bog, cutover bog and blanket bog.

All bird species were recorded by call and sightings and based on the summary findings of the two repeat surveys conducted per season, bird breeding was categorised as:

- Probable / confirmed breeder (B);
- No breeding evidence though possibly breeding (NC); and
- Non-Breeder, i.e. wintering, passage migrant or habitat unsuitable (NB).

6.4.4.2.3 Breeding Raptor Surveys

As previously stated, the study area contracted in April 2016 to the three bogs (Derryaroge, Derryadd and Lough Bannow) which make up the current proposed development site. Prior to this date vantage point surveys were conducted at a number of additional bogs, namely Derrycashel, Mountdillon, Derryshannoge, Derraghan and Derrycolumb (see Appendix 6.1). These bog groups fringe the current site; they are located to the north, west and south-west. The active breeding season for raptor will vary with species and with the natural variations between years, however typically this period can be defined as spanning March/ early April to August/ September. During the 2015 breeding raptor season 36 hours of vantage watches were conducted for each of eight vantage points which were located in the hinterland of the current site. The data collected from surveying these additional bog groups will be used to assess the value of the wider area for breeding raptor, as per SNH (2014)[28].

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[31] Countryside Bird Survey Manual: http://www.birdwatchireland.ie/LinkClick.aspx?fileticket=ZMHg4m%2BJc7k%3D&tabid=116

[32] Brown, A. F., & Shepherd, K. B. (1993). A method for censusing upland breeding waders. *Bird Study*, *40*(3), 189-195.

The survey methodology broadly followed Hardey *et al.* (2009) – *Raptors: A Field Guide for Surveys and Monitoring*, as recommended by SNH (2014). The recommendations made by Hardey *et al.* (2009) for four visits to the study area, was exceeded during the 2015 breeding season. Suitable habitat for breeding raptors was visited in each month March to September 2015 inclusive. The timing of visits was tailored to the ecology of targeted breeding raptor species, spanning the dawn, day and dusk. To account for the wide-ranging nature of breeding raptors the study area included both the proposed development site and the surrounding hinterland (see Section 6.2). In 2017, breeding raptor surveys were conducted between April and July (four visits) to a 2km radius from the planning/ development boundary (where access allowed).

Breeding raptor activity was also noted during the course of transect surveys. All areas of suitable habitat on site and to a radius of 500m from the planning/development boundary was investigated for aural or visual registrations and/ or physical signs (feathers, pellets, prey remains or white washing) on prominent features in the landscape. The location of any breeding behaviour was noted for further future investigation. Nest sites were located by conducting watches of potential nest site from a distance which would not cause disturbance. Observations of any of the following confirmed breeding, a food pass between two adults, adults carrying prey, nest with eggs or young found and/ or recently fledged young[33].

6.4.4.2.4 Woodcock

Woodcock surveys were undertaken in areas of suitable habitat on site and to a 500m radius from the planning/ development boundary. The area surveyed is mapped in Figures 6.2 below. The survey methodology broadly followed the recommendations of Gilbert *et al.* (1998)[34] for surveying woodcock. Two survey visits where undertaken in June 2016, surveyors were in position from an hour before sunset until last visible light. In 2017 (June) and 2018 (June and early July) surveys was undertaken with three visits to areas of suitable habitat. The aim of the survey was to record the presence of roding (displaying) male woodcock and thereby establish the distribution and abundance of the species in the study area. This survey method also allowed the observer to survey for owls, i.e. Barn Owls and Long-eared Owls. Evening visits between May and July can be useful in detecting calling juveniles which can assist in detecting successful pairs[34].

6.4.4.2.5 I-WeBS/ Hinterland Survey

Monthly counts (May 2016 to March 2017) and bimonthly counts (August 2017 to March 2018) were conducted at wetland water bird sites during daylight hours (ideally at dawn or before dusk) from suitable

[33] Hardey, J., Crick, H., Wernham, C., Riley, H., Etheridge, B., Thompson, D. (2006). *Raptors: a field guide to survey and monitoring*. The Stationery Office. Third Edition.

[34] Gilbert, G., Gibbons, D. W., & Evans, J. (1998). Bird Monitoring Methods: a manual of techniques for key UK species.

vantage points using binoculars and/ or telescope as required. Information collected included, numbers of breeding wildfowl or wader species, the presence of marked birds (leg-ringed or neck-collared), weather conditions and habitat types were noted. Survey methodology followed the '*I-WeBS Counter Manual – Guidelines for Irish Wetland Bird Survey Counters'* co-ordinated by BirdWatch Ireland. The area surveyed included the hinterland of the site to a 5km radius from the planning/ development boundary. The survey radius was chosen to assess the potential for the site to provide foraging habitat for wintering water birds and in particular Whooper Swan, i.e. Whooper Swan core foraging range is 5km. Particular attention was paid to breeding aggregations of Common Scoter and Common Tern, which are among the qualifying interest of the nearby Lough Ree SPA. The area surveyed is mapped in Figure 6.2 below.

6.4.4.2.6 Hen Harrier Roost Surveys

Hen Harrier Roost Surveys were conducted where suitable roosting habitat was found onsite or within the wider surroundings of the proposed development area. The proposed development traverses one 10 km grid square with known Hen Harrier roosts: N07 (NBDC 2019)[35]. Hen Harrier roost vantage points were located in some instances in adjacent 10 km grid squares, depending on the location of suitable roosting habitat relative to the proposed development. Two vantage points were selected in the hinterland of the site: the first at Mountdillon bog (N07) and the second at Derryglash bog (N06). Hen Harriers may roost communally in winter, generally in rank ground vegetation (Clarke and Watson 1997)[36]. Suitable roosting habitat is typically restricted to dense vegetation, such as heather or young commercially planted conifers. Although this species breeds in upland areas, wintering birds disperse widely and can frequently be found in lowland areas of the midlands of Ireland. Hen Harrier Roost Surveys were conducted at the two locations mentioned above, between October 2017 and March 2018.

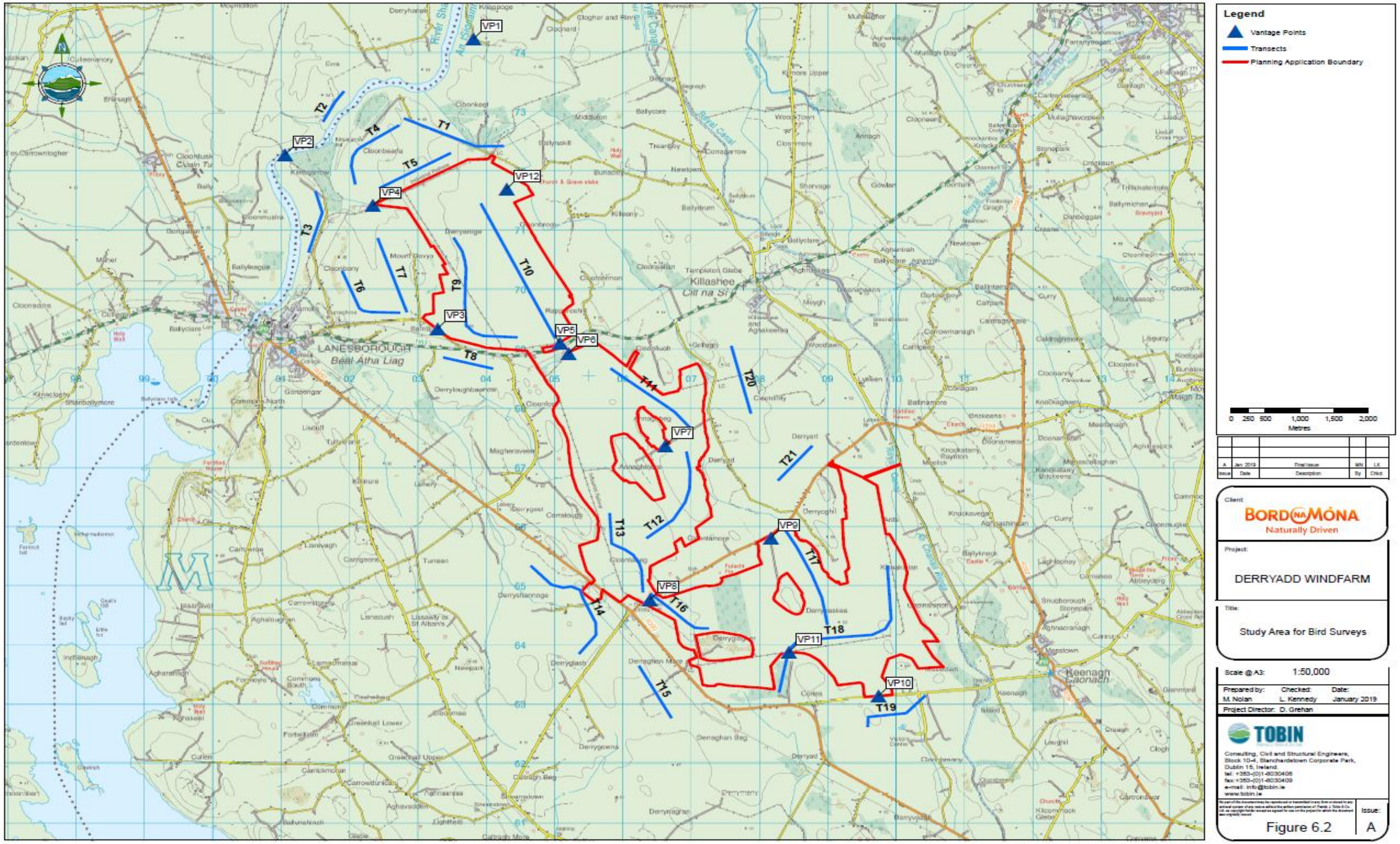
Hen Harrier Roost Survey methods followed those set out by Gilbert *et al.* (1998)[34] and were in accordance with the NPWS National Winter Hen Harrier Roost Survey recommendations (Ruddock *et al.* 2016)[37]. Surveyors were in place an hour and a half before sunset and recorded all observations of Hen Harrier until last visible light. Information recorded by surveyors from the vantage points included; the number of Hen Harrier entering a roost, the time, age, and sex, where possible.

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

[36] Clarke, R., & Watson, D. (1990). The Hen Harrier Circus cyaneus winter roost survey in Britain and Ireland. *Bird Study*, *37*(2), 84-100

[37] Ruddock, M., Mee, A., Lusby, J., Nagle, A., O'Neill, S. & O'Toole, L. (2016). The 2015 National Survey of Breeding Hen Harrier in Ireland. Irish Wildlife Manuals, No. 93. National Parks and Wildlife Service, Department of the Arts, Heritage and the Gaeltacht, Ireland.

Figure 6.2: Study Area for Bird Surveys (refer to reports in Appendix 6.1 for further details)



6.4.4.3 Mammals

A terrestrial mammal survey was carried out at the site targeting potential breeding habitat (e.g. scrub) in the vicinity of the proposed turbine locations. The key target mammals potentially occurring within habitats which may be potentially affected by the proposed development are badger, otter, bat species and, to a much lesser extent deer species. Other species as detailed in Section 6.4.4.5 are also considered in the evaluation.

Badgers setts and otter holts tend to be located in unmanaged woody vegetation associated with hedgerows / treelines and in the case of otters, drains and streams linked to more significant foraging habitat e.g. rivers and lakes (Hayden and Harrington 2000)[38]. Outside these areas, in managed farmland and/ or bare peatlands the risk of disturbance to breeding sites is very low. In this regard mitigation by avoidance was adopted in those areas not subject to walkover surveys by ensuring that turbine locations are constrained away from areas that provide suitable for badger or otter habitat as described above. The presence of other protected species including Irish Hare, Pine Marten and Red Squirrel were recorded if signs were observed. Other common mammal species were also noted.

All signs and tracks were evaluated as they were encountered in the field (Bang *et al.* 2004)[39]. Suitable mammal habitat and incidental records of other common faunal groups were also noted e.g. deer species, Irish Hare and rabbits.

Survey methods adopted during the target species surveys, for otter, badger and bat are outlined as follows.

6.4.4.3.1 <u>Otter</u>

During the multi-disciplinary survey in September 2016, April 2017, and April 2018, Otter surveys were conducted in accordance with NRA (2009)[12] guidelines, at waterbodies close to any proposed infrastructure site to confirm otter presence in the area. In addition, all drains and watercourses at lands accessed were checked for signs of otter presence and activity such as holts (breeding and temporary), slides and territorial marking points (spraints), with each sign recorded.

6.4.4.3.2 <u>Badger</u>

During the multi-disciplinary survey in September 2016, April 2017, and April 2018, Badger activity was determined by field surveys for setts, trails, latrines and feeding signs. Surveys for badger activity were

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[38] Hayden, T. J., & Harrington, R. (2000). *Exploring Irish Mammals*. Town House.

[39] Bang, P., Dahlstrøm, P., & Walters, M. (2001). *Animal tracks and signs*. Oxford university press.

undertaken within the proposed development site, paying particular attention to suitable habitat in proximity to the proposed infrastructure sites.

6.4.4.3.3 Bats

No known bat roosts or sites with significant potential for bat roosts such as old buildings, souterrains, caves, houses or other buildings will be impacted by the proposed development. Potential tree roost sites were identified within the proposed development site. The confirmation of bat roosts in trees is very difficult, even with regular bat activity surveys at potential tree roost sites, as noted by Kelleher and Marnell (2006)[40].

Three different types of bat surveys were used to gather information on the local bat fauna of the proposed development site (see Appendix 6.6):

- Passive Surveillance,
- Walking Transects, and
- Driving Transects.

Passive Surveillance (Acoustic Surveillance) involves setting up a bat detector (static recorder with an ultrasonic microphone) at a specific location in the field. There is no observer present but any bats that pass near enough to the recording unit are recorded and their calls are stored for analysis post surveying using computer software to view the recordings as sonograms. The bat detector is effectively used as a bat activity data logger. Each bat sequence is recorded as a single bat species (a bat sequence is a call sequence from the search phase to the catch phase). This type of bat surveying allows a far greater sampling effort, due to the use of numerous static units placed at numerous locations, over a shorter period of time.

Passive Surveillance was completed using Song Meter SM2BAT (2 units, hereafter known as Unit 1 and Unit 2) (192 kHz Stereo, SMX-US ultrasonic omni-directional microphone), Song Meter SM2BAT+ (2 units, hereafter known as Unit 4 and Unit 5) (192 kHz Stereo, SMX-US ultrasonic omni-directional microphone) and Song Meter SM3 (1 unit, hereafter known as Unit 3) (192 kHz Stereo, two SMX-US ultrasonic omni-directional microphones) units. New microphones were purchased to be used for this Four-Season Bat Survey. Microphones used in the June 2018 were calibrated prior to the survey and all were deemed useable for the survey.

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[40] Kelleher, C., & Marnell, F. (2006). Bat migration guidelines for Ireland. Irish Wildlife Manuals no 25. *National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland*.

Three of these data logging platforms (static units) were erected on the two anemometers located on the proposed development site (Unit 4 (at 4m height), Unit 5 (microphone as positioned at 50m height and connected to the unit via 50m extension cable), Unit 3 (this unit has the capacity for two ultrasonic microphones to be connected to the unit: one microphone was located at a height of 4m and the second microphone at 50m). The microphones located at the 50m height were strapped to a 1m steel bar and attached to the lattice frame of the anemometer. The microphones were directed away from the lattice frame of the anemometer. The remaining two static units were rotated around the proposed development site (Unit 1 and 2, both erected to 2m height) during the four-season bat survey period.

During the June 2018 bat surveys, all five units were used for the stationary locations (erected to 2m height). The microphones of each unit were position horizontally to reduce potential damage from rain. Bat echolocation calls recorded by the static recorders were analysed using SongMeter software. Myotis species were not identified to species level as this, generally, requires observation detail of the flying individual to complete full species identification. Where sufficient detail was recorded on the sonograms (i.e. sufficient information in relation to the minimum and maximum frequency of individual echolocation pulses) to identify Natterer's bat Myotis nattereri, this was noted. All other species were identified to species level.

Walking Transects, as the name suggests, involves an observer walking at a steady pace and recording any bat activity (noting the species) along the walking route. The Irish Grid Reference of the bat encounter was recorded for mapping purposes. This was completed using Pettersson D200 Heterodyne Bat Detectors and Wildlife Acoustics Echometer Touch microphones connected to iPad2s.

Driving Transects involve a team of two driving at 24km/hr along the local and regional road network adjacent to the survey area. The passenger of the vehicle, using a Wildlife Acoustics Echometer Touch microphone connected to an iPad2, records any bat encounters along the driven route. A Garmin Navigator GPS unit was used to take Irish Grid Reference points when a bat was encountered during the Driving Transects.

Due to the fact that bat are nocturnal mammals, surveying is undertaken during the nocturnal hours from dusk to dawn. Dusk refers to the time period from sunset (this varies according to the date quoted) to midnight of the date stated. Dawn refers to the time period from midnight to sunrise of the date stated (this varies according to the date quoted). Walking transects tended to be undertaken at Dusk followed by Driving transects.

In summary the following surveys were completed:

- Static recorders located on anemometers (Stationary Statics),

- Unit 3 consisted of 2 microphones, 4m and 50m respectively
- Unit 4 consisted of 1 microphone at 4m
- Unit 5 consisted of 1 microphone at 50m

- Static recorders moved from location to location (Stationary Statics),
  - Unit 1 with microphone at 2m
  - Unit 2 with microphone at 2m
- Walking Transects (within the survey site and adjacent road network), and
- Driving Transects (along the adjacent road network outside the survey site).

The bat surveys conducted allowed for the:

- Determination of any evidence of bat roosts (to support visual assessment);
- Confirmation of key habitats where bats congregate e.g. taller linear vegetation;
- Identification of bat species present in the area;
- Identification of tree lines / mature deciduous woodland areas where precautionary mitigation is recommended; and
- The findings of the survey within a large subsample of possible bat roost habitat (treelines/ hedgerows at road crossings) provided data on the likelihood of bat roosts being present in trees and other suitable structure within the proposed development area.

6.4.4.4 Fisheries and Aquatic Ecology

Ponds and lake habitats will be avoided by the proposed development. Visual Surveys of watercourses in the vicinity of proposed infrastructure were undertaken. Watercourse characteristics including bankside vegetation, substrate and flow rate were recorded. An assessment was made on the suitability of the habitat for aquatic species of conservation concern (e.g. freshwater crayfish and Atlantic Salmon). Watercourses were mapped according to Fossitt (2000)[21]. The results of water sampling carried out in surrounding watercourses is detailed in Chapter 8, Hydrology and Hydrogeology.

6.4.4.5 Other Fauna

The Common frog (*Rana temporaria*), the Smooth newt (*Triturus vulgaris*) and the Common lizard (*Lacerta vivipara*) are all protected species under the Wildlife Act 1976 (as amended) and have a widespread distribution in Ireland. Each of these species is likely to occur within the proposed development site. Pools, ponds, drainage ditches and wet grasslands provide suitable habitat for amphibians in the area. The Common lizard is widespread in suitable habitats such as dry banks, heathland and bog habitats. These species and potential breeding habitat were noted if seen.

A desk study and ecological walkover survey were carried out in 2016 to identify areas of potentially suitable habitat for the marsh fritillary butterfly (*Eurodryas aurinia*; considered one of the most endangered species in Ireland, it is protected under Annex II of the Habitats Directive and is listed under the Wildlife Acts 1976 [as amended]). Targeted surveys for marsh fritillary were subsequently carried out in October 2018 in areas of potentially suitable habitat or in the vicinity of a known record within the proposed development site (see Appendix 6.7). Marsh fritillaries were surveyed for by conducting larval and habitat suitability surveys during early October 2018, weather conditions were considered suitable for surveying. Ideally larval surveys were carried out in sunny conditions, when colonies of individuals are known to construct conspicuous webs over Devil's-bit Scabious leaves and adjacent vegetation. Suitability of the habitats for marsh fritillaries was assessed according to the following categories, which provide an approximate gradation of habitat suitability (from highly suitable to not suitable): 'Good condition'; 'Suitable, under-grazed'; 'Suitable, overgrazed'; 'Suitable, sparse'; 'Overspill'; 'Potential, rank'; 'Not suitable'. The assessment was based upon percentage of Purple Moorgrass and Devil's-bit Scabious, scrub cover, sward height and presence of tussocks (NRA 2009)[12].

A target field survey was undertaken on the 17th of October 2018 to identify potential whorl snails or suitable habitat for the species within the proposed development site (see Appendix 6.8). Three species of these tiny whorl snails which are found in Ireland are protected under the European Habitats Directive (listed on Annex II) and are usually indicators of high-quality habitat, with good continuity of habitat conditions over time. Each study area within the proposed development site was visited and walked, and a decision was made on whether to sample (based on habitat suitability) and how many samples to take. Notes were taken on habitat and vegetation type, and grid references were taken at regular intervals. The potential of each habitat area for supporting the target Vertigo species was rated as follows:

- N – not suitable for supporting target Vertigo species,
- L – low suitability, low chance of the target species occurring,
- M – moderate suitability, moderate chance of occurrence of species, or
- H – high suitability, species may occur.

Mollusc species found were identified with reference to Cameron (2003)[41], Kerney & Cameron (1979)[42] and other relevant works (e.g. Cameron *et al.* 2003)[43].

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[41] Cameron, R.A.D. (2003) Keys for the Identification of Land Snails in the British Isles. Field Studies Council, UK.

[42] Kerney, M.P. & Cameron, R.A.D. (1979) *A Field Guide to the Land Snails of Britain and North-west Europe.* Collins, St. James's Place, London.

[43] Cameron, R.A.D., Colville, B., Falkner, G., Holyoak, G.A., Hornung, E., Killeen, I.J., Moorkens, E.A., Pokryszko, B. M., Proschwitz, T.V., Tattersfiled, P. & Valovirta, I. (2003) Species Accounts for snails of the genus *Vertigo* listed in Annex II of the Habitats Directive: *V. angustior*, *V. genesii*, *V. geyeri* and *V. moulinsiana* (Gastropoda, Pulmonata: Vertiginidae). In: Speight, M.C.D., Moorkens, E.A. & Falkner, G., eds. *Workshop on Conservation Biology of European* Vertigo *species*, 2002 Dublin, Ireland. Friedrich-Held-Gesellschaft, Munchen, 2003.

Taking into consideration the species that the habitats of the proposed development site are likely to support, coupled with the characteristics of the proposed development it was considered unnecessary to carry out field surveys of other more specialised faunal groups including fungi, invertebrates and moths.

6.4.5 Baseline Evaluation Criteria

6.4.5.1 Site Evaluation Criteria

Ecological resources/receptors are evaluated following NRA (2009) guidelines (refer to Table 6.4) which set out the importance of the resource/receptor in a geographic context. These guidelines are consistent with the approach recommended in the '*Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater and Coastal*' (CIEEM 2016)[44].

The information gathered from desk studies and field surveys was used to make an Ecological Impact Assessment (EcIA) of the proposed development upon the identified ecological receptors on an importance scale ranging from international - national - county importance - local importance, high value - local importance, low value. Those features identified as being of high local importance or greater, are then given particular mention in the ecological evaluation as 'Key Ecological Receptors' when considering the potential for significant impacts and subsequent requirement for appropriate mitigation. The criteria shown in Table 6.4 have been used in evaluating ecological value within the study area. In addition, to the criteria listed in Table 6.4 the evaluation of habitats and species also considers other factors such as potential ecological value, secondary supporting values where habitats may perform a secondary ecological function and the social values of an ecological feature such as educational, recreational and economic value.

All potential impacts are assessed against parameters as set out within the NRA guidance (NRA 2009)[12] and take cognisance of guidance produced by the EPA, '*Guidelines on the information to be contained in Environmental Impact Assessment Reports*' (EPA, 2017)[45] and CIEEM (CIEEM, 2016)[44]. Via this approach, a scientific and repeatable method is applied whereby all aspects of a potential impact are considered. Unless otherwise stated, impacts identified in the assessment are considered to be adverse.

The following parameters are described when characterising impacts (following CIEEM [2016], EPA [2017] and NRA [2009]):

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[44] Chartered Institute of Ecology and Environmental Management (CIEEM) (2016). Guidelines for Ecological Impact Assessment in the UK and Ireland. Terrestrial, Freshwater and Coastal. Second Edition. January 2016.

[45] Environmental Protection Agency (EPA) (2017). Guidelines on the information to be contained in Environmental Impact Assessment Reports. Draft, August 2017.

- **Direct and Indirect Impacts:** An impact can be caused either as a direct or as an indirect consequence of a proposed development;
- **Magnitude:** Magnitude measures the size of an impact, which is described as high, medium, low or very low;
- **Extent:** The area over which the impact occurs – this should be predicted in a quantified manner;
- **Duration:** The time for which the impact is expected to last prior to recovery or replacement of the resource or feature;
    - Temporary: Up to 1 Year;
    - Short Term: The effects would take 1-7 years to be mitigated;
    - Medium Term: The effects would take 7-15 years to be mitigated;
    - Long Term: The effects would take 15-60 years to be mitigated;
    - Permanent: The effects would take 60+ years to be mitigated;
- **Likelihood:**
    - Certain/Near Certain: >95% chance of occurring as predicted;
    - Probable: 50-95% chance as occurring as predicted;
    - Unlikely: 5-50% chance as occurring as predicted and
    - Extremely Unlikely: <5% chance as occurring as predicted.
- **Frequency and Timing:** The timing of impacts in relation to important seasonal and/or life-cycle constraints should be evaluated. Similarly, the frequency with which activities (and concomitant impacts) would take place can be an important determinant of the impact on receptors and should also be assessed and described;
- **Reversibility:** An irreversible effect is one from which recovery is not possible within a reasonable timescale or there is no reasonable chance of action being taken to reverse it. A reversible effect is one from which spontaneous recovery is possible or which may be counteracted by mitigation.

Table 6.4: Criteria for Establishing Receptor Importance (NRA, 2009)

Importance	Ecological Valuation
International Importance	• European Site including Special Area of Conservation (SAC), Site of Community Importance (SCI), Special Protection Area (SPA) or proposed Special Area of Conservation. • Proposed Special Protection Area (pSPA). • Site that fulfils the criteria for designation as a ‘European Site’ (see Annex III of the Habitats Directive, as amended). • Features essential to maintaining the coherence of the Natura 2000 Network. • Site containing ‘best examples’ of the habitat types listed in Annex I of the Habitats Directive.

Importance	Ecological Valuation

	• Resident or regularly occurring populations (assessed to be important at the national level) of the following:
	  ○ Species of bird listed in Annex I and/or referred to in Article 4(2) of the Birds Directive; and/or
	  ○ Species of animal and plants listed in Annex II and/or IV of the Habitats Directive.
	• Ramsar Site (Convention on Wetlands of International Importance Especially Waterfowl Habitat 1971).
	• World Heritage Site (Convention for the Protection of World Cultural & Natural Heritage, 1972).
	• Biosphere Reserve (UNESCO Man & The Biosphere Programme).
	• Site hosting significant species populations under the Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animals, 1979).
	• Site hosting significant populations under the Berne Convention (Convention on the Conservation of European Wildlife and Natural Habitats, 1979).
	• Biogenetic Reserve under the Council of Europe.
	• European Diploma Site under the Council of Europe.
	• Salmonid water designated pursuant to the European Communities (Quality of Salmonid Waters) Regulations, 1988, (S.I. No. 293 of 1988).

National Importance	• Site designated or proposed as a Natural Heritage Area (NHA).
	• Statutory Nature Reserve.
	• Refuge for Fauna and Flora protected under the Wildlife Acts.
	• National Park.
	• Undesignated site fulfilling the criteria for designation as an NHA, Statutory Nature Reserve; Refuge for Fauna and Flora protected under the Wildlife Acts; and/or a National Park.
	• Resident or regularly occurring populations (assessed to be important at the national level) of the following:
	  ○ Species protected under the Wildlife Acts; and/or
	  ○ Species listed on the relevant Red Data list.
	• Site containing 'viable areas 'of the habitat types listed in Annex I of the Habitats Directive.

County Importance	• Area of Special Amenity. • Area subject to a Tree Preservation Order. • Area of High Amenity, or equivalent, designated under the County Development Plan. • Resident or regularly occurring populations (assessed to be important at the County level) of the following: ○ Species of bird, listed in Annex I and/or referred to in Article 4(2) of the Birds Directive;

Importance	Ecological Valuation
	○ Species of animal and plants listed in Annex II and/or IV of the Habitats Directive; ○ Species protected under the Wildlife Acts; and/or ○ Species listed on the relevant Red Data list. • Site containing area or areas of the habitat types listed in Annex I of the Habitats Directive that do not fulfil the criteria for valuation as of International or National importance. • County important populations of species or viable areas of semi-natural habitats or natural heritage features identified in the National or Local Biodiversity Action Plan (BAP), if these have been prepared. • Sites containing semi-natural habitat types with high biodiversity in a county context and a high degree of naturalness, or populations of species that are uncommon within the county. • Sites containing habitats and species that are rare or are undergoing a decline in quality or extent at a national level.
Local Importance (Higher Value)	• Locally important populations of priority species or habitats or natural heritage features identified in the Local BAP, if this has been prepared. • Resident or regularly occurring populations (assessed to be important at the Local level) of the following: ○ Species of bird listed in Annex I and/or referred to in Article 4(2) of the Birds Directive; ○ Species of animal and plants listed in Annex II and/or IV of the Habitats Directive; ○ Species protected under the Wildlife Acts; and/or ○ Species listed on the relevant Red Data list. • Sites containing semi-natural habitat types with high biodiversity in a local context and a high degree of naturalness, or populations of species that are uncommon in the locality; • Sites or features containing common or lower value habitats, including naturalised species that are nevertheless essential in maintaining links and ecological corridors between features of higher ecological value.
Local Importance (Lower Value)	• Sites containing small areas of semi-natural habitat that are of some local importance for wildlife. • Sites or features containing non-native species that are of some importance in maintaining habitat links.

The following parameters are described when characterising significance of effects (source: EPA, 2017)[45]:

- Imperceptible: An effect capable of measurement but without significant consequences.

- Not significant: An effect which causes noticeable changes in the character of the environment but without significant consequences.
- Slight Effects: An effect which causes noticeable changes in the character of the environment without affecting its sensitivities.
- Moderate Effects: An effect that alters the character of the environment in a manner that is consistent with existing and emerging baseline trends.
- Significant Effects: An effect which, by its character, magnitude, duration or intensity alters a sensitive aspect of the environment.
- Very Significant: An effect which, by its character, magnitude, duration or intensity significantly alters most of a sensitive aspect of the environment.
- Profound Effects: An effect which obliterates sensitive characteristics.

Based on these parameters, an impact is then considered to be either significant or not significant and likely to be either beneficial or adverse. Likely significant effects are predicted on the basis of the Proposed Development as set out in Chapter 2: Description of the Proposed Development.

6.4.5.2 Evaluating Sensitivity

The sensitivity of birds is defined by Percival (2003)[46] as its ecological importance and nature conservation interest at the site being assessed. Table 6.5 outlines the criteria used in Percival's method to evaluate the sensitivity of a species. A number of factors are used to determine this sensitivity.

- Whether the species is on Annex I of the EC Birds Directive;
- Whether the species is particularly ecologically sensitive – this includes large birds of prey and rare breeding birds (including divers, common scoter, hen harrier, golden eagle, red-necked phalarope, roseate tern and chough);
- Whether the site contains species at nationally important numbers (>1% of Irish population);
- Whether the site contains species at regionally important numbers (>1% of regional population, with the region usually taken as the county); and
- Whether the species is subject to special conservation measures, eg as red or amber species on the BirdWatch Ireland's (Colhoun and Cummins, 2013)[47] list of Birds of Conservation Concern (BoCCI).

[46] Percival, S. M. (2003). Birds and wind farms in Ireland: a review of potential issues and impact assessment. Ecology Consulting, 17, 2234-2236.

[47] Colhoun, K., & Cummins, S. (2013). Birds of Conservation Concern in Ireland 2014–2019. Irish Birds, 9(4), 523-544.

The sensitivity is further affected by any nature conservation designations in the area. The determination of sensitivity needs to take into account whether a species contributes to the overall objectives of the designation (including whether the species is noted as a special conservation interest species of the site), and specifically for internationally important (SPAs, it needs to consider whether the species contributes to the overall integrity of the site. The determination of sensitivity is summarised in Table 6.5.

Table 6.5: Determination of Sensitivity (Percival, 2003)

Sensitivity	Determining Factor
Very High	Species that form the cited interest of SPAs and other statutorily protected nature conservation areas. Cited means mentioned in the citation text for the site as a species for which the site is designated.
High	Species that contribute to the integrity of an SPA but which are not cited as species for which the site is designated. Ecologically sensitive species including the following: Divers, Common Scoter, Hen Harrier, Golden Eagle, Red-necked Phalarope, Roseate tern and Chough. Species present in nationally important numbers (>1% Irish population)
Medium	Species on Annex 1 of the EC Birds Directive Species present in regionally important numbers (>1% regional (county) population) Other species on BirdWatch Ireland's red list of Birds of Conservation Concern
Low	Any other species of conservation interest, including species on BirdWatch Ireland's amber list of Birds of Conservation Concern not covered above.

6.4.5.3 Determining the Magnitude of the Possible Impact

Determining the magnitude of possible impacts on ornithological receptors follows the methodology set out by Percival (2003)[46]. Once the species/ population in the study area have been evaluated in terms of their sensitivity, the next step is to determine the magnitude of the possible impacts that may occur on those species/ populations. The significance of any one impact is a product of the sensitivity of the receptor, the magnitude of the impact and the probability of that impact occurring. Percival's methodology states *'the test of significance of an impact will be whether the wind farm impact is causing a significant change to the population, its range or distribution'*. The population against which the extent of the impact is felt should be quantified. Pervical (2003)[46] defines this population as a local ecological unit of sufficient size. This population provides a baseline against which the possible effect can be assessed. A key point in the assessment is whether the proposed development would result in a reduction in the carrying capacity of the local area. The availability of alternative habitat in the wider area is also an important consideration. The magnitude of the possible impact is summarised in Table 6.6 below.

Table 6.6: Determination of Magnitude of Effect (Percival, 2003)

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

To assess the significance of the potential impact the relationship between sensitivity and magnitude must be understood. The methodology set out by Percival (2003)[46] achieves this by cross-tabulating the magnitude with the sensitivity, using Table 6.7 below, to provide a prediction of the significance of each potential impact.

Table 6.7: Significance Matrix (Percival, 2003)

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

6.4.6 Appropriate Assessment

Article 6(3) of the EU Habitats Directive requires an 'Appropriate Assessment' to be carried out by a competent authority (in this case An Bord Pleanála) where a plan or project either alone or in-combination with other plans or projects, is likely to result in a significant effect on a European site(s). In Ireland, European sites include SACs and SPAs (collectively referred to as the Natura 2000 network).

The EU Commission's methodological guidance (2001)[48] promotes a four-stage process to undertaking Appropriate Assessment with the outcome of each successive stage determining if a further stage in the process is required. The first stage is referred to as Screening. Section 177U(4) of Part XAB of the Planning and Development Acts, 2000-2017 provides for screening for Appropriate Assessment as follows:

> *"The competent authority shall determine that an appropriate assessment of [...] a proposed development [...] is required if it cannot be excluded, on the basis of objective information, that the [...] proposed development, individually or in combination with other plans or projects, will have a significant effect on a European site."*

The outcome of Stage 1 determines the necessity for undertaking a more detailed (Stage 2) Appropriate Assessment and preparation of a NIS. Section 177U(5) provides as follows:

> *"The competent authority shall determine that an appropriate assessment of a […] proposed development, […], is not required if it can be excluded, on the basis of objective information, that the […] proposed development, individually or in combination with other plans or projects, will have a significant effect on a European site."*

In the case of the proposed development, a NIS has been prepared (which accompanies the Planning Application documentation) as the potential for significant adverse effects on relevant European sites could not be excluded at the screening stage.

Stage 1 Screening (for Appropriate Assessment) was carried out without reference to mitigation measures. Mitigation is a central part of the Stage 2 appropriate assessment process and mitigation measures are tested to ensure they are effective and capable of implementation. Hence, as part of the NIS, a series of mitigation measures have been developed to ensure that the proposed development will not adversely affect the integrity of the European sites concerned. These measures are detailed in the NIS where it is concluded; following the implementation of the prescribed mitigation measures, the proposed development will not, either individually or in-combination with other plans and projects, in view of the best scientific knowledge in the field, adversely affect the integrity of the Lough Ree SPA, Lough Ree SAC, Ballykenny-Fisherstown Bog SPA, River Shannon Callows SAC or any European site and there is no reasonable scientific doubt as to that conclusion.

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[48] European Commission Environment Directorate-General (2001). Assessment of Plans and Projects Significantly Affecting Natura 2000 Sites: Methodological Guidance on the Provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC.

6.5 EXISTING ENVIRONMENT

6.5.1 Designated Conservation Sites

There are no sites designated under the EU Habitats Directive and EU Birds Directive, i.e. SACs and SPAs, located within the footprint of the proposed development (Figure 6.3). The nearest designated sites are Lough Ree SPA and SAC approximately 2.5km west of the proposed development, Ballykenny-Fisherstown Bog SPA approximately 4.5km north of the proposed development and Lough Bawn pNHA along the south-east margins of the site. As outlined previously, a NIS (as per EU Habitat Directive requirements) was completed and it has been submitted alongside the planning application.

Figure 6.3 illustrates the location of designated conservation sites within a 15km buffer around the proposed development site (see Section 6.3). Distances from each designated conservation site to the proposed development are provided in Table 6.8

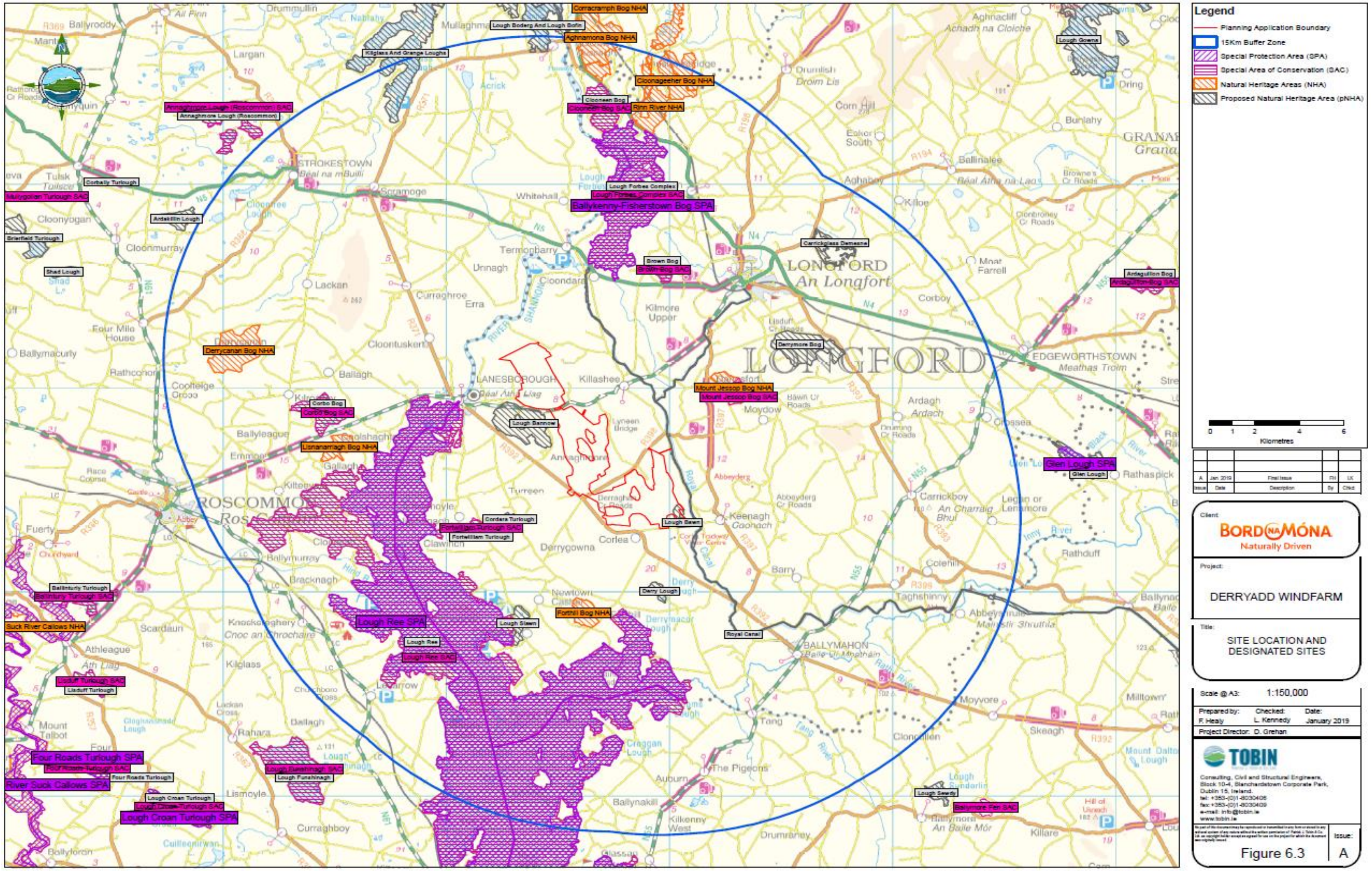
Table 6.8: Designated Conservation Site Located within 15 km of the Proposed Development

Name	Site Code	Designation*	Approximate distance from Proposed Development Site Boundary (km)
Lough Ree	004064	SPA	2.5
Lough Ree	000440	SAC	2.5
Fortwilliam Turlough	000448	SAC	4.3
Ballykenny-Fisherstown Bog	004101	SPA	4.5
Lough Forbes Complex	001818	SAC	4.67
Brown Bog	002346	SAC/pNHA	5.86
Corbo Bog	002349	SAC/pNHA	7.49
Annaghmore Lough	001626	SAC	15.79
Clooneen Bog	002348	SAC	10.81
Mount Jessop Bog	001450	SAC/NHA	5.25
Forthill Bog	001448	NHA	3.61
Derrycanan Bog	000605	NHA	11.3
Aghnamona Bog	000422	NHA	13.07
Cloonageeher Bog	001423	NHA	13.38
Lisnanarriagh Bog	002072	NHA	7.42
River Finn	002301	NHA	11.44
Lough Bawn	001819	pNHA	0
Lough Bannow	00449	pNHA	0
River Shannon Callows SAC	000216	SAC	22.8

Note:

***SPA** = Special Protected Area (European site), SAC = Special Area of Conservation (European site), NHA = Natural Heritage Area (Nationally Designated Site), pNHA = proposed Natural Heritage Area (not currently designated but recognised for their ecological value in County Development Plans)

Figure 6.3: Designated Conservation Sites



6.5.2 Flora

6.5.2.1 Rare and Protected Flora

The proposed development site is located in the Ordnance Survey National Grid 10 km square N06, N07 and N16. A species list for the proposed development site was generated using the National Biodiversity Data Centre (www.biodiversityireland.ie) in order to determine if any rare or protected species have been recorded in this area and the likelihood of their being present at the proposed development site (see Section 6.4.3). There are three historical records of rare or protected flora occurring within the proposed development site; however, no rare or protected flora were observed in the study area during field surveys.

A species list for National Grid 10 km square N06, N07 and N16 was generated to determine if any rare or protected species occur in the wider area. Table 6.9 presents the protected or rare plant species recorded as occurring in these grid squares.

Table 6.9: Protected or Rare Plants

Species	Status	Category
Cladonia portentosa	Habitats Directive Annex V	Protected Species
Leucobryum glaucum	Habitats Directive Annex IV	Protected Species
Drepanocladus sendtneri	Near threatened	Threatened Species

6.5.2.2 General Ecological Character of the Development Site

Desk Study

Bord na Móna produced ecological survey reports (i.e. Derryadd Ecological Survey Report, Derryarogue Ecological Survey Report, Lough Bannow Ecological Survey Report and Derryarogue Spring Report; see Appendix 6.3) in 2010 and 2012, detailing the key ecological features of interest at Derryaroge, Derryadd, Derryshannoge and Lough Bannow bogs. It was envisaged that information within these reports may inform the development of other land-uses and identify areas with particular biodiversity value.

The proposed development will be situated within a Bord na Móna landholding. This landholding continues to be used by Bord na Móna for commercial peat extraction. Overall the site varies greatly from areas which were not significantly impacted by the peat extraction activity, to areas that are re-vegetating since they have come out of production, to areas of bare peat which are still being harvested. The largest sections of active peat production can be found in Derryaroge and Lough Bannow bogs. In general, the areas in which peat extraction has halted contain habitats typical of re-vegetating cutover bog with heath/scrub/woodland habitats on the relatively well drained portions of the proposed development site.

A description of the onsite habitats of the site as a whole, as detailed in the following paragraphs, are provided in the Bord na Móna ecological survey reports. These habitat descriptions are based on 2012 surveys and were verified during the multi-disciplinary surveys carried out in September 2016, April 2017, and April 2018.

Habitats on the proposed development site were surveyed most recently in April 2018 and were classified in accordance with Fossitt (2000)[21]. Seventeen habitat classes were recorded including:

- Cutover bog (PB4);
- Drainage ditches (FW4);
- Earth banks (BL2);
- Scrub (WS1);
- Bog woodland (WN7);
- Oak-ash-hazel woodland (WN2);
- Conifer plantation (WD4);
- Dry grassland mosaic (GS1 & GS2);
- Wet grassland (GS4);
- Raised bog (PB1);
- Poor fen and flush (PF2);
- Transition mire and quaking bog (PF3);
- Re-colonising bare ground (ED3);
- Depositing/lowland rivers (FW2)
- Other artificial lakes and ponds (FL8);
- Buildings and other artificial surfaces (BL3); and
- Mineral islands (WS1, GS1, GS4 & FP1).

Habitats classes and their extent within the proposed development site are presented in Figure 6.4 and are described below.

Cutover bog (PB4)

Large sections of the site remain in active peat production. Topographically the site is undulating with the bare peat typically found in the low-lying areas. Within Lough Bannow bog the dominant habitat type is bare peat, a lot of which is still in production. Where peat production has been exhausted ridges of gravel have been exposed. Outside of areas of active peat production this habitat type can be found mixed into pioneer colonising colt's foot (*Tussilago farfara*) and birch scrub. At Derryadd bog large blocks of bare peat extend along both the west and east boundaries. Some sections of Derryadd contain areas of exposed marl and gravel. The bare peat at Derryaroge bog is present in narrow strips which run north to south through the centre of the bog. In addition, two large blocks of bare peat can be found along the western section of this bog. Large areas of gravel exposed by peat production are common across the northern section of Derryarogue bog. Large areas of the site can be rated as having low local ecological value as it is dominated by bare peat production bog.

Drainage ditches (FW4)

There are several drainage ditches within the proposed development site boundary. They have relatively steep banks and are up to 5 m wide. During the Bord na Móna survey, they generally contained <40 cm of stagnant water, with stagnant water levels increasing in places to approximately 1 m and sometimes greater, where drains connected. At Derryaroge a grey clay type sub-soil is located under this section of the site and it is clearly visible in the field drains (please refer to Chapter 7: Land, Soils and Geology, for further details). At the time of the ecological survey in 2012, extensive drainage work was ongoing in the south western corner of Derryadd bog.

Onsite drainage ditches contain very little aquatic fringing vegetation, although pioneer reed beds (*Phragmites australis*) do occur at the foot of the bank at scattered locations along the ditches. The drainage ditches on site are being encroached upon to varying extents by the adjacent vegetation. Drainage ditches are of moderate local importance for wildlife in providing connectivity between otherwise isolated ecological resources in the landscape. During the ecological survey undertaken by Bord na Móna in 2012, Otters were noted as using the drains in the south of the site (Lough Bannow bog).

Earth banks (BL2)

A flood defence berm was constructed in 2011 along the north western edge of Derryaroge bog in order to prevent flood water from the River Shannon entering the site. This is a highly modified habitat which is of low ecological value.

Scrub (WS1)

This habitat is scattered throughout the site and in areas bordering bog woodland habitat and drainage ditches. The scrub at the site is for the most part a *Betula/ Salix* dominated community. Similar to the findings in 2012, in April 2018, this *Betula/ Salix* community was found to be present in three states, emergent, open and closed canopy. In some areas the scrub is dominated by gorse *(Ulex europaeus)*. In most areas heather (*Calluna vulgaris*) and/ or purple moor-grass (*Molinia caerulea*) is found growing underneath or at the edges of these species within the scrub habitat. Oak, ash, hazel and pine spp. are also becoming established in older stands of scrub. Scrub is a moderately important habitat as it provides shelter and foraging opportunities for local wildlife, e.g. woodland birds and mammals.

Bog woodland (WN7)

This habitat occurs in areas of cutaway scattered throughout the site and along the margins of the site. The eastern section of Derryaroge contains well developed bog woodland. It is dominated by birch/ willow (*Betula/ Salix)* woodland. This habitat is of high local value. A large block of bog woodland was found in the eastern corner of Lough Bannow bog, fringing Lough Bawn pNHA. The areas of bog woodland ranged in thickness, from dense areas of woodland to areas that had a lesser density of trees. The main tree species were birch and scot's pine along with alder (*Alnus glutinosa*), willow (*Salix sp*.) and some gorse (*Ulex europaeus*). There was extensive evidence that the water levels fluctuate throughout these areas, with some areas being permanently water logged with a quaking feel throughout. Species within the areas of bog woodland included bog myrtle (*Myrica gale*), devil's-bit scabious (*Succisa pratensis*), bog bean (*Menyanthes trifoliata*), honeysuckle (*Lonicera periclymenum*), soft rush (*Juncus effusus*), blunt leaved bog-moss (*sphagnum palustre)*, ivy (*Hedera hibernica*), bramble (*Rubus fructicosus*), sweet vernal grass (*Anthoxanthum odoratum*), heather, star sedge (*Carex echinata*), wood horsetail (*Equisetum sylvaticum*), willow, holly (*Ilex aquifolium*), broad buckler fern (*Dryopteris dilatata*), cow wheat (*Melampyrum pratense*), water horsetail (*Equisetum fluviatile***)**, hogweed (*Heracleum sphondylium*), *Calliergon* sp., ragged robin (*Silene flos-cuculi*), lesser spearwort (*Ranunculus flammula*), lousewort (*Pedicularis sylvatica*), ribbed bog-moss (*Aulacomnium* palustre), spotted marsh orchid (*Dactylorhiza maculata*), marsh bedstraw (*Galium palustre*), yorkshire fog (*Holcus lanatus*), heath wood-rush (*Luzula multiflora agg.*) and short-fruited willowherb (*Epilobium obscurum)*. This area of bog woodland (within Lough Bawn pNHA) was classed as Annex I habitat (Natura 2000 code: 91D0) and is considered to be rare habitat in Ireland with an estimated nationwide land cover of 150 ha approximately[49].

<u>Oak-ash-hazel woodland (WN2)</u>

This habitat occurs within the eastern section of Lough Bannow bog. This woodland was immature and is still developing with birch, oak (*Quercus sp*.), rowan (*Sorbus aucuparia*), holly, hawthorn (*Crataegus monogyna*), hazel (*Corylus avellana*), guelder rose (*Viburnum opulus*), bramble, raspberry (*Rubus idaeus*), herb-robert (*Geranium robertianum*), lords and ladies (*Arum maculatum*), meadow-sweet (*Filipendula ulmaria*), honeysuckle, tufted sedge (*Carex acuta*), purple moor-grass and male fern (*Dryopteris filix-mas*). Paths through this section of the site were in regular use by Bord na Móna machinery and relatively large areas of meadow-sweet dominated wet grassland was located along the access routes to this portion of the site. A section of mature oak-ash-hazel woodland is located on the eastern section of Lough Bannow, on the eastern fringe of Lough Bawn pNHA, this woodland was relatively dry and was located on mineral soil. Species here included birch, scot's pine (*Pinus sylvestris*), ash (*Fraxinus excelsior*), alder, willow spp., hazel, herb robert, spindle (*Euonymus europaeus*),

[49] NPWS. (2008). The status of EU protected habitats and species in Ireland. *Conservation Status in Ireland of Habitats and Species listed in the European Council Directive on the Conservation of Habitats, Flora and Fauna*, *92*, 43.

enchanter's nightshade (*Circaea lutetiana*), ivy, honeysuckle, wood false brome (*Brachypodium sylvaticum*), *Hypnum sp*., bramble, viola sp., blackthorn (*Prunus spinosa*), rowan, wavy hair grass (*Deschampsia flexuosa*), meadow sweet, wood horsetail, wild strawberry (*Fragaria vesca*), holly, hawthorn, gorse, glaucous sedge (*Carex flacca*), sycamore (*Acer pseudoplatanus*), bush vetch (*Vicia sepium*), cock's foot, beech (*Fagus sylvatica*), rough meadow grass (*Poa trivialis*), spear thistle (*Cirsium vulgare*), wood dock (*Rumex sanguineus*), wood sanicle (*Sanicula europaea*), wood sedge (*Carex sylvatica*), primrose (*Primula vulgaris*), lady fern (*Athyrium filix-femina*), sorrel (*Rumex acetosa*), male fern, hart's tongue fern (*Phyllitis scolopendrium*), yew (*Taxus baccata*), wytch elm (*Ulmus glabra*), common haircap moss (*Polytrichum commune)*, yellow rattle (*Rhinanthus minor*), bay bolete (*Boletus badius*), common puffball (*Lycoperdon perlatum*) and trooping funnel cap (*Infundibulicybe geotropa*). Oak-ash-hazel woodland is locally important for common breeding birds, foraging bats and potentially badgers.

<u>Conifer plantation (WD4)</u>

A conifer plantation comprising of Sitka (*Picea sitchensis*) and Norway spruce (*Picea abies*) was planted in 1995 in Lough Bannow bog. This plantation has never thrived. Birch, scots pine and ling heather have become established within the plantation. This plant community appears to be better adapted to local conditions. Conifer plantations are highly modified habitats of low botanic value though they are locally important for common wildlife including breeding birds and protected mammal species.

<u>Dry grassland mosaic (GS1, GS2 & GS3)</u>

This habitat occurs infrequently in areas of higher ground or where nearby drains have dried the ground within the proposed development site. Species present include cocksfoot (*Dactylis glomerata*), tree saplings (willow and birch), willowherb (*Epilobium sp*.), colt's foot (*Tussilago farfara*), sweet vernalgrass (*Anthoxanthum*), grass and horsetail (*Anthoxanthum-Holcus-Equisetum)* community and Yorkshire fog (*Holcus lanatus*). These habitats have a moderate local value and act as a refuge for wildlife.

<u>Wet grassland (GS4)</u>

This habitat occurs around the margins of the proposed development and in colonising areas of cutaway bog. The wet grassland areas contained species including meadow sweet, knapweed (*Centaurea nigra*), willow, plantain spp., vetch spp., sweet vernal-grass, devil's bit-scabious, hogweed (species unknown), horsetails, red clover (*Trifolium pratense*) and creeping bent grass (*Agrostis stolonifera*). There are existing machinery paths and access tracks running through this habitat. Wet Grassland habitats have a moderate local value and act as a refuge for wildlife locally.

<u>Raised bog (PB1)</u>

Raised bog was noted in the eastern corner of Lough Bannow bog fringing Lough Bawn pNHA and infrequently around the margins of the site as a whole. The sections of raised bog that surround part of the Lough Bawn pNHA were in moderate to poor condition overall and the most westerly sections had been ditched many years ago. The ditched sections were dominated by heather; however, the most southerly section of raised bog were in somewhat better condition with a more varied flora. This habitat is of high local value.

Poor fen and flush (PF2)

Poor fen occurs throughout the site in areas of cutaway bog where pioneer poor fen species are colonising previously disturbed ground. Poor fen is most notable in low lying areas of cutaway bog. This habitat type is frequently dominated by the following species, bog cotton (*Eriophorum augustifolium*), bulbous rush (*Juncus bulbosus*) and marsh arrowgrass (*Triglochin palustris*). This habitat has a moderate local value and act as a refuge for wildlife.

Transition mire and quaking bog (PF3)

Transition mire and quaking bog can be found in the eastern corner of Lough Bannow within Lough Bawn pNHA. At present the lough has contracted and to a large extent disappeared with very small amounts of open water remaining and the entire area has a quaking feel to it. The Lough is covered with a mat of vegetation containing hummocks of vegetation interspersed with shallow water. The Lough is dominated with mosses and sedges and individual trees have spread across the surface of the Lough. Plant species in the area of the lough include purple moor grass, willow, birch, bog asphodel (*Narthecium ossifragum*), bog bean, devil's-bit scabious, star sedge, purple loosestrife (*Lythrum salicaria*), greater tussock sedge (*Carex paniculata*), bottle sedge (*Carex rostrata*), *Sphagnum palustre* (tussock forming) *S. subnitens*, heather spp., lesser tussock sedge (*Carex diandra*), marsh cinquefoil (*Comarum palustre*), ribbed bog-moss (*Aulacomnium palustre)* (tussock forming), marsh pennywort (*Hydrocotyle vulgaris*), round-leaved sundew (*Drosera rotundifolia*), wild angelica (*Angelica sylvestris*), marsh thistle (*Cirsium palustre*), ragged robin, reedmace (*Typha latifolia*), alder, mint, water horsetail, creeping bent-grass, common cotton grass (*Eriophorum angustifolium)* and lousewort. *Usnea sp*. lichen was growing on the branches of many of the trees.

Re-colonising bare ground (ED3)

This habitat category is used to describe areas of bare or disturbed ground which is re-colonising with vegetation. This habitat type is frequently associated with gravel exposed as a result of peat extraction. Vegetation cover is greater than 50% with ruderals or weed plants dominating. This habitat is present in disturbed areas on site. Species present include colt's-foot, soft rush (*Juncus effusus*), willowherb spp, cock's-foot. This habitat is of low ecological value.

Acidic pond (FL2)

Two areas of open water have developed in the northern section of Derryaroge bog. This habitat is small but has developed a diverse range of species including reed mace, soft rush, club rush (*Schoenoplectus lacustris*) bulbous rush (*Juncus bulbosus*), marsh arrowgrass (*Triglochin palustris*) and water mint (*Mentha aquatica*). The current land use practise of pumping water off site has prevented this habitat from spreading further. These habitats have a moderate local value and act as a refuge for wildlife.

Depositing/lowland rivers (FW2)

A watercourse flows through the southern section of Derryadd bog. This watercourse is a tributary of the River Shannon and has been canalised/modified. Canalised water bodies remain of local importance for wildlife and as corridors for linking semi natural areas in a managed agricultural landscape.

Other artificial lakes and ponds (FL8)

A large rectangular shaped area had been excavated in the western section of Lough Bannow and was filled with water resulting in the presence of an artificial pond. This pond did not contain many macrophytes apart from Reedmace, Floating Sweet Grass (*Glyceria fluitans*) with some Water Crow's-foot (*Ranunculus aquatilis*) also. Other examples of this type of habitat (silt ponds) are located in the south western corner of Derryadd bog and in the north eastern corner of Derryrogue. These habitats have a moderate local value and act as a refuge for wildlife.

Buildings and other artificial surfaces (BL3)

Access tracks and rail lines crisscross the site to allow Bord na Móna personnel and machinery entry to and exit from the site. The Mountdillion works is located on the northern boundary of the Derryadd bogs. A number of buildings and sheds are positioned at this location. This is a highly modified habitat.

Mineral islands (WS1, GS1, GS4 & FP1)

The site known as Derryaroge Island is part of Derryaroge Bog and the Mountdillon Group of bogs. Derryaroge island is a typical 'mineral island' or mound of glacial material and bedrock that protrudes from the surrounding bog (now cutaway and production bog) landscape. There are many examples of these types of small glacial mounds surrounded by bog in this area. The habitats found on these mounds are in contrast to the surrounding bog as they are strongly influenced by the calcareous bedrock and calcareous glacial deposits or sub-soil that underlay the site. Many of these areas are managed as farmland and Derryaroge Island is also mapped as farmland on the 2nd edition OSI 6-inch map. These sites were surveyed by Bord na Móna in 2012 as part of their Rehabilitation Plans. These areas were not surveyed again in 2018 as the sites are outside of the footprint of the proposed development. The following information is an extract from the Bord na Mona 2012 Ecology Survey Report.

"*The main part of the island is dominated by scrub (WS1) and grassland (GS1 & GS4). These habitats are criss-crossed with travel-paths, where there is exposed soil and some rutting where the ground is wet. The scrub is dominated by Blackthorn and is thick and impenetrable, although there are frequent young and maturing Ash trees developing within the scrub. Other species present include hawthorn, elder (Sambucus nigra), privet (Ligustrum vulgare), rowan, honeysuckle, bramble, ivy, male fern and soft shield fern (Polystitchum setiferum). There are several different grassland communities present on the site. The vegetation types vary according to hydrology and other environmental factors such as soil depth, amount of peat etc. The main grassland type is a dry calcareous grassland community. This is dominated by species such as glaucous sedge, yellow sedge (Carex viridula ssp.oedocarpa [C.demissa]), sweet vernal-grass (Anthoxanthum odoratum), red fescue (Festuca rubra) and bird's-foot trefoil (Lotus corniculatus). The dry grassland frequently grades into damper grassland, sometimes over short distances, which is also significantly influenced by the calcareous-rich soils but is likely to be more prevalent of peaty soils. This community contains frequent yellow sedge, carnation sedge (Carex panicea), star sedge and purple moorgrass. Small springs or damp hollows (FP1) are found in the largest open grassland area in the centre of the site and along some of the old travel patches around the margins of the site. Most of these did not have any standing water at the time of the survey (after an exceptionally dry May-June period), although they were all damp. Several others contained water, probably from heavy rainfall the previous evening. There was no sign of running water, which could be associated with springs. Calcareous-rich groundwater seepage into these shallow hollows with a high water-table could create the same habitats. The hollows were generally 1-5 m in diameter and > 0.5 m deep. The vegetation cover within the hollows was variable, with some hollows being dominated by exposed whitish mud and others dominated by brown mosses. Typical moss species associated with these hollows included brown mosses such as Scorpidium scorpoides, Drepanocladus spp. and Campylium stellatum, as well as Calliergonella cuspidata. The majority of the hollows had some development of tufa, generally a calcareous coating on plant material and mosses within the hollow. The tufa was not very well developed. Several of these hollows seemed to have been created by heavy machinery creating ruts in the travel paths that were subsequently colonised by typical species. The tufa spring indicator moss species, Palustriella commutata was searched for but was not recorded.*"

Other mineral islands are located in both Derryadd and Lough Bannow bogs. These islands are in the possession of third parties and under agricultural use. There are two islands located in Derryadd bog (Annaghmore and Annaghbeg). A single mineral island under agricultural use (Derrynaskea) is located in Lough Bannow. All of these areas are outside of the footprint of the development.

Field Surveys

Overall, the habitats described during the 2012 Bord na Móna surveys of the proposed development site remain consistent with the habitat encountered during the 2018 habitat surveys. In common with historical surveys at the site; the areas on which peat production has halted contain habitats typical of re-vegetating cutover bog with heath/scrub/woodland habitats on the relatively well drained portions of the proposed development site. In 2018, the habitat survey focused on mapping habitats within the development footprint. The habitat maps presented in Figure 6.4 A to C show the habitats of the development footprint recorded during the April 2018 survey visit. A list of the species encountered during this field survey are present in Table 6.10 below.

Table 6.10: List of Dominant Species Recorded in each of the Habitat Types within the Proposed Development Footprint

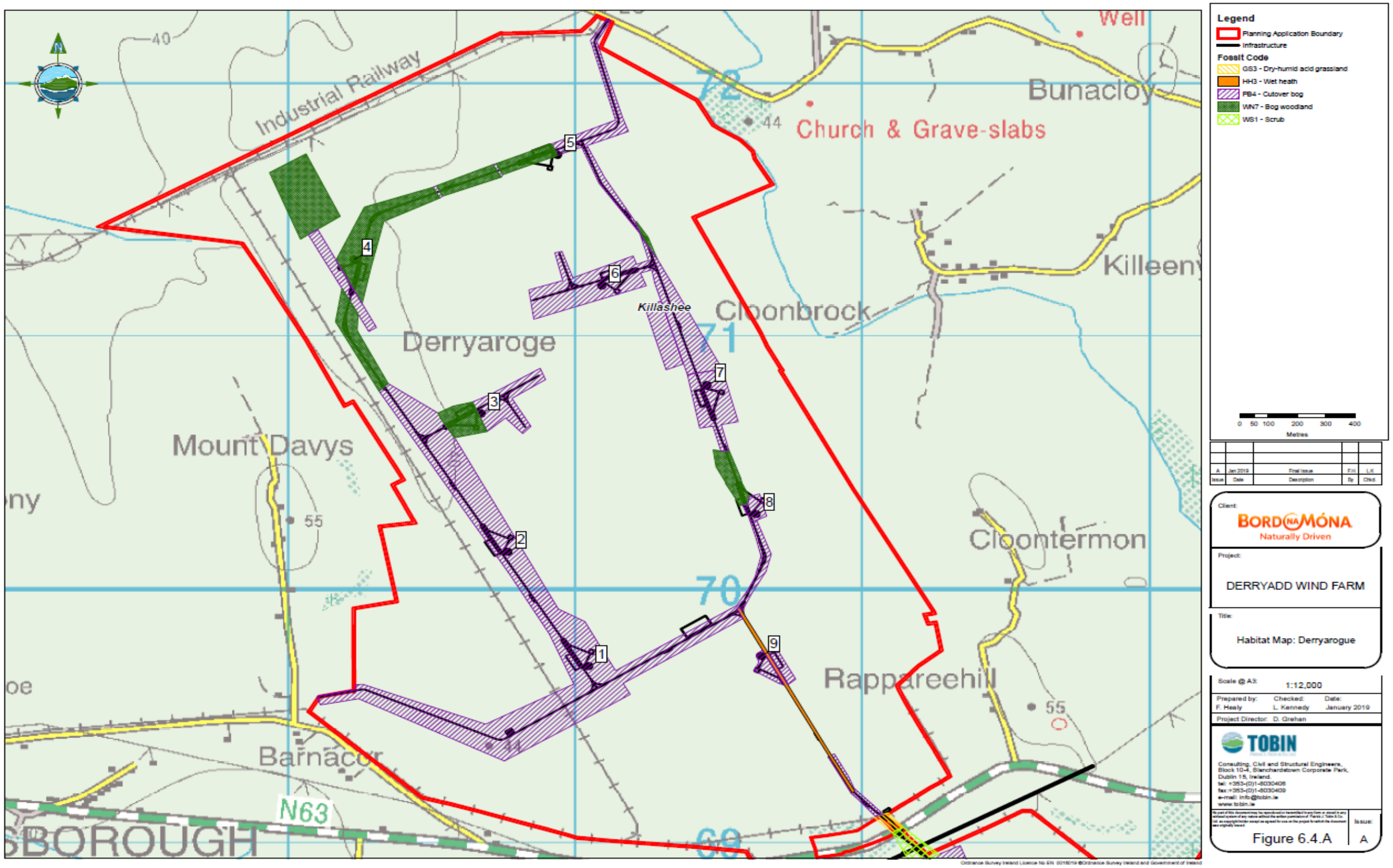
Habitat Type	Species
Drainage ditch (FW4)	
Soft rush	*Juncus effusus*
Common reed	*Phragmites australis*
Bulrush	*Typha latifolia*
Scrub WS1	
Heather	*Calluna vulgaris*
Male fern	*Dryopteris filix-mas*
Ivy	*Hedera hibernica*
Purple moor-grass	*Molinia caerulea*
Bramble	*Rubus fructicosus*
Elder	*Sambucus nigra*
Rowan	*Sorbus aucuparia*
Gorse	*Ulex europaeus*
Immature woodland (WS2)	
Alder	*Alnus glutinosa*
Silver Birch	*Betula pendula*
Downy Birch	*Betula pubescens*
Soft rush	*Juncus effusus*
Scots pine	*Pinus sylvestris*
Bramble	*Rubus fructicosus*
Willow	*Salix sp.*
Bog woodland (WN7)	
Alder	*Alnus glutinosa*

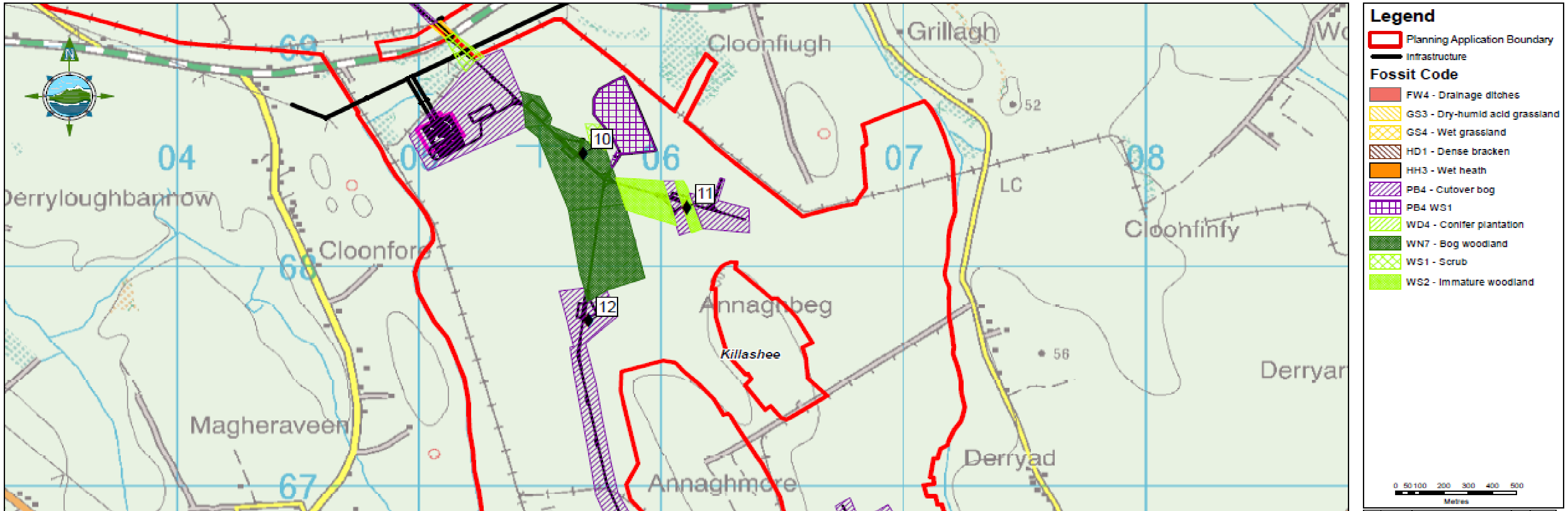
Habitat Type	**Species**
Sweet vernal grass	*Anthoxanthum odoratum*
Silver Birch	*Betula pendula*
Downy Birch	*Betula pubescens*
Star sedge	*Carex echinata*
Wood horsetail	*Equisetum sylvaticum*
Yorkshire fog	*Holcus lanatus*
Holly	*Ilex aquifolium*
Soft rush	*Juncus effusus*
Bog bean	*Menyanthes trifoliata*
Bog myrtle	*Myrica gale*
Bramble	*Rubus fructicosus*
Willow	*Salix*
Gorse	*Ulex europaeus*
Conifer plantation (WD4)	
Norway spruce	*Picea abies*
Sitka spruce	*Picea sitchensis*
Dry-humid acid grassland (GS3)	
Creeping bent grass	*Agrostis stolonifera*
Alder	*Alnus glutinosa*
Yorkshire fog	*Holcus lanatus*
Purple moor-grass	*Molinia caerulea*
Willow	*Salix*
Grey Willow	*Salix cinerea*
Gorse	*Ulex europaeus*
Wet grassland (GS4)	
Creeping bent grass	*Agrostis stolonifera*
Horsetail	*Equisetum*
Meadow-sweet	*Filipendula ulmaria*
Soft rush	*Juncus effusus*
Devil's bit-scabious	*Succisa pratensis*
Recolonising bare ground (ED3)	
Glaucous sedge	*Carex flacca*
Cocksfoot	*Dactylis glomerata*
Willowherb	*Epilobium*
Cotton grass	*Eriophorum spp.*

Habitat Type	Species
Wild Strawberry	*Fragaria vesca*
Soft rush	*Juncus effusus*
Colts foot	*Tussilago farfara*
Spoil and bare ground (ED2)	
Ling heather	*Calluna vulgaris*
Sedge	*Carex spp.*
Purple moor-grass	*Molinia caerulea*
Cutover bog (PB4)	
Creeping bent	*Agrostis stolonifera*
Birch	*Betula*
Birch	*Betula*
Silver Birch	*Betula pendula*
Downy Birch	*Betula pubescens*
Ling heather	*Calluna vulgaris*
Glaucous sedge	*Carex flacca*
Carnation sedge	*Carex panicea*
Carline Thistle	*Carlina vulgaris*
March Thistle	*Cirsium palustre*
Common cottongrass	*Eriophorum angustifolium*
Red Fescue	*Festuca rubra*
Yorkshire fog	*Holcus lanatus*
Toad rush	*Juncus bufonius*
Soft rush	*Juncus effusus*
Birds foot trefoil	*Lotus corniculatus*
Purple moor-grass	*Molinia caerulea*
Lousewort	*Pedicularis canadensis*
Creeping buttercup	*Ranunculus repens*
Willow	*Salix*
Grey Willow	*Salix cinerea*
Perennial Sowthistle	*Sonchus arvensis*
Bryophyte	*Sphagnum subnitens*
Colt's foot	*Tussilago farfara*
Colt's-foot	*Tussilago farfara*
Bulrush	*Typha latifolia*
Gorse	*Ulex europaeus*
Dense bracken (HD1)	

Habitat Type	**Species**
Purple moor-grass	*Molinia caerulea*
Bracken	*Pteridium aquilinum*
Bramble	*Rubus fructicosus*
Wet heath (HH3)	
Silver Birch	*Betula pendula*
Downy Birch	*Betula pubescens*
Ling heather	*Calluna vulgaris*
Sedge	*Carex spp*
Cocksfoot	*Dactylis glomerata*
Bryophyte	*Hypnum sp.*
Purple moor-grass	*Molinia caerulea*
Harts tongue fern	*Phyllitis scolopendrium*
Springy Turf-moss	*Rhytidiadelphus squarrosus*
Bramble	*Rubus fructicosus*
Willow	*Salix spp.*
Gorse	*Ulex europaeus*

Figure 6.4: Habitat Mapping of the Proposed Development Site





Issue	Date	Description	By	Chkd.
A	Jan 2019	Final Issue	F.H.	L.K.

Client: BORD NA MÓNA Naturally Driven

Project: DERRYADD WINDFARM

Title: Habitat Map: Derryadd

Scale @ A3: 1:16,000

Prepared by: F. Healy | Checked: L. Kennedy | Date: January 2019

Project Director: D. Grehan

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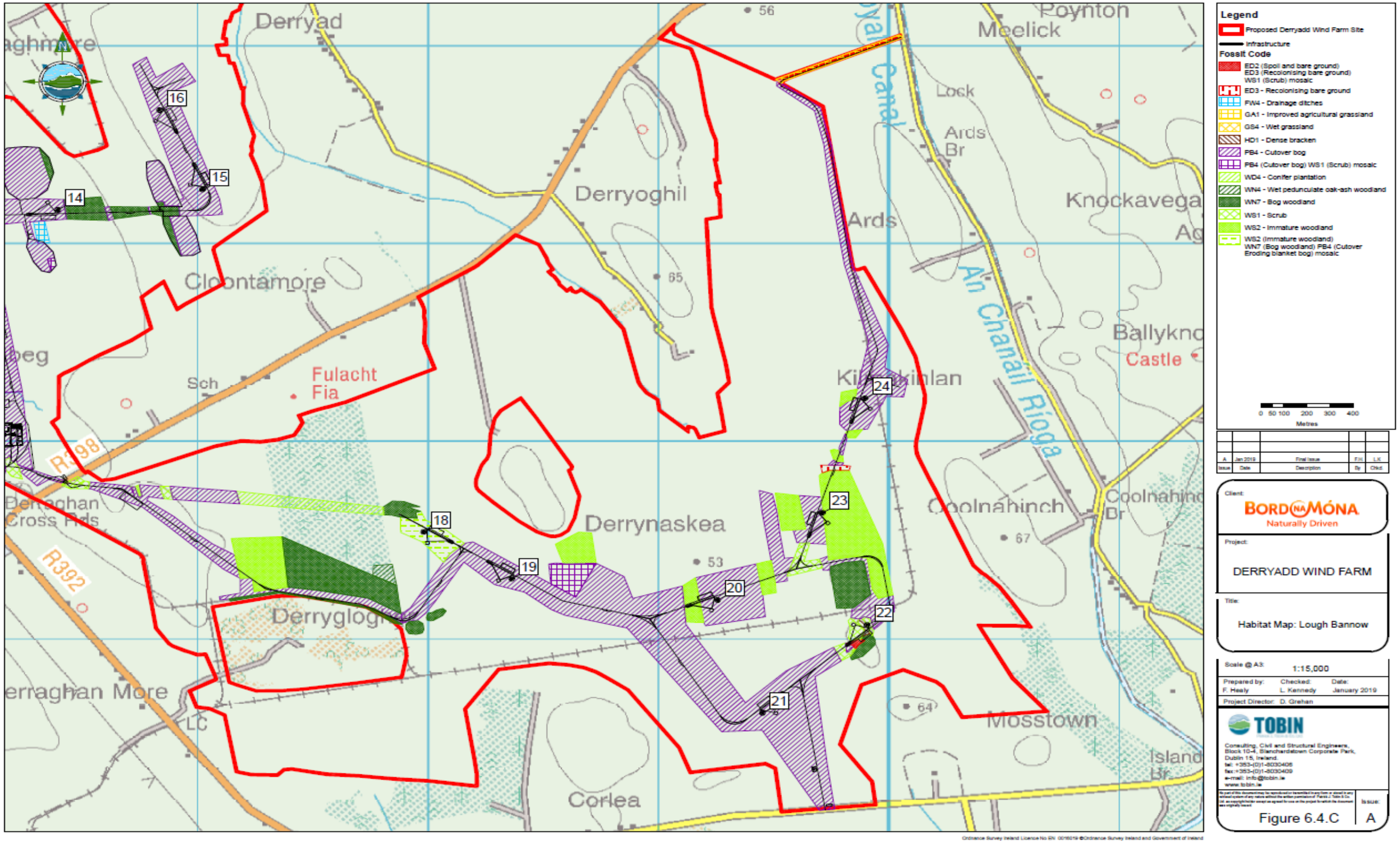
Figure 6.4.B | Issue: A


Derryad
Derryoghil
Meelick
Poynton
Lock
Ards Br
Ards
Knockavega
Clontamore
Fulacht Fia
Sch
Ballykn
Castle
R398
R392
Derrynaskea
Derryglogher
Coolnahinch
Coolnahinch Br
Moystown
Corlea
Island Br
LC
An Chanáil Ríoga
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Legend
Proposed Derryadd Wind Farm Site
Infrastructure
Fossil Code
ED2 (Spoil and bare ground) ED3 (Recolonising bare ground) WS1 (Scrub) mosaic
ED3 - Recolonising bare ground
FW4 - Drainage ditches
GA1 - Improved agricultural grassland
GS4 - Wet grassland
HD1 - Dense bracken
PB4 - Cutover bog
PB4 (Cutover bog) WS1 (Scrub) mosaic
WD4 - Conifer plantation
WN4 - Wet pedunculate oak-ash woodland
WN7 - Bog woodland
WS1 - Scrub
WS2 - Immature woodland
WS2 (Immature woodland) WN7 (Bog woodland) PB4 (Cutover Eroding blanket bog) mosaic
0 50 100 200 300 400
Metres
A | Jan 2019 | Final Issue | F.H. | L.K.
Issue | Date | Description | By | Chkd.
Client:
BORD NA MÓNA
Naturally Driven
Project:
DERRYADD WIND FARM
Title:
Habitat Map: Lough Bannow
Scale @ A3: 1:15,000
Prepared by: F. Healy
Checked: L. Kennedy
Date: January 2019
Project Director: D. Grehan
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Figure 6.4.C
Issue: A

6.5.3 Fauna

6.5.3.1 Birds

The main findings of the bird surveys are summarised in this section under breeding and wintering birds. The focus is on bird species identified as being at potential risk from impacts associated with the proposed development (Target species). Sensitivity to potential effects of the development is based on the extensive desktop study conducted, consultation with relevant stakeholders and field studies. Sensitivity factors include one or more of the following – known collision risk (with operating turbines), risk of disturbance (for example, during site clearance works and from operating turbines), displacement and species distribution within the study area. This evaluation is detailed as appropriate for individual species detailed below.

Individual breeding and wintering bird reports are presented in Appendix 6.1, please refer to this section for species observation/ location information. These reports (carried out by Malachy Walsh and Partners, McCarthy Keville O'Sullivan, and TOBIN) were produced every six months detailing key species observations from October 2014 until March 2018, i.e. four winter season reports and three breeding season reports.

Target species were identified as species sensitive to this type of development. They are species listed on Annex I of the EU Birds Directive (79/409/EEC)[50] and birds listed as being of high (Red listed) and medium (Amber listed) conservation concern (as identified by Colhoun and Cummins [2013][47]). Target species were also selected from those species which made up the special conservation interests of local SPAs. Table 6.11 and Table 6.12 below detail the special conservation interest of local SPAs. In addition, consideration is given to common species which have been identified as relatively sensitive to potential collision impacts from this type of development.

Table 6.11: Details of the Lough Ree SPA Population Relative to the All-Ireland (AI) or Republic of Ireland (ROI) Population

Lough Ree SPA Special Conservation Interest Populations			
Species	**Breeding/ Non-breeding**	**Population‡**	**Percentage of AI or ROI Population***
Common Tern	Breeding	90 pairs (1995)	2.1% (AI)
Common Scoter	Breeding	32 pairs (1999)	64% (ROI)
Whooper Swan	Non-breeding	205	1.3% (AI)
Wigeon	Non-breeding	2,466	3% (AI)
Teal	Non-breeding	233	0.5% (AI)

[50] The species listed in Annex I of the EU Birds Directive are those in danger of extinction, rare, vulnerable to specific changes in their habitat requiring particular attention for reasons of the specific nature of their habitat.

Lough Ree SPA Special Conservation Interest Populations			
Species	**Breeding/ Non-breeding**	**Population‡**	**Percentage of AI or ROI Population***
Mallard	Non-breeding	206	0.5% (AI)
Shoveler	Non-breeding	12	0.5% (AI)
Tufted Duck	Non-breeding	678	1.8% (AI)
Goldeneye	Non-breeding	47	0.5% (AI)
Little Grebe	Non-breeding	113	4.5% (AI)
Coot	Non-breeding	493	1.5% (AI)
Golden Plover	Non-breeding	5,458	3.2% (AI)
Lapwing	Non-breeding	4,053	1.9% (AI)

Note:

* AI: All Ireland, ROI: Republic of Ireland.

‡ Figures are the I-WeBS mean of peaks for the period 2004 to 2008, unless stated otherwise[51]. I-WeBS at Lough Ree were of poor quality or not conducted for the winters; 2009/10, 2011/12, 2012/13, 2013/14 & 2014/15[52].

Table 6.12: Details of the Ballykenny-Fisherstown Bog SPA Population Relative to the All-Ireland (AI) or Republic of Ireland (ROI) Population

Ballykenny-Fisherstown Bog SPA Special Conservation Interest Populations			
Species	**Breeding/ Non-breeding**	**Population**	**Percentage of AI or ROI Population***
Greenland White-fronted Goose	Non-breeding	111 (1990/ 91)	1% (AI)

Note:

*AI: All Ireland, ROI: Republic of Ireland.

Greenland White-fronted Geese have not been recorded at the site in recent years. It is thought that the Greenland White-fronted Goose population at the site has abandoned its peatland habitat in favour of grassland sites elsewhere[53].

6.5.3.1.1 Bird Species Recorded within the Study Area

Historical Records

The cutaway bog habitat of the midlands of Ireland has been shown to provide valuable habitat for breeding birds, such as breeding waders[55]. In an effort to quantify the distribution and abundance of these breeding waders Bord na Móna commissioned a study. The findings of this study are detailed in Copland

[51] Boland, H., & Crowe, O. (2012). Irish wetland bird survey: waterbird status and distribution 2001/02 2008/09. *BirdWatch Ireland, Kilcoole, Co. Wicklow*.

[52] I-WeBS Lough Ree data search: https://f1.caspio.com/dp.asp

[53] NPWS Ballykenny-Fisherstown Bog SPA site synopsis: https://www.npws.ie/sites/default/files/protected-sites/synopsis/SY004101.pdf

(2011)[54] *Birds on Cutaway Peatlands: Baseline Breeding Birds Population Survey*. Copland (2011) visited ten sites in the midlands of Ireland, three of which are within the study area of this proposed development site.

One site, Lough Bannow bog, is within the site boundary and a further two fringe (Mountdillon and Derrycashel) sites to the north of the River Shannon. All three sites were visited during the summers of 2010 and 2011. At Lough Bannow bog there were three species of note record, namely Kestrel, Snipe and Curlew. The Kestrel and Snipe were classed as a possible breeding species, while the Curlew was judged to have been unlikely to have bred. No waders or raptors were recorded at Mountdillon bog. Four species of wader were recorded at Derrycashel bog (Ringed Plover, Snipe, Lapwing and Redshank). Ringed Plover, Lapwing and Redshank were all judged to be probable breeders. Snipe was deemed to have possibly bred, owing to the observation of an individual in suitable breeding habitat.

Bird Atlas 2007-2011

The Bird Atlas project aimed to map the distribution and abundance of wintering and breeding birds across Ireland and Britain. Surveying was conducted by a network of volunteers from November 2007 to July 2011. The data was then published in '*Bird Atlas 2007-11, the breeding and wintering birds of Britain and Ireland*'[55]. A review of Bird Atlas 2007-2011 distribution maps was made for certain key species of conservation concern. This map data can be accessed at the Bird Atlas Map Store (https://app.bto.org/mapstore/specieschooser.jsp). Records for the 10km grid square (N07, N06, N16) in which the site is found and wider surroundings (N05, N17) is presented in Table 6.13 below. The absence of a breeding record from a given 10km grid square does not confirm that breeding did not occur. Nor does the absence from a 10km grid square confirm that the species cannot be found locally.

Table 6.13: Distribution of Key Species of Conservation Concern found within the Wider Surroundings of the Proposed Development Area (as per Bird Atlas 2007-2011 Distribution Maps)

Species	Non-breeding/ Wintering	Breeding	Conservation Status
Whooper Swan	Present (N05, N06 N07, N16, N17)	Absent	Annex I (EU Birds Directive), Amber Listed (BoCCI)
Wigeon	Whooper Swan	Present	Red Listed (BoCCI)

[54] Copland, A. 2011. Birds on Cutaway Peatlands: Baseline Breeding Bird Population Survey. Project report 2011. Unpublished report for Bord na Móna. BirdWatch Ireland, Co. Wicklow.

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

Species	Non-breeding/ Wintering	Breeding	Conservation Status
	(N05, N06, N07)	(N05, N06, N07)	
Shoveler	Present (N05, N06)	Probable (N05, N06)	Red Listed (BoCCI)
Pochard	Present (N05, N06)	Absent	Red Listed (BoCCI)
Tufted Duck	Present (N05, N06)	Probable (N05, N06)	Red Listed (BoCCI)
Goldeneye	Present (N05, N06)	Absent	Red Listed (BoCCI)
Little Egret	Present (N06)	Confirmed (N05, N06)	Annex I (EU Birds Directive)
Hen Harrier	Present (N05, N07)	Absent	Annex I (EU Birds Directive)
Lapwing	Present (N05, N06, N07, N17)	Probable (N05, N06, N07, N17)	Annex I (EU Birds Directive), Red Listed (BoCCI)
Golden Plover	Present (N05, N06, N17)	Absent	Annex I (EU Birds Directive), Red Listed (BoCCI)
Woodcock	Present (N16)	Probable (N16)	Red Listed (BoCCI)
Curlew	Present (N06)	Confirmed (N05)	Red Listed (BoCCI)
Redshank	Absent	Confirmed (N05, N06, N07)	Red Listed (BoCCI)
Black-headed Gull	Present (N05, N06, N07, N17)	Confirmed (N05, N06, N07)	Red Listed (BoCCI)
Herring Gull	Absent	Absent	Red Listed (BoCCI)
Barn Owl	Absent	Confirmed (N06)	Red Listed (BoCCI)
Merlin	Absent	Absent	Annex I (EU Birds Directive), Amber Listed (BoCCI)
Common Tern	Absent	Confirmed (N05)	Annex I (EU Birds Directive), Amber Listed (BoCCI)

BirdWatch Ireland Bird Sensitivity to Wind Energy Developments

BirdWatch Ireland developed a mapping tool to give a spatial indication of where protected bird species are likely to be sensitive to wind energy developments[56]. The potential impact of wind energy developments on protected birds includes loss of habitat and fragmentation, disturbance displacement, collision risk and the barrier effect (obstruction movement within the landscape). Information relating to risk and expert opinion was used to assign a sensitivity score. The bird sensitivity score has been mapped on a 1 km grid square level.

The area in which the proposed development is located (N07, N06 and N16) does not have data available (unknown) for the majority of the landholding. Bird sensitivity data is available for a section of Derryadd bog in the southwest of the proposed development area. This area has been categorised as of **Low** sensitivity to impacts from the wind energy industry. This classification indicated that impacts from wind farms in this area on protected bird species are considered to be low. This is an indicative measure and may be subject to change as new information comes to light.

Field Surveys

A comprehensive list of birds recorded within the study area is provided in Table 6.14 and Table 6.15 below. Bird species assemblages vary between seasons (breeding and non-breeding/winter), this variation is typically due to the migration rates of individual species. The winter species list details conservation status and provides comments as appropriate. The breeding species list provided information on the maximum breeding status recorded over the course of surveys. The level of conservation concern was drawn from the two lists; Birds of Conservation Concern in Ireland and from Annex I of the EU Birds Directive.

Table 6.14: Full Species List for the Winters of 2014/15, 2015/16, 2016/17 and 2017/18

Species Name	Conservation Status	Comment
Arctic Redpoll (Carduelis hornemanni)	NA	Rare winter visitor
Blackbird (*Turdus merula*)	Green Listed	Resident
Blackcap (*Sylvia atricapilla*)	Green Listed	Summer visit & small wintering pop.
Black-headed Gull (*Chroicocephalus ridibundus*)	Red Listed	Resident on Lough Ree
Blue Tit (*Cyanistes caerulus*)	Green Listed	Resident
Bullfinch (*Pyrrhula pyrrhula*)	Green Listed	Resident
Buzzard (*Buteo buteo*)	Green Listed	Resident

[56] McGuinness, S., Muldoon, C., Tierney, N., Cummins, S., Murray, A., Egan, S., & Crowe, O. (2015). Bird sensitivity mapping for wind energy developments and associated infrastructure in the Republic of Ireland. *BirdWatch Ireland, Kilcoole, Wicklow*.

Species Name	Conservation Status	Comment
Chaffinch (*Fringilla coelebs*)	Green Listed	Resident
Chiffchaff (*Phylloscopus collybita*)	Green Listed	Summer visit & small wintering pop.
Coal Tit (*Periparus ater*)	Green Listed	Resident
Coot (*Fulica atra*)	Amber Listed	Resident
Cormorant (*Phalacrocorax carbo*)	Amber Listed	Resident on Lough Ree
Crossbill (*Loxia curvirostra*)	Green Listed	Resident
Curlew (*Numenius arquata*)	Red Listed	Resident/ Winter visitor
Dunnock (*Prunella modularis*)	Green Listed	Resident
Fieldfare (*Turdus pilaris*)	Green Listed	Winter visitor
Goldcrest (*Regulus regulus*)	Amber Listed	Resident
Goldfinch (*Carduelis carduelis*)	Green Listed	Resident
Golden Plover (*Pluvialis apricaria*)	Red Listed, Annex I	Winter visitor
Great Tit (*Parus major*)	Green Listed	Resident
Greenfinch (*Carduelis chloris*)	Amber Listed	Resident
Greenland White-fronted Goose (*Anser albifrons flavirostris*)	Amber Listed, Annex I	Winter visitor
Grey Heron (*Ardea cinerea*)	Green Listed	Resident
Greylag Goose (*Anser anser*)	Amber Listed	Winter visitor
Grey Wagtail (*Motacilla cinerea*)	Red Listed	Resident, infrequent on site
Hen Harrier (*Circus cyaneus*)	Amber Listed, Annex I	Winter visitor
Herring Gull (*Larus argentatus*)	Red Listed	Rare winter visitor
Hooded Crow (*Corvus cornix*)	Green Listed	Resident
House Martin (*Delichon urbicum*)	Amber Listed	Summer visitor
House Sparrow (*Passer domesticus*)	Amber Listed	Resident but associated with buildings off site.
Jackdaw (*Corvus monedula*)	Green Listed	Resident
Jay (*Garrulus glandarius*)	Green Listed	Resident
Kestrel (*Falco tinnunculus*)	Amber Listed	Resident
Kingfisher (*Alcedo atthis*)	Amber Listed, Annex I	Scarce visitor
Lapwing (*Vanellus vanellus*)	Red Listed	Resident, infrequent on site
Lesser Black-backed Gull (*Larus fuscus*)	Amber Listed	Resident
Linnet (*Carduelis cannabina*)	Amber Listed	Resident
Long-tailed Tit (*Aegithalos caudatos*)	Green Listed	Resident
Magpie (*Pica pica*)	Green Listed	Resident
Mallard (*Anas platyrhynchos*)	Green Listed	Resident
Merlin (*Falco columbarius*)	Amber Listed, Annex I	Resident, infrequent on site
Meadow Pipit (*Anthus pratensis*)	Red Listed	Resident
Mistle Thrush (*Turdus viscivorus*)	Amber Listed	Resident
Mute Swan (*Cygnus olor*)	Amber Listed	Resident
Peregrine Falcon (*Falco peregrinus*)	Green Listed, Annex I	Resident, infrequent on site

Species Name	Conservation Status	Comment
Pheasant (*Phasianus colchicus*)	Green Listed	Resident
Pied Wagtail (*Motacilla alba*)	Green Listed	Resident
Raven (*Corvus corax*)	Green Listed	Resident
Redpoll (*Carduelis flammea*)	Green Listed	Resident
Redshank (*Tringa totanus*)	Red Listed	Resident
Reed Bunting (*Emberzia shoenichus*)	Green Listed	Resident
Robin (*Erithacus rubecula*)	Amber Listed	Resident
Rook (*Corvus frugilegus*)	Green Listed	Resident
Sand Martin (*Riparia riparia*)	Amber Listed	Summer visitor
Siskin (*Carduelis spinus*)	Green Listed	Resident
Skylark (*Aluada arvensis*)	Amber Listed	Resident
Snipe (*Gallinago gallinago*)	Amber Listed	Resident
Song Thrush (*Turdus philomelos*)	Green Listed	Resident
Sparrowhawk (*Accipiter nisus*)	Amber Listed	Resident
Starling (*Sturnus vulgaris*)	Amber Listed	Resident
Stonechat (*Saxicola torquatus*)	Amber Listed	Resident
Swallow (*Hirundo rustica*)	Amber Listed	Summer visitor
Teal (*Anas crecca*)	Amber Listed	Winter visitor
Water Rail (*Rallus aquaticus*)	Green Listed	Scarce visitor
Wheatear (*Oenanthe oenanthe*)	Amber Listed	Summer visitor/ passage migrant
Whooper Swan (*Cygnus cygnus*)	Amber Listed	Winter visitor
Wigeon (*Anas penelope*)	Red Listed	Winter visitor
Willow Warbler (*Phylloscopus trochilus*)	Green Listed	Summer visitor
Woodpigeon (*Columba palumbus*)	Green Listed	Resident
Wren (*Troglodytes troglodytes*)	Green Listed	Resident

There were nine Red Listed (BoCCI) species recorded over the four winter survey season. These species include; Black-headed Gull, Curlew, Golden Plover, Redshank, Herring Gull, Grey Wagtail, Lapwing, Wigeon, and Meadow Pipit. Red listed species in Ireland are those species which have suffered large declines in their population. Declines in wintering populations of several species including Wigeon (long term decline >50%) has resulted in their Red Listing. Black-headed and Herring Gull are Red Listed due to a 70% and 90% decline respectively in their breeding population over the past 25 plus years. Curlew, Golden Plover and Lapwing are all listed for both their breeding and wintering populations. These species have suffered 32%, 66% and 68% declines respectively in their wintering populations. Redshank breeding populations have declined (-53%) for some decades in Ireland. Grey Wagtails have suffered an 80% decline in their breeding population trending over the last 25 years. Meadow Pipit are Red Listed due to short term declines in their breeding populations which are expected to recover in the short term.

There were six Annex I listed species recorded over the course of winter surveys within the study area, namely; Golden Plover, Greenland White-fronted Goose, Hen Harrier, Kingfisher, Merlin and Peregrine Falcon. These species have been evaluated as ‘threatened’ due to large historical declines and/ or as a result of habitat loss.

Overall the level of site usage by species of high conservation concern (Red Listed/ Annex I) was found to be low. The majority of observations concerned individuals commuting over the site. Foraging onsite by species of high conservation concern was rare. In general, the species composition and assemblages are typical of habitats found on cutaway bogs in the midlands of Ireland. Bird species recorded during the three surveyed breeding seasons are summarised in Table 6.15 below.

Table 6.15: Full Species List and the Maximum Breeding Status Record over the course of 2015, 2016 and 2017 Breeding Season Surveys

Species Name	Maximum Breeding Status	Conservation Status
Blackbird (*Turdus merula*)	Possible Breeder	Green Listed
Blackcap (*Sylvia atricapilla*)	Possible Breeder	Green Listed
Black-headed Gull (*Chroicocephalus ridibundus*)	Non-Breeder (site), probable breeder (Lough Ree)	Red Listed
Blue Tit (*Cyanistes caerulus*)	Possible Breeder	Green Listed
Bullfinch (*Pyrrhula pyrrhula*)	Possible Breeder	Green Listed
Buzzard (*Buteo buteo*)	Probable Breeder	Green Listed
Canada Goose (*Branta canadensis*)	Non-Breeder (site), probable breeder (Lough Ree)	Green Listed
Carrion Crow (*Corvus corone*)	Possible Breeder	Green Listed
Chaffinch (*Fringilla coelebs*)	Possible Breeder	Green Listed
Chiffchaff (*Phylloscopus collybita*)	Possible Breeder	Green Listed
Coal Tit (*Periparus ater*)	Possible Breeder	Green Listed
Common Gull (*Larus canus*)	Non-Breeder (site), probable breeder (Lough Ree)	Amber Listed
Common Tern (*Sterna hirundo*)	Non-Breeder (site), probable breeder (Lough Ree)	Amber Listed, Annex I
Coot (*Fulica atra*)	Non-Breeder (site), confirmed breeder (Lough Ree)	Amber Listed
Cormorant (*Phalacrocorax carbo*)	Non-Breeder (site), confirmed breeder (Lough Ree)	Amber Listed
Cuckoo (*Cuculus carorus*)	Possible Breeder	Green Listed
Curlew (*Numenius arquata*)	Probable Breeder	Red Listed
Dunnock (*Prunella modularis*)	Possible Breeder	Green Listed
Garden Wabler (*Sylvia borin*)	Possible Breeder	Green Listed
Goldcrest (*Regulus regulus*)	Possible Breeder	Amber Listed
Goldfinch (*Carduelis carduelis*)	Possible Breeder	Green Listed

Species Name	**Maximum Breeding Status**	**Conservation Status**
Golden Plover (*Pluvialis apricaria*)	Possible Breeder	Red Listed, Annex I
Grasshopper Warbler (*Locustella naevia*)	Possible Breeder	Amber Listed
Great Black-backed Gull (*Larus marinus*)	Non-Breeder	Amber Listed
Great Created Grebe (*Podiceps cristatus*)	Non-Breeder (site), confirmed breeder (Fortwilliams Turlough)	Amber Listed
Great Tit (*Parus major*)	Possible Breeder	Green Listed
Greenfinch (*Carduelis chloris*)	Possible Breeder	Amber Listed
Grey Heron (*Ardea cinerea*)	Non-Breeder	Green Listed
Hen Harrier (*Circus cyaneus*)	Non-Breeder	Amber Listed, Annex I
Hooded Crow (*Corvus cornix*)	Possible Breeder	Green Listed
House Martin (*Delichon urbicum*)	Non-Breeder	Amber Listed
Jackdaw (*Corvus monedula*)	Possible Breeder	Green Listed
Jay (*Garrulus glandarius*)	Possible Breeder	Green Listed
Kestrel (*Falco tinnunculus*)	Possible Breeder	Amber Listed
Lapwing (*Vanellus vanellus*)	Non-Breeder (site), probable breeder (within c. 1km of boundary)	Red Listed
Lesser Black-backed Gull (*Larus fuscus*)	Non-Breeder (site), confirmed breeder (Lough Ree)	Amber Listed
Linnet (*Carduelis cannabina*)	Possible Breeder	Amber Listed
Little Grebe (*Tachybaptus ruficollis*)	Non-Breeder (site), probable breeder (within c. 1km of boundary and Lough Ree)	Amber Listed
Little Egret (*Egretta garzetta*)	Non-Breeder	Green Listed, Annex I
Long-eared Owl (*Asio otus*)	Confirmed Breeder	Green Listed
Magpie (*Pica pica*)	Possible Breeder	Green Listed
Mallard (*Anas platyrhynchos*)	Non-Breeder (site), confirmed breeder (within 500m of boundary and Lough Ree)	Green Listed
Merlin (*Falco columbarius*)	Confirmed Breeder	Amber Listed, Annex I
Meadow Pipit (*Anthus pratensis*)	Probable Breeder	Red Listed
Mistle Thrush (*Turdus viscivorus*)	Possible Breeder	Amber Listed
Moorhen (*Gallinula chloropus*)	Non-Breeder (site), probable breeder (within 500m of boundary and Lough Ree)	Green Listed
Mute Swan (*Cygnus olor*)	Non-Breeder (site), confirmed breeder (Lough Ree)	Amber Listed

Species Name	**Maximum Breeding Status**	**Conservation Status**
Peregrine Falcon (*Falco peregrinus*)	Non-Breeder	Green Listed, Annex I
Pheasant (*Phasianus colchicus*)	Possible Breeder	Green Listed
Pied Wagtail (*Motacilla alba*)	Possible Breeder	Green Listed
Quail (*Coturnix coturnix*)	Non-Breeder	Red Listed
Raven (*Corvus corax*)	Possible Breeder	Green Listed
Redpoll (*Carduelis flammea*)	Possible Breeder	Green Listed
Reed Bunting (*Emberzia shoenichus*)	Possible Breeder	Green Listed
Ringed Plover (*Charadrius hiaticula*)	Probable Breeder	Amber Listed
Robin (*Erithacus rubecula*)	Possible Breeder	Amber Listed
Rook (*Corvus frugilegus*)	Non-Breeder	Green Listed
Sand Martin (*Riparia riparia*)	Non-Breeder	Amber Listed
Sedge Warbler (*Acrocephalus schoenobaenus*)	Possible Breeder	Green Listed
Short-eared Owl (*Asio flammeus*)	Non-Breeder	Amber Listed
Siskin (*Carduelis spinus*)	Possible Breeder	Green Listed
Skylark (*Aluada arvensis*)	Possible Breeder	Amber Listed
Snipe (*Gallinago gallinago*)	Probable Breeder	Amber Listed
Song Thrush (*Turdus philomelos*)	Possible Breeder	Green Listed
Sparrowhawk (*Accipiter nisus*)	Probable Breeder	Amber Listed
Spotted Flycatcher (*Musciapa striata*)	Possible Breeder	Amber Listed
Starling (*Sturnus vulgaris*)	Possible Breeder	Amber Listed
Stonechat (*Saxicola torquatus*)	Possible Breeder	Amber Listed
Swallow (*Hirundo rustica*)	Non-Breeder	Amber Listed
Swift (*Apus apus*)	Non-Breeder	Amber Listed
Teal (*Anas crecca*)	Non-Breeder (site), probable breeder (Lough Ree)	Amber Listed
Tufted Duck (*Aythya fuligula*)	Non-Breeder (site), probable breeder (Lough Ree)	Amber Listed
Water Rail (*Rallus aquaticus*)	Non-Breeder (site), probable breeder (Lough Ree)	Green Listed
Wheatear (*Oenanthe oenanthe*)	Possible Breeder	Amber Listed
Whimbrel (Numenius phaeopus)	Passage	Green Listed
Whitethroat (*Sylvia communis*)	Possible Breeder	Green Listed
Willow Warbler (*Phylloscopus trochilus*)	Possible Breeder	Green Listed
Woodcock (*Scolopax rusticola*)	Probable Breeder	Red Listed
Woodpigeon (*Columba palumbus*)	Probable Breeder	Green Listed
Wren (*Troglodytes troglodytes*)	Possible Breeder	Green Listed

There were seven species recorded on the Red List (BoCCI) during breeding bird surveys (2015, 2016 and 2017). These species included; Black-headed Gull, Woodcock, Curlew, Golden Plover, Lapwing, Quail, and Meadow Pipit. Curlew, Golden Plover and Lapwing are all listed for both their breeding and wintering populations. These species have suffered 70%, 52% and 74% declines respectively in their breeding populations.

In common with winter birds surveys the following Annex I listed; Golden Plover, Hen Harrier, Merlin and Peregrine Falcon were recorded during breeding season surveys. Two additional species were recorded i.e. Common Tern and Little Egret. The European populations of these species are under treat due to loss and deterioration in habitat.

In general, the numbers of breeding birds of conservation concern recorded onsite was low. Of those species recorded which are considered of high conservation concern (Red List/ Annex I species) only four achieved the status of probable or confirmed breeder. Meadow Pipit, Woodcock and Curlew were noted displaying onsite or in habitats fringing the site (further details described below under 'Key Species of Conservation Concern'). Merlin was confirmed breeding within the study area, as evidenced by the record of a female carrying prey. However, it is judged that there was no Merlin nest onsite or in any of the habitats fringing the site owing to the low number of records accumulated over the survey period. Overall the species composition and assemblages are typical of habitats found on cutaway bogs in the midlands of Ireland.

A detailed survey of breeding and wintering birds in the proposed development area has been undertaken to inform the ecological impact evaluation. Individual survey reports are presented in Appendix 6.1. Key species of conservation significance identified are summarised below providing a brief discussion and evaluation of significance of the results as they relate to each species.

Key Species of Conservation Significance

Hen Harrier (Annex I EU Birds Directive)

This species is included on the Amber List of Bird of Conservation Concern in Ireland due the historical decline in its breeding population[47]. In 2015, an estimated 108-157 breeding pairs of Hen Harrier were recorded during the national Hen Harrier survey (Republic of Ireland [ROI])[37]. This represents a decline since the 2010 national survey. Birds within Ireland are resident. Many individuals move from upland breeding habitat to lowland feeding habitat in late summer/ early autumn. This species is mainly found in the midlands, west and south-west. On the 7th of June 2018 a consultation response from NPWS indicated the presence of a Hen Harrier winter roost c.5km to the southwest of the proposed development area.

Hen Harriers were recorded infrequently at the proposed development site. These observations were typically confined to non-breeding period (August to March) when the species is particularly nomadic. There was a combined total of 22 separate flights record at the site, as per Derryadd Wind Farm: Collision Risk Modelling Table 6 (CRM 2018; Appendix 6.5). The majority of these observations were noted to the north of the site, in the cutaway bog habitat fringing the north bank of the River Shannon (offsite). No breeding season observations were made in 2015. Three flights were recorded on the 7th of September 2016, once during a day survey at VP8 and twice during an evening survey from VP1. In addition, this species was recorded on a single occasion during the 2017 breeding season. The flight activity was in August and below PCH. Over the course of surveys both sexes were observed; typically hunting.

The total flight activity recorded from vantage point surveys for Hen Harrier amounted to 1,508 seconds, as per Derryadd Wind Farm: Collision Risk Modelling 2018 (CRM 2018; Appendix 6.5). Flight activity was not found to be strongly associated with any one area of the proposed development area. The distributions of Hen Harrier flights are shown in the relevant Bird Reports which are appended in Appendix 6.1. Given a survey effort of 2,412 hours, the number of flight lines recorded was found to be low. The species is judged not to be dependent on the onsite habitats based on occasional site use, the low levels of flight activity and the availability of similar suitable habitat in the wider area. In addition, the majority of the habitat onsite is cutover bog which is considered sub-optimal habitat for this species.

Merlin (Annex I EU Birds Directive)

The species fluctuating population trend has been the main reason for its inclusion on the Amber list of Birds of Conservation Concern in Ireland[47]. It is estimated that there are between 250-400 breeding pairs within the ROI (EO)[57]. The Action Plan for Upland Birds in Ireland 2011-2020 identified significant gaps in our knowledge of the Irish Merlin population[58]. The Merlin is a rare resident species found in the north and north-west of the country, other areas of note include; the Wicklow mountains and a sporadic populations occurring across the midlands of the country. This species has been recorded within the nearby Ballykenny-Fisherstown Bog SPA[53] (4.5km to the north of the site).

The Merlin is a wide-ranging species that was found to be an occasional visitor to the study area. Twenty winter observations were made over the four winter periods of 2014/ 15, 2015/ 16, 2016/ 17 and 2017/ 18. The majority of these records were from fringing cutover bog habitats offsite. The bulk of behavioural observations were of hunting/ foraging individuals. Breeding season records included two flights in 2015

[57] Expert opinion as no published data exists. BirdWatch Ireland

[58] BirdWatch Ireland (2010). Action Plan for Upland Birds in Ireland 2011-2020. BirdWatch Ireland's Group Action Plans for Irish Birds. BirdWatch Ireland, Kilcoole, Co. Wicklow.

and a further three flights in 2016. There no observation of this species during the 2017 breeding season surveys. Each observation was of a single individual flying below PCH. The 7th of July 2016 record included the observation of a female Merlin carrying prey at Lough Bannow bog (in the vicinity of VP9). This confirms breeding locally; however, a nest onsite is considered unlikely given how few sightings were made of the species April to September 2016. Given the low levels of flight activity, it is reasonable to conclude that the site lies on the edge of a Merlin's core foraging range (within 5km)[59], which it rarely visits.

Merlin were excluded from the collision risk analysis on the basis that flight activity was considered to be sufficiently low not to warrant an analysis (CRM 2018; Appendix 6.5). There is therefore no predicted collision risk for this species. The distribution of Merlin flights are shown in the relevant reports contained in Appendix 6.1, i.e. the reports produced for the four winter periods of 2014/ 15, 2015/ 16, 2016/ 17 and 2017/ 18 and the two breeding periods of 2015 and 2016. This species is unlikely to be dependent on the habitats of the site. The reasons for this judgement include; the low levels of flight activity onsite and the availability of suitable foraging habitat within the wider surroundings. In addition, the majority of the habitat onsite is cutover bog which is considered sub-optimal habitat for this species.

Peregrine Falcon (Annex I EU Birds Directive)

An estimated 390 breeding pairs of Peregrine Falcon are present in Ireland (ROI)[60]. Birds within Ireland are mainly resident. This species is widely distributed throughout the country although they are not considered common.

This species was found to be an irregular visitor to the site. There was a combined total of 12 separate flights record at the site, as per CRM (2018). The main behavioural observation noted was hunting. On the 27th of November 2017 a Peregrine Falcon was noted demonstrating territorial behaviour, e.g. calling and mobbing a Buzzard. However, there was no subsequent evidence of breeding found for this species onsite or in the wider area.

The total flight activity recorded from vantage point surveys for Peregrine Falcon amounted to 1,585 seconds (CRM 2018). Flight activity was not found to be strongly associated with any one area of the proposed development area. Numbers per flight ranged from one to two birds. The results of the collision risk analysis are below the threshold required for potentially significant effects. The distribution of Peregrine Falcon flights are shown in Appendix 6.1. Given the 2,412 hours survey effort, the amount of

[59] Scottish Natural Heritage (SNH) (2016). Assessing Connectivity with Special Protection Areas (SPAs). Scottish Natural Heritage.

[60] Madden, B., Hunt, J. and Norriss, D. (2009) The 2002 survey of the peregrine *Falco peregrines* breeding population in the republic of Ireland. *Irish Birds* 8:543-548.

flight activity at the site was very low. It is considered highly unlikely that this species is dependent on the onsite habitats given the occasional site usage, the low level of flight activity and the availability of prey offsite, i.e. the large assemblages of water birds found on Lough Ree.

Buzzard (Green Listed BoCCI)

Buzzard breeding numbers and range has been steadily increasing after a historical decline in Ireland[61]. Adults are largely resident within Ireland. While immature individuals are actively nomadic from their first September until they reach maturity at 2 years. This species is found predominantly in the east and north of the country. Buzzards frequent all habitats which provide open areas for hunting with trees or crags for nesting[33].

Buzzards were observed frequently within the study area. Flights were regularly recorded in the winter seasons of 2014/ 15, 2015/ 16, 2016/ 17 and 2017/ 18, totalling 176 flights. There were a combined total of 183 observations of Buzzards during the 2015, 2016 and 2017 breeding seasons. Buzzard were also occasionally recorded during transect surveys. The majority of the records consisted of single birds hunting, soaring or commuting over the study area. No nest sites were located but display behaviour and juveniles were recorded during 2015 summer vantage point surveys. As display behaviour was observed this species was judged a 'probable breeder' within the study area. In addition, during 2017 breeding raptor surveys a displaying pair was recorded within an area of mixed woodland within 2 km of the south-western site boundary at Derrygowna (see Appendix 6.1 for location details).

The distribution of Buzzard flights are shown in Appendix 6.1. While Buzzard were recorded to utilise onsite areas for foraging, the wider (agricultural/ peatland) surroundings of the proposed development is likely to provide similar suitable habitat. The fact that this species' population in increasing and range is expanding west (from a stronghold to the east and north), limits the potential for ecologically significant effects to result from the proposed development. In addition, a significant portion of the habitat onsite is bare peat which is considered sub-optimal habitat for this species.

Kestrel (Amber Listed BoCCI)

The Kestrel is widespread in Ireland although its population is on the decline[62]. Kestrels are partial migrants, individuals in upland areas move to low lying land for the winter. Kestrels breeding in lowland areas tend to be sedentary. Kestrels breed in almost any habitat which holds sufficient prey and nest sites[33].

[61] Greenwood, J. J. D., Crick, H. Q. P., & Bainbridge, I. P. (2003). Numbers and international importance of raptors and owls in Britain and Ireland. *Birds of prey in a changing environment*, 25-49.

[62] Village, A (2002) Common Kestrel *Falco tinnunculus*. In the Migration Atlas. Movements of Birds of Britain and Ireland. London pp. 246-249.

This species was regularly encountered, but in low numbers, over the course of surveys at the site. A combined total of 221 observations were made of the species during the winter seasons of 2014/ 15, 2015/ 16, 2016/ 17 and 2017/ 18 (CRM 2018). Kestrels were also commonly recorded at the site during the 2015, 2016 and 2017 breeding seasons. This species was recorded on 118 occasions during these breeding season surveys (CRM 2018). The majority of these observations involved hunting over scrub, heath and vegetated cutaway bog habitats. No evidence of breeding was located for this species at the site.

The total flight activity recorded from vantage point surveys for Kestrel amounted to 50,022 seconds (CRM 2018). Flight activity was not found to be strongly associated with any one area of the proposed development area. The number of individuals recorded per flight ranged from one to three individuals. The results of the collision risk analysis (Appendix 6.5) are below the threshold required for potentially significant effects. The widespread distribution of Kestrel population's further supports the assertion that collision risk is not predicted to result in an ecologically significant effect for this species. The distribution of Kestrel flights are shown in Appendix 6.1. This species is judged not to be dependent on the habitats on site based on the following, the relative low numbers of individuals using the site and the availability of suitable foraging and breeding habitat within the wider surroundings of the site. In addition, significant portions of the habitat onsite is bare peat which is considered sub-optimal habitat for this species.

Sparrowhawk (Amber Listed BoCCI)

The Sparrowhawk is the most common and widespread species of raptor in Ireland[63]. The species inhabits woodland and open habitat with adjoining woodland. Adults are sedentary in Ireland.

This species was frequently encountered, but in low numbers, while conducting surveys at the site. A total of 71 observations were made over the course of winter season surveys (2014/ 15, 2015/ 16, 2016/ 17 and 2017/ 18) (CRM 2018). There were a further 66 flights noted during 2015, 2016 and 2017 breeding season surveys (CRM 2018). On the 15th of December 2014 a Sparrowhawk was recorded mobbing a Hooded Crow intermittently for 16 minutes. On the 31st of May 2016 a pair was briefly observed displaying. Owing to this observation this species was deemed a 'probable breeder' at the site. In addition, during 2017 breeding raptor surveys a nest was confirmed within 2 km of the western boundary of the site at Derryloughbannow (N202418 E268728; see Appendix 6.1 for location details). Over the course of surveying, the bulk of observations were of birds hunting, commuting or soaring.

63 Newton, I. (2002). Eurasian Sparrowhawk *Accipiter nisus* In the Migration Atlas. Movements of birds of Britain and Ireland. London pp. 235-237.

The total flight activity recorded from vantage point surveys for Sparrowhawk amounted to 8,111 seconds (CRM 2018). Flight activity was not found to be strongly associated with any one area of the proposed development area. The number of individuals recorded per flight ranged from one to three individuals. The results of the collision risk analysis (Appendix 6.5) are below the threshold required for potentially significant effects. The fact that this species population is widespread supports the idea that collision risk is not predicted to result in an ecologically significant effect, i.e. any mortality that may occur as a result of the proposed development is not likely to have a significant effect on the overall population number. The distribution of Sparrowhawk flights are shown in Appendix 6.1. This species is deemed unlikely to be restricted to the habitats onsite based on the following, the relative low numbers of individuals using the site and the availability of suitable foraging and breeding habitat within the wider surroundings of the site, i.e. open agricultural landscape with adjoining woodland.

Long-eared Owl (Green Listed BoCCI)

The Long-eared Owl is the most widespread and common species of owl in Ireland[61]. Despite this its conservation status is uncertain because its secretive nature makes census work difficult. The Irish population is largely resident[64].

It is likely that Long-eared Owl bred in forestry to the north of the site in 2016, although the exact location of the nest was not found. On the 30th of June 2016 Long-eared Owl chicks were heard calling from the forestry outside the footprint of the proposed development to the north of the site (Derryaroge) during a Woodcock Survey. There were also four flights and one calling adult heard between June and August 2016. Calling chicks were heard during the 2016 breeding season, this confirmed breeding locally (the nest site was not located). This species was also recorded calling (onsite) during the 2017/ 18 winter survey season.

No observations were made of Long-eared Owl flying at PCH. There will therefore be no predicted collision risk for the species. The distribution of Long-eared Owl flights are shown in Appendix 6.1. Given the 2,412 hours survey effort, the amount of flight activity at the site is very low (although this may be due to the nocturnal habit of the species and the lack of targeted surveys for this species; however, this is not considered a significant gap in the data considering the favourable conservation status of the species). The habitats within the site are not considered unique in the wider area, i.e. wider surroundings contain similar habitats (e.g. bog/ heath/ grassland/ scrub). It is therefore reasonable to conclude that the local Long-eared Owl population is not restricted to the site. The relative abundance of the species[61] limits the potential for ecologically significant effects to result from the proposed development. Furthermore, the

[64] Williams, R. (2002) Long-eared Owl *Asio otus* In the Migration Atlas. Movements of birds of Britain and Ireland. London pp 434-436.

cutover nature of much of the site limits the potential for a significant population to exist within the site boundary.

Whooper Swan (Annex I EU Birds Directive)

The wintering population of Whooper Swan has been increasing since 1995. An estimated 15,104 (AI) birds winter in Ireland. This population is currently thought stable[65]. The birds which winter in Ireland and breed in Iceland, constitute 60% of this population. Birds arrive in September or October and remain until March or April. The birds utilise the following habitats; lakes, marshes, lagoons, sheltered inlets and have a preference for feeding on agricultural fields.

Whooper Swans were recorded regularly during vantage point surveys. Observations were confined to the typical wintering period, of September to April. The species was noted in each month, October to March inclusive in 2014/ 15, 2015/ 16 and 2017/ 18 (and frequently in the winter of 2016/ 17). There was a combined total of 149 separate flights record at the site, as per CRM (2018) These flights were primarily associated with commuting. Over the course of surveying, Whooper Swans were observed to utilise flooded bog opportunistically for roosting and feeding. Notable locations where opportunistic feeding/ roosting flocks occurred included, Derrycashel (offsite) and Derryaroge (onsite). In 2016, the largest flock feeding onsite, numbered 72 birds at Derryaroge. However, site usage differed conspicuously between the first winter (2014/ 15) and second winter (2015/ 16). The more extensive flooding which occurred in the second winter attracted greater numbers, of Whooper Swan, more frequently to the site. Flock size observed during this study period ranged from 1-148 birds. The largest flock (148 birds) was observed feeding in the fields to the east of Derryadd (offsite), as per Ornithology Report 2015/ 16 in Appendix 6.1. On the 15th of February 2018, 100 birds were recorded feeding in an area of flooded bog at Derryaroge bog (onsite). Numbers observed onsite were below national importance estimates (150 birds constitute a flock of national importance). I-WeBS surveys of the hinterland of the proposed development area recorded Whooper Swan principally along the River Shannon and in flooded fields adjacent to the river. Flock size ranged from 1-100 birds. The fields at Bunacloy Co. Longford (c. 1km north-east) hosted 200 birds in January 2017. The Fortwilliam Turlough located c. 5 km to the west of the proposed development site was also notable for its 2017/ 18 wintering population of Whooper Swan (maximum site count was 88 birds).

The total flight activity recorded from vantage point surveys for Whooper Swan amounted to 48,081 seconds (CRM 2018). Much of the recorded flight activity was recorded from vantage points that overlooked the River Shannon. The results of the collision risk analysis (Appendix 6.5) are below the

65 Crowe, O., McElwaine, J.G., Boland, H. & Enlander, I.J. Whooper Cygnus cygnus and Bewick's C. columbianus *bewickii* Swans in Ireland: results of the International Swan Census, January 2015. 2015. *Irish Birds* 10: 151-158.

threshold required for potentially significant effects. The distribution of Whooper Swan flights are shown in Appendix 6.1. Flight lines were not restricted to specific portions of the site. The maximum counts varied between years, the peak onsite/ on adjacent lands was 63 (2014/ 15), 148 (2015/ 16), 29 (2016/ 17) and 100 (2017/ 18). The exceptional rainfall[66] which occurred during the 2015/ 16 winter and resulting flooding coincided with the highest number of Whooper Swan recorded in the study area. Overall, the cutover bog habitats which make up the majority of the site are judged to be sub-optimal for this species as they typically use lakes, marshes, lagoons and sheltered inlets and regularly feed on agricultural fields. Furthermore, there are concentrations of the species within the wider surroundings (Lough Ree) in optimal habitat. Lough Ree is a traditional Whooper Swan site which provides permanent wintering habitat. During periods of flooding Whooper Swan were found to utilise the site opportunistically for foraging.

Mute Swan (Amber Listed BoCCI)

An estimated 11,440 Mute Swans winter in Ireland, however the breeding population is unknown[51]. The Irish population is non-migratory and is recognised as one of seven global populations. They can be seen throughout Ireland on suitably large water bodies generally at altitudes below 300 metres.

This species was irregularly seen onsite. The vast majority of observations were of birds on the River Shannon to the north of the site. On the 29th of March 2016 two Mute Swans were recorded feeding in a flooded area of bog onsite (Derryaroge). During the same winter Mute Swans were also noted feeding on flooded land offsite, at Mountdillon bog. The wider area supported a breeding population of the species; several broods were recorded on Lough Ree during 2016 breeding season surveys. In addition, during 2017 I-WeBS surveys a pair with cygnets was recorded at Lanesborough (offsite).

Mute Swan were excluded from the collision risk analysis on the basis that flight activity was considered to be sufficiently low not to warrant an analysis (CRM 2018). There is therefore no predicted collision risk for this species. Furthermore, given the total watch time (5,736,600 seconds) the number of flight lines recorded was found to be low. The number of birds per flight ranged from one to six individuals. The site is not crossed by any regular flight paths. The distribution of Mute Swan flights are shown in Appendix 6.1. The exceptional rainfall during the 2015/ 16 winter attracted this species to the proposed development area. This species is judged not dependent on the habitats onsite based on a single observation of foraging onsite of a flock which was well below the threshold of national importance (91 birds constitutes a flock of national importance).

[66] McCarthy, M., Spillane, S., Walsh, S., & Kendon, M. (2016). The meteorology of the exceptional winter of 2015/2016 across the UK and Ireland. *Weather*, *71*(12), 305-313.

Greenland White-fronted Goose (Annex I EU Birds Directive)

An estimated 10,977 birds winter in Ireland, with the majority of this population occurring on the Wexford slobs[51]. Outside of Wexford the population has a localised distribution; on peatlands and turloughs scattered throughout the midlands, west and north of the country. The species is increasingly abandoning traditional peatland sites in favour of agricultural fields. Greenland White-fronted Geese are a qualifying interest of the Ballykenny-Fisherstown Bog SPA (4.5km to the north of the site), although the species has not been recorded at the site in recent years[53]. During a consultation meeting with NPWS, it was pointed out that there is a Greenland White-fronted Goose roost on Inchcleraun island, Lough Ree. Inchcleraun is located over 8.5km to the south west of the site in Lough Ree.

During the winter bird field surveys undertaken from 2014/15 to 2017/18, there was a single record of this species noted within the study area. On the 11th of November 2015 three birds were recorded feeding in drains and flooded bog onsite (Derryadd bog). There was no flight activity recorded within the study area. The exceptional rainfall[66] which occurred during the 2015/ 16 winter and resulting flooding, created a temporary feeding opportunity onsite. This species is deemed not dependent on the habitats onsite based on the single observation of a flock onsite which was well below the threshold of national importance (109 birds constitutes a flock of national importance).

Barnacle Goose (Annex I EU Birds Directive)

An estimated 9,035 birds winter in Ireland, with the majority of this population occurring in the north-west of the country[51]. It is often associated with offshore islands in Ireland. This species is typically found on coastal grassland and the intertidal zones. The Irish population breeds in Greenland arriving in September and departing in April or May. There was a historical record of this species from Turreen Turlough (1km west of the site).

There was a single record of this species flying along the Shannon (offsite). On the 14th of December 2015 thirteen birds were recorded flying near Lanesborough town. This flock is not considered of national importance (153 birds constitutes a flock of national importance). This was an unusual record, as Barnacle Geese are primarily a coastal species in Ireland. There was no flight activity recorded over the site. There is no typical foraging habitat in the vicinity of the study area for this species; therefore, it is considered that the potential for impact, is imperceptible.

Greylag Goose (Annex I EU Birds Directive)

An estimated 5,000 birds winter in Ireland, from the Icelandic breeding population. This Irish population is concentrated in seven main locations in the east and north of the country. A further 1,555 made up the feral population which is increasing throughout the country[51].

On the 19th of January 2016 there was an observation of single individual feeding in an area of flooded bog onsite (Derryaroge bog). The bird was recorded to have been present onsite for the duration of the vantage point watch. Greylag Goose was also occasionally recorded at Fortwilliam Turlough located c. 5 km to the west of the proposed development area. There is no collision risk predicted based on this observation. It is considered that the potential for impact, is imperceptible based on a single record of one individual at the site.

Mallard (Green Listed BoCCI)

Irish breeding birds are resident and are augmented by migrants from Iceland. Additionally, birds bred for hunting are released each autumn in many locations throughout the country[51]. The wintering population numbers 38,000 birds. Mallard are the most widespread waterfowl species in Ireland, occurring in almost all available wetland habitats in Ireland.

Mallard were frequently recorded during vantage point surveys. The majority of records were of birds commuting along the River Shannon or feeding on flooded land within the bog groups of Mountdillon and Derrycashel (offsite). There was a combined total of 303 separate flights record at the site, as per CRM (2018). On the 15th of December 2015, the largest recorded flock (30 birds) was observed feeding in an area of flooded bog at Derrycashel. Occasionally birds were recorded feeding in drains or in flooded areas of bog onsite. Numbers observed onsite were well below national importance estimates (290 birds constitute a flock of national importance). I-WeBS surveys of the hinterland of the proposed development area regularly recorded this species at Fortwilliam Turlough, along the River Shannon and in flooded fields adjacent to the river.

The total flight activity recorded from vantage point surveys for Mallard amounted to 42,650 seconds (CRM 2018). Much of the recorded flight activity was recorded from vantage points that overlooked the River Shannon. Given the total watch time the number of flight lines recorded was found to be low (see Appendix 6.5). Numbers recorded per flight ranged from one to eight. The results of the collision risk analysis (which utilises the records that pass within the site only) are below the threshold required for potentially significant effects. The site is not crossed by any regular flight paths. The distribution of Mallard flights are shown in Appendix 6.1. The species is judged not to be dependent on the onsite habitats based on occasional site use, the levels of flight activity and low flock size and the availability of similar suitable habitat in the wider area. In addition, the cutover nature of the majority of habitats onsite limits the potential for a significant population to exist within the site boundary.

Common Tern (Annex I EU Birds Directive)

An estimated 4,189 breeding pairs of Common Tern are present in Ireland (all Ireland (AI))[67]. Birds within Ireland are migrants wintering in Africa. This species is widely distributed around the coast and at some inland sites throughout the country. The Common Tern within the wider area of the site forms a qualifying component of the Lough Ree SPA. The 90 pairs recorded at the lough[68] constitute 2.1% of the all-Ireland breeding population, making Lough Ree a nationally important site for breeding Common Tern.

Common Terns were infrequently observed over the course of surveys at the site. The first observations were made of this species during the 2016 breeding season, when two vantage points were added which overlooked the River Shannon to the north of the site. Three flights were recorded on the following dates 30th and 31st of May and once on the 17th of June 2016, twice during a dawn survey at VP1 and once during a dawn survey from VP2. In addition, during the 2017 breeding season surveys two flights were recorded for this species. The majority of observations were of individuals commuting along the River Shannon.

Numbers per flight ranged from one to two birds. Collision risk is not considered of potential significance for this species as flight activity was concentrated along the River Shannon and away from possible turbine location. The distribution of Common Tern flights are shown in Appendix 6.1. There is a Common Tern breeding colony on Lough Ree. However, there is no suitable foraging or breeding habitat onsite and this species does not generally make long distance flights over land between their breeding and feeding areas. Therefore, this species is not dependent on the onsite habitats.

Golden Plover (Red Listed BoCCI, Annex I EC Birds Directive)

An estimated 150 breeding pairs of Golden Plover are present in ROI[69], the wintering population is more abundant numbering 170,000 birds (AI)[51]. Birds within Ireland are partially migrants wintering on the coast or suitable inland habitat. This species is widely distributed around the coast and at some inland sites throughout the country. Breeding is limited to the uplands of the west and north-west of the country. Golden Plover are among the species of special conservation interest for the Lough Ree SPA[68].

The species was regularly recorded during the survey period 2014 to 2018. There was a combined total of 110 flights of the species over the winter periods 2014/ 15, 2015/ 16, 2016/ 17 and 2017/ 18 (CRM 2018). Winter observations included records of large flock (maximum count 800) however these

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[67] Hannon, C., Berrow, S.D. & Newton, S.F. (1997) The status and distribution of breeding Sandwich *Sterna sandvicensis*, Roseate *S. dougallii*, Common *S. hirundo*, Arctic *S. paradisaea* and Little Terns *S. albifrons* in Ireland in 1995. *Irish Birds* 6:1-22

[68] Lough Ree SPA site synopsis: https://www.npws.ie/sites/default/files/protected-sites/synopsis/SY004064.pdf

[69] Lauder, C. and Donaghy, A. (2008) *Breeding Waders in Ireland 2008, a review and recommendations for future actions*. Report to the National Parks and Wildlife Service, Ireland.

observations were typically confined to the River Shannon and adjacent fields. Flocks which were noted as feeding/ roosting onsite were typically smaller, ranging from 1-180 individuals. All breeding season observations of this species were made in April/ May. There were 22 observations in total made between 2015, 2016 and 2017 breeding season surveys. The location of the proposed development area is outside the breeding range for this species in Ireland. No evidence of breeding was observed for this species, it is considered that all observations of Golden Plover at the site were of non-breeding individuals. I-WeBS surveys of the hinterland of the proposed development area recorded Golden Plover principally along the River Shannon and in flooded fields adjacent to the river, i.e. the flooded areas on either side of the Shannon to the north of Lanesborough Co. Longford including Knappogue, Cloondara. Flock size ranged from 20-600 birds (2017/ 18). The Fortwilliam Turlough located c. 5km to the west of the proposed development area was also notable for its 2016/ 17 and 2017/ 18 wintering population of Golden Plover (maximum site count was 2,000 and 520 birds respectively). The site peak count at Fortwilliam Turlough is considered a nationally important flock (1% of the national population is 1,200 birds).

The total flight activity recorded from vantage point surveys for Golden Plover amounted to 1,365,026 seconds as per Derryadd Wind Farm: Collision Risk Modelling Table 6 (CRM 2018; Appendix 6.5). Much of the recorded flight activity was recorded from vantage points that overlooked the River Shannon. The view sheds for vantage points 1 and 2 overlooked the River Shannon and were so placed to provide data on bird flight activity along the Shannon. Therefore, removing this data provides an estimate of the total Golden Plover flight time onsite. The total flight activity, minus the observations made at VP 1 and 2, amounted to 955,621 seconds as per Derryadd Wind Farm: Collision Risk Modelling Table 7 (CRM 2018; Appendix 6.5) Given the total watch time the number of flight lines recorded was found to be low. The results of the collision risk analysis (Appendix 6.5) are of low potential significance. The distribution of Golden Plover flights are shown in Appendix 6.1. Golden Plover flocks were found to only use the site occasionally and the relative level of flight activity and flock size were low. Additionally, based on the information gathered during field surveys the wider surroundings contain similar suitable habitat utilised by larger flocks, e.g. flooded fields adjacent to the River Shannon. Therefore, the species were judged not to be dependent on the habitats of the site.

Lapwing (Red Listed BoCCI)

An estimated 2,000 breeding pairs of Lapwing are present in ROI[69], the wintering population reaches 210,000 annually (AI)[51]. It is unknown if breeding birds within Ireland are resident, or migrants which arrive in the autumn to coastal areas or suitable inland habitat. This species is thinly distributed across the country as a breeder. Lapwings are named of special conservation interest for the Lough Ree SPA[68].

The species was recorded infrequently over the course of surveys at the site. There were 55 flights recorded, predominantly, during the 2014/ 15, 2015/ 16, 2016/ 17 and 2017/ 18 winter months (CRM

2018). There were no breeding season observations in 2015. One flight was recorded on the 21st of June 2016; the flock flew below PCH and numbered 13 individuals. This observation was judged to be a commuting flight. In addition, during the 2017 surveys four flights were recorded for this species at the proposed development area. The largest feeding flock numbered 53 birds on flooded bog to the north of the site on Mountdillon bog (offsite). A small flock of 70 birds was noted feeding onsite (Derryadd bog). During the 2010 Copland Study, Lapwings were recorded as a probable breeder at Derrycashel bog. Derrycashel bog is an area of cutaway bog fringing the River Shannon to the north of the site. No evidence of breeding was noted within the proposed development area; however, a displaying bird was recorded within c. 1 km of the northern development boundary at Cloonkeel (in April and June 2017). This record was made to the northeast of Derryaroge bog, near Knappogue, Cloondara. I-WeBS surveys of the hinterland of the proposed development area recorded Lapwing principally along the River Shannon and in flooded fields adjacent to the river. Flock size ranged from 1-180 birds (2017/ 18). The Fortwilliam Turlough located c. 5km to the west of the proposed development area was also notable for its 2016/17 wintering population of Lapwing (maximum site count was 720 birds). Flock size was below national importance estimates (1% of the national population is 1,100 birds).

The total flight activity recorded from vantage point surveys for Lapwing amounted to 253,024 seconds (CRM 2018). Much of the recorded flight activity was recorded from vantage points that overlooked the River Shannon. The view sheds for vantage points 1 and 2 overlooked the River Shannon and were so placed to provide data on bird flight activity along the Shannon. Therefore, removing this data provides an estimate of the total Lapwing records onsite. Of the total records, 32.2% of the records were made from VPs with view sheds that overlooked proposed turbine locations, as per Derryadd Wind Farm: Collision Risk Modelling Table 7 (CRM 2018; Appendix 6.5). Given the total watch time the number of flight lines recorded was found to be low. The results of the collision risk analysis are below the threshold required for potentially significant effects. The distribution of Lapwing flights are shown in Appendix 6.1. The species is judged not to be dependent on the onsite habitats based on occasional site use, the levels of flight activity and flock size was low and the availability of similar suitable habitat in the wider area. In addition, the extensive areas of active peat production which is ongoing at the site limits the potential for a significant population to exist within the site boundary.

Curlew (Red Listed BoCCI)

There now remains no more than 150 breeding pairs of Curlew in ROI (EO)[70], the non-breeding population swells to 55,000 birds (AI)[51]. Wintering birds present in Ireland are resident or migrants from Scandinavia and Britain. This species is now thought to be a very rare breeding species in Ireland. Curlew favour open terrain for breeding: primarily wet grassland, upland and bog habitat in Ireland. The breeding distribution

70 O'Donoghue, B.G. (2017). Curlew Conservation Programme Annual Report 2017. National Parks & Wildlife Service, Killarney.

is poorly known, although breeding pairs are thought to still be present on the Shannon Callows. A breeding Curlew population occurs on both Inchenagh and Clawinch islands Lough Ree, as per a consultation meeting with NPWS. Furthermore, NPWS provided information of Curlew breeding behaviour noted at Lough Bawn (adjacent to the proposed development south easterly boundary) in March 2017 and another record of a Curlew to the south of the site at Cloonbreany Co. Longford. However, breeding was not confirmed in either case. Additional information was provided by NPWS on the 18th of October 2018: 14 Curlew were observed in a flooded section of bog c. 1km south of the southern boundary of the site (Corlea Co. Longford). Given the timing of the observation these birds were not considered to have been breeding individuals.

This species was recorded infrequently at the site. Four records of calling birds and two flights make up the combined total of winter 2014/ 15, 2015/ 16, 2016/ 17 and 2017/ 18 observations. Curlews were recorded on three occasions during 2015 breeding season surveys. Displaying birds were noted to the south-east of Lough Bannow bog (townland, Keenagh) (offsite). Flight height was between 10m and 30m, i.e. below potential collision height. Although no nest site was located this species was judged a probable breeder in the hinterland fringing the site. This displaying pair was recorded at a distance of not closer than 500m to the southeast of turbine 21. Twenty-nine flights/ records were recorded during 2016 breeding season surveys, in the following months April, June, July, August and September 2016. The majority of observation in August and September 2016 were associated with a temporary flooding event in the fields fringing Lough Bannow bog. The flooded land provided a short-lived foraging resource which attracted the birds to the area. Flock size ranged from 1-54 individuals. In addition, during 2017 breeding season surveys this species was recorded on seven occasions. The majority of this activity comprised individuals travelling across the site. No breeding activity was recorded at the site during 2017 breeding season surveys. On the 2nd of May 2018, a request was made for breeding Curlew records from NPWS. The national Curlew survey did not cover the area around Derryadd (10km grid squares: N06, N07 and N16), therefore NPWS do not hold any confirmed breeding records for this area. However, it should be noted that the absence of confirmed breeding records does not confirm the absence of breeding. A species-specific Curlew survey was undertaken May to July 2018. The area surveyed was informed by the consultation meeting with NPWS: the survey was undertaken in suitable habitat within Lough Bannow bog and to a radius of c. 1km (where access allowed). Although no Curlew were recorded during these survey, suitable breeding habitat was noted c. 1.5 km to the south of the proposed development boundary (location: N11229 62345). This peatland site is relatively large (area: c. 28 ha) and not subject to peat extraction activities. In addition, Lough Bawn was surveyed in 2018, however the habitat was considered sub-optimal for this species, given scrub is encroaching on the c. 8 ha site. See Appendix 6.1 for further location details. During I-WeBS survey on the 24th of November 2017 a notable flock of 26 Curlew was recorded at Fortwilliam Turlough (c. 5km to the west of the site). Flock size was well below national importance estimates (1% of the national population is 550 birds).

The total flight activity recorded from vantage point surveys for Curlew amounted to 18,705 seconds (CRM 2018). Much of the recorded flight activity was confined to the wintering period August to April. Given the total watch time the number of flight lines recorded was found to be very low. The results of the collision risk analysis (Appendix 6.5) are below the threshold required for potentially significant effects. The distribution of Curlew flights are shown in Appendix 6.1. The species is judged not to be dependent on the onsite habitats based on occasional site use, the levels of flight activity and flock size was low and the availability of similar suitable habitat in the wider area. In addition, the majority of the habitat onsite is cutover bog which is considered sub-optimal habitat for this species as they favour open terrain for breeding; primarily wet grassland, upland and bog habitat in Ireland.

Woodcock (Red Listed BoCCI)

Population estimates for both breeding and wintering Woodcock are unknown in Ireland. The mainly sedentary Irish population is joined by wintering birds from Fennoscandia, Russia and Britain. This species breeds in woodland of all types.

Woodcock were infrequently recorded over the survey period. There was one winter record of this species, made on the 20th of January 2016. A bird was flushed from mixed woodland. One flight and three other records were made on the following dates 5th, 6th, and 13th of July, all observation were made during either the dawn or dusk period. Three further observations were made during dedicated Woodcock surveys in 2016. The single flight observation was of a single individual flying below PCH. On the 5th of July 2016 a roding (displaying) male Woodcock was heard in the habitats fringing the north-west of Derryaroge bog (offsite). In 2017, seven Woodcock were recorded roding during the survey period indicating breeding onsite. On the 21st of March 2018 Woodcock were recorded on six occasions in an area of scrub in a northwest section of the proposed development area (Derryaroge bog). This species was also recorded on the 22nd of March 2018 off site at Mountdillon bog (c. 2 km north of the proposed development area). A species-specific Woodcock survey was undertaken in June and July 2018. In total Woodcock were recorded on four occasions during these 2018 surveys. Roding was recorded on two occasions. All records were noted in the forestry c. 500 m to the north-west of the proposed development boundary at Kilnacarrow Co. Longford. See Appendix 6.1 for further location details.

Vantage point surveys are not an effective method of recording flight activity for this species due to their nocturnal habits and cryptic nature, so collision risk modelling would not provide meaningful predictions of likely collision risks. The distribution of Woodcock flights are shown in Appendix 6.1. Woodcock was found to only use the site occasionally, the relative level of flight activity and flock size were low. The habitats of the site are not considered unique to the site, i.e. the wider area contains similar habitats (e.g.

bog/ scrub/ forestry). Furthermore, the cutover nature of much of the site limits the potential for a significant population to exist within the site boundary.

Snipe (Amber Listed BoCCI)

An estimated 5,000 breeding pairs of Snipe are present in ROI[69], winter numbers are unknown owing to the difficulties in surveying this secretive species. Birds present in Ireland are resident or migrants from Scandinavia and Britain. This species is thought to be widely distributed throughout the country, but it is difficult to survey due to its secretive nature. Snipe are noted as nesting at the nearby Fortwilliam Turlough SAC[71].

Snipe were rarely noted during vantage point surveys. Owing to its secretive nature, the most common observation of this species was of birds flying from cover having been flushed by surveyors. There were a combined total of 76 records between the three winter periods of 2014/ 15, 2015/ 16, 2016/ 17 and 2017/ 18. Of these observations a large proportion was birds flushed by surveyors from cover. Two records were made of Snipe in April of 2015. A Snipe was heard off site (Mountdillon) and another bird was flushed from an area on site (Derryaroge). Flights were recorded in each of the months May, June and July 2016. Two flights were not visible, with a further six at PCH. Of these flights, all were associated with breeding behaviour, i.e. either chipping or drumming flights. A further twelve observations were made of perched or flushed individuals. In 2017, sixteen breeding territories were identified during breeding season surveys. These displaying birds were noted across the site and within 500m of the development boundary. As display behaviour was observed this species was judged a probable breeder within the site.

Given the total watch time the number of flight lines recorded was found to be very low. The number of individuals per flight ranged from 1-18 birds. Vantage point surveys are not an effective method of recording flight activity of this species, so collision risk modelling would not provide meaningful predictions of likely collision risks. The distribution of Snipe flights are shown in Appendix 6.1. The local Snipe population is unlikely to be restricted to the habitats onsite based on the following, the habitats onsite are not unique to the site, the widespread distribution of the species, Snipe flight activity and flock size was low. Moreover, the extensive areas of active peat production and resulting bare peat, limits the availability of suitable breeding habitat for this species within the site boundary.

Ringed Plover (Green Listed BoCCI)

[71] NPWS Fortwilliam Turlough SAC site synopsis: https://www.npws.ie/sites/default/files/protected-sites/synopsis/SY000448.pdf

The breeding population trend for this species in Ireland is unknown[72]. This species is primarily sedentary in Ireland, with some augmentation to the population with an influx a birds from continental Europe during server winter weather.

There were no Ringed Plover records in 2014 or 2015; the first record of this species at the site was on the 15th of June 2016. This individual was observed in an area of cutaway bog in the Lough Bannow section of the site. In 2017, seven breeding territories were identified for this species: five territories offsite and two onsite. Of these records displaying birds were noted across the northern section of the site (Derryaroge bog) and within 500m of the proposed development boundary.

Little Egret (Annex IEC Birds Directive)

The population trends for this species in Ireland are unknown, but the species is becoming increasingly widespread throughout the country in suitable coastal and wetland sites.

Observations of this species were infrequent and clustered in habitats fringing the north of the site. Flights were recorded in each of the months May, June, July and August 2016. Five flights were below potential collision height (PCH), with a further six at PCH. There were five flights recorded during the 2017/ 18 winter survey season. One of these flights was at PCH. In 2017, 23 observations were made during the breeding season. The majority of flight observations were made in the northern section of the site (Derryaroge bog) and in the hinterland along the Shannon River. No evidence of breeding was recorded for this species. During I-WeBS surveys this species was encountered frequently in low numbers in the wider surroundings of the proposed development area: Fortwilliam Turlough, Lough Ree and the Shannon River (2017/ 18).

Collision risk is not considered of potential significance for this species as flight activity was concentrated along the River Shannon and away from turbine locations. The fact that this species is undergoing range expansion supports the assertion that collision risk is not likely to result in ecologically significant effects for this species. The distribution of Little Egret flights are shown in Appendix 6.1. This species was judged not dependent on the habitats of the site based on the following the low level of site usage, the low numbers of birds recorded and the availability of optimal habitat nearby, within the River Shannon catchment. In addition, the majority of the habitat onsite is cutover bog which is considered sub-optimal habitat for this species as they are typically found in suitable coastal and wetland sites.

Grey Heron (Green Listed BoCCI)

[72] Crowe, O., Austin, G.E., Colhoun, K., Cranswick, P.A., Kershaw, M. and Musgrove, A.J. (2008) Estimates and trends of waterbird numbers wintering in Ireland, 1994/95 to 2003/04. *Bird Study* 55:66-77.

There are estimated to be 3,000 birds recorded in Ireland each winter during national I-WeBS surveys, the number of breeding individuals is unknown. Grey Heron have shown a gradual increasing trend throughout I-WeBS surveys[51]. The species is widely distributed in Ireland at wetland site which provide sufficient feeding and breeding opportunities.

This species was infrequently recorded at the site. There were a combined total of 60 records of the species made during winter surveys (in 2014/ 15, 2015/ 16, 2016/ 17 and 2017/ 18). The total number of observations for this species increased during the 2016 breeding season, Grey Heron was recorded on 44 occasions during vantage points watches. In 2017, Grey Heron flights were recorded on 66 occasions. Over the course of surveying the majority of these observations were of birds commuting or foraging in close association with the River Shannon (off site). The species was regularly encountered during surveys of the wider surroundings of the proposed development area: Fortwilliam Turlough, Lough Ree and the Shannon River. No breeding behaviour was noted within the site boundary. The number of individuals per observation was low, numbers ranged from one to three birds.

Grey Heron populations are considered to be secure; this limits the potential for collision risk to result in an ecologically significant effect for this species. The distribution of Grey Heron flights are shown in Appendix 6.1. The species is judged not to be dependent on the onsite habitats based on occasional site use, the levels of flight activity and flock size was low and the availability of similar suitable habitat in the wider area. In addition, the cutover nature of the habitats at the site limits the potential for a significant population to exist within the site boundary.

<u>Black-headed Gull (Red Listed BoCCI)</u>

An estimated 6,103 breeding pairs of Black-headed Gull are present in AI (All Ireland)[73], counts of (wintering) Gulls are optional during nationally organised I-WeBS surveys, which results in inconsistent counts for this species group[51]. This species mainly breeds in wetlands, but it is adaptable in its habitat requirements in Ireland. Small numbers of the Irish population are thought to migrate to Southern Europe in winter, but most appear to remain in Ireland. Lough Ree is a traditional breeding site for this species[68].

Black-headed Gulls were less frequently observed during winter bird surveys. There was a combined total of 76 separate flights record between 2014/ 15, 2015/ 16, 2016/ 17 and 2017/ 18 surveys. The species was recorded regularly during both the 2015 and 2016 breeding seasons. In 2017, there were 90 flights recorded during breeding season surveys. Commuting flights made up the majority of the observations. The habitats onsite were typically not utilised for foraging. This species was most commonly encountered from vantage points which bordered the River Shannon and during hinterland surveys of

[73] Mitchell, P.I., Newton, S.F., Ratcliffe, N. and Dunn, T.E. (2004) *Seabird Populations of Britain and Ireland*. Poyser, London, UK.

Lough Ree, e.g. in 2017 c. 59% of the flights were recorded within 400m of the River Shannon. No turbines are proposed within 1,900m of the Shannon and are therefore 1,500m from this 400m corridor, as per Appendix 6.1. No behaviour which would indicate breeding in the wider area was observed. I-WeBS surveys noted maximum flock count of 120 individuals on Lough Ree.

The total flight activity recorded from vantage point surveys for Black-headed Gull amounted to 80,892 seconds (CRM 2018). The recorded flight activity peaked during May and June. This may correspond to birds from the Lough Ree breeding colonies travelling to forage and provision fledglings. The number of birds per flight ranged from one to seventy individuals. Flight activity was recorded across much of the site; however, there was a high concentration of activity in the view shed of VP06. The results of the collision risk analysis are below the threshold required for potentially significant effects. The distribution of Black-headed Gull flights are shown in Appendix 6.1. There is a traditional Black-headed Gull breeding colony on Lough Ree. However, the cutover nature of the majority of the site is limited in it potential to provide suitable foraging or breeding habitat. Therefore, this species is not dependent on the onsite habitats.

Lesser Black-backed Gull (Amber Listed BoCCI)

An estimated 4,849 breeding pairs of Lesser Black-backed Gull are present in AI[73], the wintering population is unknown due to an inconsistent nationwide survey effort for this species group[51]. The Irish population mainly breeds in wetlands, coastal cliffs and on islands at inland sites. Small numbers of this species are thought to migrate south in winter, but most appear to remain in Ireland. This species has bred previously on a number of the Lough Ree islands[68]. During a consultation meeting on the 7th of June 2018, NPWS confirmed the continued presence of a large Lesser Black-backed Gull breeding colony on islands in Lough Ree.

Lesser Black-backed Gulls were recorded regularly during breeding season vantage point surveys. Conversely this species was encountered less frequently and in lower numbers during the winter months. In 2017, this species was observed in flight on 1,147 occasions. Commuting flights made up the majority of the observations. Many of these flights involved individuals/ flocks crossing the site, however a majority of the flight concerned birds commuting along the River Shannon to the north of the site. Lesser Black-backed Gull were not found to utilise the habitats of the proposed development area for foraging, rather observations typically involved individuals/ flocks flying over the site on route to either the River Shannon or Lough Ree. Flock size ranged from 1-123. A breeding colony was location on Incharmadermot Island, Lough Ree. It was not possible to get an accurate count of the number of active nests due to restricted visibility as a result of dense vegetation; however, a high count of 240 individuals was record at the island.

Hunt *et al.* (2013) notes a breeding colony numbering 250 pair at Lough Ree SPA[74]. This species is not a qualifying interest of the Lough Ree SPA.

The total flight activity recorded from vantage point surveys for Lesser Black-backed Gull amounted to 607,693 seconds (CRM 2018). The recorded flight activity peaked during June and July. This may correspond to birds from the Lough Ree breeding colonies travelling to forage and provision fledglings. Numbers per flight ranged from 1-123 birds. Flight activity was recorded across much of the site; however, there was a high concentration of activity in the view shed of VP06. The results of the collision risk analysis (Appendix 6.5) are assessed as of low potential significance. The distribution of Lesser Black-backed Gull flights are shown in Appendix 6.1. There is a traditional Lesser Black-backed Gull breeding colony on Lough Ree. However, habitats of the proposed development area are considered unsuitable/ sub-optimal for breeding Lesser Black-backed Gulls. Therefore, this species is not considered to be dependent on the onsite habitats.

Cormorant (Amber Listed BoCCI)

An estimated 5,211 breeding pairs of Cormorants are present in AI[73], the wintering population numbers 14,000 birds[51]. The Irish population occurs in both marine coasts and freshwater. It can be found in rivers and lakes of sufficient size to provide nesting (generally in trees) and foraging habitat. Adults are typically non-migrants in Ireland. Breeding Cormorants are named among the species which contribute to the integrity of Lough Ree SPA. In 2010 86 nests were recorded on the islands of the Lough[68] this represents 1.7% of the All Ireland population.

This species was frequently encountered during surveys at the site. In total there were 100 separate flights record during winter season surveys (2014/ 15, 2015/ 16, 2016/ 17 and 2017/ 18). Cormorants were recorded regularly during both the 2015 and 2016 breeding seasons. In 2017, this species was recorded in flight on 211 occasions. Commuting flights made up the majority of the observations. This species was most commonly encountered from vantage points which bordered the River Shannon and during hinterland surveys of Lough Ree. A breeding colony was location on Incharmadermot Island, Lough Ree. The number of active nests at this site was unclear, due to restricted visibility as a result of dense vegetation; however, a high count of 38 individuals was made on the 24th of May 2016. The maximum site count was 186 birds at Lough Ree in late March 2018. This constitutes a nationally important flock of Cormorant on Lough Ree (1% of the national population is 140 (wintering) and 104 (breeding) birds).

[74] Hunt, J., Heffernan, M.L., McLoughlin, D., Benson, C. & Huxley, C. (2013) The breeding status of Common Scoter, Melanitta nigra in Ireland, 2012. Irish Wildlife Manuals, No. 66. National Parks and Wildlife Service, Department of the Arts, Heritage and the Gaeltacht, Ireland.

The total flight activity recorded from vantage point surveys for Cormorant amounted to 33,217 seconds (CRM 2018). Much of the recorded flight activity was recorded from vantage points that overlooked the River Shannon. Flock size per flight ranged from 1-7 individuals onsite. The results of the collision risk analysis (Appendix 6.5) are below the threshold required for potentially significant effects. The distributions of Cormorant flights are shown in Appendix 6.1. The habitats onsite are not suitable for breeding or foraging Cormorant. Therefore, the species is not dependent on the habitats of the site.

Other Observations

Breeding was also confirmed for Great Crested Grebe (Amber Listed BoCCI) with an active nest at Fortwilliam Turlough on the 24th of May 2016. In addition, Lough Ree is a traditional breeding site for this species, 32 pairs were recorded in 1995[68]. There were four Mute Swan (Amber Listed BoCCI) broods encountered, three on the 17th of August 2016 at the following locations; Saints Island Lough Ree, Cullaghy and Gardenstown respectively, and the fourth on the 1st September 2016 at Fallan Bridge, Fallan River. A family of Coot (Amber Listed BoCCI) were observed on the 1st of September 2016 at Cullaghy, Lough Ree. Observed Teal flight activity was concentrated along the River Shannon. On the 28th of March 2017 a Wigeon (Special Conservation Interest of Lough Ree SPA) were recorded flying across the proposed development area. Further information on bird activity including flight line mapping can be found in Appendix 6.1. Barn Owl (Red Listed BoCCI) have been reported in the Mosstown, Co. Longford area (as per NPWS consultation meeting in June 2018), however, this species was not encountered over the course of surveying within the proposed development area. Mosstown is approximately 1 km to the east of the proposed development boundary. Furthermore, NPWS provided information of a Marsh Harrier (Amber Listed BoCCI) sighting from 2017 at Lough Ree. This species was not recorded within the proposed development area. The cutaway habitats of the proposed development area are considered to be sub-optimal for these two species. In May 2017, a Redshank (Red Listed BoCCI) was recorded flying along the River Shannon. This species is deemed not dependent on the habitats onsite based on the single observation c. 1.5km from the site. Given a consistent survey effort from October 2014 to July 2018; Quail (Red Listed BoCCI) were found not to be resident onsite. Furthermore, Quail favour open spaces with suitable vegetation for concealment e.g. arable crops and rough grassland, this habitat type is rare/ absent from the proposed development area.

Meadow Pipit (Red Listed BoCCI) were found to be ubiquitous throughout the site. The species was recorded in all months from all transects. Observations of display flights indicate that this species was a probable breeder onsite. The Red Listed Meadow Pipit populations have shown significant signs of recovery (as per BWI). The 2015, Breeding Bird Report has shown a 69% increase in Meadow Pipit numbers in Northern Ireland, as per British Trust for Ornithology (BTO). It is generally considered that passerine species are not significantly impacted by wind farms, as per SNH (2014).

6.5.3.2 Mammals

Mammal surveys were undertaken on various occasions (see Table 6.3) in areas where potentially suitable habitat (woodland, scrub and treelines) occurred along the proposed internal roads and at proposed infrastructure locations (and across the proposed development site as a whole during the ecological surveys undertaken by Bord na Móna in 2012).

Based on a review of the NBDC database, Bat Conservation Ireland (BCI) website and field survey findings, the following protected mammals utilise the proposed development area and require consideration regarding potential impacts: badger, otter, pine marten, Irish hare, and bat (species). Table 6.16 lists the mammals identified within the study area and potentially occurring at proposed turbine locations based on this review.

Table 6.16: Protected Mammals Occurring in the Proposed Development Area and Legal Status

Common Name	Latin Name	Protected Status
Irish hare	*Lepus timidus subsp. hibernicus*	Habitats Directive Annex V *Wildlife Amendment Act, 2000*
European otter	*Lutra lutra*	Annex II of EU Habitats Directive Annex IV of Habitats Directive *Wildlife Amendment Act, 2000*
Eurasian badger	*Meles meles*	*Wildlife Amendment Act, 2000*
Pine marten	*Martes martes*	Habitats Directive Annex V *Wildlife Amendment Act, 2000*
Irish Stoat	*Mustela erminea subsp. hibernica*	*Wildlife Amendment Act, 2000*
Daubenton's bat	*Myotis daubentonii*	Annex IV of Habitats Directive *Wildlife Amendment Act, 2000*
Leislers bat	*Nyctalus leisleri*	Annex IV of Habitats Directive *Wildlife Amendment Act, 2000*
Natterer's bat	*Myotis nattereri*	Annex IV of Habitats Directive *Wildlife Amendment Act, 2000*
Common pipistrelle	*Pipistrellus pipistrellus sensu lato*	Annex IV of Habitats Directive *Wildlife Amendment Act, 2000*
Soprano pipistrelle	*Pipistrellus pygmaeus*	Annex IV of Habitats Directive *Wildlife Amendment Act, 2000*
Brown Long-eared bat	*Plecotus auritus*	Annex IV of Habitats Directive

Common Name	Latin Name	Protected Status
		Wildlife Amendment Act, 2000
Nathusius' pipistrelle	*Pipistrellus nathusii*	Annex IV of Habitats Directive *Wildlife Amendment Act, 2000*
Red squirrel	*Sciurus vulgaris*	*Wildlife Amendment Act, 2000*
Hedgehog	*Erinaceus europaeus*	*Wildlife Amendment Act, 2000*
Eurasian pygmy shrew	*Sorex minutus*	*Wildlife Amendment Act, 2000*

Note:
Source: National Biodiversity Data Centre (2018)

Bats

All Irish bat species are protected under the Wildlife Act 1976 (as amended) and Annex IV of the EU Habitats Directive 1992. Bats are further protected across Europe under the Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention, 1982) and the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention 1979, enacted 1983).

No site with significant potential for bat roosts such as old buildings, caves, houses and other buildings will be impacted by the development.

The proposed development area contains scattered patches of woodland habitat, which provide abundant foraging routes for bat species throughout the area. River corridors also provide foraging and commuting potential. An evaluation of potential tree roost sites conducted from the roadside and on lands accessed for survey, confirmed that very old mature decaying trees suitable as temporary summer bat roosts and possible maternal roosts, are very scarce in the study area. No trees were identified with bat signs or as having potential as maternity roosts.

The site is comprised primarily of cutover bog which has been in places re-colonised with scrub. The area is heavily drained and therefore there is limited surface water onsite. The habitats identified onsite during the walk over surveys confirmed much of the site has low habitat suitability due to the lack of linear tree-line features or true woodland. The exception to this is Leisler's and Nathusius' pipistrelle which are high flying species and therefore less reliant on liner features. Bat species recorded included foraging and commuting included Common pipistrelle (*Pipistrellus pipistrellus*), Soprano pipistrelle (*Pipistrellus pygmaeus*), Nathusius' pipistrelle (*Pipistrellus nathusii*)*,* Brown Long-eared bat (*Plecotus auritus*), Mytotis species, and Leisler's bat (*Nyctalus leisleri*).

No sites were identified which showed high potential as a maternity bat roost within the proposed development site.

Treelines with potential of being at least temporary bat roosts are identified as mature treelines in habitat maps. In this regard a standard mitigation approach will be implemented which is to identify potential suitable tree roosts requiring appropriate precautionary mitigation (based on NRA Guidelines[75]) to be implemented as appropriate for tree cutting activities during the construction phase (see Section 6.7).

Table 6.17: Summary of species found onsite during static and transect survey work

Species	Scientific Name
Common Pipistrelle	*Pipistrellus pipistrellus*
Soprano Pipistrelle	*Pipistrellus pygmaeus*
Nathusius' Pipistrelle	*Pipistrellus nathusii*
Brown Long-eared bat	*Plecotus auritus*
Mytotis species (not identified to species level)	*N/A*
Leisler's	*Nyctalus leisleri*

Appendix 6.6 of the EIAR details further information on the diversity, distribution and abundance of bat species encountered within the proposed development area, as per Derryadd Wind Farm Bat Report 2018.

<u>European Otter</u>

The otter (*Lutra lutra*) is fully protected in Ireland under the Irish Wildlife Act 1976 (as amended). It is also listed on the Irish Red Data book as 'International Important'. The otter is also protected under Annex II of the EU Habitats Directive giving it strict protection as a species of community interest for which EU nations must designate SAC. The otter is also listed on Appendix II of the Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention, 1982) of which Ireland has ratified. There is an acknowledged population of otters around Lough Ree[76].

No evidence of otter holts (breeding site) were noted within the proposed development site, however otter signs were located in Derryadd and spraints (droppings) were found in a drainage ditch in the north east of Lough Bannow bog during ecological survey work carried out by Bord na Móna between 2010 and 2012 (see Appendix 6.3). This ditch connects to the nearby Royal Canal. It is unlikely that otters remain in the drainage ditches within the site for extended periods, as they do not appear to support strong populations of suitable prey items for otters. Additionally, in November 2017 there was an ad hoc record

[75] NRA - Guidance for Treatment of Bats during the Construction of National Road Schemes.

[76] NPWS Lough Ree SAC site synopsis: https://www.npws.ie/sites/default/files/protected-sites/synopsis/SY000440.pdf

of an otter spraint recorded (offsite) on the railway bridge (over the Shannon) at vantage point 2 (location: N 01064 72271).

Eurasian Badger

The Eurasian or European Badger (*Meles meles*) is listed on Appendix III of the Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention, 1982) as a species to be protected and whose exploitation must be regulated. The species is protected in Ireland under the Irish Wildlife Act 1976 (as amended). No badger setts were observed in the vicinity of the proposed development infrastructure. Badger setts are typically located in hedgerows/ linear woodland, scrub or woodlands. The site design avoids potential badger breeding areas and includes a 50m setback from suitable habitats such as hedgerows and treelines, where possible. The population in Ireland is considered stable[77]; however, Co. Longford has the lowest density of badgers in the country, with an estimated 0.2 groups occurring per square kilometre[78].

Field surveys conducted at proposed turbine locations found limited evidence of badgers and no breeding, outlier or other setts were found. No setts were recorded at proposed infrastructure locations or within wider landholdings surveyed. However, signs including footprints were noted at all three onsite bogs, namely Derryaroge, Derryadd and Lough Bannow. During a 2018 Woodcock survey, two Badgers were recorded entering the forestry at Kilnacarrow Co. Longford: c. 750m to the north-west of the proposed development area (1,500m from the nearest part of the wind farm infrastructure). Badger numbers are found to be at their highest in areas of high-quality grazing land[78], a habitat type which is not present within the proposed development area.

Pine Marten

The Pine Marten (*Martes martes*) is fully protected in Ireland under the Irish Wildlife Act 1976 (as amended). It is also protected under Annex V of the EU Habitats Directive. The Pine Marten is also listed on Appendix III of the Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention, 1982) of which Ireland has ratified. Field surveys at the proposed infrastructure locations found no evidence of pine marten in residence at these locations. However, signs (e.g. scat) were found at other locations throughout the proposed development site.

Other Protected Mammals

[77] Sleeman, D. P., Davenport, J., More, S. J., Clegg, T. A., Collins, J. D., Martin, S. W., ... & O'Boyle, I. (2009). How many Eurasian badgers Meles meles L. are there in the Republic of Ireland?. *European Journal of Wildlife Research*, *55*(4), 333-344.

[78] Smal (1995) The Badger and habitat Survey of Ireland. NPWS

Other protected mammals noted included Irish Hare (*Lepus timidus hibernicus*). This species was noted on several occasions in grassland throughout the proposed development area.

The Irish Hare is a quarry species (may be hunted under licence) and has limited protection under domestic legislation. It is listed in the Irish Red Data book as internationally important and in Appendix III of the Bern Convention as a protected species. It is also listed under Annex V of the Habitats Directive as a species which may be exploited but not to the extent that it's favourable conservation status is compromised (Hayden and Harrington, 2000)[38].

Other protected species which may occur in the study area include red squirrel (*Sciurus vulgaris*). In 2012, squirrel (red or grey) signs were noted in Derryadd. Red squirrel is rapidly declining as grey squirrel outcompete and displace red squirrel from the midlands and eastern side of Ireland (NPWS and EHS 2008)[79]. No squirrels (grey or red) were recorded during the multi-disciplinary walkover surveys in September 2016, April 2017, and April 2018. The red squirrel occupies a variety of woodland types across much of Ireland. It is protected under the Fifth Schedule of the Irish Wildlife Act 1976 (as amended) and is on Schedule III of the Bern Convention.

No other protected mammal species were noted during the field surveys.

Other Mammals

Common mammal species noted included grey squirrel (*Sciurus carolinensis*), rabbit (*Oryctolagus cuniculus*), fox (*Vulpes vulpes*), Irish stoat (*Mustela erminea*), wood mouse (*Apodemus sylvatica*), pygmy shrew (*Sorex minutus*), hedgehog (*Erinaceus europaeus*) and brown rat (*Rattus norvegicus*) are also likely to be present within the proposed development area. This assumption is based on the widespread distribution of these species in Ireland.

On the 15th of February 2018 a Coypu (*Myocaster coypus*) track was found within the study area c. 1km to the north-west of the proposed development area at Mountdillon bog. This species has been assessed as having a potential to be a high impact invasive species in Ireland. It is listed on the Third Schedule Part 2 of the European Communities (Birds and Natural Habitats) Regulations 2011 in Ireland. Given the nature of the proposed development, it is not considered likely that its inclusion in the landscape would facilitate the further spread of this species locally, as the proposed infrastructure will be fixed. This Coypu record was subsequently reported to the NPWS.

[79] NPWS & EHS (2008) All-Ireland species action plan – Red Squirrel. National Parks & Wildlife Service, Ireland and Environment & Heritage Service, Northern Ireland

Other Fauna

Common frogs (*Rana temporaria*) were recorded in wet habitat in Derryadd bog. Drainage ditches and ponds within the study area provide potential breeding sites for common frog and smooth newt (*Lissotriton vulgaris*). These habitats will be avoided. The drainage regime proposed at the site is designed in such a manner as to be integrated into the final rehabilitation plan for the site, as per Chapter 8 of the EIAR. No reptile species were noted during the survey.

Marsh fritillary (*Euphydryas aurinia*) is considered among the most endangered species in Ireland. It is protected under Annex II of the Habitats Directive and is listed under the Wildlife Act 1976-2012. Marsh fritillary larval webs were recorded in the western section of Lough Bannow bog. This record was located in September 2016 (by TOBIN ecologists) outside of lands earmarked for turbine placement (c. 1 km to the west of T18). Typical habitat of marsh fritillary (breeding and feeding wetland sites) will be avoided by the proposed development, i.e. Devil's-bit Scabious (host plant) was not commonly encountered at the site. On October 4th and 5th 2018, targeted species-specific Marsh Fritillary surveys were undertaken in suitable habitat within the proposed development area. The two areas identified for attention were the Derryarogue mineral island and a large section of western Lough Bannow bog. These surveys uncovered Marsh Fritillary larval webs in two locations. One active larval web was found on site at location 53.6291268, -7.8980702. A second web was found at location 53.6236523, -7.8933318 however this web had been destroyed from the previous night's rain and all larvae were deceased. A map with the location of the larval webs can be found in Appendix 6.7.

The Royal Canal to the east and south of the proposed development contains an internationally important population of Desmoulin's whorl snail *(Vertigo moulinsiana)*. This species is listed under Annex II of the Habitats Directive. In Ireland it is listed as endangered[80] and has undergone severe declines across its European range[81]. The reason this species is experiencing population decline is that it favours a habitat type that has become increasingly rare in Europe. It requires tall vegetation in swamps, however the swamp must have a stable hydrology and neither dry out in the summer or flood in the winter (to the point that all vegetation is inundated). Desmoulin's whorl snail has been recorded within two of the three 10 km grid squares that contain the proposed development area: N07 and N16[82]. However, the drains found within the proposed development area are largely devoid of vegetation and dry out during extended dry

[80] Byrne, A. W., Moorkens, E. A., Anderson, R., Killeen, I. J., & Regan, E. (2009). *Ireland Red List no. 2: Non-marine molluscs*. National Parks and Wildlife Service, Department of the Environment, Heritage and Local Government.

[81] Tattersfield and Killeen (2006). Major declines in population of the wetland snail *Vertigo moulinsiana* in a UK protected wetland site. Tentacle 14: 17-18.

[82] Moorkens and Killeen (2011). Monitoring and Condition Assessent of Populations of *Vertigo geyeri* and *Vertigo augustior* and *Vertigo moulinsiana* in Ireland. Irish Wildlife Manula, No. 55. National Parks and Wildlife Service, Department of Arts, Heritage and Gaeltacht, Dublin, Ireland.

periods, it is therefore considered that they are highly unlikely to provide suitable habitat for this species. A vegetated drainage ditch that runs perpendicular to the north eastern boundary of Lough Bannow bog may contain suitable habitat for this species. This drain runs parallel to the amenity track that is proposed to provide access from the east/ the Royal Canal Way to Lough Bannow bog. A Desmoulin's whorl snail survey of the Royal Canal was undertaken in 2011[83], that noted two Desmoulin's whorl snail sites in the section of the Royal Canal that runs parallel to the proposed development area. These sites were located at Savage bridge (c. 1km north of Killashee Co. Longford) and c. 500m south of Coolnahinch bridge Co. Longford. These sites are respectively c. 4km north and c. 2.5km south of the vegetated drainage ditch mentioned above. In addition, NPWS indicated during the June 2018 consultation meeting that there is potential for Desmoulin's whorl snail to occur within Lough Bawn pNHA. On October 17th 2018, targeted species-specific Desmoulin's whorl snail surveys were undertaken in suitable habitat within the proposed development area, i.e. within the vegetated drain and within Lough Bawn pNHA (see Appendix 6.8). Desmoulin's whorl snail were not recorded at either the vegetated drainage ditch or within Lough Bawn pNHA. Neither site was considered to contain suitable habitat for this species following the survey.

Some drainage ditches within Derryaroge and Lough Bannow bogs were noted to contain stickleback fish. A desk study of Biodiversity Ireland online data for National Grid 10 km square N06, N07 and N16 was generated to establish fisheries value locally (https://maps.biodiversityireland.ie/Map). The following species were identified as occurring within the relevant national grid squares: course fish (rudd (*Scardinius erythrophthalmus*), bream (*Abramis brama*), pike (*Esox lucius*) and perch (*Perca fluviatilis*)), stone loach (*Barbatula barbatula*), tench (*Tinca tinca*) and brown troat (*Salmo trutta*). The network of drains present throughout the site are considered to have very little fisheries value and no salmonid potential. Therefore, a walkover survey and desk study were considered sufficient.

6.5.4 Aquatic Ecology

The proposed development is located within an operating Bord na Móna peat extraction site. An extensive network of field drains, arterial drainage channels of peatland, and associated silt ponds are present throughout the site which is currently operated under IPC licence P0504-01 Mountdillon Bog group.

Following site walkovers in August 2016, January 2017, and March 2018, a number of surface water features were noted on site. A number of drainage channels were identified to be flowing through or adjacent to the proposed development site. These man-made drains assist with the drainage of peatland and reclaimed peatland areas under agricultural land and forestry use. The natural surface water drainage

[83] Moorkens and Killeen (2011). A survey of potential *Vertigo moulinsiana* habitat in the Royal Canal and Environs in County Longford.

pattern in the environs of the proposed development site is shown in Figure 6.5. The streams are identified as follows:

Derryaroge Bog (Location of Turbines 1-9)

The proposed turbines T1-T9 and associated roads are located within the catchment of two streams; i) Kilnacarrow Stream (EPA ID: Stream 26_1494) is located to the north-west of the Derryaroge site and flows in a northerly direction into the River Shannon and ii) Ballynakill Stream (named locally as the Griallagh River, EPA ID: Stream 26_3574) forms a short section of the boundary but mainly runs to the east of the site in a northerly direction and joins the River Shannon to the north of the site. The catchment area for each stream was estimated using the EPA's online database (gis.epa.ie/Envision) and geographic contours available from OS maps.

Derryadd Bog (Location of Turbines 10-17)

Three streams were identified as flowing through or adjacent to the Derryadd Bog. An upper section of the Ballynakill Stream (named locally as the Griallagh River, EPA ID: (for this section) Stream 26_625a) is located to the east of turbines T10-T17. The Rappareehill Stream (EPA ID: Stream 26_3871) flows south of the Bord na Móna Mountdillion Works and then south along the western boundary of Derryadd bog before turning west and then north and joining with a number of other streams before flowing into the River Shannon. The Derrygeel Stream (EPA ID: Stream 26_593) flows across the southern section of Derryadd in a westerly direction before flowing north, joining with the Rapparreehill Stream and also the Lehery Stream (located approximately 2.7km to the west of Derryadd Bog) before flowing into the River Shannon. This collection of streams are referred to locally as the Lough Bannow Stream.

The proposed substations and overhead/underground powerlines are located in the Lough Bannow Stream catchment (Rappareehill and Derrygeel) as follows:

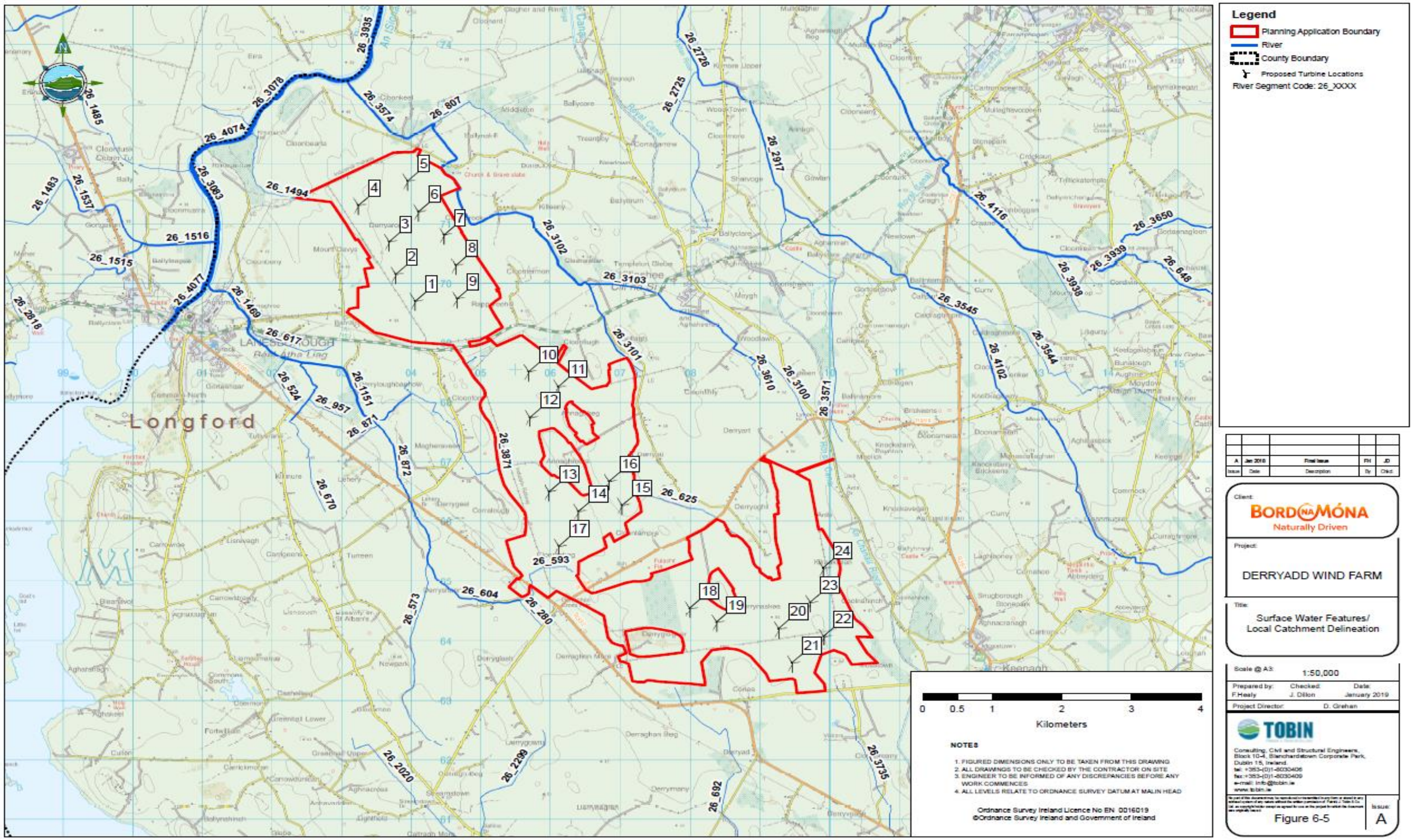
- Substation Option A is located to the south of the Mountdillon works. Substation Option A is within the catchment of the Rappareehill Stream, which discharges to the Lough Bannow Stream approximately 5km downgradient of the Substation Option A.
- Substation Option B is within the catchment of the Derrygeel Stream, which discharges to the Lough Bannow Stream approximately 2km downgradient of the substation. Three proposed borrow pits are identified within the Lough Bannow catchment and two located with the Ballynakill catchment.

Lough Bannow Bog (Location of Turbines 18-24)

Two streams were identified as flowing adjacent to the Lough Bannow Bog. The uppermost section of the Ballynakill Stream (named locally as the Griallagh River, EPA ID: Stream 26_625) flows in a northerly direction and runs along a section of the northern boundary of the site and is located to the north of turbines 18-24. There are two streams, both forming part of the Bilberry Stream (Bilberry [west Branch] EPA ID: Stream 26_692, and the Bilberry Stream, EPA ID: Stream: 26_3735) that are located to the south of the Lough Bannow bog. The Bilberry (west branch) Stream is south of the Irish Society for Prevention of Cruelty to Animals (ISPCA) headquarters and the Bilberry Stream is south of Lough Bawn pNHA. It was noted that there were no hydrometric stations located in the immediate environs of the proposed development site. Although hydrometric stations do exist on watercourses downstream of the proposed development, they include flows coming from a number of different tributaries (gis.epa.ie/Envision). As such, they are not representative of the actual flows occurring at the site.

Substantial areas of the proposed development and surrounding area have been artificially drained to enable industrial harvesting of peat. The carefully maintained network of drainage ditches effectively drain the proposed development site and surrounding area. No incidents of flooding on the Lough Bannow Bog were noted during the field surveys with the exception of some flooding noted in the middle of the bog during the winter bird surveys in December 2015. This was inline with the exceptional rainfall which occurred during the 2015/ 16 winter (McCarthy *et al.* 2016)[66]. Some flooded bog was also noted during the winter bird surveys in 2016/17, however this occurred south of the Lough Bannow Bog, outside the proposed development site. The proposed development site is not located in a flood prone area (Flood Zone A or B) based on the preliminary flood risk assessment (PFRA) maps, published by the OPW. Based on the information available and a site-specific risk assessment, the proposed development site is not considered a flood risk.

Figure 6.5: Existing Surface Water Features within the Site Boundary



6.5.5 Key Ecological Receptors

Following a review of the existing environment presented above, it is possible to determine key ecological receptors that occur within the proposed development area requiring consideration regarding potential impacts and mitigation. These include specific receptors that have been identified as being of local Importance (Higher Value) or greater.

They include specific habitats and species with high protection or conservation status. These identified key ecological receptors may potentially be impacted by works associated with the proposed development and are therefore taken forward in this report for evaluation and appropriate mitigation (as required). The significance of each species as it occurs on the site is presented in Table 6.18 and Table 6.19 below along with the rationale for its selection/ exclusion as a Key Ecological Receptor.

Table 6.18: Key Ornithological Receptor Evaluation and Selection Criteria

Name	NRA Evaluation (NRA 2009)[12]	NRA Criteria (Baseline data)	Key Receptor	Percival Sensitivity Evaluation (Percival 2003)[46]	Determining Criteria
Hen Harrier	Locally Important (Higher value)	Recorded in low numbers during the autumn and winter months. (Resident or regularly occurring populations) (assessed to be important at the local level) of the following: Species of bird, listed on Annex and/ or referred to in Articles 4 (2) of the Birds Directive)	Yes	Medium (no breeding or roost sites)	Species on Annex I of the EU Birds Directive.
Merlin	Locally Important (Higher value)	Confirmed breeder. (Resident or regularly occurring populations) (assessed to be important at the local level) of the following: Species of bird, listed on Annex and/ or referred to in Articles 4 (2) of the Birds Directive)	Yes	Medium	Species on Annex I of the EU Birds Directive.
Peregrine Falcon	Locally Important (Higher value)	Foraging at the site. (Resident or regularly occurring populations) (assessed to be important at the local level) of the following: Species of bird, listed on Annex and/ or referred to in Articles 4 (2) of the Birds Directive)	Yes	Medium	Species on Annex I of the EU Birds Directive.
Buzzard	Locally Important (Higher value)	Probable breeder at the site. (Resident or regularly occurring populations) (assessed to be important at the local level) of the following: Species of bird, protected under Wildlife Act.	Yes	Low	Any other species of conservation concern.
Kestrel	Locally Important (Higher value)	Present year round. (Resident or regularly occurring populations) (assessed to be important at the local level) of the following: Species of bird, protected under Wildlife Act.	Yes	Low	Any other species of conservation concern.
Sparrowhawk	Locally Important (Higher value)	Probable breeder at the site. (Resident or regularly occurring populations) (assessed to be important at the local level) of the following: Species of bird, protected under Wildlife Act.	Yes	Low	Any other species of conservation concern.
Long-eared Owl	Locally Important (Higher value)	Confirmed breeder locally. (Resident or regularly occurring populations) (assessed to be important at the local level) of the following: Species of bird, protected under Wildlife Act.	Yes	Low	Any other species of conservation concern.

Name	NRA Evaluation (NRA 2009)[12]	NRA Criteria (Baseline data)	Key Receptor	Percival Sensitivity Evaluation (Percival 2003)[46]	Determining Criteria
Whooper Swan	Locally Important (Higher value)	Wintering population. (Resident or regularly occurring populations) (assessed to be important at the local level) of the following: Species of bird, listed on Annex and/ or referred to in Articles 4 (2) of the Birds Directive)	Yes	Very High	Cited interest of Lough Ree SPA
Mute Swan	Locally Important (Higher value)	Present year round. (Resident or regularly occurring populations) (assessed to be important at the local level) of the following: Species of bird, protected under Wildlife Act.	Yes	Low	Any other species of conservation concern.
Greenland White-fronted Goose	Locally Important (Higher value)	Single record.	No	N/A	N/A
Barnacle Goose	Locally Important (Higher value)	Single record.	No	N/A	N/A
Greylag	Locally Important (Higher value)	Single record.	No	N/A	N/A
Mallard	Locally Important (Higher value)	Present year round. (Resident or regularly occurring populations) (assessed to be important at the local level) of the following: Species of bird, protected under Wildlife Act.	Yes	Very High	Cited interest of Lough Ree SPA
Common Tern	Locally Important (Higher value)	Present during summer months. (Resident or regularly occurring populations) (assessed to be important at the local level) of the following: Species of bird, listed on Annex and/ or referred to in Articles 4 (2) of the Birds Directive)	Yes	Very High	Cited interest of Lough Ree SPA

Name	NRA Evaluation (NRA 2009)[12]	NRA Criteria (Baseline data)	Key Receptor	Percival Sensitivity Evaluation (Percival 2003)[46]	Determining Criteria
Golden Plover	Locally Important (Higher value)	Present in winter months. (Resident or regularly occurring populations) (assessed to be important at the local level) of the following: Species of bird, listed on Annex and/ or referred to in Articles 4 (2) of the Birds Directive)	Yes	Very High	Cited interest of Lough Ree SPA
Lapwing	Locally Important (Higher value)	Predominantly a wintering population. (Resident or regularly occurring populations) (assessed to be important at the local level) of the following: Species of bird, listed on the relevant Red Data List.	Yes	Very High	Cited interest of Lough Ree SPA
Curlew	Locally Important (Higher value)	Predominantly a wintering population. (Resident or regularly occurring populations) (assessed to be important at the local level) of the following: Species of bird, listed on the relevant Red Data List.	Yes	High	Cited interest of Lough Ree SPA
Woodcock	Locally Important (Higher value)	Present year round. (Resident or regularly occurring populations) (assessed to be important at the local level) of the following: Species of bird, listed on the relevant Red Data List.	Yes	Medium	Red List BoCCI
Snipe	Locally Important (Higher value)	Displaying birds onsite. (Resident or regularly occurring populations) (assessed to be important at the local level) of the following: Species of bird, protected under Wildlife Act.	Yes	Low	Any other species of conservation concern.
Ringed Plover	Locally Important (Higher value)	Single record.	No	N/A	N/A
Little Egret	Locally Important (Higher value)	Present on fringing habitat surrounding site. (Resident or regularly occurring populations) (assessed to be important at the local level) of the following: Species of bird, listed on Annex and/ or referred to in Articles 4 (2) of the Birds Directive)	Yes	Medium	Species on Annex I of the EU Birds Directive.

Name	NRA Evaluation (NRA 2009)[12]	NRA Criteria (Baseline data)	Key Receptor	Percival Sensitivity Evaluation (Percival 2003)[46]	Determining Criteria
Grey Heron	Locally Important (Higher value)	Present year round. (Resident or regularly occurring populations) (assessed to be important at the local level) of the following: Species of bird, protected under Wildlife Act.	Yes	Low	Any other species of conservation concern.
Black-headed Gull	Locally Important (Higher value)	Present year round. (Resident or regularly occurring populations) (assessed to be important at the local level) of the following: Species of bird, listed on the relevant Red Data List.	Yes	High	Red List BoCCI
Lesser Black-backed Gull	Locally Important (Higher value)	Present year round. (Resident or regularly occurring populations) (assessed to be important at the local level)	Yes	Low	Any other species of conservation concern.
Cormorant	Locally Important (Higher value)	Present year round. (Resident or regularly occurring populations) (assessed to be important at the local level) of the following: Species of bird, protected under Wildlife Act.	Yes	High	Cited interest of Lough Ree SPA

Table 6.19: Evaluation of Key Ecological Receptors and Locations within/ adjacent to the Proposed Development Site

Site / Feature	Evaluation*	Brief Description of Ecological Receptor	Relevant Location
Bog woodland	Local Importance (Higher Value)	Bog woodland is considered to be rare habitat in Ireland with an estimated nationwide land cover of 150 ha approximately.	The best examples of this habitat are to be found in the land fringing Lough Bawn pNHA in the south-east of the proposed development site.
Transition Mire and Quaking Bog	Local Importance (Higher Value)	Transition mires and quaking bogs are peat-forming communities with low nutrient values developing on surface waters.	Transition mire and quaking bog can be found in the eastern corner of Lough Bannow within Lough Bawn pNHA.
Bats spp.	Annex IV of EU Habitats Directive	Bat species encountered onsite included: common	Habitats encountered within the proposed development area

Site / Feature	Evaluation*	Brief Description of Ecological Receptor	Relevant Location
	Wildlife Acts	pipistrelle, soprano pipistrelle, Leisler's bat, Natterer's bat, brown long-eared bat, and Myotis species. Of these species, Leisler's bats would be considered a high risk species while common pipistrelle and soprano pipistrelle would be of medium risk from wind turbines while the remaining species recorded would be considered to have a low risk from wind turbines given their flight behaviour, e.g. Leisler's bats are the highest flying species	that was considered of value to bats included: • scrub/woodland: high local value; • bare peat: low ecological value; • temporary open water; • ponds and ditches: medium low ecological value; and • works areas/ buildings: medium ecological value.
Otter	Annex IV of EU Habitats Directive Wildlife Acts	Drains and associated riparian habitats provide foraging areas for otter. Habitats onsite are considered sub-optimal for otters.	Drains onsite can potentially be used opportunistically for feeding and as corridors for travelling between otherwise isolated habitats.
Badger	Wildlife Acts	Breeding sites (setts) usually occur along base of hedgerows or amongst scrub or woodland habitat. No setts were noted onsite, habitats onsite are deemed sub- optimal for badgers.	Badgers are likely to occur at low densities in the vicinity of scrub habitat within the proposed development area. Turbines are located away from suitable breeding habitat.
Pine Marten	Annex V of EU Habitats Directive Wildlife Acts	Pine marten require forest or scrub habitats to exist in an area. They will often show a high fidelity to refuge and den sites; no such sites were located within the proposed development area.	The site has the potential for pine marten to occur at low densities throughout the proposed development area.
Marsh Fritillary	Annex II of EU Habitats Directive	Habitat quality for Marsh Fritillary is well understood and described. Good quality habitat is	The Marsh Fritillary host plant Devil's Bit Scabious was found to be most abundant along railway tracks and in areas

Site / Feature	Evaluation*	Brief Description of Ecological Receptor	Relevant Location
		defined generally as having a moderate to high coverage of Devil's Bit Scabious (*Succisa pratensis*) (more than 3 plants per m^2) growing in a low-growing unintensive sward with a height range of 10-25cm and low cover of invasive scrub.	of re-colonising bare ground within the proposed development area. It was not found in areas of dense scrub or where the sward was tall, i.e. above 25cm.
Desmoulin's whorl snail	Annex II of EU Habitats Directive	*Vertigo moulinsiana* require swamps with stable hydraulic conditions. The species has become rare as these conditions have become increasingly uncommon in Europe. This species requires a stable hydrogeology, where the water table sits at or slightly above the ground surface for much of the year[84].	Typical of commercial peat extraction facility, the proposed development contains an extensive drainage network. Furthermore, these drains are largely devoid of vegetation and are subject to drying out in the summer months. A vegetated drainage ditch that runs from Lough Bannow bog to the Royal Canal was considered to provide suitable habitat for this species. This drain is located adjacent to the amenity track that is proposed to provide access from the east to Lough Bannow bog. Lough Bawn pNHA is located in the south-eastern corner of Lough Bannow bog and could potentially provide the relevant swamp conditions required by this species.

Note:

* The evaluation for mammals is informed by protection status and observed numbers (in some cases identified).

[84] Moorkens, E.A. & Killeen, I.J. (2011) Monitoring and Condition Assessment of Populations of Vertigo geyeri, Vertigo angustior and Vertigo moulinsiana in Ireland. Irish Wildlife Manuals, No. 55. National Parks and Wildlife Service, Department of Arts, Heritage and Gaeltacht, Dublin, Ireland

6.6 POTENTIAL IMPACTS

The identification and description of impacts presented below takes account of the characteristics of the receiving environment as described throughout Section 6.5 with particular reference to the Key Ecological Receptors identified in Section 6.5.5. Impacts are presented in relation to each phase of the project (construction, operation and decommissioning).

The impacts described in this section are those ecological impacts predicted due to the proposed development prior to the consideration of any appropriate mitigation measures (refer to Section 6.7 for further details on mitigation measures). Residual effects describe potential effects that remain after all assessment and mitigation are considered, and are discussed in Section 6.7.1.1 and Section 6.7.2.2.

The potential ecological impacts of the proposed development are detailed in Section 6.6.1 (construction phase impacts), Section 6.6.2 (operational phase impacts) and Section 6.6.3 (decommissioning phase impacts) below.

6.6.1 Construction Phase Impacts

Details of the construction of the proposed development can be found in Chapter 2: Description of the Proposed Development. Construction of each of the major infrastructure elements and the installation of the wind turbines has the potential to affect biodiversity. Potential effects identified for each of the aspects of biodiversity considered in this chapter are described below. Turbines will be transported to the site within the carriageway of existing roads along a specific haul route thereby avoiding potential significant effects.

Based on the nature of the proposed development and the baseline ecological data collected on the proposed development site, the following activities warrant specific attention in the consideration of ecological impact:

- Permanent habitat loss associated with construction activity including woody vegetation clearance, site access roads, turbine foundation and borrow pit excavations, substation and temporary construction compound(s) within the defined works area for the proposed development;
- Habitat loss can occur as a result of the following activities during the construction phase of site works: stockpiling of material, peat side casting, excavations, trimming and vegetation clearance;
- It is expected that adjoining areas will have low level disturbance associated with works in the area;

- Habitat fragmentation results in the division of larger more continuous habitats, into smaller more isolated pocket[85]. This may result in a change in foraging activity for ecological receptors;
- Temporary noise and physical presence disturbance impacts from machinery and staff at work area locations to fauna (birds and mammals);
- Temporary displacement effects occur where birds/ mammals are displaced from utilising the habitats within the proposed development area due to the construction related works. These effects may occur as a result of machinery and staff working in the area;
- Stockpiling of spoil material has the potential to cause additional short-term habitat loss should it be placed in a manner that would smother vegetation;
- Pollution runoff risks to surface and/ or ground water quality through drains close to the works area, potentially linked to more ecologically important streams, rivers and lakes; and
- Risk of introduction/ spread of alien invasive species to the surrounding aquatic and terrestrial environment.

Potential ecological receptors of impacts:

- Habitats and flora that occur within the footprint of the development;
- Watercourses surrounding and downstream of the proposed wind farm; and
- Fauna susceptible to impacts from this type of development.

<u>Grid Connection Option A: Substation and Overhead Grid Connection</u>

The substation (refer to Chapter 2 for further details) is proposed for the northern margins of Derryadd bog, adjacent to the N63 road (Grid reference: N 05019 68616). In following the precautionary principle, the substation and grid connection have been carefully positioned to ensure that there will be no direct impacts on habitats of high ecological value. Neither the substation nor the grid connection are located in higher value habitats or sites that are identified as Key Ecological Receptors.

In the event of an overhead power line grid connection the line will pass over cutover bog habitat that is considered suboptimum for foraging birds. It is proposed to install a small section of overhead line to facilitate connect to an existing 110 kV overhead power that traverses the northern margins of the bog. The proposed length of the overhead line connection measures c. 480m (northern substation at Derryadd bog). Collisions with overhead powerlines can result in mortality impacts for birds. However, given the presence of the existing overhead power line in this section of the site and the short length of the proposed grid connection, it is therefore considered that the potential additional collision risk for local birds is judged

85 Andren H. (1994) Effects of Habitat Fragmentation on Birds and Mammals in Landscape with Different Proportions of suitable habitat: A review. Oikos Vol. 71, No. 3, pp355-366.

to be of low concern. It is considered likely that birds will have become accustomed to the presence of the proposed overhead power line in the landscape, which will further reduce collision risk. Therefore, this potential impact can be described as a long term, not significant negative effect. In addition, mitigation measures are proposed in Section 6.7 below.

The level of disturbance associated with the construction activities are considered to be minor/ slight and short term in duration, for further information on disturbance impacts see Section 6.6.1.3.2. Therefore, this potential impact can be described as a short term, not significant negative effect.

<u>Grid Connection Option B: Substation and Overhead/Underground Grid Connection</u>

The substation (refer to Chapter 2 for further details) is proposed for the southern margins of Derryadd bog, adjacent to the R398 road (Grid reference: N 06129 65052). As with Option A, the substation will be positioned in an area primarily consisting of cutaway bog with some re-establishing vegetation. Neither the substation nor the grid connection are located in higher value habitats or sites that are identified as Key Ecological Receptors. This habitat is considered sub-optimal for foraging birds.

It is proposed to install a small section of overhead line to facilitate connect to an existing 110 kV overhead power that traverses the southern margins of the bog. The proposed length of the overhead line connection measures c. 1km (southern substation at Derryadd bog). Overhead powerlines can present a hazard to birds through collision related mortality. However as has been previously stated; given the presence of the existing overhead power line in this section of the site and the short length of the proposed grid connection, it is therefore considered that the potential additional collision risk for local birds is judged to be of low concern. It is considered likely that birds will have become accustomed to the presence of the proposed overhead power line in the landscape, which will further reduce collision risk. In addition, mitigation measures are proposed in Section 6.7 below.

The level of disturbance associated with the construction activities are considered to be minor/ slight and short term in duration, for further information on disturbance impacts see Section 6.6.1.3.2.

In the event an underground cable is chosen as the preferred option in the southern margins of Derryadd bog, adjacent to the R392 road (Grid reference: N 06129 65052) excavation works will be required. An open trench will be dug to hold the underground cable. The cable will be positioned in an area primarily consisting of cutaway bog with some re-establishing vegetation. Approximately 1.5km of 110 kV of underground cable will need to be installed (750m distance from the substation to the existing overhead line). The cable will exit Derryshannoge Bog onto the R392 and will run along the R392 before entering the site. Impacts associated with cable installation are considered to be limited, given the localised nature of excavation works and the low ecological value of the habitats that will be crossed. Therefore, this potential impact can be described as a short term, not significant negative effect. Post construction works, the cable is considered to be a benign feature in the landscape.

6.6.1.1 Habitats

In following the precautionary principle, all turbines, substation (Option A and Option B) borrow pits, and internal roads have been carefully positioned to ensure that there will be no direct impacts on habitats of high ecological value. No turbines are located in higher value habitats or sites that are identified as Key Ecological Receptors. Furthermore, habitats of ecological value outside of these sites have largely been avoided.

Without consideration of mitigation measures the construction of turbines and associated hard standing area and access roads have the potential to result in permanent direct habitat loss within the development footprint.

Table 6.20 indicates where the infrastructure is located in various habitats, evaluation of impact and the potential area impacted. Of the c. 1,908 ha total area within the planning/ development boundary, the turbine hard standing areas, substation(s), associated infrastructure (including five temporary compounds) and internal roads combine for an area of c. 51.8 ha or 3% of the total area.

Table 6.20: Impact of Locating Internal Infrastructure in Each Habitat Type within the Proposed Development Area

Habitat (Fossitt 2000)	Area Lost to Infrastructure*	Assessment of Impact (NRA, 2009 and EPA 2017)
Cutover Bog (PB4)	36.97 ha / 71.38%	Habitat Loss Significance evaluation: **Permanent slight negative effect**
Bog Woodland (WN7)	5.72 ha / 11.03%	Habitat Loss Significance evaluation: **Permanent moderate negative effect**
Immature Woodland (WS2)	1.11 ha / 2.14%	Habitat Loss Significance evaluation: **Permanent moderate negative effect**
Scrub (WS1)	1.05 ha / 2.02%	Habitat Loss Significance evaluation: **Permanent moderate negative effect**
WS2/ WN7/ PB4	0.65 ha / 1.25%	Habitat Loss Significance evaluation: **Permanent moderate negative effect**
Wet Heath (HH3)	0.55 ha / 1.06%	Habitat Loss Significance evaluation: **Permanent moderate negative effect**

Habitat (Fossitt 2000)	Area Lost to Infrastructure*	Assessment of Impact (NRA, 2009 and EPA 2017)
ED3/ ED2 (Spoil and bare ground)/ WS1	0.033 ha / 0.06%	Habitat Loss Significance evaluation: **Permanent slight negative effect**
Dense Bracken (HD1)	0.10 ha / 0.2%	Habitat Loss Significance evaluation: **Permanent slight negative effect**
Dry-humid Acid Grassland (GS3)	0.10 ha / 0.2%	Habitat Loss Significance evaluation: **Permanent slight negative effect**
Re-colonising bare ground (ED3)	0.02 ha / 0.04%	Habitat Loss Significance evaluation: **Permanent slight negative effect**
Wet Grassland (GS4)	0.001 ha / 0.002%	Habitat Loss Significance evaluation: **Permanent slight negative effect**
Improved Agricultural Grassland (GA1)	0.345 ha / 0.67%	Habitat Loss Significance evaluation: **Permanent slight negative effect**
Buildings and Artificial Surfaces (BL3)	0.005 ha / 0.01%	Habitat Loss Significance evaluation: **Permanent slight negative effect**
Drainage Ditches	0.026 ha / 0.05%	Habitat Loss Significance evaluation: **Permanent slight negative effect**
PB4/WS1	5.385 ha / 10.4%	Habitat Loss Significance evaluation: **Permanent slight negative effect**
Bog Woodland	None	Potential impact source: Habitat loss through increased drainage of hydraulically sensitive habitats located within Lough Bawn pNHA. This impact is considered unlikely, i.e. drainage regime proposed at the site is designed in such a manner as to facilitate the rehabilitation plan. The goal of the rehabilitation plan will be to raise water levels within the site without creating open water flooding, as per Chapter 8 of the EIAR. Furthermore, the drainage design incorporates appropriate buffer zones and setback distances so as to avoid indirect hydrological impacts.
Transition Mire and Quaking Bog	None	

Note:

*Figures are given in hectares (ha) and as a percentage of the total area allotted to infrastructure (turbine hard standings, substation, associated infrastructure and internal roads).

6.6.1.2 Surface Water

No wetlands of conservation importance occur in the vicinity of the proposed turbine locations. A key consideration for the development is the protection of water quality and associated aquatic receptors in streams and rivers located in the vicinity of the development (see below).

6.6.1.2.1 Water Quality (Aquatic Receptors)

All large infrastructure projects have the potential to negatively impact on Key Ecological Receptors in the aquatic environment. In the present case, the onsite infrastructure has been carefully positioned to ensure that there will be very limited direct impacts on aquatic flora/ fauna of high ecological value.

Section 173 of the Fisheries (Consolidation) Act, 1959, states it is an offence to obstruct the passage of the smolts or fry of salmon, trout, or eels or injure or disturb the spawn or fry of salmon, trout or eels or injure or disturb any spawning bed, bank or shallow where the spawn or fry of salmon, trout or eels may be. Section 3 of the Local Government (Water Pollution) Act, 1977 (as amended by Sections 3 and 24 of the 1990 Act) states it is an offence to cause or permit any polluting matter to enter waters.

Section 171 of the Fisheries (Consolidation) Act 1959 states it to be an offence to throw, empty, permit or cause to fall deleterious matter into any waters. Under the European Community (Surface Water) Regulations, 2009, it is stated under Part III, Section 33 that '*Failure to achieve good ecological status, or where relevant, good ecological potential or to prevent deterioration in the status of a body of surface water resulting from new modifications or alterations to the physical characteristics of a surface water body, or failure to prevent deterioration of a body of surface water from high status to good status resulting from new sustainable human development activities shall not be a breach of these Regulations when all the following conditions are met*:

1) All practicable steps are taken to mitigate the adverse impact on the status of the body of surface water;

2) The reasons for those modifications or alterations are specifically set out and explained in the river basin management plan required under Article 13 of the 2003 Regulations and the objectives are reviewed every six years;

3) The reasons for those modifications or alterations are of overriding public interest and/or the benefits to the environment and to society of achieving the objectives established by Article 28 of these Regulations are outweighed by the benefits of the new modifications or alterations to human health, to the maintenance of human safety or to sustainable development; and

4) The beneficial objectives served by these modifications or alterations of the water body cannot for reasons of technical feasibility or disproportionate cost be achieved by other means, which are a significantly better environmental option'.

It is therefore essential that significant impacts to watercourses within the proposed development area and/ or catchments downstream of construction activities are avoided.

The principle impacts from the proposed development on the aquatic environment are expected to occur during the construction phase. Operational activities including maintenance are unlikely to result in significant impacts on the aquatic environment.

Water quality perturbations associated with construction activity have potential to impact upon the ecologically sensitive waterways in the vicinity of the development. However, smaller streams and drainage ditches require water quality protection measures.

For turbine locations in proximity to existing large drains, works that could give rise to impacts would be associated with sediment release during the erection of turbines or potential contamination of surface water from concrete and / or fuels used during construction. The location of infrastructure and their proximity to surface water features are detailed in Section 6.5.4.

The proposed development is not likely to have a significant effect on water quality given the very localised scale of works and the distance these works are located away from rivers, i.e. the closest watercourse (Ballynakill Stream) to a turbine location is approximately 255m away. The "*Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters*" (IFI 2016)[86] suggests a buffer zone should remain between silt traps and watercourses with natural vegetation left intact. The recommended buffer distances in the "*Planning for Watercourses in the Urban Environment. A Guideline Developed by the Shannon Regional Fisheries Board*" are 35m to 60m for large river channels (>10m) and 20m or greater for smaller channels (<10m).

Potential effects on freshwater habitats arising from the construction phase include, in the absence of mitigation, deterioration of water quality due to sediment release during the excavation of turbine foundations or potential contamination of water from concrete and / or fuels during construction. Such potential effects in the absence of mitigation could cause direct and indirect impact on aquatic ecology as follows:

- Sedimentation – temporary smothering of gravel beds with consequent loss of fish and spawning habitat;

[86] Inland Fisheries Ireland (IFI) (2016). Guidelines on protection of fisheries during construction works in and adjacent to waters. *Inland Fisheries Ireland*.

- Sediment deposition can also provide a base for growth of filamentous algae on gravel beds, leading to a build up of sediment and loss of suitable habitat for crayfish and spawning habitat for lamprey and salmonids;
- Sedimentation impacts in the absence of mitigation include smothering fish eggs and causing mortalities in fish of all ages, reducing abundance of food and impeding movement of fish;
- Sedimentation impacts in the absence of mitigation also include smothering of food prey for juvenile salmonids i.e. macro invertebrates;
- Localised construction phase reduction of surface and groundwater quality in wetlands removed from, but linked to the proposed development (e.g. transition mire and bog woodland found within the Lough Bawn pNHA); and
- Accidental leakage / spillage of oil and fuels from construction vehicles can have indirect impacts on fish, fish food and fish habitats and other aquatic species.

The potential sources of such impacts have been identified at internal infrastructure locations where works are proposed in proximity to watercourses and surface and ground water dependant habitats. All turbine locations are located away from sensitive natural watercourses and permanent drainage features and therefore the risk of pollution of surrounding watercourses is very low. Best practice construction techniques that will be adhered to during the construction of the proposed development will also minimise the potential for these impacts to occur, as per Section 6.6 below.

It is concluded that in the absence of mitigation, possible deterioration of water quality of surrounding surface water during the construction phase (approximately 24 to 30 months) may result in short term, slight adverse, significant effects on aquatic receptors.

Further details on the potential impacts on water quality and the potential hydrological connectivity of the proposed development area with local ecological features (post mitigation) are addressed in Chapter 8 of this volume of the EIAR.

6.6.1.3 Avian Community

The likely potential effects to avian communities within the vicinity of the proposed development area have been divided into two main areas, habitat loss and fragmentation and disturbance displacement. These effects are associated with both the direct habitat loss associated with construction and the disturbance caused by the activity of machinery and staff within the proposed development area.

Habitat loss and/ or fragmentation impacts from the proposed development have been considered as permanent for the purposes of the assessment. Disturbance impacts from the proposed development are expected to last for the duration of construction activities only. Details of the construction of the proposed project can be found in Chapter 2: Description of the Proposed Development and the CEMP. The duration of construction activities is considered to be approximately 24 to 30 months. This impact is therefore considered a short-term effect, as per EPA (2017)[45].

6.6.1.3.1 Habitat Loss and Fragmentation (Potential Direct Impacts)

The construction of turbine bases, access tracks, substation (Option A or Option B), grid connections, borrow pits and all other associated construction will result in a land take which will consequently reduce the availability of local habitat for birds. Assessing the impact of this habitat loss will be achieved by quantifying the area of each habitat which will be lost. The magnitude of this impact can be determined relative to the proportion of habitat available which will be lost relative to the availability of these habitats both onsite and within the wider surroundings which are utilised by key target species.

Table 6.21 below assesses the potential effect of habitat loss and fragmentation on the key avian ecological receptor species within the proposed development area, i.e. species which were recorded frequently, in potentially significant numbers, and/ or are considered of high conservation concern.
The methodology of the assessment of the impact of habitat loss and fragmentation will follow Percival (2003)[46] and EPA (2017)[45] (refer to Section 6.4.5 for further details).

Table 6.21: Assessing the Potential Impact on Local Avian Communities from Habitat Loss and Fragmentation Associated with Construction Activities

Species (Sensitivity)	**Habitat loss and Fragmentation (Magnitude)**	**Significance Evaluation* (Percival 2003[87]; EPA 2017)**
Hen Harrier (Medium)	Land taken during the construction phase of the development will be discernible, but the overall character of habitats will be similar to the pre-development circumstance. No direct loss of nesting habitat will result from land lost to construction works. No nest sites were located for the species at the site. Based on a consistent survey effort 2014 to 2018, the species was recorded in low numbers during the autumn and winter months. The species was found to infrequently use the site for foraging. Given that the internal infrastructure constitutes a small proportion (c. 51.8 ha/ 2.7%) of the total proposed development area, the wide-ranging nature of the species and the availability of similar suitable habitats in the surroundings (e.g. bog/ heath/ grassland/ scrub), the magnitude of the impact is judged of **Low Concern.**	Percival Significance is calculated as a product of the sensitivity (Medium) of the species and the magnitude (Low) of the effect. Evaluation: **Low** significance. **Permanent, slight negative effects**
Merlin (Medium)	Land taken during the construction phase of the development will be discernible, but the overall character of habitats will be similar to the pre-development circumstance. No direct loss of nesting habitat will result from land lost to construction works. Confirmed breeder within the wider surroundings, however no nest sites were located for the species at the site. Based on a consistent survey effort 2014 to 2018, the species was recorded infrequently in low numbers during the summer and winter months. Given that the internal infrastructure constitutes a small proportion (c. 51.8 ha/ 2.7%) of the total proposed development area and the availability of similar suitable habitats in the surroundings (e.g. bog/ heath/ grassland/ scrub), the magnitude of the impact is judged of **Low Concern.**	Percival Significance is calculated as a product of the sensitivity (Medium) of the species and the magnitude (Low) of the effect. Evaluation: **Low** significance. **Permanent, slight negative effects**
Peregrine Falcon (Medium)	Land taken during the construction phase of the development will be discernible, but the overall character of habitats will be similar to the pre-development circumstance No direct loss of nesting habitat will result from land lost to construction works. No nest sites were located for the species at the site. Based on a consistent survey effort 2014 to	Percival Significance is calculated as a product of the sensitivity

[87] Percival (2003) details an assessment methodology to determine the significance of an impact based on the product of the sensitivity of the receptor and the magnitude of the effect. The sensitivity of a species is defined by Percival (2003) as its ecological importance and nature conservation interest at the site being assessed. Species which are of special conservation interest of a European site have the highest sensitivity rating. The significance of any one impact is a product of the sensitivity of the receptor, the magnitude of the impact and the probability of that impact occurring. The assessment of significance follows this evaluation methodology.

Species (Sensitivity)	Habitat loss and Fragmentation (Magnitude)	Significance Evaluation* (Percival 2003[87]; EPA 2017)
	2018, the species was recorded infrequently in low numbers during the summer and winter months foraging onsite. Given that the internal infrastructure constitutes a small proportion (c. 51.8 ha/ 2.7%) of the total proposed development area, the wide-ranging nature of the species and the availability of similar suitable habitats in the surroundings (e.g. bog/ heath/ grassland/ scrub), the magnitude of the impact is judged of **Low Concern.**	(Medium) of the species and the magnitude (Low) of the effect. Evaluation: **Low** significance. **Permanent, slight negative effects**
Buzzard (Low)	Land taken during the construction phase of the development will be discernible, but the overall character of habitats will be similar to the pre-development circumstance. No direct loss of nesting habitat will result from land lost to construction works. This species was a probable breeder at the site although no nest sites were located for the species at the site. Based on a consistent survey effort 2014 to 2018, the species was recorded in low numbers during the summer and winter months foraging onsite. Given that the internal infrastructure constitutes a small proportion (c. 51.8 ha/ 2.7%) of the total proposed development area, the wide-ranging nature of the species and the availability of similar suitable habitats in the surroundings (e.g. bog/ heath/ grassland/ scrub), the magnitude of the impact is judged of **Low Concern.**	Percival Significance is calculated as a product of the sensitivity (Low) of the species and the magnitude (Low) of the effect. Evaluation: **Very Low** significance. **Permanent, slight negative effects**
Kestrel (Low)	Land taken during the construction phase of the development will be discernible, but the overall character of habitats will be similar to the pre-development circumstance. No direct loss of nesting habitat will result from land lost to construction works. No nest sites were located for the species at the site. Based on a consistent survey effort 2014 to 2018, the species was found to be present year-round, foraging onsite. Given that the infrastructure constitutes a small proportion (c. 51.8 ha/ 2.7%) of the total proposed development area, the adaptability of the species to various habitats and the availability of similar suitable habitats in the surroundings (e.g. bog/ heath/ grassland/ scrub), the magnitude of the impact is judged of **Low Concern.**	Percival Significance is calculated as a product of the sensitivity (Low) of the species and the magnitude (Low) of the effect. Evaluation: **Very Low** significance. **Permanent, slight negative effects**
Sparrowhawk (Low)	Land taken during the construction phase of the development will be discernible, but the overall character of habitats will be similar to the pre-development circumstance. No direct loss of nesting habitat will result from land lost to construction works. This species was a probable breeder at the site although no nest sites were located for the	Percival Significance is calculated as a product of the sensitivity

Species (Sensitivity)	**Habitat loss and Fragmentation (Magnitude)**	**Significance Evaluation* (Percival 2003[87]; EPA 2017)**
	species at the site. Based on a consistent survey effort 2014 to 2018, the species was recorded in low numbers during the summer and winter months foraging onsite. Given that the internal infrastructure constitutes a small proportion (c. 51.8 ha/ 2.7%) of the total proposed development area and the availability of similar suitable habitats in the surroundings (e.g. bog/ heath/ grassland/ scrub), the magnitude of the impact is judged of **Low Concern.**	(Low) of the species and the magnitude (Low) of the effect. Evaluation: **Very Low** significance. **Permanent, slight negative effects**
Long-eared Owl (Low)	Land taken during the construction phase of the development will be discernible, but the overall character of habitats will be similar to the pre-development circumstance. No direct loss of nesting habitat will result from construction land use. This species was a confirmed breeder within the wider surroundings; however, no nest sites were located for the species at the site. Based on a consistent survey effort 2014 to 2018, the species was recorded infrequently in low numbers during the summer and winter months. Given that the internal infrastructure constitutes a small proportion (c. 51.8 ha/ 2.7%) of the total proposed development area and the availability of similar suitable habitats in the surroundings (e.g. bog/ heath/ grassland/ scrub), the magnitude of the impact is judged of **Low Concern.**	Percival Significance is calculated as a product of the sensitivity (Low) of the species and the magnitude (Low) of the effect. Evaluation: **Very Low** significance. **Permanent, slight negative effects**
Whooper Swan (Very High)	Land taken during the construction phase of the development will be discernible, but the overall character of habitats will be similar to the pre-development circumstance. The exceptional rainfall during the 2015/ 16 winter period, flooded sections of the site which provided a temporary feeding opportunity to local water birds. The site does not provide optimal roosting/ foraging habitat for Whooper Swan during normal rainfall years. Based on a consistent survey effort 2014 to 2018, the species was recorded occasionally during winter months. Given that the infrastructure constitutes a small proportion (c. 51.8 ha/ 2.7%) of the total proposed development area, the wide-ranging nature of the species and the availability of similar suitable habitats in the surroundings (e.g. bog/ heath/ grassland/ scrub), the magnitude of the impact is judged of **Low Concern.**	Percival Significance is calculated as a product of the sensitivity (Very High) of the species and the magnitude (Low) of the effect. Evaluation: **Medium** significance. **Permanent, moderate negative effects**
Mute Swan (Low)	Land taken during the construction phase of the development will be discernible, but the overall character of habitats will be similar to the pre-development circumstance. The exceptional rainfall during the 2015/ 16 winter period,	Percival Significance is calculated as a product of the sensitivity

Species (Sensitivity)	Habitat loss and Fragmentation (Magnitude)	Significance Evaluation* (Percival 2003[87]; EPA 2017)
	flooded sections of the site which provided a temporary feeding opportunity to local water birds. The site does not provide optimal roosting/ foraging habitat for Mute Swan during normal rainfall years. Based on a consistent survey effort 2014 to 2018, the species was recorded occasionally year-round (primarily within River Shannon catchment). Given that the internal infrastructure constitutes a small proportion (c. 51.8 ha/ 2.7%) of the total proposed development area, the wide-ranging nature of the species and the availability of similar suitable habitats in the surroundings (e.g. bog/ heath/ grassland/ scrub), the magnitude of the impact is judged of **Low Concern.**	(Low) of the species and the magnitude (Low) of the effect. Evaluation: **Very Low** significance. **Permanent, slight negative effects**
Mallard (Very High)	Land taken during the construction phase of the development will be discernible, but the overall character of habitats will be similar to the pre-development circumstance. The exceptional rainfall during the 2015/ 16 winter period, flooded sections of the site which provided a temporary feeding opportunity to local water birds. The site does not provide optimal roosting/ foraging habitat for Mallard during normal rainfall years. Based on a consistent survey effort 2014 to 2018, the species was recorded occasionally year-round (primarily within River Shannon catchment). Given that the internal infrastructure constitutes a small proportion (c. 51.8 ha/ 2.7%) of the total proposed development area and the availability of similar suitable habitats in the surroundings (e.g. bog/ heath/ grassland/ scrub), the magnitude of the impact is judged of **Low Concern.**	Percival Significance is calculated as a product of the sensitivity (Very High) of the species and the magnitude (Low) of the effect. Evaluation: **Medium** significance. **Permanent, moderate negative effects**
Common Tern (Very High)	Land taken during the construction phase of the development will be discernible, but the overall character of habitats will be similar to the pre-development circumstance. The site does not provide suitable breeding or foraging habitat for this species. This species was primarily recorded foraging and commuting along the River Shannon off site. Based on a consistent survey effort 2014 to 2018, the species was recorded infrequently during the summer months of 2016 (primarily within River Shannon catchment). Given that the internal infrastructure constitutes a small proportion (c. 51.8 ha/ 2.7%) of the total proposed development area, the unsuitable/ sub-optimal nature of the habitats onsite and the availability of optimal habitats in the surroundings (River Shannon catchment), the magnitude of the impact is judged as **Negligible.**	Percival Significance is calculated as a product of the sensitivity (Very High) of the species and the magnitude (Negligible) of the effect. Evaluation: **Low** significance. **Permanent, not significant negative effects**
Golden Plover (Very High)	Land taken during the construction phase of the development will be discernible, but the overall character of habitats will be similar to the pre-development circumstance. On rare occasions the species was found to roost onsite. Golden	Percival Significance is calculated as a product of the sensitivity

Species (Sensitivity)	Habitat loss and Fragmentation (Magnitude)	Significance Evaluation* (Percival 2003[87]; EPA 2017)
	Plover were found not to be dependent on the habitats onsite based on the occasional site usage. Based on a consistent survey effort 2014 to 2018, the species was recorded occasionally during winter months. Given that the internal infrastructure constitutes a small proportion (c. 51.8 ha/ 2.7%) of the total proposed development area and the availability of similar suitable habitats in the surroundings (e.g. bog/ heath/ grassland/ scrub), this species was found not to be dependent on the habitats onsite for feeding, roosting or breeding. The effect of habitat loss is deemed of **Low Concern.**	(Very High) of the species and the magnitude (Low) of the effect. Evaluation: **Medium** significance. **Permanent, moderate negative effects**
Lapwing (Very High)	Land taken during the construction phase of the development will be discernible, but the overall character of habitats will be similar to the pre-development circumstance. Based on a consistent survey effort 2014 to 2018, Lapwing were found to be predominantly a wintering population. The species is judged not to be dependent on the onsite habitats given that the internal infrastructure constitutes a small proportion (c. 51.8 ha/ 2.7%) of the total proposed development area and the availability of similar suitable habitats in the surroundings (e.g. bog/ heath/ grassland/ scrub). The effect of habitat loss is deemed of **Low Concern.**	Percival Significance is calculated as a product of the sensitivity (Very High) of the species and the magnitude (Low) of the effect. Evaluation: **Medium** significance. **Permanent, moderate negative effects**
Curlew (High)	Land taken during the construction phase of the development will be discernible, but the overall character of habitats will be similar to the pre-development circumstance. Lands which will fall within the development footprint are considered sub-optimal breeding and foraging habitat for this species. Based on a consistent survey effort 2014 to 2018, the species was recorded rarely onsite during both winter and summer months. The species was most often recorded on fringing habitat surrounding the site. Given that the internal infrastructure constitutes a small proportion (c. 51.8 ha/ 2.7%) of the total proposed development area and the availability of similar suitable habitats in the surroundings (e.g. bog/ heath/ grassland/ scrub), the magnitude of the impact is judged of **Low Concern.**	Percival Significance is calculated as a product of the sensitivity (High) of the species and the magnitude (Low) of the effect. Evaluation: **Low** significance. **Permanent, slight negative effects**
Woodcock (Medium)	Land taken during the construction phase of the development will be discernible, but the overall character of habitats will be similar to the pre-development circumstance. Based on a consistent survey effort 2014 to 2018, the species was recorded as present year-round. Species specific surveys did not locate any breeding sites onsite (probable breeder locally). Woodcock was found to use the site in low numbers, additionally the internal infrastructure	Percival Significance is calculated as a product of the sensitivity (Medium) of the species and the magnitude (Low) of the effect.

Species (Sensitivity)	Habitat loss and Fragmentation (Magnitude)	Significance Evaluation* (Percival 2003[87]; EPA 2017)
	constitutes a small proportion (c. 51.8 ha/ 2.7%) of the total proposed development area and the availability of similar suitable habitats in the surroundings (e.g. bog/ heath/ grassland/ scrub). Therefore, the species were judged not to be dependent on the habitats of the site. The effect of habitat loss is deemed of **Low Concern.**	Evaluation: **Low** significance. **Permanent, slight negative effects**
Snipe (Low)	The construction of access roads and all turbine hardstand areas will result in the loss of Snipe breeding habitat. Several breeding Snipe territories were recorded onsite. Given the survey effort 2014 to 2018 the number of breeding territories was found to be low. This species has a widespread distribution throughout the country. Given that the internal infrastructure constitutes a small proportion (c. 51.8 ha/ 2.7%) of the total proposed development area and the availability of similar suitable habitats in the surroundings (e.g. bog/ heath/ grassland/ scrub), the magnitude of the impact is judged to be of **Low Concern**.	Percival Significance is calculated as a product of the sensitivity (Low) of the species and the magnitude (Low) of the effect. Evaluation: **Very Low** significance. **Permanent, slight negative effects**
Ringed Plover (Low)	The construction of access roads and all turbine hardstand areas will result in the loss of potential Ringed Plover breeding habitat. The breeding population trend for this species in Ireland is unknown[72]. In 2017, two breeding Ringed Plover territories were recorded onsite, i.e. within c.100m and 50m of proposed infrastructure. A further five were located within 500m of the proposed development. Given the survey effort 2014 to 2018 the number of breeding territories was found to be low. This species has a widespread distribution throughout the country. Given that the internal infrastructure constitutes a small proportion (c. 51.8 ha/ 2.7%) of the total proposed development area and the availability of similar suitable habitats in the surroundings (e.g. short-grazed pasture beside rivers and along lakes), the magnitude of the impact is judged to be of **Low Concern**.	Percival Significance is calculated as a product of the sensitivity (Low) of the species and the magnitude (Low) of the effect. Evaluation: **Very Low** significance. **Permanent, not significant negative effects**
Little Egret (Medium)	Land taken during the construction phase of the development will be discernible, but the overall character of habitats will be similar to the pre-development circumstance. Lands which will fall within the development footprint are sub-optimal for foraging and provide no suitable breeding habitat for this species. This species was primarily recorded commuting across the site on route to Lough Ree. Based on a consistent survey effort 2014 to 2018, the species was recorded rarely onsite during both winter and summer months. The species was most often recorded on fringing	Percival Significance is calculated as a product of the sensitivity (Medium) of the species and the magnitude (Low) of the effect. Evaluation: **Low** significance.

Species (Sensitivity)	Habitat loss and Fragmentation (Magnitude)	Significance Evaluation* (Percival 2003[87]; EPA 2017)
	habitat surrounding site. Given that the internal infrastructure constitutes a small proportion (c. 51.8 ha/ 2.7%) of the total proposed development area, the sub-optimal nature of the habitats onsite and the availability of optimal habitats in the surroundings (River Shannon catchment), the magnitude of the impact is judged of **Low Concern.**	**Permanent, slight negative effects**
Grey Heron (Low)	Land taken during the construction phase of the development will be discernible, but the overall character of habitats will be similar to the pre-development circumstance. Lands which will fall within the development footprint are sub-optimal for foraging and provide no suitable breeding habitat for this species. This species was primarily recorded commuting across the site on route to Lough Ree. Based on a consistent survey effort 2014 to 2018, the species was recorded rarely onsite during both winter and summer months. Given that the infrastructure constitutes a small proportion (c. 51.8 ha/ 2.7%) of the total proposed development area and the availability of optimal habitats in the surroundings (River Shannon catchment), the magnitude of the impact is judged of **Low Concern.**	Percival Significance is calculated as a product of the sensitivity (Low) of the species and the magnitude (Low) of the effect. Evaluation: **Very Low** significance. **Permanent, slight negative effects**
Black-headed Gull (High)	Land taken during the construction phase of the development will be discernible, but the overall character of habitats will be similar to the pre-development circumstance. Onsite habitats are sub-optimal for foraging and provide no suitable breeding habitat for this species. This species was primarily recorded commuting across the site on route to Lough Ree. Based on a consistent survey effort 2014 to 2018, the species was recorded rarely foraging onsite during both winter and summer months. Given that the internal infrastructure constitutes a small proportion (c. 51.8 ha/ 2.7%) of the total proposed development area, the low value of onsite habitats for this species (e.g. primarily peatland and scrub) and the availability of optimal habitats in the surroundings (River Shannon catchment), the magnitude of the impact is judged of **Low Concern.**	Percival Significance is calculated as a product of the sensitivity (High) of the species and the magnitude (Low) of the effect. Evaluation: **Low** significance. **Permanent, slight negative effects**
Lesser Black-backed Gull (Low)	Land taken during the construction phase of the development will be discernible, but the overall character of habitats will be similar to the pre-development circumstance. Onsite habitats are sub-optimal for foraging and provide no suitable breeding habitat for this species. This species was primarily recorded commuting across the site on route to Lough Ree. Based on a consistent survey effort 2014 to 2018, the species was recorded rarely foraging onsite during both winter and summer months. Given that the internal infrastructure constitutes a small proportion (c. 51.8 ha/	Percival Significance is calculated as a product of the sensitivity (Low) of the species and the magnitude (Low) of the effect.

Species (Sensitivity)	**Habitat loss and Fragmentation (Magnitude)**	**Significance Evaluation* (Percival 2003[87]; EPA 2017)**
	2.7%) of the total proposed development area, the short-term nature of the construction works, the inappropriate nature of the habitats onsite and the availability of optimal habitats in the surroundings (River Shannon catchment), the magnitude of the impact is judged of **Low Concern.**	Evaluation: **Very Low** significance. **Permanent, not significant negative effects**
Cormorant (High)	Land taken during the construction phase of the development will be discernible, but the overall character of habitats will be similar to the pre-development circumstance. The site does not provide suitable breeding or foraging habitat for this species. This species was primarily recorded foraging and commuting along the River Shannon off site. Based on a consistent survey effort 2014 to 2018, the species was recorded occasionally in both winter and summer months (primarily within River Shannon catchment). Given that the internal infrastructure constitutes a small proportion (c. 51.8 ha/ 2.7%) of the total proposed development area, the low value of onsite habitats for this species (e.g. primarily peatland and scrub) and the availability of optimal habitats in the surroundings (River Shannon catchment), the magnitude of the impact is judged as **Negligible.**	Percival Significance is calculated as a product of the sensitivity (High) of the species and the magnitude (Negligible) of the effect. Evaluation: **Very Low** significance. **Permanent, not significant negative effects**

Note:

* Under this rating system "very low significance" or "low significance" can be understood to mean there will be no significant effect.

6.6.1.3.2 Disturbance Displacement (Potential Indirect Impacts)

Effective habitat loss through disturbance displacement can result from the routine action of staff and machinery during the construction works at a site. Numerous studies have investigated this observation, the magnitude of the effect has been found to vary with species, breeding status and with the availability of alternative habitat nearby. These studies have been conducted within various habitat types including, upland, coastal and offshore wind farm sites. Although the result of such studies have been shown to vary, it remains clear that under particular circumstances some displacement can occur. The effect of such displacement has the potential to be ecologically significant.

At the proposed development potential disturbance displacement effects may result during construction phase of development works. These effects will vary with species, habitat choice, breeding status, range and with the duration of the construction works. Possible disturbance displacement effects will only be felt for the duration of construction works, in this instance they will therefore be considered short term in duration, i.e. the construction phase duration is 24 to 30 months.

Table 6.22 below assesses the potential effect of the disturbance displacement on key avian ecological receptor species observed within the proposed development area. The methodology of the assessment of the impact of disturbance displacement will follow Percival (2003) and EPA (2017) (refer to Section 6.4.5 for further details).

Table 6.22: Assessing the Potential Impact on Local Avian Communities from Disturbance Displacement Associated with Construction Activities

Species (Sensitivity)	**Disturbance Displacement (Magnitude)**	**Significance Evaluation* (Percival 2003[88]; EPA 2017)**
Hen Harrier (Medium)	Disturbance due to construction works can result in effective habitat loss through displacement. This effect will be short term in nature for the duration of the construction phase. Potential exists for this species to experience disturbance effects in the non-breeding season during construction works. In Bright *et al*. (2006) displacement has been suggested to occur up to 500m around construction site[89]. No direct loss of nesting habitat will result from disturbance displacement. No nest sites were located for the species onsite or within 500m of the site. The species was found to infrequently use the site for foraging. Given the short-term nature of the construction works, the wide-ranging nature of the species and the availability of similar suitable habitats in the surroundings (e.g. bog/ heath/ grassland/ scrub), the magnitude of the impact is deemed of **Low Concern.**	Percival Significance is calculated as a product of the sensitivity (Medium) of the species and the magnitude (Low) of the effect. Evaluation: **Low** significance **Short term, slight negative effects**
Merlin (Medium)	Disturbance due to construction works can result in effective habitat loss through displacement. This effect will be short term in nature for the duration of the construction phase. Potential exists for this species to experience disturbance effects in both summer and winter during construction works. A 125m protective buffer was recommended by Holmes *et al.* (1993) to prevent wintering birds from being flushed[90]. This species was recorded infrequently both onsite or within 125m of the site boundary. The species was a confirmed breeder	Percival Significance is calculated as a product of the sensitivity (Medium) of the species and the magnitude (Low) of the effect. Evaluation: **Low** significance.

[88] Percival (2003) details an assessment methodology to determine the significance of an impact based on the product of the sensitivity of the receptor and the magnitude of the effect. The sensitivity of a species is defined by Percival (2003) as its ecological importance and nature conservation interest at the site being assessed. Species which are of special conservation interest of a European site have the highest sensitivity rating. The significance of any one impact is a product of the sensitivity of the receptor, the magnitude of the impact and the probability of that impact occurring. The assessment of significance follows this evaluation methodology.

[89] Bright, J. A., Langston, R. H. W., Bullman, R., Evans, R. J., Gardner, S., Pearce-Higgins, J., & Wilson, E. (2006). Bird Sensitivity Map to provide locational guidance for onshore wind farms in Scotland. *Royal society for the protection of birds research report*, (20).

[90] Holmes, T. L., Knight, R. L., Stegall, L., & Craig, G. R. (1993). Responses of wintering grassland raptors to human disturbance. *Wildlife Society Bulletin (1973-2006)*, *21*(4), 461-468.

Species (Sensitivity)	Disturbance Displacement (Magnitude)	Significance Evaluation* (Percival 2003[88]; EPA 2017)
	within the wider surroundings; however, no nest site was located within 500m of the site boundary. Given a core foraging range of 5km for Merlin[59] and the low site usage rate for this species, it follows that the site constitutes the extreme edge of a Merlin territory which it little visits. Given the short-term duration of the construction works, and the availability of similar suitable habitats in the surroundings (e.g. bog/ heath/ grassland/ scrub), the magnitude of the impact is judged of **Low Concern.**	**Short term, slight negative effects**
Peregrine Falcon (Medium)	Disturbance due to construction works can result in effective habitat loss through displacement. This effect will be short term in nature for the duration of the construction phase. Potential exists for this species to experience disturbance effects in both summer and winter during construction works. Disturbance distances for this species range between 500-750m as recommended by Ruddock & Whitfield (2007)[91]. No suitable nesting sites were located for the species at the site or within the wider surroundings. The species was recorded infrequently in low numbers within a 500-750m radius of the site. The species is unlikely to be displaced (by construction effects) from the area based on the occasional use of the site. Given the short-term duration of the construction works, the wide-ranging nature of the species and the availability of similar suitable habitats in the surroundings (e.g. bog/ heath/ grassland/ scrub), the magnitude of the impact is judged of **Low Concern.**	Percival Significance is calculated as a product of the sensitivity (Medium) of the species and the magnitude (Low) of the effect. Evaluation: **Low** significance. **Short term, slight negative effects**
Buzzard (Low)	Disturbance displacement due to construction works will not result in significant effects for this species. No nest sites were located for this species onsite or within habitats fringing the site. The species favourable conservation status limits the potential for ecologically significant effect. Given the short-term duration of construction works, the low number of observations and the availability of similar suitable habitats in the surroundings (e.g. bog/ heath/ grassland/ scrub), the magnitude of the impact is judged of **Low Concern.**	Percival Significance is calculated as a product of the sensitivity (Low) of the species and the magnitude (Low) of the effect. Evaluation: **Very Low** significance. **Short term, slight negative effects**

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

Species (Sensitivity)	Disturbance Displacement (Magnitude)	Significance Evaluation* (Percival 2003[88]; EPA 2017)
Kestrel (Low)	Disturbance displacement due to construction works will not result in significant effects for this. No nest sites were located for this species onsite or within habitats fringing the site. The species widespread breeding distribution limits the potential for ecologically significant effect. Given the short-term duration of construction works, the low number of observations and the availability of similar suitable habitats in the surroundings (e.g. bog/ heath/ grassland/ scrub), the magnitude of the impact is judged of **Low Concern.**	Percival Significance is calculated as a product of the sensitivity (Low) of the species and the magnitude (Low) of the effect. Evaluation: **Very Low** significance. **Short term, slight negative effects**
Sparrowhawk (Low)	Disturbance displacement due to construction works will not result in significant effects for this species. No nest sites were located for this species onsite or within habitats fringing the site. The species widespread breeding distribution limits the potential for ecologically significant effect. Given the short-term duration of construction works, the low number of observations and the availability of similar suitable habitats in the surroundings (e.g. bog/ heath/ grassland/ scrub), the magnitude of the impact is judged of **Low Concern.**	Percival Significance is calculated as a product of the sensitivity (Low) of the species and the magnitude (Low) of the effect. Evaluation: **Very Low** significance. **Short term, slight negative effects**
Long-eared Owl (Low)	Disturbance due to construction works can result in effective habitat loss through displacement. This effect will be short term in nature for the duration of the construction phase. A single breeding territory was recorded outside the footprint of the proposed development to the north of the site (Derryaroge). The number of breeding territories was therefore found to be low. This species widespread distribution limits the potential for ecologically significant effects. Given construction effects will be short term in duration, the species is expected to utilise onsite habitats following construction. Therefore, the magnitude of the impact is judged to be of **Low Concern**.	Percival Significance is calculated as a product of the sensitivity (Low) of the species and the magnitude (Low) of the effect. Evaluation: **Very Low** significance. **Short term, slight negative effects**
Whooper Swan (Very High)	Disturbance due to construction works can result in effective habitat loss through displacement. This effect will be short term in nature for the duration of the construction phase. The exceptional rainfall of the 2015/ 16 winter period flooded sections of the proposed development site which provided a temporary feeding opportunity for local water birds. However, usually this site does not provide optimal roosting/ foraging habitat for Whooper Swan during normal rainfall years. In the absence of flooding, the habitats of the site will not	Percival Significance is calculated as a product of the sensitivity (Very High) of the species and the magnitude (Low) of the effect. Evaluation: **Medium** significance.

Species (Sensitivity)	Disturbance Displacement (Magnitude)	Significance Evaluation* (Percival 2003[88]; EPA 2017)
	attract this species to the area. The species is unlikely to be displaced (by construction effects) from the wider area based on the occasional use of the site during flooding events. Given the short-term nature of the construction works and the availability of optimal habitats in the surroundings (River Shannon catchment), the magnitude of the impact is judged of **Low Concern.**	**Short term, moderate effects**
Mute Swan (Low)	Disturbance due to construction works can result in effective habitat loss through displacement. This effect will be short term in nature for the duration of the construction phase. The exceptional rainfall during the 2015/ 16 winter period, flooded sections of the site which provided a temporary feeding opportunity to local water birds. The site does not provide optimal roosting/ foraging habitat for Mute Swan during normal rainfall years. This species was recorded occasionally 2014 to 2018, the vast majority of these observations was made within the River Shannon catchment (offsite). Given the short-term nature of the construction works, and the availability of optimal habitats in the surroundings (River Shannon catchment), the magnitude of the impact is judged of **Low Concern.**	Percival Significance is calculated as a product of the sensitivity (Low) of the species and the magnitude (Low) of the effect. Evaluation: **Very Low** significance. **Short term, slight negative effects**
Mallard (Very High)	Disturbance displacement due to construction works will not result in significant effects for this species. No nest sites were located for this species onsite or within habitats fringing the site. The species favourable conservation status limits the potential for ecologically significant effect. Given the short-term duration of construction works, the low number of observations and the availability of similar suitable habitats in the surroundings (e.g. drainage ditches where breeding pairs may establish nest sites during summer months and winter populations may utilise for foraging), the magnitude of the impact is judged of **Low Concern.**	Percival Significance is calculated as a product of the sensitivity (Very High) of the species and the magnitude (Low) of the effect. Evaluation: **Medium** significance. **Short term, moderate effects**
Common Tern (Very High)	Disturbance displacement due to construction works will not result in significant effects for this species. No nest sites were located for this species onsite or within habitats fringing the site. The habitats onsite are not suitable foraging habitat. Given the short-term nature of the construction works, the inappropriate nature of the habitats onsite and the availability of optimal habitats in the surroundings (River Shannon catchment), the magnitude of the impact is judged as **Negligible.**	Percival Significance is calculated as a product of the sensitivity (Very High) of the species and the magnitude (Negligible) of the effect. Evaluation: **Low** significance.

Species (Sensitivity)	Disturbance Displacement (Magnitude)	Significance Evaluation* (Percival 2003[88]; EPA 2017)
		Short term, not significant negative effects)
Golden Plover (Very High)	Disturbance due to construction works can result in effective habitat loss through displacement. This effect will be short term in nature for the duration of the construction phase. Potential exists for this species to experience disturbance effects in the non-breeding season during construction works. Disturbance displacement was found by Hotker *et al.* (2006) to be dependent on the availability of similar suitable habitat within the surroundings[92]. Golden Plover were found to only use the site occasionally, the relative level of flight activity and flock size were low, additionally the wider surroundings contains similar suitable habitat (e.g. bog/ heath/ grassland/ scrub). Therefore, disturbance displacement due to construction works will not result in significant effects for this species. The effect of disturbance displacement is deemed of **Low Concern.**	Percival Significance is calculated as a product of the sensitivity (Very High) of the species and the magnitude (Low) of the effect. Evaluation: **Medium** significance. **Short term, moderate effects**
Lapwing (Very High)	Disturbance due to construction works can result in effective habitat loss through displacement. This effect will be short term in nature for the duration of the construction phase. The majority of records for this species were made during the winter months; this period is therefore when the species is most vulnerable to the potential for disturbance impacts during the construction works. Disturbance displacement was found by Hotker *et al.* (2006) to be dependent on the availability of similar suitable habitat within the surroundings[92]. Lapwing were found to only use the site occasionally, the relative level of flight activity and flock size were low, additionally the wider surroundings contains similar suitable habitat (e.g. bog/ heath/ grassland/ scrub). Therefore, disturbance displacement due to construction works will not result in significant effects for this species. The effect of disturbance displacement is judged of **Low Concern.**	Percival Significance is calculated as a product of the sensitivity (Very High) of the species and the magnitude (Low) of the effect. Evaluation: **Medium** significance. **Short term, moderate effects**

[92] Hötker, H., Thomsen, K. M., & Köster, H. (2006). Impacts on biodiversity of exploitation of renewable energy sources: the example of birds and bats. *Facts, gaps in knowledge, demands for further research, and ornithological guidelines for the development of renewable energy exploitation. Michael-Otto-Institut im NABU, Bergenhusen*, *65*.

Species (Sensitivity)	Disturbance Displacement (Magnitude)	Significance Evaluation* (Percival 2003[88]; EPA 2017)
Curlew (High)	Disturbance due to construction works can result in effective habitat loss through displacement. This effect will be short term in nature for the duration of the construction phase. Potential exists for this species to experience disturbance effects in both summer and winter during construction works. The species was most often recorded on fringing habitat surrounding the site. Individuals displaced from fringing habitats as a result of disturbance effects occurring during construction works are expected to return following constructions of the development, additionally the wider surroundings contain similar suitable habitat (e.g. bog/ heath/ grassland/ scrub). Therefore, the magnitude of this development is deemed to be of **Low Concern.**	Percival Significance is calculated as a product of the sensitivity (High) of the species and the magnitude (Low) of the effect. Evaluation: **Low** significance. **Short term, slight negative effects**
Woodcock (Medium)	Disturbance due to construction works can result in effective habitat loss through displacement. This effect will be short term in nature for the duration of the construction phase. The species was recorded as present year-round. Species specific survey did not locate any breeding sites onsite (probable breeder offsite). Woodcock was found to only use the site occasionally, the relative level of flight activity and flock size were low, additionally the wider surroundings contains similar suitable habitat (e.g. bog/ heath/ grassland/ scrub). Therefore, disturbance displacement due to construction works will not result in significant effects for this species. The effect of disturbance displacement is deemed of **Low Concern.**	Percival Significance is calculated as a product of the sensitivity (Medium) of the species and the magnitude (Low) of the effect. Evaluation: **Low** significance. **Short term, slight negative effects**
Snipe (Low)	Disturbance due to construction works can result in effective habitat loss through displacement. This effect will be short term in nature for the duration of the construction phase. Several breeding Snipe territories were recorded onsite. The number of breeding territories was found to be low. This species has a widespread distribution throughout the country. Given construction effects will be short term in duration, the species is expected to utilise onsite habitats following construction, additionally the wider surroundings contain similar suitable habitat (e.g. bog/ heath/ grassland/ scrub). Therefore, the magnitude of the impact is judged to be of **Low Concern**.	Percival Significance is calculated as a product of the sensitivity (Low) of the species and the magnitude (Low) of the effect. Evaluation: **Very Low** significance. **Short term, slight negative effects**
Ringed Plover (Low)	The construction of access roads and all turbine hardstand areas and other infrastructure could result in effective habitat loss of potential Ringed Plover breeding habitat. In 2017, two breeding Ringed Plover territories were recorded onsite, i.e. within c.100m and 50m of proposed infrastructure. Given the survey effort	Percival Significance is calculated as a product of the sensitivity (Low) of the

Species (Sensitivity)	Disturbance Displacement (Magnitude)	Significance Evaluation* (Percival 2003[88]; EPA 2017)
	2014 to 2018 the number of breeding territories was found to be low. This species has a widespread distribution throughout the country. Given construction effects will be short term in duration, the species is expected to utilise onsite habitats following construction, additionally the wider surroundings contain similar suitable habitat (e.g. short-grazed pasture beside rivers and along lakes). Therefore, the magnitude of the impact is judged to be of **Low Concern**.	species and the magnitude (Low) of the effect. Evaluation: **Very Low** significance. **Short term, slight negative effects**
Little Egret (Medium)	It is considered that disturbance displacement due to construction works will not greatly impact this species. No nest sites were located for this species onsite or within habitats fringing the site. The range expansion which this species is currently experiencing limits the potential for ecologically significant effect. Given the short-term duration of construction works, the low number of observations and the availability of similar suitable habitats in the surroundings, the magnitude of the impact is judged of **Low Concern.**	Percival Significance is calculated as a product of the sensitivity (Medium) of the species and the magnitude (Low) of the effect. Evaluation: **Low** significance. **Short term, slight negative effects**
Grey Heron (Low)	It is considered that disturbance displacement due to construction works will not greatly impact this species. No nest sites were located for this species onsite or within habitats fringing the site. The species favourable conservation status limits the potential for ecologically significant effect. Given the short-term duration of construction works, the low number of observations and the availability of similar suitable habitats in the surroundings (e.g. River Shannon catchment), the magnitude of the impact is judged of **Low Concern.**	Percival Significance is calculated as a product of the sensitivity (Low) of the species and the magnitude (Low) of the effect. Evaluation: **Very Low** significance. **Short term, slight negative effects**
Black-headed Gull (High)	It is considered that disturbance displacement due to construction works will not greatly impact this species. The species was regularly recorded commuting across the site on route to Lough Ree. The habitats onsite do not provide optimal feeding or breeding opportunities for this species which limits the potential for ecologically significant effect. Given the short-term nature of the construction works, the inappropriate nature of the habitats onsite and the availability of optimal habitats in the surroundings (River Shannon), the magnitude of the impact is judged of **Low Concern.**	Percival Significance is calculated as a product of the sensitivity (High) of the species and the magnitude (Low) of the effect. Evaluation: **Low** significance. **Short term, slight negative effects**

Species (Sensitivity)	Disturbance Displacement (Magnitude)	Significance Evaluation* (Percival 2003[88]; EPA 2017)
Lesser Black-backed Gull (Low)	It is considered that disturbance displacement due to construction works will not greatly impact this species. The species was regularly recorded commuting across the site on route to Lough Ree. The habitats onsite do not provide feeding or breeding opportunities for this species which limits the potential for ecologically significant effect. Given the short-term nature of the construction works, and the availability of optimal habitats in the surroundings (River Shannon), the magnitude of the impact is judged of **Low Concern.**	Percival Significance is calculated as a product of the sensitivity (Low) of the species and the magnitude (Low) of the effect. Evaluation: **Very Low** significance. **Short term, slight negative effects**
Cormorant (High)	It is considered that disturbance displacement due to construction works will not greatly impact this species. No nest sites were located for this species onsite or within habitats fringing the site. The habitats onsite are not suitable foraging habitat. Given the short-term nature of the construction works, the inappropriate nature of the habitats onsite and the availability of optimal habitats in the surroundings (River Shannon), the magnitude of the impact is judged as **Negligible.**	Percival Significance is calculated as a product of the sensitivity (High) of the species and the magnitude (Negligible) of the effect. Evaluation: **Very Low** significance. **Short term, slight negative effects**

Note:

* Under this rating system “very low significance” or “low significance” can be understood to mean there will be no significant effect.

6.6.1.4 Impacts to Fauna from Construction Activities

The following activities have been identified as having the potential to impact fauna during the construction phase; disturbance due to increased human activity and vehicular access and habitat loss/ displacement and/ or damage. Disturbance associated with construction activities is only expected to occur for the duration of construction works (i.e. 24 to 30 months). In a worst-case scenario habitat loss at the site is expected to be permanent. These are considered in more detail below.

6.6.1.4.1 Bats

The principal impacts resulting from construction activities on bat fauna may be summarised as follows:

- Loss, alteration or fragmentation of key bat habitats such as scrub, woodland or pools/ temporary open water as a result of construction will impact on commuting bats. This is considered as a moderate negative effect.
- Loss or fragmentation of foraging habitats may diminish the available insect prey species and reduce feeding area for bats in some locations. This is considered as a moderate negative effect and maybe reduced to a slight negative effect if the bat habitat remains in the landscape.

During the construction phase, the removal of habitats in the vicinity of the turbines and haulage roads increases the potential impact of the proposed development on bat populations especially in relation to woodland and edge feeding species: brown long-eared bat, soprano pipistrelle, common pipistrelle and Myotis species. The use of lighting during construction will be avoided where possible so as not to deter bats from foraging, except where it is required for health and safety. The impact of construction activities on the local bat community was calculated as a product of the number of bats recorded at proposed infrastructure locations, the sensitivity of the species to the impact and whether the location contained suitable bat habitat.

The clearance of potential bat habitat at the following turbine locations may negatively impact bats during the construction phase, as per Derryadd Wind Farm Bat Survey Report (Appendix 6.6, Table 5.3).

- The location of six wind turbines is deemed to have a potential high impact on local bat populations: T2, T4, T10, T12, T19 and T22;
- The location of five wind turbines is deemed to have a potential medium impact on local bat populations: T1, T3, T5, T11 and T18;
- The location of seven wind turbines is deemed to have a potential low impact on local bat populations: T7, T8, T9, T20, T21, T23, T24; and
- The location of the remaining turbines is considered to have negligible impact on local bat populations: T6, T13, T14, T15, T16 and T17.

The clearance of potential bat habitat along the following internal haul roads may negatively impact bats during the construction phase, as per Derryadd Wind Farm Bat Survey Report (Appendix 6.7, Table 4.17).

- The location of four section of internal roads may impact on local bat populations: between T4-T5, T5-T6, T14-T15 and T20-T21.

The total area of 'bat habitat' is 434.53 ha. The length of the internal haul roads that traverse 'bat habitat' is 9km. Therefore, it is estimated that 1.24% of 'bat habitat' will be cleared to facilitate haul roads, as per Derryadd Wind Farm Bat Survey Report (Appendix 6.7). The assessment of significant effects is provided in Table 6.23.

6.6.1.4.2 Mammals

Noise associated with construction works and traffic activity may disturb resident mammals. However, in most cases, mammals within the development area are thought to be sufficiently mobile so as to temporarily relocate from works areas. Construction activities can lead to disturbance impact, the distance at which this impact is felt will depend inter alia, on the sensitivity of the receptor to the impact. Excavation works can result in disturbance impacts for badgers to a distance of 50m and for otters to a distance of 150m, as per NRA guidelines. Construction noise will not be significantly different from current commercial peat extraction activities; therefore, it is reasonable to conclude that there is a degree to which local fauna have habituation to background machinery noise. Therefore, this impact is considered to be a short term, slight negative effect.

Habitat loss is not considered to be of high concern for mammals within the proposed development area; given that the internal roads, substation, associated infrastructure and turbine hard standing area constitutes a small proportion (c. 51.8 ha/ 2.7%) of the total proposed development area and the availability of similar suitable habitats in the surroundings (e.g. bog/ heath/ grassland/ scrub), the magnitude of the impact is judged to be a permanent slight negative effect.

Impacts to otter breeding/ resting sites are not predicted given there were no confirmed holts/ resting places recorded within the proposed development site. Furthermore, it is unlikely that otter spend extended periods within the proposed development area given the habitats of the site are considered sub-optimal, however it is possible that otter holts occur within 150m of proposed construction works areas. Given no otter holts were recorded within the proposed development site and the sub-optimal suitability of habitats onsite, potential disturbance impacts are considered unlikely, short term, and may have slightly negative effects.

Pine marten signs (e.g. scat) were found throughout the proposed development area, within all three onsite bogs (Derryaroge, Derryadd and Lough Bannow). No evidence of pine marten activity was noted during surveys at proposed infrastructure locations. No breeding dens were located onsite. It is judged that there is potential for disturbance displacement during the construction of the proposed development. This is considered to be a short term slight negative effect.

Impacts to badger setts are not predicted given there were no confirmed setts/ resting places recorded within the development area. However, it is possible that unidentified badger setts occur in proximity (within 50m) to works areas and therefore this potential (disturbance) impact can be described as an unlikely short term slight negative effect.

6.6.1.4.3 Other Fauna

Desmoulin's whorl snail (*Vertigo moulinsiana*) require stable hydraulic conditions to maintain the swamp habitat that they favour, impacts on local hydrology could result in habitat loss for this species. Article 17 of the Habitats Directive (Directive 92/43/EEC) identifies drainage as a potential threat/ pressure for this species. Lough Bawn pNHA potentially contains suitable habitat for this species, however the proposed development infrastructure is not located within this pNHA and is considered that the drainage regime proposed at the site is designed in such a manner as to have no significant impact. Further details on the potential for hydrological impacts from the proposed development are detail in Chapter 8 of the EIAR. Surface water pathways exist between potential Desmoulin's whorl snail habitat and the amenity track that is proposed to provide access from the Royal Canal Way to Lough Bannow bog. If unmitigated, proposed construction activities could potentially result in water quality impacts in this location.

In summary, key receptors requiring mitigation consideration regarding potential construction phase impacts include: bats, otter, pine marten, badgers and Desmoulin’s whorl snail. The proposed development is not likely to have significant effects on any other fauna and therefore no mitigation in respect of any other species is required. The potential impacts associated with the construction phase are presented in Table 6.23 below.

Table 6.23: Potential Construction Phase Impacts on Identified Key Mammalian Receptors within the Proposed Development Site

Site/ Feature	Evaluation	Area	Potential Impact Source	Assessment of Potential Impact
Bats spp.	Annex IV of EU Habitats Directive *Wildlife (Amendment) Act, 2000*	The following locations were found to contain bat habitat that will be subject to removal. These locations have been further classed as being of high, medium or low concern: • The location of six wind turbines is deemed to have a potential high impact on local bat populations: T2, T4, T10, T12, T19 and T22; • The location of five wind turbines is deemed to have a potential medium impact on local bat populations: T1, T3, T5, T11 and T18; • The location of seven wind turbines is deemed to have a potential low impact on local bat populations: T7, T8, T9, T20, T21, T23, T24; • The location of the remaining turbines is considered to have negligible impact on local bat populations: T6, T13, T14, T15, T16 and T17; and • The location of four section of internal roads may impact on local bat populations: between T4-T5, T5-T6, T14-T15 and T20-T21. See Appendix 6.6, Table 5.3 and 4.17 for further details.	Construction phase impacts on the local bat community will include habitat loss resulting from the construction of turbines and haulage roads. Habitat loss is of particular concern for brown Long-eared Bats and *Myotis* species.	**Habitat Loss:** Permanent moderate negative effects
Otter	Annex IV of EU Habitats Directive *Wildlife Acts*	Otter signs were located in Derryadd and spraints (droppings) were found in a drainage ditch in the north east of Lough Bannow bog.	Habitat loss/ fragmentation and effective habitat loss through disturbance displacement to possible otter feeding	**Habitat Loss:** Permanent slight negative effects

Site/ Feature	Evaluation	Area	Potential Impact Source	Assessment of Potential Impact
			sites associated with construction activities at Derryadd and Lough Bannow.	**Disturbance displacement:** Short term, slight negative effects
Badger	*Wildlife (Amendment) Act, 2000*	No setts were located onsite however foot prints were recorded infrequently at each of the three onsite bogs, namely Derryarogue, Derryadd and Lough Bannow.	Habitat loss/ fragmentation and effective habitat loss through disturbance displacement to possible badger foraging habitat. Habitats onsite are judged as sub-optimal for badgers.	**Habitat Loss:** Permanent slight negative effects **Disturbance displacement:** Short term, slight negative effects
Pine Marten	Annex V of EU Habitats Directive *Wildlife Acts*	Pine Marten signs were found infrequently onsite, no signs were located at proposed turbine locations however scat or foot prints were noted at each of the three bogs onsite (Derryarogue, Derryadd and Lough Bannow).	Habitat loss/ fragmentation and effective habitat loss through disturbance displacement to possible pine marten foraging habitat.	**Habitat Loss:** Permanent slight negative effects **Disturbance displacement:** Short term, slight negative effects

Site/ Feature	Evaluation	Area	Potential Impact Source	Assessment of Potential Impact
Marsh Fritillary (*Euphydryas aurinia*)	Annex II of EU Habitats Directive	The Marsh Fritillary host plant Devil's Bit Scabious was found to be most abundant along railway tracks and in areas of re-colonising bare ground within the proposed development area. It was not found in areas of dense scrub or where the sward was tall, i.e. above 25cm.	Loss of potential breeding habitat/ habitat containing Devil's Bit Scabious. The species-specific survey located Marsh Fritillary larvae in two location, neither of which were within the proposed development footprint. The identified Marsh Fritillary breeding sites were > c.400m from the nearest infrastructure, as per Appendix X. Small areas of Devil's Bit Scabious may be lost to the development footprint, however none of the identified breeding sites will be affected.	**Habitat Loss:** Permanent slight negative effects
Desmoulin's whorl snail (*Vertigo moulinsiana)*	Annex II of EU Habitats Directive	Typical of commercial peat extraction facility, the proposed development contains an extensive drainage network. Furthermore, these drains are largely devoid of vegetation and are subject to drying out in the summer months. A vegetated drainage ditch that runs from Lough Bannow bog to the Royal Canal was considered to provide suitable habitat for this species. This drain is located adjacent to the amenity track that is proposed to provide access from the east to Lough Bannow bog. Lough Bawn pNHA is located in	Habitat loss through increased drainage of areas adjacent to the hydraulically sensitive habitats located within Lough Bawn pNHA. This impact is considered unlikely, i.e. the existing peat extraction buffer areas combined with the drainage regime proposed at the site are designed in such a manner as to ensure no significant impact, as per Chapter 8 of the EIAR.	**Habitat Deterioration:** Short term, moderate negative effects

Site/ Feature	Evaluation	Area	Potential Impact Source	Assessment of Potential Impact
		the south-eastern corner of Lough Bannow bog and could potentially provide the relevant swamp conditions required by this species.	Habitat deterioration through a reduction in water quality in the Royal Canal and adjoining drainage ditches.	

6.6.2 Operational Phase Impacts

Key identified impacts during the operational stage are discussed throughout this section. The main features of the operational phase of the proposed development that could give rise to ecological impacts include:

- Birds can potentially collide with the rotating blades of operating turbines;
- Disturbance displacement and barrier effects to birds during wind farm operation;
- Bats commuting, and foraging can potentially result in collision and death; and
- Ongoing maintenance of equipment as may be required.

6.6.2.1 Avian Community

6.6.2.1.1 <u>Collision Risk</u>

The potential for birds to collide with turbines is one of the main impacts to consider in the assessment of possible impact of an operating wind farm. Various studies have shown the susceptibility of birds to collision to be dependent on; species of bird involved the number of flights and individuals per flight, turbine height and blade length, weather (i.e. fog), topography, geography, etc. Collision risk is only associated with operating wind farms. Given the nominal 30-year life span of a wind farm, impacts are considered to be long term.

It is considered that the physical characteristic of the bird plays a crucial role in predicting the probability of a bird suffering a collision while passing through the airspace occupied by an operating turbine. The probability is predicted based on the bird wing length, weight, tail length and total body length[93]. Moreover, flight behaviour can be influenced by wing loading (ratio of body weight to wing area) and aspect ratio (ratio of wing span squared to wing area) which can affect collision risk. High wing loading is associated with species which demonstrate low manoeuvrability (e.g. swans and several species of geese), which can determine the probability of a bird successfully avoiding an imminent collision with a turbine[94]. Other species such as farmland passerines are generally more manoeuvrable and as a consequence are less susceptible to collisions[95].

Radar-tracking studies at operating wind farms have shown that birds will generally avoid colliding with turbines and do not fly into them blindly[12].

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[93] Janss, G.F.E. (2000). Avian mortality from power lines: a morphologic approach of a species-specific mortality. Biological Conservation 95:353-359.

[94] Drewitt and Langston (2006) Assessing the impact of wind farms on birds. Ibis. 148, 29-42.

[95] Bright, J., Langston, R., Bullman, R., Evans, R., Gardner, S., & Pearce-Higgins, J. (2008). Map of bird sensitivities to wind farms in Scotland: a tool to aid planning and conservation. *Biological Conservation*, *141*(9), 2342-2356.

In practice, most birds do take avoiding action when they encounter operating turbines in the landscape. Birds in flight may detect either the wind farm as a whole or an individual turbine and alter their flight paths accordingly. Avoidance may also occur as an emergency action performed by birds at close quarters with the rotating blade of an operating turbine. To account for this avoidance rate, an analysis of collision risk must incorporate an 'avoidance factor'. The avoidance factor incorporates the ability of birds to successfully avoid collisions with objects in their environment into the analysis. A high proportion of birds successfully avoid collisions with operating turbines, this is reflected in a recommended default avoidance rate of 98 percent[96] (in situations where a species-specific avoidance rate is not available).

At the proposed wind farm development site, potential exists for birds flying through the airspace occupied by operating turbines to collide with turbines. To determine collision risk to key avian target species a Collision Risk Model (CRM) has been prepared. The method of analysis has been developed by Band *et al*. (2007). For the purposes of the analysis all collisions are considered fatal, either directly or indirectly through injury. The modelling methods differ between species. Contributing factor used in the analysis include; the duration of the flight within the potential collision zone, the number of birds per observation, wingspan and flight speed, individual's body lengths, the number of hours in which a given species can be expected to be active and the time of year in which a species is likely to be present. The particulars of bird species and specifications of the turbine in combination contribute Collision Risk Model (CRM) analysis. Details of the collision risk analysis, including target species selection criteria, is presented in the Derryadd CRM report attached in Appendix 6.5.

A CRM was only prepared for those species that were observed flying at potential collision risk height and those species with sufficient amounts of flight activity. Results of the CRM show that over 20,000 seconds of flight activity within the collision risk zone is required to result in one collision every 25 years. The results of the CRM analysis are shown in Table 6.24 below. The significance of potential collision risk is evaluated in Table 6.25 below.

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[96] SNH (2016) Avoidance rates for the onshore SNH Wind Farm Collision Risk Model

Table 6.24: Collision Fatality Estimates as Predicted by the Collision Risk Model (CRM 2018)

Species	Season	Transits per year	Collisions per year	Collisions per 30 years	Years per collisions
Whooper Swan	non-breeding	11.7	0.0047	0.1412	212
Mallard	breeding/post-breeding	10.4	0.0100	0.3000	100
	non-breeding	0.7	0.0006	0.0190	1,575
Cormorant	pre-breeding/breeding	5.6	0.0075	0.2258	133
Hen Harrier	non-breeding	0.1	0.00006	0.0017	17,978
Sparrowhawk	all year	1.1	0.0013	0.0380	790
Golden Plover	non-breeding	491.0	0.4037	12.1098	2
Lapwing	non-breeding	58.9	0.0616	1.8490	16
Curlew	migration	4.8	0.0049	0.1477	203
Black-headed Gull	breeding	7.3	0.0085	0.2563	117
	non-breeding	7.2	0.0084	0.2519	119
Lesser Black-backed Gull	breeding	95.3	0.1205	3.6162	8
	migration	76.8	0.0972	2.9170	10
Kestrel	all year	10.2	0.0330	0.9901	30
Peregrine	all year	0.1	0.0002	0.0052	5,824

Note:

The three gull species: Herring Gull, Common Gull and Greater Black-backed Gull were also included in the collision risk analysis. The predicted collision risk is very low (less than zero) for all three gull species. Potential impacts are therefore not considered further.

Table 6.25: Assessing the Potential Impact on Key Avian Receptors from Collision Risk with Operating Turbines

Species (Sensitivity)	**Collision Risk (Magnitude)**	**Significance Evaluation* (Percival 2003[97]; EPA 2017)**
Whooper Swan (Very High)	The population-level consequences of predicted collision risks can be assessed by considering the additional mortality that would be caused (assuming that the collision risk is non-additive) relative to background mortality rates in the population, with a threshold level of a 1% increase in annual mortality used to determine whether the impact will be significant (Percival, 2003), see Appendix 6.5 for further details. Collision risk is predicted to be very low with no collisions predicted within the nominal 30-year operational lifetime of the wind farm. The collision risk analysis predicts only a slight change to the baseline conditions. The change is considered barely distinguishable, from the baseline situation. Therefore, it can be concluded that the collision risk for Whooper Swan is **Negligible**.	Percival Significance is calculated as a product of the sensitivity (Very High) of the species and the magnitude (Negligible) of the effect. Evaluation: **Low** significance. **Long term, slight negative effect**
Mallard (Very High)	The population-level consequences of predicted collision risks can be assessed by considering the additional mortality that would be caused (assuming that the collision risk is non-additive) relative to background mortality rates in the population, with a threshold level of a 1% increase in annual mortality used to determine whether the impact will be significant (Percival, 2003), see Appendix 6.5 for further details. Collision risk is predicted to be very low with no collisions predicted within the nominal 30-year operational lifetime of the wind farm. The collision risk analysis predicts only a slight change to the baseline conditions. The change is considered barely distinguishable from the baseline situation. Therefore, it can be concluded that the collision risk for Mallard is **Negligible**.	Percival Significance is calculated as a product of the sensitivity (Very High) of the species and the magnitude (Negligible) of the effect. Evaluation: **Low** significance. **Long term, slight negative effect**
Cormorant (High)	The population-level consequences of predicted collision risks can be assessed by considering the additional mortality that would be caused (assuming that the collision risk is non-additive) relative to background mortality rates in the population, with a threshold level of a 1% increase in annual mortality used to determine whether the impact will be significant (Percival, 2003), see Appendix 6.5 for further details. Collision risk is predicted to be very	Percival Significance is calculated as a product of the sensitivity (High) of the species and the magnitude (Negligible) of the effect.

[97] Percival (2003) details an assessment methodology to determine the significance of an impact based on the product of the sensitivity of the receptor and the magnitude of the effect. The sensitivity of a species is defined by Percival (2003) as its ecological importance and nature conservation interest at the site being assessed. Species which are of special conservation interest of a European site have the highest sensitivity rating. The significance of any one impact is a product of the sensitivity of the receptor, the magnitude of the impact and the probability of that impact occurring. The assessment of significance follows this evaluation methodology.

Species (Sensitivity)	Collision Risk (Magnitude)	Significance Evaluation* (Percival 2003[97]; EPA 2017)
	low with no collisions predicted within the nominal 30-year operational lifetime of the wind farm. The collision risk analysis predicts only a slight change to the baseline conditions. The change is considered barely distinguishable from the baseline situation. Therefore, it can be concluded that the collision risk for Cormorant is **Negligible**.	Evaluation: **Very Low** significance. **Long term, not significant negative effect**
Hen Harrier (Medium)	The population-level consequences of predicted collision risks can be assessed by considering the additional mortality that would be caused (assuming that the collision risk is non-additive) relative to background mortality rates in the population, with a threshold level of a 1% increase in annual mortality used to determine whether the impact will be significant (Percival, 2003), see Appendix 6.5 for further details. Collision risk is predicted to be very low with no collisions predicted within the nominal 30-year operational lifetime of the wind farm. The collision risk analysis predicts only a slight change to the baseline conditions. The change is considered barely distinguishable from the baseline situation. Therefore, it can be concluded that the collision risk for Hen Harrier is **Negligible**.	Percival Significance is calculated as a product of the sensitivity (Medium) of the species and the magnitude (Negligible) of the effect. Evaluation: **Very Low** significance. **Long term, not significant negative effect**
Sparrowhawk (Low)	The population-level consequences of predicted collision risks can be assessed by considering the additional mortality that would be caused (assuming that the collision risk is non-additive) relative to background mortality rates in the population, with a threshold level of a 1% increase in annual mortality used to determine whether the impact will be significant (Percival, 2003), see Appendix 6.5 for further details. Collision risk is predicted to be very low with no collisions predicted within the nominal 30-year operational lifetime of the wind farm. The collision risk analysis predicts only a slight change to the baseline conditions. The change is considered barely distinguishable from the baseline situation. Therefore, it can be concluded that the collision risk for Sparrowhawk is **Negligible**.	Percival Significance is calculated as a product of the sensitivity (Low) of the species and the magnitude (Negligible) of the effect. Evaluation: **Very Low** significance. **Long term, not significant negative effect**
Golden Plover (Very High)	The population-level consequences of predicted collision risks can be assessed by considering the additional mortality that would be caused (assuming that the collision risk is non-additive) relative to background mortality rates in the population, with a threshold level of a 1% increase in annual mortality used to determine whether the impact will be significant (Percival, 2003), see Appendix 6.5 for further details. The increase in annual mortality due to collisions is predicted to be 0.12%. The collision risk analysis predicts only a minor shift away from baseline conditions. The change will be discernible but of limited ecological significance. Therefore, it can be concluded that the collision risk for Golden Plover is **Non-negligible/ Low**.	Percival Significance is calculated as a product of the sensitivity (Very High) of the species and the magnitude (Negligible) of the effect. Evaluation: **Low** significance. **Long term, slight negative effect**

Species (Sensitivity)	Collision Risk (Magnitude)	Significance Evaluation* (Percival 2003[97]; EPA 2017)
Lapwing (Very High)	The population-level consequences of predicted collision risks can be assessed by considering the additional mortality that would be caused (assuming that the collision risk is non-additive) relative to background mortality rates in the population, with a threshold level of a 1% increase in annual mortality used to determine whether the impact will be significant (Percival, 2003), see Appendix 6.5 for further details. The increase in annual mortality due to collisions is predicted to be 0.04%. The collision risk analysis predicts only a slight change to the baseline conditions. The change is considered barely distinguishable from the baseline situation. Therefore, it can be concluded that the collision risk for Lapwing is **Non-negligible/ Low**.	Percival Significance is calculated as a product of the sensitivity (Very High) of the species and the magnitude (Negligible) of the effect. Evaluation: **Low** significance. **Long term, slight negative effect**
Curlew (High)	The population-level consequences of predicted collision risks can be assessed by considering the additional mortality that would be caused (assuming that the collision risk is non-additive) relative to background mortality rates in the population, with a threshold level of a 1% increase in annual mortality used to determine whether the impact will be significant (Percival, 2003), see Appendix 6.5 for further details. Collision risk is predicted to be very low with no collisions predicted within the nominal 30-year operational lifetime of the wind farm. The collision risk analysis predicts only a slight change to the baseline conditions. The change is considered barely distinguishable from the baseline situation. Therefore, it can be concluded that the collision risk for Curlew is **Negligible**.	Percival Significance is calculated as a product of the sensitivity (High) of the species and the magnitude (Negligible) of the effect. Evaluation: **Very Low** significance. **Long term, not significant negative effect**
Black-headed Gull (High)	The population-level consequences of predicted collision risks can be assessed by considering the additional mortality that would be caused (assuming that the collision risk is non-additive) relative to background mortality rates in the population, with a threshold level of a 1% increase in annual mortality used to determine whether the impact will be significant (Percival, 2003), see Appendix 6.5 for further details. Collision risk is predicted to be very low with no collisions predicted within the nominal 30-year operational lifetime of the wind farm. The collision risk analysis predicts only a slight change to the baseline conditions. The change is considered barely distinguishable from the baseline situation. Therefore, it can be concluded that the collision risk for Black-headed Gull is **Negligible**.	Percival Significance is calculated as a product of the sensitivity (High) of the species and the magnitude (Negligible) of the effect. Evaluation: **Very Low** significance. **Long term, not significant negative effect**
Lesser Black-backed Gull (Low)	The population-level consequences of predicted collision risks can be assessed by considering the additional mortality that would be caused (assuming that the collision risk is non-additive) relative to background mortality rates in the population, with a threshold level of a 1% increase in annual mortality used to determine whether the	Percival Significance is calculated as a product of the sensitivity (Low) of the

Species (Sensitivity)	Collision Risk (Magnitude)	Significance Evaluation* (Percival 2003[97]; EPA 2017)
	impact will be significant (Percival, 2003), see Appendix 6.5 for further details. The increase in annual mortality due to collisions is predicted to be 0.50%. The collision risk analysis predicts only a minor shift away from baseline conditions. The change will be discernible but of limited ecological significance. Therefore, it can be concluded that the collision risk for Lesser Black-backed Gull is **Non-negligible/ Low**.	species and the magnitude (Low) of the effect. Evaluation: **Very Low** significance. **Long term, slight negative effect**
Kestrel (Low)	The population-level consequences of predicted collision risks can be assessed by considering the additional mortality that would be caused (assuming that the collision risk is non-additive) relative to background mortality rates in the population, with a threshold level of a 1% increase in annual mortality used to determine whether the impact will be significant (Percival, 2003), see Appendix 6.5 for further details. The increase in annual mortality due to collisions is predicted to be 0.13%. The collision risk analysis predicts only a minor shift away from baseline conditions. The change will be discernible but of limited ecological significance. Therefore, it can be concluded that the collision risk for Kestrel is **Non-negligible**.	Percival Significance is calculated as a product of the sensitivity (Low) of the species and the magnitude (Negligible) of the effect. Evaluation: **Very Low** significance. **Long term, slight negative effect**
Peregrine Falcon (Medium)	The population-level consequences of predicted collision risks can be assessed by considering the additional mortality that would be caused (assuming that the collision risk is non-additive) relative to background mortality rates in the population, with a threshold level of a 1% increase in annual mortality used to determine whether the impact will be significant (Percival, 2003), see Appendix 6.5 for further details. Collision risk is predicted to be very low with no collisions predicted within the nominal 30-year operational lifetime of the wind farm. The collision risk analysis predicts only a slight change to the baseline conditions. The change is considered barely distinguishable from the baseline situation. Therefore, it can be concluded that the collision risk for Peregrine Falcon is **Negligible**.	Percival Significance is calculated as a product of the sensitivity (Medium) of the species and the magnitude (Negligible) of the effect. Evaluation: **Very Low** significance. **Long term, not significant negative effect**

Note:

* Under this rating system “very low significance” or “low significance” can be understood to mean there will be no significant effect.

6.6.2.1.2 Disturbance Displacement and Barrier Effect (Operational Phase)

The presence of turbines in the landscape could potentially deter birds from using the area and its surroundings, resulting in a disturbance displacement effect. Disturbance can result in a significant impact if it reduces the availability of resources for avian receptors. The literary is not in agreement on the magnitude of disturbance displacement impact associated with operating turbines; moreover, there is an increasing body of evidence to suggest that wind farms do not affect bird distribution[15]. In the event that displaced individuals can secure alternative habitat, the impact may actually be inconsequential.

It is considered that the availability of alternative feeding habitat may play a role in the disturbance effects. When resources are limited birds are less sensitive to disturbance impacts[98,15]. If disturbance displacement is said to be impacting an avian receptor, then, the significance of the impact is a product of the scale of the deterrence, as opposed to, the ability of the wider surroundings to support displaced individuals[99]. The majority of studies which show a disturbance effect relate to waterfowl, over distances of up to 800m (wintering birds) and 300m (breeding birds)[12].

An additional possible disturbance effect is the disruption to flight lines, which may result in a wind farm acting as a partial barrier to bird movements. Such a disturbance effect could be felt as either a barrier to a migration route or between a roost and feeding site. The ecological impact could prove significant if the increased energy expenditure involved in avoiding the barrier depleted the body fat reserves of an already stressed population.

The effect of disturbance displacement is expected to decrease over time. The foraging behaviour of local avian communities is expected to adjust as habituation occurs to the disturbance. In addition, Percival (2001) recommends locating turbines at a minimum of 200m apart to facilitate the free movement of birds and thereby avoid a barrier effect[100]. In the present case all turbines are proposed to be located at distances greater than 400m from their nearest neighbour. Table 6.26 below assesses the potential impact of disturbance displacement on avian communities during the operation phase of the development.

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[98] Percival, S.M. (2005) Birds and wind farms—what are the real issues? *British Birds 98*: 194–204.

[99] Langston & Pullan (2003) Wind farms and Birds: An analysis of the effects of wind farms on birds. Guidance on environmental assessment criteria and site selection issues. RSPB

[100] Percival S. M. (2001) Assessment of the effects of offshore wind farms on birds. Unpublished report for the UK Department of Trade and Industry, ETSU W/13/00565/REP, DTI/Pub URN 01/1434.
93 p. www.berr.gov.uk/files/file20258.pdf (viewed 23 September 2008).

Table 6.26: Assessing the Potential Impact on Key Avian Receptors from Disturbance Displacement and Barrier Effect (Operational Phase)

Species (Sensitivity)	**Disturbance Displacement and Barrier Effect (Magnitude)**	**Significance Evaluation* (Percival 2003[101]; EPA 2017)**
Hen Harrier (Medium)	There is limited potential for disturbance displacement effects associated with avoidance of operating turbines at the proposed development site. Disturbance distances for Hen Harrier are suggested to range from 500-750m[91]**.** There were no records of Hen Harrier breeding either onsite or in the wider surroundings. The majority of observations were confined to the autumn; it is considered that these individuals were likely birds dispersing from breeding grounds to lower lying areas for the winter. A study of foraging Hen Harrier at an existing wind farm in Co. Galway has shown this species to forage to within 50 meters of turbines[102]. Given the infrequency of observations of this species, disturbance displacement and barrier effects are deemed to be of **Low Concern**.	Percival Significance is calculated as a product of the sensitivity (Medium) of the species and the magnitude (Low) of the effect. Evaluation: **Low** significance. **Short term, slight negative effect**
Merlin (Medium)	There is limited potential for disturbance displacement effects associated with avoidance of operating turbines at the proposed development site. The upper most limits for Merlin disturbance suggested in the literature is 500m[91]. No nest sites were confirmed onsite or within a 500m radius of the planning/ development boundary. Merlin were confirmed to have bred during the 2016 breeding season, however it was considered that the nest was located offsite. This view was taken given the infrequency of observations made during the breeding season and based on the species core foraging distance of 5km[59]. As flight activity was below rotor blade height (as is typical of the flight behaviour of foraging Merlin), a barrier effect is not likely to occur. Given the low numbers recorded per observation (single individuals), the availability of	Percival Significance is calculated as a product of the sensitivity (Medium) of the species and the magnitude (Low) of the effect. Evaluation: **Low** significance. **Short term, slight negative effect**

[101] Percival (2003) details an assessment methodology to determine the significance of an impact based on the product of the sensitivity of the receptor and the magnitude of the effect. The sensitivity of a species is defined by Percival (2003) as its ecological importance and nature conservation interest at the site being assessed. Species which are of special conservation interest of a European site have the highest sensitivity rating. The significance of any one impact is a product of the sensitivity of the receptor, the magnitude of the impact and the probability of that impact occurring. The assessment of significance follows this evaluation methodology.

[102] Madden, B., & Porter, B. (2007). Do wind turbines displace Hen Harriers Circus cyaneus from foraging habitat? Preliminary results of a case study at the Derrybrien wind farm, county Galway. *Irish Birds*, *8*, 231-236.

Species (Sensitivity)	Disturbance Displacement and Barrier Effect (Magnitude)	Significance Evaluation* (Percival 2003[101]; EPA 2017)
	alternative habitat nearby and the absence of regular flight paths across the site, effects associated with disturbance displacement and barrier effect are judged of **Low Concern.**	
Peregrine Falcon (Medium)	There is limited potential for disturbance displacement effects associated with avoidance of operating turbines at the proposed development site. Several studies have suggested that Peregrine Falcons are likely to habituate to the presence of operating turbines in the landscape[91]. Furthermore, it is considered that this species is unlikely to be affected by displacement due to operating turbines[104]. The availability of alternative suitable habitat in the surroundings and the overall infrequency of occurrence of the species at the site, limit the potential for disturbance displacement effects. As flight activity was below rotor blade height, a barrier effect is not likely to occur. Disturbance displacement and barrier effects are judged to be of **Low Concern**.	Percival Significance is calculated as a product of the sensitivity (Medium) of the species and the magnitude (Low) of the effect. Evaluation: **Low** significance. **Short term, slight negative effect**
Buzzard (Low)	There is limited potential for disturbance displacement effects associated with avoidance of operating turbines at the proposed development site. Breeding activity is suggested to be reduced within 500m of operating turbines[103]. Among the birds species identified for avoidance of wind farms, Buzzards showed a decrease in breeding density of 15-53%[56]. However, no nest sites were confirmed onsite or within a 500m radius of the planning/ development boundary. Buzzards have been shown to habituate to operating turbines[92]. The favourable conservation status of this species limits the potential for ecologically significant effects. Given the low numbers recorded per observation (1 to 3 individuals), the availability of alternative habitat nearby and the absence of regular flight paths across the site, effects associated with disturbance displacement and barrier effect are judged of **Low Concern.**	Percival Significance is calculated as a product of the sensitivity (Low) of the species and the magnitude (Low) of the effect. Evaluation: **Very Low** significance. **Short term, slight negative effect**
Kestrel (Low)	There is limited potential for disturbance displacement effects associated with avoidance of operating turbines at the proposed development site. Kestrels demonstrate low displacement associated with operating wind farms[104]. No nest sites were confirmed onsite or within a 500m radius of the planning/ development	Percival Significance is calculated as a product of the sensitivity (Low) of the species and the magnitude (Low) of the effect.

[103] Pearce-Higgins, J. W., Stephen, L., Langston, R. H., Bainbridge, I. P., & Bullman, R. (2009). The distribution of breeding birds around upland wind farms. *Journal of Applied ecology*, *46*(6), 1323-1331.

[104] Madders and Whitfield (2006) Upland raptors and assessment of wind farm impacts. Ibis. 148: 43-56.

Species (Sensitivity)	**Disturbance Displacement and Barrier Effect (Magnitude)**	**Significance Evaluation* (Percival 2003[101]; EPA 2017)**
	boundary. The widespread distribution of this species limits the potential for ecologically significant effects. Given the low numbers recorded per observation (1 to 3 individuals), the availability of alternative habitat nearby and the absence of regular flight paths across the site, effects associated with disturbance displacement and barrier effect are judged of **Low Concern.**	Evaluation: **Very Low** significance. **Short term, slight negative effect**
Sparrowhawk (Low)	There is limited potential for disturbance displacement effects associated with avoidance of operating turbines at the proposed development site. Sparrowhawk activity was found to be low. The widespread breeding distribution of this species limits the potential for ecologically significant effects. There was no breeding confirmed within the proposed development area. Given the low frequency of occurrence and low numbers per observation and the absence of regular flight paths across the site, effects associated with disturbance displacement and barrier effect are judged of **Low Concern.**	Percival Significance is calculated as a product of the sensitivity (Low) of the species and the magnitude (Low) of the effect. Evaluation: **Very Low** significance. **Short term, slight negative effect**
Long-eared Owl (Low)	There is limited potential for disturbance displacement effects associated with avoidance of operating turbines at the proposed development site. Overall, Long-eared Owl activity was found to be low. The widespread breeding distribution of this species limits the potential for ecologically significant effects. The number of breeding attempts found within the study area was low. Given the low frequency of occurrence, the low numbers per observation and the absence of regular flight paths across the site, effects associated with disturbance displacement and barrier effect are judged of **Low Concern.**	Percival Significance is calculated as a product of the sensitivity (Low) of the species and the magnitude (Low) of the effect. Evaluation: **Very Low** significance. **Short term, slight negative effect**
Whooper Swan (Very High)	There is potential for disturbance displacement effects associated with avoidance of operating turbines at the proposed development site. This could result in effective habitat loss. The literature suggests disturbance distances for swans of up to 200-560m[105]. As a result of habituation swans feed closer to turbines later in the winter as food resources deplete[106]. McGuinness et al., (2015) suggests that Whooper Swan can be sensitive	Percival Significance is calculated as a product of the sensitivity (Very High) of the species and the magnitude (Low) of the effect. Evaluation: **Medium** significance. **Short term, moderate negative effect**

[105] Ree E. C. (2012) Impacts of wind farms on swans and geese: a review. Wildlife 62: 37-72.

[106] Fijn et al., (2012) Habitat use, disturbance and collision risk for Bewick Swans *Cygnus columbianus bewickii* wintering near a wind farm in the Netherlands. Wildlife 62: 97-116

Species (Sensitivity)	Disturbance Displacement and Barrier Effect (Magnitude)	Significance Evaluation* (Percival 2003[101]; EPA 2017)
	to disturbance up a distance of 600m around I-WeBS sites[107]. All local I-WeBS sites are at distances of greater than 1.5km from proposed turbine locations, as per the BWI I-WeBS online map viewer. Disturbance displacement is judged not to be a factor for this population of Whooper Swan based on the opportunistic use of the site during temporary flooding events and the concentration of the majority of the local population offsite in the River Shannon. Furthermore, should displacement occur extensive areas of suitable habitat exist within the River Shannon, its local tributaries and adjacent agricultural fields. In the Netherlands, Bewicks Swan have been shown to avoid operating turbines without resorting to large deflections from their course when flying either around or between turbines[108]. Overall, effects associated with operational disturbance displacement and the barrier effects are deemed to be of **Low Concern**. In the event a barrier effect exists for migrating birds; the additional energy expenditure involved in birds diverting around the wind farm are not considered significant in the context of the overall distances involved in migrating. Moreover, water birds utilise natural features in the landscape such as watercourses to navigate[109], thus it can be reasonably concluded that the majority of water birds will utilise the River Shannon (offsite) when migrating.	
Mute Swan (Low)	There is potential for disturbance displacement effects associated with avoidance of operating turbines at the proposed development site. This can result in effective habitat loss. However, the habitats onsite are not typically considered suitable for this species. The literature suggests disturbance distances for swans of up to 200-560m[105]. The resident breeding population present on Lough Ree is at a minimum 3.5km from proposed turbine locations. The exceptional rainfall during the 2014/ 15 winter season created a temporary feeding	Percival Significance is calculated as a product of the sensitivity (Low) of the species and the magnitude (Low) of the effect. Evaluation: **Very Low** significance. **Short term, slight negative effect**

[107] McGuinness et al., (2015) Bird sensitivity mapping for wind energy development and associated infrastructure in the Republic of Ireland. BWI.

[108] Fijn, R., Krijgsveld, K., Tijsen, W. s.l. : Wildfowl & Wetlands Trust (2012), *Habitat use, disturbance and collision risks of Bewick's Swans Cygnus columbianus bewickii wintering near a wind farm in the Netherlands* , Wildfowl, Vol. 69, pp. 97-116.

[109] Robinson et al., (2004)

Species (Sensitivity)	Disturbance Displacement and Barrier Effect (Magnitude)	Significance Evaluation* (Percival 2003[101]; EPA 2017)
	opportunity for this species onsite. During normal rainfall years the habitats of the site are unlikely to prove attractive to this species. Given the infrequency of observations, the absence of a regular flight path across the site and the availability of optimal habitat within the surroundings, disturbance displacement and barrier effects are deemed to be of **Low Concern**.	
Mallard (Very High)	There is limited potential for disturbance displacement effects associated with avoidance of operating turbines at the proposed development site. This could result in effective habitat loss. The majority of observations of this species were made in habitats fringing the site, primarily along the River Shannon to the north-west of the proposed development area. The favourable conservation status of this species limits the potential for ecologically significant effects. There was no breeding recorded within the study area. Langston and Pullan (2003) noted no disturbance related effects associated with operating turbines for Mallard[99]. Given the low frequency of occurrence and low numbers per observation and the absence of a regular flight path across the site, effects associated with disturbance displacement and barrier effect are judged of **Low Concern.**	Percival Significance is calculated as a product of the sensitivity (Very High) of the species and the magnitude (Low) of the effect. Evaluation: **Medium** significance. **Short term, moderate negative effect**
Common Tern (Very High)	There is limited potential for disturbance displacement effects associated with avoidance of operating turbines at the proposed development site. This can result in effective habitat loss. However, the habitats onsite are not considered suitable for this species. The majority of observations of this species were made in habitats fringing the site, primarily along the River Shannon to the north-west of the proposed development area. The habitats onsite are not suitable foraging habitat. There was no breeding recorded onsite, breeding has historically occurred on islands on Lough Ree (offsite). The proposed development area does not possess features which would typically attract this species onsite. Given the low frequency of occurrence and low numbers per observation and the absence of a regular flight path across the site, effects associated with disturbance displacement and barrier effect are judged of **Negligible Concern.**	Percival Significance is calculated as a product of the sensitivity (Very High) of the species and the magnitude (Negligible) of the effect. Evaluation: **Low** significance. **Short term, slight negative effect**

Species (Sensitivity)	Disturbance Displacement and Barrier Effect (Magnitude)	Significance Evaluation* (Percival 2003[101]; EPA 2017)
Golden Plover (Very High)	There is limited potential for disturbance displacement effects associated with avoidance of operating turbines at the proposed development site. This could result in effective habitat loss. A review of the literary suggests no significant effect of disturbance displacement for this species[110]. Hotker et al., (2006) observed Golden Plover to approach operating turbines to within 175m in the non-breeding season[92]. The population recorded at the proposed development area and within the surroundings is a wintering population. The majority of observations of this species have been of flocks foraging/ roosting on bare peat. Flocks recorded onsite were found to be small, numbering 1-180 individuals. The majority of the local population has been noted to occur in the fields surrounding the River Shannon to the north-west of the proposed development area. The proposed development area is located in an open landscape, this topographical characteristic limits the potential for a barrier effect. Studies have shown this species to be capable of navigating between operating turbines, even during the hours of darkness[99]. In the event a barrier effect exists for migrating birds; the additional energy expenditure involved in birds diverting around the wind farm are not considered significant in the context of the overall distances involved in migrating. Golden Plover have been shown to utilise the proposed development area in low numbers, with the majority of the local population favouring habitats located offsite, no regular flight paths have emerged from survey work, therefore disturbance displacement and barrier effect are judged to be of **Low Concern**.	Percival Significance is calculated as a product of the sensitivity (Very High) of the species and the magnitude (Low) of the effect. Evaluation: **Medium** significance. **Short term, moderate negative effect**
Lapwing (Very High)	There is limited potential for disturbance displacement effects associated with avoidance of operating turbines at the proposed development site. This could result in effective habitat loss. Numerous studies have shown no significant disturbance displacement through avoidance for this species[103]. For the most part, records of Lapwing were made during the non-breeding season. Onsite records were low in number (maximum flock size was 70 individuals). There were no records of breeding from survey work carried out	Percival Significance is calculated as a product of the sensitivity (Very High) of the species and the magnitude (Low) of the effect. Evaluation: **Medium** significance. **Short term, moderate negative effect**

[110] Fielding and Haworth (2015) Farr windfarm: A review of displacement disturbance on golden plover arising from operational turbines between 2005-2015. Haworth Conservation, Mull.

Species (Sensitivity)	Disturbance Displacement and Barrier Effect (Magnitude)	Significance Evaluation* (Percival 2003[101]; EPA 2017)
	within the proposed development area or from historical data. The ongoing commercial peat production at the proposed development area restricts the potential for a significant population to exist onsite. The proposed development area is located in an open landscape; this topographical characteristic limits the potential for a barrier effect. In the event a barrier effect exists for migrating birds; the additional energy expenditure involved in birds diverting around the wind farm are not considered significant in the context of the overall distances involved in migrating. Langton and Pullan (2003)[111] have shown this species to be adept at navigating between operating turbines[99]. Given the present of similar suitable habitat nearby, the low frequency of occurrence and low numbers per observation and the absence of a regular flight path across the site, effects associated with disturbance displacement and barrier effect are judged of **Low Concern.**	
Curlew (High)	There is limited potential for disturbance displacement effects associated with avoidance of operating turbines at the proposed development site. This can result in effective habitat loss. However, the habitats onsite are considered sub-optimal for Curlew. Breeding activity is suggested to be reduced within 500m of operating turbines[103]**.** During the 2015 breeding season, this species was considered a 'probable breeder' in the habitats fringing the south east of Lough Bannow bog (offsite). The southernmost proposed turbine (T21) is located approximately 600m from this location. No subsequent breeding attempt was recorded in 2016. Flock size was low, ranging from 1-54 individuals. The proposed development area is located in an open landscape; this topographical characteristic limits the potential for a barrier effect. In the event a barrier effect exists for migrating birds; the additional energy expenditure involved in birds diverting around the wind farm are not considered significant in the context of the overall distances involved in migrating. Curlew have been shown to utilise the proposed development area in low numbers, no regular flight paths have emerged from survey work, therefore disturbance displacement and barrier effect are judged to be of **Low Concern**.	Percival Significance is calculated as a product of the sensitivity (High) of the species and the magnitude (Low) of the effect. Evaluation: **Low** significance. **Short term, slight negative effect**

[111] Langston, R., & Pullan, J. D. (2003). *Wind farms and birds: an analysis of the effects of wind farms on birds, and guidance on environmental assessment criteria and site selection issues*. Council of Europe.

Species (Sensitivity)	Disturbance Displacement and Barrier Effect (Magnitude)	Significance Evaluation* (Percival 2003[101]; EPA 2017)
Woodcock (Medium)	There is limited potential for disturbance displacement effects associated with avoidance of operating turbines at the proposed development site. This could result in effective habitat loss. Woodcock were judged to be a 'probable breeder' in the habitat fringing the north-west of the site (offsite). In 2017, Woodcock were judged to have bred onsite. Relative to the total area of the site, the number of breeding territories was found to be low. Given the low frequency of occurrence and low numbers per observation, together with the availability of alternative habitat in the wider surroundings disturbance displacement effects are judged of **Low Concern**.	Percival Significance is calculated as a product of the sensitivity (Medium) of the species and the magnitude (Low) of the effect. Evaluation: **Low** significance. **Short term, slight negative effect**
Snipe (Low)	There is limited potential for disturbance displacement effects associated with avoidance of operating turbines at the proposed development site. This could result in effective habitat loss. Pearce-Higgins *et al*. (2012) show bird density to decline within 500m of operating turbines[112]. No nest sites were confirmed onsite or within a 500m radius of the planning/ development boundary, however several territories were recorded onsite. The widespread distribution of this species limits the potential for ecologically significant effects. Given the low numbers recorded per observation (1 - 18 individuals), the availability of alternative habitat nearby and the absence of regular flight paths across the site, effects associated with disturbance displacement and barrier effect are judged of **Low Concern.**	Percival Significance is calculated as a product of the sensitivity (Low) of the species and the magnitude (Low) of the effect. Evaluation: **Very Low** significance. **Short term, slight negative effect**
Little Egret (Medium)	There is limited potential for disturbance displacement effects associated with avoidance of operating turbines at the proposed development site. This could result in effective habitat loss. The majority of observations of this species were made in habitats fringing the site, primarily along the River Shannon to the north-west of the proposed development area. The range expansion which this species is experiencing limits the potential for ecologically significant effects. There was no breeding recorded within the study area. Given the low frequency of occurrence and low numbers per observation and the absence of a regular flight path	Percival Significance is calculated as a product of the sensitivity (Medium) of the species and the magnitude (Low) of the effect. Evaluation: **Low** significance. **Short term, slight negative effect**

[112] Pearce-Higgins, J. W., Stephen, L., Douse, A., & Langston, R. H. (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*(2), 386-394.

Species (Sensitivity)	Disturbance Displacement and Barrier Effect (Magnitude)	Significance Evaluation* (Percival 2003[101]; EPA 2017)
	across the site, effects associated with disturbance displacement and barrier effect are judged of **Low Concern.**	
Grey Heron (Low)	There is limited potential for disturbance displacement effects associated with avoidance of operating turbines at the proposed development site. This could result in effective habitat loss. The majority of observations of this species were made in habitats fringing the site, primarily along the River Shannon to the north-west of the proposed development area. The favourable conservation status of this species limits the potential for ecologically significant effects. There was no breeding recorded within the study area. Given the low frequency of occurrence and low numbers per observation and the absence of a regular flight path across the site, effects associated with disturbance displacement and barrier effect are judged of **Low Concern.**	Percival Significance is calculated as a product of the sensitivity (Low) of the species and the magnitude (Low) of the effect. Evaluation: **Very Low** significance. **Short term, slight negative effect**
Black-headed Gull (High)	There is limited potential for disturbance displacement effects associated with avoidance of operating turbines at the proposed development site. This can result in effective habitat loss. However, the habitats onsite are not considered suitable for this species. Studies show Gulls to show disturbance effects at distances of 500m[46]. Traditionally Lough Ree's islands have hosted breeding colonies of Black-headed Gull, however proposed turbine are located a minimum of 3.5km from the lake. This species was recorded infrequently at the proposed development area, with the majority if these observed concentrated to the north-west of the site along the River Shannon. Given the relative infrequency of observations, the absence of a regular flight path across the site and the availability of optimal habitat within the surroundings, disturbance displacement and barrier effects are deemed to be of **Low Concern**.	Percival Significance is calculated as a product of the sensitivity (High) of the species and the magnitude (Low) of the effect. Evaluation: **Low** significance. **Short term, slight negative effect**
Lesser Black-backed Gull (Low)	There is limited potential for disturbance displacement effects associated with avoidance of operating turbines at the proposed development site. This can result in effective habitat loss. However, the habitats onsite are not considered suitable for this species. Studies show Gulls to show disturbance effects at	Percival Significance is calculated as a product of the sensitivity (Low) of the species and the magnitude (medium) of the effect.

Species (Sensitivity)	Disturbance Displacement and Barrier Effect (Magnitude)	Significance Evaluation* (Percival 2003[101]; EPA 2017)
	distances of 500m[46]. Traditionally Lough Ree's islands have hosted breeding colonies of Lesser Black-backed Gull, however proposed turbine are located a minimum of 3.5km from the lake. This species was recorded frequently at the proposed development area, with the majority if these observed characterised as commuting flights. A regular flight path was found to cross the site between Derryarogue and Derryadd bogs. Given that turbines in Derryarogue are separated from adjacent turbines on Derryadd by 1.75km (approx.), habituation is considered to be a likely scenario. In which case this flight path would remain open to commuting individuals, therefore disturbance displacement and barrier effects are deemed to be of **Medium Concern**.	Evaluation: **Low** significance. **Short term, slight negative effect**
Cormorant (High)	There is limited potential for disturbance displacement effects associated with avoidance of operating turbines at the proposed development site. This can result in effective habitat loss. However, the habitats onsite are not considered suitable for this species. The majority of observations of this species were made in habitats fringing the site, primarily along the River Shannon to the north-west of the proposed development area. The habitats onsite do not provide suitable foraging habitat. There was no breeding recorded onsite, all records of breeding are associated with Lough Ree (offsite). Given the low frequency of occurrence and low numbers per observation and the absence of a regular flight path across the site, effects associated with disturbance displacement and barrier effect are judged of **Low Concern.**	Percival Significance is calculated as a product of the sensitivity (High) of the species and the magnitude (Low) of the effect. Evaluation: **Low** significance. **Short term, slight negative effect**

Note:

* Under this rating system "very low significance" or "low significance" can be understood to mean there will be no significant effect.

6.6.2.2 Bats

Bats have the potential to collide with operating turbines in the landscape. The potential impact is a product of the flight behaviour of the bat species in question and whether there is bat habitat present. High flying species such as Leisler's and Nathusius pipistrelle are more susceptible to collisions. It is considered that the potential impact of the proposed wind turbines with respect to commuting routes and foraging areas for bats will vary in degree from minor to major negative depending on the location. The study area was deemed to have a low-medium landscape favourability for Irish bat species. During bat surveys a minimum of six species of bat were recorded within the study area which is a high level of bat biodiversity. However, the level of bat activity was, in general, low. It is considered that if mitigation measures are undertaken as detailed in Section 6.7, the impacts of the turbines on bats will be reduced.

Due to the paucity of information on the impacts of wind turbines on bats, the 'bat risk' is determined based on what bat fauna group is recorded in the area of each turbine location. In addition, the bat fauna group is categorised as being at either a low, medium or high risk. Therefore, a separate table has been provided to determine the potential bat risk during the operational phase (Appendix 6.6, Table 5.2). Several of the turbines are deemed to have a potential to impact on bats when in operation, as detailed below. Six of these are deemed as potential high risk and therefore require a high level of mitigation.

The following proposed turbine locations were found to contain foraging bats therefore, collision risk exists in these locations. These locations have been further classed:

- The location of six wind turbines is deemed to have a potential high impact on local bat populations: T2, T4, T10, T12, T19 and T22;
- The location of five wind turbines is deemed to have a potential medium impact on local bat populations: T1, T3, T5, T11 and T18;
- The location of seven wind turbines is deemed to have a potential low impact on local bat populations: T7, T8, T9, T20, T21, T23, T24; and
- The location of the remaining turbines is considered to have negligible impact on local bat populations: T6, T13, T14, T15, T16 and T17.

Potential impacts from collision risk are evaluated as a potentially **Long term, significant negative effect** in the absence of mitigation at turbines 2 and 12, given the high-flying species, Leisler's bat, were recorded at these locations. As previously stated, this species is particularly susceptible to impacts from operating turbines. Potential impacts from collision risk are evaluated as a potentially **Long term, moderate negative effect** in the absence of mitigation at turbines 1, 3, 4, 5, 10, 11, 18, 19 and 22, given species that are considered to fly at lower heights were recorded in these locations.

Potential impacts from collision risk are evaluated as a potentially **Long term, slight negative effect** in the absence of mitigation at turbines 7, 8, 9, 20, 21, 23 and 24. Impacts from the remaining turbines are considered to be of negligibly concern.

6.6.2.3 Impacts to Fauna

No significant disturbance impacts are expected to protected mammals including otter or badger during the operational phase. The level of operational traffic, ongoing maintenance and amenity use is expected to be sufficiently low so as to avoid any disturbance impacts on birds and mammals that utilise the proposed development area. It is considered that these impacts would be a long term, imperceptible negative effect.

6.6.3 Decommissioning Phase Impacts

The decommissioning phase of the proposed development could result in disturbance to local fauna. Local fauna may be disturbed by the noise and physical presence activities of personnel and machinery during decommissioning works. The majority of mammal species are considered sufficiently mobile so as to take temporary avoidance measures during decommissioning activities. Birds may also become temporarily displaced during these works. Disturbance can result in displacement of birds from an area which can result in effective habitat loss or a reduction in the quality of the habitat, thereby leading to a reduction in bird density locally103. To avoid potential impacts on nesting birds, decommissioning activities will be timed to avoid the main period of sensitivity for birds, i.e. March 1st to August 31st. Disturbance is expected to be temporary to short-term in duration and is therefore not considered significant. The removal of turbines offsite will result in direct positive effects associated with the return of semi-natural habitat to areas which previously contained site infrastructure. Overall, it is considered that decommissioning activities will result in permanent slight positive effects of low significance.

There is potential for pollution runoff effects associated with decommissioning activities on surface water quality and, in turn aquatic biota, in the vicinity of and downstream of the works area. In the absence of mitigation and appropriate waste management, decommissioning activities have the potential to have short term, moderate negative effects on aquatic biota.

6.6.4 Cumulative Effects

6.6.4.1 Projects considered as part of the cumulative impact assessment

Information on the relevant projects within the vicinity of the proposed development was compiled on the October 31, 2018 and verified on January 29, 2019. The information was sourced from a search of the local authorities planning registers, EPA website, planning applications, EIS/ EIAR documents and planning drawings which facilitated the identification of past and future projects, their activities and their potential environmental impacts. The projects considered in relation to the potential for cumulative impacts and for which all relevant data was reviewed include those listed below.

Derraghan Ash Disposal Facility (Longford Co Co – Ref 17/320)

The development is an increase in the capacity of the operational Ash Disposal Facility to allow for the deposition of 130,000 tonnes of dry ash over and above the 550,000 tonnes permitted under Longford County Council Reg. The ash will be disposed of within engineered cells, constructed under the existing permission, and the facility will utilise permitted site services including the existing site entrance from the R392 and other site infrastructure. The facility will exclusively accept ash from Lough Ree Power Station in Lanesborough (Lanesboro) and will operate until 31st December 2020. Lough Ree Power Station and the associated Ash Disposal Facility are licenced by the EPA under an Industrial Emissions (IE) Licence [Ref. P061002]. Permission awarded on 22/02/18.

Peat Extraction: Mountdillion Group (EPA IPC 504-01)

The development is the ongoing extraction of peat (milling, harrowing, ridging and harvesting of peat into stockpiles, transportation of peat via internal rail network) from the Mountdillion group of bogs located in Counties Longford and Roscommon.

Lough Ree Peat Fired Power Station (Longford Co. Co. Planning Ref. 01/115)

The development is a peat-fired electric power generation plant, comprising of a single unit having a nominal total electricity rating of 100 megawatts at Lanesboro, and an ash disposal facility for the deposit of peat ash in a landfill to accommodate up to 550,000 tonnes of ash. Planning permission was awarded on the 14/06/2001.

Lough Ree Power Station

Planning permission (Planning ref. 17/320) was recently granted for increasing the capacity of the Lanesborough Power Station ash disposal field at Derraghan 1.5km southwest of Lough Bannow Bog. It should also be noted that an imminent planning application is very likely to be submitted in respect of the continued use and conversion to biomass of Lanesborough Power Station, which is located within the settlement of Lanesborough on the southern bank of the River Shannon. It is considered that the any in-combination effects between the proposed Derryadd Wind Farm and either or both of these developments, which represent continuation and small scale expansion of existing activities, will be Imperceptible. The significant energy infrastructure that exists in the local area is Lough Ree Power located to the west of Derryaroge Bog, and its associated grid infrastructure in the form of 110 kV pylons network (in particular the Lanesborough/Richmond and Lanesborough/Mullingar lines). The site on which the proposed development will be located is cutover peatland that is currently being used for peat extraction by Bord na Móna to predominantly provide fuel for the nearby Lough Ree Power Station at Lanesborough. The continued operation of the Lough Ree Power Station is dependent on an extension of its existing planning permission. Thus, there is potential that the Power Station could be removed from the Lanesborough skyline. If an extension to the existing consent is achieved then the plant will continue to operate and as such forms part of the Do Nothing Scenario. The predominant land use of the site and central study area is commercial scale peat extraction for the purposes of energy generation and there is a substantial peat-fired power station at the settlement of Lanesborough near the north-western periphery of the site.

Roosky Wind Farm (Roscommon Co. Co. Planning Ref. 13/3005)

A development comprising 2 no. turbines at Ballaghaderreen, Co. Roscommon. The original application (PD/07/2255) was amended in 2013 to extend the duration of the planning permission and apply for turbines with a stated 85m hub height and 125m blade diameter. This wind farm has been constructed.

Skrine Wind Farm (Roscommon Co. Co. Planning Ref. 04/103)

Planning permission Roscommon County Council register reference 04/103 (Appeal Ref. 20.208733) – a grant of planning permission issued to Provento Ireland PLC on 19/1/2005 for a development comprising 2 no. turbines at Skrine, Athleague. The turbines have a stated 64m hub height and 70m blade diameter. An extension of time was granted to Gaelectric on this planning permission, extending it until 18/1/2010. This wind farm has been constructed.

Sliabh Bawn Windfarm (Roscommon Co. Co. Planning Ref. 10/507)

Planning permission Roscommon County Council register reference 10/507 (Appeal Ref. 20.239743) – a grant of planning permission issued to Coillte Teo. on 27/3/2012 for a development comprising 20 turbines at Sliabh Bawn, Strokestown, County Roscommon. The planning permission has a life of 10 years with a permission for the windfarm for a period of 25 years from the date of commissioning. The wind farm has been constructed and is operational since March 2017.

Cloon – Lanesboro 110 kV Overhead Line (Longford Co. Co. Planning Ref. 18/139)

Planning permission Longford County Council register reference 18/139 – a grant of planning for development on the 21/08/18 at a site of the existing Cloon to Lanesboro 110 kV Overhead Line is approximately 65 kilometres long. Approximately 37km of the existing circuit is located within the functional area of Galway County Council with approximately 27km located in County Roscommon and approximately 120 metres located in County Longford. The refurbishment works within County Longford will be undertaken at structure EM365, located within the Lanesboro Substation in the townland of Aghamore (Rathcline By). The development will consist of the refurbishment of the Cloon - Lanesboro 110 kV Overhead Line which will primarily include: replacement of a large proportion of existing structures, the breaking out and reconstruction of the concrete foundation and shear blocks at the majority of end/angle mast structures, painting of mast structures, replacement of insulators, crossarms, stays and/or fittings on existing structures; and the fitting of bird flight diverters and stay guards. No additional structures are proposed along the existing circuit. Any replacement structures will be constructed at, or immediately adjacent to the existing structures they will replace and will be of a generally similar height and appearance.

Middleton House Solar Farm (Longford Co. Co. Planning Ref 18/35)

Planning permission Longford County Council register reference 18/35– a grant of planning permission issued to Harmony Solar on 15/08/2018 for a ten year permission for a solar farm on a site of approximately 51.38 hectares consisting of the following: up to 216,000 m2 of solar photo-voltaic panels on ground mounted steel frames to generate between 35MW to 50MW of electrical energy; substation and control room and associated hard standing; 14 no. inverter/transformer stations; underground power and communication cables & ducts; boundary security fence; CCTV cameras; upgraded internal access tracks; new internal access tracks and associated drainage infrastructure; provision of passing areas on lands adjacent to the L-11261 local road; access will be via the L-11261 local road through the upgrade of an existing agricultural entrance and at the existing entrance to Middleton House; and temporary construction compounds and all associated site services & works at the townlands of Middleton, Ballycore, Treanboy and Newtown,, near the village of Killashee, Co. Longford. Planning permission was awarded on the 15/08/18.

Fisherstown Solar farm (Longford Co. Co. Planning Ref. 18/146)

Planning permission Longford County Council register reference 18/146 – a grant of planning for development on the 26/08/18 at a site comprising lands within the property of the former Atlantic Mills factory. The development will comprise the construction of a solar farm with an export capacity of approximately 4MW comprising photovoltaic panels on ground mounted frames, with associated infrastructure including a switch gear control room (to be developed at 1 of 2 location options on site. No additional works proposed to the existing substation on site as part of this application), ducting and electrical cabling, internal access roads, fencing and all associated site development works at Fisherstown, Clondra,, Co. Longford. Planning permission was awarded on the 24/08/18.

6.6.4.2 Plans Considered as part of the Cumulative Assessment

- The following key plans were identified as having the potential for cumulative effects with the proposed development and were therefore considered in the cumulative effects' assessment. Longford County Development Plan 2015 – 2021;
- River Basin Management Plan 2018 – 2021 (released in April 2018); and

- Bord na Móna Draft Rehabilitation Plans. In 2013, Bord na Móna submitted draft rehabilitation plans for each of the Bord na Móna bogs, as per IPC Licence Condition 10 requirements. The plans were further updated in 2015, following rehabilitation trails.

6.6.4.3 Cumulative Impact Assessment

Cumulative effects can be defined as the additional changes caused by a proposed development in conjunction with other similar developments[113].It is similarly defined in the EIAR 2017 EPA guidance as 'The addition of many minor or significant effects, including the effects of other projects, to create larger, more significant effects.'

The Derraghan Ash Disposal facility, Peat extraction on Mountdillion and the ongoing operation of Lough Ree Peat Fired Power station can be considered together with the development with respect to cumulative impacts. All three developments operate or will operate under EPA licences. Lough Ree Peat Fired Power Station utilises peat extracted from the Mountdillon Group, the ash from the power station is disposed at the Derraghan Ash Disposal Facility. The proposed development is within the Mountdillon bog group. The surrounding peatlands will continue to be managed in accordance with their relevant EPA IPC Licences. The proposed development includes a wide range of protective measures which are designed to minimise the potential for water quality impacts on local designated site, i.e. Lough Ree SAC. These protective measures which include hydrocarbon interceptors and erosion/ sediment control measures.

Siltation of watercourse substrate and high suspended solids associated with construction and decommissioning activities have potential to add an additional, short term pollutant source to the River Shannon catchment which could result in reducing water quality downstream in-combination with other pollution sources, e.g. runoff from Mountdillon Group: peat extraction. Additional pollution sources associated with the development and other land management practices such as agriculture, could have significant effects on the surface water environment, if unmitigated. Thus, in the absence of mitigation, there is potential for in-combination effects to result from the proposed development and existing activities in the wider area such as agriculture. If unmitigated in combination water quality impacts, and in turn effects on aquatic biota, are considered short term, moderate negative effects (EPA 2017). However, with appropriate mitigation measures in place (see Section 6.7), it is considered there will be no significant effects on water quality as a result of the proposed development. As a result, it is expected there will be no cumulative effects with other plans or projects on water quality and aquatic biota. Further details on the potential cumulative effects on water quality and the potential hydrological connectivity of

[113] SNH (2012) Assessing the cumulative impacts of onshore wind energy developments.

the proposed development area with local ecological features (post mitigation) are addressed in Chapter 8 of this volume of the EIAR.

There are no existing or permitted wind farms in Co. Longford. The Roosky wind farm in Co. Roscommon is located c. 14.5km to the north of the proposed development. The Skrine wind farm in Co. Roscommon, is located c. 19km to the south-west of proposed development. Both of these wind farms are considered sufficiently distant and small (2 No. turbines at each site) to avoid cumulative effects with the proposed development.

The Sliabh Bawn wind farm is located approximately 8km west of the proposed development. This development is comprised of 20 electricity generating wind turbines. The total site area is approximately 833ha and ranges in elevation from 70m to 262m (ordnance datum). This development also contains hardstandings, a substation, a permanent meteorological mast, a communication mast and associated roads. This development is located approximately 5km south-east of Strokestown Co. Roscommon. The two sites are separate by lands of mixed agricultural use, lowland bog and the River Shannon. The two developments will have an effect on habitats onsite, however the combined impacts will be limited by the differing nature of the habitats at each development, i.e. the Sliabh Bawn site is dominated by coniferous plantation; this habitat type is rare at the proposed development site and is generally considered of low ecological value. The cumulative effects which may affect local/ regional avian communities includes:

- Cumulative collision risk;
- Cumulative Habitat Loss and disturbance displacement; and
- Creating a barrier to dispersal for regular movement or for migration.

There is potential for collision risk for species of bird which utilise the habitats of the two wind farms or birds which commute between the two sites. However, at Sliabh Bawn no species recorded onsite were of high conservation concern, as per the site's planning application EIS. The majority of species recorded at this site were passerines which are of low risk of collision. Given the favourable conservation status of the species recorded at Sliabh Bawn together with the low predicted risk of collisions identified for the species occurring onsite it is considered that cumulative collision risks are judged to be of Low Concern.

It is typically considered that a barrier effect is more likely to impact large flocks of migrating water birds than other species groups such as raptors. The European Union (2011)[114] highlighted the risks

[114] European Union (2011) EU guidance on wind energy development in accordance with the EU nature legislation.

associated with turbines when placed along migration routes or between feeding and roosting/ breeding locations. Migrating water birds require corridors within the landscape along which to migrate. Percival (2001)[115] recommends locating turbines at a minimum of 200m apart to facilitate the free movement of birds, thereby avoiding a barrier effect. The Sliabh Bawn wind farm and the proposed development are separated by a distance of 8km; this distance is considered sufficiently large enough to not produce a combined barrier effect, based on Percival (2001) recommendations.

Direct habitat loss for birds as a result of land taken by wind farm developments is typically not considered a major concern outside of nationally and internationally important sites for birds. The turbines at the two wind farms are considered sufficiently separated (8km), so as to avoid the potential for cumulative habitat loss or displacement effects.

Robinson *et al.* (2010)[116] stated that water birds show a preference for flight paths which follow natural watercourses in the landscape as opposed to flying over mountainous or hilly terrain. It is therefore reasonable to conclude that wintering water birds (locally) are more likely to follow flightlines along the River Shannon corridor, and would be less likely to cross either Sliabh Bawn wind farm or the proposed development, during migration. Wind farms in the landscape can result in a barrier effect for foraging birds when turbines are located between foraging and roosting grounds. However, given the core foraging range of water birds wintering in the River Shannon catchment is generally less than 8km (e.g. Whooper Swan less 5km[59]) the Sliabh Bawn wind farm is considered too distant to result in such cumulation effects on foraging birds. Additionally, individual species accounts as detailed in Table 6.26 (e.g. Lapwing, Golden Plover and Whooper Swan) show some bird species to be adept at navigating between operating turbines. Therefore, the impacts of cumulative barrier effect are of **Low Concern**.

On the 21st of August 2018 planning permission was granted for the refurbishment of the Cloon – Lanesboro 110 kV Overhead Line. Any replacement structure will be constructed at, or immediately adjacent to the existing structures they will replace and will be generally of similar height and appearance. The permission includes the requirement for bird flight diverters. Given the bird flight diverters and that birds will have become accustomed to the existing overhead line in the landscape

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[115] Percival S. M. (2001) Assessment of the effects of offshore wind farms on birds. Unpublished report for the UK Department of Trade and Industry, ETSU W/13/00565/REP, DTI/Pub URN 01/1434.
93 p. www.berr.gov.uk/files/file20258.pdf (viewed 23 September 2008).

[116] Robinson, W.D., Bowlin, M.S., Bisson, I., Shamoun-Baranes, J., Thorup, K., Diehl, R.H., Kunz, T.H., Mabey, S. and Winkler, D.W., (2010). Integrating concepts and technologies to advance the study of bird migration. *Frontiers in Ecology and the Environment*, *8*(7), 354-361.

significant, collision risk was judged to be of **Low Concern**. Therefore, given the low levels of collision risk associated with this proposed development, cumulative effects are not considered to be significant.

The potential impacts resulting from cumulative loss of habitat to mammals is considered insufficient to result in significant negative effects (in the overall context of total available habitat locally). Leisler's bat are a particularly susceptible cumulative collision risk owing to the 13.4km foraging distance from roosts which have been recorded for this species. Leisler's bat movements were recorded at the proposed development at Derryadd. As such, Leisler's bat may be susceptible to cumulative impacts which, if unmitigated, could be of local significance.

In relation to the Middleton House and Fisherstown Solar Farm, the planning permission granted for these two sites includes the requirement for protective measures that will ensure the protection of the wider environment/ key local receptors across all identified impact sources. These protective measures include; sediment and erosion control (such as silt traps or geotextile curtains), stockpiling kept to a minimum well away from drain and watercourse, and bulk fuel tanks properly bunded. Furthermore, given the differing nature of the proposed developments (wind farm versus solar farms) and the different types of impacts associated with each type of development, as well as the separation distances between the developments (i.e. 1.5km and 5.9km respectively, which are considered too great to have a combined direct effect), there will be no cumulative effects.

6.6.5 Do-Nothing Effect

A number of alternatives have been assessed as part of the proposed development full details of which are provided in Chapter 3: Reasonable Alternatives. Consideration of alternatives and site selection was a key part of the process in identifying a proposed development of least environmental impact. In relation to biodiversity, avoidance of ecological receptors was a key consideration during the project's development, through the use of constraint mapping and data obtained from baseline studies.

In the case of no development occurring, there would continue to be changes in biodiversity or potentially the ecological value of habitats and species as a result of on-going land management associated with the commercial peat production which is ongoing at the proposed development site. The duration of peat production at the site will vary with the depth of peat deposits. Bord na Móna is committed to peat production at Derryaroge, Derryshannoge, Derryadd and Lough Bannow until 2030. It is likely that most of the area would continue to be managed intensively for peat production until this date. Following the discontinuation of commercial peat production, the site will be allowed to naturally re-colonise with birch scrub and emergent wetland vegetation in line with the finalised IPC required rehabilitation plan.

In 2013, Bord na Móna submitted draft rehabilitation plans for each of the Bord na Móna bogs, as per IPC Licence Condition 10 requirements. The plans were further updated in 2015, following rehabilitation trails. The main elements required for rehabilitation post peat production are stabilisation of former bare peat areas largely attained through natural processes of revegetation which may require enhancement by targeted management such as fertiliser/ seeding; surface manipulation and/ or hydrological management (drain/ outfall blocking). Following peat production these rehabilitation measures will be put in place at the site. The likely outcome of these rehabilitation practises is that the site will become of greater value to protected species, including the qualifying interest of local designated sites, e.g. breeding waders and otters. It is proposed by Bord na Móna to incorporate the proposed development (If consented) into the rehabilitation plan. Bord na Mona has successfully incorporated its peat rehabilitation plans into wind farm developments at sites such as Mount Lucas windfarm and Oweninny windfarm (under construction).

6.7 MITIGATION MEASURES

Consideration of various design options has led to the current proposed design that is deemed to have the least ecological impact taking account all other location factors and constraints. The hierarchy of mitigation measures that are applied are avoidance (primarily by design), prevention and reduction.

6.7.1 Construction Phase

During the construction phase of the proposed development the following mitigation measures are proposed to avoid, prevent or reduce significant effects on key ecological receptors:

- Where areas of potentially sensitive breeding bird habitat (e.g. birch scrub) is proposed to be removed during construction, these works will be timed to avoid the breeding birds nesting season, 1st of March to 31st of August. This measure will avoid any potentially significant effects.
- The majority of construction activity will take place during daylight hours, thereby avoiding disturbance to nocturnal fauna. Drewitt and Langston (2006) present this recommendation as industry best practise[94]. On occasion deliveries (such as oversize deliveries) may arrive outside daylight hours and concrete pours for the turbine foundations may commence and conclude at dawn/ dusk. This will be an infrequent occurrence of short duration and will therefore not have any significant disturbance effects on fauna within the vicinity of the proposed development area.
- No turbines are located in high (local) value habitats and all are located in habitats not evaluated as key ecological receptors and typically of low ecological value. This mitigation by avoidance will reduce potential habitat loss impacts for key avian species.
- The proposed turbine locations and access routes will avoid potential breeding sites that protected mammals such as otter, badger and bats typically use including; field boundaries

(treelines / hedgerows), stream/ rivers and associated riparian habitats, old buildings, caves, bridges and souterrains. This measure will avoid any potentially significant effects.

- Following detailed design consideration, and as required, temporary silt screens will be installed in drains/ small streams deemed to be possibly at risk of water pollutant discharge. Mitigation for in-stream works will follow IFI recommendations as per Chapter 8.
- During the construction phase as part of the CEMP, ecological monitoring will take place by a suitably qualified Ecological Clerk of Works (ECoW)The role of the ECoW will include:
    - Supervision of construction works and ensure compliance with legislation;
    - Monitoring habitats and species during the course of construction works and effectiveness of mitigation;
    - Provision of advice regarding the avoidance and minimisation of potential disturbance to wildlife;
    - Provide recommendations on appropriate responses/ actions to site specific issues (e.g. identification of previously unrecorded breeding sites during construction works); and
    - Liaison with NPWS, IFI and other prescribed authorities, when required.
- If encountered during construction, the spread and introduction of alien invasive species and noxious weeds will be avoided by adopting appropriate mitigation measures as per guidance issued by the NRA (2010)117. The mitigation/control measures adopted will depend on the type of invasive species encountered. Some control and management measures include; physical (cutting, digging, excavating) and chemical control (herbicides). All vehicles and equipment should be cleaned before entering and exiting the site. Although no non-native invasive plant species (as per the Third Schedule Part 1 of the European Communities Regulations 2011) were recorded during baseline surveys; any invasive plant material noted (during construction activities) on site will be removed off site and disposed of at appropriate licensed waste disposal facility. Any alien invasive species found to occur within 15m of working areas will require a specialist method statement for its eradication to avoid the spread of invasive species, this will ensure compliance with the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. No. 477 of 2011). The presence of alien invasive species and requirement for actions will be confirmed by the ECoW prior to the commencement of works.
- A bat roost survey in areas of suitable habitat will be carried out prior to commencement of construction. Ivy covered trees (if confirmed to contain a bat roost) that require felling will be left to lie for a period of 24 hours to allow bats to escape. Large trees that are identified as bat roosts will be felled carefully, using the gradual dismantling technique by a tree surgeon under the supervision of a bat specialist.

[117] NRA (2010). Guidelines on The Management of Noxious Weeds and Non-native Invasive Plant Species on National Roads.

- Lighting will be avoided where possible, except where it is required for health and safety reasons, as it deters some bat species from foraging.
- For bats, mitigation is best achieved through avoidance. It is proposed that the measures detailed in Table 6.27 be put in place to avoid or lessen the degree of impacts on local bat populations during construction (which are also applicable to the decommissioning phase; see Appendix 6.6 for further details).

Table 6.27: Bat Mitigation Measures Recommended during the Construction Phase

High Level Bat Mitigation – Leisler's bats This applies to T2 and T12	**High Level Bat Mitigation** This applies to T4, T10, T19 and T22 This applies to Internal Road Network between T4 – T5	**Medium Level Bat Mitigation** This applies to T1, T3, T5, T11 and T18	**Low Level Bat Mitigation** This applies to T7, T8, T9, T20, T21, T23 and T24.
A zone of 200m around the wind to reduce favourability of this zone for foraging and commuting bats.	A zone of according to English Nature calculation around the wind turbines (from the tip of the blade) should be cleared of tall vegetation (shrubs, trees, scrub etc.) to reduce favourability of this zone for foraging and commuting bats.	A zone of 50m around the wind turbines (from the tip of the blade) should be cleared of tall vegetation (shrubs, trees, scrub etc.) to reduce favourability of this zone for foraging and commuting bats.	A zone of 50m around the wind turbines (from the tip of the blade) should be cleared of tall vegetation (shrubs, trees, scrub etc.) to reduce favourability of this zone for foraging and commuting bats.
	A corridor of 50m along the haul roads (between T4-T5) should be cleared of tall vegetation (i.e. >1m height - shrubs, trees, scrub etc.) to reduce favourability of this zone for foraging and commuting bats. A low level of vegetation should be maintained for the entire operational phase.		
Complete clearance work during the autumn and spring months. Complete clearance work at least 6 months prior to installation of wind turbines. Studies have shown that bats are attracted to clear felled forestry areas due to increase insect loading. This has been	Complete clearance work during the autumn and spring months. Complete clearance work at least 6 months prior to installation of wind turbines. Studies have shown that bats are attracted to clear felled forestry areas due to increase insect loading. This has been	Complete clearance work during the autumn and spring months. Complete clearance work at least 6 months prior to installation of wind turbines. Studies have shown that bats are attracted to clear felled forestry areas due to increase insect loading. This has been	Complete clearance work during the autumn and spring months. Complete clearance work at least 6 months prior to installation of wind turbines. Studies have shown that bats are attracted to clear felled forestry areas due to increase insect loading. This has been

High Level Bat Mitigation – Leisler's bats This applies to T2 and T12	**High Level Bat Mitigation** This applies to T4, T10, T19 and T22 This applies to Internal Road Network between T4 – T5	**Medium Level Bat Mitigation** This applies to T1, T3, T5, T11 and T18	**Low Level Bat Mitigation** This applies to T7, T8, T9, T20, T21, T23 and T24.
shown to occur for a period of 3-6 months before the insect loading reduces to pre-cleared felled levels.	shown to occur for a period of 3-6 months before the insect loading reduces to pre-cleared felled levels.	shown to occur for a period of 3-6 months before the insect loading reduces to pre-cleared felled levels.	shown to occur for a period of 3-6 months before the insect loading reduces to pre-cleared felled levels.
Provide "bat habitat" of 2 hectares/wind turbine. This land should be located at least 1km away from the nearest wind turbine. Natural regeneration of peat bog by scrub vegetation is recommended 1km outside the zone of the wind farm.	Provide "bat habitat" of 2 hectares/wind turbine. This land should be located at least 1km away from the nearest wind turbine. Natural regeneration of peat bog by scrub vegetation is recommended outside the zone of the wind farm.	Provide "bat habitat" of 1 hectares/wind turbine. This land should be located at least 1km away from the nearest wind turbine. Natural regeneration of peat bog by scrub vegetation is recommended outside the zone of the wind farm.	Provide "bat habitat" of 0.5 hectare/wind turbine. This land should be located at least 1km away from the nearest wind turbine. Natural regeneration of peat bog by scrub vegetation is recommended outside the zone of the wind farm.

6.7.1.1 Residual Effects (Construction Phase)

With the proposed avoidance measures, and careful surface water protection and waste management procedures in place (as outlined above), the existing biodiversity can be protected. Where mitigation measures are based on the best available scientific evidence, confidence can be placed in their likely success. Thus, there will be no residual effects of high significance arising from the construction phase of the proposed development.

6.7.2 Operational Phase Mitigations

During the operational phase of the development the following mitigation measures will be implemented to avoid identified effects to key receptors:

- The proposed development area will be allowed to naturally re-colonise with birch scrub and emergent wetland vegetation and thereby increase the ecological value of the site during the wind farm operation.
- In order to avoid a potential barrier effect on birds as a result of the positioning of the proposed turbines close together, the turbines have been positioned at distances greater than 400m apart as per recommendations in Percival (2001).
- In order to reduce any collision risk between special conservation interest species and the proposed development, turbines were not placed on Cloonbony Bog or in the northern section of Derryaroge Bog to ensure a suitable setback distance between the River Shannon, Lough Ree SPA, Ballykenny Fisherstown Bog SPA and the proposed development was achieved.
- In the event an overhead power line is selected as the preferred grid connection, bird flight diverters will be installed as per best practise guidelines (Eirgrid, 2012)[118].

6.7.2.1 Bat Mitigation Measures

Bat mitigation measures during the operational phase will be determined by implementing a strict surveillance programme for the first two years of operation of the proposed development in order to identify if a substantial risk exists at a particular turbine location or during a particular time-period. If surveillance results indicate medium to high bat activity levels and/or bat carcasses are collected then the following bat mitigation measures for cut-in speeds will be required at specific turbine locations.

[118] Eirgrid (2012). Ecology Guidelines for Electricity Transmission Projects. A Standard Approach to Ecological Impact Assessment of High Voltage Transmission Projects. Available at http://www.eirgridgroup.com/site-files/library/EirGrid/EirGrid-Ecology-Guidelines-for-Electricity-Transmission-Projects.pdf.

Increasing the turbine cut-in speed to 5.5 m/s from 30 minutes prior to sunset and to 30 minutes after sunrise to reduce bat collisions with turbines will be employed at turbine locations where surveillance records high bat activity levels for high risk and medium risk bat species and/or where bat carcasses are recorded. Where cut-in speeds are required, they will be operated according to specific weather conditions:

- When the air temperature is greater than 7°C as there was no bat activity recorded below this temperature during surveys; and
- In general, bat activity is highest at low wind speeds (<5.5m/s). Therefore, it has been shown that curtailing the operations of wind turbines at low wind speeds can reduce bat mortality dramatically, especially during the late summer and early autumn months.

Fatalities can be reduced by changing the speed trigger or cut-in speeds of the turbines (i.e. meaning that the turbine is not operational during low wind speeds) or by changing the turbine blades angles which will mean that higher wind speeds are needed to start the wind turbine blades moving. Modern remotely operated wind turbines allow such cut-in speeds to be controlled centrally and automatically.

Additional mitigation measures that will be employed include:

- A low level of vegetation should be maintained for the entire operational phase. This could be achieved by implementing a rehabilitation plan which is likely to suppress vegetation growth. This should be monitored to ensure that scrub vegetation does not develop within the zone around the turbines,
- Undertake a carcass search for 2 years post operation of the wind farm to determine whether a higher cut-in speed of the blades is required; and
- Maintain the immediate area around the turbines in a manner that does not attract insects and thereby avoid attracting bats to the turbines.

6.7.2.2 Residual Effects (Operational Phase)

With the proposed avoidance measures and mitigation measures in place (as outlined above), the existing biodiversity can be protected. Where mitigation measures are based on the best available scientific evidence, confidence can be placed in their likely success. Thus, there will be no residual effects of high significance arising from the operational phase of the proposed development.

6.7.3 Decommissioning Phase Mitigation

The expected life span of the proposed wind farm is at least 30 years; accordingly, mitigation measures listed below will be amended as appropriate to best practice at the time of decommissioning.

- Construction activities associated with decommissioning of the wind farm will commence outside of the bird nesting period, which begins on March 1st and continues until August 31st, in order to protect nesting birds. All birds (with the exception of those species mentioned in the Third Schedule of the Act) and their nesting places are protected under the Irish Wildlife Act 1976 (as amended).
- Decommissioning operations will be undertaken during daylight hours to avoid undue disturbance to nocturnal fauna resident locally.
- The proposed development area will be allowed to naturally re-colonise with birch scrub and emergent wetland vegetation and thereby increase its ecological value of the site following decommissioning.

6.8 MONITORING

In order to ensure the effectiveness of mitigation measures, monitoring will be required, specifically related to local fauna. This monitoring will be conducted by an appropriately qualified and experienced ornithologist/ ecologist in consultation with NPWS.

- Pre-construction surveys are required to identify the location of breeding birds onsite, in particular breeding waders (e.g. Lapwing, Ringed Plover, Woodcock and Snipe). These surveys are required to inform site clearance activities given the legal protection of all breeding birds.
- Pre-construction surveys for bat species, otter and badger (resting or breeding places) will be conducted at watercourses and woody vegetation required for cutting to confirm the conditions which have been anticipated to be encountered in the EIAR. This is required to inform site clearance activities given the legal protection of otter and badger breeding sites. A buffer zone will be established around any known otter or badger resting or breeding places through the erection of temporary posts and wires with 'no entry' signs erected. No direct impacts are expected to arise as works will require an agreed method statement and be monitored by the ECoW based on relevant guidelines (NRA 2006).

In addition, monitoring will be run in parallel with the lifetime of the wind farm, visits will be conducted in years 1, 2, 3, 5, 10 and 15[119]. The programme will aim to monitor factors which relate to collision risk, disturbance displacement/ barrier effects and habituation during the lifetime of the project. Survey methods will broadly follow SNH (2014) monitoring guideline protocols, i.e. SNH (2014) guideline should be adapted to the Irish context, as required.

- Migratory/ Wintering Waterfowl Surveys of Local water bodies;
- Vantage Point Surveys;

[119] SNH (2009) Monitoring the impact of onshore wind farms on birds.

- Onsite Breeding Birds surveys; and
- Corpse search (birds and bats) at turbine bases.

Bat Monitoring

It is recommended that if three years lapse from between pre-construction surveys and the construction of the wind turbines, it may be necessary to repeat the pre-construction surveys (EUROBATS, 2014)[120]. Surveys completed for this report concluded in 2018. Therefore, a review will be undertaken no later than spring 2021.

The mitigation measures will be monitored by a suitably qualified bat ecologist at intervals during the initial years of operation of the development to ensure successful implementation. Good practice also requires that impacts on adjoining areas are also monitored (Perrow, 2017)[121]. Monitoring will be run in parallel with the lifetime of the wind farm, visits will be conducted in years 1, 2, 10 and 20. Static surveys methods will include:

- Five nights per turbine; and
- Three periods within the months of March/April to October/November, i.e. to investigate the spring, summer and autumn bat activity.

Carcass Searches should also be undertaken to compliment the bat surveys. A minimum of one morning per turbine during the five day static survey is recommended. Carcass survey will only be undertaken in ideal bat foraging weather conditions (mild, calm and dry weather and greater than 10oC). Searches will be completed at dawn in order to find bats before scavenging of corpses occurs. Best practice carcass search protocols of the day will be followed.

6.9 SUMMARY OF SIGNIFICANT EFFECTS

This chapter presents an evaluation of the potential ecological impacts of the proposed development on the biodiversity locally and details appropriate mitigation where a potential impact is identified. The development and implementation of an outline CEMP, which will include monitoring of construction by an ECoW, is a key instrument in ensuring the implementation of all mitigation measures during construction. An outline CEMP will be included in this planning application. Impacts in relation to habitat loss and fragmentation, disturbance, collision risk and cumulative effects have been assessed as slight to

[120] Rodrigues, L., Bach, L., Dubourg-Savage, Karapandža, B., Kovâc, D., Kervyn, T., Dekker, J., Kepel, A., Bach, P., Collins, J., Harbusch, C., Park, K, Micevski, B. and Minderma, J. (2014). Guidelines for consideration of bats in wind farm projects. Revision 2014 Bonn: UNEP/EUROBATS.

121 Perrow, M. R. (2017) Wildlife and Wind Farms, Conflicts and Solutions. Volume 1 & Volume 2. Pelagic Publishing.

moderate negative effects (EPA 2017). The successful implementation of mitigation measures will render residual long-term impacts on key ecological receptors as slight negative effects (EPA 2017). Overall it can be concluded, the proposed development will not have significant effects on the flora, fauna and habitats considered as part of the assessment.

7 LAND, SOILS AND GEOLOGY

7.1 INTRODUCTION

Gavin & Doherty Geosolutions Limited (GDG) has been appointed by TOBIN Consulting Engineers (TOBIN) to assess the effects of the proposed development on the soil and geological environment.

This chapter sets out the assessment methodology and information on the existing soil and geological environment (i.e. baseline for the site). The potential effects of the proposed development are then discussed along with recommended mitigation measures for each potential effect. Any residual effects are also assessed.

7.1.1 Statement of Authority

The specialist geotechnical consultant, GDG, has been involved in all aspects of geotechnical design of wind farms, from conception through to commissioning. The GDG engineers are intimately familiar with similar projects to the proposed development, having worked on wind farms at Mount Lucas and Bruckana set in similar ground conditions.

This section has been prepared by Paul Quigley and Laura Burke of GDG. Paul Quigley is a Chartered Engineer with 22 years' experience in civil engineering and is a UK Registered Ground Engineering Adviser. He holds a Bachelor of Engineering in Civil Engineering from NUI Galway. His experience includes working in the planning, environmental impact and constraints study phases of large Irish infrastructure projects. Paul has worked on a number of windfarm projects both at planning and construction phase including Kilmeedy, Cappawhite and Castlepook windfarms and the Slagbooly windfarm peat stability assessment.

Laura is a Chartered Engineer with seven years' post graduate experience in civil engineering, three of which are within the onshore renewable energy sector. She obtained her Bachelor in Engineering in Civil Engineering from NUI Galway and a Masters in Engineering Geology from Imperial College London. She has worked on a number of windfarm projects in Ireland and the UK in the pre-construction, tender design and construction phases. These include Teevurcher, Meenwaun and Oweninny windfarm in Ireland and Dorenell and Quixwood Moor windfarm in Scotland.

7.2 METHODOLOGY

The methodology used to produce this chapter included a review of relevant legislation and guidance, a desk study, a site walkover, an intrusive investigation (in the form of trial pits, rotary cores, peat probes and laboratory tests), an evaluation of potential effects, an evaluation of significance of the effect and an identification of measures to avoid and mitigate effects.

7.2.1 Relevant legislation and guidance

This chapter has been prepared having regard to the following guidelines and policy documents:

- Geology in Environmental Impact Statements – a Guide (Institute of Geologists of Ireland (IGI) 2002);
- Department of Housing, Planning and Local Government Wind Energy Development Guidelines (2006)
- Groundwater Directives (80/68/EEC) and (2006/118/EC);
- Environmental Impact Assessment of National Road Schemes – A Practical Guide (NRA 2008a);
- Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes (NRA 2008b);
- Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements (IGI, 2013);
- Peat Landslide Hazard and Risk Assessments, Best Practice Guide for Proposed Electricity Generation Developments - Second Edition (Natural Scotland Scottish Executive, 2017); and
- Review of Wind Energy Development Guidelines "Preferred Draft Approach" (Department of Housing, Planning, Community and Local Government, 2017).
- Revised Guidelines on the Information to be Contained in Environmental Impact Assessment Reports. Draft (Environmental Protection Agency, 2017).

7.2.2 Consultation

As part of the study, GDG consulted with the following parties:

- Bord na Móna for details of existing ground investigation data;
- Geological Survey Ireland (GSI) for details on background mapping, historic ground investigations (for mining exploration) and geological heritage; and
- Environmental Protection Agency (EPA) for details on emission points and landfills.

7.2.3 Desk study

A desk study was undertaken in order to collate and review background information in advance of the site survey. The desk study was carried out initially in February 2017 and again in October 2018 and January 2019. It involved the following:

- Examination of the Geological Survey of Ireland (GSI) datasets pertaining to geological and extractive industry data and the GSI borehole database;
- Examination of Environmental Protection Agency (EPA) data including soil and subsoils;
- Examination of peat mapping provided by Bord na Móna;
- Examination of National Parks and Wildlife Service (NPWS) nature conservation designations; and
- Preparation of site maps and suitable field sheets for the site survey.

The desk study information obtained is referenced below. Following the desktop study and the site survey, geological maps were generated in GIS and are included in Appendix 7.1. Ground investigation information is included in Appendix 7.2.

As part of the study, GDG reviewed the following public information sources:

- Published geological, soil, groundwater, surface water, aquifer, recharge data obtained from the Geological Survey of Ireland (GSI);
- National Parks and Wildlife Service data of designated conservation areas;
- Waste and IPPC licensed facility data from EPA Geoportal;
- Irish Geological heritage site map from the GSI (www.gsi.ie);
- EPA online Envision Map Viewer (www.epa.ie);
- Aerial Photography from ESRI (ArcGIS).

7.2.4 Field work

Site surveys relating to the soil and geological environment and ground investigations were undertaken from October 2016 to March 2018. These included:

- A site walkover to review the ground conditions and assess the topography, geomorphology and requirements for further investigations was carried out on the 28th October 2016 and the 1st December 2016;
- No. 200 peat probes at proposed turbine locations, along access tracks and at potential borrow pits, April 2017 - March 2018;
- No. 91 trial pits at proposed turbine locations, potential substation locations, along access tracks and at potential borrow pits, October 2016 – March 2018;
- Hand shear vane tests on the material encountered in the trial pits, October 2016 – March 2018;
- No. 5 Rotary core drillings to assess interconnectivity of the proposed development site with nearby turloughs, June 2017; (this information informed the subsequent and separate borrow pit assessment)

- Logging of the soil layers and sampling of each stratum encountered; and
- Laboratory analyses of the samples collected during the above investigations.

Ground investigation locations are shown in Figures 7.12 to 7.15. Ground investigation information is included in Appendix 7.2.

7.2.5 Evaluation of Potential Effects

The 13-step approach to impact assessment proposed in the IGI guidelines (2013) is adopted for the evaluation of potential effects. The baseline environment is assessed by characterising the site topographical, geological and geomorphologic regimes from the data acquired. Following on from the identification of the baseline environment, the available data is utilised to identify and categorise potential effects on the soils and geological environment as a result of the proposed development. These assessments are undertaken by:

- Undertaking preliminary materials calculations in terms of volumetric soil and subsoil excavation and reuse associated with development design
- Assessing ground stability risks, in particular to peat stability;
- Assessing the combined data acquired and evaluating any likely effects on the soils, geology and ground stability; and
- Identifying effects and considering measures that would mitigate or reduce the identified effect.

The significance of effects of the proposed development has been assessed in accordance with the EPA guidance document *Draft Guidelines on the information to be contained in Environmental Impact Assessment Reports* (EIAR), Draft, August 2017. These are outlined in Chapter 1. The effects associated with the proposed development are described with respect to the EPA guidance in the relevant sections of this chapter.

7.3 EXISTING ENVIRONMENT (BASELINE DESCRIPTION)

The existing environment is discussed in terms of geomorphology (landscape and topography), superficial and solid geology, and peat stability. The regional review of geological and hydrogeological conditions covers a zone of 2 km from the proposed development site, as suggested in the IGI guidelines. The proposed development site is not a sensitive site in terms of the soils and geological environment, and the following sections outline this.

7.3.1 Study Area

The proposed 24 wind turbine development will be located on three bogs within the Mountdillon Group of peat production bogs, namely Derryaroge, Derryadd, and Lough Bannow cutaway bogs and a very small portion of a fourth cutaway bog, Derryshannoge. These are located in south County Longford as shown in Figure 7.1. The proposed development site has a total area of approximately 1900 hectares and is located in an area surrounded by the towns and villages of Lanesborough, Derraghan, Keenagh, and Killashee. The surrounding landscape is a mixture of forestry, agricultural land and cutaway peatland, and is predominately flat. The Royal Canal and Lough Ree are located to the east and west respectively, and the River Shannon passes the northern boundary of the proposed development site.

The proposed development is described in Chapter 2 of this EIAR. The location and layout are shown in Figure 7.1.

7.3.2 Site Topography and Geomorphology

The topography of the site is relatively flat with elevations ranging from 37mAOD to 59mAOD. A number of glacial depositions known as drumlins are identified across the site resulting in local variations in topography. They can be seen in the form of a low oval mound with one steep blunt end, known as the stoss, and another shallow sloping end, known as the lee end. The shape of the drumlins can be seen on the geological plans on Figures 7.2, 7.3, 7.8 and 7.9 in the form of tear drop shaped geological zones (*BminPDPT* on Figure 7.2 and 7.3, and *Till derived from Limestones* on Figure 7.8 and 7.9). The drumlins generally follow a NNW-SSE alignment. Localised, man made changes in topography in the form areas of shallow excavation are also present due to the peat production on site.

7.3.3 Regional Bedrock

The bedrock geology on the 1:100,000 scale mapping from the GSI indicates that this region surrounding the site extents is characterised by 17 geological formations. The regional bedrock geology is shown in Figure 7.4 and a description of the relevant bedrock formations is presented in Table 7.1

Table 7.1: Bedrock Geology Description

Formation	Abbreviation	Description
Aghamore Formation	AE	Lava and volcaniclastic breccia
Meath Formation	ME	Limestone, calcareous sandstone
Moathill formation	MH	Limestone, calcareous sandstone, shale
Rinn Point Limestone Formation	RP	Basal clastics

Ballysteen Formation	BA	Dark muddy limestone, shale
Fearnaght Formation	FT	Pale conglomerate and red sandstone
Lucan Formation	LU	Dark limestone and shale, calp
Argillaceous Limestones	AL	Dark limestone and shale, chert
Visean Limestone (undifferentiated)	VIS	Undifferentiated limestone
Dolomitised limestone (Visean Limestones)	VIS	In Visean limestone Formation
Waulsortian Limestones	WA	Massive unbedded lime-mudstone
Lackan Formation	LN	Feldspathic sandstone with jasper
Darty Limestone Formation	do	Dolomitised Limestone
Mudbank Limestone	mk	Mudbank Limestone
Carrrickateane Formation	CT	Greywacke with argillite and black shale
Finnalaghta Formation	FA	Blue-grey greywacke and black argillite
Slieve Glah Formation	SG	Siltstone, mudstone and thin turbidite

7.3.4 Local Bedrock Geology

At Derryaroge, Derryadd and the small portion of Derryshannoge within the application proposed development site, the underlying bedrock is predominantly Visean Limestone (Undifferentiated). Figure 7.5 shows the local bedrock geology.

Lough Bannow Bog is characterised by eight formations. The formations in this area are:

- Visean Limestone (Undifferentiated);
- Argillaceous Limestones;
- Ballysteen Formation;
- Meath Formation;
- Moathill Formation;
- Rinn Point Limestone Formation;
- Waulsortian Limestones; and
- Lucan Formation.

The underlying bedrock for each proposed turbine location is presented in Table 7.2. This table shows three types of bedrock formation underlying the proposed turbine locations. Faults are shown on the geological mapping in Figure 7.4 and Figure 7.5 running through Lough Bannow close to turbines T18, T21 and T24. No bedrock outcrops are indicated within the site extents in the geological mapping.

Table 7.2: Underlying bedrock formation for each proposed turbine and borrow pit location

Turbine Location	Bedrock Formation
1 to 17	Visean Limestone (Undifferentiated)
18 to 23	Moathill Formation
24	Ballysteen Formation
Borrow Pit Location	
17-1 to 17-5	Visean Limestone (Undifferentiated)
Substation	
Option A	Visean Limestone (Undifferentiated)
Option B	Waulsortian Limestones

The GSI database contain records of ground investigations carried out within and nearby to the development area. These investigations consist of boreholes located in and around the Lough Bannow bog. Logs of all but two of the boreholes are available from the database which indicate that the boreholes were drilled for mining exploration purposes. Limestone, sandstone, dolomite, wackestone, siltstone and claystone were recorded in these boreholes. These lithological descriptions are generally in agreement with those provided by the GSI as shown in Table 7.1. The depths to bedrock identified during these ground investigations are summarised in Table 7.3.These ground investigations carried out on and nearby the site are shown in Figures 7.8 and 7.9. A zone of poor core recovery was identified in Borehole DLF-3-185, located south-east of T21, which is described as *possible sinkhole material*. The log indicates the feature is infilled with weathered limestone and clay, however, voiding was not recorded.

Table 7.3: Depth to Bedrock Lough Bannow

ID Borehole	Depth to bedrock (DTB)
DLF-16-581	3
01-581-03	7.0
DLF-02-185	9.1
01-1802-01	9.5
DLF-17-581	10.4
DLF-29	10.4
LF-20	12.2
DLF-28-581	12.8

DLF-3-185	15.8
DLF-4-581	16.5
DLF-18-667	18.0

7.3.5 Mineral / Aggregate Resources

There are no active quarries on the site. The GSI data indicates that one mineral location is present in Derryaroge (Mineral ID 3976). The mineral is described as a *Shelly marl/calcareous mud as found in a trench*. The mineral and aggregate resources located in a zone of approximately 20km around the site are presented in Table 7.4 and are shown in Figures 7.4 and 7.5.

Table 7.4: Mineral and Aggregate Resources

Mineral ID	Type	Description
3106	Clay/ brick	Brick clay under bog
3976	Marl	Shelly marl/ calcareous mud
5184	Limestone	Dark grey limestone
5191	Jasper	Red jasper rock
5192	Limestone	N/A

Potential locations of borrow pits for extraction of construction aggregates for use on the scheme are within the site extents. These are discussed in terms of potential effects in Section 7.4.

7.3.6 Geological Heritage

According to the GSI, there are no Irish Geological Heritage sites inside the proposed development site. The Corlea trackway is located close to, but outside, the southern boundary of the site. The Corlea trackway is an Iron Age trackway constructed from oak planks in 148-147 BC (GSI, 2016). Figures 7.6 and 7.7 present the regional and local geological heritage in the area.

7.3.7 Regional Soils

The regional soils shown in Figure 7.2 and mapped by the EPA indicate that this region consists of 18 types of soil:

- Acid deep poorly drained mineral (AminPD);
- Acid deep well drained mineral (AminDW);
- Acid poorly drained mineral soils with peaty topsoil (AminPDPT);
- Acid shallow poorly drained mineral (AminSP);
- Acid shallow well drained mineral (AminSW);

- Acid shallow, lithosolic or podzolic type soils potentially with peaty topsoil (AminSRPT);
- Basic deep poorly drained mineral (BminPD);
- Basic deep well drained mineral (BminDW);
- Basic poorly drained mineral soils with peaty topsoil (BminPDPT);
- Basic shallow poorly drained mineral (BminSP);
- Basic shallow well drained mineral (BminSW);
- Basic shallow, lithosolic or podzolic type soils potentially with peaty topsoil (BminSRPT);
- Blanket peat (BktPt);
- Cutaway/ cutover peat (Cut);
- Fen peat (FenPt);
- Lacustrine type soils (Lac);
- Made ground (Made);
- Mineral alluvium (AlluvMIN).

Made Ground is encountered in urban areas. Alluvium deposits and raised bog are encountered along the waterways. There are no areas of blanket peat within the proposed development site.

7.3.8 Local Soils

The EPA databases indicate that the proposed project is generally underlain by *Cutover raised peat*. The peat, which is shown to underlie all of the bogs within the proposed development site, is Quaternary in age. It was formed as an extensive envelope of the landscape in the area since deglaciation approximately 7,000 – 10,000 years ago. The bogs are currently under peat production by Bord na Móna. There are two areas of Basic Poorly Drained Mineral Soils with Peaty Topsoil noted within the site extents; north of Turbine T3 and next to Turbine T22. Figure 7.3 presents the local soils.

7.3.9 Regional Subsoils

The regional subsoils in this area are shown in Figure 7.8. The dominant subsoil occurring in the region is classified as Cutover raised peat. There are also some bodies of tills present. The 12 subsoil types are characterised as follows:

- Alluvium (A);
- Blanket peat (BKtPt);
- Cutover raised peat (Cut);
- Esker comprised of gravels of basic reaction (BasEsk);
- Gravels derived from Devonian sandstones (GDSs);

- Gravels derived from limestones (GLs);
- Lacustrine sediments (Calcareous marl) (L);
- Till derived from Carboniferous sandstones and cherts (TCSsCh);
- Till derived from Palaeozoic and Carboniferous sandstones and shales (TLPCSsS);
- Till derived from Lower Palaeozoic sandstones and shales (TLSsS);
- Till derived from limestones (TLs);
- Urban.

Historical borehole records from the GSI database are presented along with their reference I.D. numbers on Figures 7.8 and 7.9.

7.3.10 Local Subsoils

Peat is encountered throughout the site. There are also some bodies of *till derived from limestones* in the development areas. The bodies of till are related to the drumlins discussed previously in Section 7.3.2. Figure 7.9 shows the local subsoils. Lacustrine Marls are also mapped within the study area and proposed development site. Marl lacustrine sediment is common in post glacial lake-bed sediments, often found underlying peat bogs such as those at the proposed development site.

The GSI database contain records of ground investigations carried out within and nearby to the development area as discussed in section 0. The depths to bedrock as identified in these boreholes are summarised in Table 7.3 and the boreholes locations are shown in Figures 7.8 and 7.9.

7.3.11 Soil Contamination

A review of the EPA website for existing and historic licensed and illegal waste activities, mines and industries was carried out to identify any potential contamination sources present in the area and to identify any potential contaminating activities near the proposed development. The desk study indicated that no illegal waste activities were present within a 2km radius of the proposed area. Four licensed Integrated Pollution Prevention Control (IPPC) sites were issued in the scheme study area as outlined in Table 7.5 and presented in Figure 7.1. No areas of particular concern were observed during the site walkover.

Table 7.5: Licensed Integrated Pollution Prevention Control (IPPC) Facilities

License Number	Name	Licences status
P0504-01	Bord na Móna Energy Limited	Licensed
P0629-01	Electricity Supply Board (Lanesborough)	Surrendered

P0610-02	Electricity Supply Board	Licensed
P0610-03	Electricity Supply Board	Under Review
P0351-01	Gem Manufacturing Company Limited	Surrendered

Licence P0610-02 relates to the licence under which the existing Lough Ree Powerstation (LRP) is currently operating. Licence P0610-03, which is currently under review as part of the application process, relates to the proposed increase in the capacity of the Ash Disposal Facility associated with the Powerstation (ESB, 2018). Bord na Móna Energy Limited have an IPC licenced activity (Reg. No. P0504-01) that covers the entire Mountdillon Bog group. The Mountdillon bog group includes the proposed development site. This licence's main class of activity is listed as the extraction of peat. The various licenced and proposed activities will not be of detriment to the proposed development.

7.3.12 Landslide Database

A review of the landslide information on the GSI Irish Landslides Database indicated that the nearest recorded landslides occurred approximately 9 km north-east of the development area (ID GSI_LS16-0043 and 044). Both events are described as peatslides and happened in February 2016 (+/- 6 months). They are characterised by an area of raised peat that has undergone some slippage. In their description of the features, the GSI (2018) note that the peatslide *appears to be relatively large and other possible slippages have occurred on the same raised bog previously*. Figure 7.10 shows the Regional Landslide Susceptibility, and Figure 7.11 shows the Local Landslide Susceptibility. The site is designated as "Low" susceptibility. The stability of the peat soils on-site is discussed in greater detail in a Peat Stability Risk Assessment (PSRA) report (Appendix 7.4) and summarised in section 7.3.17.

7.3.13 Ground Investigation

A number of phases of ground investigation (GI) of the development area were carried out and are detailed in Table 7.6.

Table 7.6: Ground Investigation Summary

Date	Investigation method	Location	Logged by	Report Available in
October 2016 – January 2017	Trial pitting	Turbine locations	GDG	Appendix 7.2.1
April 2017		Substation	Tobin	Appendix 7.2.2
December 2017		Borrow pits	Tobin	Appendix 7.2.3

March 2018		Turbine locations and haul roads	Tobin	Appendix 7.2.4
June 2017	Rotary Coring	Across Derryadd Bog	IDL	Appendix 7.2.5
April 2017	Peat probing	Turbine locations, borrow pits and haul roads	IDL	Appendix 7.2.6
March 2018			Tobin	Appendix 7.2.7
December 2017 – April 2018	Laboratory Testing	Turbine locations	Testconsult, NMTL, IDL & GSTL	Appendix 7.2.8

These investigations confirmed the general geology indicated in the geological mapping. The ground investigation indicated that the site is generally covered in peat which overlies soft to very soft silty clay or loose sand and gravels with numerous cobbles. The locations of the ground investigations are shown on Figures 7.12, 7.13, and 7.14 and details of each investigation location is presented in Appendix 7.2 (Appendix 7.2.1 to 7.2.7).

7.3.13.1 Trial Pit Summary

A summary of the ground conditions encountered during the ground investigation carried out as part of this report is given in Table 7.7.

Table 7.7: Ground profile for each turbine location

Turbine	Ground profile	Comments
Turbine 1 TP18-1 (Appendix 7.2.4)	**0.00 – 0.10m**: Black fibrous PEAT **0.10 – 2.00m:** Sandy gravelly CLAY **2.00 – 2.90m:** Very silty, slightly sandy GRAVEL with gravel, cobbles and boulders	Concluded at 2.9m due to abundance of large boulders.
Turbine 2 TP18-2 (Appendix 7.2.4)	**0.00 – 0.10m:** Black fibrous PEAT **0.10 – 0.50m:** Slightly sandy, gravelly CLAY **0.50 – 2.70m:** Slightly sandy silty CLAY with gravels, cobbles and boulders	Concluded at 2.70m due to abundance of large boulders/ bedrock .
Turbine 3 TP18-3 (Appendix 7.2.4)	**0.00 – 0.30m**: Black fibrous PEAT **0.30 – 0.80m**: Silty SAND **0.80 – 2.2m**: Sandy, gravelly SILT with sand lenses	Concluded at 2.20m due to abundance of large boulders/ bedrock.
Turbine 4 TP18-4	**0.00 – 1.6m**: Black/ brown fibrous PEAT **1.60 – 3.0m**: Very sandy, gravelly SILT/CLAY	Minor water inflow at base.

Turbine	Ground profile	Comments
(Appendix 7.2.4)		
Turbine 5 TP18-5 (Appendix 7.2.4)	**0.00 – 0.10m**: Black fibrous PEAT **0.10 – 1.30m**: Very sandy, gravelly SILT with occasional sand lenses	Concluded at 1.30m due to bedrock.
Turbine 6 TP18-6 (Appendix 7.2.4)	**0.00 – 0.80m**: Black fibrous PEAT **0.80 – 1.20m**: Shelly marl and organic CLAY **1.20 – 2.90m**: Slightly sandy laminated SILTS and CLAYS	Concluded at 2.90m due to abundance of subsidence of adjacent ground and collapse of trial pit.
Turbine 7 TP18-7 (Appendix 7.2.4)	**0.00 – 0.10m**: Black/ brown fibrous PEAT **0.10 – 1.50m**: Slightly gravelly SAND	Concluded at 1.50m due to large water inflow and collapse of trial pit.
Turbine 8 TP18-8 (Appendix 7.2.4)	**0.00 – 1.70m**: Red/ brown fibrous PEAT **1.70 – 3.30m**: Laminated sandy SILT and silty SAND	-
Turbine 9 TP18-9 (Appendix 7.2.4)	**0.00 – 1.60m**: Brown/ black fibrous PEAT **1.60 – 3.00 m**: Very sandy, gravelly SILT/ CLAY with occasional limestone cobbles and boulders	Concluded at 3.00m due to water ingress.
Turbine 10 TP18-10 (Appendix 7.2.4)	**0.00 – 0.30m**: Black fibrous PEAT **0.30 – 2.30m**: Slightly sandy gravelly SILT	Concluded at 2.30m due to abundance of large boulders.
Turbine 11 TP18-11 (Appendix 7.2.4)	**0.00 – 0.40m**: Black/ brown fibrous PEAT **0.40 – 1.30m**: Gravelly SILT	Concluded at 1.30m due to bedrock.
Turbine 12 TP18-12 (Appendix 7.2.4)	**0.00 – 2.00m**: Red/ brown fibrous PEAT **2.00 – 2.60m**: Laminated sandy SILT **2.60 – 3.20m**: Gravelly SILT/ CLAY	-

Turbine	Ground profile	Comments
Turbine 13 TP18-13 (Appendix 7.2.4)	**0.00 – 0.70m**: Brown/ black fibrous PEAT **0.70 – 3.00m**: Very sandy, gravelly SILT/ CLAY with occasional limestone cobbles and boulders	Trial pit Concluded at 3m due to water ingress.
Turbine 14 TP18-14 (Appendix 7.2.4)	**0.00 – 0.60m**: Brown fibrous PEAT	Peat probe at 2.1m; possible gravel/ gravelly till or bedrock.
Turbine 15 TP18-15 (Appendix 7.2.4)	**0.00 – 1.00m**: Black/ brown fibrous PEAT **1.00 – 2.60m**: Slightly sandy SILT/ CLAY **2.60 – 3.00m:** Very silty, sandy GRAVEL with large sub-angular to sub-rounded boulders and cobbles	Concluded at 3.00m due to boulders.
Turbine 16 TP18-16 (Appendix 7.2.4)	**0.00– 2.10m:** Red/ brown fibrous PEAT **2.10 – 3.70m:** Sandy, gravelly SILT/ CLAY	Minor inflows present.
Turbine 17 TP18-17 (Appendix 7.2.4)	**0.00 – 1.60m**: Brown/ black fibrous PEAT **1.60 – 2.70m**: Sandy, gravelly SILT/CLAY with occasional cobbles and boulders	Terminated at 2.70m due to boulders.
Turbine 18 TP 101 (Appendix 7.2.1)	**0.00 – 0.90m:** Black PEAT with very little discernible fibres and roots **0.90 – 3.10m:** Light grey soft slightly sandy gravelly CLAY with significant amount of cobbles and boulders and occasional minor lenses of yellow fine to medium sand.	Significant amount of water trickling from the interface of peat and gravelly clay. Trial Pit walls crumbling / slightly unstable after that.
Turbine 19 TP 06 (Appendix 7.2.1)	**0.00 – 1.10m**: Black to brown fibrous PEAT **1.10 – 2.00m**: Slightly clayey SILT with abundant gravels and cobbles **2.00 – 2.50m**: Slightly clayey SILT with abundant gravels, cobbles and boulders	Terminated at 2.50m due to obstruction.
Turbine 20 TP 07 (Appendix 7.2.1)	**0.00 – 1.10m**: Black to brown fibrous PEAT **1.10 – 1.40m**: Slightly silty CLAY with occasional gravels **1.40 – 2.00m**: Silty SAND with numerous gravels and cobbles	Water strike at 2.00m Terminated at 2.00m due to obstruction.
Turbine 21	**0.00 – 2.00m**: Black to brown fibrous PEAT	-

Turbine	Ground profile	Comments
TP 08 (Appendix 7.2.1)	**2.00 – 2.70m**: Slightly clayey, gravelly SILT **2.70 – 3.70m**: Silty, gravelly SAND with numerous cobbles and boulders	
Turbine 22 TP 03 (Appendix 7.2.1)	**0.00 – 3.50m**: Black to brown fibrous PEAT **3.50 – 4.50m**: Silty, gravelly SAND with abundant cobbles	-
Turbine 23 TP 04 (Appendix 7.2.1)	**0.00 – 0.05m**: Plastic fibrous Black Organic PEAT **0.05 – 0.40m**: Slightly clayey sandy, gravelly SILT with numerous cobbles **0.40 – 2.20m**: Slightly sandy, gravelly SILT/ CLAY with numerous cobbles and occasional boulders	Terminated at 2.20m due to obstruction.
Turbine 24 TP 05 (Appendix 7.2.1)	**0.00 – 1.30m**: Black to brown fibrous PEAT **1.30 – 2.70m**: Slightly clayey sandy SILT with abundant cobbles	Terminated at 2.70m due to obstruction.
Borrow Pit 17-1 TPBP1 - TPBP7 (Appendix 7.2.3)	**0.00 – 0.70m:** Black/ brown fibrous PEAT **0.70 – 1.00m:** Organic SILTS and shelly MARL **1.00 – 2.25m:** Sandy, gravelly CLAY	Concluded at 2.25 due to presence of large angular boulders.
Borrow Pit 17-2 TPBP8 – TPBP11 (Appendix 7.2.3)	**0.00 – 0.20m:** Black and brown organic PEAT **0.20 – 2.50m:** Very silty, clayey GRAVEL with numerous cobbles and boulders	Concluded at 2.50m due to presence of large angular boulders.
Borrow Pit 17-3 TPBP22 – TPBP31 (Appendix 7.2.3)	**0.00 – 0.44m:** Black and brown organic PEAT **0.44 – 1.80m:** Sandy, gravelly SILT/ CLAY	Water inflows at base of trial pit. Concluded at 1.80m due to abundance of large angular boulders and bedrock.

Turbine	Ground profile	Comments
Borrow Pit 17-4N TPBP12, TPBP19 – TPBP21 (Appendix 7.2.3)	**0.00 – 0.20m:** Black organic PEAT **0.20 – 0.90m:** Slightly sandy, gravelly CLAY	Concluded at 0.90m due to bedrock
Borrow Pit 17-4S TPBP13 – TPBP18 (Appendix 7.2.3)	**0.00 – 0.25m:** Black organic PEAT **2.50 – 2.40m:** Slightly sandy, gravelly CLAY	Water inflows at base of trial pit. Concluded at 2.40m due to obstruction.
Borrow Pit 17-5 TPBP31 (Appendix 7.2.3)	**0.00 – 0.20m:** PEAT **Noted as an area of bedrock subcrop during trial pitting**	stone was encountered at 0.2m
Substation 1 STP1, STP2, STP3, STP4 (Appendix 7.2.2)	**0.00 – 1.50m**: Brown to Black PEAT **1.50 – 3.10m**: Slightly sandy SILT/CLAY **3.10 – 3.30m**: Sandy, gravelly SILT/CLAY with Large cobbles of sandstone and limestone.	-
Substation 3 STP5, STP6 (Appendix 7.2.2)	**0.00 – 1.50m**: Red/Brown fibrous PEAT **1.50 – 2.25m**: Organic shelly MARL with occasional rootlets **2.25 – 4.50m**: Thinly laminated slightly sandy SILT/CLAY	-

7.3.14 Laboratory Test Results

During the initial ground investigations, samples were taken for laboratory testing at each turbine location. These were undertaken by different laboratories at various investigation stages as follows:

- December 2016 to January 2017 – by Testconsult Ltd from on samples from trial pitting (October 2016 – January 2017) at turbine locations;
- April 2017 - by IDL on samples from trial pitting (April 2017) at potential substation locations;
- July 2017 - By IDL on samples from rotary coring (July 2017) across Derryadd bog;

- January 2018 – by NMTL on samples from trial pitting (December 2017) at borrow pit locations; and
- April 2018 - by GSTL on samples from trial pitting (March 2018) at turbine locations and some haul roads.

The tests carried out included:

- Water content;
- Particle size distribution by wet sieving;
- Liquid limit;
- Plastic limit;
- Plastic index;
- pH;
- Sulphate concentration; and
- Point load testing.

Laboratory test results are included in Appendix 7.2.8.

7.3.15 Karst Features

Karst features are formed from the dissolution of soluble rocks such as limestone and dolomite and characterised by underground drainage systems with sinkholes and caves. GSI holds a database recording karst features and landforms (GSI, 2018). The dataset indicates that no karst features are present on site. However, a number of karst features are located outside of the site boundaries. Karst features are also discussed in further detail in Chapter 8 - Hydrology and Hydrogeology.

There are two turloughs and a group of enclosed depressions approximately 3 to 4 km to the west of the southern portion of the site, and another group of enclosed depressions approximately 2 km to the east of the northern portion of the site. An enclosed depression is regarded by the GSI as a water entry point into the ground in the form of, for example, a doline or a sinkhole. Figures 7.4, 7.5, 7.8, and 7.9 present the karst features located in the vicinity in relation to the bedrock and subsoil types. These features are predominantly recorded over the Visean Limestone (undifferentiated) bedrock with one recorded feature located over the Ballysteen formation. Table 7.2 indicates which bedrock formation underlie the various infrastructure. The karst features are also generally recorded in areas of till subsoils without any peat cover. A zone of poor core recovery was identified in historic borehole DLF-3-185, located south-east of T21 (see Figures 7.8 and 7.9), which is described as *possible sinkhole material*. The log indicates the feature is infilled with weathered limestone and clay, however, voiding was not recorded.

Karst surface features were not observed on site walkovers, although it is noted that karst features would not be easy to identify as the site is predominantly cut bog. Rotary drilling of bedrock within Derryadd Bog identified weathered limestone bedrock. Some joints in the limestone bedrock have been described as open (0.5 to 2.5 mm wide) and moderately wide (10 - 100 mm wide), indicating some minor dissolution at joints. The drilling did not encounter any significant karstic features such as voids.

It is possible that karst features (voids, conduits and highly weathered zones) are located below the site extents which have not been identified due to the thick cover of peat and subsoils.

7.3.16 Accidents / Disasters

Peat and subsoils instability is the main accident / disaster relating to soils and geology of the existing environment. This is discussed in the following section. Soil erosion due to flooding may be considered another accident or disaster; a site-specific flood assessment is discussed further in Chapter 8 – Hydrology and Hydrogeology.

7.3.17 Peat and Subsoils Stability

A qualitative assessment of the stability of peat and subsoils is presented and discussed in detail in the separate Peat Stability Risk Assessment report (Appendix 7.4). The report summarises that there is a risk of instability related to the requirement for deep excavations on the proposed development site and that mitigation measures will be put in place during the construction of the scheme to reduce the likelihood of an excavation collapsing. Mitigation measures include battering back of excavations to a safe angle (as determined through a detailed slope stability assessment by a competent temporary works designer) or construction of a granular berm or temporary sheet pile wall to support the peat and soft clays during construction. This is addressed further in Section 7.5. Following mitigation, the risk ranking of the development is considered to be low. It is concluded that the site is suitable for the proposed development.

A Peat Management Plan (PMP) has been prepared for the development which is included in Appendix 7.3. Recommendations made in this report and in the PMP will be taken into consideration during the design and construction stage of the proposed development. Best practice guidance regarding the management of peat stability must be inherent in the construction phase of the project.

7.4 POTENTIAL EFFECTS

7.4.1 Do-Nothing Effects

The do-nothing situation relevant to soils and geology is one where Bord na Móna continues to harvest peat from the site until the scheduled phased extraction is completed. Subsoils or rock are not currently being extracted from the site. As discussed in section 7.3.5, there is potential for extraction of bedrock where it is shallow and also extraction of shelly marl/calcareous mud as a mineral resource on the site. Bord na Móna has indicated, however, that it is unlikely that they would ever extract the bedrock, sands, gravels or shelly marl/calcareous mud from the proposed development site in the do-nothing scenario. There is currently limited access to these potential extraction areas.

7.4.2 Potential Effects - Construction

The proposed development is characterised by the following civil engineering works to provide the necessary infrastructure to complete the wind farm as described in Chapter 2, Description of the Proposed Development:

- Excavation of borrow pits, processing of materials and reinstatement;
- Construction of access roads (permanent and temporary) to the wind turbines and passing bays;
- Construction of amenity roads and associated carparks;
- Construction of temporary compounds including hard stands, construction material storage areas and site offices;
- Management of excavated materials;
- Excavation for turbine foundations, hardstanding foundations, substation foundations and met masts;
- Excavation for cable ducts; and
- Construction of surface water drainage system along the new roads.

The direct and indirect effects of the construction activities, and their expected duration are discussed further in the following sections. The effect on use of land and on natural resources required to carry out the works which relate to soils and geology is also discussed.

7.4.2.1 Excavation of Borrow Pits, Processing of Materials and Reinstatement

There are five potential borrow pit locations which will be excavated to provide fill material for roads, cycle tracks, hardstanding, upfill to foundations and temporary compounds. The borrow pits are located within

Derryadd Bog towards the centre of the site and are at advantageous locations with regards to hauling materials within the site. It is anticipated that the borrow pit workings are likely to be inundated by groundwater and that temporary pumping of groundwater may be required to facilitate excavation, see Chapter 8 - Hydrology and Hydrogeology. It is envisaged that the borrow pits will be excavated down to average depth of 5.5m below ground level (bgl) extending to a maximum depth of 8m bgl where required.

Estimated volumes of materials available on site are summarised in Table 7.8.

Table 7.8: Borrow Pit Summary

Borrow Pit	Estimated Surface Area (m^2)	Estimated volume – 5.5m excavation (m^3)	Excavated volume – 8m excavation (m^3)	Estimated tonnage – 5.5m	Estimated tonnage – 8m
Borrow pit 17-1	52,700	289,850	421,600	724,625	1,054,000
Borrow pit 17-3	63,600	349,800	508,800	874,500	1,272,000
Borrow pit 17-4N	22,500	123,750	180,000	309,375	450,000
Borrow pit 17-4S	21,700	119,350	173,600	298,375	434,000
Borrow pit 17-5	13,700	75,350	109,600	188,375	274,000
Total		**958,100**	**1,393,600**	**2,395,250**	**3,484,000**

Using the average borrow pit depth of 5.5m bgl, the available volumes of material are 958,100m^3. A percentage of this material may not be suitable, i.e. may not be economical to extract or may be suitable for fill but not for the upper layers of the haul roads or hardstanding areas. This volume will also be subject to a degree of bulking (an increase in volume that may occur when a block of rock or soil is excavated and transported).

Where excavations extend into competent rock, they are likely to require very heavy ripping and may even require blasting methods to extract the stronger rock. The depth of competent rock varies across each borrow pit. There is potential that blasting may be required in all borrow pits and may cause a negative short-term effect. This is addressed in Chapter 13, Noise and Vibration.

The borrow pits will be reinstated using two material sources (a) overburden from the opening of the borrow pits, and (b) mineral soils and peat excavated elsewhere on the site that cannot be reused in construction.

Given the volumes of material available from these borrow pits and should they prove suitable it is likely that they will significantly contribute to the material requirements for the project and therefore, reduce the volume of imported material required from local quarries. The use of on-site borrow pits will reduce the environmental effect of other aspects of the development by reducing the need to transport material to site. On-site processing of extracted rock materials can produce dust during construction. This is outlined in Chapter 12, Air Quality and Climate. Similarly, water may be generated from any groundwater pumping at borrow pits (refer to Chapter 8 - Hydrology and Hydrogeology). The deep temporary excavations into bedrock will create a temporary exposure of bedrock which may provide a source knowledge of the soils and geology in the area. Overall, the excavation of on-site borrow pits will have a neutral environmental effect.

7.4.2.2 Construction of Access Roads (permanent and temporary) to the Wind Turbines and Passing Bays

Access roads will be needed to accommodate the construction works and provide access to turbine locations for the whole life cycle of the wind farm. The roads will be constructed using unbound crushed aggregates and incorporate drainage to maintain the performance of the pavement during wet weather. The roads will be constructed as founded or floating roads. Founded roads are excavated down to and constructed up from a competent geological stratum, whereas floated roads are built directly on top of the peat and soft soils. The roads shall be constructed to average heights of 0.5m or 1.0m above existing ground level.

Ground investigation in the form of peat probing and trial pitting has been carried out along the proposed access routes to inform the depth of excavation and upfill required for the access tracks. Preliminary volume calculations provide an approximate estimation of fill required for the roads. It is estimated as 590,000m^3 of compacted material which is approximately equivalent to 770,000 m^3 of un-compacted material to be transported. This percentage increase conservatively accounts for the difference in volume between compacted and uncompacted material during transportation. Material will be obtained from on-site borrow pits and/or imported from locally approved quarries. The potential effect of extracting on-site material is discussed in Sections 7.4.2.1 and 7.4.2.12. The potential effect of extracting additional volumes of material from external quarries include extra pressure on transport routes and more fuel consumption. This is discussed in Chapter 14 “Traffic and Transport”.

Soil sealing is the covering of a soil with an impermeable material; it often affects agricultural land, puts biodiversity at risk and increases the risk of flooding. This is an inevitable direct effect to some extent of most types of construction. Permeable geotextile is usually placed at the base of access tracks, along with other infrastructure, as part of their typical design. However, this will have a imperceptible, negative, permanent effect due to the relatively small footprint of infrastructure and its location.

Overall, the construction of the temporary and permanent roads presents a not significant, permanent, negative effect.

7.4.2.3 Construction of Amenity Roads

For the most part the cycle ways and amenity roads will be situated on the construction traffic haul routes within the site. There are, however, some locations where the roads will be used for amenity purposes only, i.e. there is no vehicular traffic envisaged on these. There is just under 4km of this type of track. These tracks will be constructed in the same manner to the haul road access tracks. It is estimated as 40,500m^3 of compacted material which is approximately equivalent to 52,500 m^3 of un-compacted material to be transported. This percentage increase conservatively accounts for the difference in volume between compacted and uncompacted material during transportation. The construction of these will have a not significant, permanent, negative effect.

7.4.2.4 Construction of Temporary Construction Compounds including Hardstanding, Construction Material Storage Areas and Site Offices

At the commencement of the construction phase five temporary construction compounds will be constructed to provide office space, welfare facilities, concrete wash out areas, hardstands for storing materials and hazardous materials. The site accommodation is likely to consist of temporary porta-cabins constructed on a granular platform. The peat will be stripped where hardstands or development is proposed. The hardstandings shall be constructed to average heights of 0.5 or 1.0m above existing ground level.

Preliminary volume calculations provide a rough estimation of fill required for the temporary compound areas. This is estimated as 25,000m^3 of compacted material which is approximately equivalent to 32,500 m^3 of un-compacted material to be transported. This percentage increase conservatively accounts for the difference in volume between compacted and uncompacted material during transportation. It is likely that this material volume will be obtained from on-site borrow pits and/or imported from locally approved quarries. As discussed previously, there are potential effects to extraction of materials on site and also from local quarries.

The construction of the temporary compounds presents a not significant, permanent, negative effect. There is a potential for effects on groundwater as a result of washing out of concrete (see chapter 8 - Hydrology and Hydrogeology).

7.4.2.5 Management of Excavated Materials

The handling, management and re-use of excavated materials are of importance during the construction phase of the project. Excavated material will arise from all infrastructure elements of the windfarm (bases, roads, hardstandings etc.). Peat should be stockpiled no higher than 2.5m and follow the recommendations set out in the NRA Guidelines for the Management of Waste from National Road Construction Projects (NRA, 2014). Ground investigation completed to date suggests that stockpiles will need to be lower than this given the nature of the material encountered. There is potential for a moderate negative effect on soil due to erosion of inappropriately handled excavated materials. However, any effects from the handling of excavated materials will be managed through good site practice. The relatively flat topography of the site, combined with a robust sediment and erosion plan, greatly reduces the risk of erosion or sediment release to surface waters.

Organic matter loss can occur when wet peat is excavated and allowed to dry in the open air. Peat material is a major source of carbon and the loss of organic matter leads to an emission source of carbon dioxide (CO_2) and nitrogen dioxide (NO_2). A Carbon Calculator can be found in Chapter 12, Air Quality and Climate, which addresses the effect of loss of carbon to the atmosphere through the drying out of peat excavated as part of the proposed development.

As the works are located within cutover bog, it is intended that peat and unsuitable founding soils will be side cast, bermed and profiled i.e. placed adjacent to works locations. Considering the topography, it should be appropriate to do this across most of the site. It is anticipated that the height of berms and thickness of peat that is side-cast will not be greater than 1m in general, although location specific designs and assessments during the design and construction phase may allow these to reach 2m. This action is expected to have a slight negative effect.

7.4.2.6 Hydrocarbon Release

Wherever there are vehicles and plant in use, there is the potential for a direct hydro-carbon release which may contaminate the soil and subsoil. A spill has the potential to indirectly pollute water, if the soil and subsoil act as a pathway from any source of pollution. Any spill of fuel or oil would potentially present a moderate, long-term negative effect on the soil and geological environment. Good site practice will mitigate any effect in the short-term and long-term (refer to section 7.5)

7.4.2.7 Excavation for Turbine Foundations

The material encountered in the trial pits excavated at each turbine location was generally soft to very soft and not capable of supporting the applied loads from a wind turbine. Deeper excavations to more competent material will be required to construct the turbine foundations. Further ground investigation will be needed in advance of construction to determine whether the foundations can be spread or piled. It should be noted that most foundations are anticipated to require piled foundations. Where foundations are not piled, additional fill material will be needed to upfill the excavation to the levels required for the wind turbines foundations. This action is considered to have a not significant, permanent, negative effect on the environment. Preliminary volume calculations provide an approximate estimation of fill required for all of the turbine foundations assuming none of the turbines piled. It is estimated as 27,000m^3 of compacted material which is approximately equivalent to 35,000m^3 of un-compacted material to be transported. This percentage increase conservatively accounts for the difference in volume between compacted and uncompacted material during transportation.

It is likely that this material volume will be obtained from locally approved quarries considering the onerous specification usually required for this type of material, although some suitable material may be available and extracted from on-site borrow pits. The potential environmental effects of extracting material from both on-site and quarries has been discussed in Section 7.4.2.1 and 7.4.2.12.

Each turbine foundation will be investigated before and during construction to identify any potential karst features. Should significant karst features be uncovered, the potential risk posed by the features to the bearing capacity of the foundations will be addressed through the design and construction phases of the project. As discussed in Section 7.3.15, there are no recorded karst features recorded on the GSI database (GSI, 2018). Some minor dissolution was noted following rotary drilling. If a void, conduit or highly weathered zone is identified below a foundation which the initial design cannot accommodate, the solution is likely to consist of filling the feature with grout /concrete. The potential for this having a negative environmental effect on the soil and geology of the site is considered to be low. Where karst features may be present, the resultant effect on soils and geology is considered to be not significant, permanent and negative.

7.4.2.8 Excavation for Hardstanding Foundations

The environmental effects of the construction of the hardstanding foundations are similar to that of the founded access roads as discussed in Section 7.5.2.2. Ground investigation in the form of peat probing and trial pitting has been carried out along the proposed hardstanding locations to inform the depth of excavation and upfill required. Preliminary volume calculations provide an approximate estimation of fill required for all of the hardstanding foundations. It is estimated as 215,000m^3 of compacted material which is approximately equivalent to 275,000m^3 of un-compacted material to be transported. This percentage increase conservatively accounts for the difference in volume between compacted and uncompacted material during transportation..

Similar to above, some of the material may be required from local quarries. The potential effects here are considered to be not significant, permanent and negative.

7.4.2.9 Excavation for Substation Foundations

The construction of Substation Option A or Substation Option B will require removal of peat/topsoil and subsoil to a competent founding layer and upfilling with concrete or structural fill to the required finished floor level. Ground investigations at potential substations locations A and B have been undertaken for the purposes of the EIAR and have been used to inform the depth of excavation and upfill required.

Substation Option A

Preliminary volume calculations provide an estimation of fill required for the foundations for substation A assuming spread foundations are used where they are founded on competent material. This is estimated as 63,000m^3 of compacted material which is approximately equivalent to 82,000m^3 of un-compacted material to be transported. This percentage increase conservatively accounts for the difference in volume between compacted and uncompacted material during transportation.

Substation Option B

Similar to Substation Option A, preliminary volume calculations provide an estimation of fill required for the foundation of substation B assuming spread foundations are used where they are founded on competent material. The founding layer is anticipated to be slightly shallower at this location. This is estimated as 25,000m^3 of compacted material which is approximately equivalent to 32,500m^3 of un-compacted material to be transported. This percentage increase conservatively accounts for the difference in volume between compacted and uncompacted material during transportation..

The construction of substation A and B are both anticipated to have negative effects due to the potential of the need for extracting material from site or local quarries. These effects are considered to be not significance, permanent and negative.

7.4.2.10 Excavation for Met masts

The construction of met masts will require removal of peat/topsoil and subsoil to a competent founding layer and upfilling with concrete or structural fill to the required foundation formation level. A crane hardstanding will also be required to install the met mast. This will be similar but smaller than those constructed at the turbines. Ground investigations at potential locations have only been undertaken for the purposes of the EIAR and have been used to inform the depth of excavation and upfill required.

Preliminary volume calculations provide a rough estimation of fill required for the foundations and crane pad for the proposed met masts, assuming spread foundations are used where they are founded on competent material. The volume of material required for met masts options located in Derryaroge and Derryadd Bog are minimal (<20m^3 compacted material). The volume required for the Lough Bannow option is slightly higher due to deeper peat, estimated as 100m^3 of compacted material which is approximately equivalent to 150m^3 of un-compacted material to be transported. This percentage increase conservatively accounts for the difference in volume between compacted and uncompacted material during transportation.

7.4.2.11 Summary of Volumes

A summary table (Table 7.9 below) is provided with the combined volumes of both compacted and uncompacted material necessary for infrastructure.

Table 7.9: Excavation Volume Summary

Area	Combined Excavated volume compacted (m^3)	Combined Excavated volume uncompacted(m^3)
Access roads	590,000	770,000
Cycle/amenity tracks	40,500	52,500
Temporary compound	25,000	32,500
Turbines	27,000	35,000
Hardstandings	215,000	280,000
Substation A / B	63,000 /25,000	82,000 / 32,500
Met masts	100	150
Total	**960,600**	**1,252,150**

Presently the estimated volumes of compacted material required for construction is 0.9606 million m^3.

7.4.2.12 Land Use and Natural Resources

Land use and extraction of natural resource (material assets) on site include extraction of peat (cutaway/ cutover) and potential extraction of shelly marl/calcareous mud soil, and rock.

Peat extraction will be temporarily negatively affected during construction as its rate will be reduced or temporarily halted during the construction of the proposed development. Peat will be removed from below the footprint of the infrastructure with the exception of any floating roads. As a result, there is potential for depletion of a small portion of the resource in the short term. This will be mitigated through correct material management, reuse on site or harvesting of the peat in advance of the construction phase by Bord na Móna in so far as is reasonably practicable.

In terms of potential extraction of the shelly marl/calcareous soil resource, the construction stage will only have a temporary imperceptible negative effect on this in terms of delaying extraction. Construction is likely to reveal the extent and quality of this resource and other similar subsoils resources on site.

During the construction phase, there will be a depletion of natural resources due to extraction of material from borrow pits. This material is for reuse on site to build infrastructure items such as access roads, turbine foundations, hardstanding foundations and substations. The depletion of natural resources is considered to be moderate, negative and long-term effect. There is benefit in sourcing material required for construction on site, however, as opposed to external quarries. This is discussed further in Section 7.5.2.9. A positive effect of construction is that the extraction of material is likely to reveal the extent and quality of the bedrock resources on site. This is of benefit in terms of geological wealth of knowledge.

There is a potential for sterilisation of the borrow pit resources once extraction has ceased and the excavations have been reinstated with the overburden, surplus subsoils and peat from construction. This could have a moderate, permanent negative effect. This will be mitigated by diligent borrow pit design and appropriate material management to ensure the land resource available at each borrow pit is efficiently used. This would reduce the significance of the effect to not significant. The negative effect associated with the extraction of material from a borrow pit; (dust, noise, traffic) will no longer exist once extraction of the borrow pit is complete and hence, the effect of reinstatement will be a neutral one.

7.4.2.13 Human Health

There are a number potential negative effects on human health relating to soils, geology and earthworks operations during the construction phase of this project. The first is apparent in dust from material extraction and transport of soils and excavated rock which is discussed in Chapter 12 - Air Quality and

Climate. There is potential for a negative effect to human health from peat instability in excavations, the risk of which is discussed in the Peat Stability Risk Assessment (PRSA) report (Appendix 7.4) and summarised in Section 7.3.17. The risk is restricted to within and in the immediate vicinity of the excavations only considering the general site topography. Other negative effects include the typical risks to construction personnel associated with earthworks and large excavations such as falling from heights, engulfment, drowning, etc. Potential human health effects will only be present during construction. The effects of the proposed development on human health are discussed in Chapter 5.

7.4.2.14 Accidents / disasters

Peat and subsoils instability is the main accident / disaster relating to soils and geology during construction of the development and is discussed in detail in the Peat Stability Risk Assessment (PRSA) report (Appendix 7.4) and summarised Section 7.3.17. Following mitigation, the residual effects of peat and subsoil instability will be not-significant, permanent and negative. The effects of accidental fuel and oil spills arising are discussed in Section 7.4.2.6. Soil erosion due to flooding may be considered another accident or disaster; a site-specific flood assessment is discussed further in the Chapter 8 - Hydrology and Hydrogeology.

7.4.3 Potential Effects - Operation

During the operation phase of the project, no new effects on the soil and geological environment will arise. Any hydrocarbon or oil spills related to the maintenance of the site (access roads, substation, and turbines) has the potential to negatively affect the ground directly. However, mitigation measures and management controls will negate risk (refer to Section 7.5.3).

Additional unbound crushed aggregate material may be required during the operation phase where roads have settled on the peat, to resurface unbound roads and for the maintenance of the amenity trackway surface. This will be sourced from site material or from local resources which are locally approved. It is expected that only small quantities of unbound crushed aggregates may be needed. The resurfacing of roads and amenity tracks will therefore pose an imperceptible negative short-term or long-term effect.

The effects of operation on natural resources will be imperceptible and are similar if not improved upon those of the ‘do nothing scenario’. Bord na Móna, however, is projected to continue to extract peat at localised areas within the site in accordance with its EPA IPC licence during the operation of the wind farm. Peat extraction operations will not be majorly affected and access for Bord na Móna personnel may be improved by way of access routes being constructed on site.

7.4.4 Potential Effects During Decommissioning

In general, the potential effects associated with decommissioning will be similar to those associated with construction but of reduced magnitude because extensive excavation, and wet concrete handling will not be required. The potential environmental effect of soil storage and stockpiling and contamination by fuel leaks will remain during decommissioning.

7.4.5 Cumulative Effects

Cumulative effects of this project with other developments in the region, as discussed in Chapter 4 - Policy, Planning and Development Context, relate to the indirect effects that may arise due to the use of public roads as hauls roads to bring these materials to site. Chapter 14 - Traffic and Transport” details the scenarios whereby the materials will be imported onto site and assess the cumulative effects.

7.5 MITIGATION MEASURES

Mitigation measures for the construction, operation and decommissioning of the proposed development site to avoid or reduce the potential effect of the proposed development are presented below.

7.5.1 Mitigation by Avoidance

The opportunity to mitigate any effect is greatest at the design period. In this respect Bord na Móna carried out a detailed site selection process. This process identified deep peat as a specific constraint. The detailed site selection process is described in Chapter 3. Furthermore, within the chosen site, those areas of deep peat were identified, and the internal road design sought to avoid those areas where possible. Finally, although it is expected that founded roads will constitute the majority of the site, floating roads will also be considered were suitable. However, there are some risks that cannot be mitigated through design and need to be managed during construction. Mitigation through design is especially applicable in the risk to human health during a project and shall be exercised to minimise the negative risks present.

7.5.2 Mitigation Measures - Construction

The construction of the development has the potential (with no mitigation) to cause “not significant” to “moderate” short-term to long-term effects to the soil and geology of the proposed development site as outlined in Section 7.4. Implementing mitigation measures detailed below will reduce the significance of the effects. Many of the mitigation measures have been based on CIRIA (Construction Industry Research and Information Association, UK) technical guidance on water pollution control and on current accepted best practice, (CIRIA, 2001). Good site practice will be applied to ensure no fuels, oils, wastes or any other substances are stored in a manner on site in which they may spill and enter the ground. Dedicated, bunded storage areas will be used for all fuels or hazardous substances.

All works will be managed and carried out in accordance with the Construction and Environmental Management Plan (CEMP), which will be updated by the civil engineering contractor and agreed prior to any site works commencing.

7.5.2.1 Movement of Soil, Subsoils and Bedrock

The disturbance of soil, subsoil and bedrock is an unavoidable effect of the development, but every effort will be made to ensure that the amount of earth materials excavated is kept to a minimum in order to limit the effect on the geological aspects of the site. The management of geological materials is an important component of controlling dust and sediment and erosion control. Excavated peat will only be moved short distances from the point of extraction and will be used locally for landscaping. Landscaping areas will be sealed and levelled using the back of an excavator bucket to prevent erosion. Where possible, the upper vegetative layer will be stored with the vegetation part of the sod facing the right way up to encourage growth of plants and vegetation at the surface of the landscaped peat. These measures will prevent the erosion of peat in the short and long term. Peat, overburden, and rock will be reused where possible on site to reinstate borrow pits and other excavations where appropriate. A Peat Management Plan has been prepared for the development which is included in Appendix 7.3.

7.5.2.2 Vehicular movements

Vehicular movements will be restricted to the footprint of the proposed development, particularly with respect to the newly constructed access roads. This implies that machinery must be kept on roads and will not move onto areas that are not permitted for the development.

Vehicular traffic on site is reduced through the use of extracting material from borrow pits on site as opposed to sourcing from external quarries.

7.5.2.3 Waste Management

All site-generated construction waste and the storage and disposal of the waste will be managed as detailed in the Construction and Environmental Management Plan (CEMP). Waste streams (including material-related streams such as metals, paper and cardboard, plastics, wood, rubber, textiles, bio-waste and product-related streams such as packaging, electronic waste, batteries, accumulators and construction waste) will be managed, collected, segregated and stored in separate areas at the temporary compound and removed off site by a licensed waste management contractor at regular intervals during the works.

A wastewater holding tank (twin-hulled) will be used for the temporary welfare facilities and managed by a licensed contractor. The concrete wash-out areas at the batching plant will be bunded, controlled and emptied by the appropriate contractor as required. Any introduced semi-natural (road building materials) or artificial (PVC piping, cement materials, electrical wiring) materials will be taken off site at the end of the construction phase. Any accidental spillage of solid state introduced materials will be removed from the site by the appropriate means.

7.5.2.4 General Site Management

A CEMP has been developed to include the checking of assets (plant, vehicles, fuel bowsers) on a regular basis during the construction phase of the project. The purpose of this management control is to ensure that the measures in place are operating effectively, prevent accidental leakages, and identify potential breaches in the protective retention and attenuation network during earthworks operations.

Management of Fuel and Oil

A fuel management plan has been prepared (and included in the CEMP) which incorporates the following elements:

- Mobile bowsers, tanks and drums will be stored in secure, impermeable storage area, away from drains and open water;
- Fuel containers will be stored within a secondary containment system e.g. bund for static tanks or a drip tray for mobile stores;
- Ancillary equipment such as hoses, pipes will be contained within the bund;
- Taps, nozzles or valves will be fitted with a lock system;
- Fuel and oil stores including tanks and drums will be regularly inspected for leaks and signs of damage;
- Only designated trained operators will be authorised to refuel plant on site;
- Procedures and contingency plans will to be set up to deal with an emergency accidents or spills; and
- An emergency spill kit with oil boom and absorbers will be kept on site in the event of an accidental spill. All site operatives will be trained in its use.

Drainage and the Management of Sediment and Geological material

The permanent road works will require a drainage network to be in place for the construction and operational phases of the development. Fundamental to any construction phase is the need to keep water (i.e. runoff from adjacent ground upslope of the permitted development footprint) clean and manage all other run off and water from construction in an appropriate manner. This will necessitate the implementation of the aforementioned Sediment and Erosion Control Plan, with associated settlement ponds and silt traps. The Sediment and Erosion Plan is part of the CEMP for the site, which will be reviewed with the authorities prior to the construction phase of the wind farm. The good management of material on site will reduce any indirect risk to water.

The handling, storage and re-use of excavated materials are of importance during the construction phase of the project. Excavated topsoil will not be stored in excessive mounds on the site. Seeding of the work affected areas with indigenous species should proceed, only where natural revegetation or the reuse of the upper vegetated layer is unsuccessful. The re-vegetation of these areas promotes stability, reduces desiccation, run-off erosion and susceptibility to freeze/thaw action.

7.5.2.5 Hydrocarbon Release

Wherever there are vehicles and plant in use, there is the potential for a hydro-carbon release in the form of a spill that has the potential to directly pollute soil, and indirectly pollute water. This is due to the fact that soil may act as a pathway for the contamination. Any spill of fuel or oil would potentially present a moderate, long-term negative effect on the soil and geological environment.

Good site practice will mitigate any effect. Good site management by means of regular checks on plant, and diligent housekeeping of machinery reduce the potential of hydrocarbon release on site. It is important for personnel on site to have the correct training and expertise in the event that a hydrocarbon leak occurs. Mitigation of this effect reduces this likelihood and severity of any hydrocarbon spills, thus reducing effect to not significant, long-term and negative.

7.5.2.6 Excavation for Turbine Foundations

A temporary works design for foundation excavations will be carried out by a competent designer. The materials encountered in the trial pits are likely to be unstable during the excavation for the turbine bases. Where battering back of excavations to a safe angle (as determined by a detailed slope stability assessment by the competent designer) is not feasible, a physical barrier will be applied where required between the excavations and the potentially unstable material in the form of a granular berm or sheet piles. The long-term stability of the area around the wind turbine foundations will be achieved by filling the area back up to existing ground level following installation of the foundation.

The design will be carried out by a suitably qualified and experienced geotechnical engineer and the management of the ground stability will be ongoing throughout the construction phase. Each turbine foundation will be investigated before and during construction to identify any potential karst features. Excavation works will be monitored by a suitably qualified and experienced geotechnical engineer or engineering geologist. The earthworks will not be scheduled to be carried out during severe weather conditions.

Following these mitigation measures, the resultant effect will be not significant, permanent and negative.

7.5.2.7 Excavation for Hardstanding Foundations

The mitigation strategies for the hardstanding foundations follow similar procedures as the excavations for turbine and substation foundations, see Section 7.5.2.6. All works will be monitored by suitably qualified and experienced geotechnical engineer or engineering geologist.

7.5.2.8 Excavation for Substation Foundations

The mitigation strategies for the substation foundations follow similar procedures as the excavations for turbine and hardstanding foundations, see Section 7.5.2.6. All works will be monitored by suitably qualified and experienced geotechnical engineer or engineering geologist.

7.5.2.9 Natural Resources

The effect of potential depletion of peat resources will be mitigated through correct material management, reuse on site or pre-harvesting of the peat by Bord na Móna in so far as is reasonably practicable. The temporary negative effect of delaying extraction will be reduced by proper coordination between the windfarm balance of plant contactor and Bord na Móna. Potential for long term sterilisation of the borrow pit resource will be mitigated by diligent borrow pit design and appropriate material management. This would include detailed assessment of the rock resource and borrow extent to ensure efficient exploitation of any borrow pits. Following mitigation, the effect on natural resources will be not significant, permanent, negative.

7.5.2.10 Human Health

Potential human health effects will only be present in the short-term during construction. These effects will be mitigated through good site management including dust control, applications of safe systems of work and mitigation through design with particular care taken of the design of temporary works in peat.

Further mitigation of the effects on human health are discussed in Chapter 5 “Population and Human Health”.

7.5.3 Mitigation Measures - Operation

All wastes from the control building and ancillary facilities will be removed by the appropriate contractor.

The operational team will carry out maintenance works (to access roads, substation and turbines) and will put in place control measures to mitigate the risk of hydrocarbon or oil spills during the operational phase of the windfarm. Any vehicles utilised during the operational phase will be maintained on a weekly basis and checked daily to ensure any damage or leakages are corrected. The potential effects are limited by the size of the fuel tank of vehicles used on the site.

There are no other mitigation measures proposed relating to soils and geology during the operational phase of the project.

7.5.4 Decommissioning Phase

Decommissioning will comprise the removal of all over ground elements of the wind farm. Internal access roads could be removed although the Irish Wind Energy Association suggest there may be benefits to leaving them in place (IWEA, 2017). Furthermore, in the context that almost all of the internal roads will have a dual function of providing access to the turbines and amenity trackways it is intended that all of the roadways will be retained. Concrete bases will be left in the ground, covered with topsoil and allowed to naturally re-seed in line with IWEA best practises (IWEA, 2017). The area around the bases will be rehabilitated by covering it with locally sourced soil in order to regenerate the vegetation. This will also reduce run-off and sedimentation effects. A fuel management plan to avoid contamination by fuel leakage during decommissioning works will be implemented as per the construction phase mitigation measures.

7.5.5 Cumulative Effects

Cumulative effects of this project with other developments in the region relate to the use of public roads as hauls roads and are considered Chapter 14 “Traffic and Transport”. Efficient design along with material management will ensure optimisation of the volume of materials required to be imported to site. This will mitigate any cumulative effects relating to importing of material and use of public roads as haul roads.

7.6 RESIDUAL EFFECTS

The replacement of natural peat, subsoils and rock, with gravels and concrete for the construction of the infrastructure (temporary and permanent) will result in a change in ground conditions within the Proposed Development Site. Overall, this residual effect is not significant, permanent and negative.

The trial pits and stability assessment showed that there are stability issues that will need to be managed during the construction of the project. Following mitigation procedures, the residual effect in relation to peat stability will be not significant, short-term, negative effect and will be localised to excavations carried out during in construction phase.

All other potential effects on the soil and geological environment will be mitigated through good site practice; vehicular movements, hydrocarbon release, sustainable use of natural resources, human health etc. as discussed previously. Overall the residual effects from these aspects will be not significant, permanent, negative effects on the site.

7.7 CONCLUSION

Overall, the development of the project will have a negative, long-term but not significant effect on the soil and geological environment through the application of identified mitigation measures and appropriate management throughout the life cycle of the wind farm.

The site is relatively flat lying with cutaway/cutover peat overlying a soft to very soft glacial till/lacustrine marls. Due to the relatively flat, drained cutaway nature of the site, the risk of a regional scale landslide is low. Due to the nature of the peat and subsoils at the site, construction of the scheme will require deep excavations at the turbine locations. Instability of soils will be localised to the extent of excavations for the various infrastructure locations. Identified temporary works will be put in place to successfully mitigate this risk. This is likely to be in the form of a battering back of excavations to a safe angle (as determined by a detailed slope stability assessment by a competent temporary works designer) or temporary granular berm of sheet pile wall. The peat stability assessment concludes that the risk of long-term instability is considered low following mitigation procedures and completion of the construction phase. It should be noted that the excavations will be backfilled to the existing ground level.

The proposed development site is not a sensitive site in terms of the soils and geological environment. This is primarily due to the exploitation of peat by Bord na Móna and the sites relatively low geological value. In terms of the soil and geological environment, the effects of the proposed development will be not significant, permanent and negative. Cumulative effects of the movement of material as part of the proposed development with other developments in the region are discussed in Chapter 14 - Traffic and Transport.

7.8 REFERENCES

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8 HYDROLOGY & HYDROGEOLOGY

8.1 INTRODUCTION

This chapter describes the existing hydrological, hydrogeological and water quality characteristics at the proposed Derryadd Wind Farm development site. This chapter also includes an assessment of the impact on the water environment arising from the proposed 24 No. turbine development. The drainage of the proposed development is also considered which includes proposed mitigation measures to reduce any potential negative impacts associated with the construction and operation of the proposed development.

The proposed development is located approximately 3km east of Lanesborough, Co. Longford, 4km west of Killashee, Co. Longford and 8km to the north of Newtowncashel Co. Longford. The wind farm is located within the Mountdillon group of peat extraction bogs, Co. Longford.

Planning Permission is being sought from An Bord Pleanála for the installation of 24 No. wind turbines with a nominal capacity of 4 MW per turbine or approximately 96 MW in total. The turbines will have a blade tip height of a maximum of 185 metres(m) from the top of the foundation and will be accessible from internal access routes within the Bord na Móna site. The full project description is included in Chapter 2 of this EIA Report (EIAR).

The proposed development is located in Bord na Móna's Derryaroge, Derryadd, Lough Bannow and a small section of Derryshannoge Bogs and is approximately 1900 hectares (ha) in area. The permanent footprint of the proposed development measures approximately 51.8 hectares, which represents approximately 2.7% of the primary study area.

The application includes for all necessary connections to the electricity grid. All elements of the Proposed Development, including grid connection, have been assessed as part of this EIAR.

8.1.1 Statement of Authority

TOBIN Consulting Engineers (TOBIN) have completed this chapter. TOBIN Hydrologists and hydrogeologists are intimately familiar with the site characteristics for the Derryadd Wind Farm, having worked on wind farms at Lisheen and Bruckana set in similar ground conditions and water environment. This chapter has been completed by Mr. John Dillon (BSc, MSc, MCIWM, PGeo), TOBIN Consulting Engineers. John has 15 years of experience in hydrogeological/hydrological assessment for EIS/EIAR. The author is appropriately experienced and capable of undertaking this assessment having worked on wind farm projects in similar water environments including Bruckana Windfarm (42MW), Lisheen III

Windfarm (24MW), Curragh Windfarm (18.4 MW). John has experience in the hydrogeological/hydrological assessment and supervision of powerline projects including Cloon – Lanesboro 110kv uprate, North South 400kV interconnector, Moneypoint substation and Laois Kilkenny 400/110 kV substation. Cathal Kelly B.E, MIEI, MICE has also been responsible for carrying out hydraulic modelling of Flood Risk Assessment. Cathal has completed a large number of flood risk assessment for flood relief schemes, windfarms, solar farms, residential developments and commercial developments.

8.1.2 Scope of Assessment

The scope of the assessment undertaken was set out as follows:

1. Characterise the hydrological and hydrogeological baseline conditions of the existing environment based on a desktop study and site investigation.
2. Identify the possible impacts of the proposed development during construction and operation of the project on the receiving hydrological and hydrogeological environment.
3. Develop mitigation measures to reduce or eliminate the identified negative impacts.
4. Identify any residual impacts after mitigation measures are implemented.

8.2 METHODOLOGY

An examination of the existing hydrological regime was carried out through a combination of consultation with relevant authorities, a desktop review of hydrological resource and site-specific fieldwork; these elements are described further below.

The assessment of the water environment consisted of the following:

- A desk study of available information including a review of site investigations, relating to surface water and groundwater, undertaken within or adjacent to the site;
- A walk-over of the site and surrounding area;
- Groundwater level monitoring;
- Surface water quality monitoring;
- Interpretation of all data to establish the baseline environment, and
  Assessment of flood risk.

The following guidelines have been taken into consideration in the preparation of this EIAR Report:

- "Advice Notes on Current Practice in the Preparation of Environmental Impact Statements" (EPA, September 2003);
- "Guidelines on the Information to be contained in Environmental Impact Statements" (EPA, 2002);

- “Draft Guidelines on the Information to be contained in Environmental Impact Assessment Reports” (EPA, 2017); and
- “Draft Advice Notes on Preparing Environmental Impact Statements” (EPA, September 2015).

The guidelines and recommendations of the Institute of Geologists of Ireland (IGI) publication ‘Geology in Environmental Impact Statements – A Guide’ (2002) and the IGI Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements (2013) were also taken into account in the preparation of this Chapter.

8.2.1 Legislative / Guidance Review

An evaluation of the proposed development was carried out in relation to the relevant European and National legislation and other statutory policies and guidance. The following legislation was considered as part of this impact evaluation.

- S.I. No. 94 of 1997 Quality of Salmon Water Regulations;
- SI 272 of 2009 Surface Water Regulations;
- SI 9 of 2014 Groundwater Regulations;
- Consolidated EIA Directive 2011/92/EU and 2014/52/EU;
- European Communities (Water Policy) Regulations 2003 [S.I. No. 722/2003];
- Waste Management Acts 1996 as amended;
- European Communities Environmental Objectives (Groundwater) Regulations 2010 [S.I. No. 9/2010];
- European Communities (Environmental Impact Assessment) (Amendment) Regulations, 2001 [S.I. No. 538/2001];
- European Communities Environmental Objectives (Groundwater) Regulations 2010 (S.I. 9 of 2010);
- Groundwater Directives (80/68/EEC) and (2006/118/EC); and
- Water Framework Directive (2000/60/EEC).

The following documents were consulted in preparation of this report as they pertain to hydrogeology and hydrology:

- Longford County Development Plan 2015 – 2021.

In addition to the Regulations and Guidelines above, this EIAR has been prepared with cognisance to the *“Wind Energy Development Guidelines for Planning Authorities (2006)”*, the proposed draft revisions to these guidelines (December 2013) and the DCCAE (2017) *preferred draft approach - Review of the Wind Energy Development Guidelines 2006.*

8.2.2 Desktop Study

The desk top study involved a review of all available information, datasets and documentation sources pertaining to the site's natural environment.

Information retained by the Geological Survey of Ireland (GSI), the Office of Public Works (OPW) and EPA was accessed to provide the hydrological and hydrogeological setting of the site. Relevant documents and datasets used to provide the setting of the site included EPA Water Quality Data, topography maps and GSI Hydrogeological Data.

The following sources of information were utilised to establish the baseline environment:

- The Geological Survey of Ireland (GSI) groundwater records for the area were inspected, with reference to hydrology and hydrogeology;
- Office of Public Works (OPW) flood mapping;
- Catchment Flood Risk Assessment and Management (CFRAM) and Preliminary Flood Risk (PFRA) Map data;
- EPA water quality monitoring data for watercourses in the area;
- Results from the chemical analysis of water samples taken in 2015 - 2018;
- EPA Water Framework Directive Monitoring Programme; and
- Information from the River Basin Management Plan for the Shannon River Basin District (SHIRBD).

8.2.3 Field Surveys

Field work involved:

- A walkover survey of the site to identify hydrological features on site, wet ground, drainage patterns and distribution, exposures, drains etc;
- Peat Probes in 2017 and 2018;
- Trial Pitting in 2017 and 2018;
- Borehole testing in 2017, and
- Field analysis of water samples in 2017 and 2018.

Following the field surveys, the results were reviewed in ArcGIS software in conjunction with publicly available hydrological and hydrogeological data from the GSI, EPA and OPW. Various maps were produced, representing a graphical interpretation of the field results.

TOBIN Consulting Engineers carried out an investigation from April 2016 to May 2018, to assess the water environment in the vicinity of the proposed development.

Consultation with various state agencies and environmental Non-Governmental Organisations (NGO's) was undertaken to inform the EIA. All project consultation is detailed in Chapter 1 of the EIAR and all responses received are summarised in Chapter 1. Consultees were informed of updates to the site layout, as appropriate. Consultation letters were sent (September 2016, April/ May 2017 and April 2018) to the following key parties relevant to this chapter:

- An Bord Pleanála;
- Geological Survey Ireland;
- Irish Peatland Conservation Council; and
- Longford County Council.

Department	Comments and Recommendations	EIAR Chapter /Section
An Bord Pleanala	Ensure connectivity of the site is considered in detail for Ecology, Water, Turloughs, Wetlands, karst features etc. in the local and regional study area.	Chapters 6, 7 and 8, NIS
GSI	There are no (GSI) well data within the perimeter of the proposed wind farm, but a few exist on the edge. There are no landslide records within the perimeter of the proposed wind farm. Please note that the dedicated viewer http://spatial.dcenr.gov.ie/GeologicalSurvey/LandslidesViewer/index.html is being upgraded and should be live in the autumn.	Chapter 7
Irish Peatland Conservation Council	Lough Bannow pNHA habitats are particularly sensitive to any change in water quality and run off. All precautions must be met to ensure no degradation occurs on the site as a result of this development. Lough Ree SAC Lough Ree SAC/SPA is downgradient from the site.	Chapter 6

	IPCC would like for the EIS to assess any potential watercourses linking the proposed development site to Lough Ree SAC which could be adversely affected by any change in water quality that might result from large scale construction. .	
Longford County Council	Impact on environmental designations – including Natural Heritage Areas, Special Protection Areas, Special Areas of Conservation, Drainage design to be included (current and future), and anticipated water table impacts. Particular regard should be had to Section 6.2.2.7 Inland Lakes and Waterways and the Policies ILW1 to ILW17 relating to the protection of Longford's Inland Waterways.	Chapter 6 and Section 8.4.

A site investigation programme was undertaken at the subject site to acquire site specific data on the nature and characteristics of the underlying ground. The site investigation programme was undertaken in accordance with the British Standard BS 5390 (Site Investigation – Code of Practice). This enabled the site investigation programme to be undertaken in a systematic manner and provided details of a process of site investigations and interpretation methodology to characterise the underlying groundwater conditions.

A total of 5(no.) shell & auger boreholes were drilled at Derryadd Bog -see Figure 8.6. These boreholes, labelled RC1 to RC5, were drilled at a diameter of 200mm to depths varying between 15 and 20m below ground level. The drilling was carried out by Irish Drilling Limited under the supervision of TOBIN.

All five of the air rotary drilled boreholes, were retrofitted with groundwater monitoring standpipes. These installations comprised of narrow diameter piezometer tubes (50mm ID, 54mm OD), with granular material installed as a filter pack in the annulus surrounding the piezometer. A seal of concrete overlying bentonite was installed at the top of the installations above the filter pack to prevent surface water entering the borehole via the annulus. Slotted standpipe was installed beneath the seal to allow ingress of groundwater to the piezometer. Upstanding steel covers were installed at the five monitoring points.

Slug (permeability) tests were undertaken in RC3 to RC4 to provide an estimate of the hydraulic conductivity of the bedrock formation. It consists of measuring the static water level (head) in the well, then introducing a near instantaneous change in water level, and measuring the change in water level over time until the water level returns to the original static water level. The instantaneous change in head can be achieved by adding or removing a volume of water or solid into the well.

A slug test provides a very local estimate of hydraulic conductivity or transmissivity in the near vicinity of a well. As for pumping aquifer tests, several analytical methods have been developed for the analysis of slug tests. Hvorslev (1951) and Bouwer and Rice (1976) were used to analysis the data. The method of testing involved two different procedures, the first involved undertaking a rising head permeability test (Slug Test) and the second method of testing involved recording the recovery of water levels following purging of the borehole standpipe. Hydraulic characteristics can be determined by monitoring the changes in water levels over recorded time.

8.2.4 Significance and Magnitude Criteria

The significance of effects of the proposed development has been assessed in accordance with the EPA guidance document *Draft Guidelines on the information to be contained in Environmental Impact Assessment Reports* (EIAR), Draft, August 2017[122].

Table 1.1, included in Chapter 1, Section 1.8.2 of this EIAR, is taken from the EPA document. This table outlines guidance for describing the quality and significance of effects and informs the assessment of the relevant potential impacts of the proposed development within this chapter.

[122] https://www.epa.ie/pubs/advice/ea/EPA%20EIAR%20Guidelines.pdf

8.3 EXISTING ENVIRONMENT

8.3.1 Desk Based Studies

On a regional scale, the site at Derryadd and its environs is in the Shannon Hydrometric Area and Catchment. The delineation of the sub-catchments and general area of confluence is shown in Figure 8.1 'Regional Catchment Delineation'.

The proposed development site is located within the Shannon International River Basin District (SHIRBD). At a local scale, the proposed wind farm is located between the Ballynakill River to the east and the Lough Bannow River to the west of the wind farm. All rivers ultimately discharge to the River Shannon. A canalised stream is located at the southern end of Derryadd bog discharges to the Lough Bannow stream.

The topography of the site is relatively flat with elevations ranging from 37mAOD to 59mAOD.The general topography varies approximately from 45 to 59 mAOD to the south of the study area (Lough Bannow Bog) and between 37 and 47mAOD in the Derryadd and Derryaroge Bogs. Further details are included in Chapter 7 – Lands, Soils and Geology.

8.3.1.1 Surface Water Hydrology

The purpose of this section is to describe the surface water environment including the following:

- Catchments;
- Site surface water features and drainage;
- Flood assessment;
- Assessment of hydrometric data;
- Surface water abstractions within the catchment of the site; and
- Surface water quality.

8.3.1.2 Catchments

A catchment is simply defined as an area contributing water to a river and its tributaries, with all the water ultimately running off to a single outlet. The catchment boundary is the line dividing land where surface drainage flows toward a given stream from land where it drains into a separate stream.

The regional natural surface water drainage pattern, in the environs of the proposed Derryadd Wind Farm development site is shown on Figure 8.1 'Regional Catchment Delineation'. The proposed development

site is located within the River Shannon catchment, located within the Shannon River Basin District and upstream of the Lough Ree Special Area of Conservation (SAC) (Site Code 00440).
Figure 8.2 depicts Surface Water Features/Local Catchment Delineation in relation to site area' which includes a significant number of unnamed streams although EPA reference numbers have been applied for identification purposes. The proposed development is not located in a delineated area for action as set out in the 2018-2021 National River Basin Management Plan. The Royal Canal, located to the east of the proposed development is not hydrologically linked to the proposed development site.

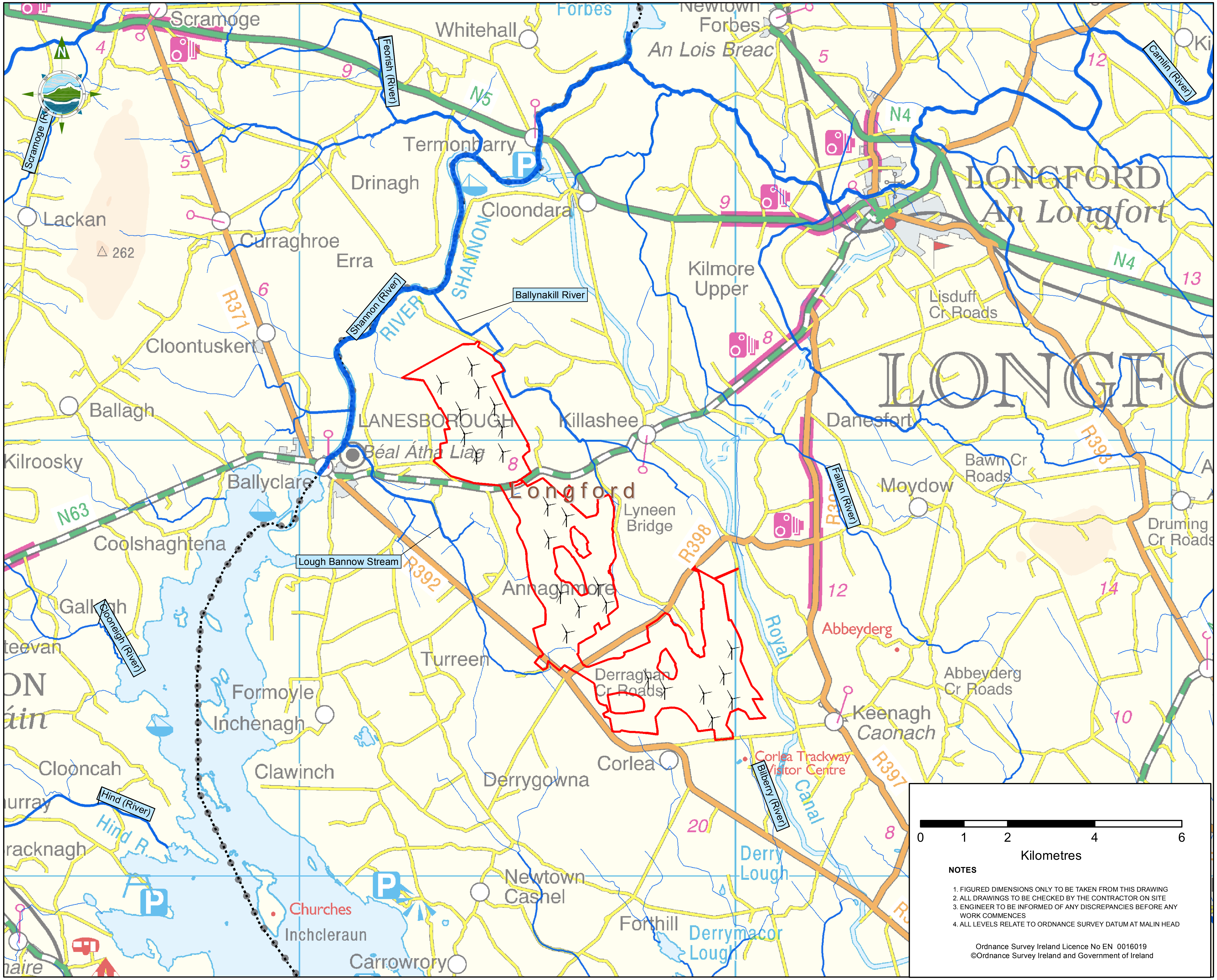
Each of the streams flowing through or adjacent to the site has its own sub-catchment area. The delineation of these catchment boundaries is shown in Figure 8.2 and Figure 8.3 (Figures 8.3A-8.3C).

The EIAR study area comprises of approximately 1900ha and has several surface water features in the region of the site. The rivers surrounding the site all discharge to the River Shannon or to Lough Ree. The main regional surface water features include the following:

- The Ballynakill River is located to the north and west of the Derryadd and Derryaroge bog;
- The Lough Bannow Stream and its tributaries are located to the east of Lough Bannow and flows Derryadd bog);
- The Ballynakill River and Lough Bannow Stream discharge to the River Shannon, north of Lanesborough; and
- The Ledwithstown River or Bilberry River flows to the south of Lough Bannow bog and discharges to Lough Ree.

A number of natural tributaries that flow into these rivers are located close to the proposed development site. The Derrygeel stream (EPA Ref: 26_1494), rises close to the northern area of the development and continues north joining additional tributaries before its confluence with the Ballynakill River. On the 15th May 2018, the channel of the Derrygeel stream (26_593) was dry where it made its way into the site. This stream had accumulated some flow by the time it exited the site boundaries.

Approximately 4km further to the west of the Bord na Móna landholding, a more karstic flow regime occurs. The landscape between Lough Ree and Lough Bannow Stream comprises a plateau (broad interfluve) which is gently undulating between 43-88 mOD. Few surface water features occur in this plateau however small sinking streams and turloughs occur to the south of the area. Two turloughs, Cordara Turlough and Fortwilliam Turlough occur 3.5km and 4.7km to the south west of Turbine 17, respectively. Cordara Turlough is connected to Fortwilliam Turlough via a sinking stream and excavated/man made drainage ditch. This stream and Cordara Turlough are dry during the summer months with a permanent water body occurring at Fortwilliam. During the January 2017 and February 2018 site visits the Cordara Turlough was in flood. Water from Cordara Turlough discharges via surface water and groundwater to Fortwilliam Turlough. Discharge from Fortwilliam Turlough is controlled via a sinkhole located on the western lip of the turlough.



Legend

- Planning Application Boundary
- River
- County Boundary

A	Jan 2018	Final Issue	FH	JD
Issue	Date	Description	By	Chkd.

Client:

BORD NA MÓNA
Naturally Driven

Project:

DERRYADD WIND FARM

Title:

REGIONAL CATCHMENT DELINEATION

Scale @ A3: 1:80,000

Prepared by: F.Healy
Checked: J. Dillon
Date: January 2019

Project Director: D. Grehan

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Figure 8.1

Issue: A

0 1 2 4 6
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NOTES

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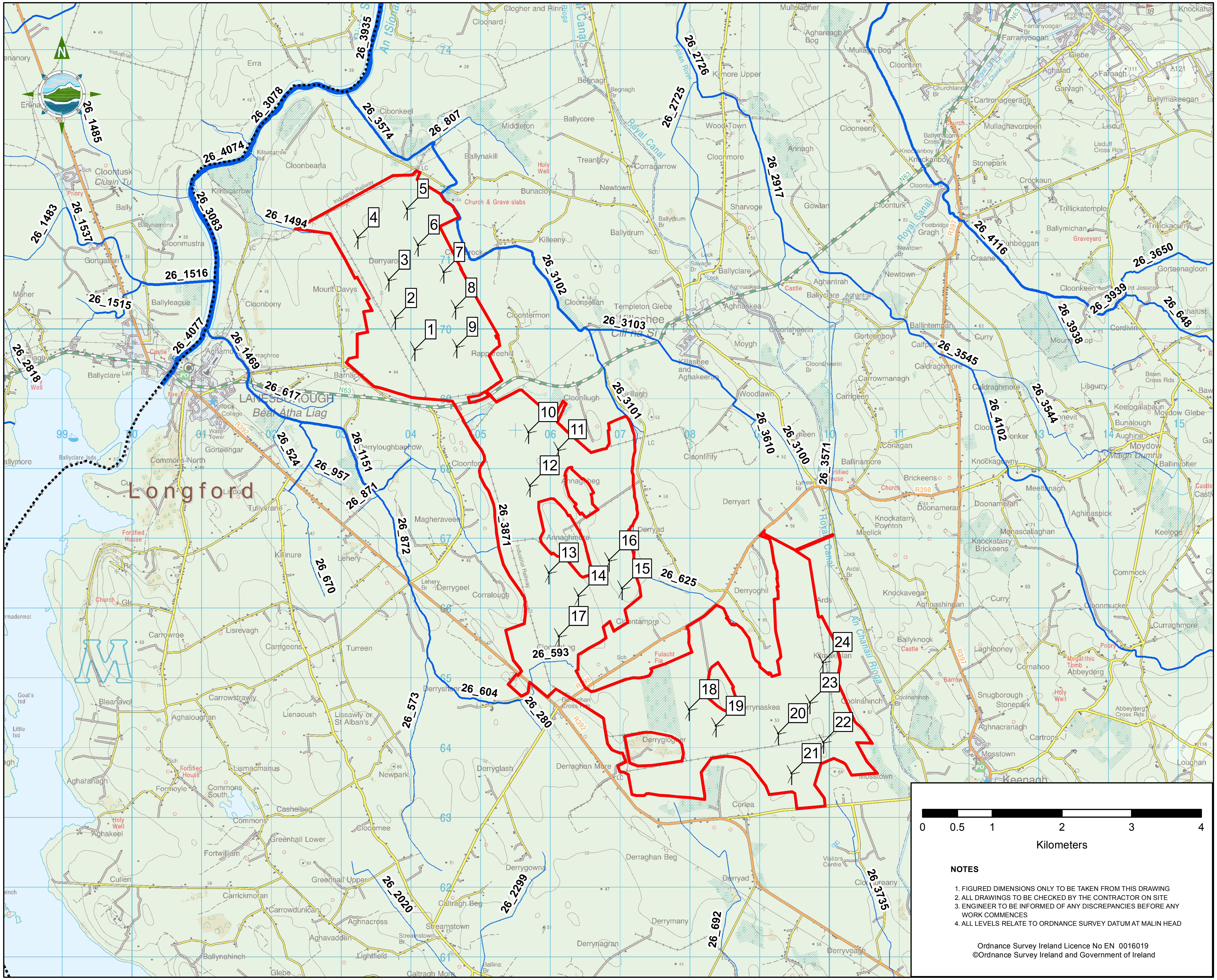

Legend

- Planning Application Boundary
- River
- County Boundary
- Proposed Turbine Locations

River Segment Code: 26_XXXX

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Issue	Date	Description	By	Chkd.
A	Jan 2018	Final Issue	FH	JD

Client:

BORD NA MÓNA
Naturally Driven

Project:

DERRYADD WIND FARM

Title:

Surface Water Features/
Local Catchment Delineation

Scale @ A3: 1:50,000

Prepared by:	Checked:	Date:
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Project Director: D. Grehan

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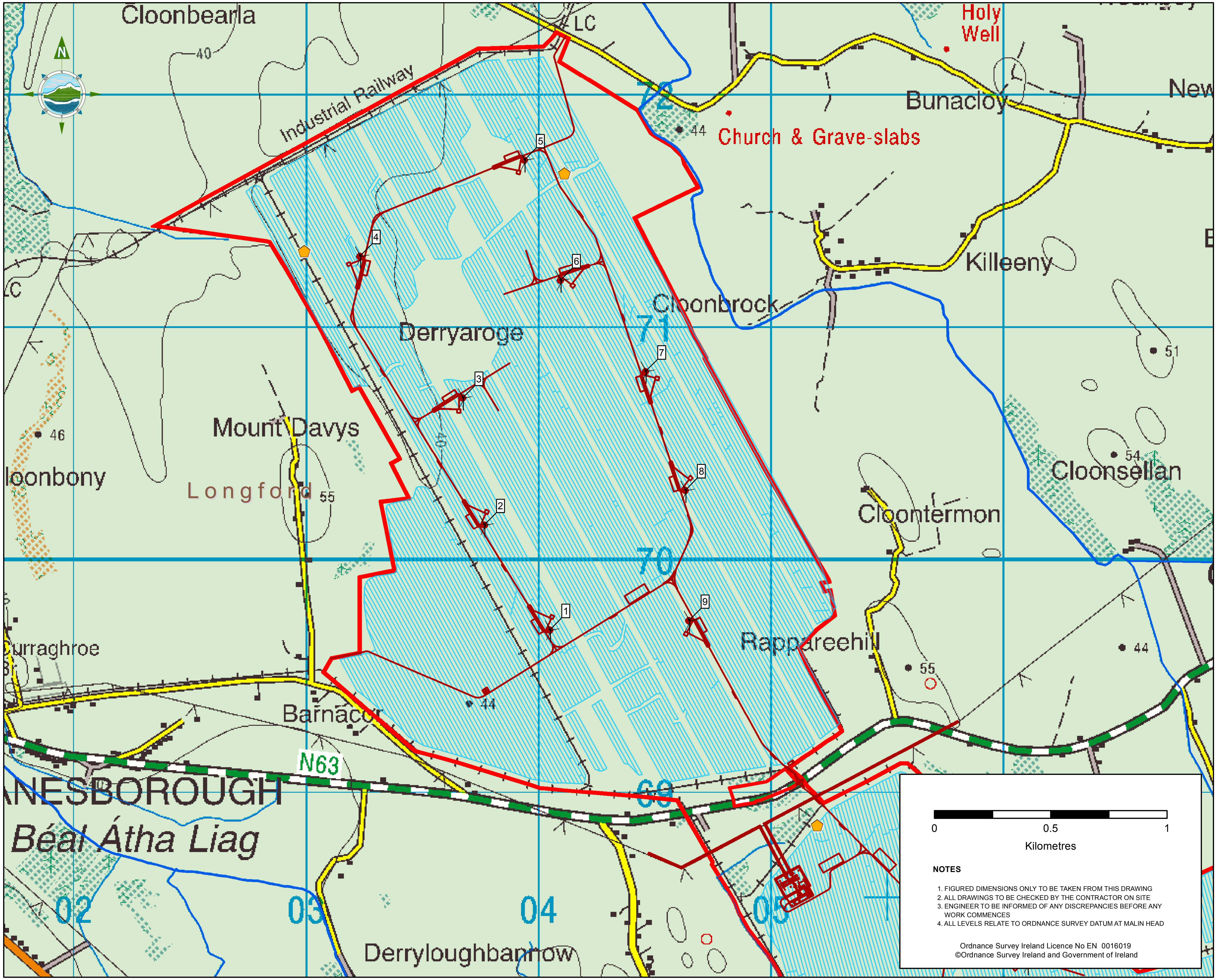
Figure 8.2

Issue: A



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Legend

- Planning Application Boundary
- River
- County Boundary
- Proposed Turbine Locations
- Drainage Layout
- Infrastructure
- Pump stations

A	Jan 2019	Final Issue	FH	JD
Issue	Date	Description	By	Chkd.

Client:
BORD NA MÓNA
Naturally Driven

Project:
DERRYADD WIND FARM

Title:
Existing Surface Water Features & Drainage within the Site Boundary - Derryarogue

Scale @ A3: 1:15,000

Prepared by: F. Healy | Checked: J. Dillon | Date: January 2019

Project Director: D. Grehan

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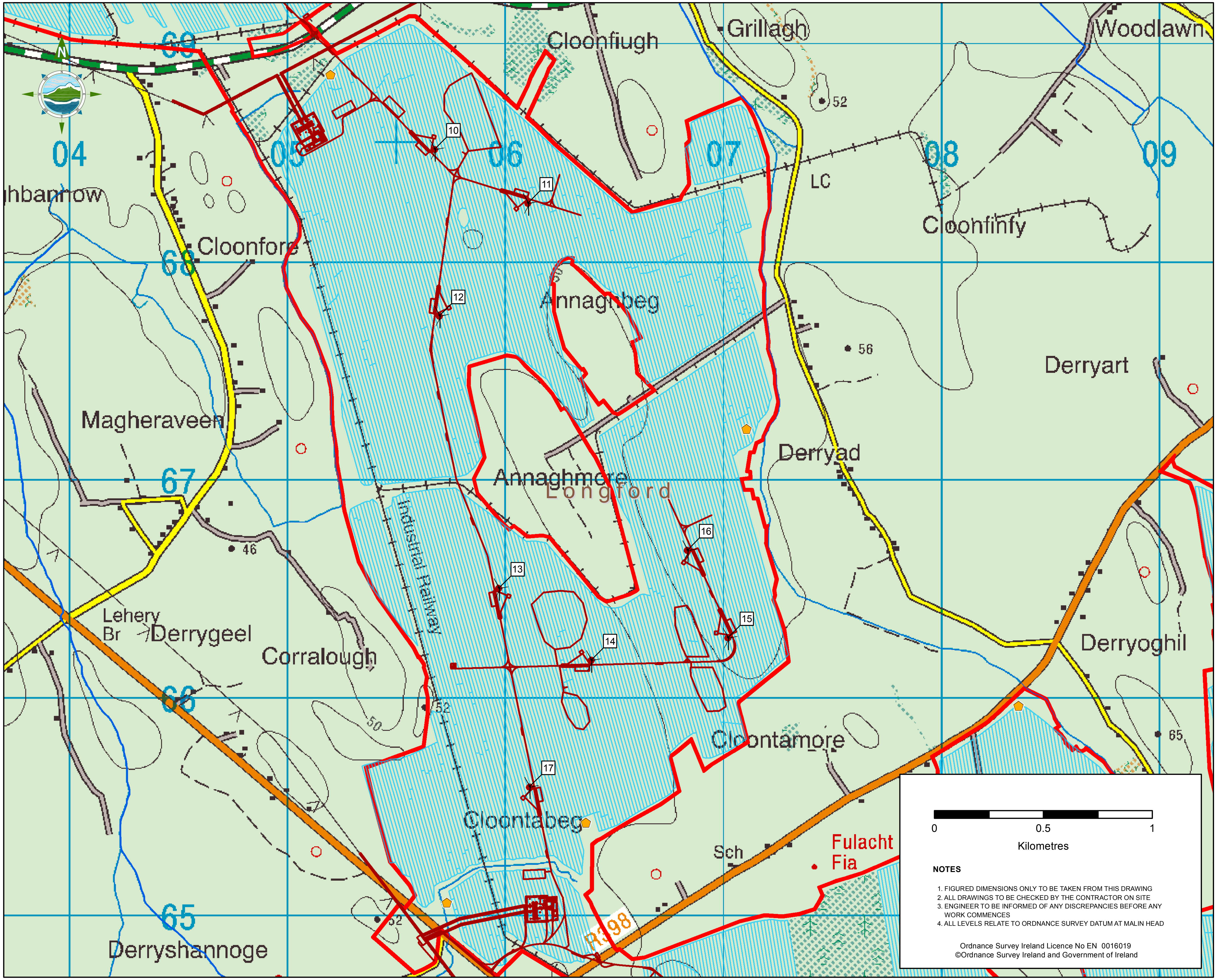
Figure 8.3A

Issue: A



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Legend

- Planning Application Boundary
- River
- County Boundary
- Proposed Turbine Locations
- Drainage Layout
- Infrastructure
- Pump stations

Issue	Date	Description	By	Chkd.
A	Jan 2019	Final Issue	FH	JD

Client: BORD NA MÓNA Naturally Driven

Project: DERRYADD WIND FARM

Title: Existing Surface Water Features & Drainage within the Site Boundary - Derryadd

Scale @ A3: 1:16,000

Prepared by: F. Healy | Checked: J. Dillon | Date: January 2019

Project Director: D. Grehan

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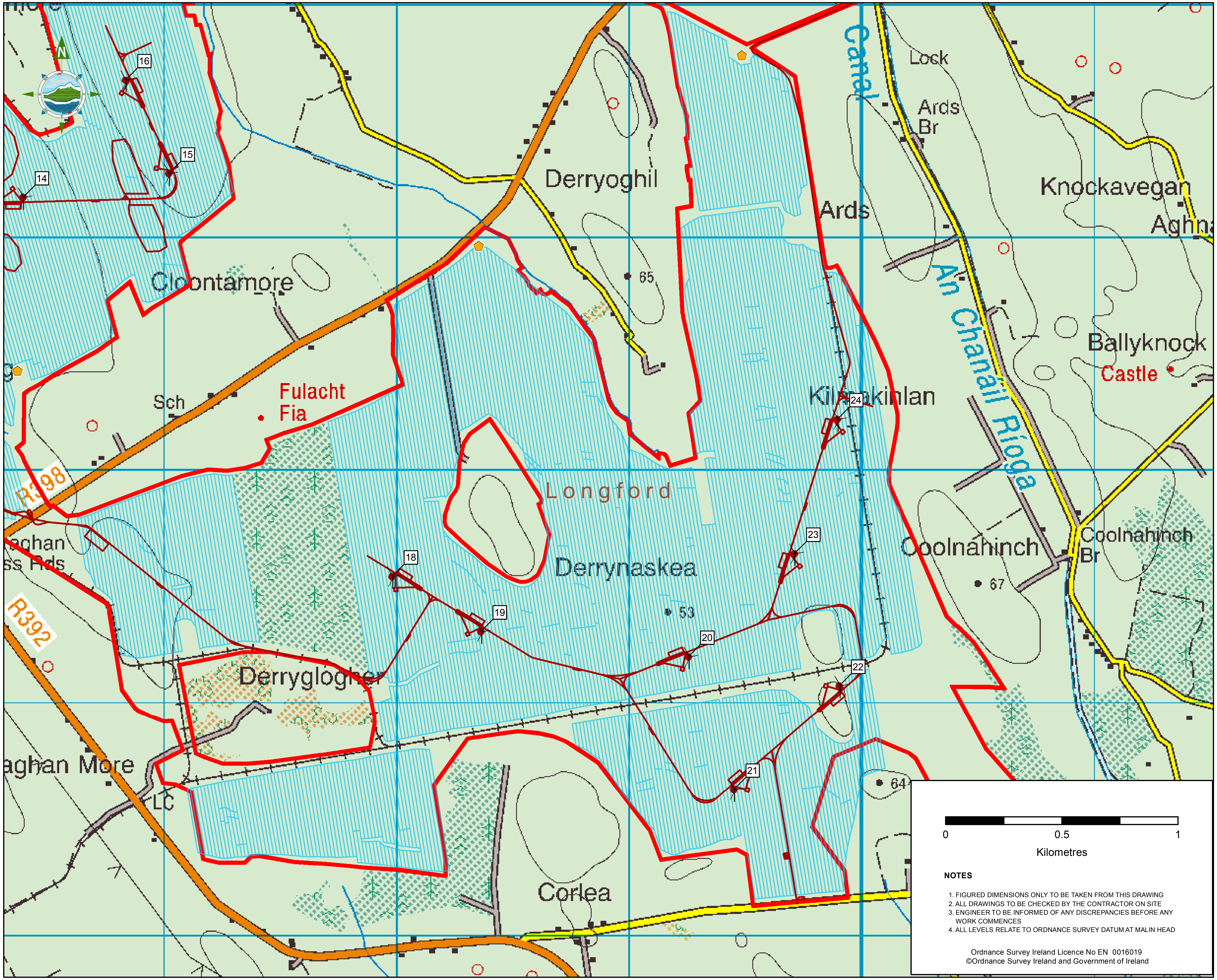
Figure 8.3B

Issue: A



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Legend

- Planning Application Boundary
- River
- County Boundary
- Proposed Turbine Locations
- Drainage Layout
- Infrastructure
- Pump stations

A	Jan 2019	Final Issue	FH	JD
Issue	Date	Description	By	Chkd.

Client:

BORD NA MÓNA
Naturally Driven

Project:

DERRYADD WIND FARM

Title:

Existing Surface Water Features & Drainage within the Site Boundary - Lough Bannow

Scale @ A3: 1:15,000

Prepared by: F. Healy
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Date: January 2019

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Figure 8.3C

Issue: A

8.3.1.3 Surface Water Features and Drainage within the Site Boundary

The proposed wind farm is located within an operating peat extraction site. An extensive network of drainage channels is present throughout the peatland which is currently operated under IPC licence P0504-01 Mountdillon bog group. The drainage hierarchy is outlined below in Diagram 8.1.

Extensive site drains and main drains are present within the Bord na Móna property. The site and main drains within the currently IPC licenced site both store water and transmit it to main drains and ultimately to the settlement ponds. The storage capacity of run-off water in the drainage network lessens the impact of sediment mobilisation to receiving water, due to the low velocity of the water and the retention time in the drains. Final settlement occurs in the settlement ponds before discharging to the adjacent drains and streams See the conceptual sketch below.

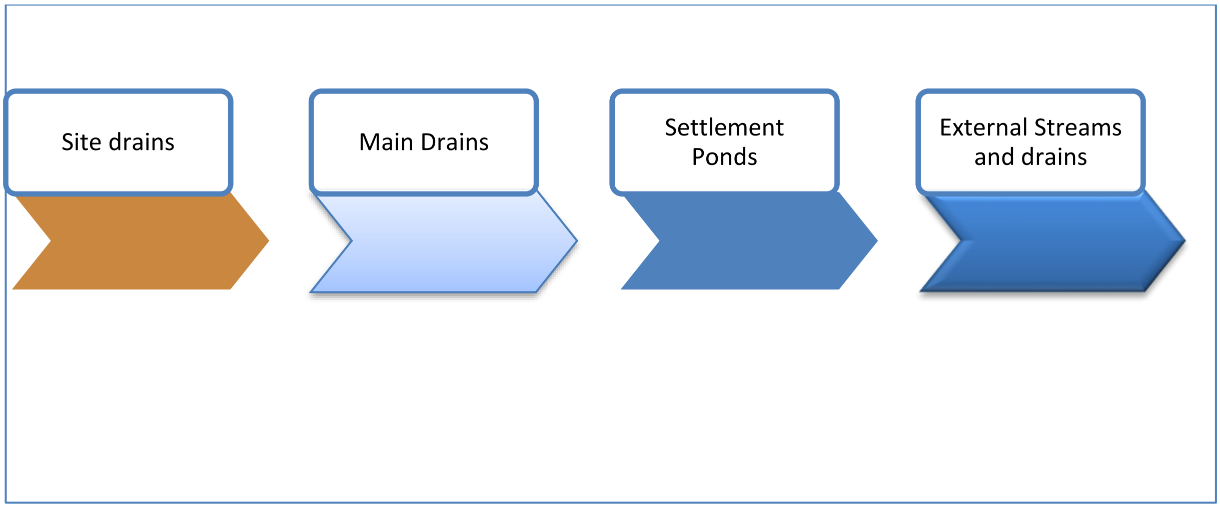


Diagram 8.1 Drainage hierarchy on peatlands.

Three streams/drainage channels were identified to be flowing through or adjacent to the proposed wind farm site (see Figure 8.2). The site and adjacent lands also include many man-made drains which flow to the watercourses identified in Figure 8.2 and assist in the drainage of peatland, reclaimed peatland areas under agricultural land use and forestry.

8.3.1.4 Flood Assessment

The OPW 'Flood Hazard Database' was used to obtain information on historical flooding events within the proposed development area. No flood events were identified within 1km of the proposed development.

The national programme of Catchment Flood Risk Assessment and Management (CFRAM) Studies comprises the execution of three parts:

(1) Preliminary Flood Risk Assessments;
(2) Flood Hazard Mapping; and
(3) The development of Flood Risk Management Plans.

The OPW initially produced a series of maps to assist in the development of the Preliminary Flood Risk Assessment (PFRA) throughout the country. These maps were produced as part of a desktop study of several sources. In July 2011, the Office of Public Works (OPW) published a series of maps showing the estimated 100-year flood plain from the Preliminary Flood Risk Assessment (PFRA) study. This information was used to establish the current baseline conditions. Areas of pluvial flooding were noted on the OPW PFRA mapping, but no records of fluvial flooding were noted for the proposed turbine locations. The PFRA study maps (i.e. the MyPlan.ie viewer) were reviewed and the proposed site is not located within a groundwater flood risk zone. There is no evidence of historic groundwater flooding at the site.

The proposed development site is not located in a flood prone area (Flood Zone A or B) based on the preliminary flood risk assessment (PFRA) maps. This dataset suggests that fluvial flooding does not occur at proposed turbine or substation locations. Based on the information available and a site-specific risk assessment it is not considered a flood risk – See Appendix 8.1.

Substantial areas of the proposed development and surrounding area have been artificially drained to enable industrial harvesting of peat. The carefully maintained network of drainage ditches effectively drain the proposed development site and surrounding area.

Drainage management works carried out as part of site activities maintain drainage systems within the proposed development site and reduce the potential for surface water ponding. Data on historical flooding is limited but records do not indicate that flooding occurs on the downgradient streams. Small areas of pluvial flooding occur within the site however improved drainage and water management has limited the potential for flooding in the three bogs. The drainage within the site is controlled by pumping from the site in accordance with the IPC licence. No incidents of flooding were noted at the site.

8.3.1.5 Assessment of Hydrometric Data

As outlined previously, the natural surface water drainage pattern in the environs of the proposed development site is shown in Figure 8.2. The streams are identified as follows:

Derryaroge Bog (Location of Turbines 1-9)

The proposed turbines T1-T9 and associated roads are located within the catchment of two streams: Stream 26_1494 located to the northern west of the Derryaroge site; and stream 26_3574 form the part of the eastern boundary of the Derryaroge site. The catchment area for each stream was estimated using the EPA's online database (gis.epa.ie/Envision) and geographic contours available from OS maps.

Derryadd Bog (Location of Turbines 10-17)

Three streams were identified as flowing through or adjacent to the proposed turbines T10-T17. Stream 26_625 is located to the east of turbines T10-T17; and streams 26_3871 and 26_593 form the western boundary.

The proposed substations and overhead/underground powerlines are located in the Lough Bannow stream catchment (26_3871 and 26_593).

- Substation Option A is located to the south of the Mountdillon works. Substation Option A is within the catchment of Stream 26_3871, which discharges to the Lough Bannow stream approximately 5km downgradient of the Substation Option A; and
- Substation Option B is within the catchment of Stream 26_593, which discharges to the Lough Bannow stream approximately 1km downgradient of the substation. Four possible borrow pits are identified within the Lough Bannow stream catchment.

The catchment area for each stream was estimated using the EPA's online database (gis.epa.ie/Envision) and geographic contours available from OS maps.

Lough Bannow Bog (Location of Turbines 18-24)

Two streams were identified as flowing adjacent to the proposed turbines T18-T24. Stream 26_625 is located to the north of turbines 18-24 and Stream 26_3735 located to the south. It was noted that there were no hydrometric stations located in the immediate environs of the proposed site. Although hydrometric stations do exist on watercourses downstream of the development, they include flows coming from a number of different tributaries (gis.epa.ie/Envision). As such, they are not representative of the actual flows occurring at the site.

8.3.1.6 Surface Water Abstractions within the Site

There are currently no known surface water abstractions from the streams adjacent to the site or from any surface water features <10km from the site boundary.

8.3.1.7 Surface Water Quality

Off-Site Surface Water Quality:

The Environmental Protection Agency (EPA) regularly monitors water bodies in Ireland as part of their remit under the Water Framework Directive (WFD) (2000/60/EC), which requires that rivers are maintained or restored to good/ favourable status. Quality of watercourses are assessed in terms of 4 No. quality classes; 'unpolluted' (Class A), 'slightly polluted' (Class B), 'moderately polluted' (Class C) and 'seriously polluted' (Class D). These water quality classes and the water quality monitoring programme are described in the EPA publication 'Water Quality in Ireland, 2016'. The water quality assessments are largely based on biological surveys. Biological Quality Ratings or Biotic Indices (Q values) ranging from Q1 to Q5 are defined as part of the biological river quality classification system. The relationship of these indices to the water quality classes defined above, are set out in Table 8.1 below.

Table 8.1: Relationship between Biotic Indices and Water Quality Classes

Biotic Index	Quality Status	Quality Class
Q5, 4-5, 4	Unpolluted	Class A
Q3-4	Slightly Polluted	Class B
Q3, 2-3	Moderately Polluted	Class C
Q2, 1-2, 1	Seriously Polluted	Class D

There are no EPA or WFD monitoring locations on the streams adjacent to the proposed site. However, samples were recorded on the River Shannon 1km downgradient of Lanesbourogh Power Station and 4km upgradient at Termonbarry village. The most recent EPA results for 2014 indicates these monitoring points indicate that the quality of water at this location is Q3 – 'Moderately Polluted' and Q3-4 – 'Slightly Polluted' (or Poor Status based on the classification in Figure 8.4 'EPA Surface Water Monitoring Locations'). Samples were also recorded on the Farran River located 5km to the west of the proposed development. The most recent EPA results for these monitoring points (West of Curry Bridge) indicate that the quality of water at this location are Q3 – Moderately polluted and Q3-4 – 'Slightly Polluted' (or Poor Status based on the classification in 'EPA Water Quality Indicators[123]').

[123] EPA **Water Quality** Indicators 2016

Table 8.2: EPA Monitoring of Biological Quality of Waters on the River Shannon Upper

Location	W of Curry Bridge	1km downstream of Termonbarry	Ballyleague Br Lanesboro
River	**Farran**	**Shannon**	**Shannon**
Station Code	**RS2680100040**	**RS26S021530**	**RS26S021600**
-			
2014	Q3-4	Q3-4	Q3
2011	Q3-4	Q4	Q3-4
2008	Q3-4	Q3-4	-
2005	Q3-4	-	Q3

The majority of EPA monitoring points on the River Shannon indicate that the overall water quality in this area is 'Moderately Polluted' and that the water quality upstream of the development is 'Slightly Polluted'. The overall status of surface water/rivers in the vicinity of the proposed site is 'Poor Status'. This classification is based on a low macroinvertebrate value (Q-Value) according to www.wfdireland.ie.

The Water Framework Directive (WFD) classified the surface waters in the southern area of the proposed Derryadd Wind Farm as Class 1a - indicating that rivers here are at risk of not achieving good status by 2015 (www.epa.ie). The northern section of the development site is classified as Class 1b – Possibly at risk of not achieving good status. This risk classification is based on a Q Class/EPA Diffuse Model or worst case of Point and Diffuse (2008) (www.wfdireland.ie).

8.3.2 Field Based Studies

Site Specific Surface Water Quality:

Surface water monitoring is conducted at the Mountdillon IPC Licence site on a regular basis as part of the IPC Licence. As shown in Table 8.3 and 8.4, results for the parameters tested were within the recommended discharge limits. All samples were taken from surface water channels during periods of low flow (low dilution factor), these results are as expected for the natural background environment in this area (in particular, elevated levels of ammonia and suspended solids would be expected in a peat soil/subsoil environment). These results provide a baseline set of results which can be used for comparative studies during the lifetime of the proposed wind farm.

Field monitoring results from January 2017 and March 2018 are included in Table 8.5 and 8.6 respectively and shown on Figure 8.5. The low conductivity values indicate that the Ballynakill and Lough Bannow River are predominately fed by surface water runoff. Approximately 3km to the west of the proposed development, higher conductivity values on a tributary to Lough Bannow River (26_280) and Fortwilliam stream indicate an increasing component of groundwater flow. The St Martins springs on the shores of Lough Ree have a similar conductivity value to Fortwilliam Turlough.

Table 8.3: Surface Water Analysis Mountdillon Bog Group IPC (2016 AER DATA)

Bord na Mona Mountdillon												
IPPC Licence P0504-01												
X	Y	Bog	SW	Monitoring	Sampled	pH	SS	TS	Ammonia	TP	COD	Colour
204806	268664	Derryadd	SW-68	Q1 16	14/03/2016	7.8	5	353	0.43	0.07	40	108
207219	268277	Derryadd	SW-70	Q1 16	15/03/2016	7.5	5	242	0.16	0.05	50	193
207139	268700	Derryadd	SW-71	Q2 16	09/06/2016	7.7	5	350	0.02	0.05	37	159
209437	266842	Lough Bannow	SW-76	Q2 16	09/06/2016	7.8	5	372	0.34	0.05	31	123
209521	261718	Lough Bannow	SW-77	Q2 16	09/06/2016	7.5	34	310	0.06	0.09	54	200
207855	263302	Lough Bannow	SW-78	Q2 16	09/06/2016	7.8	5	418	0.02	0.05	37	127
203033	265359	Derryshannoge	SW-79	Q2 16	09/06/2016	7.9	10	282	0.28	0.05	58	199
204286	272641	Derryaroge	SW-35	Q3 16	12/09/2016	6.7	6	150	0.07	0.46	115	301
203400	272510	Derryaroge	SW-36	Q4 16	12/12/2016	7.5	12	420	2.9	0.01	58	45

Table 8.4: Surface Water Analysis Mountdillon Bog Group IPC (2017 AER DATA)

Bord na Mona Mountdillon												
IPPC Licence P0504-01												
X	Y	Bog	SW	Monitoring	Sampled	pH	SS	TS	Ammonia	TP	COD	Colour
205264	266930	Derryadd	SW-72	Q1 17	20/03/2017	7.8	8	362	0.58	0.05	59	122
205704	264986	Derryadd	SW-73	Q1 17	20/03/2017	7.7	12	349	1.1	0.05	52	126
206484	264718	Lough Bannow	SW-74	Q1 17	20/03/2017	7.9	7	306	0.29	0.05	52	142
209521	261718	Lough Bannow	SW-77	Q2 17	29/05/2017	7.9	14	292	0.11	0.05	41	111
207855	263302	Lough Bannow	SW-78	Q2 17	29/05/2017	7.8	5	296	0.3	0.05	23	115
205264	266930	Derryadd	SW-72	Q3 17	27/07/2017	7.6	5	256	0.43	0.06	67	177
204007	264128	Derryshannoge	SW-81	Q3 17	27/07/2017	7.8	21	282	0.16	0.05	68	147

204924	264013	Derryshannoge	SW-82	Q3 17	27/07/2017	7.7	19	362	0.3	0.05	57	116
204271	265669	Derryshannoge	SW-85	Q3 17	27/07/2017	7.4	5	340	0.12	0.05	93	312
204674	264817	Derryshannoge	SW-86	Q3 17	27/07/2017	7.7	12	324	0.15	0.05	91	174

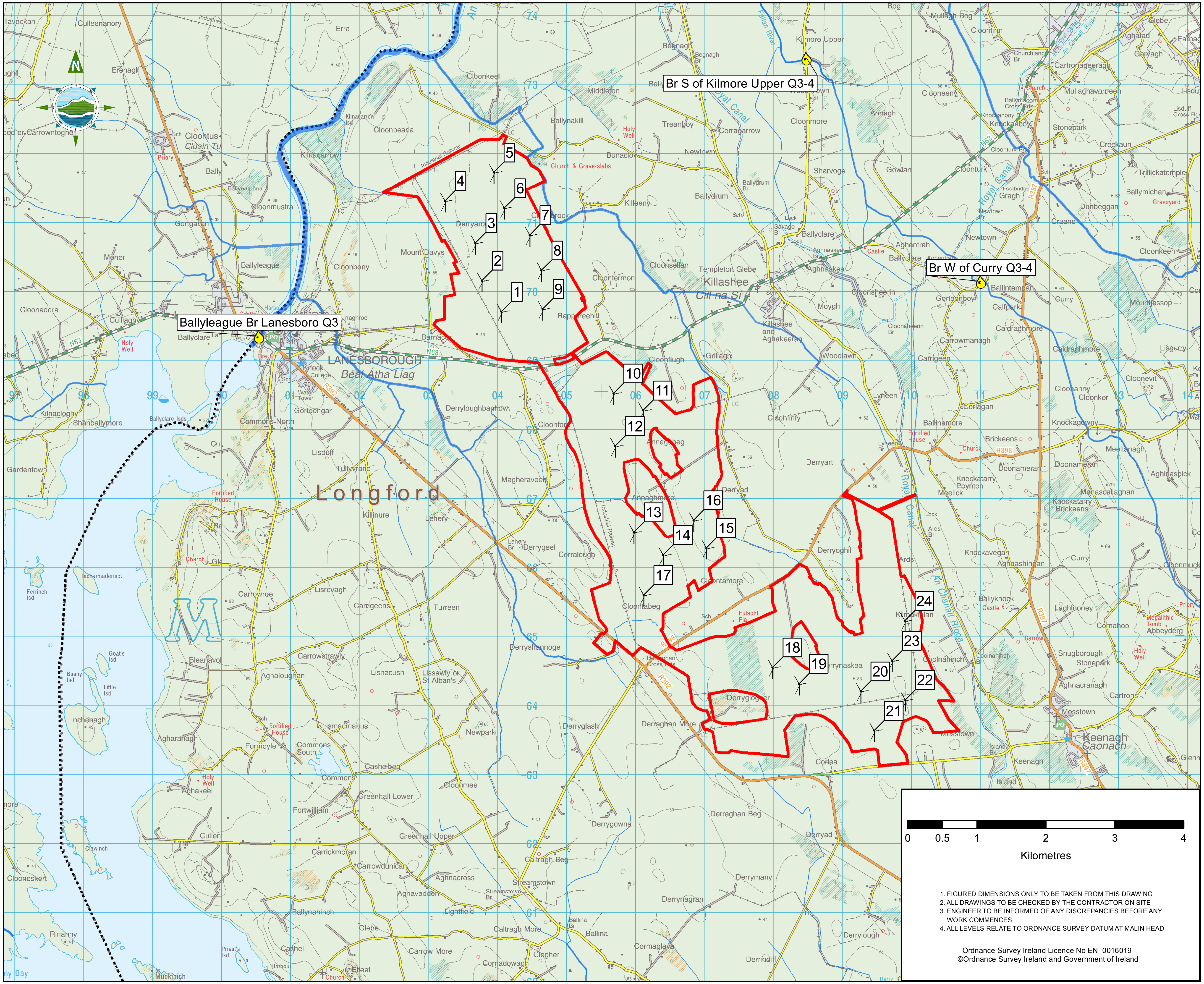
Table 8.5 Surface Water Analysis Derryadd Wind Farm 17/01/17

ID	Location	Temp	Conductivity	pH	TSS
	Units	°C	µS/cm	pH units	mg/l
S1	Lough Bannow stream 26_1150	8.2	390	6.7	<10
S2	Lough Bannow stream 26_872	7.7	391	6.8	<10
S3	Lough Bannow stream 26_280	8.5	460	7	<10
S4	Cordara Turlough	9.5	426	7	<10
S5	Fortwilliam stream inflow	10	597	7.1	<10
S6	St Martins Springs	10.5	590	7	<10
S7	Derryadd outflow to Ballynakill Stream	7.5	335	7.1	<10
S8	Ballynakill Stream upgradient of Derryadd outflow	8.2	399	7	<10
S9	Ballynakill Stream 26_625 at R398 road crossing	8.6	361	7	<10
S10	Ballynakill Stream 26_3102	7.8	359	6.9	<10
S11	Derryaroge outflow to River Shannon	8	389	6.9	<10
S12	Derryaroge bog, within site drainage ditch	8.6	347	6.9	<10
S13	Lough Bannow stream 26_593	8.6	348	6.9	<10

Table 8.6 Surface Water Analysis Derryadd Wind Farm 17/05/2018

ID	Location	Temp	Conductivity
	Units	°C	µS/cm
S1	Lough Bannow stream 26_1150	12.1	399
S2	Lough Bannow stream 26_872	12.7	400
S3	Lough Bannow stream 26_280	12.5	460
S4	Cordara Turlough	DRY	445
S5	Fortwilliam stream inflow	10.7	676
S6	St Martin's Springs	10.8	666
S7	Derryadd outflow to Ballynakill Stream	12.1	337
S8	Ballynakill Stream upgradient of Derryadd outflow	12.5	416
S9	Ballynakill Stream 26_625 at R398 road crossing	12.0	372
S10	Ballynakill Stream 26_3102	12.4	361
S11	Derryaroge outflow to River Shannon	12.4	405

S12	Derryaroge bog, within site drainage ditch	12.5	355
S13	Lough Bannow stream 26_593	8.6	348



Legend

- Planning Application Boundary
- River
- County Boundary
- Water Quality Monitoring Stations

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Issue	Date	Description	By	Chkd.
A	Jan 2019	Final Issue	FH	JD

Client:

BORD NA MÓNA
Naturally Driven

Project:

DERRYADD WIND FARM

Title:

EPA Surface Water Monitoring Locations

Scale @ A3: 1:50,000

Prepared by:	Checked:	Date:
F. Healy	J. Dillon	January 2019

Project Director: D. Grehan

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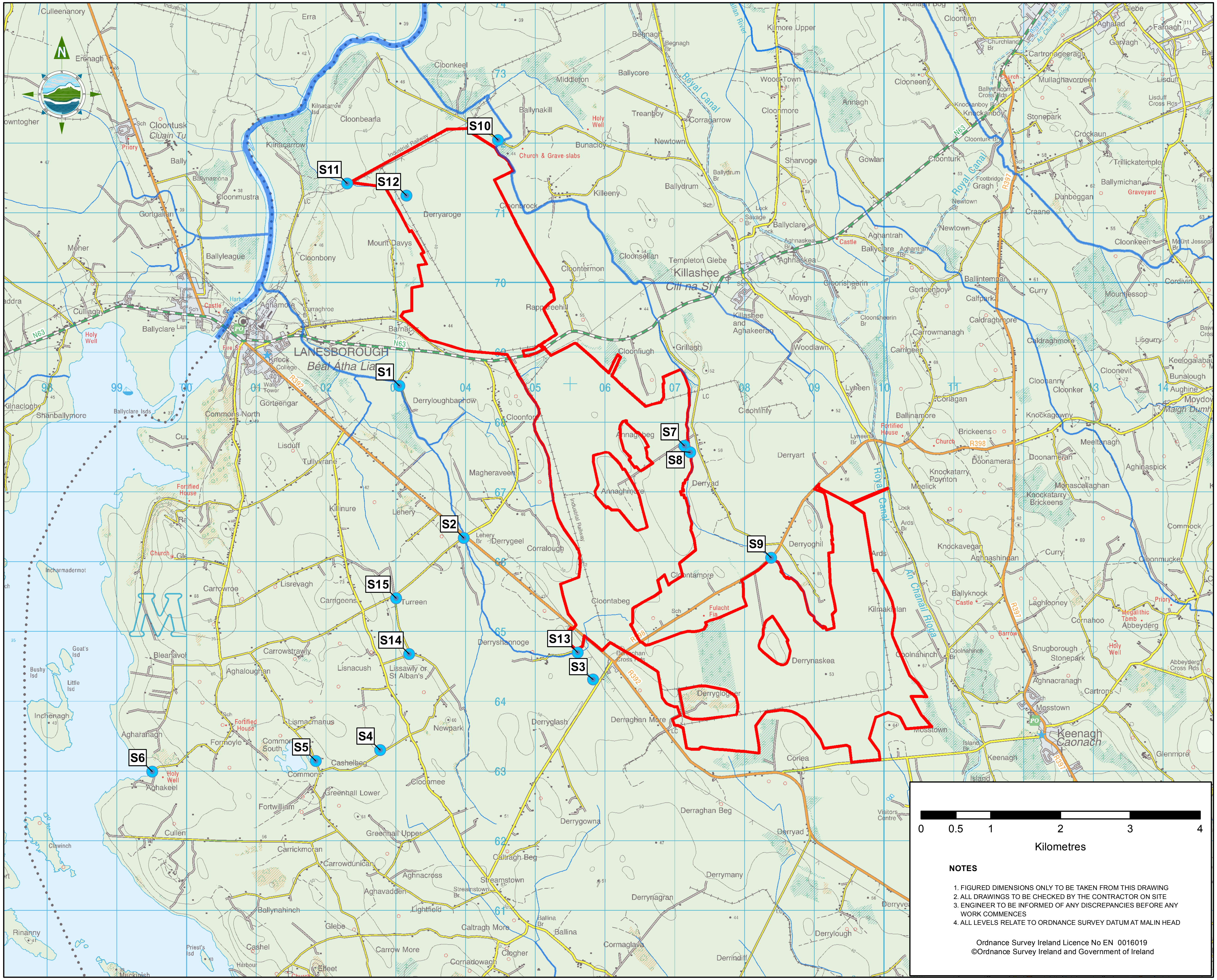
Figure 8.4

Issue: A



Legend

- Planning Application Boundary
- River
- Surface Water Monitoring 2017 & 2018

0 0.5 1 2 3 4

Kilometres

NOTES

1. FIGURED DIMENSIONS ONLY TO BE TAKEN FROM THIS DRAWING
2. ALL DRAWINGS TO BE CHECKED BY THE CONTRACTOR ON SITE
3. ENGINEER TO BE INFORMED OF ANY DISCREPANCIES BEFORE ANY WORK COMMENCES
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Issue	Date	Description	By	Chkd.
A	Jan 2019	Final Issue	FH	JD

Client: BORD NA MÓNA
Naturally Driven

Project:
DERRYADD WIND FARM

Title:
Surface Water Monitoring Locations 2017 and 2018

Scale @ A3: 1:50,000

Prepared by: F. Healy
Checked: J. Dillon
Date: January 2019

Project Director: D. Grehan

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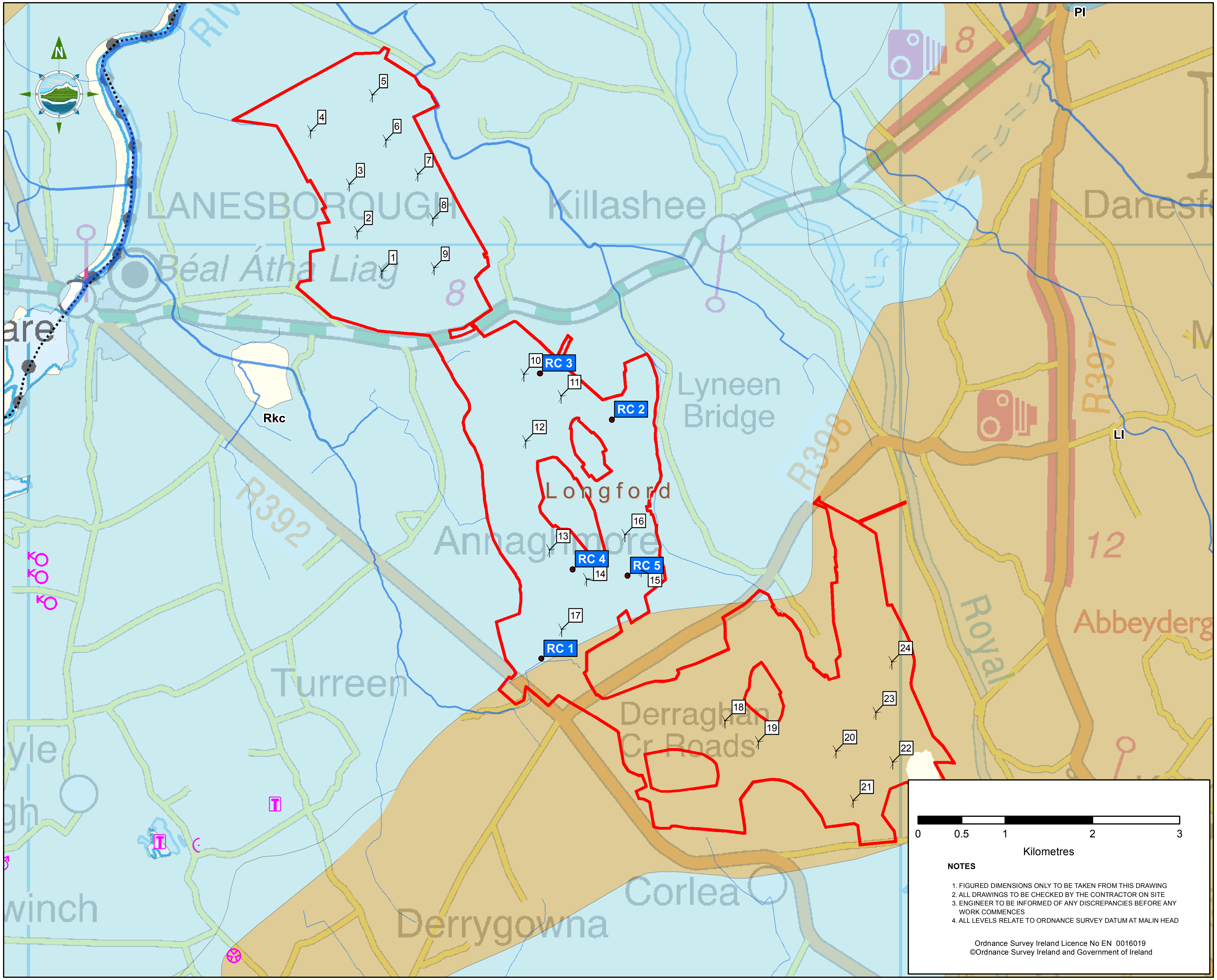
Figure 8.5

Issue: A



Legend

- Planning Application Boundary
- River
- County Boundary
- Proposed Turbine Locations

Aquifer

- Lk
- Ll
- Pl
- Rkc

Karst Features

- Borehole
- Enclosed Depression
- Spring
- Swallow Hole
- Turlough

Issue	Date	Description	By	Chkd.
A	Jan 2019	Final Issue	FH	JD

Client: BORD NA MÓNA Naturally Driven

Project: DERRYADD WIND FARM

Title: Aquifer Classifications

Scale @ A3: 1:40,000

Prepared by: F. Healy | Checked: J. Dillon | Date: January 2019

Project Director: D. Grehan

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Issue: A

Figure 8.6

8.3.2.1 Hydrogeology/Groundwater

8.3.2.1.1 Existing Groundwater Quality

The Water Framework Directive (www.wfdireland.ie) describes the groundwater quality status of the proposed development in this area as ‘Good’. These classifications are based on an assessment of the point and diffuse sources in the area that may affect the groundwater quality. The groundwater in this area was found to have been particularly at risk from Diffuse source pollution (DIF).

8.3.2.1.2 Aquifer Potential and Characteristics

Reference to the National Aquifer Map prepared by the GSI (www.GSI.ie) indicates that there are three types of Bedrock Aquifer underlying the proposed site. The Derryaroge and Derryadd Bogs are underlain by a Regionally Important Aquifer – (Conduit) Karstified (Rkc). The Lough Bannow Bog and Derryshannoge Bog are underlain by a Locally Important Aquifer, which is Moderately Productive in local zones (LI). The various aquifer classifications are illustrated in Figure 8.6 ‘Aquifer Classifications’.

The subsoil deposits overlying the bedrock are not considered to be of sufficient lateral extent or depth to represent an aquifer body and are mainly comprised of peat deposits and low permeability limestone till, and alluvial/lacustrine deposits with occasional lenses of sand and gravel (refer to Chapter 7, Lands, Soil and Geology for further information).

Summarised below in Table 8.7, are the aquifer characteristics of the underlying aquifer and surrounding aquifers.

Table 8.7: Bedrock Aquifer Classification and Characteristics

Aquifer Classification	Permeability/Flow Mechanism	Karst Features
Regionally Important (Rkc)	Regionally Important Aquifer - Karstified (conduit)	Yes
Locally Important (LI)	Productive only in Local Zones	No

Groundwater flow paths within the aquifer are expected to generally follow the local surface water catchments. Adjacent to the rivers, water levels will be closer to ground level.

The EPA report that bedrock is close to the surface within 1km of the surrounding area of the proposed site. No significant dissolution features (i.e. karst) were observed from visual appraisal of the proposed site and no karst features are recorded within the GSI Karst Database of Ireland within a 1km radius of the proposed development site. However, a turlough is located 3.6km to the southwest of T17.

8.3.2.1.3 Groundwater Vulnerability

Groundwater vulnerability represents the intrinsic geological and hydrogeological characteristics that determine how easily groundwater may be contaminated by activities at the surface. Vulnerability depends on the quantity of contaminants that can reach the groundwater, the time taken by water to infiltrate to the water table and the attenuating capacity of the geological deposits through which the water travels.

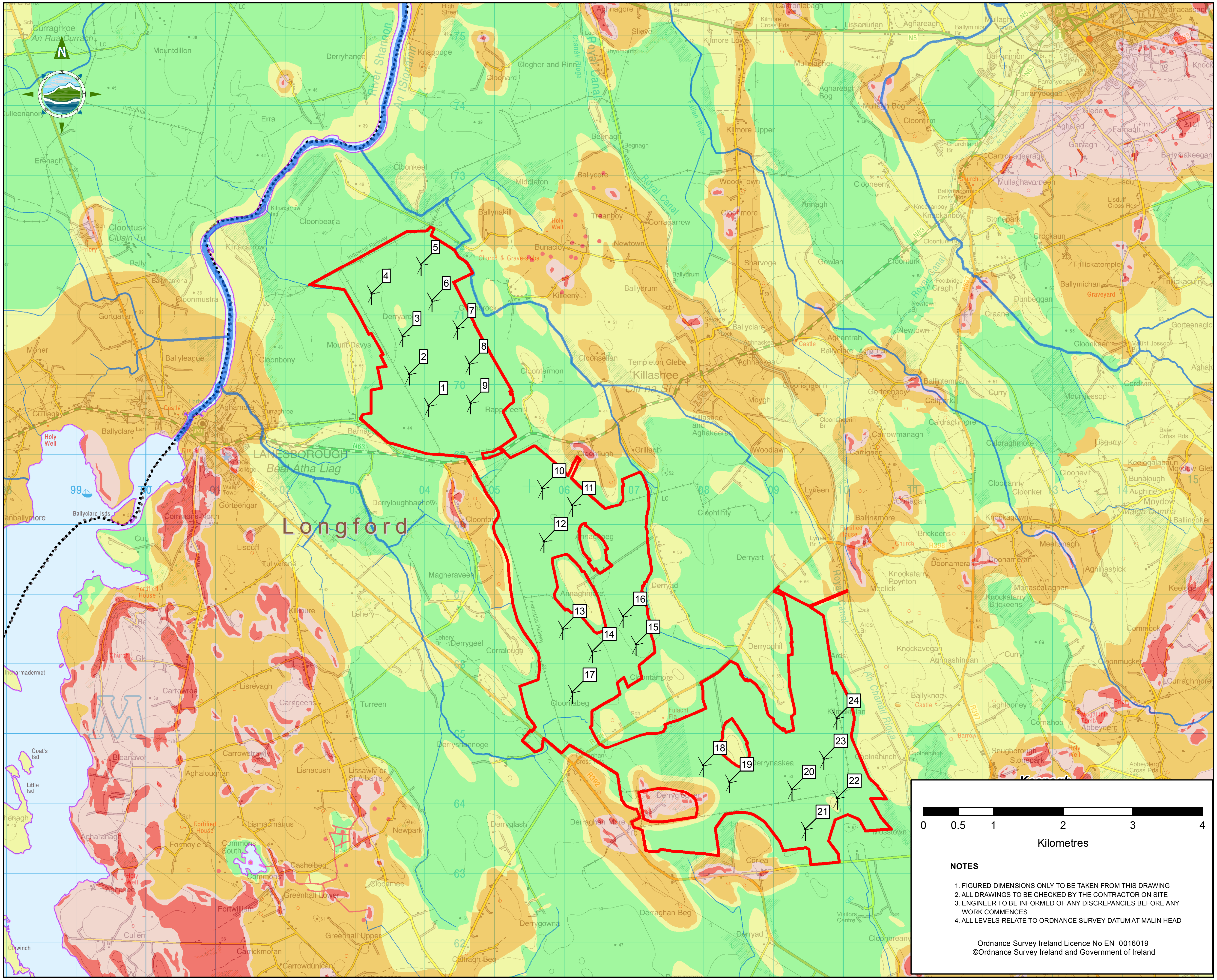
These factors are controlled by the types of subsoils that overlie the groundwater, the way in which the contaminants recharge the geological deposits (whether point or diffuse) and the unsaturated thickness of geological deposits from the point of contaminant discharge.

The groundwater vulnerability throughout the proposed site ranges from L (Low) to H (High). Figure 8.7 'Groundwater Vulnerability Map' illustrates the vulnerability classifications for this area. Site investigation and geophysics data would indicate that extensive subsoil deposits occur at most turbine locations. Shallow subsoils are noted at T5, T11 and T14.

Table 8.8: Groundwater Vulnerability Categories

Sensitivity	Hydrogeological Conditions				
	Subsoil Permeability (Type) and Thickness			Unsaturated Zone	Karst Features
	High Permeability (Sand and Gravel)	Medium Permeability (Sandy Subsoil)	Low Permeability (Clayey Subsoil/ Peat)	Sand and Gravel aquifers only	<30 radius
Extreme (E)	0 – 3.0m	0 – 3.0m	0 – 3.0m	0 – 3.0m	-
High (H)	>3.0m	3.0 -10.0m	3.0 – 5.0m	> 3.0m	N/A
Moderate (M)	N/A	>10.0m	5.0-10.0m	N/A	N/A
Low (L)	N/A	N/A	>10m	N/A	N/A

Notes: N/A Not Applicable:



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Legend

- River
- Planning Application Boundary
- County Boundary
- Proposed Turbine Locations

Groundwater vulnerability

- Extreme
- High
- Low
- Moderate
- Water
- Extreme - rock clost to surface

Issue	Date	Description	By	Chkd.
A	Jan 2019	Final Issue	FH	JD

Client: BORD NA MÓNA Naturally Driven

Project: DERRYADD WIND FARM

Title: Groundwater Vulnerability

Scale @ A3: 1:50,000

Prepared by: F. Healy | Checked: J. Dillon | Date: January 2019

Project Director: D. Grehan

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Figure 8.7

Issue: A

8.3.2.2 Groundwater Usage

According to Longford County Council and Irish Water, there are two groundwater boreholes used as part of the Lanesborough public water scheme (PWS).

Lisrevagh borehole, is located 7.3 km to the east of the development and abstracts groundwater for use in the Lanesborough public water supply scheme. The Lanesborough ESB borehole, which is located 4.5km to the west of T3, abstracts groundwater at Lanesborough. Zones of Contribution (ZOCs) were delineated for the EPA in 2011. The ZOC of a groundwater source is effectively a groundwater catchment. They are influenced by the hydrogeology of a given area, and are determined from the considerations of:

- The total outflow at the source;
- The recharge to the associated groundwater flow system;
- Groundwater flow directions and gradients; and
- Subsoil and bedrock permeabilities.

No turbine is located within 1km of the Public Water Supply ZOCs. These abstraction points and zones of contribution are included in Appendix 8.2. According to the GSI, there are no domestic wells within 0.25km of the turbines or borrow pits.

8.3.2.3 Groundwater Flow

On a regional scale, the groundwater flow direction is generally a subdued reflection of surface water drainage. Therefore, on a regional scale, the groundwater flow is considered to be towards the surrounding tributaries and the large rivers located to the east (Ballynakill River), and west (River Lough Bannow and River Derrykeel) of the proposed wind farm. Limited recharge to groundwater is likely to occur due to the low permeability peat, marl and till deposits on the site. To the north of the proposed development at Derryaroge, a 500m long, 3m deep bedrock exposure of well bedded mid grey fossiliferous limestones and calcareous shales occurs in a drainage ditch. No significant groundwater discharges or karst features occur at this location. No large springs (>100m^3/day) occur on the three bog sites. Local groundwater flow discharges to the local streams and drainage ditches in the area.

Based on the measured groundwater levels in 2017 and 2018, groundwater flow is towards the Lough Bannow Stream and internal drainage ditches (40 to 41mOD). The groundwater levels at the proposed wind farm (42 to 44 mOD) are below the Cordara and Fortwilliam turlough level (45-47mOD). Therefore, it is not possible for groundwater to discharge to the turlough area. Groundwater on site discharges to the site's arterial drainage network. Surface water discharge at Derryadd is to Lough Bannow Stream and Ballynakill River. A conceptual site model is included below in Figure 8.8.

Further to the west of the proposed development (>3.5km), a karstic groundwater system has developed on a limestone plateau area, overlain by shallow soils and bare rock. Where soils are thin or absent the epikarst layer (i.e. the upper or shallow part of a karst system, in which water is stored before it percolates to underlying aquifers) is well developed. Most groundwater flows occur in an epikarstic layer a couple of metres thick. Conversely where deep soils occur, the karstification is typically limited. Deeper groundwater flow can occur in areas associated with faults or dolomitisation.

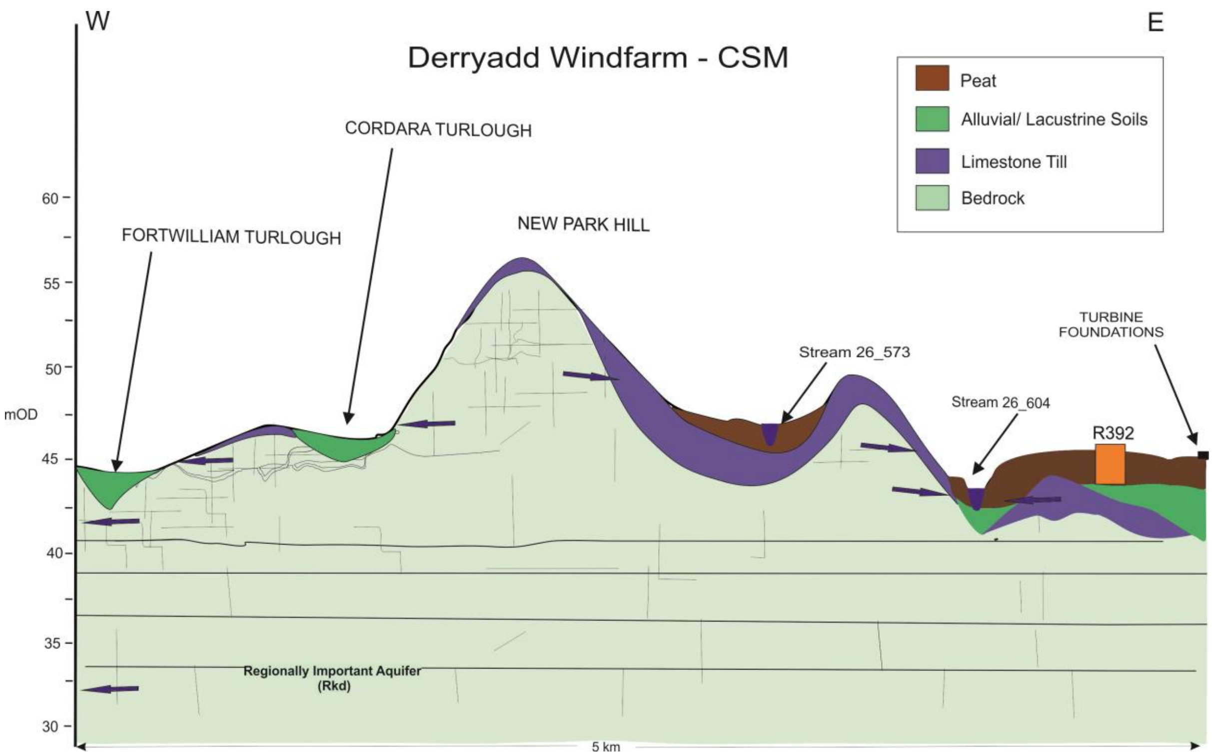

Figure 8.8: East-West Conceptual model between Turbine 17 and Fortwilliam turlough

Turbines T18-T24 are located on Dinantian Sandstones, Shales and Limestones of the Keel Inlier, which is part of the Inny GWB. This inlier is bounded to the southeast by a zone of normal step faults, downthrowing to the southeast. Given the non karstic geology underlying these turbines there is no connectivity with the turloughs located >7km the east. Groundwater in this area discharges to the sites arterial drains and to the Ballynakill stream. As outlined previously due to distance, aquifer type and groundwater flow directions there is also no complete source- pathway – receptor connectivity, with T1 to T17 turbines.

8.4 POTENTIAL IMPACTS

8.4.1 Introduction

This section addresses the potential impacts on the hydrological and hydrogeological environment of the proposed wind farm. The potential impacts may comprise direct and indirect impacts on the quality of surface waters and groundwater, and on potential the increased volume of surface water flow. The hydrological and hydrogeological assessment identified water sensitive waterbodies downstream from the proposed infrastructure works.

The current proposals for all construction activities and operational infrastructure were reviewed to identify activities likely to impact upon identified water bodies including water courses within and remote from the site. Following the identification of sensitive waterbodies, the extent and severity of potential construction, operational and decommissioning impacts were evaluated considering all proposed control measures included in the project design.

8.4.1.1 Sensitivity of Receptors

The sensitivity of an environmental receptor is based on its ability to absorb an impact without perceptible change. The hydrological environment is of moderate sensitivity for receptors draining to Shannon via hydrological links. The EPA has found the water quality in the receiving waters to be moderate (Q3 to Q3-4). There are no 'Registered Protected Areas'(RPA) nutrient sensitive rivers in hydrological/hydrogeological connection with the proposed development. There are no RPA habitat rivers in hydrological/hydrogeological connection with the proposed development. There are no RPA nutrient sensitive lakes and estuaries in hydrological/hydrogeological connection with the proposed development and there are no RPA shellfish/pearl mussel areas along the proposed development.

8.4.2 Do Nothing Effects

If the wind farm development does not proceed, the proposed development sites will remain as a peat production site. In areas where agriculture and forestry are present, normal agricultural and forestry will continue to occur into the future. There are no significant impacts to the hydrological and hydrogeological environment in a do nothing scenario.

8.4.3 Potential Effects - Construction

8.4.3.1 Construction Activities

The construction phase of the development will involve the following key activities that may have potential impacts on surface water and groundwater conditions:

- Earthworks related to:
  - Temporary site compound construction;
  - Construction of access tracks and passing bays;
  - Construction of amenity roads
  - Construction of turbine foundations and turbine hardstands;
  - Construction of either Substation Option A or Option B
  - Excavation and construction of angle masts
  - Laying of underground electrical cabling/construction of overhead line;
  - Borrow Pit excavations; and
  - Stockpiling material.
- Handling and storage of hydrocarbons, concrete and other potential water pollutants.

The construction of the temporary site compound areas, site access tracks, turbine foundations, turbine hardstands, laying of underground electrical cabling, borrow pits, drainage channels will involve the removal of vegetation and forestry and the excavation of peat, marl and mineral subsoil. Exposed and disturbed ground may increase the risk of erosion and subsequent sediment laden surface water runoff. The release of suspended solids is primarily a consequence of: the physical disturbance of the ground during the construction phase, if not correctly compacted. Incorrect site management of earthworks and excavations could, therefore, lead to loss of suspended solids to surface waters as a consequence of the following activities:

- Soil stripping, if necessary, to construct the access roads, passing bays, site compounds, turbine foundations, hardstands, borrow pits, turbines/hardstanding/roads and substations (A&B);
- Run-off and erosion from soil stockpiles (prior to reinstatement/profiling/side casting);
- Dewatering of excavations for turbine foundations, angle mast foundations and borrow pits (where necessary). The result of increased sediment loading to watercourses is to degrade water quality of the receiving waters and change the substrate character.

8.4.3.2 Hydrology and Hydrogeological Impacts

Based on construction phase activities outlined above, the potential hydrological and hydrogeological impacts can be summarised as follows:

- Surface water quality impacts;
- Surface water flow alterations; and
- Groundwater flow and quality impacts.

There is potential for an increase or a decrease in runoff due <2ha of permanent impermeable surfaces (e.g. turbine foundations) and 33ha permeable surfaces. The proposed development represents 2.7% of the three peatland areas.

This could potentially reduce the infiltration capacity of the soils in areas where earthworks are undertaken and increase the rate and volume of direct surface runoff. Surface water control measures are incorporated into the design of the proposed development. A slight reduction in peak rainfall is anticipated where areas of peat are replaced with gravel trackways and gravel hardstand areas. The potential for an increase in runoff to streams is limited as surface water runoff is already controlled and managed in accordance with the IPC licence and site management procedures.

Pre-mitigation, the potential construction impact varies from a slight negative to slight beneficial short-term impact.

There is a potential impact as a result of dewatering borrow pits and turbine bases on site. Borrow pit areas for example, are up to 10m deep, will encounter groundwater. Groundwater inflows may need to be pumped, resulting in short term localised drawdown of the water table and discharges to the surface water channels. There are no wells within 250m of the proposed borrow pit or turbine locations.

During construction of the wind farm, there is a risk of accidental pollution incidences from the following sources:

- Spillage or leakage of oils and fuels stored on site;
- Spillage or leakage of oils and fuels from construction machinery/vehicles;
- Spillage or leakage of wastewater from temporary site facilities;
- Spillage of oil or fuel from refuelling machinery on site; and
- Spillages arising during the use of concrete and cement for turbine foundations and hardstanding areas.

There will be a risk of pollution from site traffic through the accidental release of oils, fuels and other contaminants from vehicles. Concrete (specifically, the cement component) is highly alkaline and any spillage to a local watercourse would be detrimental to water quality and fauna and flora.

8.4.3.3 Borrow Pit Excavations

It is proposed that much of the material volume will be obtained from on-site borrow pits. The potential borrow pits will be excavated to provide fill material for roads, cycle tracks, hardstanding, upfill to foundations and temporary compounds. The borrow pits are located within Derryadd Bog towards the centre of the site and are at advantageous locations with regards to hauling materials within the site. Temporary pumping of groundwater will be required to facilitate excavation. The hydraulic permeability of the unconsolidated material interpreted from the data recorded from the test and is included in Appendix 8.3. The average permeability based on a number of different interpretations of the data for each shallow borehole is listed below:

RC4 : K(average) = 0.08m/day

RC3: K(average) = >0.12m/day

Based on the slug test data, the Transmissivity is at the lower range at 5 m^2/day. However, slug tests are affected borehole conditions and only stress a small volume of the aquifer (generally few feet around the well). Due to the presence of fractures (but a general absence of dolomite) in the boreholes and due to the potential variability within the formation, a conservative figure of 20 to 50 m^2/day is used.

Based on the above principles and a Transmissivity value of 20 to 50 m^2/day; required groundwater discharge rates of 1,800 to 2,300 m^3/day are obtained. The empirical estimate calculates a 0.1m drawdown at 250m. There are no wells within 250m of the borrow pits. Therefore, the potential for effect is short term and negligible.

The borrow pits will be reinstated using two material sources (a) overburden from the opening of the borrow pits, and (b) mineral soils excavated elsewhere on the site that cannot be reused in wind farm construction.

8.4.3.4 Excavation for Turbine Foundations

The material encountered in the trial pits excavated at each turbine location was generally soft to very soft and not capable of supporting the applied loads from a wind turbine. Deeper excavations to more competent material will be required to construct the turbine foundations. Additional fill material will be needed to upfill the excavation to the levels required for the wind turbines foundations. These excavations have the potential to have a slight negative short-term effect on the surface water environment. Preliminary volume calculations provide an approximate estimation of fill required for all of the turbine foundations assuming none are piled. It is estimated as 27,000m^3 of compacted material which is equivalent to 35,000m^3 of un-compacted material allowing for bulking during transportation.

8.4.3.5 Excavation for Hardstanding Foundations/Temporary Construction Compounds

The environmental effects of the construction of the hardstanding foundations are similar to that of the turbine foundations as discussed in Section 7.4.2.7. Volume calculations provide an approximate estimation of fill required for all the hardstanding foundations. It is estimated as 215,000m^3 of compacted material, which is equivalent to 280,000m^3 of un-compacted material allowing for bulking during transportation. For the compounds, it is estimated that 25,000m3 of compacted material, which is equivalent to 32,500m^3 of uncompacted material allowing for bulking during transportation will be required. It is proposed to install culverts anywhere the proposed road layout intersects a stream. The only stream crossing is located to the south of the Derryadd site (26_593) and crosses a man-made drainage channel/stream. The channel is a constructed 3m wide and constructed within peat. Culverts will be of a size adequate to carry expected peak flows.

These excavations have the potential is considered to have slight negative short-term effect on the surface water environment.

8.4.3.6 Excavation for Substation Foundations

The construction of a substation at either Option A or Option B will require removal of topsoil and subsoil to a competent founding layer and upfilling with concrete or structural fill to the required finished floor level. Ground investigations at potential substations locations A, and B, have only been undertaken for the purposes of the EIAR and have been used to inform the depth of excavation and upfill required.

8.4.3.6.1 <u>Substation Option A</u>

Preliminary volume calculations provide a rough estimation of fill required for the foundations for substation, assuming spread foundations are used where they are founded on competent material. This is estimated as 63,000m^3 of compacted material which is equivalent to 82,000m^3 of un-compacted material allowing for bulking during transportation. The potential impact is considered to have negligible to slight negative short-term effect on the surface water environment.

8.4.3.6.2 <u>Substation Option B</u>

Similar to substation A, preliminary volume calculations provide a rough estimation of fill required for the foundation of substation B assuming spread foundations are used where they are founded on competent material. The founding layer is anticipated to be slightly shallower at this location. This is estimated as 25,000 m^3 of compacted material which is equivalent to 32,500m^3 of un-compacted material allowing for bulking during transportation. The potential impact is considered to have negligible to slight negative short-term effect on the surface water environment.

8.4.4 Potential Effects - Operation

8.4.4.1 Do Nothing Effects

If the wind farm development does not proceed, the proposed development site will remain as a peat production site. In areas where agriculture and forestry are adjacent or within the site, normal agricultural and forestry will continue to occur into the future. There are no significant impacts to the hydrological and hydrogeological environment in a do nothing scenario.

8.4.4.2 Turbines, Hardstanding, Temporary Construction Compounds, Met Masts, Roads

As the site is current a peat extraction site, the installation of permanent infrastructure could result in a slight decrease in runoff during the operational phase of the wind farm. The proposed development represents 2.7% of the three peatland areas.

The presence of hardstanding areas and the additional water control measures is likely to have a slight long-term beneficial impact in the water quality in particular ammonium and suspended solids.

It is estimated that 2.7% (51.8 hectares) in total of the existing bog will be developed for the proposed wind farm infrastructure. The principal behind sustainable drainage devices is to reduce the quantity of discharge from developments to predevelopment flows and to improve the quality of run-off from proposed developments. The sustainable drainage devices will mimic existing greenfield runoff in terms of volume, rate of runoff and quality of the runoff. In this case, it is proposed to decrease the quantity of run-off to Greenfield rates by providing surface water attenuation lagoons. Attenuation lagoon details shown on Drawing No. 10325-2006 to 13025-2013.

With regard to water quality impacts, there will be no direct discharges to the surface water environment during the operational phase. Due to the nature of the development there will be vehicles periodically on the site at any given time. The potential impacts are limited by the size of the fuel tank of the vehicles using on the site. As a result, occasional/accidental emissions, in the form of oil, petrol or diesel leaks, which could cause slight/negligible temporary and localised contamination of site drainage channels.

8.4.4.3 Substation Options

The potential operational effects of either Option A or B are effectively the same. The operation of the proposed Substation (Option A or B) will require infrequent inspection and maintenance visits. Elements of the electrical plant at the substation site (primarily transformers) may contain oil for insulation purposes. The released hydrocarbons would have the potential to percolate to contaminate the surface water runoff and the surface water body into which the run-off discharges. The pre-mitigation impact is considered slight negative.

The presence of occasional maintenance workers at the proposed substation will lead to the generation of foul sewage from toilets and washing facilities. This foul sewage will be collected and tankered off-site for disposal at a licensed waste water treatment facility. The potential for impact is slight to negligible and short-term.

8.4.5 Magnitude and Significance of Impact –Construction and Operation

The magnitude of an impact includes the timing, scale, size and duration of the potential impact (pre-mitigation). The magnitude criteria for hydrology/hydrogeology are defined as set out in Table 8.9 and 8.10 below.

Table 8.9: Magnitude and Significance of Hydrological Criteria – Construction Phase (Pre-mitigation)

Criteria	Description	Duration and Frequency of Effects	Significance of potential effect
Run-off regime	Potential Increase in surface runoff may be caused by impermeable areas on site may give rise to a slight increase in surface water flow locally but is expected to have a negligible impact on the volumetric flow rate of downstream rivers.	Short term and rarely	Slight negative / Slight beneficial
Surface Water Quality	No significant loss in water quality is expected.	Short term and occasional	Slight negative
Groundwater Levels	No significant change in groundwater is expected. Slight localised drawdown predicted at the borrow pit locations. No ZOCs or wells within 250m of borrow pits or turbines.	Temporary and occasional	Negligible
Groundwater Quality	No change in groundwater quality is expected	Not applicable	Negligible

Table 8.10: Magnitude and Significance of Hydrological Criteria – Operational Phase (Pre -mitigation)

Criteria	Description	Duration and Frequency of Effects	Significance of potential effect
Run-off regime	Increased surface runoff caused by impermeable areas on site may give rise to a slight increase in surface water flow locally but is expected to have a slight potential effect on the volumetric flow rate of downstream rivers.	Long term and rarely	Slight beneficial /slight negative
Surface Water Quality	No significant loss in water quality is expected. A slight beneficial impact could occur as a result of reduced runoff from peatlands.	Long term and rarely	Slight beneficial to negligible
Groundwater Levels	No significant change in groundwater is expected.	Not applicable	Negligible
Groundwater Quality	No change in groundwater quality is expected. No ZOCs or wells within 250m of turbines. Rare potential fuel spills may occur within the proposed development.	Short-term and rarely	Negligible

Potential impacts are of slight/negligible significance.

8.4.6 Major Accidents /Disasters

As part of the requirements of the new EIA Directive, the applicant is requested to consider the "Expected Significant Adverse Effects of the project on the environment deriving from the vulnerability of the project to risks of major accidents and/or disasters which are relevant to the project concerned."

It is clear from the directive that a major accident and/or natural disaster assessment should be mainly applied to COMAH sites or nuclear installations. The propose project is not a COMAH or nuclear installation, however the assessment is included for completeness. The starting point for the scope and methodology of this assessment is that the Proposed Development will be designed, built and operated in line with best international current practice and the type of project, as such, major accidents will be extremely unlikely. The management of any potential environmental accidents will be managed through the adoption of site best practises in the CEMP. A flood risk assessment was undertaken to determine whether the site is at risk from extreme fluvial flooding events. This report is discussed in Section 8.3 and concluded that the site is not at risk from extreme flooding. The potential for a significant spillage of hydrocarbons is limited on site. The risk of a serious spillage occurring on site is negligible. Notwithstanding the negligible risk of serious spillage, additional spillage protection measures are included in the Proposed Development. During a spillage event, the spill will be collected by the drainage network and managed within the site boundary where it can be safely removed and treated/disposed. Section 8.5 outlined mitigation measures in relation to potential contaminants.

It can be concluded that the risk of accidents associated with this development is very low and would not cause unusual, significant or adverse effects on human health or the environment during the construction or operational phase.

8.4.7 Cumulative Effects

Information on the relevant projects within the vicinity of the proposed development was assessed. The information was sourced from a search of the local authorities planning registers, EPA website, planning applications, EIS documents and planning drawings which facilitated the identification of past and future projects, their activities and their potential environmental impacts. The projects considered in relation to the potential for cumulative impacts and for which all relevant data was reviewed include those listed below.

Lanesborough Power station -EPA Licence P0610-03

In December 2017 planning permission (Planning ref. 17/320) was sought to extend the capacity of the Derraghan Ash Disposal Facility. Planning permission was granted for this increase by Longford County Council on 28th March 2018. ESB applied to the EPA on 28th May 2018 for a review of IE Licence P0610-02. The Environmental Impact Assessment Report (EIAR) and the Appropriate Assessment (AA) Screening which accompanied the planning application was also submitted to the EPA with the application for the IE review. The power station is located in Lanesborough town, 2km to the west of the proposed wind farm. The ash facility is located 1.5km to the south west of Lough Bannow Bog in a separate surface water catchment to the proposed development.

Mountdillon EPA Licence P0504-01

The proposed wind farm is located within an operating peat extraction site. An extensive network of drainage channels is present throughout the peatland which is currently operated under IPC licence P0504-01 Mountdillon bog group. Peat harvesting has reduced in the last 10 years with milled peat production projected to cease in the coming years. Bord na Móna has published two documents. The *Strategic Framework for the Future Use of Peatlands* published in 2011, which outlines the future potential of the company's land holding including factors affecting potential reuse opportunities. The second document, entitled *Biodiversity Action Plan 2016-2021,* addresses peatland biodiversity management, restoration and conservation. Rehabilitation of industrial cutover peatlands is a key objective of the Bord na Móna *Biodiversity Action Plan 2016-2021*. The drainage regime proposed at the site is designed in such a manner as to be integrated into the final rehabilitation plan for the site. In 2013, Bord na Móna submitted draft rehabilitation plans for each of the Bord na Móna bogs, as per IPC Licence Condition 10 requirements. The plans were further updated in 2015, following rehabilitation trails. The main elements required for rehabilitation post peat production are stabilisation of former bare peat areas largely attained through natural processes of revegetation which may require enhancement by targeted management such as fertiliser/ seeding; surface manipulation and/ or hydrological management (drain/ outfall blocking). Following peat production these rehabilitation measures will be put in place at the site as required. The likely outcome of these rehabilitation practises is that the site will become of greater value to protected species, including the qualifying interest of local designated sites, e.g. breeding waders and otters. It is proposed by Bord na Móna to incorporate the proposed development into the rehabilitation plan, therefore it will not impede it.

Middleton House Solar Farm (Longford Co. Co. Planning Ref 18/35)

Planning permission Longford County Council register reference 18/35 – a grant of planning permission issued to Harmony Solar on 15/08/2018 for a ten year permission for a solar farm on a site of approximately 51.38 hectares consisting of the following: up to 216,000 m^2 of solar photo-voltaic panels on ground mounted steel frames to generate between 35MW to 50MW of electrical energy; substation and control room and associated hard standing; 14 no. inverter/transformer stations; underground power and communication cables & ducts; boundary security fence; CCTV cameras; upgraded internal access tracks; new internal access tracks and associated drainage infrastructure; provision of passing areas on lands adjacent to the L-11261 local road; access will be via the L-11261 local road through the upgrade of an existing agricultural entrance and at the existing entrance to Middleton House; and temporary construction compounds and all associated site services & works at the townlands of Middleton, Ballycore, Treanboy and Newtown, near the village of Killashee, Co. Longford. Planning permission was awarded on the 15/08/18. The proposed development area drains toward the Ballynakill stream.

Fisherstown Solar farm (Longford Co. Co. Planning Ref. 18/146)

Planning permission Longford County Council register reference 18/146 – a grant of planning for development on the 26/08/18 at a site comprising lands within the property of the former Atlantic Mills factory. The development will comprise the construction of a solar farm with an export capacity of approximately 4MW comprising photovoltaic panels on ground mounted frames, with associated infrastructure including a switch gear control room (to be developed at 1 of 2 location options on site. No additional works proposed to the existing substation on site as part of this application), ducting and electrical cabling, internal access roads, fencing and all associated site development works at Fisherstown, Clondra, Co. Longford. Planning permission was awarded on the 24/08/18. The proposed solar farm development is located within the River Shannon catchment, >5 km upgradient of the proposed wind farm.

8.4.7.1 Plans and Policies Considered as part of the Cumulative Assessment

The following key plans and policies were identified as having the potential to act in-combination with the proposed development to affect the relevant European Sites, as per Table 3.3.

- Longford County Development Plan 2015 – 2021;
- River Basin Management Plan 2018 – 2021 (released in April 2018); and
- In 2013, Bord na Móna submitted draft rehabilitation plans for each of the Bord na Móna bogs, as per IPC Licence Condition 10 requirements. The plans were further updated in 2015, following rehabilitation trails.

8.4.7.2 Cumulative Impact Assessment

Cumulative effects can be defined as the additional changes caused by a proposed development in conjunction with other similar developments[124].It is similarly defined in the EIAR 2017 EPA guidance as '*The addition of many minor or significant effects, including the effects of other projects, to create larger, more significant effects*.' There are no existing or permitted wind farms in Co. Longford.

In relation to the Middleton House and Fisherstown Solar Farm the planning permission granted to these two sites include the requirement for protective measures and arising from the separation distances (i.e. 1.5km and 5.9km respectively) between the developments cumulative effects are considered unlikely.

The discharges from the Bord na Móna bogs are and have been regulated and controlled by the EPA under the IPC Licensing process. The IPC Licence has been examined and revised by the EPA, as required, in line with the objectives of the WFD.

It is considered that there will be a slight/negligible potential impact on the water environment as a result of Derryadd wind farm development during the construction and operational phase. It is considered that there is no potential for significant impacts to result from the proposed development cumulatively with other planned developments. Further details on the potential cumulative impacts on water quality and the potential hydrological connectivity of the proposed development area with local ecological features (post mitigation) are addressed in Chapter 6 of this volume of the EIAR.

[124] SNH (2012) Assessing the cumulative impacts of onshore wind energy developments.

8.4.8 Decommissioning

Decommissioning of the Proposed Development would result in the cessation of renewable energy generation and the removal of infrastructural elements. These impacts have therefore been assessed as similar to the construction phase and mitigation measures for the construction phase should also be implemented during decommissioning.

Concerning the hydrological impacts, there is the potential for impact on a number of the receptors as a result of removal of the infrastructure. Changes to the internal drainage could lead to localised erosion and therefore changes in the morphological processes. This would be likely to have a low magnitude of impact for the low sensitivity watercourses, resulting in a slight and short-term effect.

8.5 MITIGATION MEASURES

As outlined in Chapter 2, Description of the Proposed Development, the design of the proposed development has considered a range of best practice construction measures which ensure avoidance of impacts throughout the construction and operational phases. Additional measures have been developed to mitigate the impacts identified in the preceding section.

8.5.1 Mitigation by Avoidance

In identifying and avoiding sensitive surface waters the proposed development has implemented 'avoidance of impact' measures. Mitigation by avoidance is viewed as part of the 'Reasonable Alternatives' outlined in Chapter 3. Examples include locating fuel storage and construction compounds >50 m upgradient of surface water streams.

A section of commercial forestry was avoided in Lough Bannow as part of the mitigation by avoidance. Forestry felling activities have the potential to cause temporary and local damage to soils and may impact on water quality, through increased erosion rates, sedimentation and nutrient losses. Furthermore, the wind farm design complied with Policy WD4 in the Longford County Development Plan 2015 – 2021, that stipulates that wind farm developments should not be located within 150m of lakes and rivers.

8.5.2 Mitigation by Prevention and Reduction

A number of mitigation measures are outlined below and are considered as in-built to the design of the project. These mitigation measures are a combination of measures to comply with legislation and best practice construction methods to be implemented in order to prevent water (surface and groundwater) pollution. Examples of these measures are the storage of potentially polluting materials in fully bunded tanks and controlling / reducing runoff from hardstand areas.

8.5.3 Mitigation Measures - Construction Phase

In order to mitigate potential impacts during the construction phase, best practice construction methods will be implemented in order to prevent water (surface and groundwater) pollution. A Construction Environmental Management Plan (CEMP) was developed for the project to ensure adequate protection of the water environment. All personnel working on the project will be responsible for the environmental control of their work and will perform their duties in accordance with the requirements and procedures of the CEMP.

During the construction phase, all works associated with the construction of the wind farm will be undertaken with due regard to the guidance contained within CIRIA Document C741 '*Environmental Good Practice on Site' (CIRIA, 2015)*.

All mitigation and management measures outlined hereunder will be incorporated into the Surface Water Management Plan, (Appendix 8.4). Mitigation measures are incorporated into the CEMP and will be incorporated into the specification for the Civil Engineering Works contract. The implementation of the Surface Water Management Plan will be overseen by the appointed Site Ecologist and the Project Manager and will be regularly audited throughout the construction phase. The Project Manager will be required to stop works on site, if he/she is of the opinion that a mitigation measure or corrective action is not being appropriately or effectively implemented.

8.5.3.1 Turbines, Hardstanding, Temporary Construction Compounds, Met Masts, Roads

As stated previously, to maximise the erosion and sediment control benefits of natural vegetation soil cover, stripping of peat is to be kept to a minimum and confined to construction areas only. Where practical, construction works will be staged to minimise the extent and duration of disturbance, e.g. plan for progressive site clearance, only disturbing areas when they are scheduled for current construction work.

To minimise any impact on the underlying subsurface strata from material spillages, all oils and solvents used during construction will be stored within specially constructed dedicated bunded areas. Refuelling of construction vehicles and the addition of hydraulic oils or lubricants to vehicles will take place in a designated area of the site, away from surface water gullies or drains. Spill kits and hydrocarbon absorbent packs will be stored in this area and operators will be fully trained in the use of this equipment.

All construction waste will be sorted and stored in on-site skips, prior to removal by a licensed waste management contractor.

Concrete

Concrete is required for the construction of the turbine bases and foundations. After concrete is poured at a construction site, the chutes of ready mixed concrete trucks must be washed out to remove the remaining concrete before it hardens. Wash out of the main concrete bottle will not be permitted on site; wash out is restricted only to chute wash out. Wash down and washout of the concrete transporting vehicles will take place at an appropriate facility offsite i.e. at the premises of the concrete supplier.

The best management practice objectives for concrete chute washout are to collect and retain all the concrete washout water and solids in leak proof containers or impermeable lined wash out pits, so that the wash material does not reach the soil surface and then migrate to surface waters or into the ground water. The collected concrete washout water and solids will be emptied on a regular basis.


Photo 1 and 2 Example Photos of Concrete Washout On Site

Fuels and Chemicals

With regard to on-site storage and handling of potentially pollutant materials:

- Fuels and chemicals will be stored within bunded areas as appropriate to guard against potential accidental spills or leakages. The bund area will have a volume of at least 110 % of the volume of such materials stored;
- All on-site refuelling will be carried out by a trained competent operative.
- Mobile measures such as drip trays and fuel absorbent mats will be used during all refuelling operations;

- No refuelling will take place within 50 m of any watercourse;
- All equipment and machinery will have regular checking for leakages and quality of performance and will carry spill kits;
- Any servicing of vehicles will be confined to designated and suitably protected areas such as construction compounds;
- Additional drip trays and spill kits will be kept available on site, to ensure that any spills from vehicles are contained and removed off site.

Erosion and Sediment Control

As outlined above, if not correctly managed, earthworks can lead to loss of suspended solids to surface waters. The main factors influencing the rate of soil loss and subsequent sediment release include:

- Climate;
- Length and steepness of slopes;
- Soil erosion potential;
- Soil Vegetation/cover;
- Duration and extent of works; and
- Erosion and sediment control measures

Runoff will be maintained at greenfield runoff rates. The layout of the development has been designed to collect surface water runoff from hardstanding areas within the development and discharge to associated surface water attenuation lagoons adjacent to the proposed infrastructure. It will then make its way into the existing field drains and existing settlement ponds infrastructure before being discharged through existing discharge points by pump or gravity flow. From here the water will outfall at the appropriate Greenfield run off rates.

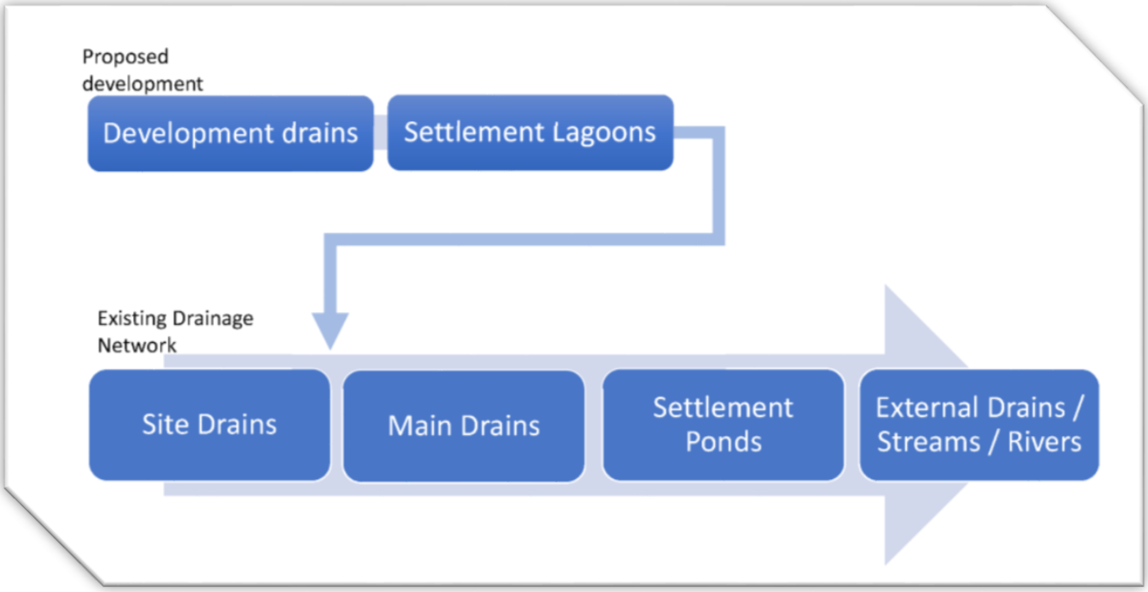

Figure 8.9: Proposed and existing drainage layout

It is proposed, that during the ground clearance of the proposed development, water control measures will be implemented by the contractor to limit the volume of water that requires treatment. The contract documents and works requirements will specify the necessity for the contractor to take all precautions needed to prevent sedimentation of water channels. Contractors will be required to specify temporary sediment control measures (i.e. grit traps or similar) to be employed along with water attenuation during construction.

Erosion and sediment control measures include:

- Minimisation of soil exposure, by controlling, in so far as is practical, where and when peat is stripped;
- During the side casting of peat, silt fences, straw bales and/or biodegradable geogrids will be used to control surface water runoff from the storage areas, if required; and
- All surface water run-off from the development will pass through settlement ponds. It is proposed to locate settlement ponds immediately downstream of the proposed infrastructure including each hardstand and along all site access tracks.

The settlement pond design is based on primary settling out of suspended solids from aqueous suspension. The theory behind the design of the settlement lagoons is the application of Stoke's Law. The settlement lagoons have been designed to provide sufficient retention time and a low velocity environment to allow suspended solids of a very small particle size to fall out of suspension prior to allowing the water to outfall to the receiving environment.

Settlement ponds will be located appropriately where required, in line with and will be installed concurrently with the formation of the road. Settlement ponds will be located as close to the source of sediment as possible and as far as possible from the buffer zones of existing watercourses. The minimum buffer zone width will be 15m as outlined above.

Settlement ponds will be regularly cleaned/maintained to provide effective and successful operation throughout the works. Outfalls and ditches will be cleaned, when required, starting up stream with the outfalls blocked temporarily prior to cleaning.

Sediment/silt removed via the contractor from ponds will be deposited at suitable locations on site, away from watercourses. It is proposed to deposit peat onto the profiled peat adjacent to roadways. Machine access is required to enable the accumulated sediment to be excavated.

- Regular inspection and maintenance of Settlement ponds and drains;
- Settlement pond maintenance and/or cleaning will not take place during periods of extended heavy rain;
- Settlement ponds will be clearly marked for safety;
- Settlement ponds will be constructed on even ground and not on sloping ground and where possible will discharge into vegetation areas to aid dispersion; and
- The settlement ponds will be monitored closely over the construction timeframe to ensure that they are operating effectively.

All stockpiled material will be side cast, battered back and profiled to reduce the rainfall erosion potential. The stockpiling of materials will be carefully supervised as per the mitigation measures listed in Chapter 7, Lands, Soils and Geology.

Traffic on site will be kept to a minimum. No haul roads will be used other than the proposed site tracks. Where haul roads pass close to watercourses, silt fencing will be used to protect the streams.

Temporary Site Compound Construction

During the construction phase, five temporary site compounds will be required. Temporary on-site toilet facilities (chemical toilets) will be used. These will be sealed with no discharge to the surface water or groundwater environment adjacent to the site.

Surface Water Flow and Watercourse crossings

Potential impacts on surface water flow during the construction phase of the wind farm are mitigated by the proposed drainage design which has been designed to minimise disturbance to the current hydrological regime by maintaining diffuse flows.

It is proposed to install culverts anywhere the proposed road layout intersects a stream or main drain. Culverts are to be of a size adequate to carry expected peak flows. Culverts will be installed to conform, wherever possible, to the natural slope and alignment of the stream or drainage line. Where required, culverts will be buried at an appropriate depth below the channel bed and the original bed material placed in the bottom of the culvert. Embedded culverts should be buried to a depth of 0.3m or 20% of their height (whichever is greatest) below the bed.

No instream works shall be carried out without the written approval of Inland Fisheries Ireland (IFI). IFI will be given sufficient notice before pre-approved in-stream works commence. There will be no discharge of suspended solids or any other deleterious matter to watercourses. Water crossings are to be constructed in accordance with the requirements of the Office of Public Works (OPW) Section 50 Consent requirements and in accordance with the CEMP.

Crossing construction will be carried out, in so far as is practical, with minimal disturbance to the stream/drainage bed and banks. If they have to be disturbed, all practicable measures will be taken to prevent soils from entering the watercourse. Cement and raw concrete will not be spilled into watercourses. Where practicable, crossings should be adequately elevated with low approaches such that water drains away from the crossing point. Earth embankments constructed for bridge approaches must be protected against erosion e.g. by re-vegetation or rock surfacing etc.

8.5.3.2 Borrow Pits

The mitigation strategies for the borrow pits follow similar procedures as the excavations for turbine and hardstanding areas. Interceptor cut-off drains around the borrow pits will be provided to divert overland flows and prevent these flows from entering the borrow pits. These flows will discharge diffusely overland, creating a buffer before entering the existing surface water management infrastructure.

8.5.3.3 Substation Options A and B

The mitigation strategies for the substation foundations follow similar procedures as the excavations for turbine and hardstanding foundations, see Section 8.5.1.17.5.2.6. All works will be monitored by suitably qualified and experienced geotechnical engineer or engineering geologist.

8.5.3.4 Major Accidents. Disasters

It can be concluded that the risk of accidents associated with this development is very low and would not cause unusual, significant or adverse effects on human health or the environment during the construction phase. No specific mitigation measures are required.

8.5.4 Mitigation Measures - Operational Phase

The following mitigation measures will be implemented during the operational stage.

8.5.4.1 Turbines, Hardstanding, Temporary Construction Compounds, Met Masts, Roads

Any vehicles utilised during the operational phase will be maintained on a weekly basis and checked daily to ensure any damage or leakages are corrected. The potential impacts are limited by the size of the fuel tank of vehicles used on the site.

8.5.4.2 Borrow Pits

There are no proposed borrow pit mitigation measures required for the operational phase.

8.5.4.3 Substation Options

Within the selected substation, all fuel will be stored in bunded areas. The bund capacity will be sufficient to accommodate 110% of the largest tank's maximum capacity or 25% of the total maximum capacities of all tanks, whichever is the greater. The exception to this being double walled tanks equipped with leak detection, which do not require additional retention.

A hydrocarbon interceptor will be installed at the proposed substation site with regular inspection and maintenance, to ensure optimal performance.

Given the requirement for sanitary facilities during occasional operation and maintenance works, wastewater effluent will be directed to an onsite holding tank, from where it will be tankered off site to a suitably licensed waste water treatment plant.

Based on the above assessment, there are no significant cumulative or in combination effects on the water/groundwater environment. Within the National River Basin Management Plan 2018 – 2021 (released in April 2018), extractive or anthropogenic pressures are not identified as a significant pressure on a catchment scale basis. As is detailed in the River Basin Management Plan 2018 – 2021, Bord na Móna is in the process of phasing out the extraction of peat for energy production by 2030. Bord na Móna expects to stabilise and rehabilitate cutaway bogs and will look to implement best-available mitigation measures to manage water quality while the phasing-out process is taking place Commercial peat extraction has decreased at the three bogs since the 2000's. The surrounding peatlands will continue to be managed in accordance with their relevant EPA IPC Licences.

8.5.4.4 Major Accidents. Disasters

It can be concluded that the risk of accidents associated with this development is very low and would not cause unusual, significant or adverse effects on human health or the environment during the construction phase. No specific mitigation measures are required.

8.5.5 Monitoring

It is recommended that local surface water features in the immediate vicinity of the site boundary are monitored pre-construction and during construction to take account of any variations in the quality of the local surface water and groundwater environment as a result of activities related to the proposed development.

Inspections and maintenance are critical after prolonged or intense rainfall while maintenance will ensure maximum effectiveness of the proposed measures. A programme of inspection and maintenance will be designed and dedicated construction personnel assigned to manage this programme. A checklist of the inspection and maintenance control measures will be developed and records kept of inspections, and maintenance.

Monitoring requirements that are stipulated under the IPC licence for the peatlands will continue to be fulfilled for the lifetime of the licence. During the construction phase, field testing and laboratory analysis of a range of parameters should be undertaken at adjacent watercourses, specifically following heavy rainfall events (i.e. weekly, monthly and event based). The monitoring will be completed at the locations and for the parameters already specified in the IPC Licence. Monitoring proposals are included in the CEMP, attached as Appendix 2.2.

8.6 RESIDUAL IMPACTS

The following conclusions can be drawn in relation to surface water and groundwater:

- The site drains to a number of tributaries surrounding the site boundary, primarily to tributaries of the River Shannon;
- The site is underlain predominantly by low permeability shallow peat, marls, lacustrine/alluvial soils and limestone tills;

- Man-made drains are located throughout the site and will continue to operate as part of the existing water management system on site. The proposed drainage plan will further enhance the water management at this location;
- The site is generally low lying and flat with very low slope gradients and consequently has a low risk due to changes caused by the development on the hydrological regime;
- Water quality in the immediate area of the site is moderate and is consistent with the expected natural water quality for an environment. The water quality reported by the EPA downstream of the site is of poor/moderate status; and
- The site overlies both locally important and regionally important aquifers of Low to High Vulnerability.

The residual impacts on the surrounding water quality, hydrology and existing drainage regime at the site are considered to be negligible and short term in nature. The existing on-site drainage system will remain active during construction and operation of the proposed wind farm and will be enhanced by a proposed drainage plan that has been designed for this development.

The construction timescale of activities within the site will be phased and short-term in duration and, thereafter, the only activities within the site that will be associated with maintaining existing drains, ongoing maintenance and monitoring during the operational phase. There are no significant long-term impacts.

8.6.1 Cumulative Effects

There are no significant cumulative effects as a result of the proposed development in relation to water environment.

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Glossary

Aquifer A subsurface layer of layers of rock or other geological strata of sufficient porosity and permeability to allow either a significant flow of groundwater or the abstraction of significant quantities of groundwater [Water Framework Directive (2000/60/EC)].

Hydraulic conductivity [m/d] is an expression of the rate of flow of a given fluid through unit area and thickness of the medium, under unit differential pressure at a given temperature. In subsoils, intergranular permeability dominates, whilst in rock, fissure permeability (via fractures and bedding discontinuities) dominates in limestone bedrock in Ireland.

Specific Capacity Q/s [m^3/d/m] The rate of discharge of water from the well divided by the resulting drawdown on the water level within the well

Specific yield (%) indicates the amount of water released from an aquifer due to drainage. By definition, it is always less than porosity due to retention of some groundwater by the subsoil/rock.

Transmissivity T [m^2/d] Transmissivity relates to the ability of an aquifer to transmit water through its entire thickness.

9 LANDSCAPE AND VISUAL IMPACT ASSESSMENT

9.1 INTRODUCTION

This chapter describes the landscape context of the proposed Derryadd Wind Farm and assesses the likely landscape and visual effects of the scheme on the receiving environment. Although closely linked, landscape and visual effects are assessed separately.

Landscape Impact Assessment (LIA) relates to assessing effects on the landscape as a resource in its own right and is concerned with how the proposal will affect the elements that make up the landscape, the aesthetic and perceptual aspects of the landscape and its distinctive character.

Visual Impact Assessment (VIA) relates to assessing effects on specific views and on the general visual amenity experienced by people. This deals with how the surroundings of individuals or groups of people may be specifically affected by changes in the content and character of views as a result of the change or loss of existing elements of the landscape and/or introduction of new elements. Visual effects may occur from; Visual Obstruction (blocking of a view, be it full, partial or intermittent) or; Visual Intrusion (interruption of a view without blocking).

Cumulative landscape and visual impact assessment is concerned with additional changes to the landscape or visual amenity caused by the proposed development in conjunction with other developments, or actions that occurred in the past, present or are likely to occur in the foreseeable future.

This landscape and visual impact assessment is based on:

- Landscape Institute and the Institute of Environmental Management and Assessment publication entitled Guidelines for Landscape and Visual Impact Assessment – Third Edition (2013).
- Department of the Environment, Heritage and Local Government Wind Energy Development Guidelines (2006).
- Scottish Natural Heritage (SNH) Assessing the Cumulative Impact of Onshore Wind Energy Developments (2012).

Visualisations and mapping supporting the Landscape and Visual Impact Assessment are prepared in accordance with:

- Scottish Natural Heritage (SNH) Visual representation of wind farms: Best Practice Guidelines (2014).

9.1.1 Statement of Authority

This Landscape and Visual Impact Assessment report was prepared by Richard Barker (MLA, PG Dip Forestry, BA Environmental), Principal Landscape Architect at Macro Works Ltd who is a Corporate Member of the Irish Landscape Institute and has over 20 years of professional experience. Relevant experience includes assessment of over 80 on-shore wind farm proposals throughout Ireland, including five Strategic Infrastructure Development (SID) projects.

9.1.2 Description of the Proposed Development

A full description of the proposed development is provided in Chapter 1 – Introduction and a detailed description of the project elements is provided in Chapter 2 – *Description of the Proposed Development.*

9.1.3 Definition of Study Area

The Wind Energy Development Guidelines published by the Department of the Environment, Heritage and Local Government (2006) specify different radii for examining the Zone of Theoretical Visibility of proposed wind farm projects ("ZTV"). The extent of this study area is influenced by turbine height as follows:

- 15 km radius for blade tips up to 100 m;
- 20 km radius for blade tips greater than 100 m; and
- 25 km in order to incorporate features of national or international renown.

In the case of this project, the blade tips are up to 185m high and, thus, the minimum ZTV radius required is 20 km from the outermost turbines of the scheme. However, several recent wind energy applications within the midlands have utilised a 30km radius study area and the same has been used in this instance for the sake of thoroughness and to reflect current best practice. The same extent of study area will also be used for the consideration of cumulative effects.

9.2 METHODOLOGY

Production of this Landscape and Visual Impact Assessment involved desktop studies and fieldwork comprising professional evaluation by qualified and experienced Landscape Architects.

9.2.1 Desktop Study

The desktop study comprised the following:

- Establishing an appropriate Study Area from which to study the landscape and visual effects of the proposed wind farm;

- Review of a Zone of Theoretical Visibility (ZTV) map, which indicates areas from which the development is potentially visible in relation to terrain within the Study Area;
- Review of relevant County Development Plans, particularly with regard to sensitive landscape and scenic view/route designations;
- Selection of potential Viewshed Reference Points (VRPs) from key visual receptors to be investigated during fieldwork for actual visibility and sensitivity;
- Preparation of an initial VRP selection map for consultation purposes (Planning Authority).

9.2.2 Fieldwork

Site visits were carried out at various times from 2016 to 2018 in order to:

- Select a refined set of VRP's for assessment.
- Record a description of the landscape elements and characteristics within the Study Area generally and also within view from each VRP.
- Capture high quality base photography from which to prepare photomontages of the proposal.

9.2.3 Assessment

The assessment of landscape and visual effects involves a description of the geographic location and landscape context of the proposed wind farm site as well as a general landscape description concerning essential landscape character and salient features of the wider Study Area. This is discussed with respect to; landform and drainage; vegetation and land use; centres of population and houses; transport routes and; public amenities and facilities. Consideration of design guidance, the planning policy context and relevant landscape designations are also considered.

Once the baseline environment was established an assessment of the likely potential significant effects associated with the proposed development was carried out. This included the following: Appraisal of salient landscape character.

- Appraisal of predicted landscape effects.
- Appraisal of predicted visual effects using standard ZTV maps as well as photomontages prepared from selected VRP locations.
- Appraisal of predicted cumulative effects using cumulative ZTV maps and cumulative photomontages.
- Discussion of mitigation measures.
- Assessment of residual effects following mitigation.

9.2.4 *Assessment Criteria for Landscape Effects*

When assessing the potential effects on the landscape resulting from a wind farm development, the following criteria are considered:

- Landscape character, value and sensitivity;
- Magnitude of likely effects; and
- Significance of landscape effects

The sensitivity of the landscape to change is the degree to which a particular landscape receptor (Landscape Character Area (LCA) or feature) can accommodate changes or new features without unacceptable detrimental effects to its essential characteristics. Landscape Value and Sensitivity is classified using the following criteria;

Table 9.1: Landscape Value and Sensitivity

Sensitivity	Description
Very High	Areas where the landscape character exhibits a very low capacity for change in the form of development. Examples of which are high value landscapes, protected at an international or national level (World Heritage Site/National Park), where the principal management objectives are likely to be protection of the existing character.
High	Areas where the landscape character exhibits a low capacity for change in the form of development. Examples of which are high value landscapes, protected at a national or regional level (Area of Outstanding Natural Beauty), where the principal management objectives are likely to be considered conservation of the existing character.
Medium	Areas where the landscape character exhibits some capacity and scope for development. Examples of which are landscapes which have a designation of protection at a county level or at non-designated local level where there is evidence of local value and use.
Low	Areas where the landscape character exhibits a higher capacity for change from development. Typically, this would include lower value, non-designated landscapes that may also have some elements or features of recognisable quality, where landscape management objectives include, enhancement, repair and restoration.
Negligible	Areas of landscape character that include derelict, mining, industrial land or are part of the urban fringe where there would be a reasonable capacity to embrace change or the capacity to include the development proposals. Management objectives in such areas could be focused on change, creation of landscape improvements and/or restoration to realise a higher landscape value.

The magnitude of a predicted landscape effect is a product of the scale, extent or degree of change that is likely to be experienced as a result of the proposed development. The magnitude takes into account whether there is a direct physical effect resulting from the loss of landscape components and/or a change that extends beyond the proposal site boundary that may have an effect on the landscape character of the area.

Table 9.2: Magnitude of Landscape Effects

Magnitude of Effect	Description
Very High	Change that would be large in extent and scale with the loss of critically important landscape elements and features, that may also involve the introduction of new uncharacteristic elements or features that contribute to an overall change of the landscape in terms of character, value and quality.
High	Change that would be more limited in extent and scale with the loss of important landscape elements and features, that may also involve the introduction of new uncharacteristic elements or features that contribute to an overall change of the landscape in terms of character, value and quality.
Medium	Changes that are modest in extent and scale involving the loss of landscape characteristics or elements that may also involve the introduction of new uncharacteristic elements or features that would lead to changes in landscape character, and quality.
Low	Changes affecting small areas of landscape character and quality, together with the loss of some less characteristic landscape elements or the addition of new features or elements.
Negligible	Changes affecting small or very restricted areas of landscape character. This may include the limited loss of some elements or the addition of some new features or elements that are characteristic of the existing landscape or are hardly perceivable.

The significance of a landscape effect is based on a balance between the sensitivity of the landscape receptor and the magnitude of the effect. The significance of landscape effects is arrived at using the following matrix:

Table 9.3: Landscape / Visual Effect Significance Matrix

	Sensitivity of Receptor				
Scale/Magnitude	Very High	High	Medium	Low	Negligible
Very High	Profound	Profound-substantial	Substantial	Moderate	Slight
High	Profound-substantial	Substantial	Substantial - moderate	Moderate-slight	Slight-imperceptible
Medium	Substantial	Substantial - moderate	Moderate	Slight	Imperceptible
Low	Moderate	Moderate-slight	Slight	Slight-imperceptible	Imperceptible
Negligible	Slight	Slight-imperceptible	Imperceptible	Imperceptible	Imperceptible

*In accordance with section 3.34 of the Guidelines for Landscape and Visual Impact Assessment[125], the shaded cells are considered to equate with 'significant' effects in EIA terms.

Note that potential beneficial landscape effects are not accounted for in the tables and matrix above. This is on the basis that commercial scale wind energy projects are very unlikely to generate beneficial landscape effects. In the rare instances that this might occur, perhaps by facilitating the rehabilitation of a degraded landscape, the benefits will be discussed in the assessment and the significance of effect would default to the lowest end of the range (Imperceptible).

9.2.5 Assessment Criteria for Visual Effects

As with the landscape effect, the visual effect of the proposed wind farm will be assessed as a function of receptor sensitivity versus magnitude of effect. In this instance, the sensitivity of visual receptors, weighed against the magnitude of visual effects.

9.2.5.1 Visual Sensitivity

Unlike landscape sensitivity, visual sensitivity is population based. Visual sensitivity is a two-sided analysis of receptor susceptibility (people or groups of people) versus the value of the view on offer at a particular location.

[125] Landscape Institute and Institute of Environmental Management & Assessment (2013). Guidelines for Landscape and Visual Impact Assessment (GLVIA). 3rd Edition. Routledge.

9.2.5.2 Susceptibility of Receptors

In accordance with the Guidelines for Landscape and Visual Impact Assessment (2013)[126], visual receptors most susceptible to changes in views and visual amenity are:

- Residents at home;
- People, whether residents or visitors, who are engaged in outdoor recreation, including use of public rights of way, whose attention or interest is likely to be focussed on the landscape and on particular views;
- Visitors to heritage assets, or to other attractions, where views of the surroundings are an important contributor to the experience;
- Communities where views contribute to the landscape setting enjoyed by residents in the area; and
- Travellers on road, rail or other transport routes where such travel involves recognised scenic routes and awareness of views is likely to be heightened.

Visual receptors that are less susceptible to changes in views and visual amenity include:

- People engaged in outdoor sport or recreation which does not involve or depend upon appreciation of views of the landscape; and
- People at their place of work whose attention may be focussed on their work or activity, not their surroundings, and where the setting is not important to the quality of working life.

9.2.5.3 Value of Views

To assess the amenity value of views, Macro Works use a range of criteria that might typically be related to high amenity value including, but not limited to, scenic designations. These are set out below:

- **Recognised scenic value of the view** (County Development Plan designations, guidebooks, touring maps, postcards etc). These represent a consensus in terms of which scenic views and routes within an area are strongly valued by the population because in the case of County Development Plans, at least, a public consultation process is required;

- **Views from within highly sensitive landscape areas**. Again, highly sensitive landscape designations are usually part of a county's Landscape Character Assessment, which is then incorporated with the County Development Plan, and is therefore subject to the public

[126] Landscape Institute and Institute of Environmental Management & Assessment (2013). Guidelines for Landscape and Visual Impact Assessment (GLVIA). 3rd Edition. Routledge.

consultation process. Viewers within such areas are likely to be highly attuned to the landscape around them;

- **Intensity of use, popularity**. Whilst not reflective of the amenity value of a view, this criterion relates to the number of viewers likely to experience a view on a regular basis and whether this is significant at county or regional scale;

- **Provision of elevated panoramic views**. This relates to the extent of the view on offer and the tendency for receptors to become more attuned to the surrounding landscape at locations that afford broad vistas.

- **Sense of remoteness and/or tranquillity**. Remote and tranquil viewing locations are more likely to heighten the amenity value of a view and have a lower intensity of development in comparison to dynamic viewing locations such as a busy street scene, for example;

- **Degree of perceived naturalness**. Where a view is valued for the sense of naturalness of the surrounding landscape, it is likely to be highly sensitive to visual intrusion by obvious human interventions;

- **Presence of striking or noteworthy features**. A view might be strongly valued because it contains a distinctive and memorable landscape feature such as a promontory headland, lough or castle;

- **Historical, cultural or spiritual value**. Such attributes may be evident or sensed at certain viewing locations that attract visitors for the purposes of contemplation or reflection heightening the sense of their surroundings;

- **Rarity or uniqueness of the view**. This might include the noteworthy representativeness of a certain landscape type and considers whether other similar views might be afforded in the local or the national context;

- **Integrity of the landscape character in view**. This criterion considers the condition and intactness of the landscape in view and whether the landscape pattern is a regular one of few strongly related components or an irregular one containing a variety of disparate components;

- **Sense of place**. This criterion considers whether there is special sense of wholeness and harmony at the viewing location; and

- **Sense of awe**. This criterion considers whether the view inspires an overwhelming sense of scale or the power of nature.

Those locations where highly susceptible receptors or receptor groups are present and which are deemed to satisfy many of the view value criteria above are likely to be judged to have a high visual sensitivity and vice versa.

9.2.5.4 Visual Effect Magnitude

The magnitude of visual effects is determined on the basis of two factors: the visual presence of the proposal and its effect on visual amenity.

Visual presence is a somewhat quantitative measure relating to how noticeable or visually dominant the proposal is within a particular view. This is based on a number of aspects beyond simply scale in relation to distance. Some of these include the extent of the view as well as its complexity and the degree of existing contextual movement experienced, such as might be obtained where turbines are viewed as part of / beyond a busy street scene. The backdrop against which the development is presented and its relationship with other focal points or prominent features within the view is also considered. Visual presence is essentially a measure of the relative visual dominance of the proposal within the available vista and is often expressed as such i.e. minimal, sub-dominant, co-dominant, dominant and highly dominant.

For wind energy developments, a strong visual presence is not necessarily synonymous with adverse effect. Instead, the 2012 Fáilte Ireland survey entitled ‘Visitor Attitudes On The Environment – Wind Farms’ found that *“Compared with other types of development in the Irish landscape, wind farms elicited a positive response when compared to telecommunication masts and steel electricity pylons”*…. and that *“most* (tourists) *felt that their presence did not detract from the quality of their sightseeing, with the largest proportion (45%) saying that the presence of the wind farm had a positive impact on their enjoyment of sightseeing…*”. Furthermore, a clear and comprehensive view of a wind farm might be preferable in many instances to a partial or cluttered view of turbine components that are not so prominent within a view. On the basis of these reasons, the visual amenity aspect of assessing effect magnitude is qualitative and considers such factors as the spatial arrangement of turbines both within the scheme and in relation to surrounding terrain and land cover. It also examines whether the development contributes positively to the existing qualities of the vista or results in distracting visual effects and disharmony.

It should be noted that as a result of this two-sided analysis, a high order visual presence can be moderated by a low level of effect on visual amenity and vice versa. Given that wind turbines do not represent significant bulk, visual effects result almost entirely from visual 'intrusion' rather than visual 'obstruction' (the blocking of a view). The magnitude of visual effects is classified in the following table:

Table 9.4: Magnitude of Visual Effect

Criteria	Description
Very High	The proposal intrudes into a large proportion or critical part of the available vista and is without question the most noticeable element. A high degree of visual disorder or disharmony is also generated, strongly reducing the visual amenity of the scene
High	The proposal intrudes into a significant proportion or important part of the available vista and is one of the most noticeable elements. A considerable degree of visual disorder or disharmony is also likely to be generated, appreciably reducing the visual amenity of the scene
Medium	The proposal represents a moderate intrusion into the available vista, is a readily noticeable element and/or it may generate a degree of visual disorder or disharmony, thereby reducing the visual amenity of the scene. Alternatively, it may represent a balance of higher and lower order estimates in relation to visual presence and visual amenity
Low	The proposal intrudes to a minor extent into the available vista and may not be noticed by a casual observer and/or the proposal would not have a marked effect on the visual amenity of the scene
Negligible	The proposal would be barely discernible within the available vista and/or it would not detract from, and may even enhance, the visual amenity of the scene

9.2.5.5 Visual Effect Significance

As stated above, the significance of visual effects is a function of visual receptor sensitivity and visual effect magnitude. This relationship is expressed in the same significance matrix as for Landscape Effects provided at Table 9.4 above.

9.2.6 Assessment Criteria for Cumulative Effects

The Scottish Natural Heritage (SNH) Guidelines 'Assessing the Cumulative Impact of Onshore Wind Energy Developments' (2012) identify that cumulative effects on visual amenity relate to 'combined' or 'sequential' visibility. The same categories have also been subsequently adopted in the Landscape Institute's 2013 revision of the Landscape and Visual Impact Assessment Guidelines.

Combined visibility occurs where the observer is able to see two or more developments from one viewpoint. Combined visibility may either be in combination (where several wind farms are within the observer's arc of vision at the same time) or in succession (where the observer has to turn to see the various wind farms).

Sequential effects occur when the observer has to move to another viewpoint to see different developments. The occurrence of sequential effects may range from frequently sequential (the features appear regularly and with short time lapses between, depending on speed of travel and distance between the viewpoints) to occasionally sequential (long time lapses between appearances, because the observer is moving very slowly and / or there are large distances between the viewpoints.)'

Cumulative effects of wind farms tend to be adverse rather than positive as they relate to the addition of moving manmade structures into a landscape and viewing context that already contains such development. Based on guidance contained within the SNH Guidelines relating to the Cumulative Effects of Wind Farms (2012) and the DoEHLG Wind Energy Guidelines (2006), cumulative effects can be experienced in a variety of ways. In terms of landscape character, additional wind energy developments might contribute to an increasing sense of proliferation. A new wind farm might also contribute to a sense of being surrounded by turbines with little relief from the view of them. The term 'skylining' is used in the SNH Guidelines to describe the effect *"where an existing windfarm is already prominent on a skyline the introduction of additional structures along the horizon may result in development that is proportionally dominant. The proportion of developed to non-developed skyline is therefore an important landscape consideration".*

In terms of visual amenity, there is a range of ways in which an additional wind farm might generate visual conflict and disharmony in relation to other wind energy developments. Some of the most common include visual tension caused by disparate extent, scale or layout of neighbouring developments. A sense of visual ambivalence might also be caused by adjacent developments traversing different landscape types. Turbines from a proposed wind farm that are seen stacked in perspective against the turbines of nearer or further developments tend to cause visual clutter and confusion. Such effects are exacerbated when, for example, the more distant turbines are larger than the nearer ones and the sense of distance is distorted. Table 9.5 below provides criteria for assessing the magnitude of cumulative effects.

Table 9.5: Magnitude of Cumulative Effect Criteria

Magnitude of Effect	Description
Very High	• The proposed wind farm will strongly contribute to wind energy development being the defining element of the surrounding landscape. • It will strongly contribute to a sense of wind farm proliferation and being surrounded by wind energy development. • Strongly adverse visual effects will be generated by the proposed turbines in relation to other turbines.
High	• The proposed wind farm will contribute significantly to wind energy development being a defining element of the surrounding landscape. • It will significantly contribute to a sense of wind farm proliferation and being surrounded by wind energy development. • Significant adverse visual effects will be generated by the proposed turbines in relation to other turbines.
Medium	• The proposed wind farm will contribute to wind energy development being a characteristic element of the surrounding landscape. • It will contribute to a sense of wind farm accumulation and dissemination within the surrounding landscape. • Adverse visual effects might be generated by the proposed turbines in relation to other turbines.
Low	• The proposed wind farm will be one of only a few wind farms in the surrounding area and will be viewed in isolation from most receptors or perceived as an extension to another development. • It might contribute to wind farm development becoming a familiar feature within the surrounding landscape. • The design characteristics of the proposed wind farm accord with other schemes within the surrounding landscape and adverse visual effects are not likely to occur in relation to these.
Negligible	• The proposed wind farm will most often be viewed in isolation or occasionally in conjunction with other distant wind energy developments.

	• Wind energy development will remain an uncommon landscape feature in the surrounding landscape. • No adverse visual effects will be generated by the proposed turbines in relation to other turbines.

9.3 EXISTING ENVIRONMENT

9.3.1 Landscape Baseline

The landscape baseline represents the existing landscape context and is the scenario against which any changes to the landscape brought about by the proposal will be assessed. This also includes reference to any relevant landscape character appraisals and the current landscape policy context (both are generally contained within County Development Plans).

A description of the landscape context of the proposed wind farm site and wider study area is provided below under the headings of landform and drainage, vegetation and land use, centres of population, transport routes and public amenities and facilities as well as the immediate site context. Additional descriptions of the landscape, as viewed from each of the selected viewpoints, are provided under the detailed assessments later using a similar structure. Although this description forms part of the landscape baseline, many of the landscape elements identified also relate to visual receptors i.e. places and transport routes from which viewers can potentially see the proposed development. The visual resource will be described in greater detail in Section 9.2.2 below.

9.3.1.1 Landform and Drainage

The proposed wind farm site is contained on cutaway peatland across a series of almost contiguous bogs, which stretch around 12km in an elongated band in a northwest – southeast orientation. Thus, the site and central study area is a vast flat plain with few notable watercourses. To the east of the site, the Royal Canal marks a transition into slightly more elevated undulating ground which beyond that rises to form the modest Castlerea Mountain and Slieve Bawn Mountain. The terrain also inclines gently to the west of the site to form low hills that separate the central study area from the substantial sized Lough Ree on the River Shannon, which wraps around the western and south-western aspects of the central study area. The River Shannon, which is the largest and longest watercourse in the country, enters the northern extents of the study area and meanders its way southwards through the west-central portion of the study area before exiting to the south.

The terrain on the western side of Lough Ree is also slightly elevated and undulating and there is another upland spine that runs to the north of Lough Ree between the settlements of Lanesborough and Strokestown. The terrain rises to form a broad upland spine to the northeast of the settlement of Longford in the outer north-eastern quarter of the study area, whilst the northern extents are generally contained in a lake rich drumlin zone.

Notwithstanding occasional spines of more elevated ground, the 30km radius study area can be described in general terms as a relatively flat lowland landscape.

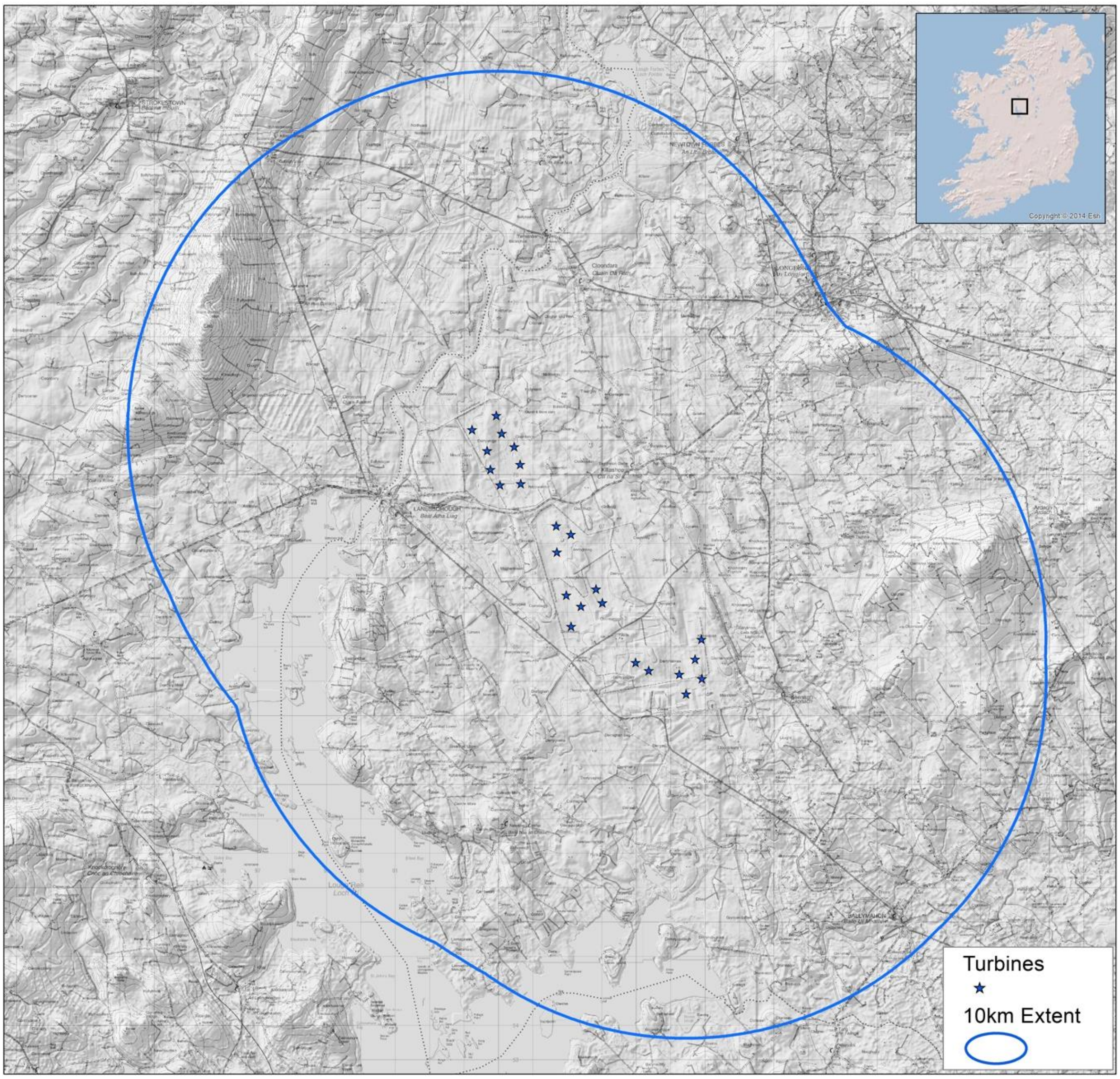


Figure 9.1: Topographical map of central study area (10km radius from turbines)

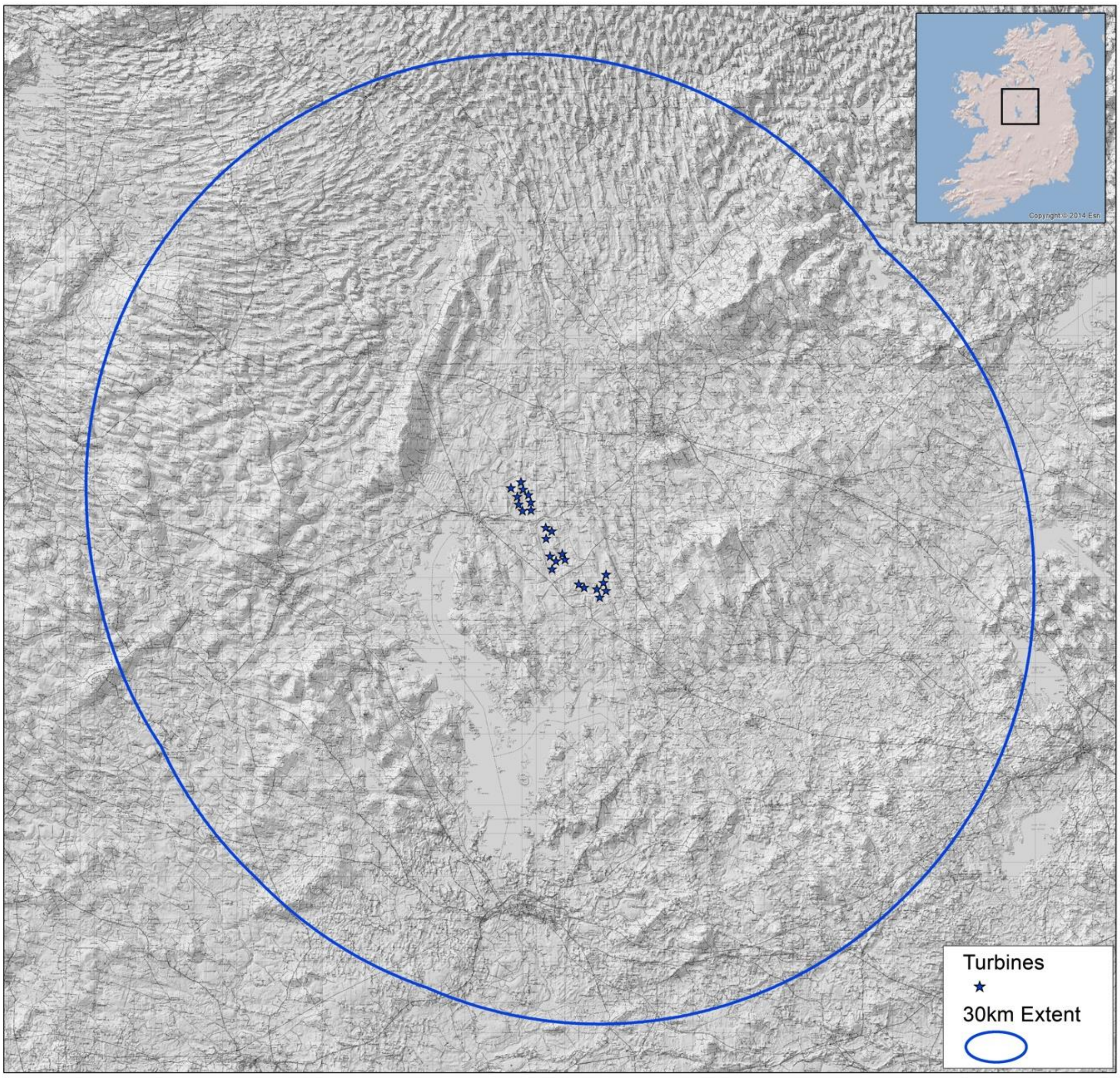


Figure 9.2: Topographical map of overall study area (30km radius from turbines)

9.3.1.2 Vegetation and Land Use

The predominant land use of the site and central study area is commercial scale peat extraction for the purposes of energy generation and there is a substantial peat-fired power station at the settlement of Lanesborough near the north-western periphery of the site. Peatland areas occur frequently throughout the wider study area as well as on both sides of the River Shannon particularly to the north of the site. The peat bogs in this area are frequently interspersed with slightly elevated islands of free draining soils that are used for agriculture, whilst the transitional bog margins tend to be contained in peatland scrub or occasional commercial conifer plantations. Conifer plantations also occur in some of the more elevated areas, but in the context of the overall study area agricultural farming is the predominant land use forming a matrix of fields and hedgerows.

There are a number of substantial sized settlements throughout the study area, which serve as rural service centres. These settlements account for a very modest proportion of urban and industrial land cover in the context of the overall study area.

Figure 9.3: Topographical map of overall study area (30km radius from turbines)

9.3.2 Landscape Policy Context and Designations

9.3.2.1 Department of Environment, Heritage and Local Government Wind Energy Development Guidelines (2006)

The Wind Energy Development Guidelines (2006) provide guidance on wind farm siting and design criteria for a number of different landscapes types. The site of the proposed development are considered to be located within a landscape that is consistent with the 'Flat Peatland' landscape type. Siting and design recommendations for this landscape type includes the following:

- **Location** Wind energy developments can be placed almost anywhere in these landscapes from an aesthetic point of view. They are probably best located away from roadsides allowing a reasonable sense of separation. However, the possibility of driving through a wind energy development closely straddling a road could prove an exciting experience.

- **Spatial Extent** The vast scale of this landscape type allows for a correspondingly large spatial extent for wind energy developments.

- **Spacing** Regular spacing is generally preferred, especially in areas of mechanically harvested peat ridges.

- **Layout** In open expanses, a wind energy development layout with depth, preferably comprising a grid, is more appropriate than a simple linear layout. However, where a wind energy development is located close to feature such as a river, road or escarpment, a linear or staggered linear layout would also be appropriate.

- **Height** Aesthetically, tall turbines would be most appropriate. In any case, in terms of viability they are likely to be necessary given the relatively low wind speeds available. An even profile would be preferred.

It is considered that the proposed Derryadd Wind Farm is entirely consistent with the guidance provided above for the 'Flat Peatland' landscape type.

9.3.2.2 Longford County Development Plan 2015-2021

The Longford County Development Plan (2015-2021) incorporates landscape and visual policies as well as a wind energy strategy. Section 6.1.1 of the Development Plan 'Landscape Character Assessment' provides a brief summary of that assessment, whilst the full version of the document can be found at Annex 4. Section 9.4.1 'Wind Energy', identifies preferred and non-preferred areas for wind energy development along with associated wind energy policies. The relevant aspects of these documents are outlined below.

9.3.2.2.1 Longford Landscape Character Assessment

The Longford Landscape Character Assessment divides the County into seven geographically distinct Landscape Character Units (LCUs) (Figure 9.4 refers). The proposed development is contained within '*LCU 6 – Peatlands*'. This landscape character unit is surrounded by three other LCUs, namely; '*LCU 3 – Shannon Basin/Lough Ree'*, which lies to the west, '*LCU 7 – Open Agriculture'*, which lies to the east and '*LCU 4 – Central Corridor'*, which lies to the northeast.

LCU 6 – Peatlands is "dominated by extensive tracts of raised bog interspersed with mixed forestry and areas of scrubby vegetation. The topography is notably flat, with the majority of the land lying below the 50m contour line. This, when combined with the limited vegetation cover and extensive peatland cover mean that views are available across wide areas throughout the unit." The landscape character assessment also identifies sensitivity designations for each of the given units. Unit 6 – Peatlands has been identified as a low sensitivity landscape, however, the corridor of the Royal Canal, which passes through this unit, has been given a 'high' sensitivity designation.

Longford County Council have listed some general landscape policies in subsection 6.1.1 of the County Development Plan and these are as follows:

LCA 1: It is the policy of the council to protect and enhance the County's landscape, by ensuring that development retains, protects and, where necessary, enhances the appearance and character of the existing landscape. Proposed developments, where located within or adjacent to sensitive landscapes (as defined in the assessment), may be required to provide a landscape report detailing how the proposal will effect on the landscape and mitigation measures to be taken where necessary to address negative effects. Proposed developments which have detrimental effect on the landscape will not normally be permitted.

LCA 2: Longford County Council recognises the diverse and unique landscape character of the County, and as such, landscape conservation areas may be designated in order to achieve its objective of protecting and enhancing the County's landscape. Physical development shall not adversely effect on areas designated as visually important/sensitive under this section.

LCA 3: It is the policy of the Council to preserve views and prospects as illustrated on the accompanying map as part of Appendix 6 and as listed in the following tables. Views are divided into full and intermittent in order to differentiate areas where scenic views may be partial or absent along a particular route. The following table lists the routes (as numbered on the map) and lists the townlands through which they pass for identification purposes.

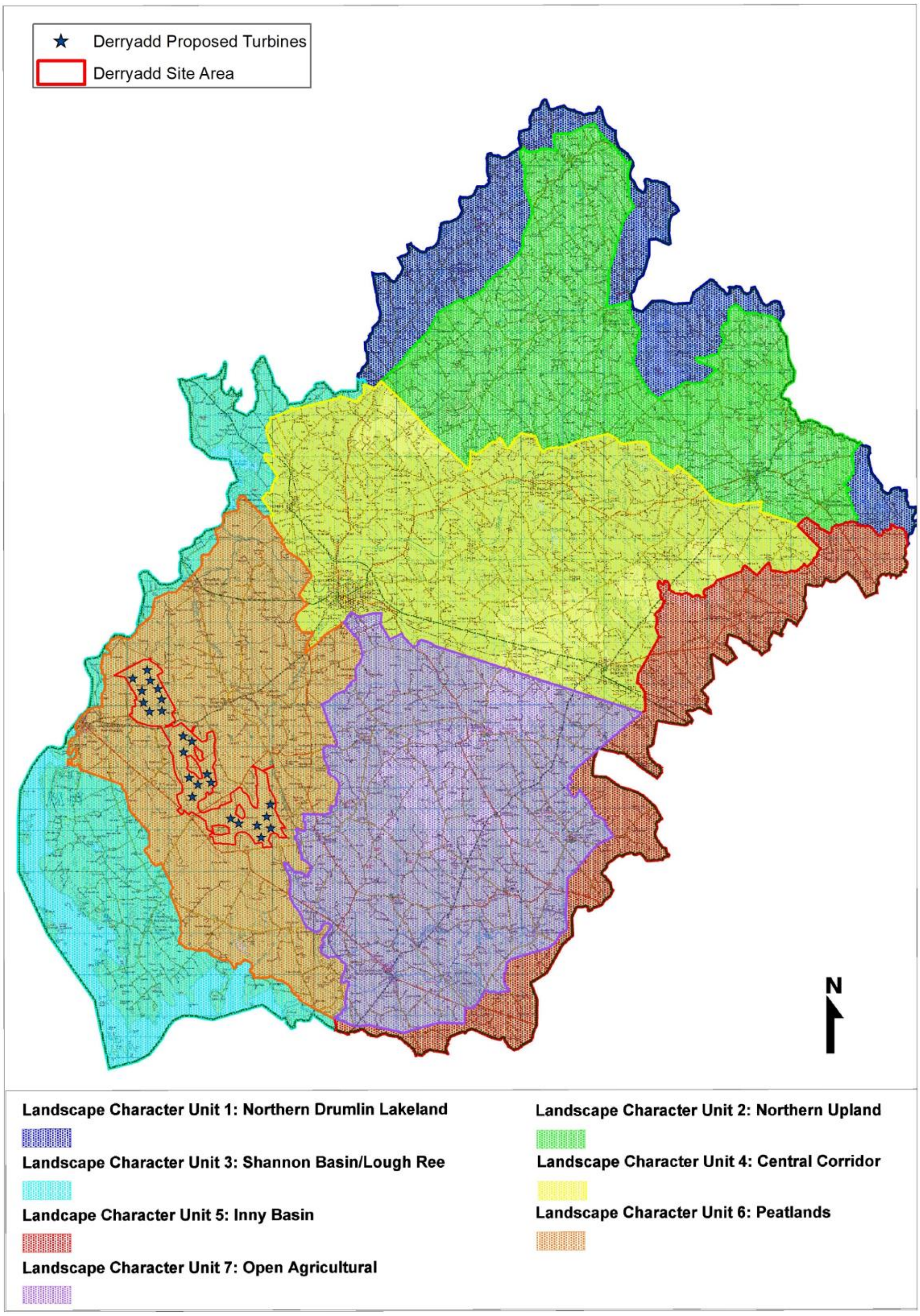


Figure 9.4: Annex 4 of the Longford County Development Plan - Longford Landscape Character Assessment showing relevant landscape character units.

9.3.2.3 Longford County Development Plan – Subsection 5.5.2.1: Wind Energy

County Longford is noted for having a substantial potential for wind farm development given its geographic size. Areas of Longford with the potential for wind farm development and where wind farms will be encouraged are identified in Appendix 5: Areas of Wind Farm Potential, and the associated map is provided below.

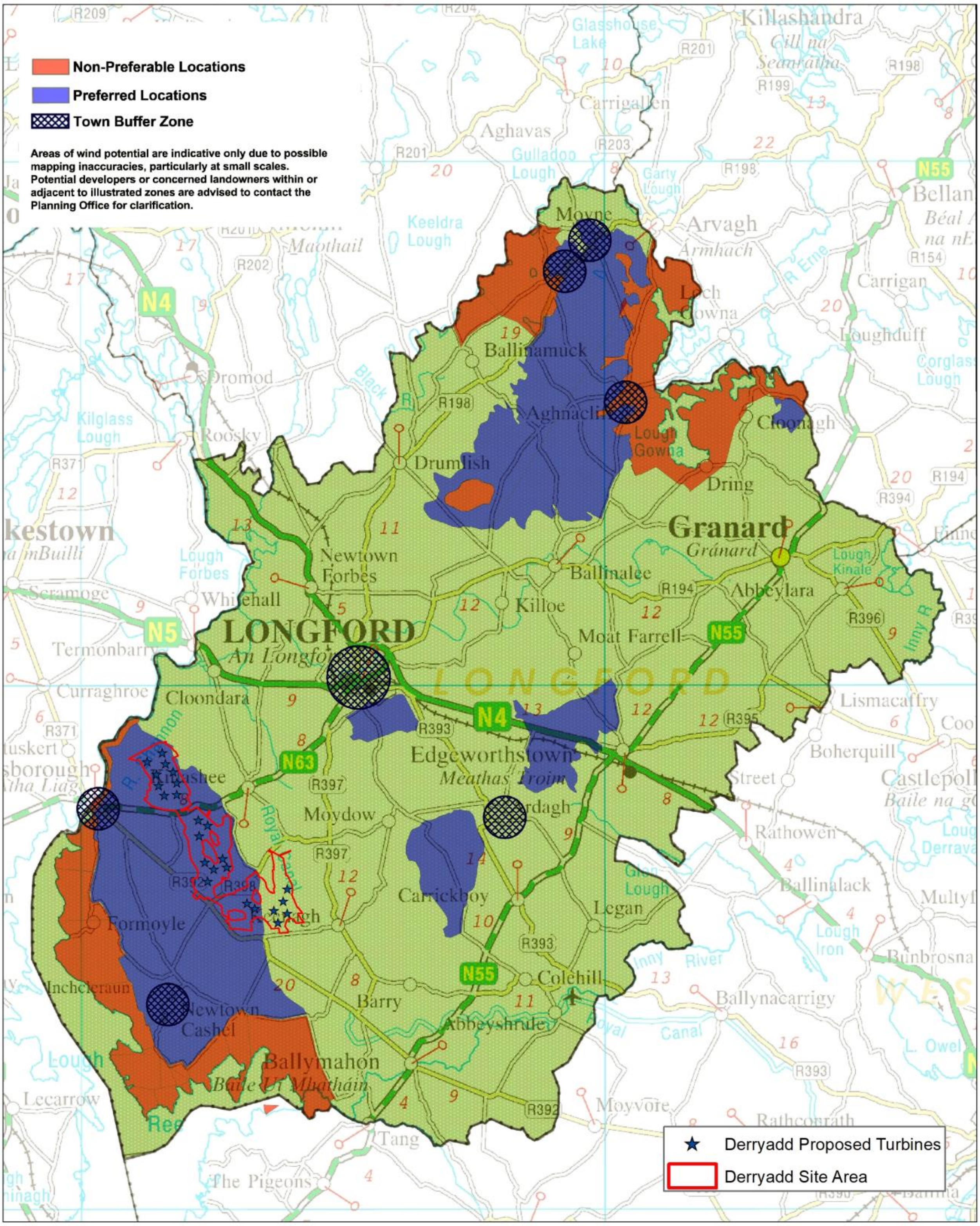


Figure 9.5: Appendix 5 of the Longford County Development Plan – Areas of Wind Farm

Longford County Council have identified a number of polices with regard to wind energy and the most relevant of these are as follows:

WD 1: Developments for wind farms will be encouraged to locate in those areas identified as having wind potential within the County, as defined on the Map contained in Appendix 5.

WD 2: Proposals for large scale industrial wind farm developments shall be directed to areas of cutaway bogs subject to the following;

a) Dependent on the completion of an investigation demonstrating suitability of the areas,
b) The preparation of revised Wind Energy Development Guidelines and the Renewable Energy Export Policy and Development Framework
c) Compliance with the necessary environmental assessments

WD 4: In assessing an application for a wind farm the following shall be taken into consideration:

a) Visual impact - both on site and over extensive areas. Applications may be required to include photo or video montages - taken from a variety of locations after discussion with the Planning Authority. Site cross sections showing existing and proposed ground levels in relation to all structures on site are required. Ideally they should be sited against a backdrop of a hill or elevated area. Non-linear type layouts are favourable. Windfarms should not be inter-visible from one another.

b) Predicted Noise Levels - developments must ensure that noise levels will not be intrusive in relation to background noise at the nearest dwelling. Blades, of single speed must rotate in the same direction. Monitoring noise levels at selected locations generally for the first year of operation of the wind farm will be a condition of planning permission. Manufacturer's certification of noise emissions will be required at application stage.

c) Design - Solid towers should be used throughout the windfarm, which should be of the same height and colour. Advertising material including the manufacturer's name or logo will not be permitted on the wind turbine.

d) Impact of associated site works - including access roads, substations, grid connections, fencing etc. Details of proposed grid connections are required at application stage. Consideration should be given to the potential landscape impacts in the context of grid connections taking into account technical feasibility and economic viability, particularly in environmentally sensitive locations. Access roads shall be un-surfaced and follow natural contours of the site. Fencing will not be permitted on any part of the site except normal livestock fencing when the land is part of an operating agricultural holding.

e) Construction - a detailed phased programme for the construction together with estimates of traffic generation is required at application stage. Consideration will be given to the potential damage to roads during the construction phase. In some cases access routes may be restricted by planning condition.

f) Proximity to Dwellings - Wind turbines should generally not be located within 500m of any dwelling but this may vary from site to site.

g) Interference with navigation, television and communication signals - A communications booster may also be required or some other technical solution. Air and sea navigation authorities may be consulted for their comments on proposed wind farm developments.

h) Impact on environmental designations - Amenity areas, Sensitive landscapes, views and prospects, Designated Tourist Areas, Natural Heritage Areas, Special Protection Areas, Special Areas of Conservation, Archaeological site, biodiversity, protected structures, national monuments etc. Wind farm developments should not be located within 100 metres of ancient monuments. The impact on migratory birds, in particular, will be assessed in consultation with the Irish Wildbird Conservancy (BirdWatch Ireland).

i) Decommissioning - proposals for restoration of the site after removal of the turbines should be included with an application. Adequate financial security will be required by planning condition.

j) Sensitivity of locations of folklore, mythology and religious significance to these developments. Evidence of consultation with local community groups is an important element of planning for such a project. Developers will also be required to assess their proposals for the impact of shadow flicker on dwellings and this information should accompany the planning application.

k) Location relative to water bodies. Wind farm developments should not be located within 150m of lakes or rivers.

l) Applicants are advised to outline future extension proposals if known. It should be noted that temporary permissions for an anemometer is without prejudice to any subsequent application for a wind farm.

9.3.2.4 Roscommon County Development Plan 2014-2020

Roscommon Landscape Character Assessment

Whilst the proposed Derryadd Wind Farm extends throughout the south-western portion of County Longford, it is also in relatively close proximity to County Roscommon and therefore has the potential to influence the landscape character of the nearest parts of this neighbouring County. Thus, relevant designations and landscape policy for County Roscommon are also considered herein.

A landscape character assessment is included within the current Roscommon County Development Plan and this divides the County in to seven Landscape Character Types (LCTs). The *'River Corridor'* LCT is the most relevant to the proposed development as it encompasses the western banks of the River Shannon and Lough Ree, which occur immediately across the Longford – Roscommon border. The generic Landscape Character Types are then further divided into 36 no. geographically distinct Landscape Character Areas (LCAs). A number of these are contained within the *'River Corridor'* LCT within the western half of the study area. The LCAs in question include; '*LCA 5 – Slieve Bawn and Feirish Bogland Basin; 'LCA 6 – Upper Lough Ree Bogland'; 'LCA 7 – Mid Lough Ree Pastureland'* and*; 'LCA 8 – Lower Lough Ree and Athlone Environs'*. These LCAs have all been designated as landscapes of 'Very High Value' which is the second highest of the four classifications outlined in the CDP).

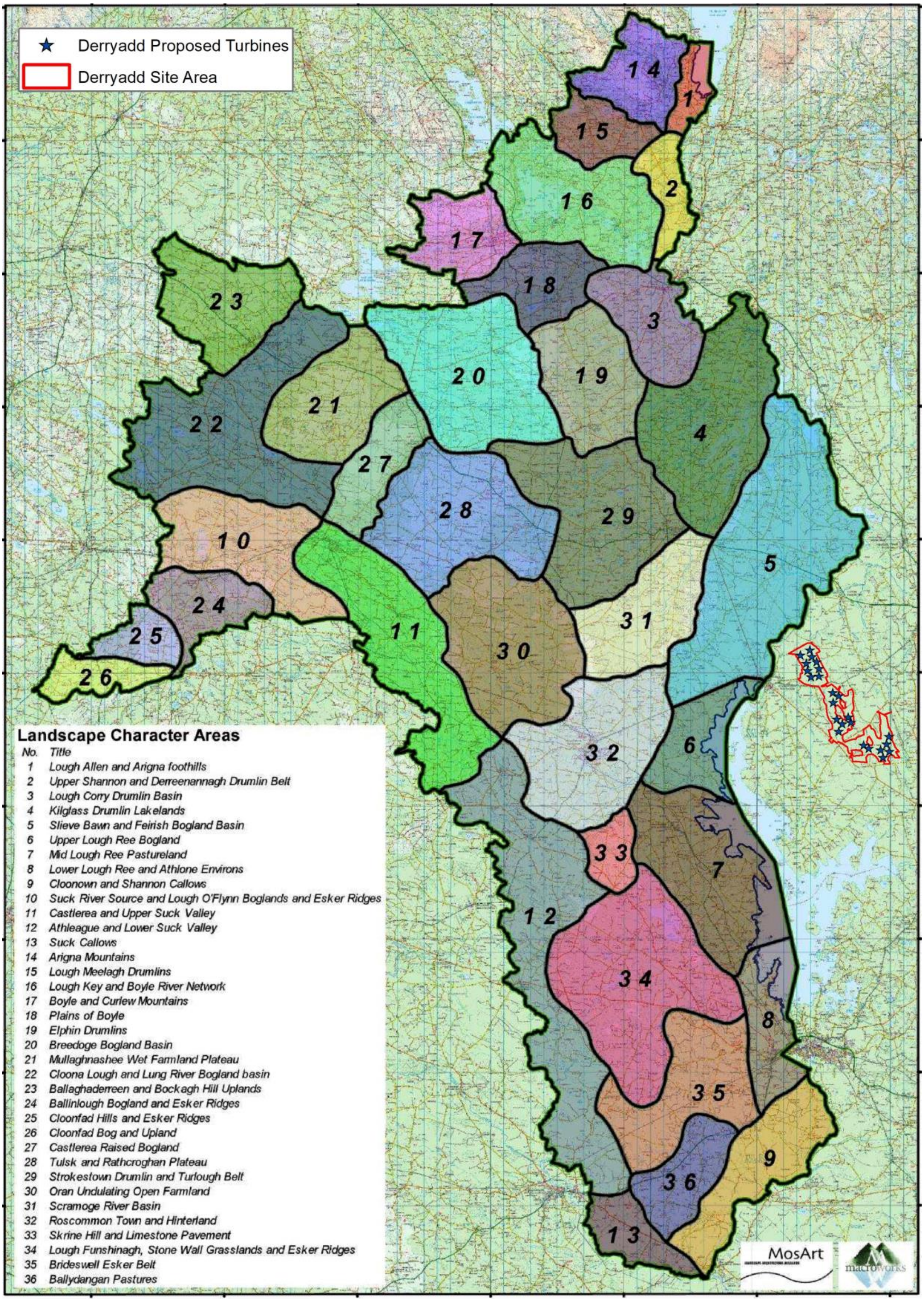


Figure 9.6: Roscommon Landscape Character Assessment – Relevant landscape character areas.

The landscape contained in 'LCA 5 - Slieve Bawn and Feirish Bogland Basin' is described as:

"….. one of the largest character areas in the county stretching from Lanesborough in the south to Lough Bo Derg in the north. Slieve Bawn forms the western edge from where the landform gently slopes eastward draining into low lying bogland where it meets the eastern boundary defined by the meandering Shannon."

LCA 5 is identified as having a 'Very High' value as it is "one of the most varied in the entire county, comprising a major waterway, extensive bogland and forest upland."

The landscape contained in 'LCA 6 – Upper Lough Ree Bogland' is described as:

"….. one of the flattest areas in the county with the western boundary delineated by the zone of theoretical visibility from Lough Ree. The area is predominantly covered in raised bog, fens and marginal farmland with transitional woodland scrub and coniferous plantation in places."

LCA 6 is identified as having a 'Very High' value "because of its nature designations and the sense of isolation."

The landscape contained in 'LCA 7 – Mid Lough Ree Pastureland' is described as:

"…..from the Hind River in the north to just north of Hudson's Bay. Its western boundary is formed by the hills to the east of Lough Funshinagh, which drain in an easterly direction down to the shores of Lough Ree. The shoreline of Lough Ree is defined by secluded bays dotted with small marinas and harbours, as well as peninsulas, the most important of which is Warren Point on which is located the medieval site of Rhindoon."

LCA 7 is identified as being a 'Very High' value landscape "due to its nature designations, good quality farmland landscape and extensive lake views as well as built heritage including windmill, church and graveyard and the canal connecting the village of Lecarrow and Blackbrink Bay as well as the medieval site at Rhindoon."

The landscape contained in LCA 8 – Lower Lough Ree and Athlone Environs is described as:

"….. stretches southwards from Hodson Bay to north of the village of Cornafulla. The western boundary is delineated by the zone of visibility from the River Shannon. This low lying area is predominantly made up of dry grassland and raised bog, most of which is reclaimed, as well smaller pockets of wet grassland and wetland."

LCA 8 is identified as being of 'Very High' value "reflecting the presence of the Shannon river corridor."

It is important to note that other LCAs occur further west of the above mentioned character areas and are also situated within the westernmost periphery of the 30km radius study area. All of these LCAs have been designated as having landscape values ranging between 'moderate' and 'high' (the lowest and second lowest value ratings, respectively).

Roscommon Renewable Energy Strategy

Map 6 of the Roscommon renewable energy strategy (Figure 9.7 below) identifies areas of wind energy development potential. The map highlights that LCAs 6, 7 and 8 are all not favoured for their wind energy potential as a result of their setting immediately adjacent to Lough Ree. However, LCA 5 – Slieve Bawn and Feirish Bogland Basin is noted as an area 'most favoured' for potential wind farm development. The lowland landscape of this LCA is comparable to that of the site of the proposed wind farm, and is therefore consistent with the County Longford 'preferred' potential wind farm development designation within the adjacent LCA 6 - 'Peatlands'.

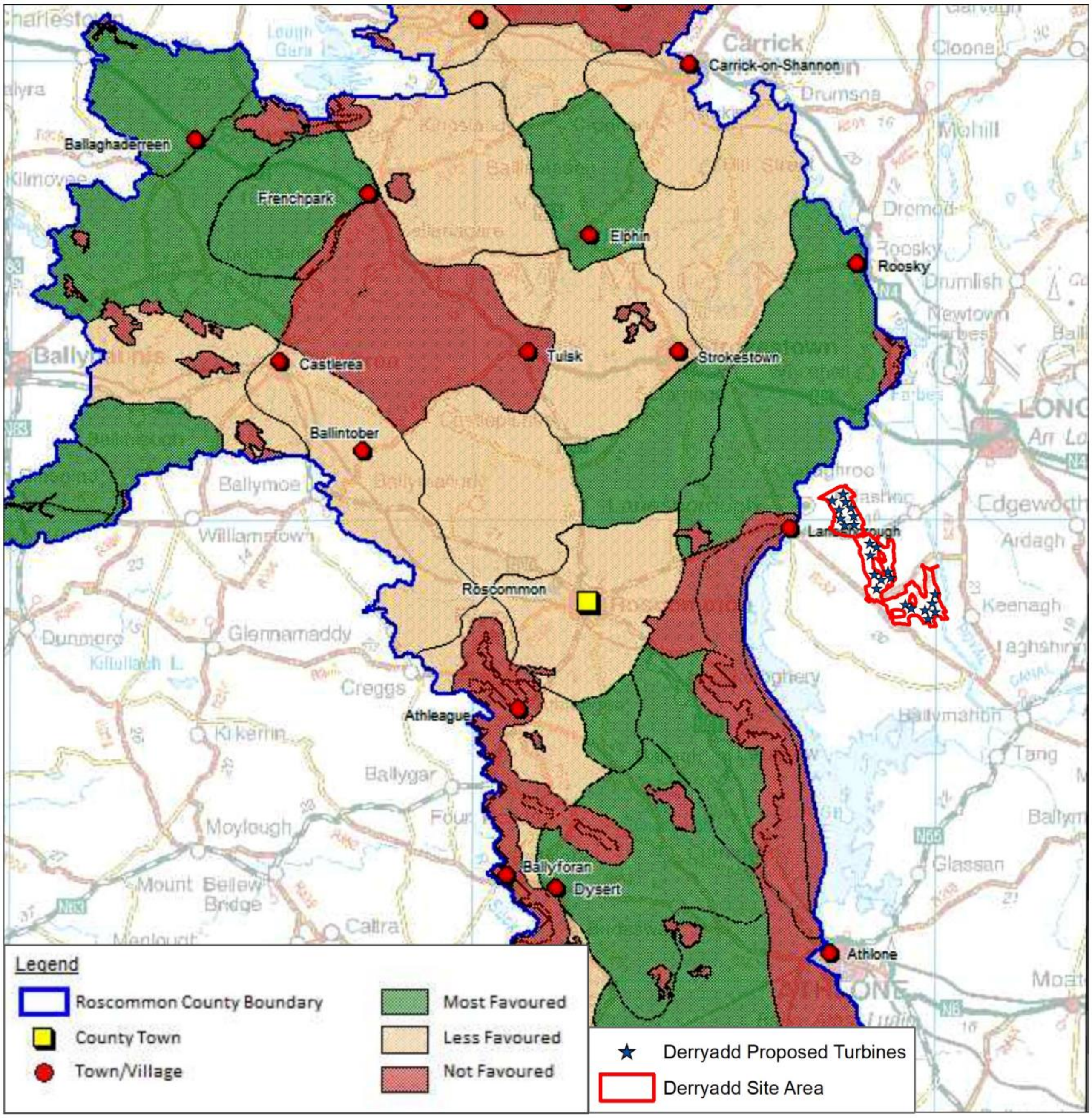


Figure 9.7: Roscommon Renewable Energy Strategy – Map 6: Areas of Wind Energy Development Potential

9.3.2.5 Westmeath County Development Plan 2014-2020

A Landscape Character Assessment is contained within the current Westmeath County Development Plan. A total of 11 no. LCAs are identified within the County. The two nearest and most relevant LCAs include, LCA 6 Lough Ree/Shannon Corridor and LCA 7 – Western Lowlands. In similar circumstances to the Roscommon Development Plan, the potential for wind energy along the Shannon corridor is designated as low. However, LCA 7 – Western Lowlands, which extends through a high proportion of the southern extents of the study area, has been identified as having a 'medium' capacity for wind energy development (Figure 9.8 refers), which is the most accommodating category available within the Westmeath Wind Energy Strategy. Again, this is consistent with the Longford County Development designation of the proposed site as a 'preferred' location for wind energy.

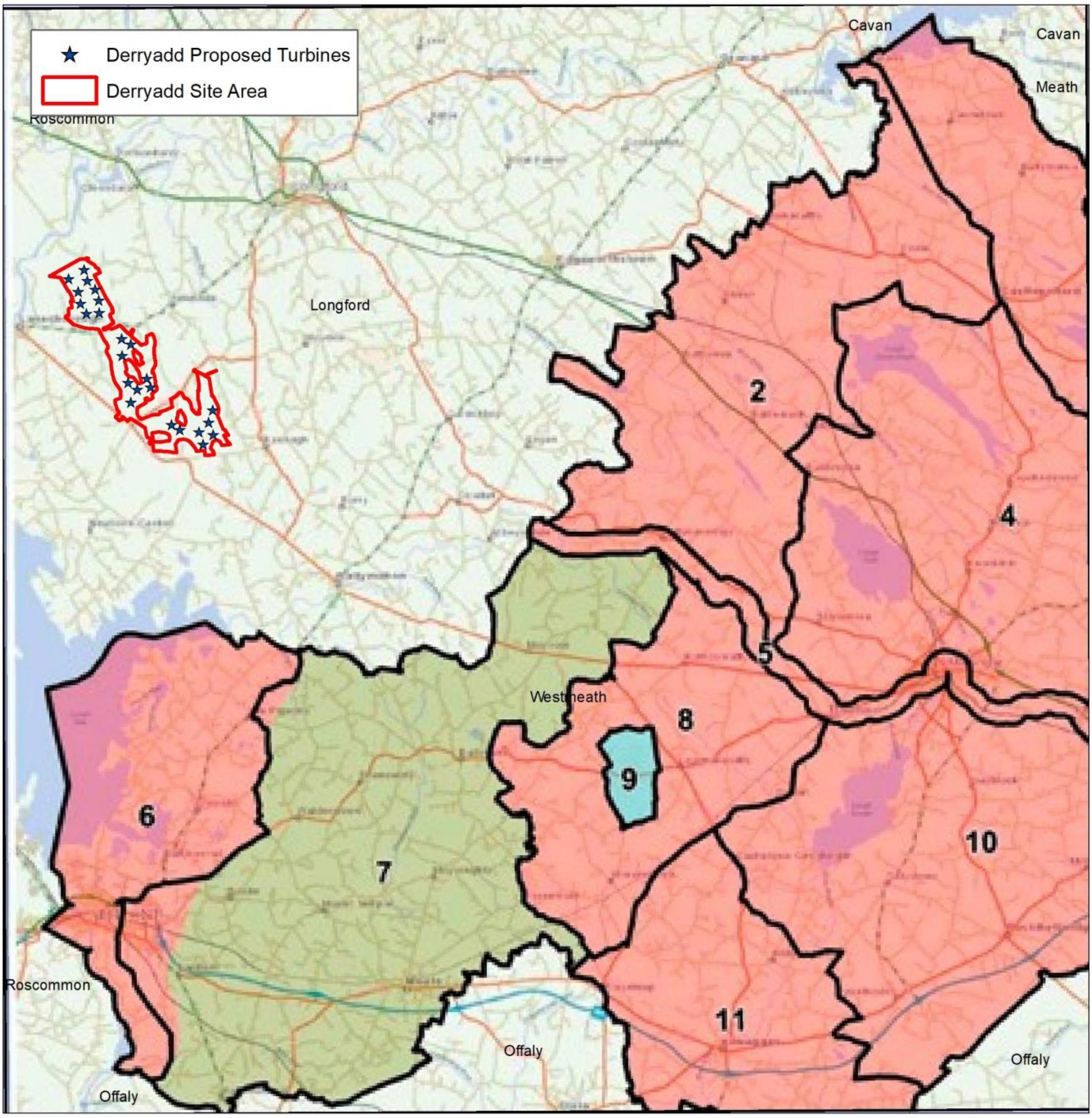


Figure 9.8: Westmeath County Development Plan 2014-2020, Map 4 – Wind Energy Development Map

9.3.2.6 Leitrim County Development Plan 2015-2021

As County Leitrim is situated over 10km from the proposed development at its nearest point, it is not considered that its landscape character will be noticeably influenced by the proposed development even if the proposed wind farm is visible in the distance. Thus, the Landscape Character Assessment for County Leitrim is not considered pertinent to this appraisal.

9.3.2.7 Conservation Interests

Although nature conservation designations are principally the concern of the Ecology and Hydrology chapters of the EIAR, they also represent landscape-based features and areas that are likely to have naturalistic characteristics that contribute to the overall landscape character of an area. For the purposes of the landscape appraisal it is mainly those conservation designations within the central study area (<5km from the site) that are most relevant.

The National Parks and Wildlife Services (NPWS) designated areas that are situated within the central study area and include; sites of European importance i.e. Special Protection Areas (SPAs), Special Areas of Conservation (SACs) in addition to sites of National importance i.e. Natural Heritage Areas (NHAs), and proposed Natural Heritage Areas (pNHAs) – these are outlined below and assessed in detail in Chapter 6: Biodiversity and the Natura Impact Statement:

- Lough Ree SPA, SAC and pNHA
- Ballykenny-Fisherstown Bog SPA
- Lough Forbes Complex SAC and pNHA
- Brown Bog SAC and pNHA
- Corbo Bog SAC and pNHA
- Fortwilliam Turlough SAC and pNHA
- Lisnanarriagh Bog NHA
- Forthill Bog NHA
- Mount Jessop Bog SAC
- Mount Jessop Bog NHA
- Lough Bannow pNHA
- Cordara Turlough pNHA
- Lough Bawn pNHA
- Derry Lough pNHA
- Royal Canal pNHA
- Derrymore Bog pNHA
- Lough Slawn pNHA

9.3.3 Visual Baseline

The visual baseline for this wind farm proposal establishes both the nature of visibility within the study area and the important receptor locations from which the development might be viewed.

Only those parts of the study area that potentially afford views of the proposed wind farm are of interest to this part of the assessment. Therefore, the first part of the visual baseline is establishing a 'Zone of Theoretical Visibility' (ZTV). The ZTV map indicates from where in the landscape of the study area the proposed development will, or will not, be visible due to terrain screening only. Terrain based ZTV analysis does not account for screening by vegetation or other terrestrial features, nor does it account for the diminishing scale in relation to distance of turbines. The main use for standard ZTV mapping is to determine an initial search area for desk-based and field-based viewpoint selection, whilst excluding those parts of the study area with no potential visibility of the scheme.

Given the limitations of standard ZTV mapping in terms of understanding the actual nature of visibility within lowland landscapes a second form of visibility analysis has been employed in this instance and this is termed Route Screening Analysis (RSA). Route Screening Analysis, as its name suggests, considers actual visibility of the proposed wind farm from surrounding roads using current imagery captured in the field then subsequently reviewed in the context of a digital model of the development. Route Screening Analysis bridges the gap for the assessor between the computer-generated, theoretical visibility modelling (expressed on the ZTV map) and the actual nature of visibility in the central study area. The findings from both the ZTV and RSA analysis is set out below.

9.3.3.1 Zone of Theoretical Visibility (ZTV)

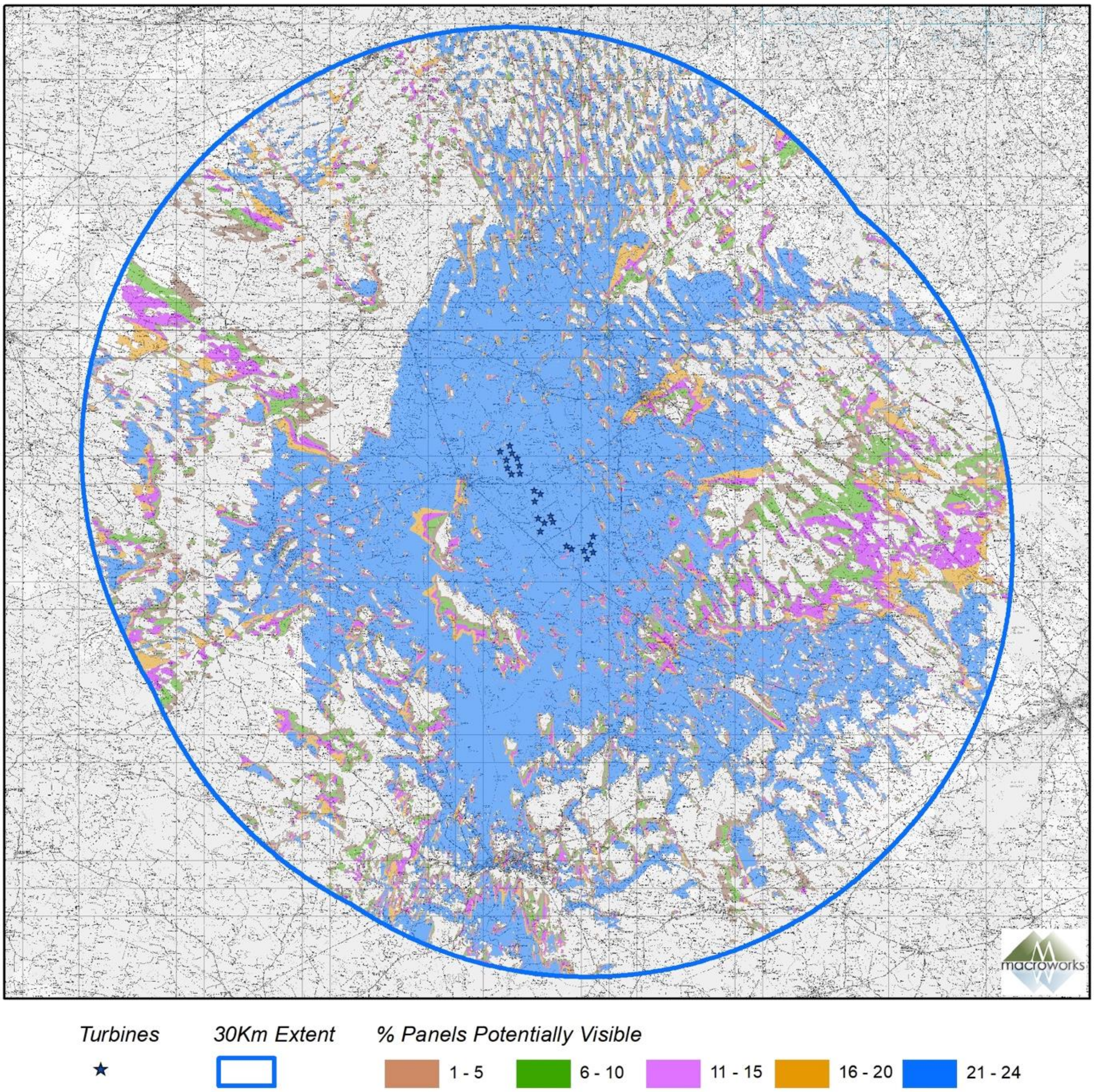


Figure 9.9: 'Tip-height' Zone of Theoretical Visibility (ZTV) Map showing from where in the study area a view of any part of the turbines up to blade tips is potentially afforded (bare-earth scenario only)

The following key points should be noted from the ZTV map:

- Consistent full visibility of the turbines is afforded within the central study area out to a distance of around 4-5km in every direction and this trend continues out to 8-10k from the site to the north and south. This zone incorporates the settlements of Lanesborough, Killashee and Keenagh as well as the N63 national secondary road and the R392 and R393 regional roads.

- Theoretical visibility of the scheme is interrupted to the west and southwest of the site at distances of around 4km by low hills that define the eastern side of Lough Ree. Thus, the eastern shores of Lough Ree are generally not afforded views of the development. Visibility returns from about the centreline of the Lough and encompasses the western shores. However, the ‘concentric’ nature of the ZTV pattern at the western side of the Lough indicates the gradual emergence of turbine blade tips above the intervening ridgeline, rather than an abrupt return to open visibility. Theoretical visibility is shown to be sporadic beyond approximately 10km throughout the western quarters and is substantially gone at distances of 20-30km, except for partial scheme visibility from elevated hilltops and ridges.

- A subtle band of higher ground to the east of the site begins to limit views of the proposed turbines from beyond about 5km. Potential visibility is substantially gone beyond 10km with only elongated, northwest-southeast running ridges afforded partial visibility. These ridges tend not to coincide with visual receptors such as roads and residential dwellings. A higher degree of theoretical visibility, albeit sporadic, is afforded to the south-eastern quarter of the study area, which coincides with a band of slightly elevated ground to the west of the settlement of Mullingar.

- A band of theoretical visibility extends to the southern perimeter of the study area along the corridor of the River Shannon and the elongated Lough Ree incorporating parts of Athlone. This is due to the low-lying nature of the intervening landscape (few screening features) and particularly across the Lough. Otherwise there is very little potential for scheme visibility from the outer south-western and south-eastern portions of the study area.

- Due to the screening effect of the elongated ridge of Slieve Bawn some 5km to the northwest of the site, there is very little opportunity for views of the development from the north-western quarter of the study area.

- The outer northern and north-eastern quarters of the study area display a distinctive ‘sand ripple’ ZTV pattern, which is typical of drumlin hill landscapes. In such landscapes of short steep slopes, visual receptors such as dwellings and roads tend to hug lower ground and will not be afforded potential views of the scheme.

9.3.3.2 Route Screening Analysis (RSA) - Roads

In a flat landscape, such as that of the central study area which incorporates a network of hedgerows, scrubby bog fringe woodlands and forest plantations, a standard ZTV map is of little value in understanding actual visibility. That is, it grossly overestimates visibility compared to an open peatland or mountain moorland landscape, for example. In order to get a clearer understanding of visibility within the central study area, Route Screening Analysis (RSA) was undertaken for every road and section of canal within a 5km radius of proposed turbines (See Appendix 9.1 for detailed RSA methodology).

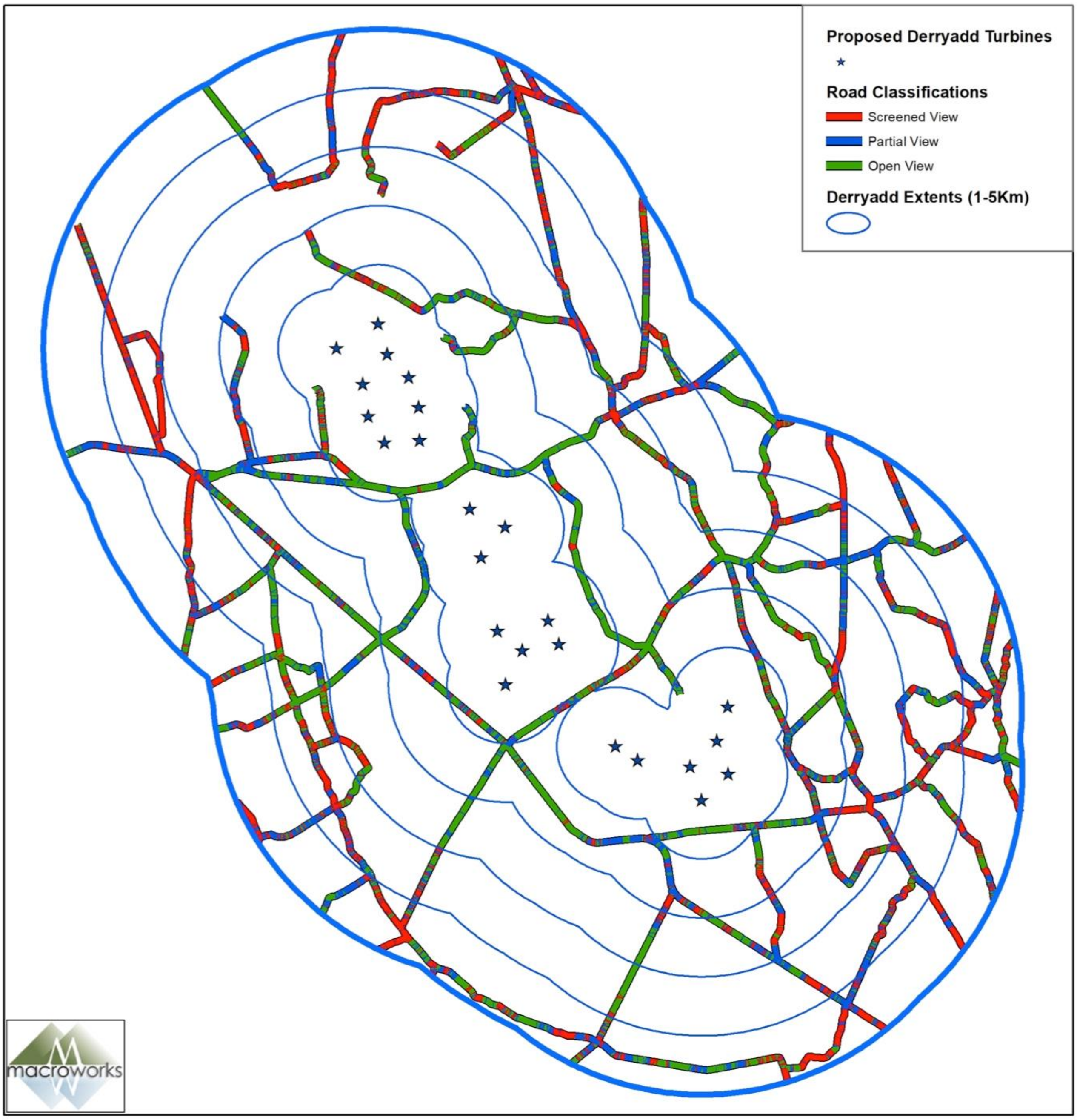


Figure 9.10: Map of Route Screening Analysis for roads within 5km of turbines (See Appendix 9.1 for larger scale map)

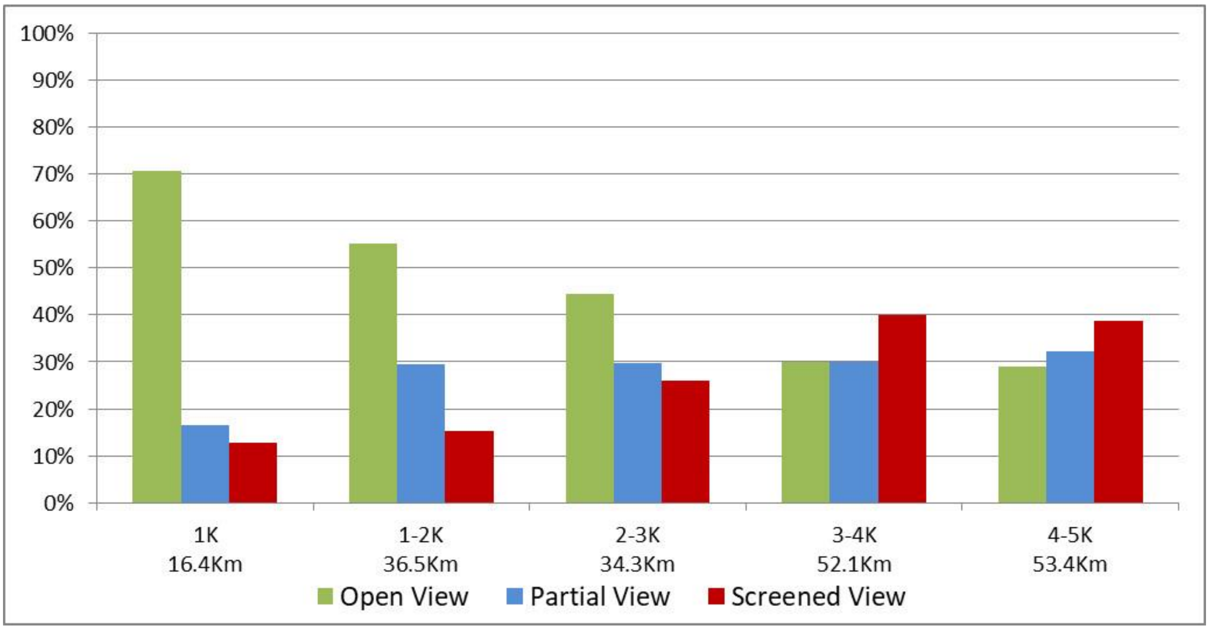


Figure 9.11: Graph of Route Screening Analysis Results from roads

As depicted on Figure 9.11, within the first distance band (0-1km) 'open visibility' (70%) is markedly higher than both 'partial visibility' (17%) and 'fully screened' (13%). This is almost certainly due to the prevalence of open cutaway peatland in this nearest zone, coupled with the scale in relation to distance of the nearest turbines, which sees them rise well above intervening vegetation. In the next 1-2km distance band 'open visibility' has noticeably reduced (down to 55%) in favour of partial visibility, which has increased to nearly 30%. The proportion of 'fully screened' views has slightly increased, but still remains much less than the other two categories of visibility. In the 2-3 km distance band 'partial visibility' remains similar and 'open visibility has again reduced (55% down to 44%), but this time in favour of 'fully screened', which increases from 15% to 25% of road sections. At around the 3km mark it would appear that a threshold is crossed, beyond which, it is more common that the proposed turbines are fully screened from view than fully visible though proportions remain relatively even for all of the visibility classes. Throughout all of the distance bands, except 0-1km, the proportion of 'partial visibility' remains relatively constant while the relative proportions of 'open visibility' and 'fully screened' have an inverse relationship (one increases while the other reduces).

The strong inverse linear relationship over distance between 'open visibility' and the 'fully screened' categories and the fact that these graphs meet at around 3km is an important factor in terms of understanding the visual absorptive capacity of this area. It indicates that at about 3km from the site, the relative scale in relation to distance of the turbines becomes similar to the height of closer intervening vegetation, mainly in the form of hedgerows and treelines. Within the nearer distance bands the turbines are comparatively taller than such intervening vegetation and tend to rise above it. Whereas, beyond 3km the reverse scenario tends to be true and open views of turbines are only likely to occur from elevated ground or when the fore-to-middle ground of a view is particularly open. It is also reasonable to extrapolate from these findings that there will rarely be a clear view of more than 5-10 turbines from dwellings in the lowland central study area, given the spatial distribution of the turbines and the fact that very few dwellings are contained within the open peatland area without some degree of screening. This theory was tested with further analysis of just the 'open visibility' class and the results are represented in a map (Figure 9.12 refers) and associated graph (Figure 9.13 refers).

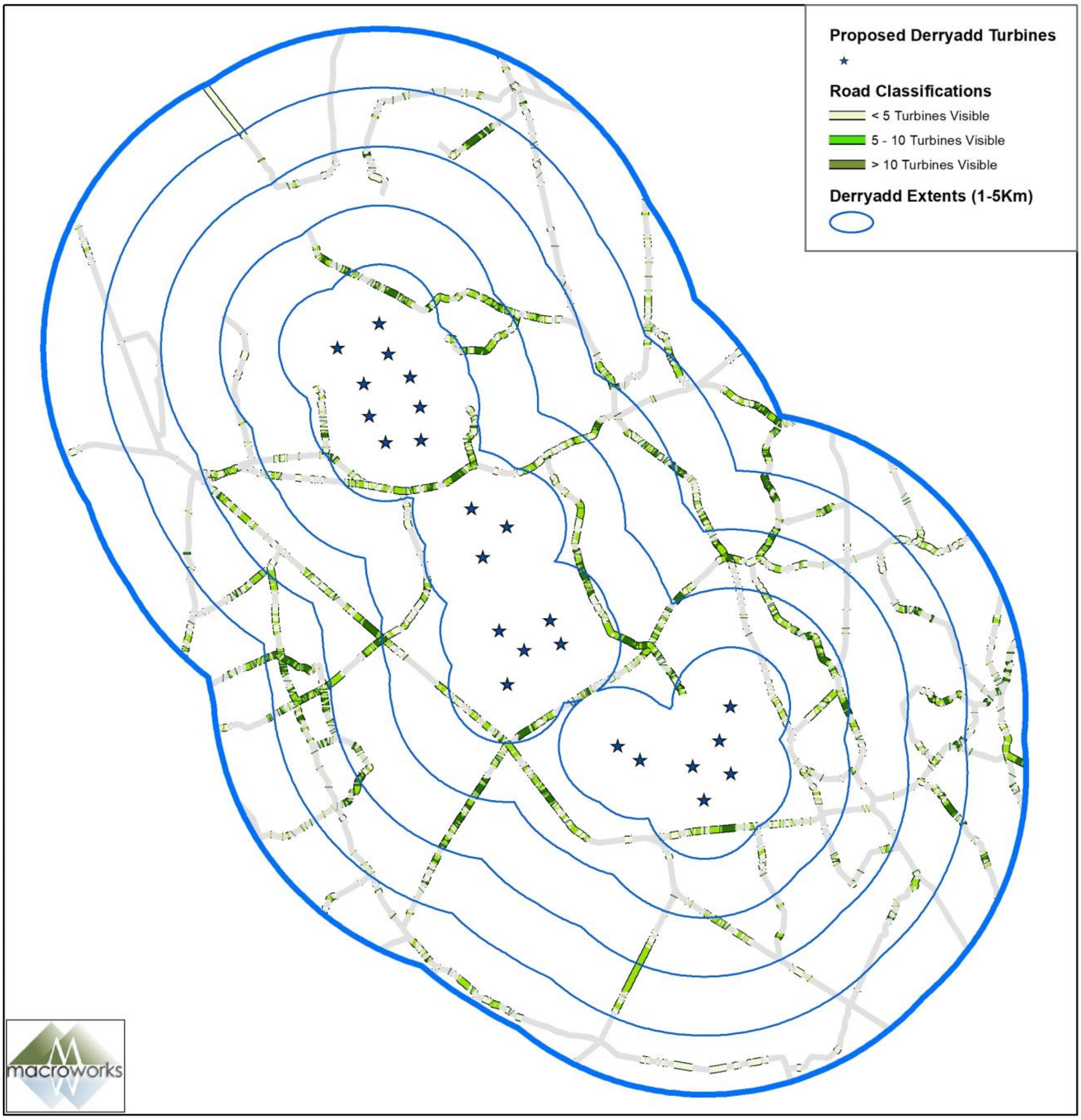


Figure 9.12: Number of turbines visible (see Appendix 9.1 for larger scale version)

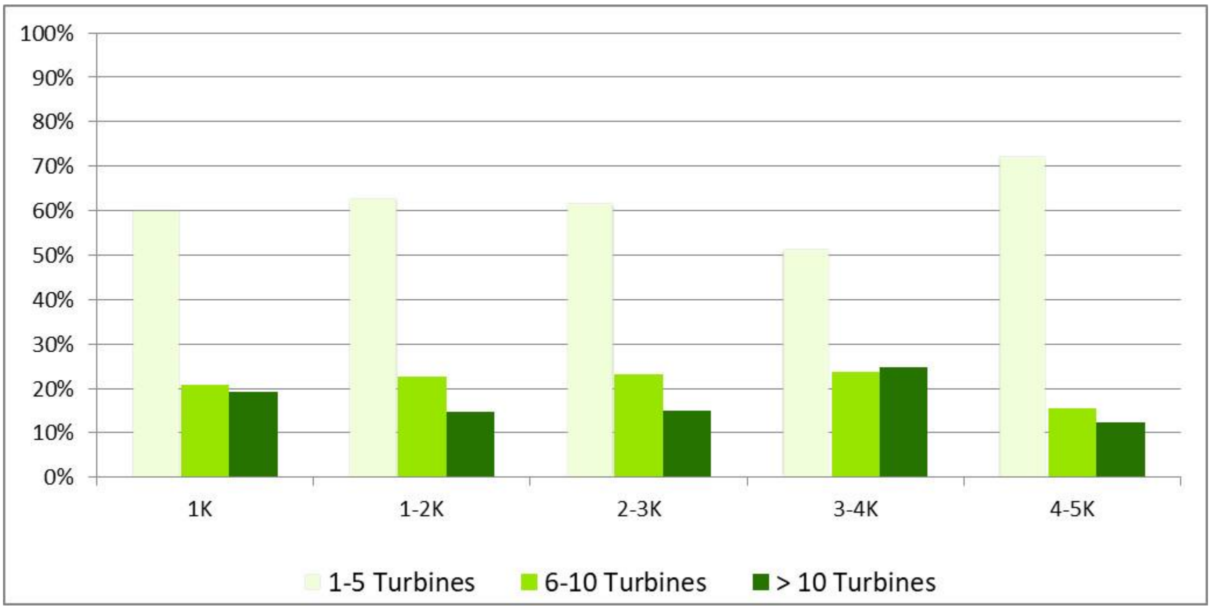


Figure 9.13: Graph showing results of additional analysis of RSA 'Open View' category to determine number of turbines visible

The graph at Figure 9.13 indicates that, by far, the most common scenario is that less than five turbines will be fully visible (blade rotation) from any section of the surveyed road network. This is consistently the case across all of the distance bands with results only ranging between 59% and 72%. A considerably lower proportion of the road network affords views of between 5 and 10 turbines. This only ranges between 23% and 15% across all of the distance bands. The least common scenario is views of more than 10 turbines and this ranges from 25% down to 12% across the distance bands, but without an obvious trend. The map at Figure 9.12 reveals that views of more than 10 turbines occur on short and sporadic sections of road throughout the nearest 2km of the site often coinciding with views across peatland. Beyond this distance threshold, views of more than 10 turbines tend to occur from slightly elevated ground to the west and southwest of the site.

9.3.3.3 Route Screening Analysis (RSA) – Royal Canal

Route Screening Analysis was also carried out in respect of the section of the Royal Canal that runs within 5km of proposed turbines. A vehicle-mounted image capture system, as used for road network RSA, was not possible along the canal so a slightly less technical process was employed. This still used the same parameters of 'Open' and 'Partial' visibility or fully 'Screened'. (See Appendix 9.1 for detailed RSA methodology).

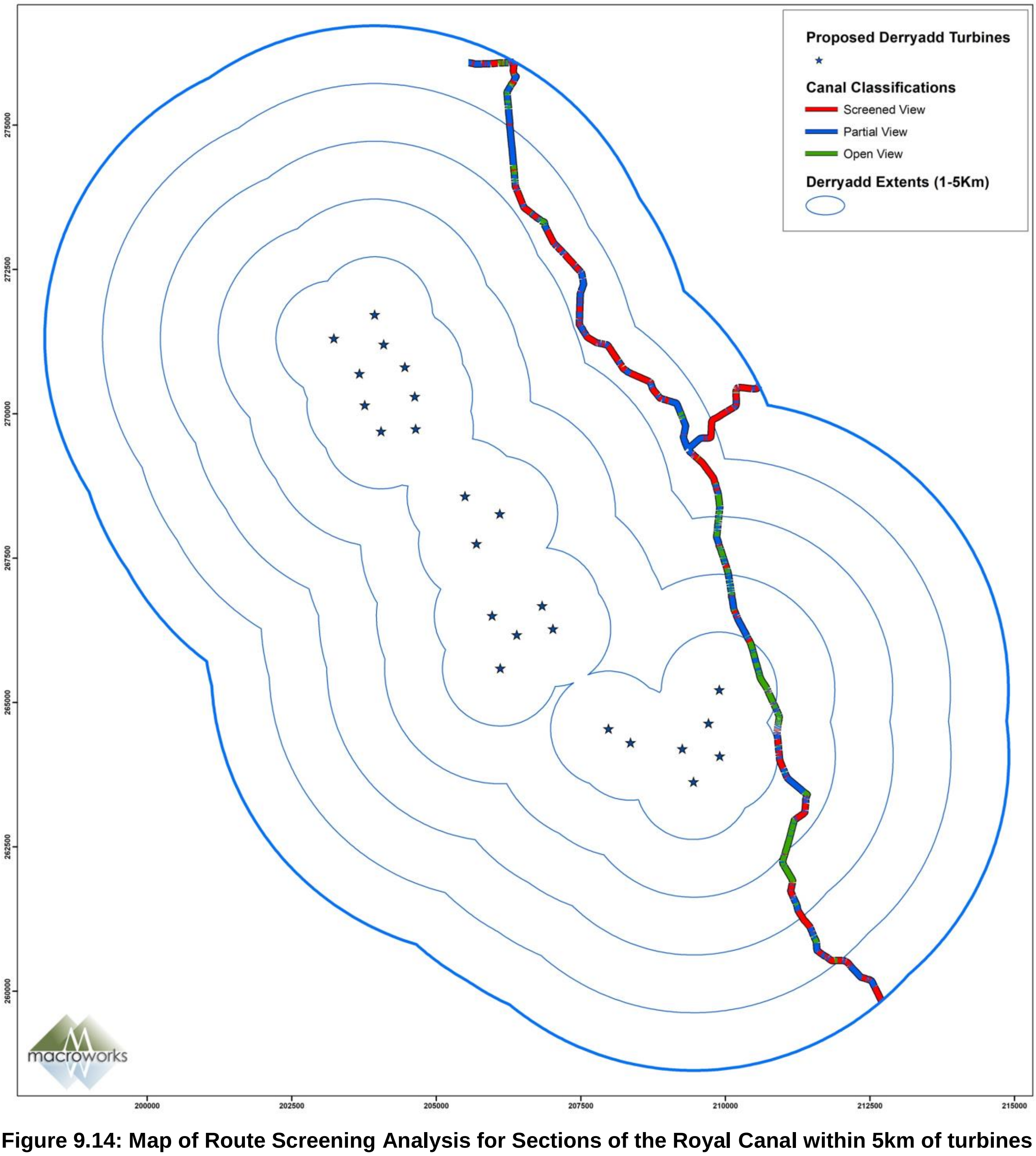


Figure 9.14: Map of Route Screening Analysis for Sections of the Royal Canal within 5km of turbines (see Appendix 9.1 for larger scale version)

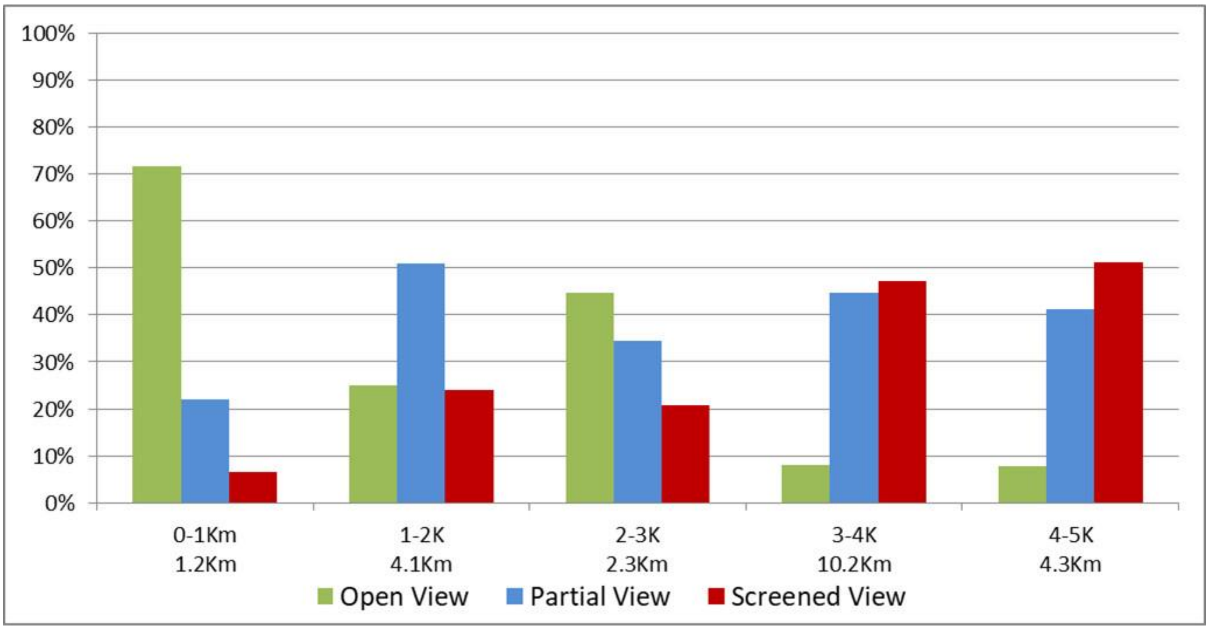


Figure 9.15: Graph of Route Screening Analysis Results from the Royal Canal

As can be seen from the canal RSA map at Figure 9.14 and the associated graph at Figure 9.15, there is a relatively high degree of open visibility for viewers within 1km of the nearest turbine (71%). What is most interesting is that open visibility falls away dramatically for the 1-2km band (down to just 25%), before returning to 45% of canal sections within the 2-3km distance band. The reason for this only become apparent when reviewing the map at Figure 9.14, which shows that there is a high proportion of the short sections of the canal within the 2-3km band that are directly aligned with the nearest group of turbines in the south-eastern portion of the site when travelling from both the north and the south. The expected general downward trend in ‘open visibility’ over distance is restored for the 3-4km and 4-5km distance bands where this classification accounts for around 8% of canal sections. Likewise, the expected increase in ‘full screening’ occurs across the distance bands except in the 2-3km band due to the same reasons of canal alignment with the nearest cluster of turbines.

Beyond 3km from the nearest turbines ‘Open’ visibility falls away dramatically in favour of partial visibility and full screening. As with the RSA from roads this is likely to be function of canal-side screening of even a modest height being sufficient to mask the view of turbines with rapidly diminishing scale-in-relation-to-distance. It is also likely to account for hedgerow and woodland vegetation beyond open sections of the canal contributing to the overall screening from the canal. In the nearer distance bands (0-3km) this intervening vegetation is less likely to be sufficient to fully screen the proposed turbines.

Given the overall degree of screening and the fact that this reduces rapidly after 3km, it is reasonable to interpret that there will be very few locations along the canal and its associated towpaths that will be afforded ‘Open’ views of more than 5 turbines or ‘Open’/’Partial’ views of more than 10 turbines.

9.3.4 Visual Receptors

9.3.4.1 Centres of Population and Houses

The most notable settlement in relation to the proposed Derryadd Wind Farm, on the basis of its size and proximity to the scheme, is Lanesborough, which is approximately 2km to the west of the northernmost portion of the site. The smaller villages of Keenagh and Killashee are situated approximately 2-3km east of the proposed site and Cloondara is approximately 4km to the northeast. Together these settlements are the main centres of population within the central study area (c. 5km radius)

The most substantial sized settlements within the wider study area include Longford Town, situated approximately 7km northeast of the site, Roscommon town approximately 17km west, Athlone approximately 21km south and Carrick on Shannon approximately 28km north of the site. Other notable settlements include Ballymahon approximately 8km southeast and Ardagh village situated approximately 10km east of the site.

There are also a number of crossroad settlements and housing clusters lining the local roads throughout the study area and to a lesser degree within the farmed fringes of the peatland site. None of these dwellings are within 750m of the proposed turbines.

9.3.4.2 Transport Routes

The principal transport route contained within the study area is the M6 motorway between Dublin and Galway. This passes through the southern perimeter of the study area and according to the ZTV map at Figure 9.9 above, will have very limited potential visibility of the proposed turbines at a closest distance of around 21km.

The next highest order roads within the study area include the N4 and N5 national primary routes. The N4 is situated approximately 10km northeast of the proposed development at its nearest point and is oriented in a northwest by southeast direction. Oriented in more of an east-west direction, the N5 diverges from the N4 at Longford Town and is approximately 5km northeast of the site at its nearest point. The N63 and N55 national secondary routes also pass through the central study area. Indeed, the N63, which is oriented in an east-west direction, passes directly through the proposed site to the east of Lanesborough. Located approximately 8km southeast of the site at its nearest point, the N55 is oriented in northeast - southwest direction. The M6 motorway is also located within the 30km study area, however it is situated over 20km south of the proposed site.

Other notable roads in the immediate vicinity of the site include the R394 regional road, which runs almost parallel to the west/southwest boundary of the proposed wind farm at varying distances of less than 2km away. Oriented in a north-south direction, the R397 regional road is situated just over 2km east of the site at its nearest point. The R398 links between the R394 and the R397 passing through the southern section of the site. Several local roads are also situated in the immediate vicinity of the proposed wind farm site. A dense network of regional and local roads also occurs within the outer extents of the study area.

The Dublin – Sligo national railway line passes through Longford approximately 9km northeast of the proposed site, whilst the Dublin to Galway national railway route passes through the settlement of Athlone, approximately 21km south of the site.

9.3.4.3 Tourism, Recreation and Heritage Features

The most notable tourist and heritage feature within the central study area is the Corlea Trackway. This is an ancient trackway of oak planks that allowed passage for Iron Age inhabitants of this area through the bog. A significant visitor centre has been erected around the exposed trackway by the OPW and hosts a variety of exhibits and audio-visual displays relating to the way of life at the time in which the trackway was constructed (148 BC). The Corlea Trackway visitor centre is approximately 1km to the south of the proposed Derryadd Wind Farm site.

Lough Ree is the second of three major lakes on the River Shannon, which also include Lough Allen to the north and Lough Derg to the south. Lough Ree and the River Shannon are popular for fishing and boating and there are local walks around parts of the shoreline. The northern end of Lough Ree is approximately 5km from the northwestern portion of the Derryadd site and the eastern shores of the Lough extend between about 5 - 8km from the site as it wraps around it to the south. The River Shannon runs approximately 2km to the northwest of the site before it passes through Lanesborough having meandered into the study area from the north.

The Hill of Uisneach is an ancient ceremonial hilltop in County Westmeath and was considered to be the centre of Ireland in Irish mythology. There are a number of archaeological remains on the hilltop, which is associated with the festival of Bealtaine. This springtime festival involves the lighting of ceremonial fires on the hilltop. The Hill of Uisneach is approximately 27km to the southeast of the Derryadd Wind Farm site. The hilltop is in private ownership, but visitors can seek access permission from the landowner.

Other notable heritage features include Abbeyderg Monastery near the settlement of Keenagh, which is approximately 3.5km east of the site.

Inchcleraun, or Quaker Island as it is otherwise known, is an island in the middle of Lough Ree that is home to the ruins of St Diarmaid's Monastery (a National Monument). Inchcleraun is approximately 9km to the southwest of the site and the ZTV map indicates only partial blade tip visibility is likely to be afforded from the island. There is also the ruins of an Augustinian Monastery on Saints Island in Lough Ree, which lies approximately 8k to the south of the site (Viewshed reference point VP6 can be considered representative of this receptor and the visual effects of the proposed wind farm on VP6 are assessed in Appendix 9.4).

Construction work is almost complete on Center Parcs Longford Forest site to the south of Ballymahon and this family holiday facility is due to open in summer 2019. The site is contained within a forested area some 12km to the southeast of the proposed wind farm site.

9.3.4.4 Views of Recognised Scenic Value

Views of recognised scenic value are primarily indicated within County Development Plans in the context of scenic views/routes designations, but they might also be indicated on touring maps, guide books, road side rest stops or on post cards that represent the area.

All of the scenic routes and views that fall inside the zone of theoretical visibility (ZTV) pattern (see Figure 9.9) were investigated during fieldwork to determine whether actual views of the proposed wind farm might be afforded. Where inter-visibility could occur, a viewpoint has been selected for use in the visual effect appraisal later in this chapter, otherwise it is omitted with explanation. In some instances, a single viewpoint is selected to represent a stretch of designated scenic route or a cluster of designated scenic views, particularly distant ones.

9.3.4.4.1 Longford County Development Plan 2015-2021

Appendix 6 of the Longford County Development Plan includes a map with a range of 'Views, Prospects and Scenic Routes'. These views are broken down into two groups; full views and intermittent views, and are described in Table 6.1 of the development plan. Table 9.6 below provides a rationale for selection of relevant designated scenic views from the Longford County Development Plan.

Table 9.6: Rationale for selecting relevant scenic designations from Longford County Development Plan

Longford CDP ref.	Relevance to visual impact appraisal?	VP ref no. herein
FULL VIEWS		
FS.1-5	**Yes Relevant** – ZTV map indicates potential for visibility at intermittent points on all routes. (One illustrative viewpoint has been chosen from this area to represent multiple designated views)	DR4
FS.6-7	**Not Relevant** – Viewpoints located outside of ZTV	-
FS.8-9	**Yes Relevant** – ZTV map indicates potential for visibility at intermittent points on both routes. (One illustrative viewpoint has been chosen from this area to represent multiple designated views)	DR4
FS.10-11	**Not Relevant** – Views are situated outside of the 30km study extents	-
FS.12	**Yes Relevant** – ZTV map indicates potential for visibility at intermittent points along route. (One illustrative viewpoint has been chosen from this area to represent multiple designated views)	DR4
FS.13-14	**Yes Relevant** – ZTV map indicates potential for visibility at intermittent points on both routes. (One illustrative viewpoint has been chosen from this area to represent multiple designated views)	DR5
FS.15	**Not Relevant** – View situated outside of the 30km study extent	-
FS.16	**Yes Relevant** – ZTV map indicates potential for visibility at intermittent points along route. (One illustrative viewpoint has been chosen from this area to represent multiple designated views)	DR5
FS.17	**Yes Relevant** – views afforded towards proposed wind farm	DR9 and DR10
FS.18	**Yes Relevant** – views afforded towards proposed wind farm	DR11

FS.19	**Yes Relevant** – views afforded towards proposed wind farm	DR12
FS.20	**Yes Relevant** – views afforded towards proposed wind farm	DR13
FS.21	**Yes Relevant** – views afforded towards proposed wind farm	DR15
FS.22	**Yes Relevant** – views afforded towards proposed wind farm	DR16
INTERMITTENT VIEWS		
IS.1	**Yes Relevant** – ZTV map indicates potential for visibility at intermittent points along route. (One illustrative viewpoint has been chosen from this area to represent multiple designated views)	DR4
IS.2	**Not Relevant** – View situated outside of the 30km study extent	-
IS.3	**Yes Relevant** – ZTV map indicates potential for visibility at intermittent points along route. (One illustrative viewpoint has been chosen from this area to represent multiple designated views)	DR4
IS.4	**Not Relevant** – View situated outside of the 30km study extent	-
IS5-6	**Yes Relevant** – ZTV map indicates potential for visibility at intermittent points along route. (One illustrative viewpoint has been chosen from this area to represent multiple designated views)	DR4
IS.7	**Not Relevant** – Viewpoint located outside of ZTV	-
IS.8-11	**Yes Relevant** – ZTV map indicates potential for visibility at intermittent points along route. (One illustrative viewpoint has been chosen from this area to represent multiple designated views)	DR4
IS.12	**Yes Relevant** – views afforded towards proposed wind farm	DR7
IS.13	**Yes Relevant** – views afforded towards proposed wind farm (One illustrative view has been chosen to represent both FS.17 and IS.13)	DR9

IS.14	**Yes Relevant** – views afforded towards proposed wind farm (One illustrative view has been chosen to represent both FS.20, IS.14 and IS.17)	DR13
IS.15-16	**Yes Relevant** – views afforded towards proposed wind farm (One illustrative view has been chosen to represent both FS.21, IS.15 and IS.16)	DR15
IS.17	**Yes Relevant** – views afforded towards proposed wind farm (One illustrative view has been chosen to represent both FS.20, IS.14 and IS.17)	DR13
IS.18	**Not Relevant** – road heavily enclosed by forest, woodland and hedgerows. Views of turbines unlikely	-

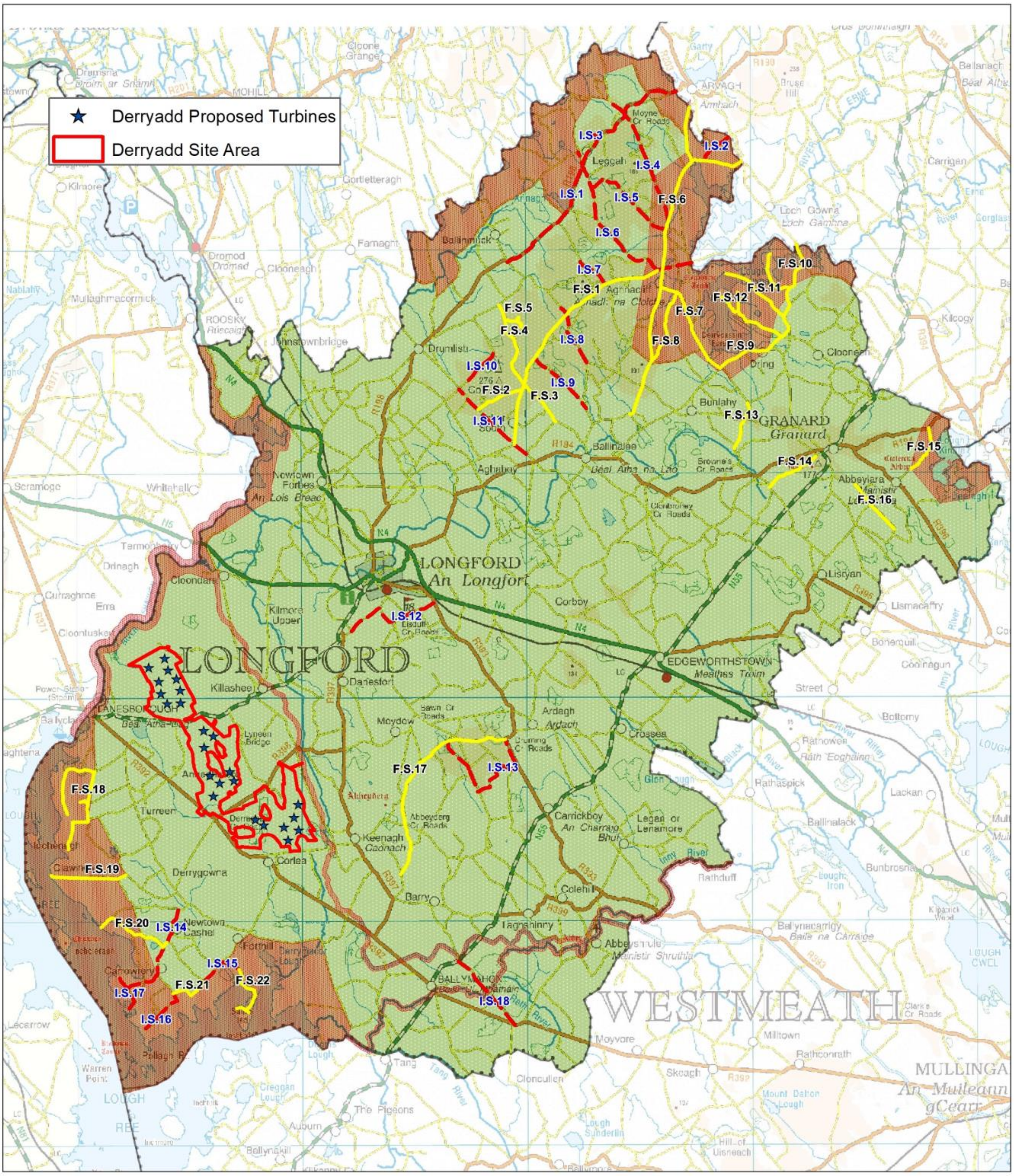


Figure 9.16: Appendix 6 of the Longford County Development Plan showing full and intermittent views in relation to the proposed development

Policy in relation to Scenic designations includes the following;

LCA 3: It is the policy of the Council to preserve views and prospects as illustrated on the accompanying map as part of Appendix 6 and as listed in the following tables. Views are divided into full and intermittent in order to differentiate areas where scenic views may be partial or absent along a particular route. The following table lists the routes (as numbered on the map) and lists the townlands through which they pass for identification purposes.

9.3.4.4.2 Roscommon County Development Plan 2014-2020

Appendix 1 of the Roscommon landscape character assessment includes maps and tables outlining designated scenic views and routes in County Roscommon. Table 9.7 below provides a rationale for selection of relevant designated scenic views and routes from the Roscommon County Development Plan.

Table 9.7: Rationale for selecting relevant scenic designations from Roscommon County Development Plan

Longford CDP ref.	Relevance to visual impact appraisal?	VP ref no. herein
SCENIC ROUTES		
R5	**Not Relevant** – Views are oriented away from the proposed development	-
R7	**Yes Relevant** – views afforded towards proposed wind farm	DR8
R8	**Not Relevant** – Viewpoint located outside of ZTV	-
SCENIC VIEWS		
V9	**Not Relevant** – Relates to immediate landscape context not distant views (20+ km)	-
V10	**Not Relevant** – Viewpoint located outside of ZTV	-
V12	**Not Relevant** – Views are oriented away from the proposed development	-
V13	**Yes Relevant** – views afforded towards proposed wind farm	DR2
V16	**Yes Relevant** – views afforded towards proposed wind farm	DR3

V17-18	**Not Relevant** – Viewpoint located outside of ZTV	-
V19	**Yes Relevant** – views afforded towards proposed wind farm	DR17
V20	**Yes Relevant** – views afforded towards proposed wind farm	DR18
V21	**Yes Relevant** – views afforded towards proposed wind farm	DR6
V22	**Not Relevant** – Views are oriented away from the proposed development	-

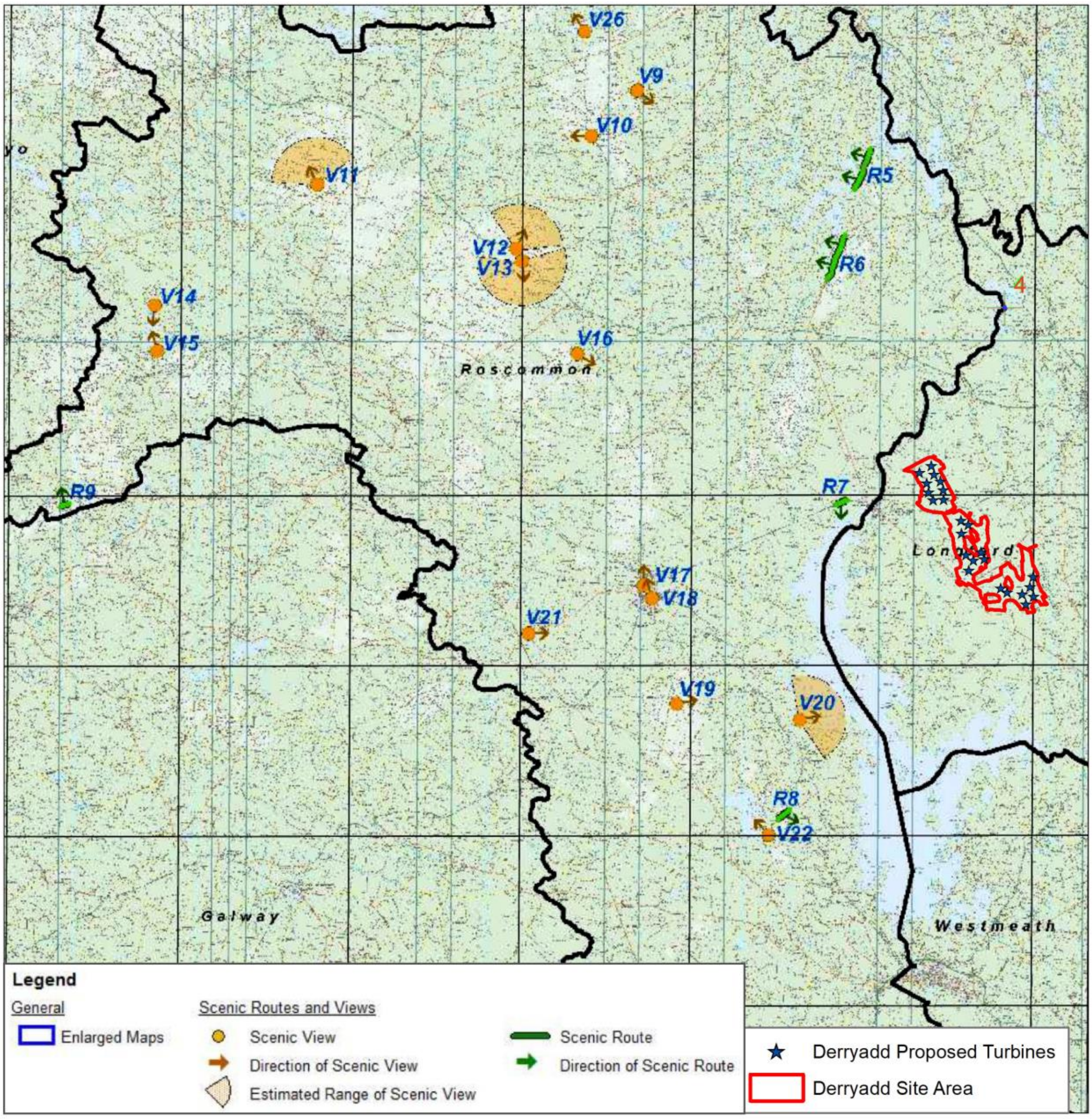


Figure 9.17: Appendix 1 of the Roscommon County Development Plan showing designated scenic views and routes in relation to the proposed development

Council Policy in relation to designated scenic views and prospects includes the following:

Objective 7.40: Seek to protect important views and prospects in the rural landscape and visual linkage between established landmarks, landscape features and views in urban areas.

9.3.4.4.3 Westmeath County Development Plan 2014-2020

The Westmeath County Development Plan indicates its scenic views "to be preserved or improved" in Volume 2, Maps 01_WH_01 – 07. Relevant maps are shown below:

Table 9.8: Rationale for selecting relevant scenic designations from Westmeath County Development Plan

Westmeath CDP ref.	Relevance to visual impact appraisal?	VP ref no. herein
1-3	**Not Relevant** – Views are oriented away from the proposed development and/or situated outside of ZTV	-
4	**Yes Relevant** - Views afforded towards proposed wind farm from Lough Ree	DR26
5-6	**Not Relevant** – Views are oriented away from the proposed development and/or situated outside of ZTV	-
7	**Yes Relevant** – views afforded towards proposed wind farm	DR19
8-9	**Not Relevant** – Views are oriented away from the proposed development and/or situated outside of ZTV	-
10	**Yes Relevant** – views afforded towards proposed wind farm	DR20
11-13	**Not Relevant** – Views are oriented away from the proposed development and/or situated outside of ZTV	-
14	**Yes Relevant** – views afforded towards proposed wind farm	DR24
15	**Not Relevant** – View oriented away from the proposed development and/or situated outside of ZTV	-
18	**Yes Relevant** – views afforded towards proposed wind farm	DR24
24	**Yes Relevant** – views afforded towards proposed wind farm	DR23
26	**Yes Relevant** – views afforded towards proposed wind farm	DR22

27	**Yes Relevant** – views afforded towards proposed wind farm	DR21
34	**Not Relevant** – View are oriented away from the proposed development and/or situated outside of ZTV	-
35	**Yes Relevant** – View oriented slightly oblique to proposed development.	DR21
36	**Not Relevant** – Viewpoint situated outside of ZTV	-
37	**Yes Relevant** – views afforded towards proposed wind farm	DR21
38	**Not Relevant** – Viewpoint situated outside of ZTV	-

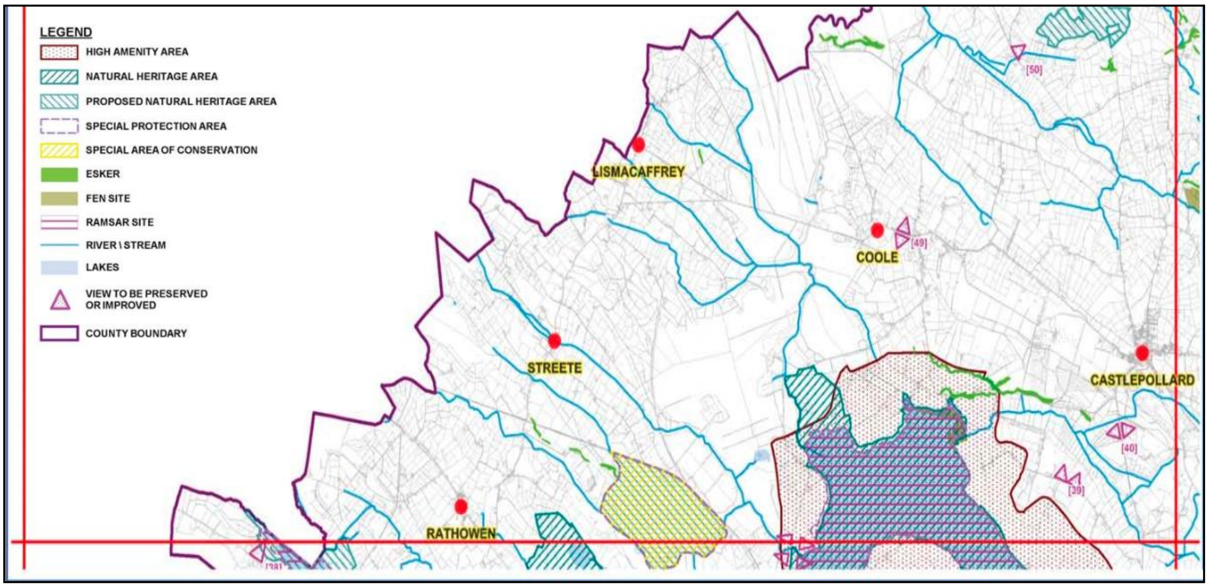


Figure 9.18: Volume 1, Map 01_WH_01 of the Westmeath County Development Plan showing designated scenic views and routes

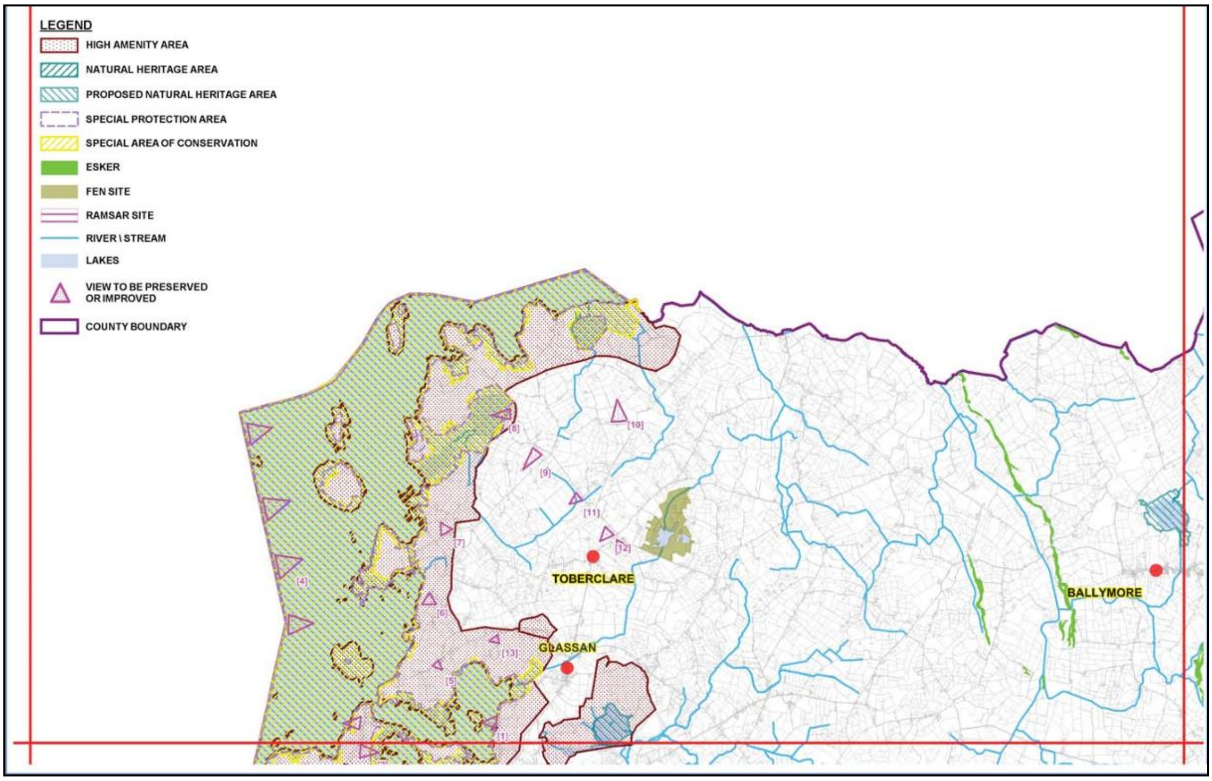


Figure 9.19: Volume 1, Map 01_WH_03 of the Westmeath County Development Plan showing designated scenic views and routes

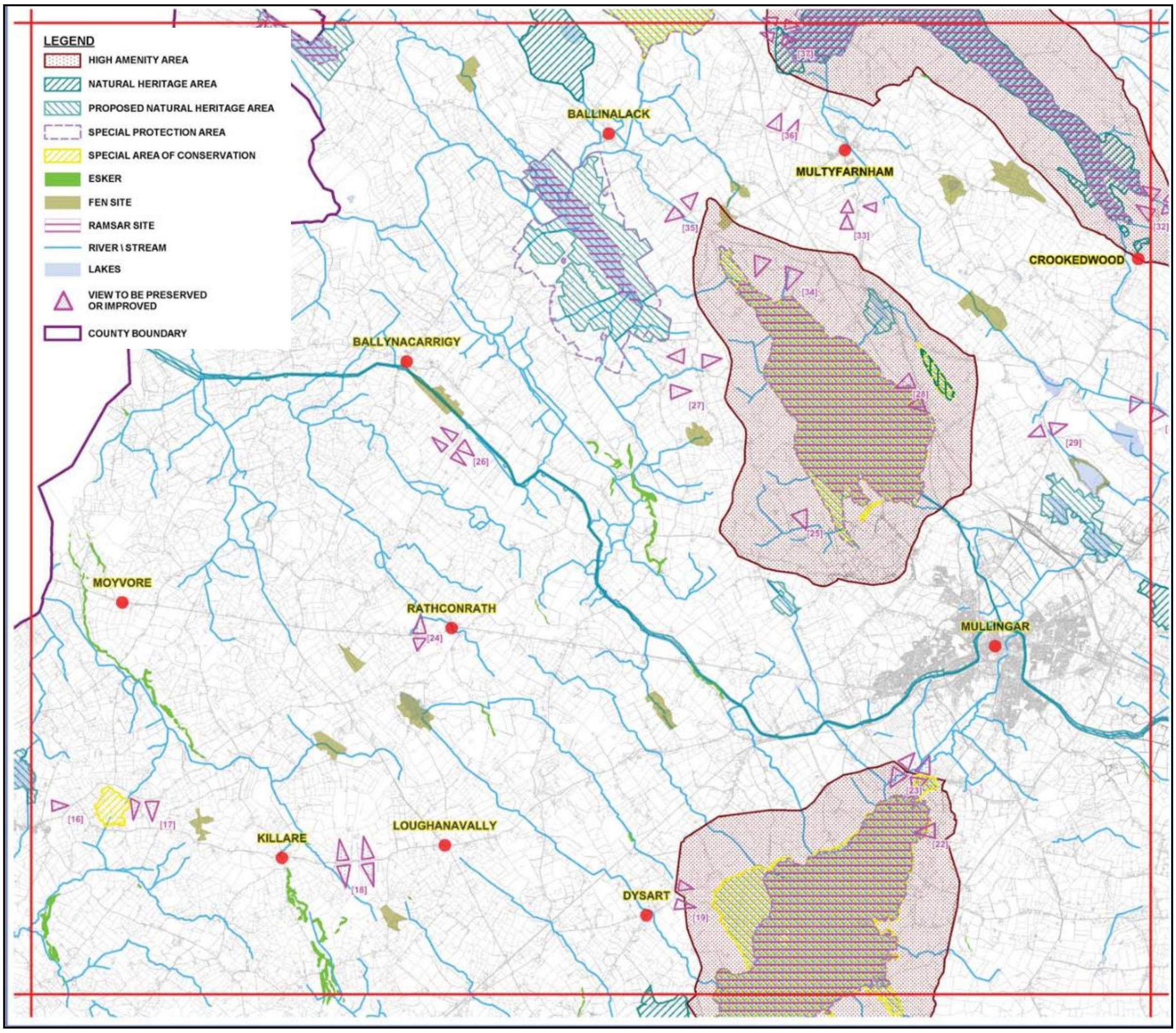


Figure 9.20: Volume 1, Map 01_WH_04 of the Westmeath County Development Plan showing designated scenic views and routes

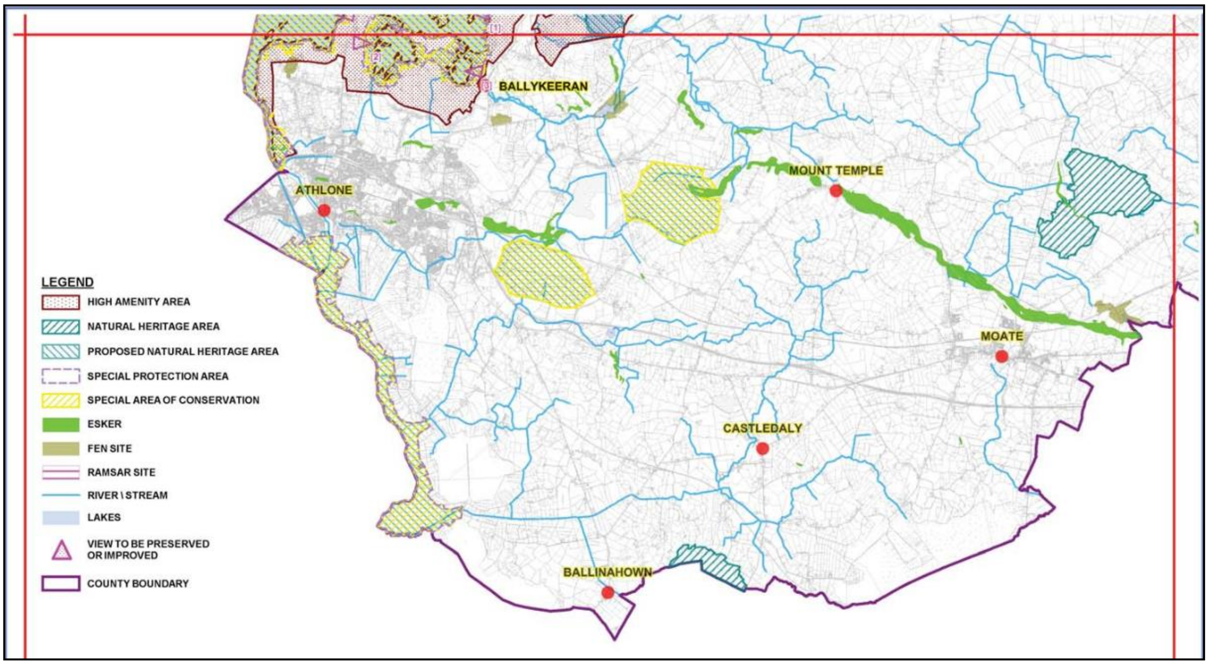


Figure 9.21: Volume 1, Map 01_WH_06 of the Westmeath County Development Plan showing designated scenic views and routes

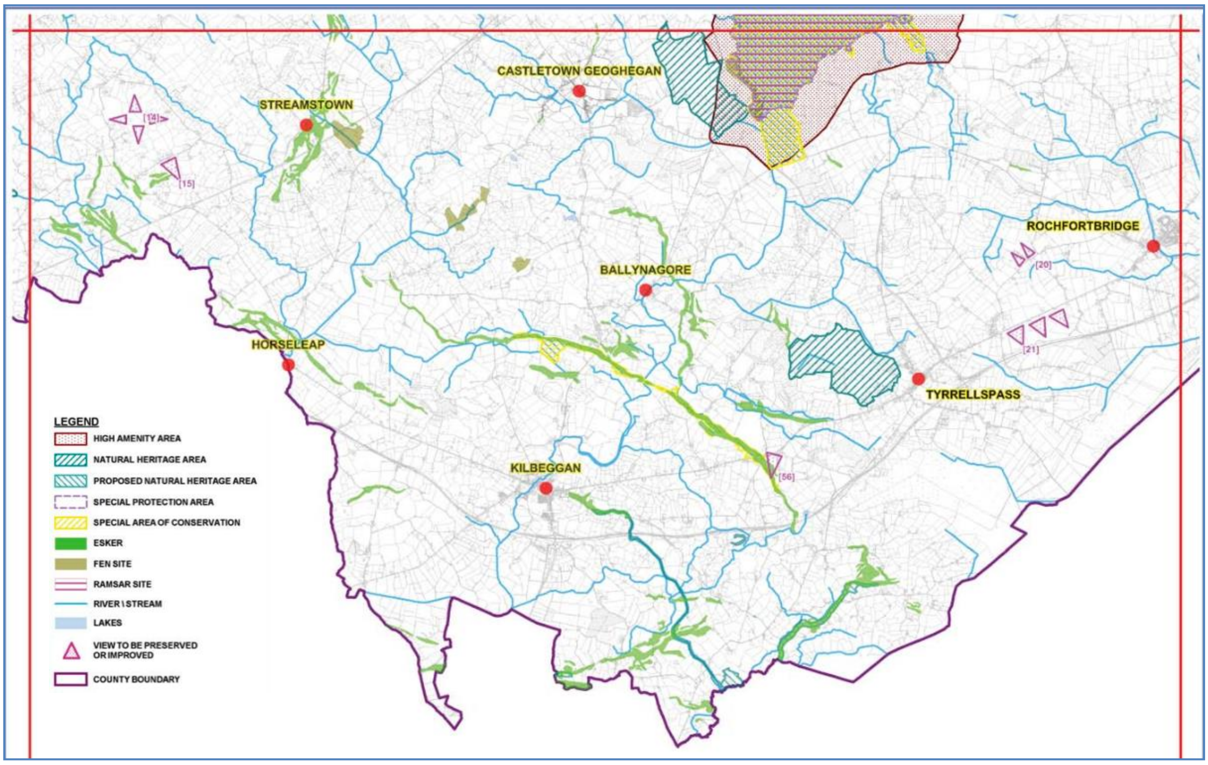


Figure 9.22: Volume 1, Map 01_WH_07 of the Westmeath County Development Plan showing designated scenic views and routes

Council Policy in relation to designated scenic views and prospects includes the following:

P-VP1: To protect views that contribute to the character of the landscape and resist development that would detract from the preservation of such views.

P-VP2: To investigate the feasibility of the provision of car parking facilities and viewing places, at points where views and prospects of special importance are obtained.

P-VP3: To remove derelict sites and structures adjacent to scenic and tourist routes, under the provisions of the Derelict Sites Act 1990.

Council Objectives in relation to designated scenic views and prospects includes the following:

O-VP1: To undertake a review of listed views within the county during the lifetime of the plan.

9.3.4.4.4 Leitrim County Development Plan 2015-2021

The Leitrim County Development Plan indicates its outstanding views and prospects, areas of high visual amenity and areas of outstanding natural beauty on 'Amenity Map' of the Development Plan. An excerpt from this map is included below:

Table 9.9: Rationale for selecting relevant scenic designations from Leitrim County Development Plan

Leitrim CDP ref.	Relevance to visual impact appraisal?	VP ref no. herein
V25	**Yes Relevant** – Views located in ZTV although oriented to the River Shannon at a short distance.	DR1
V26	**Not Relevant** – Views oriented away from proposed development	-
V27	**Not Relevant** – views not afforded towards proposed wind farm	-
V28	**Not Relevant** – views not afforded towards proposed wind farm	-

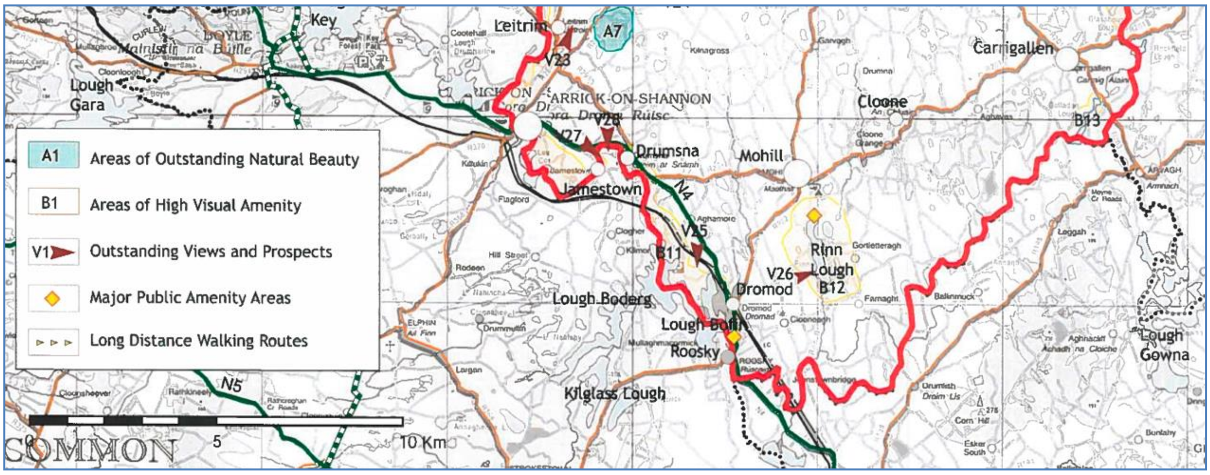


Figure 9.23: Leitrim County Development Plan, Amenity Map – outlining outstanding views and prospects, areas of high visual amenity and areas of outstanding natural beauty

Council Policy in relation to designated scenic views and prospects includes the following:

Policy 102: It is the Council's policy to protect these views from intrusive development and enhance them by the removal of the dereliction and eyesores. Lay-bys and viewing areas will be developed, as appropriate and as funds allow.

Council Objectives in relation to designated scenic views and prospects includes the following:

Objective 82: It is an objective of the Council to protect the following Views and Prospects, (Table 20 of the Development Plan refers).

9.3.4.5 Identification of Viewshed Reference Points (VRPs) as a basis for Assessment

The results of the ZTV analysis provide a basis for the selection of Viewshed Reference Points (VRPs), which are the locations used to study the landscape and visual impact of the proposed wind farm in detail. It is not warranted to include each and every location that provides a view of this development as this would result in an unwieldy report and make it extremely difficult to draw out the key effects arising from the project. Instead, the assessors endeavoured to select a variety of receptor locations that would provide views of the proposed wind farm from different distances, different angles and different contexts.

The visual impact of a proposed development is assessed using up to six categories of receptor type as listed below:

- Key Views (from features of national or international importance);
- Designated Scenic Routes and Views;

- Local Community Views;
- Centres of Population;
- Major Routes; and
- Amenity and Heritage Features.

VRPs might be relevant to more than one category and this makes them even more valid for inclusion in the assessment. In such cases, the VRP will be identified in terms of the primary reason for which it was chosen, but all attributes of the receptor location will be considered in the assessment of its sensitivity.

9.3.4.5.1 Key Views (KV)

These VRPs are at features or locations that are significant at the national or even international level, typically in terms of heritage, recreation or tourism. They are locations that attract a significant number of viewers who are likely to be in a reflective or recreational frame of mind, possibly increasing their appreciation of the landscape around them. The location of this receptor type is usually quite specific.

9.3.4.5.2 Designated Scenic Routes and Views (DR)

Due to their identification in the County Development Plan this type of VRP location represents a general policy consensus on locations of high scenic value within the Study Area. These are commonly elevated, long distance, panoramic views and may or may not be mapped from precise locations. They are more likely to be experienced by static viewers who seek out or stop to take in such vistas.

9.3.4.5.3 Local Community Views (LC)

This type of VRP represents those people who live and/or work in the locality of the proposed wind farm, usually within a 5 km radius of the site. Although the VRPs are generally located on local level roads, they also represent similar views that may be available from adjacent houses. The precise location of this VRP type is not critical; however, clear elevated views are preferred, particularly when closely associated with a cluster of houses and representing their primary views. Coverage of a range of viewing angles using several VRPs is necessary in order to sample the spectrum of views that would be available from surrounding dwellings.

9.3.4.5.4 Centres of Population (CP)

VRPs are selected at centres of population primarily due to the number of viewers that are likely to experience that view. The relevance of the settlement is based on the significance of its size in terms of the Study Area or its proximity to the site. The VRP may be selected from any location within the public domain that provides a clear view either within the settlement or in close proximity to it.

9.3.4.5.5 Major Routes (MR)

These include national and regional level roads and rail lines and are relevant VRP locations due to the number of viewers potentially affected by the proposed development. The precise location of this category of VRP is not critical and might be chosen anywhere along the route that provides clear views towards the proposal site, but with a preference towards close and/or elevated views. Major routes typically provide views experienced whilst in motion and these may be fleeting and intermittent depending on screening by intervening vegetation or buildings.

9.3.4.5.6 Public Amenity and Heritage Features (AH)

These views are often one and the same given that heritage locations can be important tourist and visitor destinations and amenity areas or walking routes are commonly designed to incorporate heritage features. Such locations or routes tend to be sensitive to development within the landscape as viewers are likely to be in a receptive frame of mind with respect to the landscape around them. The sensitivity of this type of visual receptor is strongly related to the number of visitors they might attract and, in the case of heritage features, whether these are discerning experts or lay tourists. Sensitivity is also heavily influenced by the experience of the viewer at a heritage site as distinct from simply the view of it. This is a complex phenomenon that is likely to be different for every site. Experiential considerations might relate to the sequential approach to a castle from the car park or the view from a hilltop monument reached after a demanding climb. It might also relate to the influence of contemporary features within a key view and whether these detract from a sense of past times. It must also be noted that the sensitivity rating attributed to a heritage feature for the purposes of a landscape and visual assessment is not synonymous with its importance to the Archaeological or Architectural Heritage record.

Table 9.10: Outline Description of Selected Viewshed Reference Points (VRPs)

VRP No.	Location	Direction of view
DR1	N4 at Fearnaght	S
DR2	Rathcroghan heritage area on the N5	SE
DR3	Local road at Carns	SE
DR4	Local road at Corn Hill	SW
DR5	Graveyard at Granard	SW
DR6	R366 at Castlecoote	E
DR7	Graveyard on local road at the outskirts of Longford	SW
DR8	N63 west of Lanesborough	E
DR9	Local road at Castlerea Mountain	W
DR10	Local road south of Abberyderg	W

DR11	Local road south of Lanesborough	E
DR12	Local road at Carrickmoran	NE
DR13	Local road at Elfeet	NE
DR14	Local road at Newtown Cashel	N
DR15	Local road at Corrool	N
DR16	Local road causeway to Saints Island	N
DR17	Local road at Moydow, south of Roscommon	NE
DR18	Local road west of Lough Ree	NE
DR19	Local road at Glebe east of Lough Ree	N
DR20	Local road at Littletown	N
DR21	Local road west of Lough Owel	NW
DR22	Local road south east of Ballynacarrigy	NW
DR23	R392 west of Mullingar	NW
DR24	Hill of Uisneach	NW
DR25	Lough Ree (north)	NE
DR26	Lough Ree (south)	E
LC1	Local road north of site	S
LC2	Local road southeast of Lanesborough	E
LC3	Canal crossing west of Keenagh	NW
LC4	Local road at Derryadd	W
CP1	Cloondara north of site	S
CP2	Lanesborough Bridge	E
CP3	Lanesborough east (N63)	E
CP4	Killashee	W
CP5	Keenagh (R397)	NW
CP6	Roscommon Town	E
CP7	Ballymahon	NW
MR1	R371 south of Curraghroe	SE
MR2	N5 east of Cloondara	S
MR3	N5 west of Longford	SW
MR4	R371 northwest of Lanesborough	SE
MR5	N63 at Rappareehill	NW/SE
MR6	R398 at Derrygeel	NE
MR7	R398 at Cloontabeg	N/SE
MR8	R392 southwest of site	NE

MR9	R392 northwest of Ballymahon	NW
MR10	N63 northeast of Roscommon Town	E
AH1	Royal Canal Way southeast of Killashee	W
AH2	Royal Canal Way northwest of Keenagh	W
AH3	Corlea Trackway Visitors Centre	NW

9.4 POTENTIAL EFFECTS

9.4.1 Do Nothing Scenario

Should the proposed development not proceed, the site is likely to remain as cutaway peatland and fringe scrubland, whilst slowly reverting to a more naturalistic state in response to current and future Bord na Móna restoration measures as commercial peat extraction is phased out. The continued operation of the Lough Ree Power Station is dependent on an extension of its existing planning permission. Thus, there is potential that the Power Station could be removed from the Lanesborough skyline. If an extension to the existing consent is achieved then the plant will continue to operate and as such forms part of the Do Nothing Scenario.

Overall, it is not considered that there will be any significant landscape or visual impacts in a do-nothing-scenario and the most likely outcome is that receptors will not experience any noticeable change to the baseline context.

9.4.2 Landscape Effects

9.4.2.1 Landscape Character Value and Sensitivity

Effects on landscape character will be considered at both the localised scale of the site and its immediate surrounding landscape (<5 km) as well as the broader scale of the study area (5-30km).

Central Study Area (<5km)

The site and its immediate surrounds comprise a fairly even mix of cutaway peatland and pastoral farmland and have a productive and utilitarian character. There is a strong connection between the primary industries of this area and the settlement of Lanesborough, which is a rural service centre and contains a substantial peat fired power station. The central study area is typical of many parts of the midlands landscape and whilst it could be described as representative of a midlands landscape, it is not particularly rare or distinctive in character.

In the transitional zones between sections of cutaway peatland and productive farmland there are transitional areas of undisturbed bog and scrubland as well as marginal farmland. Though not aesthetically distinctive these apparently fallow areas are often the subject of conservation based designations. Indeed, there are a number of Special Areas of Conservation and proposed Natural Heritage Areas within the central study area mainly relating to bogs and wetland features (which are set out in section *9.3.2.7 Conservation Interests*).

Notwithstanding the general utilitarian character of the central study area, there are some distinctive elements and important landscape associations. The River Shannon, which is the largest and longest river in the country, passes around 2km to the northwest of the site and aside from being the principal divide between the east and west of Ireland, has been an important waterway for millennia. The north-western extent of the Royal Canal, an important historic transport corridor and now recreational feature, passes a short distance to the east of the site. It connects from the River Shannon to the north of the site, through the midlands, to Dublin. The other important landscape and heritage association for the central study area is the 'Corlea Trackway'. This is a section of an ancient oak plank track that would have provided access to or through the bog for the area's inhabitants in the Iron Age. It is one of the oldest such features to be found in Europe and has a dedicated visitor centre.

Overall, the value of the landscape of the central study area is considered to relate more to rural productivity and the subsistence of rural communities rather than to scenic or picturesque values. Whilst there is some conservation value evident in the number of ecological designations within the central study area, such features tend to be within subtle transitional zones between the key productive land uses and only provide a modest contribution to the overall landscape character. On the basis of these reasons the landscape sensitivity of the site and central study area is deemed to be **Medium-low**.

Wider Study Area

The landscape character of the wider study area is predominantly rural consisting of lowland farming, commercial peatland harvesting and occasional forest plantations within upland areas. In this respect the character is not dissimilar to the central study area, but the proportion of peatland areas is much lower. Wind energy development is present but is not a defining landscape element.

Within the wider study area there are some sensitive landscape features and the most notable of these is the substantial sized Lough Ree on the River Shannon corridor. This has a number of heritage associations, especially relating to its islands and has been an important water body within this region since antiquity. Lough Ree is also valued for recreational and scenic amenity reasons. The River Shannon itself traverses the entire study area from north to south and is a significant landscape feature in the context of both the immediate environs of the site and the wider study area.

There is a lake rich drumlin zone within the northernmost quarters of the study area. This is an area of relatively distinctive character, where recreational and scenic value is attached to the lakes. However, vast drumlin areas occur between County Mayo and County Cavan in this region and this is not a particularly rare or susceptible landscape type.

There are a series of upland plateaus, ridges and hilltops within the outer study area and the most prominent of these is the elongated ridge of Slieve Bawn, which lies some 8km to the northwest of the site. There is a subtle area of elevated ground on the eastern side of Lough Ree that runs between approximately 5km and 8km to the west of the site and acts as something of a physical and contextual barrier between the lake and the site environs. In heritage terms the most renowned hilltop within the study area is the Hill of Uisneach some 27km to the southeast of the site. This site is steeped in Irish mythology has a number of archaeological remains and is the home of the pagan festival of Bealtaine. Nonetheless, this hilltop is contained in private ownership and is not as well known to the general public as the likes of the Hill of Tara.

Although the wider study area contains some notable landscape features it is not considered that it has a particularly rare or distinctive 'landscape image' or iconic associations. Like the central study area, the principal landscape values appear to relate to rural subsistence and productivity and these values are not particularly susceptible to new forms of rural development. Overall it is considered that the landscape sensitivity of the wider study area is **Medium-low** with some singular features of medium or high landscape sensitivity.

9.4.2.2 Magnitude of Landscape Effects

9.4.2.2.1 Physical Effects on Landscape Elements

The physical landscape as well as the character of the site and its immediate surrounds will be affected by the proposed turbines as well as ancillary development such as access and circulation roads, areas of hard standing for the turbines, met masts, substations and control buildings. By contrast, for the wider landscape of the study area, landscape effects relate almost exclusively to the influence of the proposed turbines on landscape character, as ground-based structures and activity will not be apparent.

In terms of the scale and nature of proposed works there will be 30km of new 6m wide access track provided. Hardstands around each turbine base will consist of a number of different areas for crane erection, blade storage and rotor hub laydown and will have a combined area of approx. 6500m^2 during construction and these will be reinstated to less extensive maintenance pads for the duration of the operational stage.

As hedgerows were not commonly encountered at the site during the biodiversity surveys, it is unlikely that hedgerows will need to be removed to facilitate construction of the proposed development. Of the approximately 1,900 ha total area within the planning/development boundary, the turbine foundations and hardstanding areas, substation(s), associated infrastructure (including five temporary compounds and borrow pits) and internal roads combine for an area of approximately 51.8 ha or 2.7% of the total area. There will be minor and temporary ground disturbance from trenching operations required for laying underground cables to the substation(s), but trenches will be reinstated immediately.

The proposed wind farm development will have a relatively minor physical effect on the landscape within the site as the proposed development features have a modest construction 'footprint' in the context of the overall site. Furthermore, the site consists of highly modified cutaway peatland. The current topography and land cover of the site will remain largely unaltered with construction being limited to tracks, areas of hard standing for the turbines, three additional and permanent meteorological masts as well as one substation (at one of two proposed locations) and temporary site construction compounds. A network of five on-site borrow pits will be utilised for the winning of building aggregates. Excavations will tie into existing ground levels and will be the minimum required for efficient working. Any temporary excavations or stockpiles of material will be re-graded to marry into existing site levels and reseeded or left to regenerate appropriately in conjunction with advice from the project ecologist.

The land cover of the site will only be interrupted as necessary to build the structures of the development and to provide access. There will be some minor disturbance to existing vegetation to facilitate access and construction both within the site and at pinch-points along the proposed haul route. However, much of this vegetation consists of scrubby peatland species rather than mature treelines or hedgerows. Vegetation removal can largely be replaced by natural reseeding of the on-site peatland species, or if warranted in certain cases, replaced with active reseeding where permanent clearance is not required.

Two proposed substations options are outlined within the site Only one of these will be progressed to construction (subject to a future connection agreement with EirGrid).

9.4.2.2.1.1 Substation Option A

Option A is located approximately 300m to the south of the N63 at Cloonfore. The substation proposed is a 110 kV facility within which battery storage containers will also be placed. The footprint of the proposed substation is the same for both options, i.e. approximately 142 metres in length by approximately 120 metres. The internal cable route connections from the turbines to the substation will be underground while the connection from the substation to the existing 110kV overhead transmission system will be overhead line, again subject to an EirGrid connection agreement. All are contained within the cutaway peatland site under Bord na Móna ownership.

9.4.2.2.1.2 Substation Option B

Option B is a similar distance to the north of the R398/R392 intersection at Derraghan. The substation proposed is an 110kV facility within which battery storage containers will be placed. As above, the footprint of the proposed substation is approximately 142 metres in length by approximately 120 metres. The internal cable route connections from the turbines to the substation will be underground while the connection from the substation to the existing 110kV overhead transmission system will be either overhead line or buried underground, again subject to an EirGrid connection agreement. Both the proposed underground and overhead connection to the 110KV network will traverse the R392 along a short section of both routes. The majority of the connection routes and all other infrastructure are contained within the cutaway peatland site under Bord na Móna ownership.

Both substation/battery storage options will result in a node of more intensive electrical infrastructure development within the overall site, but with a relatively modest physical footprint and, therefore, land cover disturbance. Both substation options will be set back from surrounding roads and residences such that neither will be a visually prominent feature and they will also avail of intervening vegetation screening to further aid visual assimilation within the surrounding landscape pattern. Trenching operations for burying electrical cables will result in temporary landcover disturbance and some minor vegetation removal, but such effects will be temporary, and reversible.

In summary, physical effects on land cover and landscape features will be at its greatest during construction and decommissioning phases when processes require larger working / stockpiling areas. Construction working areas and tracks will be partially reinstated during the operational phase and almost fully reinstated after decommissioning. These physical effects will be modest in the context of this extensive cutaway peatland site and will also be short term / temporary in duration. Operational stage physical landscape impacts will also be negative in nature, but to a lesser degree than at construction and decommissioning stages. Operational stage effects will be long term, but substantially reversible following decommissioning. For these reasons, significant impacts on the physical land cover and landscape features of the site are not considered likely to occur.

9.4.2.2.2 Effects on Landscape Character

Construction and Decommissioning Stages

Site activity will be at its greatest during the construction phase due to the operation of machinery on site and movement of heavy vehicles to and from site. This phase will have a more significant effect on the character of the site, but it is a short-term effect that will cease as soon as the wind farm is constructed. Thereafter, operational activities such as monitoring and maintenance are of a low frequency, scale and intensity.

Whilst there may be some site lighting required during those portions of the construction period spanning winter months (see Construction and Environmental Management Plan, Appendix 2.2), there will be no significant light-spill from the site during the operational phase as the vast majority of site activity will occur during daylight hours and little requirement from external lighting of operations facilities. Aircraft navigation lighting provided to meet Irish Aviation requirements will be fitted with directional baffles to ensure that the light is directed skywards and will be barely discernible from the ground.

The decommissioning phase will have similar short-term effects as the construction phase with the movement of large turbine components away from the site. There may be a minor loss of roadside and trackside vegetation that has grown during the operation phase of the development, but this can be reinstated upon completion of decommissioning. Areas of hard standing and access tracks that are of no further use will be reinstated and reseeded to blend with the prevailing surrounding land cover of the time. It is expected that the decommissioning phase would be completed within a period of approximately 6 months.

Due to the fact that construction and decommissioning stage effects on landscape character are substantially confined to the immediate context of the site and will be short term / temporary in nature, these are not considered to be significant.

Operational Stage

For most commercial wind energy developments, the greatest potential for landscape effects to occur is as a result of the change in character of the immediate area due to the introduction of tall structures with moving components for the duration (long term) of the operational stage. Thus, wind turbines that may not have been a characteristic feature of the area become a new defining element of that landscape character. In this instance, wind turbines are not a familiar feature of the immediate area, but they are present within the wider landscape (Sliabh Bawn Wind Farm and Skrine Wind Farm) and also within similar peatland landscape types within midland counties (Mount Lucas and Meenwaun – Offaly, Monaincha – Tipperary, Lisheen Mines and Bruckana – Tipperary/Kilkenny/Laois).

In terms of scale and function, the proposed wind farm is well assimilated within the context of the central study area, which consists of large cutaway peatlands and adjoining farmland that generally comprises a broad-grained field pattern. These productive land uses also impart a utilitarian landscape character within which the proposed wind farm will not be incongruous. Furthermore, the proposed wind farm need not affect the capacity of the underlying land uses, which can continue almost unabated below the turbines. The wind farm can be considered a supplementary layer of productivity within this landscape rather than an alternative land use.

In respect of the comparatively higher sensitivity landscape features within the study area, which include short sections of the River Shannon and the Royal Canal, it is important to consider that these are generally well contained linear corridors. As such, the turbines, if visible at all within these corridors, will tend to be partially revealed background features that occur within the surrounding rural landscape at a discrete remove from the waterway corridor itself.

Although the wind farm represents a stronger human presence and intensity of built development than currently exists on the site, it will not materially alter the salient rural landscape character. This is on the basis that wind farms are already present on flat peatland sites throughout the midlands without a sense that such areas have become industrialised. In part, this is because the nature of wind farm developments comprises dispersed (c 500m apart), point-based vertical features that do not significantly interrupt the underlying terrain and land cover patterns. Furthermore, in Ireland, they are synonymous with rural, upland and peatland landscapes rather than urban or industrial landscapes.

It is important to note that, in terms of duration, the construction and decommissioning stages represent Short Term / Temporary effects, whilst the operational stage of this wind farm proposal represents a long term, but not permanent effects on landscape character. The lifespan of the project is 30 years, after which time an assessment will be made to decommission the wind farm or apply for permission to repower for a further period. If it is decommissioned, the landscape will be reinstated to prevailing conditions. Within 2-3 years of decommissioning there would be little evidence that a wind farm ever existed on the site and thus, its effects on landscape character are reversible.

In summary, there will be long term physical effects on the land cover of the site as a result of this development, but these will be relatively minor in the context of this harvested peatland landscape and reversible following decommissioning. In terms of effects on landscape character, the scale and nature of this development can be comfortably assimilated into this productive rural landscape context without undue conflicts of scale with underlying landform and land use patterns. For these reasons the magnitude of the landscape effect is deemed to be **Medium-low** in the central study area (< c. 5 km) reducing to ‘Low’ and ‘Negligible’ at increasing distances beyond this threshold.

9.4.2.3 Significance of Landscape Effect

As outlined in section 9.2.4 above, the significance of landscape effects is a function of landscape sensitivity weighed against the magnitude of the landscape effect. This is established on the basis of the significance matrix (Table 9.3) in conjunction with professional judgement. For the central study area the significance of landscape effect is judged to be **Moderate-slight** on the basis of 'Medium-low' landscape sensitivity coupled with a 'Medium-low' magnitude of landscape effects. Although there are singular landscape features of higher sensitivity contained within the central study area, such as the River Shannon and the Royal Canal, the proposed development will not alter any salient aspects of their character, which relates much more to their immediate corridors. This is a separate consideration to the visual effects that may occur from these features when they are considered as 'visual receptors' (places from which people can view the scheme), which is addressed in the visual effect section (9.4.3) below.

Within the wider study area, beyond approximately 5km, the magnitude of effect on the character of the landscape will be no greater than 'Low' and this will further reduce as the wind farm becomes a proportionately smaller component of the overall landscape fabric. Thus, the significance of landscape effect is deemed to reduce from 'Slight' to 'Imperceptible' with increasing distance for the wider study area.

9.4.3 Visual Effects

Table 9.11 below summarises the full textual assessment of visual effects for each VRP contained in Appendix 9.4. Whilst the 'receptor sensitivity analysis table' and full textual assessment for each VRP is normally contained within the landscape and visual chapter, in this instance, given the high number of VRP's, it is considered more prudent to place this material in a separate appendix and focus herein on summarising the findings. The left hand side of the table incorporates statistical data associated with the view of turbines, whilst the right hand side contains professional judgements in respect of the same view. It is important to note that the professional judgements are based on the effects experienced in relation to the view and are not directly influenced by the statistical data. These aspects are only combined within Table 9.11 in order to identify patterns of effect to better inform the conclusions of this assessment.

Table 9.11: Summary of Visual Effects at Viewshed Reference Points (VRPs)

VRP No.	Distance to Nearest visible turbine (km)	No. of turbine Nacelles visible (Montage)	Visual receptor sensitivity	Visual Effect Magnitude	Significance of visual effect
DR1	21.1	24	High medium	Low	Slight
DR2	N/A	0	High	Negligible	Imperceptible
DR3	25.8	9	High medium	Low negligible	Slight imperceptible
DR4	19.6	23	High medium	Low negligible	Slight imperceptible
DR5	26.6	17	High	Low negligible	Slight
DR6	N/A	0	High medium	Negligible	Imperceptible
DR7	7.6	24	High medium	Medium low	Moderate slight
DR8	5.1	20	High-medium	Medium	Moderate
DR9	6.2	24	High medium	Low	Moderate slight
DR10	4.7	20	Medium	Low	Slight
DR11	5.1	23	Medium	Medium low	Moderate slight
DR12	7.0	8	Medium	Medium low	Moderate slight
DR13	7.0	18	High medium	Medium low	Moderate slight
DR14	7.0	9	High medium	Low	Slight
DR15	8.5	7	Medium	Low	Slight
DR16	6.9	4	High	Low	Moderate slight
DR17	18.7	24	High medium	Medium low	Moderate slight
DR18	13.4	21	High medium	Medium low	Moderate slight

DR19	13.7	24	High medium	Low	Slight
DR20	11.3	16	High medium	Low	Slight
DR21	28.2	9	High medium	Negligible	Slight imperceptible
DR22	22.7	24	High medium	Negligible	Slight imperceptible
DR23	23.9	24	High medium	Low negligible	Slight imperceptible
DR24	24.9	23	Very high	Negligible	Slight imperceptible
DR25	11.39	0	High	Negligible	Imperceptible
DR26	13.16	15	High	Low-negligible	Slight-imperceptible
LC1	0.9	10	Medium	High	Substantial moderate
LC2	1.0	3	Medium low	High medium	Moderate
LC3	2.1	1	Medium	Medium low	Moderate slight
LC4	0.9	21	Medium low	High medium	Moderate
CP1	5.0	7	Medium low	Medium low	Moderate slight
CP2	N/A	0	Medium	Negligible	Imperceptible
CP3	2.8	19	Medium low	Medium	Moderate
CP4	3.5	5	Medium	Medium Low	Moderate slight
CP5	2.3	5	Medium low	Medium low	Moderate slight
CP6	16.02	0	Low	Negligible	Imperceptible
CP7	7.68	1	Low	Low-negligible	Imperceptible
MR1	5.5	17	Low	Medium low	Slight
MR2	N/A	0	Low	Negligible	Imperceptible
MR3	8.1	17	Low	Low	Slight imperceptible
MR4	3.5	11	Medium low	Medium low	Moderate slight
MR5	0.8	14	Medium low	Medium low	Moderate slight
MR6	2.0	14	Medium low	Medium low	Moderate slight
MR7	0.9	21	Medium low	Medium low	Moderate slight
MR8	1.5	8	Medium low	Medium low	Moderate slight
MR9	4.9	3	Medium low	Low	Slight
MR10	14.7	14	Medium low	Low	Slight
AH1	N/A	0	High medium	Negligible	Imperceptible

AH2	1.1	4	High medium	Medium low	Moderate
AH3	1.2	21	High	Medium	Substantial moderate

Whilst construction stage visual impacts are assessed in section 9.4.3.1 below, photomontages from specific viewpoints are not considered necessary or appropriate for construction stage activities. This is mainly because construction related visual effects tend to be dynamic, transient and temporary / short term such that singular static images cannot convey the nature of the impact. Furthermore, it is reasonable to consider that the most important aspect of a visual impact assessment for a wind energy development relates to the long term visibility of the fully completed turbines from surrounding receptors. It is, therefore, the operational stage development that has been depicted in photomontages from selected viewpoints (Table 9.11).

9.4.3.1 Construction / Decommissioning Stage Visual Impacts

Construction stage visual effects will be generally contained within the site and its immediate surrounds during early phases of ground works to form new access tracks and turbine hard stands. Those most likely to be affected by construction stage visual impacts are local residents and road users on the two regional roads that dissect the site. Visual effects will tend to be negative and arise from an intensity of movement and activity within the site that is greater than current site activities. The focus of construction activities will be at site entrances within the construction compounds and also around the base of each turbine. Visual effects will arise from vehicle movements consisting of heavy machinery and workers vehicles. There is also likely to be views of bare ground following excavation and stripping activities as well as stockpiling of earth materials and construction materials. Temporary site offices and welfare facilities may also be visible within construction compounds from some very localised receptors.

Construction stage visual impacts will increase in magnitude and extent as partially constructed turbines begin to rise from the site and are visible across a wider area. They may be a brief period of visual ambiguity during the period of time that the turbines have been substantially constructed but are not yet operational as they tend to face in different directions and the blades will not be rotating as eventually intended. This is a very minor an temporary visual effect and by this stage the visual impact of the proposed development will be very similar to what will be experienced throughout the long term operational stage, which is assessed in detail below.

Decommissioning stage visual effects will be similar in nature to construction stage effects, albeit in reverse. Such effects will be Temporary in duration rather than Short Term as will be the case for construction activities.

For the reasons provided above, it is considered that significant visual impacts will not arise during construction or decommissioning stages.

9.4.3.2 Operational Stage Effects on Designated Views

There are 26 no. designated scenic views that are considered relevant to this visual impact assessment (refer to DR1 – DR26 in Table 9.11) and some of these might represent a cluster of similar views, particularly within outlying parts of the study area. Whilst this may seem to be a substantial number of scenic designations, it is important to remember that this is a 30km radius study area incorporating designations from four different County Development Plans. Most of the designated scenic routes or views are associated with long distance hilltop views across the lowland landscape of the study area. The nearest of the designated views are almost 5km from the proposed wind farm and the majority (15 no.) are more than 10k away. The remainder tend to be contained within the low crest of hills that define the eastern side of Lough Ree (DR11 – DR16) or the elevated ground associated with Castlerea Mountain to the east of the site (DR9 and DR10). The more isolated DR7 is from an elevated section of road to the west of Longford Town and DR8 is adjacent to the northern end of Lough Ree near Lanesborough.

The significance of visual effects in respect of the more outlying (>10km) scenic designations is not considered to be higher than 'Moderate-slight' in any instance (DR17 and DR18) and is generally 'Slight' or 'Slight-imperceptible' as the proposed development is a smaller scale background feature than from closer designations. It is important to reiterate that these results account for the higher order sensitivity of the designated views in question. However, the sensitivity tends to relate almost wholly to the vastness of the view on offer as opposed to any sense of the naturalistic or striking landscape features within views across rural lowlands and bogs. Two exceptions are DR17 and DR18, which overlook Lough Ree and this partly accounts for the comparatively higher significance levels for these two viewing locations. There are also two views from within Lough Ree (DR25 and DR26) with the first of these having no discernible view of turbines and the second having restricted and distant views of only a modest proportion of the development – resulting in a Slight-imperceptible effect.

The highest level of sensitivity attributed to any of the designated viewpoints is 'Very High' in respect of DR24 from the top of the Hill of Uisneach. This relates mainly to its mythological associations as the centre of Ireland and the ceremony of Bealtaine. Nonetheless, the very distant view of the proposed wind farm some 25km to the northwest only results in a Slight-imperceptible significance of visual effect at this location.

Viewpoints DR11 to DR16 lie between 5km and 8km to the west and southwest of the site, however, the rationale for their designation would appear to principally relate to views across Lough Ree in the opposite direction to the proposed wind farm. Nonetheless, several of these (DR11, DR13 and DR14) also afford elevated views to the east. Again, the highest significance of effect is deemed to be no greater than Moderate-slight for any of these views. Although the proposed wind farm has a considerable lateral extent in some of these views, the turbines are presented with a relatively generous spacing (low intensity and clutter) and with a modest degree of contrast above the flat skyline. They are a background feature of a broad, flat lowland landscape. Similarly benign views of the scheme are afforded from the slightly elevated DR9 and DR10 on the opposite side of the development. Indeed, DR9 offers one of the more contextual views of the wind farm trailing across the productive rural landscape setting of the central study area.

Viewpoint DR7 at the outskirts of Longford Town is only afforded a partial view of the northern end of the scheme and the turbines are presented in an unambiguous manner, resulting in a 'Slight' significance of visual effect. There is a higher degree of contextual ambiguity associated with viewpoint DR8 from the eastern approach to Lanesborough. In this scenario the turbines are seen to rise above the settlement and the Lanesborough Power Station with little sense of the reality of their peatland landscape setting well beyond these features. The turbines at the southern end of the development are presented with a slightly better understanding of relative distance and context as a backdrop to views of the northern end of Lough Ree. The principal view of the Lough winding its way southwards is unaffected by the turbines and on balance the significance of visual effect is determined to be 'Moderate' in this instance – the highest significance of the large scenic designation viewpoint set.

In summary, visual effects from designated scenic views will be long term in duration, but are not considered to be significant.

9.4.3.3 Operational Stage Effects on Local Community Views

In this instance there were only four viewpoints selected principally on the basis of representing typical views for local residents within approximately 5km of the proposed wind farm. However, many more of the major route (MR) centre of population (CP) and Amenity and Heritage (AH) views are also representative of the Local Community (LC) receptor set.

The visual effect issues most likely to occur in respect of local community views for peatland-based wind farms such as this are prominent (close) turbines appearing within rural residential scenes where there may be little sense of the vast cutaway peatland context that exists just beyond the nearest hedgerow (out-of-context views). This type of situation occurs in respect of LC1 and results in a 'Substantial-moderate' significance of effect. In this case the viewpoint is located at a local graveyard and turbines will be seen to rise at various scales (due to relative proximity) above and between sections of vegetation that enclose the setting. The nearest turbine also generates a degree of scale conflict in relation to a foreground farmhouse that is seen on the same alignment. A prominent turbine and several scale cohorts also emerge above a nearby hedgerow at LC2 resulting in a 'Moderate' significance of effect for a series of dwellings that flank the western side of the peatland.

LC3 is not so much a residential view, but a notable view on the local road network along the Royal Canal from a local road overpass near Keenagh. In this case a single turbine will occur on direct alignment with the Canal corridor, but in a clear and unambiguous manner that is deemed to result in a 'Moderate-slight' visual effect significance.

LC4 represents a clear contextual view of the proposed wind farm within its underlying landscape context of cutaway peatland from an area of peatland fringe farmland just to the east of the site. Though the scheme is substantially visible from LC4 throughout all of the western quarters, the turbines have a fairly relaxed arrangement and the variation in perceived scale between the nearest and furthest units generates a strong sense of perspective and sense of depth and distance to the layout. On balance the significance of effect is deemed to be 'Moderate'.

Whilst the visual impact at LC1 is close to the threshold of significance identified in Table 9.3, it is not considered to be a significant effect and nor will significant effects occur at any of the other Local Community Views.

9.4.3.4 Operational Stage Effects on Centres of Population

As with local community views, the greatest potential for significant visual effects to occur from settlement-based viewpoints is 'out-of-context' turbines appearing within a street scene without a sense of distance or contextual separation. Such effects tend to be exacerbated when turbines also present at a prominent scale. This happens to some degree in respect of viewpoint CP3 at Lanesborough where the view of four turbines can be seen directly above the road alignment of the N63 heading east resulting in a 'Moderate' significance of effect. Ameliorating circumstances for this scene include the fact that the viewer is nearing the outskirts of the settlement and the open rural landscape can be seen further to the south (also containing the proposed development). This provides a sense of distance and rural hinterland context for the proposed wind farm within this scene. Viewpoint CP2, which is also from Lanesborough (iconic view from the centre of the bridge over the Shannon) reveals no turbines due to intervening screening from vegetation and the Lanesborough Power Station. The close proximity of screening elements such as buildings and vegetation within the urban setting of Lanesborough will preclude visibility of the proposed turbines from most of the core area of the settlement. Whereas, viewpoint DR8 from a short distance to the west of the centre of Lanesborough, illustrates that when the same screening elements are further from the viewer they provide a lesser degree of screening of the comparatively taller turbines beyond.

From CP1 at Cloondara and to a lesser degree from CP5 at Keenagh the turbines are perceived to be located within the rural hinterland of the settlements with a sense of distance and contextual separation. The significance of visual effect is deemed to be Moderate-slight in both instances.

Viewpoint CP4 is located adjacent to housing estate at the edge of Kilashee village and takes in a rural context of pastoral farmland in the foreground and cutaway peatland in the middle distance to the southwest. Seven of the proposed turbines will be fully revealed from this location, but in a clear and legible arrangement within a rural context that is discrete to the immediate rural /residential setting. In this instance the significance of visual effect is deemed to be ‘Moderate slight’.

CP6 and CP7 are ‘illustrative’ views that represent the very low degree of visual exposure of the proposed wind farm from Roscommon Town and Ballymahon respectively.

Overall, visual effects at centres of population within the study area will be long term in duration, but are not considered to be significant.

9.4.3.5 Operational Stage Effects on Major Routes

The elongated site is flanked closely by the R392 regional road and dissected by the N63 national secondary road and the R398 regional road. Consequently, visual effects from these particular roads has been a primary focus for the appraisal of major routes with five out of the nine ‘major route’ (MR) viewpoints selected from them.

As major route receptors, susceptibility and overall sensitivity to visual change tends to be limited, because viewers are travelling on busy roads with foreground views dominated by the road corridor itself. In this instance the sensitivity of the major route viewpoints ranges between Medium-low and Low depending on the nature and extent of the view on offer.

The highest visual effect significance is ‘Moderate-slight’ and this occurs in relation to MR4, MR5, MR6, MR7, MR8 and MR9, which are all within 2km of nearest turbines and more often within 1km. In respect of MR5 from the N63 and MR7 from the R398, which both pass through the site, there is a clear close view of turbines on both sides of the road. However, these are also the most contextual views of the proposed development contained within its vast cutaway peatland landscape. The turbines trail away from the viewer with a strong sense of perspective due to the scale differential between the nearest and furthest units and this tends to emphasise the scale of the bog and distances between turbines. The 'highly dominant' visual presence of the scheme in these instances is balanced by the highly legible nature of the turbines within a suitably broad and robust landscape context that already relates to energy production. It should be noted that there are also around 10 no. rural / residential properties lining the R398 as it passes through the site, but these are contained within a more enclosed farmland setting with less potential for open views of the turbines than the scenario represented by MR7. Indeed, a review of Figure 9.10 and Figure 9.12 reveals that much of this populated farmland-lined section of the R398 has no visibility of turbines and where visibility does occur it most typically relates to open visibility of 5 turbines or fewer.

For viewpoints MR6 and MR8 from the R392 that runs parallel to the site between Ballymahon and Lanesborough, a surprisingly high level of screening exists in the intervening rural / peatland fringe landscape. Although the blade sets of the nearest turbines tend to rise above the treetops, the more distant units tend to be substantially screened.

In summary, visual effects along major routes, although long term in respect of duration, are not considered to be significant.

9.4.3.6 Operational Stage Effects on Tourism, Amenity and Heritage Features

There are two key tourism, amenity and heritage features within the central study area and they satisfy each of these criteria. These include the Royal Canal and its associated towpath, which forms the Royal Canal Way (part of the national way-marked trails network) and the Corlea trackway visitors centre.

Viewpoints AH1 and AH2 are both located on the Royal Canal Way with the former located close to the settlement of Kilashee and the latter near Keenagh. Both are considered to be of 'High-medium' sensitivity due to the sense of tranquillity and recreational amenity of the canal-side settings. The proposed wind farm is almost entirely screened by canal-side vegetation from AH1, which according to the Route Screening Analysis (RSA) from the canal is a fairly typical scenario (see section 9.3.3.2). Thus, the significance of visual effect at AH1 is deemed to be 'Imperceptible'. From AH2 there will be a clear view of three turbines rising in silhouette above foreground farm buildings with several smaller scale turbines less noticeable in the distance. Although the proposed wind farm will be a distinctive feature of this canal view, it is not considered to be a significant detraction from visual amenity as this is a scene of rural productivity, a key element of which, is the Royal Canal that was originally constructed in the spirit of rural industry.

AH3, at the Corlea Trackway visitor's complex, has been classified as being of High sensitivity. This is principally on the basis that visitors will be strongly attuned to the landscape around them, not only in its present form, but also attempting to gain a sense of what it was like at the time of the track way construction. This location (outside of the visitor centre building) affords one of the clearest, closest and most comprehensive views of the proposed wind farm and it is acknowledged that the scheme represents marked visual change but is not without aesthetic merit.

The most important consideration in this instance is the Trackway visitor's experience and whether the turbines are a significant detraction or not. In this respect it is important to recognise that this will not be a visitor's first view of the turbines as they will need to drive immediately to the south of the wind farm site to access the visitor centre. The visitor centre itself is an introspective building, which provides interpretive displays, and there are few opportunities to see the outside landscape and turbines to the north. The exposed section of trackway is also enclosed, but at the end of the presentation shutters rise to reveal the surrounding landscape and the turbines will be visible as a distinctive background feature in this context. This will generate a juxtaposition of the ancient and the modern, which is unlikely to be lost on visitors. On balance of these factors, a Medium magnitude of visual effect is attributed, but when coupled with the High sensitivity of this receptor, the significance of effect is deemed to be 'Substantial-moderate'.

9.4.4 Cumulative Effects

There are only 2no. existing wind energy developments within the 30km radius study area and these include;

- **Sliabh Bawn** – 20 no. turbines, 8km northwest of the proposed Derryadd Wind Farm site; and
- **Skrine** – 2 no. turbines, 20km southwest of the proposed Derryadd Wind Farm site.

9.4.4.1 Department of Environment, Heritage and Local Government (DoEHLG) 'Wind Energy Development Guidelines' (2006)

The DoEHLG guidelines provide direction on wind farm siting and design criteria for a number of different landscape types. This proposal site is deemed to be contained within a landscape context that is consistent with the 'Flat Peatland' landscape type identified within the guidelines. The guidance with respect to cumulative effect in this landscape type is:

"The openness of vista across these landscapes will result in a clear visibility of other wind energy developments in the area. Given that the wind energy developments are likely to be extensive and high, it is important that they are not perceived to crowd or dominate the flat landscape. More than one wind energy development might be acceptable in the distant background under normal atmospheric conditions."

General guidance in relation cumulative effects is provided in Chapter 6 of the Guidelines – 'Aesthetic Considerations in Siting and Design'. The most relevant aspect of guidance in this instance is contained in the fourth bullet point, which states:

"It is preferable to avoid locating turbines where they can be seen one behind another, when viewed from highly sensitive key viewpoints (for example, viewing points along walking or scenic routes, or from designated views and prospects), as this results in visual stacking and, thus, confusion. This may not be critical, however, where the wind energy development to the rear is in the distant background."

There are some instances when viewed from the southeast where the Sliabh Bawn turbines will be seen on the same alignment as turbines within the proposed development. In such instances, the Sliabh Bawn turbines are seen as much smaller, distant, background features in comparison to the nearer turbines within the proposed development. They are also contained within a separate landscape context (forested ridge). For these reasons, it is considered that the siting and design of the proposed development is consistent with the Wind Energy Development Guidelines in respect of cumulative effects.

9.4.4.2 Cumulative Zone of Theoretical Visibility

A cumulative Zone of Theoretical Visibility (ZTV) map has been prepared for the wind energy developments contained within the study area and a small scale version of this is included in Figure 9.24 below. A larger scale version is provided at Appendix 9.3.

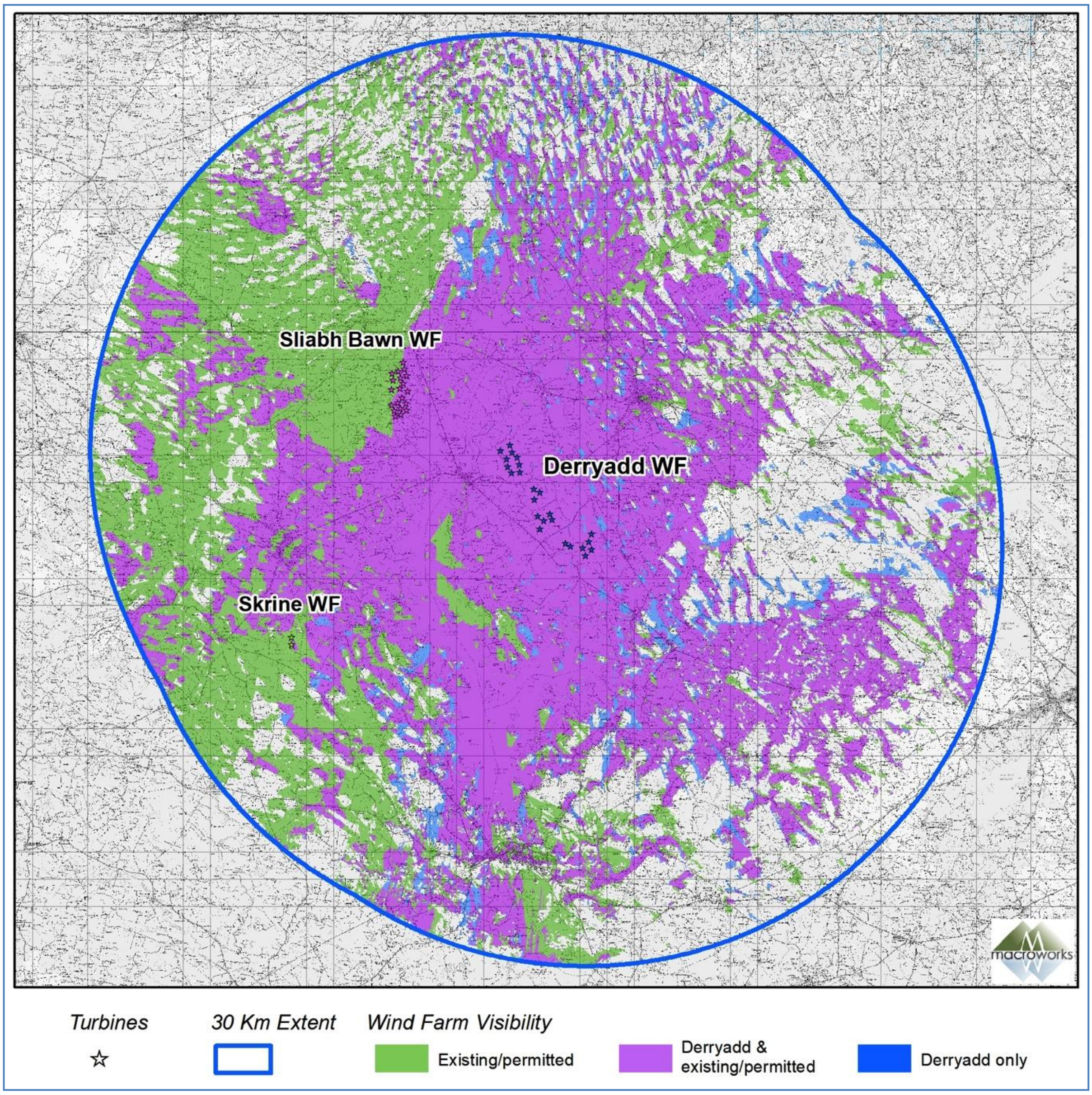


Figure 9.24: Cumulative Zone of Theoretical Visibility Map (see Appendix 9.3 for larger scale annotated version) – Green = Existing only visible; Blue = Proposed only visible; Purple = Combined visibility

The cumulative ZTV map indicates the following key points:

- The central portions of the 30km radius study area extending c.8 – 15km in all directions shows relatively comprehensive cumulative visibility (purple pattern).
- The outer eastern half of the study area has the least theoretical visibility of any wind energy developments and where this does occur it tends to be combined visibility.
- The outer western half of the study area has the most visibility of cumulative wind farms that does not include the proposed development (green pattern). This is unsurprising because the two cumulative developments (Sliabh Bawn and Skrine) both occur in this half of the study area.

- Of the areas that have theoretical visibility of at least some wind energy development only a very small proportion (3.3%) is exclusive to the proposed development. That is, the proposed scheme introduces only small areas of the landscape to views of wind turbines that do not already have potential visibility of turbines.

As with the standard ZTV map, it is important to note that actual visibility of turbines is much less than indicated in this bare-ground scenario once vegetation screening is accounted for.

9.4.4.3 Nature of Cumulative Visibility

The nature of cumulative visibility within the study area is analysed in Table 9.12 below using the same viewpoints that were used for the main visual effect assessment. This information is then used to make an assessment of the cumulative effects arising from the proposal.

Table 9.12: Assessment of Cumulative Visibility

VP Ref.	No. of other wind farms potentially in view	Nearer or further than proposal	**Combined view** (within a single viewing arc)	**Succession view** (within a series of viewing arcs from the same location)	Sequential view (view of different developments moving along a linear receptor)
DR1	1	Similar distance	Yes	No	Yes
DR2	Derryadd not visible	-	-	-	-
DR3	1	Nearer	Yes	No	No
DR4	0	-	-	-	-
DR5	1	Further	Yes	No	No
DR6	Derryadd not visible	-	-	-	-
DR7	1	Further	Yes	No	No
DR8	0	-	-	-	-
DR9	1	Further	Yes	No	No
DR10	1	Further	Yes	No	No
DR11	1	Further	No	Yes	No
DR12	0	-	-	-	-
DR13	0	-	-	-	-
DR14	0	-	-	-	-
DR15	0	-	-	-	-

DR16	0	-	-	-	-
DR17	0	-	-	-	-
DR18	1	Similar distance	Yes	No	No
DR19	1	Further	Yes	No	No
DR20	1	Further	Yes	No	No
DR21	1	Further	Yes	No	No
DR22	1	Further	Yes	No	No
DR23	1	Further	Yes	No	No
DR24	1	Further	Yes	No	No
DR25	Derryadd not visible	-	-	-	-
DR26	1	Further	No	Yes	No
LC1	1	Further	No	Yes	No
LC2	0	-	-	-	-
LC3	0	-	-	-	-
LC4	1	Further	Yes	Yes	No
CP1	0	-	-	-	-
CP2	0	-	-	-	-
CP3	0	-	-	-	-
CP4	0	-	-	-	-
CP5	0	-	-	-	-
CP6	0	-	-	-	-
CP7	0	-	-	-	-
MR1	1	Similar distance	No	Yes	Yes
MR2	0	-	-	-	-
MR3	0	-	-	-	-
MR4	0	-	-	-	-
MR5	1	Further	Yes	No	No
MR6	1	Further	No	Yes	Yes
MR7	1	Further	Yes	No	No
MR8	0	-	-	-	-
MR9	0	-	-	-	-
MR10	1	Nearer	No	Yes	No
AH1	0	-	-	-	-
AH2	0	-	-	-	-

AH3	1	Further	Yes	No	No

9.4.4.4 Cumulative Impact Assessment

Using the cumulative baseline information outlined above, a summary assessment of cumulative effects is provided hereunder.

From slightly less than half (23) of the 50 viewpoints, one other wind farm will be visible in conjunction with the proposed development and, in all but two instances, inter-visibility relates to the Sliabh Bawn scheme. However, given the separation distances involved (8km) and the fact that the Sliabh Bawn turbines tend to be seen in the background (behind the proposed turbines) clear viewing conditions are required in order for both developments to be visible from many of these viewpoints.

The Sliabh Bawn turbines are generally seen within the same viewing arc and often in direct alignment with the proposed development (combined visibility). Only in five instances are they visible in a different direction (successional visibility). This may be accounted for by the fact that the viewpoint set is selected on the basis of open visibility of the proposed development and other than for hilltop views, there are few locations with open visibility in all directions within the lowland landscape of the study area. Whilst there are a number of major routes passing through the study area that afford views of both the proposed development and the Sliabh Bawn turbines this tends to be combined visibility from particular locations rather than a sequence of views of each scheme in isolation in a journey scenario.

Whilst the Wind Energy Development Guidelines 2006 highlight the potential aesthetic issue of turbines from different schemes becoming stacked in perspective if seen on the same alignment, this is not a particular issue in this instance. This is on the basis that the Sliabh Bawn turbines are most commonly seen as small-scale distant features on an elevated forested ridge, when seen in-combination (same viewing arc) as the proposed Derryadd turbines. By comparison, the closer Derryadd turbines are seen at a much larger scale with a grid-like layout within the open, flat, lowland context of a cutaway peatland. Atmospheric perspective (fading of distant objects) also serves to differentiate between the turbines of each development ensuring that there will not be confusing or cluttered cumulative views of the two schemes. From any location where the turbines from each of these developments are seen at a comparable scale, such as from the R371 regional road that lies between these developments, they are seen at widely disparate viewing angles or in opposite directions.

It is considered that the number of schemes and total number of turbines within the 30k radius study area is very low compared to many parts of the country so the proposed scheme will contribute little to a sense of wind farm proliferation in this area. Whilst between them, Sliabh Bawn and Derryadd will total 44 turbines, neither is excessive in scale for its respective landscape context, and they are separated by a generous distance and contained in separate landscape types.

For the reasons outlined above, the magnitude of cumulative effects in respect of other wind farms is deemed to be **Low**. Thus, significant cumulative impacts are not considered to occur.

9.4.5 Cumulative Effects with Other Forms of Development

Planning permission (Planning ref. 17/320) was recently granted for increasing the capacity of the Lanesborough Power Station ash disposal field at Derraghan 1.5km southwest of Lough Bannow Bog. It should also be noted that an imminent planning application is very likely to be submitted in respect of the continued use and conversion to biomass of Lanesborough Power Station, which is located within the settlement of Lanesborough on the southern bank of the River Shannon. It is considered that the any in-combination effects between the proposed Derryadd Wind Farm and either or both of these developments, which represent continuation and small scale expansion of existing activities, will be Imperceptible.

Two Solar farms have recently been granted permission within the study area. One of these is Middleton House Solar Farm, which consists of 51 ha of solar panels (35 – 50MW) around 2km to the northeast of the proposed Derryadd Wind Farm site. The other is the much smaller Fisherstown Solar Farm (4MW), which will be located some 7km to the northeast of the site at a former industrial facility. Whilst cumulative effects between the proposed wind farm and the smaller and more distant Fisherstown solar development will be Negligible, there is some potential for in-combination effects with the larger and closer Middleton House Solar Farm.

The LVIA undertaken in respect of Middleton House Solar Farm (also prepared by Macro Works) indicates very restricted visibility of the scheme from surrounding receptors in its flat and heavily vegetated setting. Thus, there will be very few instances where the permitted solar farm and proposed Derryadd Wind Farm could be seen within the same viewing context and such locations are likely to be in close proximity to the solar farm. While the cumulative visual impacts are therefore likely to be very minor, there will be a combined landscape impact in respect of the landscape fabric of the central study area becoming more focussed on energy production, at the expense of pastoral farmland (in the case of Middleton House Solar Farm). However, this landscape has a long tradition of energy production blended with agricultural production and the effect on landscape character will not be a marked one that alters the salient values of this landscape setting. Overall, it is considered that a Low magnitude of cumulative impact will occur in respect of these two developments and this will be long term in duration, but readily reversible upon decommissioning of either site and, therefore, not significant.

9.5 MITIGATION MEASURES

Given the height of commercial wind turbines it is not generally feasible to screen them from view using on-site measures as would be the primary form of mitigation for many other types of development (where the screening and screened objects are of a more comparable scale). Instead, landscape and visual mitigation for wind farms must be incorporated into the early stage site selection and design phases. General consideration in this regard was given to the Department of Environment Heritage and Local Government's Wind Energy Development Guidelines (2006) and it is considered that the presented scheme reflects the design guidance in respect of the 'Flat Peatland' landscape type.

Whilst the required turbine separation distance to nearest dwellings is currently 500m in accordance with the Wind Energy Development Guidelines (2006), in this instance there are no turbines within 750m of the nearest dwelling. The minimum 750m setback distance for the proposed wind farm reflects the Preferred Draft Approach to the Review of the Wind Energy Development Guidelines as announced by Government in June 2017, which states that it is proposed to introduce a setback distance of 4 times the tip height between a wind turbine and the residential property. In this case, 4 x 185m = 740m. This Setback distance is an important factor because the scale in relation to distance of wind turbines drops away exponentially inside the first 3km. This is based on the principle of perspective that doubling the distance to an object halves its perceived height. Thus, there is a marked difference in the perceived scale drop-off between turbines at 0.5 km away and 1.0 km away compared to the difference between a turbine at 3.5km and 4.0km.

A buffer distance of 2km to nearest turbines was also applied to settlements (towns and villages) in the area to ensure that the proposed wind farm would not be a dominant backdrop to urban views and street scenes. This buffering also ensures the scheme is always perceived as being located within the surrounding rural hinterland of settlements, rather than being confused as peri-urban infrastructure.

9.6 RESIDUAL EFFECTS

All of the mitigation measures described in section 9.5 above are inherent in the siting and presented layout of the proposed development. Thus, the predicted landscape and visual effects already described are equivalent to 'residual' effects in the case of this appraisal.

9.7 CONCLUSION

The significance of landscape effects is assessed on the basis of the sensitivity of landscape receptors balanced against the magnitude of the landscape effect. For a proposal of this scale and extent, landscape receptors can range from entire Landscape Character Areas (LCAs) down to distinctive collections of landscape elements or individual features. Landscape effects may occur from direct physical effects and/or due to changes in landscape character in the local or wider area.

9.7.1.1 Landscape Effects

There will be physical effects on the land cover of the site as a result of this development, but these will be relatively minor in the context of the cutaway peatland context and the high proportion of existing access entrances that will be utilised during construction and operational stages. There will be a minor loss of hedgerow and peatland scrub vegetation due to the delivery of turbine components and construction, but these will be replaced by natural reseeding or reinstated insofar as possible. Internal site borrow pits will be utilised for the winning of construction material and these are of a relatively small scale in the context of the vast cutaway peatland context. Likewise, trenching operations for internal and external cable routes represent minor and temporary disturbance of already modified land.

In terms of effects on landscape character, which is the main landscape effect consideration in this instance, there is predicted to be a ‘Moderate–slight’ significance of effect within the central study area (c. 5km radius). This is on the basis of a ‘Medium-low’ landscape sensitivity judgement within this central zone, coupled with a ‘Medium-low’ magnitude of landscape effect judgement. Although higher sensitivity sections of the River Shannon and the Royal Canal are contained within this central zone they do not have a strong influence on the overall landscape character beyond their immediate corridors. Conversely, the proposed wind farm is not considered to alter the salient character of these waterways even where there is a degree of inter-visibility. The canal is also a man-made feature constructed in the spirit of industry to move goods. Thus, there is something of a thematic link to the productive nature of the proposed development. For the vast majority of the central study area the defining landscape character relates to agricultural farming and peatland harvesting with the Lanesborough Power Station standing as an iconic testament to the productive values associated with the surrounding landscape.

Throughout the wider study area, agricultural farmland remains the predominant land use with a generally lesser proportion of peatland. Occasional lakes and upland zones also occur and although these are individually considered to be of higher landscape sensitivity, on balance the wider study area is also deemed to have a Medium-low level of landscape sensitivity. In terms of landscape effect magnitude, the proposed wind farm will often be visible as a background feature in the context of the wider study area. However, it will be one of a range of rural land uses and will not significantly influence or alter landscape character even in the context of higher sensitivity landscape features, when diluted by distances in excess of 5km. Thus, the significance of landscape effect in the wider study area is considered to be Low, dissipating to Negligible with greater distance, as the proposed wind farm becomes a proportionately smaller component of the overall landscape fabric.

In respect of the landscape and wind energy policies contained within the Longford Landscape Character Assessment, which forms a part of the current Longford County Development Plan, it is considered that the proposal is an acceptable form of development that is appropriately sited entirely in a 'Low' sensitivity Landscape Character Unit (LCU6 - Peatlands), and the vast majority of the site is contained in a 'Preferred' area for wind energy development. The scheme is also deemed to be appropriately designed in respect of its receiving landscape context, which is consistent with the 'Flat Peatland' landscape type in the Wind Energy Development Guidelines (2006).

For the reasons contained herein, it is considered that the proposed development will not give rise to significant landscape effects within either the central or wider study area. This reflects the fact that it has been located and designed in accordance with relevant local and national level policy documents.

9.7.1.2 Visual Effects

Visual effects are assessed on the basis of visual receptor sensitivity versus the magnitude of the visual effect. Sensitivity is established on the basis of viewer (receptor) susceptibility as well as the value associated with the view in question. Effect magnitude is the function of the visual presence of the proposal and its effect on visual amenity. Visual effects are assessed at 50 no. Visual receptor locations throughout the study area, which are classified in terms of receptor type including; designated scenic views; key views; local community views; centres of population; major routes, and; tourism, heritage and amenity features.

Receptor sensitivity is considered to range widely across the study area between Very High at VP24 – 'Hill of Uisneach' and Low for several of the 'major route' receptors where visual amenity is strongly influenced by the busy road corridor. Those receptor locations at the upper end of the spectrum (High to High-medium) tend to be designated scenic views from hilltops and elevated ground where vast panoramic views are afforded across the relatively homogenous rural and peatland landscape of the midlands. At the lower end of the spectrum are locations that take in more contained views from within the rural lowlands where hedgerow vegetation tends to limit the extent of view across typical rural farmland. More open views are often afforded across cutaway peatlands, but in these cases the extent of visibility is balanced by the anthropogenic nature of the harvested peatland. Whilst it is acknowledged that local residents are among the most susceptible receptors, this is accounted for in the sensitivity judgements, which must also balance the value of the views on offer (local value versus regional or national value). On balance, most local views encompassing typical rural scenes are generally considered to be in the order of Medium-low in terms of receptor sensitivity. It is not considered that canal views are particularly sensitive to new forms of development such as that proposed, on the basis that they are industrial heritage features themselves. Nonetheless, the Royal Canal and its associated towpaths are a tranquil recreational feature with some of the naturalistic amenity of a river corridor and a High-medium level of sensitivity has been applied to the representative viewpoint locations in this instance (AH1 and AH2).

The majority of visual effect magnitude judgements are in the mid to low range due to a combination of high levels of screening, the dispersed layout of the scheme and the robust rural landscape context in view. However, there are a small proportion of views within close proximity to turbines where mid to high order visual effect magnitude is considered to occur. At these locations the nearest turbines invariably have a dominant visual presence within the scene and the intensity or lateral extent of turbines is also likely to be considerable. A notable aspect of this proposed wind farm is that there are several VRP locations where the turbines have a highly dominant or dominant visual presence that is moderated in terms of aesthetics by a clear and legible view of the proposed development running away from the viewer with a strong sense of perspective. This scenario most notably occurs at MR5 and MR7 on regional roads between turbine clusters and AH3 from the Corlea Trackway Visitors Centre just to the southeast of the development. In many ways these particular views epitomise the nature of the receiving environment, its assimilation potential for the proposed wind farm and the reason significant visual impacts are not considered to occur.

On the basis of sensitivity versus magnitude, only two of the VP locations are considered to experience a Substantial-moderate significance of effect. This occurs at LC1 from a local graveyard and amenity area to the north of the site and AH3 at Corlea Trackway Visitors Centre. At LC1, this level of significance occurs as a result of the development having a mid to high level of visual presence in the view (Dominant / Co-dominant) and with turbines appearing intermittently at different scales above and between sections of intervening vegetation. At AH3 the visual presence of the development is deemed to be Dominant, but the turbines are also seen with a high degree of legibility and within a vast cutaway peatland context that can absorb the scheme in terms of scale and extent. These competing factors are likely to polarise opinion as to the significance of visual effect at this location but, on balance, the overall effect is deemed to be Substantial-moderate. From experience, this is a low proportion of VPs to incur this mid to high order of significance, which is testimony to the robustness of the receiving visual context. At five of the VPs, the significance of effect is judged to be Moderate, which is also a relatively small proportion of the viewpoint set to experience mid-range significance. Seventeen of the remaining VP locations are considered to incur a Moderate-slight significance of effect with 26 no. ranging between Slight and Imperceptible. Thus, more than half of the selected representative viewpoints are considered to have a significance of visual effect of ‘Slight’ or lower.

Based on the visual effect assessment contained herein, it can be concluded that the proposed Derryadd Wind Farm will result in long term, but not permanent visual effects that are readily reversible upon decommissioning. Such effects are not considered to be significant and additional mitigation measures or redesign of the scheme is not, therefore, deemed necessary. Overall, visual effect significance will generally be in the mid to low range and only occasionally higher at some local receptors.

9.7.1.3 Cumulative Effects

There are presently two existing wind farms within the study area, so wind energy development is considered to be a familiar, but not strongly characteristic or defining feature of the landscape within the study area. The proposed wind farm will most commonly be viewed in isolation from within the lowland context of the study area, but from occasional elevated vantage points, which also tend to be designated as scenic views, the proposal will be commonly seen in conjunction with the Sliabh Bawn Wind Farm (20 turbines) some 8km to the northwest. Aside from the physical separation between these schemes, they occupy different landscape contexts with Sliabh Bawn on an upland ridge and the proposed Derryadd Wind Farm on flat cutaway peatland. This contextual separation tends to accentuate the physical distance between them and there is little sense of wind energy proliferation within the study area.

Overall, it is considered that the proposal will contribute to wind energy development becoming a more characteristic feature of this midlands context, but it is not considered to give rise to a significant cumulative effect. Instead, this effect is deemed to be Low.

Other forms of development were also considered, including planning applications for continued use and expansion of facilities associated with Lanesborough Power Station and two solar farms developments that have been recently been granted planning permission to the northeast of the proposed wind farm site. In all but the case of one of the solar farms, negligible cumulative impacts are anticipated. In the case of the nearer and larger of the two solar developments (Middleton House Solar Farm) a Low level of cumulative impact is predicted and mainly in the context of combined changes to the landscape fabric of the central study area rather than noticeable cumulative visual impacts. Thus, cumulative effects in respect of other forms of development are not considered to be significant.

10 MATERIAL ASSETS - SHADOW FLICKER

Note: Chapter 10 (Material Assets - Shadow Flicker) and Chapter 11 (Material Assets - Telecommunications, Aviation and EMF) of this Environmental Impact Assessment Report (EIAR) can be classified as “Material Assets” and, as such, are often presented together within one chapter of an EIAR. However, for the purposes of clarity and a detailed assessment of each parameter, it has been decided to deal with each topic separately within this EIAR.

10.1 INTRODUCTION

10.1.1 Background

This chapter assesses the potential for shadow flicker from the proposed Derryadd Wind Farm development to impact on sensitive receptors in the surrounding area.

Shadow flicker is a phenomenon that arises when an operational wind turbine is located between an observer (located indoors) and the sun – most common when the sun is low in the sky. Shadow flicker effects are only possible if there is an unobstructed path from the turbines to a window. If there is no view of the turbines from a dwelling, there will be no noticeable effects because the turbine’s shadow will not pass over the window.

Rotating wind turbine blades can cause brightness levels to vary periodically at locations where they obstruct the Sun’s rays. This can result in a nuisance when the shadow is cast over the windows of residential properties. This intermittent shadow is described by the term ‘shadow flicker’ and it can be a cause of annoyance at residences near onshore wind turbines if it occurs for a significant period of time during the year. Shadow flicker is an indoor phenomenon and can be noticeable inside a room if the rotating blades obstruct the direct sunlight that is illuminating the room’s window. This is largely dictated by the relative position of the turbine(s) and the window, in combination with the time of day (position of the Sun). The frequency of the flicker effect is related to the frequency of the rotating blades. It can also be dependent on the number of turbine rotors that are casting shadows on the window.

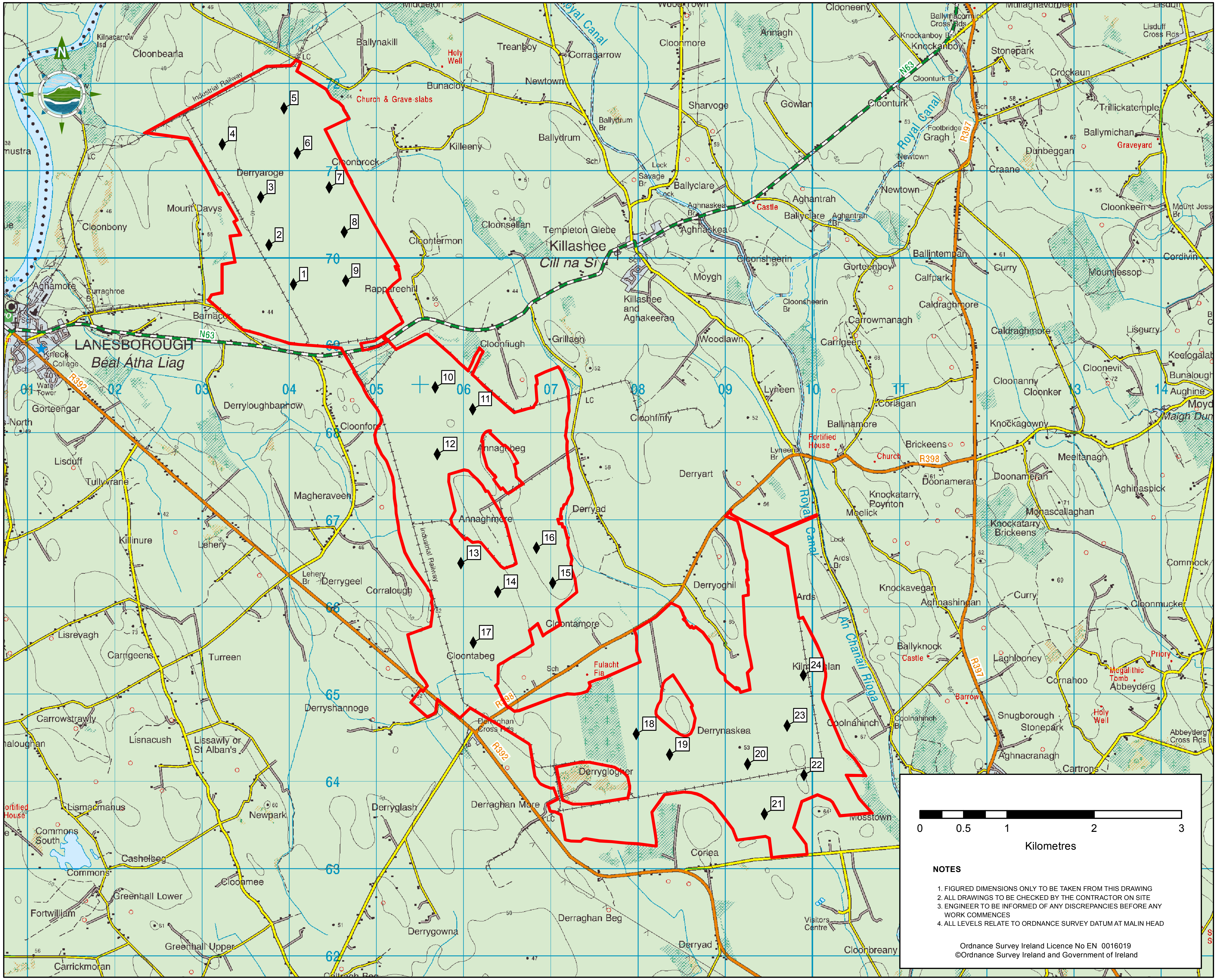
Shadow flicker could only occur if one or more turbine rotors was located between an observer within a dwelling and the sun. Shadow flicker would not occur under various real-world conditions, for example if the sky is overcast, the rotor was not spinning for any reason or blinds/curtains were drawn at the receptor location.

10.1.2 Wind Development Details

The proposed development comprises 24 turbines and is described in detail in Chapter 2 – Description of the Proposed Development. The shadow flicker assessment is based on the turbine locations described in Chapter 2 and depicted in Figure 10.1 and Appendix 10.1. All coordinates and elevations within this chapter are in Irish National Grid (TM65).

10.1.3 Statement of Authority

The technical assessment was prepared by Pager Power. Kai Frolic (Pager Power), was the lead author of the technical report on which this chapter is based. His qualifications include a Masters degree in Physics (MPhys, first class honours) from the University of Surrey (2008). He is a member of the Institute of Physics (MIsntP) and he has 10 years of experience undertaking assessments for wind farm developments, including shadow flicker assessments, on behalf of Pager Power. Siobhán Tinnelly (Associate Director, TOBIN Consulting Engineers) prepared and formatted this chapter using the technical report provided by Pager Power. Siobhán has over eighteen years of experience in environmental assessment and project management and her qualifications include a degree in Natural Sciences (Environmental Science), a Masters in Applied Hydrogeology and a Higher Diploma (postgraduate) in both Environmental Engineering and Business Management. The content of the Pager Power technical report, including the assessment of potential impact, has been directly reflected in this chapter.



Legend

- Planning Application Boundary
- Proposed Turbine Locations

NOTES

1. FIGURED DIMENSIONS ONLY TO BE TAKEN FROM THIS DRAWING
2. ALL DRAWINGS TO BE CHECKED BY THE CONTRACTOR ON SITE
3. ENGINEER TO BE INFORMED OF ANY DISCREPANCIES BEFORE ANY WORK COMMENCES
4. ALL LEVELS RELATE TO ORDNANCE SURVEY DATUM AT MALIN HEAD

Issue	Date	Description	By	Chkd.
A	Jan 2019	Final Issue	FH	ST

Client: BORD NA MÓNA Naturally Driven

Project: DERRYADD WIND FARM

Title: Proposed Wind Turbine Locations

Scale @ A3: 1:40,000

Prepared by: F. Healy | Checked: S. Tinnelly | Date: January 2019

Project Director: D. Grehan

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Figure 10.1

Issue: A

10.2 METHODOLOGY

10.2.1 Guidance

There are various sources of guidance with regard to the assessment and management of shadow flicker impacts caused by wind turbines. Guidance relevant to the proposed development is summarised below. Additional shadow flicker information from the UK is also presented to provide technical context.

Wind Energy Development Guidelines (2006)

The guidelines state that:

"Careful site selection, design and planning, and good use of relevant software, can help avoid the possibility of shadow flicker in the first instance. It is recommended that shadow flicker at neighbouring offices and dwellings within 500m should not exceed 30 hours per year or 30 minutes per day".

The guidelines also state that:

"At distances greater than 10 rotor diameters from a turbine, the potential for shadow flicker is very low. Where shadow flicker could be a problem, developers should provide calculations to quantify the effect and where appropriate take measures to prevent or ameliorate the potential effect, such as by turning off a particular turbine at certain times".

Pager Power's modelling approach in this assessment is consistent with this recommendation.

Information Note: Review of the Wind Energy Development Guidelines 2006 "Preferred Draft Approach" (June 2017)

The preferred draft approach as announced by the Department of Housing, Planning, Community and Local Government (DHPCLG) and the Department of Communications, Climate Action and Environment (DCCAE) states the following with regard to Shadow Flicker:

"The 'preferred draft approach' proposes that technology and appropriate modelling at design stage to eradicate the occurrence of shadow flicker must be confirmed in all planning applications for wind energy development. Moreover, there will be clearly specified measures for automatic wind turbine shut down, where the issue arises as a condition planning permission. In effect, no neighbouring property will experience the occurrence of shadow flicker."

This text provides for the prevention of shadow flicker due to automatic shutdown of the turbines. This means that turbines will be programmed to shut down when shadow flicker effects occur i.e. no amount of shadow flicker per day/year would be acceptable. The nature of the automatic shutdown process allows for a very short period of flicker to occur as the blades are moved into the idle position and the blade movement comes to a halt.

Parsons Brinckerhoff – Update of UK Shadow Flicker Evidence Base (2011)

Key extracts from this document are:

"This report presents an update of the evidence base which has been produced by carrying out a thorough review of international guidance on shadow flicker, an academic literature review and by investigating current assessment methodologies employed by developers and case study evidence. Consultation (by means of a questionnaire) was carried out with stakeholders in the UK onshore wind farm industry including developers, consultants and Local Planning Authorities (LPAs). This exercise was used to gauge their opinion and operational experience with shadow flicker, current guidance and the mitigation strategies that can and have been implemented."

"The three key computer models used by the industry are WindPro, WindFarm and Windfarmer. It has been shown that the outputs of these packages do not have significant differences between them. All computer model assessment methods use a "worst case scenario" approach and don't consider "realistic" factors such as wind speed and cloud cover which can reduce the duration of the shadow flicker impact."

"Mitigation measures which have been employed to operational wind farms such as turbine shut down strategies, have proved very successful, to the extent that shadow flicker cannot be considered to be a major issue in the UK."

The Companion Guide to PPS22 (PPS22 was a planning policy statement produced by the UK government in 2004 and referred to in the Parsons Brinckerhoff Report, 2011) makes the following statements:

- *Shadow flicker only occurs inside buildings where the flicker appears through a narrow window opening;*
- *Only properties within 130 degrees either side of north of the turbines can be affected at UK latitudes;*
- *Shadow flicker has been proven to occur only within ten rotor diameters of a turbine position.*

A further extract from the Parsons Brinckerhoff Report refers to the *Onshore Wind Energy Planning Conditions Guidance Note, Renewables Advisory Board and BERR (2007),* which states that only dwellings within 130 degrees either side of north relative to a turbine can be affected and the shadow can be experienced only within 10 rotor diameters of the wind farm."

Pager Power uses WindFarm software for its analysis, which is one of the industry standard models referenced within the guidance.

Furthermore, cognisance was given to EPA Guidance on EIAR in the preparation of this chapter (as outlined in Chapter 1, Section 1.8.2).

10.2.2 Discussion – 10 Rotor Diameter Exclusion Zone

It is common to use 10 rotor diameters as a maximum limit within which significant shadow flicker effects can occur. The validity of this limit is discussed at length within the relevant literature and guidance varies in different documents and countries, with some stating that effects can only occur within this distance and others stating that this is a general rule or that the risk beyond this distance is low.

The Parsons Brinckerhoff report referenced above acknowledges that the 10 rotor diameter limit is a *'one size fits all'* approach that may not be suitable depending on the latitude of the site. The Onshore Wind Energy Planning Conditions Guidance Note issued in 2007 by the Renewables Advisory Board and BERR (United Kingdom) stated that the shadow can only be experienced within 10 rotor diameters. Planning Advice Note 45 issued by the Scottish Executive in 2002 referred to *nearby dwellings (as a general rule 10 rotor diameters)*. The Best Practice Guidance to Planning Policy Statement 18 issued in 2009 by the Northern Ireland Department of the Environment stated that '*the potential for shadow flicker at distances greater than ten rotor diameters from a turbine position is very low'*. The same wording is used within Ireland's Wind Energy Development Guidelines (2006), as set out above.

In reality, there is no fixed cut off distance at which effects can occur, because this is sensitive to many parameters including the exact latitude and the terrain around the development location. This assessment has considered dwellings within 10 rotor diameters - this is aligned with the current planning guidance in Ireland and, in practice, effects are most likely to be significant at closer range to the wind farm.

10.2.3 Modelling Methodology

The analysis has been undertaken using WindFarm (Release 4) software which is one of the recommended software packages for Shadow Flicker assessment. It is a sophisticated model that incorporates:

- The terrain elevation (based on interpolated Shuttle Radar Topography Mission data);
- The path of the Sun throughout the year at the development latitude; and
- The size, position and orientation of windows at the dwelling location (window orientations were modelled as facing the wind development to ensure results are conservative).

Other features of the modelling are highly conservative. For example, there are a number of factors that could diminish shadow flicker effects namely cloud cover, varying wind direction and low wind speed. In addition, it has been assumed that all properties have a single window facing the development. The maximum value per day assumes unobstructed visibility between the window and the turbine rotors, bright weather conditions and rotor alignment with maximum potential to cast a shadow. The model therefore considers a 'worst-case scenario'.

Furthermore, regarding cloud cover, the total annual shadow flicker calculated by the model for each property assumes 100% sunshine during daytime hours. However, Met Éireann data for this region shows that the sun shines on average for 29.2% of the daylight hours per year[127]. Therefore, the total amount of shadow flicker is likely to be significantly less than the theoretical durations produced by the model. The modelled results, therefore, overestimate the likely effects. This is an appropriate conservative approach because sunshine data is statistical and will vary throughout the year, however it is likely that the level of cloud cover will reduce the effects.

The assessment has considered a 'view height' of 1.8 metres (nominal view height for an adult) above ground level and a minimum Sun elevation of 2 degrees (typical value to accommodate terrain obstruction at the horizon for low solar elevation angles). The dimensions of the turbine have been set in accordance with the turbine details included in Chapter 2 of this report.

The model has considered windows with a size of 1 metre by 1 metre with a centre that is 1.5 metres above ground directed towards the centre of the wind farm. These dimensions are considered typical for dwelling windows. The model has also assumed that each dwelling has a window facing the nearest group of wind turbines i.e. those with the most potential to cause shadow flicker effects. Where appropriate, dwellings have been modelled with two windows, each facing a different group of turbines. This has been done in cases where turbines on two separate bearings have a reasonable prospect of causing an issue.

In addition, the model has assumed that the rotor is turning at all times. In reality, low wind speeds and maintenance requirements will reduce the operational time throughout the year. The model has assumed a maximum aspect to observers, which will not be the case in all instances.

This approach represents a worst-case scenario because it maximises the potential for shadow flicker effects to occur and, therefore, predicts an over estimated potential impact.

[127] This percentage is based on Met Éireann data recorded at Mullingar over the 30-year period from 1971 to 2000 (www.met.ie).

10.2.4 Acceptable Limits

According to the Wind Energy Development Guidelines (2006) the acceptable limit for shadow flicker in Ireland is 30 hours per year with a maximum of 30 minutes per day.

Within this assessment, reference has been made to the current limit as outlined in the 2006 guidance. However, the shut-down times in Appendix 10.2 have been defined for a ‘minimal effects’ scenario in response to the requirements of the ‘preferred draft approach’ and as the worst-case impact on the operation of the windfarm.

10.3 EXISTING ENVIRONMENT

10.3.1 Sensitive Receptors

The sensitive receptors included in the assessment are depicted in pink in Figure 10.2 below. The turbine locations are shown in blue and the 10-rotor diameter buffer (orange area) is included for reference purposes.

Figure 10.2: Assessed Receptors (Map Source: © 2018 Google and DigitalGlobe)

Receptor locations were identified by the author of the technical shadow flicker assessment (Kai Frolic, Pager Power) based on inspection of mapping including aerial and street-level imagery. A total of 151 receptor locations (comprising habitable residences) were identified within the 10-rotor diameter buffer from the turbine locations.

The dwelling data, including coordinates for all habitable and derelict potential receptors within the 10-rotor diameter buffer zone and also in the vicinity of the buffer zone, was collated by Pager Power (as presented in Appendix 10.1) and totalled 187 receptors. Based on a 10-rotor diameter buffer zone, the locations of the 187 potential receptors were reviewed and the number of receptors was reduced to 151 receptors i.e. the receptors identified within the buffer zone and were not deemed to be derelict. The table of data within Appendix 10.1 titled *"Summary of merged shadow times on each house from all turbines"* includes the 151 receptors that were identified (out of the original total of 187, also detailed in Appendix 10.1) within this 10-rotor diameter buffer zone (as shown in Figure 10.2 above).

In addition, Appendix 10.1 includes more localised images than Figure 10.2 above, for information and illustrative purposes (Map Source: © 2018 Google and DigitalGlobe). The main image in this appendix includes an overview of all relevant sensitive receptors (shown as pink icons) with numbers in groups relative to the turbines (shown in blue) and the 10 rotor diameter zone (shown in orange). The supporting images include more localised images of each group of receptors.

As detailed in Chapter 5 (Population and Human Health) of this EIAR, the closest dwelling is located in excess of 750m from the nearest turbine. The study area was also the subject of a planning history search (as described in Chapter 5, Population and Human Health), to identify properties that may have been granted planning permission but that have not yet been constructed. All such properties have been included in the assessment.

10.3.2 Potential Impacts Assessment Results

Table 10.1 below summarises the key findings from the assessment of the receptors. This phase of the analysis assesses the level of predicted effect, based on conservative assumptions, in the absence of any mitigation. It categorises the number of dwellings within 10-rotor diameters that could experience effects under these conditions, with reference to the acceptable limits within the guidance. Detailed data can be found in Appendix 10.1.

Table 10.1: Results – Effects at Receptors

Number of unaffected receptors	Number of receptors predicted to experience less than 30 minutes per day and less than 30 hours per year	Number of receptors predicted to experience more than 30 minutes per day or more than 30 hours per year	Maximum hours per day predicted at any receptor	Maximum hours per year predicted at any receptor
32 (out of 151)	68 (out of 151, including dwellings with zero effects)	83 (out of 151)	0.82 (Dwelling 5)	100.6 (Dwelling 7)

Note: This table includes all habitable receptors identified within 10 rotor diameters of the proposed turbines (151 receptors).

Table 10.2 below quantifies the worst-case shadow flicker effects by turbine (within 10-rotor diameters) and Appendix 10.1 details the potential shadow flicker impact at each identified receptor.

This phase of the analysis identifies how much shadow flicker could be caused by each individual turbine, based on conservative assumptions, in the absence of any mitigation.

Table 10.2: Quantification of the predicted Shadow Flicker per Turbine

Turbine Number	Days per year of shadow flicker	Maximum hours per day	Mean hours per day	Total hours per year
1	257	0.94	0.6	155.1
2	245	1.02	0.58	142.8
3	193	0.96	0.62	119.4
4	97	0.82	0.62	59.9
5	113	0.81	0.51	57.1
6	163	0.8	0.61	99.3
7	209	1.09	0.63	130.8
8	221	1.19	0.62	136.7
9	201	0.96	0.51	102.4
10	362	1.09	0.68	244.8
11	128	0.48	0.35	44.3
12	247	1.2	0.82	202.6

13	146	0.69	0.45	65.9
14	86	0.46	0.35	30.1
15	221	1.42	0.95	209.6
16	229	1.24	0.82	187.9
17	191	0.97	0.54	103.3
18	116	1.15	0.72	83.2
19	64	0.57	0.44	28.3
20	0	0	0	0
21	105	0.69	0.56	58.8
22	139	0.9	0.66	91.6
23	167	0.8	0.56	93.9
24	269	1.26	0.69	186

Note: The minimum shut-down per year is zero hours for T20 and the maximum is 244.8 hours for T10.

Figure 10.3 illustrates the combined shadow flicker times on all dwellings from all turbines (red hatched areas), within 10-rotor diameters. The red lines illustrate the sunrise and sunset times. It can be seen that effects generally occur when the Sun is low in the sky, which is to be expected since this equates to the longest shadows.

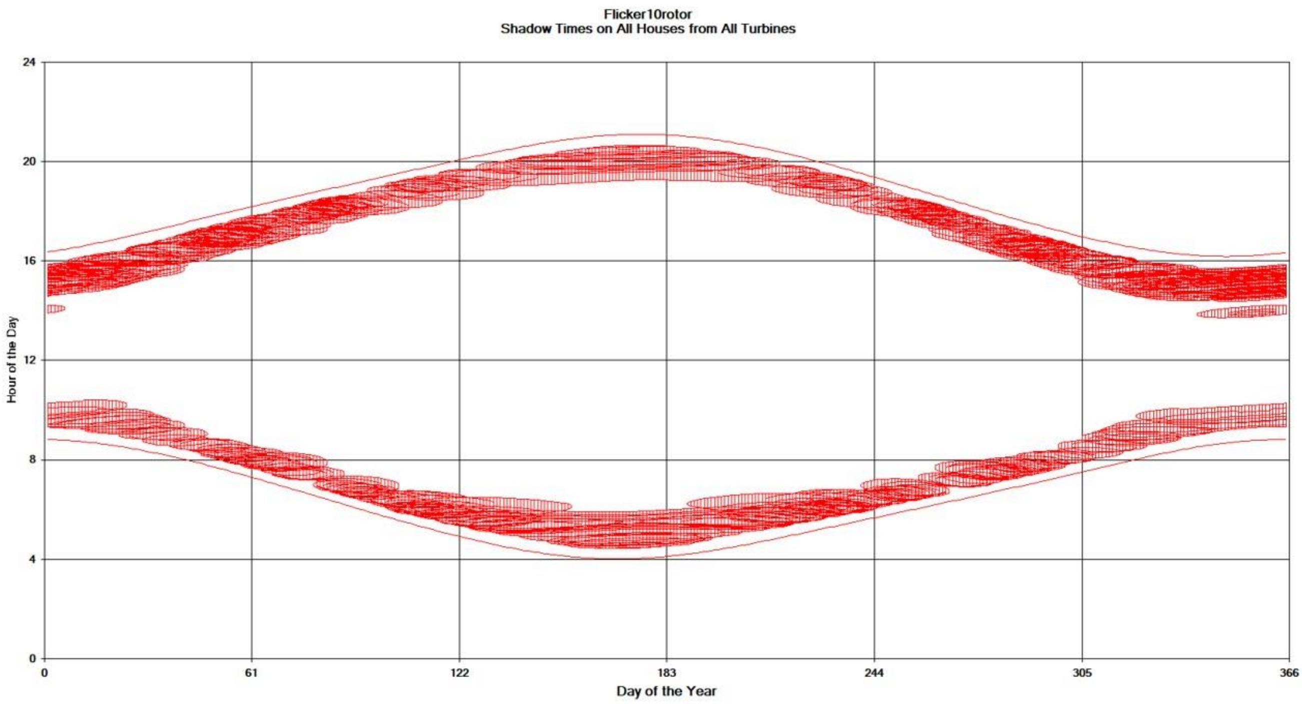

Figure 10.3: Shadow Times on all houses from all Turbine

Further detailed breakdowns are presented in the appendices, including:

- Summary of worst-case effects for each individual receptor (Appendix 10.1).
- Receptor Map (Appendix 10.1).
- Worst-case turbine shut-down scheme (Appendix 10.2).

10.3.3 Do Nothing Effects

The shadow flicker effect examined in this chapter is solely related to the proposed development of a windfarm. Therefore, should the development not proceed the effects described and examined in this chapter would not occur.

10.3.4 Potential Effects

Shadow flicker effects are only possible if there is an unobstructed path from the turbines to the window. If there is no view of the turbines from the location of a receptor, there will be no noticeable effects because the turbine shadow will not pass over the window.

Survey data regarding the level of visibility may inform the results of this assessment further. However, based on the scale of the wind farm it is reasonable to assume that a significant level of visibility will be available from the surrounding areas. It is reasonable and conservative to model effects based on assumed visibility as this captures a worst-case scenario.

The technical assessment has shown that the majority of the 151 assessed receptors would experience some effects, based on a conservative approach to the assessment, in the absence of mitigation measures. Less than half of the receptors would experience less than 30 minutes per day and less than 30 hours per year – which is acceptable based on the current limits. Mitigation is to be applied that will ensure that all effects are within acceptable limits, should the wind farm be consented.

Factors including cloud cover, variable wind speeds/direction and likely maintenance requirements will act to reduce the potential effects in real terms. The modelling is based on a comprehensive and conservative approach whereby statistical and variable mitigating factors are assumed to be worst-case.

There will be no potential effects relating to shadow flicker during the construction phase of the proposed development. For the duration of the operational life of the proposed development, unmitigated, the worst-case potential impact from shadow flicker at specific localised receptors will be likely, significant and long-term but have a momentary effect with respect to the duration of impact on a daily basis.

10.4 MITIGATION MEASURES

Screening Assessment

The shadow flicker modelling predicts a worst case 'bare earth' impact. In reality, existing screening in the form of buildings, vegetation and local topographic variations will have a significant impact on the level of shadow flicker that is predicted to be experienced by the sensitive receptors. When these additional screening features are taken into account, the actual impact in terms of incidence and duration may be significantly reduced or even eliminated. If existing screening reduces the impact below acceptable levels then no further mitigation will be required.

Screening Measures

If existing screening is not sufficient to reduce shadow flicker to acceptable levels (either the existing levels outlined in the Wind Energy Development Guidelines (2006) or Guidelines finalised during the consenting process) then additional screening measures will be proposed. Through interaction with the individual sensitive receptors, the incidence and level of shadow flicker at the specific location will be verified. Once verified, a number of measures will be proposed to the property owner such as installation of blinds/curtains in the affected room(s), planting of new screening at identified locations within the curtilage of the property and any other site-specific measures that might be agreeable with the affected party. Once the agreed measures are implemented, the effectiveness of the measures will be monitored over a period of months to establish the reduction in impact. The costs of the agreed mitigation measures will be borne by the developer. If the proposed measures are not agreeable, or the implemented measures are not effective in reducing the incidence and duration of shadow flicker to acceptable levels, then a turbine(s) shutdown scheme will be developed and implemented.

Turbine Shutdown Scheme

A worst case turbine shutdown scheme is presented in Appendix 10.2. In principle, the required times and dates for the proposed shutdown scheme (if implemented) will be programmed into the wind farm control system to automatically stop the rotor of the specific turbine(s) from turning at times when potential effects would result from the operation of the turbine. The worst-case turbine shutdown scheme presented in Appendix 10.2 will be updated (should the wind farm be consented) to reflect the impact of both the screening assessment, applied screening measures and the acceptable limits.

The implementation of the proposed mitigation measures, including a shutdown scheme to minimise any potential significant effects from the proposed development, will reduce the overall effect of the development to slight and long term.

10.5 RESIDUAL IMPACTS

There will be no residual shadow flicker impacts associated with the proposed development following the implementation of the mitigation measures outlined in Section 10.4. In summary, the potential effect of the proposed development will be slight and long term.

In conclusion, the potential for shadow flicker effects has been technically assessed considering the appropriate technical parameters and conservative assumptions. The results have been interpreted with reference to the appropriate guidance. The applicant is committed to mitigation that will ensure that any residual effects are within the acceptable limits.

11 MATERIAL ASSETS - TELECOMMUNICATIONS, AVIATION AND EMF

Note: Chapter 10 (Material Assets -Shadow Flicker) and Chapter 11 (Material Assets - Telecommunications, Aviation and EMF) of this Environmental Impact Assessment Report (EIAR) can be classified as “Material Assets” and, as such, are often presented together within one chapter of an EIAR. However, for the purposes of clarity and a detailed assessment of each parameter, it has been decided to deal with each topic separately within this EIAR.

11.1 INTRODUCTION

Radio waves and microwaves are used for a wide variety of communication purposes. The rotating blades of wind turbines can occasionally scatter electromagnetic signals causing interference to a range of communication systems. The signals can be reflected from turbine blades, so that nearby receivers may pick up both the direct and the reflected signals (Eyre, 1995). The types of communication, which may be affected, include the following:

- Television (TV) broadcasts;
- Microwave links;
- VHF Omni-directional Ranging (VOR) used for aircraft navigation;
- Instrument Landing Systems (ILS) used by aircraft an approach to landing;
- Radar;
- Safety of Life at Sea (SOLAS) transmissions;
- Loran – a long range navigational system;
- Cellular radio for portable telephones; and
- Satellite communications.

It has been found in practice that many of the above systems are not affected when a wind turbine system is put into operation (Taylor and Rand, 1991).

11.1.1 Communications and Television

Compliance Engineering Ireland (CEI) Ltd. was commissioned to undertake an assessment of the proposed Derryadd Wind Farm development on existing telecommunications signals, to ascertain whether the installation of 24 No. wind turbines and associated infrastructure will potentially interfere with services provided by telecommunications operators in the area. This assignment included consultations with operators of microwave fixed links, radio telemetry links and TV services.

11.1.2 Statement of Authority

CEI is Ireland's premier supplier of electrical test and certification services. The company was founded by staff with over twenty year's international and local experience in this area. The company was formed in 1997 with key staff being seconded from the Irish state agency Enterprise Ireland. Since its inception CEI has grown to be the only accredited electrical test laboratory in Ireland offering a wide range of certification services and provides the majority of compliance testing services in Ireland. As such, it is an essential resource to many Irish based manufacturers and service providers.

CEI has carried out over 300 RF site surveys throughout Ireland. We are recognised by Comreg as one of the foremost independent authorities on the radio frequency spectrum in Ireland and are in regular contact on EMC issues. CEI has won the 2010 Comreg tender to measure 240 mobile telephone base stations for non-ionising radiation. CEI are also the main supplier to the Irish mobile phone industry of independent NIR surveys. CEI is the only Notified Body in Ireland for the radio and EMC directives.

This chapter describes the telecommunications baseline environment of the proposed development site through a review of planning policy and guidance, consultations with telecommunications and broadcasting companies and desktop studies. Following this, a description of the potential effect predicted as a result of the construction and operation phases of the proposal is outlined.

This chapter was prepared by Seamus O Leary (B.E, C.Dip.AF, C.ENG, FIEI),a Chartered Engineer and fellow of Engineers Ireland acting on behalf of CEI Ltd. Mr. O' Leary has extensive telecommunications and broadcast planning experience working with 2rn and as a consultant. In relation to wind farm planning, Mr. O' Leary has provided assistance to RTÉ, 2rn, ESB Wind Development Ltd, ESBi, TOBIN Consulting Engineers, CEI Ltd, Bord Gais, Airtricity and SWS Ltd.

11.2 METHODOLOGY

The following section details planning guidance and policy documents relevant to the assessment of effect on communications and television.

11.2.1 Earlier consultations

The developer has conducted a number of rounds of consultations with potential stakeholders. During these earlier phases of the project, feedback from the stakeholders informed the selection of turbine locations within the wind farm. CEI has also consulted with many telecommunications, broadcast, broadband and aviation stakeholders on a number of occasions between 2016 and 2018. This allowed interference to be avoided and many existing services to be protected for RTÉ, wireless broadband and telecommunications operators. The specific dates of consultations are provided in Table 11.2 below.

11.2.2 Planning Guidance

Department of Communications Climate Action and Environment – "Preferred Draft Approach" (2017)

In line with requirements under the EU strategic Environmental Assessment Directive when preparing this plan CEI has consulted widely over a number of years and gathered the views of stakeholders.

Approximately 55 stakeholders have been identified in the fields of aviation, broadcasting and telecommunications services that have been consulted with directly on the proposed development. Over the wind farm design period, modifications have been made to adjust positions of turbines where possible to avoid interference.

Irish Wind Energy Association – Wind Energy Development Best Practice Guidelines (2012)

Chapter 3 of the Guidelines for feasibility studies states "*Wind turbines can interfere through reflection with television, radio and microwave signals. These effects are generally predictable and usually are easily avoided by careful attention to siting and other appropriate measures. The possibility of electromagnetic interference to existing nearby telecommunications facilities i.e. microwave, radio, television, should be investigated. In particular air and sea navigation authorities must be informed about potential developments*". Specific reference to potential effect on Telecommunications and Aviation systems is detailed within section 11.4 of this document.

Department of Environment Heritage and Local Government (DoEHLG) Planning Guidelines for Wind Energy (2006)

Chapter 5.10 - Interference with Communication Systems. "*Wind turbines, like all electrical equipment, produce electromagnetic radiation, and this can interfere with broadcast communications. The interference with broadcast communication can be overcome by the installation of deflectors or repeaters. Planning authorities should advise the developer to contact the individual broadcasters, both national and local, and inform them of the proposals. A list of the licensed operators is available on the ComReg website at www.comreg.ie. Mobile phone operators should also be advised of the proposed development*".

Chapter 7.15 – Electromagnetic Interference. "*Conditions regarding measures to be taken to minimise interference with the transmission of radio and television signals, air and sea transport communications and other transmissions systems in the area may be necessary. Where electromagnetic interference is difficult to predict, conditions may require the Developer to consult with the service provider concerned* *and undertake remedial works to rectify any interference caused*". The assessment takes the above guidance into account.

11.2.3 Aviation

CEI assessed the impact of the proposed development on aviation interests in the vicinity of the development site as the siting of wind turbines may have implications for the operations of the communications, navigation and surveillance systems used for air traffic control. The following details planning guidance and policy relevant to the assessment of effect on aviation.

Department of Environment Heritage and Local Government (DoEHLG) Planning Guidelines for Wind Energy (2006)

Chapter 5.11 – Aircraft Safety. "*Wind turbine siting may also have implications for the flight paths of aircraft. Regard must be had to the Irish Aviation Authority's Obstacles to Aircraft in Flight Order, 2002, (S.I. 14 of 2002), as amended, which specifies the criteria used to determine whether or not any object anywhere in the State is deemed to be an obstacle affecting aircraft operations. In addition, in order to assure the safety and efficiency of aircraft operations in the vicinity of airports, the International Civil Aviation Organisation (ICAO) has defined a volume of air space above which new objects are not permitted. No part of the wind turbine should penetrate these defined surfaces. Accordingly, wind energy developers should be advised to contact the Irish Aviation Authority at the pre-planning stage of consultation, with details of locations and proposed heights of turbines, to ensure that the proposed development will not cause difficulties with air navigation safety*".

Chapter 7.16 states in relation to Aeronautical Safety. "*Conditions regarding lighting of structures, submissions of coordinates of the turbines positions, as constructed, and/or other appropriate conditions should be included, where advised by the Irish Aviation Authority*".

Irish Aviation Authority (Obstacles to Aircraft in Flight) Order, 2002

Article 5 – "*Reporting and Information in respect of Obstacles. (1) a person who proposes to erect or to construct an object as defined in paragraph (1)(a) of Article 4 of this Order shall first notify the Authority in writing of that intention*".

National and Regional Legislation, Planning Guidance and Policy

National policy is issued on behalf of the Irish Government by the Irish Aviation Authority. As part of the consultation IAA guidance was sought and documents reviewed. This includes the IAA policy document on "Land Use planning and offshore development", version 1:10, 2014.

11.2.4 Consultation and Scoping

As part of their assessment, CEI contacted telecommunications companies, airports and relevant authorities on a number of occasions, starting in 2016. Initially, each consultee was provided with the project details available from TOBIN Consulting Engineers, including the proposed site location map of the area and then later, the “initial” turbine layout plan. The final turbine details and positions were provided in 2017 and again in 2018, as shown in Table 11.1 below. For details of these consultees refer to the listing in section 11.2.4.1 of this chapter. It is noted that the consultees have requested the final post-planning turbine details as soon as this information is available.

Table 11.1: Turbine No and Grid References (Easting and Northing)

Turbine	Easting (ING)	Northing (ING)
1	204045	269699
2	203765	270151
3	203671	270697
4	203229	271306
5	203936	271719
6	204091	271202
7	204457	270810
8	204628	270299
9	204644	269739
10	205672	268516
11	206100	268268
12	205694	267752
13	205967	266503
14	206391	266174
15	207018	266275
16	206832	266677
17	206108	265592
18	207978	264543
19	208360	264306
20	209253	264198
21	209448	263627
22	209902	264073

23	209709	264641
24	209894	265219

11.2.4.1 Consultation and Scoping – Communications

Consultation has taken place with the companies listed below in Table 11.2 and the following information has been obtained from them:

- Location of any identified microwave links; and
- Possible effects on existing links.

Table 11.2: Summary of Consultations

	Summary of Consultations		
	Company /Individual contacted/data supplied – Maps and turbine details	**Date of most recent contact (A number of rounds of consultation took place between 2016-2018)**	**Summary result and response**
1	Shannon Airport / Paul Hennessy	19/07/2016	No issue, consult with the IAA in future. No response in 2018.
2	Dublin Airport/Cork Airport / Nigel Somerfield	22/02/2016	No issue in 2016, no more communication required please.
3	Galway Airport / Donal Porter (caretaker), Alan Farrell - Galway Co Council	27/03/2018	No issue as airport not operational.
4	Knock Airport / John McCarthy / Tomas Grimes	27/03/2018	No issue
5	Sligo Airport /Joe Corcoran / Kevin Traynor (Operations Manager)	27/03/2018	No issue
6	Donegal Airport (Brendan O Baoill ATC Manager)	27/03/2018	No issue
7	City of Derry Airport	27/03/2018	No issue
8	Belfast International Airport	27/03/2018	No issue
9	Belfast City Airport	27/03/2018	No response in 2018
10	Irish Aviation Authority/ Deirdre Forrest/ John Hughes & Audrey Rafferty	27/03/2018, 1/4/2018, 12/4/18,	In 2018 response was that: (1) agree an aeronautical obstacle warning light scheme

	Summary of Consultations		
	Company /Individual contacted/data supplied – Maps and turbine details	**Date of most recent contact (A number of rounds of consultation took place between 2016-2018)**	**Summary result and response**
			for the wind farm development, (2) provide as-constructed coordinates in WGS84 format together with ground and tip height elevations at each wind turbine location (3) notify the Authority of intention to commence crane operations with a minimum of 30 days prior notification of their erection.
11	Department of Defence / Eilish Keating	27/03/2018, 12/4/18	No issue, their views are that: 1. Single turbines or turbines delineating corners of a windfarm should be illuminated by high intensity obstacle strobe lights (Red). 2. Obstruction lighting elsewhere in a windfarm will be of a pattern that will allow the hazard be identified and avoided by aircraft in flight. 3. Obstruction lights used should be incandescent or of a type visible to Night Vision Equipment. Obstruction lighting fitted to obstacles must emit light at the near Infra-Red (IR) range of the electromagnetic spectrum specifically at or near

	Summary of Consultations		
	Company /Individual contacted/data supplied – Maps and turbine details	**Date of most recent contact (A number of rounds of consultation took place between 2016-2018)**	**Summary result and response**
			850nanometres (nm) of wavelength. Light intensity to be of similar value to that emitted in the visible spectrum of light. Obstruction lights used should be incandescent or of a type visible to Night Vision Equipment.
12	Abbeyshrule Aerodrome // various clubs	27/03/2018	Owner stated verbally that there is no issue as it is so far away. Requested lights and signs on any HV power lines from the site. No response in 2018.
13	Trim Airfield // Vincent Savage/Michelle Dore/ Pat Murphy	27/03/2018	No response to date.
14	Towercom/David Enright/ Gavin Hickey / Declan Drummond	27/03/2018	No issue for Towercom
15	Eir mobile Formerly Meteor and Mosaic/ John Bagnall/ Brendan O Flaherty	27/03/2018, 27/3/2018	Turbine #10 was only 58m from a link in 2017. On 1/5/2018 John Bagnall responded that the turbine is now positioned in a good place in relation to their network. No issue for their network.
16	Eir/Thomas Sheridan	27/03/2018	No issue for the Eir microwave radio network in 2018.
17	Airspeed/Gareth Rennicks/Christian Walls/maps/ Ger Boyce, Peter O Brien	27/03/2018, 27/4/2018	No issue for Airspeed in 2017. Peter O Brien stated on 30/4/18 that there is no issue of concern for their radio circuits.

	Summary of Consultations		
	Company /Individual contacted/data supplied – Maps and turbine details	**Date of most recent contact (A number of rounds of consultation took place between 2016-2018)**	**Summary result and response**
18	Netshare / Vodafone / Gavin Byrne	27/03/2018, 27/4/2018	There is no impact on the Vodafone network. They have no objection. In 2018 Gavin Byrne responded again that Vodafone has no issue.
19	Tetra Ireland/ Thomas Barry	27/03/2018	No issue for Tetra in 2018.
20	Imagine / Equiendo - Ronnie O Neil / Michael O Donovan	27/03/2018	No issue for Imagine in 2018.
21	BT / Padraig Condon	30/03/2018	No issue for BT.
22	Three (02 legacy) / Gerry Callan	27/03/2018	No issue for Three and the O2 legacy network.
23	Virgin media / UPC / Cathal O Donnell/ Liam Allister	27/03/2018	No issue for Virgin media in 2017 and 2018.
24	Garda Síochána	27/03/2018	No response to scoping report but they had advised on 27/6/2016 that the Gardaí and Tetra had no issue. Email data sent again to Michael McDonnell on 27/3/2018 and 11/5/2018. No response in 2018.
25	ESB Telecoms Services / Donal Hasslam/ Wilson Dalikeni / Derek Jones / Paul McDonagh	27/03/2018	Highlighted potential problems for the ESB. Radio circuits from Ardagh site to control & monitor their 38kV sites maybe interfered with. Their consultants JRC advised engagement with ESB about micrositing turbine T16. They requested that BnM supply them the absolute exact details of this turbine, dimensions and

	Summary of Consultations		
	Company /Individual contacted/data supplied – Maps and turbine details	**Date of most recent contact (A number of rounds of consultation took place between 2016-2018)**	**Summary result and response**
			position (this detail was provided). They proposed that a microsite restriction should be agreed limiting movement to 25m in the sector 266 to 360 to 85 East of Irish Grid North (EIGN). The applicant confirmed the final proposed location for T16 with JRC and ESB and confirmed that that there is no proposal to microsite the turbine at this location. Bord na Móna will continue to liaise with JRC and the ESB as the project develops.
26	ESB Telecoms Ltd / Peter Byrne	27/03/2018, 27/4/2018,30/4/18	No issue for any operators on their sites in 2018.
27	02/Three (Mosaic) / Gerry Callan	27/03/2018	No issue for the 02 legacy network / Three / H3G reported from Mosaic.
28	BAI / Roger Woods	27/03/2018	No issue expected.
29	RTE /2RN / Colin Kennedy/Johnny Evans	27/03/2018	No issue. Protocol must be signed pre-construction and television and radio services remediated if interfered with.
30	Digiweb (Viatel / smart telecom) / Hugh Logue & Donal McEneaney	27/03/2018, 27/4/2018	No issue for Viatel in 2018.
31	Sigma / Brian Kearney / Jimmy Nolan	27/03/2018	No issue for Sigma to earlier proposals. No response to final turbine positions. No reply in 2018 to any contacts.

	Summary of Consultations		
	Company /Individual contacted/data supplied – Maps and turbine details	**Date of most recent contact (A number of rounds of consultation took place between 2016-2018)**	**Summary result and response**
32	Magnet / Ailish O Connor & James Canty	27/03/2018, 27/4/2018, 11/5/18	No interference expected to earlier proposals. On 17/5/2018 Magnet stated that they expect no interference.
33	Longford Fire Station / Declan Kilcline	27/03/2018, 27/4/2018	No issue but designer should plan for emergency services having access to site and plan for response to fire event. No responses in 2018 to further consultations
34	National Ambulance Service / Niamh Murphy and Pat McCreanor	27/03/2018	He noted that Niamh Murphy responded on 16/6/2016 to say that they had no issue and that she would have run it by him at that time. In 2018 he referred it on to Telent Technology Services Ltd, who have responded below. No issue.
35	RNLI / Carl MacGowan.	27/03/2018, 27/4/2018	No interference expected in 2018.
36	Coastguard / Gerry Smullen	27/03/2018	No issue in 2018.
37	Camp West & (WRCC) / Seamus Murphy/Sean Brady / Richard Sheehan	27/03/2018	No interference expected. No response to final turbine positions submitted in 2018.
38	Eastern Regional Control Centre (ERCC) / Richard Sheehan	27/03/2018	No interference expected. No response to final turbine positions submitted in 2018.
39	Northern Sound Longford / John Carrigy / Trevor Galvin	27/03/2018	No issue with the proposed development but they reserve the right to complain in the future if any interference is found upon construction.

	Summary of Consultations		
	Company /Individual contacted/data supplied – Maps and turbine details	**Date of most recent contact (A number of rounds of consultation took place between 2016-2018)**	**Summary result and response**
40	Shannonside / Trevor Galvin	27/03/2018	No issue but they reserve the right to complain if problems arise. No concerns with this in relation to our microwave links. No issue anticipated with VHF Band II but reserve the right to seek remediation if any issues arise during or after construction.
41	iradio Athlone / Jonathan Duane / Leigh Doyle	27/03/2018, 27/4/2018	No response to Scoping report to date in 2018.
42	Ripplecom/ Denis Herlihy, Piotr Zurek	27/03/2018	On 16/5/2018 Piotr replied that the final turbine positions will have no impact on their point to point links (red lines on their map) but might block the line of sight to some residential customers. Turbine 4 – Customer 64, Customer 104 Turbine 7 – Customer 65, Customer 1106622 Turbine 10 - Customer 107
43	EOBO Ltd (Bbnet) / Barry O Halloran	27/03/2018	No issue for Bbnet in 2018
44	Onwave Broadband, (Now Europasat as it took over Onwave)	27/03/2018	No response to Scoping report to date
45	Premier Broadband / web form	27/03/2018	No issue for Premier Broadband in 2017. No response in 2018

	Summary of Consultations		
	Company /Individual contacted/data supplied – Maps and turbine details	**Date of most recent contact (A number of rounds of consultation took place between 2016-2018)**	**Summary result and response**
46	Eurona Arden broadband / web mail	27/03/2018	Paul Curran stated in 2016 that Eurona operate a wireless Transmitter on Slieve Bawn and have customers in Lanesborough area. They need to be kept updated on developments in case of interference to customers. Barry Wilson replied on 11/5/2018 that in his opinion this development will have no bearing on their current or planned operations. Further updates can be sent to Barry Wilson.
47	Pure Telecom /Shane Flood	27/03/2018	In 2016 -No issue – their services are carried on Eir network so refer to Eir
48	Qsat / Sarah Herman	27/03/2018	No response needed, no issue for them in 2016.
49	Europasat /webform	27/03/2018	Responded on 12/10/2016 to ticket 633796 raised on 10/10/2016, that no interference is expected.
50	Carnsore broadband	27/03/2018	No interference expected in 2017. No response in 2018.
51	Host Ireland / David Goss	27/03/2018	Shane Bunyan has confirmed on 15/2/2017 that no interference is expected. No response in 2018.
52	Westnet / Paul Cunnane	27/03/2018	No issue in 2017. No response in 2018.

	Summary of Consultations		
	Company /Individual contacted/data supplied – Maps and turbine details	**Date of most recent contact (A number of rounds of consultation took place between 2016-2018)**	**Summary result and response**
53	Fastcom / Eamon Fowley / Ronan O Hart	27/03/2018	No issue for them in 2018.
54	Telent /Pat McGrath	03/04/2018	No issue for Telent or for services they provide to the HSE Ambulance services.
55	Communications Corp Group	27/04/2018	Keith McInerney called on 14/5/2018 and said that as far as he is aware they have no links in the area except for those operated for them by 2rn, so he has no objection. He would like to be kept informed of any developments.

A number of the companies listed above utilise additional companies for technical planning. A number share common radio planning resources, such as Vodafone who use a company called 'Netshare'. Meteor, Hutchinson/H3G and O2/Telefonica also have shared technical resources through a similar entity called 'Mosaic'. In addition, many national broadcasters such as RTE Television, RTE Radio, TG4 and TV3 use RTE Network (trading as '2rn') for transmission services. Recently, RTE Network Ltd. have rebranded as '2rn'.

An Garda Síochána use Tetra Ireland. The fire brigades and local county councils often use Sigma and CAMP for technical planning and support. The National Ambulance Service rely on Telent Ltd. There are other network entities such as Towercom Ltd. that provide and operate sites and networks for the telecommunications companies. Some companies, therefore, referred the consultation letters for the proposed Derryadd Wind Farm onto their network technical providers for consideration.

Following the provision of the proposed wind farm site boundary details and initial draft proposal for the wind farm in 2016, most operators responded by stating that they had no objection to the proposed development as it poses no threat to current microwave links. In 2017, a similar consultation process was undertaken having been informed by responses from the consultees.

The reason that the operators have concluded that there will be no interference to their microwave links is that they have performed in-house analysis of the proposed turbines using data provided to them by the developer. They have software-based simulation tools that allow them to plot the turbines on detailed maps and overlay their microwave circuits. They can then calculate the clearance between the microwave circuit and the proposed turbine. Each operator uses their own criteria for the amount of clearance they require but the common approach is to use Fresnel zone clearance calculations as shown in Figure 11.2 below.

When the final turbine positions were communicated in 2018, some operators who had no objections in 2016 and 2017 did not respond to the latest set of turbine co-ordinates.

Telecommunications operators such as Meteor, Mosaic and ESB Telecoms services responded that they have sites and links in the vicinity of the proposed site. ESB Telecoms expect some interference and engaged consultants Joint Radio Company Ltd (JRC) from the UK to do detailed analysis. JRC made a detailed analysis of possible interference and noted concerns about turbine 16. They have advised that further engagement between Bord na Móna and the ESB is required. They advise that the team should discuss with them the possibility of agreeing a microsite restriction on movement of this turbine. It should be noted that the proposed location for turbine 16 is final and that there is no proposal for micrositing of turbines as part of this planning application. However, as recommended, TOBIN Consulting Engineers engaged with ESB on behalf of Bord na Móna (telephone meeting with Paul McDonagh (ESB Telecoms) on 10/12/18) and relayed that Bord na Móna are in agreement with the ESB Telecoms request for a restriction on any future micrositing of turbine 16.

Broadband operators Ripplecom and Eurona Arden Broadband have wireless services and end customers living in the area and expect some interference to their unlicensed network. Links to end customers (public) are generally easier to remediate, if interference is found. Ripplecom have analysed the final set of turbine co-ordinates submitted in 2018 and now predict interference to 5 broadband customers.

11.2.4.2 Consultation and Scoping – Television

The following consultees were contacted in relation to potential effect of the proposed development on TV signals:

- ‘2rn’ (RTE Network Ltd – also known as RTENL Ltd);
- Virgin Media (formerly UPC Ireland).

RTENL ('2rn') were consulted, as this company provides transmission services for many Radio and TV operators such as RTE, T4G and TV3.

2rn operates an extremely important microwave link to National broadcasting that now passes between proposed turbines 6 and 7. It is a link from the 2rn Coolderry site to the 2rn main station at Cairn Hill. It is a 6 GHz radio circuit carrying all National TV and Radio circuits. At the moment, 2rn have sufficient clearance to avoid problems but they have requested that they are consulted on this matter frequently as the project moves forward to monitor the situation and make interference calculations in advance of any turbine installation. They have requested the final post-planning turbine details as soon as this information is available to assist with calculations.

2rn have also identified risk areas to local television reception such as the nearby Lanesborough village. Other areas of concern are where local residents receive TV signals from the Cairn Hill transmitter through the wind farm. A technical field survey is required to obtain a better opinion of the local reception conditions and options post build.

2RN have provided Bord na Móna with a protocol that should be signed by Bord na Móna in advance of construction. This protocol sets out how any possible interference issues will be resolved should they arise.

Virgin Media was contacted in 2016, 2017 and again in 2018. Virgin Media responded on all occasions by confirming that the proposed development at Derryadd is not in the line of sight of any of the microwave links that they currently operate near and, therefore, there will not be any interference to the Virgin Media Microwave Radio Link network, as shown below in Figure 11.1 (which illustrates Virgin's existing microwave circuits).

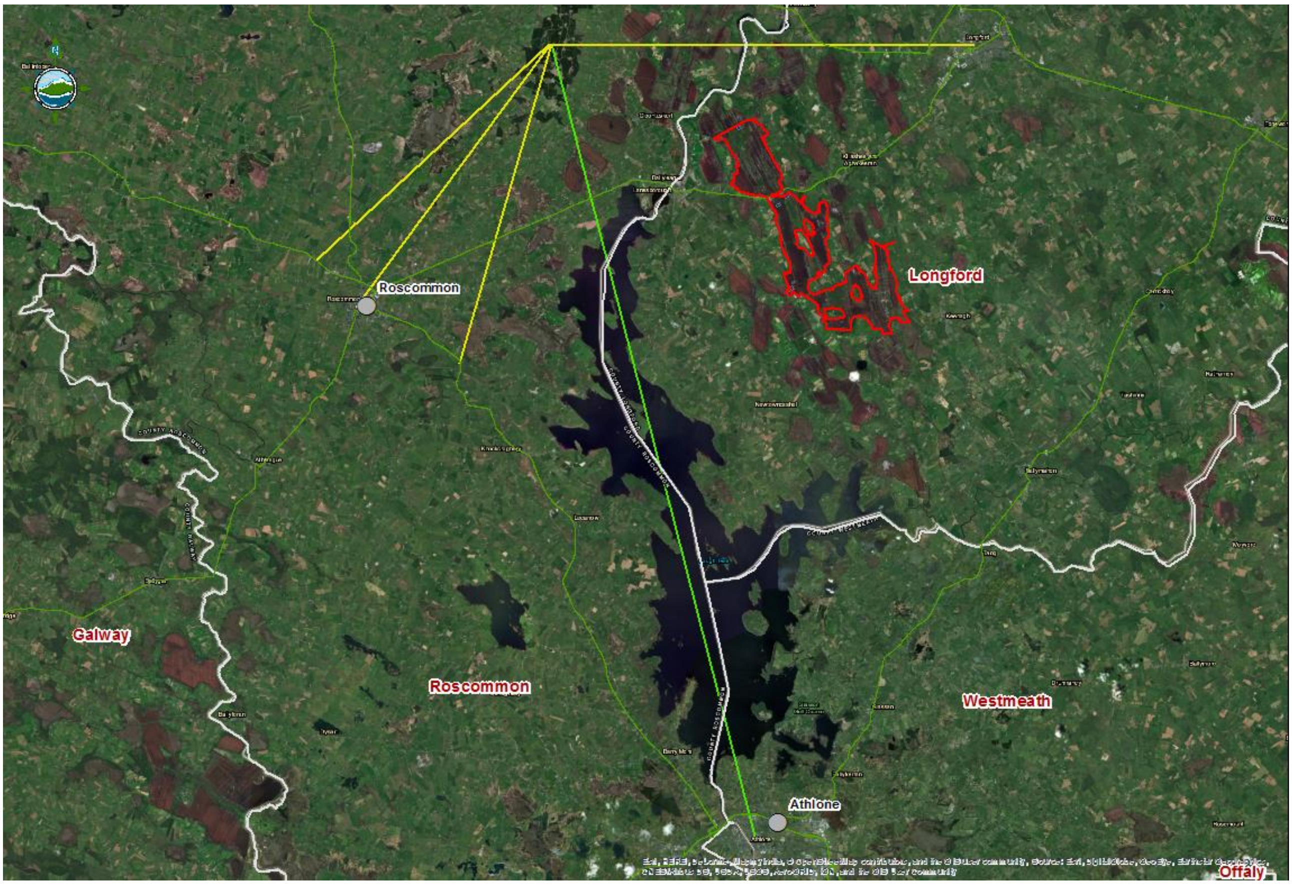

Figure 11.1: Virgin media microwave circuits in the vicinity of Derryadd Wind Farm

11.2.4.3 Consultation and Scoping – Radio

The following consultees were contacted in relation to potential effect of the proposed development on FM Radio signals:

- '2rn' (RTE Network Ltd – also known as RTENL Ltd);
- Broadcasting Authority of Ireland (BAI);
- Communicorp group (Today FM and Newstalk)
- Shannonside/Northern Sound; and
- iRadio.

2rn did not raise any concerns about FM radio or Long Wave Radio transmission interference. In general, FM radio is not adversely affected by wind turbines. However, the Microwave link carrying many FM national signals from the Coolderry link site to the main station at Cairn Hill is passing through the wind turbine site, as described in the previous section. The analysis carried out by 2rn indicates that the microwave link will not be impacted by the proposed development.

The Broadcasting Authority of Ireland (BAI) responded that a few of the proposed turbines are within 500 metres of the Slieve Bawn transmitter. Given past experience with similar installations, it is unlikely that the wind turbines will interfere with FM reception in the area.

Shannonside Radio/Northern Sound responded and did not "anticipate any issue with VHF Band II but reserve the right to seek remediation if any issues arise during or after construction".

iRadio use satellite distribution and, therefore, interference is unlikely. They also use 2rn for transmission at some sites such as Cairn Hill. Communicorp Group stated verbally that do not expect interference to their FM services and microwave radio links.

11.2.4.4 Consultation and Scoping – Aviation

Consultation was undertaken with the Irish Aviation Authority (IAA). The IAA responded in 2016 and 2018 stating that they had no issues with the proposed development as long as it complied with aeronautical lighting and positional data requirements.

The proposed development complies with and will comply with aeronautical lighting and positional data requirements.

1. The IAA stated in 2018 that the applicant should be conditioned to contacting the Irish Aviation Authority to:
2. Agree an aeronautical obstacle warning light scheme for the wind farm development;
3. Provide as-constructed coordinates in WGS84 format together with ground and tip height elevations at each wind turbine location; and
4. Notify the Authority of intention to commence crane operations with a minimum of 30 days prior notification of their erection.

The IAA noted in 2016 that the proposed development is to be located at Derryadd, Co. Longford, between Lanesboro and Keenagh. It is 11.3 km northwest of Abbeyshrule Aerodrome. It will not have any effect on the aerodrome. The IAA stated that height of the turbines would need to be ascertained to determine the effect on en-route traffic as well as on Radio Navaids. The IAA were provided with the exact heights of the proposed turbines and no objection was received from the IAA.

The Air Corps responded in 2016 and again in 2018 through the Department of Defence stating that they too had no objection *“provided that the development is lit and marked in accordance with IAA requirements”*.

The Air Corps also stated that in all locations where wind farms are permitted, it should be a condition that they meet the following lighting requirements:

- *“Single turbines or turbines delineating corners of a windfarm should be illuminated by high intensity obstacle lights;*
- *Obstruction lighting elsewhere in a windfarm will be of a pattern that will allow the hazard be identified and avoided by aircraft in flight; and*
- *Obstruction lights used should be incandescent or of a type visible to Night Vision Equipment. Obstruction lighting fitted to obstacles must emit light at the near Infra-Red (IR) range of the electromagnetic spectrum specifically at or near 850nanometres (nm) of wavelength. Light intensity to be of similar value to that emitted in the visible spectrum of light”.*

Knock Airport responded that the location is well outside their safeguarding zone and, therefore, it is not within their remit to assess it but advised that the IAA is consulted throughout the process.

Dublin, Sligo, Donegal, City of Derry, Belfast International and Cork Airports responded directly or through the Dublin Airport Authority (DAA) that they have no issue, but to liaise with the IAA.

Galway Airport did not respond to date. It is no longer in the operation of Carnmore Aviation Ltd. and it is now in the ownership of Galway County Council.

Trim Airfield was contacted. Various users of the airfield were also contacted. No response has been received to date.

Abbeyshrule Airfield was consulted. Contact was established with one of the owners – Mr. Ted McGoey. He stated verbally that he had no objection. No written response has been received yet from any stakeholders. The IAA stated that this airfield is not affected.

11.3 EXISTING ENVIRONMENT

11.3.1 Existing Environment – Communications

There are a number of radio communication links in the vicinity of the proposed development. Telecommunication operators have provided details of the existing communication links in the proposed

Derryadd Wind Farm area. Of these operators only a small number encroach on the boundary of the proposed wind farm. As a result, some operators have expressed a concern about the possibility of interference to telecommunication circuits. A summary of the communication links and the operators where interference might be experienced is shown in Table 11.3 below. Some of these operators have had their concerns addressed in earlier rounds of consultations and now only need to be updated on the planning application and before the commencement of the construction phase of the development.

Table 11.3: Operators and services expecting interference

Operator	Link
RTENL (2rn)	The existing Coolderry to Cairn Hill National Radio link lies between turbines 6 and 7 – there is no interference expected. RTENL have stated that the developer can proceed with caution but needs to keep them appraised. In addition, subject to project consent, Bord na Mona will sign a protocol agreement with 2rn which will addresss any potential interference issues and how to resolve them. Cairn Hill site – 2rn expect that the television reception for some nearby local residents will be impacted. Residents in the Lanesborough area are identified as at risk.
Eir formerly Meteor (Mosaic)	One of the EIR sites is located within the wind farm but there is now adequate clearance to avoid interference to their network
ESB Telecoms services	Seven sites have links across the wind farm to Ardagh Hill plus microwave circuits to end users. Their consultants, JRC, did extensive modelling and they expected interference from turbine T16. They advised further discussions directly with ESB Telecoms and then possibly micrositing of this turbine or restriction of the movement of this turbine within an identified sector. As stated above in Section 11.2.4.1, Bord na Móna have engaged

	with ESB Telecoms and are in agreement with this restriction on the location of turbine 16.
Three / O2 legacy network	One site and some microwave links are located within the wind farm. All microwave paths are now clear – so the development can proceed and they wish to be updated on developments and planning at all stages.
Ripplecom Broadband	Five of their customers receive signals through the wind farm. Interference is expected only to these customers but not to their licensed radio circuits.
Eurona Arden Broadband	A wireless transmitter is located on Slieve Bawn. Multiple end customers in vicinity of wind farm receive signals through the wind farm. Some interference was earlier anticipated in 2017 but not now expected in 2018 in their view. They wish to be updated as planning proceeds.

11.3.2 Existing Environment – Aviation

The nearest airport to the proposed site at Derryadd is Sligo Airport which is approximately 72 km away. Trim, and Abbeyshrule airfields are the closest to the proposed development. Abbeyshrule is 11.3 km away while Trim is 78km away.

None of the airports that responded to the consultations stated that they had any objections and they referred the project team on to the Irish Aviation Authority (IAA) for comment. The IAA stated that they had no objection to the proposed Derryadd Wind Farm provided it complies with aeronautical lighting and positional data requirements.

11.4 POTENTIAL IMPACTS

11.4.1 Do Nothing Effect

Should the development of the windfarm not go ahead, there will be no effect on telecommunications and aviation from the current status quo.

11.4.2 Potential Effect during Construction

It is not standard industry practice to consider the effects of construction or decommissioning with regard to communications links, TV transmission or aviation issues. The Irish Wind Energy Association (IWEA) Best Practice Guidelines advise that construction should be planned so as to minimise disruption to traffic. Such planning should involve discussions with the local authority. The potential effects that may arise during construction are likely to be caused by tall cranes. Such cranes are likely to be in the vicinity of the wind turbines only during a short period of time when the turbines are being erected and are likely to have effects similar to those of the wind turbines. On this basis, any effects during construction are likely to be similar to any effects during operation (i.e. not significant/imperceptible). It should be noted that these effects are temporary in nature and will completely disappear once the cranes are removed from the site.

11.4.3 Potential Effect during Operation

The operational activities of a wind farm have the potential to impact on Telecommunications and Aviation in a number of ways which are outlined in the proceeding sections.

11.4.3.1 Potential Effect during Operation – Communications

Turbines can interfere with microwave communications link systems, as they can reflect and block microwave link signals. Link operators normally also calculate their own exclusion zone criteria, which may be more onerous than just the avoidance of the main signal beam. This has been considered by the consultees.

RTE Network Ltd operate a vital national microwave trunk radio network that carries all broadcast services across Ireland. It passes through the wind farm. It is a microwave link (6 GHz) from the Coolderry link site to the RTE main station site on Cairn Hill. It generally requires at least 350 metres clearance from the link to the nearest turbine.

During the consultation phase, CEI alerted TOBIN Consulting Engineers to this fact and it was taken into consideration. Turbines T6 and T7 now are the closest to the microwave circuit. They are now approximately 500 metres away and as a result RTE Network Ltd. have not objected but wish for the development to proceed with caution and have requested that they are consulted on an on-going basis to allow them to monitor the situation. They reserve the right to object at any stage should any signal interference be observed.

ESB Telecom Services operate a number of point to multipoint microwave links through the site from at least 7 sites to the nearby Ardagh Hill ESB site. Analysis was performed by their consultants JRC Ltd to quantify the extent of the expected interference. They have recently identified turbine number T16 as the most likely to interfere with some of their radio circuits. Through pre-planning consultations with the author and TOBIN Consulting Engineers, ESB Telecoms have engaged in preliminary discussions on the project and have requested a restriction on micrositing of this turbine (T16) and further options to avoid interference to their circuits. Bord na Móna are in agreement with a restriction on the final location of T16 and consultation with ESB Telecoms will continue during the post-consent phase of the project.

Eir/ O2/Three have advised that they operate a communications site within the wind farm vicinity. There are microwave circuits to/from the site but they appear to be clear and at present they have no objections.

Ripplecom operate many microwave circuits carrying broadband to customers in the area. They expect some interference to 5 end customers. Interference is likely and if it occurs it will be reversible, frequent and of a brief duration. The developer will be able to remediate broadband service if interference occurs. **Eurona Arden Broadband** responded that they operate a wireless transmitter from the nearby Slieve Bawn mountain site to a number of customers within the vicinity of the wind farm. They do not expect interference but they want to be kept updated on all developments of the wind farm.

11.4.3.2 Calculation of clearance zones (Fresnel Zones)

Clearance zones are used to calculate the space required around a microwave communications link to protect it from interference. In order to calculate the required clearance or 'buffer zone' that is required around a microwave link, to ensure there is no interference to the signal, it is required to use the approach of calculating the diameter of a so called 'Fresnel Zone' around the main path of the microwave signal as it travels along a link from source point to destination point. The diameter of this zone varies along the path of the link and is at its widest at the centre point of the Microwave link.

The Fresnel Zone is the pattern of electromagnetic radiation that is created by a transmitting station from its antenna to receiving antennas and is ellipsoid[128] in shape. It is shown below in Figure 11.2.

As can be seen below, the cross sectional radius of the first Fresnel Zone is highest in the centre of the radio frequency (RF) path or line of site from the transmitter end to the receiver end and can be calculated using the formula below:

$$r = 17.32\sqrt{(D/4f)}$$

where:

r = radius in metres [m]

[128] Ellipsoid: 3-dimensional, elliptical or oval object, shaped roughly like a football

D = distance between two points in kilometres [km]

F = frequency transmitted in Gigahertz [GHz]

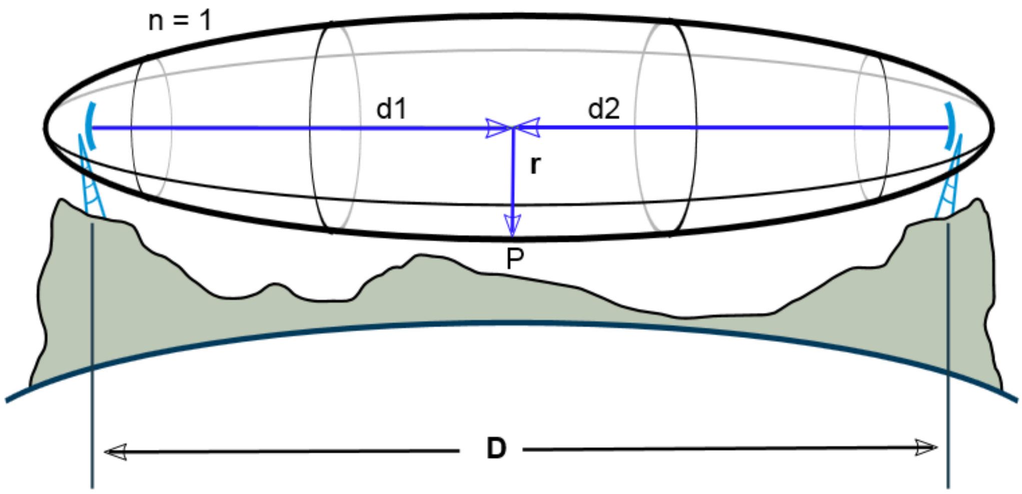

Figure 11.2: Fresnel Zone and clearance requirements

In the case of a microwave link between two points the radius of the Fresnel Zone can be determined using the above formula. Therefore the provision of an exclusion corridor is required along the path link. Based on calculations for the link, a maximum radius can be calculated for the 1st Fresnel Zone. Therefore, a total exclusion corridor of the diameter of the Fresnel Zone is required around the link. This approach is accepted currently as best practice when calculating exclusion zones. Once the Fresnel zones were determined for the relevant links these were then inputted into the design constraints register and are reflected in the final turbine layout.

11.4.3.3 Potential Effect during Operation – Magnetic fields

During the operational phase of the proposed wind farm, there will be several sources of electromagnetic emissions. The wind turbines may cause a 50 Hz magnetic field that decreases rapidly with distance from the turbine. At several metres distance from the turbine body, the electromagnetic effects are negligible. Many studies have been carried out on operational wind farms to confirm that the electromagnetic fields generated from wind turbines are less than those generated by commonly used household equipment and that the fields are safe (McCalum LC et al, Envir Health, 2014, Feb 15 13(1):9).

The control electronics will be typical of any circuits used by industry or in a conventional generating station. As with the construction phase all electrical components, equipment, apparatus and systems used during the operation phase are required by Irish and European law to comply with the EMC Directive 2004/108/EEC to ensure that the electromagnetic emissions from these devices will cause minimal interference to other equipment. The potential effect on sensitive receptors from magnetic fields during the operational phase of the development will be neutral and imperceptible.

11.4.3.4 Potential Effect during Operation – Television

The proposed development is located approximately 23 km South East of the Cairn Hill TV mast. Most residents in the vicinity of the wind farm are using this mast but others are also possibly receiving signals from other TV Masts. The planning department within RTE Network Ltd (2rn) were consulted in relation to the Derryadd Wind Farm and are aware of the development. No interference is expected to satellite, cable or Microwave based Television reception. The Cairn Hill mast provides local residents with the SAORVIEW digital TV signal and FM radio.

Based on the outline site map that was provided to 2rn, this is considered to be a large site. Viewers in this part of Co. Longford receive their ‘Saorview’ TV signals from the Cairn Hill transmitter and, with regard to the number of wind turbines being proposed and their proximity to nearby dwellings, there consequently may be some interference to television reception. The opinion of 2rn is that “any such interference would mainly affect those viewers who have their aerials orientated towards the turbines”.

When considering the impact of wind farms on TV and radio signal strengths, it is important to consider the possibility of “ghosting”. This term was used to describe a type of interference which was noticed on TV receivers which used the obsolete analogue TV system. The new digital TV system can completely correct for this interference and compensate for it in most cases.

This interference occurs if TV sets receive two similar amplitude signals; one from the direct path from the transmitter and a second signal which is reflected or diffracted from the rotating blades. The effect is termed as “ghosting” and it is caused by the phase shift between the two signals.

In addition, the movement of the turbine blades can cause a modulated “ghosting” effect, which would be at a rate equal to the speed of the blades. The amplitude of the reflected signal will be dependent on the reflectivity of the blades, which in turn is dependent on their conductivity. Figure 11.3 below illustrates how “ghosting” occurs. The BBC have conducted much research into this area and Inhouse Technologies Ltd has worked with RTE in the past on this topic to reduce the effect of interference to consumers post wind farm construction.

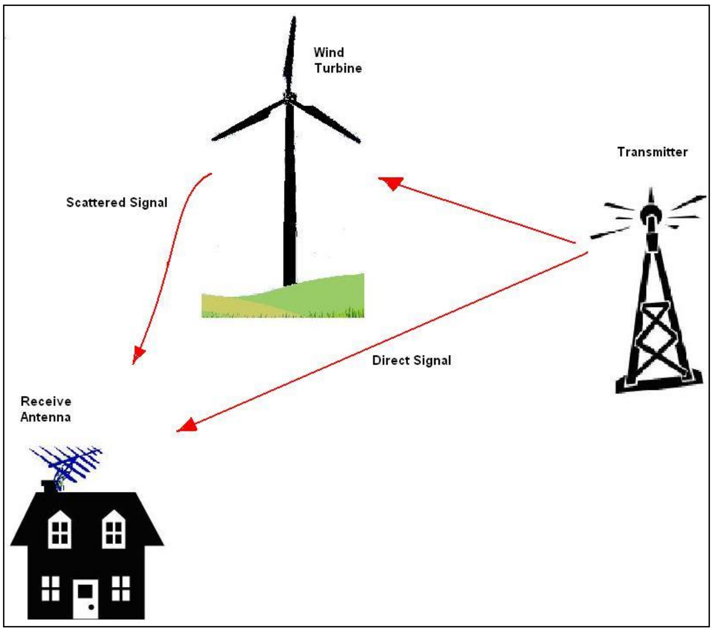

Figure 11.3: Demonstration of how 'Ghosting' occurs

The amount of interference caused is dependent on a number of different factors. These factors include the following:

- The type of broadcast signal to be received (TV only);
- Material used to make the wind turbines;
- Angle of the blades in relation to the incoming signal;
- Direction in relation to the receive antenna;
- Height;
- Distance from the transmitter;
- Distance from the receive antenna;
- Meteorological conditions;
- Site topography;
- Orientation of the rotor; and
- Rotor rotation speed.

The proposed development has the potential to impact upon some areas that are receiving digital TV signals which lie in the line of sight between the proposed development and the RTE Cairn Hill transmitter site. However, the potential number of effected receivers is greatly reduced as people now use the 'SAORVIEW' digital TV system and other digital systems. The SAORVIEW digital TV system was designed to afford much greater multipath or 'ghosting' protection against interference when compared to the old analogue TV system. The extent of interference to television reception caused by wind farms is now much less than it was in the past. However, if television interference occurs without any mitigation measures implemented to solve the issue, it will have a long-term, significant and negative effect on the end-users (for the lifetime of the wind farm). It has been agreed with 2rn that should any residual interference be noted that the developer will undertake to mitigate this to the satisfaction of 2rn. The applicant has agreed to sign a protocol agreement with 2rn (in the event of project consent) to guarantee that all mitigation measures that may be required to avoid or reduce this potential effect will be implemented.

11.4.3.5 Potential Effect during Operation – Aviation

The IAA were contacted regarding the proposed development and they responded stating that "*this proposed windfarm is located at Derryadd, Co. Longford, between Lanesboro and Keenagh. It is approximately 11.3 km Northwest of Abbeyshrule Aerodrome. It would not appear to have any effect on the aerodrome. The height of the turbines would need to be ascertained to determine the effect on en-route traffic as well as on Radio Navaids.*"

Therefore, there are no significant potential effects associated with aviation activities for the proposed wind farm. However, there will be ongoing consultation with the IAA if the project is consented to ensure that that there will be no impact on radio navaids and en-route traffic as a result of the proposed project, as described in Section 11.5.3 of this chapter.

11.5 MITIGATION MEASURES

11.5.1 Mitigation Measures - Communications

Until the possibility of interference is established, no mitigation measures are proposed. The normal practice is to site the turbine away from the established Fresnel zones of the microwave link affected. This can generally be done by moving the cause of interference some tens of metres out of the interference path. As part of the consultation process a microwave link operated by 2rn was found to be potentially interfered with by some turbines. A minimum separation distance of 500m between the microwave link circuit and the turbines was requested, and this was implemented as part of the design layout. Turbines T6 and T7 were moved to comply with protection of this existing radio circuit.

Typical mitigation measures for the protection of microwave radio circuits once interference has been found involve rerouting the circuit around the interference source using possible alternative sites to avoid the turbine. This may involve finding alternative sites nearby that can be used to house the new equipment required. This process may include adding extra cabins on a telecommunications site to house the new equipment, adding new antennas, obtaining new wireless link licences, upgrading utilities on the best chosen site to support the new equipment.

11.5.2 Mitigation Measures – Television and Wireless Broadband Domestic Reception

It is possible that a limited number of houses in the vicinity of the proposed wind farm could require some remedial measures in relation to television reception. In practice, such measures are not difficult to implement and, if necessary, will be undertaken by the developer in conjunction with a suitably acceptable broadcast integration contractor and RTÉ. A similar approach will be adopted with a wireless broadband operator.

General measures include the following:

- Replacement of the receiving aerial with a more directional or higher gain aerial;
- Repositioning the receiving aerial so that it's received signal is stronger;
- Directing the receiving aerial to an alternative transmitter that covers the area;
- Upgrading antenna cabling and connections;
- Installation of signal amplifiers;
- Development of a bespoke local solution using a receiving aerial some distance from the dwelling;
- Replacing terrestrial reception equipment with satellite reception equipment;
- Building of a new re-broadcast (RBL or 'transposer') site – sometimes this is required in extreme cases; and/or
- A combination of the above.

The requirement for the potential implementation of such measures will need to be addressed individually with service providers, should the need arise.

If the development is consented, then the developer will interact with RTENL Ltd (trading as "2rn") in respect to a protocol agreement for television reception protection. This protocol will require that the developer accept responsibility for any required remediation works to the RTE network as a result of the development.

In accordance with the protocol to be signed between the developers and 2rn, the developer is responsible for ensuring that television signals are not disrupted by the wind farm. In the event that television interference is not satisfactorily resolved through redirection of the aerial toward an alternative transmitter, the developer will employ a television engineer to inspect the premises to investigate the matter. If all redirection and reception remediation activities prove ineffective, then the developer is required under the protocol to provide a transposer or similar technology at a suitable location.

Following the implementation of any required mitigation measures, the effects on nearby receptors will be neutral, imperceptible and, as described above, unlikely.

11.5.3 Mitigation Measures - Aviation

The Irish Aviation Authority (IAA) state that, should planning permission be granted, the IAA will require an agreed scheme of aviation obstacle warning lighting, notification at least 30 days prior to the commencement of the development and as-built coordinates of the completed development for charting purposes. The proposed development will have no significant negative effect on the local environment in terms of aviation.

11.6 RESIDUAL IMPACTS

Implementation of the proposed mitigation measures will ensure that the residual effect of the proposed development is not significant/imperceptible.

Compliance Engineering Ireland Ltd. (CEI) conducted a desk-based study which commenced in February 2016 and concluded in November 2018. The desk-based study included a review of the operators of transmission paths close to the proposed wind farm. The purpose of this assessment was to ascertain whether the installation of the proposed 24 turbine wind farm at Derryadd would interfere with telecommunications links, TV reception and aviation activity in the local area.

CEI has conducted a number of rounds of consultations with stakeholders over the years 2016 to 2018 to first identify sites and links in the proposed wind farm vicinity, then to help to identify problematic microwave links and then to assist in the repositioning of the turbines away from microwave link paths, where possible. All of the identified issues have been addressed and suitable mitigation measures proposed.

By consulting with the telecommunication companies, it was possible to perform a technical due diligence of the proposed wind farm and also the nearby telecommunication links. Some links were identified and analysed. To date, work with the developer and with operators such as Eir, Three, O2 and 2rn has resulted in an agreed exclusion zone being put in place to the satisfaction of these parties. However, there is further work to be carried out to reach agreements with operators such as ESB Telecom services and broadband operators such as Ripplecom. This is beyond the scope of the assessment of interference effect.

It is envisaged that reception for some ‘Saorview’ TV signals in the area adjacent to the wind farm will be affected due to the operation of the turbines (a significant negative effect). This is a long term, significant effect that, unmitigated, will be present for the lifetime of the wind farm. However, it will be reversible and can be remediated. It is expected that some remedial actions performed in conjunction with possible alternative TV transmitter site options will overcome any interference issues. This can be investigated once the turbines are installed, if the proposed development is consented.

Furthermore, if the project is consented, a protocol agreement will be signed between the developer and 2rn (RTE Networks Ltd) that obliges the developer to maintain television reception in any areas that might be affected by the wind farm.

The final conclusion is that the proposed development will have a neutral and not significant/imperceptible effect on the local telecommunications and broadcast environment.

12 AIR QUALITY & CLIMATE

12.1 INTRODUCTION

This chapter assesses the effect on air quality and climate for the region surrounding the proposed Derryadd Wind Farm. All meteorological data contained in this report has been received from Met Éireann. This information is adjusted where necessary to take into account the proposed site's location and elevation.

The proposed wind farm is located approximately 3km east of Lanesborough, Co. Longford, 4km west of Killashee, Co. Longford and 8km to the north of Newtowncashel Co. Longford. The wind farm is located on the Mountdillon group of peat extraction bogs, Co. Longford.

Planning Permission is being sought from ABP for the installation of 24 No. wind turbines with a nominal capacity of 4 MW per turbine equivalent to 96 MW in total. The turbines will have a blade tip height of a maximum of 185 metres (m) (from the top of the foundation) and will be accessible from internal access routes within the Bord na Móna site. A full description of the proposed development is provided in Chapter 1 – Introduction and a detailed description of the project elements is provided in Chapter 2- Description of the Proposed Development.

In January 2014, the European Commission published its Climate and Energy Framework 2030[129] which seeks to drive continued progress towards a low-carbon economy and build a competitive and secure energy system that ensures affordable energy for all consumers and increase the security of the EU's energy supply. It proposes to achieve a 40% reduction in greenhouse gas (GHG) by 2030 relative to 1990, and a binding EU-wide target for renewable energy of at least 27% by 2030.

The Sustainable Energy Authority of Ireland (SEAI)[130] for the year 2015, indicates that 25.3% of electricity demand in Ireland was produced from renewable energy sources. Electricity has been an area of considerable decarbonising success and a target area for future progress in Ireland. Under the Renewable Energy Directive 2009/28/EC, Ireland is legally bound to deliver 16% of its final energy requirements from renewable sources by 2020. The National Mitigation Plan 2017[131] states that "EirGrid estimates that a total of between 3,900MW and 4,300MW of onshore renewable generation capacity will be required to allow Ireland to achieve 40% renewable electricity by 2020. This leaves a further

[129] https://ec.europa.eu/clima/policies/strategies/2030_en

[130] http://www.seai.ie/resources/publications/Renewable-Electricity-in-Ireland-2015.pdf

[131] https://www.dccae.gov.ie/documents/National%20Mitigation%20Plan%202017.pdf

requirement of between 780MW and 1,180MW to be installed by 2020 if the 2020 electricity target is to be reached, requiring an increased rate of installation."[132]

12.2 METHODOLOGY

12.2.1 EPA Description of Effects

The significance of effects of the proposed development has been assessed in accordance with the EPA guidance document *Draft Guidelines on the information to be contained in Environmental Impact Assessment Reports* (EIAR), Draft, August 2017[133]. Table 1.1 (available in Chapter 1, Section 1.8.2), is taken from the EPA document. It outlines guidance for describing the quality and significance of effects.

The effects associated with the proposed development are described with respect to the EPA guidance in the relevant sections of this chapter.

12.2.2 Air Quality Standards and Guidelines

The Environmental Protection Agency (EPA) is the competent authority responsible for the implementation of all Irish and EU ambient air quality legislation. The main air pollutants monitored by the EPA are ozone, carbon monoxide nitrogen dioxide and oxides, sulphur dioxide, particulate matter (PM_{10} and $PM_{2.5}$), benzene, lead, Poly Aromatic Hydrocarbons (PAH), Arsenic, Nickel, Cadmium and Mercury[134]. Apart from ozone, all of these pollutants result from the burning of fossil fuels, either from transport, domestic heating, electricity generating stations or industry. High ozone levels are formed from the reaction of two key pollutants nitrogen oxides (NO_x) and volatile organic compounds (VOCs) in the presence of sunlight.

The EC has formally adopted the Air Quality Framework Directive (96/62/EC). The First Daughter Directive, 99/30/EC (adopted April 1999), set specific limits for: nitrogen dioxide (NO_2), sulphur dioxide (SO_2), particulate matter (PM_{10}) and lead (Pb). In December 2001, the EC adopted the Second Daughter Directive, 2000/69/EC, relating to limit values for benzene and carbon monoxide (CO) in ambient air. The Third Daughter Directive, 2002/3/EC, established target values and long term objectives for the concentration of ozone in air. These directives have been transposed into Irish legislation by the Air Quality Standards Regulations, 2002 (S.I. No. 271 of 2002) (as amended).

[132] https://www.dccae.gov.ie/documents/National%20Mitigation%20Plan%202017.pdf

[133] https://www.epa.ie/pubs/advice/ea/EPA%20EIAR%20Guidelines.pdf

[134] http://www.epa.ie/air/quality/monitor/

The Fourth Daughter Directive 2004/107/EC relates to arsenic, cadmium, mercury, nickel and polycyclic aromatic hydrocarbons in ambient air. This completes the list of pollutants initially described in the Framework Directive (96/62/EC). The Fourth Daughter Directive was transposed into Irish legislation by The Arsenic, Cadmium, Mercury, Nickel and Polycyclic Aromatic Hydrocarbons in Ambient Air Regulations 2009 (S.I. No. 58 of 2009).

The original Air Quality Directives (except the Fourth Daughter Directive 2004/107/EC) have been replaced by one overriding European Directive, known as the Clean Air for Europe Directive (CAFE Directive) (2008/50/EC) adopted in May 2008 (transposed into Irish Law under S.I. No. 180 of 2011). The EU intends to incorporate the Fourth Daughter Directive into the CAFE Directive in the future. Within the CAFE Directive the specified limits for the protection of human health remain unchanged from those specified in S.I. No. 271 of 2002. These limit values are presented in Table 12.1 below.

Table 12.1: Air Quality Standards Regulations 2011 (based on EU Council Directive 2008/50/EC)

Pollutant	***Regulation* Note 1**	***Limit Type***	***Margin of Tolerance***	***Value***
Nitrogen Dioxide	2008/50/EC	Hourly limit for protection of human health - not to be exceeded more than 18 times/year	None	200 µg/m^3 NO_2
		Annual limit for protection of human health	None	40 µg/m^3 NO_2
		Critical level for protection of vegetation	None	30 µg/m^3 NO + NO_2
Lead	2008/50/EC	Annual limit for protection of human health	100% Note 2	0.5 µg/m^3
Sulphur dioxide	2008/50/EC	Hourly limit for protection of human health - not to be exceeded more than 24 times/year	150 µg/m^3	350 µg/m^3
		Daily limit for protection of human health - not to be exceeded more than 3 times/year	-	125 µg/m^3
		Critical level for protection of vegetation	-	20 µg/m^3

Pollutant	***Regulation*** *Note 1*	***Limit Type***	***Margin of Tolerance***	***Value***
Particulate Matter (as PM_{10})	2008/50/EC	24-hour limit for protection of human health - not to be exceeded more than 35 times/year	50%	50 µg/m³ PM_{10}
		Annual limit for protection of human health	20%	40 µg/m³ PM_{10}
$PM_{2.5}$ (Stage 1)	2008/50/EC	Annual limit for protection of human health	20% from June 2008. Decreasing linearly to 0% by 2015	25 µg/m³ $PM_{2.5}$
$PM_{2.5}$ (Stage 2)	-	Annual limit for protection of human health	-	20 µg/m³ $PM_{2.5}$
Benzene	2008/50/EC	Annual limit for protection of human health	100% until 2006 reducing linearly to 0% by 2010*	5 µg/m³
Carbon Monoxide	2008/50/EC	8-hour limit (on a rolling basis) for protection of human health	60%	10 mg/m³ (8.6 ppm)
Ozone (O_3)	2004/107/EC	8 hours	-	120 µg/m³
Cadmium (Cd)	2004/107/EC	Concentration in the PM_{10} fraction averaged over a calendar year	-	5 ng/m³**
Nickel (N)	2004/107/EC	Concentration in the PM_{10} fraction averaged over a calendar year	-	20 ng/m³**
Arsenic (As)	2004/107/EC	Concentration in the PM_{10} fraction averaged over a calendar year	-	6 ng/m³**

* 5 µg/m³ from the date of entry into force of these Regulations, reducing on 1 January 2006 and every 12 months thereafter by 1 µg/m³ to reach 0 µg/m³ by 1 January 2010

** Target value effective from 31 December 2012

Note 1 EU 2008/50/EC – Clean Air For Europe (CAFÉ) Directive replaces the previous Air Framework Directive (1996/30/EC) and Daughter Directives 1999/30/EC and 2000/69/EC

Note 2 EU 2008/50/EC states - 'Stage 2 — indicative limit value to be reviewed by the Commission in 2013 in the light of further information on health and environmental effects, technical feasibility and experience of the target value in Member States'

Due to the non-industrial nature of the proposed development, the short-term nature of the construction period and the general character of the surrounding area, air quality sampling was deemed to be unnecessary for this EIAR. Although the site is in proximity to Lanesborough Power Station it is expected that the air quality in the existing environment is good. The Lanesborough Power Station is operated under IPC Licence No. P0610-03 issued by the EPA and therefore all emissions from this site are strictly controlled and monitored.

12.2.3 Calculating Carbon Losses and Savings from the Proposed Development

12.2.3.1.1 Background

Carbon dioxide (CO_2) emissions occur naturally in addition to being released with the burning of fossil fuels. All organic material is composed of carbon, which is released as CO_2 when the material decomposes. Organic material acts as a store of carbon. Peatland habitats are significant stores of organic carbon. The vegetation on a peat bog slowly absorbs CO_2 from the atmosphere when it is active and converts it to organic carbon. When the vegetation dies, in the acidic waterlogged conditions of bogs and peatlands, the organic material does not decompose fully and the organic carbon is retained in the accumulating mass of the peatland.

The carbon balance of proposed wind farm developments in peatland habitats has attracted significant attention in recent years. When developments such as wind farms are proposed for peatland areas, there will be direct effects and loss of peat in the area of the development footprint. There may also be indirect effects where it is necessary to install drainage in certain areas to facilitate construction. The works can either directly or indirectly allow the peat to dry out, which permits the full decomposition of the stored organic material with the associated release of the stored carbon as CO_2. It is essential therefore that any wind farm development in a peatland area saves more CO_2 than is released.

12.2.3.1.2 Calculating Carbon Losses and Savings

Bord Na Móna developed a methodology based on their extensive experience for calculating carbon losses and savings from the proposed wind farm development. This was used to assess the effects of the proposed wind farm in terms of potential carbon losses and savings taking into account peat removal, drainage and site restoration. The methodology reflects the specific nature of the cutaway peat lands upon which the project is proposed to be located.

The completed worksheet, including the assumptions used in the model, is provided in Appendix 12.1 of this EIAR. The peat losses are based on the volume of peat disturbed and redistributed, and takes a ‘worst case’ approach, by assuming that the redistributed peat has high emissions associated with rushes and birch/willow scrub habitat type. The remaining in-situ peat is assumed to be undisturbed and as such is assigned a zero net emission value in this analysis.

The model calculates the total carbon emissions associated with the proposed wind farm development including manufacturing of the turbine technology, transport, construction of the development and carbon losses due to peatland disturbance.

The model also calculates the carbon savings associated with the proposed wind farm development against three comparators:

i. The average fossil emissions on the Irish Grid – based on the SEM Reference mid-merit plant
ii. The EU Fossil Fuel Comparator (a measure of the fossil intensity across the European market)
iii. A displaced ‘Load Following’ combined cycle gas turbine plant.

The expected and maximum, worst-case scenario CO_2 losses due to the proposed wind farm development and the total savings anticipated as a result of the wind farm are summarised in Section 12.4.5 .

12.3 EXISTING ENVIRONMENT

12.3.1 Air Quality

The EU Clean Air for Europe Directive requires Member States to categorise geographic areas in terms of Zones and Agglomerations for the purpose of managing Air Quality. The vicinity of the proposed Derryadd Wind Farm falls into the area classified as Zone D – Rural Ireland.

The main areas defined in each zone are:

- Zone A: Dublin
- Zone B: Cork
- Zone C: Other cities and large towns comprising Limerick, Galway, Waterford, Drogheda, Dundalk, Bray, Navan, Ennis, Tralee, Kilkenny, Carlow, Naas, Sligo, Newbridge, Mullingar, Wexford, Letterkenny, Athlone, Celbridge, Clonmel, Balbriggan, Greystones, Leixlip and Portlaoise.
- Zone D: Rural Ireland, i.e. the remainder of the State excluding Zones A, B and C.

A detailed description of the Air Quality Zones is given on the EPA website. http://www.epa.ie/air/quality/zones.

The proposed Derryadd Wind Farm site is situated within the EPA's 'Rural East' Air Quality Index for Health Region. Table 12.2 gives a summary description of the Air Quality Index for Health (AQIH) regions and the Air Quality Management Zones.

The most recent reporting by the EPA indicates that the current air quality in this region is classified as Good (according to EPA records accessed on 11/01/19).

Table 12.2: Air Quality Index for Health Regions and corresponding Air Quality Zone

AQIH Region	Definition	Comparison with Air Quality Management Zone
Dublin City	Dublin agglomeration from Shankill in south Dublin to Lucan in west Dublin to Swords in north Dublin.	Zone A Dublin conurbation
Cork City	Cork agglomeration incorporating Cork City Council jurisdiction with additional built-up areas.	Zone B Cork conurbation
Large Towns Population > 15,000	Galway, Limerick, Waterford, Clonmel, Kilkenny, Sligo, Drogheda, Wexford, Athlone, Ennis, Bray, Naas, Carlow, Tralee, Dundalk, Navan, Letterkenny, Celbridge, Newbridge, Mullingar, Balbriggan, Greystones, Leixlip and Portlaoise.	Corresponds to Zone C Large Towns
Small Towns	Towns and cities with a population between 5,000 and 15,000.	Corresponds to Zone D Rural Ireland
Rural West	Towns with population less than 5,000, villages and rural areas in Counties Clare, Cork, Donegal, Galway, Kerry, Leitrim, Limerick, Mayo, Roscommon and Sligo.	
Rural East	Towns with population less than 5,000, villages and rural areas in Counties Carlow, Cavan, Dublin, Kildare, Kilkenny, Laois, Longford, Louth, Meath, Monaghan, Offaly, Tipperary, Waterford, Westmeath,	

The Air Quality for Health Index is described in detail on the EPA website: http://www.epa.ie/air/quality/index.

The EPA undertakes air monitoring at various sites nationwide. The most proximal air quality monitoring stations to the proposed wind farm are listed in Table 12.3. Although no data is available relating to air quality in the immediate vicinity of the study area, it is expected that the air quality at the proposed Derryadd Wind Farm site can be represented by these sites. The data presented is the most recent data available and provides a reference of the air quality in a rural setting in relative proximity to the site.

Table 12.3: Air Monitoring Stations in Proximity to the Proposed Derryadd Wind Farm Site

Monitoring Station	Proximity to Derryadd Wind Farm	Air Quality Zone	Pollutants Measured	Monitoring Period
Longford Town, County Longford	Approx. 9 km	Zone D	$PM_{2.5}$	14/05/2012 to present
Mountrath, County Laois	Approx. 78 km	Zone D	SO_2, NO_2, CO, PM_{10}, C_6H_6, Pb, metals	22/09/2004 – 14/06/2005
Emo, County Laois	Approx. 78 km	Zone D	Continuous NO_2 Continuous O_3	Continuous
Kilkitt, County Monaghan	Approx. 91 km	Zone D	Continuous for each (SO_2, NO_2, O_3, PM_{10}) Pb, metals	Continuous

Current data is available for a Zone D (Rural Ireland) monitoring location at Emo in County Laois on a continuous basis; however, the measurements are limited to the monitoring of ozone and Nitrogen Dioxide only. Similarly, current data is available for a Zone D (Rural Ireland) monitoring location at Longford Town in County Longford on a continuous basis; however, the measurements are limited to the monitoring of $PM_{2.5}$ only. The monitoring location that is currently used to collate data on background air quality for Zone D (Rural Ireland) across the broader suite of air quality parameters is the Kilkitt air quality monitoring site in County Monaghan (> 91 km from the proposed site) and Mountrath monitoring site in County Laois. Reference to each monitoring location is made below.

Air Quality Monitoring at Longford Town, County Longford (Zone D – Rural Ireland)

The information on the EPA website relating to air quality monitoring notes, *"The Longford site is located on the Dublin Road, less than a mile from Longford town centre. Monitoring is done using a continuous monitor for $PM_{2.5}$. Monitoring began at this site on the 14th May 2010."*[135]

[135] http://www.epa.ie/air/quality/data/lg/

Data from the continuous monitoring presented from Longford Town shows that $PM_{2.5}$ measurements are generally below the annual target value of 25 µg/m^{3}.

Air Quality Monitoring at Mountrath, County Laois (Zone D – Rural Ireland)

An assessment of air quality was carried out in Mountrath, County Laois from the 22nd September 2004 to the 14th June 2005.[136] All pollutants monitored were found to be below the regulatory limits. Table 12.4 details results of pollutants monitored at this location. The monitoring data for Mountrath indicates that the air quality was below all limit values and demonstrating very good quality.

[136] http://www.epa.ie/air/quality/data/mr/

Table 12.4: EPA Monitoring Results at Mountrath, County Laois

Pollutant	Limit Value ($\mu g/m^3$)	Mean Concentration at Monitoring Site($\mu g/m^3$)
Nitrogen Dioxide	200	23.8
Sulphur Dioxide	50	3.9
Lead	0.5	0.04
Benzene	5	0.3
Carbon Monoxide	10,000	1,600
Particulate Matter$_{10}$	50	22.5
Particulate Matter$_{2.5}$	25	7.6

Air Quality Monitoring at Emo, County Laois (Zone D – Rural Ireland)

The information on the EPA website relating to air quality monitoring notes, *"The Emo site is located in the grounds of Emo Court, a stately home in County Laois. The site is heavily forested and was chosen to assess the levels of ozone in a forested area. Monitoring is done using a continuous monitor for ozone. Monitoring for oxides of nitrogen began in January 2013."*[137]

Data from the continuous monitoring presented from Emo Court shows that nitrogen dioxide concentration is consistently below the 200μg/m^3 limit value and Ozone concentration is consistently below the 180μg/m^3 limit (based on seven-day data available online[138]).

Air Quality Monitoring at Kilkitt, County Monaghan (Zone D – Rural Ireland)

The information on the EPA website relating to air quality monitoring notes, *"The Kilkitt site is located in the drinking water treatment works at Kilkitt in County Monaghan. This is a rural setting with little traffic or other influences on air quality. Monitoring is done using continuous monitors for nitrogen oxides, sulphur dioxide and ozone. PM$_{10}$ heavy metals and Benzo (a) Pyrene are also measured at this site."*[139] This location is the most reflective of the of the proposed Derryadd Wind Farm site and its rural nature. Data from the continuous monitoring at Kilkitt, County Monaghan shows that nitrogen dioxide concentration is consistently below the 200μg/m^3 EPA limit[140] value, with concentrations generally in the range below 10 μg/m^3.

[137] http://www.epa.ie/air/quality/data/emo/
[138] http://www.epa.ie/air/quality/data/emo/gas/
[139] http://www.epa.ie/air/quality/data/kt/
[140] http://www.epa.ie/air/quality/standards/

Ozone concentration is consistently below the 180µg/m^3 EPA limit[141] and is generally in the range of 50-65 µg/m[142] with periodic spikes in concentrations between 65-85µg/m^3.

Sulphur dioxide concentrations are consistently below the 125µg/m^3 EPA limit[143] value, with concentrations generally <2µg/m^3[144].

PM_{10} is monitored on a continuous basis. Concentrations of PM_{10} exceed the upper assessment but the 50 µg/m^3 limit for PM_{10} has not been exceeded.

12.3.2 Climate

A desk-top assessment of available climatic information was undertaken to characterise the existing climate. Meteorological data contained in this EIAR chapter has been received from Met Éireann.

According to Met Éireann[145], in general terms, Ireland's climate can be described as follows:
"The dominant influence on Ireland's climate is the Atlantic Ocean. Consequently, Ireland does not suffer from the extremes of temperature experienced by many other countries at similar latitude. The warm North Atlantic Drift has a marked influence on sea temperatures. This maritime influence is strongest near the Atlantic coasts and decreases with distance inland. The hills and mountains, many of which are near the coasts, provide shelter from strong winds and from the direct oceanic influence. Winters tend to be cool and windy, while summers, when the depression track is further north and depressions less deep, are mostly mild and less windy.".

Ireland ratified the United Nations Framework Convention on Climate Change (UNFCCC) in April 1994 and the Kyoto Protocol in 1997 (Framework Convention on Climate Change, 1999 and Framework Convention on Climate Change, 1997). For the purposes of the EU burden sharing agreement under Article 4 of the Kyoto Protocol, Ireland agreed to limit the net anthropogenic growth of the six Greenhouse Gases (GHGs) under the Kyoto Protocol to 13% above the 1990 level over the period 2008 to 2012 (ERM, 1998). The UNFCCC is continuing detailed negotiations in relation to GHGs reductions and in relation to technical issues such as Emission Trading and burden sharing.

141 http://www.epa.ie/air/quality/standards/
142 http://www.epa.ie/air/quality/data/kt/gas/
143 http://www.epa.ie/air/quality/standards/
144 http://www.epa.ie/air/quality/data/kt/gas/
145 https://www.met.ie/climate

In 2015, the Conference of the Parties (COP21) to the agreement was convened in Paris. This conference was an important milestone in terms of international climate change agreements. The "Paris Agreement", agreed by over 200 nations, has a stated aim of limiting global temperature increases to no more than 2°C above pre-industrial levels with efforts to limit this rise to 1.5°C. The aim is to limit global GHG emissions to 40 gigatons as soon as possible whilst acknowledging that peaking of GHG emissions will take longer for developing countries. Contributions to greenhouse gas emissions will be based on Intended Nationally Determined Contributions (INDCs) which will form the foundation for climate action post 2020. Significant progress was also made on elevating adaption onto the same level as action to cut and curb emissions. Since COP21, three additional conferences have been held addressing climate change matters, with the most recent (COP 24) held in Poland in December 2018. The 2018 COP reached an agreement on the implementation of what had been previously agreed in Paris. This includes how governments will measure, report on and verify their emission-cutting efforts, which are intended to strengthen delivery of what had been agreed in 2015.

12.3.3 Weather Observing Stations

Rainfall Stations

There are approximately 500 rainfall stations across the country[146], strategically located. These stations measure the daily rainfall in millimetres (mm). A number of these stations also measure additional parameters such as soil moisture, temperature, humidity, etc.

Synoptic Stations

There are currently 25 synoptic stations[147] located throughout Ireland that observe and record surface meteorological data. Parameters observed include rainfall, temperature, wind speed and direction, relative humidity, solar radiation, clouds, atmospheric pressure, sunshine hours, evaporation and visibility. They report a mixture of snapshot hourly observations of the weather known as synoptic observations and daily summaries of the weather known as climate observations[148].

12.3.3.1 Nearest Rainfall Station

The climate of the proposed wind farm location is best described by measurements collected by the National Meteorological Service from meteorological stations at Mountdillon, Co. Roscommon and Mullingar, County Westmeath.

[146] https://www.met.ie/climate/the-national-observing-network/

[147] https://www.met.ie/latest-reports

[148] http://www.met.ie/

The Mountdillon Met Éireann Weather Station, which is in operation since 2003, is located approximately 3.8km north west of the proposed wind farm site (relative to the red line boundary). The average monthly precipitation for Mountdillon is summarised in Table 12.5 below.

Table 12.5: Average Monthly Precipitation at Mountdillon (1981-2010)

Period	Total Rainfall (mm)
January	105
February	77.7
March	88.2
April	66.6
May	70.5
June	74.2
July	73.1
August	88.3
September	79.4
October	111.8
November	102.4
December	109.8
Total Annual	**1047.1**

12.3.3.2 Nearest Synoptic Station

The Mullingar Synoptic Station is the closest Met Éireann synoptic station and is located approximately 37km south east of the proposed wind farm site. This station was automated in 1998 and is still currently in operation. Specifics of each weather station relative to the proposed wind farm site are outlined in Table 12.6.

Table 12.6: Meteorological Stations adjacent to the proposed Derryadd Wind Farm

Location	Grid References	Elevation (m O.D.)	Height Difference (m)
Derryadd Wind Farm (Site Entrance, R392)	E205726 N264910	50*	-
Mountdillon Rainfall Station	E201314 N275235	40	10
Mullingar Synoptic Station	E242335 N254308	100	50

* *Elevation ranging from 37 mOD to 59 mOD across majority of the study area.*

The elevation of the rainfall gauge at Mountdillon is approximately 40 mOD and is, therefore, broadly similar to the average elevation in the planning application area at the Derryadd Wind Farm site, where elevation ranges from 37 mOD to 59 mOD approximately. The annual average precipitation at the proposed wind farm site is taken to be the measured annual average precipitation at the Mountdillon rain gauge, 1047.1mm/annum[149, 150].

Based on the average precipitation in Table 12.5, approximately 57% of the total annual rainfall is recorded during the winter period (October – March). This amount of precipitation (including snow) will normally be associated with more prolonged Atlantic frontal weather depressions passing over the region compared to the summer.

12.3.4 Evapotranspiration and Effective Rainfall

Evaporation is the return of water vapour to the atmosphere from sources such as the ground or waterbodies. Evapotranspiration is the return of water vapour to the atmosphere by both evaporation and the transpiration of plants, generally measured from a short-grass covered surface (such as a permanent pasture) adequately supplied with water.

The nearest meteorological station with evapotranspiration measuring equipment is the Mullingar Synoptic Station. Using the average potential evapotranspiration levels recorded at the Mullingar station

[149] Mean for the period 1981-2010

[150] http://www.met.ie/climate/monthly-data.asp?Num=1975

and the average precipitation levels at the Mountdillon station, the anticipated effective rainfall figures for Derryadd Wind Farm are calculated, as detailed in Table 12.7 below.

Table 12.7: Effective Rainfall for the Proposed Derryadd Wind Farm Site[151]

Month	Rainfall (mm)	Potential Evapotranspiration (PE) (mm)	Actual Evapotranspiration (mm) (PE x 0.95)	Effective Rainfall (Rainfall – Actual Evapotranspiration)
January	105	10.3	9.785	95.215
February	77.7	17.4	16.53	61.17
March	88.2	31	29.45	58.75
April	66.6	51.4	48.83	17.77
May	70.5	71.9	68.305	2.195
June	74.2	80.5	76.475	-2.275
July	73.1	79.1	75.145	-2.045
August	88.3	65	61.75	26.55
September	79.4	44	41.8	37.6
October	111.8	22.9	21.755	90.045
November	102.4	10.3	9.785	92.615
December	109.8	7.5	7.125	102.675
Total	1047	491.3	466.735	580.265

It can be noted that evapotranspiration is very low during winter months, when temperatures are lower than summer months and when relative humidity is generally higher and plant growth is minimal. The vast majority of evapotranspiration during winter months is attributable to direct evaporation from ground surfaces. During summer months, the rate of evapotranspiration increases and often exceeds the monthly rainfall. This is due to increased free evaporation from the surface and from transpiration from leaves and plants.

Effective rainfall is defined as precipitation minus actual evapotranspiration and is given in Table 12.7. Using the estimated rainfall data for the proposed development site and the potential evapotranspiration data (i.e. the water flux under non-limiting soil conditions) for the nearest synoptic station i.e. Mullingar

[151] Mullingar Rainfall and PE data used

Synoptic Station, the effective rainfall for the study area can be calculated. Previous work in the Nore River Basin[152] suggested that annual actual evapotranspiration (AE) for grassland in Ireland is typically about 95% of potential evapotranspiration (PE). AE is often estimated using this relationship and in Table 12.7, actual evapotranspiration is estimated as 95% of potential evapotranspiration to allow for seasonal soil moisture deficits.

Any rain falling on the site will infiltrate to the ground, through the soil and subsoil, evaporate from the surface or become surface water runoff. The surface system is discussed in more detail in Chapter 8 of this EIAR, Hydrology and Hydrogeology.

12.3.5 Wind

The Mullingar Met Station wind rose diagram shows that the prevailing winds are from the south west. (Refer to Appendix 12.2 'Mullingar Aerodrome Wind Rose Diagram'[153]). Based on the averages between 1979 and 2008[154], the mean annual wind speed at Mullingar is 7.6 knots (3.9 m/s) while the maximum average monthly gust reached 73 knots (37.5 m/s) over the period. The mean number of days with gales during these years was 0.8 days. The elevation of the meteorological anemometer is approximately 101 mOD. These wind speeds are likely to be indicative of those at the proposed development Derryadd Wind Farm site.

12.4 POTENTIAL IMPACTS

12.4.1 Do Nothing Effect

It is most likely that most of the area would continue to be harvested for peat for power generation until it transitions to other activities.

The proposed development site consists mainly of three cutaway bogs which have significantly depleted peat reserves, and apart from relatively small localised areas, peat harvesting operations will be substantially reduced on each of the bogs over time. Bord na Móna has also committed to cease harvesting peat for power generation before 2030[155].

[152] Daly, E. P. (1994) Groundwater resources of the Nore River basin. Geological Survey of Ireland
[153] http://www.met.ie/climate-ireland/SummaryClimAvgs.pdf

[154] http://www.met.ie/climate-ireland/1981-2010/mullingar.html

[155] https://www.bordnamona.ie/wp-content/uploads/2016/01/Sustainability_Statement_2015.pdf

12.4.2 Potential Effects -Construction Phase on Air Quality

While there will be some dust and exhaust emissions from construction activities during the construction phase, these effects will be of temporary duration and not considered likely to give rise to significant effects following the implementation of mitigation measures (Refer to Section 12.5 below). Dust or pollutants generated from the proposed development will typically arise from:

- Movement of construction vehicles;
- Transportation of turbines and construction materials to and within the site;
- Crushing of Rock for use as base for hardstanding areas (i.e. roads);
- Movement and placement of stockpiles (excavated peat, soils/fill materials); and
- Wind generated dust from stockpiles and exposed unconsolidated soils.

The predicted increase in traffic volumes resulting from the construction phase is unlikely to significantly increase levels of air pollutants or cause a breach of the air quality standards and are considered to be a short–term slight negative effect. Traffic volumes are discussed in Chapter 14, Traffic and Transport.

The levels of dust generated by crushing rock, movement and placement of stockpiles and wind generated dust from stockpiles etc. is unlikely to significantly increase levels of air pollutants or cause a breach of the air quality standards and is considered to be a short–term slight negative effect. This effect can be further reduced with the implementation of the mitigation measures designed to minimise dust generation outlined in Section 12.5 below.

12.4.3 Potential Effects - Operation Phase on Air Quality

While in operation, the wind farm will have indirect, positive effects on air quality. Wind energy is a renewable, clean and a sustainable means of electricity generation. The proposed Derryadd Wind Farm will have a positive effect on the atmospheric environment and climate by avoiding emissions of pollutants and greenhouse gases that would otherwise be emitted from a conventional, fossil fuel fired generation plant. This will have a long-term significant positive effect on air quality.

12.4.4 Potential Effects - Construction Phase on Climate

During the construction phase of the proposed development, the potential negative effects on climate will be those associated with exhaust emissions from construction traffic. These effects will be of temporary duration and their effects are not considered to be significant. The potential impact on the climate, in terms of CO_2 loss, during the turbine lifecycle is detailed in Table 12.8 below.

12.4.5 Potential Effect of the Operational Phase on Climate

The expected and maximum, worst-case scenario CO_2 losses due to the proposed wind farm development are summarised in Table 12.8 and the total savings against the three comparators listed are summarised in Table 12.9.

Table 12.8: CO_2 losses from the proposed development

Origin of Losses	CO_2 Losses (tonnes CO_2 equivalent)
Losses due to turbine lifecycle (e.g. manufacture, construction, decommissioning)	61,067
Losses due to Additional Cycling Emissions	104,490
Losses from peat land disturbance emissions	5,287
Total	170,844

The peat losses are based on the volume of peat disturbed and redistributed and takes a 'worst case' approach as described above.

Table 12.9: Wind Farm Lifetime savings

Comparator	CO_2 Savings (tonnes CO_2 equivalent)	Payback (years)
SEM Mid-Merit Plant	4,847,989	1.06
EU Fossil Fuel Comparator (FFC)	4,289,933	1.19
'Load Following' Combined Cycle Gas Turbine Plant	2,570,066	1.99

Based on the Bord na Móna model calculations as presented above, 170,844 tonnes of CO_2 will be lost to the atmosphere due to changes in the peat environment, changes in the cycling of mid-merit gas-fired generation units and due to the construction, operation and decommissioning of the proposed development. This represents a fraction of the total amount of carbon dioxide emissions that will be offset by the proposed wind farm project as set out in Table 12.9. The volume of CO_2 that will be lost to the atmosphere will be offset by the proposed development between 1.06 and 1.99 years of operation, depending on the fuel source to which it is compared.

While in operation, the wind farm will have indirect, positive effects on the climate. Wind energy is a renewable, clean and a sustainable means of electricity generation. The proposed Derryadd Wind Farm will have a positive effect on the atmospheric environment and climate by avoiding emissions of pollutants and greenhouse gases that would otherwise be emitted from a conventional, fossil fuel fired generation plant. This will have a long-term slight positive effect on climate.

12.5 MITIGATION MEASURES

12.5.1 Mitigation Measures -Air Quality during Construction

Potential effects arising from dust and exhaust emissions will be minimised through the provision of mitigation measures that will be incorporated into the Construction Environmental Management Plan (CEMP). These will include:

- Minimisation of extent of working areas;
- Stockpiling of excavated materials will be limited to the volumes required to practically meet the construction schedule;
- Drop heights of excavated materials into haulage vehicles will be minimised to a practicable level;
- Daily inspections by site personnel to identify potential sources of dust generation along with implementation measures to remove causes where found;
- Provision of a dust suppression measures (e.g. sweeps/covers/water bowsers) will be used on stockpiles and the road surface (Materials coming to site will only use specified haul routes) during periods of extended dry weather;
- Onsite borrow pits are being used where possible to minimise quantities being brought to site;
- Vehicles and plant will be routinely serviced to minimise the exhaust emissions during construction; and
- Vehicles will not be left running unnecessarily and low emission fuels will be used where possible.

12.5.2 Mitigation measures for Air Quality during Operation

No significant negative effects to Air Quality are expected during the operational phase of the development. Therefore, no mitigation measures are required in respect of Air Quality.

12.5.3 Mitigation measures for Climate Construction and Operation

During the construction phase of the proposed development, all contractors will ensure that machinery used on site is properly maintained and is switched off when not in use to avoid unnecessary exhaust emissions from construction and operational traffic.

12.5.4 Mitigation Measures -Cumulative Assessment

Potential cumulative effects on air quality and climate between the proposed wind farm development and other wind farm and infrastructure developments in the vicinity were also considered as part of the assessment. The developments assessed were those within a 20km radius of the proposed Derryadd Wind Farm.

The developments included operating and permitted wind farms. These projects are outlined in Section 4.3 of the EIAR. During the construction phase, minor emissions (including dust and emissions from plant and machinery) will occur that are short term in nature, localised and will have negligible effect on the local environment. Due to the dispersed nature of the wind farm and other large infrastructure developments in the area there is no potential for cumulative impact on either air quality or climate. During the operational phase, there will be a long term, moderate positive effect on air quality and climate. Other operating and proposed wind farms will replicate the same positive effects and generate an even greater cumulative long term, significant positive effect on air quality and climate.

12.6 RESIDUAL IMPACTS

The proposed construction works will have a negligible effect on climate. There is likely to be a slight and short-term effect on air quality through dust generation during the construction stage of the entrance road(s) and grid connection which will be mitigated effectively through the application of mitigation measures in the Construction Environmental Management Plan.

Electricity generated by the operational wind farm will result in an avoidance of greenhouse gas emissions that would otherwise occur through generation from fossil fuel sources. The carbon payback on the Derryadd Wind Farm is calculated to be 1 to 2 years. In the context of an operational lifetime of 30 years, emissions of nitrous oxides (NO_x), sulphurous oxides (SO_x), particulate matter (PM) and secondary pollutants, such as ozone, will also be avoided.

The avoided emissions, therefore, result in a moderate, positive effect on both air quality and climate.

13 NOISE AND VIBRATION

13.1 INTRODUCTION

This chapter of the Environmental Impact Assessment Report (EIAR) describes the assessment undertaken of the potential noise and vibration impact from the proposed Derryadd wind farm development on local residential amenity. The proposed development consists of 24 no. wind turbines with an overall top of foundation level to blade tip height of up to 185m metres. A full description of the proposed development is provided in Chapter 2 – *Description of the Proposed Development.*

Noise and vibration impact assessments have been prepared for operational activities and the construction phase of the proposed development to the nearest noise sensitive locations (NSL's). To inform this assessment baseline noise levels have been measured at several NSL's surrounding the proposed development. Noise predictions to the nearest NSL's have been prepared for both the construction and operational phases.

For a glossary of terms used in this chapter please refer to Appendix 13.1.

13.1.1 Statement of Authority

This chapter has been prepared by Dermot Blunnie of AWN Consulting Ltd.

Dermot Blunnie (Senior Acoustic Consultant) holds a BEng (Hons) in Sound Engineering, MSc in Applied Acoustics and has completed the Institute of Acoustics (IoA) Diploma in Acoustics and Noise Control. He has been working in the field of acoustics since 2008 and is a member of the Institute of Engineers Ireland (MIEI) and the Institute of Acoustics (MIoA). He has experience in both building and environmental acoustics and has extensive knowledge in all aspects of environmental surveying, noise modelling and impact assessment specialising in wind farm noise.

13.1.2 Fundamentals of Acoustics

A sound wave travelling through the air is a regular disturbance of the atmospheric pressure. These pressure fluctuations are detected by the human ear, producing the sensation of hearing. To take account of the enormous range of pressure levels that can be detected by the ear, it is widely accepted that sound levels are measured and expressed using a decibel scale i.e. a logarithmic ratio of sound pressures. These values are expressed as Sound Pressure Levels (SPL) in decibels (dB).

The audible range of sounds expressed in terms of Sound Pressure Levels is 0 dB (for the threshold of hearing) to 120 dB (for the threshold of pain). In general, a subjective impression of doubling of loudness corresponds to a tenfold increase in sound energy which conveniently equates to a 10 dB increase in SPL. It should be noted that a doubling in sound energy (such as may be caused by a doubling of traffic flows) increases the SPL by 3 dB.

The frequency of sound is the rate at which a sound wave oscillates is expressed in Hertz (Hz). The sensitivity of the human ear to different frequencies in the audible range is not uniform. For example, hearing sensitivity decreases markedly as frequency falls below 250Hz. In order to rank the SPL of various noise sources, the measured level has to be adjusted to give comparatively more weight to the frequencies that are readily detected by the human ear. The 'A-weighting' system defined in the international standard, BS ISO 226:2003 *Acoustics. Normal Equal-loudness Level Contours* has been found to provide the best correlations with human response to perceived loudness. SPL's measured using 'A-weighting' are expressed in terms of dB(A).

An indication of the level of some common sounds on the dB(A) scale is presented in Figure 13.1, which shows a quiet bedroom at around 35 dB(A), a nearby noisy HGV at 90 dB(A) and a pneumatic drill at about 100 dB(A).

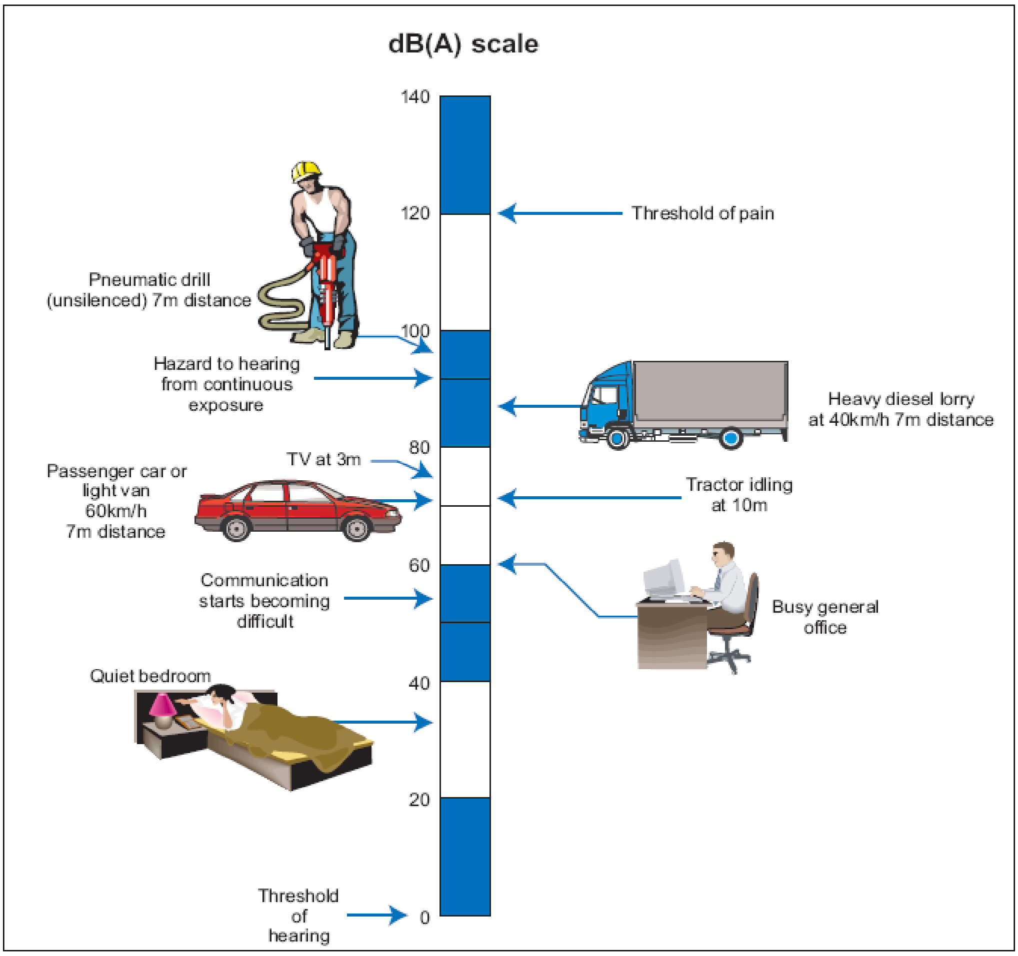

Figure 13.1: The Level of Typical Common Sounds on the dB(A) Scale (NRA Guidelines for the Treatment of Noise and Vibration in National Road Schemes, 2004)

13.2 METHODOLOGY

The assessment of impacts for the proposed development have been undertaken with reference to the most appropriate guidance documents relating to environmental noise and vibration which are set out in 13.2.3. In addition to these specific guidance documents, the following guidelines were considered and consulted for the purposes of this chapter:

- EPA Guidelines on the Information to be contained in Environmental Impact Statements, (EPA, 2002);
- EPA Advice Notes on Current Practice (in the preparation of Environmental Impact Statements), (EPA, 2003);
- EPA Guidelines on the Information to be contained in Environmental Impact Assessment Reports Draft August 2017 (EPA, 2017); and
- EPA Advice Notes for Preparing Environmental Impact Statements, (Draft, September 2015).

The assessment methodology undertaken for this assessment is summarised as follows:

- Characterise the receiving environment through baseline noise surveys at various NSL's surrounding the proposed development.
- Review of the most applicable standards and guidelines to set acceptable noise and vibration criteria for the construction and operational phases of the proposed development;
- Undertake predictive calculations to assess the potential impacts associated with the construction phase of the proposed development at NSL's;
- Undertake predictive calculations to assess the potential impacts associated with the operational of the proposed development at NSL's;
- Specify mitigation measures to reduce, where necessary, the identified potential outward impacts relating to noise and vibration from the proposed development; and,
- Describe the significance of the residual noise and vibration effects associated with the proposed development

13.2.1 Guidance Documents and Assessment Criteria

The following sections review best practice guidance that is commonly adopted in relation to developments such as the one under consideration here.

13.2.1.1 Construction Phase Noise

There is no published statutory Irish guidance relating to the maximum permissible noise level that may be generated during the construction phase of a project. Local authorities normally control construction activities by imposing limits on the hours of operation and may consider noise limits at their discretion.

In the absence of specific noise limits, appropriate criteria relating to permissible construction noise levels for a development of this scale may be found in the British Standard BS 5228-1:2009+A1:2014 *Code of practice for noise and vibration control on construction and open sites – Noise*.

The approach adopted here calls for the designation of an NSL into a specific category (A, B or C) based on existing ambient noise levels in the absence of construction noise. A threshold noise value is applied to each category. Exceedances (construction noise only) of the threshold value, at the facade of a sensitive receptor during construction, indicates a potential significant noise impact associated with the construction activities. The threshold values recommended by BS5228-1 are depicted in Table 13.1.

Table 13.1: Example Threshold Potential Significant Effect at Dwellings

Assessment category and threshold value period (T)	Threshold value, in $L_{Aeq,T}$ dB		
	Category A Note A	Category B Note B	Category C Note C
Night-time (23:00 to 07:00hrs)	45	50	55
Evenings and weekends Note D	55	60	65
Daytime (07:00 – 19:00hrs) and Saturdays (07:00 – 13:00hrs)	65	70	75

Note A Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are less than these values.

Note B Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are the same as category A values.

Note C Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are higher than category A values.

Note D 19:00 – 23:00 weekdays, 13:00 – 23:00 Saturdays and 07:00 – 23:00 Sundays.

It should be noted that this assessment method is only valid for residential properties. The following method should be followed:

For the appropriate period (e.g. daytime) the ambient noise level is determined and rounded to the nearest 5 dB. At some properties, particularly those located close to busy roads, the ambient noise levels are relatively high. However, given the rural nature of the site in general, reference has been made to the quietest properties near the development which have ambient noise levels in the range of 45 to 55 dB $L_{Aeq.T}$. Therefore, for the purposes of this assessment, as a worst case, all properties will be afforded a Category A designation.

13.2.1.2 Construction Phase Vibration

Vibration standards come in two varieties: those dealing with human comfort and those dealing with cosmetic or structural damage to buildings. With respect to this development, the range of relevant criteria used for building protection is expressed in terms of Peak Particle Velocity (PPV) in mm/s.

Guidance relevant to acceptable vibration within buildings is contained in the following documents:

- BS 7385 – Evaluation and measurement for vibration in buildings – Part 2: Guide to damage levels from groundborne vibration (BSI, 1993); and
- BS 5228-2:2009+A1:2014 – Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration (BSI, 2014).

BS 7385 states that there should typically be no cosmetic damage if transient vibration does not exceed 15 mm/s at low frequencies rising to 20 mm/s at 15 Hz and 50 mm/s at 40 Hz and above. These guidelines relate to relatively modern buildings and should be reduced to 50% or less for more critical buildings.
BS 5228 recommends that, for a soundly constructed residential property and similar structures that are generally in good repair, a threshold for minor or cosmetic (i.e. non-structural) damage should be taken as a peak particle velocity of 15 mm/s for transient vibration at frequencies below 15 Hz and 20 mm/s at frequencies above than 15 Hz. Below these vibration magnitudes minor damage is unlikely, although where there is existing damage these limits may be reduced by up to 50%. In addition, where continuous vibration is such that resonances are excited within structures the limits discussed above may need to be reduced by 50%.

The Transport Infrastructure Ireland (TII) (formerly National Roads Authority (NRA)) publication *Guidelines for the Treatment of Noise and Vibration in National Road Schemes (NRA, 2004)* also contains information on the permissible construction vibration levels during the construction phase as shown in Table 13.2.

Table 13.2: Allowable Vibration at Sensitive Properties (NRA, 2004)

Allowable vibration (in terms of peak particle velocity) at the closest part of sensitive property to the source of vibration, at a frequency of		
Less than 10Hz	**10 to 50Hz**	**50 to 100Hz (and above)**
8 mm/s	12.5 mm/s	20 mm/s

Following review of the guidance documents set out above, the values in Table 13.2 are considered appropriate for this assessment as they provide more stringent vibration criteria.

13.2.1.2.1 Additional Vehicular Activity on Public Roads

There are no specific guidelines or limits relating to traffic related sources along the local or surrounding roads. Given that traffic from the development will make use of existing roads already carrying traffic volumes, it is appropriate to assess the calculated increase in traffic noise levels that will arise because of vehicular movements associated with the development. In order to assist with the interpretation of the noise associated with additional vehicular traffic on public roads, Table 13.3, taken from *Design Manual for Roads and Bridges* (DMRB), Volume 11, Section 3, Part 7, HD 213/11 (UK Highways Agency et al, 2011) offers guidance as to the likely short term impact associated with any change in traffic noise level.

Table 13.3: Likely Impacts Associated with Change in Traffic Noise Level (Source DMRB, 2011).

Change in Sound Level (dB L_{A10})	Magnitude of Impact
0	No change
0.1 – 0.9	Negligible

Change in Sound Level (dB L_{A10})	Magnitude of Impact
1 – 2.9	Minor
3 – 4.9	Moderate
5+	Major

The guidance outlined in Table 13.3 will be used to assess the predicted increases in traffic levels on public roads associated with the proposed development and comment on the likely short-term impacts during the construction phase.

13.2.1.2.2 Operational Phase Noise

The noise assessment documented in this chapter is based on guidance in relation to acceptable levels of noise from wind farms as contained in the document *Wind Energy Development Guidelines for Planning Authorities* published by the Department of the Environment, Heritage and Local Government in 2006. These guidelines are in turn based on detailed recommendations set out in the Department of Trade and Industry (UK) Energy Technology Support Unit (ETSU) publication *The Assessment and Rating of Noise from Wind Farms* (1996). The ETSU document has been used to supplement the guidance contained within the "*Wind Energy Development Guidelines*" publication where necessary. Planning permissions and decisions issued by An Bord Pleanála and / or the local authority in relation to wind energy sites in the wider area are also reviewed here.

13.2.1.2.3 Wind Energy Development Guidelines for Planning Authorities

Section 5.6 of the *Wind Energy Development Guidelines for Planning Authorities* published by the Department of the Environment, Heritage and Local Government (2006) addresses noise and outlines the appropriate noise criteria in relation to wind farm developments.

The following extracts from this document should be considered:

> "*An appropriate balance must be achieved between power generation and noise impact*."

While this comment is noted it should be stated that the Guidelines give no specific advice in relation to what constitutes an 'appropriate balance'. In the absence of this, guidance will be taken from alternative and appropriate publications.

> "*In the case of wind energy development, a noise sensitive location includes any occupied house, hostel, health building or place of worship and may include areas of particular scenic quality or special recreational importance. Noise limits should apply only to those areas frequently used for relaxation of activities for which a quiet environment is highly desirable. Noise limits should be*

applied to external locations and should reflect the variation in both turbine source noise and background noise with wind speed."

As can be seen from the calculations presented later in this chapter the various issues identified in this extract have been incorporated into our assessment.

"*In general, a lower fixed limit of 45dB(A) or a maximum increase of 5dB(A) above background noise at nearby noise sensitive locations is considered appropriate to provide protection to wind energy development neighbours.*"

This represents the commonly adopted daytime noise criterion curve in relation to wind farm developments. However, an important caveat should be noted as detailed in the following extract.

"*However, in very quiet areas, the use of a margin of 5dB(A) above background noise at nearby noise sensitive properties is not necessary to offer a reasonable degree of protection and may unduly restrict wind energy developments which should be recognised as having wider national and global benefits. Instead, in low noise environments where background noise is less than 30dB(A), it is recommended that the daytime level of the* $L_{A90,\ 10min}$ *of the wind energy development be limited to an absolute level within the range of 35 – 40dB(A).*"

In relation to night time periods the following guidance is given:

"*A fixed limit of 43dB(A) will protect sleep inside properties during the night*."

This limit is defined in terms of the $L_{A90,10min}$ parameter. This represents the commonly adopted night time noise criterion curve in relation to wind farm developments.

It is proposed to adopt a lower daytime threshold of 40 dB $L_{A90,10\text{-}min}$ for low noise environments where the background noise is less than 30 dB(A). This follows a review of the prevailing baseline noise survey data contained in this assessment and on-going developments in terms of Irish guidance on the issue of wind turbine noise and is considered appropriate in light of the following:

- The EPA document '*Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4)*' proposes a daytime noise criterion of 45 dB(A) in 'areas of low background noise'. The proposed lower threshold here is 5 dB more stringent than this level.

- It should be reiterated that the 2006 *Wind Energy Development Guidelines for Planning Authorities* states that "*An appropriate balance must be achieved between power generation and noise impact*." Based on a review of other national guidance in relation to acceptable noise levels in areas of low background noise it is considered that the criteria adopted as part of this assessment are robust.
- In addition, the An Bord Pleanála (ABP) planning permission for the nearby Sliabh Bawn wind farm development (Ref: PL20.239743) states a lower threshold of 43dB $L_{A90,10\text{-}min}$, the proposed lower threshold here is 3 dB more stringent than this level. The relevant Sliabh Bawn planning permission condition is as follows:

> *"8. Noise levels emanating from the proposed development following commissioning shall not exceed the greater of 43dB(A) L90, or 5 dB(A) above the background noise level.*
>
> *All noise measurements shall be made in accordance with ISO Recommendations R1996/1, 2 and 3 "Acoustics – Description and Measurement of Environmental Noise"*
>
> *Prior to commencement of development, the developer shall agree a noise compliance monitoring programme for the operational wind farm with the planning authority, which shall include additional monitoring of baseline noise conditions.*
>
> *Reason: In the interest of residential amenity."*

In summary, the operational noise limits proposed for the development are:

- 40 dB $L_{A90,10min}$ for daytime in quiet environments with typical background noise of less than 30 dB $L_{A90,10min}$;
- 45 dB $L_{A90,10min}$ for daytime in environments with typical background noise greater than 30 dB $L_{A90,10min}$ or a maximum increase of 5 dB(A) above background noise (whichever is the higher); and
- 43 dB $L_{A90,10min}$ for night-time periods or a maximum increase of 5 dB(A) above background noise (whichever is the higher).

This set of criteria has been chosen as it is in line with the intent of the relevant Irish guidance and is comparable to noise planning conditions applied to similar sites in the area previously granted planning permission by An Bord Pleanála.

13.2.1.2.4 Future Potential Guidance Changes

Proposed changes to the assessment of noise impacts associated with on-shore wind energy developments are outlined in the 'Preferred Draft Approach' to the review of the 2006 Wind Energy Development Guidelines published by the Department of Environment, Community and Local Government (DECLG) in June 2017. The issue of Noise is addressed in the Appendix "*Review of the Wind Energy Guidelines 2006 – Summary of Key Aspects of "Preferred Draft Approach*" (PDA), which states the following:

> *"The proposed new robust noise restriction limits are consistent with World Health Organisation standards, proposing a relative rated noise limit of 5dB(A) above existing background noise within the range of 35 to 43dB(A) for both day and night, with 43dB(A) being the maximum noise limit permitted. The rated limit will take account of certain noise characteristics specific to wind turbines (e.g. tonal, low frequency and amplitude modulation) and, where identified, the noise limit permitted will be further reduced to mitigate for these noise characteristics. These limits will be conditioned as part of the planning permission process.*
>
> *The new noise limits are being proposed in tandem with the introduction of a new noise monitoring regime in relation to wind farms. Local authorities will enforce the noise limits as conditioned in the planning permission, in conjunction with the Environmental Protection Agency who will provide independent noise monitoring of wind farms. It is proposed that where there is evidence of non-compliance with noise limits, wind turbines will be required to be turned off until compliance with the noise limits is proven*."

It is acknowledged that this document is the subject of detailed consultation with interested parties and stakeholders. At the time of writing the document is still in draft format, therefore, in line with best practice, the core of the assessment presented in the body of this chapter is based on the guidance currently outlined in Section 5.6 of the *Wind Energy Development Guidelines for Planning Authorities.*

13.2.1.2.5 World Health Organization (WHO) Noise Guidelines for the European Region

The WHO Environmental Noise Guidelines for the European Region (2018) provide guidance on protecting human health from exposure to environmental noise. They set health-based recommendations based on average environmental noise exposure of several sources of environmental noise, including wind turbine noise. Recommendations are rated as either 'strong' or 'conditional'. A strong recommendation, "*can be adopted as policy in most situations*" whereas a conditional recommendation, "*requires a policy-making process with substantial debate and involvement of various stakeholders. There* *is less certainty of its efficacy owing to lower quality of evidence of a net benefit, opposing values and preferences of individuals and populations affected or the high resource implications of the recommendation, meaning there may be circumstances or settings in which it will not apply*".

In relation to wind turbine noise, the WHO Guideline Development Group (GDG) state the following:

> "*For average noise exposure, the GDG conditionally recommends reducing noise levels produced by wind turbines below 45 dB Lden, as wind turbine noise above this level is associated with adverse health effects.*
>
> *No recommendation is made for average night noise exposure Lnight of wind turbines. The quality of evidence of night-time exposure to wind turbine noise is too low to allow a recommendation*.
>
> *To reduce health effects, the GDG conditionally recommends that policy-makers implement suitable measures to reduce noise exposure from wind turbines in the population exposed to levels above the guideline values for average noise exposure. No evidence is available, however, to facilitate the recommendation of one particular type of intervention over another*."

The quality of evidence used for the WHO research is stated as being 'Low', the recommendations are therefore conditional.

The WHO Environmental Noise Guidelines aim to support the legislation and policy-making process on local, national and international level, thus shall be considered by Irish policy makers for any future revisions of Irish National Guidelines.

There is potential increased uncertainty due to the parameter used by the WHO for assessment of exposure (i.e. L_{den}), which it is acknowledged may be a poor characterisation of wind turbine noise and may limit the ability to observe associations between wind turbine noise and health outcomes, as stated below.

> "*Even though correlations between noise indicators tend to be high (especially between L_{Aeq}-like indicators) and conversions between indicators do not normally influence the correlations between the noise indicator and a particular health effect, important assumptions remain when exposure to wind turbine noise in Lden is converted from original sound pressure level values. The conversion requires, as variable, the statistical distribution of annual wind speed at a particular height, which depends on the type of wind turbine and meteorological conditions at a particular geographical location. Such input variables may not be directly applicable for use in*

other sites. They are sometimes used without specific validation for a particular area, however, because of practical limitations or lack of data and resources. This can lead to increased uncertainty in the assessment of the relationship between wind turbine noise exposure and health outcomes. Based on all these factors, it may be concluded that the acoustical description of wind turbine noise by means of L_{den} or L_{night} may be a poor characterization of wind turbine noise and may limit the ability to observe associations between wind turbine noise and health outcomes."

WHO document goes on to state that:

"*Further work is required to assess fully the benefits and harms of exposure to environmental noise from wind turbines and to clarify whether the potential benefits associated with reducing exposure to environmental noise for individuals living in the vicinity of wind turbines outweigh the impact on the development of renewable energy policies in the WHO European Region*."

Based upon the review set out above, it is concluded that the conditional WHO recommended average noise exposure level (i.e. 45dB L_{den}) should not currently be applied as target noise criteria for an existing or proposed wind turbine development in Ireland.

13.2.1.3 Special Characteristics

13.2.1.3.1 Infrasound/Low Frequency Noise

Low Frequency Noise is noise that is dominated by frequency components less than approximately 200Hz whereas Infrasound is typically described as sound at frequencies below 20Hz. In relation to Infrasound, the following extract from the EPA document *Guidance Note for Noise Assessment of Wind Turbine Operations at EPA Licensed Sites (NG3)* (EPA, 2011) is noted here:

"*There is similarly no significant infrasound from wind turbines. Infrasound is high level sound at frequencies below 20 Hz. This was a prominent feature of passive yaw "downwind" turbines where the blades were positioned downwind of the tower which resulted in a characteristic "thump" as each blade passed through the wake caused by the turbine tower. With modern active yaw turbines (i.e. the blades are upwind of the tower and the turbine is turned to face into the wind by a wind direction sensor on the nacelle activating a yaw motor) this is no longer a significant feature*."

With respect to infrasonic noise levels below the hearing threshold, the World Health Organisation (WHO) document *Community Noise* (WHO, 1995) has stated that:

"There is no reliable evidence that infrasounds below the hearing threshold produce physiological or psychological effects."

In 2010, the UK Health Protection Agency published a report entitled *Health Effects of Exposure to Ultrasound and Infrasound, Report of the independent Advisory Group on Non-ionising Radiation*. The exposures considered in the report related to medical applications and general environmental exposure. The report notes:

> *"Infrasound is widespread in modern society, being generated by cars, trains and aircraft, and by industrial machinery, pumps, compressors and low speed fans. Under these circumstances, infrasound is usually accompanied by the generation of audible, low frequency noise. Natural sources of infrasound include thunderstorms and fluctuations in atmospheric pressure, wind and waves, and volcanoes; running and swimming also generate changes in air pressure at infrasonic frequencies.*
>
> *For infrasound, aural pain and damage can occur at exposures above about 140 dB, the threshold depending on the frequency. The best-established responses occur following acute exposures at intensities great enough to be heard and may possibly lead to a decrease in wakefulness. The available evidence is inadequate to draw firm conclusions about potential health effects associated with exposure at the levels normally experienced in the environment, especially the effects of long-term exposures. The available data do not suggest that exposure to infrasound below the hearing threshold levels is capable of causing adverse effects."*

The UK Institute of Acoustics Bulletin in March 2009 included a statement of agreement between acoustic consultants regularly employed on behalf of wind farm developers, and conversely acoustic consultants regularly employed on behalf of community groups campaigning against wind farm developments (IAO JS2009). The intent of the article was to promote consistent assessment practices, and to assist in restricting wind farm noise disputes to legitimate matters of concern. On the subject of infrasound, the article notes:

> *"Infrasound is the term generally used to describe sound at frequencies below 20 Hz. At separation distances from wind turbines which are typical of residential locations the levels of infrasound from wind turbines are well below the human perception level. Infrasound from wind turbines is often at levels below that of the noise generated by wind around buildings and other obstacles.*
>
> *Sounds at frequencies from about 20 Hz to 200 Hz are conventionally referred to as low-frequency sounds. A report for the DTI in 2006 by Hayes McKenzie concluded that neither infrasound nor low frequency noise was a significant factor at the separation distances at which*

people lived. This was confirmed by a peer review by a number of consultants working in this field. We concur with this view."

The article concludes that:

"from examination of reports of the studies referred to above, and other reports widely available on internet sites, we conclude that there is no robust evidence that low frequency noise (including 'infrasound') or ground -borne vibration from wind farms, generally has adverse effects on wind farm neighbours".

A report released in January 2013 by the South Australian Environment Protection Authority namely, *Infrasound levels near windfarms and in other environments* (EPA, 2013)[156] found that the level of infrasound from wind turbines is insignificant and no different to any other source of noise, and that the worst contributors to household infrasound are air-conditioners, traffic and noise generated by people.

The study included several houses in rural and urban areas, both adjacent to and away from a wind farm, and measured the levels of infrasound with the wind farms operating and switched off.

There were no noticeable differences in the levels of infrasound under all these different conditions. In fact, the lowest levels of infrasound were recorded at one of the houses closest to a wind farm, whereas the highest levels were found in an urban office building.

The EPA's study concluded that the level of infrasound at houses near wind turbines was no greater than in other urban and rural environments, and stated that:

"*The contribution of wind turbines to the measured infrasound levels is insignificant in comparison with the background level of infrasound in the environment*."

A German report[157], titled "*low frequency noise incl. infrasound from wind turbines and other sources*" presents the details of a measurement project which ran from 2013. The report was published by the State Office for the Environment, Measurement and Nature Conservation of the Federal State of Baden-Württemberg in 2016 and concluded the following in relation to infrasound from wind turbines:

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156 EPA South Australia, 2013, Wind farms https://www.epa.sa.gov.au/files/477912_infrasound.pdf

157 Report available at https://www4.lubw.baden-wuerttemberg.de/servlet/is/262445/low-frequency_noise_incl_infrasound.pdf?command=downloadContent&filename=low-frequency_noise_incl_infrasound.pdf

"The measured infrasound levels (G levels) at a distance of approx. 150 m from the turbine were between 55 and 80 dB(G) with the turbine running. With the turbine switched off, they were between 50 and 75 dB(G). At distances of 650 to 700 m, the G levels were between 55 and 75 dB(G) with the turbine switched on as well as off.

"For the measurements carried out even at close range, the infrasound levels in the vicinity of wind turbines – at distances between 150 and 300 m – were well below the threshold of what humans can perceive in accordance with DIN 45680 (2013 Draft)[158]"

"The results of this measurement project comply with the results of similar investigations on a national and international level."

13.2.1.3.2 Amplitude Modulation

In the context of this assessment, amplitude modulation (AM) is defined in the IOA Noise Working Group (Wind Turbine Noise) Amplitude Modulation Working Group (AMWG) document *A Method for Rating Amplitude Modulation in Wind Turbine* (IOA, 2016) as:

"*Periodic fluctuations in the level of audible noise from a wind turbine (or wind turbines), the frequency of the fluctuations being related to the blade passing frequency (BPF) of the turbine rotor(s).*"

It is now generally accepted that there are two mechanisms which can cause amplitude modulation:

- 'Normal' AM, and;
- 'Other' AM (sometimes referred to 'Excessive' AM).

In both cases, the result is a regular fluctuation in amplitude at the Blade Passing Frequency (BPF) of the wind turbine blades (the rate at which the blades of the turbine pass a fixed point). For a three-bladed turbine rotating at 20 rpm, this equates to a modulation frequency of 1 Hz.

'Normal' AM An observer at ground level close to a wind turbine will experience 'blade swish' because of the directional characteristics of the noise radiated from the trailing edge of the blades as it rotates towards and then away from the observer.

[158] DIN 45680:2013-09 – Draft "Measurement and assessment of low-frequency noise immissions" November 2013

This effect is reduced for an observer on or close to the turbine axis, and therefore would not generally be expected to be significant at typical separation distances, at least on relatively level sites.

The RenewableUK AM project (RenewableUK, 2013) has coined the term 'normal' AM (NAM) for this inherent characteristic of wind turbine noise, which has long been recognised and was discussed in ETSU-R-97 in 1996.

'Other' AM In some cases AM is observed at large distances from a wind turbine (or turbines). The sound is generally heard as a periodic 'thumping' or 'whoomphing' at relatively low frequencies.

On sites where it has been reported, occurrences appear to be occasional, although they can persist for several hours under some conditions, dependent on atmospheric factors, including wind speed and direction.

It was proposed in the RenewableUK 2013 study that the fundamental cause of this type of AM is transient stall conditions occurring as the blades rotate, giving rise to the periodic thumping at the blade passing frequency.

Transient stall represents a fundamentally different mechanism from blade swish and can be heard at relatively large distances, primarily downwind of the rotor blade.

The RenewableUK AM project report adopted the term 'Other AM' (OAM) for this characteristic. The terms 'enhanced' or 'excess' AM (EAM) have been used by others, although such definitions do not distinguish between the source mechanisms and presuppose a 'normal' level of AM, presumably relating back to blade swish as described in ETSU-R-97.

Frequency of Occurrence of AM

Research by Salford University commissioned by the Department of Environment Food and Rural Affairs (DEFRA), the Department of Business, Enterprise and Regulatory Reform (BERR) and the Department of Communities and Local Government (CLG) investigated the issue of AM associated with wind turbine noise. The results were reviewed and published in the report 'Research into Aerodynamic Modulation of Wind Turbine Noise' (2007). The broad conclusions of this report were that aerodynamic modulation was only considered to be an issue at four, and a possible issue at a further eight, of 133 sites in the UK that were operational at the time of the study and considered within the review. At the four sites where AM was confirmed as an issue, it was considered that conditions associated with AM might occur between about 7 and 15% of the time. It also emerged that for three out of the four sites the complaints have subsided, in one case due to the introduction of a turbine control system. The research has shown that AM is a rare and unlikely occurrence at operational wind farms.

It should be noted that AM is associated with wind turbine operation and it is not possible to predict an occurrence of AM at the planning stage. It should also be noted that it is a rare event associated with a limited number of wind farms. While it can occur, it is the exception rather than the rule.

RenewableUK Research Document states the following in relation to matter:

Page 68 Module F *"even on those limited sites where it has been reported, its frequency of occurrence appears to be at best infrequent and intermittent."*

Page 6 Module F *"It has also been the experience of the project team that, even at those wind farm sites where AM has been reported or identified to be an issue, its occurrence may be relatively infrequent. Thus, the capture of time periods when subjectively significant AM occurs may involve elapsed periods of several weeks or even months."*

Page 61 Module F *"There is nothing at the planning stage that can presently be used to indicate a positive likelihood of OAM occurring at any given proposed wind farm site, based either on the site's general characteristics or on the known characteristics of the wind turbines to be installed."*

<u>*Assessment of AM*</u>

Research and Guidance in the area is ongoing with recent publications being issued by the Institute of Acoustics (IoA) Noise working Group (Wind Turbine Noise) Amplitude Modulation Working Group (AMWG) namely, *A Method for Rating Amplitude Modulation in Wind Turbine Noise* (August 2016). The document proposes an objective method for measuring and rating AM. The AMWG does not propose what level of AM is likely to result in adverse community response.

The AMWG does not propose any limits for AM. The purpose of the group is simply to use existing research to develop a Reference Methodology for the measurement and rating of amplitude modulation. The definition of any limits of acceptability for AM, or consideration of how such limits might be incorporated into a wind farm planning condition, is outside the scope of the AMWG's work and is currently the subject of a separate UK Government funded study.

13.2.1.3.3 Comment on Health Impacts

The National Health and Medical Research Council

The relevant Australian authority on health issues, the National Health and Medical Research Council (NHMRC), conducted a comprehensive independent assessment of the scientific evidence on wind farms and human health. The findings are contained in the NHMRC Information Paper: *Evidence on Wind Farms and Human Health 2015*, which concluded:

> "*After careful consideration and deliberation, NHMRC concluded that there is no consistent evidence that wind farms cause adverse health effects in humans. This finding reflects the results and limitations of the direct evidence and also takes into account the relevant available parallel evidence on whether or not similar noise exposure from sources other than wind farms causes health effects"*

Health Canada

Health Canada, Canada's national health organisation, released preliminary results of a study into the effect of wind farms on human health in 2014[159]. The study was initiated in 2012 specifically to gather new data on wind farms and health. The study considered physical health measures that assessed stress levels using hair cortisol, blood pressure and resting heart rate, as well as measures of sleep quality. More than 4,000 hours of wind turbine noise measurements were collected and a total of 1,238 households participated.

No evidence was found to support a link between exposure to wind turbine noise and any of the self-reported illnesses. Additionally, the study's results did not support a link between wind turbine noise and stress, or sleep quality (self-reported or measured). However, an association was found between increased levels of wind turbine noise and individuals reporting of being annoyed.

New South Wales Health Department

In 2012, the New South Wales (NSW) Health Department provided written advice to the NSW Government that stated existing studies on wind farms and health issues had been examined and no known causal link could be established.

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159 Health Canada 2014, Wind Turbine Noise and Health Study: Summary of Results. Available at https://www.canada.ca/en/health-canada/services/environmental-workplace-health/noise/wind-turbine-noise/wind-turbine-noise-health-study-summary-results.html

NSW Health officials stated that fears that wind turbines make people sick are ‘not scientifically valid’. The officials wrote that there was no evidence for ‘wind turbine syndrome’, a collection of ailments including sleeplessness, headaches and high blood pressure that some people believe are caused by the noise of spinning blades.

The Australian Medical Association

The Australian Medical Association put out a position statement, *Wind Farms and Health* 2014[160]. The statement said:

> “*The available Australian and international evidence does not support the view that the infrasound or low frequency sound generated by wind farms, as they are currently regulated in Australia, causes adverse health effects on populations residing in their vicinity. The infrasound and low frequency sound generated by modern wind farms in Australia is well below the level where known health effects occur, and there is no accepted physiological mechanism where sub-audible infrasound could cause health effects.*”

Journal of Occupational and Environmental Medicine

The review titled, *Wind Turbines and Health: A Critical Review of the Scientific Literature* was published in the Journal of Occupational and Environmental Medicine, 2014. An independent review of the literature was undertaken by the he Department of Biological Engineering of the Massachusetts Institute of Technology (MIT). The review took into consideration health effects such as stress, annoyance and sleep disturbance, as well as other effects that have been raised in association with living close to wind turbines. The study found that:

> “*No clear or consistent association is seen between noise from wind turbines and any reported disease or other indicator of harm to human health*.”

The report concluded that living near wind farms does not result in the worsening of the quality of life in that particular region.

160 Australian Medical Association, 2014, Wind farms and health. Available https://ama.com.au/position-statement/wind-farms-and-health-2014

13.2.1.4 Operational Phase Vibration

Vibration generated from the operation of a wind turbine unit will decrease rapidly with distance. Typically, at a distance of 100m from a 1MW turbine unit the level of vibration associated with a turbine is the order of 10^{-5} mm/s.

A recent report from Germany published by the State Office for the Environment, Measurement and Nature Conservation of the Federal State of Baden-Württemberg in 2016, "*low frequency noise incl. infrasound from wind turbines and other sources*". Conducted vibration measurements study for an operational Nordex N117 – 2.4 MW wind turbine. The report concluded that at distances of less than 300m from the turbine vibration levels had dropped so far that they could no longer be differentiated from the background vibration levels.

Considering that the shortest distance from a sensitive receptor to a turbine is greater than750m the level of vibration will be significantly below any thresholds for perceptibility. Therefore, vibration criteria have not been specified for the operational phase of the proposed development.

13.2.2 EPA Description of Effects

The significance of effects of the proposed development shall be described in accordance with the EPA guidance document *Draft Guidelines on the information to be contained in Environmental Impact Assessment Reports* (EIAR), Draft, August 2017. Details of the methodology for describing the significant of the effects are provided in Chapter 1 – *Introduction.*

The effects associated with the proposed development are described in the relevant sections of this chapter with respect to the EPA guidance and the "Descriptions of Effects" as set out in Chapter 1, Section 1.8.2.

13.2.3 Assessment Methodology

The following guidance documents have been referenced to inform the assessment methodology, further details are presented where relevant in the various section of this chapter.

13.2.3.1 The Assessment and Rating of Noise from Wind Farms – ETSU-R-97

As stated previously, the core of the noise guidance contained within the *Wind Energy Development Guidelines* guidance document is based on the 1996 ETSU publication *The Assessment and Rating of Noise from Wind Farms* (ETSU-R-97).

ETSU-R-97 calls for the control of wind turbine noise by the application of noise limits at the nearest NSL's. ETSU-R-97 considers that absolute noise limits applied at all wind speeds are not suited to wind turbine developments and recommends that noise limits should be set relative to the existing background noise levels at noise sensitive locations. Therefore, a critical aspect of the noise assessment of wind energy proposals relates to the identification of baseline noise levels through on-site noise surveys.

ETSU-R-97 states at page 58, "…*absolute noise limits and margins above background should relate to the cumulative effect of all wind turbines in the area which contribute to the noise received at the properties in question…*"

13.2.3.2 The Institute of Acoustics Good Practice Guide

The guidance contained within the Institute of Acoustics (IoA) document *A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise* (2013) (IoA GPG) and Supplementary Guidance Notes are considered to represent best practice and have been adopted for this assessment. The IoA GPG states that at a minimum continuous baseline noise monitoring should be carried out at the nearest noise sensitive locations for typically a two-week period and should capture a representative sample of wind speeds in the area (i.e. cut in speeds to wind speed of rated sound power of the proposed turbine). Background noise measurements (i.e. $L_{A90,10min}$) should be related to wind speed measurements that are collated at the site of the wind turbine development. Regression analysis is then applied to this data set to derive background noise levels at various wind speeds, and from this, the appropriate day and night time noise criterion curves can be established.

Noise emissions associated with the wind turbine can be predicted in accordance with ISO 9613: *Acoustics – Attenuation of sound outdoors, Part 2: General method of calculation* (1996). This is a noise prediction standard that considers noise attenuation offered, amongst others, by distance, ground absorption, directivity and atmospheric absorption. Noise predictions and contours are typically prepared for various wind speeds and the predicted levels are compared against the relevant noise criterion curve to demonstrate compliance with the appropriate noise criteria.

Where noise predictions indicate that reductions in noise emissions are required in order to satisfy any adopted criteria, consideration can be given to detailed downwind analysis and operating turbines in low noise mode, which is typically offered by modern wind turbine units.

Reference has been made to the IoA GPG for guidance on the methodology for the background noise survey and operation impact assessment for wind turbine noise.

13.2.3.3 Background Noise Survey

The background noise survey was conducted through installing unattended sound level meters at ten representative locations in the surrounding area.

The installation, retrieval and management of all measurement instrumentation detailed in this section has been carried out by Enfonic Ltd. (Enfonic) on behalf of TOBIN.

Enfonic are noise and vibration measurement specialists who provide acoustic survey services. Enfonic was established in 2003 with offices in Dublin and London, the company offers a range of services to the acoustic and vibration market. Enfonic's managing director, Gary Duffy, is a founding member of the Irish Branch of the Institute of Acoustics (IOA) and has organised many conferences and evening meetings. He ran the IOA Diploma in Acoustics and has advised several government departments and agencies on their respective noise related guidance.

Enfonic has confirmed that all measurement data collected during the baseline noise surveys has been carried out in accordance with the Institute of Acoustic (IoA) Guidance Document, *A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise* (2013) and accompanying, Supplementary Guidance Note 1: *Data Collection* (2014).

The analysis and assessment of all survey data has been carried out by AWN.

13.2.3.3.1 <u>Choice of Measurement Locations</u>

The noise monitoring locations were identified by preparing a preliminary noise model contour at an early stage of the assessment. Any locations that fell inside the predicted 35 dB L_{A90} noise contour were considered for noise monitoring in line with current best practice guidance outlined in the IoA GPG. The selection of the noise monitoring locations was informed by a site visit and supplemented by reviewing aerial images of the study area and other online sources of information (e.g. Google Earth).

13.2.3.3.2 <u>Measurement Periods</u>

The survey duration was typically 4-weeks, or until such time that a sufficient number of data point were captured at each survey locations. Section 2.9.1 of the IoA GPG states:

> "*The duration of a background noise survey is determined only by the need to acquire sufficient valid data over the range of wind speeds (and directions, if relevant). It is unlikely that this requirement can be met in less than 2 weeks.*"

AWN conducted an ongoing review of the survey data at regular intervals to establish when adequate data had been captured.

Noise measurements were conducted at relevant monitoring locations over the following periods:

Table 13.4: Noise Measurement Periods

Location Ref.	Location I.D.	Start Time	End Time
A	H482	01/03/17 – 14:15hrs	04/04/17 – 12:50hrs
B	H515	10/03/17 – 17:20hrs	04/04/17 – 13:10hrs
C	H544	01/03/17 – 15:05hrs	04/04/17 – 14:30hrs
D	H471	01/03/17 – 15:45hrs	24/03/17 – 00:30hrs
E	H306	01/03/17 – 16:15hrs	04/04/17 – 13:50hrs
F	H428	01/03/17 – 16:55hrs	04/04/17 – 14:40hrs
G	H552	10/03/17 – 15:50hrs	04/04/17 – 13:10hrs
H	H231	10/03/17 – 16:50hrs	04/04/17 – 12:20hrs
I	H774	10/03/17 – 15:20hrs	04/04/17 – 13:50hrs
J	H768	10/03/17 – 14:40hrs	04/04/17 – 14:10hrs

A variety of wind speed and weather conditions were encountered over the survey periods in question. As an indication to this, Figures 13.2 and**Error! Reference source not found.** 13.3 shows the distribution of wind speed and direction recorded at the two met masts for all periods of day and night between the 1st March and 4th April 2017. The wind speed data presented below relates to a turbine hub height of 120m as discussed in Section 13.2.3.5.3.

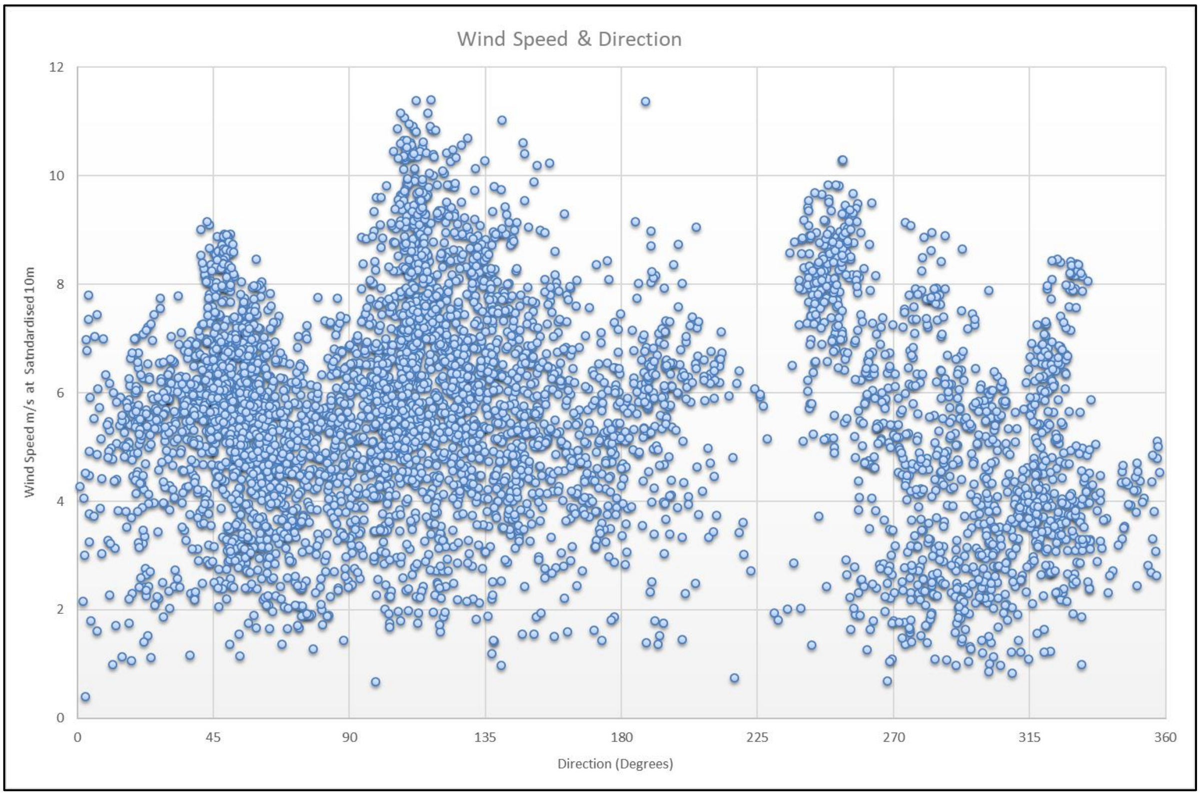


Figure 13.2: Distribution of Wind Speeds and Direction at Derryaroge Met Mast during Survey Period

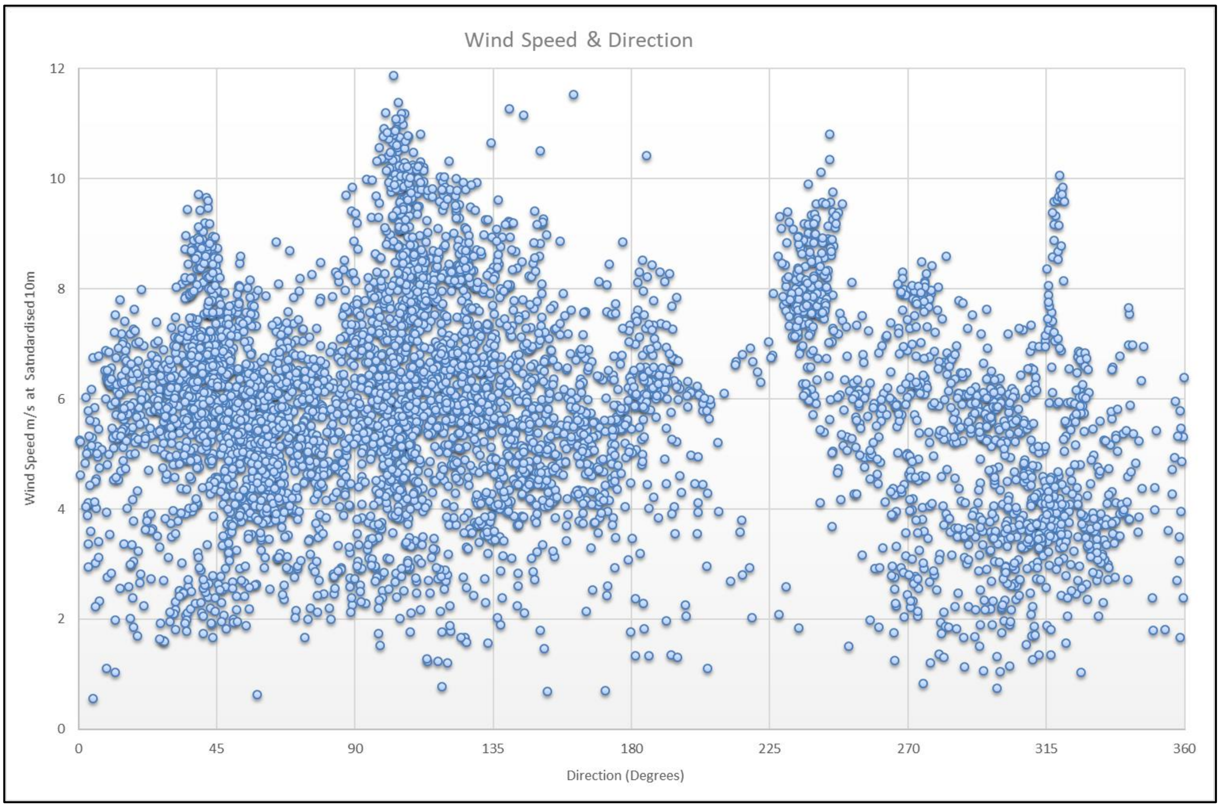


Figure 13.3: Distribution of Wind Speeds and Direction at Lough Bannow Met Mast during Survey Period

It is confirmed that survey periods were of sufficient duration to measured adequate data to determine a suitable representation of typical background in accordance with guidance contained within the IoA GPG.

13.2.3.3.3 Instrumentation

The following instrumentation was used at the various locations:

Table 13.5: Noise Measurement Instrumentation

Location	Equipment	Serial Number	Survey Period	Calibration Drift over Survey Period
A (H482)	Brüel & Kjaer Type 2250	3010911	01/03/17 to 04/04/17	-0.01 dB
B (H515)	Rion NL-52	610195	10/03/17 to 23/03/17	0.1 dB
	Brüel & Kjaer Type 2238	2151874	23/03/17 to 04/04/17	0.0 dB
C (H544)	Brüel & Kjaer Type 2250-L	2580156	01/03/17 to 23/03/17	-0.01 dB
	Brüel & Kjaer Type 2238	2562556	23/03/17 to 04/04/17	-0.2 dB
D (H471)	Brüel & Kjaer Type 2250-L	3006895	01/03/17 to 23/03/17	0.01 dB
	Brüel & Kjaer Type 2238	2125128	23/03/17 to 24/03/17	-0.2 dB
E (H306)	Brüel & Kjaer Type 2250	2590440	01/03/17 to 04/04/17	0.05 dB
F (H428)	Brüel & Kjaer Type 2250-L	3000855	01/03/17 to 04/04/17	0.05 dB
G (H552)	Rion NL-52	732094	10/03/17 to 23/03/17	0.1 dB
	Brüel & Kjaer Type 2238	2343753	23/03/17 to 04/04/17	0.1 dB
H (H231)	Brüel & Kjaer Type 2250-L	2654662	10/03/17 to 04/04/17	0.2 dB
I (H774)	Rion NL-52	620802	10/03/17 to 23/03/17	0.01 dB
	Brüel & Kjaer Type 2238	2756962	23/03/17 to 04/04/17	0.0 dB
J (H768)	Brüel & Kjaer Type 2250-L	3002367	10/03/17 to 04/04/17	-0.01 dB

Before, after and during each survey period, the measurement instrument was check calibrated using a Brüel & Kjær type 4231 Sound Level Calibrator. The calibration drifts were noted, and the maximum drifts are detailed in Table 13.5 above. Relevant calibration certificates are presented in Appendix 13.2.

Rainfall was monitored at two noise monitoring locations during the survey, Locations D, J and at the Derryaroge Met Mast. The rainfall data allows for the identification of periods of rainfall so that they can be removed from the noise monitoring data sets, in line with best practice, when calculating the prevailing background noise levels at the various locations.

Wind speed measurements were obtained from two on-site met masts, located on Derryaroge bog and Lough Bannow bog respectively. The locations of the met masts are provided in Table 13.6.

Table 13.6: Met Mast Locations

Met Mast	Co-ordinates (ING)	
	Easting	Northing
Derryaroge	203,882	270,304
Lough Bannow	208,092	264,899

13.2.3.3.4 Measurement Procedure

Measurements were conducted at all locations over the survey periods outlined in Table 13.4. Data samples for all measurements (noise, rainfall and wind) were logged continuously at 10-minute interval periods for the duration of the survey. The $L_{Aeq,10min}$ and $L_{A90,10min}$ noise parameters were measured in this instance and the results were saved to the instrument memory for later analysis.

Enfonic provided notes compiled during installation and removal of equipment from each monitoring location on the primary noise sources contributing to the noise environment in the area (e.g. identified significant noise sources in the area such as local traffic, farm yard activities etc.).

13.2.3.3.5 Consideration of Wind Shear

As part of a robust wind farm noise assessment due consideration should be given to the issue of wind shear. It is standard procedure to reference noise data to standardised 10 metre wind speed. The issue of wind shear has been considered in this assessment and followed relevant guidance as outlined in the IoA GPG. This guidance presents the following equations in relation to the derivation of a standardised wind speed at 10m above ground level:

Equation A Shear Exponent Profile: this uses the following equation:

$$U = U_{ref} \times (H \div H_{ref})^m$$

Where:

- U calculated wind speed.
- U_{ref} measured wind speed.
- H height at which the wind speed will be calculated.
- H_{ref} height at which the wind speed is measured.
- m shear exponent.

Equation B Roughness Length Shear Profile: this uses the following equation:

$$U_1 = U_2 \times [(\ln(H_1 \div z))/ (\ln(H_2 \div z))]$$

Where:

- H_1 the height of the wind speed to be calculated (10m)
- H_2 the height of the measured wind speed.
- U_1 the wind speed to be calculated.
- U_2 the measured wind speed.

z the roughness length.

Note: A roughness length of 0.05m is used to standardise hub height wind speeds to 10m height in the IEC 61400-11:2003 standard, regardless of what the actual roughness length seen on a site may have been. This 'normalisation' procedure was adopted for comparability between test results for different turbines.

Any reference to wind speed in the following sections of this chapter should be understood to be the 10m height standardised wind speed reference unless otherwise stated.

For the assessment of baseline noise data and the derivation of applicable noise criteria, wind data collected at the mast nearest to each noise sensitive location has been used. Thus, for the assessment of Locations A, B, C, G and H wind data from the Derryaroge mast has been utilised whereas at Locations D, E, F, I and J wind data was taken from the Lough Bannow mast. The background noise data has been corrected to 10m standardised height based on an assessment hub height of 120m in accordance with the guidance contained in the IoA GPG, Supplementary Guidance Note (SGN) 4: Wind Shear, July 2014.

13.2.3.3.6 <u>Analysis of Background Noise Data</u>

The data sets have been filtered to remove issues such as the dawn chorus and the influence of other atypical noise sources. An example of atypical sources would be short isolated periods of raised noise levels attributable to local sources, agricultural activity, boiler flues, operation of gardening equipment etc. Directional filtering has been applied where appropriate to minimise the influence of noise from road traffic from the N63. In addition, sample periods affected by rainfall or when rainfall resulted in prolonged periods of atypical noise levels have also been screened form the data sets. The assessment methods outlined above are in line with the guidance contained in the IoA *GPG*.

The results presented in the following sections refer to the noise data collated during 'quiet periods' of the day and night as defined in the IoA *GPG*. These periods are defined as follows:

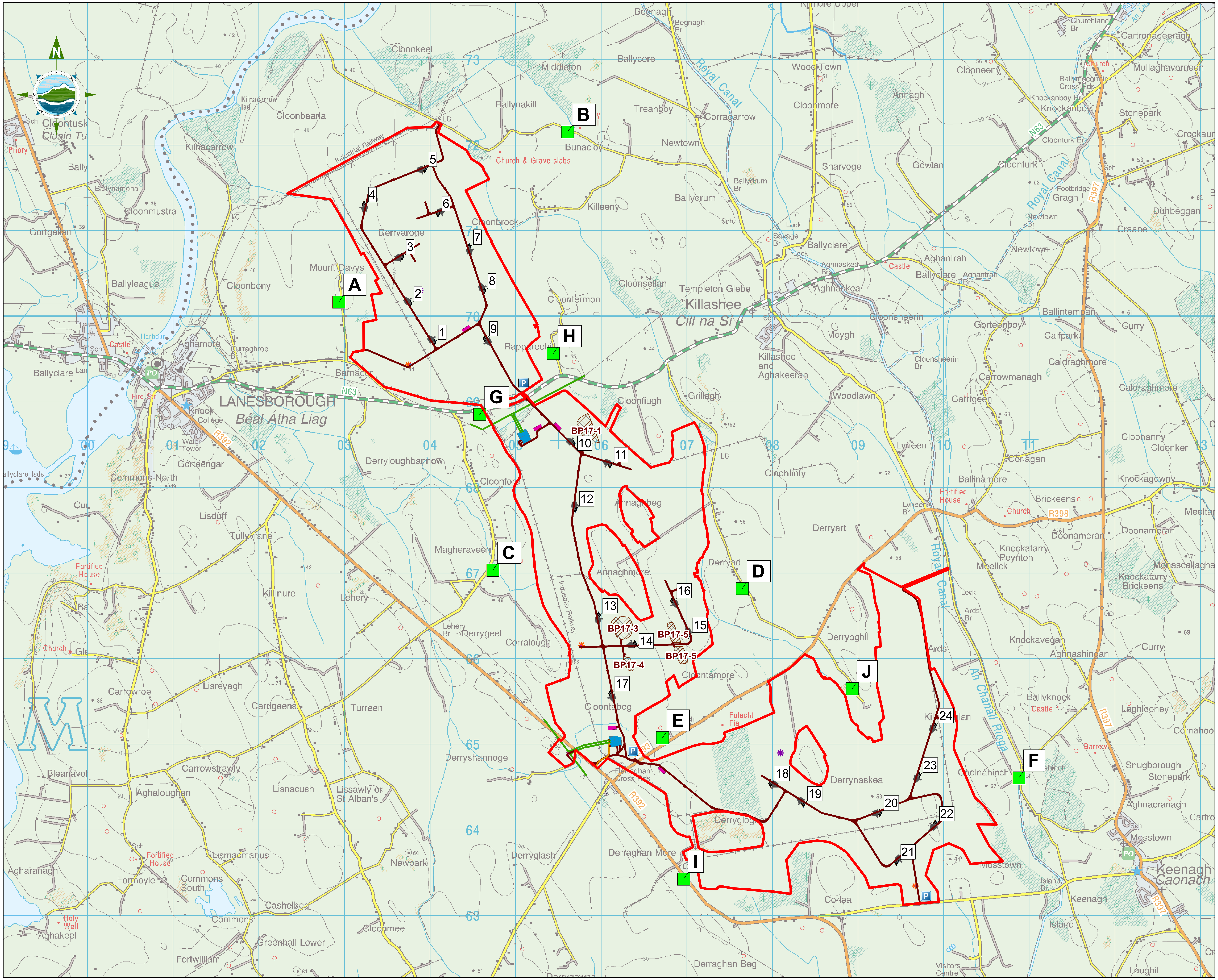
- Daytime Amenity hours are:
    - all evenings from 18:00 to 23:00hrs;
    - Saturday afternoons from 13:00 to 18:00hrs, and;
    - all day Sunday from 07:00 to 18:00hrs.
- Night time hours are 23:00 to 07:00hrs.

13.2.3.3.7 Measurement Locations

The co-ordinates for selected locations for the noise monitoring are outlined in Table 13.7 and depicted on the map in Figure 13.4.

Table 13.7: Noise Measurement Co-ordinates

Location Ref.	Location I.D.	Co-ordinates (ING)	
		Easting	Northing
A	H482	202,933	270,165
B	H515	205,606	272,152
C	H544	204,733	267,033
D	H471	207,648	266,818
E	H306	206,715	265,075
F	H428	210,878	264,607
G	H552	204,580	268,853
H	H231	205,440	269,565
I	H774	206,962	263,424
J	H768	208,933	265,649



Legend

- Planning Application Boundary
- Noise Monitoring Locations
- Amenity Car Park
- Overhead Line
- Road Layout
- UG Cables
- Proposed Substation Hardstand
- Borrow Pit Locations
- Turbine Hardstand
- Temporary Construction Compounds
- Proposed Turbine Locations
- Proposed Met Mast Locations
- Existing Met Mast Locations

0 200 400 800 1,200 1,600
Metres

Issue	Date	Description	By	Chkd.
A	Jan. 2019	Final Issue	MN	ST

Client:
BORD NA MÓNA
Naturally Driven

Project:
DERRYADD WIND FARM

Title:
NOISE MONITORING LOCATIONS

Scale @ A1: 1:20,000

Prepared by: M. Nolan
Checked: S. Tinnelly
Date: January 2019
Project Director: D. Grehan

TOBIN
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www.tobin.ie

Figure 13.4
Issue: A

Figures 13.5 to Figure 13.16 Figures 13.14 illustrate the installed noise monitoring kits at each location.

Figure 13.5: Noise Monitoring Installation – Location A (H482)

Figure 13.6: Noise Monitoring Installation – Location B (H515)

Figure 13.7: Noise Monitoring Installation – Location C (H544)

Figure 13.8: Noise Monitoring Installation – Location D (H471)

Figure 13.9: Noise Monitoring Installation – Location E (H306)

Figure 13.10: Noise Monitoring Installation – Location F (H428)

Figure 13.11: Noise Monitoring Installation – Location G (H552)

Figure 13.12: Noise Monitoring Installation – Location H (H231)

Figure 13.13: Noise Monitoring Installation – Location I (H774)

Figure 13.14: Noise Monitoring Installation – Location J (H768)

13.2.3.4 Construction Noise Calculations

A variety of items of plant will be in use for the purposes of site preparation, construction and site works. There will be vehicular movements to and from the site that will make use of existing roads. There is the potential for generation of significant levels of noise from these activities.

Due to the nature of construction activities it is difficult to calculate the actual magnitude of emissions to the local environment in the absence of a detailed construction programme. The standard best practice approach is to predict typical noise levels at the nearest sensitive receptor using guidance set out in BS 5228-1:2009+A1:2014 *Code of practice for noise and vibration control on construction and open sites –*

Noise. Construction noise predictions have been carried out using guidance set out in British Standard BS 5228-1:2009+A1:2014 *Code of practice for noise and vibration control on construction and open sites – Noise*.

The methodology adopted for the assessment of construction noise is to analyse the various elements of the construction phase in isolation. For each element, the typical construction noise sources are assessed along with typical sound pressure levels and spectra from BS 5228 at various distances from these works.

13.2.3.5 Operational Noise Calculations

A series of computer-based prediction models have been prepared to quantify the potential turbine noise level associated with the operational of the proposed development on the receiving environment. This section discusses the methodology behind the noise modelling process and presents the results of the modelling exercise.

13.2.3.5.1 DGMR iNoise V2017 Enterprise

The selected software, DGMR *iNoise Enterprise*, calculates noise levels in accordance with ISO 9613: *Acoustics – Attenuation of sound outdoors, Part 2: General method of calculation*, (ISO, 1996).

INoise is a proprietary noise calculation package for computing noise levels and propagation of noise sources. iNoise calculates noise levels in different ways depending on the selected prediction standard. In general, however, the resultant noise level is calculated considering a range of factors affecting the propagation of sound, including:

- the magnitude of the noise source in terms of A weighted sound power levels (LWA);
- the distance between the source and receiver;
- the presence of obstacles such as screens or barriers in the propagation path;
- the presence of reflecting surfaces;
- the hardness of the ground between the source and receiver;
- Attenuation due to atmospheric absorption; and
- Meteorological effects such as wind gradient, temperature gradient and humidity (these have significant impact at distances greater than approximately 400 m).

13.2.3.5.2 Input Data and Assumptions

Information available for the site has been inputted into our iNoise noise modelling software using the ISO 9613-2:1996 *Acoustics – Attenuation of sound during propagation outdoors: General method of calculation.* The input data and assumptions made are described in the following sections.

13.2.3.5.3 Proposed Turbine Details

Table 13.8 details the co-ordinates of the proposed turbines that are being considered as part of this assessment.

Table 13.8: Proposed Turbine Co-ordinates

Ref.	Co-ordinates (ING)		Ref.	Co-ordinates (ING)	
	Eastings	Northing		Eastings	Northing
T01	204,045	269,699	T13	205,967	266,503
T02	203,764	270,151	T14	206,391	266,174
T03	203,671	270,697	T15	207,018	266,275
T04	203,229	271,306	T16	206,832	266,677
T05	203,935	271,718	T17	206,108	265,592
T06	204,091	271,202	T18	207,978	264,544
T07	204,457	270,810	T19	208,361	264,307
T08	204,628	270,299	T20	209,254	264,199
T09	204,644	269,739	T21	209,448	263,627
T10	205,672	268,516	T22	209,902	264,073
T11	206,100	268,268	T23	209,709	264,641
T12	205,694	267,752	T24	209,894	265,219

The following sections detail the noise data for the various turbine units under consideration that have been used for modelling purposes.

For the purposes of this assessment, the turbine type assumed for the development site is the Vestas V126 3.3MW. The turbine is a pitch regulated upwind turbine with a three-blade rotor. For the purposes of this assessment predictions have assumed the source of noise at a hub height of 120m. Each wind turbine is secured to a circular-shaped reinforced concrete foundation.

While the noise profiles of the Vestas V126[161] wind turbine has been used for the purposes of this assessment, the actual turbine to be installed on the site will be the subject of a competitive tender process and could include turbines not amongst the turbine models currently available. The turbine eventually selected for installation on site will not give rise to noise levels of greater significance than that used for the purposes of this assessment, to ensure the findings of this assessment remain valid. Any references to the Vestas turbines in this assessment must be considered in the context of the above and

[161] Vestas Technical Report – DMS 0048-2151_V01 V126-3.3MW-Mk2A-50/60 Hz Third Octaves according to General Specification. Data has been corrected from hub height to a standardised 10m above ground wind speed for an assumed hub height of 120m. This manufacturer's data has been used, including details of noise spectra. The detailed noise spectra are not presented here for commercial reasons and associated non-disclosure agreements with the manufacturer.

should not be construed as meaning it is the only make or model of wind turbine that could be used on the site.

An appraisal of the wider study area around the proposed wind farm site identified the potential for minor cumulative impacts from the operation of the proposed development in combination with the operational Sliabh Bawn wind farm which is located approximately 8 kilometres northwest of the proposed development site. Although the Sliabh Bawn wind farm is a sufficient distance from the proposed development that cumulative impacts are unlikely it has been included in the assessment in order to demonstrate that there are no significant impacts.

Table 13.9 details the noise data used for noise modelling purposes for the Derryadd and Sliabh Bawn developments respectively.

As outlined, appropriate guidance is couched in terms of a L_{A90} criterion. The turbine noise data provided is reference in terms of its sound power level (L_{WA}). The sound power data (L_{WA}) can be used to predict the sound pressure level (L_p) or continuous equivalent sound level (L_{Aeq}) in the environment. The L_{A90} parameter on which the assessment of wind turbine noise is based is a statistical parameter derived from the measured L_P or L_{Aeq}. Best practice guidance contained within the IoA GPG states that the "*L_{A90} levels should be determined from calculated L_{Aeq} levels by subtraction of 2 dB*". Therefore, in accordance with best practice guidance, a 2 dB reduction has been applied to the predicted results in this assessment.

Table 13.9: LwA Levels Used for Prediction Model – Vestas V126 3.3MW

Wind Speed (m/s at 10m Standardised Height)	dB L_{WA}
4	93.8
5	98.5
6	103.6
7	105.0
8	105.5
9	105.7
10	105.9

Table 13.10: LwA Levels Used for Prediction Model – Sliabh Bawn Turbines

Wind Speed (m/s at 10m Standardised Height)	dB L_{WA}
4	100.0
5	104.0
6	104.0
≥7	106.0

Best practice guidance specifies that a penalty should be added to the predicted noise levels, where any tonal component is present. The level of this penalty is described and is related to the level by which any tonal components exceed audibility, defined by the relevant assessment standards. For the purposes of this assessment a tonal penalty has not been included within the predicted noise levels. A warranty will be provided by the manufacturer of the turbine for the proposed Derryadd Wind Farm site to ensure that the noise output will not require a tonal noise correction under best practice guidance.

For the purposes of all predictions presented in this IOA GPG report to account for various uncertainties in the measurement of turbine source levels, an uncertainty factor of 2 dB has been added to the manufacturer's values in line with best practice guidance for wind turbine noise assessment contained in the IOA GPG.

13.2.3.5.4 Modelling Calculation Parameters[162]

Prediction calculations for turbine noise have been conducted in accordance with ISO 9613: *Acoustics – Attenuation of sound outdoors, Part 2: General method of calculation*, 1996.

In terms of calculation a ground attenuation factor (general method) of 0.5 and no metrological correction were assumed for all calculations. The atmospheric attenuation outlined in Table 13.11 were used for all calculations in accordance with the guidance outlined in the IOA GPG.

Table 13.11: Atmospheric Attenuation Assumed for Noise Calculations (dB per km)

Temp (°C)	% Humidity	Octave Band Centre Frequencies (Hz)							
		63	125	250	500	1k	2k	4k	8k
10	70	0.12	0.41	1.04	1.92	3.66	9.70	33.06	118.4

13.2.3.6 Additional Information

Appendix 13.3 details the noise sensitive locations used in this assessment. The information has been taken from a list of receptors within 1km from the edge of study area. Noise predictions were prepared in respect of the various operational turbine wind speeds at these locations.

13.3 EXISTING ENVIRONMENT

This section documents the typical background noise levels measured in the vicinity of the noise sensitive locations in closest proximity to the proposed development site.

162 See Appendix 13.3 for further discussion of calculation parameters

13.3.1 Background Noise Levels

The following sections present an overview and results of the noise monitoring data obtained from the background noise survey in accordance with the methodology discussed in Section 13.2.3.3.

Following review of the data collated at Location D, it appeared that the data was affected by a local noise source, relatively loud in nature, which was present throughout the survey period. The survey period was therefore extended; however, it was not possible to yield any usable baseline results from the data obtained at this location due to the present of the local noise source. Given that a baseline envelope assessment was being adopted for the purposes of setting appropriate noise criteria for the site (see Table 13.11), it was considered that the baseline noise data from the nine other locations was more than sufficient for this purpose.

Location F was found to have been impacted from steady water flow noise from the nearby canal lock-gate. The results from this location have been analysed and are presented in the following sections.

In general, the significant noise sources in the area were noted to be local and distant traffic movements, activity in and around the residences, wind generated noise from local foliage and other typical anthropogenic sources typically found in such rural settings.

No significant sources of vibration were noted at any of the survey locations.

13.3.1.1 Location A

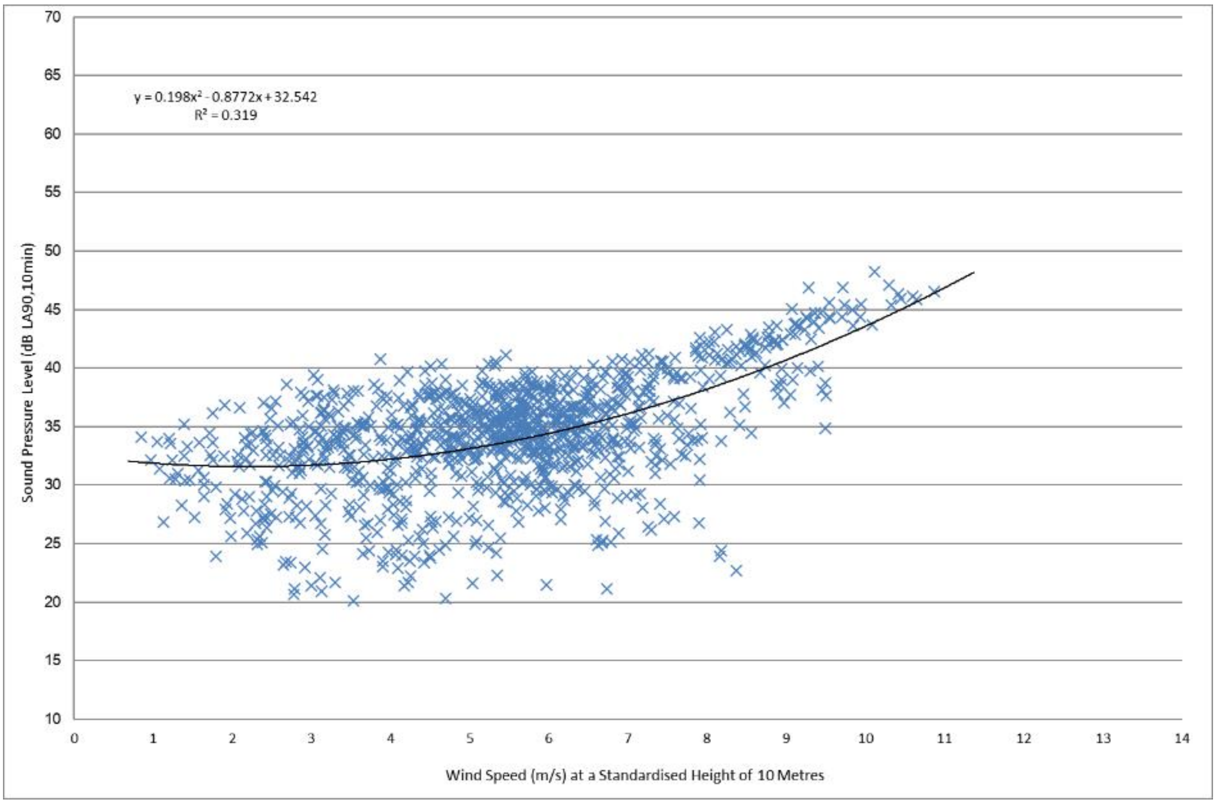


Figure 13.15: Daytime Period - Location A

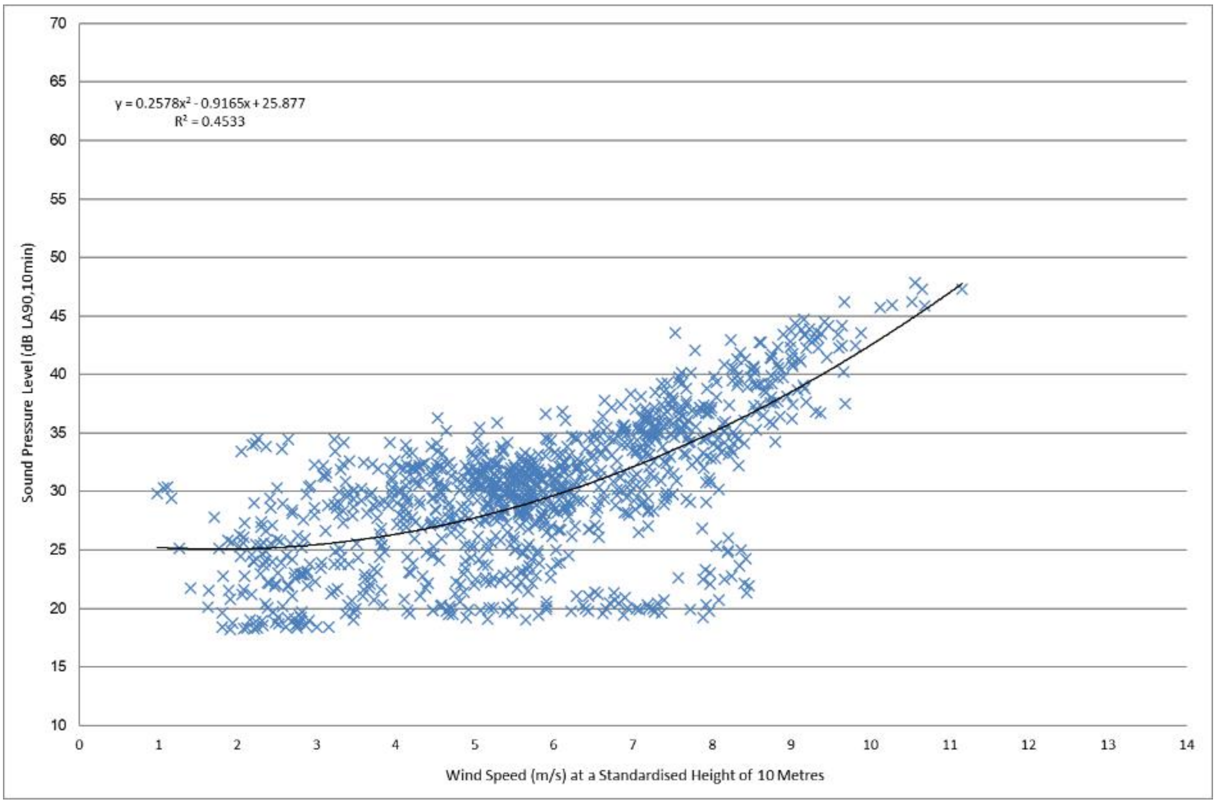


Figure 13.16: Night Period – Location A

13.3.1.2 Location B

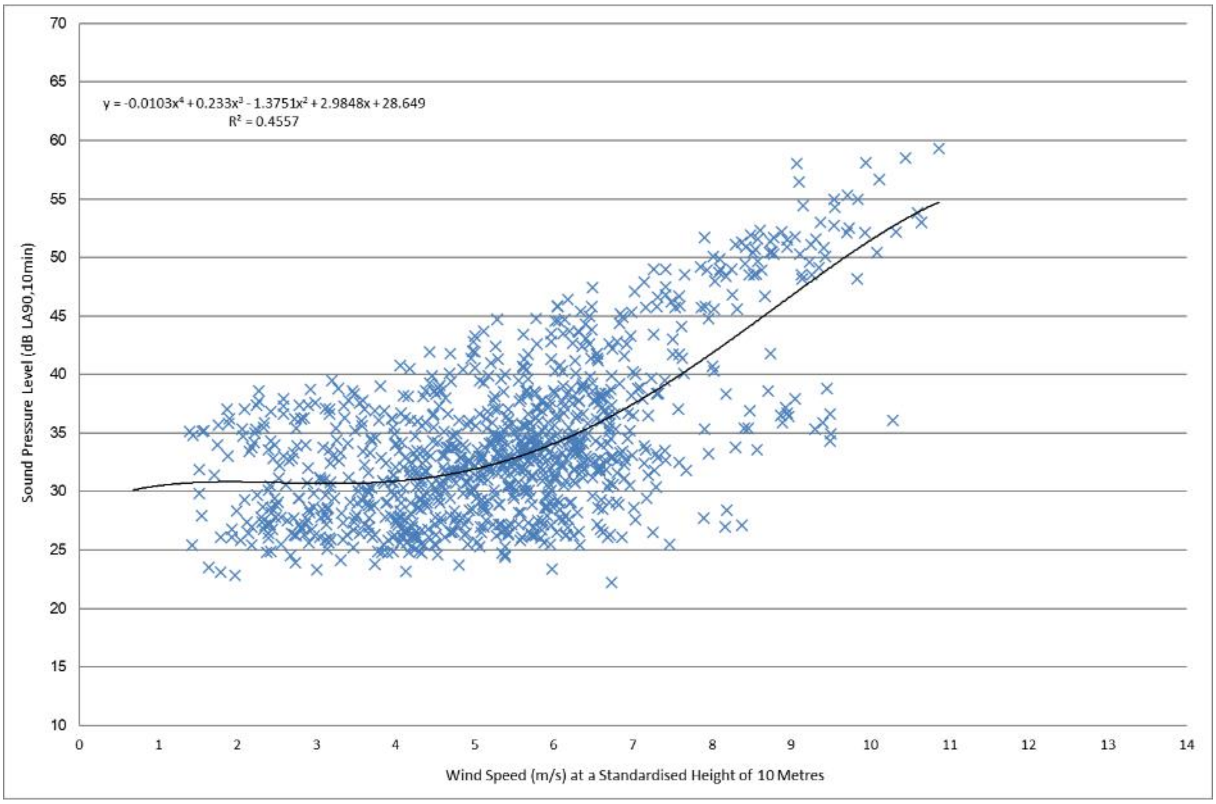


Figure 13.17: Daytime Period – Location B

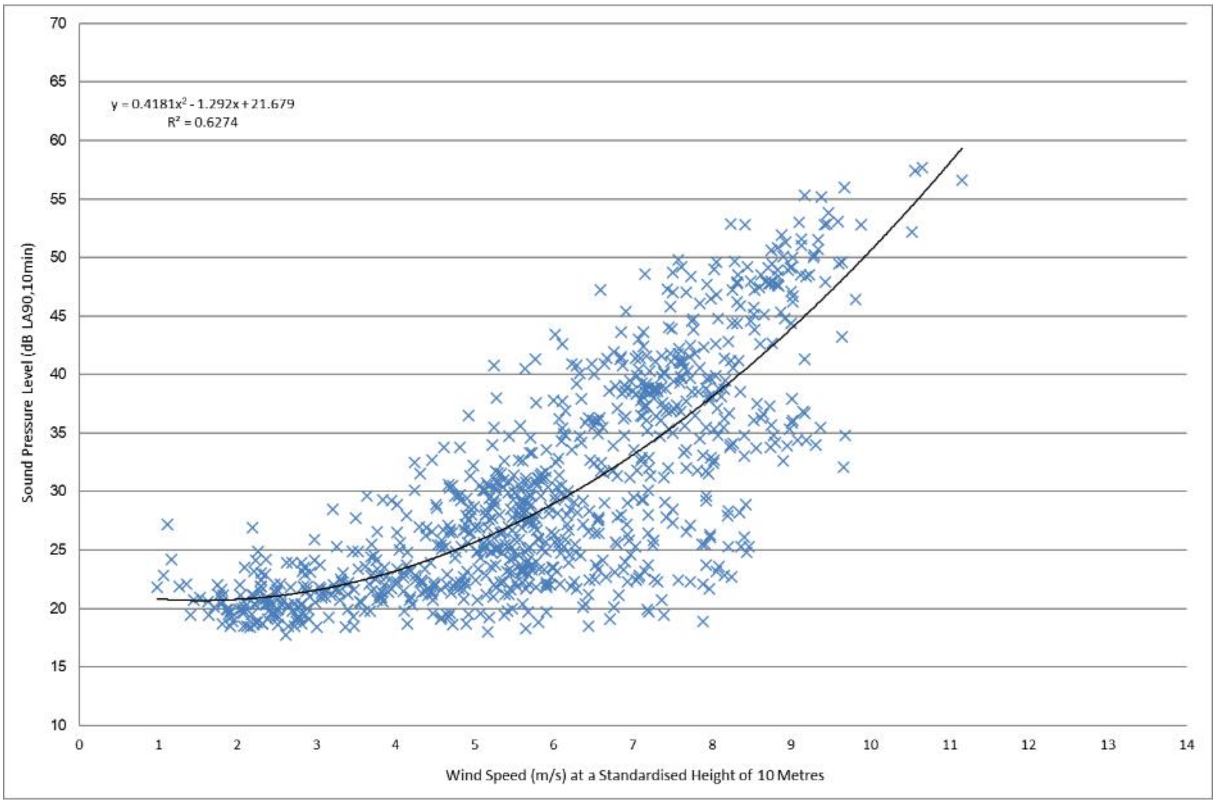


Figure 13.18: Night Period – Location B

13.3.1.3 Location C

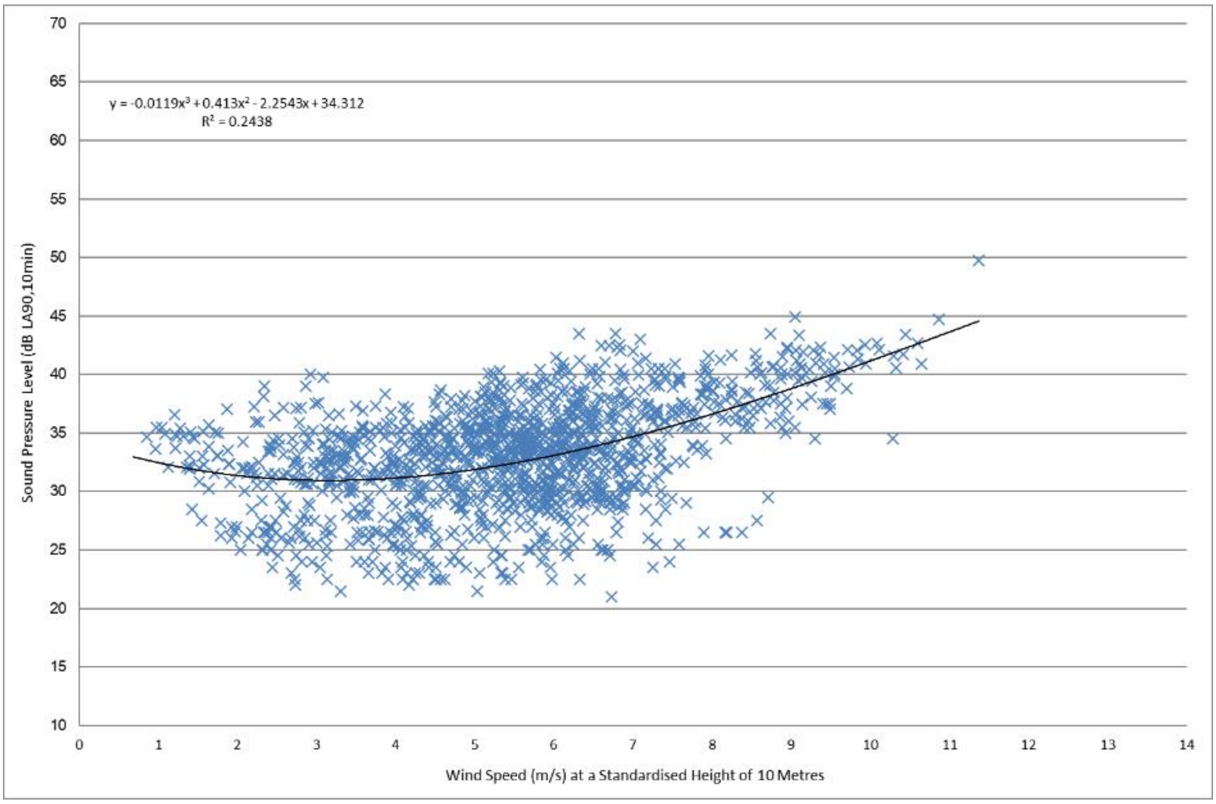


Figure.13.19: Daytime Period – Location C

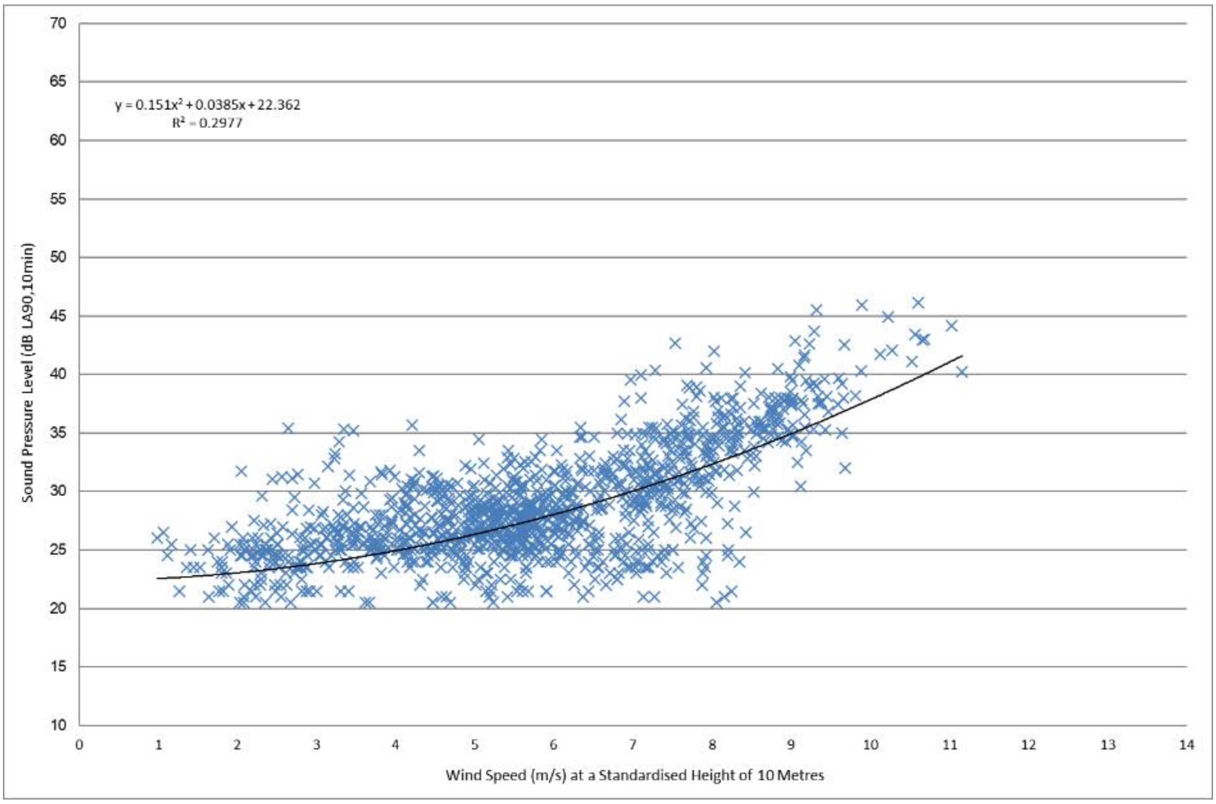


Figure 13.20: Night Period – Location C

13.3.1.4 Location E

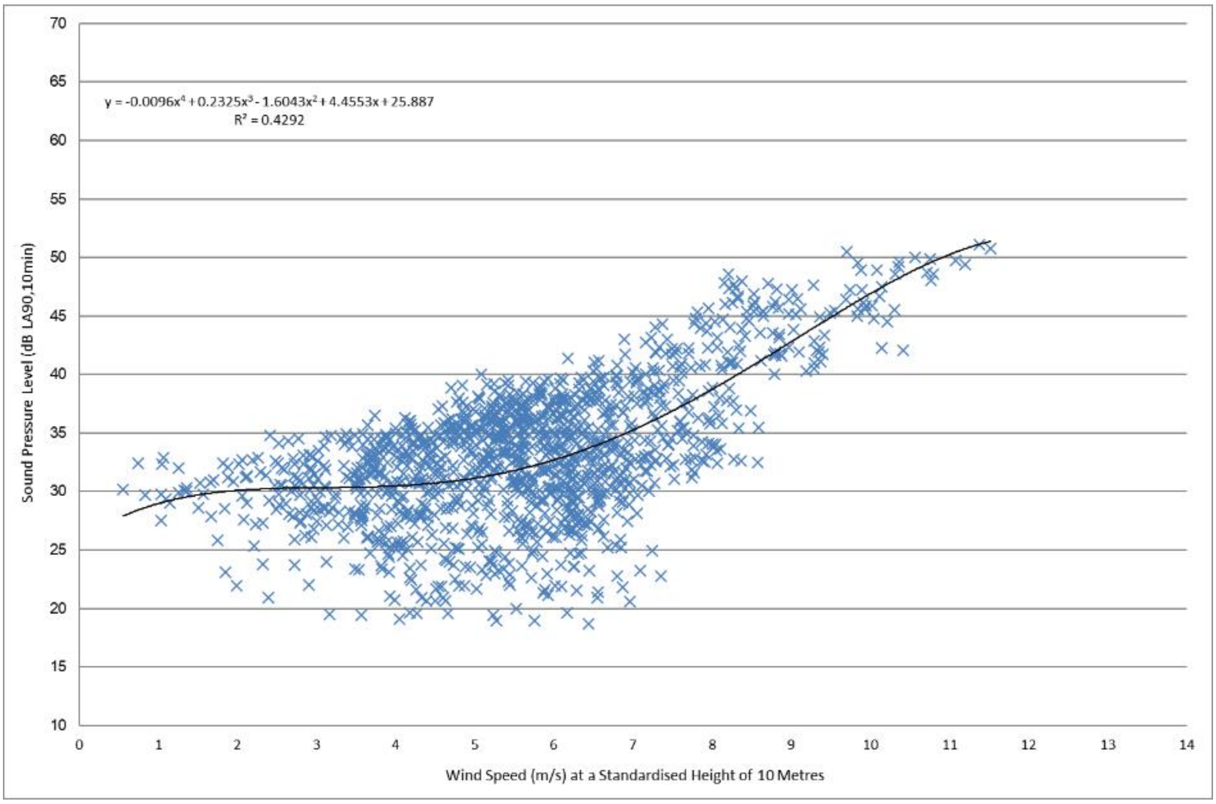


Figure 13.21: Daytime Period – Location E

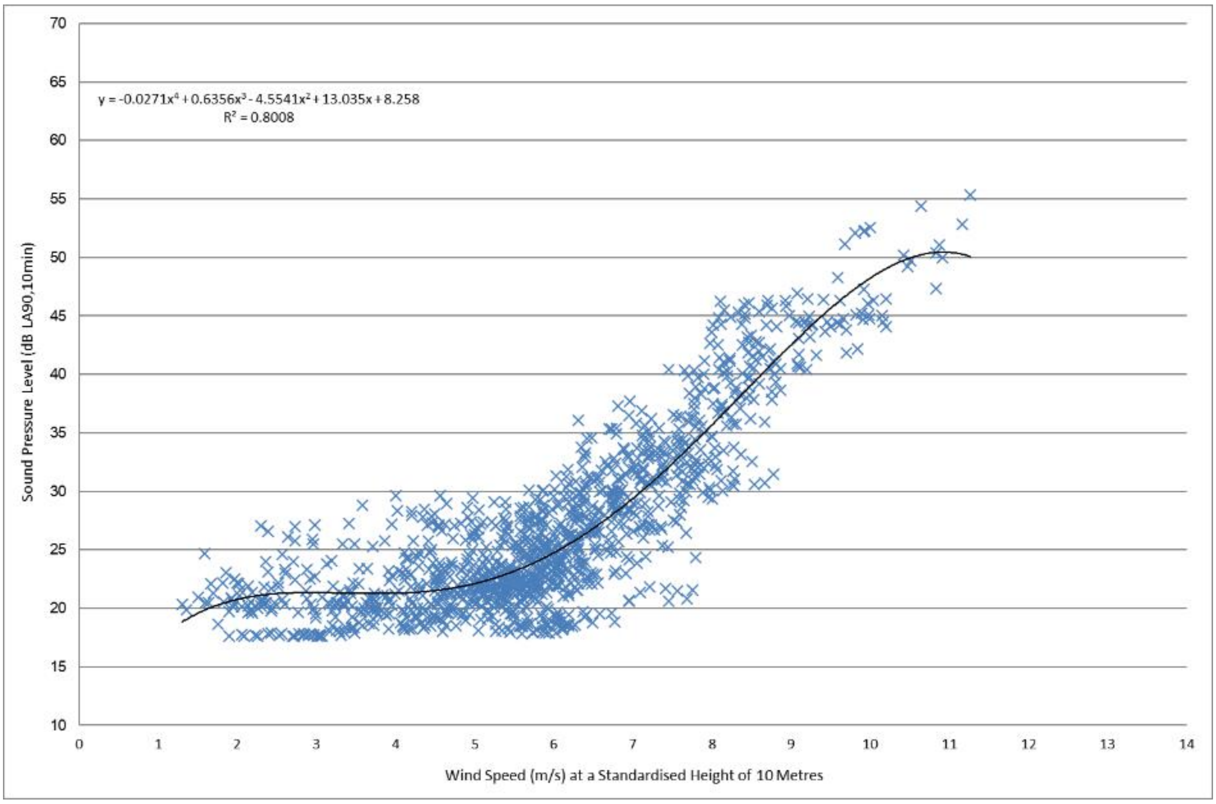


Figure 13.22: Night Period - Location E

13.3.1.5 Location F

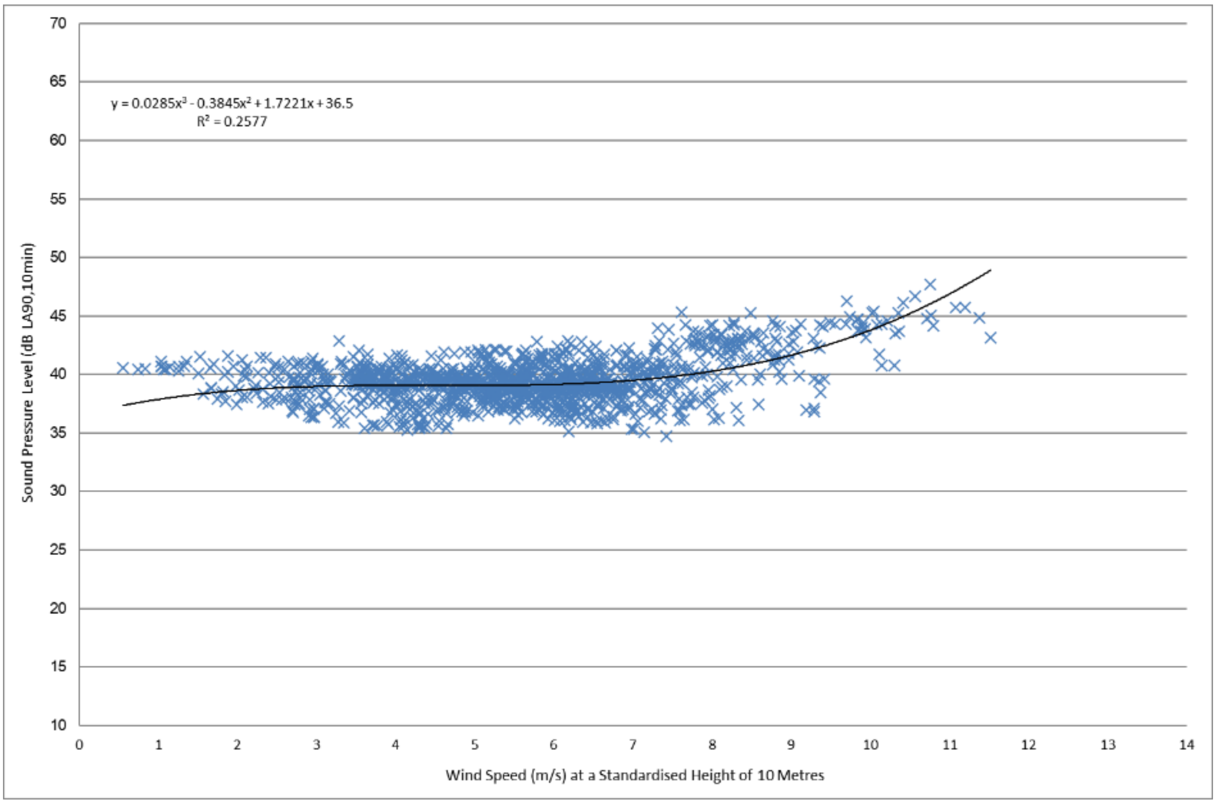


Figure 13.23: Daytime Period - Location F

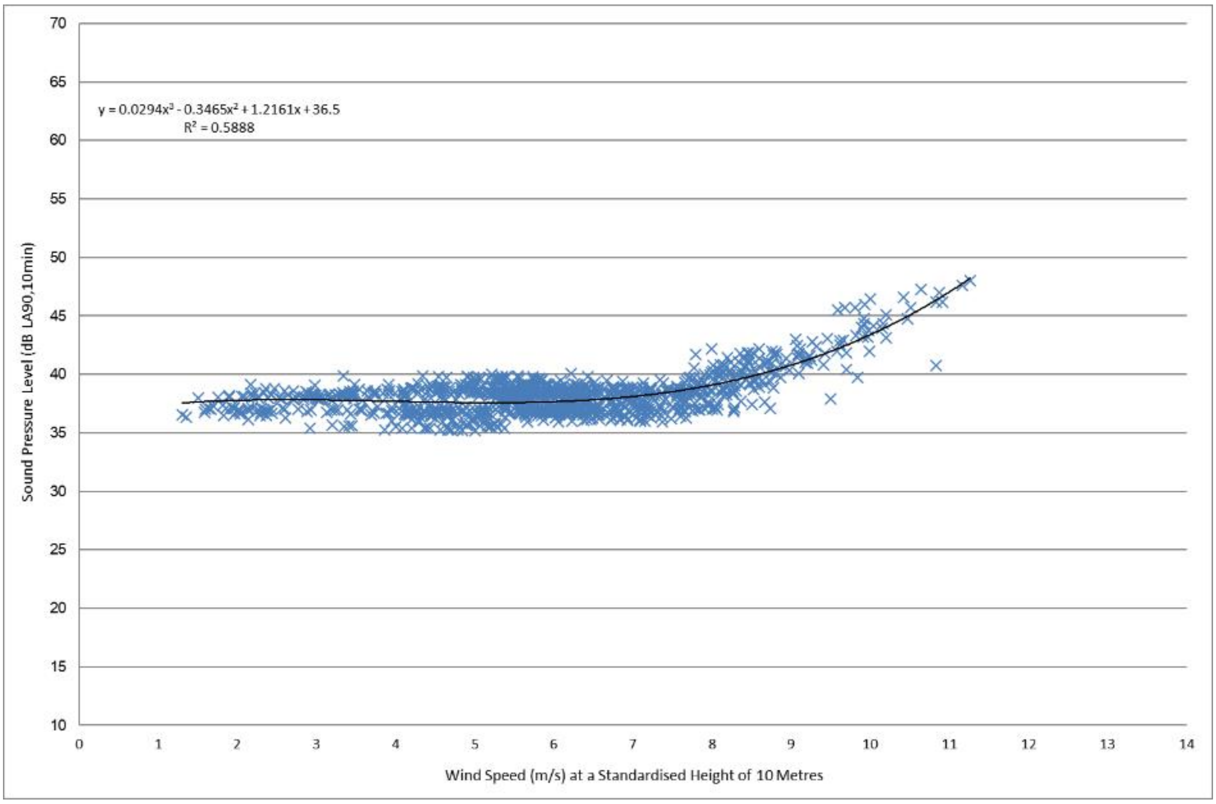


Figure 13.24: Night Period – Location F

13.3.1.6 Location G

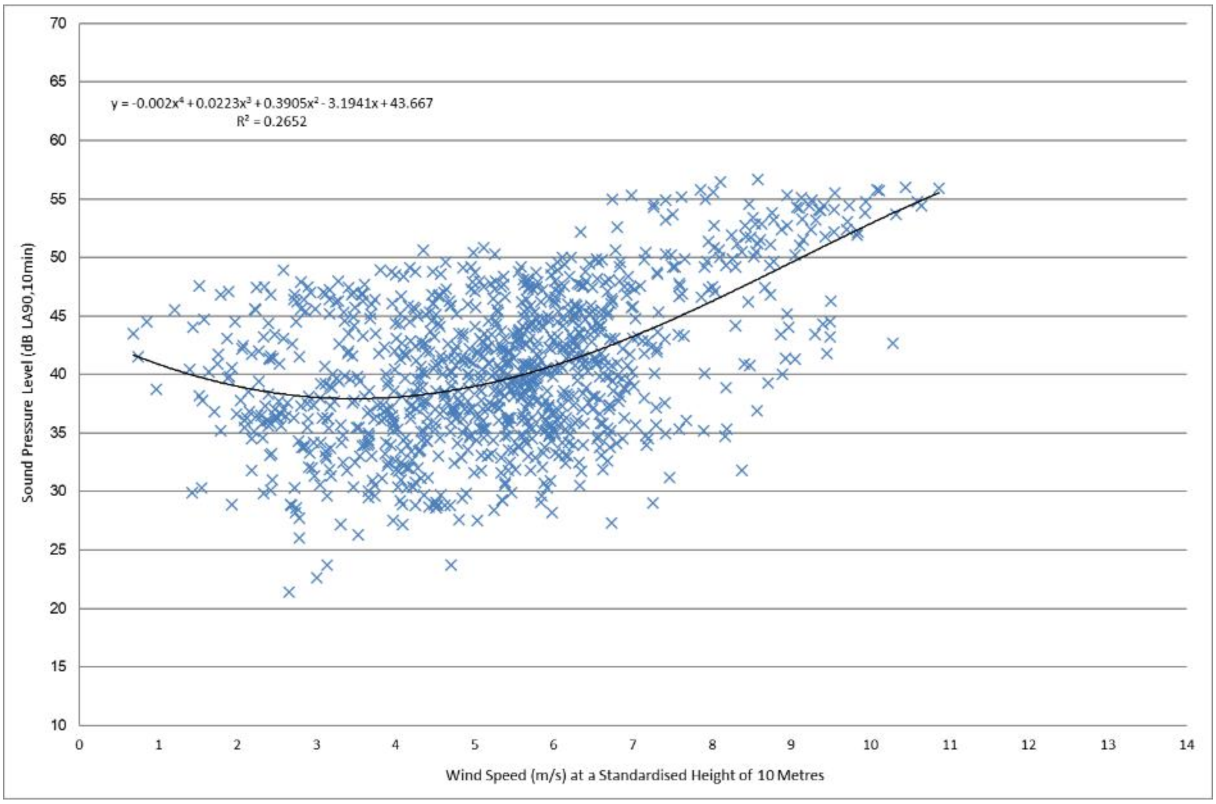


Figure 13.25: Daytime Period – Location G

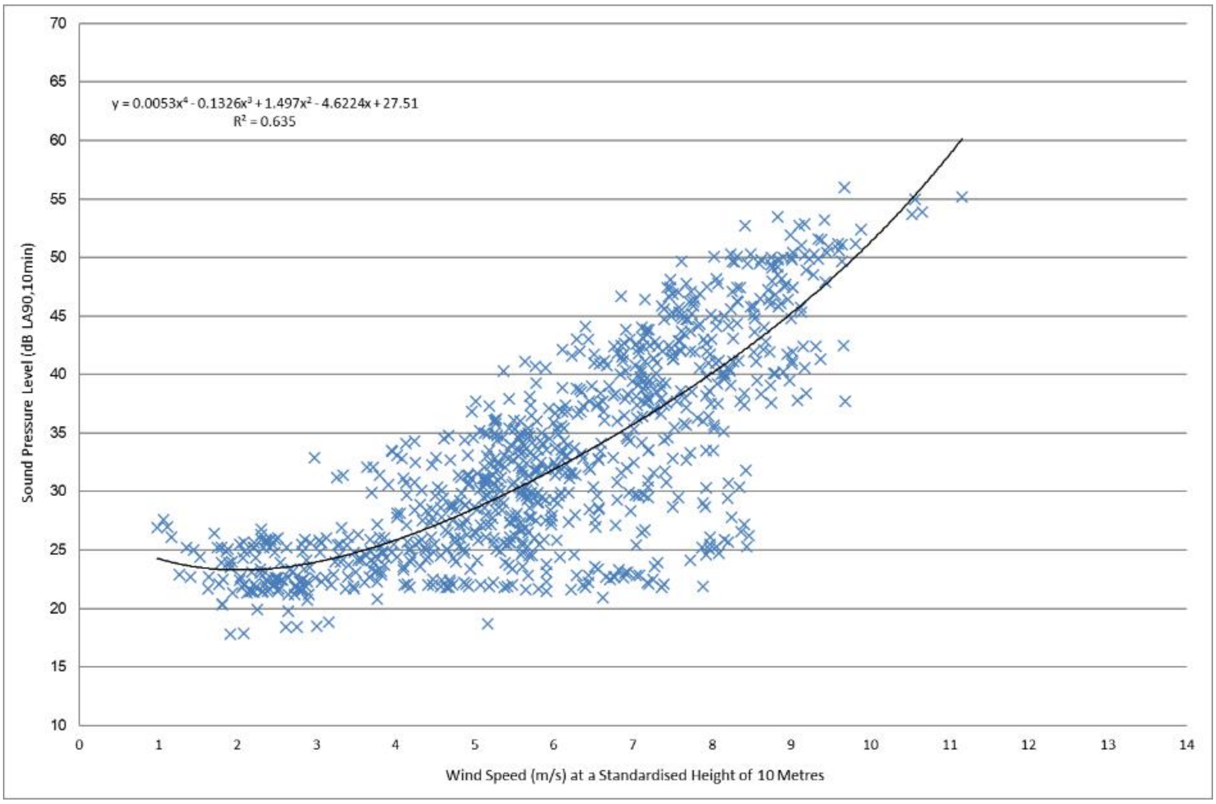


Figure 13.26: Night Period – Location G

13.3.1.7 Location H

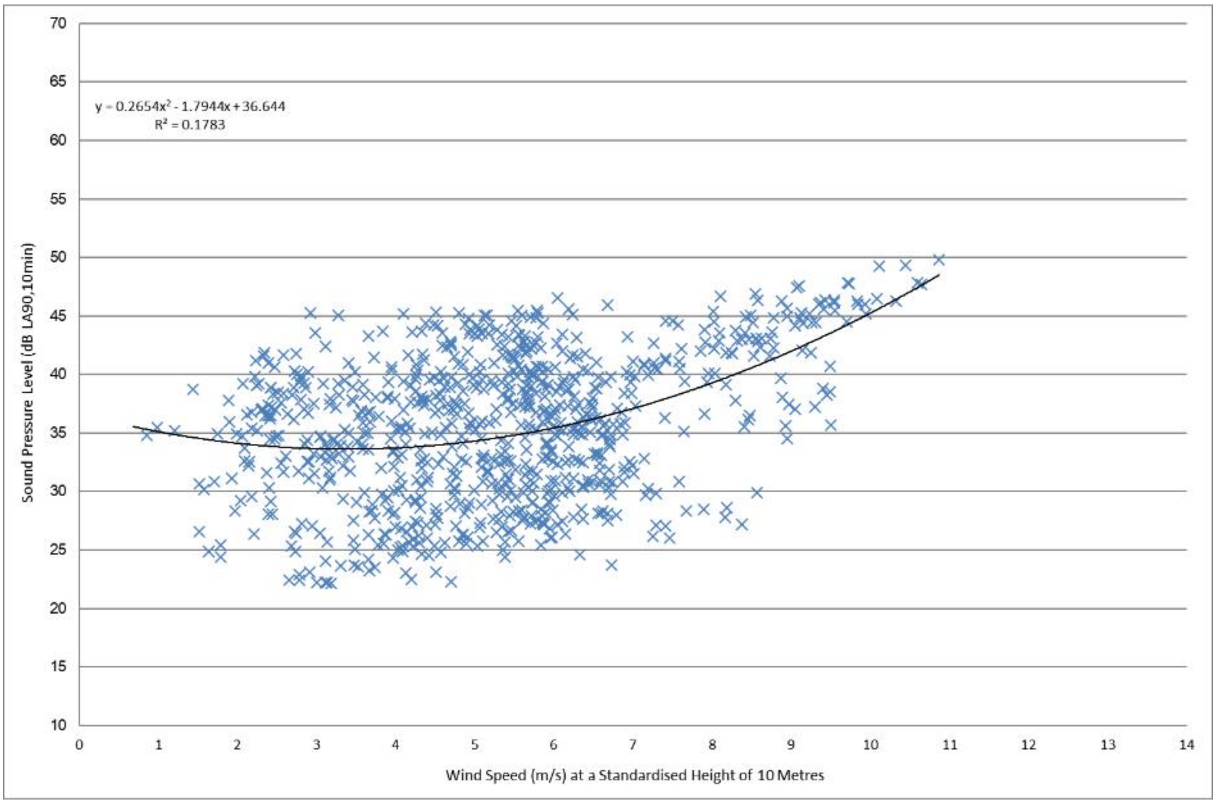


Figure 13.27: Daytime Period – Location H

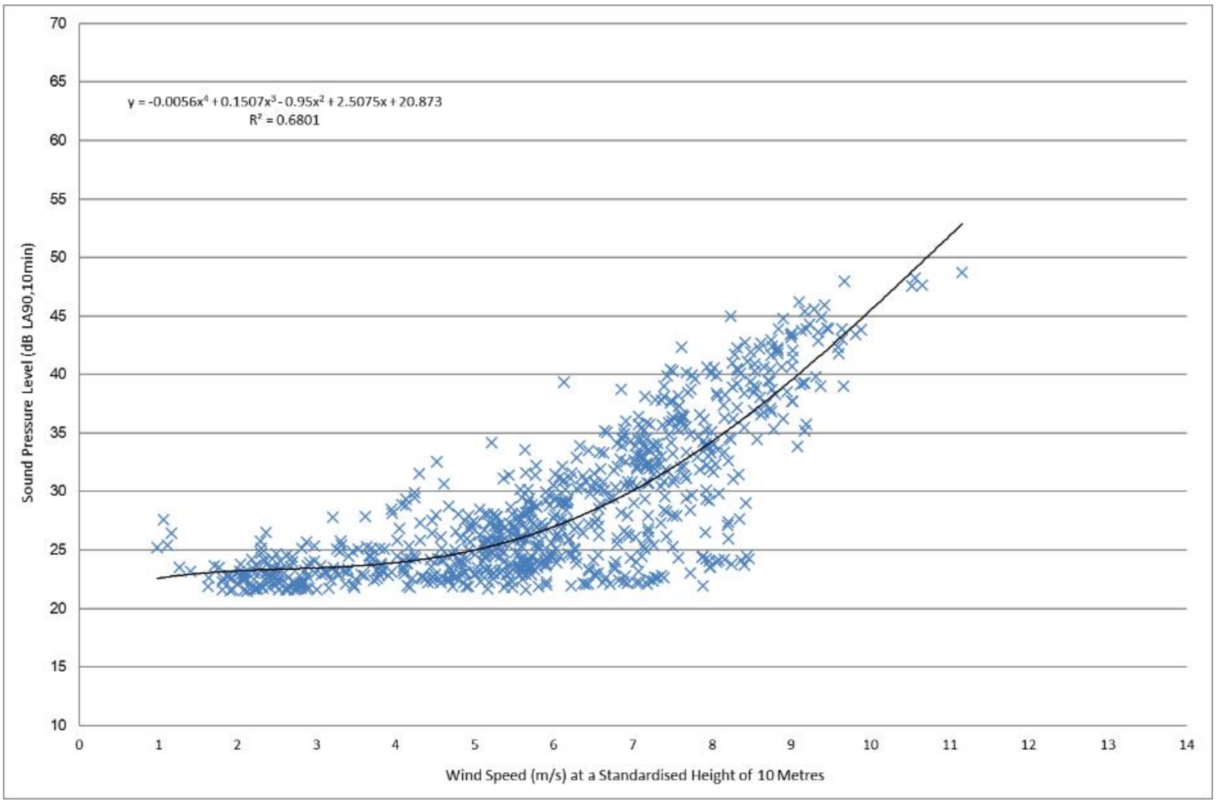


Figure.13.28: Night Period - Location H

13.3.1.8 Location I

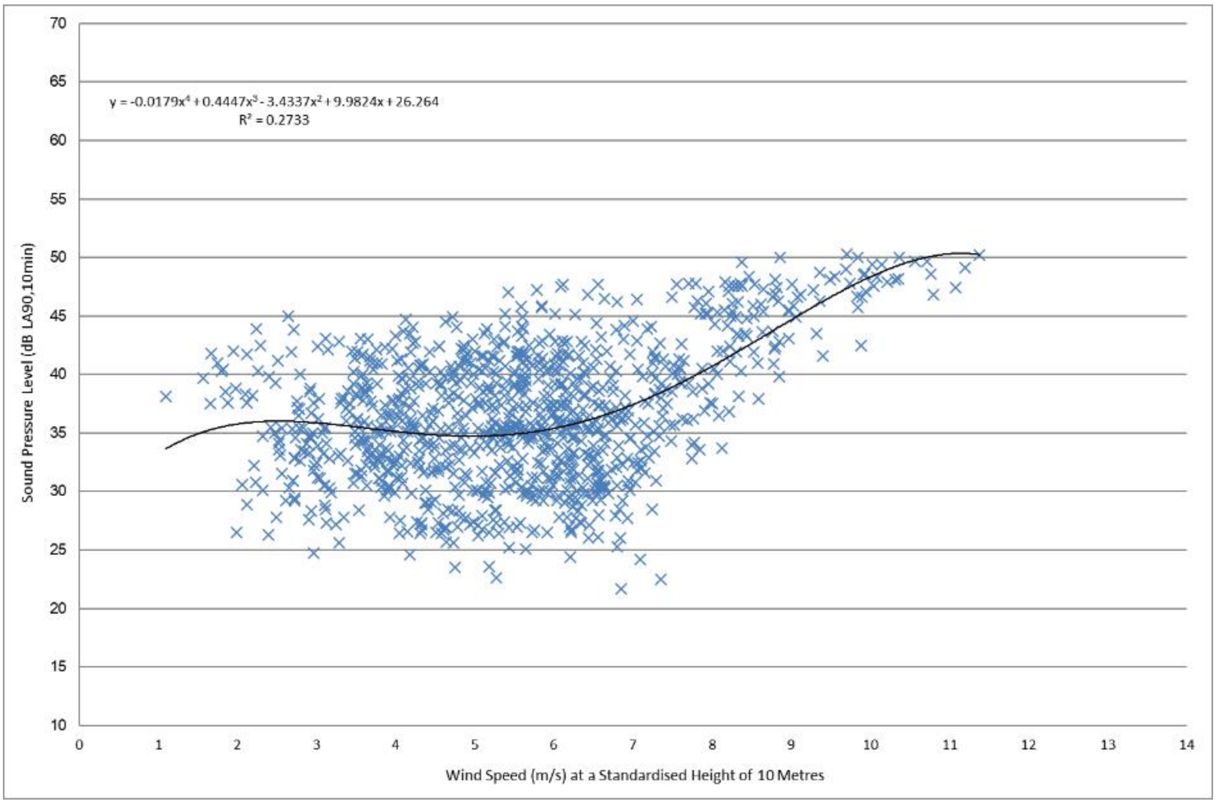


Figure 13.29: Daytime Period – Location I

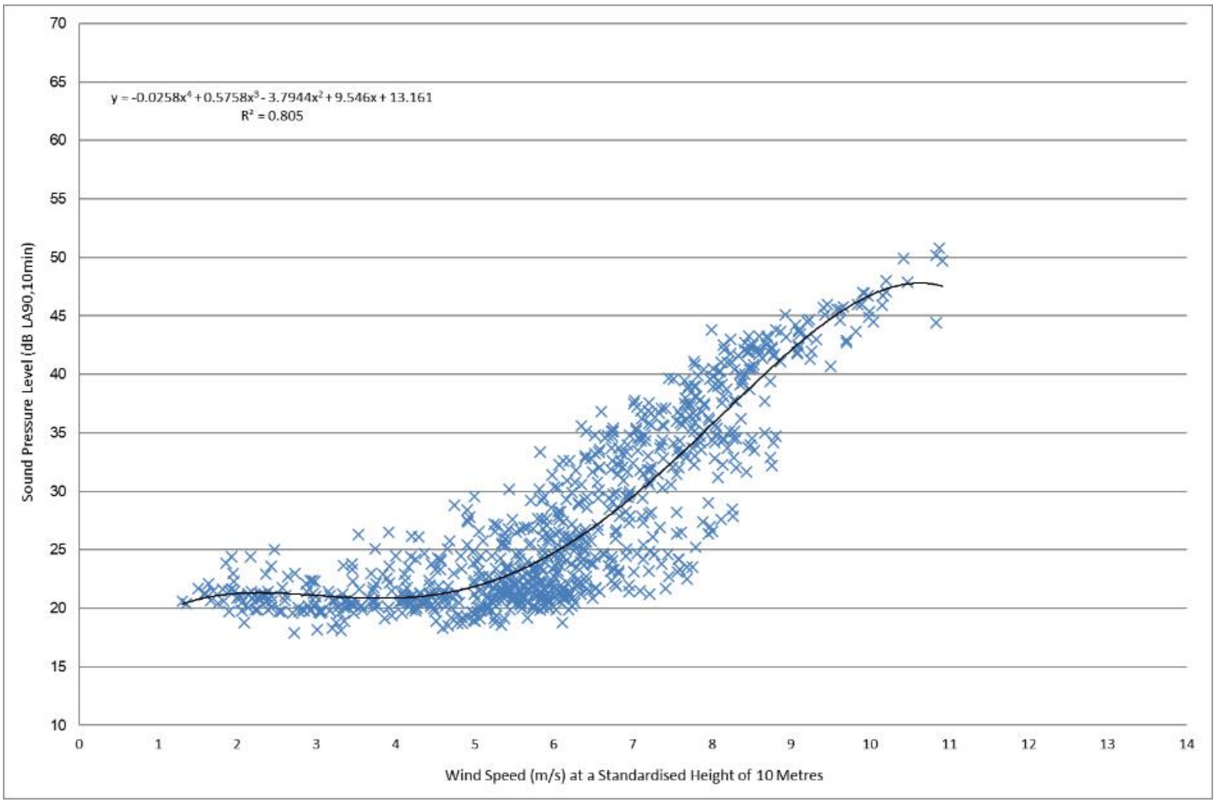


Figure 13.30: Night Period – Location I

13.3.1.9 Location J

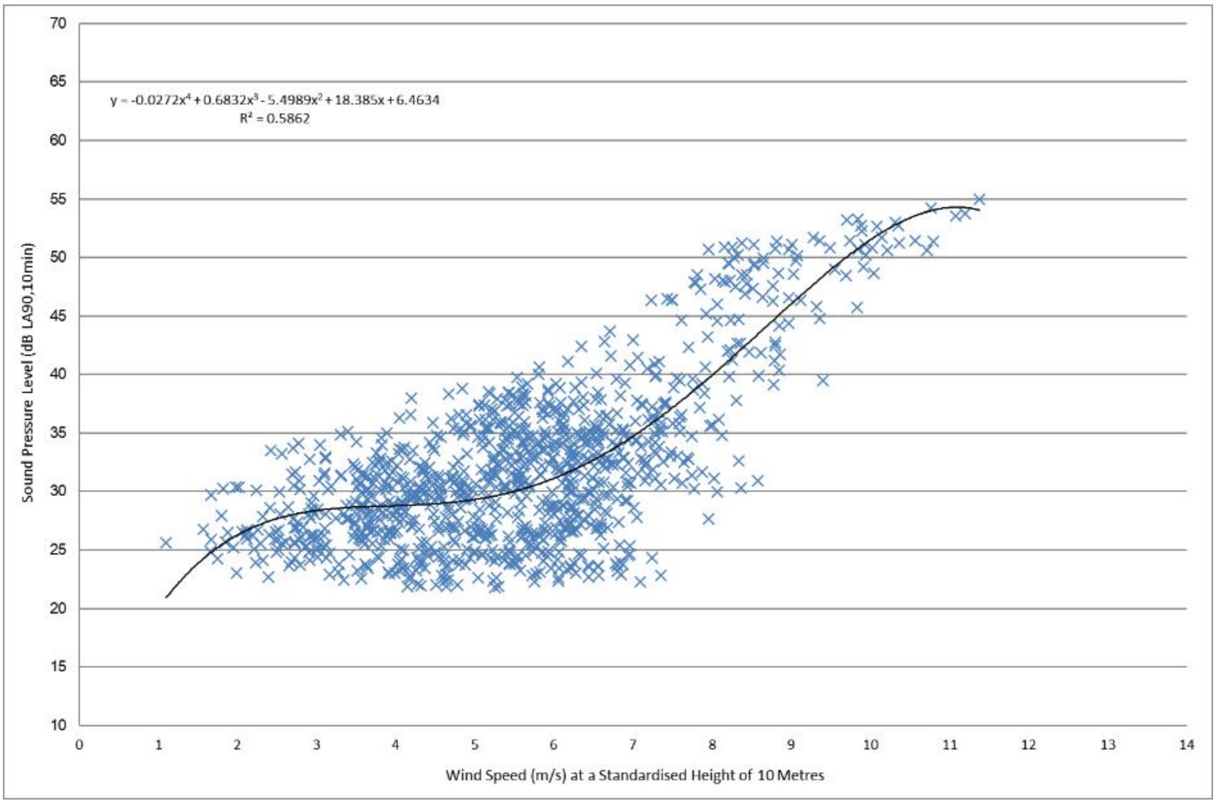


Figure 13.31: Daytime Period – Location J

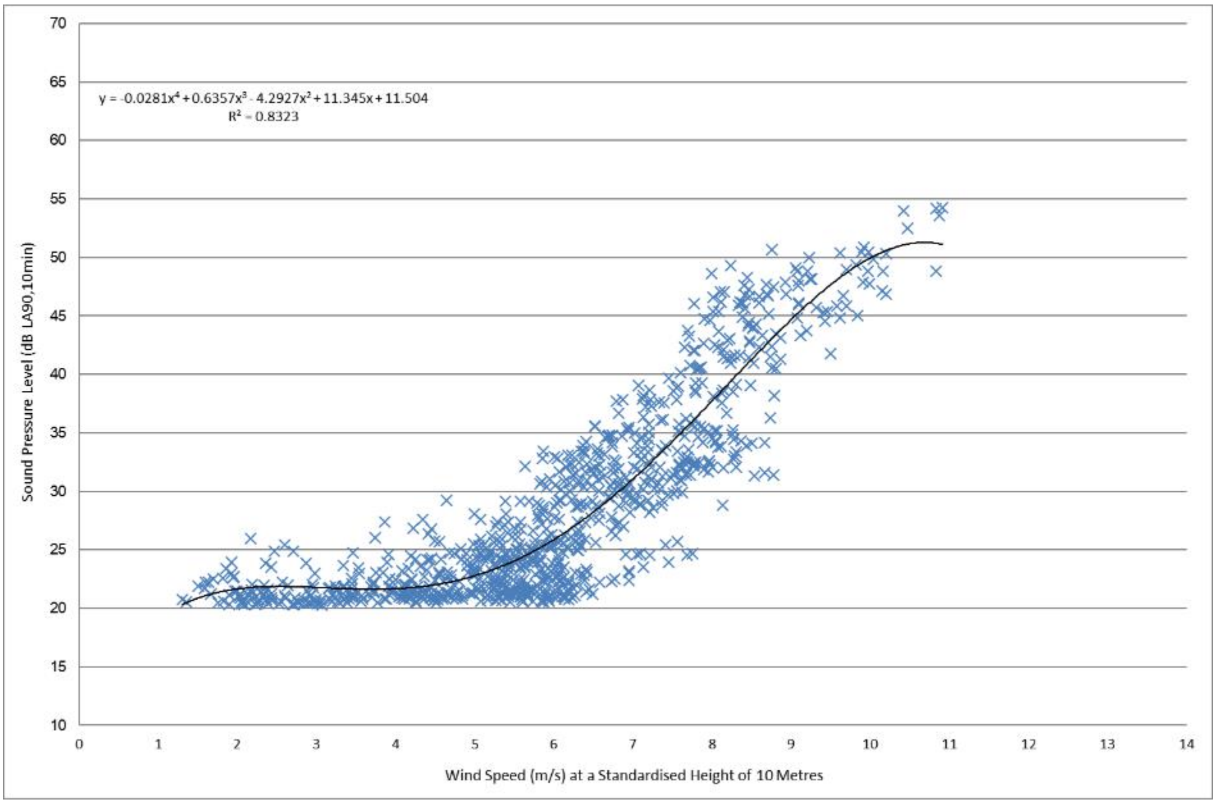


Figure 13.32: Night Period – Location J

13.3.1.10 Impact of Slieve Bawn Wind Farm on the Background Survey

It has been confirmed that the Slieve Bawn wind farm development, located approximately 6kms northwest of Lanesborough became operational on 31 March 2017.

Section 2.2 of the IoA GPG states that, "*Any contribution to background noise levels of noise from an existing wind farm must be excluded when assigning background noise and setting noise limits for a new development.*"

Methods to account for the contribution of existing turbine noise on the background noise survey are provided in Section 5.2.3 of the IoA GPG and include accounting for the contribution of the existing wind farm in the measurement data e.g. directional filtering (only including background data when it is not influenced by the existing turbines e.g. upwind of the receptor, or subtracting a prediction of noise from the existing wind farm from the measured noise levels.

Review of the background noise data for the period when the Slieve Bawn Wind Farm was operational confirmed that the wind direction over the period was southerly and therefore minimising the contribution of the turbine noise emissions at background noise survey locations. Furthermore, the worst-case predicted (omni-directional propagation and rated power i.e. highest noise emissions) impact from the Slieve Bawn wind farm at the nearest background measurement location is predicted to 18 dB $L_{AF90.}$ This level is significantly lower than the measured background noise levels at the relevant wind speeds. It is therefore confirmed that the operation of the Slieve Bawn wind farm did not impact on the background noise surveys undertaken for this assessment.

13.3.1.11 Summary

Table 13.12 presents the various derived $L_{A90,10min}$ noise levels for each of the monitoring locations for daytime quiet periods and night time periods. These levels have been derived using regression analysis carried out on the data sets in line with best practice guidance contained the IoA GPG and its SGN No. 2 *Data Collection.*

Table 13.12: Derived Levels of $L_{A90,10\text{-}min}$ for Various Wind Speeds

Location	Period	Derived $L_{A90,\ 10\text{-}min}$ Levels (dB) at Various Standardised 10m Height Wind Speeds						
		4	5	6	7	8	9	10
A (H482)	Day	32.2	33.1	34.4	36.1	38.2	40.6	43.3
	Night	26.3	27.7	29.7	32.1	35.0	38.5	42.5
B (H515)	Day	30.9	31.9	34.0	37.4	41.6	46.4	51.0
	Night	23.2	25.7	29.0	33.1	38.1	43.9	50.6
C (H544)	Day	31.1	31.9	33.1	34.7	36.6	38.8	41.2
	Night	24.9	26.3	28.0	30.0	32.3	34.9	37.8
E (H306)	Day	30.5	31.1	32.6	35.2	38.6	42.5	46.5
	Night	21.3	22.1	24.7	29.3	35.5	42.2	47.8
F (H428)	Day	39.1	39.1	39.1	39.5	40.3	41.6	43.8
	Night	37.7	37.6	37.7	38.1	39.1	40.8	43.4
G (H552)	Day	38.1	39.0	40.8	43.3	46.3	49.7	53.1
	Night	25.8	28.6	31.9	35.7	40.2	45.3	51.4
H (H231)	Day	33.7	34.3	35.4	37.1	39.3	42.0	45.2
	Night	23.8	25.0	27.0	30.1	34.3	39.4	45.1
I (H774)	Day	34.7	34.7	35.4	37.4	40.7	44.7	48.4
	Night	20.9	21.9	24.8	29.6	35.8	42.2	47.0
J (H768)	Day	28.8	29.3	31.1	34.7	40.0	46.1	51.6
	Night	21.7	22.8	25.9	31.2	37.9	45.0	50.4
Envelope	Day	28.8	29.3	31.1	34.7	36.6	38.8	41.2
	Night	20.9	21.9	24.7	29.3	32.3	34.9	37.8

A worst-case envelope based on the lowest average levels at the various wind speeds for both day and night time is also presented in Table 13.12. Therefore, the noise criteria curves for this assessment will be based on this baseline noise level envelope. This is considered a worst-case approach to this aspect of the assessment.

13.4 POTENTIAL IMPACTS

13.4.1 Do Nothing Effects

If the development is not progressed the existing noise environment will remain largely unchanged. Traffic noise is currently a significant noise source in the vicinity of some road networks in the area. In the absence of the proposed development increases in traffic volumes on the local road network would be expected over time and would likely result in slight increases in the overall ambient and background noise levels in the area.

13.4.2 Potential Effects - Construction Phase

Construction noise prediction calculations have been conducted using the methodology outlined in Section 13.2.3.4.The noise levels referred to in this section are indicative only and are intended to demonstrate that it will be possible for the contractor to comply with current best practice guidance. The predicted “worst case” levels are expected to occur for only short periods of time at a very limited number of properties. Construction noise levels will be lower than these levels for most of the time at most properties in the vicinity of the proposed development.

13.4.2.1 General Construction – Turbines and Hardstandings

13.4.2.1.1 Noise

A number of noise sources that would be expected on a construction site of this nature have been identified and predictions of the potential noise emissions calculated at the closest sensitive receptor. In this instance the closest sensitive receptor is Location H832, which is situated approximately 760m from proposed turbine T13.

Table 13.13: Typical Wind Farm Turbine Construction Noise Emission Levels

Item (BS 5228 Ref.)	Activity/Notes	Plant Noise level at 10m Distance (dB $L_{Aeq,T}$)[163]	Predicted Noise Level at 760 m (dB $L_{Aeq,T}$)
HGV Movement (C.2.30)	Removing spoil and transporting fill and other materials.	79	32
Tracked Excavator (C.4.64)	Removing soil and rubble in preparation for foundation.	77	30
Piling Operations (C.12.14)	Standard pile driving.	88	41
General Construction (Various)	All general activities plus deliveries of materials and plant	84	37
Dewatering Pumps (D.7.70)	If required.	80	33

[163] All plant noise levels are derived from BS5228: Part 1

Item (BS 5228 Ref.)	Activity/Notes	Plant Noise level at 10m Distance (dB $L_{Aeq,T}$)[163]	Predicted Noise Level at 760 m (dB $L_{Aeq,T}$)
JCB (D.8.13)	For services, drainage and landscaping.	82	35
Vibrating Rollers (D.8.29)	Road surfacing.	77	30
Total		--	44

At the nearest noise sensitive location, the predicted noise levels from construction activities are in the range of 35 to 41 dB $L_{Aeq,T}$ with a total worst-case construction level of the order of 44 dB $L_{Aeq,T}$. In all instances the predicted noise levels at the nearest NSL's are below the appropriate criteria outlined in Table 13.1 (Category A - 65 dB $L_{Aeq,T}$ during daytime periods).

This assessment is considered representative of worst-case and construction noise levels will be lower at properties located further than 760 m from the works.

There are no items of plant that would be expected to give rise to noise levels that would be considered out of the ordinary or in exceedance of the levels outlined in Table 13.1 and this finding is valid should all items of plant operate simultaneously.

13.4.2.1.2 Vibration

Due to the distance of the proposed works from sensitive locations significant vibration effects are not expected.

13.4.2.1.3 Description of Effects

With respect to the EPA's criteria for description of effects, the potential worst-case associated effects at the nearest noise sensitive locations associated with this aspect of the construction phase are described below.

Quality	*Significance*	*Duration*
Negative	Slight	Short-term

The above effects should be considered in terms that the effect is variable and that this assessment considers the locations of the greatest potential impact.

13.4.2.2 Construction of Internal Roads

It is proposed to construct new internal roads and temporary roads to access selected borrow pit areas as part of the development. Review of the road layout has identified that the nearest NSL to any point along the proposed roads is 120m to location H451(203030E, 269432N). All other locations are at greater distances with the majority at significantly greater distances. The full description of the new roads is outlined in Chapter 2 of the EIAR.

13.4.2.2.1 Noise

Table 13.14 outlines the typical construction noise levels associated with the proposed works for this element of the construction. Calculations have assumed an on time 66% for each item of plant i.e. 8-hours over a 12 hours assessment period.

Table 13.14: Indicative Noise Levels from Construction Plant at Various Distances from the New Internal Road Works

Item (BS 5228 Ref.)	Plant Noise level at 10m Distance (dB $L_{Aeq,T}$)[164]	Highest Predicted Noise Level at Stated Distance from Edge of Works(dB $L_{Aeq,T}$)			
		120 m	200 m	300 m	400 m
HGV (C.2.30)	79	50	44	40	37
Mini Tracked Excavator with Rock Breaker (C5.2)	83	54	48	44	41
Vibration Rollers (D.8.29)	77	48	42	38	35
Total	--	56	51	46	43

At the nearest noise sensitive location, the predicted noise levels from construction activities are of the order of 56 dB $L_{Aeq,T}$. In all instances the predicted noise levels at the nearest NSL's are below the appropriate criteria outlined in Table 13.1 (Category A - 65 dB $L_{Aeq,T}$ during daytime periods). As these works will progress along the route the worst-case predicted impacts will reduce. It is envisioned that they would be at the closest position to the nearest NSL for no more than 2 to 3 days.

13.4.2.2.2 Vibration

Due to the distance of the proposed works from sensitive locations significant vibration effects are not expected.

164 All plant noise levels are derived from BS5228: Part 1

13.4.2.2.3 <u>Description of Effects</u>

With respect to the EPA's criteria for description of effects, the potential worst-case associated effects at the nearest noise sensitive locations associated with this aspect of the construction phase are described below.

Quality	*Significance*	*Duration*
Negative	Slight	Temporary

The above effects should be considered in terms that the effect is variable and that this assessment considers the locations of the greatest potential impact.

13.4.2.3 Borrow Pits

To inform this aspect, a comparative noise assessment has been prepared and is outlined in the following paragraphs. Two situations for breaking out material in potential borrow pit locations are proposed and have been considered as follows:

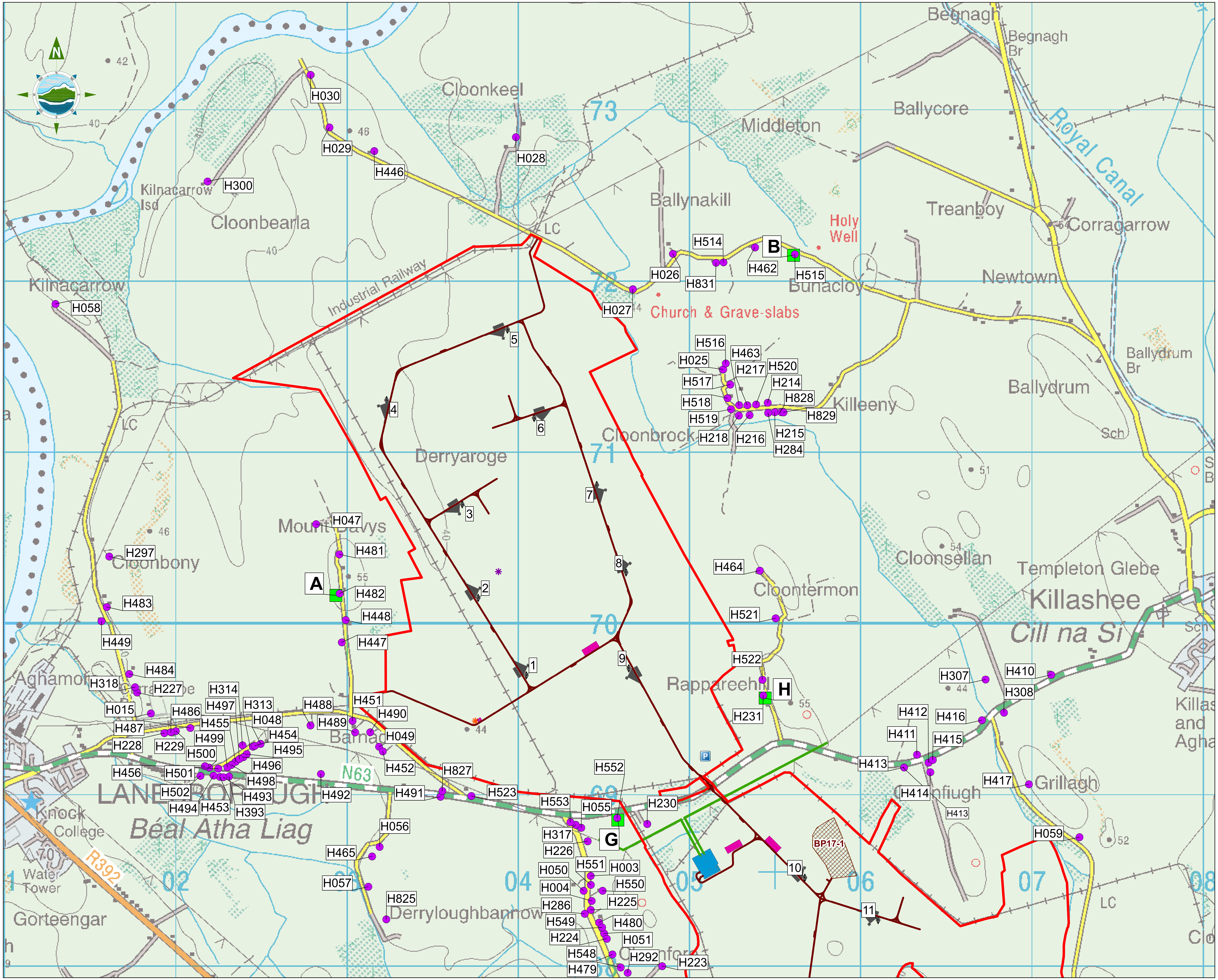
- Scenario A: Blasting operations
- Scenario B: Rock breaking operations

In terms of these activities please note the following:

- A mobile crusher will operate on site for both options.
- In Scenario B at least one rock breaker will be in use on site during daytime periods for an estimated 18-month period. For the purposes of this assessment we have assumed that two rock breakers will be operated simultaneously.
- The rock breaker will move to various locations on the site. For the purposes of this assessment we have assumed a maximum of two operational borrow pits at any one time from the proposed borrow pit locations as indicated in Table 13.15 and shown in Figure 13.33 A, B and C.
- Table 13.16 outlines the assumed noise levels for the plant items as extracted from *BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise.*
- If the blasting option is undertaken, it is estimated that a number of blasts will be required over a 3 to 4 week period at any one borrow pit location. It is expected that no more than 1 blast event would occur in a single working day.

Table 13.15: Proposed Potential Borrow Pit Locations

Borrow Pit ID	Co-Ordinates (ING)	
	Easting	Northing
BP17-1	205,848	268,690
BP17-3	206,250	266,358
BP17-4	206,320	265,943
BP17-5a	206,841	266,303
BP17-5b	206,929	266,039



Legend

- Planning Application Boundary
- Overhead Line
- Road Layout
- Proposed Substation Hardstand
- Borrow Pit Locations
- Turbine Hardstand
- Temporary Construction Compounds
- Amenity Car Park
- Proposed Turbine Locations
- Proposed Met Mast Locations
- Existing Met Mast Locations
- NSLs in vicinity of application area
- Noise Monitoring Locations

0 100 200 400 600 800

Metres

Issue	Date	Description	By	Chkd.
A	Jan. 2019	Final Issue	MN	ST

Client:

BORD NA MÓNA
Naturally Driven

Project:

DERRYADD WIND FARM

Title:

NOISE SENSITIVE RECEPTORS

Scale @ A1: 1:10,000

Prepared by: M. Nolan | Checked: S. Tinnelly | Date: January 2019

Project Director: D. Grehan

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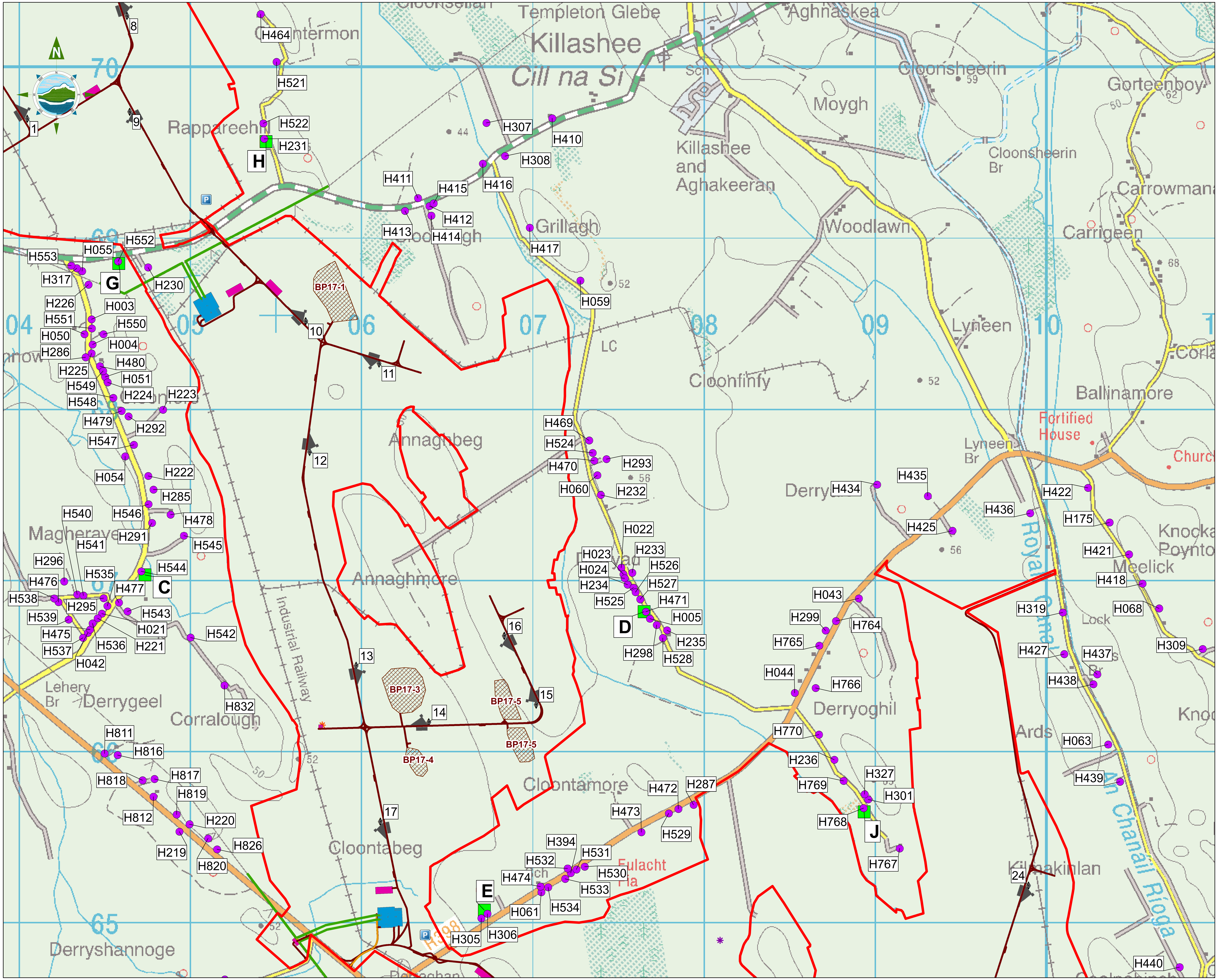
Figure 13.33.A

Issue: A



Legend

- Planning Application Boundary
- Overhead Line
- Road Layout
- UG Cables
- Proposed Substation Hardstand
- Borrow Pit Locations
- Turbine Hardstand
- Temporary Construction Compounds
- Amenity Car Park
- Proposed Turbine Locations
- Proposed Met Mast Locations
- Existing Met Mast Locations
- NSLs in vicinity of application area
- Noise Monitoring Locations

0 100 200 400 600 800
Metres

Issue	Date	Description	By	Chkd.
A	Jan. 2019	Final Issue	MN	ST

Client:
BORD NA MÓNA
Naturally Driven

Project:
DERRYADD WIND FARM

Title:
NOISE SENSITIVE RECEPTORS

Scale @ A1: 1:10,000

Prepared by: M. Nolan
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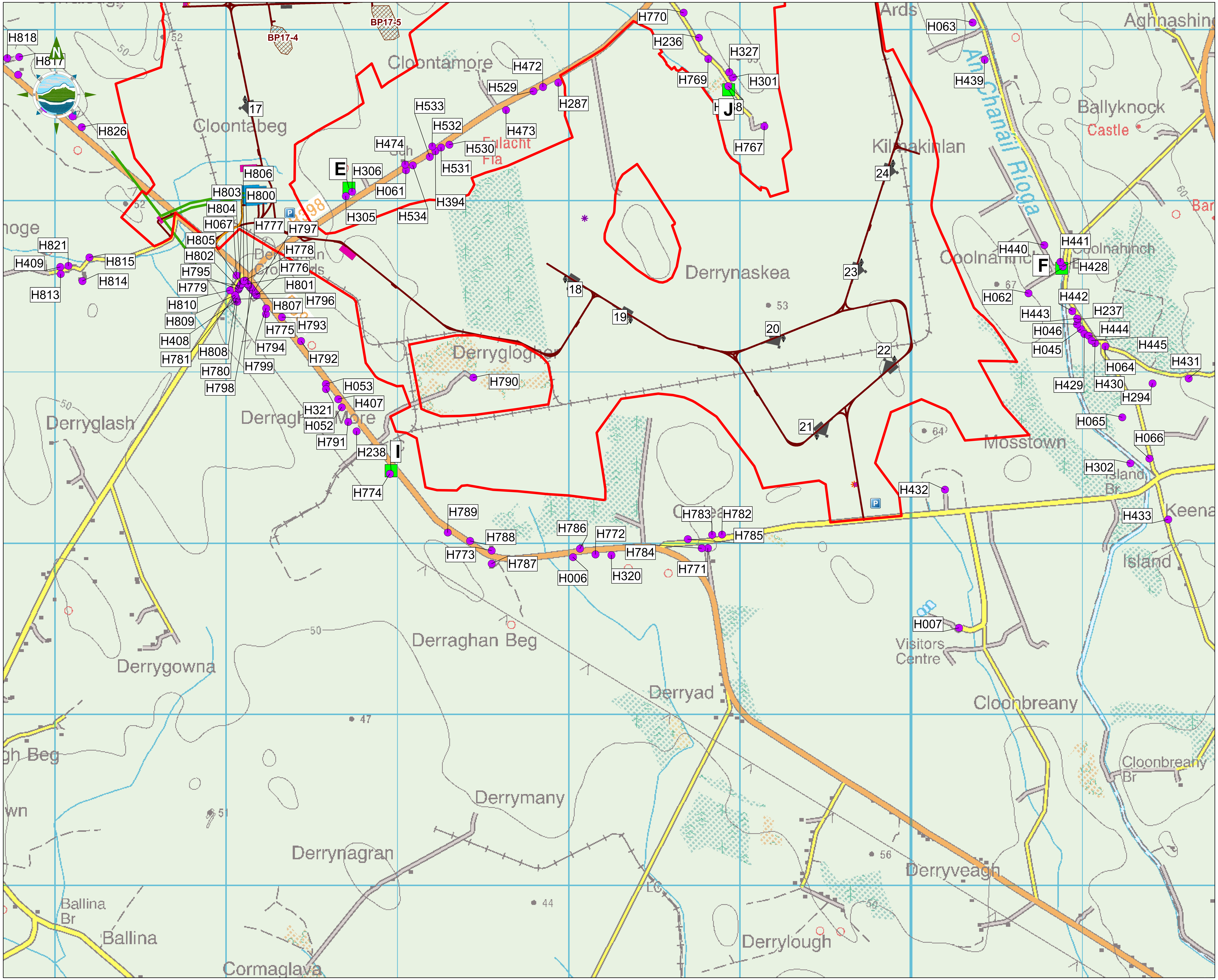
Figure 13.33.B

Issue: A



Legend

- Planning Application Boundary
- Overhead Line
- Road Layout
- UG Cables
- Proposed Substation Hardstand
- Borrow Pit Locations
- Turbine Hardstand
- Temporary Construction Compounds
- Amenity Car Park
- Proposed Turbine Locations
- Proposed Met Mast Locations
- Existing Met Mast Locations
- NSLs in vicinity of application area
- Noise Monitoring Locations

0 100 200 400 600 800

Metres

Issue	Date	Description	By	Chkd.
A	Jan. 2019	Final Issue	MN	ST

Client:

BORD NA MÓNA
Naturally Driven

Project:

DERRYADD WIND FARM

Title:

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Figure 13.33.C

Issue: A

Table 13.16: Typical Borrow Pit Plant Noise Emissions

Item	BS5228 Ref:	dB Lw Levels per Octave Band (Hz)								
		63	125	250	500	1k	2k	4k	8k	dB(A)
Crusher	C1.14	121	114	107	108	103	99	94	87	110
Rock Breaker	C9.11	119	117	113	117	115	115	112	108	121

A noise model has been prepared to consider the expected noise emissions from the proposed Borrow Pit works for the two scenarios outlined above. A percentage on-time of 66% has been assumed for the noise calculations. The worst-case predicted noise levels from operation of all combinations of borrow pits are detailed in Table 13.17 at the NSL with the greatest potential impact for this aspect of the construction phase. This scenario is based on operation of Borrow Pit BP17-1 regardless of which other Borrow pits operates simultaneously the contribution from BP17-1 is dominant at the nearest NSL's. The nearest NSL is H413 and is located approximately 500m from BP17-1.

Table 13.17: Comparison of Proposed Borrow Pit Operation Noise Levels

Location	Worst-case Predicted Noise Level from Borrow Pit Operation, dB(A)		Difference, dB(A)
	Scenario A	Scenario B	
H413	36	47	-11

Review of the predicted noise data confirms the following:

- The worst-case predicted noise levels for both Scenario A and B are well within the best practice construction noise criteria outlined in Table 13.1. It is assumed that construction works at the borrow pits will only occur during weekday daytime periods only (07:00 to 19:00hrs).
- The blasting proposal results in lower levels of construction noise since the use of the rock breaking plant is not required in this instance. Predicted noise levels are lower at all assessed locations for Scenario A.
- It is accepted that the individual blast events will be audible at some locations. Blast events will be designed and controlled such that the best practice noise and vibration limit values outlined in the mitigation section of this chapter are not exceeded.

13.4.2.3.1 Description of Effects

With respect to the EPA's criteria for description of effects, the potential worst-case associated effects at the nearest NSL associated with Borrow Pit activity during the construction phase are described below.

Quality	*Significance*	*Duration*
Negative	Slight	Temporary

The above effects should be considered in terms that the effect is variable and that this assessment considers the locations of the greatest potential impact.

13.4.2.4 Substation and Grid Connection Construction

There are two potential locations for the substation on site:

- Northern Substation Option A; and
- Southern Substation Option B.

The noise impact at the nearest NSL to each potential site has been assessed to identify the potential greatest impact associated with each option. The full description of the proposed substation arrangements for the proposed development is outlined in Chapter 2 of the EIAR.

13.4.2.4.1 Substation Construction

The nearest NSL to the Option A substation site is H230 at approximately 450m. While the nearest NSL to the Option B substation site is H067 which is approximately 490m. Assuming the same construction activities as outlined in Section 13.4.2.1 it is predicted that the likely worst-case potential noise levels at either location from construction activities associated with the substation will be in the order of 47 dB $L_{Aeq,T}$ at Location H230. This level of noise is significantly below the construction noise criterion outlined in Table 13.1.

13.4.2.4.2 Grid Connection Construction

The grid connection options for each of the two potential substation locations are outlined below:

- Option A – Overhead lines (OHL) ; and
- Option B – Overhead line (OHL) or Underground cabling (UGC).

Both grid connection options have been assessed individually and the potential worst-case option for each substation location is presented below.

For the Option A substation the connection route is within the site boundary while for the Option B substation option there is a small section of the UGC route that will be laid beneath public roads. The full description of the proposed grid connection arrangements for the proposed development is outlined in Chapter 2 of the EIAR.

Construction activities will be carried out during normal daytime working hours (i.e. weekdays 0700 – 1900hrs and Saturdays 0700 – 1300hrs).

Grid Connection Option A Substation

Table 13.18 outlines the noise levels associated with typical construction noise sources assessed with the proposed works for the Option A substation, which at a worst case (OHL) are likely to be 60m to the nearest NSL (H230). Calculations have assumed an on time of 66% for each item of plant i.e. 8-hours over a 12 hours assessment period.

Table 13.18: Indicative Noise Levels from Construction Plant at Nearest NSL from the Grid Connection Works – Northern Substation

Item (BS 5228 Ref.)	Highest Predicted Noise Level at 60m Distance from Edge of Works (dB $L_{Aeq,T}$)
Mini Tracked Excavator (C3.20)	47
Wheeled loader (C2.28)	55
Tracked excavator (C2.8)	49
Dozer (C2.13)	57
Dump truck (C2.30)	58
Road Roller (C2.30)	54
HGV Movements (20 per hour)	47

The predicted noise levels are below the appropriate criteria outlined in Table 13.1 (Category A - 65 dB $L_{Aeq,T}$ during daytime periods). The predicted noise levels at a worst-case distance of 60 m from the works are calculated to be 62 dB $L_{Aeq,T}$ which is below the assessment criteria. As these works will progress along the grid connection route the worst-case predicted impacts will reduce. It is envisioned that they would be at the closest position to the nearest NSL for no more than 2 to 3 days.

Grid Connection Option B Substation

Table 13.19 outlines the noise levels associated with typical construction noise sources assessed with the proposed works for the Southern substation option, which at a worst-case (UGC) are likely to be 200m to the nearest NSL (H067).

Table 13.19: Indicative Noise Levels from Construction Plant at Nearest NSL from the Grid Connection Works – Southern Substation

Item (BS 5228 Ref.)	Highest Predicted Noise Level at 200m Distance from Edge of Works (dB $L_{Aeq,T}$)
Mini Excavator with Hydraulic Breaker (C5.2)	48
Wheeled loader (C2.28)	41
Tracked excavator (C2.8)	35
Dozer (C2.13)	43
Dump truck (C2.30)	44
Road Roller (C2.30)	40
HGV Movements (20 per hour)	37

The predicted noise levels are below the appropriate criteria outlined in Table 13.1 (Category A - 65 dB $L_{Aeq,T}$ during daytime periods). The Predicted noise levels at a worst-case distance of 200 m from the works are calculated to be 52 dB $L_{Aeq,T.}$ As these works will progress along the grid connection route the worst-case predicted impacts will reduce. It is envisioned that they would be at the closest position to the nearest NSL for no more than 2 to 3 days.

13.4.2.4.3 Description of Effects

With respect to the EPA's criteria for description of effects, the potential worst-case associated effects at the nearest noise sensitive location associated with construction of the substation and grid connection are described below.

Quality	*Significance*	*Duration*
Negative	Slight	Temporary

The above effects should be considered in terms that the effect is variable and that this assessment considers the locations of the greatest potential impact.

13.4.2.5 Construction Traffic

This section has been prepared in order to review potential noise impacts associated with construction traffic on the local road network. Chapter 14 of this EIAR presents an assessment of traffic and transportation and reference has been made to this chapter to inform the following discussion. The following situations are commented upon here:

- Stage 1a – Concrete Pouring;
- Stage 1b – Site preparation and groundworks;
- Stage 2a – Turbine Deliveries; and,
- Stage 2b – Other deliveries

Changes in traffic noise levels associated with the additional traffic for each of the construction stages listed above have been calculated for several routes. Table 13.20 presents a summary of the data on which the calculations have been based.

Table 13.20: Information for Construction Traffic Noise Assessment

Route	Stage	Traffic Units	%HGV
N61 south of Roscommon	Existing	7,557	5.5
	1a	8,196	6.9
	1b	8,076	5.6
	2a	8,052	5.6
	2b	8,048	5.5
N63 east of Roscommon	Existing	4,469	4.9
	1a	4,779	7.3
	1b	4,779	5.0
	2a	4,754	5.1
	2b	4,751	5.0
N63 east of Lanesborough	Existing	6,961	4.9
	1a	7,519	6.5
	1b	7,399	5.0
	2a	7,375	5.0
	2b	7,371	5.0
R392 south of Lanesborough	Existing	4,117	4.9
	1a	4,528	7.5
	1b	4,408	5.0
	2a	4,384	5.1
	2b	4,380	5.0
R392 north of access	Existing	2,363	4.9
	1a	2,684	9.3
	1b	2,564	5.1
	2a	2,540	5.2
	2b	2,536	5.0

Based on the data presented above the changes in noise level relative to the noise from existing traffic flows have be calculated and are outlined in Table 13.21.

Table 13.21: Estimated Changed to Traffic Noise Levels

Route	Stage	Change in Traffic Noise Level dB(A)	Estimated Number of Day
N61 south of Roscommon	Existing	--	--
	1a	<1	24
	1b	<1	576
	2a	<1	43
	2b	<1	24
N63 east of Roscommon	Existing	--	--
	1a	+1	24
	1b	<1	576
	2a	<1	43
	2b	<1	24
N63 east of Lanesborough	Existing	--	--
	1a	<1	12
	1b	<1	288

Route	Stage	Change in Traffic Noise Level dB(A)	Estimated Number of Day
	2a	<1	0
	2b	<1	12
R392 south of Lanesborough	Existing	--	--
	1a	+1	12
	1b	<1	288
	2a	<1	43
	2b	<1	12
R392 north of access	Existing	--	--
	1a	+2	12
	1b	<1	288
	2a	<1	43
	2b	<1	12

The increase in noise levels due to additional construction traffic on each of the routes is predicted to be less than 1 dB for most Stages along most of the routes. With respect to the assessment criteria outlined in Section 13.2.1.2.1 the magnitude of this impact is negligible. During Stage 1a, the predicted increase in noise levels is between 1 and 2 dB (along the N63 east of Roscommon, the R392 south of Lanesborough and the R392 north of access). With respect to the appropriate assessment criteria, the magnitude of this impact is minor.

13.4.2.5.1 Description of Effects

With respect to the EPA's criteria for description of effects, the potential worst-case associated effects associated with construction traffic are described below.

Quality	*Significance*	*Duration*
Negative	Not significant	Temporary

13.4.3 Potential Effects -Operational Phase

13.4.3.1 Assessment of Wind Turbine Noise

As stated previously guidance in relation to acceptable levels of noise from wind farms is contained in the *Wind Energy Development Guidelines for Planning Authorities* (DEHLG, 2006) and *The Assessment and Rating of Noise from Wind Farms* (ETSU, 1996). Consideration was also given to planning conditions applied by the local authority and An Bord Pleanála in relation to other sites in the study area.

The proposed operational noise limits for the Derryadd development are:

- 40 dB $L_{A90,10min}$ for daytime in quiet environments with typical background noise of less than 30 dB $L_{A90,10min}$;

- 45 dB $L_{A90,10min}$ for daytime in environments with typical background noise greater than 30 dB $L_{A90,10min}$ or a maximum increase of 5 dB(A) above background noise (whichever is the higher), and;
- 43 dB $L_{A90,10min}$ for night-time periods or a maximum increase of 5 dB(A) above background noise (whichever is the higher).

This set of criteria has been chosen as it is in line with the intent of the relevant Irish guidance and is comparable to noise planning conditions applied to similar sites in the area previously granted planning permission by An Bord Pleanála.

Based on the statistical analysis of wind speed data and baseline noise level information, day and night time noise criteria curves have been developed and are presented in the relevant sections of this Chapter. Table 13.22 outlines the operational noise criteria that are applicable to this assessment. The lowest baseline noise levels measured at each of the various monitoring locations as part of the baseline noise survey have been used in this process in order to adopt a worst-case approach in the derivation of the noise criteria curves.

Table 13.22: Noise Criteria Curves

Location	Period	Derived Noise Criteria, $L_{A90, 10-min}$ Levels (dB) at Various Standardised 10 m Height Wind Speed						
		4	5	6	7	8	9	10
All	Day	40.0	40.0	45.0	45.0	45.0	45.0	46.2
	Night	43.0	43.0	43.0	43.0	43.0	43.0	43.0

The predicted operational noise levels for the proposed development site have been calculated. In the first instance a worst-case assessment has been completed assuming all noise locations are downwind of all turbines at the same time. The predicted levels have been compared against the adopted noise criteria curves. Table 13.23 presents the details of the exercise at all locations considered as part of this assessment.

Table 13.23: Review of Excesses of Day and Night Criterion Curves

Location	Description	Predicted Turbine Level dB L_{A90} at Various Standardised Wind Speeds (m/s)						
		4	5	6	7	8	9	10
Day Criterion Curve		40.0	40.0	45.0	45.0	45.0	45.0	46.5
Night Criterion Curve		43.0	43.0	43.0	43.0	43.0	43.0	43.9
H003	--	27.0	31.2	36.0	37.3	37.9	38.0	38.1
	Excess	--	--	--	--	--	--	--
H004	--	26.6	30.8	35.6	36.8	37.5	37.5	37.7
	Excess	--	--	--	--	--	--	--
H005	--	28.0	32.5	37.4	38.7	39.3	39.4	39.5

Location	Description	Predicted Turbine Level dB L_{A90} at Various Standardised Wind Speeds (m/s)						
		4	5	6	7	8	9	10
Day Criterion Curve		40.0	40.0	45.0	45.0	45.0	45.0	46.5
Night Criterion Curve		43.0	43.0	43.0	43.0	43.0	43.0	43.9
	Excess	--	--	--	--	--	--	--
H006	--	23.7	27.9	32.8	34.0	34.7	34.7	34.9
	Excess	--	--	--	--	--	--	--
H007	--	22.5	26.7	31.6	32.8	33.5	33.5	33.7
	Excess	--	--	--	--	--	--	--
H015	--	23.1	26.1	30.3	31.4	32.1	32.1	32.3
	Excess	--	--	--	--	--	--	--
H021	--	24.2	28.3	33.0	34.2	34.9	34.9	35.1
	Excess	--	--	--	--	--	--	--
H022	--	28.0	32.4	37.4	38.7	39.3	39.3	39.5
	Excess	--	--	--	--	--	--	--
H023	--	28.1	32.5	37.5	38.8	39.4	39.4	39.6
	Excess	--	--	--	--	--	--	--
H024	--	28.2	32.6	37.5	38.9	39.5	39.5	39.7
	Excess	--	--	--	--	--	--	--
H025	--	27.5	31.7	36.5	37.8	38.4	38.5	38.7
	Excess	--	--	--	--	--	--	--
H026	--	26.3	30.3	35.1	36.4	37.0	37.1	37.2
	Excess	--	--	--	--	--	--	--
H027	--	28.6	32.9	37.8	39.1	39.7	39.8	40.0
	Excess	--	--	--	--	--	--	--
H028	--	25.1	28.8	33.4	34.6	35.2	35.3	35.4
	Excess	--	--	--	--	--	--	--
H029	--	24.3	27.3	31.4	32.6	33.2	33.2	33.4
	Excess	--	--	--	--	--	--	--
H030	--	23.7	26.0	29.8	30.9	31.5	31.6	31.7
	Excess	--	--	--	--	--	--	--
H042	--	23.8	27.8	32.5	33.7	34.4	34.4	34.6
	Excess	--	--	--	--	--	--	--
H043	--	22.6	26.6	31.3	32.6	33.3	33.3	33.4
	Excess	--	--	--	--	--	--	--
H044	--	24.6	28.8	33.6	34.8	35.5	35.5	35.7
	Excess	--	--	--	--	--	--	--
H045	--	25.1	29.5	34.4	35.6	36.3	36.3	36.5
	Excess	--	--	--	--	--	--	--
H046	--	25.3	29.6	34.5	35.8	36.5	36.5	36.7
	Excess	--	--	--	--	--	--	--
H047	--	29.2	33.5	38.3	39.6	40.2	40.3	40.5
	Excess	--	--	--	--	--	--	--
H048	--	24.5	28.1	32.7	33.9	34.5	34.6	34.7
	Excess	--	--	--	--	--	--	--
H049	--	27.4	31.6	36.4	37.7	38.3	38.4	38.5
	Excess	--	--	--	--	--	--	--
H050	--	26.6	30.8	35.6	36.9	37.5	37.6	37.7
	Excess	--	--	--	--	--	--	--

Location	Description	Predicted Turbine Level dB L_{A90} at Various Standardised Wind Speeds (m/s)						
		4	5	6	7	8	9	10
Day Criterion Curve		40.0	40.0	45.0	45.0	45.0	45.0	46.5
Night Criterion Curve		43.0	43.0	43.0	43.0	43.0	43.0	43.9
H051	--	26.4	30.6	35.4	36.6	37.3	37.3	37.5
	Excess	--	--	--	--	--	--	--
H052	--	23.1	27.2	32.0	33.2	33.9	33.9	34.1
	Excess	--	--	--	--	--	--	--
H053	--	23.2	27.4	32.1	33.4	34.1	34.1	34.3
	Excess	--	--	--	--	--	--	--
H054	--	26.2	30.4	35.2	36.4	37.1	37.1	37.3
	Excess	--	--	--	--	--	--	--
H055	--	28.1	32.5	37.3	38.6	39.2	39.3	39.5
	Excess	--	--	--	--	--	--	--
H056	--	24.9	28.8	33.4	34.7	35.3	35.4	35.5
	Excess	--	--	--	--	--	--	--
H057	--	23.9	27.6	32.2	33.5	34.1	34.2	34.3
	Excess	--	--	--	--	--	--	--
H058	--	24.3	26.0	29.1	30.0	30.7	30.7	30.8
	Excess	--	--	--	--	--	--	--
H059	--	24.2	28.3	33.1	34.3	35.0	35.0	35.2
	Excess	--	--	--	--	--	--	--
H060	--	26.2	30.5	35.3	36.6	37.2	37.3	37.5
	Excess	--	--	--	--	--	--	--
H061	--	27.9	32.3	37.2	38.5	39.1	39.2	39.3
	Excess	--	--	--	--	--	--	--
H062	--	27.6	32.0	37.0	38.3	38.9	38.9	39.1
	Excess	--	--	--	--	--	--	--
H063	--	24.7	29.1	34.0	35.3	35.9	35.9	36.1
	Excess	--	--	--	--	--	--	--
H064	--	24.0	28.3	33.2	34.5	35.1	35.2	35.3
	Excess	--	--	--	--	--	--	--
H065	--	22.8	27.1	31.9	33.2	33.8	33.9	34.0
	Excess	--	--	--	--	--	--	--
H066	--	21.5	25.7	30.5	31.7	32.4	32.4	32.6
	Excess	--	--	--	--	--	--	--
H067	--	25.0	29.3	34.1	35.4	36.0	36.1	36.2
	Excess	--	--	--	--	--	--	--
H068	--	20.2	24.1	28.7	29.9	30.7	30.7	30.9
	Excess	--	--	--	--	--	--	--
H175	--	19.3	23.0	27.6	28.8	29.6	29.6	29.7
	Excess	--	--	--	--	--	--	--
H214	--	26.6	30.7	35.6	36.8	37.5	37.5	37.7
	Excess	--	--	--	--	--	--	--
H215	--	26.5	30.7	35.5	36.8	37.4	37.4	37.6
	Excess	--	--	--	--	--	--	--
H216	--	27.4	31.7	36.5	37.8	38.4	38.5	38.6
	Excess	--	--	--	--	--	--	--
H217	--	27.3	31.6	36.4	37.7	38.3	38.4	38.5

Location	Description	Predicted Turbine Level dB L_{A90} at Various Standardised Wind Speeds (m/s)						
		4	5	6	7	8	9	10
Day Criterion Curve		40.0	40.0	45.0	45.0	45.0	45.0	46.5
Night Criterion Curve		43.0	43.0	43.0	43.0	43.0	43.0	43.9
	Excess	--	--	--	--	--	--	--
H218	--	27.8	32.1	37.0	38.3	38.9	38.9	39.1
	Excess	--	--	--	--	--	--	--
H219	--	24.7	28.9	33.7	35.0	35.6	35.7	35.8
	Excess	--	--	--	--	--	--	--
H220	--	25.1	29.4	34.2	35.5	36.1	36.2	36.3
	Excess	--	--	--	--	--	--	--
H221	--	24.1	28.1	32.8	34.1	34.8	34.8	34.9
	Excess	--	--	--	--	--	--	--
H222	--	26.7	31.0	35.8	37.1	37.7	37.8	37.9
	Excess	--	--	--	--	--	--	--
H223	--	27.8	32.1	37.0	38.3	38.9	39.0	39.1
	Excess	--	--	--	--	--	--	--
H224	--	26.4	30.6	35.4	36.7	37.3	37.3	37.5
	Excess	--	--	--	--	--	--	--
H225	--	26.4	30.6	35.4	36.7	37.3	37.3	37.5
	Excess	--	--	--	--	--	--	--
H226	--	27.8	32.0	36.9	38.2	38.8	38.9	39.0
	Excess	--	--	--	--	--	--	--
H227	--	23.1	26.0	30.2	31.3	32.0	32.0	32.2
	Excess	--	--	--	--	--	--	--
H228	--	23.1	26.1	30.4	31.5	32.2	32.2	32.4
	Excess	--	--	--	--	--	--	--
H229	--	23.3	26.4	30.7	31.8	32.5	32.5	32.7
	Excess	--	--	--	--	--	--	--
H230	--	28.6	33.0	37.9	39.2	39.8	39.8	40.0
	Excess	--	--	--	--	--	--	--
H231	--	28.8	33.2	38.1	39.4	40.0	40.1	40.2
	Excess	--	--	--	--	--	--	--
H232	--	26.6	30.9	35.8	37.0	37.7	37.7	37.9
	Excess	--	--	--	--	--	--	--
H233	--	27.7	32.1	37.0	38.3	38.9	39.0	39.2
	Excess	--	--	--	--	--	--	--
H234	--	28.2	32.7	37.6	38.9	39.5	39.6	39.8
	Excess	--	--	--	--	--	--	--
H235	--	27.5	31.8	36.8	38.1	38.7	38.7	38.9
	Excess	--	--	--	--	--	--	--
H236	--	25.4	29.6	34.5	35.7	36.4	36.4	36.6
	Excess	--	--	--	--	--	--	--
H237	--	25.2	29.6	34.5	35.8	36.4	36.5	36.7
	Excess	--	--	--	--	--	--	--
H238	--	22.9	27.0	31.8	33.0	33.7	33.7	33.9
	Excess	--	--	--	--	--	--	--
H284	--	26.7	30.9	35.7	37.0	37.6	37.7	37.9
	Excess	--	--	--	--	--	--	--

Location	Description	Predicted Turbine Level dB L_{A90} at Various Standardised Wind Speeds (m/s)						
		4	5	6	7	8	9	10
Day Criterion Curve		40.0	40.0	45.0	45.0	45.0	45.0	46.5
Night Criterion Curve		43.0	43.0	43.0	43.0	43.0	43.0	43.9
H285	--	26.7	31.0	35.8	37.1	37.7	37.8	38.0
	Excess	--	--	--	--	--	--	--
H286	--	26.3	30.4	35.2	36.5	37.1	37.2	37.3
	Excess	--	--	--	--	--	--	--
H287	--	27.1	31.4	36.3	37.6	38.2	38.3	38.4
	Excess	--	--	--	--	--	--	--
H291	--	26.3	30.5	35.4	36.6	37.3	37.3	37.5
	Excess	--	--	--	--	--	--	--
H292	--	26.6	30.8	35.7	36.9	37.6	37.6	37.8
	Excess	--	--	--	--	--	--	--
H293	--	25.7	29.9	34.8	36.0	36.7	36.7	36.9
	Excess	--	--	--	--	--	--	--
H294	--	22.1	26.3	31.1	32.4	33.1	33.1	33.3
	Excess	--	--	--	--	--	--	--
H295	--	24.4	28.4	33.2	34.4	35.1	35.1	35.3
	Excess	--	--	--	--	--	--	--
H296	--	23.6	27.6	32.3	33.5	34.2	34.2	34.3
	Excess	--	--	--	--	--	--	--
H297	--	23.8	26.5	30.5	31.6	32.3	32.3	32.5
	Excess	--	--	--	--	--	--	--
H298	--	27.8	32.2	37.2	38.5	39.1	39.1	39.3
	Excess	--	--	--	--	--	--	--
H299	--	23.4	27.5	32.3	33.5	34.2	34.2	34.4
	Excess	--	--	--	--	--	--	--
H300	--	24.4	26.8	30.6	31.7	32.3	32.3	32.5
	Excess	--	--	--	--	--	--	--
H301	--	26.4	30.8	35.7	37.0	37.6	37.6	37.8
	Excess	--	--	--	--	--	--	--
H302	--	22.0	26.2	31.0	32.3	32.9	33.0	33.1
	Excess	--	--	--	--	--	--	--
H305	--	27.8	32.2	37.2	38.5	39.1	39.1	39.3
	Excess	--	--	--	--	--	--	--
H306	--	27.9	32.3	37.2	38.5	39.1	39.2	39.4
	Excess	--	--	--	--	--	--	--
H307	--	23.9	27.9	32.6	33.8	34.5	34.5	34.7
	Excess	--	--	--	--	--	--	--
H308	--	24.0	28.1	32.8	34.0	34.7	34.7	34.9
	Excess	--	--	--	--	--	--	--
H309	--	20.3	24.3	28.9	30.2	30.9	30.9	31.1
	Excess	--	--	--	--	--	--	--
H313	--	24.3	27.9	32.4	33.6	34.3	34.3	34.5
	Excess	--	--	--	--	--	--	--
H314	--	24.1	27.7	32.2	33.4	34.0	34.0	34.2
	Excess	--	--	--	--	--	--	--
H317	--	28.2	32.5	37.4	38.7	39.3	39.4	39.5

Location	Description	Predicted Turbine Level dB L_{A90} at Various Standardised Wind Speeds (m/s)						
		4	5	6	7	8	9	10
Day Criterion Curve		40.0	40.0	45.0	45.0	45.0	45.0	46.5
Night Criterion Curve		43.0	43.0	43.0	43.0	43.0	43.0	43.9
	Excess	--	--	--	--	--	--	--
H318	--	23.2	26.1	30.2	31.3	32.0	32.0	32.2
	Excess	--	--	--	--	--	--	--
H319	--	21.3	25.3	30.0	31.2	32.0	32.0	32.1
	Excess	--	--	--	--	--	--	--
H320	--	24.3	28.6	33.5	34.7	35.4	35.4	35.6
	Excess	--	--	--	--	--	--	--
H321	--	23.2	27.3	32.0	33.3	34.0	34.0	34.2
	Excess	--	--	--	--	--	--	--
H327	--	26.3	30.6	35.5	36.8	37.4	37.4	37.6
	Excess	--	--	--	--	--	--	--
H393	--	23.5	26.9	31.3	32.5	33.2	33.2	33.3
	Excess	--	--	--	--	--	--	--
H394	--	28.0	32.5	37.4	38.7	39.3	39.3	39.5
	Excess	--	--	--	--	--	--	--
H407	--	23.2	27.3	32.1	33.3	34.0	34.0	34.2
	Excess	--	--	--	--	--	--	--
H408	--	24.2	28.4	33.2	34.4	35.1	35.1	35.3
	Excess	--	--	--	--	--	--	--
H409	--	22.3	26.3	31.0	32.2	32.9	32.9	33.1
	Excess	--	--	--	--	--	--	--
H410	--	22.6	26.5	31.1	32.3	33.0	33.0	33.2
	Excess	--	--	--	--	--	--	--
H411	--	26.9	31.2	36.1	37.4	38.0	38.1	38.2
	Excess	--	--	--	--	--	--	--
H412	--	26.9	31.2	36.1	37.4	38.0	38.0	38.2
	Excess	--	--	--	--	--	--	--
H413	--	27.7	32.0	37.0	38.3	38.9	38.9	39.1
	Excess	--	--	--	--	--	--	--
H414	--	27.2	31.5	36.4	37.7	38.3	38.4	38.5
	Excess	--	--	--	--	--	--	--
H415	--	26.7	31.0	35.9	37.2	37.8	37.8	38.0
	Excess	--	--	--	--	--	--	--
H416	--	24.6	28.7	33.5	34.7	35.4	35.4	35.6
	Excess	--	--	--	--	--	--	--
H417	--	24.7	28.9	33.7	34.9	35.6	35.6	35.8
	Excess	--	--	--	--	--	--	--
H418	--	19.9	23.8	28.4	29.6	30.4	30.4	30.5
	Excess	--	--	--	--	--	--	--
H421	--	19.6	23.4	28.0	29.1	29.9	30.0	30.1
	Excess	--	--	--	--	--	--	--
H422	--	19.0	22.7	27.2	28.4	29.2	29.2	29.4
	Excess	--	--	--	--	--	--	--
H425	--	20.8	24.6	29.3	30.4	31.2	31.2	31.4
	Excess	--	--	--	--	--	--	--

Location	Description	Predicted Turbine Level dB L_{A90} at Various Standardised Wind Speeds (m/s)						
		4	5	6	7	8	9	10
Day Criterion Curve		40.0	40.0	45.0	45.0	45.0	45.0	46.5
Night Criterion Curve		43.0	43.0	43.0	43.0	43.0	43.0	43.9
H427	--	22.3	26.4	31.2	32.4	33.1	33.2	33.3
	Excess	--	--	--	--	--	--	--
H428	--	25.9	30.3	35.2	36.5	37.1	37.1	37.3
	Excess	--	--	--	--	--	--	--
H429	--	24.9	29.3	34.2	35.5	36.1	36.1	36.3
	Excess	--	--	--	--	--	--	--
H430	--	24.4	28.8	33.7	34.9	35.6	35.6	35.8
	Excess	--	--	--	--	--	--	--
H431	--	21.1	25.2	30.0	31.2	31.9	31.9	32.1
	Excess	--	--	--	--	--	--	--
H432	--	28.0	32.5	37.5	38.8	39.4	39.5	39.7
	Excess	--	--	--	--	--	--	--
H433	--	20.2	24.3	29.0	30.2	31.0	31.0	31.1
	Excess	--	--	--	--	--	--	--
H434	--	21.0	24.9	29.5	30.6	31.4	31.4	31.6
	Excess	--	--	--	--	--	--	--
H435	--	20.6	24.4	29.0	30.2	30.9	31.0	31.1
	Excess	--	--	--	--	--	--	--
H436	--	19.9	23.6	28.2	29.4	30.2	30.2	30.3
	Excess	--	--	--	--	--	--	--
H437	--	22.5	26.7	31.4	32.7	33.4	33.4	33.6
	Excess	--	--	--	--	--	--	--
H438	--	22.9	27.0	31.8	33.1	33.8	33.8	34.0
	Excess	--	--	--	--	--	--	--
H439	--	26.0	30.4	35.3	36.6	37.2	37.3	37.4
	Excess	--	--	--	--	--	--	--
H440	--	26.6	31.1	36.0	37.3	37.9	38.0	38.1
	Excess	--	--	--	--	--	--	--
H441	--	26.0	30.4	35.3	36.6	37.2	37.2	37.4
	Excess	--	--	--	--	--	--	--
H442	--	25.5	29.9	34.8	36.1	36.7	36.8	36.9
	Excess	--	--	--	--	--	--	--
H443	--	25.3	29.6	34.6	35.8	36.5	36.5	36.7
	Excess	--	--	--	--	--	--	--
H444	--	24.7	29.1	34.0	35.3	35.9	35.9	36.1
	Excess	--	--	--	--	--	--	--
H445	--	24.6	28.9	33.8	35.1	35.7	35.8	35.9
	Excess	--	--	--	--	--	--	--
H446	--	25.0	28.4	32.8	34.0	34.7	34.7	34.9
	Excess	--	--	--	--	--	--	--
H447	--	28.5	32.8	37.6	38.9	39.5	39.6	39.7
	Excess	--	--	--	--	--	--	--
H448	--	29.1	33.4	38.3	39.6	40.1	40.2	40.4
	Excess	--	--	--	--	--	--	--
H449	--	23.3	26.0	29.9	31.0	31.7	31.7	31.9

Location	Description	Predicted Turbine Level dB L_{A90} at Various Standardised Wind Speeds (m/s)						
		4	5	6	7	8	9	10
Day Criterion Curve		40.0	40.0	45.0	45.0	45.0	45.0	46.5
Night Criterion Curve		43.0	43.0	43.0	43.0	43.0	43.0	43.9
	Excess	--	--	--	--	--	--	--
H451	--	27.2	31.4	36.2	37.5	38.1	38.1	38.3
	Excess	--	--	--	--	--	--	--
H452	--	27.4	31.6	36.4	37.7	38.3	38.4	38.5
	Excess	--	--	--	--	--	--	--
H453	--	23.4	26.7	31.1	32.3	32.9	33.0	33.1
	Excess	--	--	--	--	--	--	--
H454	--	24.3	28.0	32.5	33.7	34.3	34.4	34.5
	Excess	--	--	--	--	--	--	--
H455	--	23.8	27.3	31.7	32.9	33.6	33.6	33.8
	Excess	--	--	--	--	--	--	--
H456	--	23.4	26.8	31.2	32.3	33.0	33.1	33.2
	Excess	--	--	--	--	--	--	--
H462	--	24.1	28.0	32.6	33.8	34.5	34.5	34.7
	Excess	--	--	--	--	--	--	--
H463	--	27.6	31.9	36.7	38.0	38.6	38.7	38.9
	Excess	--	--	--	--	--	--	--
H464	--	29.0	33.4	38.3	39.6	40.2	40.3	40.4
	Excess	--	--	--	--	--	--	--
H465	--	24.5	28.4	33.0	34.3	34.9	35.0	35.1
	Excess	--	--	--	--	--	--	--
H469	--	25.8	30.0	34.9	36.1	36.8	36.8	37.0
	Excess	--	--	--	--	--	--	--
H470	--	26.0	30.3	35.1	36.4	37.0	37.1	37.2
	Excess	--	--	--	--	--	--	--
H471	--	28.1	32.5	37.4	38.8	39.4	39.4	39.6
	Excess	--	--	--	--	--	--	--
H472	--	27.3	31.7	36.6	37.9	38.5	38.5	38.7
	Excess	--	--	--	--	--	--	--
H473	--	27.8	32.2	37.1	38.4	39.0	39.1	39.3
	Excess	--	--	--	--	--	--	--
H474	--	28.0	32.4	37.3	38.6	39.2	39.3	39.5
	Excess	--	--	--	--	--	--	--
H475	--	23.8	27.9	32.6	33.8	34.5	34.5	34.7
	Excess	--	--	--	--	--	--	--
H476	--	23.4	27.3	32.0	33.2	33.9	33.9	34.0
	Excess	--	--	--	--	--	--	--
H477	--	24.7	28.8	33.6	34.8	35.5	35.5	35.7
	Excess	--	--	--	--	--	--	--
H478	--	27.0	31.3	36.2	37.5	38.1	38.1	38.3
	Excess	--	--	--	--	--	--	--
H479	--	26.4	30.7	35.5	36.8	37.4	37.4	37.6
	Excess	--	--	--	--	--	--	--
H480	--	26.4	30.6	35.4	36.7	37.3	37.3	37.5
	Excess	--	--	--	--	--	--	--

Location	Description	Predicted Turbine Level dB L_{A90} at Various Standardised Wind Speeds (m/s)						
		4	5	6	7	8	9	10
Day Criterion Curve		40.0	40.0	45.0	45.0	45.0	45.0	46.5
Night Criterion Curve		43.0	43.0	43.0	43.0	43.0	43.0	43.9
H481	--	29.8	34.1	39.0	40.3	40.9	41.0	41.1
	Excess	--	--	--	--	--	--	--
H482	--	29.2	33.5	38.4	39.7	40.3	40.3	40.5
	Excess	--	--	--	--	--	--	--
H483	--	23.5	26.2	30.2	31.3	32.0	32.0	32.1
	Excess	--	--	--	--	--	--	--
H484	--	23.2	26.1	30.2	31.3	32.0	32.0	32.1
	Excess	--	--	--	--	--	--	--
H486	--	23.2	26.3	30.5	31.7	32.4	32.4	32.5
	Excess	--	--	--	--	--	--	--
H487	--	23.5	26.7	31.0	32.2	32.9	32.9	33.1
	Excess	--	--	--	--	--	--	--
H488	--	25.9	29.9	34.6	35.8	36.4	36.5	36.7
	Excess	--	--	--	--	--	--	--
H489	--	27.0	31.2	36.0	37.2	37.9	37.9	38.1
	Excess	--	--	--	--	--	--	--
H490	--	27.5	31.7	36.5	37.8	38.4	38.5	38.7
	Excess	--	--	--	--	--	--	--
H491	--	27.5	31.7	36.6	37.9	38.5	38.5	38.7
	Excess	--	--	--	--	--	--	--
H492	--	25.3	29.1	33.8	35.0	35.7	35.7	35.9
	Excess	--	--	--	--	--	--	--
H493	--	23.4	26.8	31.2	32.3	33.0	33.0	33.2
	Excess	--	--	--	--	--	--	--
H494	--	23.3	26.6	31.0	32.1	32.8	32.8	33.0
	Excess	--	--	--	--	--	--	--
H495	--	24.1	27.6	32.1	33.3	34.0	34.0	34.2
	Excess	--	--	--	--	--	--	--
H496	--	24.0	27.5	32.0	33.2	33.8	33.9	34.0
	Excess	--	--	--	--	--	--	--
H497	--	23.9	27.4	31.9	33.0	33.7	33.7	33.9
	Excess	--	--	--	--	--	--	--
H498	--	23.7	27.1	31.6	32.7	33.4	33.4	33.6
	Excess	--	--	--	--	--	--	--
H499	--	23.6	27.0	31.4	32.6	33.3	33.3	33.5
	Excess	--	--	--	--	--	--	--
H500	--	23.3	26.6	31.0	32.1	32.8	32.8	33.0
	Excess	--	--	--	--	--	--	--
H501	--	23.3	26.5	30.9	32.1	32.7	32.8	32.9
	Excess	--	--	--	--	--	--	--
H502	--	23.1	26.3	30.6	31.8	32.5	32.5	32.7
	Excess	--	--	--	--	--	--	--
H514	--	25.1	29.1	33.8	35.1	35.7	35.8	35.9
	Excess	--	--	--	--	--	--	--
H515	--	23.4	27.1	31.7	33.0	33.6	33.7	33.8

Location	Description	Predicted Turbine Level dB L_{A90} at Various Standardised Wind Speeds (m/s)						
		4	5	6	7	8	9	10
Day Criterion Curve		40.0	40.0	45.0	45.0	45.0	45.0	46.5
Night Criterion Curve		43.0	43.0	43.0	43.0	43.0	43.0	43.9
	Excess	--	--	--	--	--	--	--
H516	--	27.2	31.4	36.3	37.6	38.2	38.2	38.4
	Excess	--	--	--	--	--	--	--
H517	--	27.5	31.8	36.6	37.9	38.5	38.6	38.8
	Excess	--	--	--	--	--	--	--
H518	--	27.9	32.2	37.1	38.4	39.0	39.0	39.2
	Excess	--	--	--	--	--	--	--
H519	--	28.0	32.3	37.2	38.5	39.1	39.1	39.3
	Excess	--	--	--	--	--	--	--
H520	--	27.0	31.2	36.1	37.3	37.9	38.0	38.2
	Excess	--	--	--	--	--	--	--
H521	--	28.4	32.8	37.7	39.0	39.6	39.6	39.8
	Excess	--	--	--	--	--	--	--
H522	--	28.9	33.3	38.2	39.5	40.1	40.2	40.3
	Excess	--	--	--	--	--	--	--
H523	--	28.2	32.5	37.4	38.7	39.3	39.4	39.6
	Excess	--	--	--	--	--	--	--
H524	--	25.9	30.2	35.0	36.3	36.9	36.9	37.1
	Excess	--	--	--	--	--	--	--
H525	--	28.1	32.5	37.4	38.7	39.3	39.4	39.6
	Excess	--	--	--	--	--	--	--
H526	--	28.1	32.5	37.4	38.8	39.4	39.4	39.6
	Excess	--	--	--	--	--	--	--
H527	--	28.1	32.5	37.4	38.7	39.3	39.4	39.6
	Excess	--	--	--	--	--	--	--
H528	--	27.8	32.2	37.1	38.4	39.0	39.1	39.2
	Excess	--	--	--	--	--	--	--
H529	--	27.5	31.8	36.7	38.0	38.6	38.7	38.9
	Excess	--	--	--	--	--	--	--
H530	--	28.1	32.5	37.4	38.7	39.3	39.3	39.5
	Excess	--	--	--	--	--	--	--
H531	--	28.1	32.5	37.4	38.7	39.3	39.4	39.5
	Excess	--	--	--	--	--	--	--
H532	--	28.1	32.6	37.5	38.8	39.4	39.4	39.6
	Excess	--	--	--	--	--	--	--
H533	--	28.0	32.4	37.3	38.6	39.2	39.3	39.5
	Excess	--	--	--	--	--	--	--
H534	--	27.9	32.3	37.3	38.6	39.2	39.2	39.4
	Excess	--	--	--	--	--	--	--
H535	--	24.4	28.5	33.2	34.5	35.1	35.1	35.3
	Excess	--	--	--	--	--	--	--
H536	--	23.9	28.0	32.7	33.9	34.6	34.6	34.8
	Excess	--	--	--	--	--	--	--
H537	--	23.6	27.6	32.3	33.5	34.2	34.3	34.4
	Excess	--	--	--	--	--	--	--

Location	Description	Predicted Turbine Level dB L_{A90} at Various Standardised Wind Speeds (m/s)						
		4	5	6	7	8	9	10
Day Criterion Curve		40.0	40.0	45.0	45.0	45.0	45.0	46.5
Night Criterion Curve		43.0	43.0	43.0	43.0	43.0	43.0	43.9
H538	--	23.3	27.2	31.9	33.1	33.8	33.8	34.0
	Excess	--	--	--	--	--	--	--
H539	--	23.5	27.4	32.1	33.3	34.0	34.0	34.2
	Excess	--	--	--	--	--	--	--
H540	--	23.8	27.8	32.5	33.7	34.4	34.4	34.6
	Excess	--	--	--	--	--	--	--
H541	--	23.9	27.9	32.6	33.9	34.5	34.6	34.7
	Excess	--	--	--	--	--	--	--
H542	--	26.6	30.9	35.8	37.1	37.7	37.7	37.9
	Excess	--	--	--	--	--	--	--
H543	--	24.9	29.0	33.8	35.0	35.7	35.7	35.9
	Excess	--	--	--	--	--	--	--
H544	--	25.5	29.7	34.5	35.8	36.4	36.4	36.6
	Excess	--	--	--	--	--	--	--
H545	--	27.2	31.5	36.4	37.7	38.3	38.3	38.5
	Excess	--	--	--	--	--	--	--
H546	--	26.4	30.6	35.5	36.8	37.4	37.4	37.6
	Excess	--	--	--	--	--	--	--
H547	--	26.5	30.7	35.6	36.9	37.5	37.5	37.7
	Excess	--	--	--	--	--	--	--
H548	--	26.4	30.6	35.4	36.6	37.3	37.3	37.5
	Excess	--	--	--	--	--	--	--
H549	--	26.4	30.6	35.4	36.7	37.3	37.3	37.5
	Excess	--	--	--	--	--	--	--
H550	--	26.9	31.1	35.9	37.2	37.8	37.9	38.1
	Excess	--	--	--	--	--	--	--
H551	--	26.8	31.0	35.9	37.1	37.7	37.8	38.0
	Excess	--	--	--	--	--	--	--
H552	--	28.6	33.0	37.9	39.2	39.8	39.8	40.0
	Excess	--	--	--	--	--	--	--
H553	--	28.3	32.6	37.5	38.8	39.4	39.4	39.6
	Excess	--	--	--	--	--	--	--
H764	--	23.2	27.2	32.0	33.2	33.9	33.9	34.1
	Excess	--	--	--	--	--	--	--
H765	--	23.7	27.8	32.6	33.8	34.5	34.5	34.7
	Excess	--	--	--	--	--	--	--
H766	--	24.3	28.4	33.2	34.5	35.1	35.2	35.3
	Excess	--	--	--	--	--	--	--
H767	--	28.5	32.9	37.9	39.2	39.8	39.8	40.0
	Excess	--	--	--	--	--	--	--
H768	--	26.6	31.0	35.9	37.2	37.8	37.8	38.0
	Excess	--	--	--	--	--	--	--
H769	--	25.8	30.1	35.0	36.2	36.9	36.9	37.1
	Excess	--	--	--	--	--	--	--
H770	--	24.9	29.2	34.0	35.2	35.9	35.9	36.1

Location	Description	Predicted Turbine Level dB L_{A90} at Various Standardised Wind Speeds (m/s)						
		4	5	6	7	8	9	10
Day Criterion Curve		40.0	40.0	45.0	45.0	45.0	45.0	46.5
Night Criterion Curve		43.0	43.0	43.0	43.0	43.0	43.0	43.9
	Excess	--	--	--	--	--	--	--
H771	--	26.3	30.7	35.6	36.9	37.5	37.6	37.8
	Excess	--	--	--	--	--	--	--
H772	--	24.1	28.4	33.2	34.5	35.1	35.2	35.3
	Excess	--	--	--	--	--	--	--
H773	--	22.6	26.8	31.6	32.8	33.5	33.5	33.7
	Excess	--	--	--	--	--	--	--
H774	--	22.7	26.8	31.5	32.8	33.4	33.5	33.6
	Excess	--	--	--	--	--	--	--
H775	--	24.0	28.2	33.0	34.3	35.0	35.0	35.2
	Excess	--	--	--	--	--	--	--
H776	--	24.5	28.7	33.6	34.8	35.5	35.5	35.7
	Excess	--	--	--	--	--	--	--
H777	--	24.7	28.9	33.8	35.0	35.7	35.7	35.9
	Excess	--	--	--	--	--	--	--
H778	--	24.9	29.1	34.0	35.3	35.9	35.9	36.1
	Excess	--	--	--	--	--	--	--
H779	--	24.7	28.9	33.7	35.0	35.6	35.7	35.9
	Excess	--	--	--	--	--	--	--
H780	--	24.1	28.3	33.2	34.4	35.1	35.1	35.3
	Excess	--	--	--	--	--	--	--
H781	--	24.3	28.5	33.3	34.6	35.2	35.3	35.4
	Excess	--	--	--	--	--	--	--
H782	--	27.2	31.7	36.6	37.9	38.5	38.6	38.7
	Excess	--	--	--	--	--	--	--
H783	--	26.9	31.4	36.3	37.6	38.2	38.3	38.5
	Excess	--	--	--	--	--	--	--
H784	--	26.2	30.6	35.5	36.8	37.4	37.4	37.6
	Excess	--	--	--	--	--	--	--
H785	--	26.2	30.6	35.5	36.8	37.4	37.5	37.7
	Excess	--	--	--	--	--	--	--
H786	--	24.0	28.3	33.1	34.4	35.1	35.1	35.3
	Excess	--	--	--	--	--	--	--
H787	--	22.3	26.4	31.2	32.5	33.1	33.2	33.3
	Excess	--	--	--	--	--	--	--
H788	--	22.5	26.7	31.4	32.7	33.4	33.4	33.6
	Excess	--	--	--	--	--	--	--
H789	--	22.4	26.5	31.3	32.5	33.2	33.2	33.4
	Excess	--	--	--	--	--	--	--
H790	--	27.3	31.8	36.7	38.0	38.6	38.7	38.8
	Excess	--	--	--	--	--	--	--
H791	--	22.9	27.0	31.8	33.0	33.7	33.7	33.9
	Excess	--	--	--	--	--	--	--
H792	--	23.8	27.9	32.7	34.0	34.6	34.7	34.8
	Excess	--	--	--	--	--	--	--

Location	Description	Predicted Turbine Level dB L_{A90} at Various Standardised Wind Speeds (m/s)						
		4	5	6	7	8	9	10
Day Criterion Curve		40.0	40.0	45.0	45.0	45.0	45.0	46.5
Night Criterion Curve		43.0	43.0	43.0	43.0	43.0	43.0	43.9
H793	--	24.1	28.3	33.1	34.4	35.0	35.1	35.2
	Excess	--	--	--	--	--	--	--
H794	--	24.2	28.4	33.2	34.5	35.1	35.2	35.3
	Excess	--	--	--	--	--	--	--
H795	--	24.5	28.8	33.6	34.9	35.5	35.5	35.7
	Excess	--	--	--	--	--	--	--
H796	--	24.5	28.8	33.6	34.9	35.5	35.6	35.7
	Excess	--	--	--	--	--	--	--
H797	--	24.6	28.8	33.7	34.9	35.6	35.6	35.8
	Excess	--	--	--	--	--	--	--
H798	--	24.6	28.9	33.7	35.0	35.6	35.7	35.8
	Excess	--	--	--	--	--	--	--
H799	--	24.7	29.0	33.8	35.1	35.7	35.7	35.9
	Excess	--	--	--	--	--	--	--
H800	--	24.8	29.0	33.8	35.1	35.8	35.8	36.0
	Excess	--	--	--	--	--	--	--
H801	--	24.8	29.0	33.9	35.2	35.8	35.8	36.0
	Excess	--	--	--	--	--	--	--
H802	--	24.6	28.8	33.6	34.9	35.5	35.6	35.8
	Excess	--	--	--	--	--	--	--
H803	--	24.6	28.8	33.7	34.9	35.6	35.6	35.8
	Excess	--	--	--	--	--	--	--
H804	--	24.7	28.9	33.8	35.1	35.7	35.7	35.9
	Excess	--	--	--	--	--	--	--
H805	--	24.7	29.0	33.8	35.1	35.7	35.8	35.9
	Excess	--	--	--	--	--	--	--
H806	--	24.9	29.1	34.0	35.2	35.9	35.9	36.1
	Excess	--	--	--	--	--	--	--
H807	--	24.2	28.4	33.2	34.5	35.1	35.2	35.3
	Excess	--	--	--	--	--	--	--
H808	--	24.2	28.5	33.3	34.5	35.2	35.2	35.4
	Excess	--	--	--	--	--	--	--
H809	--	24.3	28.5	33.4	34.6	35.3	35.3	35.5
	Excess	--	--	--	--	--	--	--
H810	--	24.4	28.6	33.5	34.7	35.4	35.4	35.6
	Excess	--	--	--	--	--	--	--
H811	--	23.4	27.4	32.1	33.3	34.0	34.0	34.2
	Excess	--	--	--	--	--	--	--
H812	--	24.3	28.4	33.2	34.5	35.1	35.2	35.3
	Excess	--	--	--	--	--	--	--
H813	--	22.1	26.1	30.8	32.0	32.7	32.8	32.9
	Excess	--	--	--	--	--	--	--
H814	--	22.4	26.4	31.1	32.4	33.1	33.1	33.2
	Excess	--	--	--	--	--	--	--
H815	--	23.1	27.1	31.9	33.2	33.8	33.9	34.0

Location	Description	Predicted Turbine Level dB L_{A90} at Various Standardised Wind Speeds (m/s)						
		4	5	6	7	8	9	10
Day Criterion Curve		40.0	40.0	45.0	45.0	45.0	45.0	46.5
Night Criterion Curve		43.0	43.0	43.0	43.0	43.0	43.0	43.9
	Excess	--	--	--	--	--	--	--
H816	--	23.7	27.7	32.5	33.7	34.4	34.4	34.6
	Excess	--	--	--	--	--	--	--
H817	--	24.5	28.7	33.5	34.7	35.4	35.4	35.6
	Excess	--	--	--	--	--	--	--
H818	--	24.2	28.3	33.0	34.3	34.9	35.0	35.1
	Excess	--	--	--	--	--	--	--
H819	--	24.8	29.0	33.9	35.1	35.8	35.8	36.0
	Excess	--	--	--	--	--	--	--
H820	--	25.6	29.9	34.7	36.0	36.6	36.7	36.9
	Excess	--	--	--	--	--	--	--
H821	--	22.4	26.5	31.2	32.4	33.1	33.1	33.3
	Excess	--	--	--	--	--	--	--
H825	--	23.6	27.3	31.9	33.1	33.7	33.8	33.9
	Excess	--	--	--	--	--	--	--
H826	--	25.8	30.1	34.9	36.2	36.8	36.9	37.0
	Excess	--	--	--	--	--	--	--
H827	--	27.8	32.0	36.9	38.2	38.8	38.8	39.0
	Excess	--	--	--	--	--	--	--
H828	--	26.3	30.4	35.2	36.5	37.1	37.2	37.3
	Excess	--	--	--	--	--	--	--
H829	--	26.2	30.4	35.2	36.4	37.0	37.1	37.3
	Excess	--	--	--	--	--	--	--
H831	--	25.3	29.3	34.1	35.3	35.9	36.0	36.2
	Excess	--	--	--	--	--	--	--
H832	--	27.9	32.3	37.2	38.5	39.1	39.2	39.4
	Excess	--	--	--	--	--	--	--

A noise contour for the rated power wind speed (i.e. highest turbine noise emissions) is presented in Appendix 13.4.

The predicted operational noise levels at various wind speeds have been compared against the noise criteria curves outlined in Table 13.22. The predicted noise levels at all locations for the various wind speeds are below the noise criteria curves adopted for this assessment.

As previously stated, the day to day operations of the proposed development will not result in the worst-case calculation with all noise locations being downwind of all turbines at the same time.

13.4.3.1.1 Description of Effects

The predicted noise levels associated with the proposed development will be within best practice noise criteria curves recommended in Irish guidance '*Wind Energy Development Guidelines for Planning Authorities* it is not considered that a significant effect is associated with the development.

While noise levels at low wind speeds will increase due to the development and specifically the operation of the turbines, the predicted levels will remain low, albeit new sources of noise will be introduced into the soundscape.

The predicted residual operational turbine noise effects are summarised as follows at the closest NSL's to the site:

Quality	*Significance*	*Duration*
Negative	Moderate	Long Term

The above effect should be considered in terms that the effect is variable and that this assessment considers periods of the greatest potential effect.

For most of the locations assessed here the effect of the operational turbines are as follows:

Quality	*Significance*	*Duration*
Negative	Slight	Long Term

13.4.3.2 Assessment of Substation Noise

As previously stated, there are two options proposed as potential substation locations as part of this development. The proposed substation locations are indicated in Table 13.24.

Table 13.24: Proposed Substation Locations

Substation Option Ref.	Irish Grid Co-ordinates	
	Eastings	Northing
Option A	205,147	268,607
Option B	206,173	265,038

Details of the proposed substation options are described in Chapter 2 of the EIAR. The substation will typically be operational 24/7. The noise emission level associated with a typical substation that would support a development of this nature is the order of 93 dB(A) Lw as detailed in Figure 13.34.

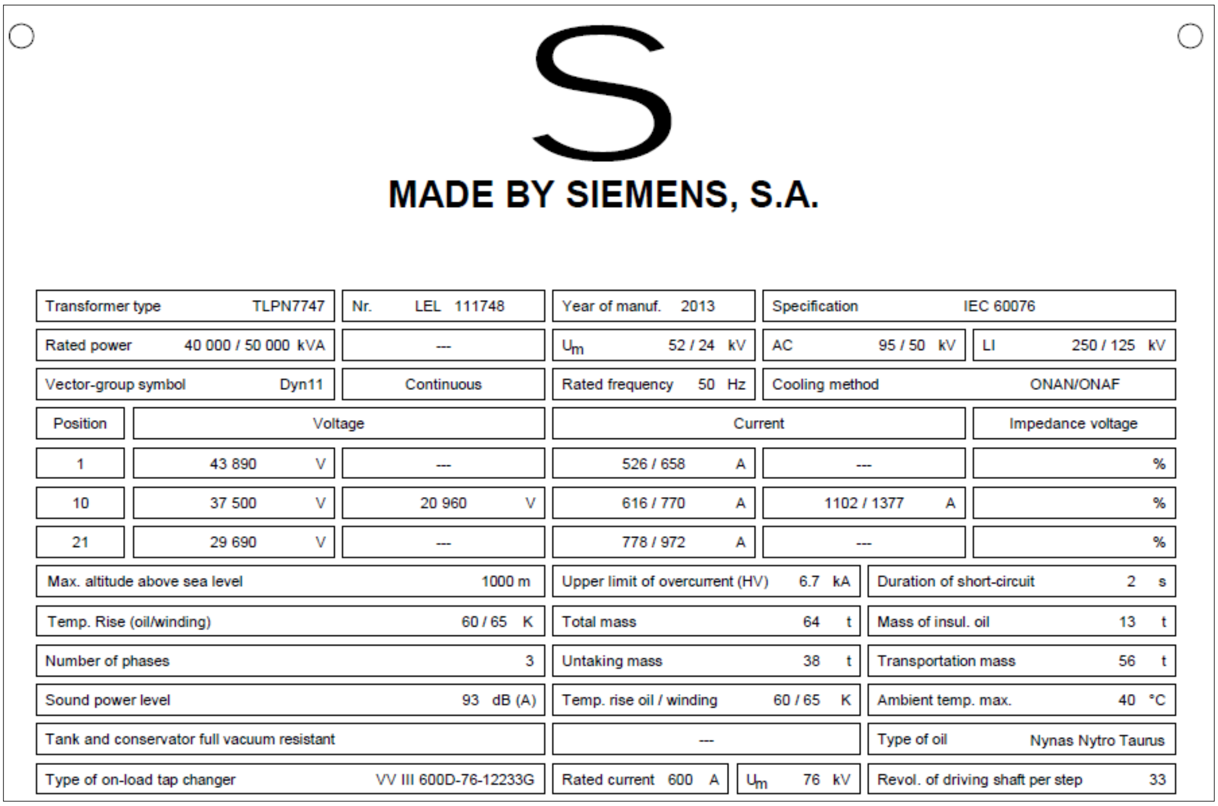


Figure 13.34: Statement of Sound Power Level (Lw) for a Typical Substation used for Assessment

An iteration of the noise model has been developed to consider the expected noise level from the operation of both substation options:

- Option A – Northern Substation
- Option B – Southern Substation.

Option A - Northern Substation

Table 13.25 presents the predicted noise levels at the nearest NSL's (i.e. the potentially most effected locations) considering the operation of the Northern Substation.

Table 13.25: Predicted Operational Noise Levels Associated with the Northern Substation

Location	Predicted L_{Aeq} dB	Location	Predicted L_{Aeq} dB
H230	25	H050	20
H552	22	H548	19
H550	21	H055	19
H223	21	H286	19
H003	21	H292	19
H551	20	H479	19
H226	20	H317	19

Location	Predicted L_{Aeq} dB	Location	Predicted L_{Aeq} dB
H004	20	H553	19
H549	20	H547	18
H480	20	H231	17
H051	20	H054	17
H224	20	H222	16
H225	20	H522	16

The highest predicted noise level associated with the operation of the Northern Substation is in the order of 25 dB(A). This level is comparable to the lower baseline noise levels measured in the area as part of the survey work undertaken for this assessment. The prediction levels are worst-case as they do not take account of screening associated with the local environment or from buildings associated with the substations. Noise from the operation of a substation will not have any significant cumulative impact on the overall noise levels associated with the operation of the proposed development at any noise sensitive location.

Option B -Southern Substation

Table 13.26 presents the predicted noise levels at the nearest NSL's (i.e. the potentially most effected locations) considering the operation of the Southern Substation

Table 13.26: Predicted Operational Noise Levels Associated with the Southern Substation

Location	Predicted $L_{Aeq,T}$ dB	Location	Predicted $L_{Aeq,T}$ dB
H067	25	H798	23
H778	24	H306	23
H806	24	H795	23
H305	24	H797	23
H801	24	H796	23
H805	24	H810	23
H800	24	H776	23
H804	24	H809	23
H799	24	H781	22
H779	24	H808	22
H777	24	H807	22
H803	23	H408	22
H802	23	H780	22

The highest predicted noise level associated with the operation of the Southern Substation is in the order of 25 dB(A). This level is comparable to the lower baseline noise levels measured in the area as part of the survey work undertaken for this assessment. Noise from the operation of a substation will not have any significant cumulative impact on the overall noise levels associated with the operation of the proposed development at any NSL.

Comment on Noise from Battery Storage Compound

There is a battery storage compound proposed to be located within the footprint of the substation. Full details of the proposed battery storage compound are outlined in Chapter 2 of the EIAR.

The contribution of noise emissions associated with the operation of the battery storage compound will not give rise to an increase in the total noise emissions for the proposed substation as outlined above. Therefore, the impact assessment presented here for the operation of the substation is representative of the cumulative noise emissions of the substation and proposed battery storage compound.

13.4.3.2.1 Description of Effects

With respect to the EPA's criteria for description of effects, the potential worst-case associated effects at the nearest NSL associated with the operation of the substation and are described below.

Quality	*Significance*	*Duration*
Negative	Not Significant	Long Term

The above effects should be considered in terms that the effect is variable and that this assessment considers the locations of the greatest potential impact.

13.4.4 Decommissioning Phase

In relation to the decommissioning phase, similar overall noise levels as those calculated for the construction phase would be expected, as similar tools and equipment will be used.

Considering that in all aspects of the construction and decommissioning the predicted noise levels are expected to be below the appropriate Category A value (i.e. 65dB $L_{Aeq,T}$) at current noise sensitive locations for the decommissioning phase.

13.5 MITIGATION MEASURES

The assessment of potential impact has demonstrated that the proposed development is expected to comply with the identified criteria for both the construction and operational phases. However, to ameliorate any noise and vibration effects, a schedule of noise control measures has been formulated for both construction and operational phases.

13.5.1 Construction Phase

Regarding construction activities, reference shall be made to BS 5228-1:2009+A1:2014 *Code of practice for noise and vibration control on construction and open sites – Noise*, which offers detailed guidance on the control of noise and vibration from construction activities. It is proposed that various practices be adopted during construction as required, including the following:

- limiting the hours during which site activities likely to create high levels of noise or vibration are permitted;
- establishing channels of communication between the contractor/developer, Local Authority and residents;
- appointing a site representative responsible for matters relating to noise and vibration;
- monitoring typical levels of noise and vibration during critical periods and at sensitive locations; and
- keeping the surface of the site access roads even to mitigate the potential for vibration from lorries.

Furthermore, a variety of practicable noise control measures will be employed. These include:

- selection of plant with low inherent potential for generation of noise and/ or vibration;
- placing of noisy / vibratory plant as far away from sensitive properties as permitted by site constraints.

13.5.1.1 Noise

The contract documents shall specify that the Contractor undertaking the construction of the works will be obliged to take specific noise abatement measures when deemed necessary to comply with the recommendations of BS 5228-1:2009+A1:2014 *Code of practice for noise and vibration control on construction and open sites – Noise*. The following list of measures will be implemented, where necessary, to ensure compliance with the relevant construction noise criteria:

- No plant used on site will be permitted to cause an on-going public nuisance due to noise.
- The best means practicable, including proper maintenance of plant, will be employed to minimise the noise produced by on site operations.
- All vehicles and mechanical plant will be fitted with effective exhaust silencers and maintained in good working order for the duration of the contract.
- Compressors will be attenuated models, fitted with properly lined and sealed acoustic covers which will be kept closed whenever the machines are in use and all ancillary pneumatic tools shall be fitted with suitable silencers.

- Machinery that is used intermittently will be shut down or throttled back to a minimum during periods when not in use.
- Any plant, such as generators or pumps, which is required to operate before 07:00hrs or after 19:00hrs will be surrounded by an acoustic enclosure or portable screen.
- During the construction programme, supervision of the works will include ensuring compliance with the limits detailed in Table 13.3 using methods outlined in BS 5228-1:2009+A1:2014 *Code of practice for noise and vibration control on construction and open sites – Noise*.
- The hours of construction activity will be limited to avoid unsociable hours where possible. Construction operations shall generally be restricted to between 7:00hrs and 19:00hrs weekdays and between 7:00hrs and 13:00hrs on Saturdays. However, to ensure that optimal use is made of good weather period or at critical periods within the programme (i.e. concrete pours) or to accommodate delivery of large turbine component along public routes it could be necessary on occasion to work outside of these hours. Any such out of hours working will be agreed in advance with the local Planning Authority.

Where rock breaking is employed in relation to the proposed borrow pit locations, the following are examples of measures that will be considered, where necessary, to mitigate noise emissions from these activities:

- Fit suitably designed muffler or sound reduction equipment to the rock breaking tool to reduce noise without impairing machine efficiency.
- Ensure all leaks in air lines are sealed.
- Erect acoustic screen between compressor or generator and noise sensitive area. When possible, line of sight between top of machine and reception point needs to be obscured.
- Enclose breaker or rock drill in portable or fixed acoustic enclosure with suitable ventilation.

Air overpressure from a blast is difficult to control because of its variability, however, much can be done to reduce the effect. A reduction in the amount of primer cord used, together with the adequate burial of any that is above the ground, can give dramatic reduction to air overpressure intensities especially in the audible frequency range. Most complaints are likely to be received from an area downwind of the blast site, and therefore, if air blast complaints are a continual problem, it would be advisable to postpone blasting during unfavourable weather conditions if possible. As air blast intensity is a function of total charge weight, then a reduction in the total amount of explosives used can also reduce the air overpressure value.

Further guidance will be obtained from the recommendations contained within BS 5228: Part 1 and the *European Communities (Construction Plant and Equipment) (Permissible Noise Levels) Regulations 1988* in relation to blasting operations.

The methods used to minimise effects may consist of some or all the following:

- Restriction of hours within which blasting can be conducted.
- A publicity campaign undertaken before any work and blasting starts (e.g. 48 hours written notification).
- The firing of blasts at similar times to reduce the 'startle' effect.
- On-going circulars informing people of the progress of the works.
- The implementation of an onsite documented complaints procedure.
- The use of independent monitoring by external bodies for verification of results.
- Trial blasts in less sensitive areas to assist in blast designs and identify potential zones of influence.

13.5.1.2 Vibration

It is recommended that vibration from construction activities be limited to the values set out in Table 13.1 It should be noted that these limits are not absolute but provide guidance as to magnitudes of vibration that are very unlikely to cause cosmetic damage. Magnitudes of vibration slightly greater than those in the table are normally unlikely to cause cosmetic damage, but construction work creating such magnitudes should proceed with caution. Where there is existing damage these limits may need to be reduced by up to 50%.

With regards to piling it is considered that, based on the large distances between locations where piling will take place and the nearest NSL's, no significant impact will be experienced. Therefore, no mitigation measures are proposed.

Specific to blasting, the following mitigation measures will be employed to control the impact during blasts:

- Trial blasts will be undertaken to obtain scaled distance analysis.
- Ensuring appropriate burden to avoid over or under confinement of the charge.
- Accurate setting out and drilling.
- Appropriate charging.
- Appropriate stemming with appropriate material such as sized gravel or stone chipping.
- Delay detonation to ensure small maximum instantaneous charges.
- Decked charges and in-hole delays.

- Blast monitoring to enable adjustment of subsequent charges.
- Good blast design to maximise efficiency and reduce vibration.
- Avoid using exposed detonating cord on the surface.

13.5.2 Operational Phase

An assessment of the operation noise levels has been undertaken in accordance with best practice guidelines and procedure as outlined in Section 13.4.3. There are no locations highlighted in this document where the proposed development in combination with the existing Sliabh Bawn wind farm exceeds the adopted day or night time noise criteria and therefore no mitigation measures are required.

If alternative turbine technologies are considered for the site an updated noise assessment will be prepared to confirm that the noise emissions associated with them satisfy the noise criteria curves outlined in this assessment. If necessary suitable curtailment strategies will be designed and implemented for alternative technologies to ensure compliance with the relevant noise criteria curves, should detailed assessment conclude that this is necessary.

In the unlikely event that an issue with low frequency noise is associated with the proposed development, it is recommended that an appropriate detailed investigation be undertaken. Due consideration should be given to guidance on conducting such an investigation which is outlined in *Appendix VI* of the EPA document entitled *Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4)* (EPA, 2016). This guidance is based on the threshold values outlined in the Salford University document *Procedure for the assessment of low frequency noise complaints*, Revision 1, December 2011.

In the unlikely event that an issue of AM is associated with the proposed development, an appropriate investigation shall be undertaken in accordance with the guidance outlined in the Institute of Acoustics (IoA) Noise working Group (Wind Turbine Noise) Amplitude Modulation Working Group (AMWG) namely, *A Method for Rating Amplitude Modulation in Wind Turbine Noise* (August 2016) or subsequent revisions.

13.5.3 Decommissioning Phase

The mitigation measures that will be considered in relation to any decommissioning of the site are the same as those proposed for the construction phase of the development, i.e. as per Section 13.5.1.

13.5.4 Monitoring

Commissioning noise surveys are recommended to ensure compliance with any noise conditions applied to the development. In the unlikely instance that an exceedance of these noise criteria is identified, the assessment guidance outlined in the IoA GPG and *Supplementary Guidance Note 5: Post Completion Measurements (July 2014)* should be followed and relevant corrective actions will be taken. For example, implementation of Noise operational modes resulting in curtailment of turbine operation can be implemented for specific turbines in specific wind conditions to ensure predicted noise levels are within the relevant noise criterion curves/planning conditions. Such curtailment can be applied using the wind farm SCADA system without undue effect on the wind farm operations.

For post-commissioning of the proposed turbine units, it is recommended that the noise monitoring detailed in the relevant section of this report be repeated with consideration of the guidance outlined in the IoA GPG and Supplementary Guidance Note 5.

13.6 RESIDUAL IMPACTS

This section summarises the likely residual noise and vibration effects associated with the proposed development following the implementation of mitigation measures.

13.6.1 Construction Phase

During the construction phase of the project there will be some effect on nearby noise sensitive properties due to noise emissions from site traffic and other construction activities. However, given the distances between the main construction works and nearby noise sensitive properties and the fact that the construction phase of the development is temporary in nature, it is expected that the various noise sources will not be excessively intrusive. Furthermore, the application of binding noise limits and hours of operation, along with implementation of appropriate noise and vibration control measures, will ensure that noise and vibration effect is kept to a minimum.

With respect to the EPA's criteria for description of effects, in terms of these construction activities, the potential worst-case associated effects at the nearest noise sensitive locations associated with the various elements of the construction phase are described below.

13.6.1.1 General Construction - Turbines and Hardstandings

Quality	*Significance*	*Duration*
Negative	Slight	Short-term

The above effects should be considered in terms that the effect is variable and that this assessment considers the locations of the greatest potential impact.

13.6.1.2 Borrow Pit Activity

Quality	*Significance*	*Duration*
Negative	Slight	Temporary

The above effects should be considered in terms that the effect is variable and that this assessment considers the locations of the greatest potential impact.

13.6.1.3 Substation Construction

Quality	*Significance*	*Duration*
Negative	Slight	Temporary

The above effects should be considered in terms that the effect is variable and that this assessment considers the locations of the greatest potential impact.

13.6.1.4 Grid Connection Construction

Quality	*Significance*	*Duration*
Negative	Slight	Temporary

The above effects should be considered in terms that the effect is variable and that this assessment considers the locations of the greatest potential impact.

13.6.1.5 Internal Road Construction

Quality	*Significance*	*Duration*
Negative	Slight	Temporary

The above effects should be considered in terms that the effect is variable and that this assessment considers the locations of the greatest potential impact.

13.6.1.6 Additional Traffic on Public Roads

Quality	*Significance*	*Duration*
Negative	Not significant	Temporary

13.6.2 Operational Phase

13.6.2.1 Wind Turbine Operation

The predicted noise levels associated with the proposed development will be within best practice noise criteria curves recommended in Irish guidance '*Wind Energy Development Guidelines for Planning Authorities* it is not considered that a significant effect is associated with the development.

While noise levels at low wind speeds will increase due to the development and specifically the operation of the turbines, the predicted levels will remain low, albeit new sources of noise will be introduced into the soundscape.

The predicted residual operational turbine noise effects are summarised as follows at the closest noise sensitive locations to the site:

Quality	*Significance*	*Duration*
Negative	Moderate	Long Term

The above effect should be considered in terms that the effect is variable and that this assessment considers periods of the greatest potential effect.

For most of the locations assessed here the effect of the operational turbines are as follows:

Quality	*Significance*	*Duration*
Negative	Slight	Long Term

13.6.2.2 Substation Operation

In relation to the proposed substation locations the associated effect at the closest noise sensitive locations is summarised as follows:

Quality	*Significance*	*Duration*
Negative	Not Significant	Long Term

13.6.3 Vibration

There are no expected sources of vibration associated with the operational phase of the proposed development. In relation to vibration the associated effect is summarised as follows:

Quality	*Significance*	*Duration*
Neutral	Imperceptible	Long Term

13.6.4 Cumulative Effects

This assessment has considered the potential cumulative impacts of the proposed development in combination with other wind energy developments in the area as required by best practice guidance discussed in Section 13.2.3.1.

Cumulative assessment has been considered here with due consideration of the proposed development in combination with the operational Sliabh Bawn wind farm development as noted in Section 13.2.3.5. The description of effects presented for the operational phase of the proposed development includes cumulative effects.

Consideration has been giving to the cumulative impacts of the proposed development in combination with the operation of the ESB Power Station situated outside the town of Lanesborough. It is noted that the wind turbine guidelines do not require that the cumulative impacts of these developments to be assessed. However, review of the predicted operational noise levels of the proposed turbines at noise sensitive locations closest to the Power Station confirms that the predicted turbines noise levels are significantly below the standard operational noise limits that would be typically applied to a Power Station Development therefore there will be no cumulative impacts.

14 TRAFFIC AND TRANSPORT

14.1 INTRODUCTION

14.1.1 Background and Objectives

The purpose of this section is to assess the effects on traffic and transport of the additional traffic movements that will be generated by the Proposed Development. The assessment assesses potential effects during both the construction and operational phases of the Proposed Development. A full description of the proposed project, including construction phasing details, is provided in Chapter 2 of this EIAR, “Description of the Proposed Development”.

For developments of this nature, the construction phase is the critical period with respect to the traffic effects experienced on the surrounding road network, in terms of both the additional traffic volumes that will be generated on the road network, and the geometric requirements of the abnormally large loads associated with the wind turbine plant. The requirements of the additional traffic and abnormal loads generated during the construction stage were assessed on both the external highway network, and at the proposed junctions that will provide access to the site. Locations where remedial measures are required to accommodate the abnormal loads are identified.

The magnitude of the increase in traffic volumes experienced on the surrounding network is identified during the various construction stages of the Proposed Development. A preliminary traffic management plan is also provided in Sections 14.5.3 and 14.8 aimed at minimising the traffic impact on the local highway network. Refer also to the Construction and Environmental Management Plan (CEMP), Appendix 2.2 of this EIAR, for the Traffic Management Plan.

14.1.2 Statement of Authority

This section of the EIAR has been prepared by Alan Lipscombe of Alan Lipscombe Traffic and Transport Consultants Ltd. Alan has a BEng (hons) degree in Transportation Engineering awarded by Napier University in Edinburgh in 1989 and is a competent expert in traffic and transport assessments. In 2007 Alan set up a traffic and transportation consultancy providing advice for a range of clients in the private and public sectors. Prior to this Alan was a founding member of Colin Buchanan’s Galway office having moved there as the senior transportation engineer for the Galway Land Use and Transportation Study. Since the completion of that study in 1999, Alan has worked throughout Ireland on a range of projects including: major development schemes, the Galway City Outer Bypass, Limerick Planning Land-Use and Transportation Study, Limerick Southern Ring Road Phase II, various studies for the NUI Galway and many wind and solar farm developments. Before moving to Galway in 1997, Alan was involved in a wide variety of traffic and transport studies for CBP throughout the UK, Malta and Indonesia. He has particular expertise in development related traffic and transport assessments, including over 30 wind farm developments.

14.1.3 Guidance and Legislation

This section of the EIAR has been completed in accordance with the guidance set out in Chapter 1. The assessment uses standard terminology to describe the likely significant effects associated with the Proposed Development. Further information on the classification of effects used in this assessment is presented in Section 1.8.2 of this EIAR.

14.1.4 Scoping & Consultation

The scope of this section of the EIAR has been informed through the scoping and consultation of relevant local authorities (Longford, Roscommon and Westmeath County Councils) and Transport Infrastructure Ireland. The key scoping response points received from these statutory consultees are summarised in Section 1.10.2 and 1.10.3 in Chapter 1 of this EIAR.

14.2 METHODOLOGY AND SECTION STRUCTURE

The report adopts the guidance for such assessments set out by Transport Infrastructure Ireland, or TII, in the document PE-PDV-02045 "*Traffic and Transport Assessment Guidelines, May 2014'*. The geometric requirements of the transporter vehicles were assessed using Autocad and Autotrack.

The Traffic and Transport Section of the EIAR is set out as follows:

- A review of the existing and future transport infrastructure in the vicinity of the Proposed Development, including an assessment of 2017 traffic flows and traffic forecasts during an assumed construction year of 2021 (Section 14.3 – Existing Environment);
- A description of the nature of the Proposed Development and the traffic volumes that it will generate during the different construction stages and when it is operational (Section 14.4 – Proposed Development and Traffic Generation);
- A description of the abnormally large loads and vehicles that will require access to the site and a review of the traffic impacts on the proposed delivery routes (Section 14.5 – Traffic Impacts, Route assessment and traffic Management);
- A review of the potential impacts of the Proposed Development (Section 14.6 – Potential Impacts);
- An assessment of cumulative impacts with other developments (Section 14.7 – Cumulative Effects);

- An identification of mitigation measures – (Section 14.8 – Mitigation Measures); and
- An assessment of residual impacts – (Section 14.9 – Residual Impacts).

14.3 EXISTING ENVIRONMENT

14.3.1 Site Location

The site of the proposed development is located in County Longford, and is shown in the context of the national and local highway networks in Figure 14.1. The western extent of the site is approximately 2 kilometres east of Lanesborough, with the site extending approximately 8kms in the west-east direction, and 9kms in the north-south direction. The townlands in which the proposed development site is located, including the potential grid connection options and ancillary works, are listed in Section 1.2, Chapter 1 of this EIAR.

14.3.2 Proposed Abnormal Load Delivery Route

The proposed port of arrival for the wind farm plant has not been identified, however, for the purpose of this assessment it is assumed that the large wind farm components will be delivered via the M6 motorway in the proximity of Athlone.

2 No. reports were prepared by TOBIN Consulting Engineers (*"Derryadd Wind Farm Haul Route Assessment Preliminary Report*" and *"Haul Route Assessment, N6 Junction 12, Preliminary Scope of Works"*) that established that the optimum delivery route from the M6 to the site for the abnormally large loads would be as follows;

- Exit the M6 at Junction 12 and travel north on N61 for approximately 48 kms to Roscommon;
- Turn right on the N61 in Roscommon at the Circle K roundabout, and continue straight through the Roscommon Mart Roundabout on the N61;
- Turn right of the N61 onto the N63 at the Lidl Roundabout in Roscommon;
- Travel east on the N63 for approximately 15 kms to Lanesborough; and
- Turn right onto R392 and travel southeast for approximately 6.5km to proposed site access.

The assessment of the abnormal load delivery route, which is shown in Figure 14.1 and discussed in Section 14.5, covers the locations of the external road network access junctions shown in Figure 14.5a and 14.5b respectively.

The TOBIN Reports are included in Appendix 14.1.

14.3.3 Proposed Construction Traffic Haul Route

The proposed route to the site of the Proposed Development, for general HGV construction traffic, consists of the route proposed for the turbine plant traffic that travels through Lanesborough, and then splits with deliveries accessing the site at site Access Junction 1 on the N63, or accessing the site via site Access Junction 2 on the R392, as indicated on Figures 14.2 and 14.5b.

Standard HGV deliveries will also be made from the east on the N63, and from the south on the R392. The foremost routes described above are, however, for the purpose of this assessment, assumed to carry all development traffic in order to test the maximum impact on the proposed routes.

14.3.4 Existing Traffic Volumes

It should be noted that traffic volumes are discussed in terms of vehicles or passenger car units (pcus) where each vehicle is expressed in terms of its demand on the network relative to the equivalent number of cars. For example, an articulated HGV is given a factor of 2.4 passenger car units (as per TII Project Appraisal Guidelines for National Roads Unit 5.2), while one of the extended loaders required to transport the wind turbine equipment was assigned a value of 10.

Continuous traffic counters are maintained by Transport Infrastructure Ireland (TII) on the N61 between Athlone and Roscommon, and the N63 between Roscommon and Lanesborough, Average Annual Daily Traffic (AADT) volume data is available for both of these locations. This information, together with short term traffic counts undertaken on various links on the delivery route, on Wednesday 17th May, 2017 (between the hours of 17:00 and 18:00), was used to provide sample background traffic volumes on the study road network.

Daily flow profiles were applied to the short period traffic counts using the data from the continuous traffic counter site on the N63 which shows that the average annual daily traffic flow, or AADT, is 10.97 times the flow observed during the hour of 17:00 to 18:00, as shown in Tables 14.1. Existing traffic volumes on all 5 points on the delivery route are shown in Table 14.2 and range from 7,802 vehicles per day on the N61 between Athlone and Roscommon down to 2,424 vehicles on the R392 just north of the proposed Access Junction 2.

Table 14.1: Observed flow in PM peak hour, all day factor and all day flow, 2017 (2-way vehicles)

Link	2-way flow	Observed hour	AADT factor	All day
N63 through Lanesborough	651	17:00 - 18:00	10.97	7,141
R392 south of Lanesborough	385	17:00 - 18:00	10.97	4,223
R392 north of access	221	17:00 - 18:00	10.97	2,424

Table 14.2: Average all day flows (AADT) by location, year 2017 (2-way vehicles)

Link	2017
N61 south of Roscommon	7,802
N63 east of Roscommon	4,585
N63 east of Lanesborough	7,141
R392 south of Lanesborough	4,223
R392 north of access	2,424

14.3.5 Future background traffic volumes

Revised guidelines for forecasting annual growth in traffic volumes were produced by the TII in October 2016, as set out by region in PE-PAG-02017 Travel Demand Projections (Unit 5.3). The delivery routes to the site are primarily in Counties Roscommon and Longford. The annual growth rate for light vehicles for the West Region, including County Roscommon, is 0.82%, while the rate for the Midland Region, including County Longford is 1.2% per year. Taking an average of these rates equates to +4.1% from 2017 to 2021 assuming a medium growth scenario. Year 2017 and 2021 AADT flows on the study area network are compared in Table 14.3.

Table 14.3: Average all day flows (AADT) by location and year (2-way vehicles)

Link	2017	2021
N61 south of Roscommon	7,802	8,122
N63 east of Roscommon	4,585	4,773
N63 east of Lanesborough	7,141	7,434
R392 south of Lanesborough	4,223	4,397
R392 north of access	2,424	2,524

The TII traffic count data recorded on the N61 and N63 were also used to estimate the existing percentage of HGVs on the study area network. The observed percentage of HGVs was 5.5% on the N61, with the rate of 4.9% observed on the N63 assumed for the other links on the route, with volumes on the study network shown in terms of vehicles and passenger car unit (pcus) in Table 14.4.

Table 14.4: AADT, percentage HGV's and volumes by vehicle type, by location, year 2021

Link	AADT (vehs)	% HGV's	Vehicles		PCUs		
			HGV flows	Cars / LGV's	HGV flows	Cars / LGV's	Total
N61 south of Roscommon	8,122	5.5%	447	7,675	1,072	7,675	8,747
N63 east of Roscommon	4,773	4.9%	234	4,539	561	4,539	5,100
N63 east of Lanesborough	7,434	4.9%	364	7,070	874	7,070	7,944
R392 south of Lanesborough	4,397	4.9%	215	4,181	517	4,181	4,698
R392 north of access	2,524	4.9%	124	2,400	297	2,400	2,697

14.4 PROPOSED DEVELOPMENT AND TRAFFIC GENERATION

14.4.1 Development Trip Generation - During Construction

For the purpose of assessing the effects of traffic generated during the construction of the Proposed Development, the construction phase is considered in two stages.

- Stage 1 - Site preparation, groundworks, and grid connection cable laying, and
- Stage 2 - Turbine construction.

With respect to the traffic impact assessment, assumptions based on typical wind farm construction projects regarding the length of the construction phases must be made to inform the assessment. These assumptions allow for a worst case scenario assessment but should not be inferred as prescriptive limitations to the construction phase. There are numerous variables which can affect a construction project programme, including weather. The construction phase of the proposed development will be carried out in accordance with the CEMP, included as Appendix 2.2 of this EIAR, which will be agreed, where required, with the Local Authority.

Stage 1 - Site Preparation ground works and cable laying

The construction phase of the Proposed Development is expected to last approximately 24 months. For assessment purposes, 600 working days have been assumed for the site preparation and ground works stage with the total numbers of deliveries made to the site during that period shown in Table 14.5. The 24 months represents a worst case scenario in terms of daily impact based on the maximum number of movements generated in the shortest timeframe.

During this construction phase there will be two distinct types of days with respect to trip generation. A total of 24 days will be used to pour the 24 concrete wind turbine foundations. Foundations will likely be poured one per day, with circa 75 concrete loads required for each turbine delivered to the site over a 12-hour period, resulting in just over 6 HGV trips to and from the site per hour. On the remaining 576 working days for this stage other general materials will be delivered to the site.

During all of Stage 1, it is estimated that 36,374 two-way trips will be made to the site by trucks and large articulated HGVs, as set out in Table 14.5, with the daily effect on the local road network shown in Tables 14.6 and 14.7.

For the purpose of this assessment, it is assumed that the grid connection between the two substation options (A and B) identified in Figure 2.1 and the national grid will be by overhead line at the Lanesborough / Richmond 110 KV line (Option A), or the Lanesborough / Mullingar KV line (Option B) by either overhead line or underground cable. Of the options indicated, Substation Option B using underground cable would have the greatest effects with respect to traffic, as it would include a 300m length of underground cable running parallel to the R392 between the substation and the existing 110 KV line located on the west side of the R392. Substation Option A would not require any underground cabling external to the site.

The figures show that on the 24 days that concrete will be delivered to the site an additional 360 two-way pcus will be added to the network (comprising 75 two-way HGV trips with 2.4 PCUs per movement), as shown in Table 14.6. Similarly, on the 576 days when other materials will be delivered to the site, traffic volumes on the local network will increase by an average of 288 PCUs, as set out in Table 14.7.

Table 14.5: General construction materials - total movements

Material	Total no Truck Loads	Truck type
Concrete	1,800	Trucks
Concrete blinding and steel	263	Large artic
Plant / fencing / compound set-up	57	Large artic
Forestry felling	0	Large artic
Crushed rock and sand	33,333*	Large artic
Ducting / cabling	706	Large artic
Grid cable laying	60	Large artic
Cranes	13	Large artic

Substation	90	Large artic
Re-fuelling / maintenance / misc	52	Large artic
Total	36,374	

** Based on 600,000m³ @ 18m³ per load = 33,333 loads*

Table 14.6: General construction materials - total movements and volumes per delivery day

Material	Total no Truck Loads	Truck type	Deliveries / day	PCU Value	Total PCUs	Movements / day (PCU's)	2- way PCU's / day
Concrete	1,800	Trucks	75	2.4	4,320	180.0	360.0

** Based on 24 foundation pouring days*

Table 14.7: General construction materials - total movements and volumes per delivery day

Material	Total no Truck Loads	Truck type	Deliveries / day (ave)	PCU Value	Total PCU's	Movements / day (PCUs)*	2- way PCU's / day
Concrete blinding and steel	263	Large artic	0.5	2.4	631.2	1.1	2.2
Plant / fencing / compound set-up	57	Large artic	0.1	2.4	136.8	0.2	0.5
Forestry felling	0	Large artic	0.0	2.4	0.0	0.0	0.0
Crushed rock and sand	33,333	Large artic	57.9	2.4	79,999.2	138.9	277.8
Ducting / cabling	706	Large artic	1.2	2.4	1,694.4	2.9	5.9
Grid cable laying	60	Large artic	0.1	2.4	144.0	0.3	0.5
Cranes	13	Large artic	0.0	2.4	31.2	0.1	0.1
Substation	90	Large artic	0.2	2.4	216.0	0.4	0.8
Re-fuelling / maintenance / misc	52	Large artic	0.1	2.4	124.8	0.2	0.4
Total	34,574		60		82,977.6	144.1	288.1

** Based on ground work period of 576working days*

Stage 2 - Turbine Construction

During the turbine construction stage, including delivery and assembly, there will be deliveries to the site made by very large vehicles, referred to in this section as extended artics, transporting the component parts of the turbines (nacelles, blades and towers) and there will be deliveries made by normal large HGVs, transporting cables, tools and smaller component parts. The types of load and associated numbers of trips made to the site during the turbine construction period are shown in Table 14.8, which summarises that a total of 216 trips will be made to and from the site by extended artics, with a further 96 trips made by conventional large articulated HGVs.

Table 14.8: Wind turbine plant - total movements

Material	Units	Quantity per unit	Total quantity	Quantity per vehicle	Total no vehicle loads	Truck type
Nacelle	24	1	24	1	24	Extended Artic
Blades	24	3	72	1	72	Extended Artic
Towers	24	5	120	1	120	Extended Artic
Sub total					216	
Transformer	24	1	24	1	24	Large Artic
Drive train and blade hub	24	1	24	1	24	Large Artic
Base & other deliveries	24	2	48	1	48	Large Artic
Sub total					96	
Total					312	

For the purpose of this assessment, an assumed delivery period is provided, although it may be subject to change. It is assumed that the turbine delivery element will progress at the rate of approximately 5 extended artic trips made by convoy to the site on approximately 2 days per week, resulting in this stage taking approximately 43 days spread over an assumed 22 week period (generally delivered at night time). On a further two days per week, lasting for approximately 12 weeks, the remaining equipment required during this phase will be delivered to the site. The additional traffic movements for these two types of days are summarised in Tables 14.9 and 14.10. In Table 14.9 a PCU equivalent value of 10 was allocated to each extended artic movement, resulting in an additional 100 PCUs on the study network on these 2 days per week, while an additional 19.2 PCUs are forecast to be on the network on two other days per week, as shown in Table 14.10, during the turbine construction phase.

Table 14.9: Wind turbine plant - large vehicles - total movements and volumes per delivery day

Material	Units	Truck type	PCU Value	Total PCUs	2- way PCUs / day
Nacelles / blades / towers	5	Extended Artic	10	50	100.0

** Based on 5 vehicles per day for 43 days (total of 216 loads)

Table 14.10: Wind turbine plant - normal vehicles - total movements and volumes per delivery day

Material	Units	Quantity per Unit	PCU Value	Total PCU's	2- way PCU's / day
Transformer	1	1	2.4	2.4	4.8
Drive train and blade hub	1	1	2.4	2.4	4.8
Other deliveries	1	2	2.4	4.8	9.6
Total	3			9.6	19.2

** Based on equipment being delivered on 24 separate days

14.4.2 Construction Employee Traffic

It is estimated that a maximum of 120 staff members will be employed on the site at any one time during the site preparation and groundworks stage of construction, reducing to a maximum of 80 staff at any one time during the turbine construction stage. If a worst case is assumed that all staff will travel to / from the site by car, at an average of 2 persons per car, then a total of 120 pcu movements (each trip is two way) will be added to the network during the groundworks stage of the development, reducing to 80 pcu trips during the turbine construction stage.

14.4.3 Development Trip Generation - During Operation

The only traffic associated with the operational phase of the wind farm will be from the wind farm operators and maintenance personnel who will visit individual turbines.

It is estimated that the traffic volumes that will be generated by the development once it is operational will be minimal. The impact on the network of these trips during the operational stage is discussed in Section 14.5.2.

14.4.4 Construction Traffic Vehicles

The delivery of turbine components including blades, tower sections and nacelles is a specialist operation owing to the oversized loads involved. The blades are the longest turbine component and in the case of the Proposed Development, 65.0m blades have been considered for the purposes of this assessment. The key dimensions are as follows:

Transport of Blades – Articulated HGV with blade

Total length	70.0 m
Length of blade	65.0 m
Inner radius	28.0 m

Transport of Tower – Using low-bed or drop deck trailers

Total length (with load)	46.7 m
Length of load	29 m
Inner radius	25.0 m

The critical vehicles in terms of size and turning geometry requirements, and used in the detailed route assessment discussed in Section 14.1.7 are the blade transporter and the tower transporter vehicles, with the geometry of each shown in Figures 14.3 and 14.4 respectively.

The vehicles used to transport the nacelles will be similar to the tower transporter although will be shorter in length.

All other vehicles requiring access to the site will be standard HGVs and will be significantly smaller than the design test vehicles.

14.5 TRAFFIC IMPACTS, ROUTE ASSESSMENT AND TRAFFIC MANAGEMENT

14.5.1 Traffic Effects During Construction

It should be noted that for the purpose of the assessment presented in this section all vehicles, travelling to and from the site of the Proposed Development, have been assumed to do so from the same direction. While this will be the case for the large turbine component parts, which will all be delivered from the direction of the M6 in Athlone, other deliveries in reality could be split from various directions. For example, during the main groundworks and construction stage when a maximum of 60 HGV's will travel to and from the site each day, all are assumed to travel from the direction of Roscommon, while in reality some will travel from the direction of Longford in the east, and Ballymahon in the south. The following assessment of the impacts on the N61, N63 and R392 is therefore based on the worst case scenario, where all traffic generated by the Proposed Development travels to/from the site from the same direction.

It is also noted that for the purpose of clarity, the traffic impacts on the various roads leading to the access junctions are assessed for each construction stage separately, while in reality there will be a degree of overlap. For example, there could be the instance when concrete deliveries (maximum of 75) are made to the site via one access junction on a particular day, while large turbine components are delivered via another access junction during the night or stone deliveries made through another additional access junction during the day.

Effect on Link Flows – During Construction

The traffic volumes generated on the N63 and R392 approaches to the site during the construction stage are impacted by both the junction strategy and by the location of the turbines within the site. With respect to junction strategy the following rules will apply;

1) For general deliveries to the site up to the size of a standard large articulated HGV, deliveries will be distributed between Access Junction 1 on the N63, and Access Junction 2 on the R392, as shown in Figure 14.5b. This is based on the assumption that deliveries to turbines 1 to 12 will be made via the former, and turbines 13 to 24 via the later.

2) The majority of standard deliveries made to turbines 18 to 24, which are situated to the south of the R398, will travel south on the R392 and will access the site at Access Junction 2. These deliveries will then be required to cross the R398 at Access junction 3 to the southern part of the site. It is expected that there will be a nominal number of deliveries to the southern part of the site that will approach from the south on the R392. These trips will turn right onto the R398 in Derraghan Village and enter the site via Access Junction 3 on the R398.

3) All extended vehicles transporting turbine blades, towers and nacelles, will gain access to the site via Access Junction 2 located on the R392. Components for turbines 1 to 9 will then be transported northward to cross the N63 at Access junction 1, and those for turbines 18 to 24 south to cross the R398 at Access Junction 3.

Background traffic volumes and development generated traffic volumes are shown for the three typical construction day scenarios discussed in Section 14.4 in Tables 14.11 to 14.14 and are summarised in Tables 14.15 to 14.18. While the actual figures presented in the tables will be subject to change, they are considered to be a robust estimation of likely effects.

In terms of daily traffic flows the potential effects may be summarised as follows:

During Stage 1 – Concrete Pouring

For 24 days when the concrete foundations are poured, an additional 480 pcus will travel on the delivery route to and from the site. On these days the percentage increase in traffic volumes experienced will range from +5.5% on the N61 south of Roscommon, to +17.8% on the R392 just to the north of Access Junction 2. Applying the worst case scenario, the effects of the development generated traffic will be experienced during this stage on the western part of the delivery route (i.e. the N61 south of Roscommon and on the N63 between Roscommon and Lanesborough) on all 24 days, however as the delivery route splits via the N63 and R392 to the east and south of Lanesborough respectively, the effects will be incurred on these links on 12 days each.

During Stage 1 - Site Preparation and Groundworks

For the remaining 576 days when general site preparation and groundworks are undertaken, an additional 408 pcus will travel on the delivery route. On these days the percentage increase in traffic volumes are forecast to range from +4.7% on the N61 south of Roscommon, to +15.1% on the R392 south of Lanesborough towards Access Junction 2. It is estimated that the effects will be experienced on the western part of the delivery route on all 576 days, and on the N63 and R392 approaching Access Junctions 1 and 2 respectively, on 288 days each.

During Stage 2 - Turbine Construction Stage – Delivery of large equipment using extended articulated vehicles

The additional 180 PCUs (made up of cars and large extended artics) will appear on the study network for 43 days. On the days this impact occurs, increases in traffic volumes are forecast to increase ranging from +2.1% on the N61 to +6.7% on the R392. It is noted that the N63 to the east of Lanesborough will not incur any additional traffic during this stage.

The most significant traffic impact may be experienced during these days primarily due to the slow speeds, size and geometric requirements of these vehicles, although these may significantly reduce if these deliveries are made during night time hours. The provision of traffic management measures, included in Sections 14.5.3 and 14.8 and included in the CEMP, will be required to minimise the impact of development traffic on the study network on these days.

During Stage 2 - Turbine Construction Stage – Other deliveries using conventional articulated HGVs

For 24 days during the turbine construction stage when other deliveries are made to the site using standard HGV's, an additional 95 pcus will travel on the delivery route to and from the site. On these days the percentage increase in traffic volumes experienced will range from +1.1% on the N61 south of Roscommon, to +3.5% on the R392 just to the north of Access Junction 2. Again, the impacts will be split evenly to 12 days each on the N63 and R392 approaches to the site.

Table 14.11: Effects of development traffic during concrete pouring

Link	Background PCUs			Development PCUs			Total PCUs		
	Car	HGV	Total	Car	HGV	Total	Car	HGV	Total
N61 south of Roscommon	7,675	1,072	8,747	120	360	480	7,795	1,432	9,227
N63 east of Roscommon	4,539	561	5,100	120	360	480	4,659	921	5,580
N63 east of Lanesborough	7,070	874	7,944	120	360	480	7,190	1,234	8,424
R392 south of Lanesborough	4,181	517	4,698	120	360	480	4,301	877	5,178
R392 north of access	2,400	297	2,697	120	360	48	2,520	657	3,177

Table 14.12: Effects of development traffic during site preparation and groundworks

Link	Background PCUs			Development PCUs			Total PCUs		
	Car	HGV	Total	Car	HGV	Total	Car	HGV	Total
N61 south of Roscommon	7,675	1,072	8,747	120	288	408	7,795	1,360	9,155
N63 east of Roscommon	4,539	561	5,100	120	288	408	4,659	849	5,508
N63 east of Lanesborough	7,070	874	7,944	120	288	408	7,190	1,162	8,352

R392 south of Lanesborough	4,181	517	4,698	120	288	408	4,301	805	5,106
R392 north of access	2,400	297	2,697	120	288	408	2,520	585	3,105

Table 14.13: Effects of development traffic turbine construction - extended Artic

Link	Background PCUs			Development PCUs			Total PCUs		
	Car	HGV	Total	Car	HGV	Total	Car	HGV	Total
N61 south of Roscommon	7,675	1,072	8,747	80	100	180	7,755	1,172	8,927
N63 east of Roscommon	4,539	561	5,100	80	100	180	4,619	661	5,280
N63 east of Lanesborough	7,070	874	7,944	80	100	180	7,150	974	8,124
R392 south of Lanesborough	4,181	517	4,698	80	100	180	4,261	617	4,878
R392 north of access	2,400	297	2,697	80	100	180	2,480	397	2,877

Table 14.14: Effects of development traffic turbine construction - other deliveries

Link	Background PCUs			Development PCUs			Total PCUs		
	Car	HGV	Total	Car	HGV	Total	Car	HGV	Total
N61 south of Roscommon	7,675	1,072	8,747	80	15	95	7,755	1,087	8,842
N63 east of Roscommon	4,539	561	5,100	80	15	95	4,619	576	5,195
N63 east of Lanesborough	7,070	874	7,944	80	15	95	7,150	889	8,039
R392 south of Lanesborough	4,181	517	4,698	80	15	95	4,261	532	4,793
R392 north of access	2,400	297	2,697	80	15	95	2,480	312	2,792

Table 14.15: Summary impact of development traffic during concrete pouring

Link	Background	Development	Total	% increase	No days
N61 south of Roscommon	8,747	480	9,227	5.5%	24
N63 east of Roscommon	5,100	480	5,580	9.4%	24
N63 east of Lanesborough	7,944	480	8,424	6.0%	12
R392 south of Lanesborough	4,698	480	5,178	10.2%	12
R392 north of access	2,697	480	3,177	17.8%	12

Table 14.16: Summary impact of development traffic during site preparation and groundworks

Link	Background	Development	Total	% increase	No days
N61 south of Roscommon	8,747	408	9,155	4.7%	576
N63 east of Roscommon	5,100	408	5,508	8.0%	576
N63 east of Lanesborough	7,944	408	8,352	5.1%	288

R392 south of Lanesborough	4,698	408	5,106	8.7%	288
R392 north of access	2,697	408	3,105	15.1%	288

Table 14.17: Summary impact of development traffic turbine construction – Extended Artics

Link	Background	Development	Total	% increase	No days
N61 south of Roscommon	8,747	180	8,927	2.1%	43
N63 east of Roscommon	5,100	180	5,280	3.5%	43
N63 east of Lanesborough	7,944	NA	NA	NA	0
R392 south of Lanesborough	4,698	180	4,878	3.8%	43
R392 north of access	2,697	180	2,877	6.7%	43

Table 14.18: Summary impact of development traffic turbine construction - other deliveries

Link	Background	Development	Total	% increase	No days
N61 south of Roscommon	8,747	95	8,842	1.1%	24
N63 east of Roscommon	5,100	95	5,195	1.9%	24
N63 east of Lanesborough	7,944	95	8,039	1.2%	12
R392 south of Lanesborough	4,698	95	4,793	2.0%	12
R392 north of access	2,697	95	2,792	3.5%	12

An assessment of the impact on link capacity on the delivery route was undertaken for the various construction stages as set out in Tables 14.19 to 14.21 with the capacity for the sample locations on the route shown in Table 14.19. The width and standard of each road varies along its length so the standard applied is meant as indicative only. In summary, the N61 between Athlone and Roscommon is generally a Type 1 single carriageway, while the majority of the route from the N61 south of Roscommon to the proposed access junctions is determined to be Type 2 single carriageway, as set out in the Transport Infrastructure Ireland Standard Document DN-GEO-03031 Road Link Design, Table 6.1. For these types of roads capacities of 11,600 and 8,600 vehicles per day respectively (at level of service D), apply. The section of the R392 leading to Access Junction 2 is generally narrower and allocated Type 3 single with a link capacity of 5,000 vehicles per day.

Background, or do nothing traffic flows, are compared to flows forecast for the various construction delivery stages in Table 14.20 with the percentage capacity reached for each stage shown in Table 14.21. Based on this assessment the N61 is forecast to operate at 75% for level of service D for the do-nothing scenario, with a maximum of 80% forecast for the 24 days during which the concrete foundations are poured.

Similarly the N63 is forecast to operate at 92% capacity for the do-nothing scenario, increasing to a maximum of 97% during the 24 concrete pouring days.

Table 14.19: Summary impact of development traffic during concrete pouring

Link	Width (m)	Link type	Capacity
N61 south of Roscommon	7.3	Type 1 single	11,600
N63 east of Roscommon	7.0	Type 2 single	8,600
N63 east of Lanesborough	7.0	Type 2 single	8,600
R392 south of Lanesborough	7.0	Type 2 single	8,600
R392 north of access	6.0	Type 3 single	5,000

Table 14.20: Link capacity and summary of link flows by construction delivery stage

Link	Link capacity	Construction deliver stage				
		Background	Concrete pour	Other site works	Turbine plant	Turbine other
N61 south of Roscommon	11,600	8,747	9,227	9,155	8,927	8,842
N63 east of Roscommon	8,600	5,100	5,580	5,508	5,280	5,195
N63 east of Lanesborough	8,600	7,944	8,424	8,352	8,124	8,039
R392 south of Lanesborough	8,600	4,698	5,178	5,106	4,878	4,793
R392 north of access	5,000	2,697	3,177	3,105	2,877	2,792

Table 14.21: Link capacity and % of link capacity by construction delivery stage

Link	Link capacity	Construction deliver stage				
		Background	Concrete pour	Other site works	Turbine plant	Turbine other
N61 south of Roscommon	11,600	75%	80%	79%	77%	76%
N63 east of Roscommon	8,600	59%	65%	64%	61%	60%
N63 east of Lanesborough	8,600	92%	98%	97%	94%	93%
R392 south of Lanesborough	8,600	55%	60%	59%	57%	56%
R392 north of access	5,000	54%	64%	62%	58%	56%

Effect on Junctions – During Construction

The capacity of the junction most affected (the N63 / R392 junction in Lanesborough) was assessed using the industry standard junction simulation software PICADY, which permits the capacity of any junction to be assessed with respect to existing or forecast traffic movements and volumes for a given time period.

The capacity for each movement possible at the junction being assessed is determined from geometric data input into the program with the output used in the assessment as follows:

Queue – This is the average queue forecast for each movement and is useful to ensure that queues will not interfere with adjacent junctions.

Degree of Saturation, or Ratio of Flow to Capacity (% Sat or RFC) – As suggested, this offers a measure of the amount of available capacity being utilised for each movement. Ideally each movement should operate at a level of no greater than 85% of capacity.

Delay – Output in minutes, this gives an indication of the forecast average delay during the time period modelled for each movement.

Scenarios Modelled

While other junctions and links on the network will experience an increase in traffic volumes passing through them, as discussed previously, the worst-case effect will be experienced during peak hours at the junction between the N63 and the R392, when, during peak construction periods, approximately 120 workers (60 cars) will pass through it. It is noted that deliveries of materials to the site will take place during the day after the workers have arrived on site, and before they leave at the end of the day, and will therefore not occur at the same time.

N63 / R392 junction Capacity Test Results

The AM and PM peak hour traffic flows for the year 2021, without and with construction workers, are shown in Figures 14.28 and 14.29, with the capacity results shown in Table 14.22. The results show that the additional car trips passing through the junction will have a minor effect, increasing the maximum ratio of flow to capacity (RFC) at the junction from 54.6% to 57.1%, which applies to the N63 east approach to the junction and is well within the acceptable limit of 85%.

Table 14.22: Junction capacity test results, N63 / R392 junction, AM and PM peak hours, without and with construction staff, year 2021

Arm	AM peak hour						PM peak hour					
	Existing			With WF construction			Existing			With WF construction		
	RFC	Q	Delay	RFC	Q	Delay	RFC	Q	Delay	RFC	Q	Delay
From Rathcline Road	14.1	0.16	0.16	14.3	0.17	0.16	11.2	0.13	0.15	11.5	0.13	0.15
From N63 east	33	0.49	0.23	39.8	0.65	0.24	54.6	1.17	0.35	57.1	1.29	0.38
Right turn from N63 west	3.9	0.06	0.08	4	0.06	0.08	6.5	0.11	0.09	6.8	0.12	0.09

Right turn from R392	2.9	0.04	0.11	2.9	0.04	0.11	4.7	0.07	0.1	13.1	0.24	0.11

14.5.2 Traffic Effects During Operation

Effect on Link Flows – During Operation

Once the Proposed Development is operational it is estimated that there will be approximately 6 - 8 staff members employed on site with a similar number of vehicle trips. It is considered that the traffic impact during this phase will be negligible.

Effect on Junctions – During Operation

Once operational, the Proposed Development is expected to generate significantly lower volumes of traffic than during the constructions stage. Based on observations from a similar site it is expected that maintenance staff and those visiting the site for amenity purposes will generate up to 20 trips per day. It is therefore concluded that the Proposed Development will have a negligible effect on the local network once constructed.

Effect on Network of Grid Connection

The Proposed Development will be connected to the national grid via either the 110 KV lines at Lanesborough/Richmond or Lanesborough/Mullingar. While Substation Option A does not require any underground cabling external to the site, Option B may be connected by overhead line or underground cable. In the case of connection by underground cable, this would require the laying of an underground grid connection cable between the site and the substation, which would be installed within the carriageway of the R392 road.

The underground cable would be installed by one construction team laying approximately 150 metres of cable per day, equating to a total of 2 days. On these days traffic will be controlled with a local "stop – go" system to ensure that the R392 remains open at all times.

14.5.3 Traffic Management of Large Deliveries

The greatest effect on the road network will likely be experienced on approximately 43 days during which the 5 very large loads comprising the tower sections, the blades and the nacelles are delivered to the site. The effects on these days may, however, be significantly reduced if these deliveries are made at night, which is now the norm.

Traffic management measures are included in Section 14.8 and include the following:

- Identification of a delivery schedule;

- Details of the alterations required to the infrastructure identified in this report and any other minor alteration identified (hedgerows etc.); and
- A dry run of the route using vehicles with similar dimensions.

The transport of large components is challenging and can only be done following extensive route selection, route proofing and consultation with An Garda Síochána, the local authority and its road section and roads authorities. Turbine components are usually transported at night when traffic is lightest. This is proposed and will be done in consultation with the roads authorities, An Garda Síochána Traffic Corp, with special permits generally required.

In some cases, temporary accommodation works are required along the turbine delivery route (TDR) such as hedge or tree cutting, temporary relocation of powerlines/poles, lampposts, signage and local road widening. Any updates to the road will be carried out in advance of turbine deliveries and following consultation and agreement with the relevant County Councils.

It is not anticipated that any sections of the local road network will be closed, although there may be delays to local traffic at various locations if the deliveries are made during daylight hours. During these periods it may be appropriate to operate local diversions for through traffic.

At a minimum, all of the deliveries comprising abnormally large loads will be made outside the normal peak traffic periods to avoid disruption to work and school related traffic.

14.5.4 Route Assessment

The turbine component delivery route assessment is confined to locations identified from base mapping and site visits with locations identified for assessment shown on Figure 14.5a for the external road network (Athlone to Lanesborough), and on Figure 14.5b for the proposed junctions that will provide access to the site.

For the locations on both the external road network and the access junctions identified in Figures 14.5a and 14.5b respectively, road alignments based on OSI mapping were supplied by the project team.

For the junctions on the delivery route a preliminary swept path analysis was undertaken at locations A-C identified in Figure 14.5a using Autotrack in order to establish the locations where the wind farm transporter vehicles will be accommodated, and the locations where some form of remedial measure may be required. For these locations the following is assumed;

- The delivery of all large turbine components will be made with the assistance of a Garda escort, so the optimum route through each junction may be selected,
- There will be sign poles and signs that will require to be moved on a temporary basis during the delivery of the large turbine vehicles.

External Route Athlone to Lanesborough

Location A – Right turn at N61 / N61 roundabout (Circle K)

The swept path analysis undertaken for this location, which is shown in Plate 14.1, is set out in Figures 14.6 and 14.7. The right turn maneuver at the roundabout is most efficiently made travelling anti-clockwise around the roundabout against the normal traffic flow. Based on this route through the roundabout the preliminary assessment indicates that this location will accommodate both the blade and tower extended artics. A significant over-run area through the centre island of the roundabout, which has mature trees in its centre, will, however be required.

Location B – Straight through at N61 / N61 roundabout (Roscommon Mart)

The large turbine vehicles will be required to travel straight through the centre island of this roundabout in order to avoid impacting on third party land. The view through the roundabout is shown in Plate 14.2, with the autotrack assessments for the blade and tower vehicles shown in Figures 14.8 and 14.9 respectively. The preliminary assessment shows that a strip on the northern side of the roundabout centre island of approximately 5 metres will be required during the construction phase while the large deliveries are made to the site.

Location C – Right turn at N61 / N63 roundabout (LIDL)

As for the Location A, the optimum route through this roundabout is to travel against the normal direction of traffic flow on the south side of the roundabout as, shown in Plate 14.3 and Figures 14.10 and 14.11. Taking this route will require the vehicle wheels to over-run the southeastern part of the central island by approximately 4m with the blade requiring an overhang approximately 7 metres.

Between the N61 / N63 roundabout and the proposed access to the site on the R392 the route travels straight through Lanesborough, as shown in Plate 14.4 and then directly south east to the site access. No other locations on this section of the route were identified as requiring a geometric assessment with the route considered adequate to accommodate the large turbine vehicles

In summary, the preliminary assessment of the N61 and N63 on haul route leading to the site has established that permanent works will not be required on third party lands. Where temporary modifications are required to existing roundabouts, including run-over areas, signs and street furniture, they will be agreed in advance with the local authority and reinstatement will be carried out as required and agreed.

Derryadd Wind Farm Site Access Junctions

The access junctions at locations 1 to 4 as indicated in Figure 14.5b were each designed to provide for the turning movements and vehicle types that will require to negotiate them.

The preliminary design for all junctions is based on the guidelines set out in in the Transport Infrastructure Ireland (TII) document Geometric Design of Junctions DN-GEO-03060, April 2017, with all signs and marking in accordance with the Traffic Signs Manual.

At locations where standard large articulated HGV's and similar will require access (Access Junctions 1 and 2), junction radii of 13m and tapers of 1:10 are provided in accordance with Section 5.6.5 of DN-GEO-03060.

At the access to the site proposed for the large turbine vehicles off the R392 (Access Junction 2), additional over-run areas are identified based on requirements identified from the autotrack assessment.

All visibility spays shown on the national and regional road network are in accordance with Tables 5.4 and 5.5 of DN-GEO-03060. These are 3 metres by 160 metres for the R393 and R398 junctions (Access Junctions 2 and 3) with speed limits of 80 km/h, and 3 metres by 215 metres at the junction on the N63 (Access junction 1) which has a speed limit of 100 km/h. For the amenity access on the L1136 visibility splays of 3m x 90 metres are shown. All of these visibility splays shall be kept clear during both the construction, and, for those in use on completion, during the operational stage.

Access junctions 1 to 8, as shown in Figure 14.5b, are described as follows;

Access Junction 1 – N63 – General traffic and crossing for turbine artics

The preliminary design layout of Access Junction 1, located on the N63 to the east of Lanesborough, is shown in Figure 14.12 with the required visibility splays set out in Figure 14.13. This junction will provide for general construction traffic making all movements to/from the site to the north and south of the N63. At this point the abnormally large extended artics that will transport the wind turbine components will cross the N63 from the southern part of the site to the north. As set out in Section 14.8, it will be particularly important at this location that all crossing movements are managed on site.

An autotrack of a large standard HGV accessing the site is shown in Figures 14.14a and 14.14b, while an extended artic transporting a blade and a tower section is shown crossing the N63 in Figures 14.15 and 14.16 respectively. Existing views at this location are provided in Plates 14.5 to 14.8.

Access Junction 2 – R392 – All construction traffic

The access junction on the R392 will provide for general construction traffic and all of the abnormally large extended artics that will require access to the site. The site layout and visibility splays to be provided at this location are shown in Figures 14.17 and 14.18, while an autotrack assessment for the extended artics that will access the site is provided in Figures 14.19 and 14.20. Similarly, autotrack assessments for large standard artic HGVs accessing the site from the north and the south are provided in Figures 14.20a and 14.20b. Existing views looking north and south along the R392, taken from the location of the proposed access are shown in Plates 14.9 and 14.10.

Access Junction 3 – R398 – Construction traffic crossing only

It is proposed that this junction on the R398 will provide for traffic crossing from the section of the site located to the north of the R398, to the south of the road, and for a limited number of deliveries made by standard HGV’s to the southern part of the site approaching from the south. The proposed site layout and visibility splays are shown in Figures 14.21 and 14.22. The layout shows that for standard deliveries the site accesses from the south and the north connect with the R398 at 90 degrees, as required by DN-GEO-03060, in order to maximise visibility. For the crossing route provided for the extended artics, it was necessary to provide an alternative route at an angle due to internal site constraints. It is noted that outside periods when extended artics are passing through this location, this angled route option will be closed off.

As set out in Section 14.8, it will be particularly important at this location that all crossing movements, particularly by the extended artic vehicles, are managed on site. An autotrack assessment for all vehicle types requiring to cross at this location is included in Figures 14.23 to 14.25, while existing views along the R398 are included as Plates 14.11 and 14.12.

Access Junction 4 – L1136 – Amenity traffic access

The proposed access junction on the L1136 will provide for local amenity traffic only. The proposed layout and visibility splays are shown in Figures 14.26 and 14.27 respectively, while photographs taken at the proposed location are included as Plates 14.13 and 14.14.

Access Junction 5 – L11554 – Grid Connection Option B Construction/Maintenance access

An access junction will be constructed off the L11554 local road that connects with the R392 north of Derryaghan village. This access junction will only be constructed if Option B is chosen as the grid connection point. The purpose of the access junction is to allow a small number of construction vehicles to access Derryshannoge Bog to the 110kv Lanesborough to Mullingar line. Two new angle masts will be constructed as part of the proposed grid connection. The construction will involve the use of excavators, HGV's and a small number of concrete deliveries.

Access Junctions 6 - 8 – Local amenity walking/cycling access

There are six other access locations proposed for the development. None of these access locations will be designed to allow vehicular access to the site and, therefore, these locations do not impact on the local traffic network. The design of these junctions is outlined in Drawing 10325-2042 and Drawing 10325-2043. The design of the junctions is such as to allow pedestrian or cycle access only and prevent any vehicles entering or exiting the site. None of the locations will be used during the construction period and access to the junctions will only be possible during the operational phase of the windfarm.

14.5.5 Provision for Sustainable Modes of Travel

14.5.5.1 Walking and Cycling

The provision for these modes is not relevant during the construction stage of the development and travel distances will likely exclude any employees walking or cycling to work.

14.5.5.2 Public Transport

There are no local public transport services that currently pass the site although mini-buses may be considered for transporting construction staff to and from the site in order to further minimise traffic generation and parking demand on site.

14.6 POTENTIAL IMPACTS

14.6.1 "Do Nothing" Effects

If the Proposed Development does not proceed there will be no additional traffic generated or works carried out on the road network and therefore no effects with respect to traffic.

14.6.2 Potential Effects - Construction

During the 24 days when the concrete foundations are poured, the effect on the surrounding road network will be negative, resulting in an increase in traffic levels of between +5.5% on the N61 and +17.8% on the R392. The effect will be temporary, lasting for 24 days, and will be slight to moderate.

During the remaining 576 days for the site preparation and ground works, including the grid connection cabling works, when deliveries to the site will take place, the effect on the surrounding road network will be negative, resulting in an increase in traffic levels of between +4.7% on the N61 and +15.1% on the R392. The effect will be temporary, lasting for up to 576 days, (288 days on the approaches to the site on the N63 and R392), and will be slight to moderate.

During the 24 days of the turbine construction stage when general materials are delivered to the site, the delivery of construction materials will result in a negative impact on the surrounding road network, increasing traffic levels by a maximum of 3.5%. The effect will be temporary, lasting 24 days and will be slight.

During the 43 days when the various component parts of the wind turbine plant are delivered to the site using extended articulated HGVs, the effect of the additional traffic on these days will be moderate due to the size of vehicles involved, resulting in increased traffic volumes of +2.1% on the N61 and 6,7% on the R392 approaching the site access. The effects will be temporary, and may be reduced from moderate to slight if these deliveries are undertaken at night, as is now the norm for these abnormally large loads.

It is considered that the above effects represent a worst case daily scenario, based on the shortest deliver phase of 24 months and the assumption that all deliveries are made via one route.

14.6.3 Potential Effects - Operation

During the operational phase the effect on the surrounding local highway network will be negative and long term, but will be imperceptible based on a projected maximum of 20 trips to and from the site per day generated by maintenance staff and visitors for amenity purposes. Notwithstanding this projected effect, there is considered to be significant potential for the proposed wind farm amenity elements combined with existing and proposed tourism attractions in the wider area to increase the level of traffic in the general area. As the level of increase is dependent on the success or attractiveness of other developments, it is considered to be independent of the proposed development. Nevertheless, a review of amenity related traffic movements will be carried out after a period of 5 full years of operation. Should the levels of traffic arising due to the use of the amenity within the proposed development and the surroundings result in a significant impact, an amenity specific traffic management plan will be agreed with Longford County Council.

14.6.4 Potential Effects - Decommissioning

The design life of the wind farm is 30 years, after which time a decision will be made to determine whether or not the turbines will be replaced by new turbines or if decommissioning will occur. If the site is decommissioned, cranes will disassemble each turbine tower and all equipment.

All infrastructure including turbine components will be separated and removed off-site for re-use, recycling and waste disposal.

It is proposed that turbine foundations and hard-standing areas will be left in place and covered with peat/soil/topsoil. It is proposed to leave the access roads in situ at the decommissioning stage. It is considered that leaving the turbine foundations, access tracks and hard-standing areas in situ will cause less environmental damage than removing and recycling them. However, if removal is deemed to be required all infrastructure will be removed with mitigation measures similar to those during construction being employed. The decommissioning will be managed on a phased basis in order to minimise the disruption to the amenity use of the site.

14.7 CUMULATIVE EFFECTS

An assessment of all developments at varying stages in the planning process (from pre-planning to operational), is set out in Section 4.3.1 of this EIAR, with an assessment of the potential cumulative traffic effects with the proposed subject Wind Farm assessed on the following criteria;

- Project status (proposed to operational);
- Degree of overlap with the proposed delivery routes for the proposed Derryadd Wind Farm development (low to high); and
- Traffic volumes (low to high).

The development or activities that were considered to have potential cumulative impacts with the proposed wind farm development in terms of traffic impacts are set out below and summarised in Table 14.23.

1) **Sliabh Bawn Wind Farm, Strokestown** – This existing wind farm comprises of 20 turbines and is located approximately 6 kilometres northwest of the proposed site. While there may be a number of maintenance and amenity trips to and from the Sliabh Bawn Wind Farm, the number of traffic movements will be low. It is therefore considered that the cumulative traffic effects between the existing Sliabh Bawn Wind Farm and the proposed development will be imperceptible.

2) **Skrine Wind Farm, Athleague** – This wind farm, comprising of 2 turbines, is also operational, and is located 20 kms to the southwest of the proposed development. Again, while the small number of maintenance trips to and from the site may share the same network as the delivery route for the proposed Derryadd Wind Farm, the cumulative traffic effects between the two developments during the construction and operational stages of the proposed development will be imperceptible.

3) **Peat Extraction** - Peat extraction from the proposed site occurs at present and will continue for a number of years with or without the proposed wind farm in place. As traffic movements relating to peat activity were included in background traffic levels, there will be no additional cumulative traffic effects between it and the proposed development.

Table 14.23: Summary of projects considered in cumulative assessment and potential for cumulative traffic effects with proposed Derryadd Wind Farm

Project	Status	Degree of overlap of highway network (low / medium / high)	Traffic volumes (low / medium / high)	Potential cumulative traffic effects
1 Sliabh Wind Farm (20 turbines)	Operational	High	Low	Imperceptible
2 Skrine Wind Farm (2 turbines)	Operational	High	Low	Imperceptible
3 Peat extraction	Operating	Not relevant	Not relevant	None (included in background traffic flows)
4 Lough Ree Power	Operating	Not relevant	Not relevant	None (included in background traffic flows)

14.8 MITIGATION MEASURES

This section summarises the mitigation measures to minimise the effects of the proposed Derryadd Wind Farm development during both the construction and operational stages.

Mitigation by Design

Mitigation by design measures include the following;

- Selection of the most appropriate delivery route to transport the wind turbine components, requiring the minimum remedial works to accommodate the vehicles as set out in Section 14.3.2 and the Route Selection Report, prepared by TOBIN Consulting Engineers and included as Appendix 14.1; and

- Approximately 50% of gravel and stone material being obtained from borrow bits located within the site boundary.

Mitigation Measures During the Construction Stage

The successful completion of this project will require significant coordination and planning and a comprehensive set of mitigation measures will be put in place before and during the construction stage of the project in order to minimise the effects of the additional traffic generated by the Proposed Development. The range of measures will include the following which are also set out in the CEMP (Appendix 2.2, Section 10), Traffic Management Plan;

- A detailed **Traffic Management Plan (TMP)**, incorporating all the mitigation measures set out in the TMP submitted as part of the CEMP, included in Appendix 2.2 of this EIAR, will be finalised and agreed with the relevant roads authorities and An Garda Síochána prior to construction works commencing on site. The detailed TMP will include the following:

  - **Traffic Management Coordinator** – a competent Traffic Management Co-ordinator will be appointed for the duration of the project and this person will be the main point of contact for all matters relating to traffic management.

  - **Delivery Programme** – a programme of deliveries will be submitted to Longford County Council in advance of the delivery of the turbine components to site.

  - **Information to locals** – Local residents in the area will be informed of any upcoming traffic related matters e.g. temporary lane/road closures (if required) or any night deliveries of turbine components, via letter drops and posters in public places. Information will include the contact details of the Contract Project Co-ordinator, who will be the main point of contact for all queries from the public or local authority during normal working hours. An "out of hours" emergency number will also be provided.

  - **A Pre and Post Construction Condition Survey** – A pre-condition survey of roads associated with the Proposed Development will be carried out prior to construction commencement to record the condition of the road. A post construction survey will be carried out after works are completed. The timing of these surveys will be agreed with the local authority.

  - **Liaison with the relevant local authority -** Liaison with the relevant local authority including the roads sections of local authorities that the delivery route traverses and An Garda Siochana, during the delivery phase of the large turbine vehicles, when an escort for all convoys will be required.

- **Implementation of temporary alterations to road network at critical junctions** – At locations where required highlighted in Section 14.5.4.

- **Identification of delivery routes** – These routes will be agreed and adhered to by all contractors.

- **Travel plan for construction workers –** While the assessment above has assumed the worst case that construction workers will drive to the site, the construction company will be required to provide a travel plan for construction staff, which will include the identification of routes to / from the site and identification of an area for parking.

- **Temporary traffic signs** – As part of the traffic management measures temporary traffic signs will be put in place at all key junctions, including the access junctions on the N63, R392, R398, L1136 and L1154. All measures will be in accordance with the *"Traffic Signs Manual, Section 8 – Temporary Traffic Measures and Signs for Road Works"* (DoT now DoTT&S) and "Guidance for the Control and Management of Traffic at Roadworks" (DoTT&S). A member of construction staff (flagman) will be present at all junctions during peak delivery times (with the exception of the L1154).

- **Delivery times of large turbine components** -The management plan will include the option to deliver the large wind turbine plant components at night in order to minimise disruption to general traffic during the construction stage.

- **Additional measures -** Various additional measures will be put in place in order to minimise the effects of the development traffic on the surrounding road network including wheel washing facilities on site and sweeping / cleaning of local roads as required.

- **Re-instatement works** - All road surfaces and boundaries will be re-instated to pre-development condition, as agreed with the local authority engineers.

- **Road Opening Licence** – Roads works associated with the grid connection cabling will be undertaken in line with the requirements of a road opening licence as agreed with the relevant County Council.

- **Trench Reinstatement** - Trenches on public roads, once backfilled, will be temporarily reinstated to the satisfaction of the roads authority. Following temporary reinstatement of trenches sections of public roads along which the cable route travels will receive a surface overlay subject to agreement with the roads authority.

14.8.1 Mitigation Measures During Operational Stage

Due to the very low volumes of traffic forecast to be generated during this stage of the development, no mitigation measures are required. It is however proposed to monitor the situation on the ground by means of a traffic survey as set out in Section 14.6.3.

14.8.2 Mitigation Measures During Decommissioning Stage

In the event that the wind farm is decommissioned after the 30 years of operation, a decommissioning plan, including material recycling/disposal and traffic management plan will be prepared for agreement with the local authority prior to decommissioning of the wind farm.

14.9 RESIDUAL IMPACTS

14.9.1 Construction Stage

During the 24 month construction stage of the proposed Derryadd Wind Farm development, it is forecast that the additional traffic that will appear on the delivery routes indicated in Figures 14.5a and 14.5.b will have a slight to moderate and short-term effect on existing road users, which will be minimised with the implementation of the mitigation measures included in the proposed traffic management plan.

Road works required to lay the grid connection cable will generally be installed in a trench at the side or in the corridor of the road, which will result in local, short term delays to traffic. It is unlikely that any road closures will be required.

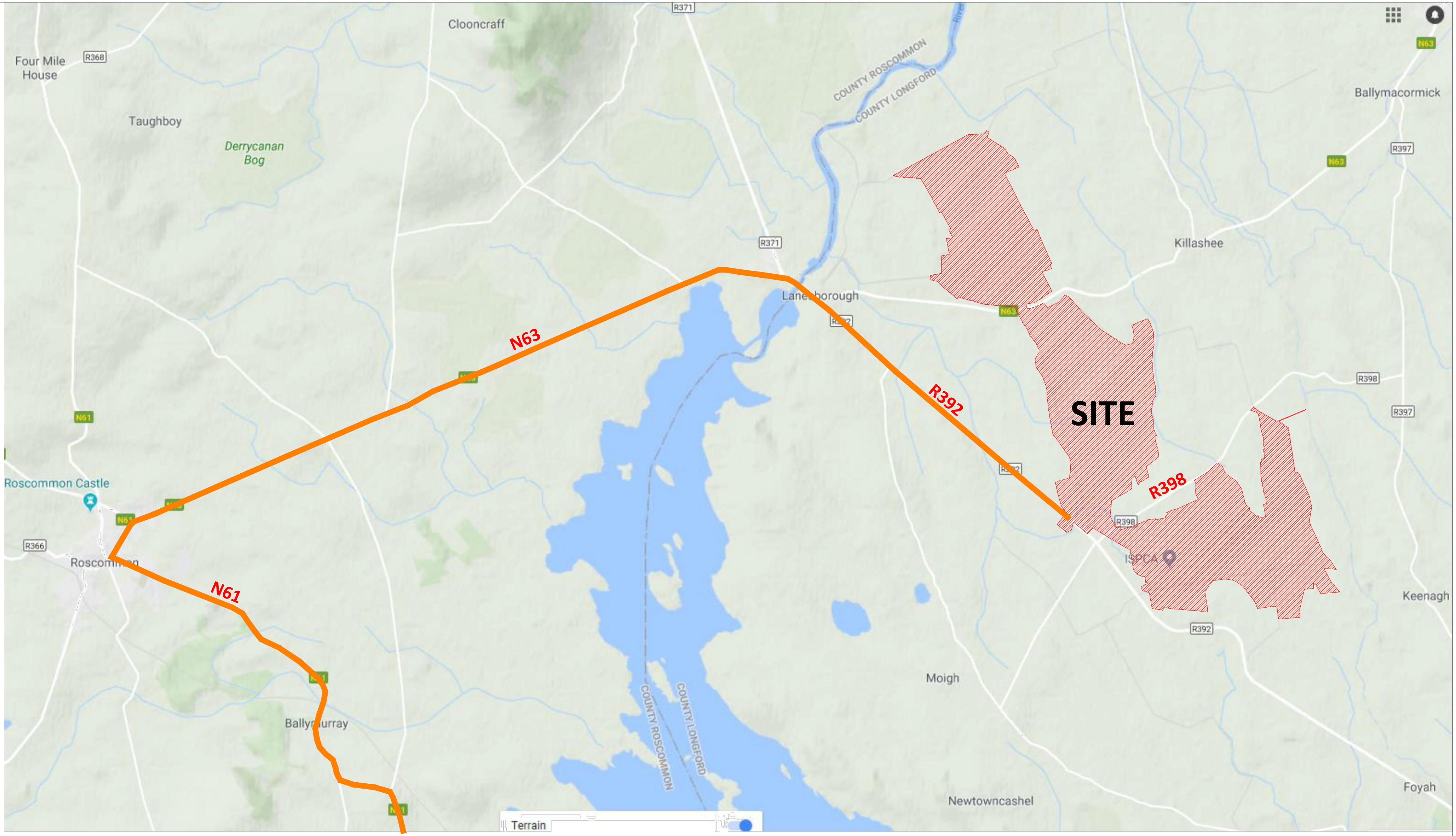
While traffic delays will be incurred resulting in a slight, temporary impact on local traffic, and potentially on local businesses, it is noted that only a short section of the cable route, and the trips that pass through it, will be affected each day.

14.9.2 Operational Stage

As the traffic impact of the Proposed Development will be imperceptible, long-term during the operational stage, there will be no residual effects during this stage of the development.

14.9.3 Decommissioning Stage

As stated above, in the event that the proposed development is decommissioned, a decommissioning plan will be prepared and implemented in order to minimise the residual effects during this stage. The decommissioning phase will employ similar mitigation measures as the operational phase. As the expected volumes of traffic will be primarily associated with the transportation off-site of turbine components and materials only, the residual impact is considered to be slight and temporary.



NOTES:

PLANNING DRAWING ONLY - NOT FOR CONSTRUCTION PURPOSES

Base mapping provided by Tobins Consulting Engineers Ltd

Figure 14.1 Site location and delivery route for wind turbine components

PROJECT:	Derryadd Wind Farm, County Longford		
CLIENT:	Bord na Mona	SCALE:	1:1000
PROJECT NO: 7230	DATE: 17.01.19	DRAWN BY:	AL

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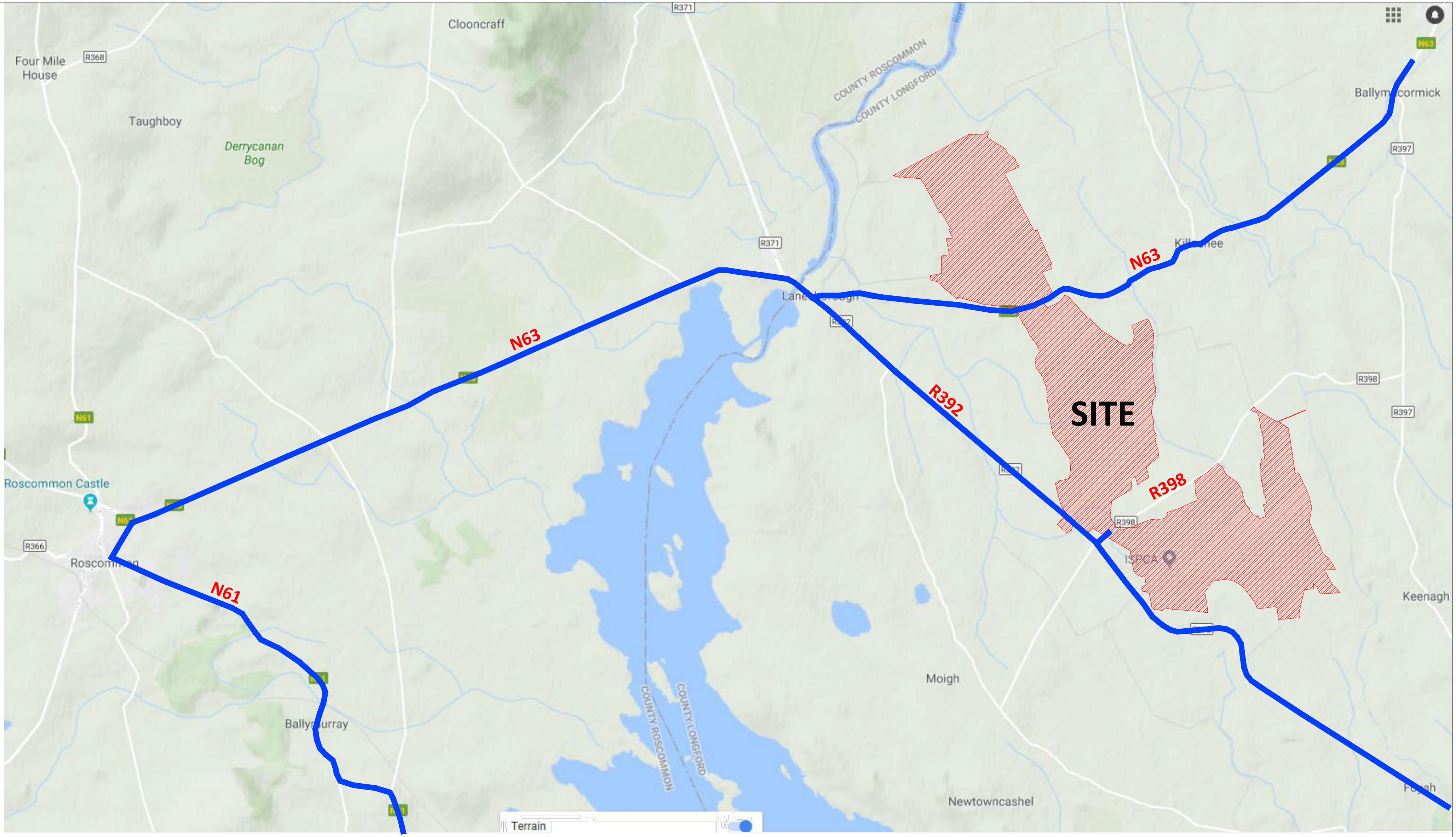
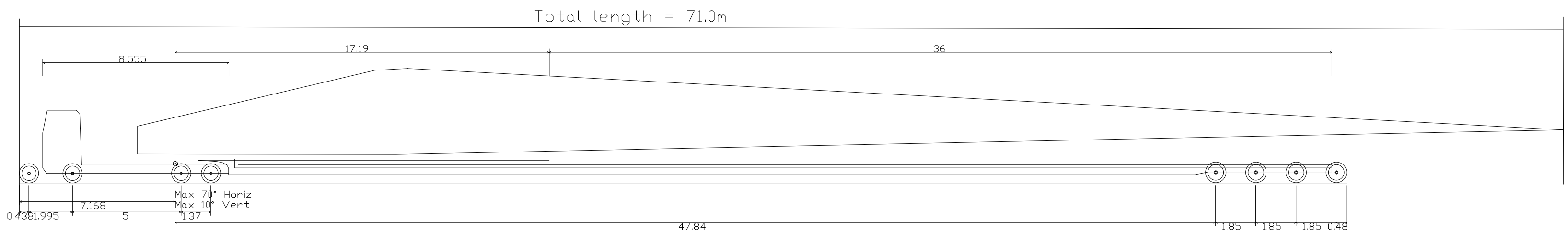


NOTES: PLANNING DRAWING ONLY - NOT FOR CONSTRUCTION PURPOSES Base mapping provided by Tobins Consulting Engineers Ltd	Figure 14.2 Proposed route for HGV construction traffic			
	PROJECT: Derryadd Wind Farm, County Longford			ALAN LIPSCOMBE TRAFFIC & TRANSPORT CONSULTANTS
	CLIENT: Bord na Mona		SCALE: 1:1000	
	PROJECT NO: 7230	DATE: 11.10.18	DRAWN BY: AL	



65 m blade	
Overall Length (vehicle only)	61.037m
Overall Width	2.550m
Overall Body Height	4.800m
Min Body Ground Clearance	0.375m
Track Width	2.500m
Lock to Lock Time	6.00s
Wall to Wall Turning Radius	9.800m

NOTES:

PLANNING DRAWING ONLY - NOT FOR CONSTRUCTION PURPOSES

Figure 14.3 Design blade extended artic profile

PROJECT:	Derryadd Wind Farm, County Longford		
CLIENT:	Bord na Mona	SCALE:	NTS
PROJECT NO: 7230	DATE: 11.09.18	DRAWN BY:	AL

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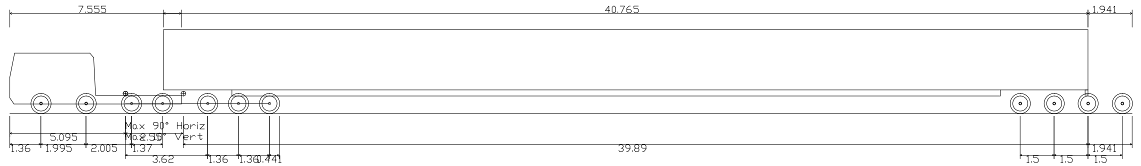

Tower (Final)	
Overall Length	49.476m
Overall Width	2.550m
Overall Body Height	3.695m
Min Body Ground Clearance	0.427m
Max Track Width	2.520m
Lock to Lock Time	6.00s
Wall to Wall Turning Radius	9.800m

NOTES:

PLANNING DRAWING ONLY - NOT FOR CONSTRUCTION PURPOSES

Figure 14.4 Design tower extended artic profile

PROJECT:	Derryadd Wind Farm, County Longford		
CLIENT:	Bord na Mona	SCALE:	NTS
PROJECT NO: 7230	DATE: 11.09.18	DRAWN BY:	AL

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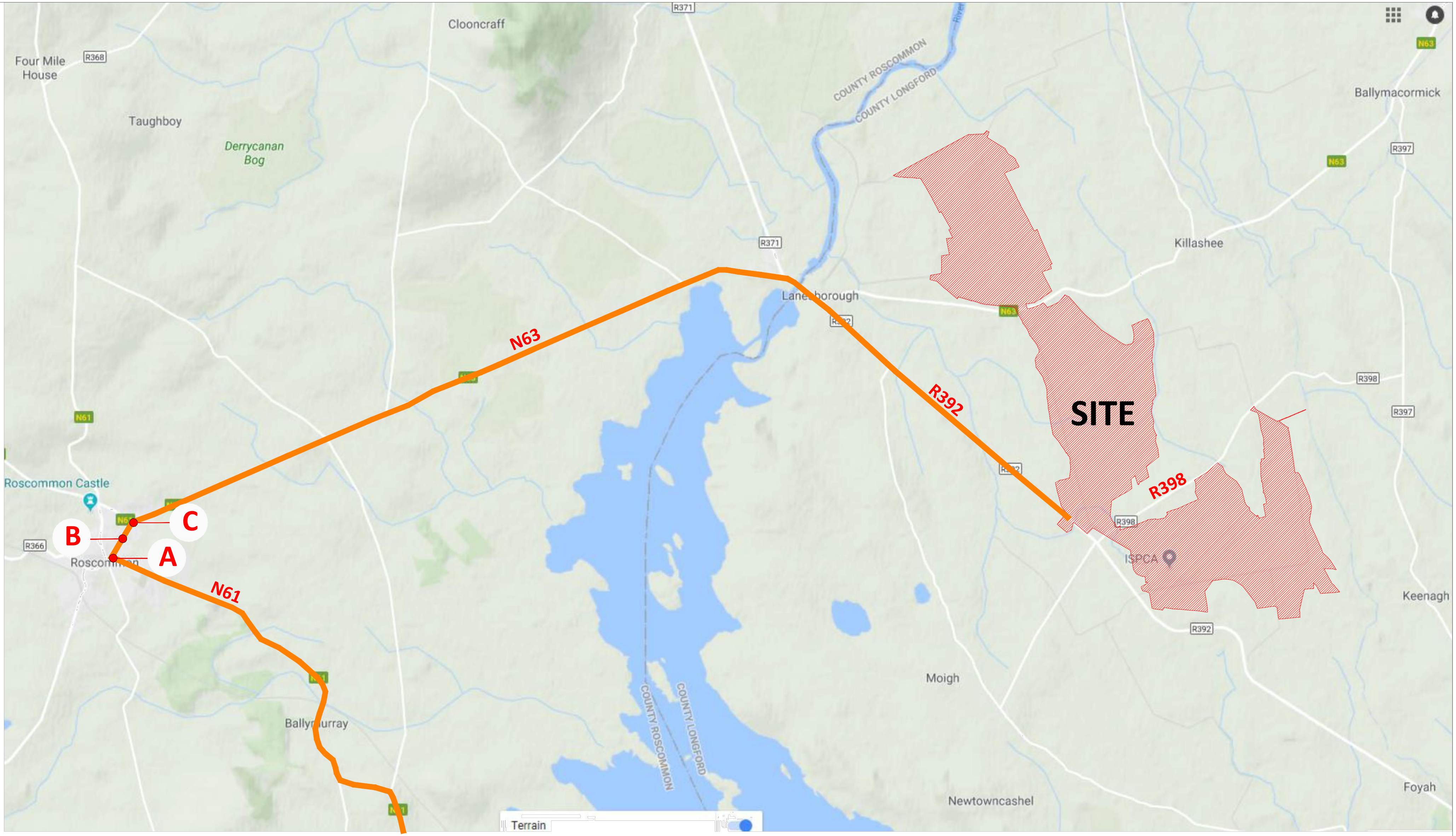
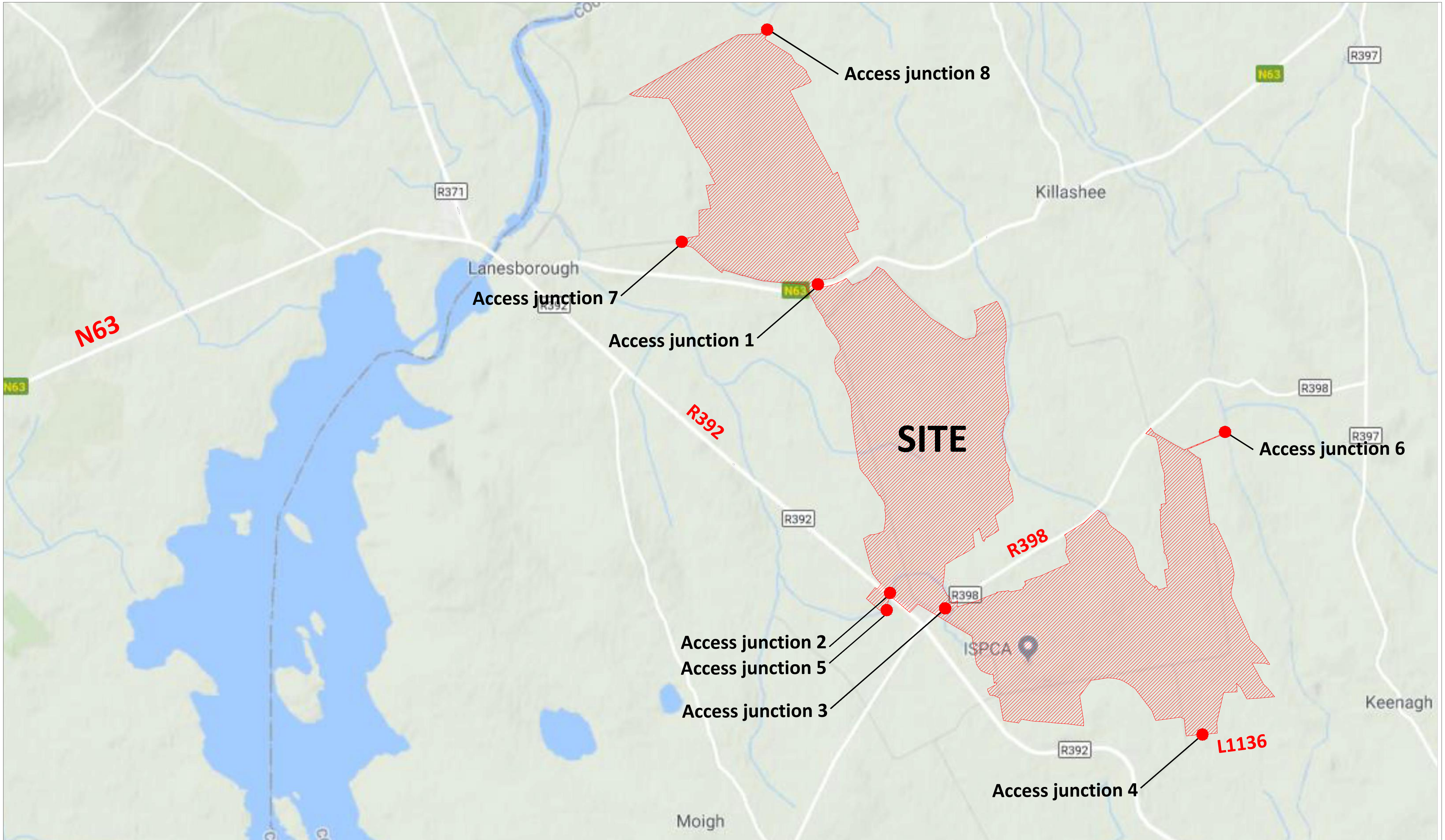


NOTES:	Figure 14.5a Location for assessment on external road network			
PLANNING DRAWING ONLY - NOT FOR CONSTRUCTION PURPOSES	PROJECT: Derryadd Wind Farm, County Longford			ALAN LIPSCOMBE TRAFFIC & TRANSPORT CONSULTANTS
Base mapping provided by Tobins Consulting Engineers Ltd	CLIENT: Bord na Mona		SCALE: 1:1000	
	PROJECT NO: 7230	DATE: 11.10.18	DRAWN BY: AL	



NOTES:

PLANNING DRAWING ONLY - NOT FOR CONSTRUCTION PURPOSES

Base mapping provided by Tobins Consulting Engineers Ltd

Figure 14.5b Location of proposed access junctions

PROJECT: Derryadd Wind Farm, County Longford			
CLIENT: Bord na Mona		SCALE: 1:1000	
PROJECT NO: 7230	DATE: 11.10.18	DRAWN BY: AL	

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NOTES:

PLANNING DRAWING ONLY - NOT FOR CONSTRUCTION PURPOSES

Base mapping provided by Tobins Consulting Engineers Ltd

Figure 14.6 Location A - Right turn at N61 / N61 roundabout (Circle K), blade extended artic

PROJECT:	Derryadd Wind Farm, County Longford		
CLIENT:	Bord na Mona	SCALE:	1:1000
PROJECT NO: 7230	DATE: 23.08.18	DRAWN BY:	AL

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NOTES:

PLANNING DRAWING ONLY - NOT FOR CONSTRUCTION PURPOSES

Base mapping provided by Tobins Consulting Engineers Ltd

Figure 14.7 Location A - Right turn at N61 / N61 roundabout (Circle K), tower extended artic

PROJECT:	Derryadd Wind Farm, County Longford		
CLIENT:	Bord na Mona	SCALE:	1:1000
PROJECT NO: 7230	DATE: 23.08.18	DRAWN BY:	AL

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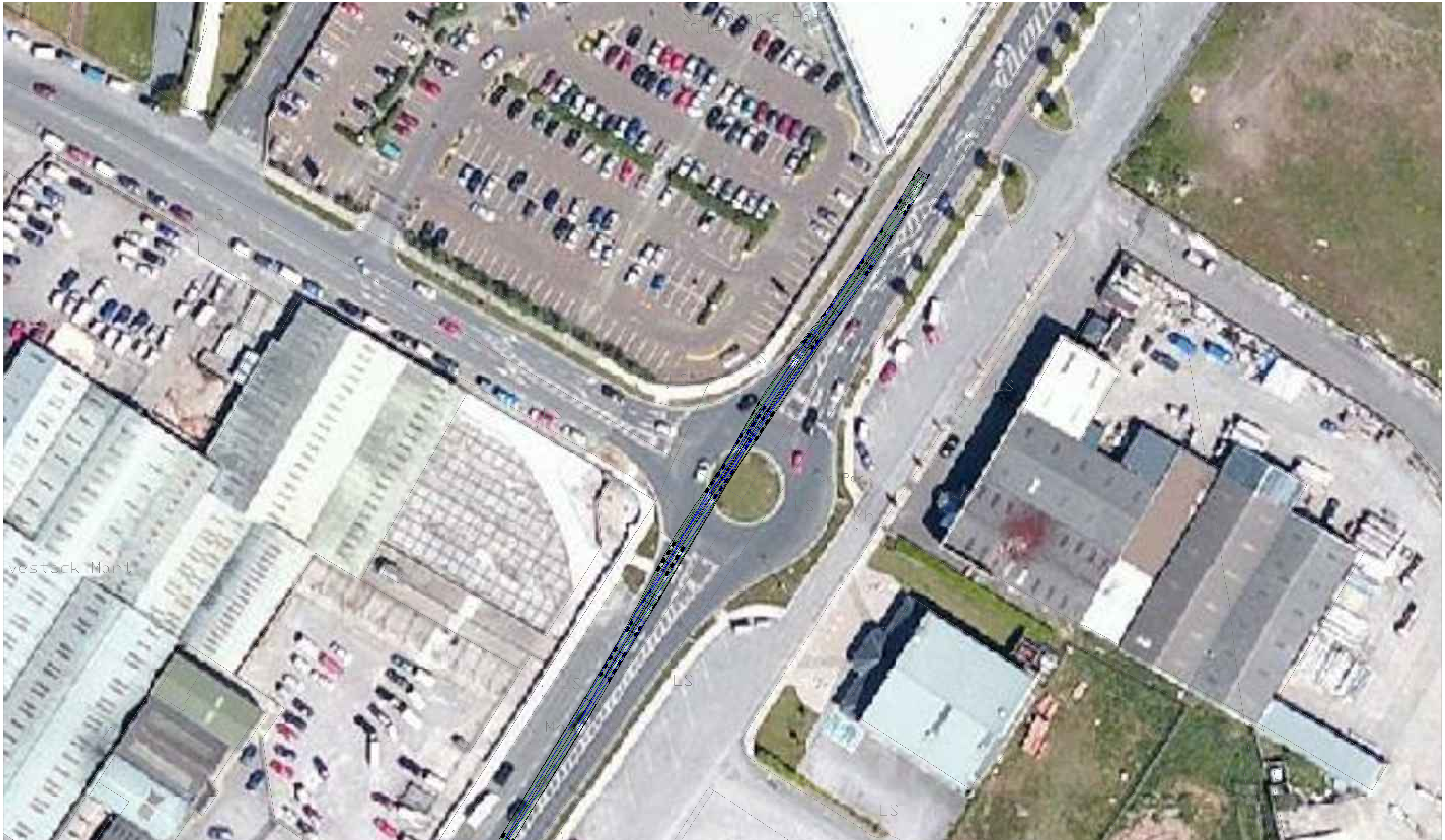

NOTES:

PLANNING DRAWING ONLY - NOT FOR CONSTRUCTION PURPOSES

Base mapping provided by Tobins Consulting Engineers Ltd

Figure 14.8 Location B - Straight through at N61 / N61 roundabout (Roscommon Mart), blade extended artic

PROJECT:	Derryadd Wind Farm, County Longford		
CLIENT:	Bord na Mona	SCALE:	1:1000
PROJECT NO: 7230	DATE: 23.08.18	DRAWN BY:	AL

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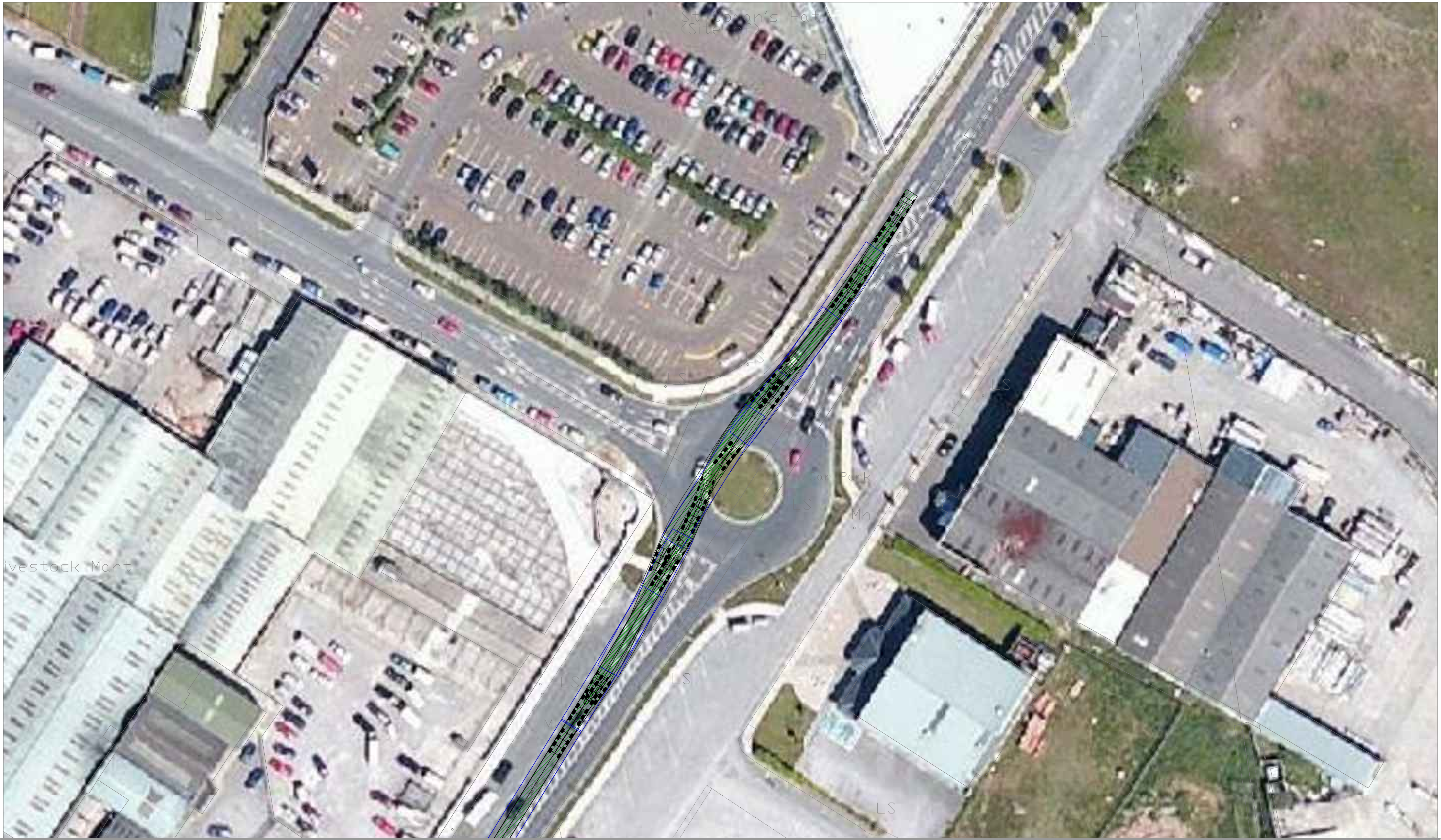

NOTES:

PLANNING DRAWING ONLY - NOT FOR CONSTRUCTION PURPOSES

Base mapping provided by Tobins Consulting Engineers Ltd

Figure 14.9 Location B - Straight through at N61 / N61 roundabout (Roscommon Mart), tower extended artic

PROJECT:	Derryadd Wind Farm, County Longford		
CLIENT:	Bord na Mona	SCALE:	1:1000
PROJECT NO: 7230	DATE: 23.08.18	DRAWN BY:	AL

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NOTES:

PLANNING DRAWING ONLY - NOT FOR CONSTRUCTION PURPOSES

Base mapping provided by Tobins Consulting Engineers Ltd

Figure 14.10 Location C - Right turn at N61 / N63 roundabout (Lidl), blade extended artic

PROJECT:	Derryadd Wind Farm, County Longford		
CLIENT:	Bord na Mona	SCALE:	1:1000
PROJECT NO: 7230	DATE: 23.08.18	DRAWN BY:	AL

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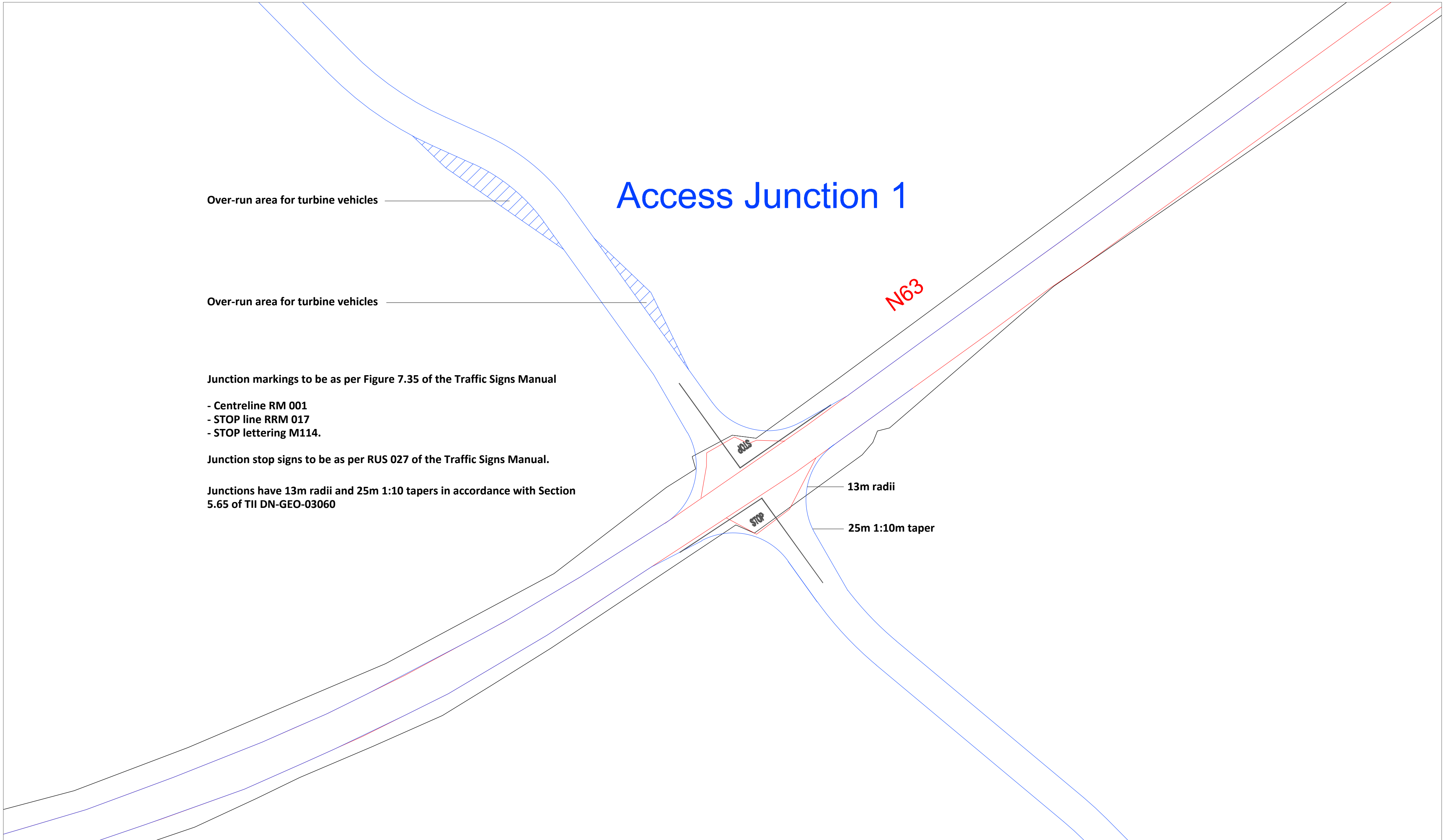
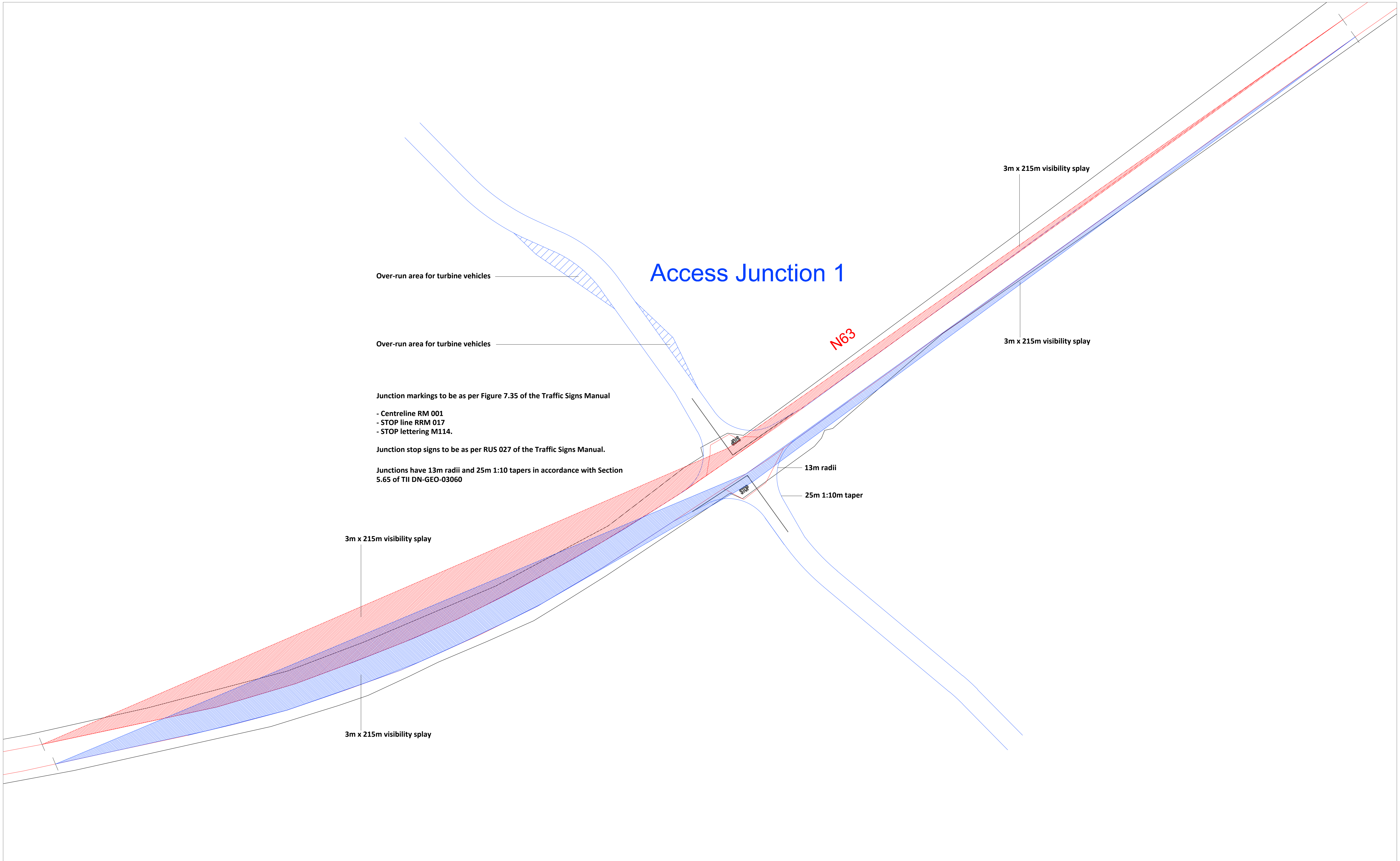
NOTES:	Figure 14.11 Location C - Right turn at N61 / N63 roundabout (Lidl), tower extended artic			
PLANNING DRAWING ONLY - NOT FOR CONSTRUCTION PURPOSES	PROJECT: Derryadd Wind Farm, County Longford			ALAN LIPSCOMBE TRAFFIC & TRANSPORT CONSULTANTS
Base mapping provided by Tobins Consulting Engineers Ltd	CLIENT: Bord na Mona		SCALE: 1:1000	
	PROJECT NO: 7230	DATE: 23.08.18	DRAWN BY: AL	



NOTES:	Figure 14.12 Access Junction 1 - N63 - General construction traffic and crossing for turbine artics, proposed layout			
PLANNING DRAWING ONLY - NOT FOR CONSTRUCTION PURPOSES	PROJECT: Derryadd Wind Farm, County Longford			ALAN LIPSCOMBE TRAFFIC & TRANSPORT CONSULTANTS
Base mapping provided by Tobins Consulting Engineers Ltd	CLIENT: Bord na Mona		SCALE: 1:1000	
	PROJECT NO: 7230	DATE: 08.08.18	DRAWN BY: AL	



NOTES:

PLANNING DRAWING ONLY - NOT FOR CONSTRUCTION PURPOSES

Base mapping provided by Tobins Consulting Engineers Ltd

Figure 14.13 Access Junction 1 - N63 - General construction traffic and crossing for turbine artics, proposed layout and visibility splay

PROJECT:	Derryadd Wind Farm, County Longford		
CLIENT:	Bord na Mona	SCALE:	1:1000
PROJECT NO: 7230	DATE: 10.09.18	DRAWN BY:	AL

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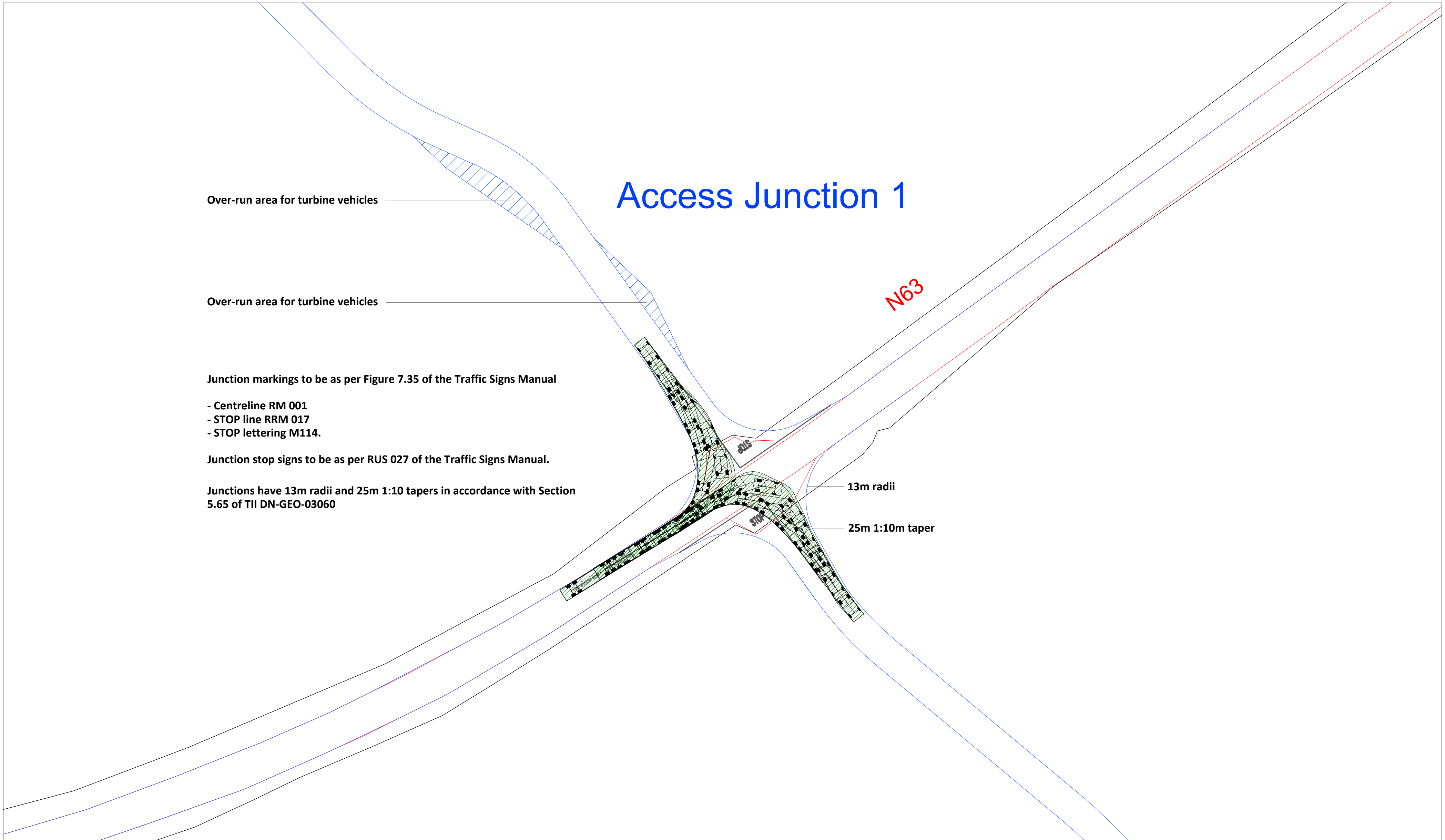
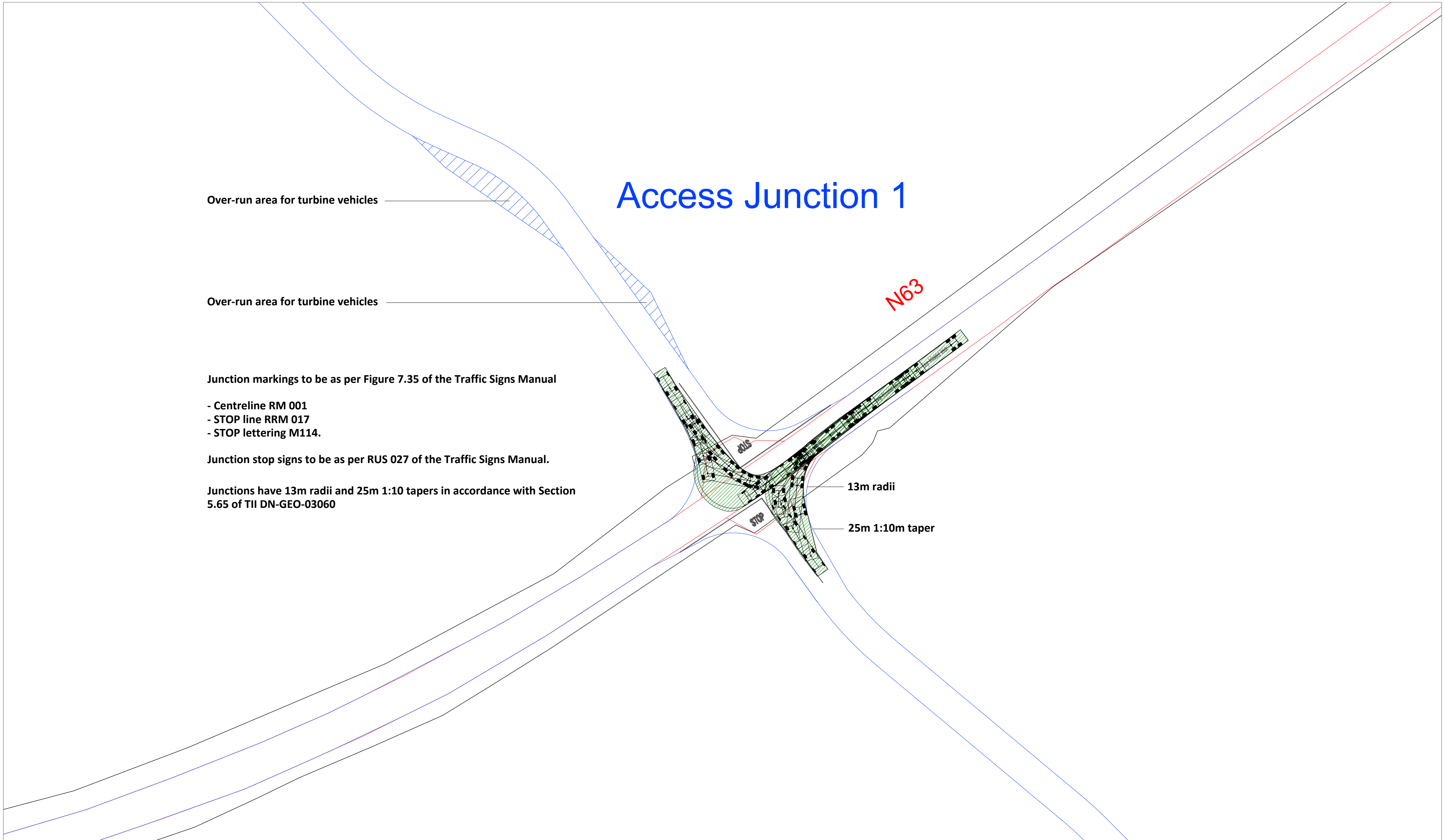
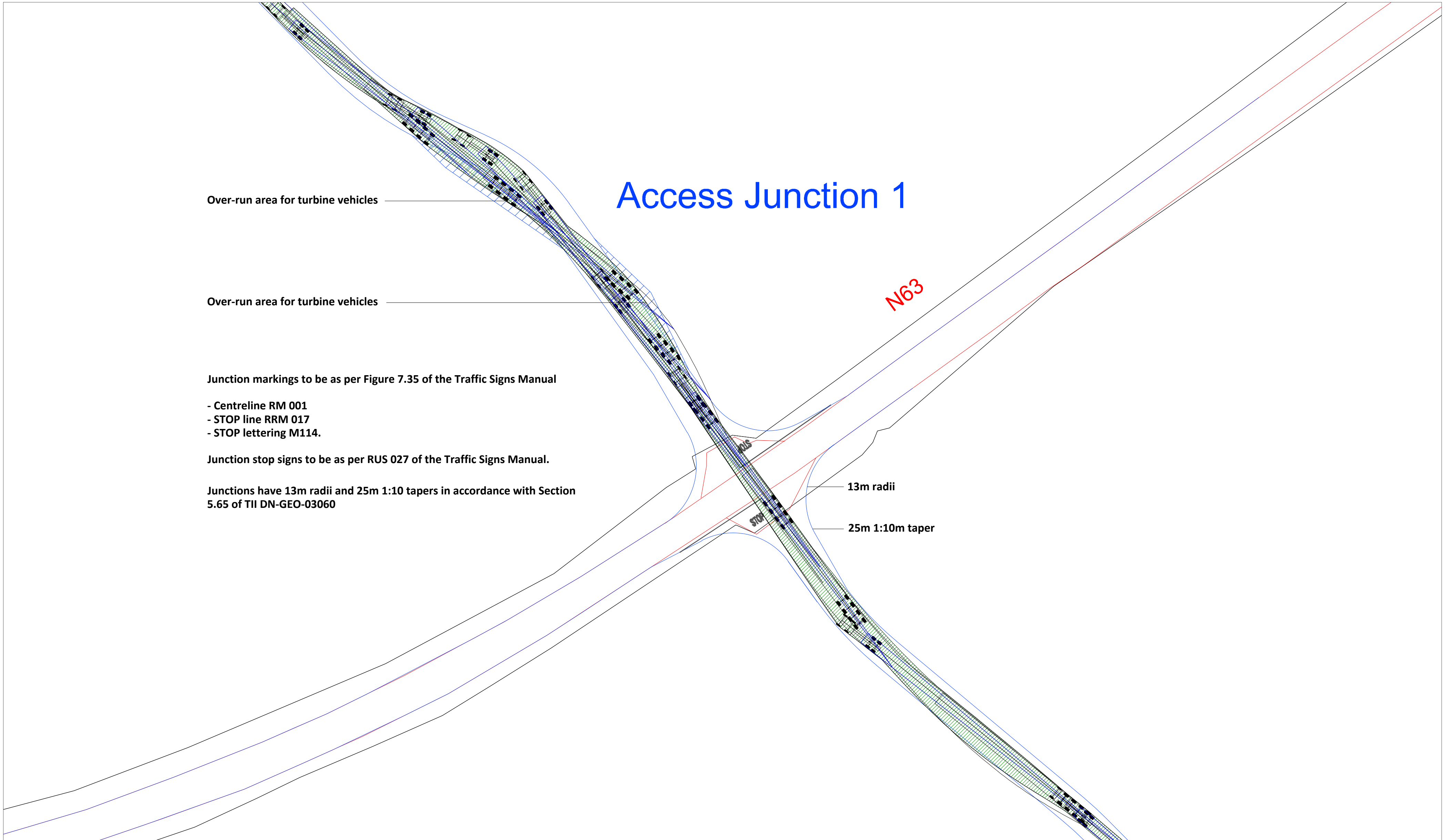


NOTES: PLANNING DRAWING ONLY - NOT FOR CONSTRUCTION PURPOSES Base mapping provided by Tobins Consulting Engineers Ltd	Figure 14.14a Access Junction 1 - N63 - General construction traffic and crossing for turbine artics, large standard artic accessing site - to / from west PROJECT: Derryadd Wind Farm, County Longford CLIENT: Bord na Mona — SCALE: 1:1000 PROJECT NO: 7230 — DATE: 08.08.18 — DRAWN BY: AL ALAN LIPSCOMBE TRAFFIC & TRANSPORT CONSULTANTS



NOTES:	Figure 14.14b Access Junction 1 - N63 - General construction traffic and crossing for turbine artics, large standard artic accessing site - to / from east			
PLANNING DRAWING ONLY - NOT FOR CONSTRUCTION PURPOSES	PROJECT: Derryadd Wind Farm, County Longford			ALAN LIPSCOMBE TRAFFIC & TRANSPORT CONSULTANTS
Base mapping provided by Tobins Consulting Engineers Ltd	CLIENT: Bord na Mona		SCALE: 1:1000	
	PROJECT NO: 7230	DATE: 08.08.18	DRAWN BY: AL	



NOTES:

PLANNING DRAWING ONLY - NOT FOR CONSTRUCTION PURPOSES

Base mapping provided by Tobins Consulting Engineers Ltd

Figure 14.15 Access Junction 1 - N63 - General construction traffic and crossing for turbine artics, blade extended artic crossing N63

PROJECT:	Derryadd Wind Farm, County Longford		
CLIENT:	Bord na Mona	SCALE:	1:1000
PROJECT NO: 7230	DATE: 08.08.18	DRAWN BY:	AL

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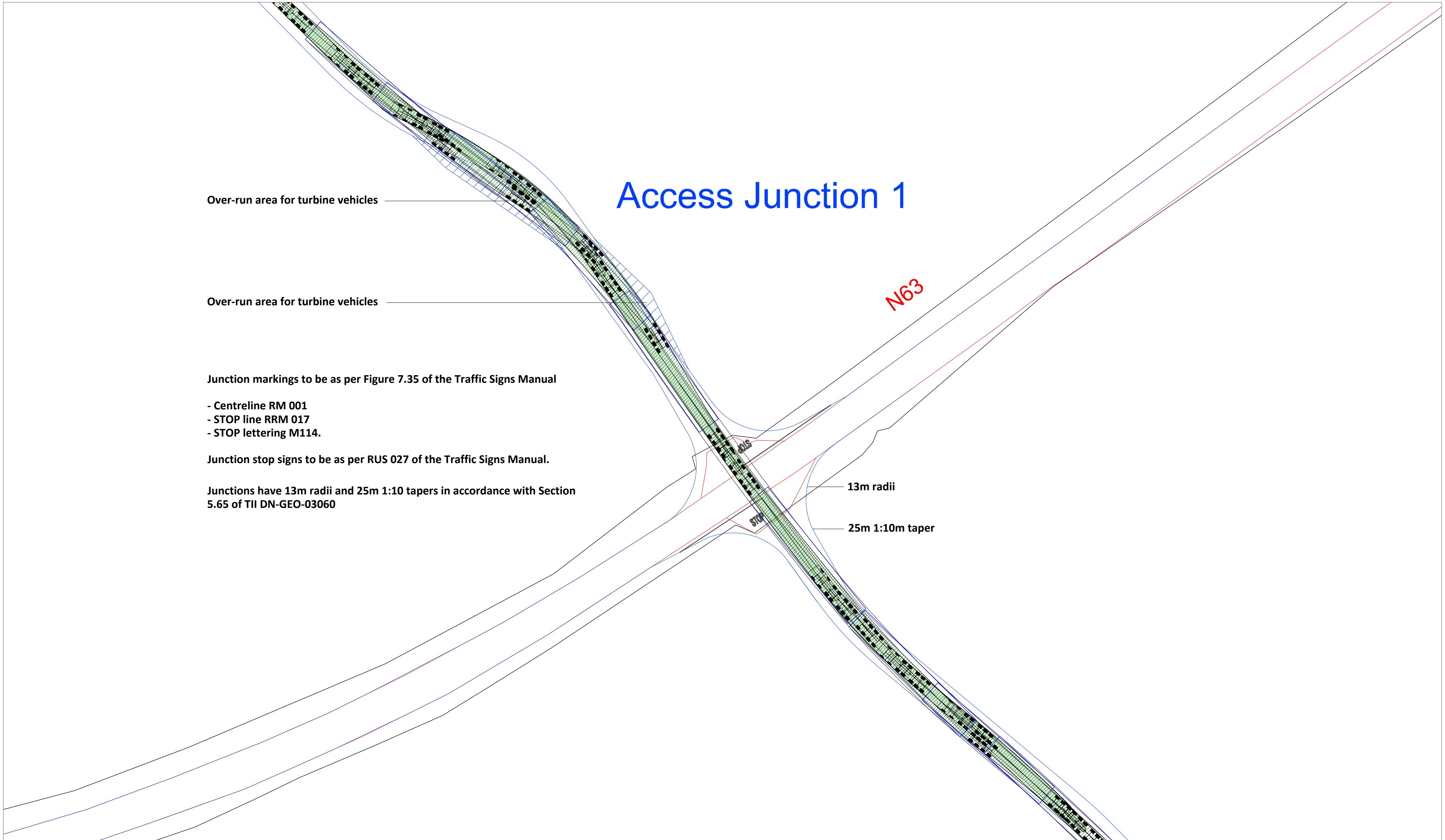

NOTES:

PLANNING DRAWING ONLY - NOT FOR CONSTRUCTION PURPOSES

Base mapping provided by Tobins Consulting Engineers Ltd

Figure 14.16 Access Junction 1 - N63 - General construction traffic and crossing for turbine artics, tower extended artic crossing N63

PROJECT:	Derryadd Wind Farm, County Longford
CLIENT:	Bord na Mona
SCALE:	1:1000
PROJECT NO:	7230
DATE:	08.08.18
DRAWN BY:	AL

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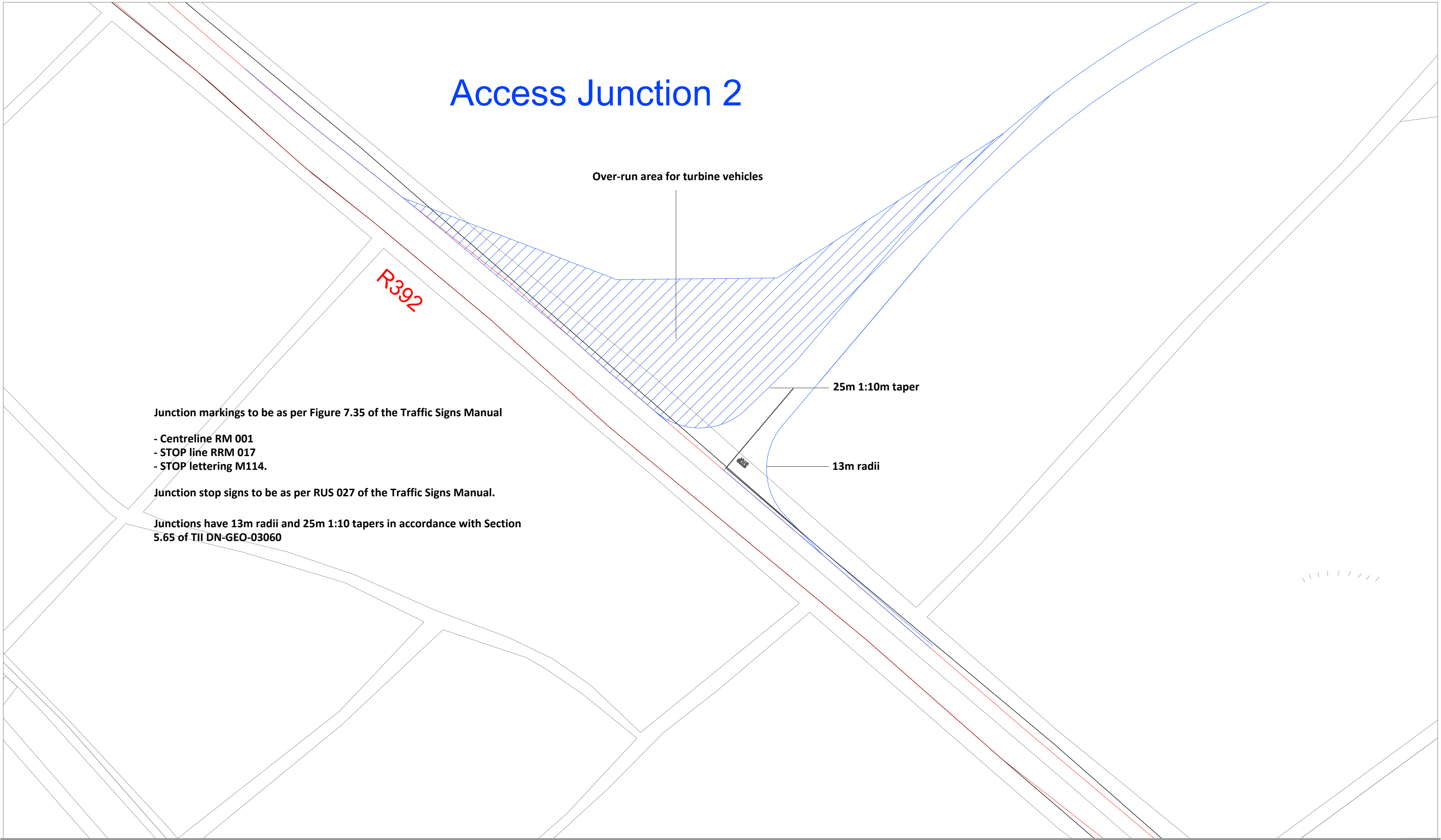


NOTES:

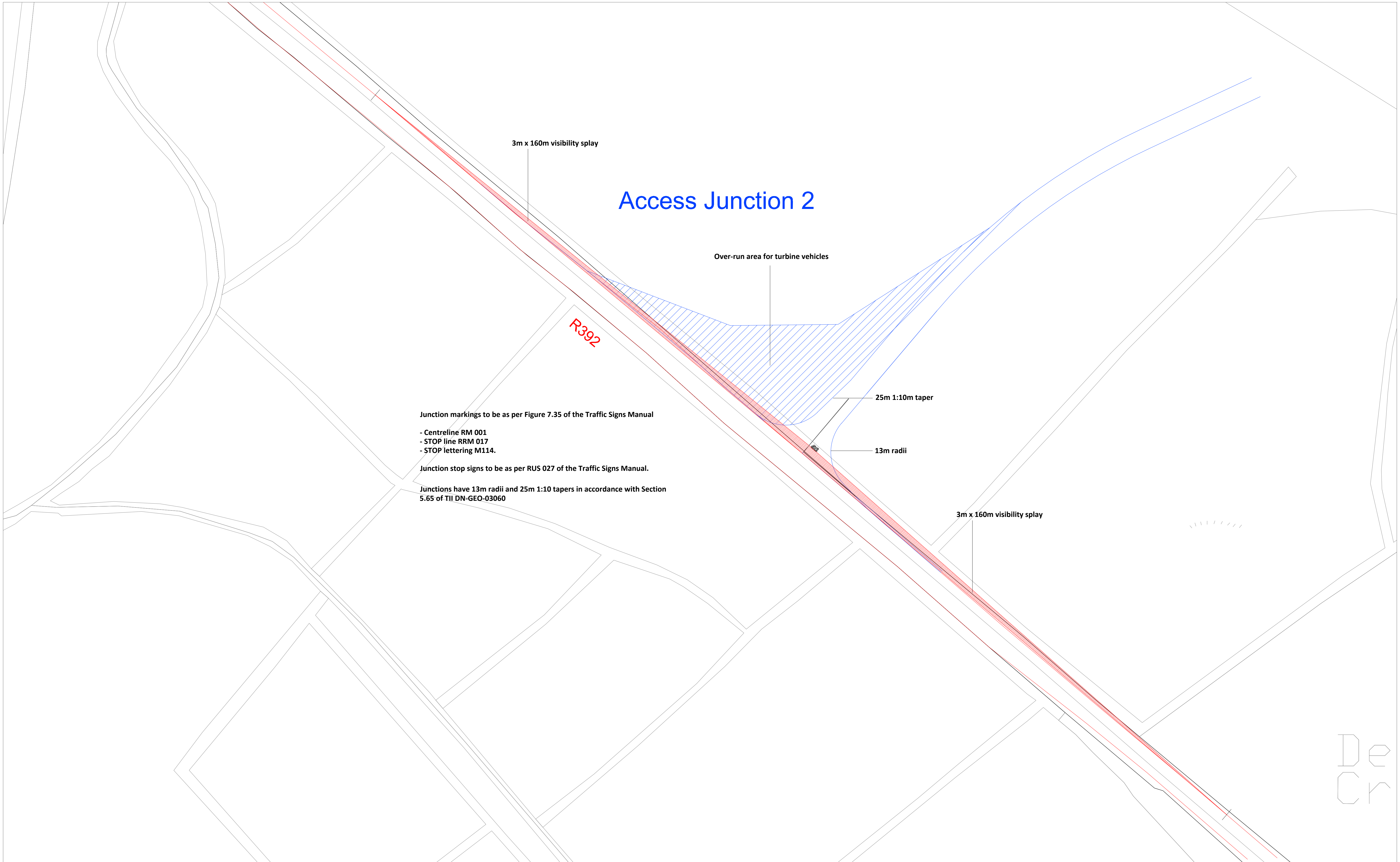
PLANNING DRAWING ONLY - NOT FOR CONSTRUCTION PURPOSES

Base mapping provided by Tobins Consulting Engineers Ltd

Figure 14.17 Access Junction 2 - R392 - All construction traffic, proposed layout

PROJECT:	Derryadd Wind Farm, County Longford		
CLIENT:	Bord na Mona	SCALE:	1:1000
PROJECT NO: 7230	DATE: 08.08.18	DRAWN BY:	AL

ALAN LIPSCOMBE
TRAFFIC & TRANSPORT CONSULTANTS



Junction markings to be as per Figure 7.35 of the Traffic Signs Manual

- Centreline RM 001
- STOP line RRM 017
- STOP lettering M114.

Junction stop signs to be as per RUS 027 of the Traffic Signs Manual.

Junctions have 13m radii and 25m 1:10 tapers in accordance with Section 5.65 of TII DN-GEO-03060

NOTES:

PLANNING DRAWING ONLY - NOT FOR CONSTRUCTION PURPOSES

Base mapping provided by Tobins Consulting Engineers Ltd

Figure 14.18 Access Junction 2 - R392 - Access for all construction traffic, proposed layout and visibility splay

PROJECT:	Derryadd Wind Farm, County Longford		
CLIENT:	Bord na Mona	SCALE:	1:1000
PROJECT NO: 7230	DATE: 10.09.18	DRAWN BY:	AL

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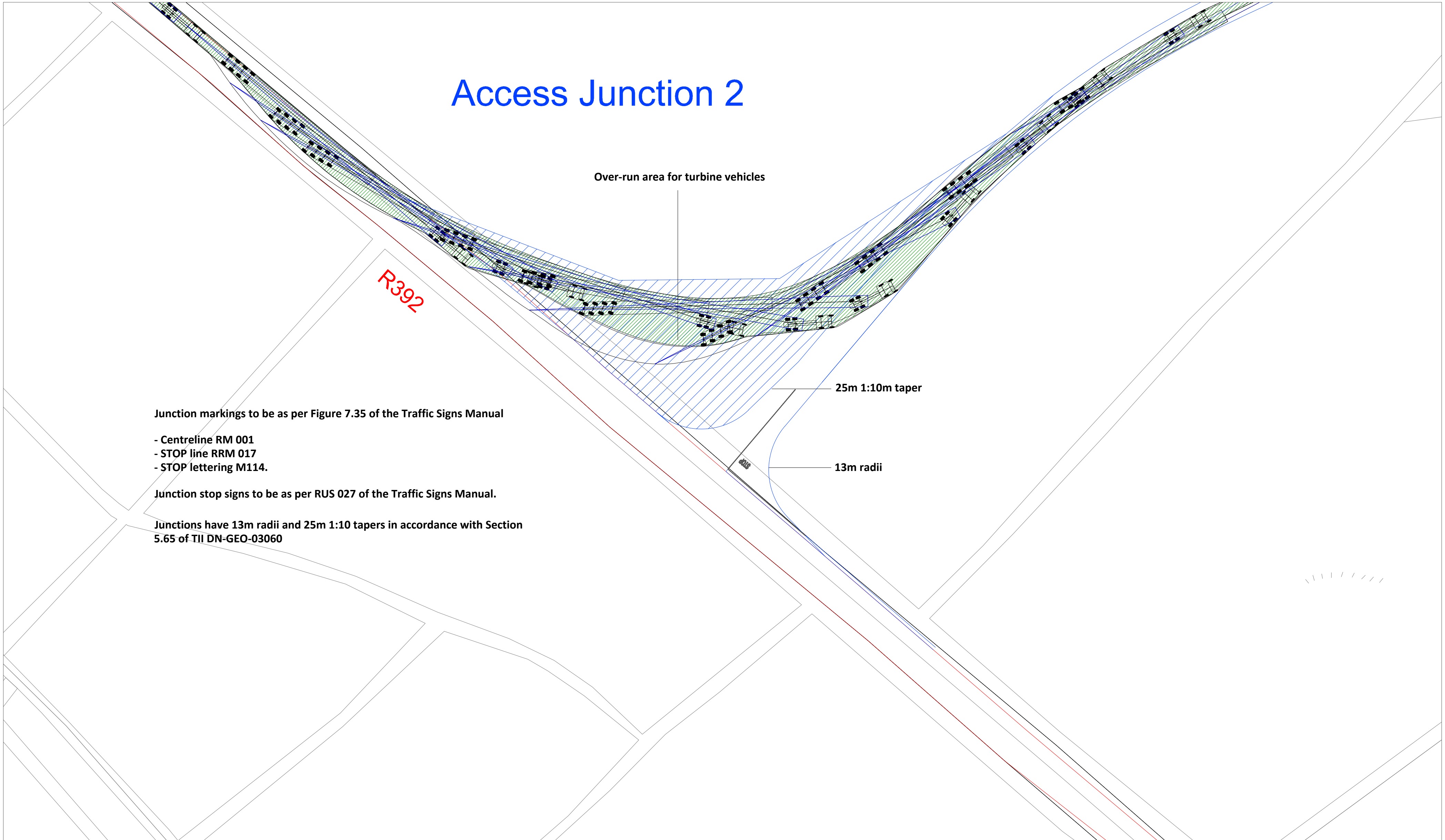
TRAFFIC & TRANSPORT CONSULTANTS



NOTES:

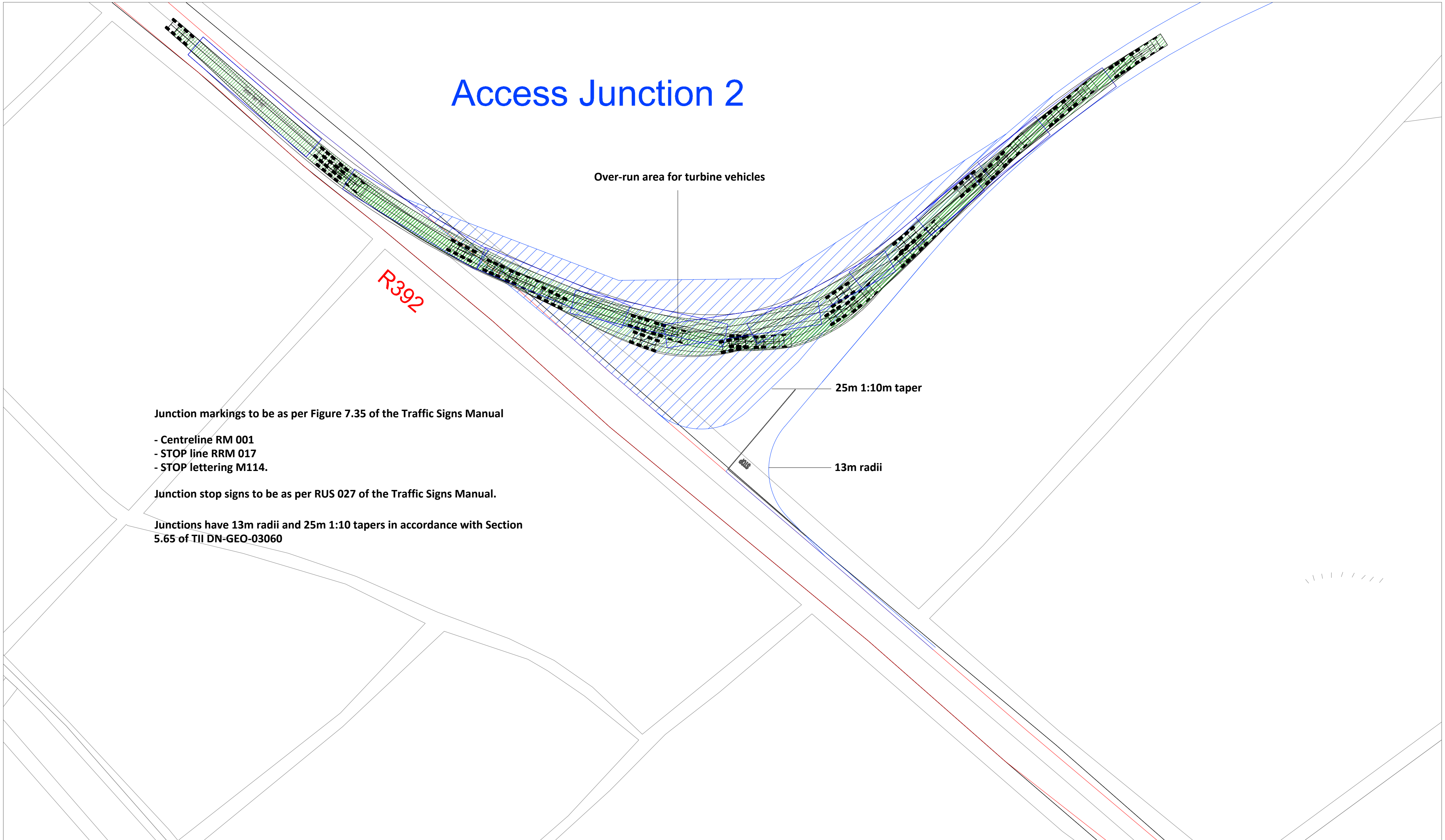
PLANNING DRAWING ONLY - NOT FOR CONSTRUCTION PURPOSES

Base mapping provided by Tobins Consulting Engineers Ltd

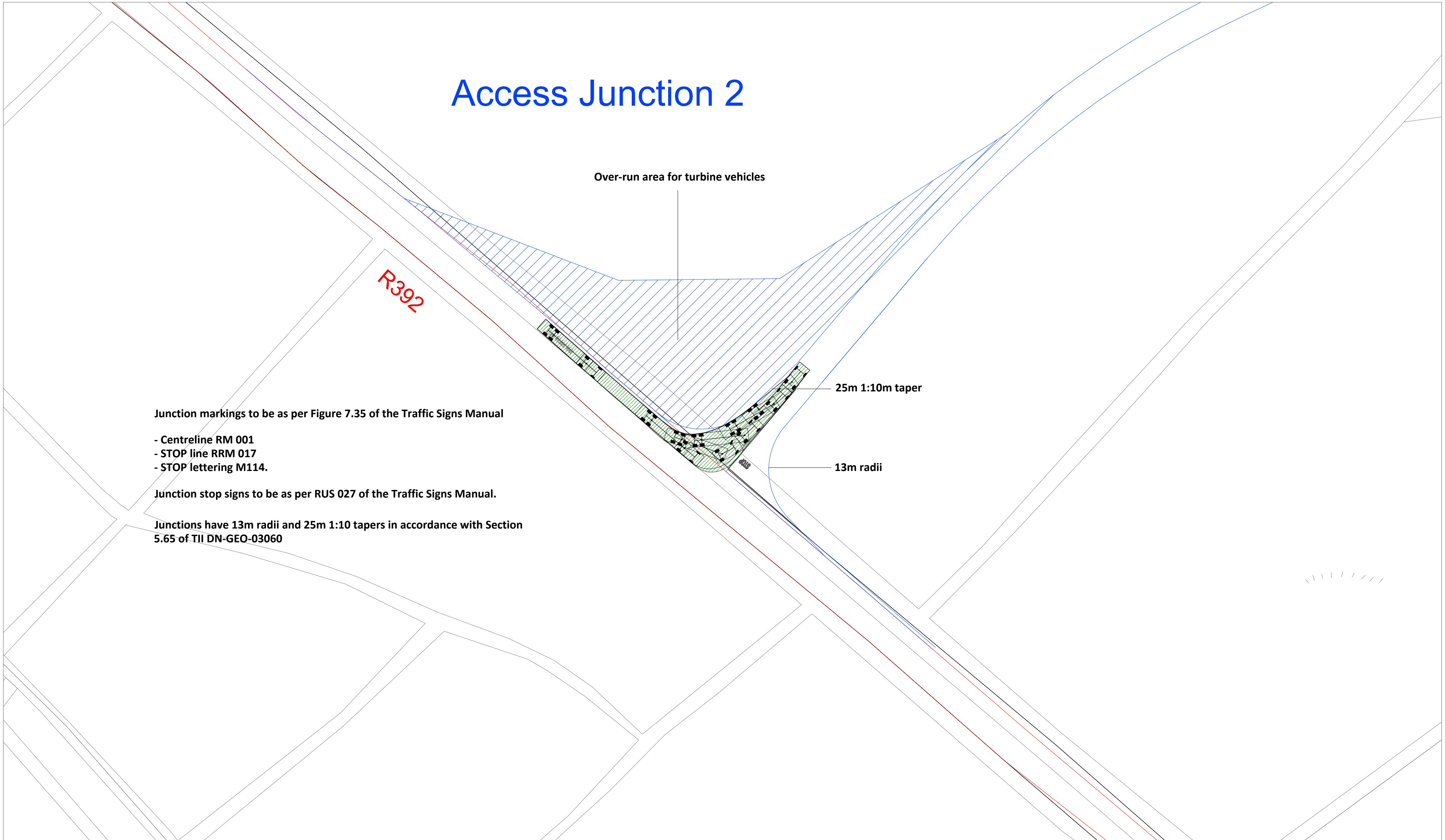
Figure 14.19 Access Junction 2 - R392 - Access for all construction traffic, blade extended artic

PROJECT:	Derryadd Wind Farm, County Longford		
CLIENT:	Bord na Mona	SCALE:	1:1000
PROJECT NO: 7230	DATE: 08.08.18	DRAWN BY:	AL

ALAN LIPSCOMBE
TRAFFIC & TRANSPORT CONSULTANTS



NOTES: PLANNING DRAWING ONLY - NOT FOR CONSTRUCTION PURPOSES Base mapping provided by Tobins Consulting Engineers Ltd	Figure 14.20 Access Junction 2 - R392 - Access for all construction traffic, tower extended artic			
	PROJECT: Derryadd Wind Farm, County Longford			ALAN LIPSCOMBE TRAFFIC & TRANSPORT CONSULTANTS
	CLIENT: Bord na Mona		SCALE: 1:1000	
	PROJECT NO: 7230	DATE: 08.08.18	DRAWN BY: AL	



NOTES:

PLANNING DRAWING ONLY - NOT FOR CONSTRUCTION PURPOSES

Base mapping provided by Tobins Consulting Engineers Ltd

Figure 14.20a Access Junction 2 - R392 - Access for all construction traffic, large standard artic accessing site - from north

PROJECT:	Derryadd Wind Farm, County Longford		
CLIENT:	Bord na Mona	SCALE:	1:1000
PROJECT NO: 7230	DATE: 24.01.19	DRAWN BY:	AL

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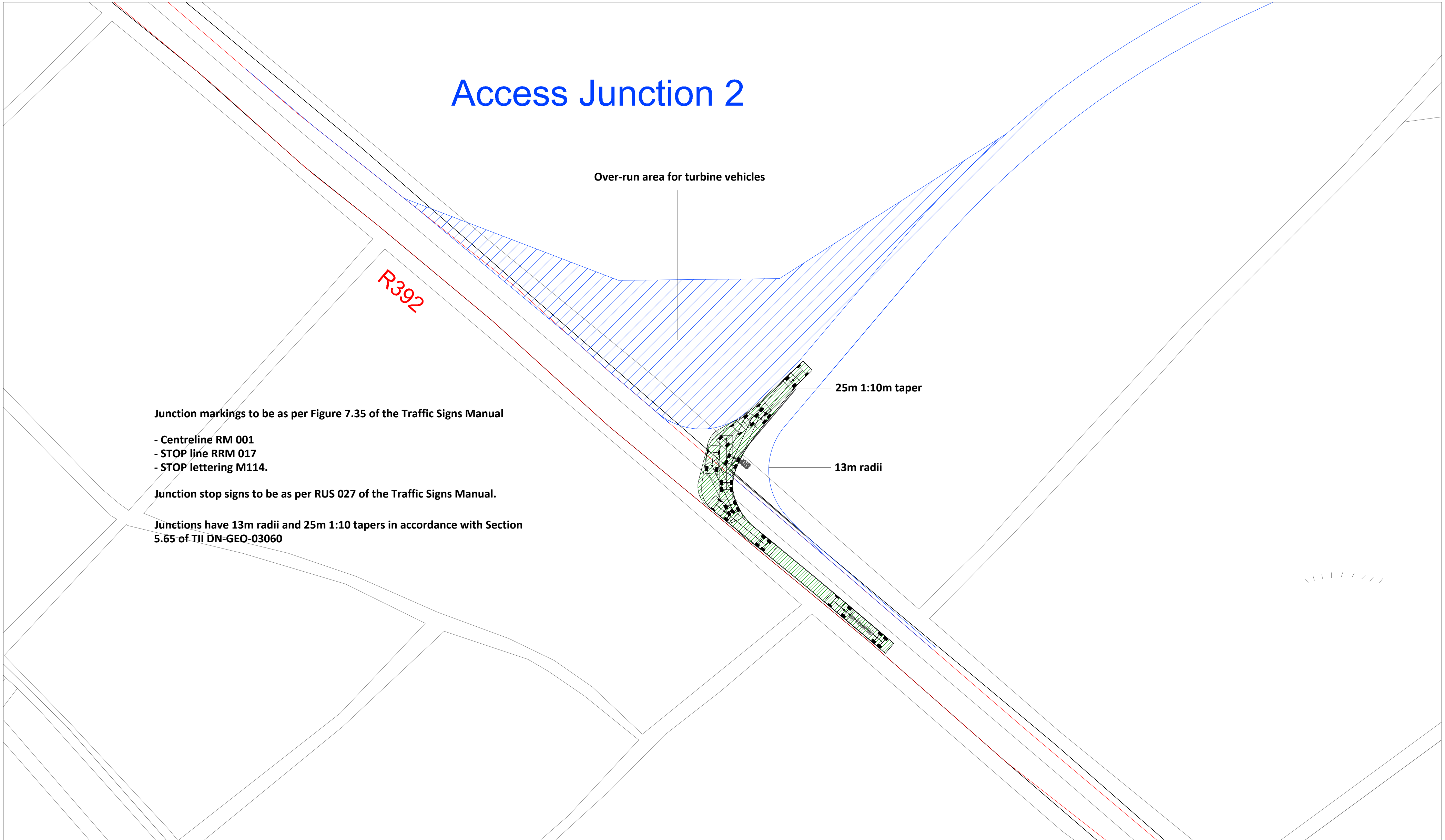

NOTES:

PLANNING DRAWING ONLY - NOT FOR CONSTRUCTION PURPOSES

Base mapping provided by Tobins Consulting Engineers Ltd

Figure 14.20b Access Junction 2 - R392 - Access for all construction traffic, large standard artic accessing site - from south

PROJECT: Derryadd Wind Farm, County Longford

CLIENT: Bord na Mona

SCALE: 1:1000

PROJECT NO: 7230

DATE: 24.01.19

DRAWN BY: AL

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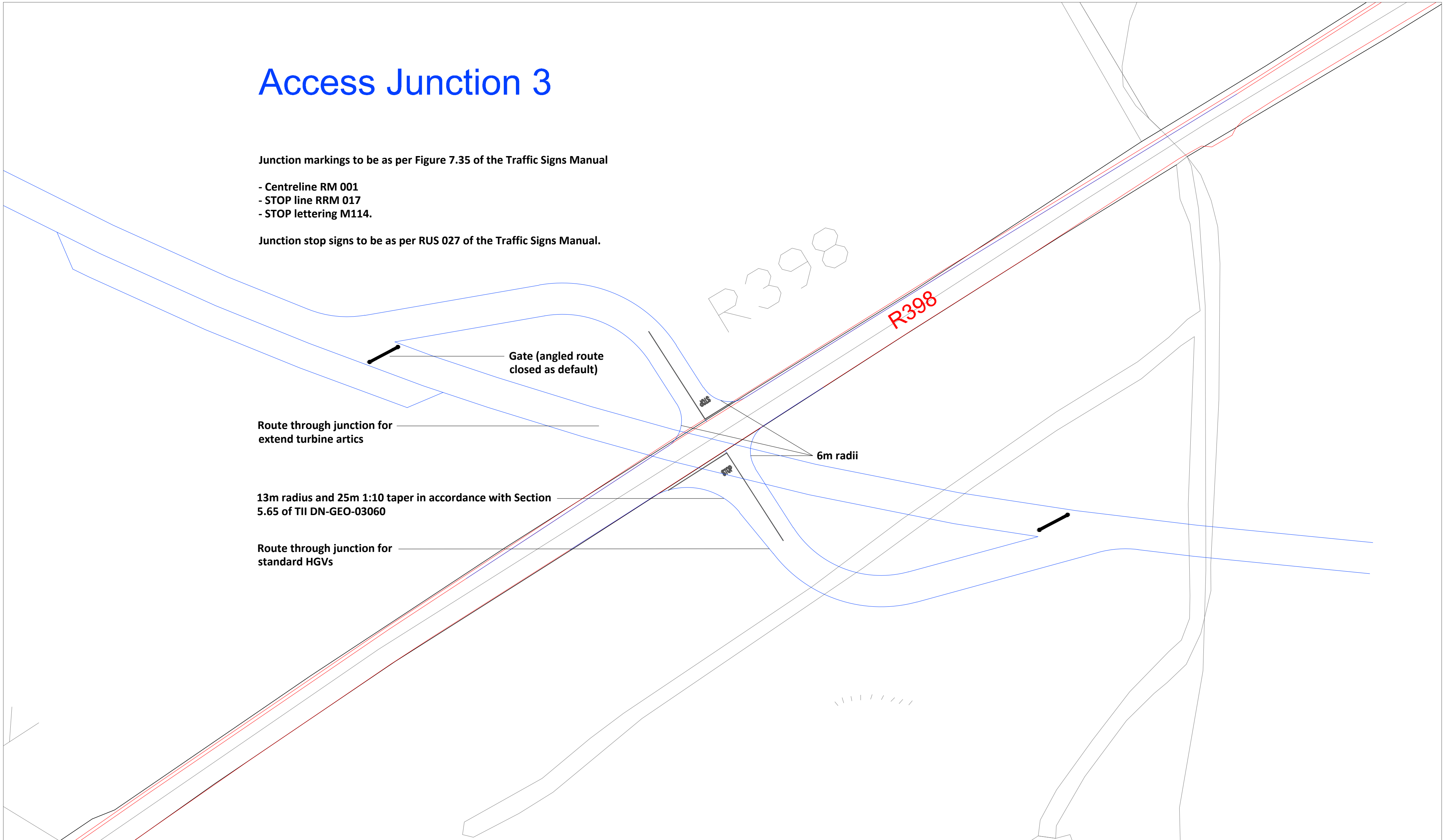

NOTES:

PLANNING DRAWING ONLY - NOT FOR CONSTRUCTION PURPOSES

Base mapping provided by Tobins Consulting Engineers Ltd

Figure 14.21 Access Junction 3 - R398 - Construction traffic crossing and access to southern site, proposed layout

PROJECT:	Derryadd Wind Farm, County Longford		
CLIENT:	Bord na Mona	SCALE:	1:1000
PROJECT NO: 7230	DATE: 03.01.18	DRAWN BY:	AL

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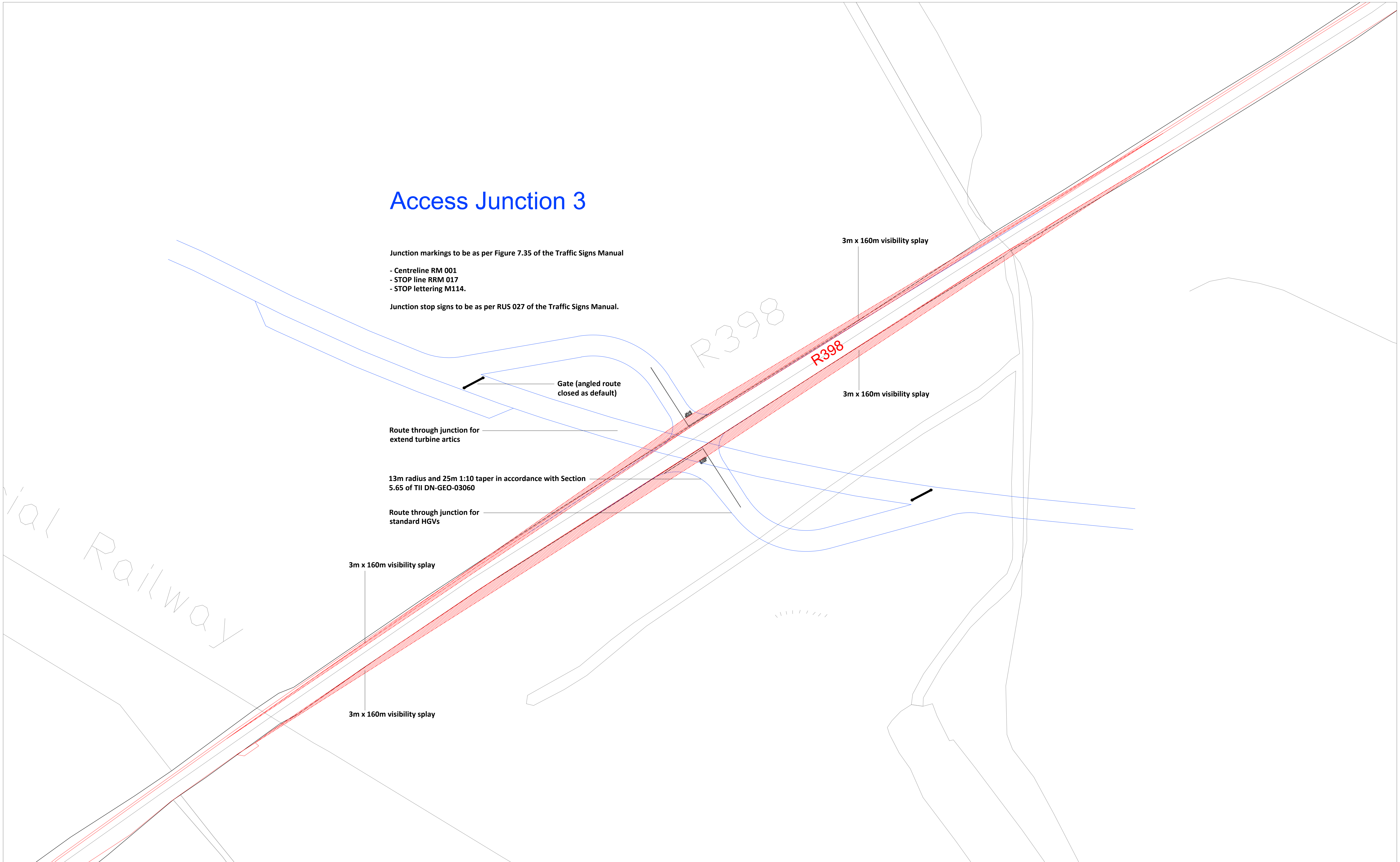

NOTES:

PLANNING DRAWING ONLY - NOT FOR CONSTRUCTION PURPOSES

Base mapping provided by Tobins Consulting Engineers Ltd

Figure 14.22 Access Junction 3 - R398 - Construction traffic crossing and access to southern site, proposed layout and visibility splays

PROJECT:	Derryadd Wind Farm, County Longford		
CLIENT:	Bord na Mona	SCALE:	1:1000
PROJECT NO: 7230	DATE: 03.01.18	DRAWN BY:	AL

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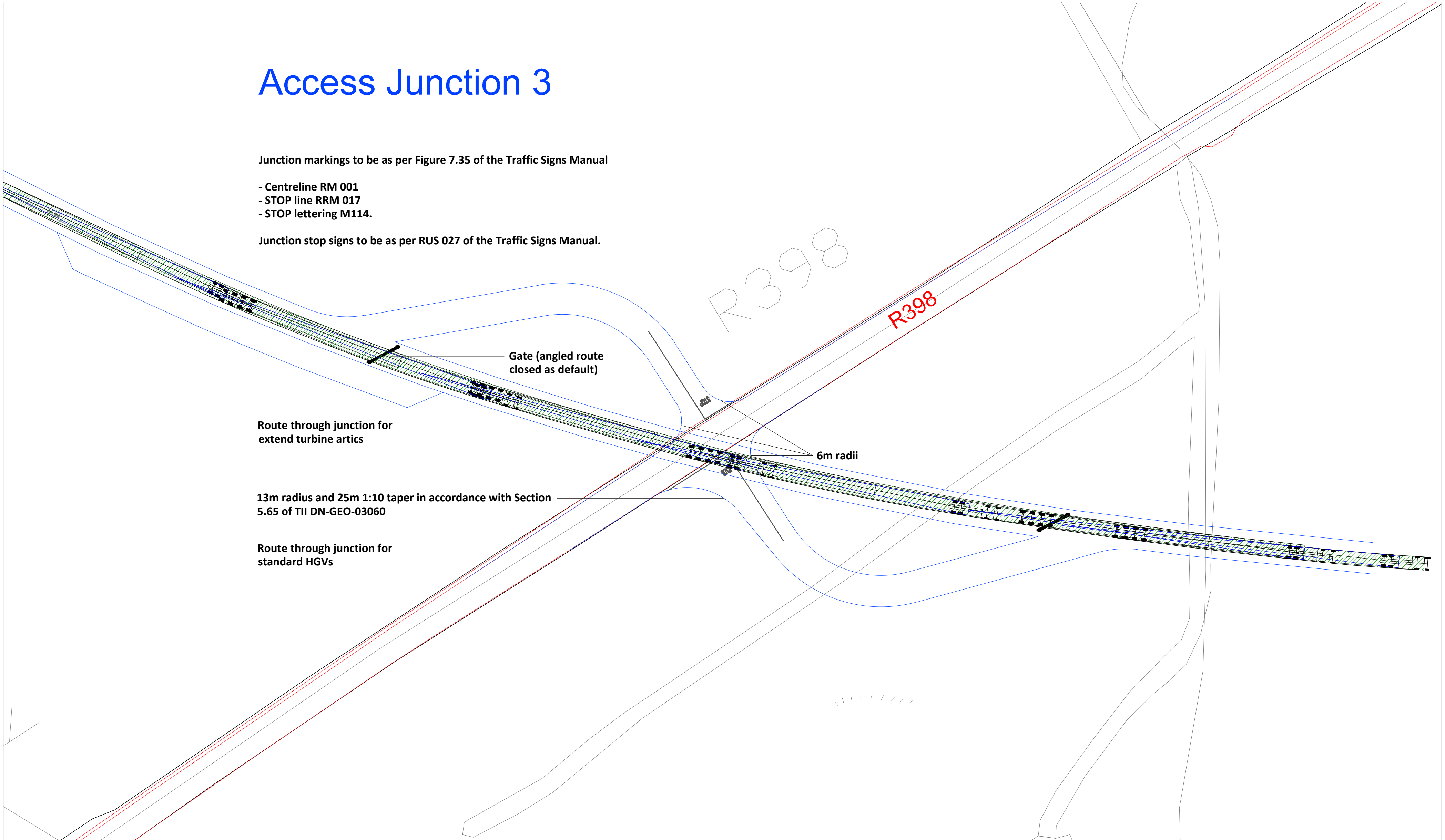
Access Junction 3



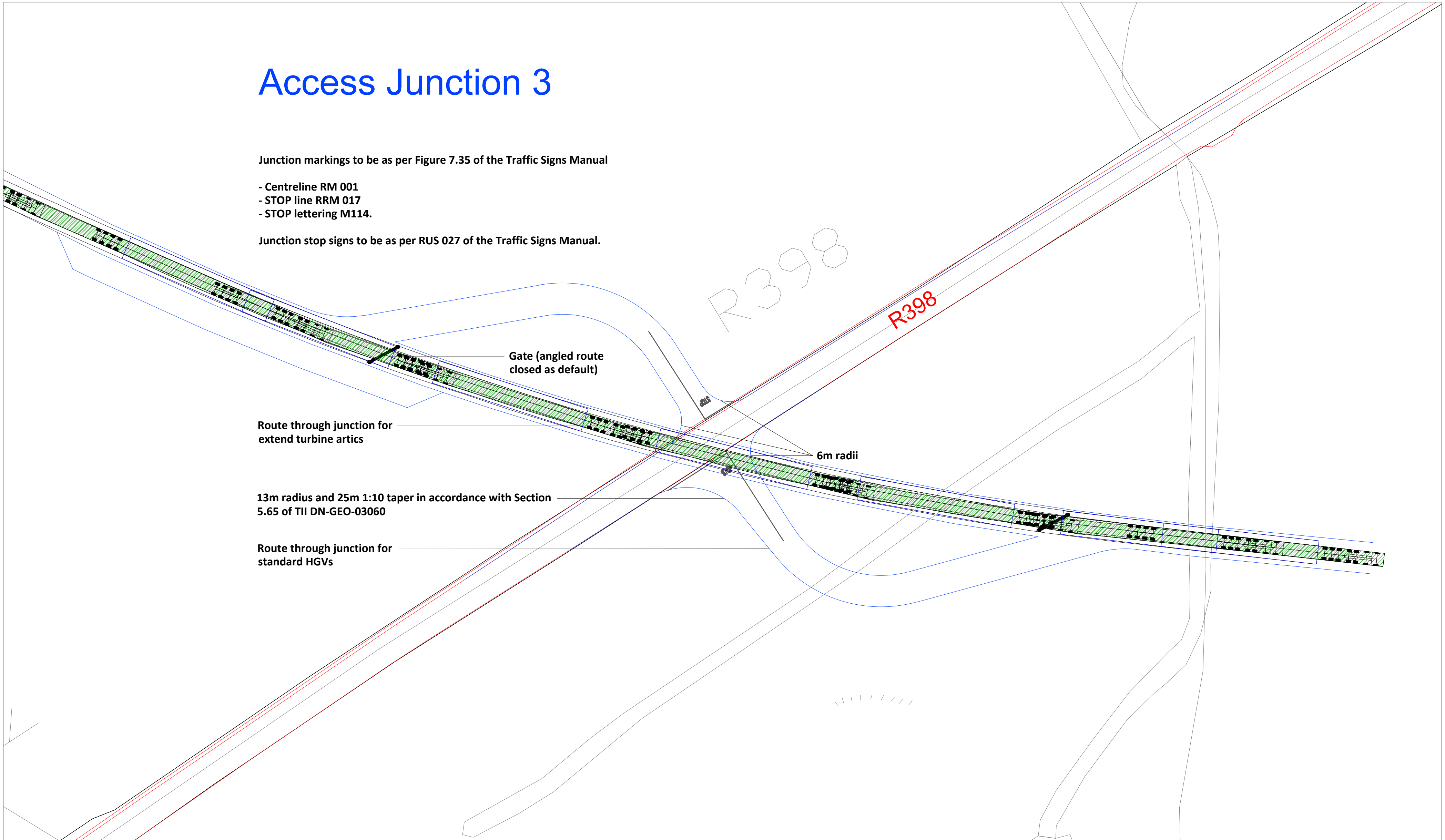
NOTES: PLANNING DRAWING ONLY - NOT FOR CONSTRUCTION PURPOSES. Base mapping provided by Tobins Consulting Engineers Ltd	Figure 14.23 Access Junction 3 - R398 - Construction traffic crossing and access to southern site, blade extended artic crossing R398			
	PROJECT: Derryadd Wind Farm, County Longford			ALAN LIPSCOMBE TRAFFIC & TRANSPORT CONSULTANTS
	CLIENT: Bord na Mona		SCALE: 1:1000	
	PROJECT NO: 7230	DATE: 03.01.18	DRAWN BY: AL	

Access Junction 3

Junction markings to be as per Figure 7.35 of the Traffic Signs Manual

- Centreline RM 001
- STOP line RRM 017
- STOP lettering M114.

Junction stop signs to be as per RUS 027 of the Traffic Signs Manual.



NOTES:

PLANNING DRAWING ONLY - NOT FOR CONSTRUCTION PURPOSES

Base mapping provided by Tobins Consulting Engineers Ltd

Figure 14.24 Access Junction 3 - R398 - Construction traffic crossing and access to southern site, tower extended artic crossing R398

PROJECT: Derryadd Wind Farm, County Longford			
CLIENT: Bord na Mona		SCALE: 1:1000	
PROJECT NO: 7230	DATE: 03.01.18	DRAWN BY: AL	

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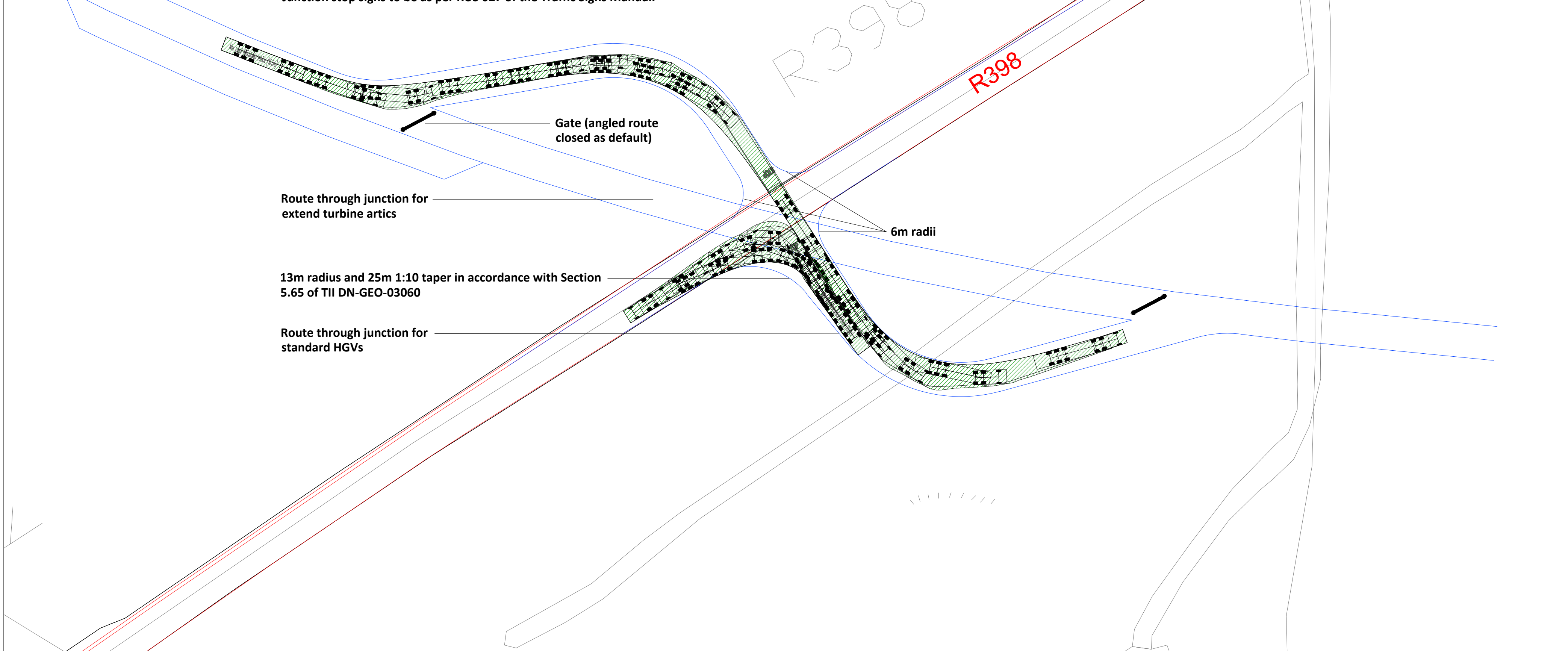
Access Junction 3

Junction markings to be as per Figure 7.35 of the Traffic Signs Manual

- **Centreline RM 001**
- **STOP line RRM 017**
- **STOP lettering M114.**

Junction stop signs to be as per RUS 027 of the Traffic Signs Manual.



NOTES:	Figure 14.25 Access Junction 3 - R398 - Construction traffic crossing and access to southern site, standard artic HGV		
PLANNING DRAWING ONLY - NOT FOR CONSTRUCTION PURPOSES	PROJECT: Derryadd Wind Farm, County Longford		ALAN LIPSCOMBE TRAFFIC & TRANSPORT CONSULTANTS
Base mapping provided by Tobins Consulting Engineers Ltd	CLIENT: Bord na Mona	SCALE: 1:1000	
	PROJECT NO: 7230 / DATE: 03.01.18	DRAWN BY: AL	

NOTES:

PLANNING DRAWING ONLY - NOT FOR CONSTRUCTION PURPOSES

Base mapping provided by Tobins Consulting Engineers Ltd

Figure 14.26 Access Junction 4 - L1136 - Amenity traffic access, proposed layout

PROJECT:	Derryadd Wind Farm, County Longford		
CLIENT:	Bord na Mona	SCALE:	1:1000
PROJECT NO: 7230	DATE: 02.09.18	DRAWN BY:	AL

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NOTES:

PLANNING DRAWING ONLY - NOT FOR CONSTRUCTION PURPOSES

Base mapping provided by Tobins Consulting Engineers Ltd

Figure 14.27 Access Junction 4 - L1136 - Amenity traffic access, proposed layout, visibility splay

PROJECT:	Derryadd Wind Farm, County Longford		
CLIENT:	Bord na Mona	SCALE:	1:1000
PROJECT NO: 7230	DATE: 02.09.18	DRAWN BY:	AL

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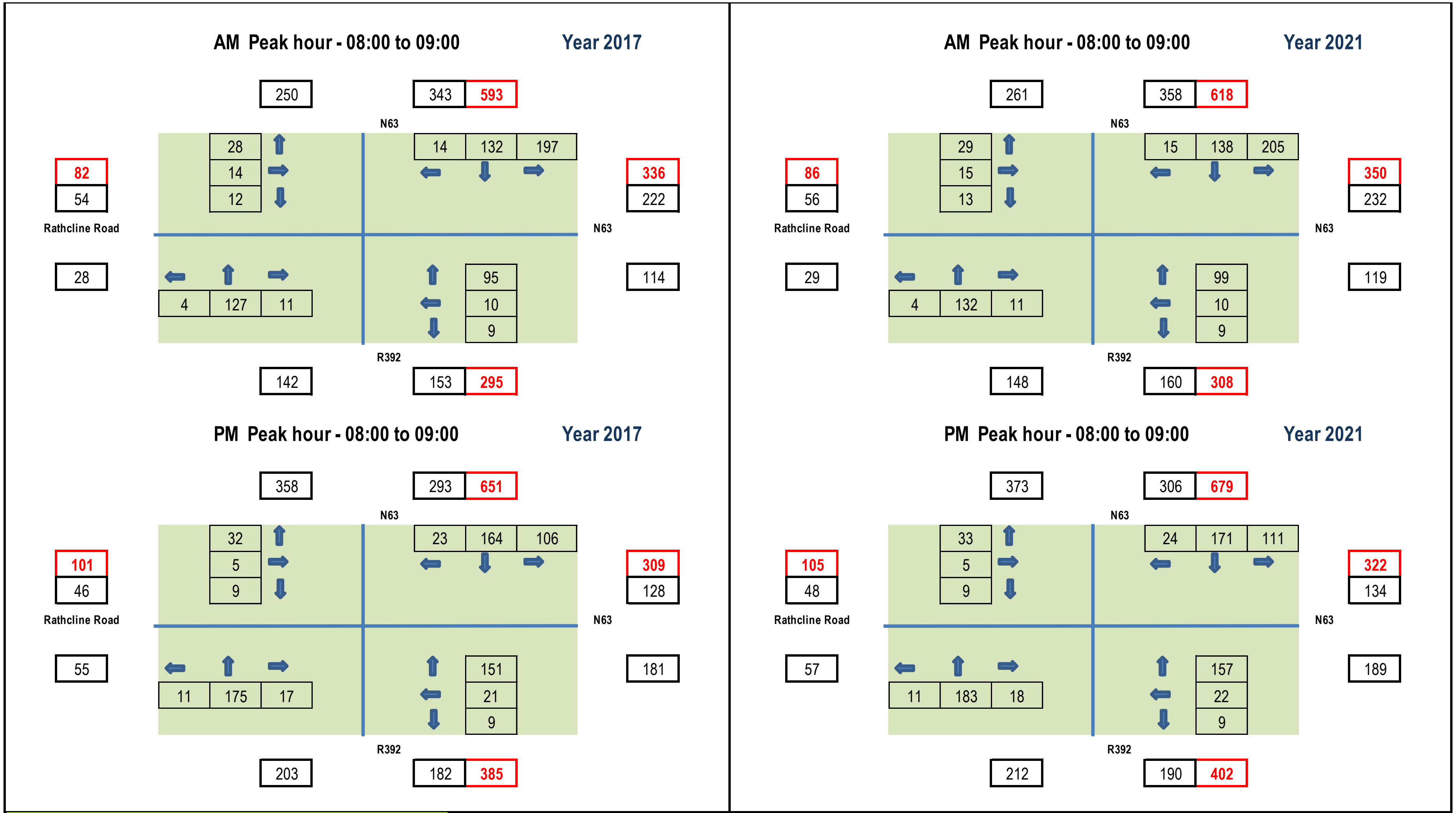

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Figure 14.28 Observed traffic flows, N63 / R392 junction, AM & PM peak hours, years 2017 and 2021

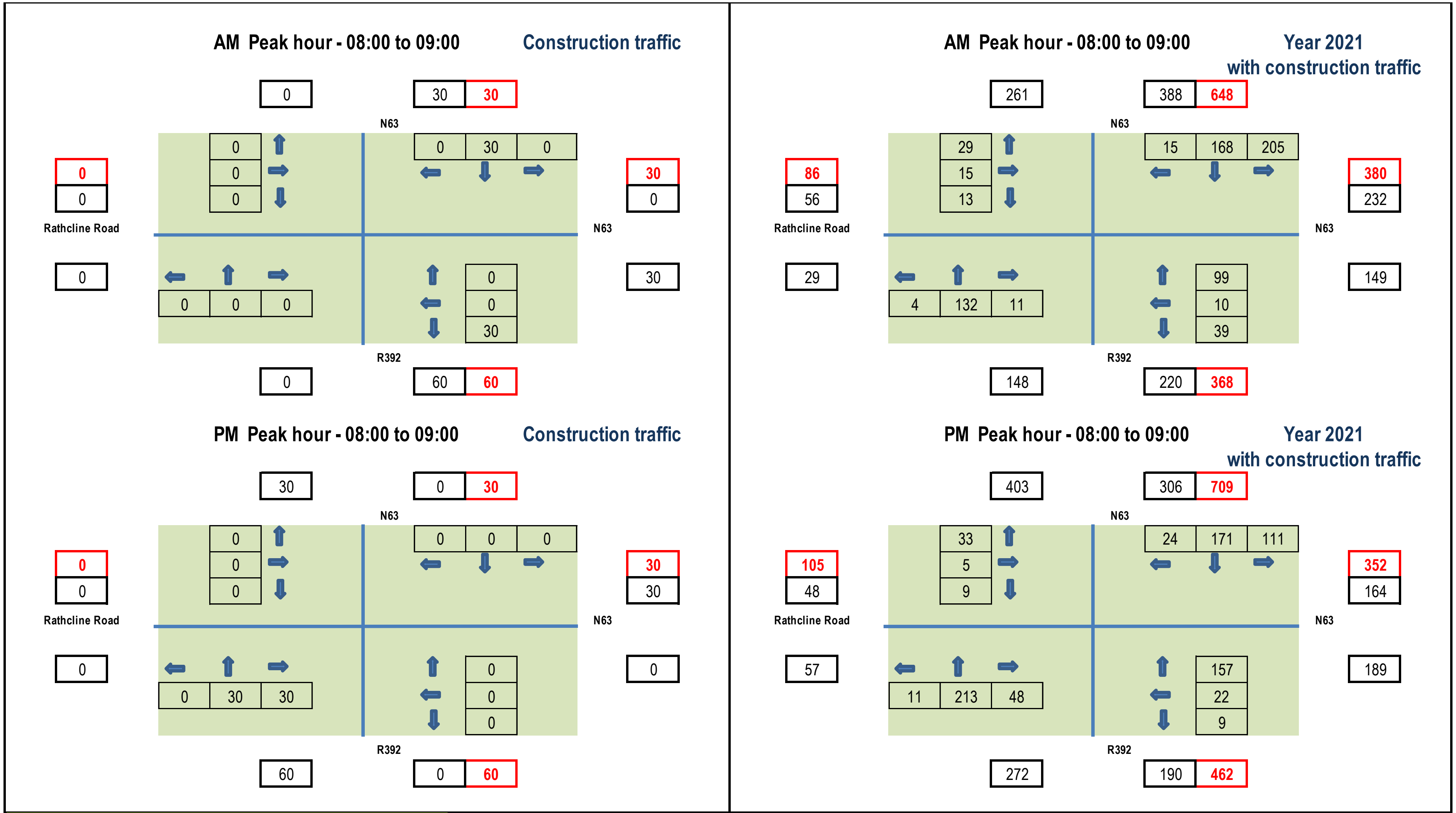

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Figure 14.29 Traffic flows, N63 / R392 junction, AM & PM peak hours, construction generated traffic, and with construction traffic year 2021

15 CULTURAL HERITAGE

15.1 INTRODUCTION

The cultural heritage chapter was prepared by Through Time Ltd. It presents the results of a cultural heritage impact assessment prepared as part of the Environmental Impact Assessment Report for the proposed Derryadd Wind Farm, Co. Longford (the 'proposed development').

This chapter assesses the likely significant effects of the proposed development on the archaeological, architectural and cultural heritage environment. The proposed development site consists of Derryaroge, Derryadd and Lough Bannow Bogs (and a small area of Derryshannoge Bog) which have a combined total area of approximately 1,900 hectares and are located in south County Longford. The layout of the proposed development was designed with consideration of the known cultural heritage, ensuring minimum impact on known above ground archaeological/architectural/cultural heritage features. The proposed development will involve ground disturbance in all elements of the proposal. Full details of the proposed development are provided in Chapter 2 of the EIAR.

Archaeological heritage generally refers to objects, monuments, buildings or landscapes of an (assumed) age typically older than AD1700 and usually recorded as archaeological sites within the Record of Monuments and Places. The term architectural heritage applies to structures, buildings, their contents and setting of an (assumed) age, typically younger than AD 1700. Cultural heritage is applied to other aspects of the landscape such as historical events, folklore and cultural associations and can accompany archaeological and architectural designation.

Where appropriate, mitigation measures to limit likely significant effects to the cultural heritage are documented and, thereafter, residual effects are identified and assessed.

15.1.1 Statement of Authority

Through Time Ltd. is a recently rebranded (2017) archaeological consultancy company that has previously traded as Arch Consultancy Ltd. for almost twenty years. Based in Athenry, County Galway, the company is directed by licensed archaeologists Martin Fitzpatrick M.A. and Fiona Rooney B.A. Both have been involved in all stages of development projects from initial design, compilation of EIAs, archaeological monitoring and resolution during construction. The projects managed ranges from the archaeological, architectural and cultural heritage components associated with developments of single dwelling houses to environmental impact assessments for large scale residual landfills, road developments and wind farms. Both directors have been involved in the development of wind farms for almost twenty years from initial design consultations, impact assessments, EIAs and involvement in ensuring that the archaeological and cultural heritage conditions attached to wind farm developments are completed to the highest professional standards. They are competent experts for the purposes of the preparation of this EIAR. This report has been compiled by both Fiona Rooney and Martin Fitzpatrick.

15.1.2 Relevant Legislation and Guidance

15.1.2.1 Current Legislation

Archaeological monuments are protected through national and international policy designed to secure the protection of the cultural heritage resource. This is facilitated in accordance with the provisions of the European Convention on the Protection of the Archaeological Heritage (Valletta Convention), which was ratified by Ireland in 1997.

The National Monuments Acts 1930 to 2014 and relevant provisions of the National Cultural Institutions Act 1997 are the primary means of ensuring the satisfactory protection of archaeological remains, which includes all man-made structures of whatever form or date except buildings habitually used for ecclesiastical purposes. A National Monument is described as:

> *"a monument or the remains of a monument the preservation of which is a matter of national importance by reason of the historical, architectural, traditional, artistic or archaeological interest attaching thereto"* (National Monuments Act 1930 Section 2).

A number of mechanisms under the National Monuments Acts are applied to secure the protection of archaeological monuments. These include the Register of Historic Monuments, the Record of Monuments and Places and the placing of Preservation Orders and Temporary Preservation Orders on endangered sites.

The minister of the Department of Culture, Heritage and the Gaeltacht (DCHG) may acquire National Monuments by agreement or by compulsory order. The State or the Local Authority may assume guardianship of any National Monument (other than dwellings). The owners of National Monuments may also appoint the Minister or the Local Authority as guardians of that monument, if the State or Local Authority agrees. Once the site is in ownership or guardianship of the State, it may not be interfered with without the written consent of the Minister.

Section 5 of the 1987 Act requires the Minister to establish and maintain a Register of Historic Monuments. Historic monuments and archaeological areas present on the Register are afforded statutory protection under the 1987 Act. Any interference with sites recorded on the Register is illegal without the permission of the Minister. Two months' notice in writing is required prior to any work being undertaken on or in the vicinity of a Registered Monument. The Register also includes sites under preservation orders and temporary preservation orders with the written consent, and at the discretion of the Minister.

Section 12(1) of the 1994 Act requires the Minister to establish and maintain a Record of Monuments and Places where the Minister believes that such monuments exist. The Record comprises a list of monuments and relevant places and a map showing each monument and relevant place in respect of each county in the state. All sites recorded on the Record of Monuments and Places receive statutory protection under the National Monuments Act 1994.

Section 12(3) of the 1994 Act provides that:

> *"Where the owner or occupier (other than the Minister) of a monument or place included in the Record, or any other person, proposed to carry out, or to cause or permit the carrying out of, any work at or in relation to such a monument or place, he or she shall give notice to the Minister to carry out work and shall not, except in the case of urgent necessity and with the consent of the Minister, commence the works until two months after the giving of notice".*

The Council of Europe, in Article 2 of the 1985 Convention for the Protection of the Architectural Heritage of Europe (Granada Convention), states that 'for the purpose of precise identification of the monuments, groups of structures and sites to be protected, each member State will undertake to maintain inventories of that architectural heritage'. The Granada Convention emphasises the importance of inventories in underpinning conservation policies.

The National Inventory of Architectural Heritage ("NIAH") was established in 1990 to fulfil Ireland's obligations under the Granada Convention, through the establishment and maintenance of a central record, documenting and evaluating the architectural heritage of Ireland. Article 1 of the Granada Convention establishes the parameters of this work by defining 'architectural heritage' under three broad categories of Monument, Groups of Buildings, and Sites:

- Monument: all buildings and structures of conspicuous historical, archaeological, artistic, scientific, social or technical interest, including their fixtures and fittings;
- Group of buildings: homogeneous groups of urban or rural buildings conspicuous for their historical, archaeological, artistic, scientific, social or technical interest, which are sufficiently coherent to form topographically definable units;

- Sites: the combined works of man and nature, being areas which are partially built upon and sufficiently distinctive and homogenous to be topographically definable, and are of conspicuous historical, archaeological, artistic, scientific, social or technical interest.

The Architectural Heritage and Historic Properties Act 1999 and the Planning and Development Act of 2000 are the main built heritage legislation. The Architectural Heritage Act requires the Minister to establish a survey to identify, record and assess the architectural heritage of the country. The National Inventory of Architectural Heritage ("NIAH") records all built heritage structures within specific counties in Ireland. The document is used to advise Local Authorities on the register of a Record of Protected Structures ("RPS") as required by the Planning and Development Act, 2000.

The Act of 2000 requires Local Authorities to establish a Record of Protected Structures to be included in the County Development Plan ("CDP"). Buildings recorded in the RPS can include Recorded Monuments, structures listed in the NIAH or buildings deemed to of architectural, archaeological or artistic importance by the Minister. Once listed in the RPS the sites/areas receive statutory protection from injury or demolition under the 2000 Act. Damage to or demolition of a site registered in the RPS is an offence. The detail of the list varies from County to County. If the Local Authority considers a building to need a repair, it can order conservation and/or restoration works. The owner or developer must make a written application/request to the Local Authority to carry out any works on a protected Structure and its environs.

Fieldwork for the National Inventory of Architectural Heritage ("NIAH") for County Longford was undertaken in 2006. Where an NIAH survey has been carried out, those structures which have been attributed a rating value of international, national or regional importance in the inventory are recommended by the Minister of Culture, Heritage and the Gaeltacht (CHG) to the relevant planning authority for inclusion on the RPS. In accordance with Section 53 of the Planning and Development Act 2000, if a planning authority, after considering a recommendation made to it under this section, decides not to comply with the recommendation, it shall inform the Minister in writing of the reason for its decision.

15.1.2.2 Code of Practice

There is a specific code of practice agreed between the Department of Culture, Heritage and the Gaeltacht, the National Museum of Ireland and Bord na Móna to provide a framework within existing legislation, policy and practice that enables Bord na Móna to progress with its programme of peat extraction within the framework of Government strategy, whilst carrying out archaeological mitigation having regard to a set of principles and actions agreed by all parties[165]. The Code draws from *Agreed Principles for the Protection of Wetlands Archaeology in Bord na Móna Bogs* and refers exclusively to the extraction of peat from peatlands where this extraction lies outside the scope of the Planning and Development Acts. This application is within the Planning and Development acts however the details of code of practice are included here to highlight how archaeology and cultural heritage forms part of the current working environment.

The Code is guided by the following agreed principles

1. The Minister for Arts, Heri[t]age and the Gaeltacht has a responsibility to protect the archaeological heritage and to exercise powers of preservation, under the National Monuments Acts 1930-2004, taking account of the European Convention on the Protection of the Archaeological Heritage (Valletta).
2. The Minister's statutory responsibilities include the maintenance of the *Record of Monuments and Places*, with the aim of providing protection to all known archaeological monuments including those uncovered in Bord na Móna bogs.
3. The Director of the National Museum of Ireland has a responsibility to enforce state ownership of all archaeological objects and to safeguard the treatment of all archaeological objects before their accession into the State's repository, under National Monuments Acts 1930-2004 and the National Cultural Institutions Act 1997, taking account of the European Convention on the Protection of the Archaeological Heritage (Valletta).

15.1.2.3 Consultations

Several bodies were consulted as part of the assessment and included:

- Department of Culture, Heritage and the Gaeltacht (DCHG) – the Heritage Service, National Monuments and Historic Properties Section: Record of Monuments and Places; Sites and Monuments Record; Monuments in State Care Database; Preservation Orders; Register of Historic Monuments;
- National Museum of Ireland, Irish Antiquities Division: topographical files of Ireland;
- National Inventory of Architectural Heritage: County Longford;
- Longford County Council: Planning Section;
- Trinity College Dublin, Map Library;

165 https://www.archaeology.ie/sites/default/files/media/publications/cop-bord-na-mona-en.pdf

- Ordnance Survey of Ireland- historical and Ordnance Survey Maps;
- The Irish Peatlands Conservation Council; and
- The Bord na Móna consultant archaeologist, Dr. Charles Mount.

15.1.2.4 Longford County Development Plan 2015-2021

Longford County Council has written policies on the preservation of archaeological, architectural and cultural heritage remains in relation to permitted development in the Longford County Development Plan 2015-2021 ("the CDP"). The principal aim is to conserve, protect and enhance Longford's archaeological and cultural heritage. These policies relate to archaeological features and objects, built structures, views and scenic routes.

Relevant policies include:

General Heritage

HER1: *"The Planning Authority shall promote the protection and conservation of heritage sites, artefacts and monuments and the integrity of their setting, as listed and illustrated in the Record of Monuments and Places".*

HER4: *"The Planning Authority shall endeavour to identify important landscapes and habitats and the importance of local character, identity and distinctiveness, in both the natural and built heritage of the County. This shall include an investigation of the Heritage Plan for the County into locally important and small-scale heritage sites. Where these have been identified as important under the Heritage Plan, they shall be afforded the relevant protection."*

Archaeological Heritage

As stated in Section 6.2.1. of the CDP, *"Archaeological Sites and Monuments are distinctive features of the historic landscape of County Longford that have been identified through research and fortuitous discovery. Such remains provide important evidence of the people and settlements that made up the County prior to the formation of the modern landscape that we recognise today. Some of the archaeological remains are distinctive and clearly visible, while others are only visible to experts or only survive beneath modern fields and settlements. Each site and monument, however, has a unique character and contribution to make to the landscape of the County and adds meaning to our understanding of the environment. Appropriate management of archaeological remains is essential to ensure the survival of these non-renewable features. These features also provide an important educational and tourism tool and contribute to creating a sense of place. Over 1700 archaeological sites and monuments are recorded in County Longford under the Record of Monuments and Places, protected* *under Section 12 of the National Monuments (Amendment) Act 1994."* It is the Council's view that *'there are also almost certainly a number of unknown sites that have not yet been discovered within the County."*

Accordingly, the Council's policy and objectives for the protection of Longford's Archaeological Heritage is as follows;

ARC 1:*"It is an objective of the Council to protect known and unknown archaeological areas, sites, structures, monuments and objects in the County. In this regard, development in the vicinity of recorded monuments shall be referred to the Department of the Arts, Heritage and Gaeltacht for comment and these considered in the assessment of any application for development. In general, development within a 20m radius of a recorded monument will not be permitted and proposed development within 75 metres discouraged (subject to other policies contained within this Plan)."*

ARC 2: *"It is an objective of the Council to protect the integrity of the settings of archaeological areas, sites, structures, monuments and objects in the County."*

ARC 3: *"It is an objective of the Council to encourage and promote appropriate management and enhancement of the County's rich archaeological heritage."*

ARC 4: *"It is an objective of the Council to encourage and promote access to and understanding of the archaeological heritage of the County."*

ARC 5: *"It is the policy of the Council to presume in favour of the physical preservation in-situ of archaeological remains and their settings, where appropriate, feasible and in accordance with the proper planning and sustainable development of the County. The approach will be favoured in these circumstances as the most appropriate means of protecting the heritage of the County, in accordance with government policy."*

ARC 6: *"It is the policy of the Council to strictly control development proposals on unzoned lands which may be detrimental to any area, site, structure, monument or object of archaeological significance, or detract from, its interpretation and setting. In this regard, the Planning Authority shall seek an assessment - to be carried out by a licensed archaeologist - of developments which may impact on a national or recorded monument, the designated zone of archaeological importance surrounding any monument or other site of archaeological significance within the County. Development will only be permitted where the Council, in consultation with the DoAHG (now DCHG)considers it acceptable as per the assessment and subject to any necessary mitigation measures proposed to prevent adverse impact on the monument and/or its settings."*

ARC 7: *"It is the policy of the Council to seek to increase awareness, appreciation and enjoyment of the archaeological heritage for all, through the provision of information to landowners and the community generally, in co-operation with statutory and other partners."*

ARC 8: *'It is the policy of the Council to investigate and promote the provision of improved access to important archaeological sites such as those National Monuments in State ownership or guardianship listed below"*

Site	Description Nat.	Mon No.	Status
Inchcleraun	Early monastery	91	State Ownership
Larkfield	Ringfort	640	State Ownership
Sonnagh	Ringfort	598	State Ownership
Aghaward	Ringfort	630	State Ownership
Granard	Motte	263	State Ownership
Corlea	Bog Trackway	677	State Ownership

Table 15.1: National Monuments listed in Co. Longford Development Plan, 2015-2021

ARC 9: *"In securing the preservation of the archaeological heritage, the Planning Authority will have regard to the recommendations of the DoAHG (now DCHG), both in respect of whether or not to grant Planning Permission and in respect of the condition to which permission would, if granted, be subject."*

ARC 10: *"Where necessary, the Planning Authority may impose, through the Development Management Process, conditions to safeguard that adequate measures are taken to identify and mitigate the archaeological impacts of any development, including where required the completion of a licensed excavation."*

ARC 11: *"It is policy of the Council to protect the National Monuments as outlined in the table entitled 'Monuments protected under Preservation Orders'."*

ARC 12: *"It is policy of the Council to protect the monuments of Archaeological, Historical and Cultural Interest as outlined in the table of the same [Table 6.5 of CDP] and illustrated on the Map included as part of Appendix 7 [Appendix 7 of CDP]."*

Architectural Heritage

According to Section 6.2.3 of the CDP the general policy of the Council is as follows;

ARCH 1: *"It is an objective of the Council to promote the maintenance and appropriate re-use of the existing building stock as a sustainable development issue and because of the contribution of older buildings, both individually and collectively, to the unique character, heritage and identity of the County."*

ARCH 2: *"It is an objective and policy of the Council that all development should be appropriate to its setting in the landscape or townscape and should respond to and reinforce local character and heritage. This will ensure that high quality environments are either maintained or created by development."*

ARCH 3: *"It is an objective of the Council that all new development in urban and rural situations shall be guided by sustainable development principles."*

ARCH 4: "It is the policy of the Council to encourage and promote the enhancement, management, protection and the promotion of access to and understanding of the architectural heritage of the County."

Record of Protected Structures

The council has also included the following policies, in addition to the statutory protection;

RPS 1: *It is the policy of the Council to ensure the protection of structures included in the Record of Protected Structures generally and in particular by:*

- *Controlling development which would alter the character of protected structures and proposed protected structures.*
- *Monitoring the condition of protected structures and proposed protected structures to identify those endangered by neglect, vandalism or unauthorized development and taking appropriate action.*
- *Preventing the endangerment of protected structures in the Council's ownership.*
- *In this regard, the Council shall seek further funding for the upkeep of protected structures within the County."*

RPS 2: "*It is the policy of the Council to issue Declarations as to the type of works that would affect the character of a protected structure and therefore require planning permission."*

RPS 3: "It is the policy of the Council to administer the Department of Arts, Heritage and the Gaeltacht's Structures At Risk Fund, including the assessment of applications, ensuring that the works enhance and do not adversely affect the character of a protected structure and have been carried out in accordance with the conditions of the fund."

In Section 5.5.2.1 of the CDP, the Longford Wind Energy Policy states, that the following will be taking into consideration when assessing applications;

'in relation to cultural heritage this includes the visual impact, the impact on environmental designations - Natural Heritage Areas, Archaeological site, Protected Structures, National Monuments etc. Wind farm developments should not be located within 100 metres of ancient monuments.

Sensitivity of locations of folklore, mythology and religious significance to these developments. Evidence of consultation with local community groups is an important element of planning for such a project."

15.2 METHODOLOGY

15.2.1 Assessment Methodology

This assessment methodology has involved the following elements, further details of which are provided in the following sections:

- Desk study, including review of cartographic sources, including historic mapping, aerial photography, baseline records and published information;
- Field walkover survey of the proposed development;
- Evaluation of likely significant effects;
- Identification of measures to avoid and mitigate the effects.

The methodology used in this assessment is based on the EPA Advice Notes on Current Practice (in the preparation of Environmental Impact Statements)[166] (EPA, 2003) on Cultural Heritage, including folklore/tradition, architecture/settlements and monuments/features, following a baseline study of the existing cultural heritage features in the area of the proposed development, as well as per the Institute of Archaeologists (IAI) Good Practice Guidelines [167](IAI,2006). The updated Advice Notes for Preparing Environmental Impact Statements (Draft)[168] (September 2015) and the EPA Guidelines on the Information to be Contained in Environmental Impact Assessment Reports[169] Draft (May 2017) have also been used.

The archaeological assessment is divided into two separate phases. Phase I involved a desktop paper survey of archaeological, historical and cartographic sources. Phase II involved a field inspection of the area of the proposed development. A description of the results of the desk based survey and field survey in relation to the proposed development is described in Section **15.3.13**.

Consultations with the National Monuments Service, Department of Culture, Heritage and the Gaeltacht requested that ground disturbance associated with the proposed development be archaeologically monitored as part of Phase II – field inspection. Archaeological monitoring of ground disturbance associated with the geotechnical site investigations was carried out in 2017 and in 2018 under licence (Licence No. 18E0177). The information from the monitoring has been included in the assessment. The department recommended that overgrown areas of the proposed development should be cleared and

[166] https://www.epa.ie/pubs/advice/ea/guidelines/EPA_advice_on_EIS_2003.pdf

[167] http://www.iai.ie/wp-content/uploads/2016/03/IAI-Code-of-Conduct-for-Archaeological-Assessment-Excavation.pdf

[168] https://www.epa.ie/pubs/consultation/reviewofdrafteisguidelinesadvicenotes/Draft%20Advice%20Notes%20for%20preparing%20an%20EIS.pdf

[169] http://www.epa.ie/pubs/advice/ea/EPA%20EIAR%20Guidelines.pdf

recorded under archaeological supervision. These works were to be carried out as part of the Phase II - field inspection, and the results incorporated into the EIAR.

An impact assessment and mitigation strategy has been prepared to highlight likely significant effects that the proposed development may have on the archaeological, architectural or cultural heritage resource.

15.2.2 Phase 1 - Desk Study

Archaeological and historical documents including the following were examined to establish the archaeological, architectural and cultural heritage potential of the proposed development:

- Record of Monuments and Places ("RMP") for County Longford;
- Sites and Monuments Record ("SMR") for County Longford;
- The Archaeological Inventory for County Longford;
- Topographical files of the National Museum of Ireland;
- Longford County Development Plan 2015-2021;
- National Inventory of Architectural Heritage;
- Co. Longford Industrial Heritage Survey;
- Cartographic sources;
- Aerial photography;
- Excavation bulletins;
- Townland names; and
- The schools collection.

Record of Monuments and Places

The Record of Monuments and Places (RMP) is a list of archaeological sites known to the National Monuments Service of the Department of Culture, Heritage and the Gaeltacht (DCHG) with accompanying RMP maps, based on the first and second editions of the OS 6" Sheets, which indicate the location of each recorded site. The list is based on the Sites and Monuments Record (SMR) files which are kept in the National Monuments Service and are updated on a regular basis. The Sites and Monuments Records (SMR) are lists with accompanying maps and files of all known archaeological sites and monuments mainly dating to before 1700. These lists were initially compiled from cartographic, documentary and aerial photographic sources.

The "zone of notification" (highlighted on the map in a light pink-coloured wash delimited by a thin black line) indicates records of monuments that are scheduled for inclusion in the next issue of the statutory

"Record of Monuments and Places". The zones do not define the exact extent of the monuments but rather are intended to identify them for the purposes of notification under Section 12 of the National Monuments Act (1930-2014).

Topographical Files of The National Museum of Ireland

This is the archive of all known finds recorded by the National Museum. The archive primarily relates to artefacts but also includes references to monuments and previous excavations. The find spots of artefacts are important contributors to the knowledge of the archaeological landscape. Location information relating to finds is an important indicator of human activity. Topographical files examined for the townlands impacted by the proposed development revealed numerous finds recovered from the area (Appendix 15.2).

Photography

The Ordnance Survey of Ireland aerial photographs (www.osi.ie) were consulted to identify any archaeological features in the landscape which may not have been previously recorded. Photomontage from the LVIA chapter were examined.

Longford County Development Plan

The County Development plan (2015 -2021) was consulted for the schedule of buildings (Record of Protected Structures) and items of cultural, historical or archaeological interest that may be affected by the proposed development.

National Monuments in State Care

The Department of Environment, Heritage and Local Government maintains a database on a county basis of National Monuments in State Care. The term National Monument is defined in Section 2 of the National Monuments Act (1930) as a monument or the remains of a monument:

"The preservation of which is a matter of national importance by reason of the historical, architectural, traditional, artistic or archaeological interest attaching thereto".

National Inventory of Architectural Heritage

The NIAH maintains a non-statutory register of buildings and structures and historic gardens and designed landscapes recorded on a county basis.

Cartographic Analysis

Consultation of the Ordnance Survey Maps from 1838 to the present day, Lewis map 1837 and Taylor and Skinner maps facilitated a further assessment of the archaeological and architectural heritage.

Excavation Bulletins

The Bulletin is a summary publication that has been produced every year since 1970. This summarises every archaeological excavation that has taken place in Ireland during that year up until 2013 and since 1987 has been edited by Isabel Bennett. This information is vital when examining the archaeological content of any area, which may not have been recorded under the SMR and RMP files. This information is also available online (www.excavations.ie) from 1970–to 2018.

County Longford Industrial Heritage Survey

The Longford Industrial Heritage Survey (LIHS) was compiled in 2008 and contains an inventory of some 701 features. Industrial Archaeology is a 'period study embracing the tangible evidence of social, economic and technological development in the period since industrialisation' (Palmer 1990, 281). The LIHS incorporates the 'place of work' in the inventory and of particular interest is the Bord na Mona infrastructure dating to the mid-late 20th century. These features have been included in the NIAH inventory – see Appendix 15.3.

Schools Collection

The Schools Collection forms part of the National Folklore Collection, created in the late 1930's it is comprised of folklore and local traditions compiled by school children throughout Ireland. Documents relating to the area of the proposed development were examined in the schools of Lanesborough, Cloontagh, Killashee and Keenagh, relating to details of community, placenames and folklore. The collection includes stories of treasures being found in the bogs and the meaning of placenames which has been included in Section 15.3.8.

15.2.3 Phase II - Field Survey

Field inspection is necessary to determine the extent and nature of archaeological and architectural remains and can also lead to the identification of previously unrecorded or suspected sites and portable finds through topographical observation and local information.

The archaeological and architectural field walking inspection entailed:

- Walking the proposed development area and its immediate environs;
- Noting and recording the terrain type and land usage;
- Noting and recording the presence of features of archaeological, architectural or cultural heritage significance;
- Verifying the extent and condition of recorded sites;
- Inspection of existing drains and measuring peat depths; and
- Archaeological monitoring of the geotechnical site investigations.

A walkover survey of the proposed development site and wider survey area site was undertaken in May 2017, April and May 2018 and an additional walkover of the substation option locations was undertaken in November 2018. Results of the archaeological monitoring of the geotechnical site investigations are included in Appendix 15.4.

15.2.4 Limitations to Field Survey

A number of areas in the bog were overgrown thus preventing a full archaeological assessment. All other areas were easily accessible, enabling a full inspection of drains and the surface of the bogs. Details of these areas are described in the Field Survey, Section 15.3.13.

15.2.5 Assessment of Likely Significant Effects

The effects of the proposed development can be assessed based on the detailed information of the project, the nature of the area affected and the range of resources potentially affected. The terminology used to describe the effects is from the Draft Revised Guidelines on the Information to be Contained in Environmental Impact Assessment Reports EPA (Aug, 2017).

Wind farms, in general, can potentially affect the architectural, archaeological and cultural heritage landscape in a number of ways, as follows. The quality of the effects can be described as follows:

- **Positive Effects**:
  - Positive effects from development includes an increase in the level and understanding of an archaeological or historical landscape as a result of archaeological assessments and subsequent fieldwork.
- **Neutral Effects**:
  - Examples of no effect or effects that are imperceptible, include recorded monuments that are listed however no surface trace survives due to clearance and/or excavation.
- **Negative/adverse Effects**: Cultural heritage can be adversely affected both directly and indirectly.

Direct Effects

- Permanent and temporary land-take, landscaping, mounding and general excavations associated with construction may result in the loss or damage of archaeological remains or physical loss to the setting of historic landscapes and to the physical coherence of the landscape.
- Construction work can alter the hydrological system resulting in changes to groundwater levels. This may have an adverse effect on archaeological sites and features.

- Landscaping associated with developments can damage or destroy sub-surface archaeological features. Root action of trees for example can have an adverse effect on archaeological layers.
- The weight of permanent embankments can cause damage to sub-surface archaeological layers and features.

Indirect effects

- Visual effects on the archaeological, architectural and cultural heritage landscape, outside the footprint of the proposed development. The construction of structures, landscaping, mounding and planting as well as boundary fences, perimeter walls and associated works can impinge on historic and archaeological landscape as well as their visual amenity value.

Cumulative effects arise when the addition of many effects, including the effects of other projects, create larger, more significant effects.

Residual effects are the degree of environmental change that will occur after the proposed mitigation measures have taken effect.

15.2.5.1 Level of Effect

The level of effect on an archaeological, historical or architectural landscape depends on a number of factors which include the existing environment and the type of monument affected. The level or severity of effect was assessed by taking the following into consideration:

- The proportion of the feature effected and the potential loss of characteristics essential to the understanding of the monument, feature or site.
- Consideration of the type, condition, vulnerability and potential amenity value of the landscape, feature, site or monument affected.
- Consideration of the likely effects of visual, noise and hydrological alterations which were informed by other specialist reports or observations.

15.2.5.1.1 Magnitude of Effects (Significance)

Magnitude of Effects	Description
Imperceptible	An effect capable of measurement but without noticeable consequences
Not Significant	An effect which causes noticeable changes in the character of the environment but without significant consequences.
Slight Effects	An effect which causes noticeable changes in the character of the environment but without affecting its sensitivities
Moderate effects	An effect that alters the character of the environment in a manner that is consistent with existing or emerging trends
Significant Effects	An effect which, by its character, magnitude, duration or intensity alters a sensitive aspect of the environment
Very Significant	An effect which, by its character, magnitude, duration, or intensity significantly alters most of a sensitive aspect of the environment.
Profound	An effect which obliterates sensitive characteristics

Table 15.2: Criteria for Rating Effect Significance on Archaeological, Architectural and Cultural Heritage.

15.3 EXISTING ENVIRONMENT

15.3.1 Introduction

This section provides a description of the receiving environment and historical background of the area of the proposed development and is based on the results of the desk based study and walk over survey. The proposed 24 wind turbine development will be located on three bogs within the Mountdillon Group of peat production bogs, namely Derryaroge, Derryadd and Lough Bannow cutaway bogs which are located in south County Longford, as shown on Figure 15:1 (also Figure 2.1 from Chapter 2 of the EIAR). The three bogs have a total area of approximately 2,300 hectares (the area of the red line boundary is approximately 1,908 hectares) and are located in an area surrounded by the towns and villages of Lanesborough, Derraghan, Keenagh, and Killashee. The surrounding landscape is a mixture of forestry, agricultural land, cutaway peatland and rolling hills. The Royal Canal and Lough Ree are located to the east and west respectively, and the River Shannon passes the northern boundary of the proposed development site.

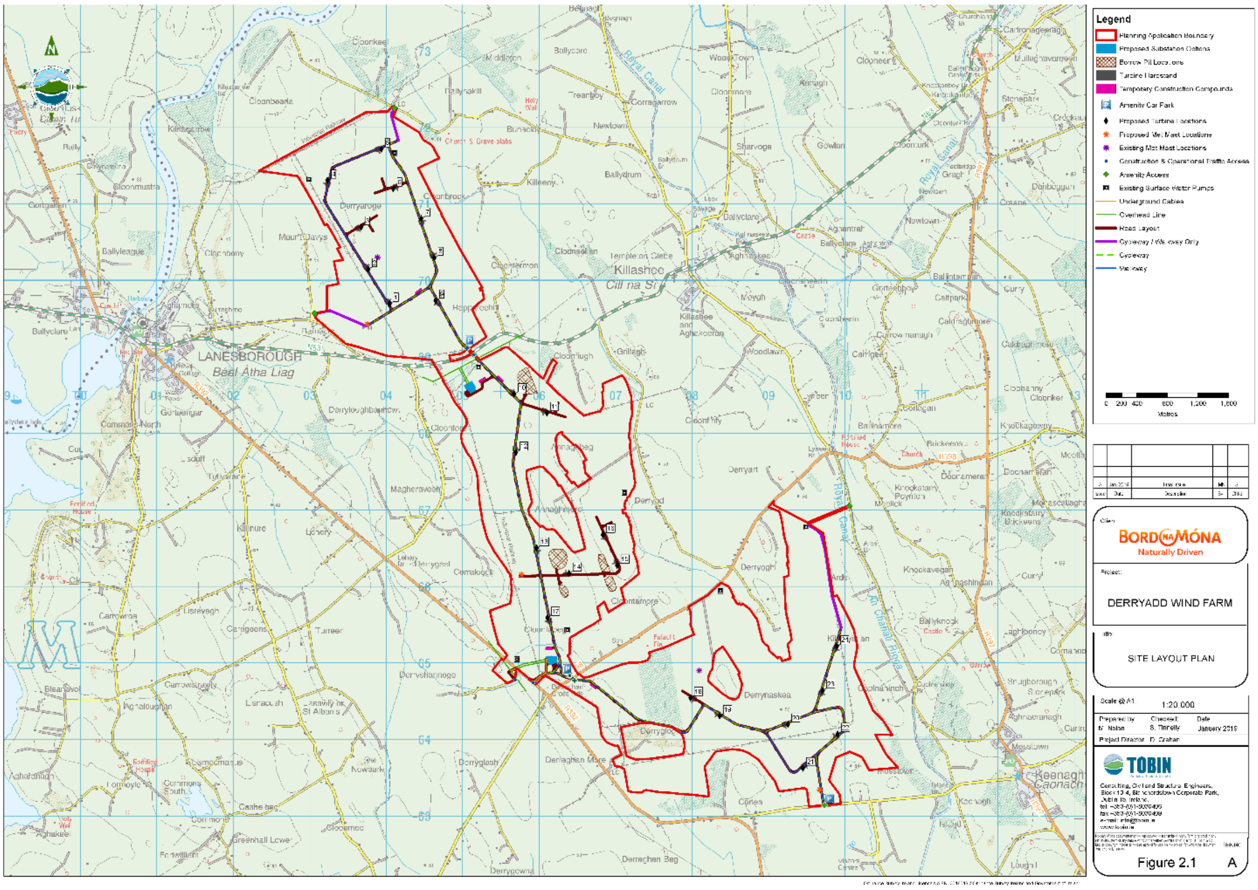


Figure 15.1: Plan of the proposed development layout.

15.3.2 Archaeological and Historical Background

Peatlands cover one-sixth of the total landmass of Ireland extending over an approximate area of 1.34 million hectares. They can be divided into two major types, raised bogs and blanket bogs, although both appear similar in character the mode of formation differs greatly. The vast majority of Ireland's raised bogs occur in the central lowlands of the country unlike blanket bogs that are predominately confined to mountainous areas and some occasional lowland areas along the western seaboard. The peatlands of County Longford form part of a regional pattern of bogs in the north midlands flanking the eastern and western sides of the Shannon. It is a landscape of rolling hills around which extensive tracts of bog developed over the last 10,000 years.

The anaerobic environment of bogs and wetlands helps create unique circumstances for the preservation of remains and have long been known for their rich abundance of archaeological deposits, which can range from the prehistoric to the 17th century. Perishable archaeological remains such as wood, leather, fabric and butter survive and have been recorded in the archive of the topographical files of the National Museum of Ireland. The earliest trackways recorded date from the beginning of the Neolithic period, around 3500 BC, when farming commenced. Dates have also been recorded from the Bronze Age through to the early historic period (AD500-1100). In County Longford these remains include a number of remarkable wooden trackways dating from the Iron Age, the most famous of which is the Corlea Trackway located approximately 0.6km from the proposed wind farm. The trackway may have formed part of the *Slighe Assail,* one of the five major early routeways of Ireland, although according to Doran the numerous toghers gave access within the bog itself (Doran, 2004). The *Slighe Assail* connected the east with the early ritual site of Cruachain or Rathcroaghan, beginning either from Dublin or Tara and crossing the Shannon at Athlone and on to Ballyleague/Lanesborough, on to Tulsk and Rathcroghan.

A variety of site types were constructed in bogs, according to the needs of the communities that built them. These include platforms for a range of activities, rows of posts, trackways and other wooden structures. Trackways (toghers) or short stretches of trackways (tertiary and secondary toghers) were constructed to traverse the peat or provide a foot holding along certain stretches of wet bog. Wooden platforms most likely functioned as hides or hunting platforms in order to exploit the natural flora and fauna of the bogs (O' Carroll, 2001). A number of trackways, wooden platforms, occupation features, artefacts and miscellaneous wooden structures have been uncovered in the Derryaroge, Derryadd and Lough Bannow bogs (IAWU, 2003). The majority of these sites did not cross bogs but rather facilitated access to or movement within a bog. This can be seen in the area of the proposed development, such as between the dryland area of Derryaroge and Mount Davys, Annaghbeg and Cloonfiugh and between Derrynaskea and Derroghil.

Further evidence for the Bronze Age have been recorded in the remains of a burnt mound in the townland of Cloontamore (LF018-085---- Fulacht Fia,) recorded in Derrynaskea Bog to the north of Turbine 18. The burnt mound or fulacht fiadh is the most common Bronze Age site within the archaeological record. Over 4500 fulachta fiadh have been recorded in the country. Although burnt mounds of shattered stone occur as a result of various activities that have been practiced from the Mesolithic to the present day, those noted in close proximity to a trough are generally interpreted as Bronze Age cooking/industrial sites. *Fulachta fiadh* generally consist of a low mound of burnt stone, commonly in horse-shoe shape and are found in low lying marshy areas or close to streams and rivers. Often these sites have been ploughed out and survive as a spread of heat shattered stones in charcoal rich soil with no surface expression in close proximity to a trough.

Early Medieval Period (AD500–1100)

Ireland underwent radical change from the 5th century AD. An upsurge in grasses and weeds is demonstrated in the pollen record, associated with increased pasture and arable farming. A combination of factors led to a revolution in the landscape. Foremost amongst these was the introduction of Christianity in the early 5th century. The new religion was readily accepted and spread throughout the country from the 5th century presenting a catalyst for change. Population expansion was also central to the transformation that swept across Ireland around this time which resulted in a complete, if uneven, spread of settlement across the country. Secular habitation sites in the early medieval period include *crannógs,* cashels and ringforts. Given the marginal wetland nature of the landscape, the area of proposed development would not have provided an ideal location for settlement. The islands of dry land would therefore have been sought after sites for activity. Two crannogs (LF017-005 and 006) were recorded in the townland of Lehery in the middle of Lough Bannow Lake however no evidence of these structures survive today.

The construction of ringforts in Ireland dates from the early Christian/medieval period (*c*. 500 AD to 1170 AD) and possibly continued up to the seventeenth century. The most recent study of ringforts has suggested that there are a total of 45,119 potential ringforts or enclosure sites throughout Ireland (Stout, 1997). Rath is the term applied to those ringforts of earthen construction, while cashel refers to those constructed from stone. A ringfort generally consists of a circular, sub circular, oval or D-shaped area, enclosed by one or more banks of earth or stone, or a combination of both. Earthen ringforts usually have an external fosse surrounding the bank, and a causewayed entrance giving access to the interior. The bank is generally built by piling up inside the fosse, the material obtained by digging the latter. The function of ringforts was generally as enclosed homesteads, with the defences protecting the houses and outbuildings in the interior, but they may also have been used for social gatherings. There are a number of ringforts recorded within proximity to the proposed wind farm, in the townland of Annaghmore (LF018-035), Derryoghil (LF018-037), Derraghan More (LF022-003, LF022-013), Rapareehill (LF018-001, LF018-015001), Cloonfore (LF017-007), Cloonfiugh (LF018-018) Derrygeel (LF018-055) and Cloontabeg (LF018-056).

Ringforts are often accompanied by underground passages known as souterrains, which are believed to have been used for the storage of goods and foodstuffs and possibly for refuge in the case of attack. Souterrains are often recorded in ringforts and one is recorded in the townland of Rapareehill at recorded monument (LF018-015002).

This period was also characterised by the foundation of a large number of ecclesiastical sites throughout Ireland during the centuries following the introduction of Christianity in the 5th century AD. The remains of Ballynakill church and ecclesiastical enclosure (LF013-045001- 45013) are located 0.8km from Turbine 5 in Derryaroge Bog.

Medieval Period (AD1100–1600)

The piecemeal conquest by the Anglo-Normans of Ireland had a fundamental impact on the Irish landscape. By the end of the 12th century the Anglo-Normans had succeeded in conquering much of the country. The Anglo-Norman invasion stimulated the development of towns and while some stone castles were constructed, earthen mottes or motte-and-bailey castles continued in use. Tower houses developed from the 15th century onwards and were defended stone settlements that originated from the early stone castles but were smaller in size accommodating extended families and their staff. A Castle/Tower House, with a circular bawn wall and ringfort (LF018-060001-3, Ballyknock) is located to the east of the Lough Bannow Bog.

Post Medieval Period

The wider area surrounding the proposed development has a number of large landed estates and houses that provide an interesting insight into the social, architectural and agricultural environment from the 17th century. A further insight into the industrial and cultural heritage of the area is provided by the Royal Canal, which was originally opened through Keenagh in 1817. Canal bridges, overflows, locks and lock keeper's houses are dotted along the canal and provide a link to the 19th century activity in the area. The canal is now navigable from Spencer Dock in Dublin and along with the canal towpaths provides a recreational route for boats/barges, walkers and cyclists.

15.3.3 Record of Monuments and Places ("RMP")

The archaeological record indicates four hundred and eighteen recorded monuments within and adjacent to the planning application boundary, of which three hundred and six are located within 500m of any ground disturbance associated with the development. Appendix 15.1 lists the recorded monuments located within 500m of any ground disturbance associated with the proposed development.

Tables 15.3, **15.4** and **15.5** as well as **Plates 15.1, 15.2 and 15.3** illustrate the recorded monuments located within 500m of the turbines and infrastructure. **Section 15.3.13** describes the recorded monuments in relation to the proposed development.

As indicated in Plate 15.1 and Table 15.3, there are a total of eleven Recorded Monuments located within 500m of the proposed development in Derryaroge Bog. Examination of the Archaeological Survey of Ireland files records that all of these have been excavated and/or are redundant.

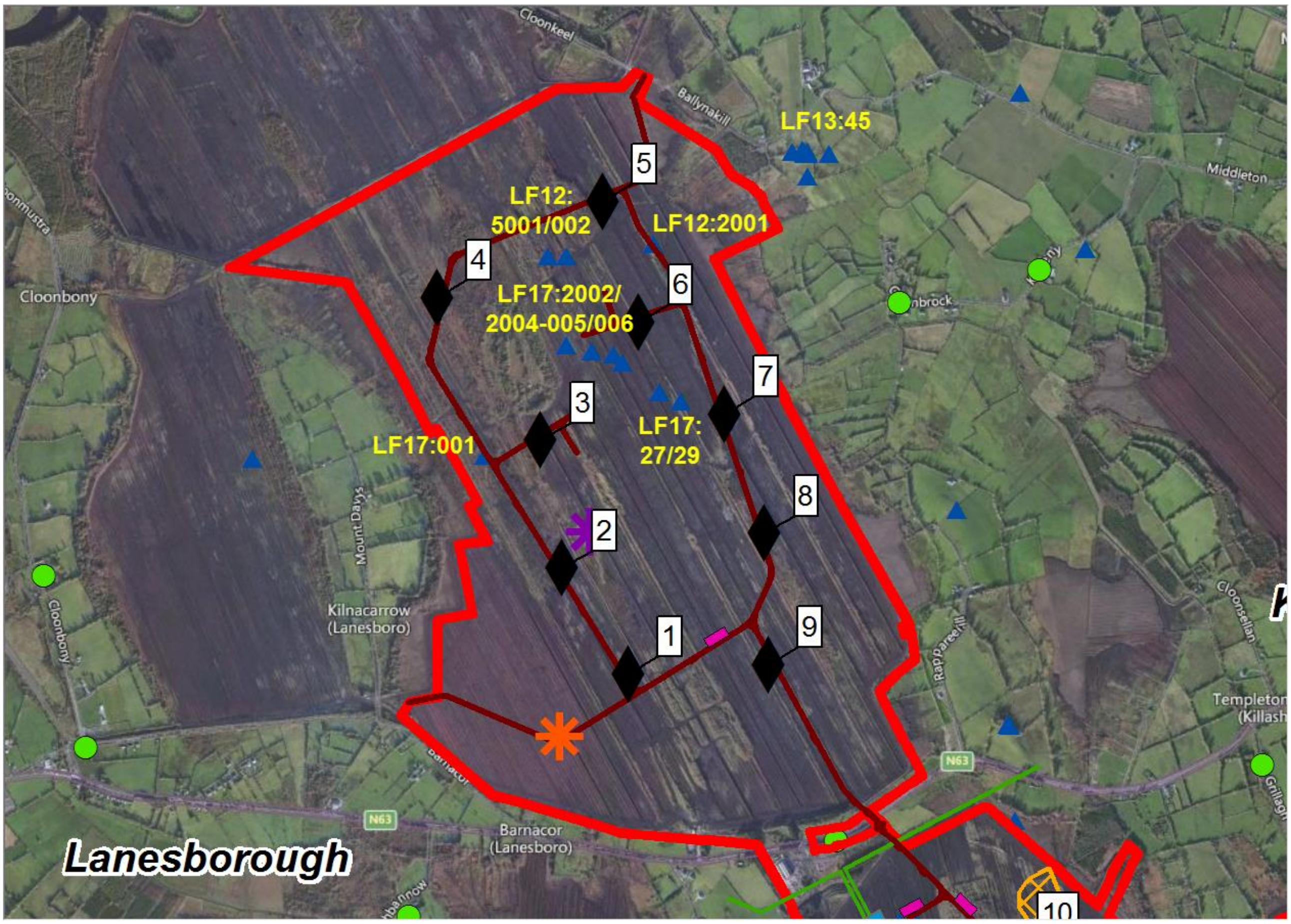


Plate 15.1: Aerial view of recorded monuments located within 500m of the proposed development in Derryaroge Bog.

RMP No.	Townland	Monument	Distance from
LF012-002001-	BALLYNAKILL Excavated	Road - gravel/stone trackway - peatland	0.3km from T5 0.3km from T6 Adjacent to internal road between T5 & T6
LF012-005001-	DERRYAROGE Redundant	Road – class 3	0.5km from T4 0.3km from T5 0.5km from T6 <0.1km internal road between T4 & T5
LF012-005002-	DERRYAROGE Excavated	Road – class 3	0.4km from T6 0.6km from T4 0.3km from T5

			<0.1km internal road between T4 & T5
LF017-002005-	DERRYAROGE Excavated	Road – class 3	0.3km from T6 0.4km from T3 <0.1km from internal road adjacent to T6
LF017-002002-	DERRYAROGE Excavated	Road – class 2	0.4km from T3 0.2km from T6 <0.1km from internal road adjacent to T6
LF017-001----	DERRYAROGE, MOUNT DAVYS Excavated	Road - gravel/stone trackway - peatland	0.3km from T3 0.6km from T2 0.5km to internal road between T3 & T4
LF017-002004- LF017-002006-	DERRYAROGE Excavated	Road – class 3 Road – class 3	0.2km from T6 0.4km from T3 0.5km from T7 <0.150km from internal road adjacent to T6
LF017-027----	DERRYAROGE Excavated	Structure – peatland	0.3km from T7 0.5km from T3 <0.250km adjacent to internal road between T6 & T7
LF017-029----	CLOONBROCK Redundant record		0.2km from T7
LF013:45	Ballynakill Church	Ecclesiastical Enclosure	<0.5km from amenity road

Table 15.3: List of Recorded Monuments within 500m of the proposed development in Derryaroge Bog.

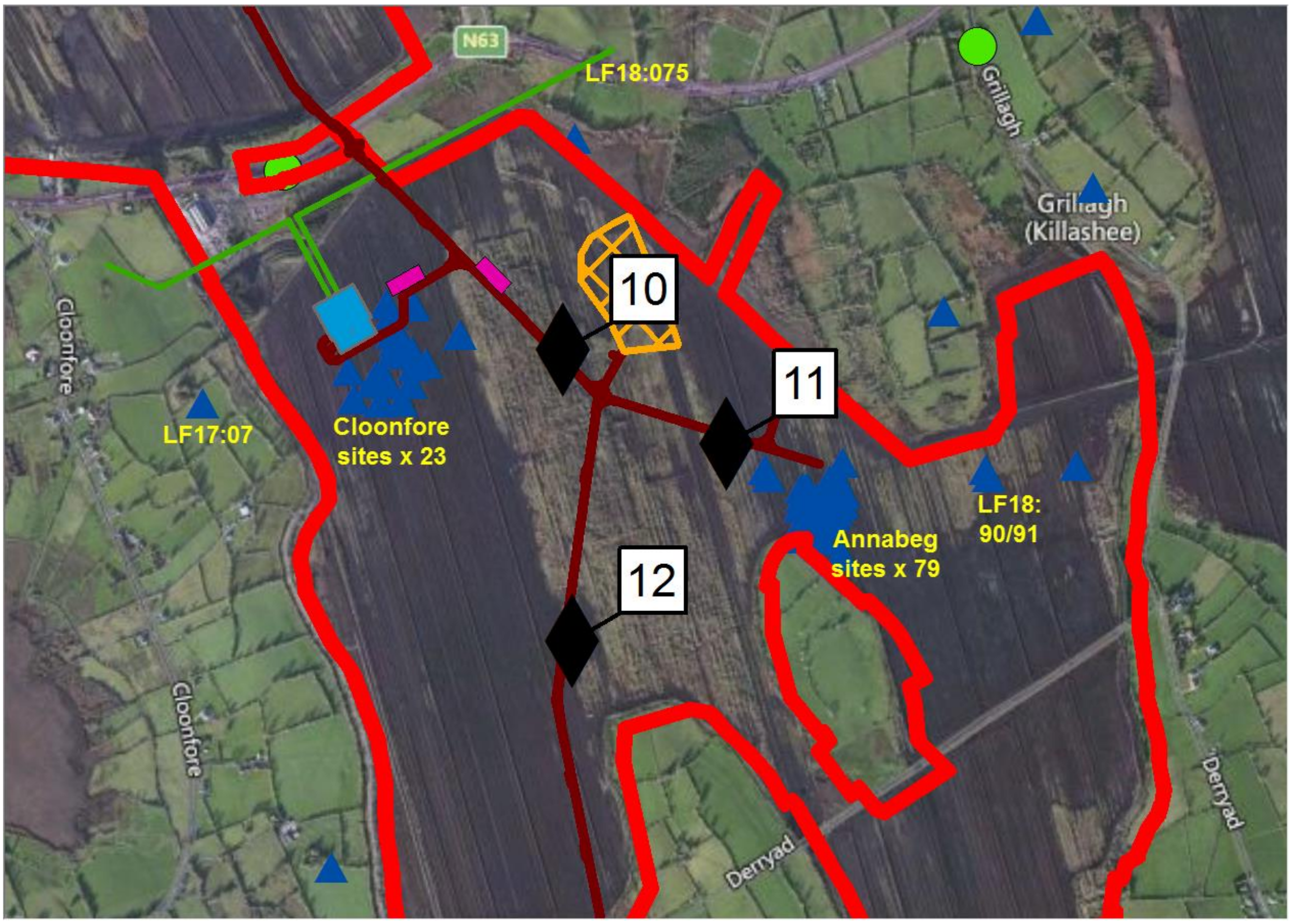


Plate 15.2: Aerial view of recorded monuments within 500m of the proposed development in the upper section of Derryadd Bog.

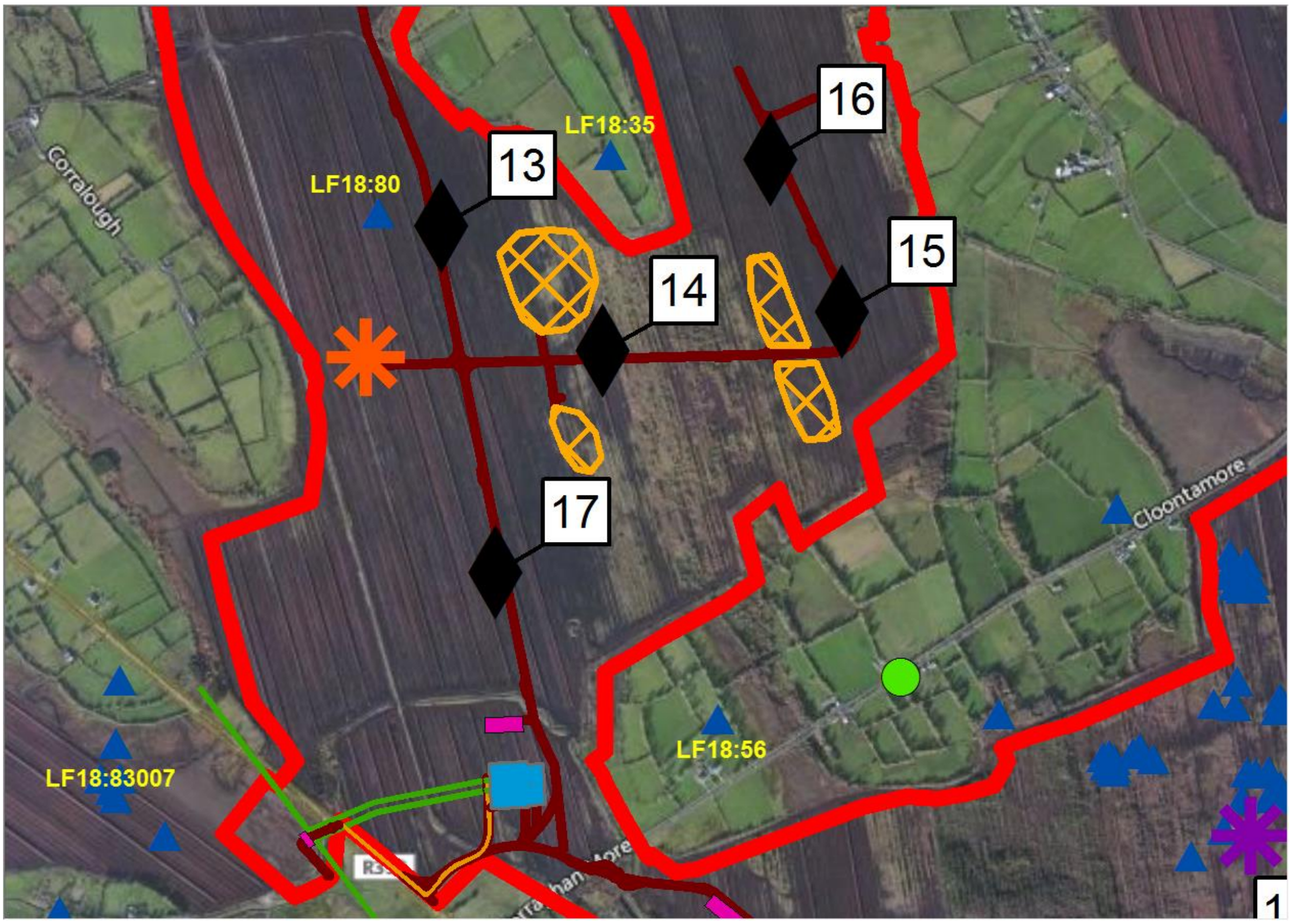


Plate 15.3: Aerial view of recorded monuments within 500m of the proposed development, in the lower section of Derryadd Bog.

As indicated on Plate 15.2 and 15.3 and Table 15.4, there are a total of 110 Recorded Monuments located within 500m of the proposed development in Derryadd Bog, five of these Recorded Monuments (LF18:75, LF17:7, LF18:35, LF18:56 & LF18:83007) are located outside the red boundary line.

RMP	Townland	Monument	Distance
LF017-007	CLOONFORE Included in revised list	Ringfort	0.3km from Substation Option A
LF018-076 LF018-076001 to 076006 (6 sites) LF018-106 to 121 (16 sites)	CLOONFORE All Excavated and/or cleared 23 sites	Road - class 3 togher Road - class 2 togher	0.2km-0.6km to T10 0.8km from T11 Situated on/adjacent to internal haul road between T9 & T10. Adjacent to Substation Option A All situated 0.3km to 0.4km from borrow pit No.1.

LF018—075	RAPAREEHILL Included in Revised list	Road - class 3 togher	Situated 0.225km from borrow pit
LF018-077---- LF018-077001-077079 LF018-105---- (79 Sites)	ANNAGHBEG All excavated and or cleared 79 sites	Road - class 3 togher Road - class 2 togher	0.1km to T11 0.2km-0.4km to T11 Situated on/adjacent to internal haul road at T11.
LF018-080----	ANNAGHMORE, CORRALOUGH Cleared	Road – class 1 togher	0.1km to T13 Situated on internal haul road at T13. Situated 0.2km from Borrow Pit. 0.3km from met mast south of T13
LF018-035----	ANNAGHMORE Included in Revised list	Ringfort – rath	0.3km to T16 0.4km to T13 0.5km to T14 Surrounded by internal haul roads <0.4km in distance Situated 0.2km from Borrow Pit 2
LF018-083007	DERRYSHANNOGE Redundant Record	Road –	0.4km internal haul road
LF018-090 LF018_091	CLONFIUGH Not included in revised list	ROAD	<0.5km internal haul road
LF018-056	CLOONTABEG	Ringfort	<0.5km from internal haul road

Table 15.4: List of Recorded Monuments in the vicinity of Turbines 10-17 and infrastructure on Derryadd Bog.

As indicated on Plate 15.4 and Table 15.5, there are 185 recorded monuments located within 500m of the proposed development in Lough Bannow Bog, the majority of which have been excavated and/or cleared.

RMP	Townland	Monument	Distance
LF018-084071-	DERRYNASKEA Included in Revised list	Burnt Spread	0.4 km from T18 <0.5km from internal haul road between T18 & T19
LF018-084012- LF018-084013 LF018-084049-50- LF018-084042 LF018-084073 to 76 & 084041	DERRYNASKEA Included in Revised list Included in Revised list Included in Revised list Included in Revised list Not in revised list	Road – class 2 togher Road – class 2 togher Road – class 3 togher Road – class 2 togher	<0.5km from internal haul road north west of T18
LFO22-070----	Not in revised list	Road – class 3 togher	0.4km from T19 0.1km from T18 Adjacent to T18 and internal haul road
LF018-081001 to 081012, LF018-081014, to 081052- LF018-082002 to 082017 LF018-122, to 156 (102 sites)	DERRYOGHIL All cleared and/or Excavated	Road class 2 togher Road class 2 togher Unclassified Togher Platform Peatland Structure Peatland	0.1km to 0.5km from proposed cycle way and planning application area

LF022-057029 to 057034 LF022-086----	CORLEA All cleared and/or Excavated	Road – class 3 togher Platform Peatland	0.4 km from T21 Surrounded by and adjacent to internal haul route between T21 & T22.
LF022-057001-3 LF022-057028- LF022-085---- LF022-078---- LF022-095---- LF022-077---- LF022-057004, 057005,57006- LF022-067---- LF022-057038- LF022-057039-	CORLEA All excavated and/or cleared	Road – togher Road – class 3 togher Road – class 3 togher Road – unidentified togher Platform Peatland Road – class 2 togher Road – class 3 togher Road – class 3 togher Road – class 2 togher Road – class 2 togher Road – class 3 togher	0.2kmT21,04-5kmT22 0.2kmT21,04-5kmT22 0.2kmT21,04-5kmT22 0.2kmT21,04-5kmT22 0.2kmT21,04-5kmT22 0.2kmT21,04-5kmT22 0.2kmT21,04-5kmT22 0.2kmT21,04-5kmT22 0.2kmT21,04-5kmT22 Situated on and within 0 – 0.4km from mast Surrounded by and adjacent to internal haul route between T21 & T22.
LF022-057041- LF022-084---- LFO22-057027- LFO22-096---- LFO22-057035- LFO22-057021- LFO22-090---- LFO22-083---- LFO22-079---- LFO22-073---- LFO22-057020- LFO22-057042- LFO22-057019- LFO22-057016- LFO22-057017- LFO22-088----	CORLEA All cleared and/or excavated	Road – class 3 togher-Redundant Road - unclassified togher Road – class 3 togher Platform – peatland Road – class 3 togher Road – class 3 togher Platform - peatland Platform – peatland Road – class 3 togher Platform – peatland Road – class 3 togher Road – class 3 togher-Redundant Road – class 3 togher	0.3-0.5 km T21 Surrounded by and adjacent to internal haul route between T21 & T22. Situated on and within 0 – 0.4km from mast

LFO22-080---- LFO22-076---- LFO22-057018- LFO22-087----		Road – class 2 togher Road – class 3 togher Road – unclassified togher Road – class 2 togher Road – unclassified togher Road – class 3 togher Road – class 3 togher ALL EXCAVATED AND/OR CLEARED	
LFO22-089---- LFO22-057008, 057009, 057010, 057011, 057012- LFO22-075---- LFO22-093---- LFO22-057023, 057024, 057025, 056026-	CORLEA All cleared and/or Excavated	Road – unclassified togher Road – class 3 togher Platform – peatland Road – class 3 togher Road – class 3 togher Road – class 3 togher Road – class 3 togher	0.3-0.5 km T21 Surrounded by and adjacent to internal haul route between T21 & T22. Situated on and within 0 – 0.4km from mast
LF022-057036- LF022-058006- LF022-057013- LF022-074---- LF022-094---- LF022-057015- LF022-057014- LF022-081---- LF022-082---- LF022-092----	CORLEA All cleared and/or Excavated	Road – class 2 togher Road – class 3 togher Road – class 3 togher Road – class 1 togher Platform - peatland Road – class 3 togher Road – class 3 togher Road – unclassified togher Road – class 2 togher Road – class 3 togher	0.3-0.5 km T21 Surrounded by and adjacent to internal haul route between T21 & T22. Situated on and within 0 – 0.4km from mast
LFO22-066007- LFO22-066008 LF022-066001--	CORLEA All cleared and/or Excavated	Redundant record Redundant record Road – class 2 togher	0.4km T23 0.5 km T24 0.4km T23 0.5 km T24

			0.2-0.3km from internal haul road between T22 & T23
LF022-066002 to LF022-066006-	CORLEA All cleared and/or Excavated	Road – class 3 togher	0.5 km T23 0.5 km T22 0.1-0.2km from internal haul road between T22 & T23

Table 15.5: List of Recorded Monuments within 500m of proposed development on Lough Bannow Bog

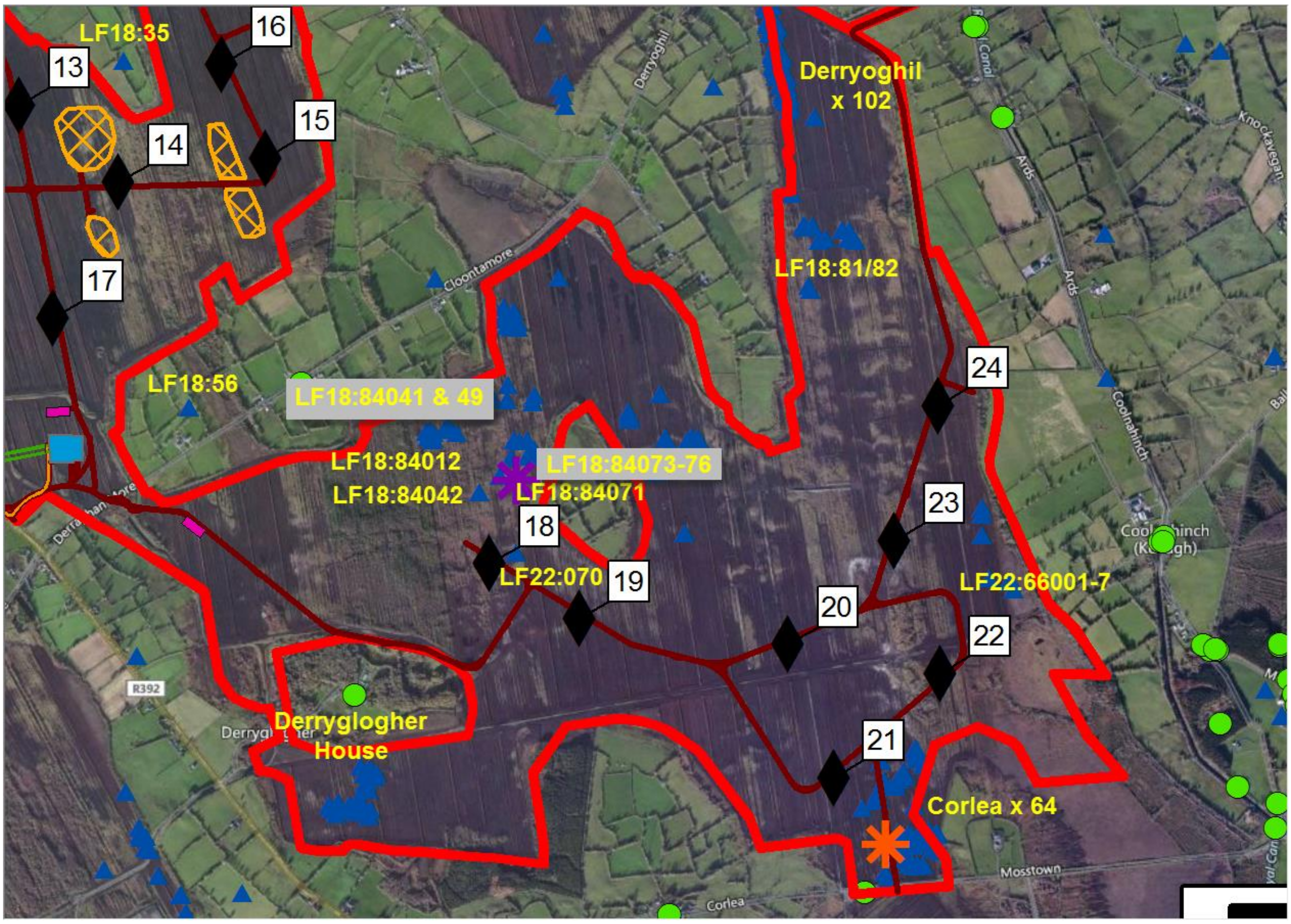


Plate 15.4: Aerial view of recorded monuments within 500m of the proposed development in Lough Bannow Bog.

15.3.4 Topographical Files of the National Museum of Ireland

Topographical files examined for the townlands impacted by the proposed development revealed numerous finds recovered from the area (Appendix 15.2). The majority of artefacts were retrieved during the harvesting of peat and include finds of quern stone, a bell, a grave slab, an iron knife, a furnace bottom, a billhook, a bronze spearhead, a wooden vessel made of hazel with bog butter, a copper axe head, a copper alloy cross, a leather container for wrapping bog butter, a tub shaped piece of bog butter, a wood platter and a wooden goblet roughout, a variety of wooden bowls, a copper alloy basin and a flint stone. These are described in **Section 15.3.13** in relation to the proposed development.

15.3.5 Photography

The Ordnance Survey of Ireland aerial photographs (www.osi.ie) were consulted to identify any archaeological features in the landscape that may not have been previously recorded. There was no evidence of additional archaeological, architectural or cultural heritage features recorded on the aerial photographs within the area of the Application Site. Photomontages associated with the Landscape and Visual Impact as detailed in Chapter 9 of this EIAR were examined.

15.3.6 Longford County Development Plan

The Longford County Development Plan (2015 -2021) ("the CDP") was consulted for the schedule of buildings (Record of Protected Structures) and items of cultural, historical or archaeological interest that may be impacted by the proposed development. There are 13 Protected Structures located within 2km from the proposed development (Table 15.6). These are described in Section 15.3.8 and none of these structures will be directly impacted by the proposed development.

15.3.7 National Monuments in State Care

The Department of Environment, Heritage and Local Government maintains a database on a county basis of National Monuments in State Care. The term National Monument is defined in Section 2 of the National Monuments Act (1930) as a monument or the remains of a monument…

> "*The preservation of which is a matter of national importance by reason of the historical, architectural, traditional, artistic or archaeological interest attaching thereto".*

A National Monument in State Care is located to the south of the proposed development, listed as the Bog Trackway in Corlea, Mon No. 677. It is located 0.6km from the boundary of the proposed development and will not be directly impacted. The national monument Inchcleraun (No. 91), an early Medieval Ecclesiastical Site is located to the south-west of the proposed development, however it will not be directly impacted.

15.3.8 National Inventory of Architectural Heritage

The NIAH maintains a non-statutory register of buildings and structures recorded on a county basis. The register indicates that no structures will be directly impacted by the proposed development with one structure recorded within 500m of the proposed location of Turbine 21. The structure consists of rails/level crossing (NIAH 13402204) which is associated with the Bord na Móna works and will not be directly impacted by the proposed development. Derryglogher Lodge (13402201), the site of the National Animal Centre (ISPCA), is located 300m from the proposed internal haul road and will not be directly impacted. Table 2 (See Section 15.2.6) details the structures registered in the NIAH, located within 2km of the proposed development. A specific visual impact study of the proposed development has been completed and is included in Chapter 9 of this EIAR.

The NIAH also maintains a non-statutory register of historic gardens and designed landscapes also recorded on a county basis. The Mosstown House walled garden complex (NIAH 13313026) was built in c. 1760 and extended c. 1860. It is located *c.* 1.5km from the proposed development. In the late seventeenth century Mosstown House was the seat of Viscount Newcomen and was subsequently the home of the Kingston and Murray families before its demolition c. 1962. The house and demesne are located adjacent to the estate village of Keenagh. The gateway to Mosstown House, known as 'The White Gates' (NIAH 13313008), has ashlar limestone piers and carved sandstone eagle finials. It was apparently built after the first World War by Belgian refugees, replacing (and possibly incorporating the fabric of) an earlier gateway to the site. Also part of the estate is the dovecote (NIAH 13313010) built in c. 1810. There is also a gate lodge, (NIAH 13313006) probably serving as a secondary entrance to Mosstown House, and a single-bay lime kiln (NIAH 13313007) within the grounds. The estate walls (NIAH 13313009), are still evident at irregular intervals. Built c. 1750 they are now partially collapsed and overgrown. The Mosstown House walled garden complex (NIAH 13313026) was built in c. 1760 and extended c. 1860. A substantial complex of walled gardens, with well-built boundary walls, cut stone detailing, a gardener's shed and a Tudor Revival style entrance doors make up the boundary structure. To the south of this walled garden is a linear feature which may have been an ornamental canal - a feature sometimes found on the larger country estates in Ireland dating from the late-seventeenth and early-eighteenth centuries. To the south is a Tudor-Revival style former gate-lodge, built c. 1830 (NIAH 13313020). It still retains its distinctive features including original timber framed leaded glass windows, decorative timber bargeboards and carved limestone detailing to the interior of the porch.

Situated close to the Derryaroge Bog area is Cloonbony House (NIAH 13401701), built circa 1800 it stands as a detached three-bay two-storey house. It has a long approach avenue to the south and formerly had a gate lodge at the entrance close to village of Lanesborough, now no longer extant. Cloonbony House lies to the west of proposed Turbines T2, T3 and T4 at between 2-2.1 km. Middleton House (NIAH 13401339), built circa 1760 is a detached four-bay two-storey house. It is set back from the road in extensive mature grounds to the south of Cloondara. It was the residence of Montford Esq. c 1777-83 (Taylor & Skinner map) the Montford family later bought the estate of Middleton c.1750. The house lies north-east of proposed Turbines T5, T6 and T7 at a distance of 2.2km to 2.4km. Derryloughbannow House (NIAH 13401702) is located 2km to the west of the proposed Substation Option

A and 1.4km from turbine1. Built circa 1820 it is comprised of a detached four-bay single storey vernacular house, now disused.

Several 19th century water pumps are also recorded in the vicinity of the proposed development. Cloonbrock water pump, (NIAH 13401340), is located to the east of the proposed development, lying 0.9km-1.4km away from T5, T6, T7 & T8. Kileeny water pump (NIAH 13401341), lying east of Cloonbrock water pump is situated between 1.5km-1.9km east of T5, T6, T7 & T8 and is a typical late nineteenth-century water pump. Two 19th century features, a water pump and Corlea House (NIAH 13401341, NIAH 13402203) are located 0.75km to the west of the southern end of the proposed application boundary. A house dating to the late 19th century (NIAH 13402202) is located in the townland of Derraghan Beg and is 1.8km to the south of turbine 18.

Bord na Móna narrow gauge railways and ancillary structures are a principal element of the twentieth century industrial and economic heritage and played a vital role in the utilisation of peat as a natural resource during the mid-to-late twentieth-century. The simple steel and concrete level gates (NIAH 13401811 and 13402204) were part of the railway system originally used by Bord na Móna to transport sod peat to the sidings at Lanesborough 'A' Power Station. These rails lie south of Turbines 1 and 21 (Plate 15.5). The rails (NIAH 1340181) are located 150m from the amenity road that exists the Derryaroge Bog in the south. Located c.100m from the amenity road exiting the Lough Bannow Bog in the south, are the rails (NIAH 13402204).

The Royal Canal, which was originally opened through Keenagh in 1817, then closed to boat traffic in 1962, was reopened in September 2010. The canal is now navigable from Spencer Dock in Dublin through to Clondra in Co. Longford passing through Keenagh en route. Mosstown harbour (NIAH 13313021) was built c. 1817 and functioned as a harbour/dock/port. This area is particularly busy during the summer months while the canal towpaths provide a recreational route for both walking and cycling. Canal bridges, overflows, locks and lock keepers' houses are dotted along the canal and provide a bridge to our industrial and cultural heritage. The Lock Keepers House (NIAH 13313001), a detached three-bay single-storey structure built c. 1815, is located adjacent to Lock 41 (NIAH 13313003) and Coolnahinch Bridge (NIAH13313002). They are all located to the north west of Keenagh and east of the proposed development on Lough Bannow Bog. Adjacent to the proposed amenity road in the townland of Ards is the remains of a Lock Keepers House (NIAH 13401819) and Lock 42 (NIAH 13401818). To the south of this is Ards Bridge (NIAH 13401817) built in 1810-1820.

In the Derryadd Bog area, Grillagh Corn Mill (NIAH 13401810) is situated north-east of proposed Turbines 10 & 11 and lies at a distance of 1.2km from Turbine 11 and 1.3km from T10. It was built c. 1800 and was extended c. 1860 and comprises of a multiple-bay two-storey former corn mill while to the west is a former corn drying kiln. It is located on the roadside with former millrace running parallel to the road. This vernacular corn mill provided a basic service to local farmers and was also an important source of employment for the local community. The remaining structures still in situ on the site, particularly the early machinery, represent an important part of the social, technical and architectural heritage of the Killashee area. The thatched cottage at Cloontamore (NIAH 13401814) is a detached three-bay single-storey house, built c. 1800 and lies 1-1.5km from Turbines 14, 15 and 17.

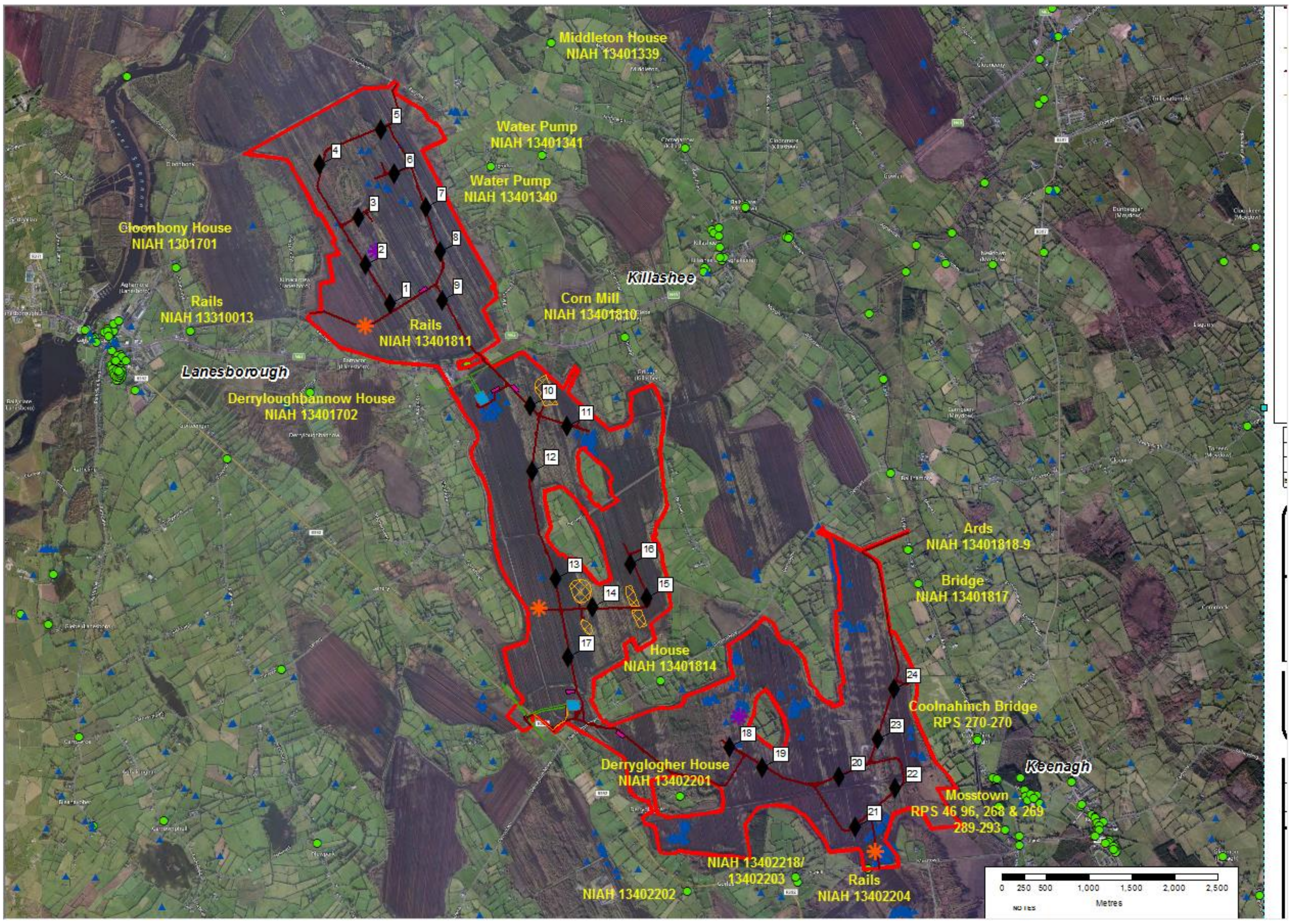


Plate 15.5: Aerial view of proposed development with NIAH and RPS.

NIAH Reg. No.	Record of Protected Structure No.	Description	Townland	Distance to Application Boundary
13401810	85	Corn mill	Grillagh	0.7km
13313002	271	Bridge	Coolnahinch	0.6km
13313001	270	Former Lock Keepers House	Coolnahinch	0.6km
13313003	272	Lock	Coolnahinch	0.6km
13313005	268	Mosstown (Mill) House	Keenagh	0.6km
13313004	96	Corn mill	Mosstown	0.6km
13313006	269	Former Gate Lodge	Keenagh	0.7km
13313007	289	Kiln	Mosstown	0.9km
13313009	290	Demesne Boundary Wall	Mosstown	0.9km
13313020	291	Former Gate Lodge	Mosstown	0.8km
13313010	46	Aviary/Dovecote/ Pigeon House Demesne	Mosstown	1km
13313026	292	Walled Garden Complex	Mosstown	0.9km
13313008	293	Gateway	Mosstown	1.4km

Table 15.6: Details of the Protected Structures and the distance to the boundary

Name	NIAH Ref.	Distance from Turbines	Distance to Application Site Boundary	Description of visual aspect from the buildings
Cloonbony House	13401701	T1 - 2.4km away T2 – 2.1km away T3 - 2.1km away T4 – 2.0km away	0.1km	Located W of proposed development. Screening to the E.
Middleton House	13401339	T5 – 2.2km away T6 – 2.3km away T7 – 2.3km away	1.6km	It is located NE of turbines. Planted forestry to SW and W
Cloontamore Cottage	13401814	T17 - 1.1km away T15 – 1km away T14 – 1.2km away T18 – 1km away T19 – 1.5km away	0.5km from north & 0.3km from south boundary	Turbines located to N and S. No screening.
Corlea House	13402203	Met Mast – 1.2km	0.75km	Located to the W of the southern end of proposed development. Some screening to the N.
Derraghan Beg	13402202	T18 – 1.8km	0.5km to boundary at N	Located to the S of the boundary. Screening to the N and E.

Derryloughbannow	13401702	T1 – 1.4km	0.7km to boundary at N	Located to the S and W of the boundary. Screening to NE.
Derryglogher Lodge (I.S.P.C.A. Centre)	13402201	T18 – 0.8km away T19 – 1km away T20 – 1.8km away T21 – 2km away	0.3km to boundary at N and 0.2km to boundary at S	Located to S of T21-T22 and W of T23. House has natural woodland surround
Mosstown House & Demesne	13313005	T.21 – 1.7km away T22 – 1.2km away T23 – 1.4km away	0.7-0.9km from site boundary	Located SE of proposed development with some screening between them

Table 15.7: Details of houses within 2km of the Application Site boundary that are recorded in the NIAH.

15.3.9 Previous Archaeological Work in the Area

The bogs of Derryaroge, Derryadd and Lough Bannow have undergone previous surveys, excavations and re-assessments (Appendix 15.4). Since Bord na Móna works commenced in the area in the 1950's, there has been an increase in the number of artefacts and sites identified during the peat-cutting and harvesting. The first archaeological excavations in these bogs were carried out in the 1950's by Etienne Rynne on behalf of the National Museum of Ireland. Following this an extensive European Community (EC) sponsored training and research programme on the archaeology of Irish wetlands was carried out in the late 1980's led by Barry Raftery. In 1991 the Archaeological Survey of Ireland's Peatland was carried out by the Irish Archaeological Wetland Unit (IAWU), and since then two re-assessment surveys have been carried out by Archaeological Development Services (ADS) on behalf of Bord na Móna. The first of these was undertaken in 1999 with the second in 2013.

Peat extraction in the Derryaroge bog in the late 1950's revealed the remains of a number of archaeological features. These were recorded and excavated by Etienne Rynne on behalf of the National Museum of Ireland and consisted of roads – gravel/stone trackways, wooden toghers and structures (NMI I.A. 32/57; 4/58-,Rynne). The remains of a togher was also excavated by Barry Raftery in the townland of Mount Davys (LF017:028).

In 1991, the Derryadd Bog and the Lough Bannow bog were surveyed by the IAWU recording hundreds of archaeological features, predominantly roadways and peatland structures. In 1999 the re-assessment carried out by ADS on behalf of Bord na Móna found that many of these had been cleared by the peat milling and harvesting operations undertaken at the site.

In the townland of Cloonfore, at the rear of the Bord na Móna Mountdillon Works, a number of toghers were excavated (Licence Nos. 00E514-523), by Noel Dunne in 2000. In the townland of Annaghbeg the 1991 survey carried out by the IAWU recorded 75 features (LF018-076001- 076079), three of which were excavated recording bronze age dates. The survey in 1991, could not trace any of the 75, but did record eight previously unrecorded toghers in the area of the concentration. The sites were comprised primarily of roads – class 2 and class 3 toghers.

Lough Bannow Bog is a large area of production bog within the Bord na Móna Mountdillon Group of bogs previously referred to by Bord na Móna as Lough Bannow 1, 2, 3 and 4. The numerical divisions are no longer in use by Bord na Móna but are included here to aid the descriptions of the several seasons of archaeological works undertaken.

The southern extent of the bog, Lough Bannow 1, also known as Corlea South, was the focus of the preliminary excavations carried out by Raftery in 1989. At that time five sites were excavated including the substantial Iron Age transverse plank trackway known as Corlea 1 (Raftery 1996). By the time of the 2013 re-assessment survey no sites remained extant in Lough Bannow 1.

Lough Bannow 2 and 3 are north of the unclassified road that runs north eastwards towards Keenagh village. Forty-nine sites were identified in Lough Bannow 2 in 1991 (IAWU 1993). Thirty-four sites were identified in 1999 (Dunne 1999) eight of which were subsequently excavated as part of the 2000 Mitigation project (Dunne 2000). The zone was 1km north northwest of the Corlea visitor centre and intensive investigations of nine toghers within the area had previously been carried out by Barry Raftery between 1988 and 1990. The majority of the sites were dated to the Neolithic, with some however ranged in dates to the early historic period. No sites were recorded in Lough Bannow 2 during the 2013 re-assessment survey (Whitaker 2014).

Lough Bannow 3, the eastern part of the centre of the bog, had eighteen sites during the preliminary survey in 1991 with eleven sites recorded in 1999. Two of these were excavated during the 2001 mitigation project (Whitaker 2009). In the townland of Derryglogher, approximately 2km to the west of Lough Bannow 2, a cluster of eleven archaeological sites were recorded. In 1991 IAWU excavated a single cutting through this site, incorporating two toghers. A large expanse of bogland located north of

Lough Bannow 2 and 3, surrounds Derrynaskea island and Derryoghil peninsula. Dense concentrations of archaeological sites from the west through north to east indicate evidence of human activity. One togher to the west of the island excavated by IAWU in 1991 gave a dendrochronological date of 974BC. Lough Bannow 4 is the northern extent of the bog and is bounded by the R398 that runs south-west towards Derraghan. The narrow north-east extent of Lough Bannow 4 or Derryoghil was the location of thirty nine excavations carried out by Raftery (1996). Eleven sites were excavated in Derryoghil 'South' with the remaining twenty eight excavated in Derryoghil 'North', which is within the same area that the 2015 excavations took place. Twenty-five new sites were recorded in Derryoghil North (IAWU 1993) while the 1999 Bord na Móna re-assessment Survey (Dunne 1999) identified seventy eight sites. The most recent survey carried out in 2013 (Whitaker 2014) identified fifteen sites, nine of which were selected for excavation with samples from two additional sites. The location of multiple sites, spanning several centuries, in the same area and along the same orientation suggests that this was an important routeway or area within the bog. In 2015 excavations were carried out by Jane Whitaker of Irish Archaeological Consultancy Ltd. for Bord na Móna under licences 15E0205–15E0213. The sites selected for excavation included four Road-Class 3 Toghers, two platforms and three Road-Class 2 Toghers. The features dated from the Neolithic period to the Bronze Age.

15.3.10 Cartographic Analysis

Consultation of the Ordnance Survey Maps from 1838 to the present day provided further information to aid the Cultural Heritage Assessment.

Lewis topographical map of 1837 depicts the area in general with the main route from Mullingar to Roscommon/Strokestown indicated running through the town of Lanesborough. The route of the Royal Canal is also depicted as are the towns of Mosstown and Kenagh. No details of the area where the proposed development site will be located are featured. The first edition map represents the first detailed cartographic evidence of the proposed wind farm site. It indicates that all of the proposed turbines (1-24) are located within areas marked as *boggy* or *rough pasture.* The 1st edition (historic) map indicates that the proposed location of a number of turbines are positioned close to townland and/or baronial boundaries (Figures 15.3-11). According to Kelly (2006) the modern day boundaries and in particular barony boundaries 'coincide with ancient tribal boundaries'. Numerous bog bodies and metal finds have been discovered over the years along barony boundaries.

Examination of the Ordnance Survey of Ireland maps indicate a change in the layout of the townland boundaries from the 1st edition (1829-46) to the 3rd edition (1900-1921) (Figure 15.2). The proposed amenity road runs along the south side of the townland boundary.

Figure 15.2: Plan indicating townland boundary from 1st edition (in red) and the 3rd edition (in blue) along amenity road exiting Lough Bannow Bog (OSI).

A comparison of the first and third edition ordnance survey maps indicate no major changes in the landscape effected by the proposed development. Some small farmsteads in the surrounds have disappeared while subdivision of land parcels is also evident, this being a product of early/mid nineteenth century land reform and reorganisation. The first and third edition ordnance survey maps show a general sparsely settled landscape with the landed estates of Mount Davy's House, Middleton House, Glebe House, Cloontamore House, Derryglogher Lodge, Cloonbony House and Mosstown House and Demesne located within 2km of the proposed development site.

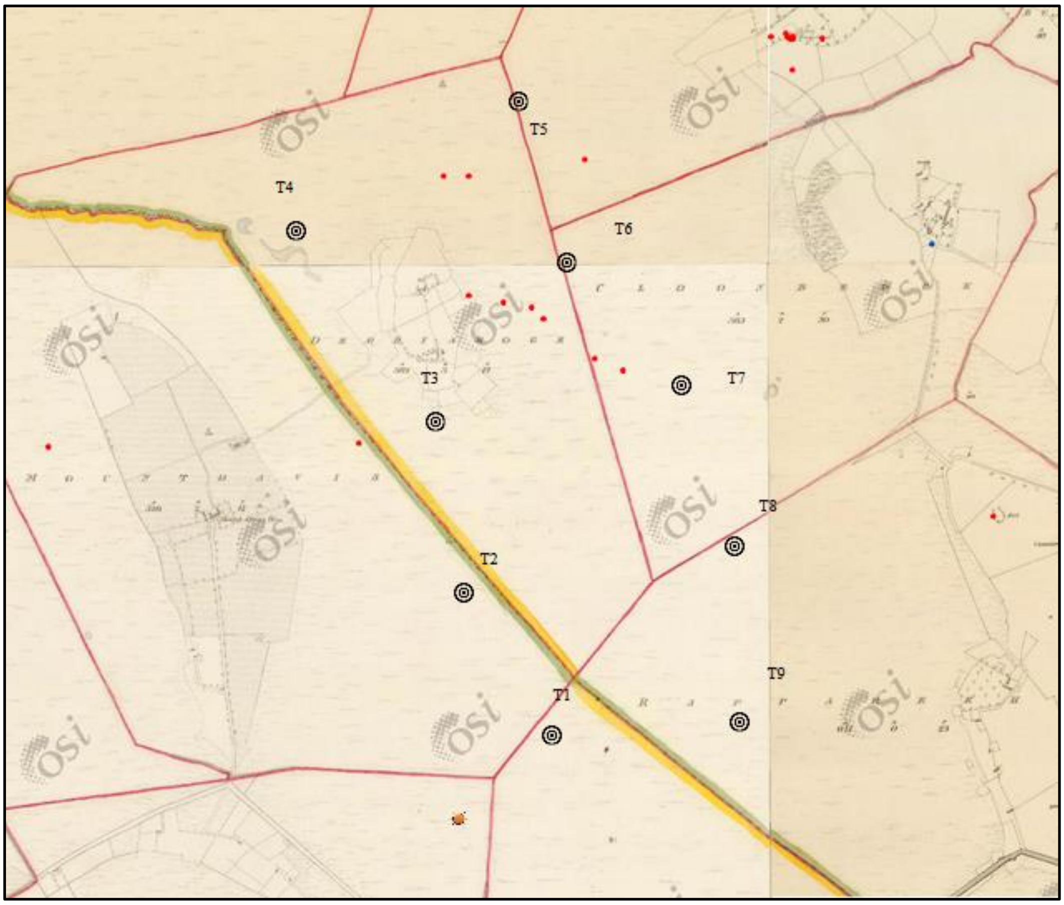


Figure 15.3: Extract from first edition ordnance survey map Turbines 1-9 (after OSI.ie).

Examination of the ordnance survey maps show a dryland island in the townland of Derryaroge with a roadway running west to Mount Davys (Fig. 15:16). The area is divided into small fields, with two houses and internal roads. These houses may not be of particular architectural significance however their presence is testimony of the former distribution of the population in this landscape. Turbine 3 is located to the south of this raised area while Turbine 4 is situated to the north-west.

A description of where the proposed development crosses townland and barony boundaries is detailed in **Section 15.3.13**.

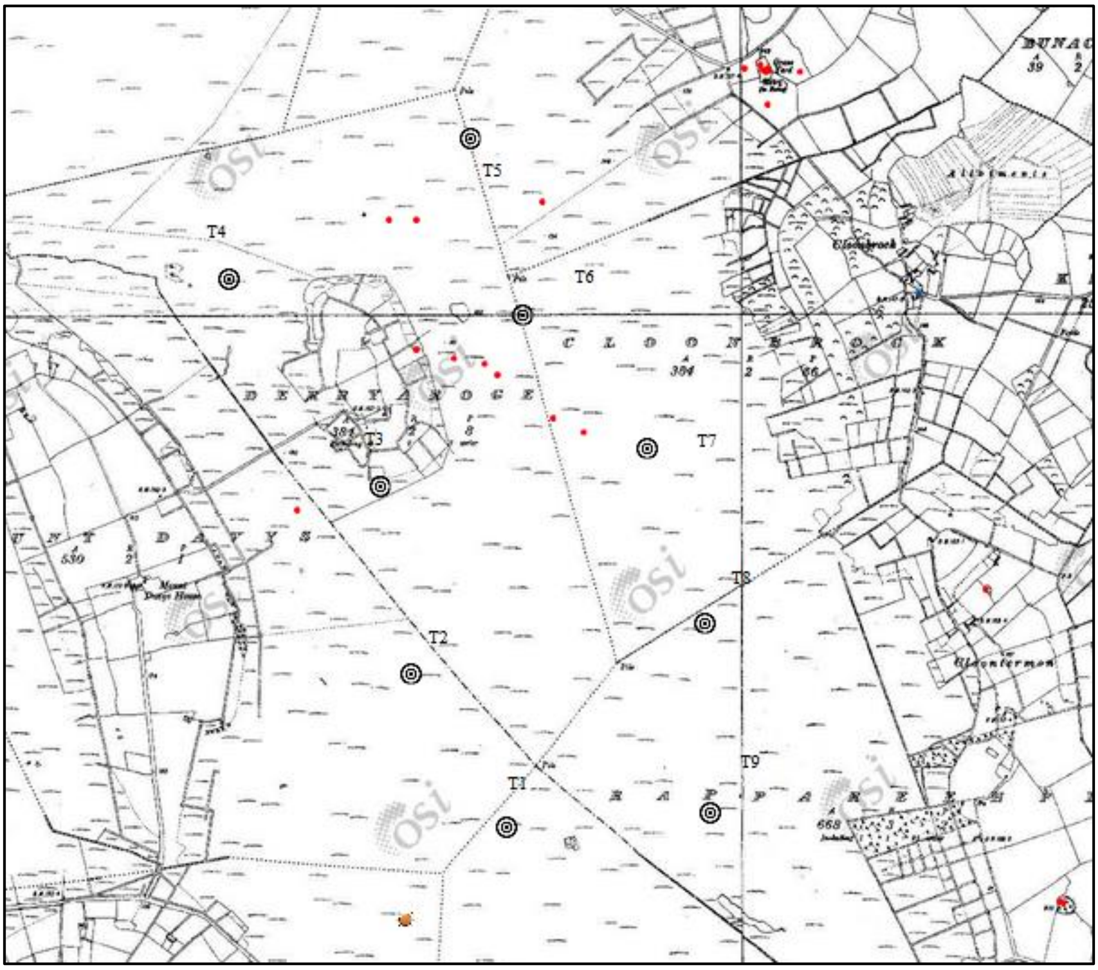
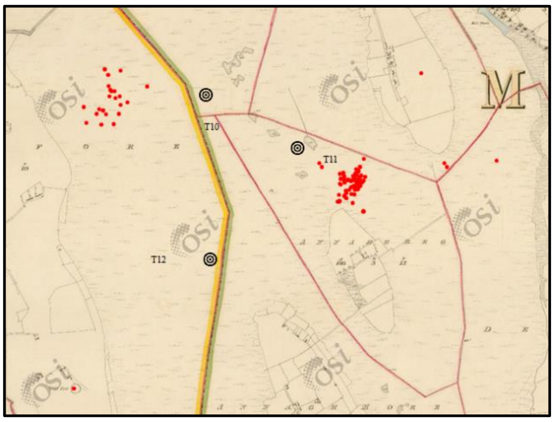


Figure 15.4: Extract from third edition ordnance survey map Turbines 1-9 (after OSI.ie).



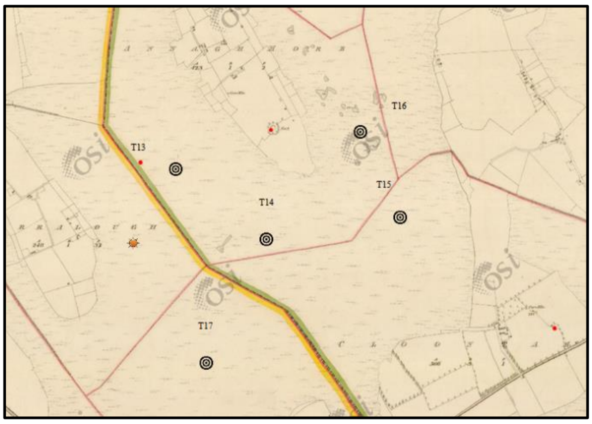


Figure 15.5 and Figure 15.6: Extract from first edition ordnance survey map Turbines 10-17 (after OSI.ie).

Figure 15.7 and Figure 15.8: Extract from third edition ordnance survey map Turbines 10-17 (after OSI.ie).

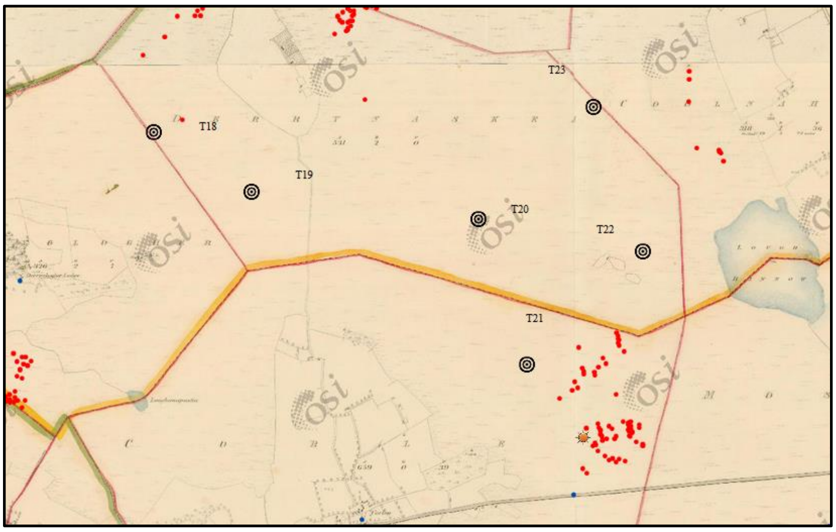


Figure 15.9: Extract from first edition ordnance survey map Turbines 18-24 (after OSI.ie).

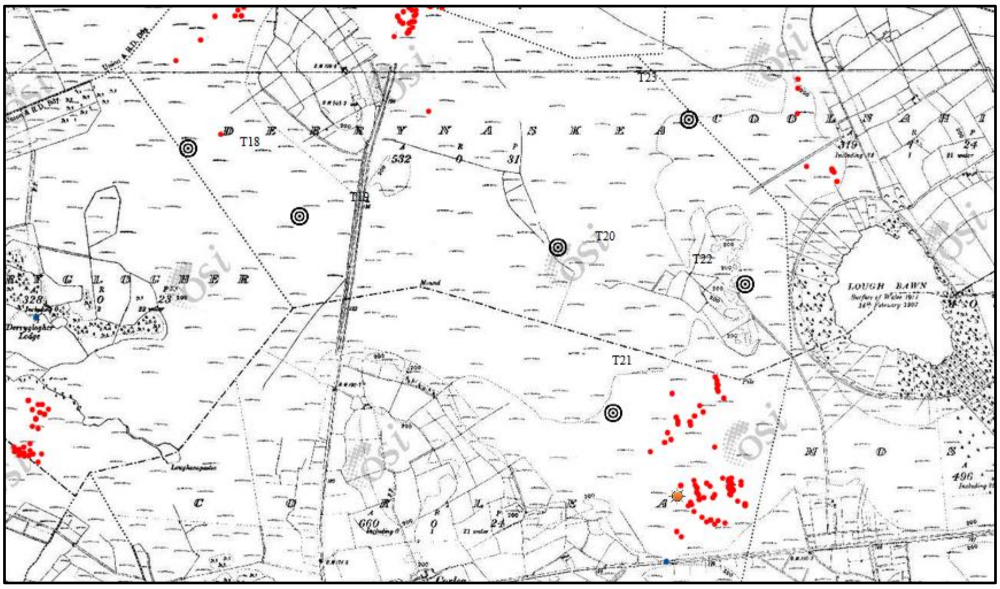


Figure 15.10: Extract from third edition ordnance survey map Turbines 18-24 (after OSI.ie).

15.3.11 Townland Names

Townlands are the smallest land divisions in the Irish landscape and many may preserve early Gaelic territorial boundaries that pre-date the Anglo-Norman conquest. The layout of Irish townlands was recorded and standardised by the work of the Ordnance Survey in the 19th century. The Irish translation of townland names often refer to natural topographical features, but name elements may also give an indication of the presence of past human activities within the townland. The Schools Collection records the meaning of the placenames in the area of the proposed development. The following table provides the possible translation of the Irish origin of the townland names within or adjacent to the Application Site.

Table 15.8: Townlands within the boundary of the proposed development and their translations.

Name	Derivation	Possible Meaning	Barony	Civil Parish
Annaghbeg	An tEanach Beag	Small marsh	Moydow	Killashee
Annaghmore	An tEanach Mor	Big marsh	Moydow	Killashee
Ards	Na hArda	High, a height	Moydow	Kilcommock
Ballynakill	Bhaile na Cille	The town of the church or wood	Moydow	Killashee

Barnacor	Barr na Cora	Top of weir, stone-fence, ford	Rathcline	Rathcline
Cloonbearla	Cluain Bearla	English meadow, pasture	Moydow	Killashee
Cloonbony	Cluain Buinneach	Lawn of the stream	Rathcline	Rathcline
Cloonbrock	Chluain Broc	Pasture of (the) badgers	Moydow	Killashee
Cloonfinfy	Chluain Fuinche	Meadow/pasture of the Ash	Moydow	Killashee
Cloonfiugh	Cluain Fiúch	Pasture of the boil	Moydow	Killashee
Cloonfore	Cluain Fobhair	Meadow, pasture 'Meadow of the spring'	Rathcline	Rathcline
Cloonkeel	Cluain Caoil	Narrow meadow / marshy stream	Moydow	Killashee
Cloontabeg	Cluainte Beaga	Small pastures	Rathcline	Rathcline
Cloontamore	Cluainte Mór	Big pastures	Moydow	Killashee
Coolnahinch	Cúil na hInse	Corner, nook, island; river meadow	Moydow	Kilcommock
Corlea	An Chorr Liath	Grey round hill	Rathcline	Kilcommock
Corralough	Corr an Locha	Round/Pointed hill, lake inlet	Rathcline	Rathcline
Derraghan Beg	An Doireachán Beag	Little Oak Wood	Rathcline	Cashel
Derraghan Mor	An Doireachán Mór	Great Oak Wood	Rathcline	Cashel
Derryadd	Doire Fhada	Wood of the Yew Wood	Moydow	Killashee
Derryaroge	Doire an Ghroig	Wood, grove, thicket	Moydow	Killashee
Derryart	Doire Airt	Wood of the Yew Wood	Moydow	Killashee

Derrygeel	Doire Gaill	Wood of the foreigner / standing stone	Rathclline	Rathcline
Derryglogher	Doire gClochair	Oak, wood stony place	Moydow	Kilcommock
Derrynaskea	Doire na Sciath	Wood of the Yew Wood	Moydow	Kilcommock
Derryoghil	Doire Eochaille	Wood of the Yew Wood	Moydow	Kilcommock
Derryshannoge	Doire Sean Bhog	Old soft Wood, grove, thicket	Rathcline	Cashel
Kilmakinlan	Cill Mhic Caoinleain	Church of the son of Caoinlean	Moydow	Kilcommock
Mosstown	Caonach Mór	Big moss	Rathcline/Moydow	Kilcommock
Mount Davys	Cluain Creamha	Meadow, lawn of wild garlic	Rathcline	Rathcline
Rapareehill	Cnoc an Ropaire	The robbers hill	Moydow	Killashee

15.3.12 Field Survey

A field inspection of the proposed Derryadd Wind Farm site was undertaken in May 2017 and in April/May 2018. This allowed the opportunity of first-hand observation of the terrain, which can often result in the discovery of hitherto unrecorded sites and finds. The results of the archaeological monitoring of the geotechnical site investigations at Turbines 1-17, combined with the Bord na Móna Peat Depth Survey (2015), were also used to inform the field survey. Peat production at all three bogs, has resulted in a general landscape consisting of cutaway bogs divided by drainage ditches and higher bank areas known as 'railway fields'. In some instances, the vegetation has re-established and these areas are now overgrown while in others the recently harvested peat results in a flat expanse of bog.

Derryaroge Bog

The proposed internal road travels north from the N63, entering the bog in the townland of Rappareehill. It crosses an internal railway (still in operation) and is located c. 1km to the east of the NIAH site listed as 'Rails' (reg. 13401811) (Plate 15:1). A proposed amenity car park is located adjacent to the N63. The internal road runs along the townland boundary between Cloonfore and Rappareehill and crosses a number of railway fields. Many of the existing drains are overgrown with heathers, grasses and willow trees.

Turbine 9 is located in the townland of Rappareehill on a disused railway field which is heavily overgrown. The archaeological record indicates there are no recorded monuments located within 500m. The archaeological monitoring of the geotechnical excavations (Licence No. 18E0177) revealed peat for a depth of 1.4m coming down on to the natural grey clay with occasional boulders.

The proposed internal road extends north and divides to serve the east and west side of the windfarm development. To the west it extends to turbine 1 through an overgrown area with peat depths recorded at 0-1m (Bord na Móna Peat Depth Survey, 2015). A temporary construction compound is located along this internal road. No recorded monuments are located within 500 m of this internal road.

Turbine 1 is located in an area of cutaway bog in the townland of Cloonfore (Plate 15.4). The archaeological record indicates that there are no recorded monuments within 500m. An examination of the accessible drains revealed nothing of archaeological significance. Archaeological monitoring of site investigations (Licence No. 18E0177) in April 2018 recorded peat to a depth of 0.70m, overlying the natural grey clay.

Plate 15.6: View of drains at Turbine 1 and the proposed internal haul road between turbines 1 and 9, taken from the north.

The proposed internal road will extend 140m west from turbine 1 to a proposed met mast location (Fig. 15:1, Plate 15.6) and a proposed amenity road. The archaeological record indicates no recorded monuments within 500m of these proposals. A walk-over survey of the area including an examination of the existing drains revealed nothing of archaeological significance. Peat depths in this area range from 0.50m to 1m in depth. This compares with the Bord na Móna Peat Depth Survey (2015) that recorded peat depth of +2.6m.

Between turbine 1 and turbine 2, the field walk-over of the proposed internal road recorded varying peat depths ranging from 0-1m in depth.

Turbine 2 will be located in the townland of Mount Davys 0.8km to the south south-east of Mountdavis House. Field inspection and archaeological monitoring of the site investigations in this area revealed the scrub overlying natural grey clay. No features and/or finds of archaeological significance were recorded in the walkover survey.

The internal road from turbine 2 to turbines 3 and 4 runs adjacent to a Bord na Móna railway line. The cartographic record indicates it continues through the barony boundary of Rathcline and Moydow and the townland boundary between Mountdavys and Derryaroge (Figure 15.4). The archaeological record indicates a gravel/stone trackway (LF017-001) is located 500m to the west. This recorded monument was excavated by E. Rynne, in 1957 and nothing survives today.

Plate 15.7: View of area of proposed internal haul road between turbines 1, 2 and 3, taken from the south.

Plate 15.8: View of ditch excavated in the townland of Derryaroge, adjacent to turbine 4, taken from the south.

The field walkover survey recorded peat depths of 0-0.50m where drains were accessible. The internal road between Turbines 3 and 4 extends through parts of disused railway fields which are heavily overgrown. Considering the depth of peat at these locations, archaeological features and/or artefacts may still survive in situ. Archaeological inspection of the drains was prevented due to the overgrown nature of the terrain.

Turbine 3 and Turbine 4 are located within the townland of Derryaroge in an area of cutaway bog where regeneration has resulted in a covering of thick vegetation and wild grasses**.** The walk over survey at Turbine 4 was not possible due to the overgrown nature of the terrain. A deep drainage ditch (2-3m in depth) has recently been excavated in this area and runs north south between the turbine locations.

Field inspection and archaeological monitoring of the site investigations in the area of Turbine 3, revealed the scrub overlying natural grey clay. No features and/or finds of archaeological significance were recorded in this area.

Turbine 4 is located in an area of thick vegetation with cutaway bog to the east. The 1st edition Ordnance Survey map indicated a lake to the north-west of the turbine location. The lake is not indicated on the 3rd edition 1927 map (Figure 15.4 & 15.5). The existing peat level of 1.6m (confirmed during archaeological monitoring of the geotechnical site investigations) combined with the cartographic evidence suggests sub-surface archaeological features may survive in this area.

Between Turbine 4 and 5, the proposed internal road runs through an area of cutaway bog where regeneration has resulted in a covering of thick vegetation and wild grasses. Access to these areas was not possible. The archaeological record indicates two recorded monuments (LF012-005001 and LF012-005002) are located 1km south and will not be impacted.

Turbine 5 is located in the townland of Ballynakill, and cartographic evidence indicates it incorporates part of the townland boundary with Derryaroge. The turbine will be located 0.7km from Ballynakill medieval church and possible ecclesiastical site (LF013:045) (Plate 15.1) and 0.2km to the north-east of a gravel trackway (LF012-2001). This recorded monument was excavated by E Rynne, in 1957 and nothing survives today.

Field inspection recorded peat depths of 0.05m overlying a natural grey clay. This was confirmed by the archaeological monitoring of site investigations at this location.

A proposed amenity road is located north-east of Turbine 5. The archaeological record indicates that there are no recorded monuments within 500m of this infrastructure. The field walkover survey recorded peat depths of 0-1.5m, with no features and/or artefacts of archaeological significance evident.

Between Turbine 5, 6 and 7, the proposed internal road is located in the townlands of Ballynakill and Cloonbrock along a section of bog that has been harvested in recent years. The field walk-over survey recorded peat depths of 0-0.4m, with no features and/or artefacts of archaeological significance evident.

Turbine 6 is located in the townland of Cloonbrock and cartographic evidence indicates it incorporates part of the townland boundary with Derryaroge (Figure 15.4). The archaeological record indicates Turbine 6 is located 100m-200m from four recorded monuments (LH017-002002, LH017-002004, LH017-002005, LH017-002006) classified as toghers. Three of these were recorded by the Archaeological Wetland survey and one excavated by Bord na Mona in 1957. No trace of these survives today. Field inspection in the area of turbine 6 combined with the archaeological monitoring of the site investigations recorded peat levels to a depth of 0.5-1m. No features and/or artefacts were recorded during the course of the monitoring and the field inspection.

A proposed internal road extends 200m west from turbine 6 and is located 50- 60m from the *zone of notification* surrounding the recorded monuments LH017-002002, LH017-002004, LH017-002005, LH017-002006. No evidence of these sites was recorded during the field walk-over survey. The reduction in peat depths from 1m (BnM Peat Depth Survey, 2015) to a current depth of 0.5m, probably accounts for this.

Plate 15.9: View of drains in the area of the internal road north west of turbine 6, taken from the north west.

Turbine 7 is located in the townland of Cloonbrock. The archaeological record indicates no recorded monuments within 500m. Field inspection combined with the archaeological monitoring of site investigations of this area recorded a thin peat covering the natural grey clay and sand evident. No features and/or artefacts were recorded during the course of the monitoring and the field inspection.

Plate 15.10: General view of area of Turbine 8, from the north.

Turbine 8 is located in the townland of Rappareehill on a disused railway field which is heavily overgrown with heathers, grasses and willow trees (Plate 15.10). The archaeological record indicated no recorded monuments within 500m. The field walk-over survey combined with the archaeological monitoring of the site investigations recorded the peat for a depth of 1.70m overlying the natural grey clay.

The proposed internal road between Turbines 7 and 9 are located in the townlands of Cloonbrock and Rappareehill. The archaeological record indicates no recorded monuments within 500m. The field walkover survey recorded peat depths of 0-0.50m where drains were accessible.

Derryadd Bog

The proposed internal road enters Derryadd Bog from the N63, to the east of the Mountdillon Works Offices and extending south-east to turbine 10, a proposed location for Substation Option A and proposed temporary construction compounds (Fig. 15:1). The archaeological record indicates a cluster of recorded monuments (LF017-076 -076006, LF017-106-121) in the townland of Cloonfore, 500m south-west (Table 15.3). These features were excavated in 2000 by Noel Dunne and were comprised primarily of roadways suggesting they may have been used as a crossing area between the dryland promontory at Annaghbeg and the dryland island at Cloonfiugh.

The field walkover survey combined with the Bord na Móna, Peat Depth Surveys of 2015 recorded varying depths of peat, up to a maximum of 1m. No features and/or artefacts of archaeological significance were encountered in the walk-over survey.

The proposed Substation Option A is located to the west of the internal road on cutaway bog, in the townland of Cloonfore. The archaeological record indicates a cluster of recorded monuments (LF017-076 -076006, LF017-106-121) within 500m. These features were excavated in 2000 by Noel Dunne and no trace survives today. A recorded monument (LF017-007) is recorded 300m to the west. The field walkover survey combined with the Bord na Móna, Peat Depth Surveys of 2015 recorded varying depths of peat, up to a maximum of 0.5m. No features and/or artefacts of archaeological significance were encountered in the walkover survey.

The proposed overhead line connection between Substation Option A and the existing Lanesborough/ Richmond 110kV line will require approximately 700m of new 110 kV transmission line and the installation of 6 new lattice towers/wooden polesets. A field walkover of this area recorded no features of archaeological significance.

Turbine 10 is located in the townland of Cloonfore in an area of cutaway bog where regeneration has resulted in a covering of thick vegetation (Plate 15.11). The walk-over survey was not possible due to the overgrown nature of the terrain. The archaeological record indicates a cluster of recorded monuments (LF017-076-076006, LF017-106-121) as detailed above, located over 200m west. These features have been excavated and no trace survives. Archaeological monitoring of the geotechnical site investigations in April 2018 recorded no peat, with scrub overlying the grey clay with occasional boulders.

Plate 15.11: General view of the location of turbine 10, taken from the east.

A borrow pit will be located to the north-east of Turbine 10, in an area partially overgrown with willow trees and vegetation, in the townland of Rappareehill. The archaeological record indicates no recorded monuments located within 500m. The topographical files of the National Museum of Ireland records the find of a wooden platter (NMI Reg. 1958:25) discovered near the surface of the old railway, located to the east of the borrow pit.

The internal road between Turbine 10 and 11 is in an area of cutaway bog overgrown in parts with willow trees and vegetation. The cartographic record indicates that it crosses the townland boundary of Cloonfiugh and Annaghbeg. Field walk-over recorded shallow peat deaths with subsoil evident throughout. Two recorded monuments (LF018-090 & 091) are located to the east of the internal haul road extending from Turbine 11. Recorded in the townland of Cloonfiugh, these sites are not scheduled for inclusion in the revised list of RMP's.

Turbine 11 is located in an area of overgrown cutaway bog, in the townland of Annaghbeg**.** Recorded monuments (LF018-076001- LFF018-076079) are located 300m to the east. These sites were recorded in the IAWU survey in 1991 however, no evidence survived in the re-assessment survey in 1999. The sites were comprised primarily of roads – class 2 and class 3 toghers. Both the archaeological monitoring of the geotechnical site Investigations and the BnM Peat Depth Survey in 2015, recorded natural clays below the scrub.

The proposed internal road between Turbine 10 and 12, runs south-west through an area overgrown with trees, preventing an archaeological assessment. The cartographic record indicates the proposed internal road will cross a number of townland boundaries and the barony boundary between Moydow and Rathcline (Figures 15.5-15.6).

Turbine 12 is located in an area of cutaway bog in the townland of Cloonfore. The archaeological record indicates no recorded monuments within 500m. The cartographic record indicates the turbine location will incorporate part of the townland boundary between Cloonfore and Annaghmore and the barony boundary of Rathcline and Moydow. Archaeological monitoring of the geotechnical site investigations revealed the peat for a depth of 2m overlying the grey clay.

The internal road runs 1.5km south to Turbine 13, in the townland of Annaghmore. The archaeological record indicates that the route extends through the recorded monument LF18-080. This monument was recorded by the IAWU as a togher (1999), extending east-west for 500m in length, it was 2.6m in width and 0.15m in depth. Site inspection in 2017, found no evidence of this togher on the surface or in the existing north-south running drains. It would appear that this site has been cleared in the course of peat harvesting (Plates 15.12 & 15.13). A field walk-over survey in 2018 recorded a depth of peat at 0.30m compared to the BnM Peat Depth Survey of 2015, which recorded levels of peat of 2.5m.
The proposed turbine 13 is located immediately east of the internal road in the townland of Annaghmore. While the archaeological record indicated a togher, as described above, no trace of it survives today. The recorded reductions in peat levels in this area suggest that is was removed during peat harvesting.

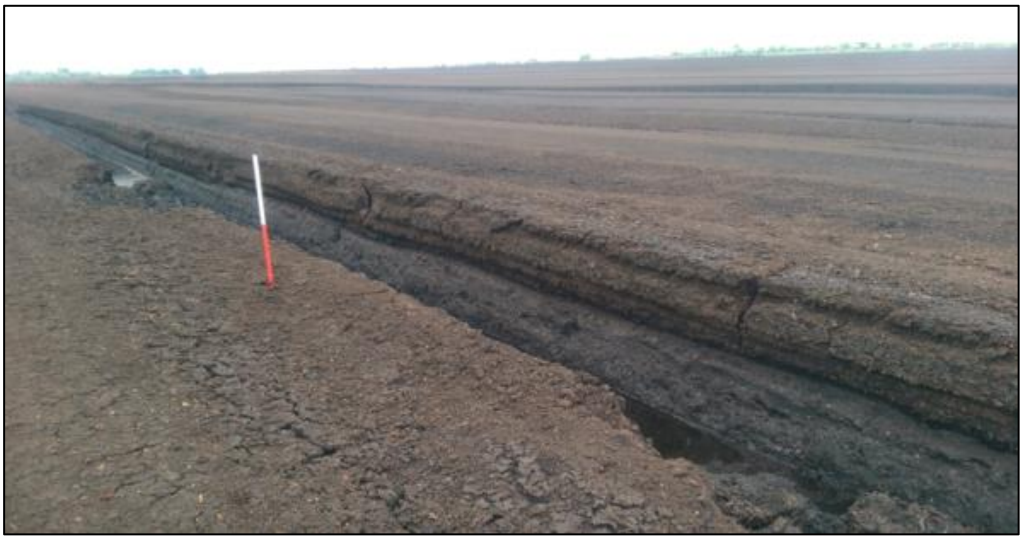


Plate 15.12 and Plate 15.13: View of internal road between Turbines 12 to 13, recorded in May 2017 and in April 2018.

Between Turbines 13 and 14, a borrow pit is proposed on either side of the internal road. Both are located in areas of cutaway bog where regeneration has resulted in a covering of vegetation. The northern borrow pit is located in the townland of Annaghmore and has a ringfort (LF018-035) located 250m to the north-east. The smaller southern borrow pit is located in the townland of Cloontamore. No recorded monuments are located within 500m of this proposal. The northern borrow pit option recorded peat depths of 0.50m. Turbine 14 is located in cutaway bog in the townland of Annaghmore. A rath (LF018-035) is recorded 500m to the north north-east. Walkover survey, inspection of drains and the archaeological monitoring of the geotechnical site investigations revealed a maximum peat depth of 1.2m. Nothing of archaeological significance was noted in the exposed peat.

The proposed internal road between Turbines 14 and 15 runs east before extending in a north north-west direction to turbine 16 and beyond. Between turbines 14 and 15, the proposed internal road is partially overgrown preventing assessment.

A proposed borrow pit (Figure 15.1) located in the townland of Cloontamore, is situated to the west and south-west of turbine 15. The proposed borrow pit will extend either side of the internal roadway at this location. The area is partially overgrown preventing full assessment. Archaeological monitoring of geotechnical site investigations in December 2017 recorded no peat in this area with the vegetation overlying the natural grey clay.

Turbine 15 is located in an area of cutaway bog, in the townland of Cloontamore. No recorded monuments located within 500m of the proposed turbine. The field walkover survey recorded no features and/or artefacts of archaeological significance. Archaeological monitoring of the site investigations and the BnM Peat Depth Survey both record peat depths of 1m with the occasional inclusion of roots and wood fragments.

Plate 15.14: General view of area of Turbine 16 and internal haul road between T15 and T16, taken from the north.

The internal haul road extends north from turbine 15 to turbine 16 (Plate 15.14). Varying depths of peat 0.1-1.5m were recorded during the field walkover. Nothing of archaeological significance was encountered.

Turbine 16 is located in the townland of Annaghmore. A ringfort/rath (LF018-035) is located 300m to the east. Archaeological monitoring of the geotechnical site investigations revealed peat for a depth of 2.10m overlying natural grey clay. Occasional inclusions of woody material were revealed in the peat however, inspection identified these as natural and not of archaeological significance.

The internal road extends south from turbine 13 and west from Turbine 14 to the location of a proposed met mast (Plate 15.15). Field walkover of the internal road and the area of the met mast revealed varying depths of peat of 0-1m however no features and/or artefacts of archaeological significance were encountered.

Plate 15.15: View of area of proposed met mast and internal road, taken from the west.

Turbine 17 is located in an area of cutaway bog, in the townland of Cloontabeg. No recorded monuments are located within 500m. The archaeological monitoring of the geotechnical site investigations revealed the peat for a depth of 1.20m. At approximately 1m below the present ground level, excavations revealed roots and wood fragments.

The internal road runs south from Turbine 17 to the proposed Substation Option B in the townland of Derraghan More. The cartographic evidence indicates the road crosses the townland boundary of Cloontamore and Derraghan More and the barony boundary of Moydow and Rathcline. The archaeological record records no monuments within 500m. The field walkover survey recorded peat depths ranging between 0.5-1m and no features and/or artefacts of archaeological significance were identified.

Substation Option B is located in an area of cutaway bog with no recorded monuments within 500m. The field survey and archaeological monitoring of the geotechnical site investigations recorded peat depths of less than 0.50m.

The DRAFT overhead line connection to Substation Option B will require approximately 1,000m of new 110 kV transmission line and 8 new lattice towers/wooden polesets. The line runs west from the proposed substation option to connect with the existing line in the townland of Derryshannoge. The archaeological record indicates a cluster of recorded monuments within 500m west of the infrastructure (Plate 15.1). The installation of polesets in this area will not impact on any archaeology. The field walkover survey recorded peat depths ranging from 0.5m to 1m.

A proposed internal road will travel east from the western end of the polesets to join with the proposed Substation Option B. The archaeological record indicates no recorded monuments within 500m. The field walk-over survey recorded cutaway bog and an overgrown disused railway field with significant peat depths remaining (Plate 15.16). The BnM Peat Depth Survey (2015) records depths of peat of 1.1-2.5m.

Plate 15.16: View of the 'disused railway field' that runs south in the townland of Derraghan More, taken from the north.

The internal road runs south from the proposed Substation Option B, to exit Derryadd Bog. A ringfort (LF018-056) is located approximately 450m to the east. A proposed amenity carpark is located at this exit and no features and/or artefacts of archaeological significance were recorded during the field walkover.

Lough Bannow

The internal road enters the Lough Bannow Bog from the R398, in the townlands of Cloontabeg/Derryaghan More. Archaeological monitoring of the geotechnical site investigations recorded peat depths of 3.70m overlying the grey clay (Plate 15.17).

A proposed temporary construction compound is located to the immediate east of the internal road in the townland of Cloontabeg. The archaeological record indicates no monuments within 500m.

Plate 15.17 and Plate 15.18: View of higher peat levels at entrance to Lough Bannow Bog and internal haul route from the NW.

The internal road travels south-east through an area of cutaway bog (Plate 15.18). The cartographic record indicates it will run through the townlands of Derryghan More, Cloontabeg, Derrynagloher and Derrynaskea and the barony boundary of Rathcline and Moydow The field walkover and inspection of drains conducted in April and May 2018 recorded varying peat depths of 0.1-1m. No features and/or artefacts of archaeological significance were identified. The proposed route runs 250m to the north of Derryglogher House (NIAH 1340220). Field examination and BnM Peat Depth Survey record 0.1 to 1m of peat at this location.

Turbine 18 is located in an area of overgrown cutaway bog in the townland of Derrynaskea (Plate 15.19). The BnM Peat Depth Survey (2015) recorded a minimum peat depth of +2.6m at this location. The archaeological record indicates a road – class 3 togher (LF22:070) to the immediate east which is not scheduled for inclusion on the revised list. A concentration of archaeological sites to the north, west and east of Derrynaskea island indicate intense activity in this area. A cluster of monuments (LF018-084071-LFF018-084073-76, 84041-042, 84012, 84049 of which are located within 500m) are recorded to the north of the proposed turbine. The sites were comprised primarily of roads – class 2 and class 3 toghers. The topographical files of the National Museum of Ireland record a wooden vessel (NMI Reg. 1958:17) from the townland of Derrynaskea.

Plate 15.19: View of proposed location for Turbine 18 and internal road.

Plate 15.20: Proposed location for T21.

The internal haulage road runs south-east for 500m to Turbine 19 which is located in the townland of Derrynaskea. No archaeological monuments are recorded within 500m while the BnM Peat Depth Survey of 2015, record peat depths of 0-1m at this location. No features and/or artefacts of archaeological significance were encountered in the course of the filed walkover survey.

The internal road extends south-east from Turbine 19 before dividing in two, to serve the windfarm infrastructure in the south and the east. Extending through cutaway bog, the archaeological record indicates no monuments within 500m at this location. The cartographic record indicates that it crosses the townland boundary of Derrynaskea and Corlea.

Turbine 21 is located in the townland of Corlea in an area of cutaway bog (Plate 15:20). The archaeological record indicates a cluster of monuments to the immediate east (Plate 15.4). The 2013 re-assessment survey found that no sites remain extant, indicating that all these sites have been excavated and/or cleared. A proposed amenity road, met mast and carpark are located to the south of Turbine 21 and will travel through the area of the monument cluster detailed above. The field walkover surveys of May 2017 and April 2018 and the BnM Peat Depth Survey records peat depths of 0.1-1m in this area. Nothing of archaeological significance was encountered.

The internal road extends north-east from Turbine 21 to Turbine 22, across an area of partially overgrown cutaway bog. The cluster of recoded monuments detailed in the description of Turbine 21 are located to the south. The field walkover survey recorded levels of peat, up to 1m deep.

Turbine 20 is located in an area of cutaway bog in the townland of Derrynaskea. Nothing of archaeological significance was encountered in this area while the BnM Peat Depth Survey of 2015, recorded depths of peat of 0-1m.

The internal road continues through cutaway bog giving access to the proposed Turbines 22 and 23. Both Turbines 23 and 22 are located in the townland of Derrynaskea. Field inspection recorded these areas overgrown thus preventing an inspection of the ground and drains. The archaeological record indicates no recorded monuments located within 500m of these turbines. The BnM Peat Depth Survey of 2015, recorded peat levels of 0-1m.

The internal road extends north to Turbine 24 through an area of cutaway bog, parts of which are overgrown thus preventing inspection. The cartographic analysis indicates the road will cross over the townland boundary of Derrynaskea and Kilmakinlan. The BnM Peat Depth Survey of 2015, recorded depths of peat of 0-1m.

Turbine 24 is located in the townland of Kilmakinlan. No recorded monuments are located within 500m of this turbine. Field walk-over survey and the BnM Peat Depth Survey of 2015, recorded subsoil and the peat at levels of 0-1m.

A proposed amenity road runs north of turbine 24 and exits Lough Bannow Bog along an existing Bord na Móna drain, joining the existing cycle way along the Royal Canal (see Figure15.1). The cartographic analysis records that the road will cross the townland boundary of Kilmakinlan and Ards. The field walk-over survey recorded a linear earthen bank (1.60m in height and 2m in width) surviving for a distance of c. 1.3km along the south end of the amenity road (Figure 15.2). Cartographic analysis indicate that this is not a townland boundary and may be associated with drainage excavations.

15.3.13 Summary

The cultural heritage assessment encompassed a desk based and walk-over survey of the area of the development and all recorded sites located within 500m of the proposed infrastructure. The wider cultural heritage landscape and the setting of the proposed development in relation to this was also assessed.

All of the archaeological sites detailed are recorded in the Record of Monuments and Places and receive statutory protection under the National Monuments Act 1995. No surviving recorded monument will be directly impacted. All Protected Structures receive statutory protection under the Planning and Development Act, 2000. No protected structures will be directly impacted. In addition to the protected structures all sites recorded in the National Inventory of Architectural Heritage were examined. No NIAH sites will be directly impacted.

The proposed development crosses numerous townland boundaries, of which no above ground expression survives.

15.3.14 Haul Routes

A cultural assessment was carried out on the proposed haul routes to the proposed development (Chapter 14 Traffic - Section 14.1.1.). All the haul routes proposed are existing roads and it is not proposed to alter them. The vast majority of the monuments and structures are located on either side of the roadway and will not be impacted (Appendix 15.5).

15.3.14.1 Proposed Abnormal Load Delivery Route

The proposed haul route will use exit 12 from the M6 at Athlone, travel north to Roscommon Town, east to Lanesborough and then south-east along the R392 for 6.5km to the proposed site access.
The assessment recorded a total number of 21 Recorded Monuments, 11 Recorded Protected Structures and 18 NIAH features along the proposed abnormal load delivery route.

The route exits the M6 at Athlone travelling north on the N61, bypassing Lecarrow to Roscommon Town. The NIAH features and protected structures along the road date to the 19th and 20th century. Two 19th century churches NIAH/RPS are located adjacent to the road between Athlone and Lecarrow. A telephone box (RPS 4500766) along the N61 adjacent to Lecarrow, is a Protected Structure. The route will pass through the town of Knockcroghery which was famous for its production of clay pipes in the 19th century. According to Weld, in 1832, there were eight kilns producing 100-500 pipes per week and by the late 1800's there were almost 100 employed. The production continued up until the early 20th century. A water pump (RPS 4200515, NIAH 31818003) dating to the mid-19th century is located set back from the main road. The town of Knockcroghery was almost totally destroyed by fire in 1921 with only a number of the original houses surviving along the main street (RPS 4200514, NIAH 31818002). A house was built on the site of a former clay workshop (RPS 4200513, NIAH 31818001). The railway station (RPS 4200519, NIAH 31818007) is located at the edge of the town and was used up until the 1960's.

There are twelve Recorded Monuments within 10m of the N61 between Athlone and Roscommon. These sites are comprised of eight ringforts (RO48:53, RO45:155, RO45:225, RO45:112, RO45:103, RO42:67, RO42:38) one barrow (RO42:100), a meeting house/burial ground (RO42:172001/2) and two megalithic structures (RO45:53001/2). Southwest of Lecarrow the megalithic tombs (RO45:53) is accessed from the N61 road.

The proposed route extends north to the historic town of Roscommon (RO39-43) and runs along the edge of the *zone of notification* of the town. Roscommon is derived from the Irish *Ros Comáin*, meaning Colman's Wood. A monastery (RO039-0430006-) was founded here by St Comán, who died in AD 747. The town continued to be of importance throughout the medieval period. There are two recorded Monuments along this section of the route. RO39:47 marks the location of an archaeological excavation while (RO40:24) is a ringfort.

The proposed haul route travels east from Roscommon town on the N63 crossing the Shannon at Ballyleague and Laneborough. West of Laneborough, two monuments, a church and well (RO36:48001/2) and a redundant record (RO36:67) are recorded. The well which is dedicated to St Faithleic is still venerated and accessed from the N63 through a stile in the wall.

The historic town of Lanesborough (LF17:3) located on the eastern side of the River Shannon and Lough Ree, is accessed via a 6-arch road bridge originally built c. 1835-1843 (NIAH 13310001). The structure has been considerably altered since the 1970's. It is situated at the site of a ford (RO37:009, LF17:3003) and replaced an earlier medieval nine-arch stone bridge (RO37:005, LF17:3001) which was described in 1682 as 'in length and breadth the largest in the kingdom'. According to the Urban Archaeological Survey (Bradley et al., 1985) the extent of the 13th century Anglo-Norman borough at Lanesborough is unknown and it may be that the 17th century plantation settlement overlies it. The Down Survey (1655-6) map and notes by Nicholas Dowdall in 1682 indicate that the 17th century borough was quite small, consisting of one main street with property plots extending off on both sides. No traces of any 17th century buildings survive today, with the castle and the fort having been levelled. Numerous NIAH features are located in the town- many of which are associated with the Bord na Móna works (RPS 303). The BnM housing development at Lanesboro consisted of sixty-one houses being built for workers (NIAH 13310022). The estate was designed by Frank Gibney and although the alterations have been made internally the plan remains the same. Numerous 19th century features survive in the town with evidence of railings/gates and houses dating to that period.

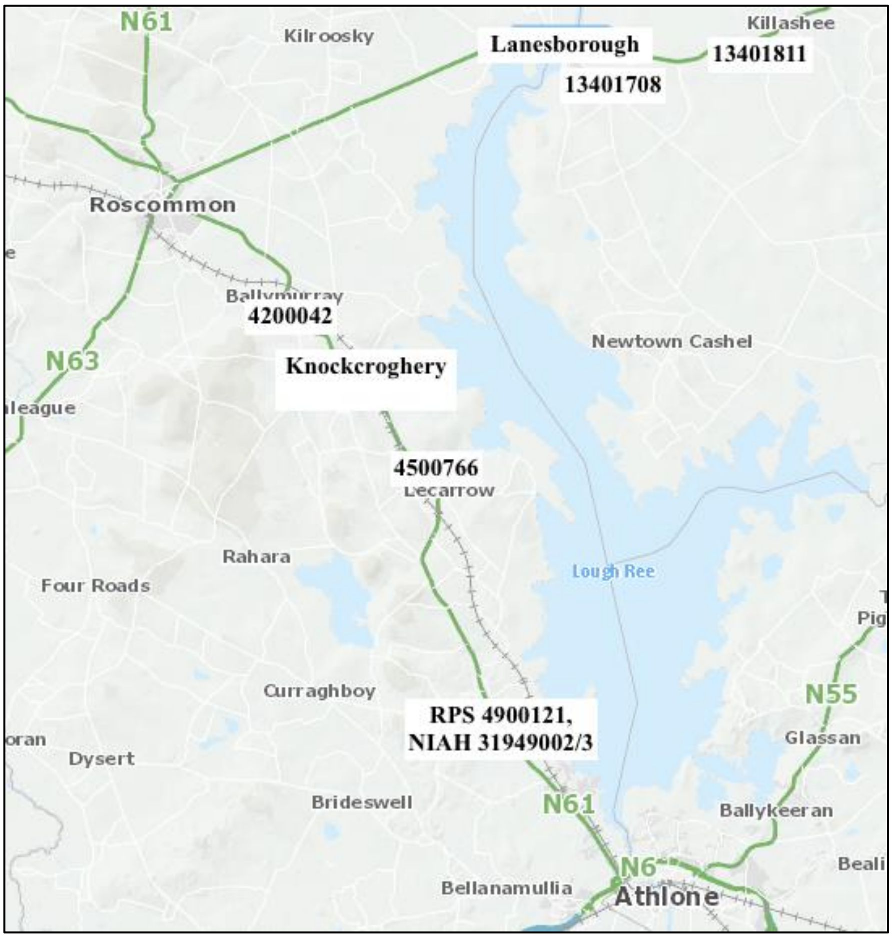


Figure 15.11: Plan of RPS and NIAH along the proposed haul route.

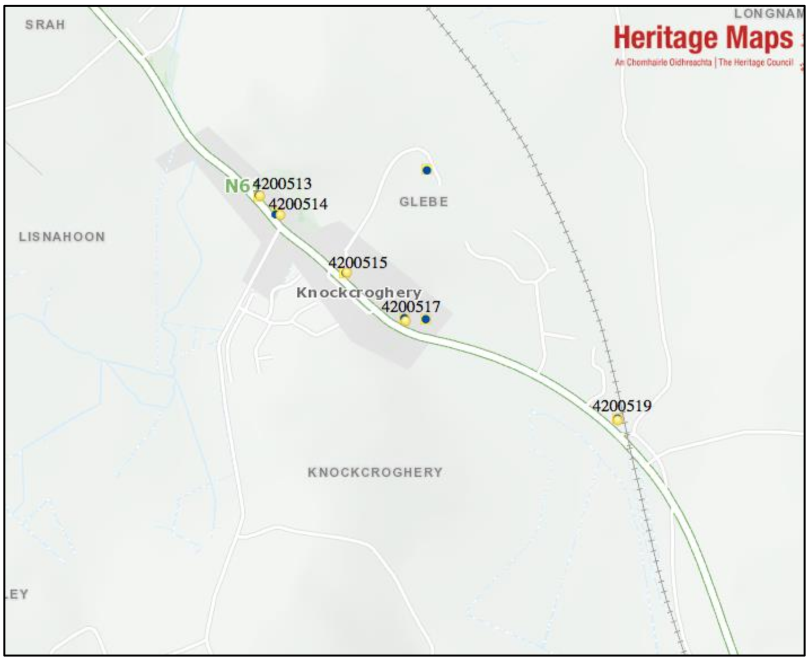


Figure 15.12: Plan of RPS in the town of Knockcroghery.

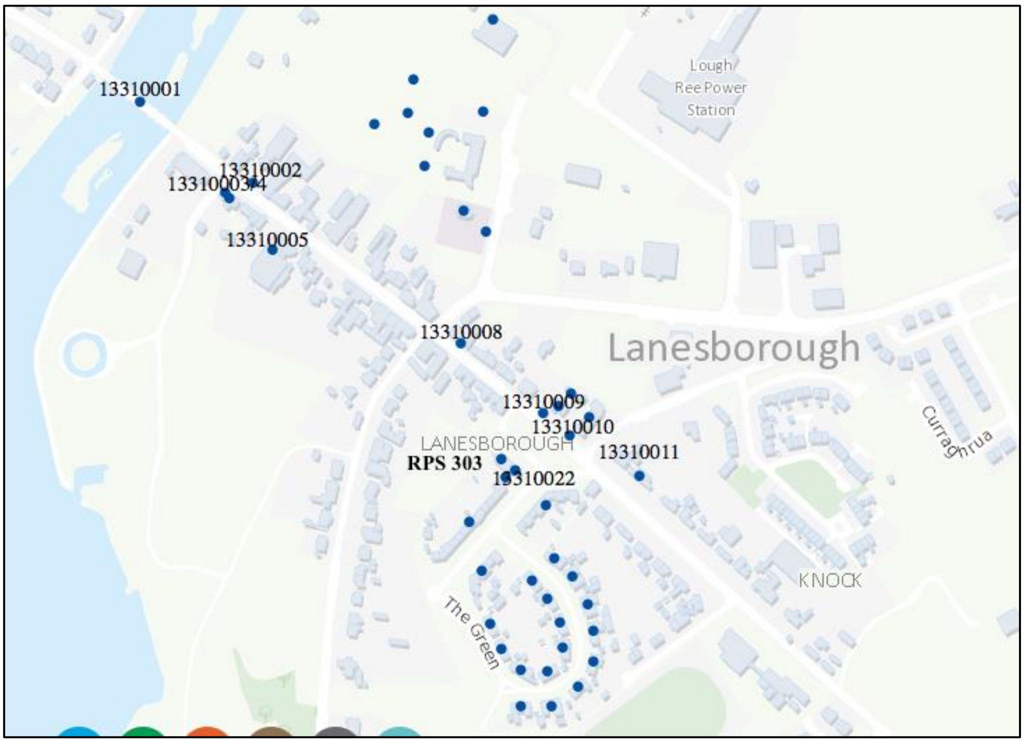


Figure 15.13: Plan of NIAH and RPS features in Lanesborough.

The proposed haul route travels south-east on the R392 to the site entrance. Two ringforts (LF17:11, LF18:55) are located within 10m of the R392 and the NIAH feature (13401708 an old school house) is situated along the south side of the road.

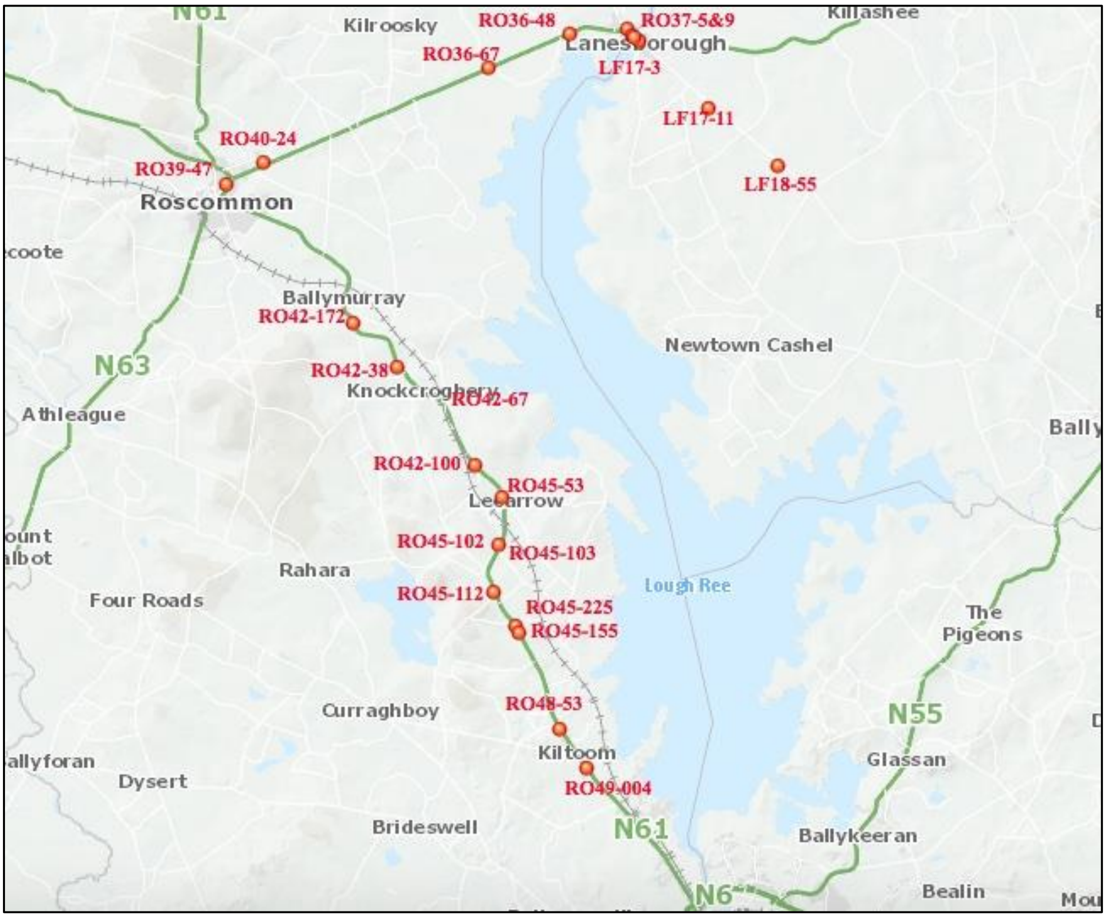


Figure 15.14: Plan of recorded monuments on the proposed abnormal haul route.

15.3.14.2 Proposed Construction Traffic

The proposed route to the site of the proposed development, for general HGV construction traffic, will primarily use the same route as detailed above. The route will differ in that it will divide at Lanesborough accessing Junction 1 on the N63. The proposed route will cross the rails (NIAH 13401811) located on the N63.

It is expected that further HGV traffic will travel from the south and east on existing roads from the towns of Longford and Ballymahon.

15.4 POTENTIAL IMPACTS

Following on from the identification of the baseline environment, the available data is utilised to identify and categorise potential impacts likely to affect the cultural heritage environment as a result of the proposed development. Impacts can be assessed based on the detailed information on the project, the nature of the area affected, and the range of resources potentially affected. Wind farms, in general, can potentially affect the cultural heritage landscape in a number of ways (See Section 15.2.5 and Table 15.2 for categorisation).

15.4.1 Do Nothing Effects

If the Proposed Development were not to proceed, then potential effects on cultural heritage assets would not apply with no need for mitigation. The area of the proposed development continues as a working bog (for the proposed extraction period) and with all peat extraction governed by the existing Code of Practice.

15.4.2 Potential Effects (Direct) - Construction

The proposed development will involve the mechanical excavation of peat layers down to and through geologically deposited strata to enable ground engineering works. As identified in Section 15.3.2 and 15.3.13, three hundred and six recorded monuments are located within 500m of the proposed development infrastructure, only 9 of which survive. No extant recorded monument will be directly impacted. As a result, the proposed development will have a **long-term neutral effect of no significance** on extant recorded monuments. No National Monuments and/or Protected Structures are located within 500m of the proposed development infrastructure. The proposed development will have a **long-term neutral effect of no significance** on National Monuments, Protected Structures and NIAH located within 500m of the proposed development infrastructure.

Some areas of the bogs are overgrown (see Section 15.3.13), preventing a visual inspection as part of the assessment. Archaeological features and/or artefacts may survive in these overgrown areas. Levels of peat recorded in the bog range from 0m to at least 2.6m. It is possible that sub-surface wetland archaeological features and/or artefacts survive where significant peat levels exist.

15.4.2.1 Potential effects on sub-surface archaeology

The field walkover of the proposed development recorded no features and/or finds of archaeological significance on the surface of the peat or within the drains. It is possible however that hitherto unrecorded sub-surface archaeology survives below ground level, either within the peat or at the level of the underlying natural subsoil. Ground disturbance associated with the proposed development may have a potential impact on unrecorded sub-surface archaeology, however the potential impact cannot be measured.

15.4.2.2 Turbines, Hardstanding, Temporary Construction Compounds, Met Masts

The following are located in areas where there is no peat surviving or depths of peat less than 1m and therefore has an **unlikely probability** of potential wetland archaeology been revealed; Turbines 1, 2, 3, 5, 6, 7, 10, 11, 13, 14, 15, 17, 19, 20, 21, 23 and 24, met masts and the temporary construction compounds. Turbines 12, 16, 18 and 22 are located in areas where peat is measured at depths of more than 1m and therefore have a **likely probability** of potential wetland archaeology been revealed.

15.4.2.3 Borrow Pits

The proposed borrow pits in the townlands of Rappareehill, Annaghmore and Cloontamore are situated in partially overgrown areas. Peat depths in these areas are recorded at 0-0.5m and therefore there is an **unlikely probability** of potential wetland archaeology surviving.

15.4.2.4 Internal Roads (Permanent/Temporary), Amenity Roads, Car Parks, Passing bays

Sections of the internal roads, amenity roads, car parks and passing bays cross the bog where there is no peat surviving and therefore has an **unlikely probability** of potential wetland archaeology been revealed. In other areas the internal road, amenity roads, car parks and passing bays cross the bog with peat depths of up to 2m and so there is a **likely probability** of potential wetland archaeology been revealed. The proposed underground grid connection will run alongside the internal road.

15.4.2.5 Substation Options

15.4.2.5.1 Option A (including Overhead Grid Connection)

Located in the townland of Cloonfore, the proposed Substation Option A and overhead grid connection are in an area with peat depths of 0-0.5m. There is an **unlikely probability** of potential wetland archaeology been revealed.

15.4.2.5.2 Option B (including Overhead and Underground Connections)

Substation Option B is located in the townland of Derraghan More and the assessment recorded no features and/or artefacts of archaeological significance. The proposed underground connection travels west across the bog with peat depths 0.5m to 2m, so there is a **likely probability** of potential wetland archaeology surviving along this line.

15.4.2.6 Haul Routes

The proposed haul routes travel on existing national and regional roads. As there are no proposed changes requiring ground disturbance, the route will have a **neutral effect of no significance** on cultural heritage features. The increased traffic associated with the development has a **neutral effect of no significance** on the structural integrity of all the RPS and NIAH along the haul routes (see Chapter 13 Noise & Vibration).

15.4.3 Potential Effects (Indirect) - Construction

Indirect effects are where a feature or site of archaeological, architectural heritage merit or their setting is located in close proximity to a proposed development. Indirect impacts here are mainly concerned with impacts on setting (see Chapter 9: Landscape and Visual Impact of this EIAR).

Impacts on settings of sites may arise when a development is proposed immediately adjacent to a recorded monument or cluster of monuments. While the proposed development may not physically impact on a site, it may alter the setting of a monument or group of monuments. For purposes of assessing visual impact on setting, the uniqueness of the monuments, the potential interrelationships of monuments, the inter-visibility of monuments, visual dominance and whether a setting is altered or unaltered can be used to assess impact.

The proposed development will involve the construction of twenty-four turbines and associated infrastructure. During construction machinery will have a **temporary negative effect** on the surrounding archaeological, architectural and cultural heritage landscape.

While some of the proposed development infrastructure will be visible from surrounding recorded cultural heritage sites, it should still be possible to view part of the site, without the infrastructure/construction machinery in the background.

15.4.4 Potential Effects (Direct)- Operation

There are **no likely direct effects of significance** during the operational phase of the proposed development on the cultural heritage environment. There will be a visual effect on the setting of cultural heritage features within the application site and in the wider environment.

15.4.5 Potential Effects (Indirect) – Operation

There will be a visual impact on the cultural heritage environment. The upstanding proposed development infrastructure will be visible from the surrounding cultural heritage features and from a distance from the historic towns of Lanesborough, Keenagh and Killashee.

15.4.5.1 Turbines and Met Masts

There will be **no significant visual effect** on extant monuments with any significant surface expression as many of the recorded monuments in the immediate surrounds have been excavated or removed during peat operations. The turbines will be visible from the recorded monuments that do survive in the area and from a considerable distance in the surrounding landscape. Numerous RPS and NIAH structures recorded in the area of the proposed development have some screening surrounding therefore the proposed development will have a **neutral effect of no significance** on setting. A specific visual impact study of the proposed development has been completed and is included in Chapter 9 of this EIAR.

There will be an indirect, **long-term negative** effect on the cultural heritage environment in the following areas; Corlea Trackway Visitor centre (LVIA AH3); The Royal Canal (LVIA AH1-2, LC3); the RPS and NIAH of the town of Killashee (LVIA CP4).

15.4.5.2 Substation Options

15.4.5.2.1 Option A

The proposed overhead grid connection will be visible from the cultural heritage features. However, it should still be possible to view these features from one side or the other without the infrastructure in the background.

15.4.5.2.2 Option B

The proposed overhead grid connection will be visible from the cultural heritage features. However, it should still be possible to view any monument from one side or the other without the infrastructure in the background.

15.4.6 Cumulative

Cumulative impacts encompass the combined effects of multiple developments or activities on a range of receptors. In this case, the receptors are the cultural heritage features in the immediate vicinity of the Proposed Development.

Sliabh Bawn Wind Farm and the Lanesborough Power Station are visible to the north-west of the proposed development. When the location of the proposed development is taken into consideration the overall **long-term negative effect** on the archaeological landscape will increase slightly.

It must be noted that this increase in cumulative impact does not result in any direct effects to archaeology or cultural heritage.

15.5 MITIGATION MEASURES

This section provides a description of measures to mitigate potential negative effects identified in **Section 15.4.**

15.5.1 Pre-Construction

Some parts of the bog are overgrown preventing a full assessment (section 15.3.13). The National Monuments Service, Department of Culture, Heritage and the Gaeltacht, requires these areas to be cleared. Pre-construction, the clearance of overgrown areas is to be monitored by an archaeologist, under licence as issued by the minister (DCHG) under section 26 of the National Monuments Acts (1994-2014).

In the event of archaeological features, finds and/or deposits being encountered during the monitoring, all relevant authorities should be notified immediately. Preservation in-situ or preservation by record (excavation) may be required.

15.5.2 Mitigation Measures – Construction

The following mitigation measures will be implemented during the construction phase:

- All ground disturbance associated with the construction of the proposed development will be monitored by a suitably qualified archaeologist working under licence as issued by the minister (DCHG) under section 26 of the National Monuments Acts (1994-2014).
- In the event of archaeological features, finds and/or deposits been encountered during the monitoring, all relevant authorities should be notified immediately. Preservation in-situ or preservation by record (excavation) may be required.

It is not possible to mitigate against potential negative effects on setting arising during construction of the proposed development. Therefore, no mitigation measures are being proposed. In the absence of mitigation, likely indirect effects during the construction phase of the windfarm infrastructure will have a **likely negative short-term effect** on the setting of these monuments.

15.6 RESIDUAL IMPACTS

15.6.1 Construction Phase Residual Effects

There will be **no residual effects** during construction phase on the archaeological, architectural and cultural heritage resource within the wind farm development site after mitigation measures have taken place. There will be **negative short-term** visual effects on the archaeological, architectural or cultural heritage resource in the wider area.

15.6.2 Operational Phase Residual Effects

There will be **no residual effects** during operation on the archaeological, architectural and cultural heritage resource within the wind farm development site after mitigation measures have taken place. There will be **negative** long-term visual effects on the archaeological, architectural or cultural heritage resource.

15.6.3 Decommissioning Phase Effects

No new effects are predicted during the decommissioning phase of the project on the archaeological, architectural and cultural heritage environment. Therefore, no mitigation is required.

15.7 STATEMENT OF SIGNIFICANCE

This assessment has identified **no likely significant direct effects (negative)** from the proposed development on the receiving environment (where accessible), given the layout and design of the proposed development and the mitigation measures recommended. Parts of the proposed development (Turbines 12, 16, 18, 22 and sections of the infrastructure) are located in areas with peat depths up to 2.6m and there is a **likely probability** of potential subsurface wetland archaeology surviving in-situ.

The proposed development will have a **long term negative significant (indirect –visual) effect** on the surrounding archaeological, architectural and cultural heritage landscape. The cumulative effects of the Sliabh Bawn Wind Farm, Lanesborough power station and the proposed development will have a likely **long term negative significant indirect effect** on the cultural environment.

In the event of new archaeology features being revealed, the proposed development will have a **Long Term Positive Significant Direct Effect.** The proposed new amenity development will increase the awareness of the cultural heritage of the area thus having a **Long Term Positive Significant Effect**.

Therefore, the overall effect on cultural heritage as a result of the proposed development is assessed as slight/moderate.

16 INTERACTION OF THE FOREGOING

16.1 INTRODUCTION

The significant effects of the proposed development and the measures proposed to mitigate these effects have been outlined in this EIAR. However, in any development with the potential for environmental effect there is also the potential for interaction between effects of the different environmental aspects.

The result of these interactions may either exacerbate the magnitude of the effect or may in fact ameliorate it. As part of the requirements of an EIAR, the interaction of the effects on the surrounding environment needs to be addressed.

Table 16.1 below outlines the different environmental aspects which have potential to interact as a result of the proposed development. Interactions have been clearly identified in the early stages of the project and where the potential exists for interaction between environmental impacts, the EIAR specialists have taken the interactions into account when making their assessment. Potential interactions (both positive and negative) have been considered for the construction, operation and decommissioning phases of each of the different environmental aspects.

Table 16.1: Interaction between Environmental Aspects (positive and negative)

Interaction Matrix	Bio-diversity	Land, Soils & Geology	Hydro (Ology & Geology)	Landscape & Visual	MA - Shadow Flicker	MA Telecomms Aviation & EMF	Air Quality & Climate	Noise & Vibration	Traffic & Transport	Archaeology Architect.& Cultural Heritage	Population & Human Health
Biodiversity		√	√	√				√	√		
Land, Soils & Geology			√				√			√	√
Hydro (Ology & Geology)											√
Landscape& Visual								√	√	√	√
MA-Shadow Flicker											√
MA- Telecomms., Aviation& EMF							√				√
Air Quality & Climate									√		√
Noise & Vibration									√		√
Traffic &Transport											√
Archaeology, Architect. & Cultural Heritage											
Population & Human Health											

16.2 DISCUSSION OF INTERACTIONS

In addition to Table 16.1, the following section summarises the primary interrelationships of aspects of the environment with the potential for significant effects as a result of the proposed development.

16.2.1 Human Beings

Human beings will interact with other environmental aspects including landscape and visual impacts, shadow flicker impacts, telecommunications impacts, air quality and climate, noise impacts and traffic impacts, associated with the proposed development.

Interactions of Human Beings and Landscape & Visual Impacts

There will be no significant interaction between human beings and landscape and visual impacts during the construction phase of the development.

The landscape and visual impact of the development during the operational phase may be considered to be one of the potentially significant environmental impacts for this type of development. Based on the visual effect assessment undertaken for this development, it is concluded that the proposed Derryadd Wind Farm will result in long term, but not permanent, visual effects that are readily reversible upon decommissioning. Such effects are not considered to be significant. Overall, visual effect significance will generally be in the mid to low range and only occasionally higher at some local receptors.

With respect to cumulative effect, the proposed wind farm will most commonly be viewed in isolation from within the lowland context of the study area, but from occasional elevated vantage points, which also tend to be designated as scenic views, the proposal will be commonly seen in conjunction with the Sliabh Bawn Wind Farm, approximately 8km to the northwest. Aside from the physical separation between these schemes, they occupy different landscape contexts with Sliabh Bawn on an upland ridge and the proposed Derryadd Wind Farm on flat cutaway peatland. Overall, it is considered that the proposal will contribute to wind energy development becoming a more characteristic feature of this midlands context, but it is not considered to give rise to a significant cumulative effect.

Decommissioning stage visual effects will be similar in nature to construction stage effects, albeit in reverse. Such effects will be temporary in duration. As such, there will be no significant interaction between human beings and landscape and visual impacts during the construction phase of the development.

Interactions of Human Beings and Shadow Flicker

There will be no significant interaction between human beings and shadow flicker during the construction phase of the development.

As described in Chapter 10, the shadow flicker assessment concluded that the operational development has the potential (unmitigated) to result in a shadow flicker impact on a specific number of localised receptors (a worst-case, long-term, momentary effect). However, the implementation of proposed mitigation measures, including a shutdown scheme to minimise any potential significant effects from the proposed development, will ensure that any residual effects are within the acceptable limits.

There will be no significant interaction between human beings and shadow flicker during the decommissioning phase of the development.

Interactions of Human Beings and Telecommunications, Aviation and EMF

There will be no significant interaction between human beings and telecommunications, Aviation and EMF during the construction phase of the development.

During the operational phase, generating electricity from wind energy has the potential to interfere with the quality of radio waves and microwaves used for communication purposes; including TV signals, radio signals, aircraft landing, navigation systems and microwave links. As outlined in Chapter 11, a comprehensive list of operators were contacted in relation to potential electromagnetic interference.

Following consultation with the communication service providers, the original wind farm layout was altered to avoid interference with transmission links. As a result, the proposed development is not expected to affect the telecommunications networks of any communications service providers. The developer will ensure that any signal interference directly resulting from the proposed wind farm is addressed.

There will be no significant interaction between human beings and telecommunications, Aviation and EMF during the decommissioning phase of the development.

Interactions of Human Beings, Air Quality/Climate, Land, Soils and Geology and Hydrology and Hydrogeology

During the construction phase of the development, there is potential for short-term interaction between human beings, air quality/climate and land, soils and geology.

This interaction is primarily associated with the disturbance of ground within the proposed development site which may result in suspended solids and dust emissions. Suspended solids, unmitigated, may enter nearby watercourses and be transported off site by construction vehicles. Dust emissions, unmitigated, may impact on air quality.

It should be noted that the area that may potentially be disturbed for the proposed wind farm infrastructure is estimated as approximately 2.7% of the total application area. In addition, detailed mitigation measures are proposed within Chapters 7 (Land, Soils and Geology), 8 (Hydrology and Hydrogeology) and 12 (Air Quality and Climate) of the EIAR to reduce the potential direct and indirect impact on human beings from the proposed construction works. The CEMP, Appendix 2.2, includes further details on dust suppression and surface water management plans for the construction phase of the development.

As the operation of the proposed development will provide renewable electricity to the grid and reduce the reliance on fossil fuels, the interaction between the development and climate is positive. Furthermore, a reduction in the use of fossil fuels will improve air quality.

The decommissioning of the development will result in a reduction of the electricity being produced from a renewable energy source i.e. the reverse of the positive impact of the operational phase of the development on climate and air quality.

Interactions of Human Beings and Noise Impacts

Wind farms generate noise in the vicinity of the development during both their construction and operational phases. The closest occupied dwelling is located in excess of 750m from the nearest proposed turbine. Noise and vibration impacts have been considered in Chapter 13 of the EIAR and it has been found that during both the construction and operational phases of the proposed development, these impacts are predicted to be within the relevant guidance limits. Likewise, any works required during the decommissioning of the proposed development will not result in a significant noise impact on nearby sensitive receptors.

Interactions of Human Beings and Traffic Impacts

Public perception of the construction phase will be influenced primarily from the impact of traffic movement. When taken in context with the existing traffic flows in the area, the construction of the proposed development will not result in a significant increase in traffic volumes on the surrounding road network. Any increase will be temporary in nature (expected duration of construction phase is approximately 24 months) and once the wind farm is operational, traffic movements to and from the site will be imperceptible, based on a projected maximum of 20 trips to and from the site per day generated by maintenance staff and visitors for amenity purposes.

16.2.2 Landscape and Visual Impact

Interactions of Landscape and Visual and Tourism & Amenities

There will be no significant interaction between Landscape and Visual Impacts and Tourism and Amenities during the construction phase of the development.

As noted above, the landscape and visual impact of the operational development may be considered to be one of the potentially significant environmental impacts for this type of development. If such impacts were determined to be negative, potentially negative interaction impacts on tourism and amenity would result.

Taking into account all of the evidence from the photomontages and the zone of theoretical visibility (ZTV) for the proposed development, the addition of 24 No. wind turbines will not result in a significant level of landscape and visual impact. The proposal to develop the area for amenity purposes will have a positive impact on tourism and health in the area. Potential Impacts on Tourism are discussed in Chapter 5 of the EIAR.

Interactions of Landscape and Visual and Cultural Heritage

There will be no significant interaction between Landscape and Visual Impacts and Cultural Heritage during the construction phase of the development.

Negative landscape and visual impact on amenity resources can arise during the operational phase of a wind farm with respect to archaeological features, as many archaeological sites receive numbers of visitors. For the proposed development, the design of the wind farm incorporated the results of historical and project-specific archaeological testing and assessment within the application area. The Corlea Trackway Visitors Centre located approximately 1.2km south of the nearest proposed turbine, was also considered in the project design and impact assessment, for both Landscape and Visual Impact and Cultural Heritage. As described in Chapter 3 of the EIAR, the proposed development was redesigned a number of times based on environmental surveys and feedback from the consultation process. Areas from the original study area were excluded from the proposed development including Cloonboney and the northern area of Derryaroge Bog. The redesign resulted in a reduction in the number of turbines proposed for this development and, as such, reduced the potential impact on the setting of cultural heritage features.

There will be no significant interaction between Landscape and Visual Impacts and Cultural Heritage during the decommissioning phase of the development, as works will be curtailed to the location of the infrastructure proposed for the development which has been designed with consideration for archaeological features in the vicinity of the project.

16.2.3 Biodiversity

Interactions of Biodiversity, Lands, Soils & Geology and Hydrology & Hydrogeology

Exposing soils and peat during the construction phase has the potential, if not properly managed, to cause sedimentation of nearby watercourses. It is envisaged that the excavation of turbine foundations and the construction of internal site tracks could potentially lead to increased suspended solids in surface water run-off. However, mitigation measures will be put in place to control siltation occurring during the construction phase and ensure protection of the aquatic environment. Excavation and removal of soils for the construction of permanent features such as hardstands and access tracks may potentially lead to habitat loss. Excavation is also proposed at the potential borrow pit areas within the development. However, the total area for the proposed ground works and infrastructure comprises only 2.7% of the overall EIAR study area.

There is also the potential, if not properly managed, for a negative interaction between the site drainage regime and aquatic ecology during the construction phase of the proposed development.

Suitable mitigation measures will be put in place to control erosion and sedimentation of receiving waters. During the construction and operational phases of the development, the existing on-site drainage scheme and the surface water management plan for the development will ensure that there is no negative interaction between Lands, Soil and Geology, Hydrology and Hydrogeology and Biodiversity by controlling the runoff of water from the site (at greenfield run off rates) and via controlled and carefully designed attenuation ponds.

In addition, as discussed in Chapter 8, Hydrology and Hydrogeology, comments received from statutory bodies during the consultation process have also been addressed in the Biodiversity Chapter (Chapter 6) and the Natura Impact Statement.

Mitigation measures will be implemented during the decommissioning phase of the development, similar to the construction and operational phase, to ensure that there is no significant interaction between Lands, Soil and Geology, Hydrology and Hydrogeology and Biodiversity.

Interactions of Biodiversity and Landscape and Visual

There will be no significant interaction between Biodiversity and Landscape and Visual Impacts during the construction phase of the development, with the exception of site lighting during those portions of the construction period spanning winter months. This is a short-term, temporary impact and is addressed in the CEMP, Appendix 2.2.

There is the potential for interaction between Biodiversity, in terms of Landscape Character, and Landscape and Visual during the operational phase of the development. However, this interaction is not deemed to be significant. There will be no significant light-spill from the site during the operational phase as the vast majority of site activity will occur during daylight hours and there will be little requirement for external lighting of the operations facilities. Aircraft navigation lighting provided to meet Irish Aviation requirements will be fitted with directional baffles to ensure that the light is directed skywards and will be barely discernible from the ground.

The decommissioning phase will have similar short-term effects as the construction phase with the movement of turbine components away from the site. There may be a minor loss of roadside and trackside vegetation that has grown during the operational phase of the development, but this can be reinstated upon completion of decommissioning. Areas of hard standing and access tracks that are of no further use will be reinstated and reseeded to blend with the prevailing surrounding land cover of the time. It is expected that the decommissioning phase would be completed within a period of approximately 6 months.

Interactions of Biodiversity, Noise and Vibration and Traffic and Transport

There is potential for interaction between biodiversity, noise and vibration and traffic and transport during the construction phase of the development. However, as noted above, noise and vibration impacts during both the construction and operational phases (and the decommissioning phase) of the proposed development are predicted to be within the relevant guidance limits.

Detailed baseline surveys of the biodiversity in the local and regional area of the proposed development have been undertaken and, as a result of the incorporation of the findings of the surveys into the project design and site layout plan, construction works will be carried out at a significant distance from protected areas of biodiversity. Traffic using the site during the construction, operational and decommissioning phases of the development will be restricted to the use of the designated internal access roads. Potential direct and indirect effects on Biodiversity have also been considered in the AA Screening Report and NIS that accompanies this application and mitigation measures proposed, where appropriate.

16.2.4 Traffic and Transport

Interactions of Traffic and Transport and Air Quality and Climate

There will be no significant interaction between Traffic and Transport and Air Quality and Climate during the construction and decommissioning phases of the development, with the exception of exhaust emissions from construction vehicles. This is a short-term, temporary impact and is addressed in the CEMP, Appendix 2.2.

As the potential traffic associated with the operational phase of the proposed development will be very low, there will be no significant interaction between Traffic and Transport and Air Quality and Climate.

16.2.5 Cultural Heritage

Interactions of Cultural Heritage and Lands, Soils & Geology

For the proposed development, the design of the wind farm incorporated the results of historical and project-specific archaeological testing and assessment within the application area. No sites with statutory protection will be directly impacted by the proposed development. However, as some parts of the bog are overgrown, clearance of overgrown areas will be monitored by an archaeologist pre-construction, under licence. In the event of archaeological features, finds and/or deposits being encountered during the monitoring, all relevant authorities will be notified immediately. Preservation in-situ or preservation by record (excavation) may be required.

Similarly, the construction works (ground disturbance) associated with the proposed development will be monitored by a suitably qualified archaeologist working under licence.

16.2.6 Positive Interaction of Elements

In addition to the interactions noted above, the proposed Derryadd Wind Farm development has the potential to have positive impacts on the receiving environment, as follows:

Short Term

- Creation of up to 120 jobs during the construction phase and the use of local materials and goods

Long Term

- Creation of a secure and sustainable energy resource;
- The provision of a valuable new use (consisting of wind energy production and amenity) of the current land which comprises cutaway peatland; and
- A positive effect on both air quality and climate.

Furthermore, the development of wind farms is regarded by many to enhance the reputation of a region as an environmentally friendly place to visit. Any possible short-term impact is strongly counterbalanced by the benefits to society of clean, renewable energy and, in the case of Derryadd Wind Farm, an amenity for the community.

Where a potential impact as a result of the proposed development has been noted during the environmental impact assessment, relevant and appropriate mitigation measures have been identified and proposed. A detailed chapter highlighting the specific mitigation measures proposed for the development is included in this EIAR (Chapter 17 – Schedule of Mitigation Measures).

16.3 CONCLUSION

All environmental factors are interrelated to some extent. However, the most common interactions are between human beings and visual perception, noise, air quality and ecological resources. Having studied the interaction of potential impacts during the construction, operational and decommissioning phases it has been determined that no amplification effect is anticipated. The proposed development will have some positive impacts on an international, national, regional and local level. It is important to note that the physical, environmental and landscape and visual impacts are almost entirely reversible upon decommissioning of the development.

17 MATRIX OF MITIGATION MEASURES

17.1 INTRODUCTION

Mitigation of potential impacts has been incorporated into the proposed development either by avoidance of potential impacts or by the design of the proposed development (as described in Chapter 3, Reasonable Alternatives). Where relevant, these measures are detailed in each chapter of the EIAR.

In addition, during the construction and operational phases of the development, all personnel working on the project will be responsible for the environmental control of their work and will perform their duties in accordance with the requirements and procedures of the Construction Environmental Management Plan (CEMP). During the construction phase of the development, all works associated with the construction of the proposed Derryadd Wind Farm will be undertaken with due regard to the guidance contained within CIRIA Document C741 '*Environmental Good Practice on Site' (CIRIA, 2015)*.

17.2 SCHEDULE OF MITIGATION MEASURES FROM EIAR

The following table summarises the mitigation measures proposed within the EIAR.

Table 17.1: Schedule of Mitigation Measures within the EIAR

Item	Mitigation Measure	Project Stage
Chapter 5 – Population and Human Health		
5.1	The proposed development will be constructed and operated in a manner such that the effect on population and human health is minimal. Mitigation measures for environmental aspects associated with the proposed development which may be human related such as Water (Chapter 8), Landscape and Visual Impact (Chapter 9), Material Assets - Shadow Flicker (Chapter 10), Air Quality and Climate (Chapter 12), Noise and Vibration (Chapter 13) and Traffic and Transport (Chapter 14) are discussed in the relevant sections below.	Construction and Operational Phase
Chapter 6 – Biodiversity		
6.1	Where areas of potentially sensitive breeding bird habitat (e.g. birch scrub) is proposed to be removed during construction, these works will be timed to avoid the breeding birds nesting season, 1st of March to 31st of August.	Construction Phase
6.2	The majority of construction activity will take place during daylight hours, thereby avoiding disturbance to nocturnal fauna. On occasion, deliveries (such as oversize deliveries) may arrive outside daylight hours and concrete pours for the turbine foundations may commence and conclude at dawn/ dusk. This will be an infrequent occurrence of short duration and will, therefore, not have any significant disturbance effects on fauna within the vicinity of the proposed development area.	
6.3	No turbines are located in high (local) value habitats and all are located in habitats not evaluated as key ecological receptors and typically of low ecological value.	

6.4	The proposed turbine locations and access routes will avoid potential breeding sites that protected mammals such as otter, badger and bats typically use including; field boundaries (treelines / hedgerows), stream/ rivers and associated riparian habitats, old buildings, caves, bridges and souterrains.	
6.5	Following detailed design consideration, and as required, temporary silt screens will be installed in drains/ small streams deemed to be possibly at risk of water pollutant discharge. Mitigation for in-stream works will follow IFI recommendations as per Chapter 8.	
6.6	During the construction phase as part of the CEMP, ecological monitoring will take place by a suitably qualified Ecological Clerk of Works (ECoW)The role of the ECoW will include: • Supervision of construction works and ensure compliance with legislation; • Monitoring habitats and species during the course of construction works and effectiveness of mitigation; • Provision of advice regarding the avoidance and minimisation of potential disturbance to wildlife; • Provide recommendations on appropriate responses/ actions to site specific issues (e.g. identification of previously unrecorded breeding sites during construction works); and • Liaison with NPWS, IFI and other prescribed authorities, when required.	
6.7	If encountered during construction, the spread and introduction of alien invasive species and noxious weeds will be avoided by adopting appropriate mitigation measures as per guidance issued by the NRA (2010)170. The mitigation/control measures adopted will depend on the type of invasive species encountered. Some control and management measures include; physical (cutting, digging, excavating) and chemical control (herbicides). All	

[170] NRA (2010). Guidelines on The Management of Noxious Weeds and Non-native Invasive Plant Species on National Roads.

	vehicles and equipment should be cleaned before entering and exiting the site. Although no non-native invasive plant species (as per the Third Schedule Part 1 of the European Communities Regulations 2011) were recorded during baseline surveys; any invasive plant material noted (during construction activities) on site will be removed off site and disposed of at appropriate licensed waste disposal facility. Any alien invasive species found to occur within 15m of working areas will require a specialist method statement for its eradication to avoid the spread of invasive species, this will ensure compliance with the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. No. 477 of 2011). The presence of alien invasive species and requirement for actions will be confirmed by the ECoW prior to the commencement of works.	
6.8	A bat roost survey in areas of suitable habitat will be carried out prior to commencement of construction. Ivy covered trees (if confirmed to contain a bat roost) that require felling will be left to lie for a period of 24 hours to allow bats to escape. Large trees that are identified as bat roosts will be felled carefully, using the gradual dismantling technique by a tree surgeon under the supervision of a bat specialist.	
6.9	Lighting will be avoided where possible, except where it is required for health and safety reasons, as it deters some bat species from foraging.	
6.10	For bats, mitigation is best achieved through avoidance. It is proposed that the measures detailed in Chapter 6, Biodiversity (Table 6.27) be put in place to avoid or lessen the degree of impacts on local bat populations during construction (which are also applicable to the decommissioning phase).	
6.11	The proposed development area will be allowed to naturally re-colonise with birch scrub and emergent wetland vegetation and thereby increase the ecological value of the site during the wind farm operation.	Operational Phase

6.12	In order to avoid a potential barrier effect on birds as a result of the positioning of the proposed turbines close together, the turbines have been positioned at distances greater than 400m apart as per recommendations in Percival (2001).	
6.13	In order to reduce any collision risk between special conservation interest species and the proposed development, turbines were not placed on Cloonbony Bog or in the northern section of Derryaroge Bog to ensure a suitable setback distance between the River Shannon, Lough Ree SPA, Ballykenny Fisherstown SPA and the proposed development was achieved.	
6.14	In the event an overhead power line is selected as the preferred grid connection, bird flight diverters will be installed as per best practice guidelines (EirGrid, 2012).	
6.15	Bat mitigation measures during the operational phase will be determined by implementing a strict surveillance programme for the first two years of operation of the proposed development in order to identify if a substantial risk exists at a particular turbine location or during a particular time-period. If surveillance results indicate medium to high bat activity levels and/or bat carcasses are collected then bat mitigation measures for cut-in speeds will be required at specific turbine locations (further details of the measures are included in Chapter 6, Biodiversity).	
6.16	Additional bat mitigation measures that will be employed include: • A low level of vegetation should be maintained for the entire operational phase. This could be achieved by implementing a rehabilitation plan which is likely to suppress vegetation growth. This should be monitored to ensure that scrub vegetation does not develop within the zone around the turbines.	

	• Undertake a carcass search for 2 years post operation of the wind farm to determine whether a higher cut-in speed of the blades is required; and • Maintain the immediate area around the turbines in a manner that does not attract insects and thereby avoid attracting bats to the turbines.	
Chapter 7 – Land, Soils and Geology		
7.1	Good site practice will be applied to ensure no fuels, oils, wastes or any other substances are stored in a manner on site in which they may spill and enter the ground. Dedicated, bunded storage areas will be used for all fuels or hazardous substances. It is important for personnel on site to have the correct training and expertise in the event that a hydrocarbon leak occurs.	Construction Phase
7.2	All works will be managed and carried out in accordance with the Construction and Environmental Management Plan (CEMP), which will be updated by the civil engineering contractor and agreed prior to any site works commencing.	
7.3	Excavated peat will only be moved short distances from the point of extraction and will be used locally for landscaping. Landscaping areas will be sealed and levelled using the back of an excavator bucket to prevent erosion. Where possible, the upper vegetative layer will be stored with the vegetation part of the sod facing the right way up to encourage growth of plants and vegetation at the surface of the landscaped peat. These measures will prevent the erosion of peat in the short and long term. Peat, overburden, and rock will be reused where possible on site to reinstate borrow pits and other excavations where appropriate.	

7.4	Vehicular movements will be restricted to the footprint of the proposed development, particularly with respect to the newly constructed access roads. Vehicular traffic on site will be reduced through the use of extracting material from borrow pits on site as opposed to sourcing from external quarries.	
7.5	All site-generated construction waste and the storage and disposal of the waste will be managed as detailed in the CEMP. A wastewater holding tank (twin-hulled) will be used for the temporary welfare facilities and managed by a licensed contractor. The concrete wash-out areas at the batching plant will be bunded, controlled and emptied by the appropriate contractor as required. Any introduced semi-natural (road building materials) or artificial (PVC piping, cement materials, electrical wiring) materials will be taken off site at the end of the construction phase. Any accidental spillage of solid state introduced materials will be removed from the site by the appropriate means.	
7.6	The permanent road works will require a drainage network to be in place for the construction and operational phases of the development. A Sediment and Erosion Control Plan is part of the CEMP for the development, which will be reviewed with the authorities prior to the construction phase of the wind farm. Excavated topsoil will not be stored in excessive mounds on the site. Seeding of affected areas with indigenous species should proceed, only where natural revegetation or the reuse of the upper vegetated layer is unsuccessful.	
7.7	A temporary works design for foundation excavations (and hardstanding and substation foundations) will be carried out by a competent designer. The design will be carried out by a suitably qualified and experienced geotechnical engineer and the management of the ground stability will be ongoing throughout the construction phase. Each turbine foundation will be investigated before and during construction to identify any potential karst features. Excavation works will be monitored by a suitably qualified and experienced geotechnical engineer or engineering geologist. The earthworks will not be scheduled to be carried out during severe weather conditions.	

7.8	The effect of potential depletion of peat resources will be mitigated through correct material management, reuse on site or pre-harvesting of the peat by Bord na Móna in so far as is reasonably practicable. Potential for long term sterilisation of the borrow pit resource will be mitigated by diligent borrow pit design and appropriate material management.	
7.9	Potential human health effects will be mitigated through good site management including dust control, applications of safe systems of work and mitigation through design with particular care taken of the design of temporary works in peat.	
7.10	All wastes from the control building and ancillary facilities will be removed by the appropriate contractor.	Operational Phase
7.11	The operational team will carry out maintenance works (to access roads, substation and turbines) and will put in place control measures to mitigate the risk of hydrocarbon or oil spills during the operational phase of the windfarm. Any vehicles utilised during the operational phase will be maintained on a weekly basis and checked daily to ensure any damage or leakages are corrected.	
Chapter 8 – Hydrology and Hydrogeology		
8.1	A Construction Environmental Management Plan (CEMP) was developed for the project to ensure adequate protection of the water environment. In addition, mitigation measures for the protection of the aquatic environment are detailed in the Surface Water Management Plan, Appendix 8.4 of the EIAR. The implementation of the Surface Water Management Plan will be overseen by the appointed Site Ecologist and the Project Manager and will be regularly audited throughout the construction phase. The Project Manager will be required to stop works on site, if he/she is of the opinion that a mitigation measure or corrective action is not being appropriately or effectively implemented.	Construction Phase

8.2	To minimise any impact on the underlying subsurface strata from material spillages, all oils and solvents used during construction will be stored within specially constructed dedicated bunded areas. Refueling of construction vehicles and the addition of hydraulic oils or lubricants to vehicles will take place in a designated area of the site, away from surface water gullies or drains. Spill kits and hydrocarbon absorbent packs will be stored in this area and operators will be fully trained in the use of this equipment. All construction waste will be sorted and stored in on-site skips, prior to removal by a licensed waste management contractor.	
8.3	Concrete is required for the construction of the turbine bases and foundations. Wash out of the main concrete bottle will not be permitted on site; wash out is restricted only to chute wash out. Wash down and washout of the concrete transporting vehicles will take place at an appropriate facility offsite i.e. at the premises of the concrete supplier. The best management practice objectives for concrete chute washout are to collect and retain all the concrete washout water and solids in leak proof containers or impermeable lined wash out pits, so that the wash material does not reach the soil surface and then migrate to surface waters or into the ground water. The collected concrete washout water and solids will be emptied on a regular basis.	
8.4	Fuels and chemicals will be stored within bunded areas as appropriate to guard against potential accidental spills or leakages. The bund area will have a volume of at least 110 % of the volume of such materials stored. No refueling will take place within 50 m of any watercourse.	
8.5	It is proposed that during the ground clearance of the proposed development water control measures will be implemented by the contractor to limit the volume of water that requires treatment. The contract documents and works requirements will specify the necessity for the contractor to take all precautions needed to prevent sedimentation of water channels. Contractors will be required to specify temporary sediment control measures (i.e. grit traps or similar) to be employed along with water attenuation during construction. Runoff from the surface	

	water attenuation lagoons will be maintained at greenfield runoff rates. Interceptor cut-off drains around the borrow pits will be provided to divert overland flows and prevent these flows from entering the borrow pits.	
8.6	Erosion and Sediment Control measures will be implemented at the site. All stockpiled material will be side cast, battered back and profiled to reduce the rainfall erosion potential. Traffic on site will be kept to a minimum. No haul roads will be used other than the proposed site tracks. Where haul roads pass close to watercourses, silt fencing will be used to protect the streams.	
8.7	It is proposed to install culverts anywhere the proposed road layout intersects a stream or main drain. Culverts are to be of a size adequate to carry expected peak flows. Culverts will be installed to conform, wherever possible, to the natural slope and alignment of the stream or drainage line. Where required, culverts will be buried at an appropriate depth below the channel bed and the original bed material placed in the bottom of the culvert. Embedded culverts should be buried to a depth of 0.3m or 20% of their height (whichever is greatest) below the bed.	
8.8	No instream works shall be carried out without the written approval of Inland Fisheries Ireland (IFI). IFI will be given sufficient notice before pre-approved in-stream works commence. There will be no discharge of suspended solids or any other deleterious matter to watercourses. Water crossings are to be constructed in accordance with the requirements of the Office of Public Works (OPW) Section 50 Consent requirements and in accordance with the CEMP. Cement and raw concrete will not be spilled into watercourses. Where practicable, crossings should be adequately elevated with low approaches such that water drains away from the crossing point. Earth embankments constructed for bridge approaches must be protected against erosion e.g. by re-vegetation or rock surfacing etc.	

8.9	Any vehicles utilised during the operational phase will be maintained on a weekly basis and checked daily to ensure any damage or leakages are corrected.	Operational Phase
8.10	Within the selected substation, all fuel will be stored in bunded areas. The bund capacity will be sufficient to accommodate 110% of the largest tank's maximum capacity or 25% of the total maximum capacities of all tanks, whichever is the greater. The exception to this being double walled tanks equipped with leak detection, which do not require additional retention. A hydrocarbon interceptor will be installed at the proposed substation site with regular inspection and maintenance, to ensure optimal performance.	
8.11	Given the requirement for sanitary facilities during occasional operation and maintenance works, wastewater effluent will be directed to an onsite holding tank, from where it will be tankered off site to a suitably licensed waste water treatment plant.	
Chapter 9 – Landscape and Visual		
9.1	There are no significant potential impacts identified for the proposed development that relate to the Landscape and Visual Impact assessment. As such, mitigation measures for the construction phase of the development are not proposed for the Landscape and Visual Impact assessment.	Construction Phase
9.2	Given the height of commercial wind turbines it is not generally feasible to screen them from view using on-site measures as would be the primary form of mitigation for many other types of development (where the screening and screened objects are of a more comparable scale). Instead, landscape and visual mitigation for wind farms must be incorporated into the early stage site selection and design phases. General consideration in this regard was given to the Department of Environment Heritage and Local Government's Wind Energy Development Guidelines (2006) and it is considered that the presented scheme for Derryadd Wind Farm reflects the design guidance in respect of the 'Flat Peatland' landscape type.	Operational Phase

9.3	Whilst the required turbine separation distance to nearest dwellings is currently 500m in accordance with the Wind Energy Development Guidelines (2006), in this instance there are no turbines within 750m of the nearest dwelling. The minimum 750m setback distance for the proposed wind farm reflects the Preferred Draft Approach to the Review of the Wind Energy Development Guidelines as announced by Government in June 2017.	
9.4	A buffer distance of 2km to nearest turbines was also applied to settlements (towns and villages) in the area to ensure that the proposed wind farm would not be a dominant backdrop to urban views and street scenes.	
Chapter 10 – Material Assets – Shadow Flicker		
10.1	There are no significant potential impacts identified for the proposed development that relate to the Shadow Flicker assessment. As such, mitigation measures for the construction phase of the development are not proposed for the Shadow Flicker assessment.	Construction Phase
10.2	The shadow flicker modelling predicts a worst case 'bare earth' impact. If existing screening reduces the impact below acceptable levels then no further mitigation will be required.	Operational Phase
10.3	If existing screening is not sufficient to reduce shadow flicker to acceptable levels (either the existing levels outlined in the Wind Energy Development Guidelines (2006) or Guidelines finalised during the consenting process) then additional screening measures will be proposed. Through interaction with the individual sensitive receptors, the incidence and level of shadow flicker at the specific location will be verified. Once verified, a number of measures will be proposed to the property owner such as installation of blinds/curtains in the affected room(s), planting of new screening at identified locations within the curtilage of the property and any other site-specific measures that might be agreeable with the affected party. Once the agreed measures are implemented, the effectiveness of the measures will be monitored over a period of months to establish the reduction in impact. The costs of the agreed mitigation measures will be borne by the developer. If the proposed measures are not	

	agreeable, or the implemented measures are not effective in reducing the incidence and duration of shadow flicker to acceptable levels, then a turbine(s) shutdown scheme will be developed and implemented.	
Chapter 11 – Material Assets – Telecommunications, Aviation and EMF		
11.1	There are no significant potential impacts identified for the proposed development that relate to the Telecommunications, Aviation and EMF assessment. As such, mitigation measures for the construction phase of the development are not appropriate for the Material Assets -Telecommunications, Aviation and EMF assessment.	Construction Phase
11.2	Communications: Until the possibility of interference is established, no mitigation measures are proposed. Typical mitigation measures for the protection of microwave radio circuits once interference has been found involve rerouting the circuit around the interference source using possible alternative sites to avoid the turbine.	Operational Phase
11.3	Television and Wireless Broadband: It is possible that a limited number of houses in the vicinity of the proposed wind farm could require some remedial measures in relation to television reception. In practice, such measures are not difficult to implement and, if necessary, will be undertaken by the developer in conjunction with a suitably acceptable broadcast integration contractor and RTé. A similar approach will be adopted with a wireless broadband operator.	
11.4	Television and Wireless Broadband: If the development is consented, then the developer will interact with RTENL Ltd (trading as "2rn") in respect to a protocol agreement for television reception protection. This protocol will require that the developer accept responsibility for any required remediation works to the RTE network as a result of the development.	
11.5	Aviation: The Irish Aviation Authority (IAA) state that, should planning permission be granted, the IAA will require an agreed scheme of aviation obstacle warning lighting, notification at least 30 days prior to the	

	commencement of the development and as-built coordinates of the completed development for charting purposes. The proposed development will have no significant negative effect on the local environment in terms of aviation.	
Chapter 12 – Air Quality and Climate		
12.1	Air Quality: Potential effects arising from dust and exhaust emissions will be minimised through the provision of mitigation measures that will be incorporated into the Construction Environmental Management Plan (CEMP). These will include: • Minimisation of extent of working areas; • Stockpiling of excavated materials will be limited to the volumes required to practically meet the construction schedule; • Drop heights of excavated materials into haulage vehicles will be minimised to a practicable level; • Daily inspections by site personnel to identify potential sources of dust generation along with implementation measures to remove causes where found; • Provision of a dust suppression measures (e.g. sweeps/covers/water bowsers) will be used on stockpiles and the road surface (Materials coming to site will only use specified haul routes) during periods of extended dry weather; • Onsite borrow pits are being used where possible to minimise quantities being brought to site; • Vehicles and plant will be routinely serviced to minimise the exhaust emissions during construction; and • Vehicles will not be left running unnecessarily and low emission fuels will be used where possible.	Construction Phase

12.2	Climate: During the construction phase of the proposed development, all contractors will ensure that machinery used on site is properly maintained and is switched off when not in use to avoid unnecessary exhaust emissions from construction traffic.	
12.3	Air Quality: No significant negative effects to Air Quality are expected during the operational phase of the development. Therefore, no mitigation measures are required in respect of Air Quality.	Operational Phase
12.4	Climate: During the operational phase of the proposed development, all contractors will ensure that machinery used on site is properly maintained and is switched off when not in use to avoid unnecessary exhaust emissions from operational traffic.	
Chapter 13 – Noise and Vibration		
13.1	The contract documents shall specify that the Contractor undertaking the construction of the works will be obliged to take specific noise abatement measures when deemed necessary to comply with the recommendations of BS 5228-1:2009+A1:2014 *Code of practice for noise and vibration control on construction and open sites – Noise*. It is proposed that various practices be adopted during construction as required, including the following: • limiting the hours during which site activities likely to create high levels of noise or vibration are permitted; • establishing channels of communication between the contractor/developer, Local Authority and residents; • appointing a site representative responsible for matters relating to noise and vibration; • monitoring typical levels of noise and vibration during critical periods and at sensitive locations; and • keeping the surface of the site access roads even to mitigate the potential for vibration from lorries.	Construction Phase

	Furthermore, a variety of practicable noise control measures will be employed (including for rock breaking that may be required at the borrow pit locations). These include: • selection of plant with low inherent potential for generation of noise and/ or vibration; • Fit suitably designed muffler or sound reduction equipment to the rock breaking tool to reduce noise without impairing machine efficiency; • Enclose breaker or rock drill in portable or fixed acoustic enclosure with suitable ventilation; and • placing of noisy / vibratory plant as far away from sensitive properties as permitted by site constraints.	
13.2	Potential impacts from air overpressure will be managed by scheduling blast events during favourable weather conditions. Further guidance will be obtained from the recommendations contained within BS 5228: Part 1 and the *European Communities (Construction Plant and Equipment) (Permissible Noise Levels) Regulations 1988* in relation to blasting operations. Additional methods used to minimise effects may consist of some or all the following: • Restriction of hours within which blasting can be conducted. • A publicity campaign undertaken before any work and blasting starts (e.g. 48 hours written notification). • The firing of blasts at similar times to reduce the 'startle' effect. • On-going circulars informing people of the progress of the works. • The implementation of an onsite documented complaints procedure. • The use of independent monitoring by external bodies for verification of results. • Trial blasts in less sensitive areas to assist in blast designs and identify potential zones of influence. • Ensuring appropriate burden to avoid over or under confinement of the charge.	

	• Accurate setting out and drilling, appropriate charging and stemming.	
13.3	It is recommended that vibration from construction activities be limited to the values set out in Chapter 13 of the EIAR. Where there is existing damage these limits may need to be reduced by up to 50%.	
13.4	With regards to piling it is considered that, based on the large distances between locations where piling will take place and the nearest NSL's, no significant impact will be experienced. Therefore, no mitigation measures are proposed.	
13.5	There are no locations highlighted in this document where the proposed development in combination with the existing Sliabh Bawn wind farm exceeds the adopted day or night time noise criteria and, therefore, no mitigation measures are required.	Operational Phase
13.6	If alternative turbine technologies are considered for the site an updated noise assessment will be prepared to confirm that the noise emissions associated with them satisfy the noise criteria curves outlined in this assessment. If necessary, suitable curtailment strategies will be designed and implemented for alternative technologies to ensure compliance with the relevant noise criteria curves, should detailed assessment conclude that this is necessary.	
13.7	In the unlikely event that an issue with low frequency noise is associated with the proposed development, it is recommended that an appropriate detailed investigation be undertaken. Due consideration should be given to guidance on conducting such an investigation which is outlined in *Appendix VI* of the EPA document entitled *Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4)* (EPA, 2016).	
13.8	In the unlikely event that an issue of Amplitude Modulation (AM) is associated with the proposed development, an appropriate investigation shall be undertaken in accordance with the guidance outlined in the Institute of	

	Acoustics (IoA) Noise working Group (Wind Turbine Noise) Amplitude Modulation Working Group (AMWG) namely, *A Method for Rating Amplitude Modulation in Wind Turbine Noise* (August 2016) or subsequent revisions.	
Chapter 14 - Traffic and Transport		
14.1	The range of mitigation measures for the construction phase of the proposed development will include a detailed Traffic Management Plan (TMP) which will be finalised and agreed with the relevant roads authorities and An Garda Síochána prior to construction works commencing on site. The detailed TMP will include the following: • Traffic Management Coordinator – a competent Traffic Management Co-ordinator will be appointed for the duration of the project and this person will be the main point of contact for all matters relating to traffic management. • Delivery Programme – a programme of deliveries will be submitted to Longford County Council in advance of the delivery of the turbine components to site. • Information to locals – Local residents in the area will be informed of any upcoming traffic related matters e.g. temporary lane/road closures (if required) or any night deliveries of turbine components, via letter drops and posters in public places. Information will include the contact details of the Contract Project Co-ordinator, who will be the main point of contact for all queries from the public or local authority during normal working hours. An "out of hours" emergency number will also be provided. • A Pre- and Post- Construction Condition Survey – A pre-condition survey of roads associated with the Proposed Development will be carried out prior to construction commencement to record the condition of the road. A post construction survey will be carried out after works are completed. The timing of these surveys will be agreed with the local authority.	Construction Phase

	• Liaison with the relevant local authority - Liaison with the relevant local authority including the roads sections of local authorities that the delivery route traverses and An Garda Síochána, during the delivery phase of the large turbine vehicles, when an escort for all convoys will be required. • Implementation of temporary alterations to road network at critical junctions – At locations where required highlighted in Chapter 14, Section 14.5.4. • Identification of delivery routes – These routes will be agreed and adhered to by all contractors. • Travel plan for construction workers – While the assessment above has assumed the worst case that construction workers will drive to the site, the construction company will be required to provide a travel plan for construction staff, which will include the identification of routes to / from the site and identification of an area for parking. • Temporary traffic signs – As part of the traffic management measures temporary traffic signs will be put in place at all key junctions, including the access junctions on the N63, R392, R398, L1136 and L1154. All measures will be in accordance with the "Traffic Signs Manual, Section 8 – Temporary Traffic Measures and Signs for Road Works" (DoT now DoTT&S) and "Guidance for the Control and Management of Traffic at Roadworks" (DoTT&S). A member of construction staff (flagman) will be present at all junctions during peak delivery times (with the exception of the L1154. • Delivery times of large turbine components -The management plan will include the option to deliver the large wind turbine plant components at night in order to minimise disruption to general traffic during the construction stage.	

	• Additional measures - Various additional measures will be put in place in order to minimise the effects of the development traffic on the surrounding road network including wheel washing facilities on site and sweeping / cleaning of local roads as required. • Re-instatement works - All road surfaces and boundaries will be re-instated to pre-development condition, as agreed with the local authority engineers. • Road Opening Licence – Roads works associated with the grid connection cabling will be undertaken in line with the requirements of a road opening licence as agreed with the relevant County Council. • Trench Reinstatement - Trenches on public roads, once backfilled, will be temporarily reinstated to the satisfaction of the roads authority. Following temporary reinstatement of trenches sections of public roads along which the cable route travels will receive a surface overlay subject to agreement with the roads authority.	
14.2	Due to the very low volumes of traffic forecast to be generated during the operational stage of the development, no mitigation measures are required. It is however proposed to monitor the situation on the ground by means of a traffic survey, as set out in Chapter 14, Section 14.6.3.	Operational Phase
Chapter 15 – Archaeology, Architectural and Cultural Heritage		
15.1	Some parts of the bog are overgrown preventing a full assessment (section 15.3.13). The National Monuments Service, Department of Culture, Heritage and the Gaeltacht, requires these areas to be cleared. Pre-construction, the clearance of overgrown areas is to be monitored by an archaeologist, under licence as issued by the minister (DCHG) under section 26 of the National Monuments Acts (1994-2014). In the event of archaeological features, finds and/or deposits being encountered during the monitoring, all relevant authorities should be notified immediately. Preservation in-situ or preservation by record (excavation) may be required.	Construction Phase

15.2	All ground disturbance associated with the construction of the proposed development will be monitored by a suitably qualified archaeologist working under licence as issued by the minister (DCHG) under section 26 of the National Monuments Acts (1994-2014).	
15.3	In the event of archaeological features, finds and/or deposits been encountered during the monitoring, all relevant authorities should be notified immediately. Preservation in-situ or preservation by record (excavation) may be required.	
15.4	It is not possible to mitigate against potential negative effects on setting arising during construction of the proposed development. Therefore, no mitigation measures are proposed.	
15.5	It is not possible to mitigate against potential negative effects on setting arising during the operational phase of the proposed development. Therefore, no mitigation measures are proposed.	Operational Phase

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