5. POPULATION AND HUMAN HEALTH

5.1 Introduction

This section of the Environmental Impact Assessment Report (EIAR) identifies, describes and assesses the potential effects of the Proposed Development on population and human health and has been completed in accordance with the EIA guidance and legislation set out in Chapter 1: Introduction. The full description of the Proposed Development is provided in Chapter 4 of this EIAR.

One of the principal concerns in the development process is that human beings, as individuals or communities, should experience no significant diminution in their quality of life from the direct, indirect or cumulative effects arising from the construction, operation and decommissioning of a development. Ultimately, all the impacts of a development impinge on human beings, directly and indirectly, positively and negatively. The key issues examined in this chapter of the EIAR include population, human health, employment and economic activity, land-use, residential amenity, community facilities and services, tourism, property values, shadow flicker, noise, and health and safety.

There are 67 properties located within 1.5 kilometre of the proposed turbine locations with 18 of those properties participating in the Proposed Development. The closest occupied dwelling is located approximately 700 metres from the nearest proposed turbine location (T3). There is a derelict property that is located approximately 528m from the nearest proposed turbine location (T2). Of the 67 no. properties located within 1.5 kilometres of the proposed turbines, 61 are dwellings (including 14 participating properties) and 6 are derelict.

5.1.1 Statement of Authority

This section of the EIAR has been prepared by Ellen Costello and Eoin O'Sullivan and reviewed by Michael Watson, of MKO. Ellen is an Environmental Scientist who joined the company in 2019 and has been involved in a number of wind energy EIAR applications. Ellen holds a BSc. in Earth Science and a MSc. in Climate Change: Integrated Environmental and Social Science Aspects where she focused on renewable energy development in Ireland and its implications on environment and society. Eoin is an experienced geo-environmental scientist and has over ten years' experience in the design, implementation and interpretation of all phases of geo-environmental and geotechnical site investigations. Eoin has also got extensive experience in the preparation of population and human health assessments and reports for EIAs. Eoin is also proficient in undertaking detailed quantitative risk assessments for the protection of controlled waters and human health. Eoin holds an MSc in Environmental Engineering and is a Chartered Member of the Chartered Institute of Water and Environmental Management (CWEM) and Chartered Environmentalist (CEnv) with the Society of Environment. Michael Watson is a Project Director with MKO; with over 19 years' experience in the environmental sector. His project experience includes the management and productions of Environmental Impact Statements (EISs)/EIARs, particularly within the wind energy sector.

5.2 Population

5.2.1 Receiving Environment

This socio-economic study of the receiving environment included an examination of the population and employment characteristics of the area. Information regarding population and general socio-economic data were sourced from the Central Statistics Office (CSO), the Clare County Development Plan 2017 – 2023, Fáilte Ireland and any other literature pertinent to the area. The study included an examination of the population and employment characteristics of the area. This information was sourced from the Census of Ireland 2016, which is the most recent census for which a complete dataset is available, also the Census of Ireland 2011, the Census of Agriculture 2010 and from the CSO website (www.cso.ie). Census information is divided into State, Provincial, County, Major Town and District Electoral Division (DED) level.

The Proposed Development is located approximately 5 kilometres to the east of Miltown Malbay and approximately 7 kilometres to the south of Ennistimon Co. Clare. The Proposed Development is accessed via an existing access track off the local road to the northwest of the site. The site itself is served by a number of existing forestry and agricultural roads and tracks. Please refer to Figure 1-1 of Chapter 1: Introduction, for the site location.

In order to assess the population in the vicinity of the Proposed Development, the Study Area for the Population section of this EIAR was defined in terms of the District Electoral Divisions (DEDs) where the Proposed Development is located, and where relevant, nearby DEDs which may be affected by the Proposed Development. The Proposed Development lies within five DEDs: Annagh, Ballyvaskin, Moy, Cloonanaha, and Formoyle, as shown in Figure 5-1. All five of these DEDs will collectively be referred to hereafter as the Study Area for this chapter.

The Study Area has a population of 2,074 persons, as of 2016 and comprises a total land area of 123.26 km^2 (Source: CSO Census of the Population 2016). In order to assess the population along the underground cable route, a review of properties and planning applications in the vicinity of the proposed underground cable route was carried out. The active construction area for the underground cable route will be small, ranging from 150 to 300 metres in length at any one time, and it will be transient in nature as it moves along the route. Should separate crews be used during the construction phase they will generally be separated by one to two kilometres. The findings of the population review indicated that where development occurs along the route, the lands nearby comprise farm dwellings and associated farm buildings and thus the population is very sparse. The land-use along the underground cable route comprises commercial forestry, agriculture and public roads.

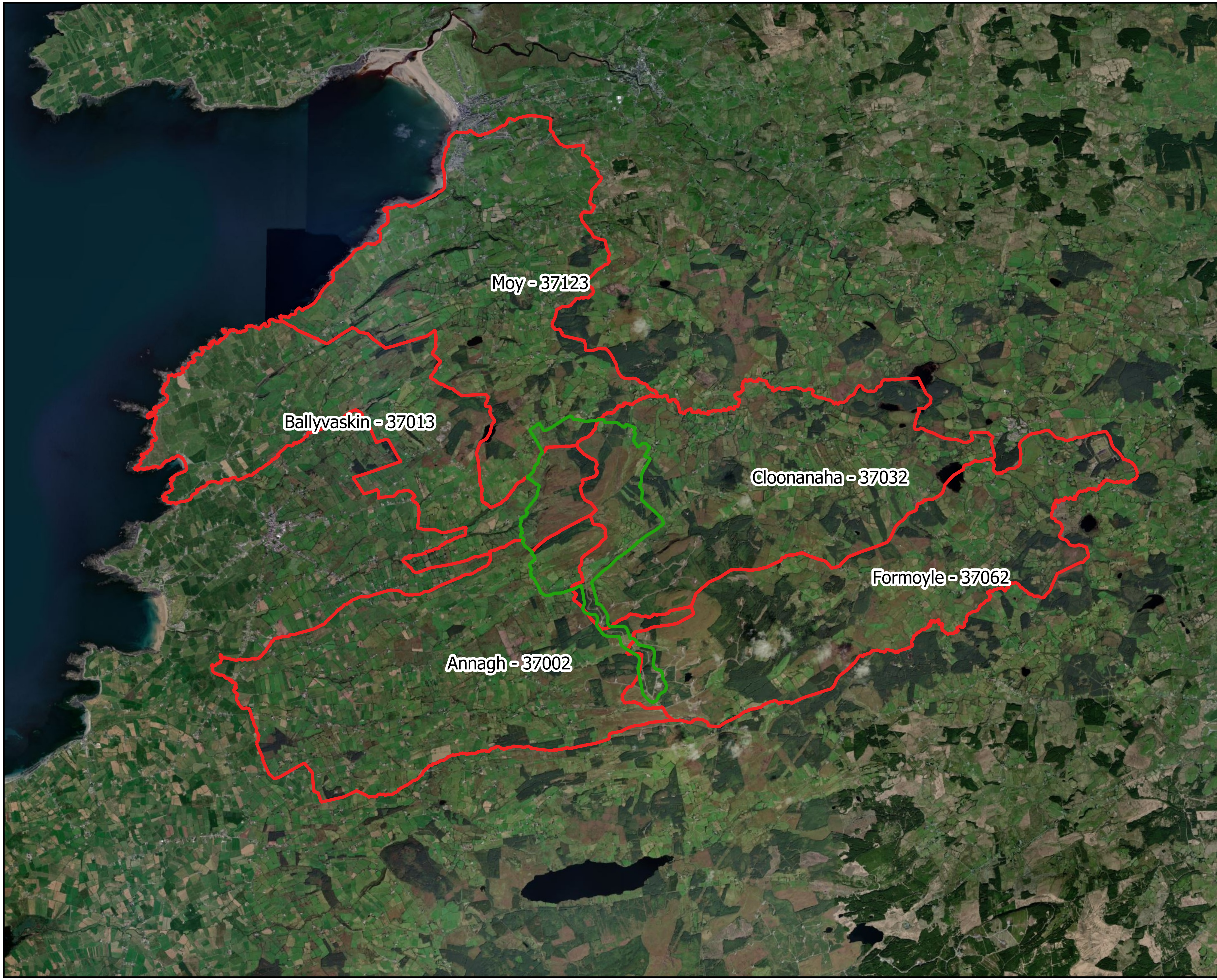
5.2.2 Population Trends

In the period between the 2011 and the 2016 Census, the population of Ireland increased by 3.8%. During this time, the population of County Clare grew by 1.4% to 118,817 persons. Other population statistics for the State, County Clare and the Study Area have been obtained from the Central Statistics Office (CSO) and are presented in Table 5-1.

Table 5-1 Population 2011 – 2016 (Source: CSO)

Area	Population Change		% Population Change
	2011	2016	2011 - 2016
State	4,588,252	4,761,865	3.8%
County Clare	117,196	118,817	1.4%
Study Area	2061	2074	0.6%

The data presented in Table 5-1 shows that the population of the Study Area increased by 0.6% between 2011 and 2016. There is a small increase in population growth for the Study Area and the population growth rate is lower than that of the County. When the population data is examined in closer detail, it shows that the rate of population increase within the Study Area is unevenly spread through the District Electoral Divisions (DEDs). Moy DED is the only division to have shown an increase in population, experiencing a 7.3% growth in population while the four other DEDs experienced a decline in population.



Map Legend

- Study Area DEDs
- EIAR Site Boundary

Drawing Title	
Population Study Area	
Project Title	
Slieveacurry Renewable Energy Development, Co. Clare	
Drawn By: EC	Checked By: MW
Project No.: 170224c	Drawing No.: Figure 5-1
Scale: 1:100000	Date: 29.10.2021

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Annagh (DED) experienced a population decline of 0.8%, Ballyvaskin (DED) experienced a population decline of 2%, Cloonanaha (DED) experienced a population decline of 5.3% and Formoyle (DED) experienced a population decline of 3.2%. Of the DEDs that make up the Study Area for this assessment, the highest population was recorded in Moy DED, with 692 persons recorded during the 2016 Census, while the population for Annagh was 504, Ballyvaskin was 399, Cloonanaha was 267 and Formoyle was 212.

5.2.3 Population Density

The population densities recorded within the State, County Clare and the Study Area during the 2011 and 2016 Census are shown in Table 5-2.

Table 5-2 Population Density in 2011 and 2016 (Source: CSO)

Area	Population Density (Persons per square kilometre)	
	2011	2016
State	67.49	70.05
County Clare	33.97	34.44
Study Area	16.72	16.83

The population density of the Study Area recorded during the 2016 Census was 16.83 persons per km^2. This figure is significantly lower than the national population density of 70.05 persons per km^2 and the county population density of 34.44 persons per km^2. These findings indicate that the study area has a low population density.

Similar to the trends observed in population, the population density recorded across the Study Area site varies between DEDs. Formoyle DED has the lowest population density, at 8.8 persons per km^2, while Cloonanaha DED has a slightly higher population density at 10.4 persons per km^2, Annagh DED has a population density of 17.9 persons per km^2, Ballyvaskin DED has a population density of 19.2 persons per km^2, and Moy DED has the highest population density, at 27 persons per km^2.

5.2.4 Household Statistics

The number of households and average household size recorded within the State, County Clare and the Study Area during the 2011 and 2016 Censuses are shown in Table 5-3.

Table 5-3 Number of Household and Average Household Size 2011 – 2016 (Source: CSO)

Area	2011		2016	
	No. of Households	Avg. Size (persons)	No. of Households	Avg. Size (persons)
State	1,654,208	2.73	1,702,289	2.75
County Clare	42,648	2.71	43,469	2.69
Study Area	767	2.72	798	2.59

In general, the figures in Table 5-3 show that the number of households within the State and County has increased from 2011 to 2016. The number of households in the Study Area has also increased slightly, however the average size of the household has decreased slightly from 2011 to 2016 within the Study Area. Average household size recorded within the Study Area during the 2016 Census is slightly below that of the County level, and further below that of State level. Similar to the trends observed above, the average household size recorded across the Study Area varies between DEDs. Formoyle DED had the highest, with 2.9 persons per household recorded in 2016, while Ballyvaskin DED and Cloonanaha DED was lower with an average of 2.6 persons per household in 2016, and Annagh and Moy were the lowest with 2.5 persons per household in 2016.

5.2.5 Age Structure

Table 5-4 presents the population percentages of the State, County Clare and Study Area within different age groups as defined by the Central Statistics Office during the 2016 Census. This data is also displayed in Figure 5-2.

Table 5-4 Population per Age Category in 2016 (Source: CSO)

Area	Age Category				
	0 - 14	15 – 24	25 - 44	45 - 64	65 +
State	21.1%	12.1%	29.5%	23.8%	13.4%
County Clare	21.5%	11.5%	26.2%	26.0%	14.9%
Study Area	19.1%	13.2%	20.6%	30.1%	17.0%

The proportion of the Study Area population is broadly similar to those recorded at national and county level for most categories. For the Study Area, the highest population percentage occurs within the 45-64 age category.

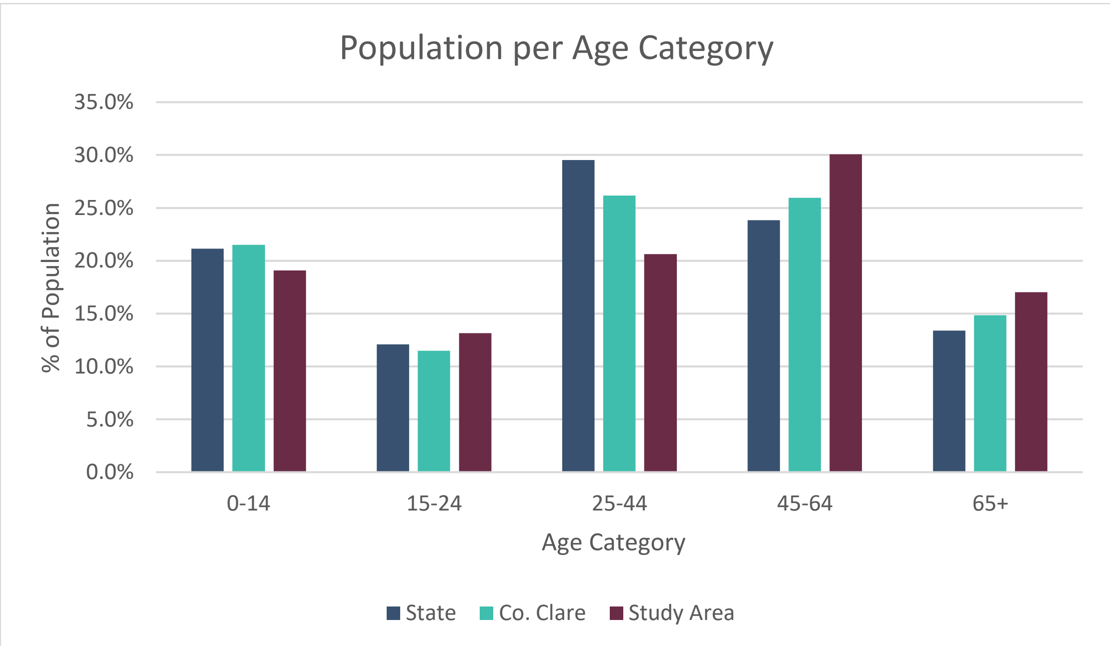


Figure 5-2 Population per Age Category in 2016 (Source: CSO)

5.2.6 Employment and Economic Activity

5.2.6.1 Economic Status of the Study Area

The labour force consists of those who are able to work, i.e. those who are aged 15+, out of full-time education and not performing duties that prevent them from working. In 2016, there were 2,304,037 persons in the labour force in the State. Table 5-5 shows the percentage of the total population aged 15+ who were in the labour force during the 2016 Census. This figure is further broken down into the percentages that were at work or unemployed. It also shows the percentage of the total population aged 15+ who were not in the labour force, i.e. those who were students, retired, unable to work or performing home duties.

Table 5-5 Economic Status of the Total Population Aged 15+ in 2016 (Source: CSO)

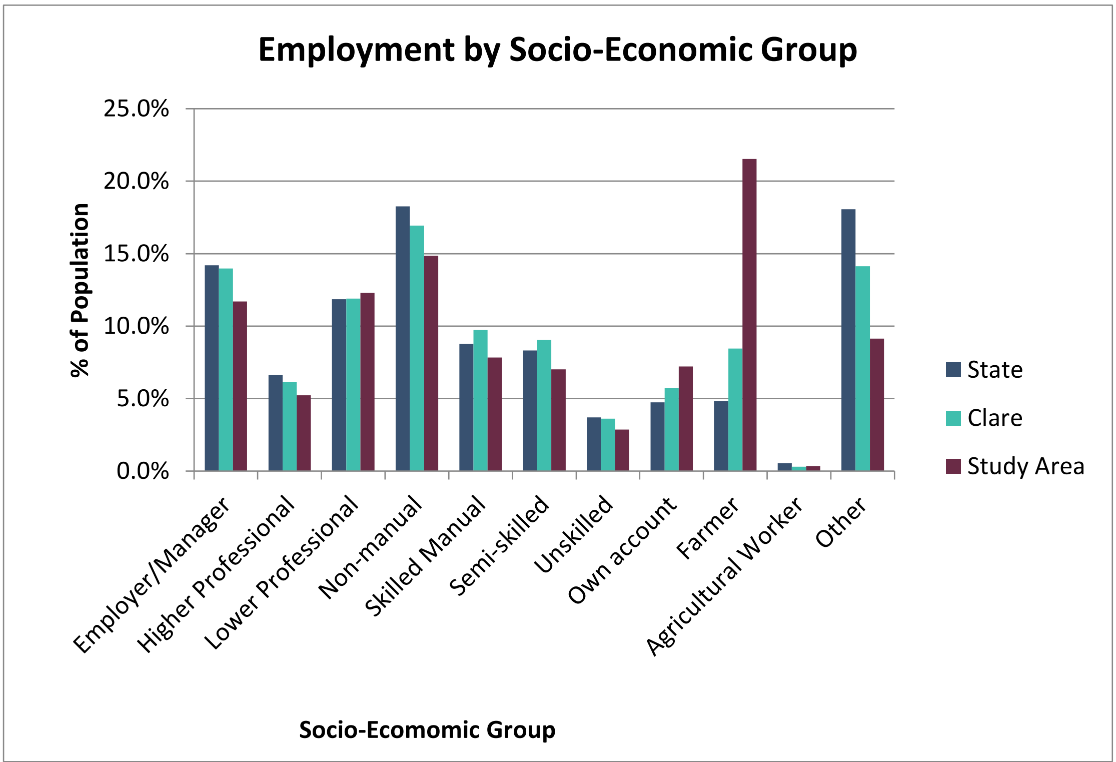
Status		State	County Clare	Study Area
% of population aged 15+ who are in the labour force		**61.4%**	**60.6%**	**59.0%**
% of which are:	At work	87.1%	87.6%	90.4%
	First time job seeker	1.4%	1.2%	0.9%
	Unemployed	11.5%	11.2%	8.7%
% of population aged 15+ who are not in the labour force		**38.6%**	**39.4%**	**41.0%**
% of which are:	Student	29.4%	28.4%	29.1%
	Home duties	21.1%	20.2%	21.8%
	Retired	37.6%	40.8%	42.2%
	Unable to work	10.9%	9.8%	6.5%
	Other	1.0%	0.9%	0.4%

Overall, the principal economic status of those living in the Study Area is broadly similar to that recorded at State and County level. During the 2016 Census, the percentage of people over the age of 15 who were in the labour force was similar at both state and county level, but lower within the study area with only 59% in the labour force. Of those who were not in the labour force during the 2016 Census, the highest percentage of the Study Area population were 'Retired' individuals, similar to state and county populations.

5.2.6.2 Employment by Socio-Economic Group

Socio-economic grouping divides the population into categories depending on the level of skill or educational attainment required. The 'Higher Professional' category includes scientists, engineers, solicitors, town planners and psychologists. The 'Lower Professional' category includes teachers, lab technicians, nurses, journalists, actors and driving instructors. Skilled occupations are divided into manual skilled such as bricklayers and building contractors; semi-skilled such as roofers and gardeners; and unskilled, which includes construction labourers, refuse collectors and window cleaners. Figure 5-3 shows the percentages of those employed in each socio-economic group in the State, County Clare and the Study Area during 2016.

Figure 5-3 Employment by Socio-Economic Group in 2016 (Source: CSO).



The highest level of employment within the Study Area was recorded in the Farmer category. The levels of employment within the Employer/Manager, Higher Professional, Non-Manual, Skilled Manual, Semi-skilled, Un-skilled, and Other categories in the Study Area were lower than those recorded for the State and County Clare, while those recorded within the Lower Professional, Own Account, and Farmer, categories were higher. The level of employment in the Agricultural Worker category were lower than those recorded for the State and the same as those recorded for County Clare.

The CSO employment figures grouped by socio-economic status includes the entire population for the Study Area, County and State in their respective categories. As such, the socio-economic category of 'Other' is skewed to include those who are not in the labour force.

5.2.6.3 Employment and Investment Potential in the Irish Wind Energy Industry

5.2.6.3.1 *Background*

A report entitled '*Jobs and Investment in Irish Wind Energy – Powering Ireland's Economy*' was published in 2009 by Deloitte, in conjunction with the Irish Wind Energy Association (IWEA). This report focused on the ability of the Irish wind energy industry to create investment and jobs. In terms of the overall economic benefit to be obtained from wind energy, the report states in its introduction:

> *"Ireland is fortunate to enjoy one of the best wind resources in the world. Developing this resource will reduce and stabilise energy prices in Ireland and boost our long-term competitiveness as an economy. It will also significantly reduce our dependence on imported fossil fuels."*

More recently, a report published in 2014 by Siemens entitled '*An Enterprising Wind - An economic analysis of the job creation potential of the wind sector in Ireland*', also in conjunction with the Irish Wind Energy Association (IWEA), concluded that, *'a major programme of investment in wind could have a sizeable positive effect on the labour market, resulting in substantial growth in employment.'* The results of the research indicate that the majority of jobs created as a result of wind energy development in Ireland are likely to be in the industry category, followed by grid jobs and finally potential manufacturing jobs. The creation of jobs would be as a result of a major programme of investment in wind energy.

5.2.6.3.2 Energy Targets

The Climate Action Plan 2019 (CAP) was published on the 1st August 2019 by the Department of Communications, Climate Action and Environment. The CAP sets out an ambitious course of action over the coming years to address the impacts which climate may have on Irelands environment, society, economic and natural resources. The CAP includes a commitment that 70% of Ireland's electricity needs will come from renewable sources by 2030. It is envisaged that wind energy will provide the largest source of renewable energy in achieving this target.

5.2.6.3.3 Employment Potential

The 2014 report *"An Enterprising Wind: An economic analysis of the job creation potential of the wind sector in Ireland"* published by the Irish Wind Energy Association (IWEA) predicted that the wind energy sector in Ireland would result in 6,659 direct jobs in a scenario where 4GW capacity is achieved by 2020. This figure of 6,659 is broken down further; 5,596 of these jobs are associated directly with the construction and installation of windfarms, while the remaining 1,063 jobs are associated with the national grid. Under this scenario this contributes 1.66 direct jobs per Megawatt (MW) of wind capacity throughout the various stages of installation. According to Wind Energy Ireland, the installed wind capacity in Ireland is over 4.2GW as of February 2021, which would support employment during the last decade. Ireland needs to achieve a total of 8.2GW of onshore wind by 2030 which will further support further employment.

The Sustainable Energy Authority of Ireland[1] estimates, in their '*Wind Energy Roadmap 2011-2050*', note that '*Onshore and offshore wind could create 20,000 direct installation and O&M jobs by 2040*'. Furthermore, '*wind energy resource represents a significant value to Ireland by 2050. This value is presented in terms of its ability to contribute to our indigenous energy needs, the benefits of enhanced employment creation and investment potential, and the ability to significantly abate carbon emissions to 2050*'

The 2014 report '*The Value of Wind Energy to Ireland*', published by Pőyry, stated that growth of the wind sector in Ireland could support 23,850 jobs (construction and operational phases) by 2030. If Ireland instead chooses to not develop any more wind, then by 2030 the country will be reliant on natural gas for most of our electricity generation, at a cost of €671 million per annum in fuel import costs.

Internationally, a report issued by WindEurope in September 2017, entitled '*Wind energy in Europe: Scenarios for 2030*' details various scenarios in Europe in respect to the EU target for renewable energy. According to WindEurope's High Scenario, which assumes favourable market and policy conditions including the achievement of a 35% EU renewable energy target (slightly higher than the 32% EU target for renewables), '*397 GW of wind energy capacity would be installed in the EU by 2030, 298.5 GW onshore and 99 GW offshore. In this scenario, the wind energy industry would invest €351bn by 2030, and it would create 716,000 jobs*'.

[1] *SEAI (2019),* https://www.seai.ie/publications/Wind_Energy_Roadmap_2011-2050.pdf

As of September 2021, there were 5,585 Megawatts (MW) of wind energy capacity installed on the island of Ireland[2]. Of this, 4,309 MW was installed in the Republic of Ireland, with 1,276MW installed in Northern Ireland. The majority of the Republic of Ireland's installed wind energy capacity is located in Counties Donegal, Galway, Cork and Kerry, contributing to employment potential on the Island of Ireland.

5.2.6.3.4 Economic Value

The Deloitte report states that the construction and development of wind energy projects across the island of Ireland would involve approximately €14.75 billion of investment from 2009 up to 2020, €5.1 billion of which would be retained in the Irish economy (€4.3 billion invested in the Republic of Ireland and €0.8 billion in Northern Ireland).

The report also states that increasing the share of our energy from renewable sources will deliver significant benefits for the electricity customer, the local economy and society. It estimates that between 25 and 30% of capital investment is retained in the local economy. This typically flows to companies in construction, legal, finance and other professional services. The report states:

> *".. the framework acknowledges the need to put the energy/climate change agenda at the heart of Ireland's economic renewal. Every new wind farm development provides a substantial contribution to the local and national economy through job creation, authority rates, land rents and increased demand for local support services. More wind on the system will also result in lower and more stable energy prices for consumers while helping us achieve our energy and emissions targets."*

A 2019 report by Baringa, '*Wind for a Euro: Cost-benefit analysis of wind energy in Ireland 2000-2020*', has analysed the financial impact for end consumers of the deployment of wind generation in Ireland over the period 2000-2020. The report calculates how the costs and benefits for consumers would have differed if no wind farms had been built. The analysis indicated that the deployment of 4.1 GW of wind generation capacity in Ireland between 2000 and 2020 (2018-2020 results being projective) will result in a total net cost to consumers, over 20 years, of €0.1bn (€63 million to be exact), which equates to a cost of less than €1 per person per year since 2000. Further cost benefit analysis noted that wind energy has delivered €2.3 billion in savings in the wholesale electricity market. As such, the economic benefit of renewable energy to consumers is greater than what would have been if Ireland did not invest in wind power. This tallies with the Deloitte report which indicated that more wind energy feeding into the national grid would result in lower and more stable energy costs for consumers.

The Proposed Development will, if consent is granted, contribute to the economic value that renewable energy brings to the country.

5.2.7 Land-Use

As previously noted, the Proposed Development is currently used for coniferous forestry, agriculture and turf cutting. Land-use in the wider landscape comprises a mix of agriculture, low density housing, wind farms and commercial forestry.

The total area of farmland within the five DEDs around the wind farm site measures approximately 12,436 hectares, comprising approximately 72.7% of the Study Area, according to the CSO Census of Agriculture 2010. There are 337 farms located within the five DEDs, with an average farm size of 26.6 hectares. This is smaller than the 32.6 hectare average farm size for Co. Clare.

Within the Study Area, farming employs 672 people, and the majority of farms are family-owned and run. Table 5-6 shows the breakdown of farmed lands within the Study Area. Pasture accounts for the

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[2] *Wind Energy Ireland (formerly IWEA) – Facts and Stats, https://windenergyireland.com/about-wind/facts-stats*

largest proportion of farmland, which is followed by silage, grazing and hay. There are no lands farmed for potatoes, crops or cereal within the study area.

Table 5-6 Farm Size and Classification within the Study Area in 2010 (Source: CSO)

Characteristic	Value
Size of Study Area	12,436 hectares
Total Area Farmed within Study Area	8,956 hectares
Farmland as % of Study Area	72.7%
Breakdown of Farmed Land	**Area (hectares)**
Total Pasture	4,875 ha
Total Silage	2,443 ha
Grazing	1,075 ha
Total Hay	562 ha
Total Potatoes	0 ha
Total Cereals	0 ha
Total Crops	0 ha

5.2.7.1 Equine Industry

A search of stud farms and equestrian facilities located within 10km of the proposed development was undertaken as part of the assessment. The closest stud farm/equestrian facility is Hestakot Horse Farm which is located approximately 3.6 km to the southwest of the Proposed Development site..

There have been no known studies carried out in Ireland on the impacts of wind farms on the equine industry. In 2014 Marshall Day Acoustics published a document entitled *'Summary of research of noise effects on Animals'*. The Marshall Day study specifically assessed the impacts of varying levels of noise on horses in three differing behavioural settings. The three behavioural settings studied included horses in stables, breeding mares and racing horses.

Horses in Stables

The study by Marshall Day Acoustics found that horses, stabled at the Flemington Racecourse Australia at the same time as a music concert on the site, when exposed to $L_{Aeq,15min}$ of 54-70 dB showed little response to the music noise unless the noise was particularly impulsive. The horses stabled at Flemington Racecourse were thoroughbreds, and stables were located 200 metres from the concert.

Breeding Mares

A study by Le Blanc et al (1991) and summarised by Marshall Day studied the effects of simulated aircraft noise over 100 dB and visual stimuli on pregnant mares. The study focused on pregnancy success, behaviour, cardiac function, hormonal production and rate of habitation. Le Blanc concluded the following:

> *Le Blanc et al (1991) found that birth success of pregnant mares was not affected by F-14 jet aircraft noise. While the 'fright-flight' reaction was initially observed, the mares did adapt to the noise.*

Racehorses

Marshall Day Acoustics concluded the following in relation to their study on the impacts of noise on racehorses:

> *Marshall Day Acoustics have observed horses grazing in paddocks directly under the main approach path of the Christchurch International Airport where noise levels are in excess of 90 dB (LAmax) during an aircraft flyover. Although these horses are arguably "used to" the noise, there was generally little recognition by them of an aircraft passing, let alone any sign of disturbance. This tends to support the conclusions by Le Blanc et al (1991).*

5.2.7.1.2 Guidance

In the absence of national policy or guidance in relation of the development of wind farms near stud farms/equestrian centres, MKO have reviewed the British Horse Society's *'Advice on Wind Turbines and Horses – Guidance for Planners and Developers'.* A copy of the guidance document is included in Appendix 5-1 of this EIAR.

The British Horse Society policy statement states the following in relating to the siting of wind turbines in the vicinity of equine businesses:

> *The BHS strongly recommends that the views and concerns of local equestrians should be recognised and taken into account when determining separation distances and that normally a minimum separation distance of 200m or three times blade tip height (whichever is greater) will be required between a turbine and any route used by horses or a business with horses.*

As mentioned previously, the closest stud farm/equestrian facility is located approximately 3.6km from the nearest proposed Slieveacurry turbine location and is therefore at a distance of eighteen times the British Horse Society's recommended minimum separation distance of 200 metres as noted above. It also exceeds the 525 metres separation distance (based on three times the turbine blade tip height of 175 metres.

5.2.8 Services

The Proposed Development is located approximately 5 kilometres to the east of Miltown Malbay and approximately 7 kilometres to the south of Ennistimon Co. Clare. The Proposed Development is accessed via an existing access track off the local road to the northwest of the site. The site itself is served by a number of existing forestry and agricultural roads and tracks. The main services for the Study Area are located within Miltown Malbay which is classified as a small town and Ennistimon, which is classified as a service town. Additionally, the nearest county town, Ennis, where larger scale retail and services are available, lies approximately 21.5km east of the Proposed Development.

5.2.8.1 Education

The nearest school to the Proposed Development is Cloonanaha National School, located approximately 1.1 km to the east of the Proposed Development site boundary at its closest point. Rockmount Mixed National School is located approximately 1.6 km to the west of the Proposed Development site boundary at its closest point and Moy National School is located approximately 3 km to the northwest of the Proposed Development site boundary.

The closest secondary school is Ennistimon Vocational School located approximately 7.1km north of the Proposed Development site boundary, and CBS Secondary School in Ennistimon is located approximately 7.3 km north of the Proposed Development site boundary.

The closest third-level institutes to the site are Limerick Institute of Technology, Mary Immaculate College, National University of Ireland Galway and Galway-Mayo Institute of Technology, all located in excess of 40km northeast and southeast of the Proposed Development.

5.2.8.2 Access and Public Transport

The Proposed Development is accessed via an existing access track off the local road to the northwest of the site. The site itself is served by a number of existing forestry and agricultural roads and tracks. The nearest bus routes from which several daily connections are available, can be accessed in Milltown Malbay, approximately 5km east of the site.

5.2.8.3 Amenities and Community Facilities

Most of the amenities and community facilities, including GAA and other sports clubs, youth clubs, recreational areas, retail and personal services are available in the nearby towns of Milltown Malbay, Lahinch, and Ennistimon, and the village of Inagh. Larger scale services are available in the larger county town of Ennis.

The varied environment of this area of County Clare provides many opportunities for swimming, walking, cycling and playing golf. There are a number of beaches to the west of the Proposed Development which are located along the Wild Atlantic Way tourist route, the closest being White Strand Beach, south of Milltown Malbay, which is located 7.3km west of the Proposed Development. The Lahinch to Kilrush walking route is approximately 7.2km west of the Proposed Development at its closest point where there is a walking and cycling trail along a dismantled railway stretching 40km from Lahinch to Kilrush.

Community Benefit proposals, which would enhance local amenities and community facilities are described in Chapter 4: Description of the Proposed Development.

5.3 Tourism

5.3.1 Tourism Numbers and Revenue

Tourism is one of the major contributors to the national economy and is a significant source of full time and seasonal employment. During 2019, total tourism revenue generated in Ireland was approximately €9.5 billion, an increase on the €9.4 billion revenue recorded in 2018. Overseas tourist visits to Ireland in 2019 grew by 0.7% to 9.7 million (‘*Tourism Facts 2019*, Fáilte Ireland, March 2021).

Ireland is divided into seven tourism regions. Table 5-7 shows the total revenue and breakdown of overseas tourist numbers to each region in Ireland during 2019 (‘*Tourism Facts 2019*, Fáilte Ireland, March 2021).

Table 5-7 Overseas Tourists Revenue and Numbers 2019 (Source: Fáilte Ireland)

Region	Total Revenue (€m)	Total Number of Overseas Tourists (000s)
Dublin	€2,210m	6,644
Mid-East/Midlands	€ 348m	954

Region	Total Revenue (€m)	Total Number of Overseas Tourists (000s)
South-East	€261m	945
South-West	€970m	2,335
Mid-West	**€472 m**	**1,432**
West	€653m	1,943
Border	€259m	768
Total	**€5,174 m**	**15,021**

The Proposed Development is located within the Mid-West Region. According to '*Regional tourism performance in 2019'* (Fáilte Ireland, March 2021) the Mid-West Region which comprises Counties Clare, Limerick and Tipperary, benefited from approximately 9.5% of the total number of overseas tourists to the country and approximately 9% of the associated tourism income generated in Ireland in 2019.

Although the data for 2019 is not available, Table 5-8 presents the most recent breakdown of overseas tourist numbers and revenue to the Mid-West region during 2017 ('*2017 Topline Tourism Performance by Region,* Fáilte Ireland, August 2018). As can be observed in Table 5-8, County Clare had the highest number of overseas tourists visiting the Region during 2017 and had tourism revenue at €158 million.

Table 5-8 Overseas Tourism to Mid-West Region during 2017 (Source: Fáilte Ireland)

Region	Total Revenue (€m)	Total Number of Overseas Tourists (000s)
Limerick	261	647
Clare	158	749
Tipperary	23	53

5.3.2 Tourist Attractions

There are no key identified tourist attractions pertaining specifically to the site of the Proposed Development itself.

Key tourist attractions within County Clare include the Cliffs of Moher, the Burren National Park and Bunratty Castle and Folk Park. Within the north and west of the county, many additional tourist attractions are found in Ennis, Miltown Maybay and Spanish Point, Lahinch and Liscannor, Creagh, Quilty, Lisdoonvarna, Kilfenora, Inagh, Doonbeg and Cooraclare, all of which lie within 20 kilometres of the Proposed Development. The Discover Ireland website (www.discoverireland.ie) lists the following attractions within each location:

- White Strand Beach, south of Milltown Malbay, which is located 7.3km west of the Proposed Development.
- The Lahinch to Kilrush walking route is approximately 7.2km west of the Proposed Development at its closest point where there is a walking and cycling trail along a dismantled railway stretching 40km from Lahinch to Kilrush.

- A number of golf courses including Lahinch Golf Course 7.5km north-west of the site and Castle Course in Lahinch 7.5km north-west of the site.
- The Cliffs of Moher, a UNESCO Global Geopark, and tourist visitor centre is located approximately 12.6km northwest of the Proposed Development. Hags Head, a natural landmark and unique rock formation situated at the southern extent of the Cliffs of Moher is another popular tourist destination and is located 13km northwest of the Proposed Development.
- Doolin Cave and Visitors Centre, which includes gardens and a small farm, is an award winning tourist attraction that is located 19.2km northwest of the Proposed Development. Doolin pier, an important transport location for ferry connections to the Aran Islands and for boat tours beneath the Cliffs of Moher, is located 16.7km northwest of the Proposed Development.
- Dysert O'Dea Castle and Archaeology Centre, a restored 15th Century Castle surrounded by heritage walking trails at many archaeological sites, is located approximately 15.4km northeast of the Proposed Development.
- As the County Hub, Ennis has many outdoor recreational and tourist amenities within its vicinity, including: Golf Courses; Hotels; Walking Trails and Parkland, and is located 18km east of the Proposed Development.

5.3.3 Tourist Attitudes to Wind Farms

5.3.3.1 Scottish Tourism Survey 2016

BiGGAR Economics undertook an independent study in 2016, entitled '*Wind Farms and Tourism Trends in Scotland*', to understand the relationship, if any, that exists between the development of onshore wind energy and the sustainable tourism sector in Scotland. In recent years, the onshore wind sector and sustainable tourism sector have grown significantly in Scotland. However, it could be argued that if there was any relationship between the growth of onshore wind energy and tourism, it would be at a more local level. This study therefore considered the evidence at a local authority level and in the immediate vicinity of constructed wind farms.

Eight local authorities had seen a faster increase in wind energy deployment than the Scottish average. Of these, five also saw a larger increase in sustainable tourism employment than the Scottish average, while only three saw less growth than the Scottish average. The analysis presented in this report shows that, at the Local Authority level, the development of onshore wind energy does not have a detrimental impact on the tourism sector. It was found that in the majority of cases (66%) sustainable tourism employment performed better in areas surrounding wind farms than in the wider local authority area. There was no pattern emerging that would suggest that onshore wind farm development has had a detrimental impact on the tourism sector, even at the very local level.

Overall, the conclusion of this study is that published national statistics on employment in sustainable tourism, demonstrate that there is no relationship between the development of onshore wind farms and tourism employment at the level of the Scottish economy, at local authority level, nor in the areas immediately surrounding wind farm development. However the report also concluded that *'Although this study does not suggest that there is any direct relationship between tourism sector growth and wind farm development, it does show that wind farms do not cause a decrease in tourism employment either at a local or a national level.'*

5.3.3.2 Fáilte Ireland Surveys 2007 and 2012

In 2007, Fáilte Ireland in association with the Northern Ireland Tourist Board carried out a survey of domestic and overseas holidaymakers to Ireland in order to determine their attitudes to wind farms. The purpose of the survey was to assess whether the development of wind farms impacts on the enjoyment of the Irish scenery by holidaymakers. The survey involved face-to-face interviews with 1,300 tourists (25% domestic and 75% overseas). The results of the survey are presented in the Fáilte Ireland Newsletter 2008/No.3 entitled 'Visitor Attitudes on the Environment: Wind Farms'.

The Fáilte Ireland survey results indicate that most visitors are broadly positive towards the idea of building wind farms in Ireland. There exists a sizeable minority (one in seven) however who are negative towards wind farms in any context. In terms of awareness of wind farms, the findings of the survey include the following:

- Almost half of those surveyed had seen at least one wind farm on their holiday to Ireland. Of these, two thirds had seen up to two wind farms during their holiday.
- Typically, wind farms are encountered in the landscape while driving or being driven (74%), while few have experienced a wind farm up close.
- Of the wind farms viewed, most contained less than ten turbines and 15% had less than five turbines.

Regarding the perceived impact of wind farms on sightseeing, the Fáilte Ireland report states:

> *"Despite the fact that almost half of the tourists interviewed had seen at least one wind farm on their holiday, most felt that their presence did not detract from the quality of their sightseeing, with the largest proportion (45%) saying that the presence of the wind farm had a positive impact on their enjoyment of sightseeing, with 15% claiming that they had a negative impact."*

In assessing the perceived impact of wind farms on beauty, visitors were asked to rate the beauty of five different landscapes types: Coastal, Mountain, Farmland, Bogland and Urban Industrial, and then rate on a scale of 1-5 the potential impact of a wind farm being sited in each landscape. The survey found that each potential wind farm must be assessed on its own merits. Overall however, in looking at wind farm developments in different landscape types, the numbers claiming a positive impact on the landscape due to wind farms were greater than those claiming a negative impact, in all cases.

Regarding the perceived impact of wind farms on future visits to the area, the Fáilte Ireland survey states:

> *"Almost three quarters of respondents claim that potentially greater numbers of wind farms would either have no impact on their likelihood to visit or have a strong or fairly strong positive impact on future visits to the island of Ireland. Of those who feel that a potentially greater number of wind farms would positively impact on their likelihood to visit, the key driver is their support for renewable energy and potential decreased carbon emissions."*

The report goes on to state that while there is a generally positive disposition among tourists towards wind development in Ireland, it is important also to take account of the views of the one in seven tourists who are negatively disposed towards wind farms. This requires good planning on the part of the wind farm developer as well as the Local Authority. Good planning has been an integral component of the Proposed Development throughout the site design and assessment processes. Reference has been made to the '*Planning Guidelines on Wind Energy Development 2006*' and the '*Draft Revised Wind Energy Development Guidelines December 2019*' in addition to IWEA best practice guidance, throughout all stages, including pre-planning consultation and scoping.

The 2007 survey findings are further upheld by a more recent report carried out by Fáilte Ireland on tourism attitudes to wind farms in 2012. The results of the updated study were published in the 'Fáilte Ireland Newsletter 2012/No.1 entitled 'Visitor Attitudes on the Environment: Wind Farms – Update on 2007 Research'. The updated survey found that of 1,000 domestic and foreign tourists who holidayed in Ireland during 2012, over half of tourists said that they had seen a wind turbine while travelling around the country. Of this number of tourists, 21% claimed wind turbines had a negative impact on the landscape. However, 32% said that it enhanced the surrounding landscape, while 47% said that it made no difference to the landscape. Almost three quarters of respondents claim that potentially greater numbers of wind farms would either have no impact on their likelihood to visit or have a strong or fairly strong positive impact on future visits to the island of Ireland.

Further details regarding the general public perception of wind energy, including those living in the vicinity of a wind farm, are presented in Section 5.4 below.

5.4 Public Perception of Wind Energy

5.4.1 Sustainable Energy Ireland Survey 2003

5.4.1.1 Background

The results of a national survey entitled 'Attitudes Towards the Development of Wind Farms in Ireland' were published by the Sustainable Energy Authority of Ireland (SEAI) in 2003. A catchment area survey was also carried out by SEAI (formerly SEI) in order to focus specifically on people living with a wind farm in their locality or in areas where wind farms are planned.

5.4.1.2 Findings

The SEAI survey found that the overall attitude to wind farms is very positive, with 84% of respondents rating it positively or very positively. One percent rates it negatively and 14% had no opinion either way. Approximately two thirds of respondents (67%) were found to be positively disposed to having a wind farm in their locality. Where negative attitudes were voiced towards wind farms, the visual impact of the turbines on the landscape was the strongest influence. The report also notes however that the findings obtained within wind farm catchment areas showed that impact on the landscape is not a major concern for those living near an existing wind farm.

With regards to the economic and environmental impacts of wind farm development, the national survey reveals that attitudes towards wind energy are influenced by a perception that wind is an attractive source of energy:

> *"Over 8 in 10 recognise wind as a non-polluting source of energy, while a similar number believe it can make a significant contribution to Ireland's energy requirements."*

The study reveals uncertainty among respondents with regards to the issues of noise levels, local benefits and the reliability or otherwise of wind power as an energy source. It goes on to state however that the finding that people who have seen wind farms rate these economic and environmental factors more favourably is a further indication that some experience of the structures tends to translate into positive attitudes towards wind energy.

Similar to the national survey, the surveys of those living within the vicinity of a wind farm also found that the findings are generally positive towards wind farms. Perceptions of the impact of the development on the locality were generally positive, with some three-quarters of interviewees believing it had impacted positively.

In areas where a wind farm development had been granted planning permission but was not yet under construction, three quarters of the interviewees expressed themselves in favour of the wind farm being built in their area. Four per cent were against the development. The reasons cited by those who expressed themselves in favour of the wind farm included the fact that wind energy is clean (78%), it would provide local jobs (44%), it would help develop the area (32%) and that it would add to the landscape (13%). Those with direct experience of a wind farm in the locality are generally impressed with it as an additional feature in the landscape. The report states:

> *"It is particularly encouraging that those with experience of wind turbines are most favourable to their development and that wind farms are not solely seen as good in theory, but are also seen as beneficial when they are actually built."*

Few of those living in proximity either to an existing wind farm or one for which permission has been granted believe that the development damages the locality, either in terms of damage to tourism potential or to wildlife. The survey found that there is a clear preference for larger turbines in smaller numbers over smaller turbines in larger numbers.

5.4.1.3 Survey Update 2017

Additionally, a survey carried out by Interactions in October 2017, published by the SEAI, show 47% of Irish adults polled said they were are strongly in favour of wind power in Ireland while a further 38% favour it. Overall this is a 4% increase in favourable attitudes towards wind power compared with similar research in 2013.

The SEAI survey found that the overall attitude to wind farms is very positive, with 84% of respondents in favour of the use of wind energy in Ireland. Approximately two thirds of respondents (70%) would prefer to power their home with renewable energy over fossil fuels, and 45% would be in favour of a wind farm development in their area.

The survey also captured the perceived benefits of wind power among the public. Of those surveyed three quarters selected good for the environment and reduced Carbon Dioxide emissions while fewer people, just over two in three, cited cheaper electricity.

5.4.1.4 Conclusions

The main findings of the SEAI survey indicate that the overall attitude to wind farms is "almost entirely positive". The study highlights that two-thirds of Irish adults are either very favourable or fairly favourable to having a wind farm built in their locality, with little evidence of a "Not In My Back Yard" (NIMBY) effect. The final section of the 2017 report states:

> *"The overwhelming indication from this study is that wind energy enjoys great support and, more specifically, that the development of wind farms is supported and welcomed. The single most powerful indicator of this is to be found among those living in proximity to an existing wind farm: over 60% would be in favour of a second wind farm or an extension of the existing one. This represents a strong vote in favour of wind farm developments – especially important since it is voiced by those who know from direct experience about the impact of such developments on their communities."*

5.4.2 Public Perceptions of Wind Power in Scotland and Ireland Survey 2005

5.4.2.1 Background

A survey of the public perception of wind power in Scotland and Ireland was carried out in 2003/2004 by researchers at the School of Geography & Geosciences, University of St. Andrews, Fife and The Macaulay Institute, Aberdeen ('*Green on Green: Public Perceptions of Wind Power in Scotland and Ireland*', Journal of Environmental Planning and Management, November 2005). The aims of the study were to ascertain the extent to which people support or oppose wind power, to investigate the reasons for these attitudes and to establish how public attitudes relate to factors such as personal experience of operational wind farms and their proximity to them.

5.4.2.2 Study Area

Surveys were carried out at two localities in the Scottish Borders region, one surrounding an existing wind farm and one around a site at which a wind farm had received planning permission but had not yet been built. Surveys were also carried out in Ireland, at two sites in Counties Cork and Kerry, each of which has two wind farms in proximity.

5.4.2.3 Findings

The survey of public attitudes at both the Scottish and Irish study sites concluded that large majorities of people are strongly in favour of their local wind farm, their personal experience having engendered positive attitudes. Attitudes towards the concept of wind energy were described as "overwhelmingly positive" at both study sites in Scotland, while the Irish survey results showed almost full support for renewable energy and 92% support for the development of wind energy in Ireland.

The results of the survey were found to agree with the findings of previous research, which show that positive attitudes to wind power increase through time and with proximity to wind farms. With regards to the NIMBY effect, the report states that where NIMBY-ism does occur, it is much more pronounced in relation to proposed wind farms than actual wind farms. The Scottish survey found that while positive attitudes towards wind power were observed among those living in proximity to both the proposed and existing wind farm sites, people around the proposed site were less convinced than those living in proximity to the existing site. Retrospective questioning regarding pre- and post-construction attitudes at the existing site found that attitudes remained unchanged for 65% of respondents. Of the 24% of people who altered their attitudes following experience of the wind farm, all but one became more positive. The report states:

> *"These results support earlier work which has found that opposition to wind farms arises in part from exaggerated perceptions of likely impact, and that the experience of living near a wind farm frequently dispels these fears. Prior to construction, locals typically expect the landscape impacts to be negative, whereas, once in operation, may people regard them as an attractive addition."*

The reasons that people gave for their positive attitude to the local wind farm were predominantly of a global kind, i.e. environmental protection and the promotion of renewable energy, together with opposition to a reliance on fossil fuels and nuclear power. Problems that are often cited as negative impacts of wind farms, such as interference with telecommunications and shadow flicker were not mentioned at either site. With regards to those who changed to a more positive attitude following construction of the wind farm, the reasons given were that the wind farm is *"not unattractive (62%), that there was no noise (15%), that community funding had been forthcoming (15%) and that it could be a tourist attraction (8%)".*

The findings of the Irish survey reinforce those obtained at the Scottish sites with regards to the increase in positive attitudes to wind power through time and proximity to wind farms. The survey of public attitudes at the sites in Cork and Kerry found that the highest levels of support for wind power were recorded in the innermost study zone (0 – 5 kilometres from a point in between the pair of wind farms). The data also suggests that *"those who see the wind farms most often are most accepting of the visual impact".* The report also states that a previous Irish survey found that most of those with direct experience of wind farms do not consider that they have had any adverse impact on the scenic beauty of the area, or on wildlife, tourism or property values. Overall, the study data reveals *"a clear pattern of public attitudes becoming significantly more positive following personal experience of operational wind farms".*

With regards to wind farm size, the report notes that it is evident from this and previous research that wind farms with small numbers of large turbines are generally preferred to those with large numbers of smaller turbines.

5.4.2.4 Conclusions

The overall conclusions drawn from the survey findings and from the authors' review of previous studies show that local people become more favourable towards wind farms after construction, that the degree of acceptance increases with proximity to them, and that the NIMBY-ism effect does not adequately explain variations in public attitudes due to the degree of subjectivity involved.

5.4.3 IWEA Interactions Opinion Poll on Wind Energy

Published in January 2020, IWEA undertook a national opinion poll on Wind Energy November 2019 with the objective to "*measure and track public perceptions and attitudes around wind energy amongst Irish adults*." Between November 20th – 30th 2019, a nationally represented sample of 1,019 adults and a booster sample of 200 rural residents participated in an online survey. The 2019 results indicate that 79% of both the nationally represented sample and rural sample strongly favour or favour wind power while 16% of both samples neither favour or oppose it. Amongst those in favour of wind power, the majority cited environmental and climate concerns as their main reasons for supporting such developments. Other reasons cited for supporting wind energy developments include: "economic benefits," "reliable/efficient," "positive experience with wind energy" and recognise it as a "safe resource." When questioned about wind developments in their local area, 55% of nationally represented sample favour or tend to favour such proposals and 51% of the rural population reported the same. Reasons cited for supporting wind developments in their local area include: "good for the environment," "social responsibility," "create jobs," "good for the community." In the same survey, 30 to 31% neither favour/opposed, 6 to 7% tended to oppose and 9 to 11% strongly opposed.

The IWEA November 2019 survey follows previous national opinion polls asking the same questions on wind energy undertaken in October 2017 and November 2018. The 2019 survey results are consistent with the 2017 and 2018 figures and thus indicate that approximately 4 out of 5 Irish adults have continued to support for wind energy in recent years.

5.5 Health Impacts of Wind Farms

5.5.1 Health Impact Studies

While there are anecdotal reports of negative health effects on people who live very close to wind turbines, peer-reviewed research largely does not support these statements. There is currently no published credible scientific evidence to positively link wind turbines with adverse health effects. The main publications supporting the view that there is no evidence of any direct link between wind turbines and health are summarised below.

1. ***'Wind Turbine Sound and Health Effects – An Expert Panel Review', American Wind Energy Association and Canadian Wind Energy Association, December 2009***

This expert panel undertook extensive review, analysis and discussion of the large body of peer-reviewed literature on sound and health effects in general, and on sound produced by wind turbines in particular. The panel assessed the plausible biological effects of exposure to wind turbine sound. Following review, analysis, and discussion of current knowledge, the panel reached consensus on the following conclusions:

- *"There is no evidence that the audible or sub-audible sounds emitted by wind turbines have any direct adverse physiological effects.*
- *The ground-borne vibrations from wind turbines are too weak to be detected by, or to affect, humans.*
- *The sounds emitted by wind turbines are not unique. There is no reason to believe, based on the levels and frequencies of the sounds and the panel's experience with*

sound exposures in occupational settings, that the sounds from wind turbines could plausibly have direct adverse health consequences."

The report found, amongst other things, that:

- *"Wind Turbine Syndrome" symptoms are the same as those seen in the general population due to stresses of daily life. They include headaches, insomnia, anxiety, dizziness, etc.*
- *Low frequency and very low-frequency 'infrasound' produced by wind turbines are the same as those produced by vehicular traffic and home appliances, even by the beating of people's hearts. Such 'infrasounds' are not special and convey no risk factors;*
- *The power of suggestion, as conveyed by news media coverage of perceived 'wind-turbine sickness', might have triggered 'anticipatory fear' in those close to turbine installations."*

2. ***'Wind Turbine Syndrome – An independent review of the state of knowledge about the alleged health condition', Expert Panel on behalf of Renewable UK, July 2010***

This report consists of three reviews carried out by independent experts to update and understand the available knowledge of the science relating to infrasound generated by wind turbines. This report was prepared following the publication of a book entitled '*Wind Turbine Syndrome*', in 2009 by Dr. Pierpont, which received significant media attention at the time. The report discusses the methodology and assessment carried out in the 2009 publication and assessed the impact of low-frequency noise from wind turbines on humans. The independent review found that:

- *"The scientific and epidemiological methodology and conclusions drawn (in the 2009 book) are fundamentally flawed;*
- *The scientific and audiological assumptions presented by Dr Pierpont relating infrasound to WTD are wrong; and*
- *Noise from Wind Turbines cannot contribute to the symptoms reported by Dr. Pierpont's respondents by the mechanisms proposed."*

Accordingly, the consistent and scientifically robust conclusion remains that there is no evidence to demonstrate any significant health effects in humans arising from noise at the levels of that generated by wind turbines.

3. ***'A Rapid Review of the Evidence', Australian Government National Health and Medical Research Council (NHMRC) Wind Turbines & Health, July 2010***

The purpose of this paper was to review evidence from current literature on the issue of wind turbines and potential impacts on human health and to validate the finding of the *'Wind Turbine Sound and Health Effects - An Expert Panel Review'* (see Item 2 above) that:

- *"There are no direct pathological effects from wind farms and that any potential impact on humans can be minimised by following existing planning guidelines."*
- *There is currently no published scientific evidence to positively link wind turbines with adverse health effects.*
- *'This review of the available evidence, including journal articles, surveys, literature reviews and government reports, supports the statement that: There are no direct pathological effects from wind farms and that any potential impact on humans can be minimised by following existing planning guidelines."*

4. *'Position Statement on Health and Wind Turbines', Climate and Health Alliance, February 2012*

The Climate and Health Alliance (CAHA) was established in August 2010 and is a coalition of health care stakeholders who wish to see the threat to human health from climate change and ecological degradation addressed through prompt policy action. In its Position Statement in February 2012, CAHA states that:

> *"To date, there is no credible peer reviewed scientific evidence that demonstrates a direct causal link between wind turbines and adverse health impacts in people living in proximity to them. There is no evidence for any adverse health effects from wind turbine shadow flicker or electromagnetic frequency. 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 Statement explores human perceptions of wind energy and notes that some people may be predisposed to some form of negative perception that itself may cause annoyance. 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... 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."*

CAHA notes the existence of *"misinformation about wind power"* and, in particular, states that:

> *"Some of the anxiety and concern in the community stems originally from a self-published book by an anti-wind farm activist in the United States which invented a syndrome, the so-called "wind turbine syndrome". This is not a recognised medical syndrome in any international index of disease, nor has this publication been subjected to peer review."*

CAHA notes that:

> *"Large scale commercial wind farms however have been in operation internationally for many decades, often in close proximity to thousands of people, and there has been no evidence of any significant rise in disease rates."*

This, it states, contrasts with the health impacts of fossil fuel energy generation.

5. *'Wind Turbine Health Impact Study -Report of Independent Expert Panel' – Massachusetts Departments of Environmental Protection and Public Health (2012)*

An expert panel was established with the objective to, inter alia, evaluate information from peer-reviewed scientific studies, other reports, popular media and public comments and to assess the magnitude and frequency of any potential impacts and risks to human health associated with the design and operation of wind energy turbines. In its final report, the expert panel set out its conclusions under several headings, including noise and shadow flicker.

In relation to noise, the panel concluded that there was limited or no evidence to indicate any causal link between noise from wind turbines and health effects, including the following conclusions:

> *"There is no evidence for a set of health effects, from exposure to wind turbines that could be characterized as a "Wind Turbine Syndrome."*
>
> *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.*
>
> *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."*

In relation to shadow flicker, the expert panel found the following:

> *"Scientific evidence suggests that shadow flicker does not pose a risk for eliciting seizures as a result of photic stimulation.*
>
> *There is limited scientific evidence of an association between annoyance from prolonged shadow flicker (exceeding 30 minutes per day) and potential transitory cognitive and physical health effects."*

6. ***Wind Turbines and Health, A Critical Review of the Scientific Literature, Massachusetts Institute of Technology (Journal of Occupational and Environmental Medicine Vol. 56, Number 11, November 2014)***

This review assessed the peer-reviewed literature regarding evaluations of potential health effects among people living in the vicinity of wind turbines. The review posed a number of questions around the effect of turbines on human health, with the aim of determining if stress, annoyance or sleep disturbance occur as a result of living in proximity to wind turbines, and whether specific aspects of wind turbine noise have unique potential health effects. The review concluded the following with regard to the above questions:

- Measurements of low-frequency sound, infrasound, tonal sound emission, and amplitude-modulated sound show that infrasound is emitted by wind turbines. The levels of infrasound at customary distances to homes are typically well below audibility thresholds.
- No cohort or case–control studies were located in this updated review of the peer-reviewed literature. Nevertheless, among the cross-sectional studies of better quality, no clear or consistent association is seen between wind turbine noise and any reported disease or other indicator of harm to human health.
- Components of wind turbine sound, including infrasound and low frequency sound, have not been shown to present unique health risks to people living near wind turbines.
- Annoyance associated with living near wind turbines is a complex phenomenon related to personal factors. Noise from turbines plays a minor role in comparison with other factors in leading people to report annoyance in the context of wind turbines.

A further 25 reviews of the scientific evidence that universally conclude that exposure to wind farms and the sound emanating from wind farms does not trigger adverse health effects, were compiled in September 2015 by Professor Simon Chapman, of the School of Public Health and Sydney University Medical School, Australia, and is included as Appendix 5-2 of this EIAR. Another recent publication by Chapman and Crichton (2017) entitled '*Wind turbine syndrome; A communicated disease'* critically discusses why certain health impacts might often be incorrectly attributed to wind turbines.

7. ***Position Paper on Wind Turbines and Public Health: HSE Public Health Medicine Environment and Health Group, February 2017***

The Health Service Executive (HSE) position paper on wind turbines and public health was published in February 2017 to address the rise in wind farm development and concerns regarding potential impacts on public health. The paper discusses previous observations and case studies which describe a broad range of health effects that are associated with wind turbine noise, shadow flicker and electromagnetic radiation.

A number of comprehensive reviews conducted in recent years to examine whether these health effects are proven has highlighted the lack of published and high-quality scientific evidence to support adverse effects of wind turbines on health.

The HSE position paper determines that current scientific evidence on adverse impacts of wind farms on health is weak or absent. Further research and investigative processes are required at a larger scale in order to be more informative for identifying potential health effects of exposure to wind turbine effects. They advise developers on making use of the Draft Wind Energy Development Guidelines (2006), as a means of setting noise limits and set back distances from the nearest dwellings.

8. ***Environmental Noise Guidelines for the European Region: World Health Organisation Regional Office for Europe, 2018.***

The WHO *Environmental Noise Guidelines for the European Region* (2018) provide guidance on protecting human health from exposure to environmental noise. They set health-based recommendations based on average environmental noise exposure of several sources of environmental noise, including wind turbine noise. Recommendations are rated as either 'strong' or 'conditional'. A strong recommendation, "*can be adopted as policy in most situations*" whereas a conditional recommendation, "*requires a policy-making process with substantial debate and involvement of various stakeholders. There is less certainty of its efficacy owing to lower quality of evidence of a net benefit, opposing values and preferences of individuals and populations affected or the high resource implications of the recommendation, meaning there may be circumstances or settings in which it will not apply*".

The objective of the World Health Organisation (WHO) Environmental Noise Guidelines for the European Region that was published in October 2018 is to provide recommendations for protecting human health from exposure to environmental noise from transportation, wind farm and leisure sources of noise. The guidelines present recommendations for each noise source type in terms of L_{den} and L_{night} levels above which there is risk of adverse health risks.

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 L_{den}, as wind turbine noise above this level is associated with adverse health effects.*
>
> *No recommendation is made for average night noise exposure L_{night} 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 policymakers implement suitable measures to reduce noise exposure from wind turbines in the population exposed to levels above the guideline values for average noise exposure. No evidence is available, however, to facilitate the recommendation of one particular type of intervention over another.*"

The quality of evidence used for the WHO research is stated as being 'Low', the recommendations are therefore conditional.

The WHO Environmental Noise Guidelines aim to support the legislation and policy-making process on local, national and international level, thus shall be considered by Irish policy makers for any future revisions of Irish National Guidelines.

There is potential increased uncertainty due to the parameter used by the WHO for assessment of exposure (i.e. L_{den}), which it is acknowledged may be a poor characterisation of wind turbine noise and may limit the ability to observe associations between wind turbine noise and health outcomes, as stated below.

> "*Even though correlations between noise indicators tend to be high (especially between 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 L_{den} is converted from original sound pressure level values. The conversion requires, as variable, the statistical distribution of annual wind speed at a particular height, which depends on the type of wind turbine and meteorological conditions at a particular geographical location. Such input variables may not be directly applicable for use in other sites. They are sometimes used without specific validation for a particular area, however, because of practical limitations or lack of data and resources. This can lead to increased uncertainty in the assessment of the relationship between wind turbine noise exposure and health outcomes. Based on all these factors, it may be concluded that the acoustical description of wind turbine noise by means of L_{den} or L_{night} may be a poor characterization of wind turbine noise and may limit the ability to observe associations between wind turbine noise and health outcomes...*
>
> *...Further work is required to assess fully the benefits and harms of exposure to environmental noise from wind turbines and to clarify whether the potential benefits associated with reducing exposure to environmental noise for individuals living in the vicinity of wind turbines outweigh the impact on the development of renewable energy policies in the WHO European Region.*"

Based upon the review set out above, it is concluded that the conditional WHO recommended average noise exposure level (i.e. 45dB L_{den}) should not currently be applied as target noise criteria for an existing or proposed wind turbine development in Ireland.

9. ***Infrasound Does Not Explain Symptoms Related to Wind Turbines:** Finnish Government's Analysis, Assessment and Research Activities (VN TEAS), 2020*

The study targeted to adverse health effects of wind turbine infrasound and was funded by the Finnish Government's Analysis, Assessment and Research Activities (VN TEAS).

It was found that the low-frequency, inaudible sounds made by wind turbines are not damaging to human health despite fears that they cause unpleasant symptoms. The project, which was carried out over two years, examined the impact of low-frequency—or infrasound—emissions which cannot be picked up by the human ear.

People in many countries have blamed the infrasound waves for symptoms ranging from headaches and nausea to tinnitus and cardiovascular problems, researchers said.

Interviews, sound recordings and laboratory tests were used to explore possible health effects on people living within 20 kilometres (12 miles) of the generators.

The report notes:

> *'...the behavioral findings of the current study suggest that wind turbine infrasound cannot be reliably perceived and it does not result in increased annoyance. Participants that showed health effects did not show signs of increased infrasound sensitivity and did not rate wind turbine sounds more annoying.*

As a result:

'These findings do not support the hypothesis that infrasound is the element in turbine sound that causes annoyance. Instead, they suggest that people who have health symptoms which they associate with wind turbine sound are not likely to have these symptoms because they perceive turbine sound more annoying than controls, at least in laboratory settings. It is more likely that these symptoms are triggered by other factors such as symptom expectancy'.

5.5.2 Turbine Safety

Turbines pose no threat to the health and safety of the general public. The Department of the Environment, Heritage and Local Government (DoEHLG)'s '*Wind Energy Development Guidelines for Planning Authorities 2006*' and the '*Draft Revised Wind Energy Development Guidelines'* (Department of Housing, Planning and Local Government (DoHPLG), December 2019) (currently out for public consultation), iterate that there are no specific safety considerations in relation to the operation of wind turbines. Fencing or other restrictions are not necessary for safety considerations and should be kept to a minimum. People or animals can safely walk up to the base of the turbines.

The adopted 2006 Guidelines and the Draft 2019 Guidelines state that there is a very remote possibility of injury to people from flying fragments of ice or from a damaged blade. However, most blades are composite structures with no bolts or separate components and the danger is therefore minimised. The build-up of ice on turbines is unlikely to present problems. The wind turbines will be fitted with anti-vibration sensors, which will detect any imbalance caused by icing of the blades. The sensors will cause the turbine to wait until the blades have been de-iced prior to resuming operation.

Turbine blades are manufactured of glass reinforced plastic which will prevent any likelihood of an increase in lightning strikes within the site of the Proposed Development or the local area. Lightning protection conduits will be integral to the construction of the turbines. Lightning conduction cables, encased in protection conduits, will follow the electrical cable run, from the nacelle to the base of the turbine. The conduction cables will be earthed adjacent to the turbine base. The earthing system will be installed during the construction of the turbine foundations.

5.5.3 Electromagnetic Interference

The provision of underground electric cables of the capacity proposed is common practice throughout the country and installation to the required specification does not give rise to any specific health concerns.

The extremely low frequency (ELF) electric and magnetic fields (EMF) associated with the operation of the proposed cables fully comply with the international guidelines for ELF-EMF set by the International Commission on Non-Ionizing Radiation Protection (ICNIRP), a formal advisory agency to the World Health Organisation, as well as the EU guidelines for human exposure to EMF. Accordingly, there will be no operational impact on properties (residential or other uses) as the ICNIRP guidelines will not be exceeded at any distances even directly above the cables.

The EirGrid document '*EMF & You: Information about Electric & Magnetic Fields and the electricity transmission system in Ireland'* (EirGrid, 2014) provides further practical information on EMF and is included as Appendix 5-3 of this EIAR.

Further details on the potential impacts of electromagnetic interference to telecommunications and aviation are presented in Chapter 14.2: Material Assets.

5.5.4 Assessment of Effects on Human Health

As set out in the Department of Housing, Planning, Community and Local Government '*Key Issues Consultation Paper on the Transposition of the EIA Directive 2017*' and the guidance listed in Section

1.2.2 of Chapter 1: Introduction, the consideration of the effects on populations and on human health should focus on health issues and environmental hazards arising from the other environmental factors, for example water contamination, air pollution, noise, accidents, disasters.

A wind farm is not a recognised source of pollution. It is not an activity that falls within any thresholds requiring Environmental Protection Agency licensing under the Environmental Protection Agency Licensing Act 1992, as amended. As such, a wind farm is not considered to have ongoing significant emissions to environmental media and the subsequent potential for human health effects during construction, operation or decommissioning for the reasons explained below in this section and on the basis of published research discussed in Section 5.5.

Chapter 8: Land, Soils and Geology, Chapter 9: Water, Chapter 10: Air and Climate, Chapter 11: Noise and Vibration and Chapter 14: Material Assets (Traffic and Transport) provide an assessment of the effects of the Proposed Development on these areas of consideration. There is the potential for negative effects on human health during the wind farm construction phase related to potential emissions to air of dust, potential emissions to land and water of hydrocarbons, release of potentially silt-laden runoff into watercourses and noise emissions. The assessments however show that the residual impacts are not significant and do not have the potential to cause negative health effects for human beings. On this basis, the potential for negative health effects associated with the Proposed Development is imperceptible.

The proposed site design and mitigation measures outlined in Chapter 8 and Chapter 9 ensures that the potential for impacts on the water environment are not significant. No impacts on local water supplies are anticipated.

As set out in Chapter 9, potential health effects are associated with negative impacts on public and private water supplies and potential flooding. There are no mapped public or group groundwater scheme protection zones in the area of the Proposed Development.

The preliminary Flood Risk Assessment has also shown that the risk of the proposed wind farm contributing to downstream flooding is also very low.

The proposed project is for the development of a renewable energy project, a wind farm, capable of offsetting carbon emissions associated with the burning of fossil fuels. During the operational stage the wind farm will have a long term, significant, positive effect on air quality as set out in Chapter 10 which will contribute to positive effects on human health.

5.5.5 Vulnerability of the Project to Natural Disasters and Major Accidents

As outlined in Section 5.5.4 above, a wind farm is not a recognised source of pollution. Should a major accident or natural disaster occur, the potential sources of pollution onsite during the construction, operational and decommissioning phases, are limited. Sources of pollution with the potential to cause significant environmental pollution and associated negative effects on health, such as bulk storage of hydrocarbons or chemicals, storage of wastes etc., are limited.

There is limited potential for significant natural disasters to occur at the Proposed Development site. Ireland is a geologically stable country with a mild temperate climate. The potential natural disasters that may occur are therefore limited to peat instability, flooding and fire. The risk of peat instability is addressed in Chapter 8: Soils and Geology and the Geotechnical Peat Stability Assessment Report included in Appendix 8-1. The findings of the geotechnical assessment showed that the Proposed Development has an acceptable margin of safety, is considered to be at low risk of peat failure and is suitable for wind farm development. Overall, the peat characteristics on the Proposed Development site are similar to that encountered on many developed wind farm sites. Flooding is addressed in Chapter 9: Hydrology and Hydrogeology. It is considered that the risk of significant fire occurring, affecting the wind farm and causing the wind farm to have significant environmental effects is limited and therefore a significant effect on human health is similarly limited. As described earlier, there are no significant sources of pollution in the wind farm with the potential to cause environmental or health effects. Also, the spacing of the turbines and distance of turbines from any properties limits the potential for impacts on human health. The issue of turbine safety is addressed in Section 5.5.2.

Major industrial accidents involving dangerous substances pose a significant threat to humans and the environment; such accidents can give rise to serious injury to people or serious damage to the environment, both on and off the site of the accident. The wind farm site is not regulated or connected to or close to any site regulated under the Control of Major Accident Hazards Involving Dangerous Substances Regulations i.e. SEVESO sites and so there are no potential effects from this source.

5.6 Property Values

In the absence of any Irish studies on the effect of wind farms on property values, this section provides a summary of the largest and most recent studies from the United States and Scotland.

The largest study of the impact of wind farms on property values has been carried out in the United States. '*The Impact of Wind Power Projects on Residential Property Values in the United States: A multi-Site Hedonic Analysis*', December 2009, was carried out by the Lawrence Berkley National Laboratory (LBNL) for the U.S Department of Energy. This study collected data on almost 7,500 sales of single-family homes situated within ten miles of 24 existing wind farms in nine different American states over a period of approximately ten years. The conclusions of the study are drawn from eight different pricing models including repeat sales and volume sales models. Each of the homes included in the study was visited to demonstrate the degree to which the wind facility was visible at the time of the sale, and the conclusions of the report state that "The result is the most comprehensive and data rich analysis to date on the potential impacts of wind energy projects on nearby property values."

The main conclusion of this study is as follows:

> *"Based on the data and analysis presented in this report, no evidence is found that home prices surrounding wind facilities are consistently, measurably, and significantly affected by either the view of wind facilities or the distance of the home to those facilities. 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."*

This study has been recently updated by LBNL who published a further paper entitled '*A Spatial Hedonic Analysis of the Effects of Wind Energy Facilities on Surrounding Property Values in the United States*', in August 2013. This study analysed more than 50,000 home sales near 67 wind farms in 27 counties across nine U.S. states, yet was unable to uncover any impacts to nearby home property values. The homes were all within 10 miles of the wind energy facilities - about 1,100 homes were within 1 mile, with 331 within half a mile. The report is therefore based on a very large sample and represents an extremely robust assessment of the impacts of wind farm development on property prices. It concludes that:

> *"Across all model Specifications, we find no statistical evidence that home prices near wind turbines were affected in either the post-construction or post announcement/pre-construction periods."*

Both LBNL studies note that their results do not mean that there will never be a case of an individual home whose value goes down due to its proximity to a wind farm – however if these situations do exist, they are considered to be statistically insignificant. Therefore, although there have been claims of significant property value impacts near operating wind turbines that regularly surface in the press or in local communities, strong evidence to support those claims has failed to materialise in all the major U.S. studies conducted thus far.

A further study was commissioned by RenewableUK and carried out by the Centre for Economics and Business Research (Cebr) in March 2014. Its main conclusions are:

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

A relatively new study issued in October 2016 '*Impact of wind Turbines on House Prices in Scotland'* (2016) was published by Climate Exchange. Climate Exchange is Scotland's independent centre of expertise on climate change which exists to support the Scottish Governments policy development on climate and the transition to a low carbon economy. A copy of the report is included as Appendix 5-4 of this EIAR.

The report presents the main findings of a research project estimating the impact on house prices from wind farm developments. It is based on analysis of over 500,000 property sales in Scotland between 1990 and 2014. The key findings from the study are:

- **No evidence of a consistent negative effect on house prices**: Across a very wide range of analyses, including results that replicate and improve on the approach used by Gibbons (2014), we do not find a consistent negative effect of wind turbines or wind farms when averaging across the entire sample of Scottish wind turbines and their surrounding houses. Most results either show no significant effect on the change in price of properties within 2km or 3km or find the effect to be positive.
- **Results vary across areas**: The results vary across different regions of Scotland. Our data does not provide sufficient information to enable us to rigorously measure and test the underlying causes of these differences, which may be interconnected and complex.

Although there have been no empirical studies carried out in Ireland on the impacts of wind farms on property prices, the literature described above demonstrates that at an international level, wind farms have not impacted property values in the local areas. It is a reasonable assumption based on the available international literature, that the provision of a wind farm at the proposed location would not impact on the property values in the area.

5.7 Shadow Flicker

5.7.1 Background

Shadow flicker is an effect that occurs when rotating wind turbine blades cast shadows over a window in a nearby property. Shadow flicker is an indoor phenomenon, which may be experienced by an occupant sitting in an enclosed room when sunlight reaching the window is momentarily interrupted by a shadow of a wind turbine's blade. Outside in the open, light reaches a viewer (person) from a much less focused source than it would through a window of an enclosed room, and therefore shadow flicker assessments are typically undertaken for the nearby adjacent properties around a proposed wind farm site.

The frequency of occurrence and the strength of any potential shadow flicker impact depends on several factors, each of which is outlined below.

1. ***Whether the sunlight is direct and unobstructed or diffused by clouds:***

If the sun is not shining, shadow flicker cannot occur. Reduced visibility conditions such as clouds, haze, and fog greatly reduce the chance of shadow flicker occurring.

"*Cloud amounts are reported as the number of eights (okta) of the sky covered. Irish skies are completely covered by cloud for over 50% of the time. The mean cloud amount for each hour is between five and six okta. This is due to Ireland's geographical position off the northwest of Europe, close to the path of Atlantic low-pressure systems which tend to keep the country in humid, cloudy airflows for much of the time. A study at 12 stations over a 25-year period showed that the mean cloud amount was at a minimum in April and maximum in July. Cloud amounts were less at night than during the day, with the mean minimum occurring roughly between 2100 and 0100 GMT and the mean maximum occurring between 1000 and 1500 GMT at most stations."* (Source: Met Éireann, www.met.ie).

2. ***The presence of intervening obstructions between the turbine and the observer:***

For shadow flicker to occur, the windows of a potentially affected property must have direct visibility of a wind turbine, with no physical obstructions such as buildings, trees and hedgerows, hills or other structures located on the intervening land between the window and the turbine.

Any obstacles such as trees or buildings located between a property and the wind turbine will reduce or eliminate the occurrence and/or intensity of the shadow flicker.

3. ***How high the sun is in the sky at a given time:***

At distances of greater than approximately 500m between a turbine and a receptor, shadow flicker generally occurs only at sunrise or sunset when the shadow cast by the turbine is longer. The current adopted 'Wind Energy Development Guidelines for Planning Authorities' published by the Department of Environment, Heritage and Local Government (DoEHLG) in 2006, iterates that at distances greater than ten rotor diameters from a turbine, the potential for shadow flicker is very low (*'Wind Energy Development Guidelines for Planning Authorities'*, DoEHLG, 2006).

Figure 5-4 illustrates the shadow cast by a turbine at various times during the day; the red shading represents the area where shadow flicker may occur. When the sun is high in the sky, the length of the shadow cast by the turbine is significantly shorter.

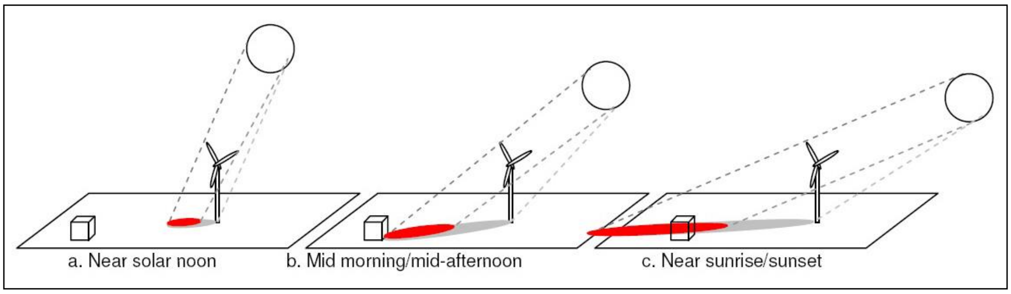

Figure 5-4 Shadow-Prone Area as Function of Time of Day (Source: Shadow Flicker Report, Helimax Energy, Dec 2008)

4. ***Distance and bearing, i.e. where the property is located relative to a turbine and the sun:***

The further a property is from the turbine the less pronounced the impact will be. There are several reasons for this: there are fewer times when the sun is low enough to cast a long shadow; when the sun is low it is more likely to be obscured by either cloud on the horizon or intervening buildings and vegetation; and the centre of the rotor's shadow passes more quickly over the land reducing the duration of the impact.

At a distance, the turbine blades do not cover the sun but only partly mask it, substantially weakening the shadow. This impact occurs first with the shadow from the blade tip, the tips being thinner in section than the rest of the blade. The shadows from the tips extend the furthest and so only a very weak impact is observed at distance from the turbines. (Source: Update of Shadow Flicker Evidence Base, UK Department of Energy and Climate Change, 2010).

5. ***Property usage and occupancy:***

Where shadow flicker is predicted to occur at a specific location, this does not imply that it will be witnessed. Potential occupants of a property may be sleeping or occupying a room on another side of the property that is not subject to shadow flicker, or completely absent from the location during the time of shadow flicker events. As shadow flicker usually occurs only when the sun is at a low angle in the sky, i.e. very early in the morning after sunrise or late in the evening before sunset, even if there is a bedroom on the side of the property affected, the shadow flicker may not be witnessed if curtains or blinds in the bedroom are closed.

6. ***Wind direction, i.e. position of the turbine blades:***

The direction of wind turbine blades changes according to wind direction, as the turbine rotor turns to face the wind. In order to cast a shadow, the turbine blades must be facing directly toward or away from the sun, so they are moving across the source of the light relative to the observer. This is demonstrated in Figure 5-5 below.

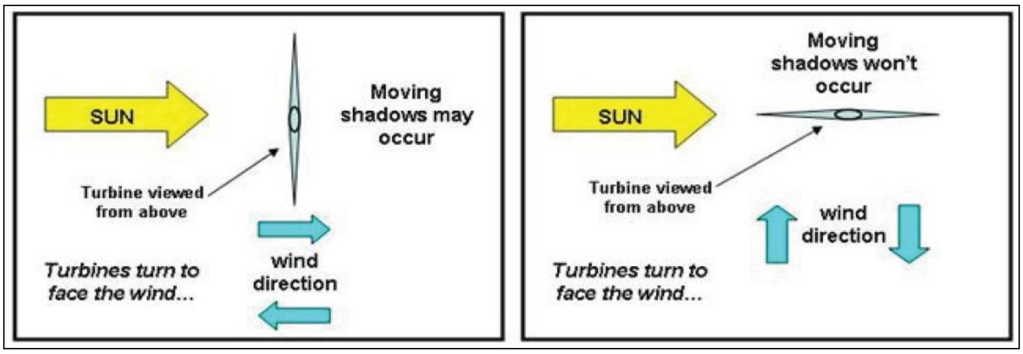

Figure 5-5 Turbine Blade Position and Shadow Flicker Impact (Source: Wind Fact Sheet: Shadow Flicker, Noise Environment Power LLC)

7. ***Rotation of turbine blades:***

Shadow flicker occurs only if there is sufficient wind for the turbine blades to be continually rotating. Wind turbines begin operating at a specific wind speed referred to as the 'cut-in speed', i.e. the speed at which the turbine produces a net power output, and they cease operating at a specific 'cut-out speed'. Therefore, even during the sunlight hours when shadow flicker has been predicted to occur, if the turbine blades are not turning due to insufficient wind speed, no shadow flicker will occur.

5.7.2 Guidance

The current, adopted guidance for shadow flicker in Ireland is derived from the '*Wind Energy Development Guidelines for Planning Authorities 2006'* (DoEHLG), and the '*Best Practice Guidelines for the Irish Wind Energy Industry'* (Irish Wind Energy Association, 2012). The 2006 DoEHLG Guidelines state that at distances greater than 10 rotor diameters from a turbine, the potential for shadow flicker is very low.

The DoEHLG 2006 wind energy guidelines recommend that shadow flicker at dwellings within 500 metres of a proposed turbine location should not exceed a total of 30 hours per year or 30 minutes per day. The closest occupied residential property is located approximately 700 metres from the nearest turbine location. Refer to Section 5.2.

The DoEHLG guidelines state that shadow flicker lasts only for a short period of time and occurs only during certain specific combined circumstances, as follows:

- the sun is shining and is at a low angle in the sky, i.e. just after dawn and before sunset, **and**
- the turbine is located directly between the sun and the affected property, **and**
- there is enough wind energy to ensure that the turbine blades are moving, **and**
- the turbine blades are positioned so as to cast a shadow on the receptor.

Although the DoEHLG thresholds apply to properties located within 500 metres of a proposed turbine location, for the purposes of this assessment, the guideline thresholds of 30 hours per year or 30 minutes per day have been applied to all properties located within ten rotor diameters (i.e. assumed at 1.5 kilometres as a worst-case scenario) of the proposed turbines within the Proposed Development (as per IWEA guidelines, 2012). The DoEHLG Guidelines state that at distances greater than 10 rotor diameters from a turbine, the potential for shadow flicker is very low.

The adopted 2006 DoEHLG guidelines are currently under review. The DoHPLG released the *'Draft Revised Wind Energy Development Guidelines'* in December 2019 for public consultation. The Draft 2019 guidelines recommend local planning authorities and/or An Bord Pleanála impose conditions to ensure that:

> *"no existing dwelling or other affected property will experience shadow flicker as a result of the wind energy development subject of the planning application and the wind energy development shall be installed and operated in accordance with the shadow flicker study submitted to accompany the planning application, including any mitigation measures required."*

The Draft 2019 Guidelines are based on the recommendations set out in the *'Proposed Revisions to Wind Energy Development Guidelines 2006 – Targeted Review'* (December 2013) and the *'Review of the Wind Energy Development Guidelines 2006 – Preferred Draft Approach'* (June 2017).

The assessment herein is based on compliance with the current DoEHLG Guidelines limit (30 hours per year or 30 minutes per day). However, it should also be noted the Proposed Development can be brought in line with the requirements of the 2019 draft guidelines, should they be adopted while this application is in the planning system, through the implementation of the mitigation measures outlined in Section 5.9.3.9.

5.7.3 Scoping

Section 2.5 in Chapter 2 of this EIAR describes the scoping and consultation exercise undertaken for the Proposed Development. The HSE issued a Consultation Report on the Proposed Development in March 2020. With respect to Shadow Flicker, the HSE recommended that a shadow flicker assessment be undertaken to identify all dwellings and sensitive receptors which may be impacted by shadow flicker. The assessment should also include all proposed mitigation measures.

5.7.4 Shadow Flicker Prediction Methodology

Shadow flicker occurs only under certain, combined circumstances, as detailed above. Where shadow flicker does occur, it is generally short-lived. The DoEHLG guidelines state that careful site selection, design and planning, and good use of relevant software can help avoid the possibility of shadow flicker, all of which have been employed at the site of the Proposed Development. Proper siting of wind turbines is key in eliminating shadow flicker.

The occurrence of shadow flicker can be precisely predicted using specialist computer software programmes specifically developed for the wind energy industry, such as WindFarm (ReSoft) or

WindFarmer (DNV.GL) or AWS OpenWind. The computer modelling of the occurrence and magnitude of shadow flicker is made possible by the fact that the sun rises and sets in the same position in the sky on every day each year.

Any potential impact can be precisely modelled to give the start and end time (accurate to the second) of any incidence of shadow flicker, at any location, on any day or all days of the year when it might occur. Where a shadow flicker impact is predicted to occur, the total maximum daily and annual durations can be predicted, along with the total number of days. Any incidence of predicted shadow flicker can be attributed to a particular turbine or group of turbines to allow effective mitigation strategies to be planned and proposed as detailed further below.

For the purposes of this shadow flicker assessment, the software package ReSoft WindFarm Version 5.0.1.2 has been used to predict the level of shadow flicker associated with the proposed wind farm development. WindFarm is a commercially available software tool that enables developers to analyse, design and optimise proposed wind farms. It allows proposed turbine layouts to be optimised for maximum energy yield whilst taking account of environmental, planning and engineering constraints.

5.7.5 Shadow Flicker Assessment Criteria

5.7.5.1 Turbine Dimensions

The turbine model to be installed on the site will have an overall ground-to-blade tip height in the range of 175 metres maximum to 173 metres minimum; blade length in the range of 75 metres maximum to 66.5 metres minimum and hub height in the range of 108.5 metres maximum to 100 metres minimum. It is considered that a worst-case scenario for potential shadow flicker effects is a combination of the maximum rotor diameter and the minimum hub height (therefore providing the maximum tip height). For the purposes of this assessment, a turbine with a tip height of 175m, blade length of 75m (rotor diameter of 150m) and a hub height of 100m was modelled in order to assess a worst-case scenario. While these dimensions have been used for the purposes of this assessment, the actual turbine to be installed on the site will be the subject of a competitive tender process and could include turbines with alternative dimensions within the proposed size range.

Regardless of the make or model of the turbine eventually selected for installation on site, the maximum tip height will be 175 metres and the maximum rotor diameter will be 150m, and the potential shadow flicker impact it will give rise to will be no more than that predicted in this assessment. With the benefit of the mitigation measures outlined in this section, any turbine to be installed onsite will be able to comply with the DoEHLG 2006 guidelines thresholds of 30 minutes per day or 30 hours per year, or with any revised guidelines if required, through the use of turbine control software.

Any references to the turbine dimensions in this shadow flicker assessment should be considered in the context of the above and should not be construed as pre-determining the dimensions of the wind turbine to be used on the site.

5.7.5.2 Study Area

The study area for the shadow flicker assessment is ten times rotor diameter from each turbine as set out in the Wind Energy Development Guidelines for Planning Authorities', DoEHLG, 2006. All residential properties located within ten rotor diameters which is assumed to be 1.5 kilometres have been included in the assessment. A planning history search to identify properties that may have been granted planning permission, but not yet been constructed, was carried out. Any property with a valid planning permission for a dwelling house was also added to the sensitive receptors' dataset.

There is a total of 67 No. receptors identified within the shadow flicker study area, of which 61 are inhabitable dwellings and 6 are derelict properties. The shadow flicker study area and sensitive receptor locations are shown in Figure 5-6. There is a derelict property located 528 metres from the closest turbine, the owner of this property is a participating landowner in the Proposed Development. Following that, the closest turbine to any sensitive receptor is located in excess of 700m.

Map Legend

- EIAR Site Boundary
- Proposed Turbine Locations

Properties

- Derelict
- Dwelling
- Shadow Flicker Assessment Area - 1500m (10x150m Rotor Diameter)

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Drawing Title	Shadow Flicker Study Area
Project Title	Slieveacurry Renewable Energy Development, Co. Clare
Drawn By: Ellen Costello	Checked By: Michael Watson
Project No.: 170224c	Drawing No.: Figure 5-6
Scale: 1:25000	Date: 29.10.2021

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5.7.5.3 Assumptions and Limitations

Due to the latitude of Ireland and the UK, shadow flicker impacts are only possible at properties 130 degrees either side to the north as turbines do not cast shadows on their southern side (ODPM Annual Report and Accounts 2004: Housing, Planning, Local Government and the Regions Committee; Planning Policy Statement 22; Draft Revised Wind Energy Development Guidelines 2019). As such properties located outside of this potential shadow flicker zone will not be impacted. However, in this assessment, all 67 no. properties within 360 degrees of the Proposed Development within the study area were assessed for shadow flicker impact.

At each property, shadow flicker calculations were carried out based on 4 no. notional windows facing north, east, south and west, labelled Windows 1, 2, 3 and 4 respectively. The degrees from north value for each window is:

- Window 1: 0 degrees from North
- Window 2: 90 degrees from North
- Window 3: 180 degrees from North
- Window 4: 270 degrees from North

Each window measures one-metre-high by one-metre-wide, and tilt angle is assumed to be zero. The centre height of each window is assumed to be two metres above ground level and no screening due to trees or other buildings or vegetation is assumed. It was not considered necessary or practical to measure the dimensions of every window on every property in the study area. While the actual size of a window will marginally influence the incidence and duration of any potential shadow flicker impact, with larger windows resulting in slightly longer shadow flicker durations, any incidences or durations or shadow flicker can be countered by the measures outlined in Section 5.9.3.4 below.

The use of computer models to predict the amount of shadow flicker that will occur is known to produce an over-estimate of possible impact, referred to as the 'worst-case impact', due to the following limitations:

- The sun is assumed to be shining during all daylight hours such that a noticeable shadow is cast. This will not occur in reality.
- The wind is always assumed to be within the operating range of the turbines such that the turbine rotor is turning at all times, thus enabling a periodic shadow flicker. Wind turbines only begin operating at a specific 'cut-in speed', and cease operating at a specific 'cut-out speed'. In periods where the wind is blowing at medium to high speeds, the probability of there being clear or partially clear skies where the sun is shining and could cast a shadow, is low.
- The wind turbines are assumed to be available to operate, i.e. turned on at all times. In reality, turbines may be switched off during maintenance or for other technical or environmental reasons.
- The turbine rotor is considered (as a sphere) to present its maximum aspect to observers in all directions. In reality, the wind direction and relative position of the turbine rotor would result in a changing aspect being presented by the turbine. The rotor will actually present as ellipses of varying sizes to observers from different directions. The time taken for the sun to pass across the sky behind a highly elliptical rotor aspect will be shorter than the modelled maximum aspect.

The total annual shadow flicker calculated for each property assumes 100% sunshine during daytime hours, as referred to above. However, weather data for this region shows that the sun shines on average for 29.4% of the daylight hours per year. This percentage is based on Met Eireann data recorded at Shannon Airport over the 30-year period from 1981 to 2010 (www.met.ie). The actual sunshine hours at the Proposed Development and therefore the percentage of time shadow flicker could actually occur is 29.4% of daylight hours. Table 5-9 therefore lists the annual shadow flicker calculated for each property when corrected for the regional average of 29.4% sunshine, to give a more accurate annual average shadow flicker prediction.

Table 5-9 outlines whether a shadow flicker mitigation strategy is required for any property within the study area which may be impacted by shadow flicker.

5.7.6 Shadow Flicker Assessment Results

5.7.6.1 Daily and Annual Shadow Flicker

The ReSoft WindFarm computer software was used to model the predicted daily and annual shadow flicker levels in significant detail, identifying the predicted daily start and end times, maximum daily duration and the individual turbines predicted to give rise to shadow flicker.

The model results assume worst-case conditions, including

- 100% sunshine during all daylight hours throughout the year,
- An absence of any screening (vegetation or other buildings),
- That the sun is behind the turbine blades,
- That the turbine blades are facing the property, and
- That the turbine blades are moving.

The maximum daily shadow flicker model assumes that daylight hours consist of 100% sunshine. This is a conservative assumption which represents a worst-case scenario. Following the detail provided above on sunshine hours, a sunshine factor of 29.4% has been applied to the annual shadow flicker results. Taking this information into consideration, the predicted shadow flicker which is estimated to occur at nearby dwellings is presented in Table 5-9.

The predicted maximum daily and annual shadow flicker levels are then considered in the context of the DoEHLG's guideline daily threshold of 30 minutes per day and annual threshold of 30 hours per year. If there is a predicted exceedance of the threshold limits at any property, the turbines that contribute to the exceedance are also identified.

The DoEHLG Wind Energy Guidelines recommend that shadow flicker at dwellings within 500 metres of a proposed turbine location should not exceed a total of 30 minutes per day or 30 hours per year. As detailed in Section 5.1 there are no sensitive receptors less than 700 metres of the proposed turbine locations. There is one derelict property located 528 metres to the northeast of turbine no. 2 and is the property of a participating landowner in the Proposed Development. However, for the purposes of this assessment, the predicted shadow flicker levels have been modelled for all receptors within 1,500 metres of the proposed turbine locations.

A total of 67 No. receptors have been modelled as part of the shadow flicker assessment, the results of which are presented in Table 5-9. Former residential dwellings termed as "derelict" within this assessment are defined as properties that are currently in an uninhabitable condition.

Table 5-9 Maximum Potential Daily & Annual Shadow Flicker – Proposed Slieveacurry Renewable Energy Development, Co. Clare

House ID	ITM Coordinates (Easting)	ITM Coordinates (Northing)	Description	Distance to Nearest Turbine (metres)	Nearest Proposed Turbine No.	Max. Daily Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker Adjusted for Average Regional Sunshine (hrs:min:sec)	Proposed Turbine(s) Giving Rise to Daly Shadow Flicker Exceedance	Mitigation Strategy Required (Daily)	Mitigation Strategy Required (Annual)
1	512952	681689	Dwelling	1006	T2	00:51:36	64:30:00	18:59:30	2	No**	No
2	510039	680384	Dwelling	1483	T3	00:25:12	10:48:00	3:10:48	N/A	No	No
3	510358	680253	Dwelling	1160	T3	00:31:48	17:42:00	5:12:42	3	Yes	No
4	510313	680498	Dwelling	1224	T3	00:30:00	15:18:00	4:30:18	N/A	No	No
5	510730	680605	Derelict	851	T3	01:06:00	64:18:00	18:55:58	1,3	No*	No
6	510773	680747	Dwelling	878	T3	00:58:12	66:30:00	19:34:50	1,3	Yes	No
7	510795	680756	Dwelling	864	T3	00:58:48	69:12:00	20:22:32	1,3	Yes	No
8	510939	681008	Dwelling	879	T1	00:42:00	95:30:00	28:07:10	1,3	Yes	No
9	513337	681877	Dwelling	1381	T2	00:28:48	35:06:00	10:20:06	N/A	No	No
10	510940	681407	Dwelling	1052	T1	00:36:36	37:42:00	11:06:02	1	Yes	No
11	510885	681380	Dwelling	1082	T1	00:35:24	35:42:00	10:30:42	1	Yes	No
12	511289	681321	Dwelling	732	T1	00:58:12	110:12:00	32:26:52	1,4	Yes	Yes
13	511494	681771	Dwelling	1028	T1	00:29:24	25:48:00	7:35:48	N/A	No	No
14	511487	681806	Dwelling	1063	T1	00:28:48	28:54:00	8:30:34	N/A	No	No
15	511948	681472	Dwelling	703	T1	01:34:48	120:54:00	35:35:54	1,2	Yes	Yes
16	511917	681611	Dwelling	834	T1	01:22:12	84:06:00	24:45:46	2	Yes	No
17	513918	681413	Dwelling	1398	T5	00:27:36	15:30:00	4:33:50	N/A	No	No

House ID	ITM Coordinates (Easting)	ITM Coordinates (Northing)	Description	Distance to Nearest Turbine (metres)	Nearest Proposed Turbine No.	Max. Daily Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker Adjusted for Average Regional Sunshine (hrs:min:sec)	Proposed Turbine(s) Giving Rise to Daly Shadow Flicker Exceedance	Mitigation Strategy Required (Daily)	Mitigation Strategy Required (Annual)
18	511982	681596	Dwelling	832	T1	01:36:00	93:24:00	27:30:04	1,2	Yes	No
19	512022	681565	Dwelling	812	T1	01:43:12	106:06:00	31:14:26	1,2	Yes	Yes
20	512123	681534	Dwelling	793	T2	01:54:00	125:06:00	36:50:06	1,2,5	Yes	Yes
21	510900	679956	Dwelling	699	T3	00:48:36	115:12:00	33:55:12	3,7	Yes	Yes
22	513472	681016	Dwelling	801	T5	00:45:00	45:24:00	13:22:04	2,5	No**	No
23	513401	680946	Dwelling	702	T5	00:51:36	58:30:00	17:13:30	2,5	No**	No
24	512990	682133	Dwelling	1423	T2	00:00:00	0:00:00	0:00:00	N/A	No	No
25	513545	681794	Dwelling	1460	T5	00:27:36	38:12:00	11:14:52	N/A	No	No
26	511472	681722	Dwelling	988	T1	00:29:24	29:30:00	8:41:10	N/A	No	No
27	511879	681583	Dwelling	801	T1	01:15:36	86:24:00	25:26:24	1,2	Yes	No
28	514261	680402	Dwelling	1414	T5	00:26:24	12:42:00	3:44:22	N/A	No	No
29	514186	681141	Dwelling	1477	T5	00:25:12	11:18:00	3:19:38	N/A	No	No
30	514176	680393	Dwelling	1330	T5	00:28:12	14:30:00	4:16:10	N/A	No	No
31	513205	678918	Dwelling	1233	T6	00:30:00	32:24:00	9:32:24	N/A	No	No
32	510982	678013	Dwelling	1306	T7	00:00:00	0:00:00	0:00:00	N/A	No	No
33	512882	681127	Derelict	529	T2	01:34:12	190:30:00	56:05:30	1,2,4,5	No*	No*
34	510904	678525	Derelict	899	T7	00:00:00	0:00:00	0:00:00	N/A	No	No
35	513408	680032	Derelict	734	T5	00:34:48	28:24:00	8:21:44	6	No*	No

House ID	ITM Coordinates (Easting)	ITM Coordinates (Northing)	Description	Distance to Nearest Turbine (metres)	Nearest Proposed Turbine No.	Max. Daily Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker Adjusted for Average Regional Sunshine (hrs:min:sec)	Proposed Turbine(s) Giving Rise to Daly Shadow Flicker Exceedance	Mitigation Strategy Required (Daily)	Mitigation Strategy Required (Annual)
36	514132	680061	Dwelling	1358	T5	00:28:48	19:24:00	5:42:44	N/A	No	No
37	514102	679788	Dwelling	1445	T5	00:28:12	30:36:00	9:00:36	N/A	No	No
38	513819	679736	Dwelling	1240	T5	00:26:24	12:30:00	3:40:50	N/A	No	No
39	513135	679828	Dwelling	739	T5	00:48:00	86:42:00	25:31:42	4,6,8	Yes	No
40	513201	679768	Dwelling	814	T6	00:45:00	82:54:00	24:24:34	4,6	Yes	No
41	513815	679470	Dwelling	1418	T5	00:26:24	14:06:00	4:09:06	N/A	No	No
42	513634	679434	Dwelling	1309	T6	00:29:24	21:06:00	6:12:46	N/A	No	No
43	513646	679169	Dwelling	1425	T6	00:28:12	31:42:00	9:20:02	N/A	No	No
44	512840	678927	Dwelling	1019	T8	00:11:24	1:12:00	0:21:12	N/A	No	No
45	512966	679146	Derelict	904	T6	00:37:12	33:54:00	9:58:54	8	No*	No
46	512770	679138	Derelict	801	T6	00:46:12	75:36:00	22:15:36	8	No*	No
47	512622	678759	Dwelling	960	T8	00:00:00	0:00:00	0:00:00	N/A	No	No
48	512165	678579	Dwelling	913	T8	00:00:00	0:00:00	0:00:00	N/A	No	No
49	512129	678334	Dwelling	1112	T7	00:00:00	0:00:00	0:00:00	N/A	No	No
50	512077	678317	Dwelling	1095	T7	00:00:00	0:00:00	0:00:00	N/A	No	No
51	511595	678103	Dwelling	1130	T7	00:00:00	0:00:00	0:00:00	N/A	No	No
52	511397	678085	Dwelling	1143	T7	00:00:00	0:00:00	0:00:00	N/A	No	No
53	511313	678048	Dwelling	1188	T7	00:00:00	0:00:00	0:00:00	N/A	No	No

House ID	ITM Coordinates (Easting)	ITM Coordinates (Northing)	Description	Distance to Nearest Turbine (metres)	Nearest Proposed Turbine No.	Max. Daily Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker Adjusted for Average Regional Sunshine (hrs:min:sec)	Proposed Turbine(s) Giving Rise to Daly Shadow Flicker Exceedance	Mitigation Strategy Required (Daily)	Mitigation Strategy Required (Annual)
54	511020	678047	Dwelling	1261	T7	00:00:00	0:00:00	0:00:00	N/A	No	No
55	510783	678042	Dwelling	1367	T7	00:00:00	0:00:00	0:00:00	N/A	No	No
56	510927	678542	Dwelling	871	T7	00:00:00	0:00:00	0:00:00	N/A	No	No
57	510957	678583	Dwelling	820	T7	00:00:00	0:00:00	0:00:00	N/A	No	No
58	510961	678680	Dwelling	744	T7	00:00:00	0:00:00	0:00:00	N/A	No	No
59	510573	678901	Dwelling	950	T7	00:39:36	51:30:00	15:09:50	7	Yes	No
60	510478	678248	Dwelling	1390	T7	00:00:00	0:00:00	0:00:00	N/A	No	No
61	510657	679500	Dwelling	854	T7	00:40:48	39:24:00	11:36:04	7	No	No
62	510401	679349	Dwelling	1072	T7	00:33:36	18:48:00	5:32:08	7	No**	No
63	510217	679245	Dwelling	1249	T7	00:29:24	14:54:00	4:23:14	N/A	No	No
64	512922	682079	Dwelling	1348	T2	00:00:00	0:00:00	0:00:00	N/A	No	No
65	510125	679053	Dwelling	1352	T7	00:27:36	14:12:00	4:10:52	N/A	No	No
66	513084	681951	Dwelling	1299	T2	00:30:00	22:54:00	6:44:34	N/A	No	No
67	512874	681435	Dwelling	749	T2	00:56:24	83:24:00	24:33:24	2,5	Yes	No

* Derelict Property

**Participating Property

Of the 67 No. properties modelled; it is predicted that 28 properties may experience daily shadow flicker levels in excess of the DoEHLG guideline threshold of 30 minutes per day. This prediction is assuming worst-case conditions (i.e. 100% sunshine on all days where the shadow of the turbines passes over a house, wind blowing in the correct direction, no screening present, etc.) and in the absence of any turbine control measures.

Of these 28 No. properties:

- 23 No. properties are inhabitable dwellings (including 4 Participating Properties); and
- 5 No. properties are derelict properties

Of the 67 no. properties modelled, when the regional sunshine average (i.e. the mean number of sunshine hours throughout the year) of 29.4% is taken into account, the DoEHLG guideline limit of 30 hours per year is predicted to be exceeded at 5 of the inhabitable properties and 1 derelict property.

Additionally, it is worth reiterating that the predicted shadow flicker listed in Table 5-9 is considered conservative and in reality, the occurrence and/or duration of shadow flicker at these properties is likely to be eliminated or significantly reduced as the following items are not considered by the model:

- Receivers may be screened by topography, cloud cover and/or vegetation/built form i.e. adjacent buildings, farm buildings, garages or barns;
- Each receiver will not have windows facing in all directions onto the wind farm.
- At distances, greater than 500-1000m '*the rotor blade of a wind turbine will not appear to be chopping the light but the turbine will be regarded as an object with the sun behind it. Therefore, it is generally not necessary to consider shadow casting at such distances'* (Danish Wind Industry Association, accessed 2010).

Section 5.9.3.4 below outlines the mitigation strategies which may be employed at the potentially affected properties to ensure that the current adopted 2006 DoEHLG guidelines are complied with at any dwelling within the 1.5km study area. The same mitigation strategies, outlined in Section 5.9.3.4, could be taken further to achieve stricter shadow flicker controls, should the shadow flicker requirements of the Draft Revised Wind Energy Development Guidelines (2019) be adopted, as currently proposed, while this application is in the planning system.

5.7.6.2 Comparative Shadow Flicker Assessment

A comparative assessment was undertaken where a turbine with alternative dimensions within the proposed size range as detailed in Section 4.1 was modelled and compared against the worst-case scenario as set out in Section 5.7.6.1 and Table 5-9. The two modelled turbines are as follows:

- **Lowest Hub (100m) & Longest Blade (75m)** – modelled as the worst-case scenario and presented in Table 5-9 in Chapter 5 in the EIAR.
- **Highest Hub (108.5m) & Shortest Blade (66.5m)**

For all turbines modelled, the study area remained unchanged at 1.5km. The assessment results are presented in Appendix 5-5: Comparative Shadow Flicker Assessment.

The findings of the assessment indicate that of the 67 no. properties modelled, daily shadow flicker exceedance is experienced at 28 properties for the Lowest Hub & Longest Blade turbine (as detailed in Section 5.7.6.1), and at 26 properties for the Highest Hub & Shortest Blade turbine. Of the 67 properties modelled, when adjusted for regional sunshine, annual shadow flicker exceedance is experienced at 6 properties for the Lowest Hub & Longest Blade turbine (as detailed in Section 5.7.6.1), and at 3 properties for the Highest Hub & Shortest Blade turbine. The results of this comparative assessment support the consideration that a worst-case scenario for potential shadow flicker effects is the Lowest

Hub & Longest Blade turbine, i.e. a combination of the maximum rotor diameter and the minimum hub height (therefore providing the maximum tip height).

5.7.6.3 Cumulative Shadow Flicker

The cumulative assessment of shadow flicker generated by the Proposed Development and other existing and permitted wind farms within 1.5km was carried out based on the methodology, assumptions and criteria outlined in Section 5.7.4 and Section 5.7.5.

Table 5-10 below shows the potential cumulative shadow flicker impact of the Proposed Development in combination with existing and proposed wind farm developments within the 1.5km shadow flicker study area of the Proposed Development. Within the shadow flicker study area there is one constructed wind farm: Slievecallan Wind Farm (29 constructed, rotor diameter 90m, tip height 125m, Planning Reference PL03.237524) and this has been included in the cumulative shadow flicker assessment.

Table 5-10 indicates that of the 67 properties within 1.5km of the Proposed Development, 9 properties have the potential for cumulative shadow flicker impacts, when the Slievecallan wind farm is assessed in combination with the Proposed Development. Figure 5-7 illustrates the zone of combined impact potential between the Proposed Development and Slievecallan wind farm. Mitigation strategies are outlined in Section 5.9.3.9.2.

Map Legend

- EIAR Site Boundary
- Proposed Turbine Locations

Properties

- Derelict
- Dwelling
- Proposed Development Shadow Flicker Assessment Area - 1500m (10x150m Rotor Diameter)

Cumulative Shadow Flicker

- Slievecallan Turbine Locations
- Slievecallan Wind Farm Shadow Flicker Assessment Area - 900m (10x90m Rotor Diameter)

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Drawing Title	
Cumulative Shadow Flicker Assessment	
Project Title	
Slieveacurry Renewable Energy Development, Co. Clare	
Drawn By	Checked By
Ellen Costello	Michael Watson
Project No.	Drawing No.
170224c	Figure 5-7
Scale	Date
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Table 5-10 Potential Cumulative Shadow Flicker Impact from the Proposed Slieveacurry Wind Farm and Slievecallan Wind Farm

House no.	ITM Coordinates (Easting)	ITM Coordinates (Northing)	Status	Nearest Proposed Turbine No. *	Distance to Nearest Turbine (metres)	Max. Daily Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker Adjusted for Average Regional Sunshine (hrs:min:sec)	Turbine(s) contributing to Cumulative Shadow Flicker impact*	Further Assessment Required
31	513205	678918	Dwelling	27	387	01:10:48	126:48:00	37:20:08	8, 24, 26, 27, 28	Yes
37	514102	679788	Dwelling	23	853	00:28:12	47:48:00	14:04:28	5, 23	No
38	513819	679736	Dwelling	23	887	00:27:00	39:30:00	11:37:50	6, 23	No
41	513815	679470	Dwelling	23	662	00:33:36	37:12:00	10:57:12	6, 23	Yes
42	513634	679434	Dwelling	23	761	00:29:24	55:36:00	16:22:16	6, 23, 27	No
43	513646	679169	Dwelling	27	603	00:37:48	100:24:00	29:33:44	6, 23, 24, 27	Yes
44	512840	678927	Dwelling	27	675	00:32:24	34:24:00	10:07:44	7, 26, 27	Yes
45	512966	679146	Derelict	27	706	00:37:12	54:06:00	15:55:46	8, 27	No
46	512770	679138	Derelict	8	701	00:46:12	89:48:00	26:26:28	7, 8, 27	No**

*Turbines 1-8 are part of the proposed Slieveacurry Wind farm. Turbines 9- 37 comprise the Slievecallan Wind Farm.

**Derelict

Daily Cumulative

Of the properties with the potential for a cumulative impact to arise, Table 5-10 above illustrates that only 4 no. properties warrant further assessment (houses 31, 41, 43 & 44). Table 5-11 below provides further assessment in relation to these 4 no. properties and details that the Proposed Development does not give rise to daily shadow flicker exceedance at any of the 4 properties. Table 5-11 also shows that there is no overlap on any particular day, when shadow flicker is predicted to arise from the Proposed Development and the existing Slievecallan Wind Farm. On this basis, there will be no cumulative daily shadow flicker impact.

Table 5-11 Potential Cumulative Daily Shadow Flicker Impact from the Proposed Slieveacurry Wind Farm and Slievecallan Wind Farm

Property No.	Max. Potential Daily Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Turbine(s) contributing to Cumulative Shadow Flicker impact*	No. of Days 30min/day Threshold is Exceeded by Proposed Development and Slievecallan Wind Farm	No. of Days 30min/day Threshold is Exceeded by Proposed Development (Turbines 1-8)	No. of Days 30min/day Threshold is Exceeded by Slievecallan Wind Farm (Turbines 9-27)	No. of Days where any levels of Shadow Flicker produced by the Proposed Development overlaps with that of Slievecallan Wind Farm	Mitigation Required by Proposed Development
31	01:10:48	8, 24, 26, 27, 28	112	0	112 (January to March; September to December)	0	No, there are no days that overlap.
41	00:33:36	6, 23	23	0	23 (January to February; October to November)	0	No, there are no days that overlap.
43	00:37:48	6, 23, 24, 27	73	0	73 (January to March; September to December)	0	No, there are no days that overlap.
44	00:32:24	7, 26, 27	15	0	15 (February to March; September to October)	0	No, there are no days that overlap.

Annual Cumulative

Table 5-10 above shows there is a potential for annual cumulative impacts at 1 no. property (house no. 31) amounting to 37:20:08 over the course of the year. Mitigation strategies are outlined in Section 5.9.3.9.2.

5.8 Residential Amenity

Residential amenity relates to the human experience of one's home, derived from the general environment and atmosphere associated with the residence. The quality of residential amenity is influenced by a combination of factors, including site setting and local character, land-use activities in the area and the relative degree of peace and tranquillity experienced in the residence.

As previously noted, the Proposed Development is currently used for coniferous forestry, agriculture and turf cutting, therefore a certain level of industrial activity and traffic movements are associated with the site, which will assist in the assimilation of the Proposed Development into the receiving environment. There are no occupied properties located within 700 metres of a proposed turbine location.

When considering the amenity of residents in the context of a proposed wind farm, there are three main potential impacts of relevance: 1) Shadow Flicker, 2) Noise, and 3) Visual Amenity. Shadow flicker and noise are quantifiable aspects of residential amenity while visual amenity is more subjective. Detailed shadow flicker and noise modelling have been completed as part of this EIAR (Section 5.7 above refers to shadow flicker modelling, Chapter 11 addresses noise). A comprehensive landscape and visual impact assessment has also been carried out, as presented in Chapter 12 of this EIAR. Impacts on population and human health during the construction, operational and decommissioning phases of the Proposed Development is assessed in relation to each of these key issues and other environmental factors such as noise, traffic and dust; see Impacts in Section 5.9 below. The impact on residential amenity is then derived from an overall judgement of the combination of impacts due to shadow flicker, changes to land-use and visual amenity, noise, traffic, dust and general disturbance.

5.9 Likely Significant Impacts and Associated Mitigation Measures

5.9.1 'Do-Nothing' Scenario

If the Proposed Development was not developed, the site will continue to function as it does at present, with no changes made to the current land-use of commercial forestry, turf cutting and agriculture.

If the Proposed Development were not to proceed, the opportunity to capture an even greater part of County Clare's valuable renewable energy resource would be lost, as would the opportunity to further contribute to meeting Government and EU targets for the production and consumption of electricity from renewable resources and the reduction of greenhouse gas emissions. The opportunity to generate local employment and investment and to diversify the local economy would also be lost.

5.9.2 Construction Phase

5.9.2.1 Health and Safety

Pre-Mitigation Impacts

Construction of the Proposed Development will necessitate the presence of a construction site. Construction sites and the machinery used on them pose a potential health and safety hazard to construction workers if site rules are not properly implemented. This will have a short-term potential significant negative impact.

Proposed Mitigation Measures

The Proposed Development will be constructed, operated and decommissioned in accordance with all relevant Health and Safety Legislation, including:

- Safety, Health and Welfare at Work Act 2005 (No. 10 of 2005);
- Safety, Health and Welfare at Work (General Application) Regulations 2007 (S.I. No. 299 of 2007), as amended;
- Safety, Health and Welfare at Work (Construction) Regulations 2013 (S.I. 291 of 2013), as amended; and
- Safety, Health and Welfare at Work (Work at Height) Regulations 2006 (S.I. No. 318 of 2006).

During construction of the Proposed Development, all staff will be made aware of and adhere to the Health & Safety Authority's '*Guidelines on the Procurement, Design and Management Requirements of the Safety, Health and Welfare at Work (Construction) Regulations 2006*'. This will encompass the use of all necessary Personal Protective Equipment, Risk Assessment and Method Statements and adherence to the site Health and Safety Plan.

Fencing will be erected in areas of the site where uncontrolled access is not permitted. Appropriate health and safety signage will also be erected on this fencing and at locations around the site.

The Proposed Development will connect to the existing Slievecallan 110kV substation. Connection via Slievecallan would comprise underground cabling, measuring approximately 7.1 km in total, located on existing forest roads / land, agricultural land and within the public road corridor. Health and safety guidelines for working within and around electrical substations and overhead lines will be adhered to on site.

Residual Impact

With the implementation of the above, there will be a short-term potential slight negative residual impact on health and safety during the construction phase of the Proposed Development.

Significance of Effects

Based on the assessment above there will be no significant direct and indirect effects on health and safety during the construction phase of the Proposed Development.

5.9.2.2 Employment and Investment

The design, construction and operation of the wind farm will provide employment for technical consultants, contractors and maintenance staff. Up to approximately 70 jobs could be created during the construction, operation and maintenance phases of the Proposed Development. The construction phase of the wind farm will last between approximately between 12 – 18 months. Most construction workers and materials will be sourced locally, thereby helping to sustain employment in the construction trade. This will have a short-term significant positive impact.

The injection of money in the form of salaries and wages to those employed during the construction phase of the project has the potential to result in an increase in household spending and demand for goods and services in the local area. This would result in local retailers and businesses experiencing a short-term positive impact on their cash flow. This will have a short-term slight positive indirect impact.

The Proposed Development will result in an influx of skilled people into the area, bringing specialist skills for both the construction and operational phases that could result in the transfer of these skills into the local workforce, thereby having a long-term positive impact on the local skills base. Up-skilling and training of local staff in the particular requirements of the wind energy industry is likely to lead to additional opportunities for those staff as additional wind farms are constructed in Ireland. This will have a long-term moderate positive indirect impact. According to the Irish Wind Energy Association there are over 4,400 jobs related to wind energy in Ireland in 2019, a figure which is projected to grow to over 6,000 by 2020.

Proposed Community Benefit Scheme

The applicant company has given careful consideration to the issue of community gain arising from the Proposed Development, if permitted and constructed. Community gain from significant development proposals, including wind farms, whilst a relatively recent approach, is now a common consideration for developers and, indeed, planning authorities. This approach recognises that, with any significant wind farm proposal, the locality in which the site is situated is making a significant contribution towards helping achieve national renewable energy and climate change targets, and the local community should derive some benefit from accommodating such a development in their locality.

Community gain proposals can take a number of forms, generally depending on the nature and location of the Proposed Development and the nature and make-up of the local community. In some instances, funds are paid by the developer, either annually or as a one-off payment, to a community fund that is administered by a voluntary committee. These funds may then be used for a variety of projects, such as environmental improvements, local amenities and facilities, voluntary and sporting groups and clubs, educational projects and energy efficiency improvement works.

The community gain proposal for the Proposed Development is to contribute to community benefit scheme to support local environmental improvements and recreational, social or community amenities and initiatives in the locality of the Proposed Development.

The community benefit scheme proposes to provide a fund of €100,000 per annum over the lifespan of the Proposed Development based on the current estimated generating capacity. This will equate to potential funding of €3 million to the local community, which is a substantial contribution.

The number and size of grant allocations will be decided by a Community Fund liaison committee with various groups and project benefiting to varying degrees depending on their funding requirement.

Overall, it is concluded that the socio-economic impacts of the Proposed Development will be beneficial on a local, regional and national level.

5.9.2.3 Population

Those working on the construction phase of the Proposed Development will travel daily to the site from the wider area. The construction phase will have no impact on the population of the area in terms of changes to population trends or density, household size or age structure.

5.9.2.4 Land-use

It is envisaged that the current land uses of coniferous forestry, agriculture and turf cutting will continue on site in conjunction with the Proposed Development. The Proposed Development will have no impact on existing land-uses as it has been designed to co-exist with these land-uses. Whilst there will be a change of land use to facilitate the development of the wind turbines and infrastructure, this is an acceptable and unavoidable part of the Proposed Development.

The existing land-use of forestry, agriculture and road networks will continue on the proposed underground cable route. There will be a requirement to place an unbound surface layer over the underground cable route where it transverses forestry and agricultural land, as per ESB design requirements, in order to accommodate maintenance vehicles. This is an acceptable and unavoidable part of the Proposed Development.

5.9.2.5 Tourism and Amenity

Given that there are currently no tourism attractions specifically pertaining to the site there are no impacts associated with the construction phase of the Proposed Development. With regard to tourist attractions and amenity use around the site, described in Section 5.3.2, traffic management safety measures will be in place. Please see Traffic impacts below for further details on proposed mitigation measures.

In terms of the proposed underground cable route, as there will be some traffic restrictions in place through the construction phase, there may be a short-term slight negative impact to local tourism. Any impacts will however be limited to the active construction area (generally a 150m to 300m stretch of road) and will be temporary in nature. See Traffic impacts below for further details on proposed mitigation measures.

5.9.2.6 Noise

Pre-Mitigation Impacts

There will be an increase in noise levels in the vicinity of the Proposed Development during the construction phase, as a result of heavy machinery and construction work which has the potential to cause a nuisance to sensitive receptors located closest the Proposed Development. These impacts will be short-term in duration. The noisiest construction activities associated with wind farm development are excavation and pouring of the turbine bases and the extraction of stone from the borrow pit. Excavation of a base can typically be completed in one to two days however, and the main concrete pours are usually conducted in one continuous pour, which is done within a matter of hours.

Construction noise at any given noise sensitive location will be variable throughout the construction project, depending on the activities underway and the distance from the main construction activities to the receiving properties. The potential noise impacts that will occur during the construction phase of the Proposed Development are further described in Chapter 11: Noise and Vibration.

With regard to the proposed underground cable route, construction works may give rise to noise impacts on sensitive receptors in the area, however these noise impacts will be temporary in nature as the works move along the underground cable route.

Proposed Mitigation Measures

Best practice measures for noise control will be adhered to onsite during the construction phase of the Proposed Development in order to mitigate the slight short-term negative impact associated with this phase of the development. These measures will include:

- No plant used on site will be permitted to cause an on-going public nuisance due to noise.
- The best means practicable, including proper maintenance of plant, will be employed to minimise the noise produced by on site operations.
- All vehicles and mechanical plant will be fitted with effective exhaust silencers and maintained in good working order for the duration of the contract.
- Compressors will be attenuated models fitted with properly lined and sealed acoustic covers which will be kept closed whenever the machines are in use and all ancillary pneumatic tools shall be fitted with suitable silencers.

- Machinery that is used intermittently will be shut down or throttled back to a minimum during periods when not in use.
- Any plant, such as generators or pumps, which is required to operate outside of general construction hours will be surrounded by an acoustic enclosure or portable screen.
- During the course of the construction programme, supervision of the works will include ensuring compliance with the limits detailed in Chapter 11 using methods outlined in British Standard BS 5228-1:2014+A1:2019 Code of practice for noise and vibration control on construction and open sites – Noise.
- The hours of construction activity will be limited to avoid unsociable hours where possible. Construction operations shall generally be restricted to between 7:00hrs and 19:00hrs Monday to Saturday. However, to ensure that optimal use is made of good weather periods or at critical periods within the programme (i.e. concrete pours, large turbine component delivery, rotor/blade lifting) it could occasionally be necessary to work out of these hours.

Where rock breaking is employed in relation to the proposed borrow pit location, the following are examples of measures that will be employed, where necessary, to mitigate noise emissions from these activities:

- Fit suitably designed muffler or sound reduction equipment to the rock breaking tool to reduce noise without impairing machine efficiency.
- Ensure all leaks in air lines are sealed.
- Use a dampened bit to eliminate ringing.
- Erect acoustic screen between compressor or generator and noise sensitive area. When possible, line of sight between top of machine and reception point needs to be obscured.
- Enclose breaker or rock drill in portable or fixed acoustic enclosure with suitable ventilation.

Residual Impact

Following the implementation of the above mitigation measures, there will be a short-term imperceptible negative residual impact due to an increase in noise levels during the construction phase of the Proposed Development.

Significance of Effects

Based on the assessment above there will be no significant direct or indirect effects.

5.9.2.7 Air (Dust)

Pre-Mitigation Impacts

Potential dust emission sources during the construction phase of the Proposed Development include tree felling, upgrading of existing access tracks and construction of new access roads, turbine foundations, construction compounds, borrow pits, and laying of underground cabling. An increase in dust emissions has the potential to cause a nuisance to sensitive receptors in the immediate vicinity of the site. The entry and exit of construction vehicles from the site may result in the transfer of mud to the public road, particularly if the weather is wet. This may cause nuisance to residents and other road users. These impacts will not be significant and will be relatively short-term in duration. The potential dust impacts that may occur during the construction phase of the Proposed Development are further described in Chapter 10: Air and Climate.

Proposed Mitigation Measures

All aggregate material for the construction of roads and turbine bases will be sourced onsite and will only be outsourced where necessary; therefore, reducing the need to transport this material to the site. Truck wheels will be washed to remove mud and dirt before leaving the site. All plant and materials vehicles shall be stored in the dedicated compound area. Areas of excavation will be kept to a minimum, and stockpiling will be minimised by coordinating excavation, spreading and compaction. Construction traffic will be restricted to defined routes and a speed limit will be implemented.

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

The active construction area along the proposed underground cable route options will be small, ranging from 150-300 metres in length at any one time. Should separate crews be used during the construction phase they will generally be separated by 1-2 kilometres. All construction machinery will be maintained in good operational order while on-site, minimising any emissions that are likely to arise. Aggregate materials for the construction of the underground cable route will be sourced from the on-site borrow pits to reduce the amount of emissions associated with vehicle movements.

Potential dust emissions during the construction period will not be significant and will be relatively short-term in duration.

Residual Impact

Following the implementation of the above mitigation measures, there will be a short-term imperceptible impact due to dust emissions from the construction of the Proposed Development.

Significance of Effects

Based on the assessment above there will be no significant direct or indirect effects.

5.9.2.8 Traffic

Pre-Mitigation Impacts

It is proposed that large wind turbine components will be delivered to the site of the Proposed Development, from a port that connects to the national primary roads, for example Port of Galway, Shannon Foynes Port or Dublin Port via the N85 National Secondary Road. From Ennis the turbines will be transported northwest along the N85 National Secondary Road to Inagh before turning left on to the R460 Regional Road and transported west for 4.2km to the junction with the L1074 Local Road. The turbines will be transported west/northwest for 4.2km before turning left onto a local road at Fahabeg. At Fahabeg, the turbines will be transported southwest for 2km after which it will take a sharp left onto a local road approaching the proposed wind farm development site from the northwest. The construction phase of the Proposed Development will last for approximately 12 -18 months. The proposed turbine delivery and construction traffic route is shown in Figure 14-1 in Chapter 14 of this EIAR.

Non-turbine construction traffic will be comprised of Heavy Goods Vehicle (HGV) and Light Goods Vehicle (LGV) movements involved in the delivery of construction materials to the site and the export of excess construction materials and plant from the site. A complete Traffic and Transportation Assessment (TTA) of the Proposed Development has been carried out by Alan Lipscombe Traffic and Transport Consultants. The full results of the TTA are presented in Section 14.1 of Chapter 14: Material Assets.

The types of vehicles that will be required to negotiate the local network represent abnormal size loads and a detailed assessment of the geometry of the proposed route was therefore undertaken. This will have a temporary slight to moderate negative impact on existing road users, which will be minimised with the implementation of the mitigation measures included in the proposed traffic management plan.

Proposed Mitigation Measures

A Traffic Management Plan will be developed and implemented to ensure any impact is short term in duration and slight in significance during the construction of the Proposed Development. Prior to commencement of any works, the occupants of dwellings in the vicinity of the proposed works will be contacted and the scheduling of works will be made clear. Local access to properties will also be maintained throughout any construction works and local residents will also be supplied with the number of the works supervisor in order to ensure that disruption will be kept to a minimum.

Aggregate materials for the construction of any additional site tracks will be obtained from two borrow pits on the site of the Proposed Development. This will significantly reduce the number of delivery vehicles required to access the site.

Residual Impact

Once a traffic management plan is implemented for the construction phase of the Proposed Development, there will be a short-term imperceptible negative residual impact on local road users.

Significance of Effects

Based on the assessment above there will be no significant direct or indirect effects.

5.9.2.9 Shadow Flicker

Shadow flicker, which occurs during certain conditions due to the movement of wind turbine blades, as described in Section 5.7 of this chapter, occurs only during the operational phase of a wind energy development. There are therefore no shadow flicker impacts associated with the construction phase of the Proposed Development.

5.9.3 Operational Phase

The effects set out below relate to the operational phase of the Proposed Development including the period when turbines are being commissioned.

5.9.3.1 Health and Safety

Pre-Mitigation Impact

The operational phase of the Proposed Development poses little threat to the health and safety of the public. The Department of the Environment, Heritage and Local Government (DoEHLG)'s '*Wind Energy Development Guidelines for Planning Authorities 2006*' state that there are no specific safety considerations in relation to the operation of wind turbines. Fencing or other restrictions are not necessary for safety considerations. People or animals can safely walk up to the base of the turbines.

The DoEHLG Guidelines state that there is a very remote possibility of injury to people from flying fragments of ice or from a damaged blade. However, most blades are composite structures with no bolts or separate components and the danger is therefore minimised. The build-up of ice on turbines is unlikely to present problems. The wind turbines will be fitted with anti-vibration sensors, which will detect any imbalance caused by icing of the blades. The sensors will cause the turbine to wait until the blades have been de-iced prior to beginning operation.

The turbine blades are typically manufactured of wood and laminated layers of glass fibre which will prevent any likelihood of an increase in lightning strikes within the site of the Proposed Development or the local area. Lightning protection conduits will be integral to the construction of the turbines. Lightning conduction cables, encased in protection conduits, will follow the electrical cable run, from the nacelle to the base of the turbine. The conduction cables will be earthed adjacent to the turbine base. The earthing system will be installed during the construction of the turbine foundations. There will be no impact on health and safety.

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

Proposed Mitigation Measures

Notwithstanding the above, the following mitigation measures will be implemented during the operation of the Proposed Development to ensure that the risks posed to staff and landowners remain negligible throughout the operational life of the wind farm.

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

Staff associated with the project will conduct frequent visits, which will include inspections to establish whether any signs have been defaced, removed or are becoming hidden by vegetation or foliage, with prompt action taken as necessary.

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

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

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

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

Residual Impact

With the implementation of the above mitigation measures, there will be a long-term, imperceptible residual impact on health and safety during the operational life of the Proposed Development.

Significance of Effects

Based on the assessment above there will be no significant direct or indirect effects.

5.9.3.2 Employment and Investment

The operational phase will present an opportunity for mechanical-electrical contractors and craftspeople to become involved with the maintenance and operation of the wind farm. On a long-term scale, the Proposed Development will create approximately 2 jobs during the operational phase relating to the maintenance and control of the wind farm, having a long-term slight positive effect.

The injection of money in the form of rental income to the landowners who are participating in the Proposed Development, where a rental agreement has the potential to result in an increase in household spending and demand for goods and services in the local area. This would result in local retailers and businesses experiencing a long-term positive impact on their cash flow. This will have a long-term slight positive indirect impact.

Rates payments for the wind farm will contribute significant funds to Clare County Council, which will be redirected to the provision of public services within Co. Clare. These services include provisions such as road upkeep, fire services, environmental protection, street lighting, footpath maintenance etc. along with other community and cultural support initiatives.

5.9.3.3 Population

The operational phase of the Proposed Development will have no impact on the population of the area with regards to changes to trends, population density, household size or age structure.

5.9.3.4 Property Values

As noted in Section 5.6 above, the conclusions from available international literature indicate that property values are not impacted by the positioning of wind farms near houses. It is on this basis that it can be reasonably concluded that there would be a long-term imperceptible impact from the Proposed Development.

5.9.3.5 Land-use

The footprint of the Proposed Development, including turbines, roads, underground cable route etc., will occupy only a small percentage of the total Study Area defined for the purposes of this EIAR. The main land-use of commercial forestry, agriculture and turf cutting in the EIAR primary study area will continue to co-exist with the Proposed Development. The Proposed Development will have no impact on other land-uses within the wider area.

5.9.3.6 Noise

A baseline assessment of the existing background noise conditions was carried out, the results of which are presented in Chapter 11 of the EIAR. A noise assessment of the operational phase of the Proposed

Development has also been carried out through modelling of the development using noise prediction software. The predicted noise levels for the Proposed Development have been compared with the existing background noise levels and the best practice guidance levels for noise emissions from wind farms.

Details of the noise assessment carried out by AWN Consulting are presented in Chapter 11 of the EIAR. The noise assessment determined that the predicted operational noise effect at the closest noise sensitive receptors to the site is of a moderate, negative, long-term nature. It is noted that this effect considers the periods of greatest potential effect prior to mitigation, i.e. the worst-case scenario. For the majority of locations assessed, operation of the proposed turbines will have a slight, negative, long-term effect. The noise assessment notes that these effects should be considered in terms that the effect is variable, and that this assessment considers periods of the greatest potential effect.

As stated in the noise assessment in Chapter 11, it has been demonstrated that the relevant national guidance in relation to noise associated with proposed wind turbines can be satisfied, therefore the predicted impact associated with the operational turbines is long term and not significant. If required, a detailed curtailment strategy matrix will be finalised as part of the detailed design for the selected turbine technology to achieve the noise criteria at each of the noise sensitive locations.

5.9.3.7 Traffic

One to two service technicians may have to attend to the site of the proposed wind farm on a weekly basis during the operational phase of the project. A Traffic and Transportation Assessment (TTA) of the Proposed Development has been completed by Alan Lipscombe Traffic and Transport Consultants, the results of which are presented in Section 14.1 of this EIAR. The TTA found that there will be a long-term neutral impact on traffic created during the operational phase of the proposed wind farm.

5.9.3.8 Tourism

Pre-Mitigation Impacts

Given that there are currently no tourism attractions or amenity walkways located within the Proposed Development site there are no impacts associated with the operational phase of the Proposed Development. The Department of the Environment, Heritage and Local Government's *Wind Energy Development Guidelines for Planning Authorities* 2006 state that "*the results of survey work indicate that tourism and wind energy can co-exist happily*". It is not considered that the Proposed Development would have an adverse impact on tourism infrastructure in the vicinity. Renewable energy developments are an existing feature in the surrounding landscape, which will assist in the assimilation of the Proposed Development into this environment.

5.9.3.9 Shadow Flicker

Pre-Mitigation Impacts

Assuming worst-case conditions, a total of 28 properties may experience daily shadow flicker in excess of the DoEHLG guideline threshold of 30 minutes per day. Of these 28 properties, 5 no. are currently derelict, and 4 no. are participating properties. The DoEHLG total annual guideline limit of 30 hours is exceeded at 6 properties once the regional sunshine average of 29.4% is considered. Of these 6 properties, 1 no. property is derelict. There will be no perceived shadow flicker impacts on derelict properties and therefore, they are not subject to mitigation strategies

Proposed Mitigation Measures

Where daily or annual shadow flicker exceedances are predicted at any occupied receptor or 3rd party property, a site visit will be undertaken firstly to determine the existing screening and window orientation. This will determine if the receptor has an actual line of sight to any turbine. Once this is completed and all of the potential receptors identified, the following measures will be employed,

Screening Measures

In the event of an occurrence of shadow flicker exceeding guideline threshold values of 30 minutes per day at residential receptor locations, mitigation options will be discussed with the affected homeowner, including:

- Installation of appropriate window blinds in the affected rooms of the residence;
- Planting of screening vegetation;
- Other site-specific measures which might be agreeable to the affected party and may lead to the desired mitigation.

If agreement can be reached with the homeowner, then it would be arranged for the required mitigation to be implemented in cooperation with the affected party as soon as practically possible and for the full costs to be borne by the wind farm operator.

Wind Turbine Control Measures

If it is not possible to mitigate any identified shadow flicker limit exceedance locally using the measures detailed above, wind turbine control measures will be implemented.

Wind turbines can be fitted with shadow flicker control units to allow the turbines to be controlled to prevent the occurrence of shadow flicker at properties surrounding the wind farm. The shadow flicker control units will be added to any required turbines.

A shadow flicker control unit allows a wind turbine to be programmed and controlled using the wind farm's SCADA control system to change a particular turbine's operating mode during certain conditions or times, or even turn the turbine off if necessary.

All predicted incidents of shadow flicker can be pre-programmed into the wind farm's control software. The wind farm's SCADA control system can be programmed to shut down any particular turbine at any particular time on any given day to ensure that shadow flickers occurrences at properties which are not naturally screened or cannot be screened with measures outlined above. Where such wind turbine control measures are to be utilised, they need only be implemented when the specific combined circumstances occur that are necessary to give rise to the shadow flicker effect in the first instance. Therefore, if the sun is not shining on a particular day that shadow flicker was predicted to occur at a nearby property, there would be no need to shut down the relevant turbines that would have given rise to the shadow flicker at the property. Similarly, if the wind speed was below the cut-in speed that caused the turbine rotor to rotate and give rise to a shadow flicker effect at a nearby property, there would be no need to shut down the relevant turbines that otherwise would have caused shadow flicker.

The atmospheric variables that determine whether shadow flicker will occur or not, are continuously monitored at the wind farm site and the data fed into the wind farm's SCADA control system. The strength of direct sunlight is measured by way of photocells, and if the sunlight is of sufficient strength to cast a shadow, the shadow flicker control mechanisms come into effect. Wind speed and direction are measured by anemometers and wind vanes on each turbine and on the wind farm's met mast, and similarly, and if wind speed and direction is such that a shadow will be cast, the shadow flicker control mechanisms come into effect. The moving blades of the turbine will require a short period of time to cease rotating and as such there may be a very short period (less than 3 to 5 minutes) during which the blades are slowed to a complete halt. The turbines giving rise to shadow flicker may be turned off on different days to prevent excessive wear and tear on any single turbine.

In order to ensure that the model and SCADA system is accurate and working well a site visit will be carried out to verify the system. The shadow flicker prediction data will be used to select dates on which a shadow flicker event could be observed at one or multiple affected properties and the following process will be adhered to.

1. *Recording the weather conditions at the time of the site visit, including wind speeds and direction (i.e. blue sky, intermittent clouds, overcast, moderate breeze, light breeze, still etc.).*
2. *Recording the house number, time and duration of site visit and the observation point GPS coordinates.*
3. *Recording the nature of the sensitive receptor, its orientation, windows, landscaping in the vicinity, any elements of the built environment in the vicinity, vegetation.*
4. *In the event of shadow flicker being noted as occurring the details of the duration (times) of the occurrence will be recorded*
5. *The data will then be sent to the wind farm operational team to confirm that the model and SCADA system are working.*
6. *Following 12 months of full operation of the Proposed Development a report can be prepared for the Local Authority describing the shadow flicker mitigation measures used at the wind farm and confirming the implementation and successful operation of the system.*

This method of shadow flicker mitigation has been technically well-proven at wind farms in Ireland and also in areas outside Ireland that experience significantly longer periods of direct sunlight.

In order to demonstrate how the SCADA control system can be applied to switch off particular turbines at the relevant times and dates, Table 5-12 lists the 19 properties at which a shadow flicker mitigation strategy may be necessary to ensure the DoEHLG 30-minute per day shadow flicker threshold is not exceeded. In this case, the relevant turbine(s) would be programmed to switch off for the time required to reduce daily shadow flicker to below the guideline limit of 30 minutes. The SCADA control system would be utilised to control shadow flicker in the absence of being able to agree suitable screening measures with the relevant property owner. The mitigation strategy outlined in Table 5-13 below is based on the worst-case scenario. The details presented in Table 5-12 list the days per year and the turbines that could be programmed to switch off at specific times, in order to reduce daily shadow flicker to a maximum of 28 minutes, which is below the guideline limit of 30 minutes.

Table 5-12 Shadow Flicker Mitigation Strategy for Daily Shadow Flicker Exceedance – Turbine Numbers and Dates

Property No.	No. of Days 30min/day Threshold is Exceeded	Turbine(s) Producing Shadow Flicker Exceedance	Days of Year When Mitigation May be Required (Dates)*	Post-mitigation Maximum Daily Shadow Flicker (hrs:mins:sec)
3	14	3	3rd April - 9th April and 2nd September - 8th September	≤00:30:00
6	65	1 3	29th March - 9th April, 2nd September - 14th September; 10th February - 1st March, 12th	≤00:30:00

Property No.	No. of Days 30min/day Threshold is Exceeded	Turbine(s) Producing Shadow Flicker Exceedance	Days of Year When Mitigation May be Required (Dates)*	Post-mitigation Maximum Daily Shadow Flicker (hrs:mins:sec)
			October - 31st October	
7	69	1 3	28th March - 9th April, 2nd September - 15th September; 9th February - 29th February, 13th October - 2nd November	≤00:30:00
8	92	1 3	3rd March - 20th March, 22nd September - 9th October; 8th January - 4th February, 7th November - 4th December	≤00:30:00
10	33	1	27th January - 11th February, 30th October - 15th November	≤00:30:00
11	26	1	1st February - 13th February, 29th October - 10th November	≤00:30:00
12	91	1 4	9th January - 15th February, 27th October - 3rd November; 11th January - 17th January, 24th November - 1st December	≤00:30:00
15	148	1 2	1st January - 17th January, 24th November - 31st December; 1st January - 5th February, 5th November - 31st December	≤00:30:00
16	70	2	1st January - 25th January and 18th November - 31st December	≤00:30:00

Property No.	No. of Days 30min/day Threshold is Exceeded	Turbine(s) Producing Shadow Flicker Exceedance	Days of Year When Mitigation May be Required (Dates)*	Post-mitigation Maximum Daily Shadow Flicker (hrs:mins:sec)
18	89	1 2	9th December - 31st December; 1st January - 24th January, 18th November - 31st December	≤00:30:00
19	106	1 2	1st January - 8th January and 4th December - 31st December 1st January - 25th January, 18th November - 31st December	≤00:30:00
20	139	1 2 5	1st January - 18th January and 23rd November - 31st December; 1st January - 25th January and 16th November -31st December; 11th January- 15th January and 26th November - 1st December	≤00:30:00
21	112	3 7 8	26th May - 17th July; 4th January to 4th February; 10th January – 3rd February; 6th November - 30th November 26th February – 1st March; 10th October – 13th October	≤00:30:00
27	97	1 2	12th December - 30th December; 1st January - 29th January, 13th November - 31st December	≤00:30:00

Property No.	No. of Days 30min/day Threshold is Exceeded	Turbine(s) Producing Shadow Flicker Exceedance	Days of Year When Mitigation May be Required (Dates)*	Post-mitigation Maximum Daily Shadow Flicker (hrs:mins:sec)
				≤00:30:00
39	65	4 6 8	5th June - 6th June and 4th July - 5th July; 8th April - 5th March, 6th August - 2nd September; 9th March – 11th March; 29th September – 1st October	≤00:30:00
40	71	4 6	1st June - 4th June, 7th July - 9th July; 14th April - 9th March, 2nd August - 27th August;	≤00:30:00
59	58	7	3rd May - 31st May; 10th July – 7th August	≤00:30:00
61	35	7	6th March – 22nd March, 18th September - 5th October	≤00:30:00
67	102	2 5	18th January - 13th February, 28th October - 23rd November; 1st January - 14th January, 28th November - 31st December	≤00:30:00

**Note: days of year are based on the year 2020*

Where a shadow flicker mitigation strategy is to be implemented, it is likely that the control mechanisms would only have to be applied to one turbine to bring the duration of shadow flicker down to the 28-minute post-mitigation shadow flicker target.

Overall, the details presented in Table 5-12 demonstrate that using the turbine control system, it will be possible to reduce the level of shadow flicker at any affected property to below the daily guideline limit of 30 minutes, by programming the relevant turbines to switch off at the required dates and times.

Table 5-13 lists the 5 properties at which a shadow flicker mitigation strategy may be necessary to ensure the DoEHLG 30-hour annual shadow flicker threshold is not exceeded. In this case, the relevant turbine(s) would be programmed to switch off for the time required to ensure that the annual shadow flicker limit of 30 hours annually is not exceeded. The SCADA control system would be utilised to control shadow flicker in the absence of being able to agree suitable screening measures with the relevant property owner. Table 5-13 below illustrates the relevant turbines that may need to be controlled, based on the worst-case scenario.

Table 5-13 Shadow Flicker Mitigation Strategy for Annual Shadow Flicker Exceedance

Property No.	Max. Annual Shadow Flicker Adjusted for Average Regional Sunshine (hrs:min:sec)	Turbine(s) Producing Shadow Flicker Exceedance	Post-mitigation Maximum Annual Shadow Flicker (hrs:mins:sec)
12	32:42:54	1,4	≤30:00:00
15	35:58:50	1,2	≤30:00:00
19	31:42:53	1,2	≤30:00:00
20	37:25:20	1,2,5	≤30:00:00
21	33:55:12	3,7	≤30:00:00

Notwithstanding the approach set out above should shadow flicker associated with the permitted development be perceived to cause a nuisance at any home, the affected homeowner is invited to engage with the Developer. Should a complaint or query in relation to shadow flicker be received within 12 months of commissioning of the wind farm, field investigation/monitoring will be carried out by the wind farm operator at the affected property. The homeowner will be asked to log the date, time and duration of shadow flicker events occurring on at least five different days. The provided log will be compared with the predicted occurrence of shadow flicker at the residence, and if necessary, a field investigation will be carried out.

Residual Impact

Following the implementation of the above suite of mitigations measures, the current DoEHLG guideline limit of 30 mins per day or 30 hours per year will not be exceeded and this will result in a long-term, imperceptible negative residual impact from shadow flicker on human health.

Significance of Effects

Based on the assessment above and the mitigation measures proposed there will be no significant effects related to shadow flicker.

5.9.3.9.2 *Cumulative Shadow Flicker Mitigation Measures*

Pre-Mitigation Impacts

It has been demonstrated in Section 5.7.6.2 that, assuming worst-case conditions, there are no properties that experience daily cumulative shadow flicker in excess of the DoEHLG guideline threshold of 30 minutes per day. The DoEHLG total annual guideline limit of 30 hours is exceeded at 1 property (house no.31) once the regional sunshine average of 29.4% is considered.

Proposed Mitigation Measures

Daily Cumulative Shadow Flicker

No mitigation required.

Annual Cumulative Shadow Flicker

Table 5-14 below lists the 1 no. property at which a shadow flicker mitigation strategy may be necessary to ensure the DoEHLG 30-hour annual shadow flicker threshold is not exceeded. As detailed in Table 5-14, Property 31 will potentially experience over 37hrs and 20mins of annual shadow flicker from the Proposed Development and the constructed Slievecallan Wind Farm combined. The Proposed Development contributes 9hrs 32mins of this shadow flicker impact annually with the constructed Slievecallan Wind Farm contributing just over 27hrs 48mins annually. In this case, the relevant Proposed Development turbine (Turbine 8) would be programmed to switch off for a maximum of 5hrs and 41mins to reduce annual shadow flicker to a maximum of 30 hours annually. The SCADA control system would be utilised to control shadow flicker in the absence of being able to agree suitable screening measures with the relevant property owner. This is based on the worst-case scenario.

Residual Impact

Following the implementation of the above suite of mitigations measures, the current DoEHLG guideline limit of 30 hours per year will not be exceeded and this will result in a long-term, imperceptible negative residual cumulative impact from shadow flicker on human health

Significance of Effects

Based on the assessment above and the mitigation measures proposed there will be no significant effects related to shadow flicker.

Table 5-14 Cumulative Annual Shadow Flicker Mitigation Measures for the Proposed Slieveacurry Wind Farm and Slievecallan Wind Farm

House no.	Max. Potential Cumulative Annual Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Potential Annual Shadow Flicker Adjusted for Average Regional Sunshine (hrs:min:sec)	Turbine(s) contributing to Cumulative Shadow Flicker impact*	Max. Potential Annual Shadow Flicker contributed to by Proposed Development (Turbines 1-8)	Max. Potential Annual Shadow Flicker contributed by Slievecallan Wind Farm (Turbines 9-37)	Max. Potential Cumulative Annual Shadow Flicker Exceedance that requires mitigation (hrs:mins:sec)	Proposed Development Turbines to be controlled	Post-mitigation Maximum Annual Shadow Flicker by the Proposed Development (hrs:mins:sec)
31	126:48:00	37:20:08	8, 24, 26, 27, 28	9:24:58	27:55:10	7:20:08	T8	≤30:00:00

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5.9.3.10 Interference with Communication Systems

Wind turbines, like all large structures, have the potential to interfere with broadcast signals, by acting as a physical barrier or causing a degree of scattering to microwave links. The alternating current, electrical generating and transformer equipment associated with wind turbines, like all electrical equipment, also generates its own electromagnetic fields, and this can interfere with broadcast communications. The most significant effect at a domestic level relates to a possible flicker effect caused by the moving rotor, affecting, for example, radio signals. The most significant potential effect occurs where the wind farm is directly in line with the transmitter radio path. This interference can be overcome by the installation of deflectors or repeaters.

As part of the scoping and consultation exercise undertaken by MKO, the national and regional broadcasters and fixed and mobile phone operators were contacted regarding potential interference from the Proposed Development. Full details are provided in of Chapter 2: Background to the Proposed Development and Section 14.2 (Telecommunications and Aviation) of Chapter 14: Material Assets. Copies of the scoping responses received are presented in Appendix 2-2 of the EIAR.

Responses were received from Airspeed, Broadcasting Authority of Ireland, BT Communications Ireland, ComReg (Commission for Communications Regulation), Department of Defence, Eir, ESB Telecoms, Irish Aviation Authority, Imagine Group, Lighthouse Networks Ltd, Ripplecom, RTE Transmission Network (2rn), Tetra Ireland Communications (emergency services), Towercom, Three Ireland Ltd, Viatel, Virgin Media and Vodafone Ireland. None of the above list have stated any telecoms links within the area of the Proposed Development. The Department of Defence and the Irish Aviation Authority responded with the following requirements: the turbines will be marked on maps, lit at night and entered into aircraft navigation databases and therefore can be avoided during flight.

Further detail on the actions taken to ameliorate any potential interference, including micro-siting of turbines can be found in Chapter 2 and Chapter 14. Following these measures, there will be no interference risk from any of the proposed turbines providing the design complies with recommended buffer zones and telecommunication solutions. Therefore, the Proposed Development will have no impact on telecommunications.

5.9.3.11 Residential Amenity

Pre-Mitigation Impacts

Potential impacts on residential amenity during the operational phase of the proposed wind farm could arise primarily due to noise, shadow flicker or changes to visual amenity. Detailed noise and shadow flicker modelling have been carried out as part of this EIAR, which shows that the Proposed Development will be capable of meeting all required guidelines in relation to noise thresholds and the shadow flicker thresholds set out in the Wind Energy Guidelines (DoEHLG 2006).

The visual impact of the Proposed Development is addressed comprehensively in Chapter 12: Landscape and Visual. The Proposed Development has been designed to maximise turbine separation distances to dwellings in the area, with no turbines located within 700 metres of an occupied dwelling. This project achieves the four times tip height separation distance recommended in the Draft Revised Wind Energy Development Guidelines (2019, DoHPLG), which explicitly addresses residential visual amenity. An assessment of roadside screening was carried out for roads within 5km of the proposed turbine locations, with both the methodology and findings of this are described in Chapter 12. Along roads immediately surrounding the site, there is a significant level of dense and intermittent screening, particularly to the north, north-east, south and west. Roads to the north-west, south-west and east were shown to have very little screening and there were open, unobstructed views towards the Proposed Development. In consideration of this, visual effects arising from these roads have been assessed in detail via photomontage viewpoints located on these routes and are presented in Chapter 12. As detailed in Section 12.8.3.3.5 in Chapter 12, four photomontage viewpoints were specifically selected to assess the visual effects on residential amenity and receptors of local community importance in close proximity to the Proposed Development. These four viewpoints show a worst-case scenario where there are open views in very close proximity with no screening. Residual visual effects were found to be 'Moderate', which is appropriate and acceptable for a wind energy development of this scale and type.

Proposed Mitigation Measures

There are no turbines proposed within 700 metres of any occupied dwelling, which is equal to 4 times the turbine tip height (700m) from any property, a recognised parameter in assisting in the protection of residential visual amenity. All mitigation as outlined under noise and vibration, dust, traffic, visual amenity and shadow flicker in this EIAR will be implemented in order to reduce insofar as possible impacts on residential amenity at properties located in the vicinity of the Proposed Development works, including along the proposed turbine and construction materials haul route.

Residual Impact

With the implementation of the mitigation measures outlined in relation to noise and vibration, dust, traffic, shadow flicker and visual amenity, the Proposed Development will have an imperceptible impact on residential amenity.

Significance of Effects

Based on the assessment above there will be no significant direct or indirect effects on residential amenity.

5.9.4 Decommissioning Phase

The wind turbines proposed as part of the Proposed Development are expected to have a lifespan of approximately 30 years. Following the end of their useful life, the wind turbines may be replaced with a new set of turbines, subject to planning permission being obtained, or the site may be decommissioned fully. The substation will remain in place as it will be under the ownership of ESB.

The works required during the decommissioning phase are described in Section 4.9 in Chapter 4: Description of the Proposed Development. Upon decommissioning of the Proposed Development, the wind turbines will be disassembled in reverse order to how they were erected. The turbines will be disassembled with the same model of cranes that were used for their erection. The turbine will be removed from site using the same transport methodology adopted for delivery to site initially. The turbine materials will be transferred to a suitable recycling or recovery facility.

All above ground turbine components would be separated and removed off-site for recycling. Turbine foundations would remain in place underground and would be covered with earth and reseeded as appropriate. Leaving the turbine foundations in-situ is considered a more environmentally prudent option, as to remove that volume of reinforced concrete from the ground could result in environment emissions such as noise, dust and/or vibration.

Site roadways could be in use for purposes other than the operation of the development by the time the decommissioning of the Proposed Development is to be considered, and therefore it may be more appropriate to leave the site roads in situ for future use. It is envisaged that the roads will provide a useful means of extracting the commercial forestry crop which exists on the site. If it were to be confirmed that the roads were not required in the future for any other useful purpose, they could be removed where required.

The underground electrical cabling connecting the Slieveacurry Renewable Energy Development to the existing 110kV substation in the townland of Knockalassa will be removed from the underground cable ducting at the end of the useful life of the renewable energy development. The cable ducting will be left in-situ as it is considered the most environmentally prudent option, avoiding unnecessary excavation and soil disturbance for an underground element that is not visible.

An outline decommissioning plan is contained in the CEMP in Appendix 4-4 of this EIAR for the decommission of the Proposed Development, the detail of which will be agreed with the local authority prior to any decommissioning. The potential for effects during the decommissioning phase of the proposed wind farm has been fully assessed in the EIAR.

Any impact and consequential effect that occurs during the decommissioning phase will be similar to that which occurs during part of the construction phase when turbines were being erected. The impacts and associated effects will be materially less than during the construction phase as significant ground works are not required to decommission a wind farm

The decommissioning phase will have no impact on shadow flicker, interference with communications system, employment, tourism or health & safety once all standard construction phase mitigation measures described above are implemented.

5.9.5 Cumulative Effects

For the assessment of cumulative impacts, any other existing, permitted or Proposed Developments (wind energy or otherwise) have been considered. The factors to be considered in relation to cumulative effects include population and human health, biodiversity, land, soil, water, air, climate, material assets, landscape, and cultural heritage as well as the interactions between these factors.

The potential cumulative impact of the Proposed Development (which includes the proposed means of grid connection) and other relevant developments has been carried out with the purpose of identifying what influence the Proposed Development will have on the surrounding environment when considered cumulatively and in combination with relevant approved, and existing projects in the vicinity of the proposed site.

Further information on projects considered as part of the cumulative assessment are given in Chapter 2: Background to the Proposed Development. The impacts with the potential to have cumulative effects on human beings are discussed below and in more detail in the relevant chapters: noise (Chapter 11), visual impacts (Chapter 12) and traffic (Chapter 14).

5.9.5.1 Employment and Economic Activity

Wind farms within 20 kilometres of the Proposed Development which may be proposed, permitted or operational/existing contribute to short term employment during the construction stages and provide the potential for long-term employment resulting from maintenance operations. This results in a long-term significant positive impact.

The commercial forestry activities on the site of the proposed wind farm provides between 3-6 months of employment, either for harvesting or replanting per year. These activities can continue while the proposed wind farm is under construction and operating, resulting in a long-term moderate positive cumulative impact.

5.9.5.2 Tourism and Amenity

There are no key identified tourist attractions pertaining specifically to the site of the Proposed Development itself.

It is not considered that the Proposed Development together with other projects in the area will cumulatively affect any tourism infrastructure in the wider area. As mentioned previously, wind farms are an existing feature in the surrounding landscape, which will assist in the assimilation of the Proposed Development into this environment. As also noted in Section 5.3 above, the conclusions from available research indicate there is a generally positive disposition among tourists towards wind development in Ireland. It is on this basis that it can be concluded that there would be a long-term imperceptible cumulative impact from the Proposed Development and other wind farm developments in the area.

5.9.5.3 Traffic

All other wind farms, are either complete, or will be complete when the Proposed Development reaches the construction stage, resulting in no potential for cumulative impact between the Proposed Development and the neighbouring developments.

5.9.5.4 Air (Dust)

The nature of the Proposed Development is such that, once operational, it will have a long-term, moderate, positive impact on the air quality.

During the construction phase of the Proposed Development and the construction phase of other developments within 20 kilometres of the wind farm site that are yet to be constructed, there will be minor emissions from construction plant and machinery and potential dust emissions associated with the construction activities. However, once the mitigation proposals, as outlined in Section 10.2.4.2 and Section 10.3.4.2 of Chapter 10 are implemented during the construction phase of the Proposed Development, there will be no cumulative negative effect on air and climate.

The nature of the Proposed Development and other wind energy developments within 20 kilometres are such that, once operational, they will have a cumulative long-term, significant, positive effect on the air quality and climate.

5.9.5.5 Health and Safety

The Proposed Development will have no impacts in terms of health and safety. There is no credible scientific evidence to link wind turbines with adverse health impacts. All other existing, permitted or Proposed Developments (wind energy or otherwise) would be expected to follow all relevant Health and Safety Legislation during the construction, operation and decommissioning phases of the development. It is assumed also that all mitigation measures in relation to the other cumulative projects will also be implemented. It is on this basis that it can be concluded that there would be a long-term imperceptible cumulative impact from the Proposed Development and other developments in the area.

5.9.5.6 Property Values

As noted in Section 5.6 above, the conclusions from available international literature indicate that property values are not impacted by the positioning of wind farms near houses. It is on this basis that it can be concluded that there would be a long-term imperceptible cumulative impact from the Proposed Development and other wind farm developments in the area.

5.9.5.7 Services

The rate payments from the Proposed Development and other projects in the area will contribute significant funds to Clare County Council, which will be redirected to the provision of public services within the County. In addition, the injection of money into local services though the establishment of community benefit funds is also expected to be a long-term positive cumulative impact.

5.9.5.8 Shadow Flicker

As outlined in Tables 5-10, 5-11 and 5-14 above, 1 no. dwellings may be impacted by shadow flicker from the Proposed Development in combination with permitted wind farms within 5km of the development site. As such, the monitoring and subsequent mitigation measures as outlined in Section 5.9.3.9.2 will be implemented to ensure any dwelling which may be impacted by shadow flicker as a result of the Proposed Development will be in compliance with the thresholds set out in the 2006 DoEHLG Wind Energy Guidelines.

5.9.5.9 Residential Amenity

Pre-Mitigation Impacts

In the extremely unlikely event that all permitted and proposed projects as described in the cumulative assessment in Chapter 2 are constructed at the same time, there is the potential for a resulting short term, significant, cumulative, negative impact to occur on residential amenity, in relation to noise and vibration, dust, traffic, telecommunications and visual amenity.

Proposed Mitigation Measures

There are no turbines as part of the Proposed Development that will be located within 700 metres of any occupied dwellings. All mitigation as outlined under noise and vibration, dust, traffic, visual amenity and telecommunications in this EIAR will be implemented in order to reduce insofar as possible impacts on residential amenity at properties located in the vicinity of the Proposed Development works, including along the proposed turbine and construction materials haul route. It is assumed also that all mitigation measures in relation to the other cumulative projects will also be implemented.

Residual Impact

The Proposed Development will have a short-term, slight negative effect on residential amenity during construction works. During the operational phase, noise and shadow flicker from the proposed and permitted projects will be limited to below guideline levels or as committed to by the developer, resulting in a long-term, imperceptible residual impact from on residential amenity.

Significance of Effects

Based on the assessment above there will be no significant direct or indirect effects.

5.10 Summary

Following consideration of the residual impacts (post-mitigation) it is noted that the Proposed Development will not result in any significant effects on Human Beings in the area surrounding the Proposed Development. Following appropriate mitigation, the DoEHLG Wind Energy Guideline shadow flicker limits will not be exceeded at any property.

Provided that the Proposed Development is constructed and operated in accordance with the design, best practice and mitigation that is described within this application, significant effects on population and human health, associated with health and safety, noise, dust, traffic and shadow flicker, are not anticipated at international, national or county scale.