Environmental Impact Assessment Report

Volume 2 of 3 – Main Report

For

LACKAN WIND FARM

INISHCRONE, COUNTY SLIGO

Prepared for:
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PREAMLE

Lackan Wind Energy Ltd (LWEL) intends to apply for planning permission to extend the lifespan of the existing Lackan Wind Farm at Kilglass, Inishcrone County Sligo. On 28 October 2003 An Bord Pleanala upheld Sligo County Council's decision to grant planning permission for the wind farm – planning numbers PL 02/816 and PL 21.203388 refer. Condition 2 limits the lifespan of the permission to 20 years from the date of the order. Condition 2 states:

> '*This permission is for a period of twenty years from the date of this order. The wind turbines and related ancillary structures shall then be removed unless, prior to the end of the period, planning permission shall have been granted for their retention for a further period.*
>
> ***Reason:*** *To enable the impact of the development to be re-assessed, having regard to changes in technology and design during the period of twenty years*'.

Construction of the wind farm commended in September 2006, and it was operational in March 2007. The wording of the planning permission has reduced the permitted lifespan of the wind farm to approximately 16½ years, placing it at a commercial disadvantage with other wind farms. Conditions defining the lifespan of wind farms are now typically 25 or 30 years from the date of commissioning. This takes account of the time needed from granting permission to constructing and commissioning wind farms; securing financing, procuring turbines; securing a grid connection, tendering construction, and the construction stage. The purpose of this application is to extend the lifespan of the wind farm by 12 years to bring it into line with recent permissions granted to similar infrastructure.

Government policy sets out ambitious targets for increasing renewable energy generation capacity (70% electricity generation from renewables by 2030) in parallel with a trajectory towards net zero carbon emissions by 2050. Wind energy is identified as one of four areas of renewable energy potential, along with solar, biomass and wave energy, to achieve these targets. Extending the lifespan of this existing wind farm will contribute to these targets.

The installed capacity of the Lackan Wind Farm is 6MW (3 No. turbines with 2MW capacity each). Sligo County Council has requested that an environmental impact assessment be conducted for this application. As the wind farm is already constructed and operational, many of the impacts normally associated with wind farm construction are not relevant, e.g., transport and construction impacts. The impacts associated with the wind farm are well defined and measured, e.g., noise emissions from the wind farm. The EIA has therefore focused on these impacts and screened out many impacts typically addressed in wind farm EIA's.

Irish Government policy supports an increase in the capacity of electricity generation from renewable energy. EU Directive 2009/28[1] (June 2009) promotes the use of energy from renewable sources. Ireland is also obliged under the Kyoto Protocol to limit greenhouse gas emissions[2], and wind energy represents one of the most immediate options for doing this. This is recognised in the current County Sligo Development Plan (CDP). More recently, the Programme for Government, 2020[3], sets our society on a trajectory towards net zero emissions by 2050, with a 7% reduction average in emissions per annum. It commits us to the rapid decarbonization of the energy sector, to deliver at least 70% renewable electricity by 2030.

Ireland has a huge potential energy resource in wind power. Strong Atlantic frontal systems flowing across the country provide Ireland with enough wind power to potentially supply 19 times Ireland's electricity requirements from onshore resources alone.

Ireland currently depends largely on fossil fuels for its energy needs, accounting for 75.9% of 2019 total primary energy requirements (TPER) (*Energy in Ireland*, SEAI December 2021[4]). Energy trends observed in 2020 are significantly influenced by the economic downturn resulting from the Covid response. The share of TPER and usage trends for each of the energy sources is summarised in Table 0-1 (source SEAI[4]).

Table 0-1: Growth Rates, Quantities & Share in Final Consumption of Energy

Fuel Type	2020		2005		2019 - 2020		2015 - 2020		2005 - 2020	
	Quantity (ktoe)	Share (%)	Quantity (ktoe)	Share (%)	Absolute change (%)	Overall change (%)	Absolute change (%)	Overall change (%)	Absolute change (%)	Overall change (%)
Oil	5,825	52	8,196	65	-1,197	-17.0	-10.1	-2.1	-28.9	-2.3
Gas	1,960	17	1,369	11	-13	-0.7	14.3	2.7	43.2	2.4
Coal	272	2	484	4	6	2.2	-23.1	-5.1	-43.9	-3.8
Peat	189	2	274	2	6	3.2	-6.0	-1.2	-30.9	-2.4
Fossil fuels	**8247**	**73**	**10,324**	**82**	**-1,198**	**-12.7**	**-5.8**	**-1.2**	**-20.1**	**-1.5**
Waste Non-Renewable	54	0	0	0	-3	-5.4	21.9	4.0	---	---
Electricity	2,464	22	2,094	17	19	0.8	11.1	2.1	17.6	1.1
Renewables	482	4	188	1	-8	-1.6	20.2	3.7	156.0	6.5
Total	**11,246**	**100**	**12,606**	**100**	**-1,190**	**-9.6**	**-1.5**	**-0.3**	**-10.8**	**-0.8**

Notes:

1. ktoe – kilo tonnes of oil equivalent

The following are the main trends in the national fuel share:

- The public health measures taken to combat the COVID-19 pandemic had far-reaching impacts on all aspects of society during 2020, including on our energy use and resulting CO_2 emissions.
- Total energy consumption fell by 8.7% against a backdrop of a 4.2% contraction of the economy.
- Practically all of the reduction in energy use occurred in the transport sector because of reduced mobility during the COVID-19 pandemic.
- Oil use decreased by 16.5% - the largest annual reduction observed to date - largely due to reduced transport energy use.
- Ireland did not meet its EU 2020 overall renewable energy target. The overall share of renewable energy was 13.5%, compared to the target of 16%.
- Ireland succeeded against its EU 2020 renewable energy target for transport (10.2% vs. 10%), and just missed its renewable energy target for electricity (39.1% vs. 40%).
- Ireland achieved just half its 2020 renewable energy target for heating and cooling (6.3% vs. 12%).
- Energy from renewable sources grew by 8.9% in 2020.
- Peat used for electricity generation fell by 51%.
- 42% of all electricity generated in 2020 came from renewable sources.
- 86% of all renewable electricity came from wind, with the remaining 14% evenly split across hydroelectricity and bioenergy sources.
- Ireland had a total installed wind capacity of 4.3GW at the end of 2020 - an increase of 180 MW in 2019.

Renewable contributions to electricity generation were targeted to increase to 40% by 2020, with wind energy expected to represent the majority of this generating capacity; renewables accounted for 39.1% of gross electricity consumption in 2020, just falling shy of the target. As of March 2022, there was ~4,332MW of installed capacity of wind in Ireland, capable of producing ~11,166GWhr (gigawatt hours) of electricity per annum – 2,074MW connected by Eirgrid (TSO-connected)[5] and 2,258MW connected by ESB (DSO-connected)[6].

The Irish energy industry will derive the following benefits from the development of wind energy:

- Security of energy supply.
- Reduced reliance on fuel imports.

- Reduced payments for energy imports.
- Increased investment.
- Less pollution with a reduction in greenhouse gas emissions.

The site, which is the subject of this environmental impact assessment (EIA), is in the townland of Lackan, Kilglass, approximately 3.5km to the northeast of Inishcrone. The site is suitable for a wind farm development due to:

- Its suitability with regard to good wind speeds. Data published in the SEAI wind speed atlas of Ireland indicates mean wind speeds between approximately 8.0m/sec across the site at 75m height above ground. The on-site measurements and generation to date confirms these modelled values.
- Grid connection. The wind farm is already connected the national grid with combination of 20kV underground cabling and overhead powerline. The grid connection extends from the on-site control room to the Inishcrone 38kV ESB substation.
- Good access to the site. The wind farm is accessed from regional road R297 via a local road.
- Minimal likely impacts on the surrounding residential amenity. The nearest occupied third-party house is located ~535m from the nearest turbine – greater than the four times the tip height offset (i.e., 400m). There are 40 occupied dwellings within 1km of the turbines. As there are no third-party houses within 500m of the turbines potential impacts associated with noise and shadow flicker are largely avoided as outlined in the Wind Farm Guidelines (June 2006[7] and December 2019[8]). Noise measurements undertaken while the turbines are running confirms this.
- Minimal likely impacts on the surrounding environment:
    - The site is in low-lying wet grassland. The ecology assessment indicates that no significant impact on flora, fauna or the aquatic environment has occurred. The Appropriate Assessment Screening Report indicates no impact on the designated sites in the wider area.
    - No earthworks are required. As such there is no potential impact on archaeology. No previously unrecord archaeological features were discovered during monitoring of earthworks in 2006 and 2007.
    - The coastal plain landscape demonstrates a capacity to absorb the small-scale wind farm. The wind farm is now part of the landscape and its continued operation for an additional 12 years will not negatively affect landscape or visual receptors.

The Applicant

Lackan Wind Energy Ltd is a locally owned company. It developed and is operating the Lackan Wind Farm. Its directors continue to develop renewable energy projects in Counties Sligo, Mayo and Donegal. Lackan Wind Energy Ltd is very involved with the local community, supporting a range of clubs, events and activities across a wide spectrum of interests.

The Consultants

Keohane Geological & Environmental Consultancy

Keohane Geological & Environmental Consultancy (KGEC) (Ivy House, Clash, Carrigrohane) is a Cork-based consultancy specialising in geological and environmental sciences. Over the past 18 years, KGEC has prepared planning applications and/or EIARs for a number of wind farm developments in counties Mayo, Cork, Donegal, Sligo and Roscommon, including the EIARs for the Black Lough Wind Farm and Carrowleagh Wind Farm.

JKW Environmental
JKW Environmental carried out the ecological assessment. The survey work was completed by Jamie Wood, B.Sc., M.Sc., C.Env, and Katie Neary BSc. Jamie is the Owner of JKW Environmental and is the lead Environmental Scientist / Ecologist leading a team of 4 employees. He is a qualified and experienced ecologist with over 20 years field work experience. Jamie has worked on numerous large scale infrastructural projects across the country and has the range of skills and experience to provide a robust environmental and ecological appraisal of a project / site. Jamie is a Chartered Environmentalist and entitled to use the C.Env postnominal. He has extensive experience in working as an Ecological Clerk of Works and in the design, completion and assessment of a broad range of ecological surveys including, Bird Surveys, Bat Surveys, Freshwater Monitoring, Terrestrial Mammal Surveys, Habitat assessment, Invasive species assessment, management and control services, Japanese Knotweed treatment and control. Katie holds a Bachelor of Science degree in Environmental Science and has been working for JKW for the past 3 years as a field ecologist

AV Acoustics
Iain Mac Phee of AV Acoustics (Ballymoneen, Inishcrone, Co Sligo) undertook the noise impact assessment for the proposed development. Iain holds the Institute of Acoustics Diploma in Acoustics and Noise Control, and is an active member of the Irish branch of the Institute. Iain has been working in the fields of nose measurement and control for about 30 years. In the last 10 years, Iain has undertaken noise impact assessments for developers for a wide range of projects, throughout Ireland, and previously spent 20 years working in the UK on machinery noise measurement and control. In addition, he has undertaken environmental noise measurements for both developers and statutory bodies, to ensure compliance, or otherwise, with conditions pertaining to noise associated with planning permissions or licensing, typically wind farms, quarries, licensed premises and factories.

EIAR Structure

Annex I and Annex II of Directive 2011/92/EU (as amended by Directive 2014/52/EU[9]) lists projects and activities that require assessment. Annex II refers to wind farms but doesn't give thresholds – these are to be set by the Member States. Statutory Instrument No. 296 of 2018[10] gives effect to Directive 2011/92/EU (as amended by Directive 2014/52/EU) on the assessment of the effects of certain public and private projects on the environment. An EIA is required for energy developments which fall within category 3(i) of the Fifth Schedule Part II of the Planning & Development Regulations 2001 (S.I. 600 of 2001).

> '*Installations for the harnessing of wind power for energy production (wind farms) with more than 5 turbines or having a total output of greater than 5 megawatts*'.

The Lackan Wind Farm consists of 3 No. turbines with a total installed capacity of 6MW. Sligo County Council has requested that an EIA be carried out for the project to comply with the Board's condition No.2, to re-assess the impact of the development having regard to changes in technology and design since the grant of planning permission.

The EIAR has been prepared using the grouped format structure as recommended in the EPA's '*Guidelines on the Information to be contained in Environmental Impact Statements'* - 2002[11], '*Guidelines on the Information to be contained in Environmental Impact Assessment Reports'* – 2022[12], and '*Advice Notes on Current Practice (in the Preparation of Environmental Impact Statements)'*[13].

Using the grouped format structure, the EIAR examines each topic as a separate section. Each specialist section refers to the relevant specialist topic using the following general structure:

- The existing / baseline environment.
- Direct and indirect impact assessment of the development, which takes account of the other nearby permitted and proposed developments (potential cumulative impacts).

– Impact mitigation (avoidance, reductive and/or mitigation measures), with an assessment of predicted residual impacts.

The EIAR is submitted in three volumes:

- Volume 1: Non-Technical Summary
- Volume 2: Main Report
- Volume 3: Appendices

The non-technical summary provides an overview of the work presented in the main body of the EIAR. It is a shortened and simplified version of Volume 2 but contains all the key information presented in a non-technical format. Scoping of the EIAR was developed from the Sixth Schedule of the Planning & Development Regulations 2001, EPA Guidelines and in consultation with the relevant organisations. The main body of the EIAR describes the proposed development, and examines the impact of the proposed development on the following aspects of the environment:

- Population & Human Health
- Biodiversity
- Land
- Soil
- Water
- Air & Climate
- Cultural Heritage
- Material assets
- Landscape
- Interaction of the Foregoing

For each topic, a screening process was undertaken to identify those topics that are important / relevant to the development – refer to Section 1.6. As discussed in Section 1.6, the aspects of the environment were prioritised or screened out. For each topic discussed, the potential impacts (direct and indirect) and mitigations are discussed. Cumulative impacts associated with nearby developments are also assessed, where appropriate.

1 INTRODUCTION

1.1 Global, EU and National Policy

Wind farm development and its inherent benefits are supported by global, national and local policy. Local policy is discussed in Section 1.2. The historic policies and strategy documents leading to, and underpinning, the current framework in which the proposal should be considered include:

- Kyoto Protocol, 1997 – sets targets for the reduction in the emission of greenhouse gases.
- EU White Paper on Renewable Sources of Energy[14], November 1997- sets a strategy to supply 12% of EU energy requirements from renewable sources by 2010.
- Campaign for Take Off[15], April 1999 - sets out the action plan for the implementation of the White Paper.
- Green Paper on Sustainable Energy[16], 1999 – sets an initial target for renewable energy capacity in Ireland at 500MW by 2005. Further targets were set up to 2010.
- Strategy for Intensifying Wind Energy Deployment[17], 2000. Arising from one of the recommendations of the Green Paper, the Renewable Energy Strategy Group was established. Their report presents recommendations for the future growth of the wind energy industry in Ireland. This was a key report for the industry.
- National Climate Change Strategy[18], 2000 – relates the growth of renewable energy capacity with achievement of Ireland's obligations under the Kyoto Protocol.
- Consequent to the EU White Paper, Directive 2001/71/EC[19] addresses the obligation of Member States to establish a programme to increase the gross consumption of electricity from renewable energy sources. This directive sets out indicative targets for each Member State and discusses support schemes. The target set for Ireland was to increase green electricity from 3.6% (1997 figure) to 13.2% by 2010.
- Green Paper – Towards a Sustainable Energy Future for Ireland[20], October 2006. This paper sets a new target of 15% by 2010 of electricity consumption to be met by renewable energy, with a further target of 30% penetration by 2020.
- White Paper - Delivering a Sustainable Energy Future for Ireland, March 2007[21].
- National Development Plan 2007 – 2013[22], January 2007. With respect to the energy sector, this sets out programmes to improve the electricity network, provision of a second north-south inter-connector and investment in the renewable energy sector, including the large-scale deployment of wind energy.
- Carbon Budget - 2009[23]. The target set by Government (carbon budget 2009) is 40% of electricity needs to come from renewable sources by 2020. This target increase is unpinned by the investment in the All-Island national electricity grid as outlined in the NDP 2007 – 2013.
- EU Directive 2009/28/EC[1] on the promotion of the use of energy from renewable sources. This Directive sets out targets for each Member State for the increase in the use of energy from renewable sources. For Ireland, the 2020 target is set at 16% (from a 2005 base of 3.1%) for the share of energy from renewable sources in gross final consumption of energy.
- Strategy for Renewable Energy 2012 – 2020[24], May 2012. This strategy document confirms the commitment of Government to support the renewable energy industry on environmental and economic grounds.
- Green Paper – Energy Policy in Ireland[25], May 2014. This is a consultation paper seeking input on six priority areas for the energy sector. There are no new targets as such.

More recent and current Government policies and strategies which outline targets for increased renewable energy deployment are:

- European Council – Climate and energy policy framework for 2030[26], October 2014. This sets out new targets for carbon emission reduction, new targets for renewable energy penetration, increased energy efficiency and installation of interconnector infrastructure.
- United Nations, 2015[27]. The Paris Agreement is a legally binding international treaty on climate change. It was adopted by 196 Parties at COP 21 in Paris, on 12 December 2015 and entered into force on 4 November 2016. Its goal is to limit global warming to well below 2ºC, preferably to 1.5ºC, compared to pre-industrial levels.
- The Climate Action and Low Carbon Development Act 2015. This placed national climate policy on a statutory footing for the first time in Ireland with the ultimate aim of pursuing the transition to a low carbon, climate resilient and environmentally sustainable economy by 2050. It provided for a National Mitigation Plan (NMP) to reduce greenhouse (GHG) emissions, a National Adaptation Framework (NAF) to respond to changes caused by climate change and Sectoral Adaptation Plans (SAPs). It also established the Climate Change Advisory Council (the Advisory Council), an independent advisory body tasked with assessing and advising on Ireland's transition towards a low carbon economy by 2050.
- Climate Action Plan 2019 – To Tackle Climate Breakdown[28], June 2019. This sets out the targets, strategy actions to reduce reliance on fossil fuels and reduce carbon emissions across all sectors. The consultation for the Climate Action Plan for 2021 was launched in March 2021.
- Interim Climate Actions 2021. Its purpose is to maintain a whole-of-government focus on implementation and continue to progress new climate actions while the Plan to reach 7% per annum reductions is developed.

The more important policies and strategy documents are discussed in detail in the following sections.

The Kyoto Protocol

The Kyoto Protocol was adopted in 1997 and came into effect in 2005. It is a legally binding agreement under which:

> '*industrialized countries will reduce their collective emissions of greenhouse gases by 5.2% compared to the year 1990 (but note that, compared to the emissions levels that would be expected by 2010 without the Protocol, this limitation represents a 29% cut). The goal is to lower overall emissions of six greenhouse gases - carbon dioxide, methane, nitrous oxide, sulphur hexafluoride, hydro fluorocarbons, and per fluorocarbons, averaged over the period of 2008-2012. National limitations range from 8% reductions for the European Union and some others to 7% for the US, 6% for Japan, 0% for Russia, and permitted increases of 8% for Australia and 10% for Iceland*.'

The Kyoto Protocol is the protocol relating to the United Nations Framework Convention on Climate Change (UNFCCC or FCCC), an international environmental treaty produced at the Earth Summit, held in Janeiro, Brazil, June 1992. The treaty is intended to achieve '*stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system*'.

The Kyoto Protocol establishes legally binding commitments for the reduction of four greenhouse gases and two groups of gases produced by "Annex I" (industrialized) nations, as well as general commitments for all member countries. Under Kyoto, industrialized countries agreed to reduce their collective GHG emissions by 5.2% compared to the year 1990.

Kyoto includes defined "flexible mechanisms" such as Emissions Trading, the Clean Development Mechanism and Joint Implementation to allow Annex I economies to meet their greenhouse gas (GHG) emission limitations.

Proponents also note that Kyoto is a first step as requirements to meet the UNFCCC will be modified until the objective is met, as required by UNFCCC Article 4.2(d).[8].

The European Climate Change Programme (ECCP) is the Europeans strategy to implement the Kyoto protocol. The European Union committed to reduce its annual GHG emissions to 8% below 1990 by the period 2008-2012. While each member state has implemented programmes to allow them to achieve the emission reduction targets, it is recognised that the three additional mechanisms provided by Kyoto must also be adhered to if the overall targets are to be met. These three mechanisms include clean development mechanism, joint implementation and emissions trading. Ireland's legal and regulatory framework allows for the use of these mechanisms.

The EU Emissions Trading Scheme (ETS) was implemented in January 2005. The initial phase of the scheme was only open to large companies such as energy producers and energy intensive industries. The scheme allowed such companies to trade in emissions of CO_2. The ETS currently covers 105 installations in Ireland and is administered by the Environmental Protection Agency.

In December 2012, the Doha Amendment to the Kyoto Protocol was adopted. The Doha Amendment established the second commitment period of the Kyoto Protocol. As of 14 May 2015, 31 counties ratified the amendment; 144 are needed for the amendment to come into force. Ireland has yet to submit its instrument of acceptance of the amendment to the United Nations Framework Convention on Climate Change.

Ireland National Climate Change Strategy 2007-2012

The National Climate Change Strategy 2007-2012 outlines the ways in which Ireland is going to meet its targets regarding greenhouse gas emissions. The Strategy represents a collective effort across all sectors to meet the targets set by the Kyoto Protocol. One of the principal measures to be undertaken regarding Energy Supply in the Strategy is that 15% of electricity to be generated from renewable sources by 2010 and 33% by 2020.

Ireland has agreed to limit its average annual emissions to no more than 13% above 1990 levels over the 5-year period from 2008 – 2012. The Strategy recognises that Ireland will have to increase its greenhouse gas emission reductions in the 2012 period; actions taken now will have to have consideration of the increased targets which will be set post 2012; the way which Ireland produces and uses energy will have to be radically altered and the levels of energy use for transport will have to be significantly reduced.

The production of electricity accounted for 96% of energy emissions in 2005 in Ireland while the energy sector accounted for 23% of all emissions in the country in 2005. The production of energy from renewable sources represents an effective method of decreasing emissions. In recognition of this the government has set ambitious targets for renewable sources in the production of energy such as 15% of the electricity consumed will be from renewable sources by 2010 and 33% by 2020. This will result in annual emissions savings of 1.47 Mt up to 2010.

Incentives such as the Renewable Electricity Feed-in-Tariff (REFIT) are in place to help Ireland achieve these targets. REFIT aims to more than double the contribution of renewable sources in electricity production from 5.2% in 2004 to 13.2% by 2010 by increasing the total capacity of renewable energy technologies built to 1,450MW. This additional capacity will require a capital investment in the region of €440 million by developers and a total investment by consumers in the region of €120 million over the fifteen-year life of the support programme. The new capacity will prevent the emission of over 1 million tonnes of polluting greenhouse gases annually.

REFIT differs from the previous "AER" support programme project as project developers are free to negotiate with any electricity suppliers in the liberalised electricity market. The purchase price is negotiated between the generator and supplier directly. The consumer interest is protected by imposing price caps beyond which compensation to suppliers will not be paid. Ireland has more than doubled the connected renewable generating capacity over the past two years. There is now ~4,332MW (as of March 2022) of wind capacity connected to the national grid. The current trend is for connection of ~300MW of wind generation per annum.

White Paper – Delivering a Sustainable Energy Future for Ireland

The White Paper - Delivering a Sustainable Energy Future for Ireland[22] supersedes the Green Paper – Towards a Sustainable Energy Future for Ireland which was published in October 2006. The White Paper is the result of a consultation process of the Green Paper. The White Paper sets out the Governments Energy Policy Framework 2007- 2020 to deliver sustainable energy future for Ireland. The White Paper identifies the Governments overriding policy objective as ensuring that energy is consistently available at competitive prices with minimal risk of supply disruption. Enhancing the diversity of fuels used for power generation is cited as a Strategic Goal for the country. Ensuring that Ireland can meet its energy requirements in a sustainable manner in the future is vital to the country meeting its Kyoto targets. Accelerating the growth of renewable energy sources is a strategic goal which is identified in the White Paper.

An investment of approximately €8.5 billion in energy over the 5-year period of the National Development Plan is expected. This investment in energy will come partly from the Exchequer, from the Energy Semi-State bodies and from other non-public sources.

During the consultation process on the Green Paper the growth in wind energy was broadly welcomed. However possible intermittency of the power supply was raised as an issue. It was agreed that further development of wind energy should take place and in order to ensure its efficiency that electricity storage capacity be developed along with dedicated back-up generators.

Section 3 of the White Paper outlines the Policy Framework regarding energy supply in Ireland. Currently over 90% of Irish Energy is imported. This reliance on imported energy sources and Ireland peripheral position in relation to Ireland has left Ireland in a vulnerable position in terms of energy disruption and imported price volatility.

It is estimated by Section 3.4 of the White Paper that by 2020 Ireland could rely on natural gas for 70% of its energy generation. In order to address this and the issues which accompany such reliance, the Government is committed to delivering substantial growth in the renewable energy sectors. A target of 33% of the energy consumption being derived from renewable sources has been set. Wind energy is set to play a pivotal role in achieving this target.

The White Paper also recognises that the expansion of the renewable energy industry will have the effect of creating additional employment opportunities. Currently the industry employs over 12,000 and this figure could grow in line with the expansion of the industry.

Strategy for Intensifying Wind Energy Deployment

The Renewable Energy Strategy Group was formed in November 1999 by the Minister of State at the Department of Public Enterprise. The group was formed to devise a strategy for the increased contribution of onshore wind energy to electricity generation. The Green Paper on Sustainable Energy announced that a target of 500MW of energy be produced by renewable sources, the majority of this energy will be produced by wind energy. The main aim of the Strategy to implement a support hierarchy to allow this target to be reached. The Renewable Energy Strategy Group recommended that an open market approach be taken to the provision of renewable energy and that project cap size be removed; this will ensure that the only constraints affecting the creation of renewable energy sources are commercial considerations and technical limitations.

The Group recommends a Plan led approach to wind farm provision and identifies the three main elements which require integration under this approach as appropriate location, adequate availability of the wind resource and accommodating electricity network infrastructure. The Strategy centres on a cohesive plan led approach to market mechanisms, grid upgrading and spatial planning.

The identification of suitable wind farm locations is the role of spatial planning. These locations are identified by the availability of wind and the strength of the electricity networks. The short-term strategy recommends that local authorities identify areas as 'preferred', 'open for consideration', 'strategic', and 'no-go' areas for wind energy development and that these should be included in the Development Plans. The strategy also recognises the need for large-scale developments to meet Government targets. Larger developments, such as the Shronagree Wind Farm will mean fewer grid connections.

Strategy for Renewable Energy: 2012 – 2020

In May 2012, the DCENR published the Government's Strategy for Renewable Energy 2012 – 2020. The document confirms that the development of renewable is at the heart of the Government's energy policy. The strategy states that:

> *The development of renewable energy is central to overall energy policy in Ireland. Renewable energy reduces dependence on fossil fuels, improves security of supply, and reduces greenhouse gas emissions creating environmental benefits while delivering green jobs to the economy, thus contributing to national competitiveness and the jobs and growth agenda.*

Five strategic goals are set out, namely:

Strategic Goal 1 -	Progressively more renewable electricity from onshore and offshore wind power for the domestic and export markets
Strategic Goal 2 -	A sustainable bioenergy sector supporting renewable heat, transport and power generation.
Strategic Goal 3 -	Green growth through research and development of renewable technologies including the preparation for market of ocean technologies.
Strategic Goal 4 -	Increase sustainable energy use in the Transport sector through biofuels and electrification.
Strategic Goal 5 -	An intelligent, robust and cost-efficient energy networks system.

To realise these strategic goals, some of the key actions to be taken in relation to the wind industry include:

1. *Support delivery of the 40% target for renewable electricity through the existing GATE processes. A further targeted Gate may be developed, if necessary, following a review of the take-up of Gate 3 offers. While developing a next phase plan led approach for additional onshore capacity in future.*
2. *Work to overcome the existing obstacles and delays in the GATE processes including the environmental and permitting and any emerging regulatory barriers.*
3. *Ensure the cost effective and timely delivery of investment in the key strategic transmission projects under Grid 25 by Eirgrid and in the distribution network by ESB Networks, so that on average at least 200MW of new renewable generation is being connected per annum to ensure we can deliver our 2020 target.*
4. *Take forward the Local Authority Renewable Energy Strategies template being developed by SEAI through working with and local authorities to assist in developing Local Authority Renewable Energy Strategies for renewable energy development commensurate with spatial planning and environmental needs.*

European Council – Climate and Energy Policy Framework for 2030

On 24 October 2014, the European Council published its new climate and energy policy framework for 2030. The most significant targets agreed include:

1. A reduction of at least 40% of greenhouse gas emissions by 2030.
2. At least 27% Renewable Energy, binding at EU level, by 2030. The current share of renewables in the energy mix across the European Union is 14%.

3. An increase of at least 27% in Energy Efficiency. This is a non-binding target and is to be reviewed in 2020.
4. Installation of 15% interconnection capacity by 2030. This is a non-binding target. It would require the installation of 15MW interconnector capacity (i.e. electricity import / export capacity) for every 100MW of generation capacity installed.

Paris Agreement
The Paris Agreement sets out a global framework to avoid climate change by limiting global warming to below 2°C and pursuing efforts to limit it to 1.5°C. It also aims to strengthen countries' ability to deal with the impacts of climate change and support them in their efforts.

The Paris Agreement is the first-ever universal, legally binding global climate change agreement, adopted at the Paris climate conference (COP21) in December 2015. The EU and its Member States are among the close to 190 Parties to the Paris Agreement. The EU formally ratified the agreement on 05 October 2016, thus enabling its entry into force on 04 November 2016. For the agreement to enter into force, at least 55 countries representing at least 55% of global emissions had to deposit their instruments of ratification.

As a contribution to the objectives of the agreement, countries have submitted comprehensive national climate action plans (nationally determined contributions, NDCs). These are not yet enough to reach the agreed temperature objectives, but the agreement traces the way to further action. Governments agreed to:

- Come together every 5 years to assess the collective progress towards the long-term goals and inform parties in updating and enhancing their NDCs.
- Report to each other and the public on how they are implementing climate action.
- Track progress towards their commitments under the Agreement through a robust transparency and accountability system.
- Strengthen societies' ability to deal with the impacts of climate change.
- Provide continued and enhanced international support for adaptation to developing countries.

The Katowice package adopted at the UN climate conference (COP24) in December 2018 contains common and detailed rules, procedures and guidelines that operationalise the Paris Agreement. It covers all key areas including transparency, finance, mitigation and adaptation, and provides flexibility to parties that need it in light of their capacities, while enabling them to implement and report on their commitments in a transparent, complete, comparable and consistent manner. It will also enable the parties to progressively enhance their contributions to tackling climate change, in order to meet the agreement's long-term goals.

The EU's initial NDCs under the Paris Agreement was the commitment to reduce greenhouse gas emissions by at least 40% by 2030 compared to 1990 levels. In December 2020, the EU submitted its updated and enhanced NDCs to reduce emissions by at least 55% by 2030 from 1990 levels, and information to facilitate clarity, transparency and understanding (ICTU) of the NDC. The EU and its Member States, acting jointly, are committed to a binding target of a net domestic reduction of at least 55% in greenhouse gas emissions by 2030 compared to 1990.

Climate Action Plan 2019
The 2019 Climate Action Plan sets out a detailed sectoral roadmap, which is designed to deliver a cumulative reduction in emissions, over the period 2021 to 2030. The sectors targeted are electricity generation, buildings, transport, agriculture, enterprise & services and waste & the circular economy. The plan outlined 183 actions across these sectors, with responsibilities and clear timelines for delivery mapped out. The actions were broken down into over 600 measures to achieve the actions.

In relation to electricity the plan includes:

- Increase reliance on renewables from 30% to 70% adding 12GW of renewable energy capacity (with peat and coal plants closing) with some of this delivered by private contracts.
- Put in place a coherent support scheme for micro-generation with a price for selling power to the grid.
- Open up opportunity for community participation in renewable generation as well as community gain arrangements.
- Streamline the consent system, the connection arrangements, and the funding supports for the new technologies on- and off-shore.

Targets in the other sectors that will have a direct significant impact on electricity includes:

- Transport: Accelerate the take up of EV cars and vans so that Ireland reaches 100% of all new cars and vans being EVs by 2030. This will enable achieving Ireland's target of 950,000 EVs on the road by 2030. This means approximately one third of all vehicles sold during the decade will be Battery Electric Vehicle (BEV) or Plug-in Hybrid Electric Vehicle (PHEV). This will result is a significant increase in demand for renewable electricity generation.

Interim Climate Actions 2021
This report sets out 250 actions spread across all the commercial and industrial sectors, including electricity generation, transport, public sector, forestry, marine, waste and agriculture. For each action, the steps necessary for its delivery are set out, along with the timescale and responsible parties and stakeholders. There are 22 actions detailed for the electricity sector. Those relating to onshore wind generation include:

- **Action 30**: Ensure that updated planning guidelines for onshore wind are published in 2021.
- **Action 31**: Review the policy position on the development of private networks/direct lines with a view to developing the legislative position in the context of the transposition of the Clean Energy Package.
- **Action 32**: Review the existing electricity transmission and distribution network tariff structures to assess what changes may be necessary to deliver equitable, cost reflective and transparent charges that facilitate investment in our low carbon transition and the new ways in which the network will be used in the future.
- **Action 33**: Transposition of Internal Market for Electricity Directive (EU) 2019/944.
- **Action 34**: Assess the network development required to integrate higher levels of RES-E and develop a high-level network development plan to (and beyond) 2030.
- **Action 35**: Deliver further Onshore Renewable Energy Support Scheme auctions.
- **Action 36**: Oversight of RESS Community Benefit Funds and community enabling framework.
- **Action 37**: Ensure that 15% of electricity demand is met by renewable sources contracted under Corporate Power Purchase Agreements.
- **Action 38**: Facilitate very high penetration of variable renewable electricity by 2030 (both System Non-Synchronous Penetration and average) through system services and market arrangements.

Additional actions are set out for the offshore wind industry.

1.2 Development Policy

There are a number of guidance documents, plans and strategy documents concerning wind farm development. These include the 'Sligo County Development Plan 2017-2023', '*Wind Farm Development - Guidelines for Planning Authorities*' Department of the Environment, Heritage & Local Government, June 2006[7], and '*Draft Revised Wind Energy Development Guidelines*' Department of the Housing, Planning & Local Government, December 2019[8].

1.2.1 County Development Plan - 2017

The Sligo County Development Plan 2017-2023[29] addresses the issue of wind farms in Chapter 11. The policies relevant to the proposed development are:

SP-EN-1 *Support the sustainable development, upgrading and maintenance of energy generation, transmission, storage and distribution infrastructure, to ensure the security of energy supply and provide for future needs, as well as protection of the landscape, natural, archaeological and built heritage, and residential amenity and subject to compliance with the Habitats Directive*.

SP-EN-2 *Facilitate the sustainable production of energy from renewable sources, energy conversion and capture in forms such as wind power, hydro-power, wave-generated energy, bioenergy, solar technology and the development of Waste to Energy/Combined Heat and Power schemes at appropriate locations and subject to compliance with the Habitats Directive*.

All such development proposals will be assessed for their potential impact on urban and rural communities, Natura 2000 sites, designated Sensitive Rural Landscapes, Visually Vulnerable Areas, Scenic Routes and scenic views, as well as in accordance with strict location, siting and design criteria.

SP-EN-5 *Collaborate with urban and rural communities in the development of community level energy efficiency and renewable energy projects, subject to visual, landscape, heritage, environmental and amenity considerations and subject to compliance with the Habitats Directive.*

SP-EN-7 *Protect significant landscapes from the visual intrusion of large-scale energy infrastructure*.

Section 13.9.2 of the CDP sets out the development standards for wind energy projects. It states:

'*The Planning Authority will have regard to the DoEHLG's Wind Energy Development Guidelines (June 2006) and any revised guidelines, when considering wind energy applications*.

The Guidelines outline the main criteria to be used in assessing development proposal. These criteria include:

- *environmental impact – effects on landscape, natural and archaeological heritage;*
- *seeking visual harmony and balance – choice of turbines, towers, colour and siting;*
- *keeping secondary structures to a minimum – buried on-site cabling, minimal fencing, transformers placed inside towers where possible;*
- *keeping access roads to a minimum – using established roads where possible and following natural contours if roads are necessary;*
- *managing the building site – removing waste, avoiding erosion, replanting the land*.

In assessing proposals for wind farms, the Council will require detailed information to Environmental Impact Assessment (EIA) standard. Assessment in accordance with government guidelines will have regard to visual impact (including the scarring effect of access roads), noise, electro-magnetic interference, ecological impact, safety (including aircraft safety and navigation) and land use implications.

Proposals will generally be discouraged in or close to pNHAs, cSACs, SPAs, designated Sensitive Rural Landscapes, Visually Vulnerable Areas, Scenic Routes, protected views, Zones of Archaeological Potential'.

The issues listed in the County Development Plan, where they relate to an operational wind farm, are addressed in the relevant chapters of this EIAR.

1.2.2 Department Guidelines

Local Authorities have been using the Department of the Environment, Heritage & Local Government Guidelines to assist in the consideration of planning applications for wind farms. These guidelines were published first in September 1996, were revised in 2004 (and issued as draft) and were finalised in June 2006.

The guidelines were initially prepared to facilitate planning authorities in dealing with the increased number of planning applications resulting from the ESB-approved offer of Power Purchase Agreements under the Alternative Energy Requirement, AER1. Under the rules of AER1, a ceiling of 15MW of generation capacity was set for any one project or developer. It is this ceiling, set by the AER1 competition that initially informed and influenced the scale of wind farm development in Ireland. It should be noted that the guidelines do not actually place any limit on wind farm size.

The guidelines act as the guiding principles for Planning Authorities when they are deciding planning applications for wind farms. The Guidelines offer advice on many aspects of wind farms such as the siting of turbines, impacts on the local environment and natural heritage and the effect which wind farms have on landscape / visual impact. The guidelines are not prescriptive in nature as they recognise that each location is different and should be treated as such.

In December 2013, the Department of Environment, Community and Local Government (DoECLA) published proposed revisions[30] to the 2006 Guidelines for public consultation. The consultation closed on 21 February 2014. The proposed revisions to the 2006 Guidelines relate to noise, proximity to dwellings and shadow flicker. The Department published the draft revised guidelines in December 2019[8].

1.2.3 Other Relevant Policy and Strategy Documents

The Climate Action and Low Carbon Development (Amendment) Bill 2021 will support Ireland's transition to Net Zero and achieve a climate neutral economy by no later than 2050. The Bill was published on 23 March 2021. It is working its way through the Houses of the Oireachtas. It will establish a legally binding framework with clear targets and commitments set in law, and ensure the necessary structures and processes are embedded on a statutory basis to ensure we achieve our national, EU and international climate goals and obligations in the near and long term. Some of the key components of the Bill include:

- Sets an objective of climate neutrality by 2050.
- Sets an interim target of a 51% reduction in GHG emissions by 2030 relative to a baseline of 2018.
- Provides a framework for the development of enabling plans and strategies to reach the 2030 and 2050 targets as follows:
    - Annual climate action plans.
    - Five-yearly long-term climate action strategies.
    - Five-yearly carbon budgets.
    - Sectoral emission ceilings.
    - National adaptation framework.
- Changes to the Climate Change Advisory Council including to its functions and membership.
- All local authorities must make individual local climate action plans.
- Climate Reporting by the Minister to a Joint Oireachtas Committee.

Achieving these ambitious targets will require a move away from traditional energy production from fossil fuel and an increasing uptake of renewable energy such as wind.

1.3 Need for the Development

Renewable energy is recognised as having a vital part to play in Ireland meeting its Climate Action targets for the reduction of greenhouse gas emissions and reaching a zero-carbon economy by 2050. The Irish Government implemented the Climate Action Plan to allow these targets to be met. Ireland has long been dependant on fossil fuels to produce energy. Ireland's peripheral location in Europe and its reliance on non-renewable sources of energy has left the country in a vulnerable position in terms of future energy provision and its costs.

Renewable energy sources are not only an opportunity for Ireland to reduce its greenhouse gas emissions and its reliance on foreign sources of energy but also an opportunity to create employment within the energy industry.

Wind energy is recognised as the renewable source of energy which is the fastest and most economical to put into operation. As such it is considered to be of vital importance in the short to medium term in Ireland's national policy regarding the production of green energy.

While the Arklow Bank offshore wind turbines contribute to the national grid (25MW installed capacity) onshore wind farms must not be overlooked. Land-based wind farms continue to provide the most economically viable means of exploiting wind energy.

Wind energy offers the opportunity for Ireland to reduce its greenhouse gas emissions while adding power to the national electricity grid; reduce the country's reliance on imported sources of energy while using indigenous resources and creating employment. The cost of generating energy from wind is made up primarily of the capital cost, with low operational costs, this ensures energy price stability. The Lackan Wind Farm has been operating for the past 16 years, and in that time has produced approximately 320GWhr of electricity. With professional maintenance, the turbines can efficiently operate for an additional 12 years (beyond their permitted lifespan) thereby utilising existing infrastructure, including the existing grid connection.

1.3.1 Benefits of Wind Energy Development

The benefits of wind energy include the following:

- Provision of much needed electrical capacity, particularly with aggressive targets to increase the electrical vehicle fleet in Ireland by 2030.
- Zero greenhouse gas emissions to the atmosphere during operation and contribution towards attainment of Climate Action targets.
- Abatement of other pollutants and environmental protection.
- Reduction of energy importation.
- Use of indigenous resources.
- Security of energy supply.
- Improvement of the balance of payments. Ireland paid €6.8 billion for fuel imports in 2019.
- Energy price stability.
- Contribution to sustainable development.

Costs of Wind Energy Development

The costs associated with wind energy include both economic and environmental costs and are described below.

Economic Cost

The cost of wind energy is influenced by technical factors such as the wind speed at the site, wind turbine availability and price, position of the turbines and the cost of finance. The cost of generating electricity from wind is made up primarily of the capital cost, with low operational costs. For the Lackan Wind Farm, the capital costs have been expended. Operational costs will increase slightly as the turbine age, but with careful maintenance, they will last a further 12 years.

Once operational, wind energy is probably the least expensive method of generating electricity in Ireland in terms of real costs.

Environmental Cost

The environmental costs include land take, habitat loss, potential bird strikes, noise and visual impacts. In general, it is found that visual impact is the primary concern. With its coastal location 3.2km northeast of the Killala Bay / Moy Estuary SPA (Special Protection Area), potential impacts on birds are also an important aspect for assessment. These topics are discussed in greater detail in the following chapters.

1.4 Public Attitudes to Wind Energy

Throughout the development of wind energy technology, public attitudes towards clean and renewable energy generation have been surveyed regularly. In America and Europe public support has strengthened for cleaner and “greener” energy production.

On the whole, the public favours the development of renewable energy in combination with increased energy efficiency to meet energy needs.

In a research summary of independent studies in the UK which canvassed individuals living close to an existing or proposed site, every study demonstrated that the overwhelming majority of residents in areas with a wind project favour wind power, both in theory as a renewable energy source and in practice in their areas. While wind energy was, in general, highly supported, areas with a wind farm had an even higher support rate. An average of 8 out of 10 people supported their local wind farm[31]. Other surveys had similar results including surveys in Wales,[32] the Netherlands,[33,34] Sweden[35] and North America[36,37].

In Ireland, the Irish Wind Energy Association (IWEA) commissioned a survey by Drury Research, published in 1999[38]. The survey found that:

- 67% of respondents agreed that the Government should support the development of wind energy in Ireland.
- 93% of those aware of wind energy are in support of its development.
- Wind, solar power, hydro and wave power rank highest in terms of their perceived environmental friendliness.
- When asked to rank forms of energy in terms of their environmental friendliness, wind power attracted the highest mean score.
- Perceived disadvantages of wind power were much more likely to centre on its ability to provide a continuous power supply, more so than any perceived unsightliness.

In 2003, Sustainable Energy Ireland (SEI) completed a series of surveys on the attitude of towards wind farms in Ireland[39]. The results show that Irish people are generally positively disposed to wind farms; 8 out of 10 of those questioned are favourably disposed to the construction of more wind farms in Ireland.

A study was also carried out in 2004 by the School of Geography & Geoscience (University of St. Andrews) and The Macaulay Institute on the public perceptions of wind power in Scotland and Ireland[40]. The study areas were in northeast Scotland and southwest Ireland. The study found that the majority of people are in favour of wind farms and that opposition subsided following the construction of a wind farm, the opposition arising from exaggerated negative perception of the impacts.

For the wind farm in western Ireland, the study found that '*many people stated that they had expected negative impacts from the wind farms, the key anticipated problems being visual intrusion (89 per cent) and noise (59 per cent). However, 73 per cent of respondents, across all zones, feel that their fears have not been realized, the modal reason amongst this group being that they have 'not experienced any problems' (27 per cent). Other replies indicated that people do not notice the turbines (either visually or aurally), and that they have 'become part of the background' (14 per cent)'*.

In 2007, Fáilte Ireland in association with the Northern Ireland Tourist Board carried out a visitor survey on the attitudes of tourists, both domestic and overseas holidaymakers, to wind energy projects, which was updated in 2012[41]. The purpose of the survey was to access whether or not the development of wind farms would impact on the enjoyment of the Irish scenery by holidaymakers. The survey involved interviews with domestic and overseas tourists. Similar results were obtained in both surveys. The majority of the respondents (85% in 2007 and 79% in 2012) perceived wind farms as a positive, with 15% / 21% negative towards wind farms. However, it found that the landscape onto which the wind farm is to be sited had a significant impact on attitudes. Although 21% considered wind energy projects as having a fairly or very negative impact on sightseeing, this figure increased to 40% for wind projects sited on coastal landscapes and 35% on mountain moorland. Only 24% were opposed to wind farm construction on bogland, and 21% on industrial land. A majority expressed a preference for wind farms with fewer, larger turbines.

1.5 Alternatives to Proposed Development

Alternatives to the proposed developments are generally considered in terms of:

- Alternative sites.
- Alternative site layout and design.
- Alternative technologies.

The importance of the consideration of the alternatives is highlighted in Section 3.4 of the EPA's *Guidelines on the Information to be contained in Environmental Impact Assessment Reports'*[12].

As this is an operational wind farm and the proposed development relates to the extension of its operational lifespan, the alternatives are:

- Repowering the wind farm, which could be assessed under alternative wind farm design.
- Removal of the wind farm and restoration of the site. The installed capacity (6MW) would need to be constructed at another site.

1.5.1 Alternative Sites

An alternative site is not relevant to the proposed development.

1.5.2 Repowering - Alternative Wind Farm Design

At some wind farms, with older, less efficient turbines, an option considered is to replace the turbines with newer, generally larger turbines. This option would use the existing infrastructure as far as possible. The installed capacity (6MW) could be replaced with one or two turbines. This would incur significant capital costs for removing the existing turbines and installing new turbines.

As the existing turbines have a significant lifespan remaining, it was decided to seek permission to extend their permitted lifespan. This is considered the most environmentally friendly approach, avoiding manufacturing and construction impacts.

1.5.3 Alternative Technology

If the operational lifespan of the Lackan Wind Farm is not extended and the wind farm is removed, then fossil fuel power stations will likely in the short-term be used to offset the reduction to the green electricity; eventually the generation capacity would be replaced by renewable generation at another site.

1.5.4 Technical Difficulties

There were no technical difficulties encountered during the environmental assessment conducted at the site.

1.6 Pre-Submission Consultation

In the course of the preparation of the EIAR for the wind farm, several organisations and individuals were consulted. Many of those consulted did not express any view on the development. Those contacted are listed in Table 1-1. Correspondence received is provided in Appendix 1-1.

Table 1-1: List of Consultees

Contact	Organisation
Planning Office / Sligo County Council	
Development Application Unit / National Parks & Wildlife Service	
Failte Ireland	
Environmental Protection Agency	
Inland Fisheries Ireland	
Transport Infrastructure Ireland	
Office of Public Works	
Irish Aviation Authority	
Geological Survey of Ireland	
RTE	
Tetra Ireland	
Netshare	
Cellnex Telecom, Ireland	
Vodafone	
An Garda	
Department of Agriculture, Food and the Marine	
Department of Environment, Climate and Communications	
Department of Housing, Local Government & Heritage	

Consultation was carried out with local authority officials for the project in August 2021. The Planning Department officials indicated that an environmental impact assessment would be required for the proposed extension to the operational lifespan of the wind farm.

1.7 Scoping

An initial scoping of possible impacts of the proposed development was carried out to identify those impacts thought to be potentially significant. This scoping study was carried out to examine the impacts in the various categories listed in the Sixth Schedule of the Planning & Development Regulations 2001, EPA Guidelines and in consultation with the relevant organisations, and as listed above in the Preamble.

Discussions between the developer, landowners, interested parties and relevant agencies through a consultation process, ensured the most significant impacts and areas of greatest concern were focused throughout the EIA process. The level of work carried out for each topic reflects the potential impact on each area, as identified during the scoping process.

The scoping process was based on:

- Consultation with the Planning Department of Sligo County Council.
- Consultation with landowners and interested parties.
- Having regard to the various published guidelines and the CDP.
- A review of the project documentation relating to the original application for the wind farm.
- Experience of the consultants in preparing EIARs.

1.7.1 Scope of EIAR

The emphases placed on potential impacts following the scoping process are described below:

Population & Human Health

Impacts affecting the population in the vicinity of the proposed wind farm include:

- Possible flickering shadows from the moving blades in nearby residences.
- Noise.
- Health and safety.
- Property prices.
- Socio-economics and tourism.

These potential impacts are not expected to significantly affect human beings in the surrounding environment due to the offset distances from dwellings. They are addressed in Chapter 4.
Locally, wind turbines can increase background noise levels. For nearby residents, this can be a nuisance. Monitoring of noise was undertaken to access the noise levels in the local area. This topic is addressed in Chapter 5.

Biodiversity

Biodiversity is an important factor for consideration as the site is located in a coastal location near the Killala Bay / Moy Estuary SPA. To assess potential impacts, a full ecological survey was carried out, including mapping of habitats, identification of flora and fauna species, and birds impact assessments. These topics are discussed in Chapter 10.

Land

Land uses on and near the site were identified. Wind farm developments can have implications for existing and future land use. Their development does offer an attractive alternative, especially in areas of low agricultural potential, such as that at Lackan. Their impact can be both positive and negative. This topic is discussed in Chapter 12.

Soil

The site is not located in an area of geological/hydrogeological importance, nor is it a geological heritage site. Extending the lifespan of the wind farm will not have any significant impacts on the soils, geology or hydrogeology. The site is near flat and with construction already completed, slope stability is not an issue. Decommissioning and restoration of the site is not expected to have a significant impact on soil, geology, slope stability or hydrogeology. These topics are discussed in Chapter 8.

Water

The site is within the catchment of a few small streams and land drains that discharge to the sea at a few locations through the coastal wave barrier. The extended operational lifespan will not have any significant impact on surface water runoff or quality. Earthworks associated with the decommissioning and restoration of the site could potentially impact on surface water quality. This topic is discussed in Chapter 7.

Air & Climate

The Lackan Wind Farm is generating electricity that would otherwise be generated by fossil fuel burning power stations. Extending the lifespan of the wind farm will therefore maintain its contribution to the green electricity and have a positive impact on climate and climate change. This topic is discussed in Chapter 11.

Cultural Heritage

Archaeological testing and monitoring were carrying out pre-construction and during construction of the Lackan Wind Farm. Extending the lifespan of the wind farm will not have an impact on archaeology or cultural heritage. The decommissioning and restoration of the site will stay within the original construction footprint, so no impact on previously unknown archaeology will occur. This topic is discussed in Chapter 9.

Material Assets

Material assets can include land, natural resources, roads, and utilities. Wind energy is one of Ireland's largest, commercially viable energy resources. The rotating blades of a wind turbine can occasionally cause interference to electro-magnetically propagated signals. Such interference can, in theory, have an impact on all forms of electromagnetic communications such as cellular radio communications, aircraft instrument landing systems and television broadcasts. To assess the impact of electro-magnetic effects, a consultation exercise with communications operators was carried out. The results of this exercise are discussed in Chapter 13.

Roads and traffic are also considered a material asset. Wind farms can increase traffic volumes on local roads. These are mostly associated with the construction phase, which is not relevant to the proposed development. Operational traffic impacts are not significant. Traffic will increase for the decommissioning and restoration phase. Traffic and transportation are discussed in Chapter 6.

Landscape

The main objective of the landscape assessment is to evaluate the impacts of the existing wind farm on the surrounding landscape. Depending on public perception, visual impact is likely to be the impact of greatest concern. The Lackan Wind Farm is located on the coastal zone as defined in Section 10.4 of the 2017-2023 CDP, adjacent to areas designated as Normal Rural Landscape. The coastal zone is considered a Visually Vulnerable area. This topic is discussed in Chapter 3.

Table 1-2 shows the organisation of the topics within the EIAR. It is noted that there are several issues cutting across a few prescribed environmental factors; these are cross referenced where appropriate and discussed in Chapter 15 – Interactions of the Foregoing.

Table 1-2: Organisation of Topics within EIAR

Prescribed Environmental Factor	EIAR Chapter Heading	Chapter Number	Topics Addressed
Population & Human Health	Population & Human Health	4	– Demographics – Health & Safety – Socioeconomics – Tourism – Shadow flicker
	Noise & Vibration	5	– Wind farm noise – Cross reference to health
Biodiversity	Biodiversity	10	– Flora – Fauna – Aquatic Ecology – Natura Impact Statement
Land	Land	12	– Land use
Soil	Soils, Geology & Hydrogeology	8	– Overburden – Bedrock – Hydrogeology – Slope stability / peat landslide risk
Water	Surface Water & Hydrology	7	– Water Quality – Water Use – Runoff Volumes & Treatment Capacity – Flooding
Air & Climate	Air, Climate & Climate Change	11	– Air Quality – Local Climatic Conditions – Climate Change
Material Assets	Roads & Transport	6	– Road Network – Transport of over-sized loads
	Material Assets	13	– Utilities – Electromagnetic Interference
Cultural Heritage	Architecture, Archaeology & Cultural Heritage	9	– Archaeology – Cultural Heritage – Architecture
Landscape	Landscape & Visual Assessment	3	– Landscape Context – Landscape Character – Views & Prospects

1.8 Contributors

The EIAR was prepared by KGEC. Specialist sub-consultants employed with reference to specific portions of the study were as follows:

JKW Environmental - Biodiversity
AV Acoustics - Noise Assessment

1.9 Format of EIS

The EIAR was prepared having regard to guidelines issued by several Government and Industry Agencies, including:

a. *Guidelines on the Information to be Contained in Environmental Impact Statements*[11].
b. *Guidelines on the Information to be Contained in Environmental Impact Assessment Reports*[12].
c. *Advice notes on Current Practice (in the preparation of Environmental Impact Statements)*[13].

d. *Wind Farm Development – Planning Guidelines*[7].
e. *Draft Revised Wind Energy Development Guidelines*[8].

The document has been structured according to the direct format structure, as described in EPA guidelines and advise notes. The guidelines recommend that EIAR documents be kept as concise as possible. The report is submitted in three volumes:

Volume 1: Non-Technical Summary
Volume 2: Main Document
Volume 3: Appendices.

2 DESCRIPTION OF THE PROPOSED DEVELOPMENT

2.1 Site Setting

The wind farm is located approximately 3.5km northeast of Inishcrone on a low-lying coastal plain in the townland of Lackan. The grid connection extends from the on-site control building to the south towards the Inishcrone 38kV ESB substation.

The site is situated within wet calcareous pasture. A man-made sea dyke extends along the western boundary of the site. This low-lying coastal zone was previously liable to flooding. The area within the 'redline' planning boundary is 2.3ha within a landholding of 15.51ha. The developed footprint within the 'redline' planning boundary is approximately 0.7ha.

The surrounding lands consist predominantly of agricultural fields used for grazing. Elevations range from approximately 2mOD to 10mOD. Figure 2-1 shows the site location. Figure 2-2 shows the Google Earth aerial photograph of the site taken in 2022. The site is accessed from the R297 (Inishcrone – Dromore West), via country road L-6502 that extends west from Kilglass. Additional details regarding access to the site are provided in Chapter 6.

The Lackan Stream (EPA segment code 34_3151) and tributaries drains the site. First order stream (segment code 34_1180) rises near Kilglass and flows generally in a north-westerly direction. A second first order stream rises to the south of the site and flows generally in a northerly direction. The two streams meet near turbine T3 and flow in a northerly direction, discharging to the sea just north of turbine T1. Part of the flows from this stream diverts along a drain near turbine T2, passing under the wind farm access track and discharging to the sea to the west of T2.

There are 40 dwellings within 1km of the turbines. There are no dwellings within 500m of the turbines. Turbines are a minimum of 535m from the closest dwellings. Dwellings within 1km of the turbines are shown on Figure 2-3 and listed in Table 2-1.

Table 2-1: List of Houses within 1km of Turbines

House No.	Distance to Nearest Turbine (m)	ID of Nearest Turbine	House No.	Distance to Nearest Turbine (m)	ID of Nearest Turbine
H1	580	T2	H21	885	T3
H2	615	T2	H22	865	T3
H3	585	T3	H23	840	T3
H4	570	T3	H24	720	T3
H5	750	T2	H25	735	T3
H6	715	T3	H26	800	T3
H7	795	T3	H27	845	T3
H8	945	T3	H28	860	T3
H9	620	T3	H29	815	T3
H10	605	T3	H30	820	T3
H11	550	T3	H31	850	T3
H12	550	T3	H32	855	T3
H13	535	T3	H33	830	T3
H14	535	T3	H34	905	T3
H15	535	T3	H35	840	T3
H16	580	T3	H36	850	T3
H17	645	T3	H37	830	T3
H18	625	T3	H38	980	T1
H19	995	T3	H39	955	T1
H20	975	T3	H40	940	T1

2.2 Planning History

The planning history associated with this site is provided below.

02/426 - Erect a metrological measuring mast 50 metres in height (the mast will be a temporary structure and will be erected for a period not exceeding 24 months) at Lackan, Kilglass Inishcrone. Application lodged on 28 June 2002. Sligo County Council decided to grant permission on 15 October 2002, with the final grant issued on 27 November 2002.

02/816 – Construction of 3 no. wind turbines, 60 metre hub height and 80 metre rotor diameter, access trackways, 4.5 metres in width, a substation building and associated site development works. Application lodged on 07 April 2002. Sligo County Council decided to grant permission on 15 October 2002. The Council's decision was appealed to An Bord Pleanala by a third party. The Bord upheld the Council's decision in its grant dated 28 October 2003 – An Bord Pleanala reference number PL 21.203388.

2.3 Description of the Development

The development comprises of:

- 3 No. turbines with tip height of 99.5m, each with a generating capacity of 2MW.
- Control building.
- Internal site tracks and hardstand areas.
- Internal underground cabling, linking each turbine to the on-site control building.
- Connection to National grid. The ESB constructed a 20kV connection consisting of a combination of underground cabling and overhead powerline mounted on single wooden poles.
- Site signage, landscaping and ancillary works.

The Lackan Wind Farm was commissioned in 2007. Its planning permission allows for an operational period of 20 years from the date of the order (date of grant). This permitted lifespan extends to October 2023. It is proposed to extend this permitted lifespan by an additional 12 years to October 2035. The main components of the existing wind farm are described in the following subsections and have been assessed as part of the EIA and discussed in subsequent chapters.

2.3.1 Wind Farm Layout

The purpose of the wind farm layout is to maximise its energy production. However, this was balanced against environmental factors including distance from houses, absorption into the landscape, site topography, offsets from water courses and the avoidance / reduction of noise and shadow flicker impacts.

The wind farm site layout is shown on Figure 2-4. Detailed drawings of the site layout are provided in the drawings accompanying the planning application.

2.4 Wind Farm Components

The main components of the Lackan Wind Farm (as listed in Section 2.3) are described in the following subsections.

2.4.1 Turbines

The site layout is presented in Figure 2-4. The turbines installed are the Enercon E70 with a 64m hub height and tip height of 99.5m. A sketch of the E70 turbine is provided as Figure 2-5. The turbines are the generic three bladed, tubular tower model with horizontal axis. The rotor blades are bolted to the central hub, which is connected to the nacelle. Plate 2-1 shows a photograph of the Lackan turbines as viewed from the sea dyke looking south.

Plate 2-1: View of Lackan Wind Turbines

Plate 2-2 illustrates the components housed in, and general arrangement of, the turbine nacelle.

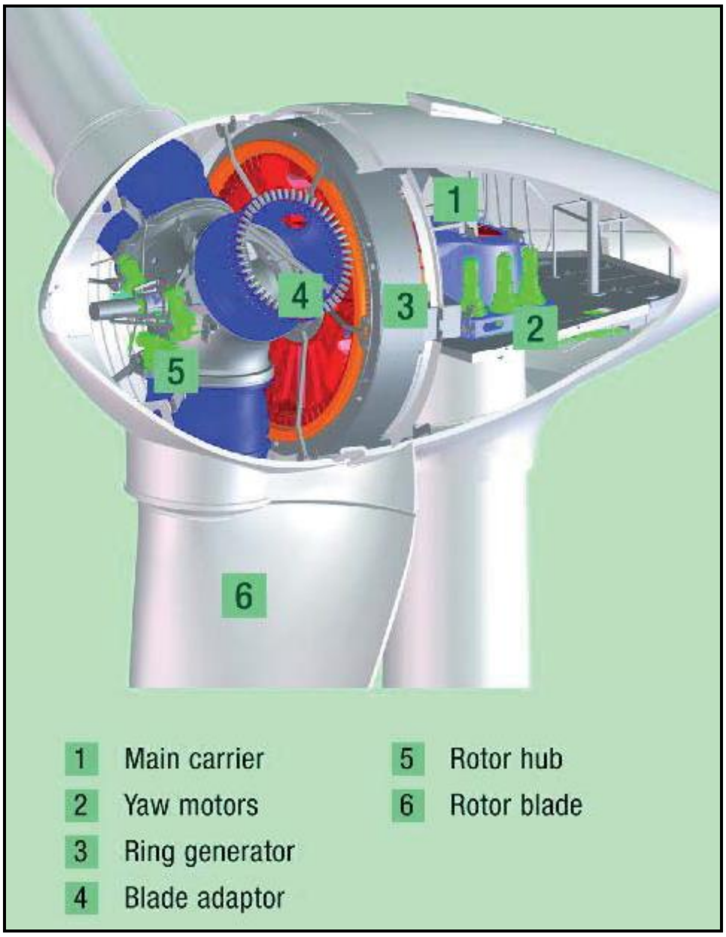


Plate 2-2: Illustration of Enercon E70 Nacelle

Earthing and isolation protect these components from lightning strikes. A polyester hood made from reinforced glass fibre covers the nacelle. The hood is sound insulated to ensure minimal noise emissions.

The blades are made of glass fibre reinforced polyester. Blades typically turn at between 6 and 21.5 revolutions per minute (rpm) depending on wind speed. Start-up is generally achieved at a wind speed of around 2 to 3m/sec (measured at the hub), with optimum power generation at approximately 12 to 13m/sec. Storm control permits operation at wind speeds up to 34m/sec, but with reduced power output.

The yaw mechanism turns the nacelle and blades into the wind, the movement of which is controlled by sensors that monitor wind direction.

The tower of the turbine is a conical steel column which consisted of three sections, bolted together. The tower sections length and foundation diameter for the Enercon E70 turbine with a 64m hub height are summarised in Table 2-2.

Table 2-2: Specifications for Enercon E70 with 64m Hub Height

Turbine Component	Size / Capacity	Weight
Foundation Diameter – shallow foundation with buoyancy	19.1m diameter	---
Concrete Volume	376m^3	---
Tower Section 1 (top section)	25.95m	39 tonnes
Tower Section 2	21.2m	49 tonnes
Tower Section 3	14.95m	53 tonnes
Foundation Section	2.0m	12 tonnes

Securing the tower to the foundation is done using a foundation section with is cast into the reinforced concrete foundation, extending 750mm above the top of the foundation. The third section is then bolted to the foundation section. The diameter of the tower at its base is 4.2m, tapering to 2.1m at the top of the tower where it joins the nacelle. The first floor of the tower is approximately 3m above ground level, as the transformer is located inside the tower basement. It is accessed by a steel staircase and steel hatch door.

The first floor houses the control units. From the first floor, an internal ladder leads up to the nacelle. There are four intermediate floors between the tower base and the nacelle. A safety harness is provided when climbing to the nacelle. It connects to a central runner integral with the ladder.

The Enercon E70 turbine uses a direct drive system. The benefits of a direct drive system are reduced mechanical stress and wearing of moving parts, less maintenance, higher level of grid compatibility, more efficient energy conversion, and lower mechanical noise emission.

Turbines generate electricity at a voltage in the range 440 to 690V. The transformer, located in the basement of each turbine steps up the voltage to 20kV. The internal wind farm 20kV cables connect the turbine to the control building.

The wind turbines incorporate a SCADA system that monitors performance of the turbine. To ensure power quality, the SCADA system monitors, controls and records voltages, current and frequency. If these parameters are not within specified ranges, the turbine will shut down and automatically notify the service team.

The turbine is multiple coated to protect against corrosion. They are coloured to an off-white / light grey finish to blend into the skyline background. This minimises visual impact, as recommended by the following guidelines on wind energy development:

- Department of the Environment, Heritage & Local Government – '*Wind Farm Development – Guidelines for Planning Authorities*'.
- Scottish Natural Heritage – '*Sitting and Designing Wind Farms in the Landscape*[42]'.

The locations of the Lackan turbines are provided in Table 2-3.

Table 2-3: Lackan Turbine Locations

Turbine ID	ITM		IG		Ground Elev. (mOD)
	Easting	Northing	Easting	Northing	
T1	530022	833811	130055	333805	4.8
T2	530146	833530	130179	333524	4.1
T3	530427	833403	130460	333397	9.4

2.4.2 Turbine Foundations

The foundations used for the Lackan turbines are shallow and circular (19.1m diameter), sized to counteract the buoyancy uplift forces. Plate 2-3 shows a section through the E70 turbine. Plates 2-4 to 2-6 show the ground conditions encountered during foundation excavations at Lackan.

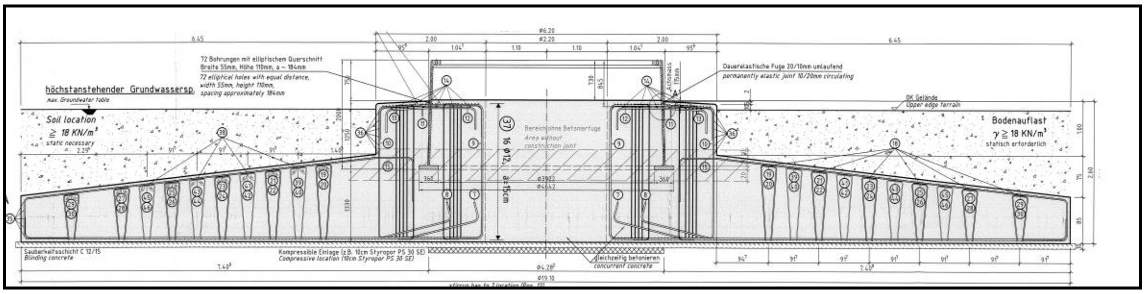


Plate 2-3: E70 Turbine Foundation Section

Plate 2-4: Photos of Turbine T1 Foundation Earthworks

Plate 2-5: Photos of Turbine T2 Foundation Earthworks

Plate 2-6: Photos of Turbine T3 Foundation Earthworks

Plate 2-7 shows some of the construction steps for the E70 turbine. Note that these are not from the Lackan site. The first shows the foundation section resting on the concrete blinding layer and the second shows the completed foundation prior to removal of the formwork and the backfilling of the ballast over the foundation.

Plate 2-7: E70 Foundation Construction Photos

2.4.3 Site Control Building

Underground cables link the turbines to the on-site control building. It consists of an ESB switchgear room, high voltage room and customer control / metering room. Its construction was to ESB specifications. The overall outside dimensions of the building are 9.52m by 4m wide with a reinforced concrete roof, covered with a pitched roof. The external walls have a smooth plaster finish. It is located near the site entrance between turbines T2 and T3. A gravel parking area is provided adjacent to the control building. Photographs of the control building are provided in Plate 2-8. Details of the control buildings are provided in the planning drawings.

Plate 2-8: Photos of Lackan Control Building

2.4.4 Internal Site Roads and Hardstands

Approximately 630m of site access tracks were constructed to access the turbines from an existing farm lane into the landholding. These were constructed as floating road to minimise ground disturbance. Roads are approximately 4m wide with a gravel finish. There are no roadside drains; over-the-edge drainage is used. Plate 2-9 shows examples of the access tracks at Lackan Wind Farm.

Plate 2-9: Photos of Access Tracks at Lackan

A level hardstand area of approximately 35m x 22m was constructed adjacent to each turbine location. This area was used to accommodate the cranes during the assembly of the turbines. An additional assembly area (35m x 15m) was provided adjacent to the cranage area for storage of components during turbine construction. The hardstand areas at Lackan have been allowed revegetated naturally, so are currently covered with grass. Plate 2-10 shows photographs of the hardstands. Plate 2-11 shows a schematic of the turbine hardstand.

Plate 2-10: Photo of T2 and T1 Hardstands

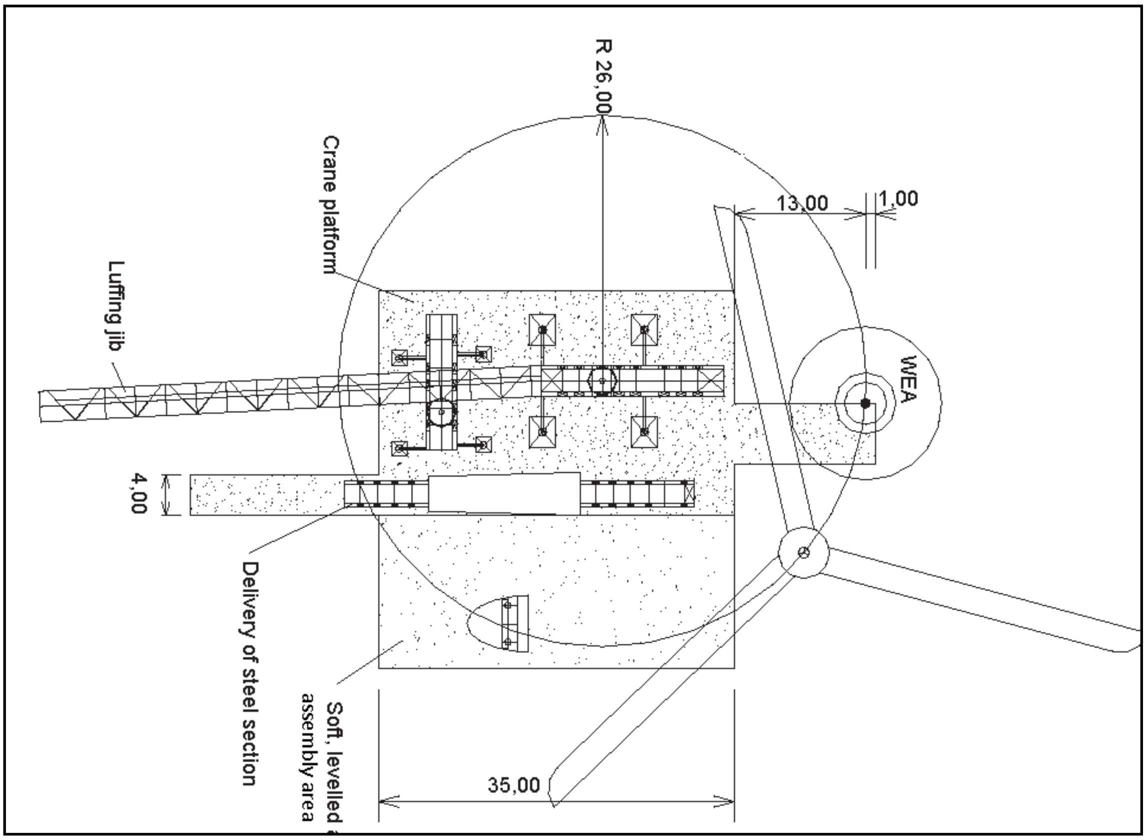


Plate 2-11: Enercon E70 Cranage Area Layout

2.4.5 Site Drainage

Drainage from the site infrastructure is over-the-edge to the adjoining improved grassland. Roadside drainage channels were not installed. There are a number of streams and field boundary drains on the site. These discharge through the coastal defensive dyke to the sea at three locations. Existing drainage features are discussed in Chapter 7.

2.4.6 Internal Site Cabling

Underground 20kV cables link each turbine to the wind farm control building. The on-site cabling follows the site tracks and are offset approximately 1m to 2m. Cables were installed in PVC ducting. For these single circuits, the cable trench was typically 400mm wide and 1,300mm deep. The material excavated from the trench was reused as backfill. For sections crossing site track, the ducting was surrounded in lean-mix concrete for added strength.

2.4.7 Grid Connection

The wind farm is connected to the Inishcrone 38kV ESB substation with a combination of 20kV underground cabling and overhead powerline mounted on single wooden poles. The grid connection route is shown on Figure 2-1. The underground section extends from the control building, along the farm lane, extends east through fields and then south crossing local road L6502; it then extends south along a farm lane and east across a field to the end pole – see Plate 2-14. There are two other underground sections near the Inishcrone substation as shown on Figure 2-1.

Plate 2-12: Grid Connection End Pole Looking South from L6502

2.5 Operational Lifespan & Decommissioning

Servicing of the turbines is conducted in accordance with the service contract with Enercon. The operation of the wind farm is monitored remotely, and a caretaker oversees its day to day running.

The expected physical lifespan of the turbines is 30 years from the date of commissioning. For this reason, the owner wants to secure planning permission to extend its permitted operational period by 12 years. After this time, the owner will decide whether to replace (subject to planning permission) or decommission the turbines.

The Planning Guidelines for wind farm developments (DEHLG, June 2006)[7] set out the guidance for restoration in Section 5.14 as follows:

> '*The decommissioning of a wind energy development once electricity ceases to be generated must be assessed. Plans for decommissioning should be outlined at the planning stage. Issues to be addressed include restorative measures, the removal of above ground structures and equipment, landscaping and/or reseeding roads. It may be appropriate to allow tracks to remain, e.g., as part of a walking route after decommissioning*'.

Scottish Natural Heritage (SNH, now NatureScot) also provides guidance on restoration and decommissioning of onshore wind farms (SNH, 2013)[43]. The Guidelines represent recent research into site restoration and decommissioning of wind farm infrastructure. One important point to note is that reinstatement proposals for a wind farm are made up to 30 years in advance, so within the lifespan of the wind farm, technological advances and preferred approaches to reinstatement are likely to change. As noted in the Guidelines, it is therefore '*best practice not to limit options too far in advance of actual decommissioning but to maintain informed flexibility until close to the end-of-life of the wind farm*'.

In developing the reinstatement programme, a number of factors need to be considered when selecting the best option for each component of the wind farm. These are:

1. Re-powering of the wind farm. This will be an important factor in determining how the reinstatement of the wind farm will progress. If there is a decision to re-power (i.e., replace the turbines with new turbines), then site access roads are likely to remain or perhaps be moved, re-using the road making material.
2. Carbon impact. The removal of foundations will have a much higher carbon footprint than to leave the foundations in place.

3. Hydrological impact. Removal of infrastructure, such as roads, may change the hydrological conditions at the site. Beneficial habitats may become established at the site which may be damaged by the removal of roads and this would need to be considered. However, an assessment of that potential impact could only be made towards the end of the wind farm operational lifespan.
4. Landowners' preferences in consideration of their ongoing land uses. The wind farm access roads may be used by the landowners for uses other than the wind farm. They may therefore want the roads (or section of roads) to remain for on-going agricultural uses.
5. Grid Operator requirements. As part of the major users' connection agreement, [which Lackan Wind Energy Ltd entered into with the ESB (distribution system operator – DSO)], access must be provided to the control building for system operator staff. Ownership of part the control building, and grid connection has been transferred to the system operator. After decommissioning of the wind farm, the site control building may be needed to support the local grid network. Therefore, the control building would need to remain, along with the access roads servicing it.

An outline of the proposed decommissioning preferences for the Lackan Wind Farm is outlined as follows:

- **Turbine Superstructure**: On decommissioning, cranes will disassemble the turbines. All the component parts are bolted together, so this is a relatively straightforward process. These will be taken off site, either for recycling or sold as second-hand turbines for installation at another site. Market conditions at the time of decommissioning will determine whether they will be sold for reuse or recycling.
- **Turbine Foundations**: Leave the concrete foundation is place, only cutting out the steel foundation section to a level below grade. The turbine foundation will then be completely covered and reinstated with subsoil and topsoil. Leaving the foundation in place (rather than breaking out the concrete) is considered the most environmental benign approach.
- **Roads**: It is proposed to leave the roads in situ for agricultural use, for access to the control building. Some of the spur roads will be removed and restored to original land use.
- **Cranage Hardstands**: Cranage area restoration will involve the partial removal of stone with re-grading and reinstatement of the area with topsoil / peat stripped during construction or imported topsoil, returning it to original condition.
- **Underground Cabling**: It is proposed to remove the cables from site for recycling. This can be achieved by digging trial pits at intervals along the cable route, cutting the cable and pulling them out. Ducting will be left in place and plugged so it doesn't create preferential pathways for water movement.
- **Control Building**: Part of the site control building and grid connection is owned by the ESB Networks (DSO). It is likely that the control building and grid connection will remain in place, becoming integrated into the local distribution system.

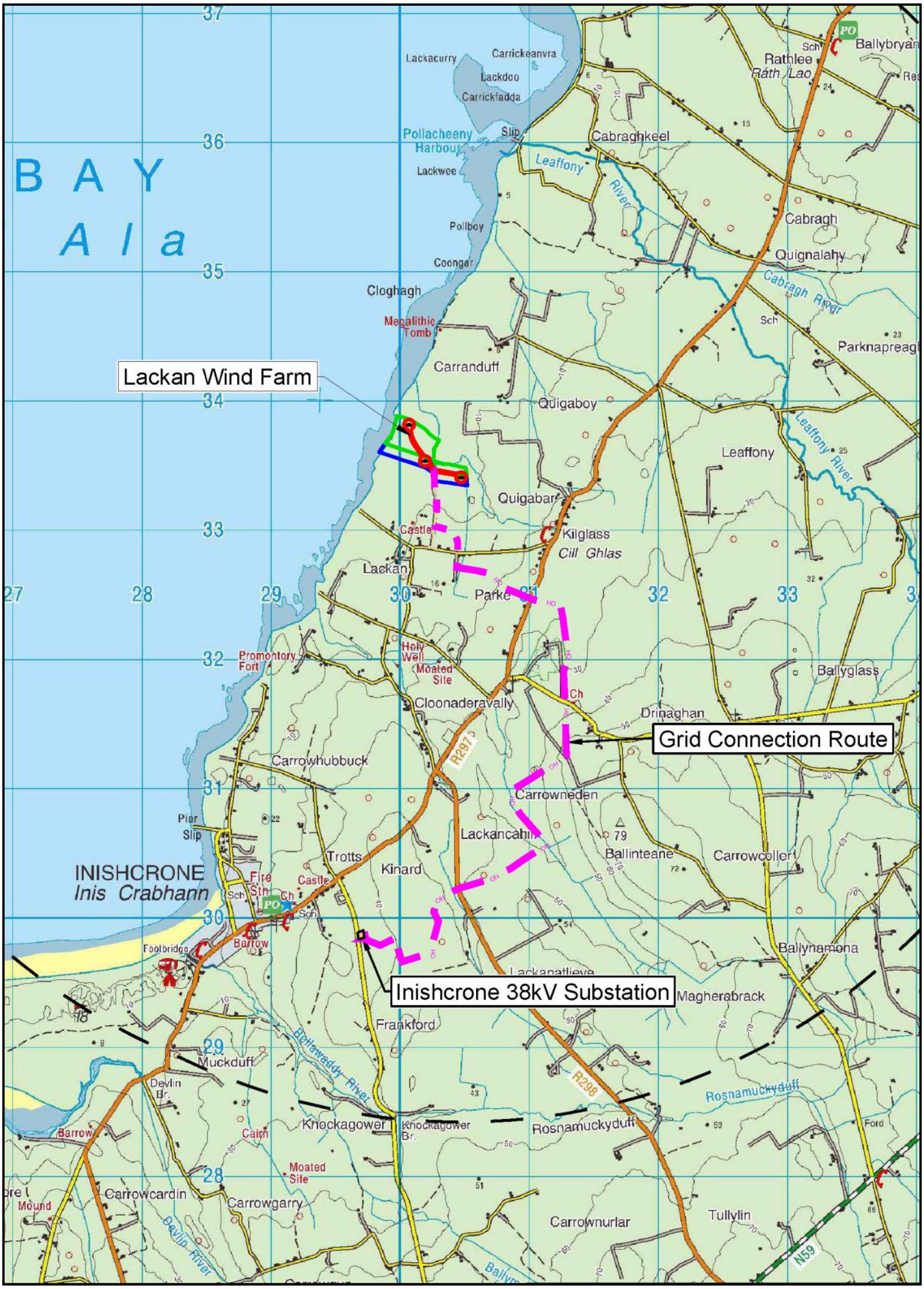


Figure 2-1: Site Location Map

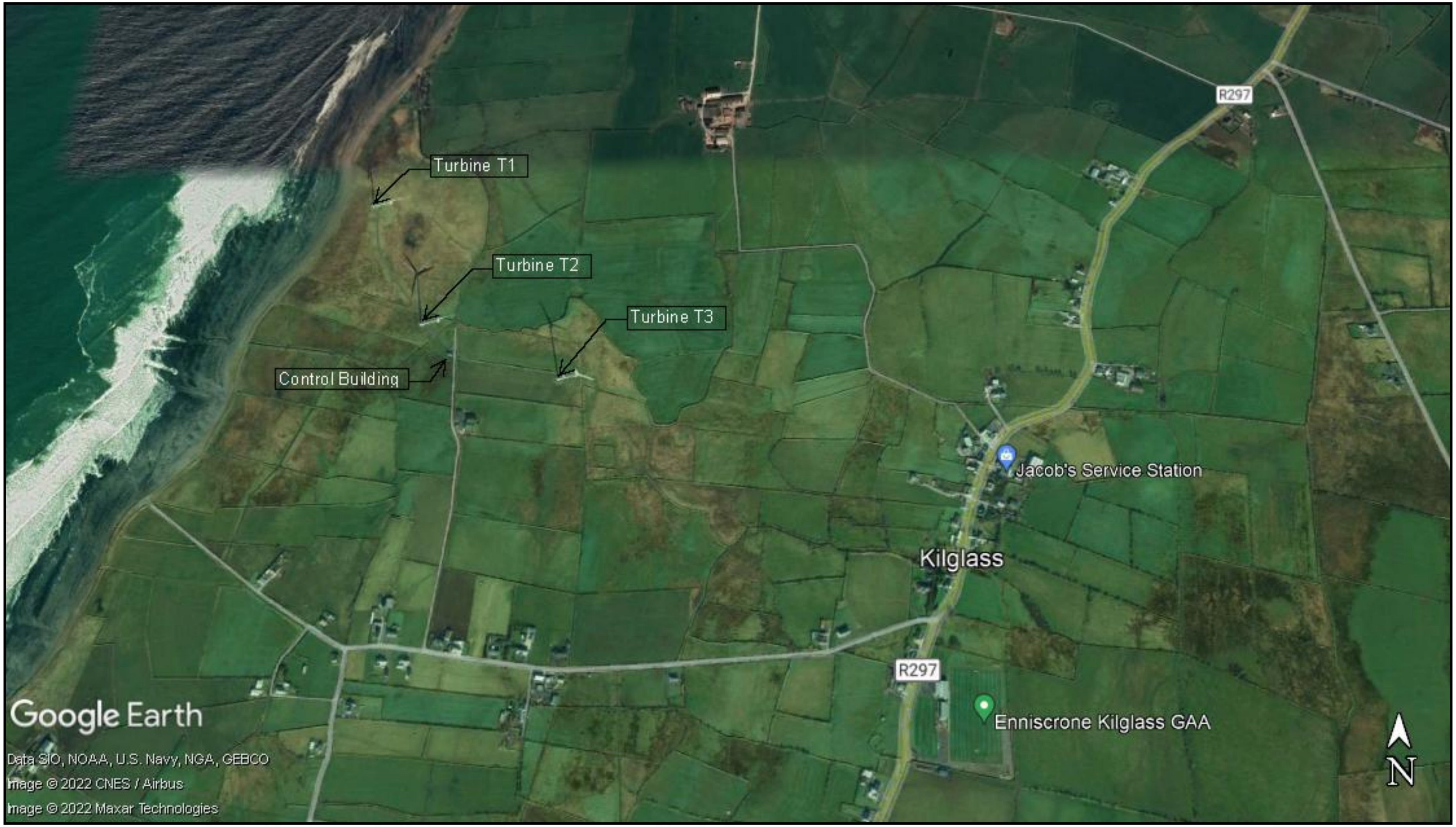


Figure 2-2: Aerial Photograph – 2022

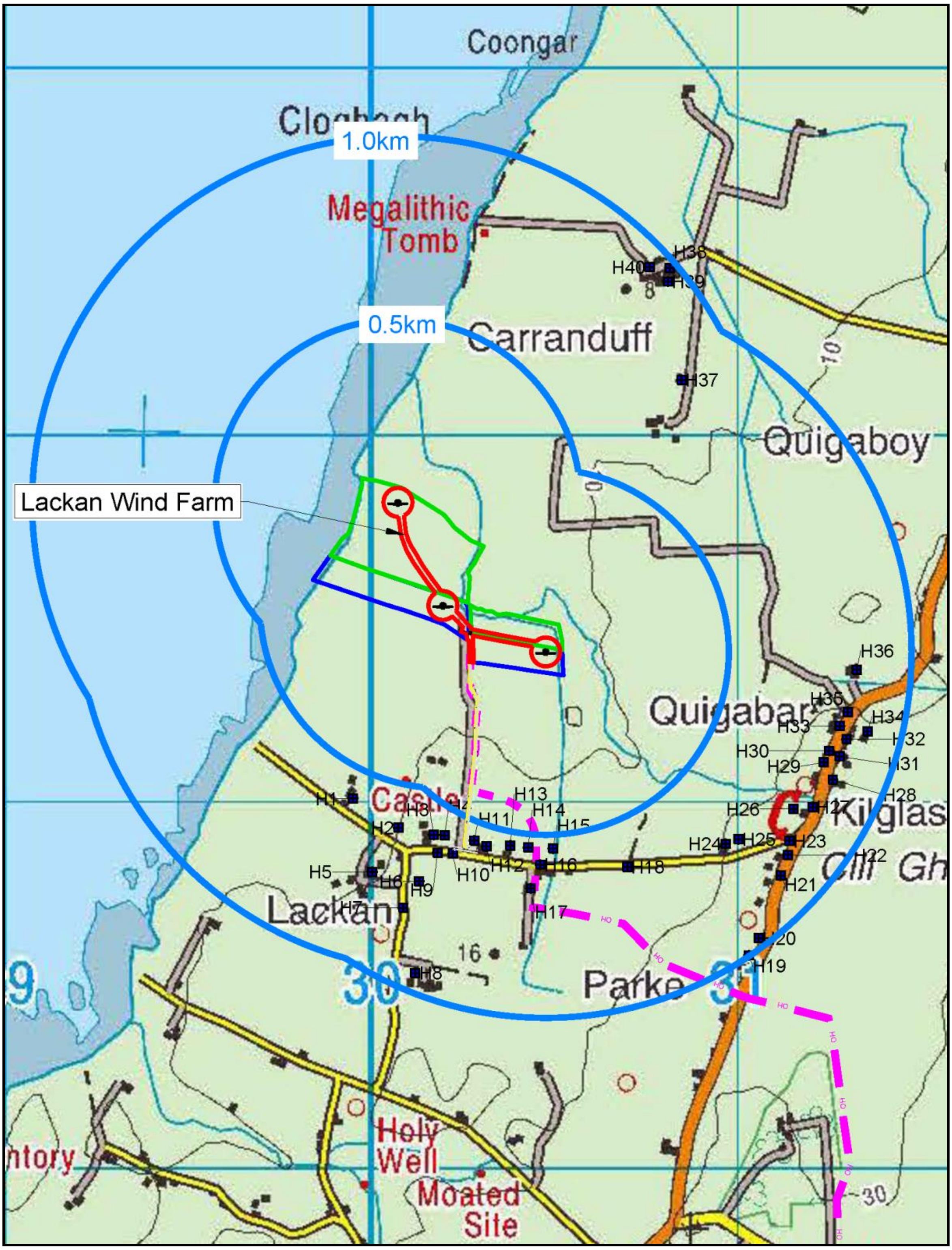


Figure 2-3: **House Location Map**

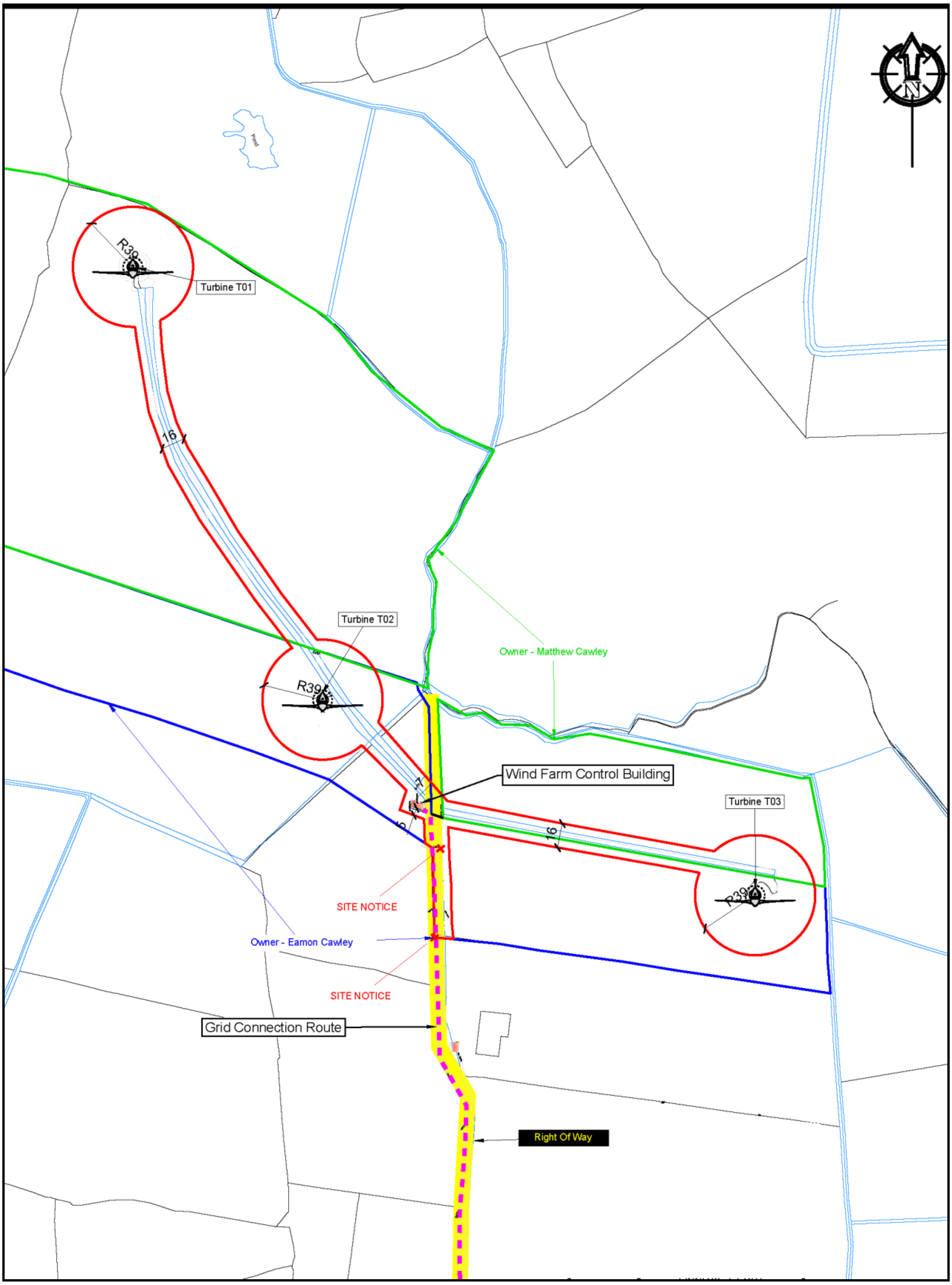


Figure 2-4 Site Layout Plan

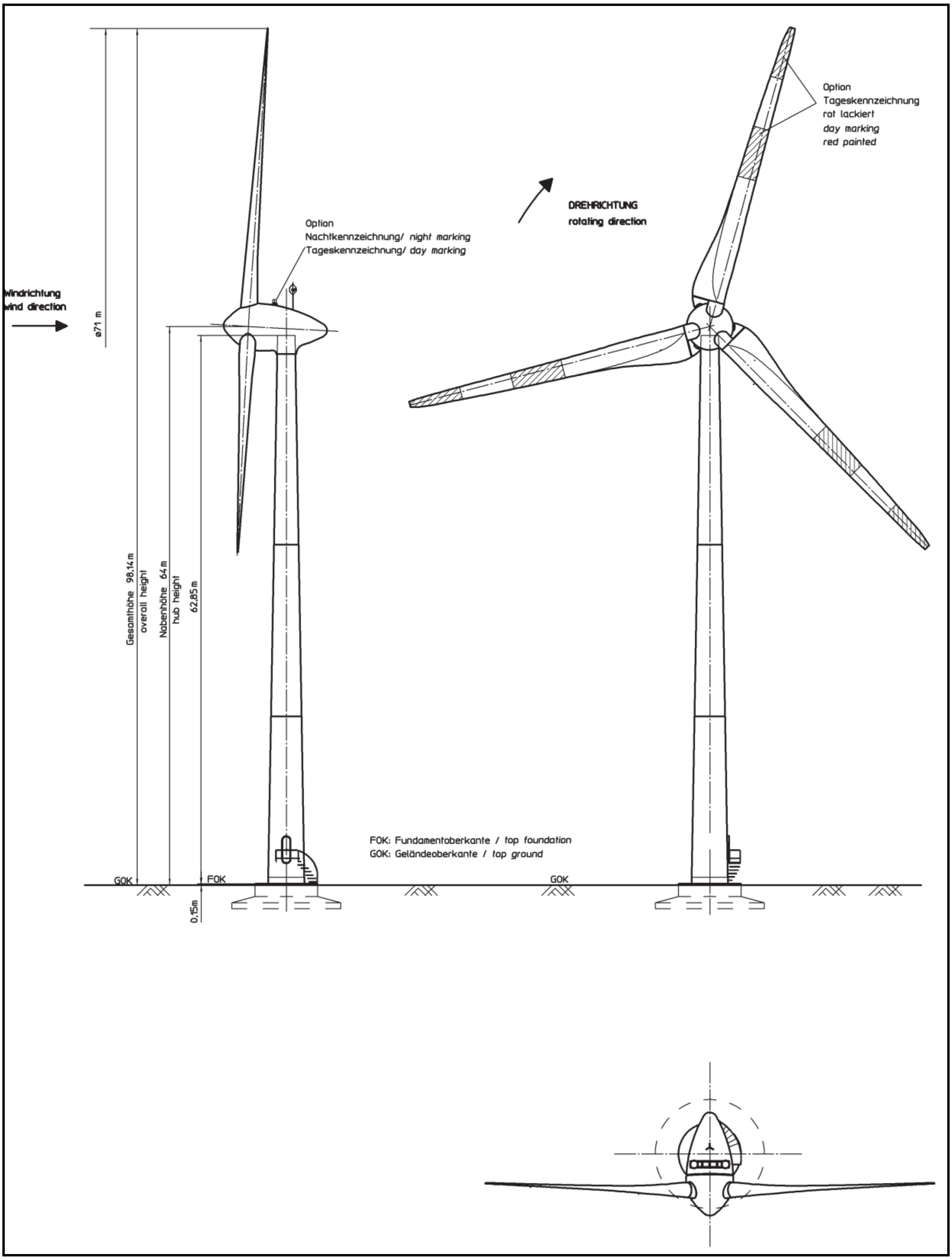


Figure 2-5 Enercon E70 Turbine with 64m Hub

3 LANDSCAPE & VISUAL

3.1 Introduction

This chapter describes the existing landscape and visual character of the site and its surrounds. The potential impact of the continued operation of the wind farm and grid connection on the surroundings is also described. The description of the area is based on survey information and analysis carried out during 2021 and 2022, and the author's familiarity with the area having carried out assessments for the nearby Carrowleagh Wind Farm and Black Lough Wind Farm.

The term landscape refers primarily to the visual appearance of the land, including shape, form and colour, and their interaction to create specific patterns and pictures that are distinctive to particular localities. However, the landscape is not purely a visual phenomenon because its character relies closely on its physiography and its history. Hence, in addition to the scenic and/or visual dimension, there are a whole range of other dimensions to landscape, including geology, topography, soils, ecology, archaeology, landscape history, land use, buildings and settlement, architecture and cultural associations. It is not just the countryside and mountain moorlands, it is also the urban environment. It is defined by the Council of Europe (2000[44]) as '*Landscape is an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors'*.

Landscape requires particular consideration for wind energy developments due to the importance attached to it by individuals and communities. Landscape is important because it provides, for example, a shared public resource, the setting for day-to-day living, work and recreation, an environment for wildlife, connection to the past and a sense of place, and a source of income from tourism and agriculture.

Landscape is not static; it is continually changing resulting from land use changes, population growth and new infrastructure, including wind energy developments. There is a requirement to accommodate change, but in a way that is sustainable; this means *development that meets the needs of the present without compromising the ability of future generations to meet their own needs'* (WCED, 1987[45]). This requires a balance being reached between environmental, economic and social pressures. Government response to the climate change emergency has increased the environmental weighting in this equation. Notwithstanding this, a robust impartial landscape and visual impact assessment (LVIA) must be undertaken.

There are two aspects of the LVIA: (a) assessment of landscape effects; and (b) assessment of visual effects. The assessment of landscape effects addresses effects on the landscape as a resource in its own right. The assessment of visual effects addresses effects on specific views and on the general visual amenity experienced by people.

Potential adverse impact on the landscape remains one of the most critical factors facing wind farm development. Wind farms by their nature must be visible in the landscape, however, being visible on the landscape, does not necessarily mean that it is a negative impact. In deciding on the acceptability and suitability of a wind farm, the landscape *character*, *sensitivity*, and *value* must each be assessed:

– *Landscape character* can be established for an area where there is visual distinctiveness and identity through a continuity of similar characteristics.

– *Landscape sensitivity* concerns the extent to which a landscape can accommodate change without unacceptable loss of existing character or interference with values.

- *Landscape values* can be described as the environmental or cultural benefits that are derived from various landscape resources. These resources may include physical and visual components as well as image of the landscape.

The assessment for the Lackan Wind Farm is different to other wind farm assessments in that it is an operational wind farm, whose owner seeks to extend its operational lifespan by 12 years. As such, the landscape and visual impacts are already being experienced.

3.2 Assessment Methodology

In addition to the EPA Guidelines, there are several guidelines used in carrying out the LVIA, including:

1. Wind Energy Development Guidelines for Planning Authorities, June 2006.
2. Draft Revised Wind Energy Development Guidelines, December 2019.
3. Visual Assessment of Wind Farms: Best Practice, (Scottish Natural Heritage, 2002).
4. Siting and Designing Wind Farm in the Landscape Guidance, Version 3a, (Scottish Natural Heritage, August 2017).
5. Visual Representation of Wind Farms: Version 2.2, (Scottish Natural Heritage, 2017).
6. Assessing the Cumulative Impact of Onshore Wind Energy Developments, (Scottish Natural Heritage, March 2012), updated (NatureScot, 2018).
7. Guidelines for Landscape and Visual Impact Assessment, (The Landscape Institute/Institute of Environmental Management and Assessment, UK, 2013).
8. Photography and Photomontage in Landscape and Visual Impact Assessment, (Landscape Institute Advice Note 01/11, 2011).
9. Landscape Character Assessment (LCA) and Landscape and Visual Impact Assessment (LVIA) of Specified Infrastructure Projects – Overarching Technical Document, PE-ENV-01101, Transport Infrastructure Ireland (TII), December 2020.

The approach to the assessment has regard to the above guidance documents:

- A search area base map was first prepared showing the development, other existing wind farms and permitted wind farms. NatureScot Guidance recommend a maximum radius of 60km; an area 39km (east-west) x 41km (north-south) was used for the Lackan Wind Farm base map. Figure 3-1 shows the search area base map. It shows the main settlements, views & prospects, etc.
- A draft Zone of Theoretical Visibility (ZTV) was prepared to define the study area. This included plotting the key landscape and visual receptors in the search area.
- From the search area map and draft ZTV analysis, it was demonstrated that the Ox Mountains contained visibility to the southeast; the rolling hills near Dromore West contains visibility to the east; and the rolling topography south of Ballina contained views from the south, so a study area 39km (east-west) and 32km (north-south) was more than sufficient for the Lackan Wind Farm. This is in line with the 2006 (and draft 2019) Guidelines – '*For blade tips up to 100m in height, a Zone of Theoretical Visibility radius of 15km would be adequate (this is greater than the current standard by some 50% but reflects the technical difficulty of depicting "small and medium" turbines at 20km)*'. The turbines at Lackan have a blade tip height of 99.5m.
- The baseline landscape character, sensitivity and values were described.
- Detailed ZTVs were prepared showing the Lackan Wind Farm by itself and in combination with the operational wind farms.
- Key viewpoints were selected from where photographs were taken to illustrate the nature and degree of visual effects.
- An assessment of the landscape and visual impacts of the Lackan Wind Farm, in combination with the existing wind farms, was then undertaken.

The information collected during the desk-based assessment and site walkover were used to establish the landscape and visual significance and sensitivity of the receiving environment. These are summarised in Tables 3-1 (Landscape) and 3-2 (Visual).

Table 3-1: Rating of Landscape Significance & Sensitivity

Rating of Landscape Significance & Sensitivity	Criteria / Landscape Receptor Examples
Very High	A landscape protected by an international or national designation (Special Area Amenity Order (SAAO), designated ecological landscapes (cSAC, SAC, SPA, NHA, pNHA, etc.)), Landscape Conservation Areas, UNESCO/ICOMOS Landscape Sites (World Heritage Sites/Tentative sites & Geoparks). A landscape widely acknowledged for its distinctive features and the quality and value of its elements and edge condition. A landscape with distinctive character and very susceptible to change. Distinctive/unique land uses of widely acknowledged landscape quality. Very careful and considered design and mitigation required. Landscape types may include, but are not limited to: ○ Nationally important tourism, cultural, recreational & amenity landscapes, open spaces and parklands. ○ Protected coastal landscapes / seascapes. ○ Dark sky reserve landscapes Tranquil or remote landscapes. Absence of negative elements (e.g. volumes of traffic, noise, dereliction, unmanaged areas).
High	A landscape widely acknowledged as containing elements of national importance. National designation may apply. A landscape containing nationally important (and in some cases regionally important) historical, ecological and socio-cultural features. A landscape acknowledged for its high quality and value. A landscape having the capacity to accommodate change to a certain degree. Elements critical to maintaining the landscape character of said high-rated areas (e.g. primary or characteristic landforms, landcover, landscape types; distinctive but characteristic boundaries; etc.). Community, sports, and recreational landscapes which cannot be replaced locally. Notable high value landscape features that could not be replaced (e.g. distinctive wooded copse, historic boundaries). Landscape setting to high value cultural heritage features (archaeological and/or architectural). May have some negative elements, but otherwise contains highly rated landscape elements
Medium	A landscape that exhibits positive character. A landscape that is locally important, but that might contain some regionally important elements. A landscape of some quality and value but with some adverse conditions. A landscape whose character, land use pattern, and scale would have the capacity to accommodate change. Some negative elements/detracting features present. Elements important to but critical for maintaining the landscape character of an area (e.g. secondary landform, landcover, landscape types; general development; strong but not dominate boundaries; etc.). Commonplace but not characteristic elements with recognisable structure and characteristic patterns with some sense of place. Distinctive / unique land uses of some acknowledged landscape quality. Landscapes with some detracting features present. Sporting and recreational landscapes which could be replaced locally - but not readily without further effects. Ecological or cultural landscapes or interest - but not designated nor meriting designation. Notable landscape elements that could be replaced.

Rating of Landscape Significance & Sensitivity	Criteria / Landscape Receptor Examples
Low	A landscape of local importance but with some degraded elements or conditions. A landscape where lack of management/intervention is evident. A landscape where change is unlikely to be detrimental. Elements not important to maintaining the landscape character of an area (e.g. low value general vegetation, trees and hedgerows; contradictory landscape types; poor or discordant development; etc.). Land uses without acknowledged landscape quality. Industrial/post-industrial landscapes with little cultural heritage antiquity. Marginal land on urban fringe / some peri-urban landscapes/areas of dereliction with low aesthetics value and few elements of interest. Sporting and recreational landscapes where they can be easily replaced locally.
Very Low / Negligible	A degraded landscape. Infrastructural landscapes of no cultural heritage antiquity, including major transport corridors. Landscape where negative elements (e.g. traffic, noise, derelict, neglect, evidence of anti-social behaviour such as graffiti, vandalism, littering etc.) dominate the overall character. Brownfield sites with no associations of note. A landscape where change is likely to be positive.

Table 3-2: Rating of Visual Significance / Sensitivity

Rating of Visual Significance & Sensitivity	Criteria / Visual Receptors Examples
Very High	Designated views, viewpoints, and vistas. Areas containing protected views as outlined in Development Plans or landscape policies. Very highly aesthetic views and vistas, with lack of visual clutter and absence of traffic and other elements which may cause visual degradation. Night-time views within dark sky reserves.
High	Viewers with a proprietary interest and prolonged viewing opportunities such as local residents and frequent recreational users. Existing high-quality views from public open spaces, where viewers are likely to experience the type of change resulting from the proposed scheme as an adverse or positive change and/or the quality of the existing view, as likely to be perceived by the viewer, is assessed as being high. Views from high usage public spaces, direct observers (e.g. views from local residential properties, residential care units with direct views to the development). Non-designated views of distinctive or characteristic landscapes from general road network. Views to and from local ridges, hills, high-points, buildings of note. Views to and from sites of regional ecological and / or cultural interest. Some visual discordance in streetscape. Traffic movements distracting visually but not predominant.
Medium	Viewers with a moderate interest in their environment such as recreational travellers and less frequent users of recreational facilities, e.g. walkers along canal, users of any adjacent parks, who are likely to experience the type of change resulting from the proposed scheme as an adverse (or positive) change in their view and/or the quality of the existing view, as likely to be perceived by the viewer, is assessed as being medium. Viewers within a landscape dominated by traffic. Visual condition of the landscape is degraded. Non-designated views of distinctive or characteristic landscapes from general road network. Views to and from open spaces, local parks. Views from sports and recreational facilities. Views to and from sites of local ecological and / or cultural interest. Views from general community, schools, institutional buildings, and associated outdoor areas.

Rating of Visual Significance & Sensitivity	Criteria / Visual Receptors Examples
Low	Viewers with a passing interest in their surroundings or whose interest is not specifically focused on the landscape, e.g. workers who are likely to experience the type of change resulting from the proposed scheme as an adverse (or positive) change in their view and/or the quality of the existing view, as likely to be perceived by the viewer, is assessed as being low. Viewers within an exclusively trafficked landscape (i.e. a major roadway or adjacent to one with no mitigation). Views of unremarkable landscapes from general road network. Viewers of users of recreational facilities where the purpose of that recreation is not related to the view. Views to and from industrial landscapes of little or no cultural heritage antiquity or aesthetic merit.
Very Low / Negligible	Areas of dereliction and poor visual quality due to such elements as graffiti, vandalism, derelict and run-down buildings and structures and littering. Views to and from degraded or abandoned urban or peri-urban landscapes or areas of dereliction with very low aesthetics value and little or no elements of interest. Views to brownfield or damaged landscapes with no associations of note. Views dominated by transportation and other infrastructure of no aesthetics merit.

3.3 Characteristics of the Development

The main characteristics of the development that could impact on landscape and visual character are:

1. Extended operational period of the wind farm.
2. Extended operational period of the grid connection.
3. Works associated with the decommissioning of the wind farm involving earthworks and cranes to disassemble the turbines.

3.4 Impact Assessment

3.4.1 Impact Assessment Methodology

The criteria in the EPA (2017) draft Guidelines are used to evaluate and describe the potential impacts. These are summarised as follows:

- **Character, Extent, Scale and Context** of effects (*e.g.,* area, number, localised, wide-spread, construction or operation, direct/indirect/cumulative, seasonal, day/night *etc*.).
- **Significance** of effects (e.g., imperceptible, not significant, slight, moderate, significant, very significant, profound).
- **Duration** of effects (*e.g.,* momentary, brief, temporary, short-term, medium-term, long-term, permanent, reversible).
- **Frequency** of effects (*i.e.,* will occur once, rarely, daily, monthly, constant *etc*.).
- **Probability** of effects (*i.e.* likelihood that identified effects will occur. *e.g.* likely/unlikely).
- **Quality** of effects (*i.e*., positive, neutral, negative/adverse).

The criteria for assessment of the magnitude of the landscape and visual effects are set out in Table 3-3.

Table 3-3: Criteria for Assessment of Magnitude of Landscape & Visual Effects

Magnitude of Effect	Criteria / Typical Description
Very High	Major alteration to, or complete loss of, key landscape or visual characteristics or components of the baseline condition. Effects likely to be experienced at a very large scale, considered permanent and irreversible.
High	Notable or longer-term change to a widespread area or view or a notable change in continuous or key landscape or visual characteristics or components.
Medium	Moderate or longer-term change over a restricted area or view or a moderate change in key landscape or visual characteristics or components.
Low	Minor short or medium-term change over a restricted area or view or a minor change in key landscape characteristics or components.
Very Low / Negligible	Imperceptible change in key landscape or visual characteristics or components.

3.4.2 Do-Nothing Scenario

In the 'do-nothing' scenario, the wind farm will continue to operate with the benefit of the existing planning permission until October 2023, after which it would need to be decommissioned and the site returned to low-intensity grazing. The current landscape and visual effects being experienced from the operation wind farm would largely be reversed.

3.5 Visual Assessment

3.5.1 Existing Visual Baseline

The existing visual baseline is based on the available information from the County Development Plan and fieldwork carried out. Establishing the visual baseline includes identification of people who may be affected by the development, the identification of the views and viewpoints from which the turbines are visible and identification of scenic and vulnerable features closest to the site.

In County Sligo, the scenic and vulnerable features within the study are include:

1. The ridgelines of the Ox Mountains to the east and northeast of the site.
2. Atlantic coast.
3. Shoreline of Lough Talt.
4. Scenic routes:
    a. R294 from The Gap (Mayo County boundary) to Mullany's Cross; Views of Lough Talt and Ox Mountains.
    b. R297 from Scurmore to Dromore West; Views of Killala Bay and Atlantic Ocean.
    c. Easky coastal scenic road (L-2401) between junctions with Dromore West - Easky road (R297); Views of Sligo Bay, the coast, Ox Mountains and Donegal Bay.
    d. Coast road from R297 at Dromore West to N59 at Beltra (L-2302 & L-2204); Views of Atlantic Ocean, Sligo Bay, Ballysadare Bay, Ox Mountains, Knocknarea and Ben Bulben.
    e. Aughris Head (L-2301 turning onto L-6301) between junctions with Beltra - Dromore West coastal road (L-2302); Views of Knocknarea, Ben Bulben, the coast and Sligo & Donegal Bays.
    f. Derk road (L-6215) from junction with Beltra - Dromore West coastal road (L-2204) to sea shore; Views of Ballysadare Bay, Knocknarea, Coolera Peninsula, Coney Island, Rosses Point, Sligo Bay and Ben Bulben.
    g. Dromore West to Mullany's Cross (L-2702, L-4701 & L-4702); Views of Lough Easky, Ox Mountains and Atlantic Ocean.

h. L-8701 & L-8702 from junction with L-4701 at Masshill to junction with R294 at Largan; Views of Lough Talt and Ox Mountains.
i. Ladies Brae road from Carroweden (L-4602 & L-2205) leading to N59 via L-2304 and L-2303 and continuing northwards to Beltra - Dromore West coastal road (L-2302) via L-6205; Views of Ox Mountains and Atlantic Ocean.
j. Carroweden to Coolaney and continuing to junction with N59 at Lugnadeffa (L-8601, L-6804 & L-2801); Views of Ox Mountains and Atlantic Ocean.
k. Coast road from Mayo County boundary at Rathmurphy northwards to its junction with R297 at Scurmore; Views of Killala Bay.

The scenic and vulnerable features closest to the site in County Mayo include:

1. The ridgeline of the Ox Mountains to the east of the site.
2. The shorelines of the lakes to the southwest of the site (Ballymore Lough, Carrowkeribly Lough and Lough Conn), and the shoreline of the Moy River further west and southwest.
3. Scenic routes:
    a. Between the Gap and Cregganalara – the R294 regional road.
    b. Route running north from Ballina following the local road on the eastern bank of the River Moy estuary.
    c. Route following the R315 from Lahardaun to Pontoon (west of Lough Conn).
    d. L134 from Knockmore to north of Ross West (between Lough Conn and Lough Cullin).
    e. Local road from Beltra to the R315 junction at Lough Conn.
    f. Local road east of Lough Conn, from Garrycloonagh to Brackwanshagh.

The operational and permitted wind farms in the study area are summarised in Table 3-4.

Table 3-4: Operational & Permitted Wind Farms in Study Area

Wind Farm Name	Brief Description	Distance from Lackan Wind Farm (km)
Carrowleagh	17 No. turbines with 99.5m tip height (64m hub and 71m rotor diameter) for 16 No. turbines and one turbine with 125m tip height (78m hub and 92m rotor diameter)	Located 12.4km to 15km to the southeast.
Black Lough	6 No. turbines with 125m tip height (78m hub and 92m rotor diameter)	Located 11.2km to 11.9km to the southeast
Bunnyconnellan	12 No. turbines with 99.5m tip heights (64m hub and 71m rotor diameter)	Located 16.9km to 18.5km to the southeast
Killala	5 No. turbines with 125m tip height (74.5m hub and 100m rotor diameter). With planning for a 6th	Located 11.6km to 12.2km the west
King's Mountain	10 No. turbines with 100m tip height (60m hub and 80m rotor diameter)	Located 17.7km to 19.2km to the south-southeast
Dunneill	13 No. turbines with 75m tip height (49m hub and 52m rotor diameter)	Located 14km to 15.6km the south-southeast
Kilbride	Planning permission is for 21 No. Enercon E70 turbines (85m hub height and 71m rotor diameter)	Located between 12km and 14km to the south
Glenree	Planning permission is 1 No. turbine (81m hub height and 138m rotor diameter)	Located 16.5km to the south
Stokane	Planning permission is 1 No. turbine (50m tip height)	Located 11.9km to the southeast

3.5.2 Visibility of Turbine

A zone of theoretical visibility (ZTV) map was prepared using the following:

- An Ordnance Survey contour map (DTM) of the 39km x 32km study area.
- A Discovery Series map 1:50,000.
- ReSoft Wind Farm software.

The ZTV map indicates areas where the Lackan Wind Farm is theoretically visible in the landscape. The ZTV is used to carry out a preliminary assessment of the visibility of the turbines. The ZTV presents a 'smooth earth', worse-case visibility of the turbines as it doesn't take account of local screening provided by hedgerows, trees, buildings and local topographical features. As such, the ZTV shows areas from where the turbines will not be visible.

Figure 3-2 shows the visibility of the Lackan Wind Farm by itself. The ZTV shows potential visibility as calculated for half the blade length (i.e., the hub height plus half the blade length – in accordance with the draft guidelines[8]. As shown in Figure 3-2, the turbines will potentially be visible primarily from areas within 10km of the wind farm. Within this area, approximately half the theoretical visibility is from the sea. Beyond 10km, theoretical visibility becomes patchy and is mostly from mountain slopes facing towards Lackan. The Ox Mountains effectively screens views of the turbines from areas to the east of the mountains; rolling coastal topography around Dromore West screens visibility from the east, as it does to the south of Ballina.

3.5.3 Cumulative Visibility

A further ZTV was prepared showing the cumulative theoretical visibility of the other six operational wind farms (as listed in Table 3-4). Figure 3-3 shows the visibility of:

1. Areas from where only the six operational wind farms are theoretically visible - shown orange/brown. This theoretical visibility occurs mainly in the northeast corner of the map area; large areas to the south of Ballina, including Lough Conn; areas west of the Killala Wind Farm; and in small patches to the east of the Ox Mountains.
2. Areas from where both the other operational wind farms and the Lackan Wind Farm are theoretically visible - shown blue. This has a similar theoretical visibility distribution to that of the Lackan Wind Farm by itself (refer to Figure 3-2).
3. Areas from where only the Lackan Wind Farm is theoretically visible - shown red. These occur as very small patches scattered across the area west of the Ox Mountains.

The conclusion from the ZTV analysis is that the Lackan Wind Farm does not increase the areas from where the other operational wind farms in the study area are theorical visibility.

3.5.4 Wireframe & Photograph Analysis

ReSoft Wind Farm software was used to create a number of wireframe views from several viewpoints selected based on the visibility of the Lackan Wind Farm in the landscape, with visually important or sensitive locations preferentially selected. Photographs were then taken from these same locations. These photographs and wire frame view formats, taken over various distance ranges, are presented in Figures 3-4 to 3-17. For each viewpoint location the current view and wireframe are shown, followed by the current view and the view that would be experienced with the turbines removed (i.e., the Lackan Wind Farm is photoshopped out of the photograph). Viewpoint locations are shown on Figure 3-1. A description of the viewpoints is presented in Table 3-5.

Table 3-5: Description of Viewpoints

Viewpoint Number	Location	Distance from Wind Farm
VP1	Viewpoint No.1 – From Local Road in Clooneenmore	4.8km
VP2	Viewpoint No.2 – From R297 / L6409 Junction in Quignalahy	2.88km
VP3	Viewpoint No.3 – From R297 at Inishcrone-Kilglass GAA Grounds	0.97km
VP4	Viewpoint No.4 – From Kilglass Community Hall	1.6km
VP5	Viewpoint No.5 – From Shoreline at Promontory Fort	1.95km
VP6	Viewpoint No.6 – From Foreshore at Lackan	0.62km
VP7	Viewpoint No.7 – From Ross Beach, Killala, County Mayo	8.3km

The assessment is based on an evaluation of the viewpoint *sensitivity* and the *magnitude and significance* of change experienced by the presence of the wind farm for each landscape or visual receptor. As the wind farm is already there, the assessment considers the capacity demonstrated by the landscape / visual receptor to absorb the wind farm and consequently, the visual impact of its extended lifespan against its removal. The significance of an impact is determined by the nature of the receptor to be affected and the nature / magnitude of the effect. The flow chart below sets out the approach taken in the assessment.

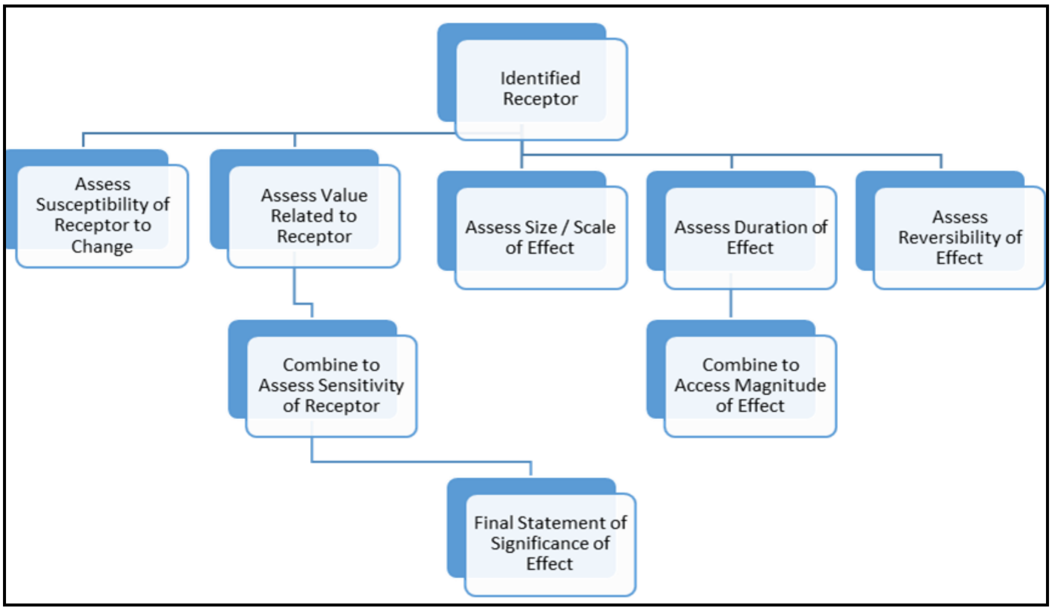


Plate 3-1: Flow Chart for Visual Impact Assessment

<u>Viewpoint No.1 - View from Local Road in Clooneenmore</u>

The viewpoint is located approximately 4.8km to the northeast of Lackan Wind Farm on a local road used mostly for local traffic. This location was selected to represent middle -distance views of the site from the local road network between the N59 and R297 – refer to Figure 4-1. The views from this location are dominated by near views of the flat marginal agricultural land. The Lackan Wind Farms is clearly visible from this location but is not a dominant feature in the landscape from this distance, due to the wide viewing scope offered in this flat landscape.

From the ZTVs, it would be expected that the Lackan and other operational wind farms would be visible from this location. In the wireframe, the Lackan Wind Farm and Killala Wind Farm are visible, but the Killala Wind Farm is largely set against the backdrop of the mountains near Ballycastle and difficult to see. The other operational wind farms are theoretically visible, but in the opposite viewing direction.

Visual Impact

At 4.8km, the Lackan Wind Farm will be clearly visible in most weather conditions. The Killala Wind Farm will not be visible in the background in all but the clearest weather conditions. The local road network in this area are not scenic routes, being used mostly by local traffic. Due to the wide viewing range available in this flat landscape, the wind farm does not form a dominant visual element in the landscape. The existing view demonstrates the capacity of the landscape to absorb this development. Due to distance and mountain backdrop of the Killala Wind Farm, it is not clearly visible, so there is no-imperceptible cumulative visual impact. Likewise, the other operational wind farms are distant from this location and although theoretically visible, they are screened by near view vegetation screening. The extension of the wind farm operational period by 12 years will not change the current visual impact experienced. The presence of the Lackan Wind Farm is considered a not significant long-term visual effect. The location is not a designated view or near a visually vulnerable feature, so visual sensitively is low-medium. As such, the overall magnitude is considered Very Low / Negligible.

Viewpoint No.2 – View from R297 / L6409 Junction in Quignalahy

The viewpoint is located approximately 2.88km to the north of Lackan Wind Farm on the R297 regional road between Easky and Inishcrone. This is a designated scenic route in the Sligo CDP. The road is a commuter route and an important tourist route, being part of the Wild Atlantic Way. This location was selected to represent near views of the site from a coastal scenic route – refer to Figure 4-1. Again, the views from this location are dominated by near views of the flat marginal agricultural land. The Lackan Wind Farms is clearly visible from this location and forms a major feature in the landscape from this distance.

From the ZTVs, it would be expected that the Lackan and other operational wind farms would be visible from this location. In the wireframe, the Lackan Wind Farm and Killala Wind Farm are visible, but the Killala Wind Farm is largely set against the backdrop of the mountains near Ballycastle; it sits between Lackan turbines T1 and T2 from this perspective, but difficult to see due to hazy weather conditions. The other operational wind farms are theoretically visible, but in the opposite viewing direction.

Visual Impact

At 2.88km, the Lackan Wind Farm will be clearly visible in most weather conditions. The Killala Wind Farm will not be visible in the background in all but the clearest weather conditions, as demonstrated in the photograph. While the wind farm forms a major visual element of the landscape, it does not dominate the vista. From this perspective, the turbines have an even spacing with a regular linear layout. This gives a sense of order which ameliorates the visual impact. Again, the existing view demonstrates the capability of the landscape to absorb this development. Due to distance and mountain backdrop of the Killala Wind Farm, it is not clearly visible, so there is no-imperceptible cumulative visual impact. Likewise, the other operational wind farms are distant from this location and although theoretically visible, they are screened by near view vegetation screening. The extension of the wind farm operational period by 12 years will not change the current visual impact experienced. The presence of the Lackan Wind Farm is considered a not significant long-term visual effect. The location is a designated scenic route, so visual sensitively is Very High. As such, the overall magnitude is considered Medium.

Viewpoint No.3 – View from R297 at Inishcrone-Kilglass GAA Grounds

The viewpoint is located on the R297 regional road just outside the Inishcrone-Kilglass GAA grounds, in Kilglass village. It is 0.97km to the southeast of the wind farm. This is a designated scenic route in the Sligo CDP. The road is a commuter route and an important tourist route, being part of the Wild Atlantic Way. This location was selected to represent near, side, views of the site from a coastal scenic route, and a focal point for community activity – refer to Figure 4-1. The views from this location are dominated by distant views of Killala Bay and the Mayo coastline. The Lackan Wind Farms is clearly visible from this location and forms a major feature in the landscape from this distance.

From the ZTVs, it would be expected that the Lackan and other operational wind farms would be visible from this location. In the wireframe, only the Lackan Wind Farm is visible. The other operational wind farms are theoretically visible, but outside the viewing angle of the wireframe, mostly in the opposite viewing direction.

Visual Impact

At 0.97km, the Lackan Wind Farm will be clearly visible in most weather conditions. While the wind farm forms a major visual element of the landscape, it does not dominate the vista. From this perspective, the turbines have an even spacing but with a staggered linear layout. There is still a sense of order which ameliorates the visual impact. The existing view demonstrates the capability of the landscape to absorb this small-scale wind farm. There is no-imperceptible cumulative visual impact with other operational wind farms – they are screened by near topography, the built environment and vegetation. The extension of the wind farm operational period by 12 years will not change the current visual impact experienced. The presence of the Lackan Wind Farm is considered a moderate long-term visual effect. The location is a designated scenic route, so visual sensitively is Very High. As such, the overall magnitude is considered Medium.

<u>Viewpoint No.4 – View from Kilglass Community Hall</u>

The viewpoint is located just off the R297 regional road in the car park of the Kilglass Community Hall. It is 1.6km to the south of the wind farm. The R297 is a designated scenic route in the Sligo CDP. This location was selected to represent near views of the site from a coastal scenic route, and a focal point for community activity – refer to Figure 4-1. The views from this location are dominated by pleasant near views of grazing land, defined by limestone walls and mature stands of trees surrounding Kilglass House & Woodland (just to the right of the view). Distant sea views also form a major component of the view. The Lackan Wind Farms is clearly visible from this location but does not form a major feature in the landscape; the turbines are partially screened by a house and small factory and appear at a scale proportionate to the trees just to the left of the turbines.

From the ZTVs, it would be expected that the Lackan and other operational wind farms would be visible from this location. In the wireframe, only the Lackan Wind Farm is visible. The other operational wind farms are theoretically visible, but outside the viewing angle of the wireframe, mostly in the opposite viewing direction.

Visual Impact

At 1.6km, the Lackan Wind Farm will be clearly visible in most weather conditions. It does not form a major visual element of the landscape and is seen as being in proportion to the trees and built environment between the viewpoint and turbines. It could even appear as part of the small factory. Although in close proximity, it does not dominate the vista. From this perspective, the turbine spacing, and layout appear irregular. That said, the wind farm doesn't appear out of place. There is no-imperceptible cumulative visual impact with other operational wind farms - they are screened by near topography, the built environment and vegetation. The extension of the wind farm operational period by 12 years will not change the current visual impact experienced. The presence of the Lackan Wind Farm is considered a slight long-term visual effect. The location is near a designated scenic route, so visual sensitively is Very High. As such, the overall magnitude is considered Low.

<u>Viewpoint No.5 – View from Shoreline at Promontory Fort</u>

The viewpoint is located on the shoreline at the Promontory Fort. It is 1.95km to the south of the wind farm. The coastline is designated visually vulnerable in the Sligo CDP. This location was selected to represent near views of the site from a coastal location, which has added significance as a cliff-edge fort (with a number of archaeological features – huts and souterrain) – refer to Figure 4-1. The views from this location are dominated by the sea views and coastline cliffs and beaches. The Lackan Wind Farms is clearly visible from this location and forms a major feature in the landscape; their height is exaggerated against the flat coastal plain and the higher vantage point.

From the ZTVs, it would be expected that the Lackan and other operational wind farms would be visible from this location. In the wireframe, only the Lackan Wind Farm is visible. The other operational wind farms are theoretically visible, but outside the viewing angle of the wireframe, mostly in the opposite viewing direction.

Visual Impact

At 1.95km, the Lackan Wind Farm will be clearly visible in most weather conditions. While the wind farm forms a major visual element of the landscape, it does not dominate the vista – the coastal sea views are the dominant feature. From this perspective, the turbines have an even spacing with a regular linear layout. This gives a sense of order which ameliorates the visual impact. There is a sense of that the wind farm is suitability located at this exposed windy site. There is no-imperceptible cumulative visual impact with other operational wind farms - they are distant, screened by near topography, the built environment and/or vegetation. The extension of the wind farm operational period by 12 years will not change the current visual impact experienced. The presence of the Lackan Wind Farm is considered a moderate long-term visual effect. The location is at a visually vulnerable feature at the coastline, so visual sensitively is Very High. As such, the overall magnitude is considered Medium.

Viewpoint No.6 – View from Foreshore at Lackan

The viewpoint is located on the shoreline just 620m south of the wind farm. The coastline is designated visually vulnerable the Sligo CDP. This location was selected to represent near views of the site from a coastal location – refer to Figure 4-1. The views from this location are dominated by the sea views, coastline shingle beaches, and the flat marginal farmland extending to the east. The Lackan Wind Farm is clearly visible from this location and forms a major feature in the landscape. While closer than viewpoint No.6, the turbines don't appear as tall due to the lower elevation of the viewpoint.

From the ZTVs, it would be expected that the Lackan and other operational wind farms would be visible from this location. In the wireframe, only the Lackan Wind Farm is visible. The other operational wind farms are theoretically visible, but outside the viewing angle of the wireframe, mostly in the opposite viewing direction.

Visual Impact

At 620m, the Lackan Wind Farm will be clearly visible in most weather conditions. While the wind farm forms a major visual element of the landscape, it does not dominate the vista – the coastal sea views are the dominant feature. From this perspective, the turbines have an even spacing with a regular linear layout. This gives a sense of order which ameliorates the visual impact. Again, there is also a sense that the wind farm is suitability located at this exposed windy site. There is no-imperceptible cumulative visual impact with other operational wind farms - they are distant, screened by near topography, the built environment and/or vegetation. The extension of the wind farm operational period by 12 years will not change the current visual impact experienced. The presence of the Lackan Wind Farm is considered a moderate long-term visual effect. The location is at a visually vulnerable feature at the coastline, so visual sensitively is Very High. As such, the overall magnitude is considered Medium.

Viewpoint No.7 – View from Ross Beach, Killala, County Mayo

The viewpoint is located on the western shoreline of Killala Bay, approximately 8.3km from Lackan Wind Farm. This is a populator destination for beachgoers. The entire coastline of County Mayo is designated as Vulnerable Areas in the CDP. This location was selected to represent views from the opposite shore of Killala Bay, as requested by the planning authority during its assessment of the original application. The views from this location are dominated by the beaches and near coastal features (beaches, dunes, etc). The background is dominated by the mountains of Donegal, Leitrim and Mayo and Sligo. The Lackan Wind Farm is clearly visible from this location as the turbines rise above the coastal plain backdrop, but they only form a minor feature in the wider landscape. From the ZTVs, it would be expected that the Lackan and other operational wind farms would be visible from this location. In the wireframe, the Lackan Wind Farm and five of the six other operational wind farms are visible – Dunneill, King's Mountain, Black Lough, Carrowleagh and Bunnyconnellan. Killala Wind Farm is theoretically visible from this location but in the opposite viewing direction. However, it isn't visible due to the immediate topography at the beach.

Visual Impact

The Lackan Wind Farm will be visible in most weather conditions as it raises above the low-lying coastal plain. The other operational wind farm will however be only visible in the clearest of weather conditions; they are all set against the backdrop of the Ox Mountains (the turbines don't break the skyline) and they are between twice and three times the distance from this viewpoint. The Killala Wind Farm will not be visible in the opposite viewing direction due to a slight rise in the nearby intervening topography. The local road network in this area are not scenic routes. Due to distance and the wide viewing range available, the wind farm forms a minor visual element in the landscape. The existing view demonstrates the capacity of the landscape to absorb this development. Due to distance and mountain backdrop of the other wind farms, they will only be visible in the clearest weather, so there is slight-not significant cumulative visual impact. The extension of the wind farm operational period by 12 years will not change the current visual impact experienced. The presence of the Lackan Wind Farm is considered a slight long-term visual effect. The location is designated a vulnerable area, so visual sensitively is Very High. As such, the overall magnitude is considered Medium.

3.6 Landscape Assessment

3.6.1 Landscape Appraisal of County Sligo

Landscape policy is addressed in Section 7.4 of the current County Development Plan (2017 – 2023). A landscape characterisation and appraisal study was commissioned by Sligo County Council and completed by CAAS Environmental Consultants in 1996 and has been included in subsequent development plans. The landscape characterisation map (Plate 4-2) classifies the County according to its visual sensitivity and capacity to absorb new development without compromising the scenic character of certain areas. It designates the following:

- **Normal Rural Landscapes:** areas with natural features (e.g., topography, vegetation) which generally have the capacity to absorb a wide range of new development forms – these are largely farming areas and cover most of the County. At the same time, certain areas located within normal rural landscapes may have superior visual qualities, due to their specific topography, vegetation pattern, the presence of traditional farming or residential structures. These areas may have limited capacity for development or may be able to absorb new development only if it is designed to integrate seamlessly with the existing environment.

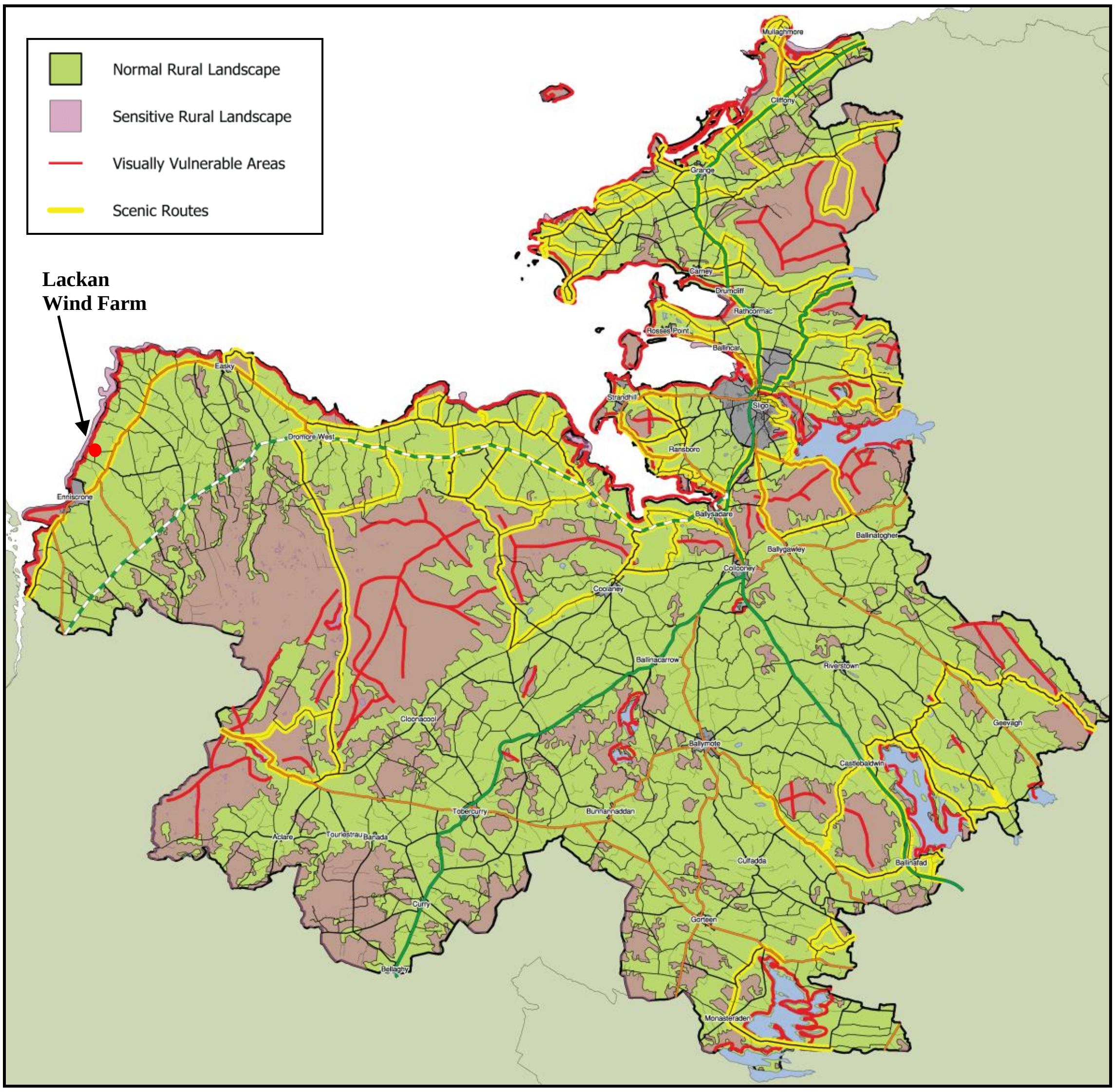


Plate 3-2: County Sligo Landscape Characterisation Map

- **Sensitive Rural Landscapes:** areas that tend to be open in character, highly visible, with intrinsic scenic qualities and a low capacity to absorb new development – e.g., Knocknarea, the Dartry Mountains, the Ox Mountains, Aughris Head, Mullaghmore Head etc.
- **Visually Vulnerable Areas:** distinctive and conspicuous natural features of significant beauty or interest, which have extremely low capacity to absorb new development – examples are the Ben Bulben plateau, mountain and hill ridges, the areas adjoining Sligo's coastline, most lakeshores etc.
- **Scenic Routes:** public roads passing through or close to Sensitive Rural Landscapes, or in the vicinity of Visually Vulnerable Areas, and affording unique scenic views of distinctive natural features or vast open landscapes. In addition to remote views, scenic routes have often a distinctive visual character conferred by old road boundaries, such as stone walls, established hedgerows, lines of mature trees, adjoining cottages or farmyards together with their traditional, planted enclosures etc., all of which warrant protection.

The landscape characterisation and protection policies are:

P-LCAP-1 *Protect the physical landscape, visual and scenic character of County Sligo and seek to preserve the County's landscape character. Planning applications that have the potential to impact significantly and adversely upon landscape character, especially in Sensitive Rural Landscapes, Visually Vulnerable Areas and along Scenic routes, may be required to be accompanied by a visual impact assessment using agreed and appropriate viewing points and methods for the assessment.*

P-LCAP-2 *Discourage any developments that would be detrimental to the unique visual character of designated Visually Vulnerable Areas*

P-LCAP-3 *Preserve the scenic views listed in Appendix F and the distinctive visual character of designated Scenic Routes by controlling development along such Routes and other roads, while facilitating developments that may be tied to a specific location or to the demonstrated needs of applicants to reside in a particular area. In all cases, strict location, siting and design criteria shall apply, as set out in Section 13.4 Residential development in rural areas (development management standards).*

P-LCAP-4 *Strictly control new development in designated Sensitive Rural Landscapes, while considering exceptions that can demonstrate a clear need to locate in the area concerned. Ensure that any new development in designated Sensitive Rural Landscapes:*

- *does not impinge in any significant way on the character, integrity and distinctiveness of the area;*
- *does not detract from the scenic value of the area;*
- *meets high standards of siting and design;*
- *satisfies all other criteria with regard to, inter alia, servicing, public safety and prevention of pollution.*

P-LCAP-5 *Protect the historic and archaeological landscapes of the County.*

P-LCAP-6 *Preserve the status of traditionally open/unfenced landscapes. Fencing in upland or amenity areas will not normally be permitted unless such fencing is essential to the viability of the farm and conforms to best agricultural practice. The nature of the material to be used, the height of the fence and, in the case of a wire fence, the type of wire to be used will be taken into account. Barbed-wire shall not be used for the top line of wire. Stiles or gates at appropriate places will be required.*

P-LCAP-7 *Where possible, preserve the open character of commonage and other hill land and secure access thereto.*

Section 10.4 of the CDP addresses the Coastal Environment. Wind farms are cited as being one of the five pressures on the coastal zone. The coastal zone is defined in the CDP as the area between the high-water mark and the nearest scenic route or other continuous road parallel to the coast. The Lackan Wind Farm is therefore located in the coastal zone.

Policies relating to development in the coastal zone are:

P-DCZ-1 *Generally restrict development in the coastal zone except where it can be demonstrated that it does not detract from views, visually intrude on the coastal landscape or impact on environmentally sensitive areas. Between coastal roads and the sea, exceptions will be considered only for sustainable tourism development, public infrastructural works and development that is contiguous with existing towns and villages and subject to compliance with the Habitats Directive.*

P-DCZ-2 *Restrict the location of industrial development within the coastal zone to resource-based activities that have a clear and demonstrable need, i.e. those dependent on resources available at the sea or coast (e.g. maritime industries, mariculture). All such proposals will be subject to the strict application of location, siting and design criteria and subject to compliance with the Habitats Directive.*

P-DCZ-3 *Prohibit development in coastal areas where the natural erosion process is likely to threaten the viability of such development*.

3.6.2 Wind Farm Guidelines

The wind farm Guidelines describe six landscape types that represent the likely situations in which wind farms would be developed. These are:

- Mountain moorland
- Hilly and flat farmland
- Flat peatland
- Transitional marginal land
- Urban / industrial
- Coast

Of these, Coast best describes the landscape type of the Lackan Wind Farm. A summary of the recommendations is provided in Table 4-6.

Table 3-6: Summary of Landscape Character Based Recommendations

Landscape Type	Location	Spatial Extent	Cumulative Effect	Spacing	Layout	Height
Coast	Set back from water.	Do not cross over between beaches and rocky promontories	A second wind energy development may be acceptable only at a very great distance with minimal visual presence.	Regular is most appropriate. Graded spacing may be acceptable on promontories.	Linear, especially along beaches. A cluster may be acceptable on promontories.	Tall may be acceptable, especially along beaches. Profile should be even.

The key characteristics of coastal landscape given in the Guidelines are:

- Beaches, dunes, rocks, promontories and/or cliffs.
- High rocky crags may have scrub, heather, bracken and gorse as land cover, whereas flatter areas are more likely to comprise farmland.
- Seashores can also include harbours, hamlets, villages and towns and some of these may have developed into seaside holiday resorts.

- This landscape type involves openness, nature and recreation and thus may be sensitive. Coastal landscapes identified through sensitivity analysis, as being rare scenic quality may not be appropriate for wind energy development.
- The essential key here is one of simplicity and rational order. The juncture of land and sea is extremely attractive to the eye. Its linearity or, perhaps more likely, curvilinearity creates a strong aesthetic contrast with the planar quality of the sea in geometric terms. Both are, nevertheless, essentially simple and elemental. Rather than inhibiting the introduction of a wind energy development, the associations and symbolism of the seashore challenge the wind energy development design to achieve aesthetic excellence. The simplicity of many coastlines prompts a corresponding simplicity regarding the introduction of wind energy developments.

The wind farm design guidance is given in terms of location, spatial extent, spacing, layout, height and cumulative effect.

Location
Wind energy developments should be set back from the sea and clearly located on solid ground. They are suited to low beach shorelines as well as rocky promontories.

Spatial Extent
This depends on the length of shoreline. In order to achieve simplicity, a wind energy development should not extend beyond one particular kind of shore. Accordingly, it should physically relate to a beach or a rocky promontory but not bridge the two.

Spacing
Regular turbine spacing would be most appropriate in order to achieve a serenity and composure that reflect those of the sea. A promontory could be used to achieve a dramatic aesthetic effect using graded spacing with the gradual tightening occurring seawards.

Layout
Wind energy developments should reflect the linearity of the shore by a corresponding linear or staggered linear layout. However, on a headland with a peak or hill, a clustered layout might be used to crown and thus accentuate the feature.

Height
Turbines can generally be tall, especially close to and parallel to beaches. More caution might be necessary in regard to promontories where the scale of the projecting land mass should be considered. The profile should be even in response to the flatness of the sea.

Cumulative Effect
Generally, along any length of shoreline one wind energy development can be visible in the fore or middle ground. A second one may be acceptable in the far distant background, provided it is only dimly visible under normal atmospheric conditions in order to preserve the spatial, scenic and thematic integrity of the shore. The principal objective is to ensure that multiple wind energy developments are not visible in close proximity from any one seaside location due to their generally sensitive nature.

The Lackan Wind Farm is compatible with some, but not all, the guidelines for wind farms in coastal landscapes. It is set back from the sea, consisting of medium height turbines with regular spacing. It is also located within the extent of a single coastal type – low-lying farmland adjacent to the shore. It is the only wind farm in this area, so cumulative effects are minimal. Its layout however doesn't parallel the shoreline; other constraints (for example, house offsets) informed the layout. This is not pronounced due to the low number of turbines – i.e., with only three turbines, the layout isn't a dominant aspect of the wind farm and from many perspectives appears with a regularly spaced linear layout.

3.6.3 Landscape Effects

The landscape effects are associated with the operation of the wind farm in the landscape. The infrastructure associated with the turbines including the access roads and control building are not readily visible beyond the immediate vicinity of the site. The overhead (visible) section of the grid connection is at least 825m from the control building. As such, the overhead powerline doesn't relate visually to the wind farm.

The wind farm is in the lowland coastal zone, with turbines at elevations of between approximately 4mOD and 9mOD. The landscape character is illustrated in Plate 3-3.

Plate 3-3: Landscape Character at Lackan (from North and South)

The ZTV indicates that the wind farm is potentially visible from a relatively contained area, primarily within 10km of the wind farm. Within this area, approximately half the theoretical visibility is from the sea. Beyond 10km, theoretical visibility becomes patchy and is mostly from mountain slopes facing towards Lackan. The Ox Mountains effectively screens views of the turbines from areas to the east of the mountains. Rolling coastal topography around Dromore West screens visibility from the east, as it does to the south of Ballina.

Based on the Landscape Receptor criteria in Table 4-1, the sensitivity of the landscape at the site might be rated as Very High – '*Landscape types may include but are not limited to: ……Protected coastal landscapes / seascapes'*. However, in its assessment of the original planning application, the Council state that '*while the proposed development is located in a sensitive area as designated in SCDP, the coast line at this location is non-descript in its nature comprising of a low lying coastal plain*'. As such, the sensitivity of the landscape at the site is rated as Medium[1] – '*a landscape that exhibits positive character. A landscape that is locally important, but that might contain some regionally important elements*'.

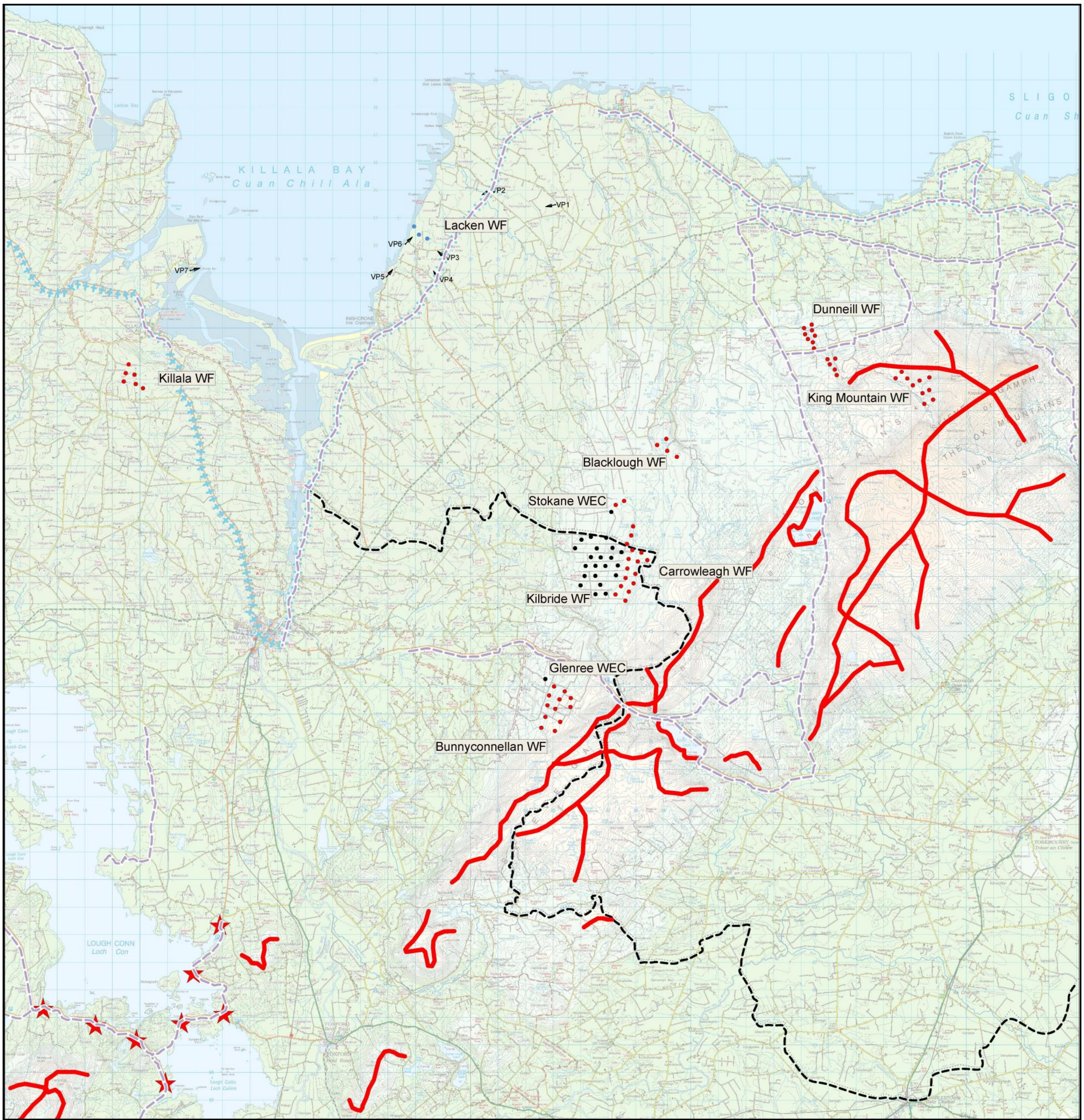
The extension of the lifespan of the Lackan Wind Farm by a further 12 years is considered a likely wide-spread, long-term not significant neutral effect. The cumulative effect is considered imperceptible due to the distances from other wind farms (refer to Table 3-4). The impact is reversible with the decommissioning of the wind farm.

There will be no visual change with the extension of the lifespan of the Lackan Wind Farm. The wind farm has become part of the landscape at Lackan, which has demonstrated capacity to absorb this development.

[1] Note that the visual sensitivity, as discussed in Section 3.5, is rated as Very High from scenic routes and visually vulnerable area.

3.7 Conclusions

The impact of the Lackan Wind Farm on the landscape along this coastal zone has been assessed. The conclusion is that the landscape has proven its capacity to absorb the development and impacts relating to extending its lifespan for an additional 12 years are not significant. The overhead section of the grid connection starts approximately 1km from the wind farm, so for most observers it has no association with it. The single pole powerline appears the same as those used for the local distribution network. Its use for a further 12 years will have an imperceptible visual impact.



Legend	
★	Scenic Views
▬ (red)	Visually Vulnerable Areas-Features
● (black)	Permitted Wind Farm
● (red)	Operational Wind Farm
▬ (purple)	Scenic Route
♦♦	Wid Atlantic Way
▬ (black)	Mayo-Sligo Border
↑VPXX	Viewpoints 1 to 7

Note: The coastline, lake shores and riverbanks are designated Vulnerable Areas in the Landscape Appraisal of County Mayo

Figure 3-1: LVIA Study Area

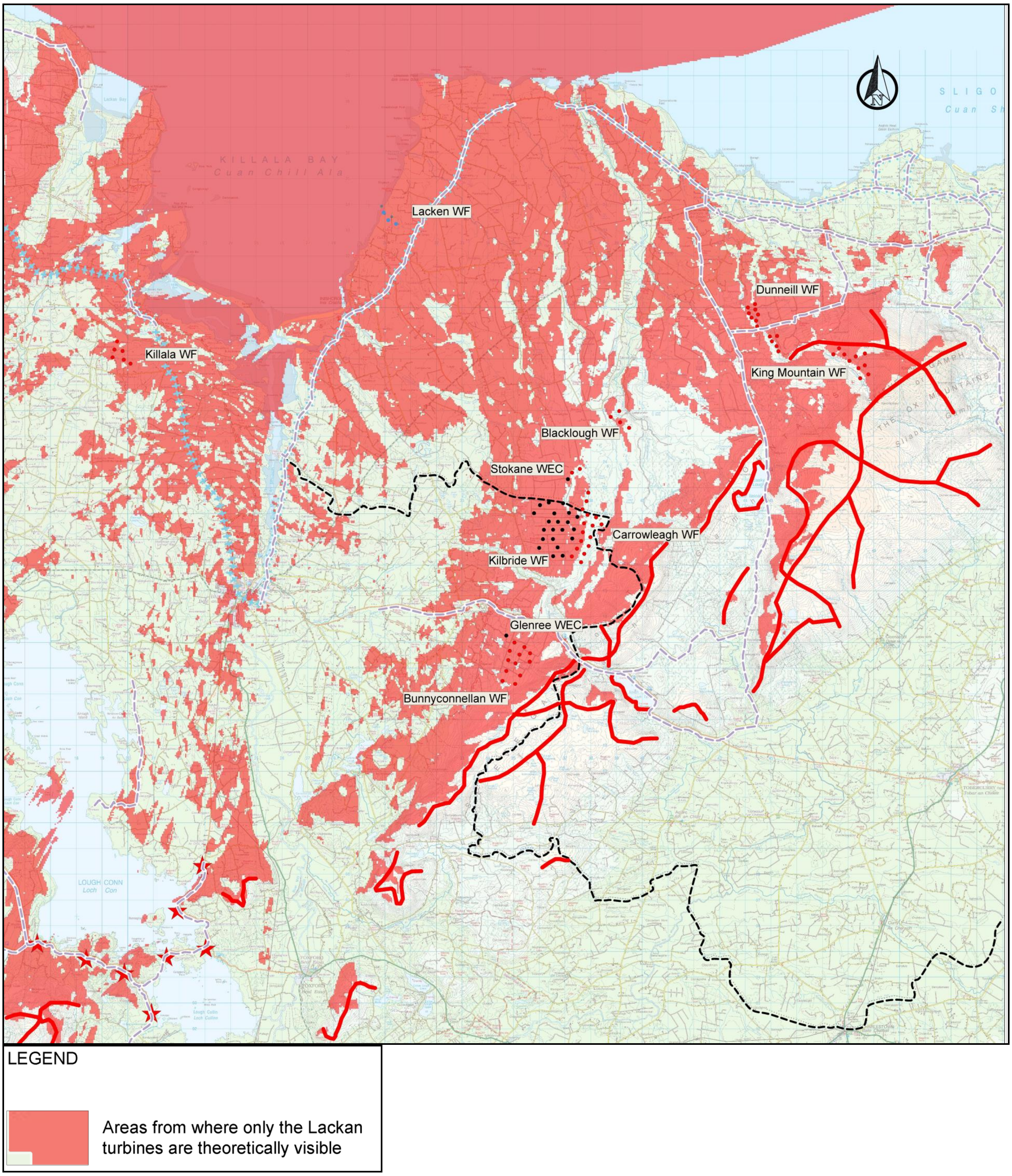
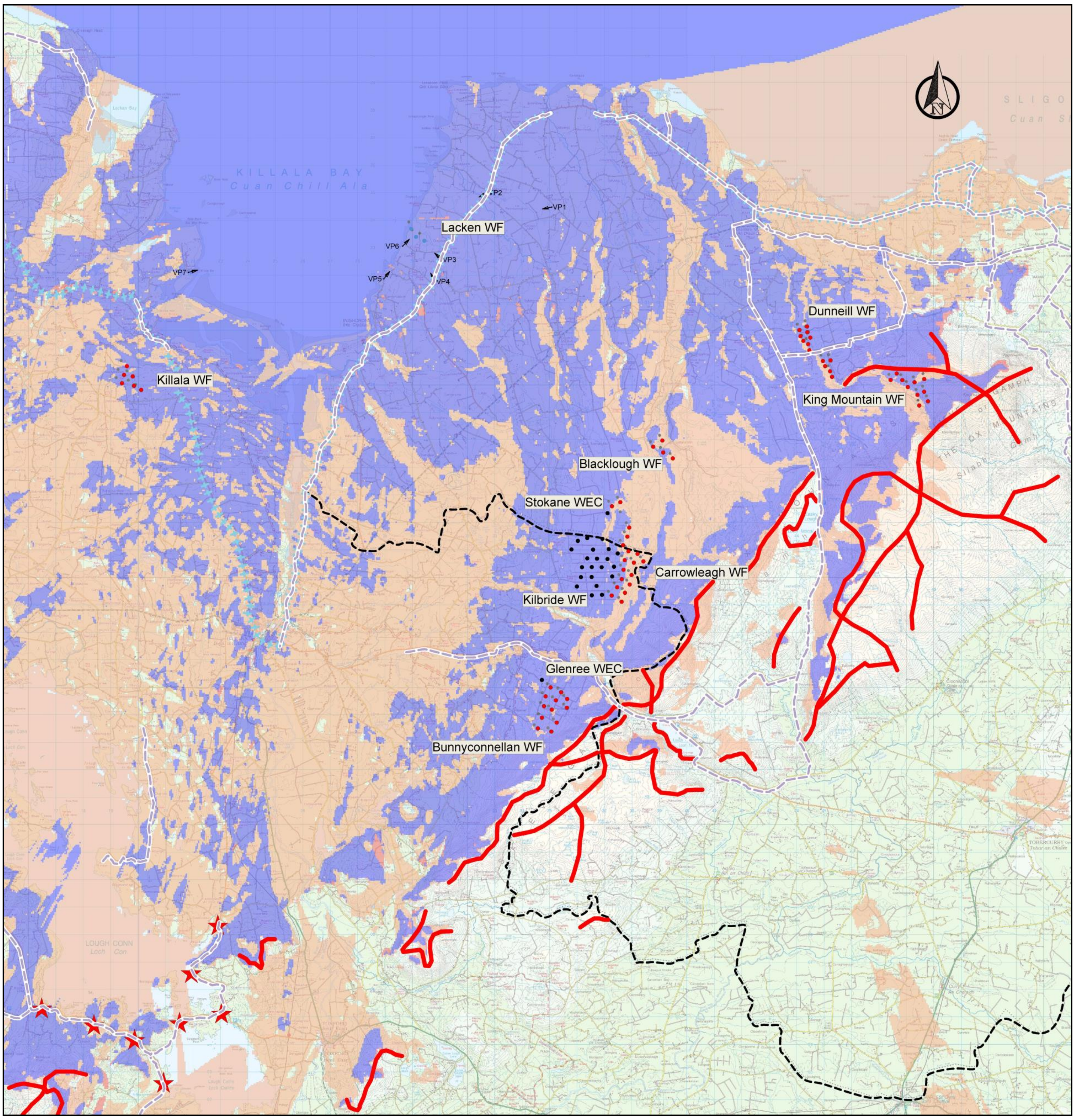


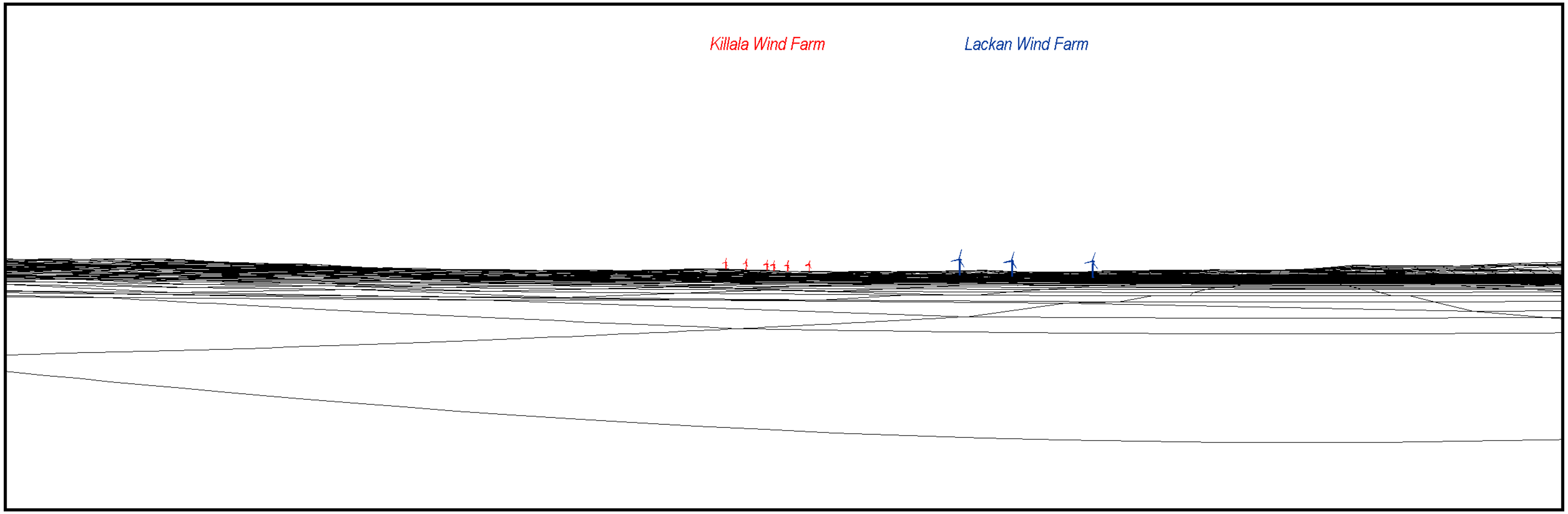
Figure 3-2: Zone of Theoretical Visibility – Lackan Wind Farm



LEGEND

	Areas from where only the six operational wind farms are theoretically visible
	Areas from where both the operational wind farms and the Lackan turbines are theoretically visible
	Areas from where only the Lackan turbines are theoretically visible

Figure 3-3: Zone of Theoretical Visibility – Lackan & Operational Wind Farms



Wireframe View of Lackan Wind Farm

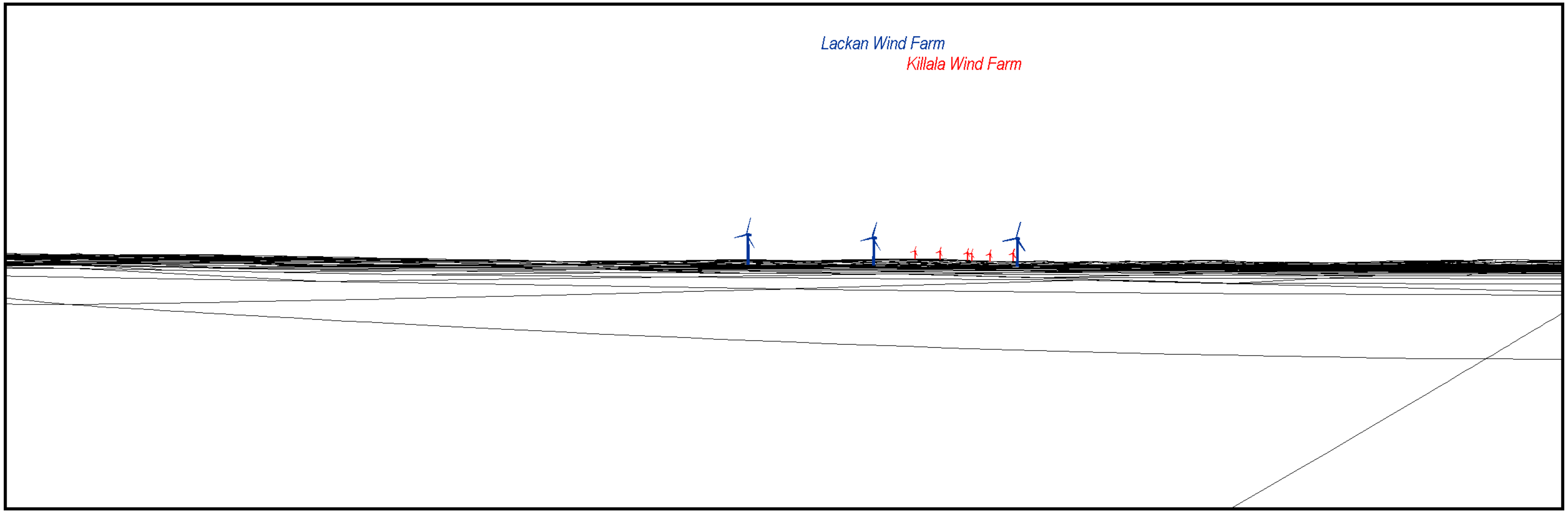
Existing View of Lackan Wind Farm

Figure 3-4: **Viewpoint No.1: From Local Road in Clooneenmore**


View with Lackan Wind Farm Photoshopped from Image


Existing View of Lackan Wind Farm

Figure 3-5: Viewpoint No.1: From Local Road in Clooneenmore



Wireframe View of Lackan Wind Farm

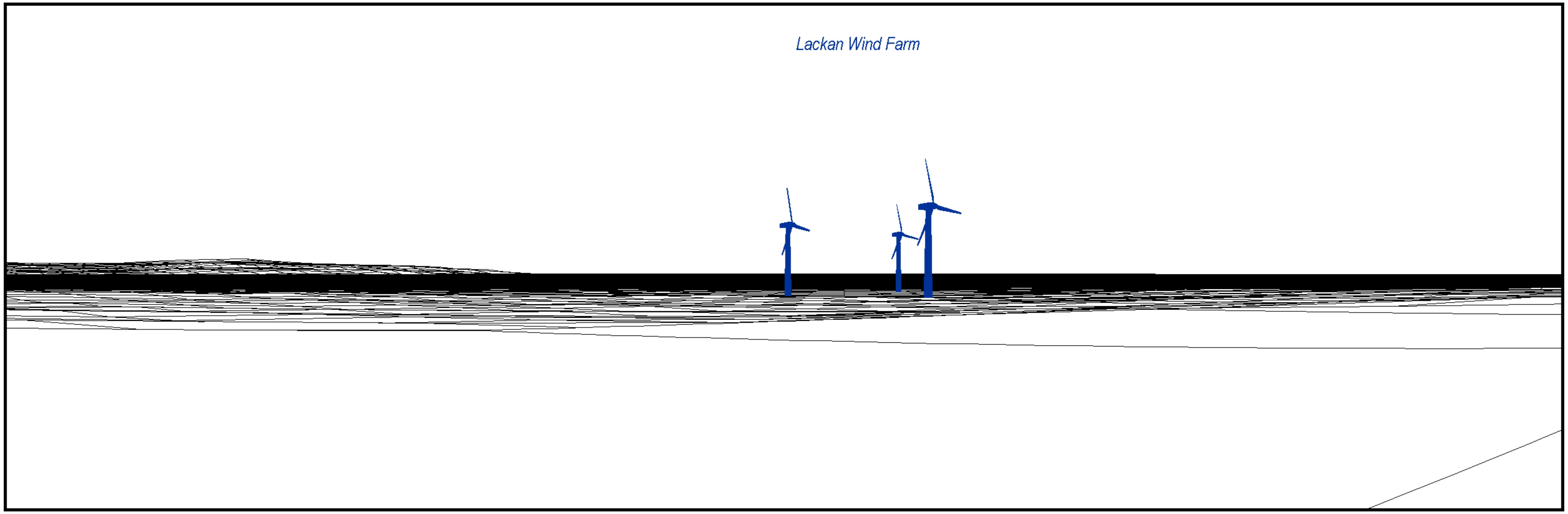
Existing View of Lackan Wind Farm

Figure 3-6: Viewpoint No.2: From R297 / L6409 Junction in Quignalahy

View with Lackan Wind Farm Photoshopped from Image

Existing View of Lackan Wind Farm

Figure 3-7: Viewpoint No.2: From R297 / L6409 Junction in Quignalahy



Wireframe View of Lackan Wind Farm

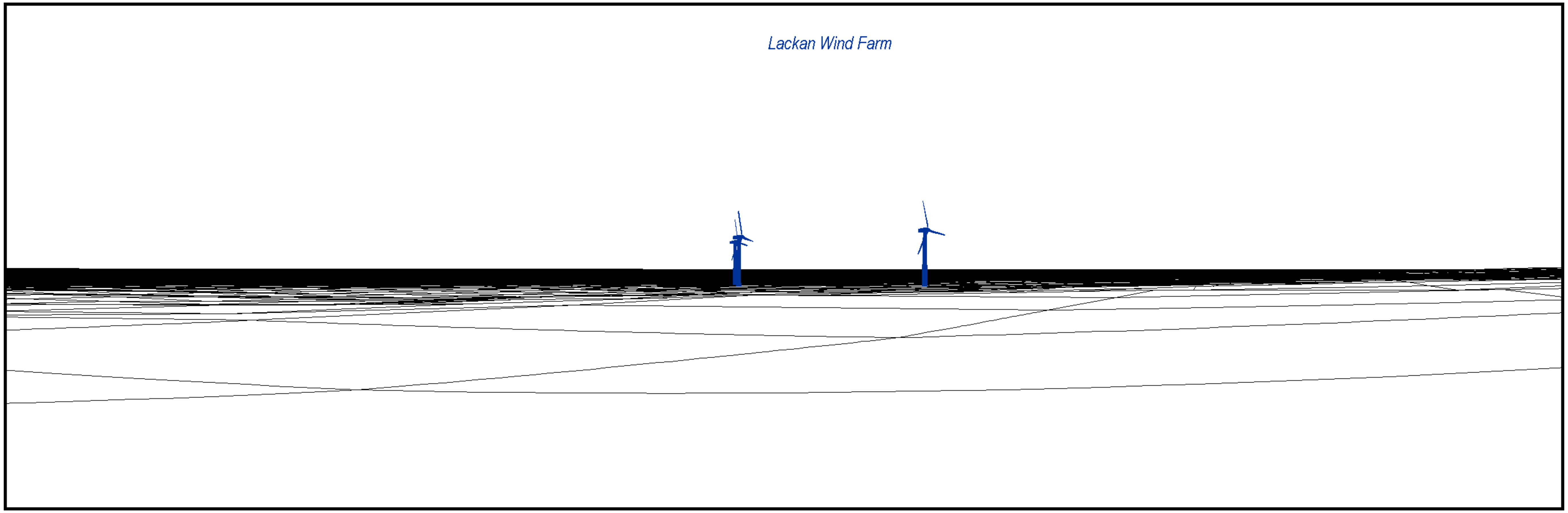

Existing View of Lackan Wind Farm

Figure 3-8: Viewpoint No.3: From R297 at Inishcrone-Kilglass GAA Grounds


View with Lackan Wind Farm Photoshopped from Image


Existing View of Lackan Wind Farm

Figure 3-9: Viewpoint No.3: From R297 at Inishcrone-Kilglass GAA Grounds



Wireframe View of Lackan Wind Farm

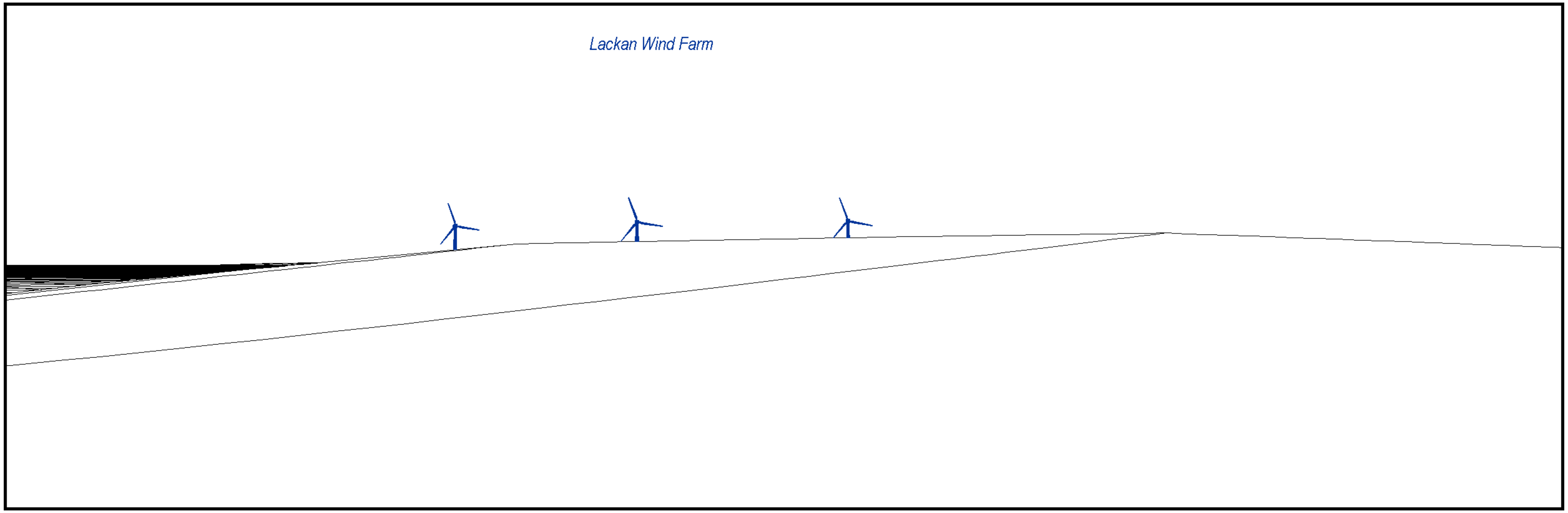
Existing View of Lackan Wind Farm

Figure 3-10: Viewpoint No.4: From Kilglass Community Hall

View with Lackan Wind Farm Photoshopped from Image

Existing View of Lackan Wind Farm

Figure 3-11: Viewpoint No.4: From Kilglass Community Hall



Wireframe View of Lackan Wind Farm

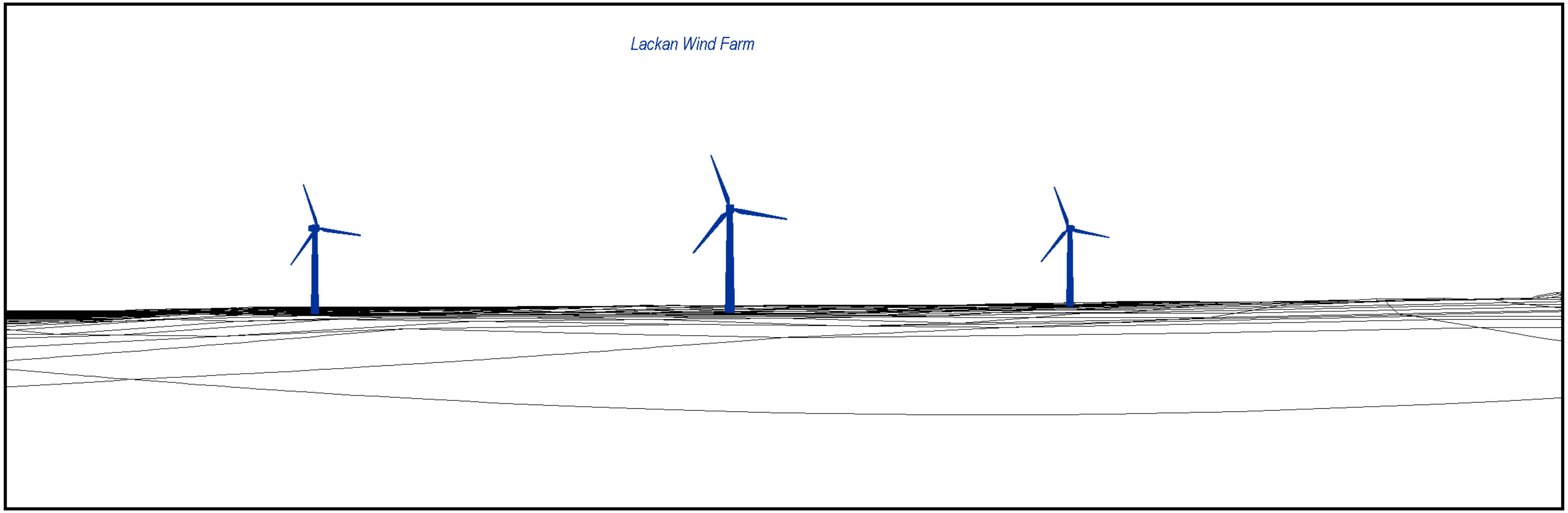

Existing View of Lackan Wind Farm

Figure 3-12: Viewpoint No.5: From Shoreline at Promontory Fort


View with Lackan Wind Farm Photoshopped from Image


Existing View of Lackan Wind Farm

Figure 3-13: Viewpoint No.5: From Shoreline at Promontory Fort



Wireframe View of Lackan Wind Farm

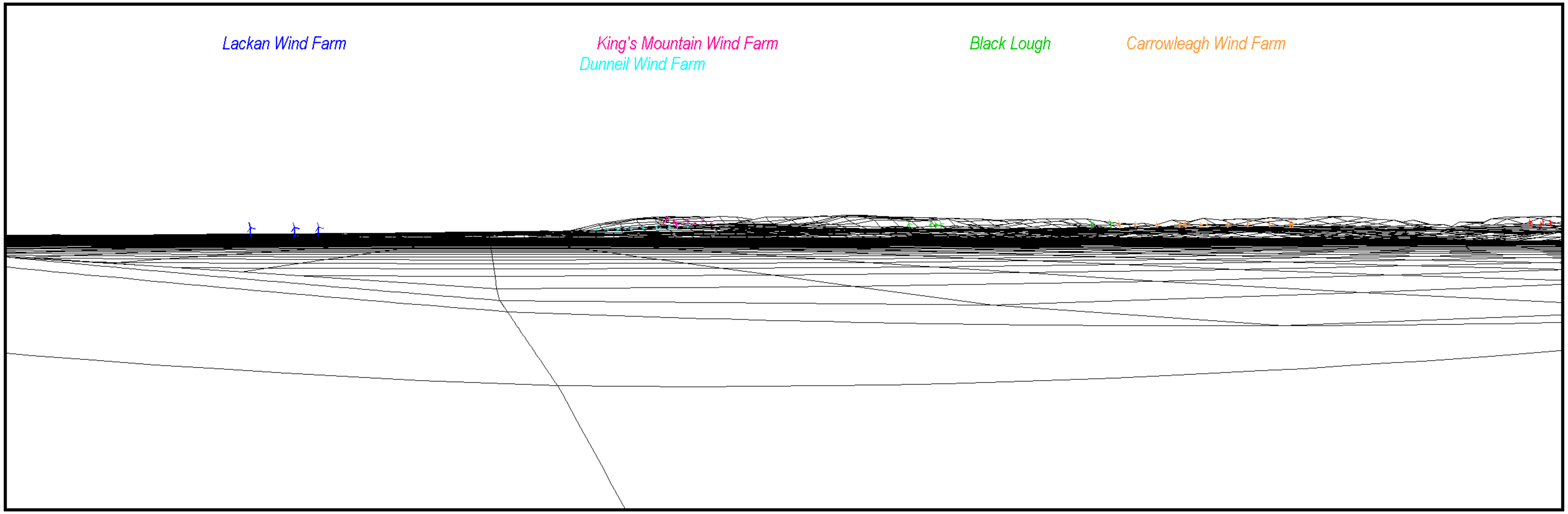
Existing View of Lackan Wind Farm

Figure 3-14: Viewpoint No.6: From Foreshore at Lackan


View with Lackan Wind Farm Photoshopped from Image


Existing View of Lackan Wind Farm

Figure 3-15: Viewpoint No.6: From Foreshore at Lackan



Wireframe View of Lackan Wind Farm

Existing View of Lackan Wind Farm

Figure 3-16: Viewpoint No.7: From Ross Beach, Killala County Mayo

View with Lackan Wind Farm Photoshopped from Image

Existing View of Lackan Wind Farm

Figure 3-17: Viewpoint No.7: From Ross Beach, Killala County Mayo

4 POPULATION & HUMAN HEALTH

4.1 Introduction

Population & Human Health is a required assessment topic under the current EPA Guidelines[12]. The population in the vicinity of the site, potential impact of the wind farm thereon and mitigation measures are presented in this chapter. The aspects covered include socio-economics, tourism and shadow flicker. The other main areas examined with respect to the potential effects of the wind farm on the surrounding population are noise (Chapter 5), traffic (Chapter 6) and visual impacts / amenity (Chapter 3). There are other environmental topics which have cross cutting themes with Population & Human Health such as land use and material assets. These are discussed separately and in Chapter 14 – Interaction of the Foregoing.

A full description of the proposed development is provided in Chapter 2. In summary the development consists of a wind farm with 3 No. turbines, access roads, hardstands, control building and grid connection.

Wind energy developments have potential to impact on the surrounding population directly and indirectly, positively and negatively. The purpose of the EIA process is to identify potential significant impacts and propose mitigation to ensure that the surrounding population and communities, experience no reduction in the quality of life resulting from the direct or indirect impacts of the wind farm

4.2 Methodology

The approach taken to establish the baseline population was to carry out desk-based research on the location of dwellings, land use, amenities and centres of population. Sources of information include aerial maps, Sligo County Council's planning application portal, census data, Fáilte Ireland and the Sligo CDP.

Field surveys were then carried out to confirm the location of dwellings in the vicinity of the Lackan Wind Farm. Dwellings within 1km of the turbines were mapped. Using these surveys, the settlement pattern around the project site was established. Table 2-1 lists the dwellings within 1km of the turbines and these are shown on Figure 2-3 (House Location Map).

The assessment was carried out in accordance with regard to the following guidance:

- EPA Guidelines on the Information to be Contained in Environmental Impact *Assessment Reports'* (EPA, 2022).
- EPA Advice Notes on Current Practice in the Preparation of Environmental Impact Statements (EPA, 2003) (and revised draft advice notes September 2015).
- Fáilte Ireland Guidelines on the Treatment of Tourism in an Environmental Impact Statement[46].
- Environmental Impact Assessment of Projects – Guidance on the preparation of the Environmental Impact Assessment Report. European Commission. 2017.
- Health Impact Assessment Guidance, Institute of Public Health Ireland. 2009.
- Sligo County Development Plan 2017 – 2023.

4.3 Population in the Existing Environment

The wind farm is in a rural coastal setting in west County Sligo. The nearest settlements are Inishcrone and Easky, to the southwest and northeast, respectively. Ballina is the largest town in the area, located 15km to the south-southwest. Figure 2-1 (Discovery Series Map No. 24) shows the site location.

The wind farm is in Lackan townland. According to the CSO, the 2016 census indicates the population of Lackan was 84; in 2011 it had a population of 72; and in 2006 it was 77. This indicates an overall increase of 9% since the wind farm was commissioned. This SSA forms part of the larger Kilglass electoral division, which includes most of Inishcrone. The population of Kilglass ED recorded in the 2016 census was 1,604; in 2011 it was 1,639; and in 2006 it was 1,347. Similar to the population statistics at the townland level, this indicates an overall increase of 19% since the wind farm was commissioned, however, there is a decrease from 2011 to 2016 of 2.1%.

Employment statistics are available at the ED level for Kilglass. These are compared to State and County figures and presented in Plate 4-1.

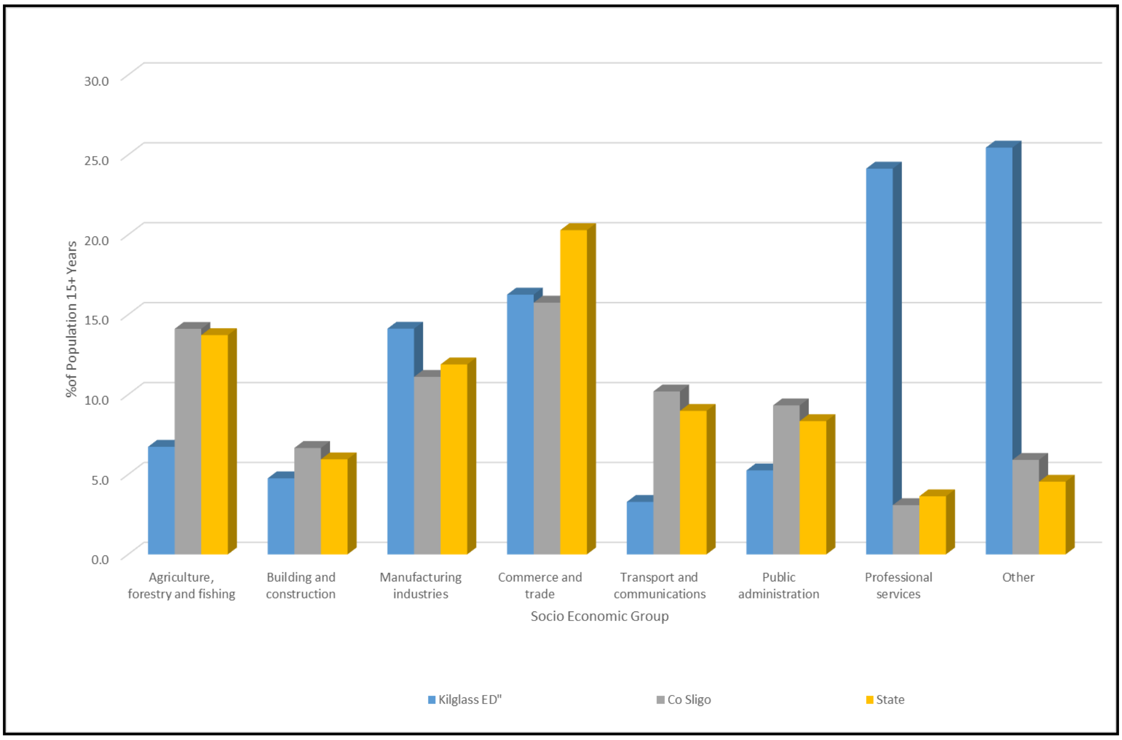


Plate 4-1: Employment by Socio-Economic Group – 2016
(Source - CSO)

As demonstrated in Plate 4-1, the main area of employment is professional services and 'other' in Kilglass ED, between them accounting for 50% of employment. Both are well above the County and State figures.

4.3.1 Tourism, Recreation and Amenity

Tourism is recognised in Ireland as an important sector for the economy. 'In 2019, out-of-state (overseas and Northern Ireland) tourist expenditure amounted to €5.6 billion. With a further €1.8 billion spent by overseas visitors on fares to Irish carriers, foreign exchange earnings were €7.4 billion. Domestic tourism expenditure amounted to €2.1 billion, making tourism a €9.5 billion industry'[47]. Failte Ireland includes County Sligo in the Border Region (along with Cavan, Donegal, Leitrim, and Monaghan). The Border Region saw approximately 3.322M visitors generating revenues of approximately €869 million. While the industry experienced a decline in 2020 and 2021 due to travel restrictions, it is expected to rebound and grow further in the coming years, particularly the domestic tourism expenditure.

Visitor attitude surveys conducted by Failte Ireland indicate that the main reason tourists visit Ireland is the beautiful scenery. Half of the reasons given by visitors related to environmental factors and half related to the way of life of the people. '*It is important to note that there appears to be evidence that the visitor's expectations of 'beautiful' scenery does not exclude an admiration of new modern developments – such as windfarms – which appear to be seen as indicative of a modern, informed and responsible attitude to the environment*'[48].

Tourism is recognised in the Sligo CDP as playing an important contribution to the socioeconomics of the County and is strongly encouraged and protected. Section 4.4. sets out the specific tourism policies and objectives as follows:

***P-TOU-1**:* *Promote the development of tourism in a sustainable manner and encourage the provision of a comprehensive range of tourism facilities, subject to location, siting and design criteria, the protection of environmentally sensitive areas and other planning considerations. Development that might be detrimental to scenic and heritage assets, in cSACs, SPAs, proposed NHAs, designated Sensitive Rural Landscapes and Visually Vulnerable Areas, and along designated Scenic Routes will be strictly controlled.*

***P-TOU-2**:* *Support the development of high-quality tourist accommodation, especially hotels and guesthouses, and ensure high standards of architectural and urban design in all new tourist accommodation and facilities.*

***P-TOU-3**:* *Ensure that all built elements of agri-tourism developments are appropriately designed, satisfactorily integrated into the landscape, conserve natural heritage, protect the environment and do not have a negative impact on the visual/scenic amenity of the countryside, on natural heritage or on the environment.*

***P-TOU-4**:* *Provide signposting, interpretative signs, information boards and improve roads, existing amenity and viewing areas, and provide for car parking, public facilities and access in scenic areas (refer also to Chapter 6, Section 6.7 Outdoor recreation).*

***P-TOU-5**:* *In recognising the special amenity value of mountains, moorlands and forests, valleys and lakes, it is the Council's policy to facilitate the use of these areas for activities such as touring, sightseeing, mountaineering, and hill-walking. This will be done in co-operation with state agencies, local community groups and other interested bodies and. In this regard, the Council will seek to improve access and create public rights of way, within the available financial resources (refer also to Section 6.7 Outdoor Recreation in Chapter 6).*

***P-TOU-6**:* *Promote walking, rambling and cycling as tourism activities within the Plan area (refer also to Section 6.7 Outdoor Recreation in Chapter 6).*

***P-TOU-7**:* *Explore the provision of sustainable medium- and long-distance walking routes, in co-operation with adjoining local authorities (refer also to Section 6.7 Outdoor Recreation in Chapter 6 and Section 8.3 Cycle and pedestrian movements in Chapter 8).*

P-TOU-8: *Support and promote, with the co-operation of private landowners, public access to heritage sites and features of natural heritage, geological and archaeological interest, coastal areas, islands, mountains, rivers, lakes and other natural amenities.*

P-TOU-9: *Support the growth of cultural tourism in the County and its potential for niche tourism products by facilitating the development of cultural events, infrastructure and activities*.

For the coastal zone, the specific polices are:

P-CZT-1: *Ensure that future caravan, camping and parking facilities in coastal areas will not be visually intrusive or impact on sensitive coastal environments (e.g. sand dune systems), by requiring, inter alia, appropriate siting, layout, design and natural screening, and compliance with the requirements of the Habitats Directive. On beaches, within dunes and in other vulnerable areas, manage and control car parking, vehicular and pedestrian movements in compliance with the requirements of the Habitats Directive where relevant.*

P-CZT-2: *Promote awareness of the sensitivity of the coastal environment through the provision of heritage appreciation programmes, public information boards and other appropriate means.*

P-CZT-3: *Maintain and develop small piers and harbours along the Sligo Coast, subject to funding and compliance with the requirements of the Habitats Directive.*

Objectives relating to the Wild Atlantic Way are:

O-WAW-1: *Along the Wild Atlantic Way, identify existing and potential coastal walking routes which can be developed as a tourism product and a local amenity. These routes will ideally be permanent, of high quality and adequately managed, should allow for further expansion and provide links to other activities and facilities.*

O-WAW-2: *At designated locations, provide facilities and access points for controlled water-sports activities, in a manner that avoids conflict with nature conservation and activities such as swimming, sailing, fishing and mariculture.*

O-WAW-3: *Provide Signature Discovery Point infrastructure at Mullaghmore, subject to appropriate siting and design.*

O-WAW-4: *Monitor the future development of the County's section of the Wild Atlantic Way touring route to ensure that the scenic and tourism value of this important amenity is maintained. This will be done in co-operation with state agencies, local community groups and other bodies interested in protecting the coastal environment and in improving access and visitor management to the Wild Atlantic Way. (A-4-2)*

Tourism development objectives are:

O-TOU-1: *Secure the establishment of a flagship visitor attraction in the County, subject to normal development control standards and compliance with the requirements of the Habitats Directive.*

O-TOU-2: *Examine the feasibility of providing walkways on upland areas (e.g. Dartry Mountains, Bricklieves and Ox Mountains etc.), subject to availability of resources and subject to compliance with the requirements of the Habitats Directive.*

County Sligo is recognised as having some of Ireland's leading tourist attractions. Its world-class attractions bring visitors from all over Ireland, as well as many overseas visitors from the UK, USA and mainland Europe. It is recognised as an important contributor to the local economy. Bord Failte provides figures for 2019 on a county basis (Bord Failte, 2019). For County Sligo, there were 531,000 visitors (including 2% share of overseas visitors to Ireland) who generated €115M in revenues. Tourism has been identified as an important sector for job creation in the County. Nationally, the tourism sector employees approximately 200,000 people, with a target of 250,000 employed in the sector by 2025[49]. While the 2016 Census doesn't refine employment numbers to the tourism sector, it provides a figure of 2,671 (~8.9% of total employment) in employment in the 'Caring, Leisure and Other Service Occupations' in County Sligo. This includes employment in the service industries (hotel and restaurants), B&B accommodation, marine tourism, leisure activities, golf courses, etc. With only 2% of the countrywide share of overseas visitors, there is room for growth in this sector in the County.

The scenery, natural heritage and cultural heritage of County Sligo are the primary tourist attractions. There are a range of attractions from mountains, lakes, rivers, rugged coastlines, woodlands etc. with their associated activities including trekking, hill walking, mountaineering, water sports, fishing, sailing etc. The CDP lists numerous treks, waymarked walking routes, cycling routes, cultural tourism destinations, the Wild Atlantic Way, surf centres, etc, which mark out the importance of tourism to the County Sligo.

The local tourism products are discussed below under the headings of context, character, significance, and sensitivity in accordance with the Failte Ireland guidelines[48].

<u>Context</u>

As noted, the scenery, natural heritage and cultural heritage of County Sligo are the primary tourist attractions. The locations, features, facilities, and activities that make up the local tourism product include the following:

- Hotels in Inishcrone and Easky. The closest holiday accommodation to the Lackan site is in Inishcrone.
- The closest golf course is in Inishcrone, just off the R297 between Inishcrone and Ballina. There is also a pitch & putt course in Inishcrone.
- Boating facilities are located in Inishcrone, Easky and Ballina. There is boat charter for sea angling, pleasure trips and dolphin watching off Inishcrone pier.
- Surf centres at Inishcrone and Easky.
- The Ocean Sands hotel offers pony trekking activities in partnership with the Iceford Stables, which is located on Quay Road near Ballina. This equestrian facility is 11km southwest of the wind farm site.
- Walking and cycling routes in the area include Western Way, a way-marked walk. This is located approximately 15km to the south of the wind farm, running between Bunnyconnellan and Ballina. The Sligo Way is located approximately 14km to the southeast (at its closest point), running north from Lough Talt passed Lough Easky and then east over the Ox Mountains towards Coolaney.
- The Wild Atlantic Way is marketed as one of the longest defined coastal routes in the world; 2,600km in length, it extends from the Inishowen Peninsula in County Donegal to Kinsale in County Cork. In Sligo, it follows the costal roads through the county, including the N15, R291, R292, N59 and R297. Fáilte Ireland has identified 161 Discovery Points along the 2,600km of the Wild Atlantic Way, 7 of which are in County Sligo. The closest to the Lackan Wind Farm are Aughris Head, Easky and Inishcrone piers. As discussed in Chapter 3, the R297 passes close to the site.
- Other tourism products offered in County Sligo includes festivals, greenways, water parks, etc. Festivals in Sligo include 'Sligo Food Festival', 'Inishcrone & District Agricultural Show', 'Celtic Fringe Festival', 'Sligo Jazz Festival', 'Bunnyconnellan Show', 'Fleadh Cheoil na hEireann', 'Tread Softly – Season of Yeats', and 'Inishcrone Black Pig Festival'.

<u>Character</u>

The scenery, natural heritage and cultural heritage of County Sligo are the primary tourist attractions. There are a range of attractions from mountains, lakes, rivers, rugged coastlines, woodlands etc. with their associated activities including trekking, hill walking, mountaineering, water sports, fishing, sailing etc.

The principal tourism products offered in west County Sligo are connected to the coastal scenery and associated water-based activities. The associated activities include sailing, surfing, sea kayaking and other marine-related pursuits, trekking, cycling and walking. The tourist season is largely seasonal, being busiest between May and August.

Significance
Tourism makes a significant contribution to the local economy of Sligo. Income includes accommodation through holiday home lettings, B&B accommodation, bike and boat rentals, hotels, hostels, glamping, and spas. In 2019, the Border Region (including Sligo) saw approximately 3.322M visitors generating revenues of approximately €869 million, with Sligo receiving €115M.

Sensitivity
The key tourist attractions of national importance in the vicinity of Lackan include the Wild Atlantic Way and the three associated Discovery Points in west County Sligo. These are 20km east (Aughris Head), 9km northeast (Easky Pier) and 3.3km southwest (Inishcrone Pier) of the Lackan Wind Farm. As shown in the ZTV (Chapter 3), the Lackan Wind Farm can't be seen from Aughris Head or Easky Pier but can be seen from Inishcrone Pier.

The promotion and development of the tourism industry is an objective of the Sligo CDP. Tourists' attitudes to wind energy developments are seen in a positive light by most visitors. The Lackan Wind Farm is a small-scale development on the coastal plain. It is not incompatible with the development of tourism in the County. This is proven with much of the tourist-related infrastructure in Inishcrone being developed since the wind farm was commissioned.

4.3.2 Settlement Pattern near Site

The settlement pattern near the site consists of isolated farmhouses and ribbon development extending out from Kilglass village. The closest house to any turbine is 535m (turbine T3 offset from houses H13, H14 and H15). The houses near the site are shown on Figure 2-3 and listed in Table 2-1.

4.4 Public Health & Wind Farms

There have been a number of studies carried out in relation to the alleged negative health effects on residents living in proximity to wind turbines. It has been alleged that infrasound and low frequency noise from turbines causes a range of symptoms, referred to as wind turbine syndrome. In 2009 Nina Pierpont published her report entitled '*Wind Turbine Syndrome – A Report on a Natural Experiment*'[50]. In her report she outlines a number of case studies of residents living within 2km of wind turbines experiencing symptoms such as headaches, sleep disturbance, tinnitus, dizziness, irritability and nausea. She makes a causative link between the symptoms and the introduction of wind turbines into the local environment.

In response to this report and to the general concerns raised, a number of independent studies were carried to assess the issues, including:

1. American Wind Energy Association and Canadian Wind Energy Association, Wind Turbine Sound and Health Effects – An Expert Panel Review, December 2009[51].
2. Renewable UK – Wind Turbine Syndrome (WTS) – An Independent Review of the State of Knowledge about the Alleged Health Condition, Health and Safety Briefing, July 2010[52].
3. Australian Government National Health and Medical Research Council (NHMRC) – Public Statement: Wind Turbines and Health, July 2010 (under review)[53].
4. Massachusetts Department of Environmental Protection & Massachusetts Department of Public Health – Wind Turbine Health Impact Study: Report of Independent Expert Panel, January 2012[54].

5. Climate and Health Alliance – Position Statement: Health and Wind Turbines, February 2012[55].
6. Sidney School of Public Health - Spatio-temporal Differences in the History of Health and Noise Complaints about Australian Wind Farms: Evidence for the Psychogenic, "Communicated Disease" Hypothesis, March 2013[56].

Copies of these six studies, in full or in part, are included in Appendix 4-1 and a short synopsis of their findings and conclusions is provided below.

American Wind Energy Association and Canadian Wind Energy Association
To assess the conflicting views in relation to wind turbines and human health, the American and Canadian wind energy associations established an expert scientific panel to review the then current literature on the subject. The multidisciplinary panel was comprised of medical doctors, audiologists, and acoustical professionals from the United States, Canada, Denmark, and the United Kingdom. Following review, analysis, and discussion of the then current knowledge, the panel reached consensus on the following key points:

- *There is nothing unique about the sounds and vibrations emitted by wind turbines.*
- *The body of accumulated knowledge about sound and health is substantial.*
- *The body of accumulated knowledge provides no evidence that the audible or subaudible sounds emitted by wind turbines have any direct adverse physiological effects.*

It concluded that:

1. *Sound from wind turbines does not pose a risk of hearing loss or any other adverse health effect in humans.*
2. *Subaudible, low frequency sound and infrasound from wind turbines do not present a risk to human health.*
3. *Some people may be annoyed at the presence of sound from wind turbines. Annoyance is not a pathological entity.*
4. *A major cause of concern about wind turbine sound is its fluctuating nature. Some may find this sound annoying, a reaction that depends primarily on personal characteristics as opposed to the intensity of the sound level*.

Renewable UK
In response to a number of high-profile media articles stemming from the pre-publication of the Pierpont 2009 '*Wind Turbine Syndrome'* book, Renewable UK engaged three independent experts to determine if there was any robustness or efficacy of the science unpinning Dr. Pierpont's research. The three experts discredited the research and conclusions drawn by Dr. Pierpont; they conclude that:

1. The scientific and epidemiological methodology and conclusions drawn are fundamentally flawed.
2. The scientific and audiological assumptions presented by Dr Pierpont relating infrasound to WTS are wrong.
3. Noise from wind turbines cannot contribute to the symptoms reported by Dr Pierpont's respondents by the mechanisms proposed.

Australian Government National Health and Medical Research Council
The Australian NHMRC reviewed the literature on the issue of wind turbines and potential impacts on human health. The purpose of the review was to ascertain if the statement '*there are no direct pathological effects from wind farms and that any potential impact on humans can be minimised by following existing planning guidelines*' can be supported. A summary of it review is as follows:

1. *There is no reliable evidence that infrasounds below the hearing threshold produce physiological or psychological effects.*

2. *Infrasound associated with modern wind turbines is not a source which will result in noise levels which may be injurious to the health of a wind farm neighbour.*
3. *Findings clearly show that there is no peer-reviewed scientific evidence indicating that wind turbines have an adverse impact on human health.*
4. *Sound from wind turbines does not pose a risk of hearing loss or any other adverse health effects in humans. Subaudible, low frequency sounds and infrasound from wind turbines do not present a risk to human health.*
5. *The Chatham-Kent Public Health Unit (Ontario, Canada) reviewed the current literature regarding the known health impacts of wind turbines in order to make an evidence-based decision. Their report concluded that current evidence fails to demonstrate a health concern associated with wind turbines. 'In summary, as long as the Ministry of Environment Guidelines for location criteria of wind farms are followed … there will be negligible adverse health impacts on Chatham-Kent citizens. Although opposition to wind farms on aesthetic grounds is a legitimate point of view, opposition to wind farms on the basis of potential adverse health consequences is not justified by the evidence' (Chatham-Kent Public Health Unit, 2008).*
6. *Wind energy is associated with fewer health effects than other forms of traditional energy generation and in fact will have positive health benefits.*
7. *There are, at present, very few published and scientifically-validated cases of an SACs of wind farm noise emission being problematic … the extent of reliable published material does not, at this stage, warrant inclusion of SACs … into the noise impact assessment planning stage.*
8. *While a great deal of discussion about infrasound in connection with wind turbine generators exists in the media there is no verifiable evidence for infrasound and production by modern turbines*.

The opposing view is that noise from wind turbines produces a cluster of symptoms which has been termed Wind Turbine Syndrome (WTS). The main proponent of WTS is a US based paediatrician, Dr Pierpont, who has released a book 'Wind Turbine Syndrome: A report on a Natural Experiment, presents case studies explaining WTS symptoms in relation to infrasound and low frequency noise. Dr Pierpont's assertions are yet to be published in a peer-reviewed journal, and have been heavily criticised by acoustic specialists. Based on current evidence, it can be concluded that wind turbines do not pose a threat to health if planning guidelines are followed.

<u>Massachusetts Department of Environmental Protection & Department of Public Health</u>

The Massachusetts Department of Environmental Protection and Department of Public Health convened a panel of independent experts to identify any documented or potential health impacts of risks associated with exposure to wind turbines. The attributes of concern include noise, infrasound, vibration and flicker.

The findings of the study in relation to noise are:

1. *Most epidemiologic literature on human response to wind turbines relates to self-reported "annoyance," and this response appears to be a function of some combination of the sound itself, the sight of the turbine, and attitude towards the wind turbine project.*
    a. *There is limited epidemiologic evidence suggesting an association between exposure to wind turbines and annoyance.*
    b. *There is insufficient epidemiologic evidence to determine whether there is an association between noise from wind turbines and annoyance independent from the effects of seeing a wind turbine and vice versa.*
2. *There is limited evidence from epidemiologic studies suggesting an association between noise from wind turbines and sleep disruption. In other words, it is possible that noise from some wind turbines can cause sleep disruption.*

3. *A very loud wind turbine could cause disrupted sleep, particularly in vulnerable populations, at a certain distance, while a very quiet wind turbine would not likely disrupt even the lightest of sleepers at that same distance. But there is not enough evidence to provide particular sound-pressure thresholds at which wind turbines cause sleep disruption. Further study would provide these levels.*
4. *Whether annoyance from wind turbines leads to sleep issues or stress has not been sufficiently quantified. While not based on evidence of wind turbines, there is evidence that sleep disruption can adversely affect mood, cognitive functioning, and overall sense of health and well-being.*
5. *There is insufficient evidence that the noise from wind turbines is directly (i.e. independent from an effect on annoyance or sleep) causing health problems or disease.*
6. *Claims that infrasound from wind turbines directly impacts the vestibular system have not been demonstrated scientifically. Available evidence shows that the infrasound levels near wind turbines cannot impact the vestibular system.*
    a. *The measured levels of infrasound produced by modern upwind wind turbines at distances as close as 68 m are well below that required for non-auditory perception (feeling of vibration in parts of the body, pressure in the chest, etc.).*
    b. *If infrasound couples into structures, then people inside the structure could feel a vibration. Such structural vibrations have been shown in other applications to lead to feelings of uneasiness and general annoyance. The measurements have shown no evidence of such coupling from modern upwind turbines.*
    c. *Seismic (ground-carried) measurements recorded near wind turbines and wind turbine farms are unlikely to couple into structures.*
    d. *A possible coupling mechanism between infrasound and the vestibular system (via the Outer Hair Cells (OHC) in the inner ear) has been proposed but is not yet fully understood or sufficiently explained. Levels of infrasound near wind turbines have been shown to be high enough to be sensed by the OHC. However, evidence does not exist to demonstrate the influence of wind turbine-generated infrasound on vestibularmediated effects in the brain.*
    e. *Limited evidence from rodent (rat) laboratory studies identifies short-lived biochemical alterations in cardiac and brain cells in response to short exposures to emissions at 16Hz and 130dB. These levels exceed measured infrasound levels from modern turbines by over 35dB.*
7. *There is no evidence for a set of health effects, from exposure to wind turbines that could be characterized as a "Wind Turbine Syndrome".*
8. *The strongest epidemiological study suggests that there is not an association between noise from wind turbines and measures of psychological distress or mental health problems. There were two smaller, weaker, studies: one did note an association, one did not. Therefore, we conclude the weight of the evidence suggests no association between noise from wind turbines and measures of psychological distress or mental health problems.*
9. *None of the limited epidemiological evidence reviewed suggests an association between noise from wind turbines and pain and stiffness, diabetes, high blood pressure, tinnitus, hearing impairment, cardiovascular disease, and headache/migraine.*

<u>Climate and Health Alliance</u>

In response to claims that there are adverse health effects associated with human exposure to wind turbines, the Climate and Health Alliance (CAHA) developed its position paper.

The CAHA found that '*despite the existence of large scale commercial wind turbines in densely populated areas for over 20 years, there is **no credible evidence** in the peer reviewed published scientific literature that there are any direct adverse physiological health effects from exposure to wind turbines'* and that '*there is no evidence in the peer reviewed published scientific literature that suggests that there are any adverse health effects from ''infrasound'' (a component of low frequency sound) at the low levels that may be emitted by wind turbines'*.

The position paper notes the role that perception and psycho-sociological factors play. It states that '*fear and anxious anticipation of potential negative impacts of wind farms can also contribute to stress responses, and result in physical and psychological stress symptoms'* and that '*some people experience distress when they perceive a threat to the place that they live in the form of changes to the landscape, like a wind farm, but also other industrial developments, such as new housing estates, coal mines, or supermarkets'*. These '*local concerns about wind farms can be related to perceived threats from changes to their place and can be considered a form of "place-protection action", recognised in psychological research about the importance of ''place‟ and people's sense of identity*'.

<u>*Sidney School of Public Health*</u>
The Sidney School of Public Health examined how, with widespread allegation of the adverse effects turbines have on human health, the nocebo effects (negative reaction to harmless substance due to suggestion) potentially confounds any future investigations on the subject.

The report studies the records of complaints about noise or health obtained from wind farm companies regarding residents living near 51 Australian wind farms, expressed as proportions of estimated populations residing within 5km of wind farms, and corroborated with complaints in submission to three government public enquires and news media records and court affidavits.
The findings of the study are summarised as follows:

1. Of the 51 wind farms, 33 have never been the subject of noise or health complaints. There are 21,592 residents within 5km of these 33 wind farms.
2. Only 131 individuals across Australia living within 5km of a wind farm have ever complained – 1 in 250. Of these, 94 of these complainants live within 5km of a wind farm targeted by anti-wind farm groups.
3. A majority (104 of the 131) of noise and health complaints commenced after 2009 when anti-wind farm groups began to add health concerns to their concerns.

The report concluded that '*in view of scientific consensus that the evidence for wind turbine noise and infrasound causing health problems is poor, the reported spatio-temporal variations in complaints are consistent with psychogenic hypotheses that health problems arising are "communicated diseases" with nocebo effects likely to play an important role in the aetiology of complaints'.*

4.5 House Prices

The impact of wind turbines on house prices is a concern for residence living in the vicinity of proposed wind farms. Several studies have been conducted in an effort to quantify what, if any, this impact is. The studies carried out include:

1. Royal Institute of Charter Surveyors and Oxford Brookes University study carried out in the UK in 2007[57]. This study examined house price trends near two wind farms in Cornwall. This study did not find a link between the wind farm and house prices. Price variation near one wind farm was noted, but was attributed to other factors.
2. The Lawrence Berkley National Laboratory study carried out in the United States in 2009[58]. This study looked at house prices for almost 7,500 transactions within 10 miles of 24 existing wind farms distributed across the United States. The study concluded that there was no evidence that house prices are affected by proximity of wind farms. The report stated that '*although the analysis cannot dismiss the possibility that individual or small numbers of homes have been or could be negatively impacted, if these impacts do exist, they are either too small and/or too infrequent to result in any widespread and consistent statistically observable impact*'.
3. The Lawrence Berkley National Laboratory study carried out in the United States in 2013[59] to update the 2009 study. The study was updated in 2013 which confirmed the findings of the 2009 study – i.e. that there was '*no statistical evidence that home prices near wind turbines were affected in either the post-construction or post announcement/pre-construction periods*'.

4. Renewable UK and Cebr study carried out in the UK in 2014[60]. This study examined whether wind farms have an effect on the values of residential properties located within 5km of seven wind farms. Using Land Registry figures, house prices within 5km of wind farms and those in the wider area are compared for the period 1995 to 2013. This study found that there was '*no evidence that prices had been affected by either the announcement, construction or completion of the wind farms for six out of seven sites.* For the one site that did see a downturn in house prices '*following the announcement that a wind farm would be built; however once the turbines were erected, local house price growth returned to the county-wide norm*'.

There is no house price study done for wind farms in Ireland, but it is reasonable to draw a similar conclusion to the studies listed above for the Lackan Wind Farm. A review of the planning files for the area, indicate that there have been several houses, within 1km of the turbines, granted planning permission and constructed after the Lackan Wind Farm.

4.6 Characteristics of the Development

The characteristics of the development that could potentially have an impact on population and human health include:

1. Turbine operation:
    a. Noise during the extended operational phase. Detailed noise surveys were carried out for the project, which is presented in Chapter 5 – Noise & Vibration.
    b. Shadow flicker is an operational phase issue where shadows from the rotating blades pass by dwellings resulting in a flickering effect. This effect is greatly diminished at distances of 10 times rotor diameter; in this instance 710m. Shadow flicker is discussed in this chapter.
    c. Visual impact. The presence of turbines can impact on the visual amenity of residents close to a wind farm. An offset distance from dwellings of 4 times tip height is recommended in the draft Guidelines. The minimum offset distance provided in 535m. Visual impact is discussed in Chapter 3 – Landscape & Visual.
    d. Potential impacts on local road users during the operational phase will be impermeable. The issue is addressed in Chapter 6 – Traffic & Transport.
2. Decommissioning:
    a. During the decommissioning phase, there will be increased HGV traffic volumes to / from the site which could affect local road users. The issue is addressed in Chapter 6 – Traffic & Transport.
    b. Earthworks - during decommission, and if unmitigated, there is potential for release of sediment to the watercourse draining the site. This could affect surface water users downstream of the site. The issue is addressed in Chapter 7 – Water. The movement of plant and machinery will increase noise levels in the short term. This is discussed in Chapter 5 – Noise & Vibration.

4.7 Impact Assessment

4.7.1 Do-Nothing Impact

In the 'do-nothing' scenario, the wind farm will continue to operate with the benefit of the existing planning permission until October 2023, after which it would need to be decommissioned. In this scenario, the impacts associated with the operation of the wind farm will be reversed.

4.7.2 Health and Safety

The wind farm is operated in accordance with the Safety, Health & Welfare at Work (Construction) Regulations 2006, and as amended and with the Irish best practice guidelines (as available). Aspects of the development will present health and safety issues. These are discussed as follows:

Construction Health and Safety

The wind farm is constructed so construction health & safety is not relevant. This will become relevant during decommissioning. Relevant legislation will be followed by contractors involved in that phase of the project.

Operational Health and Safety

Access to the wind farm is restricted by a locked gate at the wind farm entrance. The land-bank has only stock-proof fencing, so access cannot be controlled; it is impractical to fence the entire site.

Access to the turbines is through a steel door at the base of the structure. These are locked at all times, as is the control building to prevent unauthorised entry.

The workings of the turbines do not present any danger to the public. The components of a wind turbine are designed to last 30 years and are equipped with several safety devices to ensure safe operation during their lifetime:

- Vibration and noise sensors will detect if the turbine starts shaking and turns the turbine off.
- Sensors, including smoke sensors, in the nacelle check the operation of the turbine.
- The rotor blades are tested statically by applying weight to bend the blades and dynamically by testing the blade's ability to withstand fatigue from repeating bending more than 5 million times.
- The turbines have two independent fail-safe brake mechanisms to stop the turbine. The aerodynamic breaking system is the main braking system. Mechanical braking serves as a backup system. This is in additional to the yawing and blade pitch mechanisms.

Remote monitoring systems keep track of all operations on the wind turbines and regular safety audits are carried out to ensure the safety of all personnel working on or visiting the site. The health and safety record of the wind energy industry worldwide is exceptionally good. Wind energy has the best safety record of any form of power production[61]. By the avoidance of the use of other energy production methods, particularly fossil fuel and nuclear, there are indirect health and safety benefits of wind energy. The minimum desirable distance between wind turbines and occupied buildings, calculated on the basis of visual impact and expected noise levels, will always be greater than that necessary to meet safety requirements (i.e., one and a half times the height of the turbine).

4.7.3 Socio-Economics

The operation of the wind farm provides employment to Enercon’s service and maintenance department, based in Sligo. The wind farm provides employment to one wind farm operator. There is also a direct benefit to local landowners, benefiting from the lease of land to Lackan Wind Energy Ltd.

Lackan Wind Energy Ltd has provided financial support to local clubs, events and projects. It has donated approximately 1% of the net revenue from the wind farm to the local community. It will continue to do so during the extended lifespan of the wind farm. The wind farm also pays rates to the County Council, which is used to provide services to the wider community.

On a national scale, the wind industry supports 5,130 jobs throughout the supply chain. Based on the required installed capacity to achieve 2030 targets, it is estimated that the wind energy sector can increase this to 7,020 jobs. This will increase total payment to workers from €225M/annum to €305M/annum. The construction and development of wind energy projects across the island will involve billion of investment, much of which will be retained in the local Irish economy. Total baseline local authority contributions are reportedly greater than €5M in a number of counties, including County Sligo[62].

4.7.4 Tourism, Recreation and Amenity

It has been suggested that wind farms may be considered by some tourists to spoil the scenery. Equally, it has been suggested that wind farms fit in extremely well with Ireland's clean, green image, and that such developments help foster that image of a clean environment for tourists.

With increased targets for renewable penetration in Ireland, '*the potential conflict that could arise from this confluence of scenic landscapes and opportunity areas for wind farms, Fáilte Ireland, in association with the Northern Ireland Tourist Board (NITB), decided in 2007 to survey both domestic and overseas holidaymakers to Ireland to determine their attitudes to wind farms'*[63]. The survey involved face-to-face interviews with 1,300 domestic and overseas tourists in the Republic and in Northern Ireland. The main findings of the survey are as follows:

1. There is a generally positive disposition among tourists towards wind farm development in Ireland. Most felt that the presence of wind farms did not detract from the quality of their sightseeing, with 45% indicating that wind farms had a positive impact on their enjoyment.
2. One in seven tourists were negatively disposed towards wind farms, with 15% claiming a negative impact on their enjoyment of the landscape. The greater the beauty of the landscape, the higher the negativity towards wind farms.
3. Wind farms compared well to tourist's attitude to other developments such as pylons and telecommunication masts.
4. Almost 75% of respondents claimed that greater numbers of wind farm would either have no impact on their likelihood to visit or have a strong or fairly strong positive impact on future visits.
5. There was a preference towards wind farms with fewer turbines; for the same installed capacity, tourists preferred few large turbines over a larger group of small turbines.

In 2008, the Scottish Government released its commissioned report from Glasgow Caledonian University on the economic impacts of wind farms on Scottish tourism[64]. The report was commissioned in the context of ambitious renewable targets for 2020, which required a doubling of Scotland's then installed renewable capacity, and importance of Scotland's tourism industry.

Similar to Sligo, Scottish tourism depends heavily on the country's landscape, with 92% of visitors stating that scenery was important in their choice of Scotland as a holiday destination. The research sought to provide an evidence base on one contentious element of most wind farm proposals – i.e., impact on tourism. The research sought to identify the potential number of tourists that would be affected; the reaction of those tourists affected; and the economic impact of those reactions (fall in numbers and/or downward price pressure).

It is stated in the report that '*this research set out to establish if meeting targets on renewables would significantly impact on the possibility of meeting tourism targets. Our overall conclusion is that the effects are so small that, provided planning and marketing are carried out effectively, there is no reason why the two are incompatible*'.

Evidence would suggest that wind farms in their own right are not tourist attractions. Delabole was the first operational wind farm in the UK, being built in 1991 and consisting of 10 No 400kW turbines. It became a tourist attraction for a number of years forming an associated attraction of the Gaia Energy Centre located nearby. The Gaia Energy Centre opened in 2001 but closed in

2004 due to lower than projected tourist numbers. The Delabole Wind Farm was repowered in 2010 – i.e., the ten turbines were replaced with four larger turbines.

Wind farms have been incorporated into tourist trails, forming one of a number of varied attractions along a particular route. For example, Leitrim, Roscommon and Sligo County Councils have published a booklet outlining a series of walking routes aimed at tourists. "*The Miner's Way and Historical Trail Map Guide*"[65] illustrates eleven walks, two of which incorporate wind farms.

The Lackan Wind Farm has been operating for approximately 16½ years. In that time there have been a number of tourism-related developments permitted and / or constructed in Inishcrone. Overall, the wind farm is considered to have a neutral effect on tourism – it neither attracts nor deters tourists from the area. The extension of the wind farm lifespan by 12 years will similarly have a neutral effect.

4.7.5 Moving Shadows

Wind turbines can cast long shadows when the sun is low in the sky in early morning and late evening. Shadow flicker can occur when the shadow of the moving blades pass a house or window causing a shadow to flick on and off. This affect only lasts a short time and happens only in specific combined circumstances when:

- The sun is shining and is at a low angle at sun rise and sun set.
- The turbine is directly between the sun and the property.
- The blades are moving.
- The wind is blowing in a direction such that the turbine blades are perpendicular to the cast shadow.

The shadow casting model calculates times throughout the year when a turbine viewed from the window of a house, is in line with the sun, casting moving shadows (flicker effect) on residences in close proximity to the turbines. This will not generally have an effect on health or safety, but may on limited occasions present a brief, minor nuisance effect for some neighbours. The shadow casting model assumes the following:

- The model does not consider any obscuring features around the residences, which would minimise views of the site and hence reduce or eliminate the potential for shadow casting.
- It does not consider actual or likely hours of sunshine, but assumes 100% sunshine.
- It does not examine the times when the wind direction will be in line with the sun, the turbine, and the window in question. This is a necessary prerequisite for the turbine blades to cast moving shadows across a window.

The Met Eireann climate data for Knock Airport synoptic station indicates the number of days with no sunshine is 61.1 (30-year mean 1971 – 2000). Table 4-1 summaries the sunshine hours for Knock Airport synoptic station.

Table 4-1: Knock Airport Monthly and Annual Mean Values (1971 – 2000)

Sunshine	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Mean Daily Duration	1.3	1.9	2.6	4.3	5.0	4.4	3.7	3.8	3.2	2.4	1.7	0.9	2.9
Greatest Daily Duration	7.9	9.3	10.8	13.4	15.1	15.8	14.8	13.7	11.4	9.3	9.6	6.7	15.8
Mean No. of Days with No Sun	9.5	7.3	5.7	2.8	2.0	2.2	2.2	2.1	3.4	5.0	8.1	10.8	61.1

Plate 4-2 shows the mean annual sunshine hours for the Country.

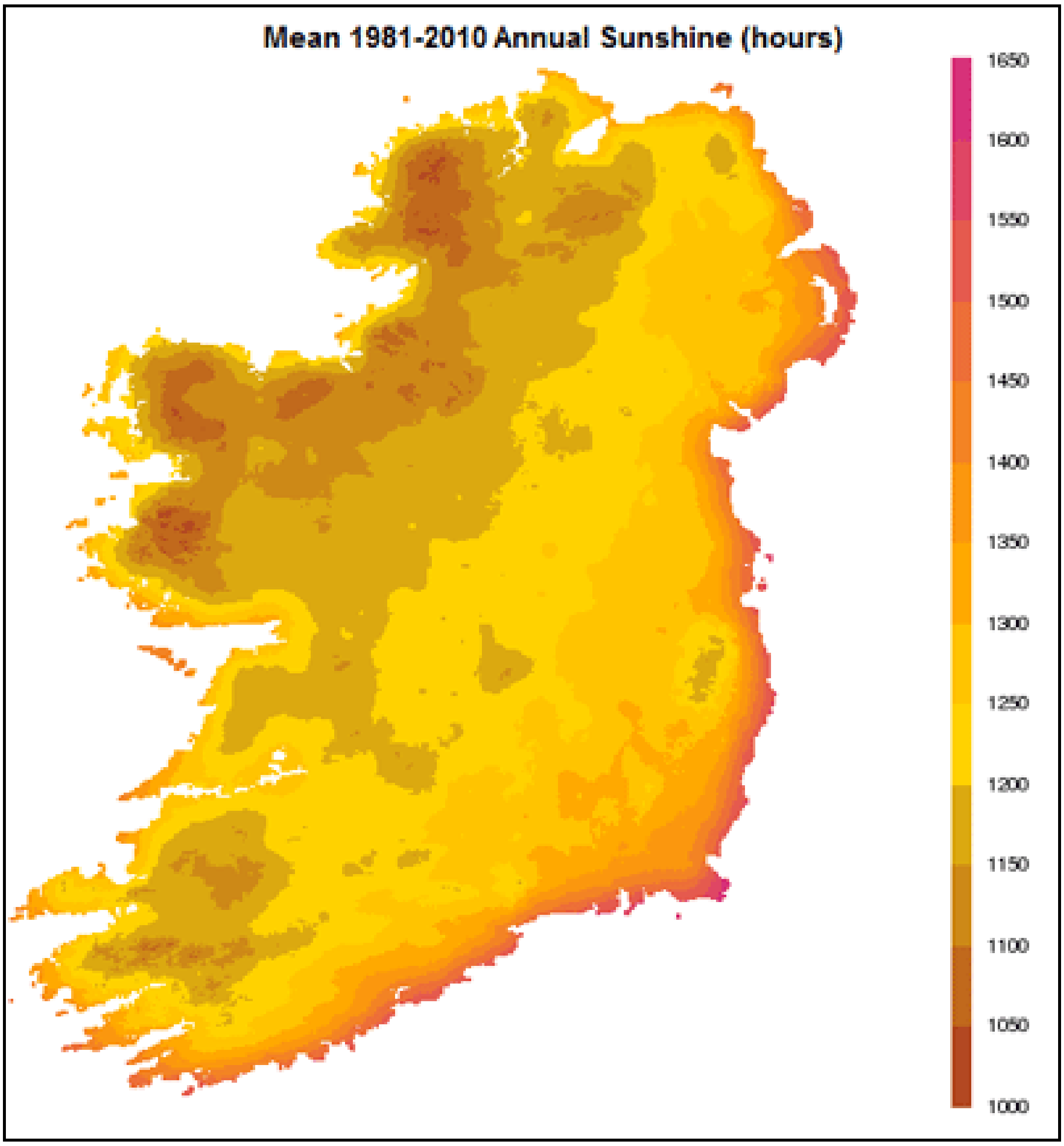


Plate 4-2: Mean Annual Sunshine Hours (1981 – 2010)

As seen on Plate 4-2, the site has between 1,100 and 1,150 hours of sunshine per annum. On average, Ireland normally gets between 1,100 and 1,600 hours of sunshine each year. The sunniest months are May and June. During these months, sunshine duration averages between 5 and 6.5 hours per day over most of the country. The extreme southeast gets most sunshine, averaging over 7 hours a day in early summer. December is the dullest month, with an average daily sunshine ranging from about 1 hour in the north to almost 2 hours in the extreme southeast. Over the year as a whole, most areas get an average of between 3¼ and 3¾ hours of sunshine each day.

Figure 4-1 shows the geographical distribution of shadow flicker occurring for the Lackan Wind Farm and assuming 100% sunshine during daylight hours. This indicates that under worse-case scenario, shadow flicker will not affect any of the houses surrounding the site for more than 30 hours per year. As shown on Figure 4-1, the pattern of shadow casting indicates that shadows from turbine T3 may affect houses to the southeast, near the R297 / L6502 junction (houses H26 and H27). This would occur during sunset in summer months. These houses are greater than 800m from T3. At greater than 10 times the rotor diameter (i.e., 710m), shadow casting is not an issue.

As noted, the model is run assuming 100% sunshine during daylight hours (i.e., ~4,480 hours in Sligo), when in fact there are on average only 1,250 hours of sunshine per annum at the site – i.e., sunshine for ~$^{1}/_{3}$ of the time, not 100% as modelled. It is therefore expected that the actual occurrence of moving shadow will be significantly lower than the model prediction output. There have been no complaints in relation to moving shadows from the residents near the wind farm.

There are no wind farms close to the Lackan Wind Farm, so cumulative shadow flicker effects cannot occur.

4.8 Mitigation Measures

4.8.1 Health and Safety

Construction/Decommission Health and Safety

A site-specific health & safety statement for the decommissioning phase of the project will be prepared in accordance with the Safety, Health & Welfare at Work (Construction) Regulations 2006. This will address all issues of the decommissioning project including:

- general site safety
- footwear required
- heavy equipment operation
- scaffolding
- protective clothing
- crane operation
- lockout/tag-out procedures for electrical work
- working at heights

FAS Safepasses will be required for all construction, delivery, and security staff. All tower crane operators, slingers/signallers and telescopic handler operators will be required to have a Construction Skills Certificate Scheme (CSCS) Card. The site manager will be responsible for the implementation of procedures outlined in the safety statement.

Public safety will be addressed by restricting site access. Appropriate warning signs will be posted, directing all visitors to the site manager.

Operational Health and Safety

A safety, health and welfare statement for the operation of the wind farm has been prepared in accordance with relevant regulations, including the Safety Health and Welfare at Work Act 2005, Safety Health and Welfare at Work (General Application) Regulations 2007, Safety Health and Welfare at Work (Construction) Regulations 2013.

The turbines and control building are locked, restricting unauthorised access.

The minimum desirable distance between wind turbines and occupied buildings, calculated on the basis of visual impact and expected noise levels, will always be greater than that necessary to meet safety requirements (i.e., one and a half times the height of the turbine).

4.8.2 Socio-Economics

The wind farm provides employment for the service and maintenance contractor and the local wind farm operator. It provides ongoing sustainable income for the landowners involved. The directors of Lackan Wind Energy Ltd provide financial support to the local community clubs, projects and events. They will continue to do so during the extended lifespan of the wind farm. As these effects are positive, no mitigation measures are necessary.

4.8.3 Tourism, Recreation and Amenity

No mitigation is required for tourism, recreation or amenity.

4.8.4 Moving Shadows

There are no third-party houses located within 500m of any of the turbines. At this distance, the effects of shadow are greatly reduced and are generally not considered a concern. Furthermore, it is expected that the actual occurrence of shadow flicker will be significantly lower than the model prediction output. This is mainly due to the weather experienced in Western Ireland.

The operators of Lackan Wind Farm have not received complaints on shadow casting from the turbines since its commissioning. As noted, the houses that could potentially be affected to the southeast are greater than ten times the rotor diameter from the nearest turbine, as which distance shadow casting is not an issue. No mitigation is considered necessary for its extended lifespan.

4.8.5 Reflected Light

The use of semi-matt paint significantly reduces potential for light reflecting from the turbines. Additional mitigation measures are not required.

4.9 Conclusions on Population & Human Health

Operation of the wind farm is carried out in accordance with best industry practice. The wind farm provides employment, lease income and a source of funds for local clubs, projects and activities. The extended lifespan of the wind farm will not affect the tourists' product in the Inishcrone area; it is expected to a neutral effect. The turbines are not a nuisance to the local residents in terms of shadow casting or reflected light. On balance, the Lackan Wind Farm is having a positive effect on human beings.

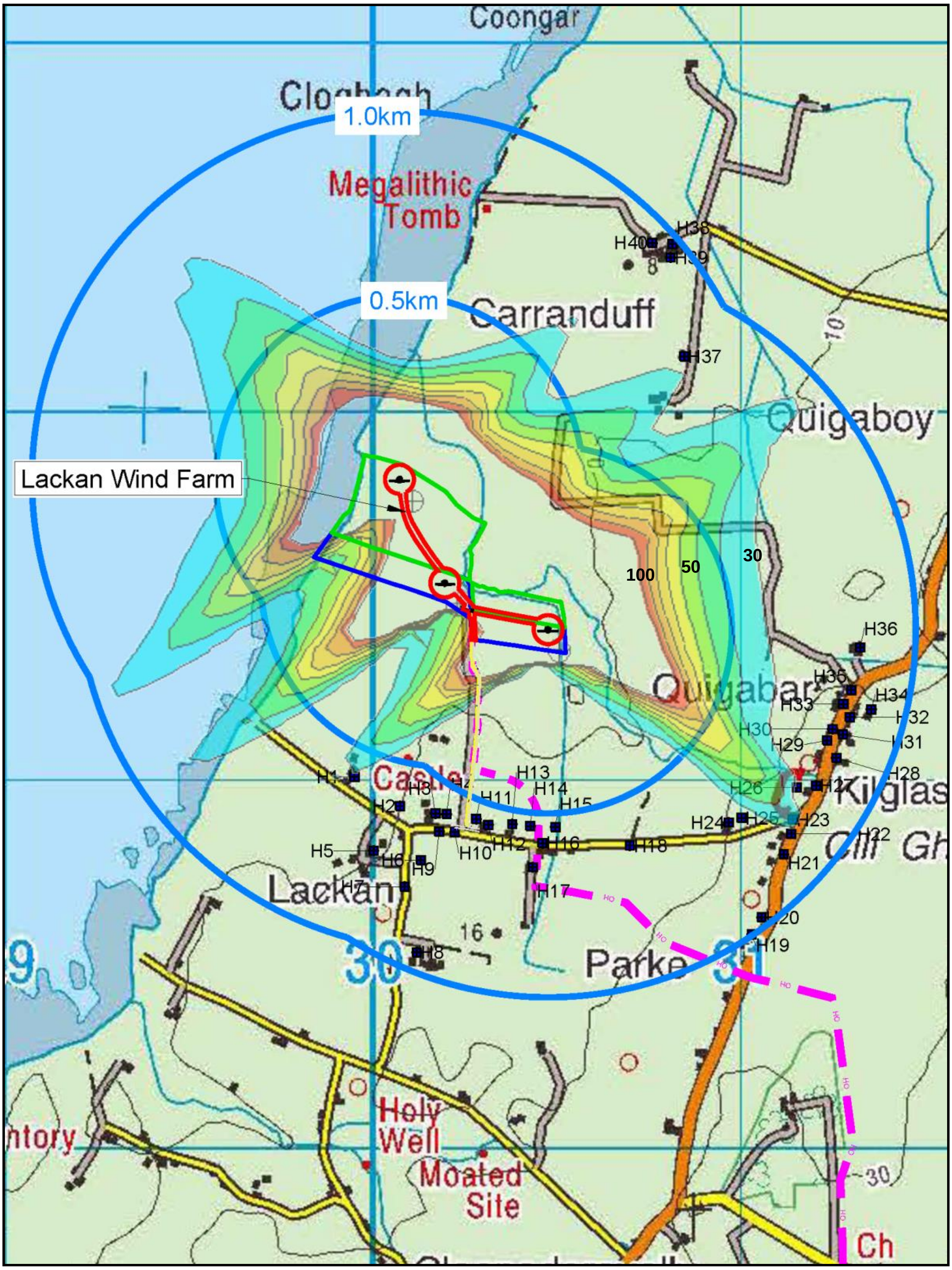


Figure 4-1: Lackan Wind Farm - Shadow Flicker Hours per Year

5 NOISE & VIBRATION

5.1 Introduction

This chapter of the EIAR describes the assessment undertaken of the noise and vibration from the operational Lackan Wind Farm on the local residential amenity. It assesses the continued operation of the wind farm, consisting of 3 No. turbines, for an additional 12 years.

The nearest properties are located approximately 500m – 600m from the nearest turbine location.

Noise and vibration impact assessments have been prepared for the operation of the development. To inform this assessment, a noise monitoring programme was conducted at several representative Noise Sensitive Locations (NSLs) over a number of weeks to assess both operational and background noise levels.

Best practice 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)* was followed.

5.1.1 Statement of Authority

This assessment was prepared in accordance with the EIA Directive 2014/52/EX, current EPA guidelines and best practice by the following staff of Enfonic Ltd.

Gary Duffy, BEng, MIOA (Principal Consultant) in the managing director of Enfonic with over 25 years' experience as an acoustic engineer and consultant. He has extensive knowledge in the field of noise measurement, prediction, and impact assessment. He co-wrote the EPA's original guidance note on noise and represented the IOA on the technical advisory committee of the Department of the Environment's revision of Part E (Sound Insulation) of the Building Regulations. He is a founder member of the Irish branch of the Institute of Acoustics and a sitting member of the current committee.

Patricia Redondo (Acoustic Consultant) holds a BEng in Communication Systems Engineering, MSc in Acoustic Engineering and is an associate member of the Institute of Acoustics (AMIOA). She has extensive experience in both building and environmental acoustics including surveying, noise modelling and impact assessment.

5.1.2 Fundamental of Acoustics

The audible range of sounds can be expressed in terms of Sound Pressure Levels (SPL) and ranges from 0dB (for the threshold of hearing) to 130dB (for the threshold of pain). 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 3dB.

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 is most sensitive to the frequency range of language (300Hz-3,000Hz) and decreases substantially as frequency falls.

It is necessary to adjust the measured noise level by an instrument to reflect the sensitivity response of human hearing and the 'A-weighting' system has been defined in the international standard, BS ISO 226:2003 Acoustics to do this. A SPL measured using 'A-weighting' is expressed in terms of dBA.

An indication of the level of some common sounds on the dBA scale is shown on Table 5-1.

Table 5-1: Commons Sounds on dBA Scale

Source	Decibel Level (dBA)
Threshold of hearing	0
Rustling Leaves	10
Whisper	20
Quiet Rural Setting	30
Quiet Living Room	40
Suburban Neighbourhood	50
Normal Conversation	60
Busy Street Traffic	70
Vacuum Cleaner	80
Heavy Truck	90
Jackhammer	100
Front Row of Rock Concert	110
Threshold of Pain	130
Military Jet Take-off	140

5.2 Methodology

The assessment methodology undertaken for this assessment is summarised as follows:

- Review of the most applicable standards and guidelines to set acceptable noise criteria for the operational phases of the proposed development.
- A baseline survey to assess the existing noise levels with the wind farm operating and with the wind farm shut down.
- Undertake predictive calculations to assess the potential impacts associated with the extended operational period of the wind farm at NSL's.

5.3 Guidance

The assessment of impacts for the extended operational period of the wind farm have been undertaken with reference to the most appropriate guidance documents relating to environmental noise and vibration. The following guidelines in particular were considered and consulted for the purposes of this chapter:

- EPA Guidelines on the Information to be contained in Environmental Impact Statements.
- EPA Advice Notes on Current Practice (in the preparation of Environmental Impact Statements).
- EPA Guidelines on the Information to be contained in Environmental Impact Assessment Reports May 2022.
- EPA Advice Notes for Preparing Environmental Impact Statements.
- British Standard BS 7385 – Evaluation and measurement for vibration in buildings – Part 2: Guide to damage levels from ground borne vibration reference.
- ISO 1996: 2017: Acoustics - Description, Measurement and Assessment of Environmental Noise.
- The Assessment and Rating of Noise from Wind Farms (1996) published by Department of Trade & Industry (UK) Energy Technology Support Unit.
- Institute of Acoustics' Good Practice Guides to the Application of ETSU-R-97.

- Wind Energy Development Guidelines from the Department of Housing, Local Government and Heritage.
- BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise.

A list of useful Acoustic Terminology used in this report can be found at: http://www.acoustic-glossary.co.uk/

5.3.1 Operational Phase Noise

The noise assessment summarised in this chapter is based on current guidance and best practice 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 UK's Department of Trade and Industry – (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.

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) (WEDG-06) outlines the appropriate noise criteria in relation with wind farms developments. The following extract from it sets out the general aim of an impact assessment:

> *"An appropriate balance must be achieved between power generation and noise impact."*

It should be noted that there is no specific advice is given by the Guidelines in relation to what constitutes an 'appropriate balance'. Guidance will be taken from alternative and appropriate publications.

Furthermore, a Noise Sensitive Location is defined as follows:

> *"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 topics identified in this extract have been incorporated into this assessment. It should be noted that the noise limits are defined in terms of the $L_{A90,10min}$ parameter.

> *"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 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 5 dB(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 30 dB(A), it is recommended that the daytime level of the LA90,10min of the wind energy development be limited to an absolute level within the range of 35-40 dB(A)."

In relation to night-time periods the following guidance is given:

"A fixed limit of 43 dB(A) will protect sleep inside properties during the night."

Note again this limit is defined in terms of the $L_{A90,10min}$ parameter. This represents the commonly adopted night-time noise criterion in relation to wind farm developments.

It is proposed to adopt a lower daytime threshold of 40 dB(A) $L_{A90,10min}$ for low noise environments where the background noise is less than 30 dB(A).

This follows a review of 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: License Applications, Surveys and assessments in Relation to Scheduled Activities' 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 the aforementioned EPA NG4 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 appropriate.

At summary of the operational noise limits set out in WEDG-06 is as follows:

- 35 to 40 dB for quiet daytime environments of less than 30dB.
- 45dB for daytime environments greater than 30dB or a maximum increase of 5dB above background noise (whichever is the higher).
- 43dB for night-time periods or a maximum increase of 5dB above background noise (whichever is the higher)[2].

Period definitions from the IoA GPG [17] are as follows:

- Daytime Amenity hours are:
    - All evenings from 18:00 to 23:00hrs.
    - Saturday afternoons from 13:00 to 18:00hrs.
    - All day Sunday from 07:00 to 18:00hrs.
- Night-time hours are 23:00 to 07:00hrs.

[2] While the caveat of an increase of 5dB above background is not explicit within the current guidance it is commonly applied in noise assessments prepared and is detailed in numerous examples of planning conditions issued by local authorities and An Bord Pleanála. For the purposes of this assessment consideration will be given to the commonly adopted approach of also applying the 5dB(A) above background allowance for night-time periods as well as the daytime period.

The Assessment and Rating of Noise from Wind Farms – ETSU-R-97

The core of the noise guidance contained within the *Wind Energy Development Guidelines 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 noise sensitive properties. It is considered that absolute noise levels applied at all wind speeds are not suited to wind turbine developments and therefore best practice is to adopt noise limits relative to background noise levels in the vicinity of the noise sensitive locations. Therefore, a critical aspect of the noise of wind energy proposals related to the identification of baseline noise level through on-site noise surveys.

Institute of Acoustics Good Practice Guidance

The original ETSU-R-7 concepts underwent through standardisation and modernisation in 2013 with the Institute of Acoustics publication of the *A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise* including six acoustic consultants in the UK and Ireland in the application of these methods. Numerous improvements in the accuracy and robustness are described in particular the treatment of wind shear and the general adaptation to larger wind turbines.

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)*, 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 background noise monitoring should be carried out at the nearest NSLs, 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 collected at the site of the wind turbine development, best-fitting polynomial curve is applied to these data sets, to derive background noise levels at various wind speeds to establish the appropriate daytime and night-time noise criterion limits.

The study area is defined in the Good Practice Guide as:

> *"The study area should cover at least the area predicted to exceed 35dB L_{A90} up to 10m/s wind speed from all existing and proposed turbines."*

ISO 9613: Acoustics – Attenuation of Sound Outdoors

Noise emissions associated with the wind turbine(s) 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 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.

Future Potential Guidance Changes

Proposed changes to the assessment of noise impacts associated with onshore wind energy developments were issued in December 2019. As part of the public consultation process of the *Draft Revised Wind Energy Development Guidelines December 2019* guidance, considerable concerns in relation to the proposals were expressed by various parties including members of the Institute of Acoustics and various experts in the field of wind turbines noise assessments.

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 this report is based on the guidance currently outlined in *Section 5.6 of the Wind Energy Development Guidelines for Planning Authorities*.

World Health Organization (WHO) Noise Guidelines for the European Region

The WHO Environmental Noise Guidelines for the European Region (2018) [20] provide guidance on protecting human health from exposure to environmental noise. It sets 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. Lden), 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 LAeq-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. It may be concluded that the acoustical description of wind turbine noise by means of Lden or Lnight may be a poor characterization of wind turbine noise and may limit the ability to observe associations between wind turbine noise and health outcomes.”*

The 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 Lden) should not currently be applied as target noise criteria for an existing or proposed wind turbine development in Ireland.

Special Characteristics

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)* is noted here:

> *"There is similarly no significant infrasound from wind turbines. Infrasound is high level sound at frequencies below 20Hz. 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 20Hz. 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 20Hz to 200Hz 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)* 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, titled *"low frequency noise incl. infrasound from wind turbines and other sources"* presents the details of a measurement project 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:

> *"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)"*
>
> *"The results of this measurement project comply with the results of similar investigations on a national and international level."*

Amplitude Modulation

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.
- '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 1Hz.

'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.

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 UK Departments of Environment Food and Rural Affairs (DEFRA), of Business, Enterprise and Regulatory Reform (BERR) and 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.

Prediction of AM
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 the matter:

> *"even on those limited sites where it has been reported, its frequency of occurrence appears to be at best infrequent and intermittent."*
>
> *"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."*
>
> *"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."*

Assessment of AM
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.

<u>Tonal Noise</u>
Tonal noise has been described as containing a discrete frequency component, most often of a mechanical origin. Examples can include the hum from an electrical transformer located at the base of a wind turbine, which can exhibit low frequency tones, the dial tone on a phone, a mid-frequency tone, and whistling which tends to comprise higher frequency tones.

Tonal noise may also be caused by wind turbine components (e.g., meshing gears) or non-aerodynamic instabilities interacting with a rotor blade surface or unstable flows over holes or slits on the turbine nacelle. Improvements in gearbox design and the use of anti-vibration techniques have resulted in significant reductions in mechanical sound generation. The most recent direct drive machines have no high-speed mechanical components and therefore mechanical noise levels are generally reduced.

Mechanical noise in the nacelle can be attenuated by conventional noise control methods. These include measures to reduce vibration forces in moving parts such as improved acoustic and vibration isolation around rotating equipment as well as improved sound insulation design of nacelle and machinery housings.

Prediction of Tonal Noise

It should be noted that tonal noise is associated with wind turbine operation, and it is not possible to predict an occurrence of tonality 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.

Assessment of Operational Special Characteristics

Appropriate guidance for the assessment of special acoustic characteristics include:

Low Frequency: *University of Salford Proposed Criteria for the Assessment of Low Frequency Noise Disturbance, Revision 1*

Amplitude Modulation: *IOA Noise Working Group (Wind Turbine Noise) Amplitude Modulation Working Group Final Report, A Method for Rating Amplitude Modulation in Wind Turbine Noise*

Tones: *ISO/PAS 20065:2016 Acoustics — Objective method for assessing the audibility of tones in noise — Engineering method*

Should a complaint arise once a development is operational, these characteristics can be assessed using the relative techniques and, if necessary, appropriate penalties applied.

5.3.2 Decommissioning Phase Noise

To set appropriate decommissioning noise limits for the proposed development, reference has been made to BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise [7]. This provides information on the prediction and measurements of noise from construction sites and operations such as mines and quarries. It also includes a large database of source noise levels for commonly used equipment and activities on construction sites.

The standard provides guidance on the 'threshold of significant effect' in respect of noise impact at dwellings. One suggested method for determining threshold noise levels is known as 'ABC method'. This involves measuring existing ambient noise levels at noise sensitive locations and categorising them A, B or C accordingly, with the relevant threshold level derived from the category as set out in Table 5-2.

Table 5-2: BS 5228 - Example of significant effect at dwellings

Assessment category and threshold value period (L_{Aeq})	Threshold value, in decibels (dB)		
	Category A A)	Category B B)	Category C C)
Night-time (23.00−07.00)	45	50	55
Evenings and weekends D)	55	60	65
Daytime (07.00−19.00) and Saturdays (07.00−13.00)	65	70	75
NOTE 1 A significant effect has been deemed to occur if the total L_{Aeq} noise level, including construction, exceeds the threshold level for the Category appropriate to the ambient noise level. *NOTE 2 If the ambient noise level exceeds the threshold values given in the table (i.e. the ambient noise level is higher than the above values), then a significant effect is deemed to occur if the total L_{Aeq} noise level for the period increases by more than 3 dB due to construction activity.* *NOTE 3 Applied to residential receptors only.*			
A)	Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are less than these values.		
B)	Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are the same as category A values.		
C)	Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are higher than category A values.		
D)	19.00–23.00 weekdays, 13.00–23.00 Saturdays and 07.00–23.00 Sundays.		

5.3.3 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. 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.

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 [25]. 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.

Health Service Executive (HSE) Public Health Medicine Environment and Health Group

In Ireland the HSE Public Health Medicine Environment and Health Group drafted a position paper in 2017 title Position Paper on Wind Turbines and Public Health. The group identified that there is no published scientific evidence to support adverse effects of wind turbines on health and concluded that:

> *"Published scientific evidence is inconsistent and does not support adverse effects of wind turbines on health. However, adequate setback distances and meaningful engagement with local communities are recommended in order to address public concern."*

5.3.4 Operational Phase Vibration

Vibration generated from the operation of a wind turbine unit will decrease rapidly with distance through the ground. Typically, at a distance of 100m from a 1MW turbine unit the level of vibration associated with a turbine is the order of 10-5mm/s which would be imperceptible.

A report from Germany published by the State Office for the Environment, Measurements and Nature Conservation of the Federal State of Baden-Württemberg in 2016, "low frequency noise incl. infrasound from wind turbines and other sources" conducted a 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 measured from a sensitive receptor external amenity to a turbine hardstanding is greater than 500m the level of vibration will be significantly below the threshold for perceptibility. Therefore, vibration criteria have not been specified for the extended operational phase.

5.3.5 EPA Description of Effects

The significance of effects shall be described in accordance with the EPA *guidelines on the information to be contained in Environmental Impact Assessment Reports*.

The effects associated with the wind farm are described in the relevant sections of this chapter with respect the EPA guidance and description of effects.

5.4 Receiving Environment

As the wind turbines are operational, this stage of the assessment was to determine typical background noise levels in the vicinity of the noise sensitive locations in closest proximity to the development site across a range of wind speeds.

This was done through installing unattended sound level meters at three representative locations in the surrounding area for approximately a four-week period. The wind speed data at hub height was obtained from the wind turbines.

5.5 Impact Assessment

5.5.1 Do Nothing Impact

In the 'do-nothing' scenario, the wind farm will continue to operate with the benefit of the existing planning permission until October 2023, after which it would need to be decommissioned. Traffic noise is currently a significant noise source in the vicinity of some road networks in the area. With the decommissioning of the wind farm in 2023 / 2024, increases in traffic volumes on the local road network would be expected and would likely result in slight increases in the overall ambient and background noise levels in the area.

5.5.2 Construction Phase Impacts

As the site is already constructed and operational, there are no construction related noise impacts.

5.5.3 Operational Phase Impacts

Existing Background noise limits

Any noise limits imposed on the development are determined by the planning authority. In determining the limits, guidance from ETSU-R-97 and WEDG-06 publication are commonly used, which in part derive limits from Background noise levels.

Planning permission for the Lackan Wind Farm (reference Pl 08/216) included condition 10(a) in relation to noise which states:

> *"Noise levels emanating from the proposed development following commissioning, when measured externally at a noise sensitive location, shall not exceed 45 dB(A) at any time."*

This fixed limit level was in keeping with recommended limits in ETSU-R-97.

Choice of the Measurements Locations

Several locations were chosen as being suitable to represent the ambient noise conditions within the study area and noise monitoring was conducted at these sites. Two locations were near the turbines and the third location was a proxy location. These are shown in **Figure 5-1** and detailed in Table 5-3.

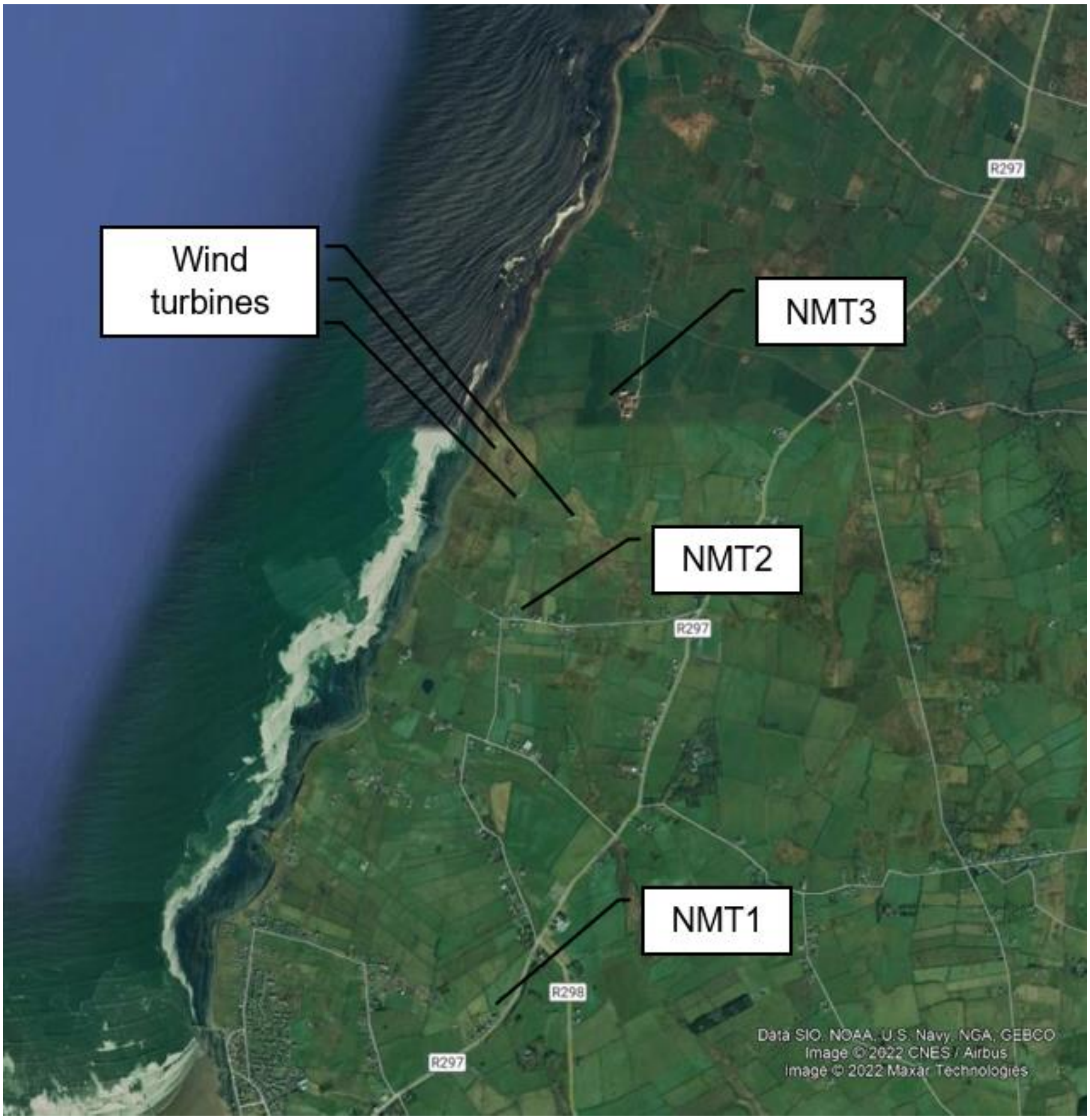


Figure 5-1: Location of the Noise Monitoring Locations

Table 5-3: NMTs Co-ordinates and Descriptions

Location	Easting	Northing	Description	Distance from Site
NMT1	130002	330706	Private garden of Lackan Wind Farm owner	c. 2.6km to the south
NMT2	130190	332894	Private garden, to the south of the wind turbines	c. 650m to the south
NMT3	130642	334033	Farm, to the north of the wind turbines	c. 650m to the north

Traffic noise from the local road network was the dominant source at the locations. In addition, other sources such as agricultural and livestock were observed.

NMT1 was selected as a proxy location to represent the houses located to the east of the wind turbines that are a similar distance away.

5.5.4 Measurement Periods

The survey duration was approximately four weeks. Sections 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."*

The survey was conducted in general accordance with *ISO 1996: 2017: Acoustics - Description, Measurement and Assessment of Environmental Noise* and followed the methodology contained in EPA NG4. Specific details are set out below.

The monitoring periods for each site is outlined in Table 5-4**Table 5-4**.

Table 5-4: Noise Measurement Periods

Location ID	Start Date	End Data
NMT1	15/06/2022	21/07/2022
NMT2	15/06/2022	15/07/2022
NMT3	15/06/2022	21/07/2022

A variety of wind speed and weather conditions were encountered over the survey period. The wind turbines were operative throughout except for approximately 4 days when the turbines were turned off to facilitate the measurement of background noise. The gathered data during the shutdown period is to facilitate the establishment of appropriate noise limits under current guidance.

5.5.5 Instrumentation

A Noise Monitoring Terminal (NMT) was installed at each monitoring location. The NMT consists of of a Sound Level Meter (SLM), outdoor microphone, batteries, etc. The microphone was positioned at a height of 1.5m and at least 3m from reflective surfaces. The SLMs used are outlined in Table 5-5.

Table 5-5: Noise Measurement Instrumentation

Location ID	Equipment	Serial Number
NMT1	Brüel and Kjaer 2250	2699597
NMT2	Brüel and Kjaer 2250 Light	2654662
NMT3	Brüel and Kjaer 2250	3001350

Before and after the measurements, the instruments were field calibrated using a Brüel & Kjær type 4231 Sound Level Calibrator.

Rainfall was monitored at NMT3 to allow the removal of noise data during precipitation, in line with best practice outlined in *IOA GPG Supplementary Guidance Note 2: Data Processing and Derivation of ETSU-R-97 Background Curves*.

Wind speed and direction measurements were obtained from turbine-based anemometers provided by the client.

Noise levels in terms of measurement parameters $L_{Aeq,10min}$, $L_{A90,10min}$ and 1/3 octave frequency bands were logged by each NMT.

5.5.6 Consideration of Wind Shear

Wind shear is defined as the increase of wind speed with height above ground. As part of robust wind farm noise assessment due consideration should be given to the issue of wind shear. 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 uses the following equation:

Shear Exponent Profile:

$$U = U_{ref} \left[\frac{H}{H_{ref}}\right]^m$$

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 uses the following equation:

Roughness Length Shear Profile:

$$U_1 = U_2 \frac{\ln\left(\frac{H_1}{z}\right)}{\ln\left(\frac{H_2}{z}\right)}$$

Where:
U_1: the height of the wind speed to be calculated (10m)
U_2: the height of the measured wind speed
H_1: the wind speed to be calculated
H_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.

The background noise data has been analysed with respect to a 10m standardised height based on an assessment hub height of 93m in accordance with the guidance contained in the *IoA GPG, Supplementary Guidance Note (SGN) 4: Wind Shear, July 2014*.

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.

5.5.7 Analysis of Noise Data

The data sets have been filtered to remove issues such as the dawn chorus and the influence of other atypical noise sources. Examples of atypical sources include isolated periods of raised noise levels attributable to local sources e.g., agricultural activity, boiler flues, operation of gardening equipment, etc. In addition, sample periods affected by rainfall or when rainfall resulted in prolonged periods of atypical noise levels have also been screened from the data sets. The assessment methods outlined above are contained in the IoA GPG.

The results presented in the following sections refer to the noise data collated for the amenity periods.

Ambient & Background Noise
In general, the significant noise sources in the area were noted to be local and distant traffic, domestic activity in and around the residences, wind generated noise from local foliage and other anthropogenic sources typically found in such rural settings.

No significant sources of vibration were noted at any of the survey locations.

The measured $L_{A90,10mins}$ ambient noise levels at each monitoring location i.e. with turbines operating, for daytime and night-time amenity hours is presented in Table 5-6.

Table 5-6: Measured Levels of $L_{A90,10min}$ for Various Wind Speeds for Ambient Noise

Location ID	Period	Derived $L_{A90,10mins}$ Levels (dB) at Various Standardised 10m Height Wind Speeds (m/s)						
		4	5	6	7	8	9	10
NMT1	Day	36	37	39	41	43	45	48
	Night	32	33	35	37	40	43	47
NMT2	Day	35	37	40	42	44	45	45
	Night	34	36	38	40	41	42	42
NMT3	Day	36	38	41	43	45	46	46
	Night	37	38	40	42	44	45	47
Nominal	**Day**	**35**	**37**	**39**	**41**	**43**	**45**	**45**
	Night	**32**	**33**	**35**	**37**	**40**	**42**	**42**

The measured $L_{A90,10mins}$ background noise levels at each monitoring location i.e., with no turbines operating is presented in Table 5-7.

Table 5-7: Measured Levels of $L_{A90,10min}$ for Various Wind Speeds for Background

Location ID	Period	Derived $L_{A90,10mins}$ Levels (dB) at Various Standardised 10m Height Wind Speeds (m/s)						
		4	5	6	7	8	9	10
NMT1	Day	37	38	38	38	38	38	38
	Night	32	34	34	34	34	34	34
NMT2	Day	34	35	35	35	35	35	35
	Night	31	31	31	31	31	31	31
NMT3	Day	35	36	36	36	36	36	36
	Night	29	29	29	29	29	29	29
Nominal	**Day**	**34**	**35**	**35**	**35**	**35**	**35**	**35**
	Night	**29**	**29**	**29**	**29**	**29**	**29**	**29**

The Nominal criteria represents the lowest background level from all NMTs per wind speed bin. The noise criteria limits are derived from these levels to represents a worst-case impact assessment.

5.5.8 Noise Limits

The WEDG-06 guidance sets out fixed limits for Daytime and Night-time periods. It also allows for the limit to increase in order to account for background noise levels which are already at or close to the limit value. In summary it gives the following recommendations:

- 35 to 40 dB for quiet daytime environments of less than 30dB.
- 45dB for daytime environments greater than 30dB or a maximum increase of 5dB above background noise (whichever is the higher).
- 43dB for night-time periods or a maximum increase of 5dB above background noise (whichever is the higher).

Following a review of the background noise data from the shutdown periods, it could not be established if the <u>maximum increase of 5dB above background</u> element was appliable. This was due to insufficient data as the duration of the provided shutdown periods did not satisfy the requirements of IOA SGN 2.

Without this relative background criteria, only the fixed limit element can apply which makes for more onerous criteria. Therefore, the following fixed limits should be applied as appropriate for the site:

- 45dB for Daytime
- 43dB for Night-time

The above criteria assumes that the study area does not satisfy the low background noise criteria i.e., Daytime noise levels below 30dB. Due to the requirements of IOA SGN 2 not being satisfied, it cannot be categorially stated that this condition is not met. However, the background data that was gathered and set out in Table 5-4 ranges from 35-45dBA which indicates that this is unlikely.

5.5.9 Wind Turbine Noise Results

In accordance with the ETSU-R-97 guidance, the wind farm noise can be calculated with formula:

$$L_{pw} = 10\log_{10}\left(10^{\frac{L_{pc}}{10}} - 10^{\frac{L_{pb}}{10}}\right)$$

Where
L_{pw}: wind farm noise, dB(A)
L_{pc}: combined wind farm and background noise as measured, dB(A)
L_{pb}: background noise only, dB(A)

Using the Nominal criteria from Table 5-6 and Table 5-7 above, the calculated wind farm noise levels are given in Table 5-8.

Table 5-8: Derived L_{pw} values for various wind speeds

Metric	Period	Derived $L_{A90,10mins}$ Levels (dB) at Various Standardised 10m Height Wind Speeds (m/s)						
		4	5	6	7	8	9	10
L_{pw}	Day	28	33	37	40	42	45	45
	Night	29	31	34	36	40	42	42

Tonality
A tonal characteristic to a given noise level may cause more annoyance than the same noise level without it. The overall noise level is known as the 'rating level' and is the arithmetic sum of the wind farm noise level, L_{pw} and a tonal penalty, K_T. It is this level which determines whether the wind farm has complied with the limits set in the planning condition.

No tonal characteristics were observed at any wind speed during the monitoring period so no penalty applies. Therefore, the rating level remains as per Table 5-8.

Discussion
The results demonstrate that the current operational noise condition i.e., "*shall not exceed 45 dB(A) at any time"* is being satisfied at all wind speeds. The site is therefore operating within the current planning condition.

For the proposed continued operation period, the wind farm is also likely to operate within the proposed Daytime and Night-time limits of 45dBA and 43dBA respectively.

Description of Effects
With respect to the EPA's criteria for description of effects; the noise impact associated with the wind turbines at the nearest noise sensitive locations is as follows:

Quality	Significance	Duration
Negative	Not significant	Long-term

5.5.10 Decommissioning Phase Impacts

A variety of items of plant will be in use for the purposes of site decommissioning works. There will be vehicular movements to and from the site that will make use of the existing road network and there is potential for the generation of significant levels of noise from these activities.

A detailed decommissioning programme is not yet known so noise impacts cannot be fully quantified at this point. However, using the measured Daytime noise levels and the guidance set out in Table 5-2, the appropriate noise Category is A with a noise limit of 65dBA.

Given the likely items of plant associated with a decommissioning phase and the distances from the wind turbines to the NSLs, it is considered the works can be conducted without exceeding the limit above.

To ensure compliance, the contract documents shall specify that the Contractor undertaking 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 on open sites – Noise*

5.5.11 Cumulative Impacts

There are no wind farms or significant developments (existing or proposed) near the Lackan Wind Farm. Apart from the traffic noise as discussed above, no cumulative impacts are predicted.

5.6 Mitigation Measures & Monitoring

The above assessment is based on a noise monitoring programme intended to assess compliance with the current planning condition; to reassess the wind farm noise effects having regard to changes in guidelines and technology since its commissioning; and to derive future planning conditions.

Monitoring is recommended to ensure compliance with any noise conditions applied to the extended operational period of the wind farm. 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.

During the extended operational period of the wind farm, it is recommended that the noise monitoring programme detailed in the relevant section of this report be followed with consideration of the guidance outlined in the *IoA GPG* and *Supplementary Guidance Note 5*.

5.7 Residual Effects

This section summarises the likely residual noise and vibration effects associated with the extended operational period of the Lackan Wind Farm following the implementation of mitigation measures.

5.7.1 Wind Turbine Operation

The predicted noise levels associated with the Lackan Wind Farm are within best practice noise criteria recommended in Irish guidance *'Wind Energy Development Guidelines for Planning Authorities, 2006'*, [14] and has been supplemented with guidance from ETSU-R-97 and the IOA GPG and its supplementary guidance notes. It is not considered that a significant effect is associated with the development.

There are no expected sources of vibration associated with the operational phase of the Lackan Wind Farm.

5.8 Interactions

No significant interactions of noise emissions with other aspects of the environment during the extended operational period or decommissioning phase are predicted.

5.9 Difficulties Encountered

There were no difficulties associated with compiling the material used in the noise impact assessment. However, a less onerous noise limit may have been applied if more background noise data were achievable.

6 TRAFFIC & TRANSPORT

6.1 Introduction

Traffic and transport are generally of greatest interest for the construction stage of wind farms when over-sized loads need to be delivered to the site. As the Lackan Wind Farm is operational, this aspect is not relevant to the proposed extension of the operational lifespan by 12 years. This chapter therefore assesses the traffic associated with the operational phase of the wind farm and the predicted traffic associated with the decommissioning phase. It was prepared by Keohane Geological & Environmental Consultancy.

6.2 Methodology

This chapter adopts the guidance for such assessments set out by the National Roads Authority (NRA) in the document '*Guidelines for Traffic and Transport Assessments*'[66].

The methodology used is outlined as follows:

1. A desk-based review of the road network in the vicinity of the site.
2. An assessment of the traffic volumes and types during the extended operational phase.
3. An assessment of the likely traffic associated with the decommissioning of the wind farm and the removal of the turbines. This included a review of access routes used during the wind farm construction and an estimate the traffic volumes that will be generated during the decommissioning phase.
4. An assessment of the impact on local roads near the site entrance and users of these local roads.

6.3 Existing Road Network

The existing road network in the vicinity of the site is seen in the location map, Figure 2-1. The nearest national route, the N59, runs in a northeast-southwest direction approximately 6.5km to the southeast of the site between Dromore West and Ballina. The nearest regional route, the R297, runs in a northeast-southwest direction approximately 1km to the southeast, linking Easky and Inishcrone. County roads, used by local traffic, are used to access the site from the R297. The L6502 runs eastwards from the R297 at Kilglass and passes to the south of the wind farm. It ends at the foreshore in Lackan. A farm lane extends north from the L6205 into the site.

The delivery route for turbine components, from Killybegs to the Lackan Wind Farm in 2007, was the N59 as far as Dooeighney (Sligo – Mayo border), turning north onto the R297, going through Inishcrone and turning west (left) onto local road L6502 to the site.

6.4 Impact Assessment

6.4.1 Do Nothing Impact

In the 'do-nothing' scenario, the wind farm will continue to operate with the benefit of the existing planning permission until October 2023, after which it would need to be decommissioned. In this scenario, the traffic associated with the decommissioning would be experienced sooner than if the lifespan is extended by 12 years.

6.4.2 Construction Phase Impacts

As the site is already constructed and operational, there are no construction related impacts.

6.4.3 Operational Phase Impacts

The wind farm is monitored remotely using the SCADA system. Enercon service and maintenance department provide 24-hour monitoring and many faults are rectified remotely. Regular maintenance for each turbine is 48 hours per year, which equates to approximately 6 visits to site per turbine or 18 visits for the 3 turbines. This will result in approximately 1 visit to site every 3 weeks for scheduled maintenance. This, with unscheduled maintenance (fault repair) will mean that it is likely that there will be a maintenance team on site once per week on average. This work is usually carried out by a 2-man team using a van. The impact of this on local traffic is imperceptible.

6.4.4 Decommissioning Phase Impacts

The decommissioning phase impacts will be similar to the construction phase impacts but of lesser magnitude. The magnitude of the impact would depend on the restoration programme for the site. For example, with the concrete foundation left in place, the HGV traffic associated with removing concrete used in turbine foundations would avoid approximately 120 HGV loads. It is noted that the wind farm was constructed with no significant impact on roads and traffic, so its decommissioning will not present any significant issues.

The potential decommissioning phase impacts on traffic and roads include:

1. Increase in local traffic, in particular an increase in HGVs carrying concrete, if foundations are removed. There will also be an increase due to workers to and from the site and works may attract on-lookers.
2. Transport of oversized loads – approximately 60 for the 3 turbines – with an additional 20 normal loads, approximately, for turbines components. This would depend on the end-of-life options for the turbines. For example, if the turbines are dismantled for re-use at another site, then the number of oversized loads would be approximately 20. However, if the turbines are sold for recycling, then the towers may be cut on site for ease of transport. Similarly, blades are unlikely to be reused, so would be cut up on site for ease of transport.
3. Delivery of the crane to the site – approximately 35 loads for the 2 cranes.
4. Modification of roads to accommodate wide sweeps at corners.
5. Heavy loads passing over small bridges and culverts not designed for such loads. There are no small bridges on the route to the site that are unsuitable for oversized loads.
6. The short-term increase in local traffic volume increases the risk of collision.
7. Tree branch overhang – requirement for hedgerow maintenance.

6.5 Mitigation Measures

No mitigation measures are required for the extended operational phase of the wind farm. A traffic management plan (TMP) will be prepared prior to the commencement of decommissioning. This will take account of the end-of-life use of the turbines and agreed site restoration, both of which will dictate the types and number of HGV movements. Any oversized loads will likely use the same route to the N59 as used during the construction phase.

6.6 Conclusions on Traffic & Transport

Access to the site has been proven during the construction of the wind farm and its operation since 2007. No significant issues are envisaged during the extended lifespan of the wind farm or its decommissioning. A traffic management plan will be prepared and agreed with County Council prior to decommissioning.

7 WATER

7.1 Introduction

This chapter of the EIAR addresses hydrology (surface water) in the existing environment, the potential direct and indirect impacts of the continued operation of the wind farm and grid connection on hydrology and the proposed mitigation measures to avoid or reduce potential impacts. It was prepared by Keohane Geological & Environmental Consultancy. Aquatic ecology of the site was assessed by JKW Environmental and is presented in Chapter 10.

In summary the development consists of an operational wind farm with 3 No. turbines, access roads, hardstands, control building and grid connection. The assessment addresses the extension of the permitted development for an additional 12 years.

7.1.1 Scope & Purpose

This chapter of the EIAR provides details of the surface water environment in which the development is located. It identifies the surface water catchment(s), drainage patterns, surface water uses, runoff characteristics, and flood potential. It provides baseline surface water quality data based on publicly available information and monitoring carried out as part of this assessment.

The purpose of the assessment is to identify the potential direct impacts of the extended lifespan of the wind farm on the hydrology (surface water quality, runoff characteristics etc.) within the site and potential indirect impact beyond the site boundary; to assess the potential impacts in the context of other developments (proposed / completed) to determine cumulative effects. Having identified and quantified the potential impacts, to recommend measures to avoid, mitigate and/or reduce significant potential negative impacts for the extended operational phase and decommissioning phase of the development.

7.1.2 Policies & Guidelines

There are several local, national and international policies and guidelines relied upon on the preparation of this chapter. These include:

1. Water Framework Directive (2000/60/EC).
2. County Sligo Development Plan 2017 - 2023.
3. Department of the Environment, Heritage & Local Government, June 2006. *Wind Farm Development – Planning Guidelines*.
4. Department of the Housing, Planning & Local Government, December 2019. *Draft Revised Wind Energy Development Guidelines.*
5. Irish Wind Energy Association, 2012. *Best Practice Guidelines for the Irish Wind Energy Industry*.
6. Office of Public Works (OPW), November 2009. *The Planning System and Flood Risk Management Guidelines for Planning Authorities*.
7. Department of the Environment, Community and Local Government, 13 August 2014. *Use of OPW Flood Mapping in Assessing Planning Applications, and Clarifications of Advice Contained in the 2009 DECLG Guidelines for Planning Authorities – "The Planning System and Flood Risk Management*". Circular PL 2/2014.
8. Construction Industry Research and Information Association (CIRIA), 2015. *Site Handbook for the Construction of SuDs: Technical Guidance C753*.

9. Construction Industry Research and Information Association (CIRIA), 2017. *The SuDS Manual: Technical Guidance C698*.
10. Construction Industry Research and Information Association (CIRIA), 2006. *Control of Water Pollution from Linear Construction Sites: Technical Guidance C698*.
11. Construction Industry Research and Information Association (CIRIA), 2001. *Control of Water Pollution from Construction Sites. Guidance for Consultants and Contractors: Technical Guidance C532*.
12. Environmental Protection Agency, 2002. *Guidelines on the information to be contained in Environmental Impact Statements*.
13. Environmental Protection Agency, August 2017. *Guidelines on the information to be contained in Environmental Impact Statement Reports – draft*.
14. Environmental Protection Agency, 2003. *Advice Notes on current practice in the preparation of Environmental Impact Statements*.
15. Welstead, J., Hirst, R., Keogh, D., Robb G. and Bainsfair, R. 2013. *Research and Guidance on Restoration and Decommissioning of Onshore Wind Farms. Scottish Natural Heritage Commissioned Report No. 591*.
16. Eastern Regional Fisheries Board. *Requirements for the Protection of Fisheries Habitat During Construction and Development Works at River Sites*.

<u>Wind Farm Guidelines</u>
The 2006 wind farm planning guidelines set out some general considerations for surface water. These are:

- Site drainage and hydrological effects, such as water supply and quality and watercourse crossings.
- Degradation of habitats through alteration or disturbance, in particular arising from changes to hydrology that may alter the surface or groundwater flows and levels, and drainage patterns critical in peatlands and river headwaters.
- Storage and transfer of material, including use of bunded storage areas for use during construction and operational phases to avoid any pollution of surface or ground waters.
- Avoid the excavation of drains, where possible, unless it is necessary for geotechnical or hydrological reasons.
- If drains are unavoidable, ensure that silt traps are constructed and that there is only diffuse discharge of water.
- Avoid blocking existing drains.
- Important features such as streams should be properly bridged or culverted.
- Culverts should be placed under roads, where appropriate, to preserve existing surface drainage channels.
- Carefully monitor and control any pumping of water from excavated turbine bases to ensure that water is directed into existing water courses, forestry drains or specially constructed drains, all with adequate capacity to deal with the volumes of water encountered.

In addition to the above, the 2019 draft wind farm guidelines require/recommend that:

- Developers and the Local Authority should have regard to the Water Framework Directive and support the implementation of the relevant recommendations and measures as outlined in the relevant River Basin Management Plan.
- A flood risk assessment be carried out in accordance with the 2009 flood risk management guidelines.
- A Construction Environment Management Plans (CEMPs) be prepared prior to construction and include the mitigation measures detailed in the EIAR. A draft should be submitted with the planning application. In relation to surface water, the following is recommended to be included in the CEMP:
  - containment of all construction-related fuel and oil within specially constructed bunds to ensure that fuel spillages are fully contained; such bunds shall be roofed to exclude rainwater.

- a water and sediment management plan, providing for means to ensure that surface water runoff is controlled such that no silt or other pollutants enter local water courses or drains.
- details of a water quality monitoring and sampling plan.

Many of the aspects addressed in the Guidelines deal with the construction phase of the wind farm, which aren't relevant to the proposed development. The above aspects are discussed in this chapter in terms of the extended operational phase and decommissioning phase.

County Development Plan

Section 9.4 of the County Development Plan (2017 – 2023) addresses surface water drainage. It outlines eight polices in relation to the interaction of development with the surface water environment, including the protection of surface water quality, surface water habitats and the natural drainage systems.

Section 10.1 of the County Development Plan (2017 – 2023) addresses water quality (surface, coastal and groundwater). It outlines several polices to protect water quality including policy P-WQ-4 to '*prohibit any development which is likely to lead to the deterioration of water quality*'.

Section 10.4.5 of the County Development Plan (2017 – 2023) addresses coastal flooding and erosion. The associated policies relate to coastal zone protection and flood risk assessment. Section 10.7 addresses flood risk management. Policies relating to flood risk management include the requirement for developer to carry out a flood risk assessment. Policy P-FRM-6 '*require development proposals, where appropriate, to be accompanied by a detailed flood risk assessment in accordance with the provisions of the DoEHLG's Planning System and Flood Risk Management Guidelines for Planning Authorities and to address flood risk management in the detailed design of development, as set out in Appendix B of the Guidelines'*. Section 13.2.10 outlines the requirements for flood risk assessment.

7.1.3 Sources of Baseline Data

The main sources of baseline data and information relating to the surface water environment include:

1. Surface water data including catchments, flows, surface water quality etc - Environmental Protection Agency www.epa.ie, www.catchments.ie and http://www.wfdireland.ie/maps.html . For the purposes of this assessment, watercourses shown on the EPA web-mapping are defined as streams / rivers and watercourses not shown are referred to as drains (these are generally man-made drains installed for land drainage purposes.
2. Historical flood information and flood risk maps - Office of Public Works www.opw.ie , www.cframs.ie and www.floodmaps.ie
3. Rainfall data - Met Eireann www.met.ie
4. Designated sites – National Parks & Wildlife Service www.npws.ie

7.1.4 Assessment Methodology

The assessment was carried out with reference to relevant policies, regulations and guidelines, as listed above, and following this general methodology:

1. The design and as-built of the development was reviewed to identify elements which could have the potential to impact or change hydrology or impact surface water quality.
2. Consultation was carried out with agencies with an interest in the surface water environment, including IFI, (refer to Table 1-2).
3. A literature review was carried out to determine any policies and / or guidelines to which the wind farm should have regard.

4. A desk-based assessment of the surface water quality, flows and drainage pattern in the catchment relevant to the development, was undertaken. Any particularly sensitive surface water receptors were identified – surface water abstractions for drinking water, sensitive aquatic habitats or fauna, etc.
5. A field survey was conducted to identify any significant hydrological features. The field surveys included inspection of the surface water management features of the wind farm to assess their efficiency.
6. Review of the biodiversity chapter prepared for the project by JKW Environmental to assess the interaction of surface water with ecology
7. Findings from the desk-based study and field surveys were used to improve the surface water environment for the extended operation of the wind farm.

The site walkovers and collection of data were carried out on several occasions between February and May 2022. Data collected included:

1. Mapping of surface water drainage.
2. Collection of surface water quality data.
3. Identification of local users of surface water for drinking water supply.

The information collected during the desk-based assessment and site walkover were used to establish the importance, quality and sensitivity of the receiving surface water environment. This follows the NRA (2008).

Table 7-1: Estimation of Importance of Hydrology Attributes

Importance	Criteria	Typical Examples
Extremely High	Attribute has a high quality or value on an international scale	River, wetland or surface water body ecosystem protected by EU legislation e.g. 'European sites' designated under the Habitats Regulations or 'Salmonid waters' designated pursuant to the European Communities (Quality of Salmonid Waters) Regulations, 1988.
Very High	Attribute has a high quality or value on a regional or national scale.	River, wetland or surface water body ecosystem protected by national legislation – NHA status. Regionally important potable water source supplying >2500 homes. Quality Class A (Biotic Index Q4, Q5) Flood plain protecting more than 50 residential or commercial properties from flooding. Nationally important amenity site for wide range of leisure activities.
High	Attribute has a high quality or value on a local scale	Salmon fishery. Locally important potable water source supplying >1000 homes. Quality Class B (Biotic Index Q3-4). Flood plain protecting between 5 and 50 residential or commercial properties from flooding. Locally important amenity site for wide range of leisure activities.
Medium	Attribute has a medium quality or value on a local scale	Coarse fishery. Local potable water source supplying >50 homes. Quality Class C (Biotic Index Q3, Q2-3). Flood plain protecting between 1 and 5 residential or commercial properties from flooding.
Low	Attribute has a low quality or value on a local scale	Locally important amenity site for small range of leisure activities. Local potable water source supplying <50 homes. Quality Class D (Biotic Index Q2, Q1) Flood plain protecting 1 residential or commercial property from flooding. Amenity site used by small numbers of local people.

7.1.5 Consultation

As part of the EIA process, consultation was carried out with organisations and individuals regarding the proposed development, namely IFI and OPW. IFI provided comment; while it acknowledged the consultation request, the OPW didn't provide any technical comment. The information package sent, and the consultation responses received, are provided in Appendix 1-1. The relevant response is summarised here and incorporated, where appropriate, into the avoidance, mitigation and monitoring proposals for the wind farm.

Inland Fisheries Ireland (IFI)
IFI responded by email in May 2022 noted that the wind farm lies close to a stream flowing into Killala Bay which is a migratory route for salmon, sea trout, lamprey and eel into the River Moy system. It requested that the following be considered:

1. *The adjacent stream should be assessed in terms of aquatic biodiversity with particular emphasis on habitat for fish.*
2. *Any on-site drainage system and the adjacent stream should be assessed to ensure there is no pollution, sedimentation, or erosion due to the existing infrastructure. Maintenance or mitigation measure may be required.*
3. *A survey for the presence of invasive species should be carried out and a management plan put in place where found*.

Items 1 and 3 relate to ecology and biodiversity and are addressed in Chapter 10. Item 2 is addressed in this chapter.

7.2 Hydrology in the Receiving Environment

The site is within hydrometric area 34 (Moy and Killala Bay). Hydrometric area 34 includes the surface catchment drained by the River Moy and all streams entering tidal water in Killala Bay between Benwee Head and Lenadoon Point, County Sligo.

The site is in the lower catchment of the Quigabar sub-catchment (EPA name Quigabar_010). It extends to an area of 20.9km^2, along the coast. This catchment is drained by the Quigabar Stream, Lackan Stream and Pollboy West Stream to Killala Bay. The Lackan Stream (EPA segment code 34_3151) and tributaries drains the wind farm site. A first order stream (segment code 34_1180) rises near Kilglass and flows generally in a north-westerly direction. A second first order stream rises to the south of the site and flows generally in a northerly direction. The two streams meet near turbine T3 and flow in a northerly direction, discharging to the sea just north of turbine T1. The discharge point is breach in the sea dyke. Some flow from this stream diverts to a drain that passes turbine T2, then follows field boundary drains to a culvert under the sea dyke.

The Killala Bay / Moy Estuary is a Special Area of Conservation (SAC), proposed Natural Heritage Area (pNHA), Special Protection Area (SPA) is located approximately 3.4km to the southwest of the wind farm.

The main surface water features on the site are shown on Figure 7-1.

7.2.1 Runoff Estimates

The nearest synoptic weather station to Lackan is Belmullet County Mayo, approximately 59km to the west of the site at an elevation of 9mOD. The mean monthly rainfall for Belmullet synoptic station is summarised in Table 7-2, along with long-term average evaporation. An extreme rainfall event of 79.6mm/day was recorded during the 30-year period 1981 to 2010. Local rain gauge stations indicate annual rainfall of up to 1,467mm in recent years.

Table 7-2: Monthly and Annual Average Rainfalls (mm)

Belmullet													
Period	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**
1961 - 1990	133.2	95.1	99.4	62.8	64.7	67.4	71.2	99.6	101.1	139	131.6	132.7	**1,197.8**
1981 - 2010	134	97.1	99.2	72	70.4	72.1	79	101.9	101.8	145.9	134	137.4	**1,244.8**
Greatest Daily Total – Belmullet													
1981 - 2010	44.7	31.3	25.6	25.9	42.2	38.9	33.2	49.5	62.6	79.6	43	41.7	**79.6**
Evaporation – Belmullet													
Long Term Average	24.7	34.3	52.9	82	109.2	115.6	107.6	91.3	67.3	41	24.4	19.8	**770.1**
Inishcrone													
2021	137.4	79.8	124.4	54.3	88.3	49.2	105.2	121.7	103.1	150.3	92	---	**---**
2020	119.5	257.5	121.7	13.3	27.4	116.4	106.3	95.1	70.8	165.3	183.2	190.8	**1,467.3**

Met Eireann also provide 30-year (1981 to 2010) rainfall amounts for 1km x 1km grids across the county. This indicates that the long-term rainfall amount for the site is 1,093mm/annum. Using the 30-year average for 1981-2010, the long-term effective rainfall for the site would be ~595mm/annum

The catchment characteristics are quantified as soil type 5 (very low winter rain acceptance potential). The runoff co-efficient of the landholding (15.51ha) is estimated at 0.5. There is peaty topsoil and clays across the site. The potential for soakage is minimal. Based on the mean annual gridded rainfall data for 1km x 1km grid, Q_{BAR} for the 15.51ha landbank is estimated at 0.16m^3/sec.

There is no gauging station on the stream in the vicinity of the site. The nearest gauging station are on the larger rivers in adjacent catchments. The EPA hydrotool is used to estimate flows for the Lackan Stream catchment based on the flow estimate provided for the 5.139km^2 catchment of the Pollboy West Stream sub-catchment. The Lackan Stream has a sub-catchment area of approximately 3.64km^2. The flows are provided in Table 7-3.

Table 7-3: Flow Estimates for Lackan Stream

Flow Percentile	Flow Volumes - Pollboy West Stream (m^3/sec)	Flow Volumes - Lackan Stream (m^3/sec)
Q1%	0.515	0.365
Q5%	0.307	0.217
Q10%	0.237	0.168
Q20%	0.163	0.115
Q30%	0.124	0.088
Q40%	0.097	0.069
Q50%	0.077	0.055
Q60%	0.062	0.044
Q70%	0.051	0.036
Q80%	0.04	0.028
Q90%	0.028	0.020
Q95%	0.022	0.016
Q99%	0.016	0.011

7.2.2 Surface Water Quality

The EPA monitors water quality in rivers, lakes and the coastal environment – refer to https://gis.epa.ie/EPAMaps/. There are no EPA monitoring stations on the Lackan Stream. The River Waterbody WFD Status 2013-2018 is unassigned.

Measurement of field parameters were taken in the streams draining the site on 23 May and 26 June 2022. Measurements recorded are provided in Table 7-4. Locations are shown on Figure 7-2.

Table 7-4: Surface Water Field Measurements

Parameter	Units	WQ1		WQ2		WQ3	
		23/05/'22	26/96/'22	23/05/'22	26/96/'22	23/05/'22	26/96/'22
Temp	°C	12.9	13.2	12.9	12.9	15.3	13.3
pH	pH Units	8.26	8.81	8.84	8.84	8.76	8.51
EC	µS/cm	845	777	776	777	713	735
DO	%O_2 (mg/l)	98.5 (10.2)	95.6 (9.8)	97.7 (10.1)	97.2 (10.0)	90.2 (8.8)	81.1 (8.3)
Turb.	NTU	10.5	9.5	0	0.7	0	3.4
TDS	mg/l	549	505	504	505	463	477
Oils	µg/l	0	0	0	0	0	0

Notes:
EC - Electrical Conductivity; Turb. – Turbidity; TDS - Total Dissolved Solids

WQ1 is upgradient of the wind farm site; WQ2 is located downstream of turbine T1, but upstream of turbines T2 and T3; and WQ3 is downstream of the site. The results indicate slightly alkaline water. Turbidity is slightly higher in the upstream sample, but not elevated; turbidity in WQ2 and WQ3 is close to zero. Hydrocarbons were not detected in any samples. Based on walkover surveys of the site and the water quality monitoring, the Lackan Wind Farm is not contributing to pollution in the streams draining the site. Roadside drainage channels were not installed. Roads were finished slightly proud of the adjacent fields. Over-the-edge drainage is use, so rainwater runoff is filtered as it makes its way to the field boundary drains.

7.2.3 Surface Water Usage

The surface water streams draining the site are not used as a drinking water supply source.

7.2.4 Peatland Hydrology

While there is blanket peat within the landholding, the wind farm infrastructure has been developed on tills. Peatland hydrology is therefore not a significant factor at the Lackan site and so not discussed further.

7.2.5 Flood Risk Assessment

The Flood Risk Assessment (FRA) was carried out in accordance with the Office of Public Works (OPW) Flood Risk Management Guidelines[67] as updated and clarified in 2014[68]. Flood risk assessment is carried out in three stages, with increasing detail in progressive stages. The need for progression to a more detailed stage is dependent on the outcome of each stage until the level of detail of the FRA is appropriate or it has been demonstrated that flooding is not a relevant issue for the area or site. The three stages are:

1. Flood risk identification.
2. Initial flood risk assessment.
3. Detailed flood risk assessment.

Stage 1 - Flood Risk Identification
The purpose of this stage is to identify whether there may be any flooding or surface water management issues related to the proposed development site that may warrant further investigation. A number of sources of reference information are available as outlined below.

National Flood Hazard Mapping
These digital maps, managed by the OPW, identify previous flooding incidents in Ireland. The surrounding areas including all the rivers in the catchment area of the site were investigated. There were no reported incidents of flooding at the site itself or in the streams draining the site. Flooding events are recorded on the in the wider area Carroneden, Leaffony, and Carrowhubback.

OPW River Flood Extent Maps

The OPW flood extent mapping indicates that coastal flooding will occur in the landbank. The present day 1:1,000-year flood extent (i.e., Annual Exceedance Probability (AEP) of 0.1%) is shown on Plate 7-1.

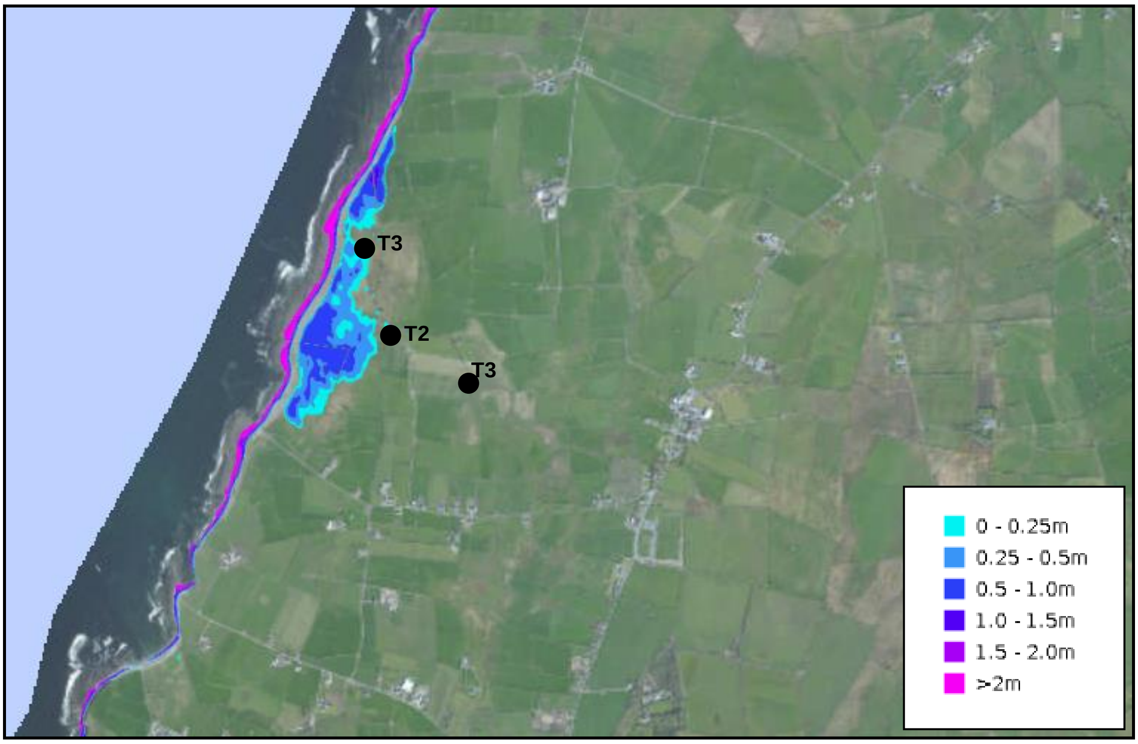


Plate 7-1: OPW Present Day Coastal Flood Hazard Map

Plate 7-2 shows the mid-range future scenario of the 0.1% AEP (1 in 1000 year) flood depths for the coastal flood hazard.

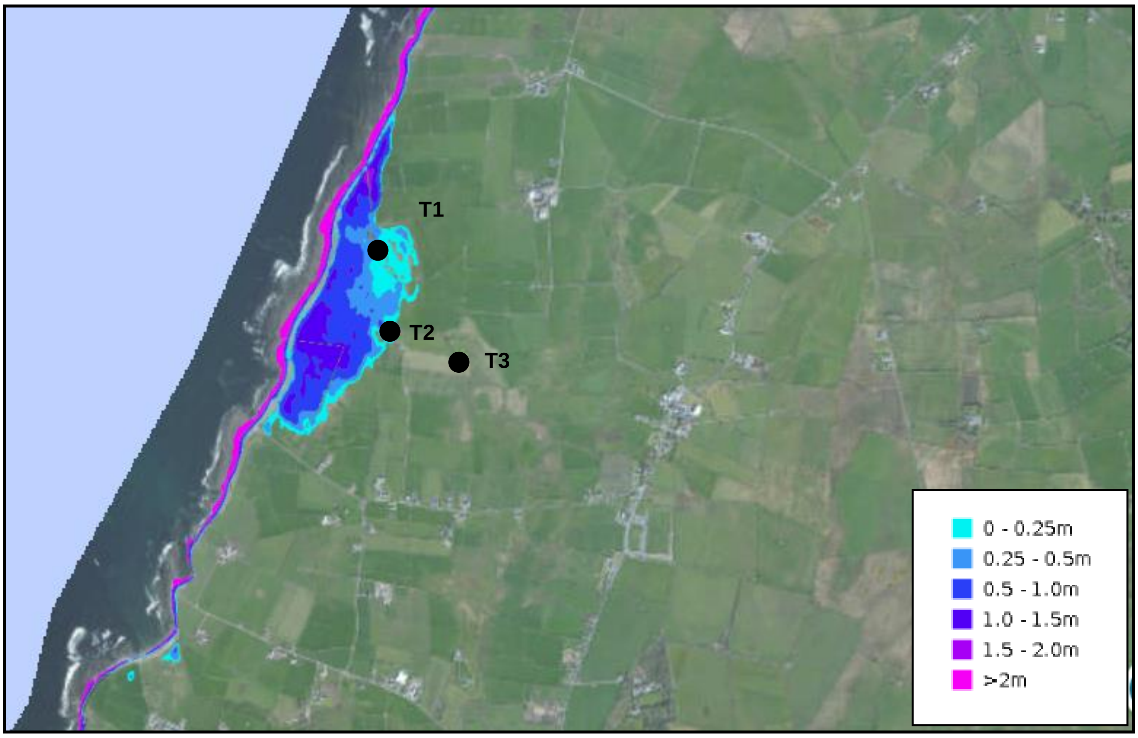


Plate 7-2: OPW Mid-Range Future Extent Coastal Flood Hazard Map

As seen on Plate 7-1, turbine T2 and T3 and the control building are outside the extent of the present day 1:1000-year coastal flooding. Turbine T1 is located in an area where between 0m and 0.25m water depth is modelled. It is noted that T1 has been constructed on a slightly elevated platform – refer to Plate 2-10. The topographical survey of the site indicates it is approximately 1.3m higher than the surrounding land, so based on this modelling it won't flood.

As seen on Plate 7-2, turbine T3 and the control building are outside the extent of the mid-range future 1:1000-year coastal flooding scenario. Both turbines T1 and T2 are located in areas where between 0m and 0.25m water depth is modelled. As noted, T1 has been constructed 1.3m above the surrounding land, so based on this modelling it won't flood. Turbine T2 is just slightly higher than the surrounding land – refer to Plate 2-10. The topographical survey of the site indicates it is approximately 0.2m higher than the surrounding land, so based on this modelling, flood water would likely surround the turbine. As noted in Section 2.4.1, the access door to the turbines is approximately 3m above ground level. As such, flood water will not enter the turbine. The cable ducting entering the basement of the turbine through the foundation is sealed, so is not an entry point for water into the turbine.

<u>OSI Mapping</u>
The historic OSI maps for the area indicate that this area is liable to flooding.

<u>Site Walkover</u>
As part of the hydrology impact assessment, a site walk over was carried out to map the drainage from the site. During this site walkover it was noted that the site is low lying with several drains. Drains discharged through the sea dyke via breaches, through permeable cobble layers and a stone culvert. Photographs of the three discharge locations are shown in Plates 7-3 to 7-5, from south to north. Flows were not discernible in the central discharge.

Plate 7-3: Drain & Culvert Through Dyke – Southern Discharge

Plate 7-4: Drain & Culvert Through Dyke – Central Discharge

Plate 7-5: Drain & Culvert Through Dyke – Northern Discharge

As shown in the photographs, the areas north of the site have flooded as flows are restricted at the northern discharge point. This is the main discharge point for the streams draining the site.

Stage 2 - Initial Flood Risk Assessment
Flooding issues with respect to any development can affect three main areas. These are areas upgradient of the site, the site itself and down gradient of the site.

<u>Flooding Risk Upgradient of the Site</u>
The site infrastructure is already constructed. It doesn't interfere with drainage through the area, so doesn't contribute to flooding upstream of the site.

<u>Flooding Risk at the Site</u>
Parts of the site are at risk of flooding as modelled by the OPW. Present day flood extent modelling indicates that turbine T1 could experience up to 0.25m of water depth. T1 is constructed 1.3m above the surrounding ground level, so doesn't flood. There has been no flooding since the commissioning of the wind farm that has affected any of the turbines or control building. OPW modelling indicates that turbines T1 and T2 could experience up to 0.25m of water depth during a flood event with an Annual Exceedance Probability of 0.1%.

The operator has confirmed that since the wind farm was commissioned, it flooded once. This occurred in 2014 or 2015 as a result of coastal flooding. The flood water covered the road to within approximately 100m of turbine T1. The wind farm remained operational during this flood event.

<u>Flooding Down Gradient of the Site</u>
The site is on a near flat low-lying coastal plain. The wind farm doesn't affect the flooding that occurs in the adjacent lands. The mitigation measures incorparted into the site design that maintain the greenfield site conditions include: to reduce water runoff and maintain current water storage capacity are as follows:

- Hardstands and roads are made from permeable hardcore, allowing absorption of rainfall thereby reducing the potential runoff volumes from the site.
- Hardstands have been allowed to revegetate, reducing the volume of potential runoff.
- Over-the-edge drainage is used, so runoff isn't delivered to downstream drains faster than it would have been had roadside drains been used.
- The footprint of the development is small. Most of the development is near flush with natural ground level, so the flood storage capacity on site is very close to the pre-development storage capacity – only the footprint of T1 (approximately 300m^2) is above natural ground levels.

Conclusion
Taking all of the above into account the following is concluded:

1. Risk of flooding upgradient of the development site is not affected.
2. The site is identified as being liable to flooding. However, the risk of flooding is not changed by the presence of the wind farm. The infrastructure is robust and can withstand occasional flooding that might occur in the future.
3. There is no appreciable increase in runoff from the site so there is no increased risk of flooding downgradient of the site.

The information available for the stage one flood risk assessment has identified and quantified the flood risk at the site. As a result of these conclusions and in accordance with the guidelines there is no requirement to go any further in the staged process of the flood risk assessment. There is no flood risk associated with the grid connection infrastructure.

7.2.6 Importance of Surface Water / Hydrology Attributes

Based on the NRA Guidelines, the importance of the site in terms of surface water and hydrology is rated as high. As noted by IFI, streams draining the site flow into Killala Bay which is a migratory route for salmon, sea trout, lamprey and eel into the River Moy system. The streams are distant from the Killala Bay / Moy Estuary SAC and, in consideration of the activities at the wind farm, water entering Killala Bay at Lackan would have little / no influence on water quality in the SAC.

7.3 Characteristics of the Proposed Development

The main characteristics of the development that could impact on surface water quality and hydrology include:

1. Use of oils on site during the maintenance and servicing of the turbines during the operational phase.
2. Increased runoff from handstands and roads during the extended operational lifespan of the wind farm. During the operational phase, driving rain is intercepted by the tower and runoff is concentrated at the base of the tower.
3. Underground cabling can potentially provide a preferential flow path during the operational phase.
4. Decommission of the site with the removal, of partial removal, of site infrastructure. Note that there works will be undertaken regardless of the extension of the operational lifespan.

The potential direct impacts associated with the above are deterioration of surface water quality on and leaving the site, and a potential increase in volume and rates of runoff leaving the site. Unmitigated, this could potentially result in indirect impacts to downstream aquatic habitats. Unmitigated, increased runoff rates could potentially result in indirect impacts downstream such as increased erosion along the stream channels. As noted in Section 7.2.5, increased flooding downstream resulting from the development is not anticipated.

7.4 Impacts Assessment

7.4.1 Impact Assessment Methodology

The criteria in the EPA (2017) draft Guidelines are used to evaluate and describe the potential impacts. These are set out in Table 7-5.

Table 7-5: Description of Potential Effects

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 noticeable2 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.
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	**Extent** 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).

The following sections detail the potential impacts, prior to mitigation, which have been identified from the assessment methodology presented above. The main potential direct impacts of the development on the surface water environment are:

- Deterioration of surface water quality from silt and / or hydrocarbons. The potential would be minimal during the operational phase but increase during the decommissioning phase.
- Increase in runoff from a rainstorm event during the extended operational phase. This would increase the peak flow to the streams draining the site. The possible increase in runoff results from a change in the surface runoff coefficient due to turbines, hardstands and roads. Changes in flow regime could also potentially arise from preferred pathways provided by cable trenches.
- Culverting of drains and streams. Although already installed during the construction stage, the potential impacts are associated with the operational phase.

Potential indirect impacts would be associated with deterioration of aquatic habitats resulting from pollution and potential for increased flooding downstream of the site.

7.4.2 Do Nothing Scenario

In the 'do-nothing' scenario, the wind farm will continue to operate with the benefit of the existing planning permission until October 2023, after which it would need to be decommissioned and the site returned to low-intensity grazing.

7.4.3 Surface Water Quality

Construction Phase
As the site is already constructed and operational, there are no construction related impacts.

Operational Phase
There is little potential for direct and indirect impacts on surface water quality during the extended operational phase of the wind farm. There would be little or no earthworks, no concrete pours and comparably little hydrocarbons used or stored. The potential sources of surface water contamination during the operational phase are:

- Oils and greases used in the maintenance of the turbines are brought to site as needed and waste oils are taken from site as they occur by the turbine maintenance contractor. The oils and greases are used in the equipment within the turbine, isolated from the environment, so do not present a risk to the surface water environment.
- Wind Farm access road maintenance will require relatively small volumes of aggregate. There is potential for washing of fines from freshly placed aggregate.
- There are no likely significant potential impacts on surface water or hydrology during the extended operational phase of the grid connection. It is possible that during the lifespan of the wind farm / grid connection, faults in the cable would necessitate repair or replacement of sections of the cable. The fault location would be identified using non-intrusive techniques and the cable section replaced. There would be a temporary localised imperceptible negative potential impact on surface water quality during the repair works.

Decommissioning Phase
The potential impacts associated with decommissioning of the wind farm will be similar to those typically associated with its construction but of reduced magnitude. The main potential impact is the pollution of water courses from silt and diesel associated with earthworks during the removal / covering of hardstands, foundations, roads and cabling and rehabilitating these areas. The return of the site to pre-construction conditions, with the removal the turbines and some infrastructure will result in a return to greenfield runoff characteristics. The extent of the works will depend on the agreed dimensioning plan for the site, which would not be agreed until nearer the closure of the wind farm in 2035. As noted in the Scottish Natural Heritage guidelines on restoration and decommissioning of wind farms it is '*best practice not to limit options too far in advance of actual decommissioning but to maintain informed flexibility until close to the end-of-life of the wind farm*'. It is likely that the grid connection and control building would remain, forming part of the National grid network.

Contamination by fuel leaks will remain during the decommissioning and site restoration but will not be significant

7.4.4 Surface Water Runoff – Volumes & Rates

Construction Phase
As the site is already constructed and operational, there are no construction related impacts.

Operational Phase
There is potential for direct and indirect impacts on the hydrology of the site and receiving waters during the operational phase. These are:

- The development footprint extends to approximately 0.7ha. For a given rainstorm event the volume and rate of runoff could be increased due to the change in runoff characteristic. An increase in runoff rates and volumes from the site, which, unmitigated, will be a long term, intermittent, imperceptible-slight negative impact downstream of the site.
- The access roads crosses one small drain located between the control building and turbine T2. A 400mm diameter concrete pipe was used, which is sufficient for the volume of flows observed. Blockages could impede flows, particularly during heavy rainfall events. Local flooding or surface water ponding could result. Unmitigated, this would be a long-term, intermittent, slight-moderate localised negative impact.

- During the operational phase, driving rain is intercepted by the towers and runoff is concentrated at the base of the towers. This is a long-term, intermittent, slight negative impact.
- Cable trenches can potentially provide preferred pathways for water movement. This could lead to erosion of the trench backfill material. It could also provide preferential movement for contaminants. Unmitigated, this would represent a long-term, not-significant negative localised impact.

Decommissioning Phase
The decommissioning of the wind farm would reverse impacts on hydrological aspects of the site. The extent of this would depend on the final restoration plan for the site. For example, it is likely that not all the roads would be removed, being used for farming purposes and the control building and grid connection could remain, becoming part of the local ESB network.

During decommissioning, there is potential for impacts on surface water quality from silt laden runoff from earthworks areas and fuel spills or leaks. The magnitude of the impacts would depend on the decommissioning plan for the wind farm. If all infrastructure is removed, the potential impacts would have localised slight short-term negative effects.

7.4.5 Cumulative Impacts

There are no wind farms or significant developments (existing or proposed) near the wind farm or in the local surface water catchment. No cumulative impacts are predicted.

7.5 Mitigation Measures for Hydrology

In its consultation response (see Appendix 1-1), the IFI outlined its general requirements to assess water quality as it relates to the fisheries and aquatic biodiversity.

The mitigation measures to address the requirements of IFI and to mitigate other potential direct and indirect impacts on surface water are set out in the sections for the operational and decommissioning phases.

7.5.1 Operational Phase

Mitigation measures to be employed during the extended operation phase and decommissioning phase of the wind farm are:

- To mimic as close as possible greenfield runoff rates and volumes, permeable finishes on roads and hardstands were used. Over-the-edge drainage along the length of the roadways is used to send water to its natural overland flow drainage pathway; water is not delivered to drains / streams from long sections of roads.
- Vegetation has been allowed develop on the hardstands. This slows flow and reduces erosion potential.
- Site drainage is inspected and maintained as part of the operation of the wind farm. Culverts are cleared of debris, so blockages do not occur.
- Rainfall concentrated at the turbine towers runs onto the handstands, which are vegetated, slowing flows and preventing erosion.
- Clay plugs were installed along the length of the cable trenches to prevent them acting as preferential pathways.
- There is no storage of diesel on the site and waste oils are removed immediately by the service company.

7.5.2 Decommissioning Phase

The mitigation measures to be implemented for the decommissioning phase are set out below:

- A decommissioning and restoration plan will be prepared one year prior to the expiry of the planning permission. This will identify the infrastructure to be removed and the methods for its removal. It will incorporate the mitigation measures outlined here and identify areas of ecological and biodiversity improvement opportunities. It will have regard to the waste management hierarchy with a focus on reuse and recycling.
- The developer will appoint an environmental clerk of works (ECoW) for the duration of the decommissioning. The ECoW will have an environmental management background with practical experience of wind farm projects. The ECoW will monitor the environmental aspects of the works (water quality, performance of surface water management infrastructure, etc.). The ECoW will have the authority to instruct the contractor to implement additional mitigation measures, if deemed appropriate. The ECoW will maintain a written record of all environmental issues on site, including incidents and monitoring results. This file will be made available to the relevant Authorities upon request. The ECoW will be responsible for notifying the relevant Authorities of any environmental incident.
- Following mobilisation to site, surface water management infrastructure will be the first works carried out. Additional controls will be installed as needed as construction progresses through the site, and/or as identified during site inspections of surface water management infrastructure.
- During the decommissioning phase, best practices will be employed to minimise the release of sediment laden storm water runoff, including:
    - Clean surface water runoff will be diverted around earthworks area to minimum the volume of silted water generated. To achieve this, temporary plastic diversion barriers (or equivalent) will be installed.
    - Areas where roads and hardstands are removed will be reinstated on an on-going basis and reseeded. This will reduce areas of soil exposed to erosion.
    - Stockpiled aggregate and soils will be kept a minimum distance of 50m from any watercourse. Silt fences will be placed downgradient of stockpiles to treat any polluted runoff.
    - The public road serving the site will be kept clean of mud and debris so that silt is not washed to watercourses and outside the control of the wind farm. If mud or debris is tracked onto the public road from vehicles leaving the wind farm site, the road will be swept.
    - Earthworks will be suspended during extreme weather conditions. An extreme rainfall event will be classified as an event that corresponds to the Met Éireann Orange – Weather Alert for rainfall. The ECoW will monitor the weather forecast to make preparations ahead of adverse weather conditions.

Met Eireann Orange – Weather Alert for Rainfall
50 mm – 70 mm in 24 hrs
40 mm – 50 mm in 12 hrs
30 mm – 40 mm in 6 hrs

- Hydrocarbons (oils, diesel and chemicals) will be stored and managed in an appropriate manner to ensure no negative impacts. Specific measures will include:
    - Any storage of oils and diesel on site will be in steel or plastic tanks of good integrity and bunded to 110 % of tank capacity. All fuel and hydraulic fluids will be stored in the site COSHH store located in the site compound.
    - Refuelling will be carried out directly from delivery vehicles. Refuelling of mobile plant will not take place within 50m of any sensitive receptor. Refuelling by mobile bowser may be used for small generators etc. Toolbox talks on refuelling will be given to delivery drivers in addition to plant operatives.
    - Fuels, lubricants and hydraulic fluids for equipment used on the construction site will be carefully handled to avoid spillage, properly secured against unauthorised access or vandalism, and provided with spill containment according to best codes of practice.

    - Any spillage of fuels, lubricants or hydraulic oils will be immediately contained, and the contaminated soil removed from the site and properly disposed of.
    - Waste oils and hydraulic fluids will be collected in leak-proof containers and removed from the site for disposal or re-cycling.
    - Appropriate spill control equipment, such as oil soakage pads, will be kept in the site plant to deal with any accidental spillage. Spare spill kits will be kept at the construction site compound.
- The grid connection infrastructure is owned by the ESB. It is likely to remain in use after the wind farm is decommissioned. If removed, the mitigation measures to be employed will be driven by the decommissioning approach to be taken. If the ducting is to remain in situ and put to other uses than only the cables would be removed for recycling. In this scenario, there would be excavations at intervals along the underground sections. The ducting would be plugged so it doesn't act as a preferential pathway. If the ducting is to be excavated and removed, works would be limited to short sections minimising the amount of disturbed ground and soil exposed to runoff; inspecting the section of trenching to be completed each day and identifying and installing the surface water protection measures prior to excavation works commencing (such as placement of sandbags to protect watercourses, placement of sandbags to direct runoff from the works area, erecting silt fencing where appropriate, etc); placing excavated material from trenches so that any rainfall runoff (carrying silt) will be into the trench. If the poles associated with the overhead sections would be removed, they would be pulled up and taken for recycling. The holes would be backfilled with clean soil.

7.6 Monitoring

Monitoring of surface water quality is not proposed for the operational phase of the wind farm.

During decommissioning earthworks, the ECoW will undertake weekly inspections of the streams draining the site. Turbidity monitoring will be carried out on the streams upstream and downstream of the site. An investigation will be carried out if the turbidity of the downstream location is higher than the upstream location. It should be noted that turbidity fluctuates naturally with the stage of the stream; higher values occurring during high flow events, so alerts may not necessarily be attributed to on-site works. Monitoring results will be maintained on site and available for inspection by Council and Inland Fisheries Ireland staff.

7.7 Worst-Case Scenario

The worse-case scenario would be if there was a pollution event (release of silt-laden water or fuel spillage) into the watercourses draining the site. The potential for this occurring is during the decommissioning phase. Pollution events during the operational phase are very unlikely. This could result in impacts on water quality, aquatic habitats, and aquatic fauna downstream of the event. With the implementation of the mitigation measures, inspections, and monitoring, the risk of this occurring is extremely low.

In the very unlikely event of this occurring, the following emergency response will be implemented:

1. Safety of site personnel and any potentially affected neighbours will be checked as a priority and appropriate action taken.
2. The appropriate authorities will be notified. This will include the County Council Environment Section, IFI, etc
3. The ECoW will assess the situation and carry out a risk assessment to inform the appropriate mitigation to be undertaken. The priority will be to prevent any further release of silt-laden water or fuel spillage.
4. Remedial works will be carried out at the location of the incident. The rest of the wind farm site will be inspected, and similar remedial works carried out where appropriate.

5. Surveys of the affected water course will be carried out and remedial measures carried out, where possible.

7.8 Predicted Impacts of the Proposal

With the implementation of these avoidance and mitigation measures, the predicted impacts of the development are:

1. The impacts on surface water quality are predicted to be imperceptible, localised brief negative impacts during the operational phase. No significant indirect impact is predicted on the aquatic habitats and fauna downstream of the site.
2. The impacts on surface water quality are predicted to be not significant, localised temporary negative impacts during the decommissioning phase.
3. The impacts on hydrology / runoff characteristics of the site are predicted to be imperceptible, localised intermittent long-term negative impacts during the operational phase. These will be at least partially reversible with the decommissioning and restoration of the site.

7.9 Difficulties Encountered in Compiling

There were no difficulties encountered in the compiling the water chapter.

7.10 Interactions

Interactions associated with surface water and hydrology with other aspects of the environment include:

– The streams draining the site discharge into Killala Bay which is a migratory route for salmon, sea trout, lamprey and eel into the River Moy system which rely on good water quality. Due to the size of the stream relative to the receiving waters, no significant cumulative impact is predicted.

7.11 Conclusions on Hydrology

The hydrology of the site is typical of a low-lying coastal zone. The impacts on hydrology and surface water have been identified and assessed. Where impacts have been identified, mitigation measures will be implemented to avoid or reduce the risk of impacts occurring. On balance, the operational lifespan of the wind farm can be extended with no significant impact on the surface water environment.

Figure 7-1: Site Drainage Details

8 SOILS, GEOLOGY & HYDROGEOLOGY

8.1 Introduction

This chapter of the EIAR addresses soils, geology and hydrogeology in the existing environment, the potential direct and indirect impacts of the continued operation of the wind farm and grid connection on soils, geology and hydrogeology, and the proposed mitigation measures to avoid or reduce potential impacts. It was prepared by Keohane Geological & Environmental Consultancy.

A full description of the development is provided in Chapter 2. In summary the development consists of an operational wind farm with 3 No. turbines, access tracks, hardstands, control building and grid connection. The assessment addresses the extension of the permitted development for an additional 12 years.

8.1.1 Scope & Purpose

This chapter of the EIAR provides details of the geological environment in which the development is sited. It identifies and describes the unconsolidated deposits and bedrock geology underlying the site. The extent, depth and condition of peat deposits is assessed to determine the existing peat landslide risk at the site and to inform a qualitative construction-related peat landslide risk assessment.

The purpose of the assessment is to identify the potential direct impacts of the extended lifespan of the wind farm on geology within the site and potential indirect impacts beyond the site boundary; to assess the potential impacts in the context of other developments (proposed / completed) to determine cumulative effects. Having identified and quantified the potential impacts, to recommend measures to avoid, mitigate and/or reduce significant potential negative impacts for the extended operational phase and decommissioning phase of the development.

8.1.2 Policies & Guidelines

There are several local, national and international policies and guidelines relied upon on the preparation of this chapter. These include:

1. County Sligo Development Plan 2017 - 2023.
2. Department of the Environment, Heritage & Local Government, June 2006. *Wind Farm Development – Planning Guidelines*.
3. Department of the Housing, Planning & Local Government, December 2019. *Draft Revised Wind Energy Development Guidelines.*
4. Irish Wind Energy Association, 2012. *Best Practice Guidelines for the Irish Wind Energy Industry*.
5. Environmental Protection Agency, 2002. *Guidelines on the information to be contained in Environmental Impact Statements*.
6. Environmental Protection Agency, August 2017. *Guidelines on the information to be contained in Environmental Impact Statement Reports – draft*.
7. Environmental Protection Agency, 2003. *Advice Notes on current practice in the preparation of Environmental Impact Statements*.
8. Welstead, J., Hirst, R., Keogh, D., Robb G. and Bainsfair, R. 2013. *Research and Guidance on Restoration and Decommissioning of Onshore Wind Farms. Scottish Natural Heritage Commissioned Report No. 591*.

Wind Farm Planning Guidelines
In relation to soils / geology, the Wind Energy Guidelines[7] recommend the following scope of assessment:

- A geological assessment of the locality.
- A geotechnical assessment of the overburden and bedrock.
- A landslide and slope stability risk assessment.
- An assessment of bog burst or landslide hazard.
- Location of geological heritage areas.
- Location of any significant mineral or aggregate potential.
- Assessment of impacts on groundwater.
- Details of borrow pits and blasting proposals.

The 2019 draft revised wind energy Guidelines[8] largely mirror the 2006 Guidelines in terms of the scope of soils/geology assessment. In addition to the above, the draft revised Guidelines require an assessment of peatland hydrology and carbon balance. The hydrology of the site is addressed in Chapter 7 (Water). Carbon balance is addressed in Chapter 11 (Air & Climate).

County Development Plan
Chapter 7 of the County Development Plan (2017 - 2023) sets out a number of objectives and policies in relation to geology. Section 7.1.3 of the CDP addresses Geological Heritage Sites. This is discussed in Section 8.2.1 below.

8.1.3 Sources of Baseline Data

The main sources of baseline data and information relating to geology include:

1. Soils, bedrock, hydrogeology, heritage etc - Geological Survey of Ireland - www.gsi.ie
2. Archived maps and reports - Department of Communication, Climate Action & Environment - https://secure.dccae.gov.ie/goldmine/index.html
3. Land use - Environmental Protection Agency - www.epa.ie
4. Designated sites – National Parks & Wildlife Service www.npws.ie
5. Sligo County Development Plan – list of geological heritage sites in County Sligo.

The literature reviewed as part of the desk study included:

1. Geology of Sligo-Leitrim, Geological Survey of Ireland (GSI), 1996[69].
2. Soils Association of Ireland and their Land Use Potential, M. J. Gardiner and T. Radford, National Soil Survey of Ireland, 1980[70].
3. Directory of Active Quarries, Pits, and Mines in Ireland, GSI 2001[71].
4. Landslides in Ireland, GSI 2006[72].
5. The Bogs of Ireland, Feehan and O'Donovan[73].
6. 2017 – 2023 Sligo County Development Plan.
7. Memoir of Localities of Minerals of Economic Importance and Metalliferous Mines in Ireland, The Mining Heritage Society of Ireland, 1998[74].

8.1.4 Assessment Methodology

The assessment of geology was carried out with reference to relevant policies, regulations and guidelines (listed above) and following this general methodology:

1. Consultation was carried out with agencies with an interest in the geological environment, including GSI, etc, (refer to Table 1-2).
2. A literature review was carried out to determine any policies and / or guidelines to which the development should have regard.

3. A desk-based assessment of the geological setting relevant to the development was undertaken. No sensitive geological receptors were identified during the desk-based assessment.
4. A field survey to assess geological conditions at the site.
5. Review of the Biodiversity chapter (Chapter 10) prepared for the project by JKW Environmental to assess the interaction of geology/hydrogeology/hydrology with ecology.

The site walkovers and collection of data were carried out on several occasions between February and May 2022. The data collected was augmented with data obtained from the pre-construction site investigation reports for the development; and formation approval works carried out by KGEC in 2007. The aspects considered in the assessment were slope stability, bedrock and overburden geology, hydrogeology and the interaction of these with ecology. These are discussed in the sub-sections below.

The information available from desk-based assessment, site walkovers, ground investigations and oversight of construction earthworks were used to establish the importance, quality and sensitivity of the receiving soils / geology / hydrogeology environment. This follows the NRA (2008) guidelines as summarised in Tables 8-1 and 8-2 for soils / geology and hydrogeology, respectively.

Table 8-1: Estimation of Importance of Soil & Geology Attributes

Importance	Criteria	Typical Examples
Very High	Attribute has a high quality, significance or value on a regional or national scale Degree or extent of soil contamination is significant on a national or regional scale Volume of peat and/or soft organic soil underlying route is significant on a national or regional scale*	Geological feature rare on a regional or national scale (NHA) Large existing quarry or pit Proven economically extractable mineral resource
High	Attribute has a high quality, significance or value on a local scale Degree or extent of soil contamination is significant on a local scale Volume of peat and/or soft organic soil underlying route is significant on a local scale	Contaminated soil on site with previous heavy industrial usage Large recent landfill site for mixed wastes Geological feature of high value on a local scale (County Geological Site) Well drained and/or highly fertility soils Moderately sized existing quarry or pit Marginally economic extractable mineral resource
Medium	Attribute has a medium quality, significance or value on a local scale Degree or extent of soil contamination is moderate on a local scale Volume of peat and/or soft organic soil underlying route is moderate on a local scale	Contaminated soil on site with previous light industrial usage Small recent landfill site for mixed wastes Moderately drained and/or moderate fertility soils Small existing quarry or pit Sub-economic extractable mineral resource
Low	Attribute has a low quality, significance or value on a local scale Degree or extent of soil contamination is minor on a local scale Volume of peat and/or soft organic soil underlying route is small on a local scale.	Large historical and/or recent site for construction and demolition wastes Small historical and/or recent landfill site for construction and demolition wastes Poorly drained and/or low fertility soils Uneconomically extractable mineral resource

Notes - * relative to the total volume of inert soil disposed of and/or recovered.

Table 8-2: Estimation of Importance of Hydrogeology Attributes

Importance	Criteria	Typical Examples
Extremely High	Attribute has a high quality or value on an international scale	Groundwater supports river, wetland or surface water body ecosystem protected by EU legislation e.g. SAC or SPA status
Very High	Attribute has a high quality or value on a regional or national scale	Regionally Important Aquifer with multiple wellfields Groundwater supports river, wetland or surface water body ecosystem protected by national legislation – NHA status Regionally important potable water source supplying >2500 homes Inner source protection area for regionally important water source
High	Attribute has a high quality or value on a local scale	Regionally Important Aquifer Groundwater provides large proportion of baseflow to local rivers Locally important potable water source supplying >1000 homes Outer source protection area for regionally important water source Inner source protection area for locally important water source
Medium	Attribute has a medium quality or value on a local scale	Locally Important Aquifer Potable water source supplying >50 homes Outer source protection area for locally important water source
Low	Attribute has a low quality or value on a local scale	Poor Bedrock Aquifer Potable water source supplying <50 homes

8.1.5 Consultation

As part of the EIA process, consultation was carried out with organisations and individuals who might have an interest in the soils / geology aspects of the project, namely GSI. The information package sent, and the consultation responses received, are provided in Appendix 1-1. The response from GSI is summarised here and incorporated, where appropriate, into the avoidance, mitigation and monitoring proposals for the wind farm development.

The GSI advised that it had no specific comments to make on the proposed extension to the operational lifespan of the wind farm.

8.2 Receiving Environment

The site is located on the low-lying coastal plain protected from sea flooding by a dyke. The terrain is controlled by the underlying bedrock geology, which consists of near flat lying limestone formations. Bedrock outcrop is frequent along the coast. Drilling at the site indicates up to 1.2m of peat and up 3m of glacial deposits. Topography at the site is very gently sloping from east to west, ranging in elevation from approximately 7mOD to 2mOD. Turbines are at elevations of approximately 4.8mOD, 4.1mOD and 9.4mOD. Site location maps are provided as Figure 2-1 and 2-2. Plates 8-1, 8-2 and 8-3 show the general topography at turbine locations.

The site is currently used for rough grazing. The site is serviced by tracks, used by service vehicles to access the turbine locations.

Plate 8-1: View of General Topography – Turbine T1

Plate 8-2: View of General Topography – Turbine T2


Plate 8-3: View of General Topography – Turbine T3

8.2.1 Geological Heritage Sites

The GSI - Irish Geological Heritage Section (IGH) and NPWS (National Parks and Wildlife Service) has been conducting a programme since 1998 to identify and select important geological and geomorphological sites throughout the country for designation as NHAs (Natural Heritage Areas) – the Irish Geological Heritage Programme. This is being addressed under 16 different geological themes such as economic geology, karst, Devonian, coastal, Quaternary, etc. For each theme, a larger number of sites from which to make the NHA selection are being examined, in order to identify the most significant scientifically. The criteria of designating the minimum number of sites to exemplify the theme means that many sites of national importance are not selected as the very best examples. However, a second tier of County Geological Sites (CGS) (as per the National Heritage Plan) means that many of these can be included in County Development Plans and receive a measure of recognition and protection through inclusion in the planning system.

It is a policy (P-NH-1) of the Sligo CDP to '*protect, sustainably manage and enhance …geological heritage… of County Sligo in recognition of its importance for nature conservation and biodiversity, and as a non-renewable resource, in association with all stakeholders*'. It is also a policy (P-NCODS-6) of the CDP to '*provide guidance for developers and the general public in relation to nature conservation outside designated sites and the conservation and enhancement of biodiversity and geological heritage in general'*. Section 7.1.8 of the CDP addresses Geological Heritage Sites. It is an objective (O-SGI-1) to '*Protect from inappropriate development, and maintain the character, integrity and conservation value of those features or areas of geological interest that are listed in this Plan or that may be proposed by the DAHG and/or the GSI in the lifetime of this Plan'*. Appendix C of the CDP lists the 24 geological heritage sites identified in the County.

The site is not listed in the Sligo CDP as being a site of Geological Interest. The nearest designated site to the development is the Inishcrone Foreshore Rock Exposures. This consist of Tertiary igneous intrusions and some contact or thermal metamorphism of host limestones. The heritage site extends from the foreshore at Inishcrone village, north towards Lackan. Figure 8-1 shows the location of the heritage site relative to the wind farm.

8.2.2 Economic Geology

According to the Directory of Active Quarries, Pits and Mines in Ireland[71], there no quarries within the vicinity of the site. There are however several sand & gravel pits to the southeast of the N59, but these are distant from the wind farm.

The GSI's aggregate potential mapping (https://dcenr.maps.arcgis.com/apps/webappviewer) indicates that the site has:

1. No potential for granular aggregate.
2. Moderate to high potential for crushed rock aggregate.

The site and immediate environs are not listed in the Memoir of Localities of Minerals of Economic Importance. There is no known history of mining within the site or within the immediate vicinity of the site.

8.2.3 Overburden Geology

The superficial geology is described from the GSI's Geology of Sligo-Leitrim and from the GSI website. The superficial deposits are largely derived from glaciation and the development of peat post-glaciation. The retreat of the ice sheet during the last glaciation, approximately 10,000 years ago, deposited tills and sand/gravel. The overburden deposits underlying the site and coastal zone consist of till derived from limestones (TLs). Small areas of blanket peat are shown on and near the site. These were found to be up to 1.2m deep. To the east of the site there is extensive coverage of till derived from metamorphic rocks (TMp), which are partially covered by expanses of blanket peat.

Figure 8-2 is sourced from the GSI website and shows the overburden geology of the area. It shows the site almost completely covered with limestone tills and pockets of blanket bog.

Boreholes drilled at the site for the turbine foundations indicated overburden depths ranging from 0.4m (at turbine T1) to 4.5m (at turbine T2). There are no groundwater boreholes in the GSI database within 1km of the turbine that might have informed overburden thickness. The aquifer vulnerability ranges from extreme to high across the site indicating overburden thinness less than 5m.

8.2.4 Regional Bedrock Geology

According to the GSI – Geology of Sligo-Leitrim, the area is underlain by the Ballina Limestone Formation. The regional bedrock geology is shown on Figure 8-3.

The bedrock geology of the area is dominated by the Ox Mountain inlier and surrounding younger limestone rocks. The Ox Mountains consists of metamorphic rocks which have been repeatedly folded and metamorphosed. Three major rock units make up the inlier, which are separated by major faults and slides; these are the Slishwood Division, the Dalradian Supergroup and the Callow Succession. These rocks present a range of metamorphic rocks depending on their original rock type and include such rock types as schists, gneisses, phyllites, psammites, quartzite, marbles and metavolcanics. The Dalradian Supergroup is represented in the rocks to the southeast of the site. These metamorphic rocks lie 14km to the southeast of the site.

At the start of the Carboniferous period the sea transgressed, covering much of Ireland. This resulted in a series of sedimentary deposits dominated by limestone and shales with lesser sandstone formations. The rocks found within and immediately adjacent to the site are described in greater detail. The formations present are the Lower Ballina Limestone Formations and Lower Ballina Limestone Formations. Tertiary-aged dolerite dykes and gabbro are intruded into the Ballina Limestone Formation. These are described from the literature as follows:

Ballina Limestone Formation Lower (BL) – The Ballina Limestone Formation is one of the Upper Limestone formations. It consists of grey fine-grained limestones with subordinate interbedded calcareous shales. These are best exposed along the coast at Killala Bay. Here the formation is seen to rest directly on sandstones which are the local equivalent of the Mullaghmore Sandstone. The coral fauna of the Lower Ballina Limestone Formation is characterised by caniniids and phaceloid lithostrotionids. The Lower Ballina Limestone Formation underlies turbine T1.

Ballina Limestone Formation Upper (BU) – The Upper Ballina Limestone Formation is as described above. It is differentiated from the Lower Ballina Limestone Formation by the presence of the coral fauna cerioid lithostrotionids. The Lower Ballina Limestone Formation underlies turbines T2 and T3, and the control building.

Tertiary Dykes - Dykes formed approximately 58 million years ago when Europe and North America split apart to produce what is now the North Atlantic Ocean. Hot magma rose along fractures and cracks that formed in the limestone as the North Atlantic opened. The magma cooled and hardened as vertical sheets or dykes of dolerite baking the adjacent limestone as it cooled. Bands of white marble formed as a result of this contact metamorphism.

8.2.5 Hydrogeology

The Lackan site is located within the Foxford and Easky West groundwater bodies. Both have good Ground Waterbody WFD Status 2013-2018, and both are assessed as not at risk.

Groundwater is an important resource for drinking water supply, accounting for 25% of water supplies in Ireland. In County Sligo, groundwater accounts for approximately 25% of drinking water supplies. There are however no groundwater wells in the vicinity of the site according to the GSI database; the nearest is 2km to the southwest.

On the GSI website, the Upper Ballina Limestone Formation is classified as a regionally important karst aquifer with good development potential (Rkd). The Lower Ballina Limestone Formation is classified as locally important, generally moderately productive in local zones (Ll). The bedrock aquifer map is shown on Figure 8-4.

Aquifer vulnerability is classified by the GSI as extreme to high – i.e., less than 5m of overburden overlying the bedrock aquifer. The aquifer vulnerability map is shown provided in Figure 8-5.

As discussed in Chapter 7, drinking water for the area is sourced from Lough Easky and distributed locally by a group scheme. The GSI database doesn't indicate the presence of any wells within 2km of the site. However, private wells were noted at a number of houses in the area. These wells are distant from the turbines and are not affected by the turbines.

8.2.6 Existing Slope Stability

Based on available data from the GSI, there are no records of slope failure within the wind farm site, or along the proposed grid route. GSI records indicate that the nearest occurred approximately 15km to the south in the Ox Mountains.

The site is near flat. No landslides occurred during its construction, and none are predicted to occur during its extended operation or decommissioning. The GSI maps the site and surrounding area as having Low susceptibility to landslide – this is the lowest of eight rankings used.

8.2.7 Contaminated Land

According to EPA web-mapping, there are no land uses within the wind farm site that could give rise to contaminated land. There were no potential contaminated land sites identified during the site walkovers.

8.2.8 Field Survey Results

Walkover surveys of the site and surrounding area were carried out on several occasions between February and May 2022. Data on ground conditions pre-development is also available from site investigation works. Ground conditions at the turbine locations are summarised in Table 8-3.

Table 8-3: Summary of Ground Conditions at Turbine Locations

Turbine	Peat / Overburden Thickness (m)	Comments
T1	0.4	Limestone bedrock encountered at 0.4m below ground surface
T2	4.2	Overburden consists of 1.2m of peat overlying gravely sand CLAY and gravely silty SAND. Overlies limestone bedrock.
T3	0.5	Gravely sandy CLAY overlying limestone bedrock.

From the findings of the walkover and site investigations, the site is described as low-lying flat coastal terrain. Overburden is generally thin consisting of thin peaty topsoil on gravely tills. There are deeper deposits of overburden found at T2 with peat up to 1.2m deep over approximately 3m of glacial tills. Bedrock consists of thinly bedded limestone, with gently sloping bedding.

8.2.9 Importance of Soils, Geology & Hydrogeology Attributes

Based on the NRA Guidelines, the importance of the site in terms of soils and geology is rated as low. The soil quality is poor; there are no pits or quarries at the site and the potential for developing same is low; there is no soil contamination identified and given the historic land use, the potential of encountering soil contamination is low; and there are no landfills on the site. While there are geological heritage sites in the wider area, the wind farm has had no impact on them.

The importance of the site in terms of hydrogeology is rated as very high. The Upper Ballina Limestone Formation is classified as a regionally important karst aquifer with good development potential (Rkd). The Lower Ballina Limestone Formation is classified as locally important, generally moderately productive in local zones (Ll); there are no source protection zones for wells / groundwater.

8.3 Characteristics of the Development

The main characteristics of the development that could impact on soils, geology and hydrogeology are:

1. Use of oils on site during the maintenance and servicing of the turbines during the operational phase.

2. Decommission of the site with the removal, or partial removal, of site infrastructure. Note that there works will be undertaken regardless of the extension of the operational lifespan.

8.4 Impact Assessment

8.4.1 Impact Assessment Methodology

The criteria in the EPA (2017) draft Guidelines are used to evaluate and describe the potential impacts. These are set out in Table 8-4.

Table 8-4: Description of Potential Effects

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 noticeable2 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.
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	**Extent** 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).

The following sections detail the potential impacts, prior to mitigation, which have been identified from the assessment methodology presented above

8.4.2 Do Nothing Scenario

In the 'do-nothing' scenario, the wind farm will continue to operate with the benefit of the existing planning permission until October 2023, after which it would need to be decommissioned and the site returned to low-intensity grazing.

8.4.3 Construction Phase

As the site is already constructed and operational, there are no construction related impacts.

8.4.4 Operational Phase

There are no likely significant potential impacts on geology or hydrogeology during the extended operational phase of the wind farm. Some traffic is associated with the maintenance of turbines and these maintenance vehicles and activities could result in minor accidental leaks or spills of fuel/oil. Unmitigated this would be a localised, imperceptible, temporary negative effect on soils.

Maintenance of access roads will also require the occasional use of plant or machinery which could result in minor soil contamination as a result of leaks or spills due to an accident, breakdown or poor maintenance. Unmitigated this would be a localised, imperceptible, temporary negative effect.

A small amount of imported granular material may be required to maintain access roads during operation which could impact the source quarry. This would be localised, imperceptible, permanent positive effect.

8.4.5 Decommissioning

The potential impacts associated with decommissioning of the wind farm will be similar to those typically associated with its construction but of reduced magnitude and would depend on the decommissioning and restoration plan prepared and agreed with the planning authority. These will include:

1. Earthworks associated with the removal / restoration of hardstands, foundations, roads and cabling and rehabilitating these areas. This would be done by removing imported aggregate for reuse off site and covering these areas with locally sourced subsoil and topsoil to encourage vegetation growth The extent of the works will depend on the agreed dimensioning plan for the site, which would not be agreed until nearer the closure of the wind farm in 2035. An outline of the proposed decommissioning plan is provided in Section 2.6.
2. Other impacts such as possible soil compaction and contamination by fuel leaks will remain during site restoration but will not be significant.

8.5 Avoidance, Remedial or Reductive Measures

The avoidance and mitigation measures for the operational and decommissioning phases are presented in the subsections below.

8.5.1 Operational Phase

The mitigation measures for the extended operation phase of the wind farm are:

1. Should a spill / leak occur, contaminated soil will be excavated and removed from site to an authorised facility to treat or dispose of this soil.
2. Aggregate used for road maintenance will be sourced from a quarry with similar geochemistry to the bedrock on site – I.e., limestone quarries.

8.5.2 Decommissioning

On decommissioning of the wind farm, cranes will be used to disassemble and remove the turbines. The foundations will be covered over with subsoil and topsoil and allowed to re-vegetate naturally. Leaving the foundation in place (rather than breaking out the concrete) is considered the most environmental benign approach. The Wind Energy Ireland (WEI) states that when decommissioning a wind farm '*the concrete bases could be removed, but it may be better to leave them under the ground, as this causes less disturbanc*e'.

Some of the roads will be left in place and used to access the farmland of the site. The on-site control building is also likely to be left in place and become part of the National grid. Otherwise, it would be removed, and the site restored to grassland.

The grid connection infrastructure is owned by the ESB. It is likely to remain in use after the wind farm is decommissioned. If removed, cables will be recycled; timber poles will be recycled; plastic and metal will also be recycled. Excavations for poles will be backfilled with clean soil. Excavated soils along the underground sections will be reused to backfill trenches.

8.6 Monitoring

Monitoring of soils, geology, and hydrogeology are not considered necessary for the extended operational phase. Monitoring of the decommissioning works will be carried out by the ECoW and project engineer. This will involve visual inspection of the works for soil storage, stability, and water quality. Monitoring will also include the management of waste to ensure the beneficial reuse of excavated soils or concrete C&D is optimised. No significant issues are envisaged in relation to soils, geology, and hydrogeology. Remedial measures, if required, will be implemented as appropriate.

8.7 Worst-Case Scenario

The worst-case scenario generally for wind farms is a peat landslide that would impact on water quality in streams draining the site. However, based on site conditions this will not occur.

8.8 Predicted Impacts of the Proposal

With the implementation of these avoidance and mitigation measures, no significant impacts on soils, geology, and hydrogeology are predicted.

8.9 Difficulties Encountered in Compiling

There were no difficulties encountered in the compiling the soils and geology chapter.

8.10 Interactions

Interactions associated with soils / geology with other aspects of the environment include:

- The importation of aggregate for road maintenance will increase traffic on local roads.
- The offsite reuse of aggregate and concrete C&D at the decommission stage of the wind farm will avoid winning of rock from local quarries.
- The return of part of the site to pre-construction conditions will result in a slight gain of habitat within the development footprint.

8.11 Conclusions on Soils, Geology & Hydrogeology

The extended operational period of the wind farm will not have a significant impact of soils, geology, or hydrogeology.

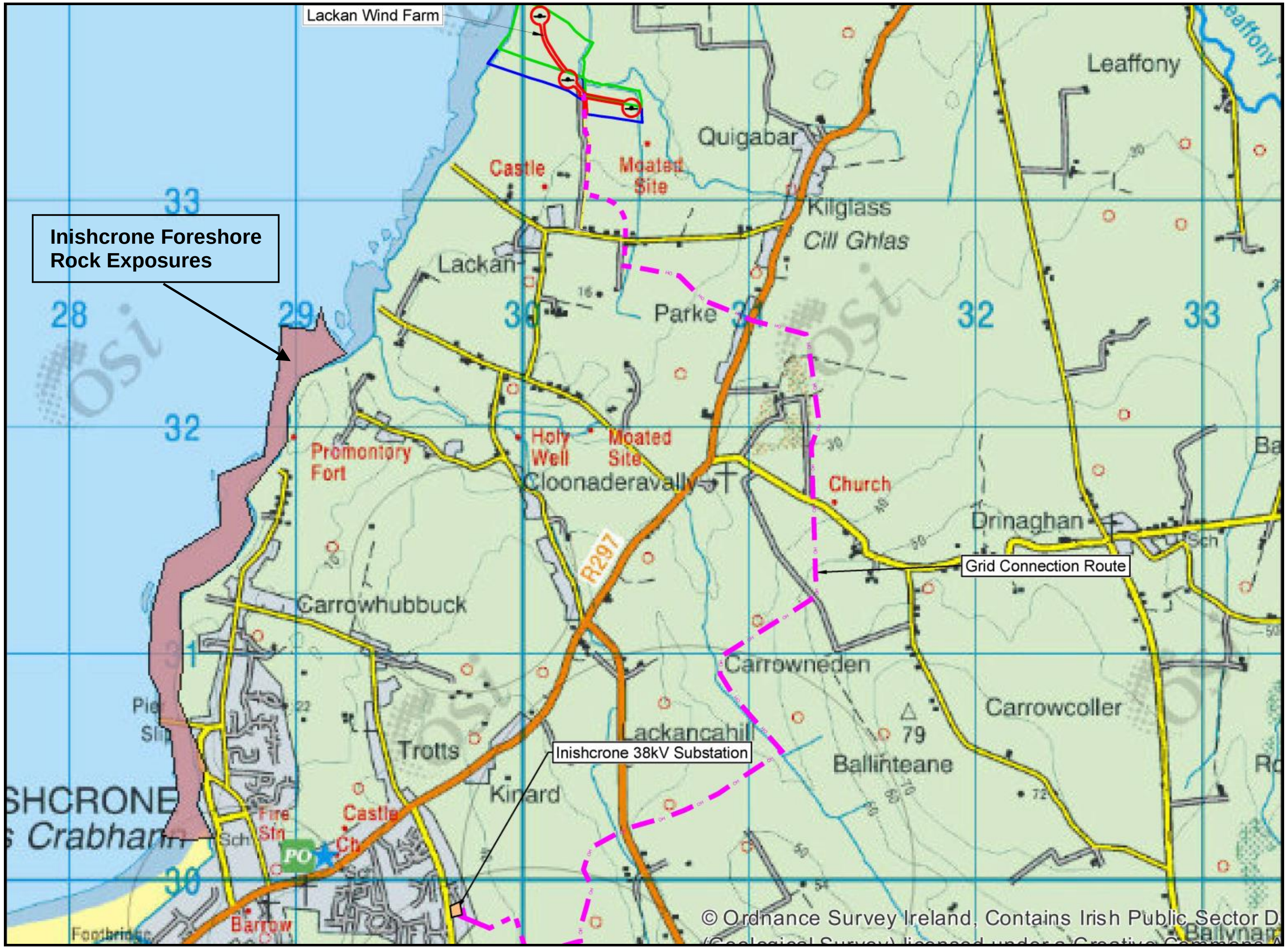


Figure 8-1: **Geological Heritage Sites**

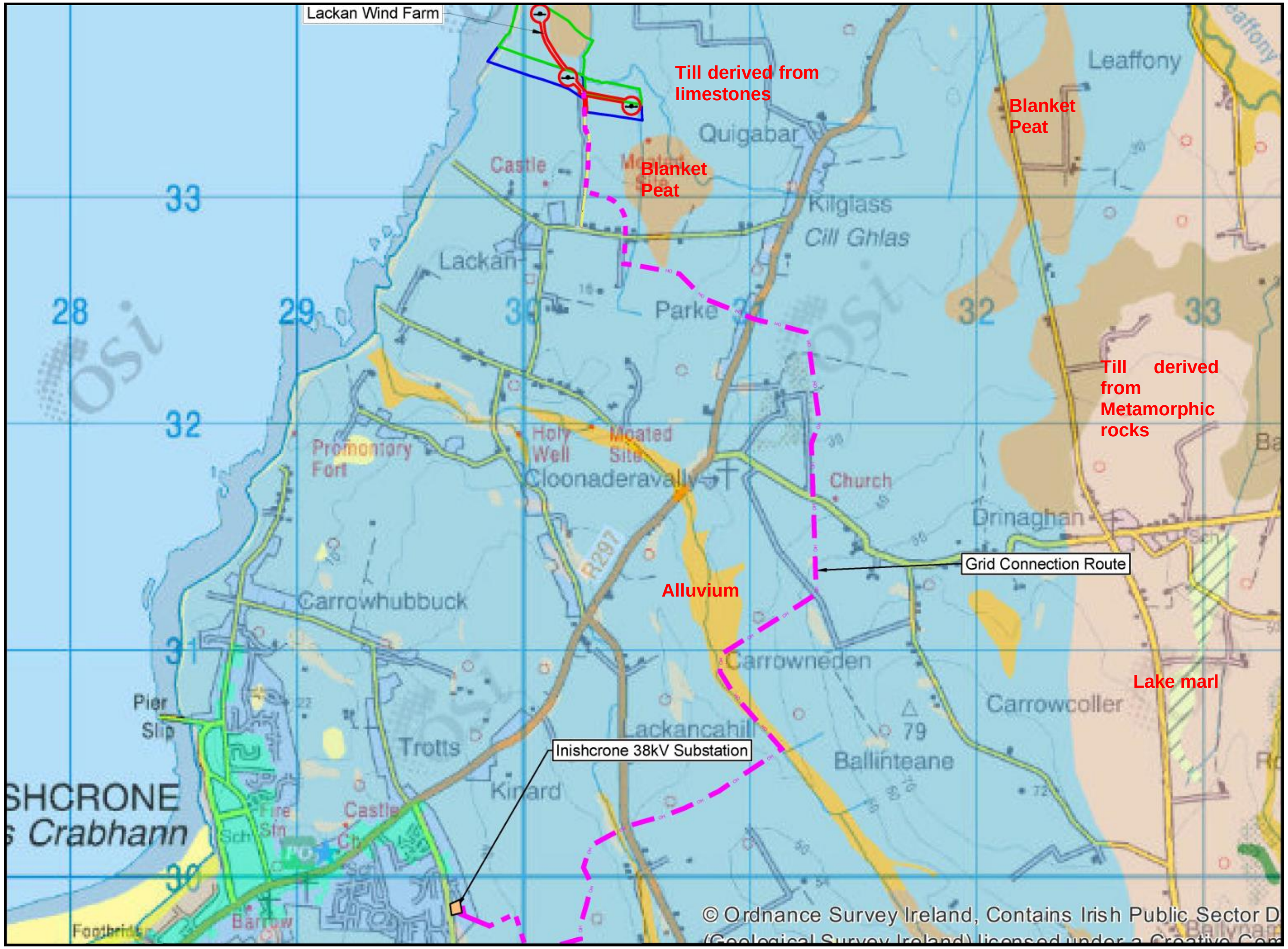


Figure 8-2: Overburden Geology Map

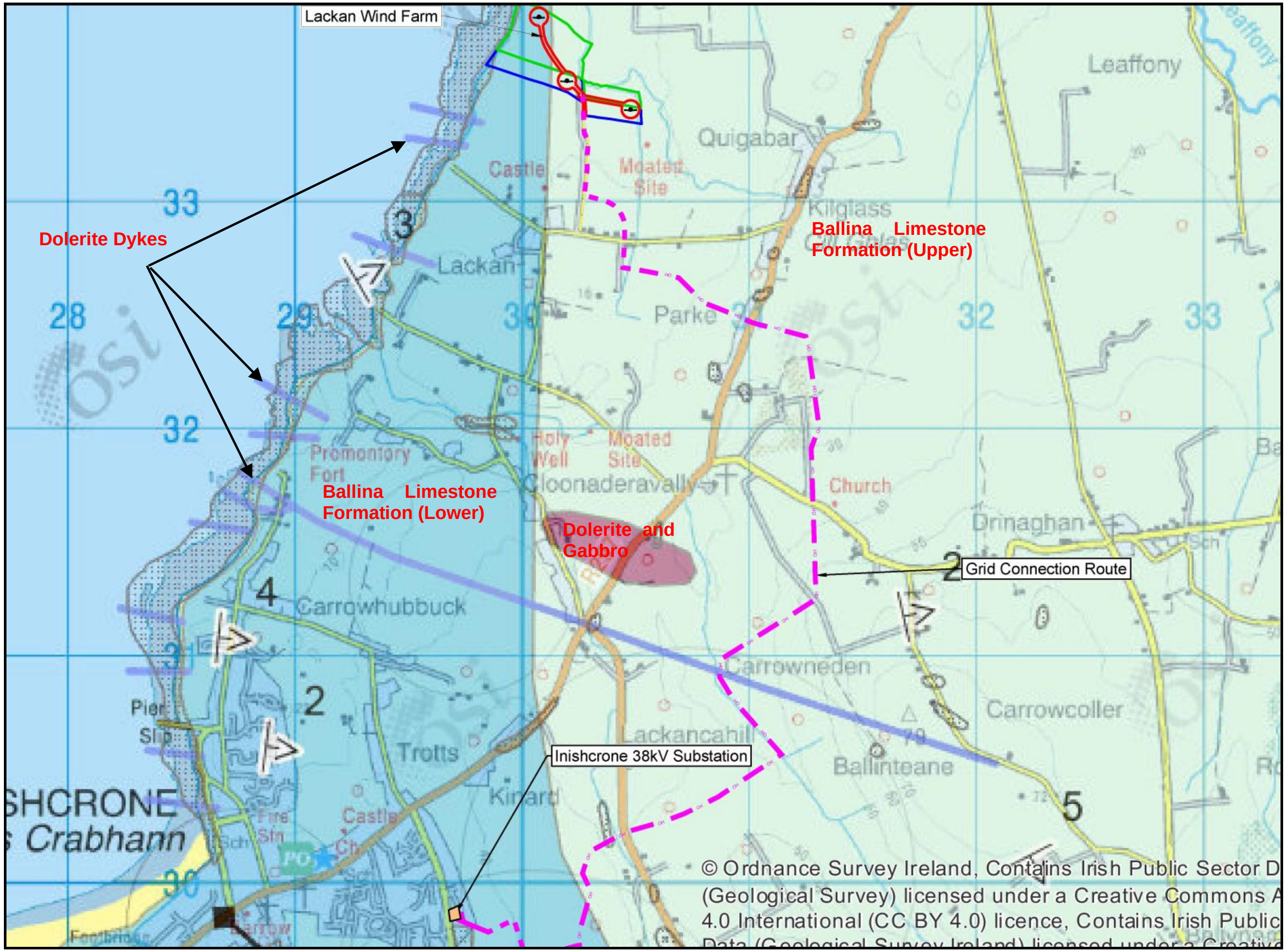


Figure 8-3: Regional Bedrock Geology Map

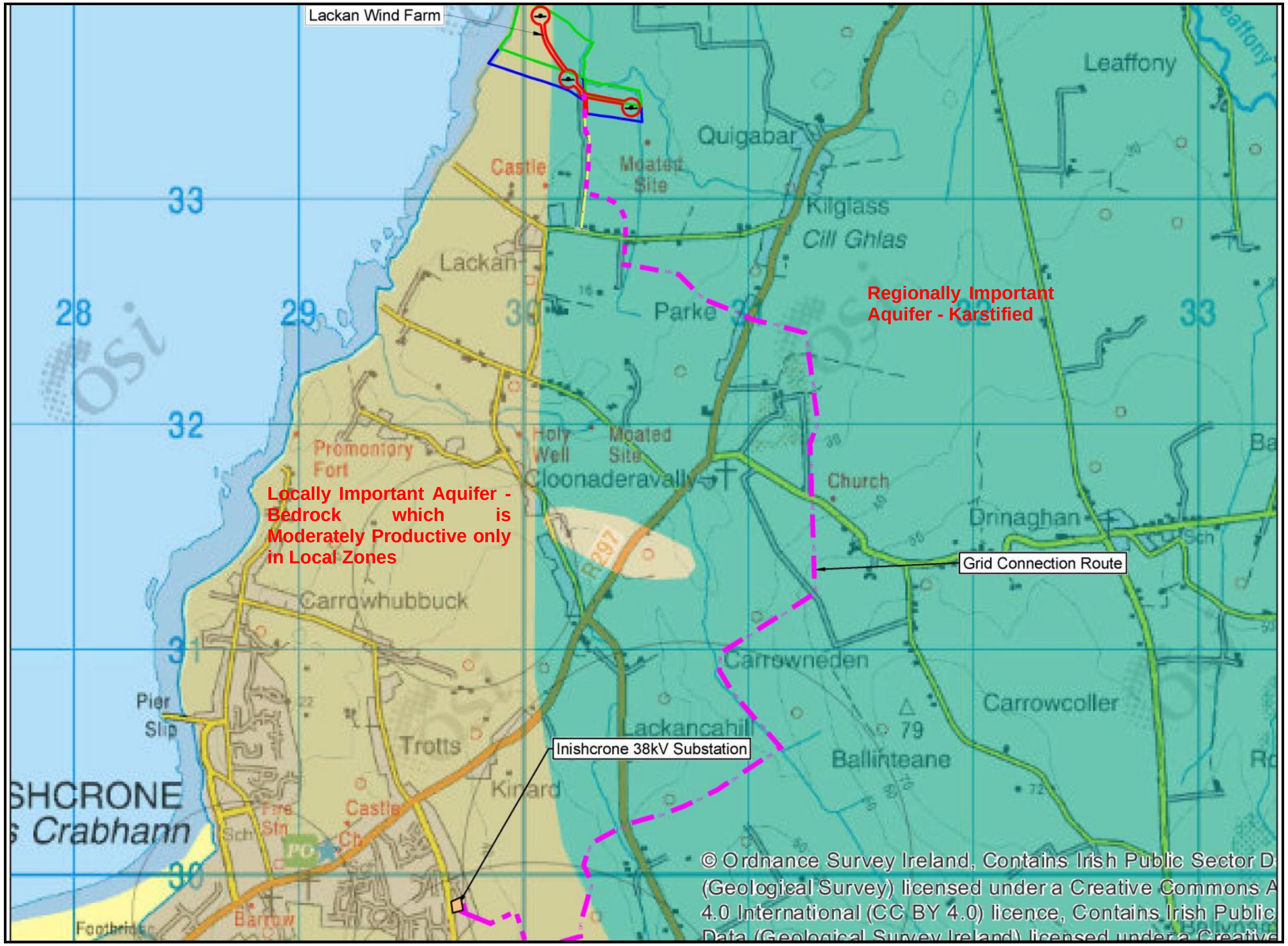


Figure 8-4: Bedrock Aquifer Map

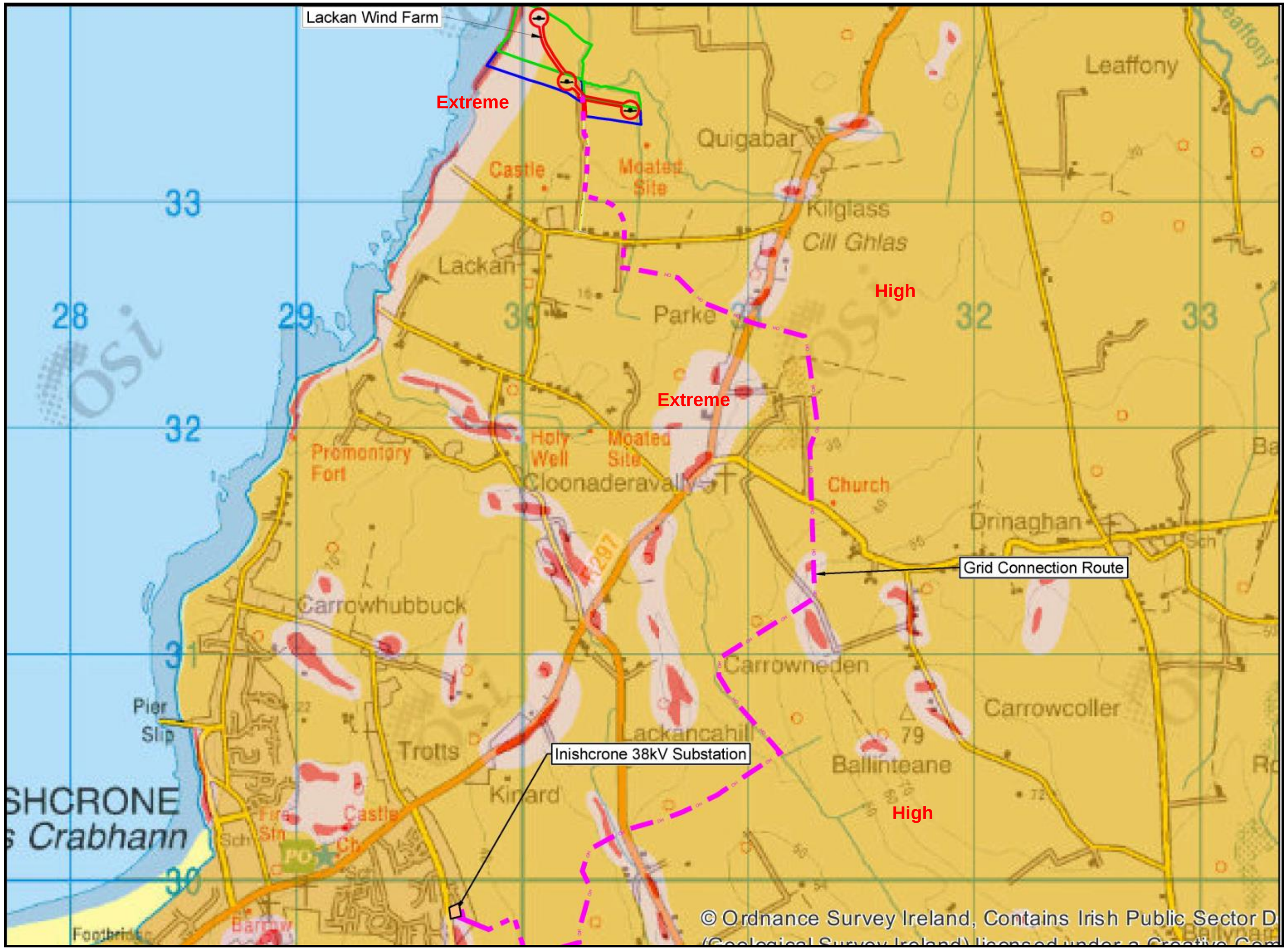


Figure 8-5: Aquifer Vulnerability Map

9 ARCHAEOLOGY ARCHITECTURE & CULTURAL HERITAGE

9.1 Introduction

This chapter of the EIAR addresses archaeological, architectural, and cultural heritage in the existing environment, the potential direct and indirect impacts of the continued operation of the wind farm and grid connection on archaeological, architectural, and cultural heritage, and the proposed mitigation measures to avoid or reduce potential impacts. It was prepared by Keohane Geological & Environmental Consultancy.

A full description of the proposed development is provided in Chapter 2. In summary the development consists of an operational wind farm with 3 No. turbines, access roads, hardstands, control building and grid connection. The assessment addresses the extension of the permitted development for an additional 10 years, and its decommissioning.

Potential impacts on archaeology and architectural are present mainly during the construction phase when earthworks could uncover previously unknown archaeological features. Construction of the Lackan Wind Farm was completed in 2007 with pre-construction testing and construction phase monitoring carried out. The visual impacts on the archaeological landscape during the operational phase were also assessed during the planning process and deemed not to detract from archaeological and architectural monuments. This assessment therefore focused on the extended operational period and the decommissioning of the wind farm and grid connection.

9.1.1 Definitions

Definitions of key terms used throughout this chapter are outlined below.

Archaeological Heritage
Archaeological heritage can be described as the study of past human societies through their material remains and artefactual assemblages. The Valetta Treaty (or the European Convention on the Protection of the Archaeological Heritage, 1992) defines archaeological heritage as “all remains and objects and any other traces of humankind from past times” this includes “structures, constructions, groups of buildings, developed sites, moveable objects, monuments of other kinds as well as their context, whether situated on land or under water”.

Architectural Heritage
Architectural heritage is defined in the Architectural Heritage (National Inventory) and Historic Monuments (Miscellaneous Provisions) Act, 1999 as structures and buildings together with their settings and attendant grounds, fixtures and fittings, groups of such structures and buildings, and sites, which are of architectural, historic, archaeological, artistic, cultural, scientific, social or technical interest.

Cultural Heritage
Cultural Heritage is an expression of the ways of living developed by a community and passed on from generation to generation, including customs, practices, places, objects, artistic expressions and values. Cultural Heritage is often expressed as either Intangible or Tangible Cultural Heritage (ICOMOS, 2002). Environmental Protection Agency (EPA) Guidelines (2003) define cultural heritage as including archaeological heritage, architecture, history, landscape and garden design, folklore and tradition, geological features, language and dialect, religion, settlements, inland waterways (rivers), and place names. The more recent draft EPA Guidelines (2017) includes archaeology, architectural heritage and folklore and history under the broad category of cultural heritage.

9.2 Methodology

The approach taken to the assessment was to review the archaeological assessments undertaken for the original application. This included desk-based assessment, field surveys. Test trenching and construction monitoring.

Review of available published literature and resources was also carried out. This included the County Development Plan and Record of Monuments and Places (RMP), Sites and Monuments Record (SMR), National Inventory of Architectural Heritage (NIAH) and Database of Irish Excavation Reports (www.excavations.ie).

9.3 Existing Environment

The Lackan Wind Farm is in the townland of Lackan, in the parish of Kilglass in County Sligo. The archaeological background of the area is described in the report provided in Appendix 9-1. The archaeological and architectural features near the site are shown on Figure 9-1. A full description of the features nearest the wind farm is given in Appendix 9-1.

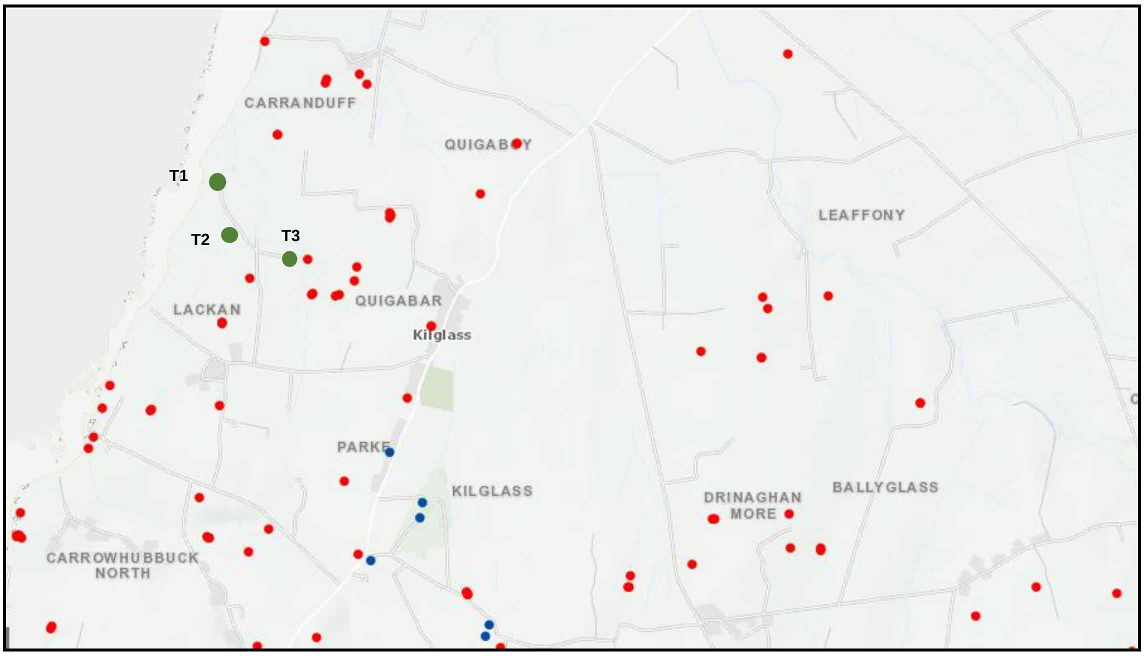


Figure 9-1: Archaeological & Architectural Features near Lackan Wind Farm
Sites & Monuments (SMRs) shown red.
National Inventory of Architectural Heritage shown blue.

The closest architectural features are in Parks and Kilglass and include:

1. Detached four-bay single-storey thatched house, built c. 1820, located 1.1km to the southeast.
2. Detached three-bay two-and-a-half-storey rendered house, built c. 1830, located 1.4km to the southeast.
3. Detached three-bay single-cell Gothic-style stone and rendered Church of Ireland church, built c. 1829, located 1.6km to the southeast.

9.3.1 Previous Assessments

Archaeological assessment was conducted in 2003 during the planning process for the wind farm. The archaeological assessment carried out by Mary Henry Archaeological Services Ltd is provided in Appendix 9-1. The findings and conclusions from that assessment were:

1. The presence of prehistoric sites (fulacht fiadh); early Christian sites (ringforts); and medieval sites (two moated sites and a tower house, indicate that the townland of Lackan has been a focus of settlement for centuries.
2. There were no archaeological features identified in the construction footprint during site walkover. It was noted that turbine T3 is located 120m northwest of moated site (SL010-019) and 60m west of a fulacht Fiadh (SL010-030).
3. Eleven pre-construction test trenches were excavated; 4 trenches at turbine T1, for a total length of 78m; 4 trenches at turbine T2, for a total length of 80.1m; and 3 trenches at turbine T3 for a total length of 64m.
4. No archaeological features were found in any of the trenches.
5. The turbines will be seen from a number of archaeological features in the landscape and therefore have a direct visual impact, but that it would not detract from these monuments.
6. Due to its proximity to known archaeological features, earthworks should be monitored during construction of turbine T3.

Mary Henry Archaeological Services Ltd carried out archaeological monitoring during the construction phase earthworks for the entire site in accordance with planning condition No. 7b. The field monitoring report is provided in Appendix 9-2. No archaeological features or remains were uncovered while monitoring ground works. It was concluded that no further archaeological mitigation measures were required for the project. The summary of the testing from the www.excavation.ie is as follows:

Eleven trenches were opened. No archaeological features were revealed in any of them. Due to the topography and landscape attributes of the siting of two of the proposed turbines (wet, marshy and low-lying areas and close to the coast), it is most unlikely that there are any surviving archaeological remains, as this area was probably subject to extensive sea incursion and flooding up until the time that the coastal defences were built. The hostile coastal terrain would have made human activity, and particularly fishing, very dangerous, if not impossible.

A second record of testing is documented in Lackan, to the south of, and unrelated to, the wind farm. The summary of the testing from the www.excavation.ie is as follows:

Pre-development investigations were carried out of a proposed development area at Lackan, Inishcrone, Co. Sligo. The proposed development area was stripped of topsoil to the level of the natural subsoil. No finds or features of archaeological significance were revealed.

9.4 Impact Assessment

This section evaluates the likely significant impacts on the archaeological, architectural and cultural heritage landscape with reference to the EPA Description of Effects (2017, 50). The effects are described as positive, neutral or negative under the following headings:

- 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.

9.4.1 Construction Impact

As the site is already constructed and operational, there are no construction related impacts.

9.4.2 Operational Impact

The operational phase impacts are associated with the visual impact the turbines have on the archaeological landscape. As noted, this was assessed during the planning stage and deemed not to detract from archaeological and architectural monuments. To assess the visual impact, photographs were taken from the nearest features – refer to Figure 3-12 and 3-13.

9.4.3 Decommissioning Phase

The decommissioning of the wind farm will involve works within the footprint of the development with the removal of infrastructure. Imported aggregate will be removed from the footprint of the hardstand and roads which are earmarked for restoration. Previously excavated subsoil / topsoil will be used to return these areas to agricultural land. This may include the importation of clean soil from other sites. No significant impacts on archaeology, architecture or cultural heritage are predicted.

9.5 Mitigation Measures

Works will stay within the development footprint. Excavation works will not be carried out within ground not previously disturbed by the construction works.

9.6 Conclusions

No significant impacts are predicted for the extended lifespan of the wind farm and grid connection, or its decommissioning.

10 BIODIVERSITY

10.1 Introduction

This chapter assesses the potential impacts of the proposed development on the biodiversity of the site. This assessment has been undertaken by JKW Environmental and examines the potential ecological impacts of the project. The purpose of this assessment is to:

- Identify the habitats of the site.
- Identify the existing fauna of the site.
- Identify the potential impact of the development.
- Recommend measures to mitigate probable impacts.
- Identify any residual impacts to the site's ecology.

The scope of the following assessment follows the guidance outlined in the CIEEM's Guidelines for Ecological Impact Assessment (2006 & 2018). The following impact assessment is based upon a review of existing desktop information and the results of on-site field surveys outlined below.

10.2 Methodology

10.2.1 Desk Study

A desktop assessment was carried out to collate available information on the biodiversity baseline of the land-holding and surrounding area. The following baseline data was gathered during the desk study:

- A review of the National Biodiversity Database was completed to identify the presence or otherwise of protected species occurring within close proximity to the proposed site. Species list reports for the custom approximate 2km grid square in which the project site and surrounding areas are located and were downloaded from www.biodiversityireland.ie and reviewed.
- A review of the NPWS online database to identify the presence or otherwise of designated conservation areas (i.e., SPAs, SACs, NHAs and pNHAs).
- Review of aerial photography and satellite imagery for the proposed site.
- A review of the bat landscape classification was also completed. A landscape conservation guide for Irish bat species was published in 2011 (Lundy *et al*., 2011). This study identified core areas of favourable habitat for bat species in Ireland. The publication was reviewed to identify whether the project site occurs within the core area for any bat species.
- Review of Sligo County Council Planning Portal for any other information pertaining to the biodiversity in the area surrounding the project site.
- A review of the planning application documents for the wind farm and records of operational phase monitoring carried out.
- Review of the Bird Atlas for Wintering and Breeding birds.

10.2.2 Site Investigations

Habitat Survey

Habitat surveys were carried out in June 2022 to identify, describe, map and evaluate habitats and to verify information gathered at the desk study stage. The habitat survey was undertaken in accordance with the Heritage Council Draft Best Practice Guidance for Habitat Survey and Mapping. Habitats were classified using Fossitt's Guide to Habitats in Ireland (2000) which classifies habitats according to a hierarchical framework with Level 1 habitats representing broad habitat groups, Level 2 representing habitat sub-groups and Level 3 representing individual habitats. The field survey focused on identifying Level 3 habitats. The National Vegetation Classification (NVC) User's Handbook also informed the approach to the habitat surveys.

The DAFOR scale was used to characterise the vegetation within each habitat. This scale refers to plant species in terms of dominance, abundance, frequency, occasional and rare (DAFOR). Habitat surveys were undertaken within the optimum survey period for identifying vegetation.

In this report, scientific and common names for higher plants follow those in the Botanical Society of the British Isles (BSBI) standard list, published on its website www.bsbi.org.uk. Scientific and common names for bryophytes follow Smith (2004). Scientific and common names of mammals follow Whilde (1993).

Extended Survey

The "extended" part of the habitat survey refers to surveys for the presence or otherwise of protected fauna particularly mammal species such as badger, otter, bats etc. The mammal survey involved walking either side of hedgerows and other field boundaries, along watercourses and through woodland/scrub areas recording any field signs of mammal activity. These field signs, as described in Neal & Cheeseman (1996) and Bang & Dahlstrom (2011), include:

- mammal breeding and resting places, such as setts, holts, lairs.
- Pathways.
- Prints.
- faecal deposits.
- latrines (and dung pits used as territorial markers).
- feeding signs (snuffle holes).
- Hair.
- scratch marks.

Bird Surveys

The methodology adopted for the avian field surveys was derived from the Scottish Natural Heritage (SNH) Survey Methods for assessing the impacts of onshore windfarms on bird communities (2017). These guidelines outline specific survey methodologies for undertaking surveys to assess the potential impact of wind farms to lowland/farmland species. However, due to the small scale of the wind farm, with three turbines already operational, it falls beneath the threshold of development for full application of the SNH guidance. As a consequence, the level of survey time completed at the Lackan site has been scaled down to reflect the limited scale of the project. The method of survey has not been altered.

The breeding and non-breeding season surveys involved completing vantage point watches from one vantage point.

Vantage point surveys carried out between September 2021 and December 2021 consisted of monthly 3-hour watches. Surveys carried out between January 2022 and August 2022 consisted of monthly 6-hour watches, either spilt between morning and evening or a 3-hour watch carried out on two separate days within the month.

A total of 54 hours of watching was completed during both the non-breeding season in 2021 - 2022 and the breeding season of 2022.

SNH and Natural England guidance for surveys at wind farms recommend that field surveys focus on those species of high nature conservation value for which there is potential for impacts to occur. These target species tend to be limited to those species of conservation concern, which, as a result of their flight patterns or response behaviour are considered to be susceptible to either displacement due to wind turbine operation or collision with turbine blades. In general target species belong to one or more of the following groupings:

- Species listed under Annex 1 of the EC Directive of the Conservation of Wild Birds (i.e the EU Bird Directive).
- Red listed Birds of Conservation Concern in Ireland (BoCCI).

Weather conditions were noted during each survey. Any sensitive/target species present during the survey were recorded along with approximate numbers, flight direction and flight height.
The avifauna of the wind farm site was previously surveyed in 2002 as part of the original EIA which was submitted with the planning application. This survey included a walkover of the site recording a qualitative list of bird species that were observed within and in the vicinity of the site.

Bird monitoring was carried out at the operational wind farm in 2009 by Dr Patrick Crushell, which consisted of a vantage point survey, walked transects and carcass surveys.

Carcass search surveys were completed by Rouse Developments twice yearly, at each turbine, from 2007 to 2022. JKW Environmental also carried out monthly carcass search surveys at each turbine between January 2022 and July 2022. The following details were to be considered during field surveys: GPS location of each bird carcass, photographic record, carcass condition (intact (carcass that is completely intact or not badly composed), scavenged (evidence that the carcass was fed upon by a scavenger/predator) or feather spot (ten or more feathers indicating predation or scavenging or two or more primary feathers must be present to consider the carcass a casualty)), distance from the turbine location, date, time, etc.

Bat Surveys
The suitability of the project site to support bats was evaluated by reviewing the bat landscape favourability model (Lundy *et al*. 2011) and appraising the habitats occurring within the site or their potential to support foraging bats. This latter appraisal was completed with reference to the foraging habitat preferences of bats, as detailed by Collins *et al*. (2016) and the SNH (2019) guidance for appraising the habitat risk for bats.

No structures, which could be potential bat roosts, occur within a 200m buffer area surrounding the existing turbine locations.

Bat activity surveys were completed during the 2022 bat activity season. Two rounds of bat activity surveys were completed. The activity surveys were based on continuous automatic bat detector surveys. The spring survey was undertaken between the 14th May and 29th May 2022, over a period of 16 consecutive nights. The summer survey was undertaken between 22nd June and 30th June 2022, over a period of 9 consecutive nights. The automatic bat detector survey was undertaken using a Song Meter Mini Bat Ultrasonic Bat Detector. Bat detectors were positioned at each turbine location.

The Song-Meter was set to record continuously throughout each night of monitoring. Recording commenced 30 minutes before sunset and terminated 30 minutes after sunrise. Analysis of bat calls recorded during the activity surveys was undertaken using Kaleidoscope software.

Matthews *et al.* (2016) recently categorised nightly activity into low, medium and high groups with low activity assigned to <3 passes per night; medium assigned to 3 – 49 passes per night; and high assigned to ≥50 passes per night. This activity hierarchy is used in the analysis and interpretation of automatic monitoring results. In addition to using the Matthews *et al.* (2016) bat activity hierarchy, a bat activity index for each of the above is also provided by calculating the number of bat passes per hour throughout each monitoring period. Although a useful indication of bat activity levels, this index cannot be used to infer population abundance or the number of individuals using the site (Hayes 2000, Kunz *et al.* 2007). It is also noted that the rate of echolocation varies between species and that this influences the number of calls associated with species. For instance, a lower rate of echolocation is associated with Leisler's bats, especially when compared to Myotis bats. Thus, a lower number of passes based on recorded calls would be expected for Leisler's bats when compared to other species.

10.3 Site Evaluation & Impact Assessment Methodology

10.3.1 Site Evaluation

The nature conservation value of habitats and ecological sites occurring within the site are based upon an established geographic hierarchy of importance as outlined by the National Roads Authorities (NRA, 2009). The outline of this geographic hierarchy is provided below and this has been used to determine ecological value in line with the ecological valuation examples provided by the NRA (see NRA, 2009). The geographic evaluation hierarchy is as follows:

- International Sites (Rating A).
- National Importance (Rating B).
- County Importance (Rating C).
- Local Importance (higher value) (Rating D).
- Local Importance (lower value) (Rating E).

10.3.2 Impact Assessment Methodology

Impact Magnitude

Impact magnitude refers to changes in the extent and integrity of an ecological receptor. The CIEEM (2006) defined integrity of designated conservation areas as "*the coherence of the ecological structure and function across the area, that enables it to sustain the complex of habitat and/or the levels of populations of the species for which it was classified*". For non-designated sites this can be amended to: "the coherence of ecological structure and function, that enables it (the site or populations supported by the site) to be maintained in its present condition'. For the purposes of this assessment the impact magnitude is influenced by the intensity, duration, frequency and reversibility of a potential impact and is categorised as follows:

- High magnitude impact: that which results in harmful effects to the conservation status of a site, habitat or species and is likely to threaten the long-term integrity of the system.
- Moderate magnitude impact: that which results in harmful effects to the conservation status of a site, habitat or species, but does not have an adverse impact on the integrity of the system.
- Low magnitude impact: that which has a noticeable effect but is either sufficiently small or of short duration to cause no harm to the conservation status of the site, habitat or species.
- Imperceptible: that which has no perceptible impact.
- Positive: that which has a net positive impact for the conservation status of a site, habitat or species.

Impact Significance

The significance of impacts is determined by evaluating the nature conservation value of the site, habitat or species concerned together with the magnitude of the impacts affecting the system. The more ecologically valuable a receptor and the greater the magnitude of the impact, the higher the significance of that impact is likely to be. Table 10-1 outlines the levels of impact significance to be used during the assessment of impacts. The probability of an impact occurring will also be outlined when defining the significance of impacts.

Table 10-1: Impact Significance Criteria

Nature Conservation Value	Magnitude of Potential Impact			
	High	**Moderate**	**Low**	**Imperceptible**
International	Severe	Major	Moderate	Minor
National	Severe	Major	Moderate	Minor
County	Major	Moderate	Minor	Minor
Local	Moderate	Minor	Minor	Negligible
Low	Minor	Negligible	Negligible	Negligible

Impact Assessment – Birds

The sensitivity of a species follows the approach outlined by Percival (2003), which defines a species sensitivity by evaluating its ecological importance and nature conservation interest. Species sensitivity is ranked on a scale from very high to low. The criteria used to rank species sensitivity is outlined in Table 10-2.

Table 10-2: Criteria for Ranking Bird Sensitivity

Sensitivity	Determining Factor
Very High	Species listed as qualifying interests for SPAs and other statutorily protected nature conservation areas.
High	Species that contribute to the integrity of an SPA but which are not listed as qualifying interests for which the site is designated. Ecologically sensitive species including the following: Red Grouse; hen harrier; and golden eagle. 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 of BirdWatch Ireland's amber list of Birds of Conservation Concern not covered above.

Once the species/populations 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 impact magnitude is based on the scale of loss or alteration to key elements/features of the baseline conditions. Impact magnitude is ranked on a five-point scale from very high to negligible. Table 10-3 outlines the criteria for determining the impact magnitude of wind farm developments.

Table 10-3: Criteria for Determining the Impact Magnitude

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

Magnitude	Description
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

The determination of impact significance is carried out by assessing together the predicted magnitude of impact and the sensitivity of the local bird community. Table 10-4 below outlines the impact significance matrix used for assessing the impact significance of the proposed development to bird species.

Table 10-4: Impact Significance Matrix for Assessing Impacts to Bird Species

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

10.4 Characteristics of the Development

A description of the development is provided in Chapter 2.

10.4.1 Description of Existing Environment

Lackan Wind Farm is situated at Lackan, County Sligo, approximately 3.5km north of Inishcrone. The wind farm is located on pasture fields whose perimeters are divided by high grass bank ditches, to the north, east and south. The site has an overall flat topography.

10.4.2 Designated Sites

The wind farm site is not under any existing statutory conservation or ecological designations, nor is it a non-designated site of conservation importance.

Five European Sites occur within the 15km surrounding the wind farm. The European Sites are shown on Figure 10-1 and 10-2. All designated conservation areas occurring in the wider surrounding are listed in Table 10-5. The distance of each European Site from the wind turbine locations is also listed on Table 10-5.

None of the designated conservation areas listed in Table 10-5 are connected to the project site. The nearest European Sites to the project site, namely the Killala Bay/Moy Estuary SAC and the Killala Bay/Moy Estuary SPA, are located approximately 3.6km and 3.2km to the south. No NHAs occur within the 15km buffer. Eight pNHAs occur within the 15km buffer. No pathways such as viable hydrological pathways connect elements of the project to these SAC or SPA, or any other of the SACs, SPAs or pNHAs occurring in the wider area surrounding the project site.

Table 10-5: Designated Conservation Areas in the Surrounding Area

Site Code	Site Name	Distance from Project Site
000458	Killala Bay/Moy Estuary SAC	3.6km to the south
002298	River Moy SAC	12.7km to the south
000516	Lackan Saltmarsh and Kilcummin Head SAC	9.7km to the northwest
002006	Ox Mountains Bogs SAC	11km to the east
004036	Killala Bay/Moy Estuary SPA	3.2km to the southwest
002298	River Moy SAC	12.7km to the south
000516	Lackan Saltmarsh and Kilcummin Head SAC	9.7km to the northwest
002006	Ox Mountains Bogs SAC	11km to the east

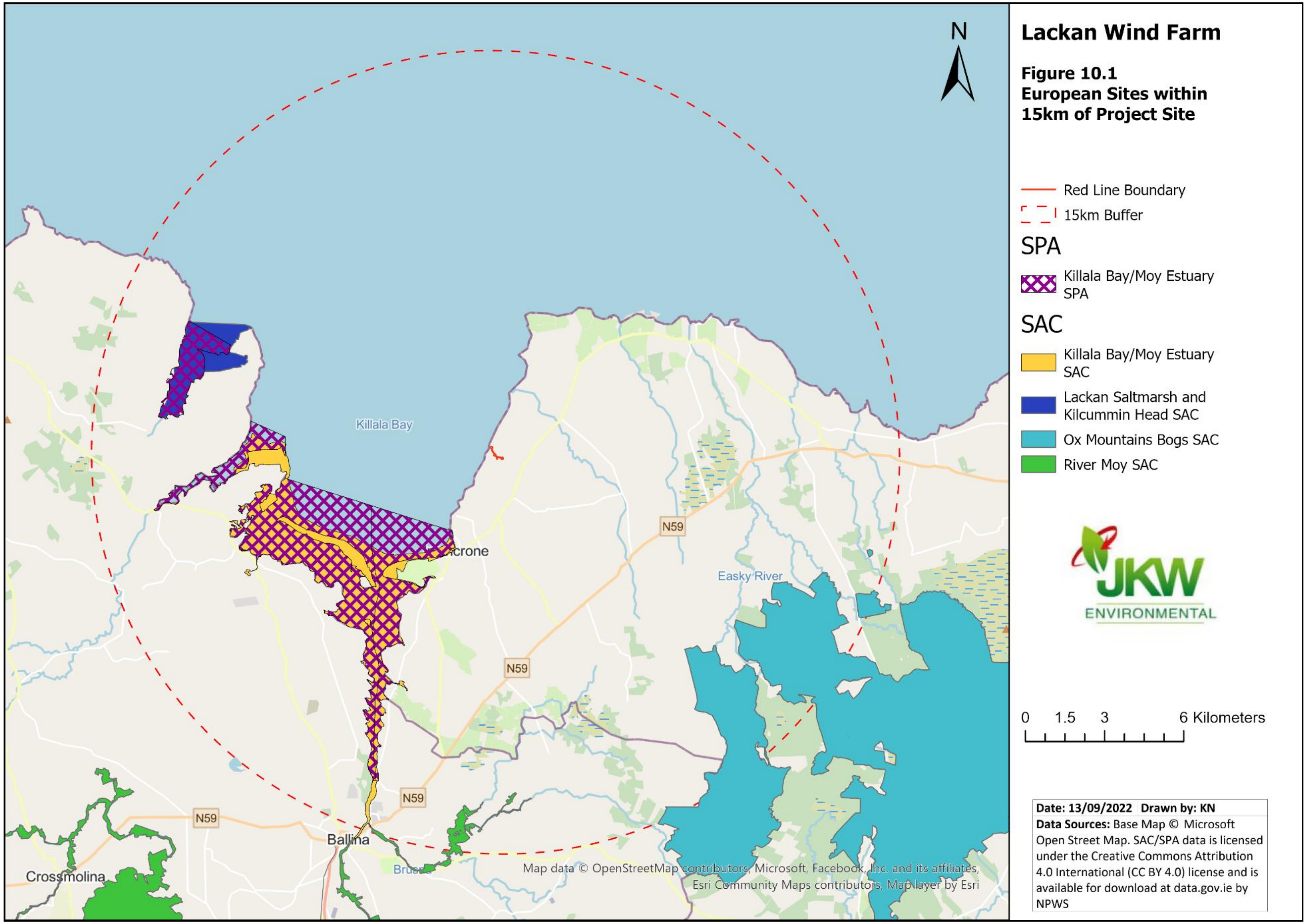


Figure 10-1: European Sites within 15km

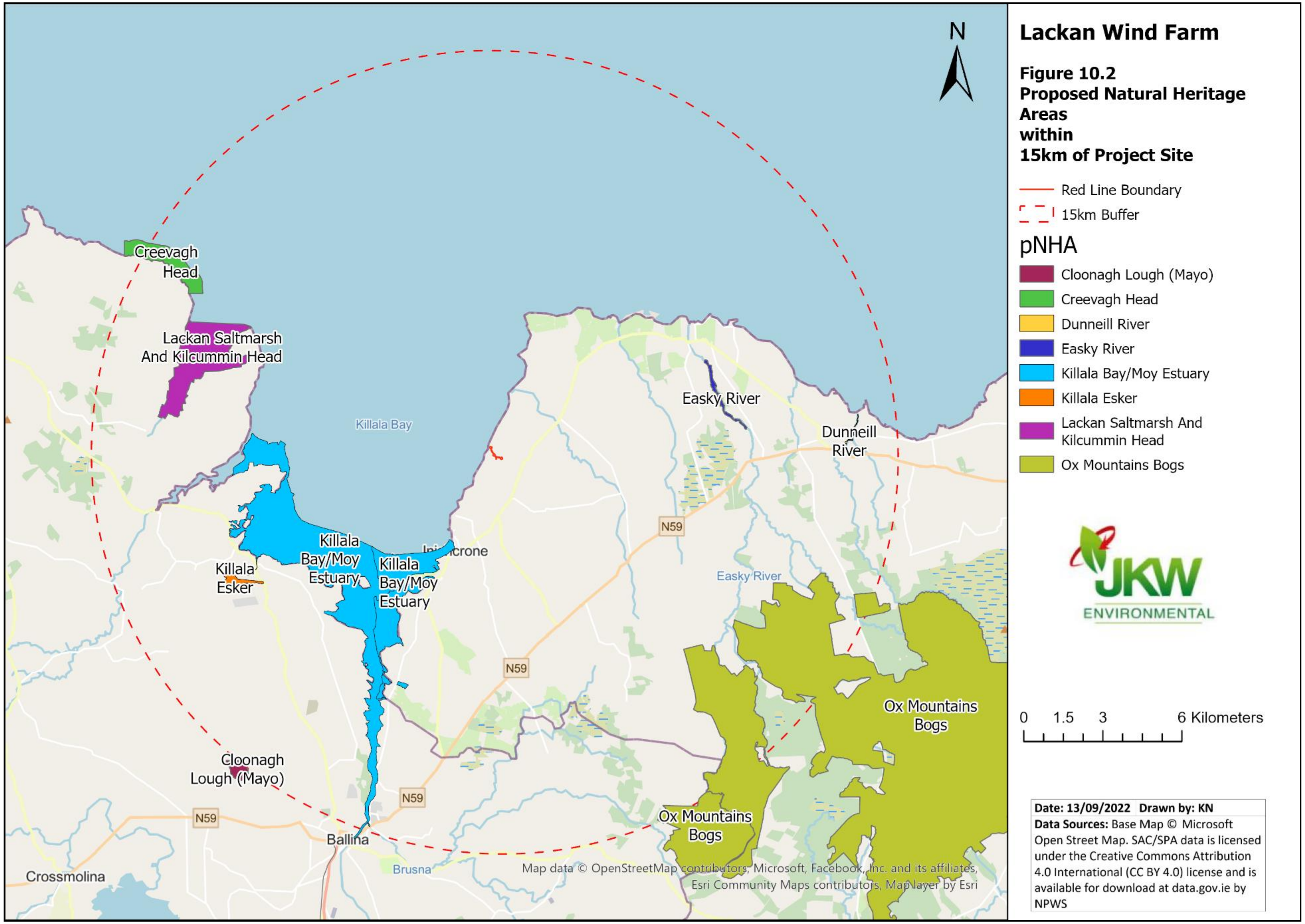


Figure 10-2: Proposed Natural Heritage Areas within 15km

10.4.3 Records of Rare, Threatened or Protected Species

A review of the National Biodiversity Data Centre (NBDC) website (www.biodiversityireland.ie) (accessed June 2022) was completed to identify the presence of any records for rare, threatened or protected flora or fauna occurring within the vicinity of the project site. Records of all rare, threatened and protected species occurring within the wider vicinity of the project site were downloaded from the NBDC. The area searched for records is based on a 2km polygon (G33B) area surrounding the project site as shown on Figure 10-3. Four amber listed species (BoCCI), Swallow, Starling, Tree Sparrow and House Sparrow, were listed in this polygon. Cuvier's Beaked Whale (*Ziphius cavirostris*) and Irish Hare (*Lepus timidus* subsp. *hibernicus*) were also recorded within this polygon.

Figure 10-3: Search Area for Records of Rare, Threatened and/or Protected Species

10.4.4 Terrestrial Habitats

Habitats occurring at the project site are described in accordance with Level III of the Guide to Habitats in Ireland (Fossitt, 2000). The Level III habitats dominating the project site are described in the following sub-sections below. A habitat map of the project site is provided as Figure 10.4. The main habitats in the vicinity of the wind farm are: **Wet Grassland GS4** and **Improved agricultural grassland GA1.**

A review of historical aerial photography between 1995 and the present day does not indicate, apart from the construction of the wind farm, any changes to the land cover and habitats occurring within the project site boundary over the last 27 years.

The habitats around T1 have been classified as **GA1 Improved agricultural grassland** dominated by Rye-grasses (*Lolium* spp.), White Clover (*Trifolium repens),* meadow-grasses *(Poa* spp.) and Silverweed (*Potentilla anserina*). Creeping Buttercup (*Ranunculus repens*), plantains (*Plantago* spp.) were also present. The areas around T2 and T3 are classified as **Wet grassland GS4** dominated by Soft rush (*Juncus effusus*), Sharp rush (*Juncus acutus*), Yellow Iris (*Iris pseudacorus*), Creeping Buttercup (*Ranunculus repens*), Marsh Thistle (*Cirsium palustre*), Silverweed (*Potentilla anserina*), Meadowsweet (*Filipendula ulmaria*), Water Mint (*Mentha aquatica*), and horsetails (*Equisetum* spp.). Grazing occurs throughout the site with the land around T2 and T3 heavily poached in areas. The western coastal boundary consists of a high sea dyke of cobble and boulder on limestone bedrock forming an **Exposed rocky shore LR1**. Field boundaries include **Hedgerows WL1**, comprised mainly of Gorse (*Ulex europaeus*) and Bramble (*Rubus fruticosus* agg.). Common reed (*Phragmites australis)* is found along the banks of the stream.

10.4.5 Aquatic Habitats

A stream, Quigabar_010, runs along the eastern boundary of the wind farm and is given a WFD (2013-2018) 'Good' status. This stream discharges at the coast north of the wind farm. The water was clear and riverbed substrate was comprised of small amount of cobble and large boulders and was highly silted in areas. The stream has large amount of macrophyte growth with the principal species recorded instream being *Iris pseudacorus* and *Phragmites australis.*

The stream has been assessed in terms of aquatic biodiversity with particular emphasis on habitat for fish in accordance with Dept. Agriculture Northern Irelands advisory leaflet "The Evaluation of Habitat for Salmon and Trout". The stream has a spate nature with very low levels of water during summer months and likely subject to winter flood flows. There is an absence of suitable salmonid spawning habitat and pools. The stream is also subject to excessive shading from macrophyte growth.

A **Drainage ditch FW4** runs along the field boundary between the substation and T2. The drain is well vegetated with Willowherb and Yellow Flag Iris.

10.4.6 Fauna

Mammals
A targeted survey within the project site and along field boundaries surrounding the project site was completed for field signs indicating the presence of badgers and other mammals such as pine marten, stoat, hedgehog and fox. No evidence of protected species such as badgers were recorded at the project site. Evidence of rabbit burrows was recorded in field boundaries southwest of T1.

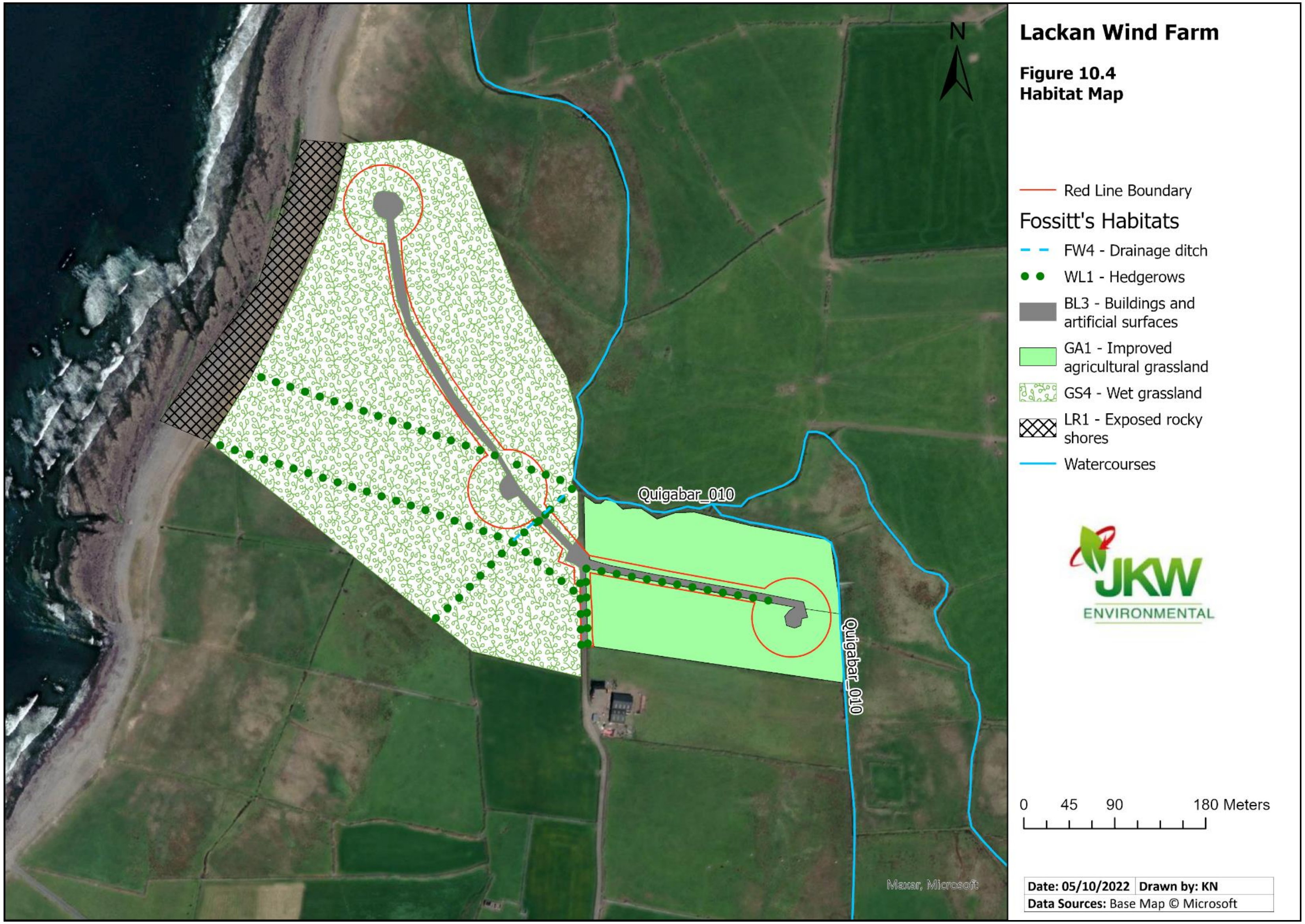


Figure 10-4: Habitat Map

Bats

The project site is located in an area classified as moderate importance for all bat species. The subject site and immediate adjacent lands were searched for potential bat roost sites. During site visits structures and trees were assessed for their potential to support roosting bats. No trees were identified with the area which would provide suitable bat roosting potential. The substation and farm sheds to the south were subject to a preliminary roost assessment. This included an inspection of the exterior, searching for evidence of bat usage, including any bat specimens, droppings, staining, feeding remains, etc. The surveys did not identify any evidence of roosting bats or of any use by bats, and the structures are not considered optimal as significant bat roost such as maternity roost/other significant roost for bat species.

As shown in Table 10-6 to 10-8 four bat species were recorded during the automatic monitoring during the spring survey period; Leisler's Bat, Common Pipistrelle, Soprano Pipistrelle and Myotis species.

Table 10-6: Summary of Spring Bat Activity Recorded at T1

	Soprano Pipistrelle	Common Pipistrelle	Leisler's
Survey Dates	**No. of Bat Passes Recorded**		
14 – 29 May 2022	133	87	74
Total passes/night	8.3	1.7	4.6
Bat passes/hour/night	0.75	0.5	0.4

Table 10-7: Summary of Spring Bat Activity Recorded at T2

	Soprano Pipistrelle	Common Pipistrelle	Leisler's	Myotis sp.
Survey Dates	**No. of Bat Passes Recorded**			
14 – 29 May 2022	231	167	185	11
Total passes/night	14.4	10.4	11.6	0.7
Bat passes/hour/night	1.3	0.95	1.1	0.06

Table 10-8: Summary of Spring Bat Activity Recorded at T3

	Soprano Pipistrelle	Common Pipistrelle	Leisler's
Survey Dates	**No. of Bat Passes Recorded**		
14 – 29 May 2022	414	229	493
Total passes/night	26	14.3	31
Bat passes/hour/night	2.4	1.3	2.8

The automatic monitoring completed showed generally low-medium levels of bat activity during the 11 nights of monitoring in May 2022 Matthews et al. (2016).

As shown in Tables 10-9 to 10-11 three bat species were recorded during the summer survey period; Leisler's Bat, Common Pipistrelle and Soprano Pipistrelle.

Table 10-9: Summary of Summer Bat Activity Recorded at T1

	Soprano Pipistrelle	Common Pipistrelle	Leisler's
Survey Dates	**No. of bat passes recorded**		
22 - 30 June 2022	10	4	13
Total passes/night	1.1	0.4	1.4
Bat passes/hour/night	0.12	0.04	0.15

Table 10-10: Summary of Summer Bat Activity Recorded at T2

	Soprano Pipistrelle	Common Pipistrelle	Leisler's
Survey Dates	**No. of bat passes recorded**		
22 - 30 June 2022	61	25	58
Total passes/night	6.7	2.7	6.4
Bat passes/hour/night	0.74	0.3	0.71

Table 10-11: Summary of Summer Bat Activity Recorded at T3

Survey Dates	Soprano Pipistrelle	Common Pipistrelle	Leisler's
	No. of bat passes recorded		
22 - 30 June 2022	26	12	29
Total passes/night	2.8	1.3	3.2
Bat passes/hour/night	0.31	0.14	0.35

The automatic monitoring completed showed generally low-medium levels of bat activity during the 9 nights of monitoring in June 2022 Matthews *et al*. (2016).

Birds

Birdwatch Ireland provides bird sensitivity mapping for wind energy developments and associated infrastructure in the Republic of Ireland. The area around the wind farm has been classified as 'No Data' which corresponds to a sensitivity of below the minimum score of 14.8. The target species recorded during vantage point surveys are:

Oystercatcher

Oystercatchers were recorded on seven occasions during the 2021-2022 surveys.

Two Oystercatchers were recorded travelling north to south along the coastline and outside the boundary of the wind farm. On a separate occasion, a flock of three Oystercatchers were again recorded flying north to south along the coastline. A flock of nine Oystercatchers were recorded in July flying south to north along the coastline. During the August 2022 surveys, a flock of 18 Oystercatchers were recorded travelling north to south along the coastline.

Small flocks of Oystercatchers, between 3-4, were recorded on three separate occasions during the 2021-2022 vantage point surveys, roosting along the reef adjacent to Lackan Wind Farm.

Oystercatchers (14 individuals) were recorded during the bird surveys carried out in 2002 as part of the original EIA.

Great Northern Diver

One Great Northern Diver flightline was recorded during the 2021-2022 surveys. This flightline was recorded south of the wind farm site, flying north to south along the shoreline.

Mute Swan

Mute Swan were recorded three times during the 2021-2022 surveys. One flightline was mapped showing two Mute Swans flying from the shore to the west of the wind farm boundary travelling north towards Pullaheany Harbour. Two Mute Swans were recorded in July flying along the coastline south towards Inischrone. Two Mute Swans were also recorded on slack water west of the wind farm boundary.

Kestrel

The October 2021 survey recorded a Kestrel hunting over the fields to the south of the site. The August 2022 survey recorded a Kestrel hunting over fields to the southwest of the site. All Kestrel activity was recorded outside of Lackan Wind Farm boundary.

A Kestrel was also observed flying over the site during the 2009 survey.

Heron

Six Heron flightlines were recorded during the 2021-2022 surveys. During the May 2022 survey, two flightlines recorded the same bird which flew through the western corner of the wind farm site, landed in fields to the south of the site and then flew north to the shoreline outside the site boundary. The July surveys recorded a single Heron travelling north along the shoreline, and a second flightline of a single Heron flying north between T2 and T3. Two Herons were also observed roosting in a field just east of the vantage point location.

The 2009 survey recorded one Heron flying within the site boundary.

Great Black-backed Gull
Great Black-backed Gulls were recorded 15 times during the 2021-2022 surveys. Flightlines were concentrated along the shoreline and over the fields to the south of the wind farm. No flights were recorded within the boundary of the wind farm. Great Black-backed Gulls were also recorded perched along the rocky shoreline west of the site boundary. One flightline was recorded during the August 2022 survey traveling south past T1 and T2.

Great Black-backed Gulls were also recorded during the 2009 survey. Activity was described as flying over the shoreline to the west of the site.

Little Egret
Little Egret were recorded three times during the 2021-2022 surveys. No activity was recorded within the site boundary. Activity was recorded flying north to south and south to north along the shoreline to the west. One flight was recorded over the fields to the south of the site.

Curlew
Small numbers of Curlew, 1-2 individuals, were recorded on four occasions during the 2021-2002 surveys. No activity was recorded within the site boundary. Curlew was observed flying along the shoreline and perched on the rocky shoreline to the west of the site.

The 2002 bird survey also shows one record of a single curlew along the shoreline to the west.

Cormorant
Cormorants were observed, in small numbers, on eight occasions during the 2021-2022 surveys. All activity was recorded as being outside the site boundary and concentrated along the shoreline to the west.

Brent Goose
Brent Geese were recorded four times throughout the 2021-2022 surveys. Similar to other species all activity was recorded along the shoreline to the west. No activity was recorded within the site boundary.

Herring Gull
Herring Gull was recorded once during the 2021-2022 surveys. Activity was mapped as a flightline along the shoreline to the west of the site. A flock of 18 Herring Gulls were recorded roosting on the shoreline to the southwest of Lackan Wind Farm.

Herring Gull was also recorded during the 2002 surveys completed for the original EIA. The 2009 surveys also recorded Herring Gull occurring outside the site boundary along the shoreline.

Lesser Black-backed Gull
Lesser Black-backed Gulls were observed once during the 2021-2022 surveys along the shoreline to the west. No activity was recorded within the site boundary.

Ringed Plover
One Ringed Plover was recorded, on the shoreline southwest of the site, during the May 2022 survey. Two Ringed Plover were recorded travelling south along the shore during the June 2022 survey.

Twenty Ringed Plovers were recorded along the shoreline during the 2002 survey. The 2009 survey also recorded 18 Ringed Plover along the shoreline to the west.

No target species were recorded within the vicinity of the existing turbines. The majority of bird activity were recorded along the shoreline to the west. The activity recorded within the site boundary during the 2021-2022 vantage point surveys includes:

- A single Heron commuting through the western corner of the site during the May 2022 survey.
- A single Heron commuting north between T2 and T3.
- A single Great Black-backed Gull commuting through the western end of Lackan Wind Farm adjacent to T1 and T2.

The results of the vantage point surveys are presented in Table 10-12 below.

Carcass search surveys were also completed by Rouse Developments twice yearly, at each turbine, from 2007 to 2022. A carcass search was carried out in 2009 by Dr Patrick Crushell. JKW Environmental also carried out monthly carcass search surveys at each turbine between January 2022 and July 2022. No carcasses or evidence of predation was recorded during any of the searches completed.

Table 10-12: Details of Flight Observations for Birds

Oystercatcher					
Date	**Weather**	**No. Birds**	**Flight Time (s)**	**Flight Height (m)**	**Description**
16/03/2022	Blue sky light cloud, light SW wind 1dg excellent visibility.	4			OC roosting on reef
16/03/2022	Blue sky light cloud, light SW wind 1dg excellent visibility.	2	45	20-40m	Commuting along coastline
20/03/2022	Cloud cover moderate SE wind, dry 8dg excellent visibility.	3	30	<20m	Commuting along coastline
12/05/2022	Cloud cover moderate SW wind 12dg excellent visibility.	3			Roosting on reef
08/07/2022	Some cloud 18dg SW wind excellent visibility.	4			Roosting on reef
08/07/2022	Cloud clearing 20dg moderate SW wind excellent visibility.	9	30	<20	Commuting north along the shoreline
04/08/2022	Sunny 18dg no wind excellent visibility.	18	30	<20m	Commuting south along shoreline
Great Northern Diver					
Date	**Weather**	**No. Birds**	**Flight Time (s)**	**Flight Height (m)**	**Description**
05/04/2022	Overcast moderate NW wind dry ,11dg good visibility.	1	45	<20m	Commuting off shoreline
Mute Swan					
Date	**Weather**	**No. Birds**	**Flight Time (s)**	**Flight Height (m)**	**Description**
20/03/2022	Cloud cover moderate SE wind dry,8dg excellent visibility.	2			2 MS in slack water west of site boundary
20/03/2022	Cloud cover moderate SE wind, dry 8dg excellent visibility.	2	120	<20m; 20-40	MS moved up to Pullaheany Harbour.
08/07/2022	Sunny 21dg moderate SW wind excellent visibility.	2	240	<20	Commuting south

Kestrel					
Date	**Weather**	**No. Birds**	**Flight Time (s)**	**Flight Height (m)**	**Description**
15/10/2021	Strong NW wind 50% cloud cover occasional heavy showers good visibility.	1	120	20-40	Hunting
04/08/2022	Sunny 26dg no wind excellent visibility.	1	60	20-40	Hunting
Heron					
Date	**Weather**	**No. Birds**	**Flight Time (s)**	**Flight Height (m)**	**Description**
12/05/2022	Cloud cover moderate SW wind 12dg excellent visibility.	1	45	<20	Commuting west to shoreline
12/05/2022	Cloud cover moderate SW wind 12dg excellent visibility.	1	45	<20	Commuting south
03/06/2022	Bright day cloud increasing 16dg light NE wind excellent visibility.	1	45	<20	Commuting south
08/07/2022	Some cloud 18dg SW wind excellent visibility.	2			Roosting in field
08/07/2022	Sunny 21dg moderate SW wind excellent visibility.	1	45	<20	Commuting north
08/07/2022	Sunny 21dg moderate SW wind excellent visibility.	1	75	<20	Commuting north
Great Black-backed Gull					
Date	**Weather**	**No. Birds**	**Flight Time (s)**	**Flight Height (m)**	**Description**
10/02/2022	Strong NW wind occasional heavy showers good visibility 6dg.	2			Roosting on reef
03/06/2022	Bright morning light NE wind 15dg excellent visibility.	1	75	40-120	Commuting south off the shore
03/06/2022	Bright morning light NE wind 15dg excellent visibility.	2	60	20-40	Commuting north
08/07/2022	Some cloud 18dg SW wind excellent visibility.	1	75	<20	Commuting north
08/07/2022	Sunny 21dg moderate SW wind excellent visibility.	1	75	<20	Commuting south along shoreline
04/08/2022	Sunny 26dg no wind excellent visibility.	1	120	<20; 20-40m	Commuting south, past T1 and T2
Little Egret					
Date	**Weather**	**No. Birds**	**Flight Time (s)**	**Flight Height (m)**	**Description**
12/01/2022	Cloud cover, light to moderate SW wind dry with good visibility.	1	30	<20	Commuting across fields to the south of site boundary

16/03/2022	Blue sky light cloud, light SW wind 1dg excellent visibility.	3	75	20-40	Commuting north along shoreline
16/03/2022	Blue sky light cloud, light SW wind 5dg excellent visibility.	3	75	<20	Commuting south along shoreline
Curlew					
Date	**Weather**	**No. Birds**	**Flight Time (s)**	**Flight Height (m)**	**Description**
15/10/2021	Strong NW wind 50% cloud cover occasional heavy showers good visibility.	1			Foraging on reef
11/01/2022	Some cloud cover moderate SW wind, dry with good visibility.	2	45	<20	Commuting north along shore
12/01/2022	Cloud cover moderate SW wind dry with good visibility.	1	30	<20	Commuting north along shore
04/08/2022	Sunny 18dg no wind excellent visibility.	1	30	<20	Commuting south along shore
Cormorant					
Date	**Weather**	**No. Birds**	**Flight Time (s)**	**Flight Height (m)**	**Description**
11/01/2022	Cloud cover moderate SW wind light showers good visibility 4dg.	1	60	20-40	Commuting north off shore
20/03/2022	Cloud cover moderate SE wind, dry 8dg excellent visibility.	1	30	<20	Commuting north off shore
20/03/2022	Cloud cover moderate SE wind, dry 8dg excellent visibility.	1	45	<20	Commuting south off shore
03/06/2022	Bright morning light NE wind 15dg excellent visibility.	1	90	<20	Commuting south off shore
03/06/2022	Bright morning light NE wind 15dg excellent visibility.	2	30	<20	Commuting south along shore
03/06/2022	Bright day cloud increasing 18dg light NE wind excellent visibility.	1			Perched on reef
04/08/2022	Sunny 26dg no wind excellent visibility.	1	90	<20	Commuting north off shore
04/08/2022	Sunny 26dg no wind excellent visibility.	1	60	<20	Commuting north along shore
Brent Goose					
Date	**Weather**	**No. Birds**	**Flight Time (s)**	**Flight Height (m)**	**Description**
15/10/2021	Strong NW wind 50% cloud cover occasional heavy showers good visibility.	4	75	20-40	Commuting south off shore

11/01/2022	Cloud cover moderate SW wind, light showers good visibility 4dg.	5	45	20-40; <20	Circled over reef
05/04/2022	Overcast moderate NW wind, light drizzle 11dg good visibility.	13	45	<20	Commuting north off shore
05/04/2022	Overcast moderate NW wind, occasional showers 11dg good visibility.	5	45	<20	Commuting north off coast
Herring Gull					
Date	**Weather**	**No. Birds**	**Flight Time (s)**	**Flight Height (m)**	**Description**
10/02/2022	Strong NW wind occasional heavy showers good visibility 6dg.	10			Perched on reef
04/08/2022	Sunny 18dg no wind excellent visibility.	18			Roosting on reef
Lesser Black-backed Gull					
Date	**Weather**	**No. Birds**	**Flight Time (s)**	**Flight Height (m)**	**Description**
10/02/2022	Strong NW wind occasional heavy showers good visibility 6dg.	3			Roosting on reef
Ringed Plover					
Date	**Weather**	**No. Birds**	**Flight Time (s)**	**Flight Height (m)**	**Description**
12/05/2022	Cloud cover moderate SW wind 12dg excellent visibility.	1			Perched on reef
03/06/022	Bright morning light NE wind 15dg excellent visibility.	2	45	<20	Commuting south along reef

Other Terrestrial Fauna
No evidence of other protected fauna such as common frog, common lizard, smooth newt, butterflies, dragonflies etc. was recorded during the site surveys.

10.4.7 Site Evaluation

Habitats
Habitats within the footprint of the turbines are not representative of any Annex I or priority habitats. Habitats within the landholding surrounding the existing turbines are not representative of any Annex I habitats. The turbine area is typical of improved agricultural grassland and wet grassland.

No protected or rare plant species were recorded. As such, the project site is of Local Importance (lower value).

Avian Species
The most significant impact arising from a wind farm development would be the loss of rare or sensitive bird species. The sensitivity of a species can be defined as its ecological importance and nature conservation interest at the site being assessed (Percival 2003). In this report the sensitivity of species is defined by whether the species is listed on Annex I of the EU birds directive, on BirdWatch Ireland’s list of Birds of Conservation Concern (BoCCI) or listed as a qualifying interest if the nearby Kilalla Bay/Moy Estuary SPA.

During the vantage point surveys (2021-2022) sensitive bird species were recorded within the site boundary, including:

- A single Heron commuting through the western corner of the site during the May 2022 survey.
- A single Heron commuting north between T2 and T3.
- A single Great Black-backed Gull commuting through the western end of Lackan Wind Farm adjacent to T1 and T2.

Several sensitive species were recorded along the shoreline to the west. The species recorded were typical of the habitats in this area.

BoCCI Red listed species recorded during the 2021-2022 vantage point surveys include:

- Kestrel.
- Curlew (also a QI of the Kilalla Bay/Moy Estuary SPA).
- Oystercatcher.

BoCCI Amber listed species include:

- Herring Gull.
- Lesser Black-backed Gull.
- Brent Geese.
- Cormorant.
- Ringed Plover (also a QI of the Kilalla Bay/Moy Estuary SPA).
- Mute Swan.
- Great Northern Diver (Annex I).

Bat Species
An assessment of the quality of the habitat at the site and in the wider landscape was conducted. The report 'Landscape Conservation for Irish Bats and Species Specific Roosting Characteristics' (Lundy et al, 2011), using over 17,000 records from Bat Conservation Ireland's database, analysed habitat and landscape associations for the 9 resident bat species in Ireland. Modelling species distributions offers an alternative to direct mapping, allowing the prediction of species current, future and past distributions. Results of the modelling analyses shows a negative association with Bog/Marsh/Heath habitat for Brown long-eared, Common Pipistrelle, Nathusius' pipistrelle, Leisler's, Daubenton's, Whiskered and Natterer's bats. All 9 species have a positive association with broadleaf woodland, 6 out of 9 with mixed forestry and 6 out of 9 with riparian habitat.

Lackan Wind Farm site is situated in an exposed setting with limited shelter being provided throughout the site. There is no sheltering vegetation located in the vicinity of the turbine locations. Given the low to medium activity level were recorded for all bats, which indicates that populations of a small size are likely to occur in the vicinity of the project site and bat species have been classified as receptors of local importance, lower value.

10.5 Impacts Assessment

10.5.1 Do Nothing Scenario

In the 'do-nothing' scenario, the wind farm will continue to operate with the benefit of the existing planning permission until October 2023, after which it would need to be decommissioned and the site returned to low-intensity grazing.

10.5.2 Construction Phase

As the site is already constructed and operational, there are no construction related impacts.

10.5.3 Operation Phase

Habitats
The extended operation phase of the wind farm will not cause additional significant or adverse direct impacts to the quality or functionality of the habitats occurring within the site.

Designated Conservation Areas
The Screening Report for Appropriate Assessment is provided under separate cover with this application and evaluates the potential of the extended operation phase of the wind farm to result in likely significant effects to European Sites (i.e., SAC and SPAs). No NHAs are located within the vicinity of the wind farm. The AA Screening has resulted in a ***Finding of No Significant Effects*** and as such a Stage II Appropriate Assessment was not required.

Terrestrial Non-Volant Mammals
The extended operation phase of the wind farm will not cause additional impacts to the ground dwelling mammals likely to occur within the vicinity of the site.

Bats
In general, the operation phase of wind farms have the potential to negatively affect bats and their populations through displacement and barrier effects and fatalities resulting from collisions and barotrauma.

Studies to date in Europe and the USA (Kunz et al, 2007; Arnett et al, 2008, Rydell et al, 2010) have shown that bat mortality at wind turbines is a serious issue. Bats are known to be killed either through a fatal change in pressure within the lungs (barotrauma) when flying too close to the blades or through collision with rotor blades. To date, there is no published results of a study of bat mortality from Irish wind turbines but the mortality rate is most likely similar to the UK and the rest of Europe. However, many of the European and American studies feature wind farms with significantly larger number of turbines which are sited along known bat migration routes where thousands of bats commute seasonally. Currently there is no evidence that mortality of bats occurs at the same scale in Ireland. Large scale bat migration is not known to occur in Ireland although bats may migrate considerable distances from roosting areas to swarming sites for mating purposes in autumn. Such swarming sites are often caves in upland areas.

The potential for displacement of bats from foraging habitats due to their avoidance of wind turbines is still poorly understood and is likely to result in species-specific behavioural responses. A number of studies have shown that bats avoid foraging in areas in the immediate vicinity of turbines. Other studies have shown that pipistrelle species become habituated to the presence of turbines and are in general not displaced from foraging habitats located adjacent to wind turbines (Bach & Rahmael, 2004).

Current guidance on the assessment of the potential risk posed by wind farms to bats is outlined in Natural England's Technical Information Notes TIN 051: Bats and Onshore Wind Turbines (Mitchell-Jones & Carlin, 2009) and the Bat Conservation Trust's (BCT) Bat Survey Guidelines (as outlined in Table 10.1 of the BCT guidance). With reference to these documents the criteria used to establish fatality risk of the wind farm to bat species are as follows:

- Habitat quality surrounding the wind farm layout.
- Presence of bat roosts that may be affected by the wind farm layout.
- Number of high value bat habitat features altered by the wind farm layout.
- Levels of bat activity recorded.
- Sensitivity of recorded species at the individual and population level.

The quality of the habitat within and surrounding Lackan Wind Farm is representative of a low favourability habitat for bat species. There is an absence of high value linear, structured vegetation within the vicinity of the turbine locations. The open and exposed nature of the site, along with the typical high wind speeds recorded in this area also detracts from the suitability of this site to function as foraging habitat for bat species. The results of baseline surveys support this, with low to medium activity levels dominating the bat activity recorded during monitoring surveys.

No known or potential bat roosts will be affected by the wind farm. No potential roosting opportunities occur within 200m of any of the turbines. In light of the lack of any known or potential roost sites in the vicinity of the wind farm, no negative impacts to bat roosts are predicted to occur.

Low to medium bat activity was recorded during monitoring in the vicinity of the turbines. Based upon the results of the monitoring completed during May and June 2022, there will be no potential for the operation phase of the turbines to result in significant negative impacts to the local bat populations occurring in the wider surrounding area.

Birds

Operating wind farms have the potential to affect birds through:

- Death through collision or interaction with turbine blades.
- Direct habitat loss through wind farm construction.
- Displacement through indirect loss of habitat if disturbance causes birds to avoid the wind farm and surrounds.

The level of activity recorded during 2002, 2009 and 2021-2022 bird surveys is within the range of what would be expected from the habitats present and the time of year the surveys were carried out. There were no notable changes in the species composition recorded during vantage points surveys in 2021-2022, surveys carried out by Dr Patrick Crushell in 2009 and the surveys carried out in 2002 as part of the original EIA. The 2021-2022 surveys are the most comprehensive surveys carried out at the site to date. The results of these surveys indicate that a wide range of species continue to utilize the areas surrounding the wind farm, particularly the rocky shoreline to the west.

A BoCCI Red listed species, Kestrel, was recorded hunting close to the site and indicates that they continue to hunt within close proximity to the operating turbines. Oystercatcher, BoCCI Red listed species, was recorded during both the 2002 survey and the 2021-2022 vantage point surveys. Oystercatcher activity was recorded along the shoreline to the west during the 2002 survey and the 2021-2022 survey. This indicates that the species continues to utilize the areas adjacent to the wind farm and it is unlikely that any displacement or disturbance effects have occurred due to the operation of the wind farm.

Both Curlew and Ringed plover are qualifying interests of the Killala Bay/Moy Estuary SPA. Both species were recorded around the shoreline outside the wind farm boundary during the 2002 surveys. Ringed Plover was again recorded along the shoreline during the 2009 survey. The results of vantage point surveys during 2021-2022 showed that Curlew and Ringed Plover continue to use the shoreline to the west of the site indicating that it is unlikely that any displacement or disturbance effects have occurred due to the operation of the wind farm.

Based on the data available from the 2002 original EIA, the 2009 surveys carried out by Dr Patrick Crushell, the vantage point surveys carried out during 2021 and 2022 and carcass searches carried out by Rouse Developments from 2007-2022, Dr Patrick Crushell in 2009 and JKW Environmental during 2022, it is considered unlikely that the operational turbines at Lackan Wind Farm have had any significant negative impacts on bird species found within the area and particularly to the qualifying species of the Killala Bay/Moy Estuary SPA, Ringed Plover and Curlew, which were recorded in the vicinity of the wind farm in 2002 and 2021-2022.

The area of habitat loss due to Lackan Wind Farm is small. Due to the wide availability of other areas in the vicinity of the site, the small amount of habitat that has been lost and the relatively small number of birds that may be affected due to habitat loss associated with the application site are not considered significant.

Collision can result in the direct mortality or lethal injury of birds and can result not only from collisions with wind turbine blades but also with towers, nacelles etc. Collision risk can be influence by topography and weather, particularly during periods of poor visibility i.e., fog. Other factors influencing collision risk include species-specific flight behaviour and morphology (de Lucas *et al*, 2008). With the exception of notable examples such as Altamont Pass, the majority of studies assessing collision caused by wind farms have recorded relatively low levels of mortality. However, this may be a reflection of the fact that many wind farms are located away from large concentrations of birds. Percival (2003) suggested that wind farms in Ireland are most likely to have a serious negative impact on birds where high densities of seabirds, wintering wildfowl or breeding raptors occur.

Another factor which may have influenced the low mortality rates of previous studies is the fact that mortality rates are based only on found corpses. This may lead to an under-recording of mortality if scavenging rates of corpses are high in the vicinity of wind farms. In general, it is considered that collision rates are likely to be low provided wind farms are sited in areas that do not support significant populations of rare and relatively long-lived species with low reproductive rates.

The absence of any collision fatalities around the operational turbines indicates that no bird collisions occurred within the days preceding the carcass surveys.

10.5.4 Decommissioning Phase

If the site is decommissioned, the turbines will be removed and recycled where possible. The crane hardstands and most of the access track would be reinstated; however, it is not proposed to remove the turbine foundation.

Fuel used by site plant presents a risk to the aquatic environment if spills or leaks occur during decommissioning. However, only small volumes would be stored on site at any one time. If spills or leaks occurred unmitigated, it would present a localised not significant short term negative impact.

The activities at the site during decommissioning may temporarily displace wildlife from using the site, but this would be short-term with most of the work carried out during daylight hours to minimise the use of construction lighting. No significant impact is therefore predicted.

10.5.5 Cumulative Impacts

The proximity of wind farms to each other and the physical placement of the turbines, whether in lines or clusters, may have a cumulative negative impact on birds and other wildlife. The Lackan Wind Farm was considered in combination with other plans and projects in the area that could result in cumulative impacts on European Sites, Nationally designated sites and protected species. This included a review of online Planning Registers and served to identify past and future plans and projects, their activities and their predicted environmental effects. The projects considered are listed below.

No significant effects as a result of the Lackan Wind Farm in relation to disturbance, displacement or mortality of faunal species has been identified. Therefore, there is no potential for the extended operational period to contribute to any cumulative effect in this regard. The extended operational period of Lackan Wind Farm will not result in any significant residual effects on biodiversity and will not contribute to any cumulative effect when considered in combination with other plans and projects. In the review of the projects that was undertaken, no connection that could potentially result in additional or cumulative impacts was identified. Neither was any potential for different (new) impacts resulting from the combination of the various projects and plans in association with the Lackan Wind Farm.

Table 10-13: Wind Farms within Vicinity of Lackan

Wind Farm Name	Brief Description	Distance from Lackan Wind Farm (km)
Carrowleagh	17 No. turbines with 99.5m tip height (64m hub and 71m rotor diameter) for 16 No. turbines and one turbine with 125m tip height (78m hub and 92m rotor diameter)	Located 12.4km to 15km to the southeast.
Black Lough	6 No. turbines with 125m tip height (78m hub and 92m rotor diameter)	Located 11.2km to 11.9km to the southeast
Bunnyconnellan	12 No. turbines with 99.5m tip heights (64m hub and 71m rotor diameter)	Located 16.9km to 18.5km to the southeast
Killala	6 No. turbines with 125m tip height (74.5m hub and 100m rotor diameter).	Located 11.6km to 12.2km the west
King's Mountain	10 No. turbines with 100m tip height (60m hub and 80m rotor diameter)	Located 17.7km to 19.2km to the south-southeast
Dunneill	13 No. turbines with 75m tip height (49m hub and 52m rotor diameter)	Located 14km to 15.6km the south-southeast
Kilbride	Planning permission is for 21 No. Enercon E70 turbines (85m hub height and 71m rotor diameter)	Located between 12km and 14km to the south
Glenree	Planning permission is for 1 No. turbine (81m hub height and 138m rotor diameter)	Located 16.5km to the south
Stokane	Planning permission is for 1 No. turbine with 150m tip height	Located 11.9km to the southeast

10.6 Mitigation Measures

10.6.1 Construction Phase

As the site is already constructed and operational, no construction phase mitigation is required.

10.6.2 Operation Phase

In order to minimise the potential for interactions and potential collisions between bats and turbines, scrub, hedgerows, treelines and other structured vegetation will be prevented from establishing within 50m of the rotor area of the turbine during the extended operational phase of the wind farm.

Vehicles coming onto the site for maintenance will be periodically checked for oil leaks to avoid the risk of pollution.

10.6.3 Decommissioning Phase

Mitigation measures to be implemented during the decommissioning phase to protect the aquatic environment include:

- Transformers will be sealed or oil drained prior to removal from the turbines. Any waste oil will be removed from site by a waste oil collection contractor.
- All plant and machinery to be serviced before being mobilised to site.
- Plant maintenance will not be carried out on site.
- Refuelling will be completed in a controlled manner using drip trays at all times.
- Mobile bowsers, tanks and drums will be stored in secure, impermeable bunded storage areas away from open water.
- Only designated trained operators will be authorised to refuel plant on site.
- Procedures and contingency plans will be set up to deal with emergency accidents or spills.
- While no significant earthworks are anticipated for the decommissioning plan, silt fences will be placed downgradient of any such works. Fences will be embedded into the topsoil to ensure all runoff water is captured and filtered.

Decommissioning works will be carried out during daylight hours, unless in exceptional circumstances. This will avoid disturbance to wildlife foraging at night. It will also avoid the use of construction lighting, which could affect bats using the site. Exceptional circumstances would include crane lifts during calm weather.

10.7 Residual Impacts

10.7.1 Operational Phase

Table 10-14 summarises the residual impacts of the extended operational period of the wind farm to the receiving biodiversity.

Table 10-14: Residual Impacts of the Development

Habitat	Potential Impact	Mitigation	Residual Impact
Habitats	No Impact	N/A	No significant residual impact predicted
Non-volant	No Impact	N/A	No significant residual impact predicted
Bats	Collision with turbine blades resulting in fatalities	Implement the SNH guidelines to ensure adverse impacts to bat are reduced	The risk of fatalities is reduced by adhering to the SNH 50m buffer distance. A residual risk to individual bats will remain. However in light of the low levels of activity recorded at the site it is unlikely that the wind farm will pose a significant risk to the conservation status of bat populations.
Birds	Disturbance and/or collision with turbine blades resulting in fatalities	Implement SNH guidelines to ensure adverse impacts to birds are reduced	No significant residual impact predicted. Bird survey data indicate that the wind farm has not had a significant impact on bird species using the area for foraging.

10.7.2 Decommissioning Phase

Following mitigation outlined above there is no potential for any significant residual effect.

10.8 Conclusion

Following consideration of the residual effects (post mitigation) it is concluded that the wind farm will not result in any significant effects on any of the identified key environmental receptors (KERs). No significant effects on receptors of International, National or County Importance were identified. The potential for effects on the European Designated Sites is fully described in the Appropriate Assessment Screening Report that accompanies this application. The AA Screening concludes that in view of best scientific knowledge and on the basis of objective information, the Lackan Wind Farm by itself or in combination with other plans or projects, is not likely to have significant effects on the European Sites that were assessed as part of the Appropriate Assessment process. No potential for impacts on any nationally designated site was identified.

Provided that the Lackan Wind Farm continues to be operated in accordance with the design, best practice and mitigation that is described within this application, significant individual or cumulative effects on ecology are not anticipated at the international, national or county scales or on any of the identified KERs.

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11 AIR, CLIMATE & CLIMATE CHANGE

11.1 Introduction

This chapter of the EIAR addresses air quality and climate in the existing environment, the potential direct and indirect impacts of the continued operation of the wind farm and grid connection on air quality and climate, and the proposed mitigation measures to avoid or reduce potential impacts. It was prepared by Keohane Geological & Environmental Consultancy.

A full description of the development is provided in Chapter 2. In summary the development consists of an operational wind farm with 3 No. turbines, access tracks, hardstands, control building and grid connection. The assessment addresses the extension of the permitted development for an additional 12 years.

11.2 Methodology

11.2.1 Scope & Purpose

This chapter of the EIAR provides details of the air quality and climate at the Lackan Wind Farm site. The site is located in a rural coastal environment with no major sources of air pollution, such as heavy industries. The nearest sources of potential air pollution were identified. Air quality monitoring was not deemed necessary; air quality data from the EPA is used.

The purpose of the assessment is to identify the potential direct and indirect impacts of the development on air and climate at the site and beyond the site boundary; to assess the potential impacts in the context of other developments (proposed / completed) to determine cumulative effects. Having identified and quantified the potential impacts, to recommend measures to avoid, mitigate and/or reduce significant potential negative impacts for the extended operational phase and decommissioning phase of the development. Emissions associated with other forms of energy production (fossil fuel powered plants) are discussed as the Lackan Wind Farm would offset emissions from these facilities in other parts of the country.

11.2.2 Policies & Guidelines

There are a number of local, national and international policies and guidelines relied upon on the preparation of this chapter. Refer to Section 1.1 for polices on climate. Others include:

1. County Sligo Development Plan 2017.
2. Air Quality in Ireland 2019, EPA (25 September 2020).
3. Statutory Instrument No 180 of 2011 (Air Quality Standards Regulations) transposes the Ambient Air Quality and Cleaner Air for Europe (CAFÉ) Directive (2008/50/EC) in Irish legislation. This sets limits for a large range of parameters.
4. Climate Action Plan 2019. The 2019 Climate Action Plan sets out a detailed sectoral roadmap, which is designed to deliver a cumulative reduction in emissions, over the period 2021 to 2030. The sectors targeted are electricity generation, buildings, transport, agriculture, enterprise & services and waste & the circular economy. The plan outlines 183 actions across these sectors, with responsibilities and clear timelines for delivery mapped out – see Section 1.1.

County Sligo Development Plan 2017

Chapter 10 (Environmental Quality) of the County Development Plan (2017) sets out a number of objectives and policies in relation to air (Section 10.2) and climate change (Section 10.6). It notes that the air quality in County Sligo is very high as there are few industries contributing to air pollution, and smoky coal use was banned in 2003. There is also movement of clean air across the county from westerly Atlantic winds.

Air quality policies are:

P-AQ-1: Support the ban on bituminous coal in Sligo City and Environs and encourage the use of smokeless fuel throughout the County.

P-AQ-2: In conjunction with the EPA, ensure that all existing and new developments are operated in a manner that does not contribute to deterioration in air quality.

P-AQ-3: Ensure all new and – where possible – existing developments incorporate appropriate measures to minimise odour nuisance from the development.

P-AQ-4: Promote the retention of trees, hedgerows and other vegetation, and encourage tree planting as a means of air purification and filtering of suspended particles

In relation to climate adaptation and mitigation polices as they relate to the Lackan Wind Farm, the polices of the Council are:

P-CAM-1: Support the implementation of the *National Climate Change Adaptation Framework 2012,* by including relevant measures in any forthcoming adaptation plans. Such plans shall be in accordance with national guidance issued by the DoECLG and EPA and undertaken in collaboration with the Northern and Western Regional Assembly, Mayo County Council, Roscommon County Council, Leitrim County Council and Donegal County Council.

P-CAM-2: Prepare a climate change adaptation strategy for County Sligo in compliance with national guidance and in consultation with all relevant stakeholders.

P-CAM-3: Raise public awareness and build local resilience in relation to climate adaptation.

P-CAM-4: Facilitate and assist County Sligo's transition to a low-carbon economy and society.

P-CAM-5: Promote, support and implement measures that reduce man-made GHGs, including energy management, energy efficiency, compact development patterns, low-carbon buildings and sustainable transport.

P-CAM-6: Consult and encourage partnerships with stakeholders when addressing climate change matters, particularly through the development plan process.

P-CAM-7: Promote and support the research and development of local renewable energy sources.

P-CAM-8: Promote and support the use of renewable energy in all sectors.

P-CAM-9: Support community participation in, and benefit from, renewable energy and energy efficiency projects.

P-CAM-10: Support local innovation, economic activity and job creation in the "green "economy by encouraging investment in products, services and technologies needed in a low carbon future.

<u>Air Quality Standards Regulations</u>

Statutory Instrument No 180 of 2011 (Air Quality Standards Regulations) transposes the Ambient Air Quality and Cleaner Air for Europe (CAFÉ) Directive (2008/50/EC) in Irish legislation. This sets limits on a wide range of air quality indicators, many of which are associated with burning of fossil fuels for energy production and also emission of greenhouse gases identified as being responsible for accelerating climate change, in particular carbon dioxide. Emissions of other chemicals, such as nitrous oxides (N_2O), sulphur dioxide (SO_2) and particular matter ($PM_{2.5}$ and PM_{10}). The current limits (to protect human health) for $PM_{2.5}$ are 20μg/m^3 (annual mean). The limits for PM_{10} are 50μg/m^3 (24-hour mean), not to be exceeded more than 35 times per year and 40 μg/m^3 (annual mean).

<u>Air Quality in Ireland</u>

This report sets out the air quality monitoring programme in Ireland, the air quality in Ireland, the pressures on good air quality, the impacts of poor air quality on human health and the possible solutions to improve air quality. The key findings of the report are:

1. Air quality in Ireland is generally good however there are localised issues in some cities, towns and villages
2. There was an exceedance of the EU annual average legal limit values in 2019 at one urban traffic station in Dublin due to pollution from transport.
3. Ireland was above World Health Organization air quality guidelines at 33 monitoring sites across the country – mostly due to the burning of solid fuel in cities, towns and villages.
4. Ireland was above the European Environment Agency reference level for PAH, a toxic chemical, at 4 monitoring sites due to the burning of solid fuel.
5. Particulate matter, from the burning of solid fuel, is estimated to cause 1,300 premature deaths per year.
6. Nitrogen dioxide (NO_2) from transport emissions is polluting urban areas.
7. Indications are that Ireland will exceed EU limit values for NO_2 at further monitoring stations in the future.

There are currently 102 air quality monitoring stations in the national network. The closest to the Lackan Wind Farm site is located in Sligo Town. The monitoring station has been offline since December 2021. The nearest operational monitoring station is located in Castlebar.

11.3 Local Climate

The nearest synoptic station to the Lackan Wind Farm is located in Knock Airport County Mayo, approximately 40km southeast of the site at an elevation of 200mOD. There are no 30-year averages available for this station. The next nearest station, for which 30-year average data is available, is Belmullet County Mayo. Table 9-1 gives a summary of average mean temperatures, humidity, rainfall etc. based on a 30-year period between 1981 and 2010 for Belmullet.

Table 11-1: Climatic Data from Belmullet Synoptic Station

Monthly And Annual Mean & Extreme Values 1981-2010													
	Jan	*Feb*	*Mar*	*Apr*	*May*	*Jun*	*Jul*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*	*Year*
TEMPERATURE *(degrees Celsius)*													
mean daily max.	8.9	9.1	10.4	12.2	14.6	16.2	17.6	17.8	16.5	13.7	11.0	9.2	13.1
mean daily min.	3.7	3.6	4.7	5.8	7.9	10.4	12.2	12.2	10.7	8.4	6.0	4.2	7.5
mean	6.3	6.4	7.6	9.0	11.2	13.3	14.9	15.0	13.6	11.1	8.5	6.7	10.3
absolute max.	13.9	15.1	19.5	24.4	26.6	27.0	29.9	27.7	25.4	20.1	16.3	14.9	29.9
absolute min.	-8.1	-5.4	-5.7	-2.1	0.2	1.4	5.1	3.1	0.8	-1.7	-4.5	-7.6	-8.1
mean no. of days with air frost	4.0	3.8	1.2	0.4	0.0	0.0	0.0	0.0	0.0	0.1	1.1	3.5	14.1
mean no. of days with ground frost	10.6	10.0	6.5	5.4	1.7	0.1	0.0	0.0	0.4	2.0	5.6	10.0	52.3
RELATIVE HUMIDITY *(%)*													
mean at 0900UTC	86.0	85.8	84.1	81.1	78.7	81.4	84.9	85.1	84.5	85.7	86.1	86.8	84.2
mean at 1500UTC	81.7	79.1	77.5	73.7	73.3	77.2	79.7	79.2	77.9	80.0	82.3	84.3	78.8

Monthly And Annual Mean & Extreme Values 1981-2010													
	Jan	*Feb*	*Mar*	*Apr*	*May*	*Jun*	*Jul*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*	*Year*
SUNSHINE ***(hours)***													
mean daily duration	1.4	2.3	3.1	5.2	6.1	5.2	4.4	4.4	4.0	2.8	1.6	1.2	3.5
greatest daily duration	8.3	9.6	11.6	14.1	15.5	15.9	15.1	13.9	12.1	10.4	8.2	7.2	15.9
mean no. of days with no sun	10.3	6.0	5.9	2.7	2.0	2.8	3.5	3.2	3.7	5.5	8.3	10.8	64.8
RAINFALL ***(mm)***													
mean monthly total	134.0	97.1	99.2	72.0	70.4	72.1	79.0	101.9	101.8	145.9	134.0	137.4	1244.8
greatest daily total	44.7	31.3	25.6	25.9	42.2	38.9	33.2	49.5	62.6	79.6	43.0	41.7	79.6
mean no. of days with >= 0.2mm	23	20	22	18	17	17	20	20	20	23	23	23	246
mean no. of days with >= 1.0mm	19	16	17	13	13	12	14	15	15	19	20	19	192
mean no. of days with >= 5.0mm	10	7	7	4	4	4	5	6	6	10	10	9	82
WIND ***(knots)***													
mean monthly speed	15.4	14.6	14.0	12.2	11.6	11.4	11.1	11.2	12.0	13.3	13.3	13.8	12.8
max. gust	94	93	88	75	66	63	67	56	73	73	80	93	94
max. mean 10-minute speed	55	60	58	43	42	45	45	40	50	52	47	59	60
mean no. of days with gales	7.0	4.8	3.1	1.4	0.9	0.2	0.2	0.4	1.5	2.6	3.1	4.4	29.6
WEATHER ***(mean no. of days with..)***													
snow or sleet	4.5	4.2	3.1	1.4	0.1	0.0	0.0	0.0	0.0	0.0	0.9	3.0	17.3
snow lying at 0900UTC	0.4	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.8	1.6
hail	9.2	7.8	7.4	4.4	1.7	0.1	0.0	0.1	0.5	3.3	5.6	7.5	47.7
thunder	1.1	0.7	0.6	0.4	0.5	0.5	0.6	0.6	0.3	0.6	0.5	0.9	7.2
fog	1.0	0.4	0.9	1.4	1.4	1.7	2.9	1.9	1.2	0.7	0.9	0.7	15.1

In addition, there are rainfall gauge stations located in Inishcrone, Ballina, Lisglennon and Easky. The station at Easky didn't record data for the second half of 2021. The nearest rain gauge station is located at Inishcrone golf course approximately 4km to the southwest. Table 11-2 gives a summary of monthly rainfalls for each station for 2021.

Table 11-2: Monthly and Annual Rainfall Averages (mm) for 1981-2010

Month	**Rain Gauge Station**			
	Inishcrone	**Ballina Golf Club**	**Lisglennon Waterworks**	**Easky**
January	137.4	153.2	158.9	160.2
February	79.8	89.7	86.3	60.3
March	124.4	106.8	100.0	110.3
April	54.3	51.0	41.8	57.4
May	88.3	105.1	94.5	101.8
June	49.2	39.0	39.5	55.3
July	105.2	99.8	107.8	84.5
August	121.7	121.8	113.9	---
September	103.1	115.2	85.8	---
October	150.3	166.4	181.2	---
November	92.0	82.1	95.7	---
December	116.3	110.6	118.3	---
Total	**1,222**	**1,240.7**	**1,223.7**	**---**

As shown in Table 11-2, the rainfall recorded in west county Sligo and east County Mayo is approximately 1,230 mm/year. The 30-year (1981 to 2010) rainfall 1km x 1km grid data available from Met Eireann indicates a rainfall of 1,138mm/year.

Data published in the SEAI wind speed atlas of Ireland indicates mean wind speeds of approximately 8.0m/sec across the site at 75m height above ground.

11.3.1 Air Quality

The EPA's Air Quality Index for Health (AQIH) for Ireland provides an indicator of air quality across the Country. Lackan Wind Farm is located in Zone D (Rural Ireland, i.e. the remainder of the State excluding Zones A (Dublin), B (Cork) and C (other cities & large towns)). It is located in Air Quality Index Region Zone 80 of Region 6 (Rural West) and has an air-quality index of 3 Good). The AQIH has a scale of 1 to 10, with 1 being Good air quality and 10 being Very Poor air quality. The AQIH is based on the measurement of five parameters. Table 11-3 lists the parameters and the range for Good air quality with an index score of 1 to 3.

Table 11-3: Good Air Quality Index Concentrations

Parameter	Units	Index 1	Index 2	Index 3
Ozone gas	$\mu g/m^3$ (8-hour mean)	0 – 33	34 – 66	67 – 100
Nitrogen dioxide gas	$\mu g/m^3$ (1-hour mean)	0 – 67	68 – 134	135 – 200
Sulphur dioxide gas	$\mu g/m^3$ (1-hour mean)	0 – 29	30 – 59	60 – 89
$PM_{2.5}$ particles	$\mu g/m^3$ (24-hour mean)	0 - 11	12 – 35	24 - 35
PM_{10} particles	$\mu g/m^3$ (24-hour mean)	0 - 16	34 - 50	34 - 50

Note
1. The highest (worse) concentration of any one of the five parameters determines the air quality index.

The EPA maintain a network of ambient air quality monitoring sites across the Country, most of which are in urban environments. The closest to the site is in Sligo Town. It was commissioned in June 2020. Monitoring is carried out using continuous monitors for nitrogen dioxide and particulates ($PM_{2.5}$ and PM_{10}). It has been offline since December 2021.

11.3.2 Potential Sources of Air Pollution

According to the EPA web-mapping, there are no licensed activities or industries near the Lackan Wind Farm (within 5km) that have any significant contribution to pressures on air quality. There are a number of quarries in the wider area, as listed in Chapter 8. Quarries can contribute to PM_{10} and $PM_{2.5}$ particulates in the air, however, these are too distant from the Lackan site to affect local air quality.

11.4 Impacts Assessment

11.4.1 Do-Nothing Scenario

In the 'do-nothing' scenario, the wind farm will continue to operate with the benefit of the existing planning permission until October 2023, after which it would need to be decommissioned and the site returned to low-intensity grazing. After this time, and at least in the short term, the electricity it would have generated over the additional 12 years will likely be generated from fossil fuels, and the opportunity to avoid pollutant emissions missed.

11.4.2 Construction Phase

As the site is already constructed and operational, there are no construction related impacts.

11.4.3 Operation Phase

The continued operation of the wind farm for an additional 12 years will displace fossil fuel electricity generation, which is oil and gas; coal and peat powered generating plants have been closed or are scheduled to close in Ireland. Each year, for every megawatt of energy that displaces fossil fuel power production, environmental, economic and social benefits include:

- Clean electricity to meet the electricity needs of 650 homes
- Removes the need to import 6,450 barrels of oil
- The avoidance of 2,700 tonnes of CO_2
- The avoidance of 49 tonnes of SO_2
- The avoidance of 5.5 tonnes of NO_x
- The avoidance of 175 tonnes of slag and ash for landfill

The Lackan Wind Farm, with an installed capacity 6MW will result in a net savings in emissions of:

- Clean electricity to meet the electricity needs of 3,900 homes.
- Removes the need to import 38,700 barrels of oil.
- The avoidance of 16,200 tonnes of CO_2.
- The avoidance of 294 tonnes of SO_2.
- The avoidance of 33 tonnes of NOx.
- The avoidance of 1,050 tonnes of slag and ash for landfill.

The Lackan Wind Farm will therefore continue to have an indirect long-term positive effect on climate.

11.4.4 Decommissioning Phase

Potential impacts on air quality and climate during decommission include:

1. Emissions associated with the earthworks during the decommissioning phase of the project including:
    a. Dust emissions from vehicle movements. In dry windy weather, vehicle movements will give rise to fugitive dust emissions. The site is coastal and exposed to wind from most directions, so wind-borne dust emissions are likely to occur. Indirect impacts include staining of vegetation, deposition in adjacent watercourses and soiling of roads. Respirable dust fractions (i.e., below 10µm-diameter) potentially effect respiratory and cardiovascular systems. Unmitigated, windblown dust emissions during decommissioning earthworks would be a slight temporary intermittent localised negative impact.
    b. Exhaust emissions from transport and site plant. Turbine components will be taken offsite with large haulage vehicles. There will also be several machines used on site during decommissioning –excavating, disassembling turbines etc. These vehicles emit exhaust fumes, including carbon dioxide and particulate matter. Unmitigated, this would result in an imperceptible short-term local negative impact.
    c. Excavation of peaty topsoil for the restoration of tracks and hardstands. Peat excavated during the construction phase will be reused to restore tracks and hardstand. Peat is an organic soil which stores carbon. Its excavation can lead to drying out and release of carbon to the atmosphere. Unmitigated, this is an imperceptible permanent localised negative impact. Clean topsoil may also be brought to site for this purpose.

11.4.5 Cumulative Impacts

There are several operational and permitted wind farms is County Sligo. However, none are located within 10km of the Lackan Wind Farm.

11.5 Mitigation Measures

The avoidance and mitigation measures for the operational and decommissioning phases are presented in the subsections below.

11.5.1 Operational Phase

The continued operation of the wind farm is not expected to have any negative impact on the climate of the area. The wind farm will generate electricity that would otherwise be generated by fossil fuel burning power stations. There are no atmospheric emissions (greenhouse gases and other pollutants) from wind energy generation.

The change in Ireland's climate has been identified as one of the most serious environmental problems that Ireland faces at present. The release of greenhouse gases such as CO_2 from the burning of fossil fuels is a known contributor to climate change. Wind energy avoids the emissions of nitrogen oxides, sulphur dioxide and carbon dioxide.

The wind farm has an installed capacity of 6MW. This capacity would otherwise be provided by carbon intensive technologies, such as fossil fuel burning power stations. Its continued use for a further 12 years will avoid the release of greenhouse gases to the atmosphere.

No mitigation measures are required for the operational phase.

11.5.2 Decommissioning Phase

To minimise impacts on air quality during the decommissioning phase the following mitigation will be implemented:

1. All plant and machinery will be kept in good working order.
2. All plant and machinery will be turned off when not in use.
3. In dry windy weather, dust suppression will be carried out to prevent fugitive dust emissions.
4. Clean soils will be imported to site for restoration if available rather than disturbing in-situ peaty topsoil.
5. Reseeding of exposed soils will be carried out on an ongoing basis so that soils exposed to wind erosion are kept to a minimum.
6. A speed limit of 15kph will be enforced on site roads.
7. The public roads adjacent to the site will be kept in a clean condition. They will be swept when necessary.
8. All component parts removed from site will be reused or recycled as far as possible.

12 LAND

12.1 Introduction

This chapter of the EIAR addresses land use in the existing environment, the potential direct and indirect impacts of the continued operation of the wind farm and grid connection on land use, and the proposed mitigation measures to avoid or reduce potential impacts. It was prepared by Keohane Geological & Environmental Consultancy.

A full description of the development is provided in Chapter 2. In summary the development consists of an operational wind farm with 3 No. turbines, access tracks, hardstands, control building and grid connection. The assessment addresses the extension of the permitted development for an additional 12 years.

12.2 Methodology

The methodology used in the preparation of this chapter is outlined as follows:

1. A desk-based review of the land uses in the vicinity of the site was carried out using aerial photography, Corine (2018) land use maps available on EPA Maps.
2. Surveys carried out during site visits in 2022. This included windscreen surveys and site walkover.
3. Review of other chapters of this EIAR where other aspects of the environment cross-cut and interact with land use, such as soils & geology, and biodiversity.

12.3 Current Land Use

The landholding covers approximately 15.51ha of low-lying coastal grassland. As discussed in Chapter 8 (Soil, Geology & Hydrogeology), the soil assemblages consist mainly of tills with small pockets of peat developed. According to An Foras Taluntais (now Teagasc) report[70], the principal soil type found at the site is degraded grey, brown podzolics (50%) of the Flat to Undulation Lowland physiographic division. Associated soils are peat (15%), brown earths (15%), gleys (10%) and podzols (5%). The parent material is mostly limestone glacial till. This soil type covers approximately 3.08% of the country (excluding major lake and urban areas), approximately 210,577ha.

The use range for this soil type, and associated peats, gleys and podzols, is limited. Its use is typically limited to grassland, with relatively small areas cultivated. The Corine land use mapping (2018) (EPA web-mapping) shows the site as agricultural pastures. The current land uses at the site are grazing and the wind farm itself. The 2018 Corrine land use mapping indicates that the coastal plain of Sligo is in pasture.

The surrounding land use is dominated by agricultural grassland with small stands (2ha to 5ha, typically) of commercial forestry.

The site is not contained within any designated nature sites, including National Heritage Area (NHA), Special Area of Conservation (SAC), or Special Protection Area (SPA). The nearest designated site is Killala Bay/Moy Estuary Special Protection Area, located approximately 3.2km southwest of the site.

There are no hospitals, schools, hotels or guesthouses within 1km of the site. Figure 2-3 shows the 40 dwellings located within 1km of the turbines. The nearest centre of population to the site is Kilglass, located approximately 1km to the east. Inishcrone is the closest town, located approximately 3.5km to the southwest.

12.4 Impacts Assessment

The Lackan Wind Farm is located in a rural coastal landscape. The wind farm has been operational since 2007. It consists of tracks, hardstands, turbines and control building. This infrastructure has a footprint of approximately 0.7ha. This makes up approximately 4.5% of the landbank. Approximately 0.5ha of this would be restored on the decommissioning of the wind farm. Extending the operational lifespan of the wind farm would delay the restoration of this area by a further 12 years. This is an imperceptible long-term negative impact with respect to land take. However, this on-going land take will facilitate a significant long-term positive impact with respect to the continued land use diversification.

With respect to recreation and tourism, there is no evidence to suggest that wind farms deter tourists. The amenity of the site will not be adversely affected. Indeed, many wind farms have an important educational role, and are themselves, tourist attractions. Directors of the wind farm have facilitated school tours to the wind farm for educational purposes. As discussed in Section 1.4, Fáilte Ireland and the Northern Ireland Tourist Board carried out a visitor survey on the attitudes of tourists to wind energy projects[41]. The majority of the respondents perceived wind farms as a positive. This is discussed in Chapters 1 and 4. Inishcrone remains a significant destination village for tourist with multiple attractions including the beaches, water sports, walks, golf course, angling, restaurants and spas. It is a listed stop along the Wild Atlantic Way, which has been developed and marketed since the Lackan Wind Farm was commissioned.

The amenity of the beach walks adjacent to the site have not been adversely affected by the wind farm. While there are no designated walking routes through or near the site, walkers do use the beach / coastal protection dyke adjacent to the site. This has not been affected by the wind farm, nor will it be by its extended operational lifespan.

The land use of the site will continue to be diversified and, for the landowners, is considered a long-term moderate positive impact.

The impacts would largely be reversed with the decommissioning of the wind farm. Some of the site would be restored and returned to the original land use. The extent of this would depend on the final restoration proposals for the site – refer to Section 2.6. Some of the tracks would be retained for agricultural use. It is also possible that the control building, and grid connection would remain, integrating into the local distribution network.

12.4.1 Do-Nothing Scenario

In the 'do-nothing' scenario, the wind farm will continue to operate with the benefit of the existing planning permission until October 2023, after which it would need to be decommissioned and the site returned to low-intensity grazing.

12.4.2 Cumulative Impacts

No cumulative impact on land use is envisaged with other projects.

12.5 Mitigation Measures for Land Use

A small area within the landholding has been developed for the wind farm. The remaining lands are still in agricultural use. No mitigation is needed for land use during the extended operational period. Upon decommissioning much of the infrastructure will be removed and most of the development footprint will be restored to agricultural use.

12.6 Conclusions on Land Use

The land uses on the site and within 1km of the site boundary include grazing and forestry. Extending the operational lifespan of the wind farm will not have a significant impact on any of these land uses. Its extension will provide continued diversification of the land use for the landowners, in otherwise low productivity lands, and is seen as a positive impact.

13 MATERIAL ASSETS

13.1 Introduction

This chapter of the EIAR addresses material assets in the existing environment, the potential direct and indirect impacts of the continued operation of the wind farm and grid connection on material assets, and the proposed mitigation measures to avoid or reduce potential impacts. The material asset of roads / transport infrastructure is addressed separately in Chapter 6. It was prepared by Keohane Geological & Environmental Consultancy.

A full description of the development is provided in Chapter 2. In summary the development consists of an operational wind farm with 3 No. turbines, access tracks, hardstands, control building and grid connection. The assessment addresses the extension of the permitted development for an additional 12 years.

13.2 Methodology

A desk-based assessment was carried out to identify the material assets at and near the site. Windscreen surveys were then carried out to confirm the information gathered during the desk-based exercise. Stakeholders of the material assets identified where contacted about the project to determine any potential impacts on their assets.

13.3 Material Assets in Existing Environment

Material assets in the existing environment can be considered to include built services and infrastructure including electricity infrastructure, roads, utilities, and telecommunications. The Lackan Wind Farm can be considered a material asset. As noted, roads and traffic are discussed separately in Chapter 6. Natural resources could include groundwater resources, quarrying / mining potential and wind resource. Groundwater resources and quarrying / mining potential are discussed in Chapter 8.

13.3.1 Electricity Transmission / Distribution Infrastructure

There is a 20kV grid connection installed for the Lackan Wind Farm, consisting of a combination of underground cabling and overhead powerline. This is an ESB asset, linking the wind farm to Inishcrone 38kV substation. The wind farm grid connection is shown on Figure 2-1. The local 10kV overhead distribution system services the houses, businesses, and farms in the area. These lines generally follow the road network.

As discussed in Chapter 1, Government targets for electricity generation from renewables require additional renewable capacity to be installed / maintained. The installation of renewable capacity, including Lackan Wind Farm, required strengthening of the transmission and distribution networks.

13.3.2 Utilities

The immediate area is not serviced by mains sewer. Individual wastewater treatment units are used. Inishcrone has a municipal wastewater treatment plant. The area is serviced by main waters, but it is likely that private wells are also used, although not included in the GSI database – refer to Section 8.2.5.

13.3.3 Telecommunications

The telecommunication infrastructure in the area includes:

- Truskmore main TV/FM transmission station – 47km west-northwest of Lackan
- Ballintrillick, Sligo regional studio – 46km northeast of Lackan
- Finisklin, Industrial Estate, Sligo – 37km east of Lackan
- Castlebar TV/FM transposer station – 47km south of Lackan
- Lough Talt Community Scheme (Self-help) antenna

Service providers have indicated that the wind farm does not interfere with their services.

13.3.4 Wind Energy Resource

Wind energy has the following attributes:

- It is the country's biggest energy resource.
- It is clean, renewable and sustainable as a means of electricity generation.
- It is a cost-effective energy options for reducing global warming.
- The operation of a wind farm has practically zero emissions.

The Lackan Wind Farm is located in an exposed coastal area, with good wind speeds, averaging approximately 8m/sec at 75m height above ground. With an installed capacity of 6MW, the Lackan Wind Farm contributes approximately 20GWhr of renewable energy generation per annum.

13.4 Impacts Assessment

Extending the operational lifespan of the Lackan Wind Farm by a further 12 years will have positive and negative impacts on the material assets in the receiving environment.

13.4.1 Electromagnetic Interference

The rotating blades of a wind turbine may occasionally cause interference to electro-magnetically-propagated signals. Such interference can, in theory, have an impact on all forms of electromagnetic communications as follows:

- Satellite communications
- RADAR
- Cellular radio communications
- Aircraft instrument landing systems
- Terrestrial microwave links
- Television broadcasts.

Interference to a communication system that is based on the propagation of electromagnetic waves can be of a number of forms:

- Electromagnetic Interference (EMI) that emanates from the turbines.
- Signal scattering results from the obstruction presented by the blades, an effect that mimics the presence of a lower power source that operates from the location of the wind turbine.
- Signal obstruction as it passes through the area swept by the rotating blade.

Interference from Turbines
An electric generator or motor will generate electromagnetic energy that will be propagated in the vicinity of the machine. A wind turbine operates in the same manner. Wind turbines are required to be tested prior to sale. The test ensures that it meets the required European standard with regard to level of emissions (EN 55011 - Industrial, Scientific and Medical Equipment. Radio-Frequency Disturbance Characteristics. Limits and Methods of Measurement, 2016+A2:2021) and immunity to interference (EN 61000, Electromagnetic Compatibility (EMC) – multi part document). Electromagnetic interference has not been an issue for the Lackan Wind Farm.

Signal Scattering
Large wind turbines can act as sources of re-radiation. They produce delayed 'ghost' signals that are altered in amplitude by the rotation of the blades. The amplitude of the re-radiated signals is greatest when the plane in which the blades rotate is orientated so that the angle of incidence, and reflection are equal. This is called the 'specular reflection' condition. Specular reflection may occur for some proportion of the time, as the blade of the wind turbine will turn into the wind about a vertical axis.

Signal Obstruction
Wind turbines obstruct the path of the wanted signal and therefore reduce the signals strength. This obstruction occurs when the turbine turns through 90º as a result of the specular reflection condition. This effect is less significant than the generation of delayed signals that cause picture degradation. This effect needs to be avoided in the case of point-to-point networks.

Assessment
A number of telecommunication companies were contacted for the Lackan Wind Farm including:

– Irish Aviation Authority	– Radio Teilifis Eireann
– Vodafone	– An Garda Siochana - ICT Department
– Cellnex	– Netshare
– Tetra	

None of the above consultees indicated that the wind farm has caused any interference with their communications. They expressed no concern for the extended lifespan of the wind farm operation.

13.4.2 Electricity Transmission / Distribution Infrastructure

The wind farm is connected to the Inishcrone 38kV substation. Embedded generation, such as wind farms, strengthen the local network. No impacts are predicted for the extended operational lifespan of the wind farm.

13.4.3 Wind Resource

In addition to reducing harmful atmospheric emissions, wind energy is an indigenous, secure and sustainable resource in contrast to fossil fuels, which are ultimately unsustainable. Current rates of use of fossil fuels (coal, oil, and gas) are 300,000 times greater than the rate at which these fuels are naturally created. The continued use of this wind energy resource slows down this depletion, providing an alternative power source.

The wind farm is making effective use of an exposed coastal site on land presently used for low intensity grazing. The local climatic conditions are very suitable for such development (refer to Chapter 11). The local wind resource can be considered a material asset, which is being harnessed. The wind farm, with an installed capacity of 6MW, has an annual output of approximately 20GWhr, enough to power approximately 3,000 homes. This is a long-term moderate regional positive impact.

13.5 Mitigation Measures

Following consultation with the carriers in the area, no interference with the networks is occurring or predicted in the future. The RTE (2rn) protocol has been signed, which commits Lackan Wind Energy Ltd to install infrastructure to rectify interference with its broadcasts' reception. No further mitigation is deemed necessary.

13.6 Conclusions on Material Assets

Wind energy is one of Ireland's largest, commercially viable energy resources, and is also a clean, renewable, and sustainable means of electricity generation. The extended lifespan of the Lackan Wind Farm will maintain this 'green' electricity resource, without compromising other natural resources in the area. No interference with telecommunication network is predicted. The overall impact of the wind farm on the material assets of the area is therefore positive.

The local telecommunication providers that have responded to the information pack provided to them have indicated that the wind farm is not interfering with their telecommunication signals, and do not expect any interference in the future.

14 INTERACTION OF THE FOREGOING

The impacts of the development have been assessed for the various aspects of the environment, as discussed in the preceding chapters. While these assessments are not conducted in isolation, their focus is on the specific aspect of the environment under consideration. This chapter reviews all the aspects of the environment and identifies interactions between them. Table 14-1 summarises the interactions for both the extended operational phase (O) and decommissioning phase (D) of the wind farm. Each aspect of the environment is listed on the left column and the top row. The interactions are discussed in terms of the impacts associated with the aspect of the environment listed in the column with the aspects of the environment listed across the top row. For example, the impacts of the wind farm associated with landscape are discussed in terms of their interaction with each of the other aspects of the environment. The interaction is therefore not necessarily reciprocal.

Table 14-1: Interaction Matrix

	Phase	Landscape	Noise	Population	Traffic	Soils & Geology	Water	Climate	Cultural Heritage	Ecology	Avian Ecology	Material Assets	Electromagnetic Interference
Landscape	O			Neutral					Neutral				
	D			Positive					Positive				
Noise	O			Neutral						Neutral	Neutral		
	D			Negative						Negative	Negative		
Population	O												
	D												
Traffic	O												
	D	Negative	Negative	Negative				Negative		Negative			
Soils & Geology	O												
	D												
Water	O												
	D					Negative				Negative			
Climate	O			Positive		Positive	Positive			Positive	Positive		
	D												
Cultural Heritage	O												
	D												
Ecology	O												
	D					Positive	Positive				Negative		
Avian Ecology	O												
	D												
Material Assets	O			Positive									
	D				Negative								
Electromagnetic Interference	O												
	D												

Legend

- No Significant Interaction
- Negative Interacting Impact
- Positive Interacting Impact
- Neutral Interacting Impact

14.1 Impact Interactions

14.1.1 Landscape

The landscape impacts associated with the wind farm on the population is subjective. Some people dislike turbines, while others view them positively. For this reason, the interaction is shown as being neutral.

Archaeological features across a landscape can sometimes be connected by line of slight, with some significance attached to that connection. These features existing in an archaeological landscape rather than isolated individual features. In these circumstances, turbines could interrupt that connectivity. There are also views of the wind farm from the promontory fort. There has been no such connectivity established for the area around the site. As such a neutral interaction is assigned.

14.1.2 Noise

Noise is one of the aspects of the environment considered in terms of its impact on the population. Noise from the turbines is audible but is within the emission limit values set out in the planning conditions. It is unlikely to change during the extended lifespan of the wind farm, so is considered neutral. The decommissioning will result in short-term increase noises, but a reduction in noise with the decommissioning of the turbines, so is deemed a positive interaction.

Noise during decommissioning may deter wildlife from using the site. Wildlife usage of the site returns to normal post decommissioning.

14.1.3 Population

Population is discussed in terms of settlement pattern, shadow flicker and recreation and amenity. These aspects of the discussion do not have any significant interaction with other aspects of the environment.

14.1.4 Traffic

The traffic associated with the extended operation phase will remain largely unchanged from current levels. No significant interaction is predicted with other aspects of the environment during the operational phase.

There will be an increase in traffic for a short period of time during the decommissioning phase. Additional HGV traffic during decommissioning will have a temporary negative impact on the landscape, in terms of HGV movements; it will increase traffic noise on the roads leading to the site; it will increase dust and emissions associated with HGVs and therefore impact air quality; it will have a negative interaction (inconvenience) with local road users; and will temporarily displace wildlife using the site.

14.1.5 Soils & Geology

No significant interactions are predicted with other aspects of the environment during the operational or decommissioning phases.

14.1.6 Water

No significant interactions are predicted with other aspects of the environment during the operational phase.

During the decommissioning phase there is a potential negative interaction with soil & geology, and ecology if runoff water erodes exposed soils and carries silt to the streams draining the site.

14.1.7 Climate

The generation of electricity from clean renewable sources during the extended operational period of the wind farm will have positive impacts on a number of other aspects of the environment, including:

- Offsetting the production of greenhouses gases thereby slowing the rate of climate change and its negative impact on human beings.
- Climate change is predicted to result in more extreme weather events in Ireland, which will result in erosion of soils and more frequent and severe flooding events. Again, offsetting the production of greenhouse gases will have positive interactions for human beings, soils, hydrology and ecology.

No significant interactions are predicted with other aspects of the environment during the decommissioning phase.

14.1.8 Cultural Heritage

No negative impacts are predicted for archaeology and cultural heritage. Hence, there are no interactions envisaged on the other aspects of the environment either during the extended operational phase or decommissioning phase.

14.1.9 Biodiversity

No significant impacts are predicted for the extended operational period of the wind farm. As such, no significant interactions are predicted with other aspects of the environment.

The return of the site to predevelopment habitats during decommissioning will have a slight positive impact on landscape.

The return of vegetation over site infrastructure will decrease (marginally) erosion of soils and potential to carry silt to the streams draining the site.

The displacement of wildlife during the decommissioning phase may have a negative knock-on effect for avian fauna using the site for foraging.

14.1.10 Avian Ecology

The impacts associated with avian fauna are not predicted to have any significant interaction with other aspects of the environment. The temporary displacement of raptors from the site during decommissioning could increase the numbers of prey species, but for this short period, this is considered insignificant.

14.1.11 Material Assets

Impacts on material assets and their interaction occur during both the operational phase and decommissioning phase. The alternative use of the land resource has a positive impact for the landowners involved during the operational phase of the wind farm.

During decommissioning, there will be an increase in traffic which will have a negative interaction with the roads, as considered a physical material asset. The removal of the turbines would also result in decreased rates payments to the local authority which are used for the maintenance of these roads.

14.1.12 Electromagnetic Interference

Electromagnetic interference is not expected to be an issue during either the operational or decommissioning phases. As such, no significant interactions are predicted with other aspects of the environment.

14.2 Conclusions on the Interaction of the Foregoing

The interactions of all environmental factors indicate an overall positive development capable of continuing to provide a clean, renewable and sustainable energy source for the region. The main impacts have been discussed in the preceding chapters and appropriate remedial measures are presented where necessary. The extended operational period of the Lackan Wind Farm will have no significant impact on the environment.

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