5. POPULATION AND HUMAN HEALTH

5.1 Introduction

This chapter of the Environmental Impact Assessment Report (EIAR) identifies, describes and assesses the potential significant, direct and indirect effects of the proposed 15-year extension of operation of the existing Carnsore Wind Farm (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 individuals or communities, should experience no significant diminution in their quality of life from the direct or indirect effects arising from the construction, operation and decommissioning of a development. Ultimately, all the impacts of a development impinge on human health, 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. A detailed quantitative noise impact assessment of the Proposed Development is provided in Chapter 11: Noise and Vibration.

5.1.1 Statement of Authority

This section of the EIAR has been prepared by Eoin Hurst and Ellen Costello, and reviewed by Michael Watson, of MKO.

Eoin is a Project Environmental Engineer with MKO with over 12 years of progressive experience in private sector civil and environmental engineering consultancy. Eoin holds a BE in Civil Engineering from NUI Galway and a MSc in Environmental Technology from Imperial College London. Prior to starting with MKO in 2019, Eoin worked as an Environmental Engineer with Tetra Tech in the United States.

Ellen is an Environmental Scientist who joined MKO in 2019 and has been involved in a number of wind energy EIAR applications. Ellen holds a BSc. (Hons) in Earth Science from Trinity College Dublin and a MSc. in Climate Change: Integrated Environmental and Social Science Aspects from the University of Copenhagen where she focused on renewable energy development in Ireland and its implications on environment and society.

Michael Watson is a Project Director with MKO; with over 18 years' experience in the environmental consulting sector. His project experience includes the management and delivery of Environmental Impact Statements / EIARs, with a particular focus on the renewable energy (wind) sector.

5.2 Population

5.2.1 Receiving Environment

Information regarding population and general socio-economic data were sourced from the Central Statistics Office (CSO), the Wexford County Development Plan 2013 – 2019, 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 within seven (7) townlands as listed in Table 1-1 of Section 1.1 of this EIAR. The Proposed Development is located approximately 8 kilometres (km) south of Rosslare Harbour and approximately 15km east of Kilmore Quay in County Wexford. 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 DEDs where the proposed wind farm is located, as well as nearby DEDs which may be affected by the proposed development.

The site of the Proposed Development lies within the Lady's Island DED as shown in Figure 5-1. The adjacent DEDs include Tacumshin, Kilscoran and St. Helen's. All of these DEDs will collectively be referred to hereafter as the Population Study Area for this chapter. The Population Study Area has a population of 4,342 persons, as of 2016 and comprises a total land area of 54.8 square kilometres (km^2) (Source: CSO Census of the Population 2016). The primary settlements (population centres) within the Study Area include Rosslare Harbour, Tagoat, Kilrane and Lady's Island.

There are 5 no. private residential dwellings within 500m of the existing turbines, which is the recommended minimum setback distance as per both the *2006 Wind Energy Development Guidelines (WEDG)* and the *2019 Draft Revised Wind Energy Development Guidelines.* The closest dwelling to any turbine is located approximately 314m northwest from Turbine 13, opposite the wind farm site entrance at the northern site boundary. It is noted that this dwelling was first granted planning permission in November 2001, at which time construction of the Carnsore Wind Farm was underway. This is more than the recommended setback distance relating to the turbine tip-height (i.e. 4 times the tip-height of 300m), outlined in the *2019 Draft Revised WEDG* from this dwelling. The potential impacts from shadow flicker effects upon these 5 dwellings are assessed in Section 5.7. Potential noise related impacts at these dwellings are detailed in Chapter 11 of this EIAR.

5.2.2 Population Trends

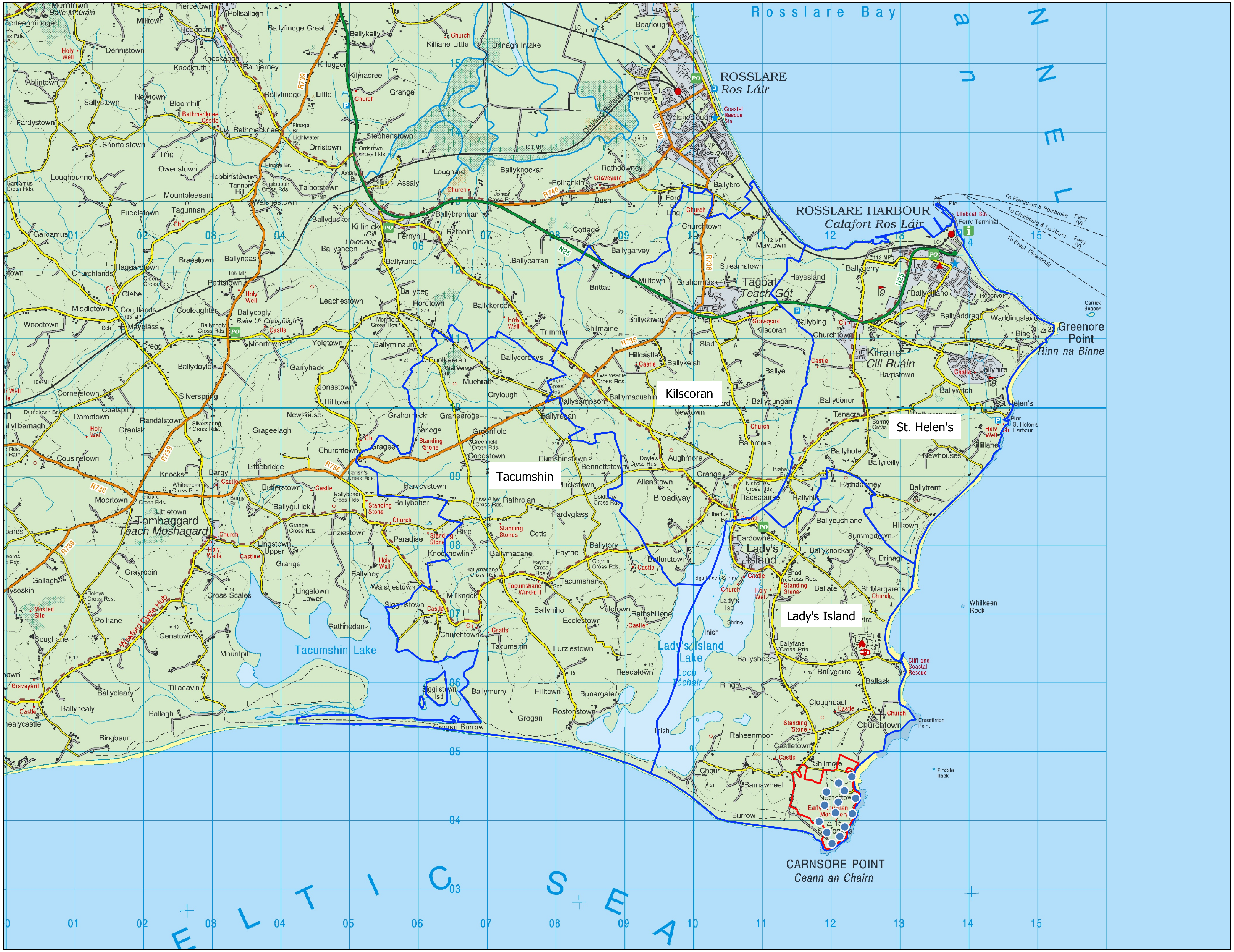
In the four years between the 2011 and the 2016 Census, the population of Ireland increased by 3.8%. During this time, the population of County Wexford grew by 3.0% to 149,722 persons. Further population statistics for the State, County Wexford and the Study Area have been obtained from the Central Statistics 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 Wexford	145,320	149,722	3.0
Population Study Area	4,159	4,342	4.4

The data presented in Table 5-1 shows that the population of the Study Area increased by 4.4% between 2011 and 2016. This rate of population growth is higher than that recorded at both the State level and the County level. When the population data is examined in closer detail, it shows that the rate of population change is unevenly distributed within the Study Area DEDs, with some areas experiencing significant increases, and others significant decreases. The highest increase in the population between 2011 and 2016 occurred within Lady's Island DED, which experienced an 8.6% population increase. In comparison, the population of Kilscoran DED experienced a decrease of 1.3%, while the population of Tacumshin DED remained unchanged during the same period.

Of the DEDs that form the Study Area for this assessment, the highest population during the 2016 Census was recorded in St. Helen's DED with 2,240 persons reported. The lowest population within the Study Area was reported in Tacumshin DED, with 528 persons recorded.



Map Legend

- Turbines
- Wind Farm Site Boundary
- District Electoral Divisions

Drawing Title: Population Study Area	
Project Title: Carnsore Wind Farm EIAR	
Drawn By: EH	Checked By: TB
Project No.: 210202	Drawing No.: Fig 5-1
Scale: 1:50,000	Date: 8/06/21

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5.2.3 Population Density

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

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

Area	Population Density (Persons per square kilometre)	
	2011	2016
State	67.5	70.1
County Wexford	61.5	63.3
Population Study Area	75.9	79.3

The population density of the Study Area recorded during the 2016 Census was 79.3 persons per km^2. This figure is significantly higher than both the National population density of 70.1 persons per km^2 and the County population density of 63.3 persons per km^2.

Similar to the observed population and household trends, the population density recorded across the Study Area varies between DEDs. St. Helen's DED had the highest reported population density of 185.9 persons per km^2 while Tacumshin DED, with a density of 30.8 persons per km^2 was the lowest.

5.2.4 Household Statistics

The number of households and average household size recorded within the State, County Wexford 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	2.8	1,702,289	2.8
County Wexford	52,652	2.7	54,289	2.7
Population Study Area	1,627	2.5	1,684	2.5

In general, the figures in Table 5-3 show that while the number of households within the State, County and the 4 no. DEDs has increased slightly, the average number of people per household remained unchanged within the Study Area. Average household size recorded within the Study Area during the 2011 and 2016 Censuses are in line with that observed at State and County level during the same time periods.

5.2.5 Age Structure

Table 5-4 presents a breakdown of the population percentages for the State, County Wexford and the Study Area, within age groups as defined by the CSO in 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	1,006,552	576,452	1,406,291	1,135,003	637,567
County Wexford	32,952	16,946	40,034	37,805	21,985
Population Study Area	907	408	1,042	1,175	810

The proportion of the Study Area DED population within each age category is similar to those recorded at national and County level for most categories. For the Study Area, the greatest percentage of the population (24.0%) is within the 25-44 age category.

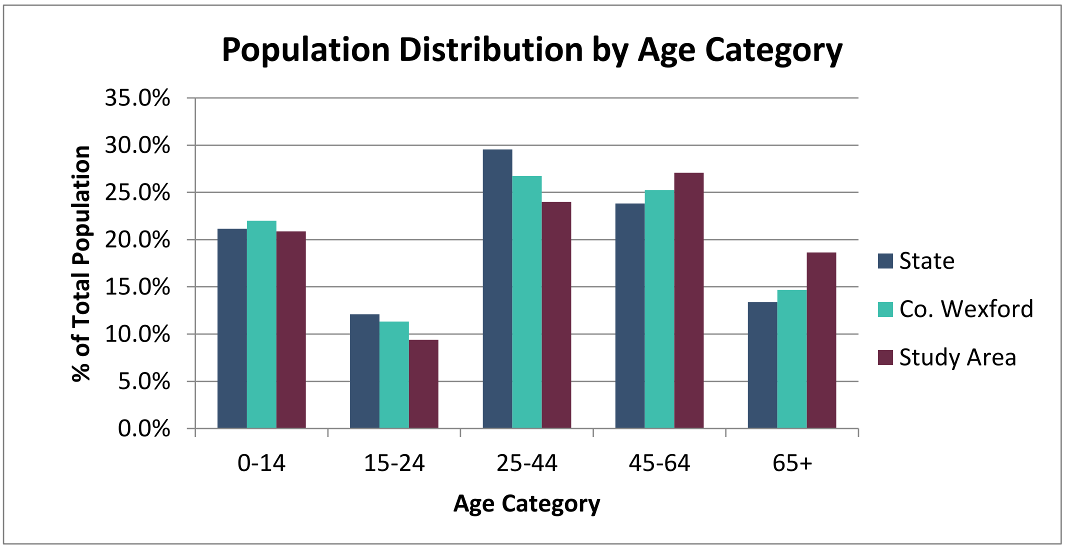

Figure 5-2 Population Distribution by Age Category in 2016

5.2.6 Employment and Economic Activity

5.2.6.1 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 Wexford and the Study Area, as reported during the 2016 Census.

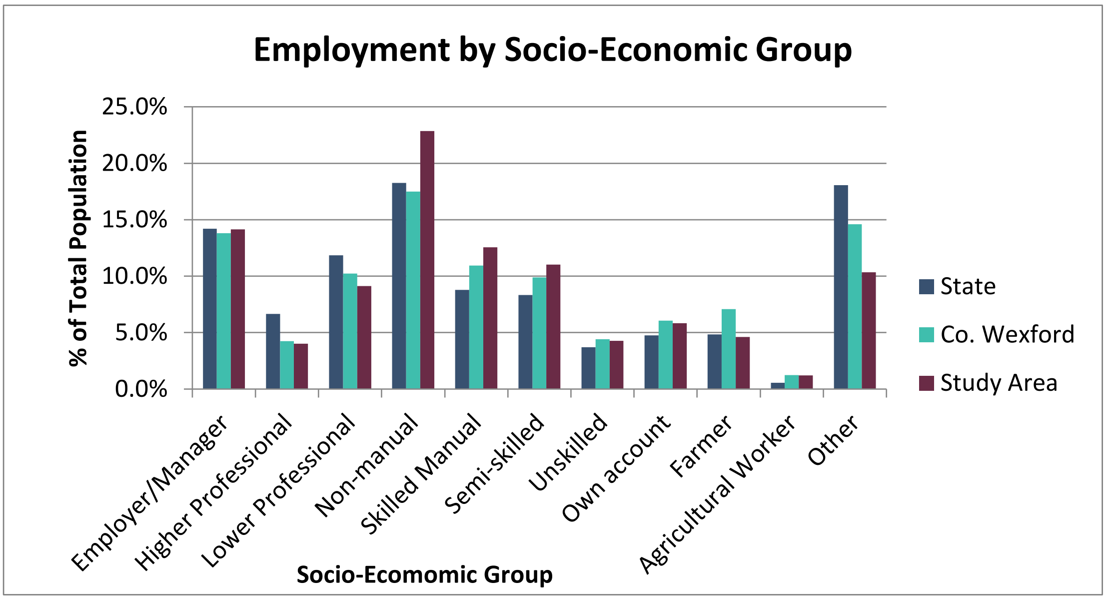

Figure 5-3 Employment by socio-economic group in 2016

The highest level of employment within the Study Area was recorded in the Non-Manual category, at 22.9% of total population. The levels of employment reported for the Study Area within the Employer/Manager (14.1%), Unskilled (4.3%), Own Account (5.8%) and Agricultural Worker (1.2%) categories were similar to the State and County figures. Levels of employment reported within the Skilled Manual (12.6%) and Semi-skilled (11.0%) categories for the Study Area were greater than both the State and County rates, while those reported within the Higher Professional (4.0%), Lower Professional (9.1%) and Farmer (4.6%) categories were lower than both State and County figures.

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.

5.2.6.2 Employment and Investment Potential in the Irish Wind Energy Industry

5.2.6.2.1 *Background*

The Sustainable Energy Authority of Ireland (SEAI) estimates, in their *Wind Energy Roadmap 2011-2050*[1], that onshore and offshore wind could create 20,000 direct installation and operation/maintenance jobs by 2040 and that the wind industry would also have an annual investment potential of €6-12 billion by the same year.

A 2014 report *The Value of Wind Energy to Ireland*[2], published by Pőyry, stated that growth of the wind sector in Ireland could support 23,850 jobs (construction and operational phases) by 2030. If

[1] *Sustainable Energy Authority of Ireland 2011, Wind Energy Roadmap to 2050 Available at: https://www.seai.ie/publications/Wind_Energy_Roadmap_2011-2050.pdf*

[2] *Poyry Management Consulting: The Value of Wind Energy to Ireland': A report to Irish Wind Energy Association 2014. Available at: https://windenergyireland.com/images/files/9660bd6b05ed16be59431aa0625855d5f7dca1.pdf*

Ireland instead chooses to not develop any more wind, 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.

Siemens, in conjunction with the WEI, published a report in 2014 titled *An Enterprising Wind: An economic analysis of the job creation potential of the wind sector in Ireland*[3], which concluded, *'a major programme of investment in wind could have a sizeable positive effect on the labour market, resulting in substantial growth in employment.'*

The report considers the three potential types of direct employment created, as a result of increased investment in wind energy, to be:

- Wind Energy Industry Employment:
  - Installation
  - Development
  - Planning
  - Operation and Maintenance
  - Investor activity
- Electricity Grid Network Employment
- Potential Wind Turbine Manufacturing Employment

Wind Energy Ireland (WEI) released a report in March 2021 *Our Climate Neutral Future Zero by 50* [4] in light of the Government's announcement of new, ambitious energy targets in the same month. The report outlines the potential for 50,000 jobs to be created in the renewable energy industry in order to meet the build out requirements to achieve a Net -Zero carbon emissions by 2050. The report estimates that at least 25,000 jobs will be in the onshore and offshore wind energy sector.

KPMG released a report with WEI in April 2021 titled '*Economic impact of onshore wind in Ireland*[5] which states that the wind sector currently supports 5,130 jobs (not including employment in grid development) with a '*with a strong foothold in rural Ireland…[…]… through its direct and indirect activities and employment, the sector supports payment of labour incomes totalling €225 million'.*

As of May 2021, there were over 5,510 Megawatts (MW) of wind energy capacity installed on the island of Ireland. Of this, 4,235 MW was installed in the Republic of Ireland, with 1,276 MW installed in Northern Ireland. The majority of the Republic of Ireland's installed wind energy capacity is located in Counties Mayo, Galway, Cork and Wexford.

5.2.6.2.2 Economic Value

A 2009 Deloitte report in conjunction with the Irish Wind Energy Association (now Wind Energy Ireland, WEI) titled 'Jobs and Investment in Irish Wind Energy – Powering Ireland's Economy'[6] 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).

[3] *Siemens, IWEA 2014 An Enterprising Wind: An economic analysis of the job creation potential of the wind sector in Ireland. Available at: https://www.esri.ie/system/files/media/file-uploads/2015-07/BKMNEXT250.pdf*
[4] *Wind Energy Ireland, MaREI March 2021 Our Climate Neutral Future Zero by 50. Available at: https://windenergyireland.com/images/files/our-climate-neutral-future-0by50-final-report.pdf*
[5] *KPMG, Wind Energy Ireland April 2021 Economic impact of onshore wind in Ireland. Available at: https://windenergyireland.com/images/files/economic-impact-of-onshore-wind-in-ireland.pdf*
[6] *Deloitte, Irish Wind Energy Association 2009 Jobs and Investment in Irish Wind Energy Powering Ireland's Economy. Available at: https://windenergyireland.com/images/files/9660bd5e72bcac538f47d1b02cc6658c97d41f.pdf*

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.

The April 2021 KPMG report discussed above states that by 2030, the onshore wind industry along will bring an Additional Gross Value (GVA) of €550million per annum to the Irish economy, will contribute €305millon total payment in incomes across the supply chain and has the potential to contribute approximately €100millon to local authority rates, if 2030 targets are reached. Furthermore, it is estimated that €2.7billion in capital would be invested in the country through to 2030 if Climate Action Plan targets are reached.

If consented, the Proposed Development will continue to contribute to the economic value that renewable energy brings to the country. In addition, Carnsore Wind Farm has the potential to bring significant positive benefit to the local community. The existing wind farm contributes annual commercial rates of in excess €195,000 per annum to Wexford County Council. In excess of €3million has been paid in commercial rates to Wexford County Council during the wind farm's operation to date. These rates have assisted the Council in the provision of services in both the local area and throughout the County. It is expected that the Proposed Development will can maintain current levels of employment primarily in the Operation and Maintenance (O&M) of the wind farm.

5.2.6.2.3 Energy Targets

The Climate Action Plan 2019 (CAP) was published on the 1st of 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.

In March 2021, the Government of Ireland approved the Climate Bill which aims for net-zero emissions by 2050 and an Interim Target of 51% reduction to be reached by 2030, relative to a baseline of 2018. The Government is required to adopt a series of economy-wide five-year carbon budgets, with the first two five-year carbon budgets correlating to the Interim Target. The Bill also provides the framework for Ireland to meet its international and EU climate commitments and to become a leader in addressing climate change. The Bill states that Local Authorities must prepare individual Climate Action Plans which will include both mitigation and adaptation measures and must be updated every five years. Local Authority Development Plans must align with their Climate Action Plan.

In order to achieve these targets, Ireland's dependency on fossil fuels needs to drop from 80% dependency today to 5% dependency in 2050. MaREI forecast that 25GW of renewable electricity capacity is needed by 2050, compared with 4.5GW that is currently available today[7].

5.2.7 Land-Use

As previously noted, the majority of the proposed wind farm site comprises farmland (pasture and rough grazing), with a small proportion of vegetated scrub and grassland also within the site boundary. The predominant surrounding land use within the population study area is that of farmland.

At the northeast study area boundary, a cluster of commercial developments surround Rosslare Europort and the town of Rosslare Harbour. These commercial developments are primarily freight terminals and logistics warehouses.

The total area of farmland within the 4 DEDs around the wind farm site measures approximately 4,309 ha, comprising 78.7% of the Study Area, according to the CSO Census of Agriculture 2010. There are 84 farms located within the 4 DEDs, with an average farm size of 51.3 ha. This is significantly larger than the 41.2 ha average farm size for Co. Wexford.

Within the Study Area, farming employs 189 people, and the majority of farms are family-owned and run. Table 5-5 shows the breakdown of farmed lands within the Study Area. 'Total crops' accounts for the largest proportion of farmland (1,888ha), followed by 'pasture' (1,482ha).

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

Characteristic	Value
Size of Study Area	5,480 ha
Total Area Farmed within Study Area	4,309 ha
Farmland as % of Study Area	78.7%
Breakdown of Farmed Land in Study Area [1]	**Area (hectares) [1]**
Total Pasture	1,482 ha
Total Silage	688 ha
Total Crops, Fruit & Horticulture	1,888 ha
Total Cereals	1,298 ha
Rough Grazing	47 ha
Total Hay	201 ha
Potatoes	300 ha

1. *Categories and areas as per CSO, 2010. Sum of category areas does not equal total area of farmland.*

[7] *Wind Energy Ireland, MaREI March 2021 Our Climate Neutral Future Zero by 50. Available at: https://windenergyireland.com/images/files/our-climate-neutral-future-0by50-final-report.pdf*

5.2.8 Services

The Proposed Development site is not currently located within a functional local area plan (LAP) by Wexford County Council. As such the Wexford County Development Plan 2013-2019 (WCDP) is referred to in terms of development of local services.

According to the WCDP, the nearest Hub to the Proposed Development is Wexford Town, located approximately 18km to the north, while the nearest Town is Rosslare Harbour, located approximately 8km to the north. Rosslare Harbour contains the main services and local amenities within a reasonable driving distance (12km) from the Proposed Development.

The nearest settlement to the Proposed Development site is the village of Lady's Island, located approximately 3.2km to the northwest. Development or services within the vicinity of Lady's Island are not discussed in the main volume of the WCDP, however CSO data demonstrates that within the wider Lady's Island Electoral Division, the population has increased by 8.6% between 2011 and 2016. The 2016 Census reported a population of 620 persons. It appears that there are limited services/facilities and employment potential within the village, and hence it is likely that residents will continue to commute to the larger urban centres. Recent residential developments have primarily taken place along the L3046 to the north of the village, in close proximity to Lady's Island National School.

5.2.8.1 Education

The nearest primary school to the Proposed Development site is Scoil Mhuire (Lady's Island National School) located approximately 4.3km to the northwest, on the northern side of the village of Lady's Island.

The location of other primary schools within the Study Area in relation to the Proposed Development include:

- Kilrane National School, 6.5km north.
- St. Mary's National School, Tagoat, 7.1km north-northwest.

The nearest secondary schools to the Proposed Development site are located in Bridgetown, approximately 13.5km to the west-northwest, and in Wexford Town, approximately 17km to the northwest. The secondary schools in the surrounding area include Bridgetown College, Coláiste Éamonn Rís, Loreto Secondary School, St. Peter's College and Presentation Secondary School.

5.2.8.2 Access and Public Transport

Access to the Proposed Development site is via an existing site entrance off the local road (Nethertown Lane) at the northern site boundary. The primary route to the site is via the N25 national road to Tagoat and then follows the L3060 local road south through Lady's Island. The site is not served directly by public transport. The nearest bus stop is located at Carne, approximately 1.6km north-northeast of the Proposed Development. The current No. 378 bus service runs on Friday's only from Wexford Town. The nearest railway station is located at Rosslare Europort, 7.7km to the northeast, from which Irish Rail provide daily links to towns along the Dublin Connolly to Rosslare line.

5.2.8.3 Amenities and Community Facilities

The majority of amenities and community facilities, including GAA and other sports clubs, youth clubs and recreational areas available in the area are located in the centres of settlement throughout the wider area. Retail and personal services within the vicinity are provided in the larger settlements such as Rosslare and Wexford Town. The Church of the Assumption and Lady's Island Pilgrimage Centre are located approximately 3.2km to the northwest.

An existing coastal path, the Carnsore Point coastal walking trail, adjoins the southeast site boundary, linking two beaches at the northeast and southwest wind farm site boundary. This path is used regularly by the local community and tourists. ESB are currently in discussions with Wexford County Council with a view to maximising the public amenity and historic value of this site.

There are several other walking and cycling trails within the Study Area. The designated Wexford Eurovelo 1 cycle route runs from Rosslare Harbour west to Ballyhack, through much of the Study Area. The Norman Way heritage trail runs from Rosslare Harbour to Lady's Island and west towards Kilmore Quay.

Plate 5-1 View of Proposed Development from Carnsore Point Coastal Walking Trail

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 €9.1 billion revenue recorded in 2018. Overseas tourist visits to Ireland in 2019 grew by 0.7% to 9.7 million ('Key Tourism Facts 2019, Fáilte Ireland, March 2021). Ireland is divided into seven tourism regions. Table 5-6 shows the total revenue and breakdown of overseas tourist numbers to each region in Ireland during 2019 ('Key Tourism Facts 2019, Fáilte Ireland, March 2021).

Table 5-6 Overseas Tourists Revenue and Numbers 2019

Region	Total Revenue (€m)	Total Number of Overseas Tourists (000s)
Dublin	€2,210m	6,644
Mid-East/Midlands	€348m	954
South-East	**€261m**	**945**

South-West	€970m	2,335
Mid-West	€472m	1,432
West	€653m	1,943
Border	€259m	768
Total	**€5,173m**	**15,021**

The proposed wind farm site is located within the South-East Region. According to 'Regional tourism performance in 2019' (Fáilte Ireland, September 2019) the South-East Region which comprises Counties Carlow, Kilkenny, Waterford and Wexford, benefited from approximately 6.3% of the total number of overseas tourists to the country and approximately 5% of the associated tourism income generated in Ireland in 2019.

5.3.2 Tourist Attractions

There are currently no advertised public tourist attractions pertaining specifically to the site of the proposed development. As detailed in Section 5.2.8.3 a coastal walkway follows the southeast perimeter of the Proposed Development.

The historic medieval ruins of St. Vogue's church and graveyard, monuments listed in the Sites and Monuments Record (SMR), are located within the Proposed Development site boundary. The church is located approximately 93m south of the existing Turbine No. 4, in the southern portion of the site. The church is considered an important local heritage asset and is in the guardianship of Wexford County Council. Further details of the church and associated monuments are provided in Chapter 12: Cultural Heritage. Although no formal public access currently exists to the church, potential improvements are being discussed between ESB and Wexford County Council to maximise the historic value of the site.

There are a number of significant tourist attractions within the Study Area, particularly the County Wexford coastline with numerous sandy beaches, including Burrow Beach adjacent to the southwest of the site and Carne Beach 1.8km to the northeast. Carne Beach Caravan and Camping Park provides tourist accommodation during the summer months. Sailing, fishing, horse riding, kayaking and surfing are popular activities.

The village of Lady's Island is home to the oldest Marian shrine in Ireland and a popular pilgrimage site with a large annual event held each August. Lady's Island Lake is the largest coastal lagoon in the country, a designated EU site attracting large numbers of breeding and wintering birds, and as such also attracts significant numbers of eco-tourists.

Section 5.2.8.3 outlines some of the main cycling, walking and heritage trails within the surrounding area. Given the area's proximity to Rosslare Europort, 'The Sunny Southeast' is also a popular destination for overseas tourists, with the Proposed Development situated between the tourist centres of Wexford Town and Kilmore Quay.

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. This study indicated that 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.

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 landscape 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 IWEA Interactions Opinion Poll on Wind Energy

In January 2021 IWEA published the results of their most recent nationwide annual poll on attitudes to wind energy, the Public Attitudes Monitor. The results of the opinion poll were published via Wind Energy Ireland, the representative body for the Irish wind industry. The objective of the poll was to 'measure and track public perceptions and attitudes around wind energy amongst Irish adults.'

Between 12th – 18th November 2020, a representative sample of 1,004 Irish adults together with a booster sample of 203 rural residents participated in an online survey. The 2020 results reported that 50% of the nationally representative sample 'strongly favour', 32% 'tend to favour' and 15% 'neither favour nor oppose' wind power. Of the rural population surveyed 42% 'strongly favour', 40% 'tend to favour' and 14% 'neither favour nor oppose' wind power. The survey has been run annually since 2017 and while there has been a marginal decrease in those in favour of wind power nationally during this time (from 85% to 82%) there has been a marginal increase in those in favour from the rural population (from 79% to 82%).

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 view that it as a 'safe resource'.

When questioned about wind energy developments in their local area, 54% of the nationally representative sample either 'favour' or 'tend to favour' such proposals compared to 52% of the rural population reporting the same. There was a high level of agreement with positive benefits concerning wind in energy the local area from both the nationwide and rural populations, with over 80% of each group in agreement that it 'reduces CO_2 emissions' and is 'good for the environment', with over 75% of each group agreeing that it leads to 'cheaper electricity'. Over 60% of each population group agreed that wind energy 'supports energy independence' and 'creates employment'.

The IWEA November 2020 survey follows the structure of previous national opinion polls on wind energy undertaken since 2017. The 2020 survey results are consistent with previous year's figures and thus indicate that approximately 4 out of 5 Irish adults have continued to support wind energy in recent years.

5.4.2 Sustainable Energy Ireland Survey 2003

5.4.2.1 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.

5.4.2.2 Findings

The SEAI survey found that the overall attitude to wind farms was very positive, with 84% of respondents rating it positively or very positively. One percent rated 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 noted, 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 revealed that attitudes towards wind energy were 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 revealed 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 went 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 wind farm 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.

5.4.2.3 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 was 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.

5.4.2.4 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 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."*

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

5.4.3.1 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.

5.4.3.2 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 Wexford, each of which has two wind farms in proximity.

5.4.3.3 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 Wexford 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.

5.4.4 Public Perception 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 syndrome does not adequately explain variations in public attitudes due to the degree of subjectivity involved.

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 has not supported 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 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.

2. ***'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."*

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 5.1 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 provide recommendations for protecting human health from exposure to environmental noise originating from various sources such as transportation noise, wind turbine noise and leisure noise. The Guideline Development Group (GDG) defined priority health outcomes and from this were able to produce guideline exposure levels for noise exposure.

For average noise exposure, the GDG conditionally recommends reducing noise levels produced by wind turbines below 45 dB Lden. The GDG recognise the potential for increased risk of annoyance at levels below this value but cannot determine whether this increase risk can impact health. Wind turbine noise above this level is associated with adverse health effects.

The GDG points out that evidence on health effects from wind turbine noise (apart from annoyance) is either absent or rated low/very low quality and effects related to attitudes towards wind turbines are hard to differentiate from those related to noise and may be partly responsible for the associations. The GDG also recognises that the percentage of people exposed to noise from wind turbines is far lower than other sources such as road traffic and state that any benefit from specifically reducing population exposure to wind turbine noise in all situations remains unclear.

That being said, the GDG recommends renewable energy policies include provisions to ensure noise levels from wind farm developments do not rise above the guideline values for average noise exposure. The GDG also provides a conditional recommendation for the implementation of suitable measures to reduce noise exposure.

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 antivibration 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 from 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 systems will be integral to the construction of the turbines. Lightning protection systems will run from the nacelle to the base of the turbine. The lightning protection system 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 20 kilovolt (kV) underground electric cables required at the Proposed Development to connect the turbines to the substation is common practice throughout the country and installation to the required specification does not give rise to any specific health concerns. Note that all underground utilities are in place for the existing wind farm and no new intrusive works are proposed. Cables are buried in trenches at approximately 0.8m below ground level (bgl).

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 ESB document 'EMF & You' (ESB, 2017) provides further practical information on EMF (https://esb.ie/docs/default-source/default-document-library/emf-public-information_booklet_v9.pdf?sfvrsn=0). A copy of this document 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: 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 1.7.2 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 and natural 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 (EPA) 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.

Chapter 8: Land, Soils and Geology, Chapter 9: Water, Chapter 10: Air and Climate, Chapter 11: Noise and Vibration and Chapter 14: Material Assets (including 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 a wind farm's 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. However, it is important to note that in the case of the Proposed Development, no construction activities are proposed, and therefore, these effects are not relevant.

A limited number of potential effects on human health area assessed in terms of the Operational phase of the Proposed Development. The assessments however show that the residual impacts are not significant and will not lead to significant effects on any environmental media with the potential to lead to health effects for humans. 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 wind farm site.

The Proposed Development is for the extension of operational life of an existing 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, slight, 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 both the construction, operational and decommissioning phases are limited. No construction works are proposed and therefore there will be no requirement for bulk storage of chemicals or waste materials with the potential to cause significant environmental pollution.

There is limited potential for significant natural disasters to occur at the proposed Carnsore Wind Farm site. Ireland is a geologically stable country with a mild temperate climate. The potential natural disasters that may occur are therefore limited to flooding and fire. The risk of 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 5.2 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 in northwest 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 based on data from 12 weather monitoring 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 dwelling, 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 the Environment, Heritage and Local Government (DoEHLG) in 2006, states that at distances greater than ten times the turbine rotor diameter from a wind turbine base, the potential for shadow flicker is very low.

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.

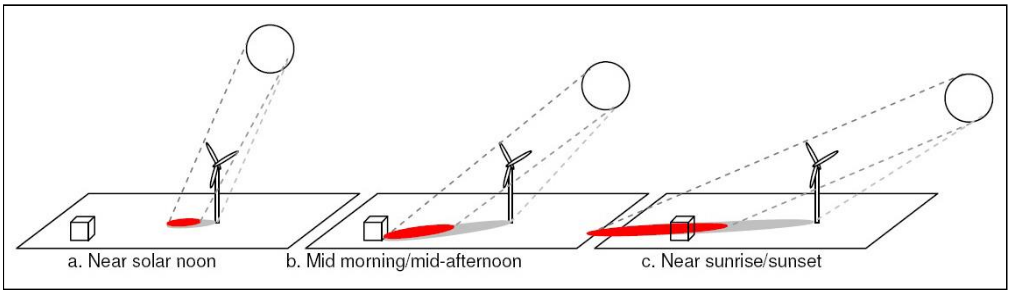

Figure 5-4 Shadow-Prone Area as Function of Time of Day (Source: Helimax Energy, 2008)

4. *Distance and bearing, i.e., property location 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. 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 illustrated in

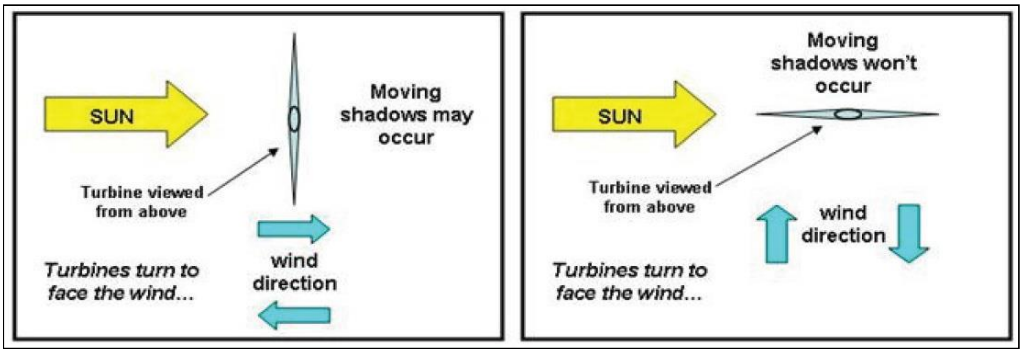

Figure 5-5 Turbine Blade Position and Shadow Flicker Impact (Source: Wind Fact Sheet: Shadow Flicker, Noise Environment Power LLC)

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 322 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 to cast a shadow on the dwelling.

The guideline thresholds of 30 hours per year, or 30 minutes per day, have been applied to all dwellings located within ten rotor diameters (i.e. 500 metres) of the existing 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. In the case of the Proposed Development the rotor diameter is 50m so the equivalent distance of 10 rotor diameter is also 500m, so this distance has been applied. Therefore, the shadow flicker assessment criteria is considered more robust in the case of the Proposed Development.

The adopted 2006 DoEHLG guidelines are currently under review. The Department of Housing, Local Government and Heritage (DoHLGH) 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 (ABP) 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 as set out in the '*Proposed Revisions to Wind Energy Development Guidelines 2006 – Targeted Review*' (Department of Environment Community and Local Government [DoECLG], December 2013) and the subsequent '*Review of the Wind Energy Development Guidelines 2006 – Preferred Draft Approach*' (Department of Housing, Planning, Community and Local Government [DoHPCLG], June 2017).

The applicant is aware that the Department of the Environment, Heritage and Local Government (DoEHLG) Wind Energy Development Planning Guidelines (2006) are currently being revised. The assessment herein is based on compliance with the DoEHLG 2006 Guidelines limit (30 hours per year or 30 minutes per day).

5.7.3 Scoping

Chapter 2 of this EIAR describes the scoping and consultation exercise undertaken for the proposed Carnsore Wind Farm. MKO's scoping document stated that shadow flicker would be assessed using a specialist computer software programme specifically designed for the wind energy industry. This assessment is included in the following sections of the EIAR. No scoping responses relating to shadow flicker were received.

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 DoHPCLG 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), WindPRO (EMD), 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 WindFarm Version 5.0.1.2 (WindFarm) from ReSoft has been used to predict the level of shadow flicker associated with the Proposed Development. WindFarm is commercially available software 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

Planning permission is being sought to maintain the existing turbines at the site, which have a maximum tip-height of 75 metres above the top of foundation. For the purposes of this assessment, these existing turbines, with a rotor diameter of 50m and a hub height of 50m, were modelled in order to assess a worst-case scenario. As the maximum 75m turbine tip-height is known, the model provides an accurate assessment of the potential shadow flicker impacts.

With the benefit of the mitigation measures outlined in section 5.9.3.7, all turbines installed on-site will comply with the current adopted 2006 DoEHLG guideline thresholds of 30 minutes per day, or 30 hours per year, or with any revised guidelines if required.

Any references to the turbine dimensions in this shadow flicker assessment should be considered in the context of the above.

5.7.5.2 Study Area

At the outset of the project, during the constraints mapping process detailed in Section 3.3.5.1 of this EIAR, all dwellings within 2km of the development site boundary were identified and mapped. This included all occupied and unoccupied dwellings. In addition, a planning history search to identify properties that may have been granted planning permission, but not yet been constructed, was carried out. These properties were also added to the study area's dataset.

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, i.e., 500 metres, have been included in the assessment.

There are a total of 5 No. residential dwellings located within ten rotor diameters (500 metres) of the existing turbine locations. There are no residential dwellings located closer than 300 metres (4 times tip height) from the nearest proposed turbine location. The shadow flicker study area and dwelling locations are shown in Figure 5-6.

Map Legend

- Carnsore Site Boundary
- Turbine Layout
- Shadow Flicker Study Area (10xRD of 50m = 500m)
- Dwellings

N

Drawing Title	
Shadow Flicker Study Area	
Project Title	
Carnsore WF, Co. Wexford	
Drawn By: EC	Checked By: MW
Project No.: 210202	Drawing No.: Figure 5-6
Scale: 1:12500	Date: 15/07/2021

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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 of 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 2 no. properties within 360 degrees of the Proposed Development within the study area (500m from turbines) 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 5.9.3.7 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.
- Each turbine rotor is modelled perpendicular to each individual sensitivity receptor, to maximise the turbines aspect at each window and consequentially the potential instance for shadow flicker. 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 topographical information used in the model is limited to elevation changes and does not factor in the potential cover provided by vegetation and man-made structures.

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 35.9% of the daylight hours per year. This percentage is based on Met Éireann weather data for this region, recorded at Rosslare, Co. Wexford over the 30-year period from 1981 to 2010[8]. The mean regional daily sunshine duration over this 30-year period ranges from 1.8 to 6.9 hours, depending on the month. The greatest recorded regional daily sunshine duration, meanwhile, ranges from 7.2 to 15.7 hours, again depending on monthly variability(www.met.ie). The actual sunshine hours at the Proposed Development and therefore the percentage of time shadow flicker could actually occur is 35.9% of daylight hours. **Error! Reference source not found.** therefore lists the annual shadow flicker calculated for each property when corrected for the regional average of 35.9% 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 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 for maximum shadow hours per day, and maximum shadow hours per year 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 there is a window facing each turbine,
- 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 35.9% 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 5-7.

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 dwelling, 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 5.2.1 there are no dwellings less than 300 metres from the existing turbine locations. There is one residential dwelling located 314 metres to the north-west of turbine no. 13. However, for the purposes of this assessment, the predicted shadow flicker levels have been modelled for all dwellings within ten rotor diameters (500 metres) of the proposed turbine locations.

A total of 5 No. dwellings have been modelled as part of the shadow flicker assessment, the results of which are presented in Table 5-7. Former residential dwellings termed as 'derelict' within this assessment are defined as properties that are currently in an uninhabitable condition.

[8] Rosslare Weather Station, Co. Wexford was closed in 2007/2008

Table 5-7 Maximum Potential Daily & Annual Shadow Flicker – Carnsore Wind Farm, Co. Wexford

Dwelling ID No.	ITM Coordinates (Easting)	ITM Coordinates (Northing)	Description	Distance to Nearest Turbine (metres)	Nearest 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 Daily Shadow Flicker Exceedance	Mitigation Strategy Required (Daily)	Mitigation Strategy Required (Annual)
1	711809	604817	Dwelling	314	T13	00:40:12	69:48:00	25:06:31	13	Yes	No
2	711478	604721	Dwelling	450	T11	00:28:12	36:12:00	13:01:19	N/A	No	No
3	712086	605165	Dwelling	490	T14	00:00:00	0:00:00	0:00:00	N/A	No	No
4	711344	604376	Dwelling	496	T1	00:25:12	38:12:00	13:44:29	N/A	No	No
5	711332	604339	Dwelling	497	T1	00:25:12	35:42:00	12:50:31	N/A	No	No

Of the 5 No. dwellings modelled, it is predicted that one of these locations (Dwelling ID No. 1) may experience daily shadow flicker levels in excess of the DoEHLG guideline threshold of 30 minutes per day. This prediction assumes worst-case scenario 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.). .

Of the 5 No. properties modelled, when the regional sunshine average (i.e., the mean number of sunshine hours throughout the year) of 35.9% is taken into account, the DoEHLG guideline limit of 30 hours per year is predicted to not be exceeded at any of the residential dwellings.

Additionally, it is worth reiterating that the predicted shadow flicker listed in Table 5-7 is considered conservative and in reality, the occurrence and/or duration of shadow flicker at these dwellings is likely to be eliminated or significantly reduced as the following items are not considered by the model:

- Dwellings may be screened by topography, cloud cover and/or vegetation/built form i.e., adjacent buildings, farm buildings, garages or barns; and,
- Each dwelling will not have windows facing in all directions onto the wind farm.

Section 5.9.3.7 below outlines the mitigation strategies which may be employed at the potentially affected dwelling within a distance of 500m (10 rotor diameters) of the Proposed Development.

5.7.6.2 Cumulative Shadow Flicker

For the assessment of cumulative shadow flicker, any other existing, permitted or proposed wind farm developments would be considered where it was located within two kilometres of the proposed turbines, and where the dwellings included in the shadow flicker assessment were within 10 rotor diameters of both the proposed turbines, and the other existing, permitted or proposed wind farms. There are no other existing and permitted wind turbines located within 14km of the Proposed Development. The closest existing windfarm is the Richfield Wind Farm, located approximately 15.5km west of the Proposed Development.

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.

The Proposed Development is located on a site mainly consisting of exposed coastline and low-lying agricultural land. As such, the amount of people accessing the site relates mainly to locals and tourists, either farmers working on the site, or those walking or visiting the adjacent beaches. Per the detailed layout description in Chapter 1 of this EIAR there are no third-party dwellings within 300 metres of the existing turbines (i.e., 4 times tip-height).

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 have also been carried out, as presented in Chapter 13 of this EIAR. Impacts on human beings 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 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 were not to proceed, the alternative land-use option to maintaining the existing wind energy development at the site would be to decommission the wind farm and restore the site to its original use as agricultural lands for pasture and crops. It is noted that existing agricultural land-uses at the site will also continue unchanged if the Proposed Development does proceed. The environmental impact of this is considered neutral in the context of the EIAR.

If the Proposed Development were not to proceed, the opportunity to capture a significant part of County Wexford's valuable wind 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 maintain and generate local employment and investment and to diversify the local economy would also be lost.

5.9.2 Construction Phase

As has been detailed in Chapter 1 and Chapter 4 of this EIAR, no new construction will occur as part of the Proposed Development, since the proposal seeks to extend the operational life of a pre-existing wind farm and associated on-site infrastructure. Therefore, there is no potential for construction phase related impacts commonly discussed, such as may relate to Population and Human Health, including Health and Safety, Noise, Dust and Traffic related impacts.

5.9.2.1 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 wind farm.

5.9.3.1 Health and Safety

Pre-Mitigation Impact

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

Proposed Mitigation Measures

Notwithstanding the above, mitigation measures that are currently in place will continue during the extended operation of the Proposed Development to ensure that the risks posed to staff, landowners and the general public remain negligible throughout the operational life of the wind farm.

An operational phase Health and Safety Plan is currently in place and will continue 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.

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 operation and maintenance (O&M) of the wind farm. On a long-term basis, the proposed development will maintain approximately 2-3 part-time staff during the operational phase relating to the maintenance and control of the wind farm, having a long-term slight positive effect.

Proposed Community Benefit Scheme

Two important areas of Government policy development are nearing completion which will have a bearing on the establishment of future community benefit funds, the draft updated Wind Energy Guidelines and the Renewable Energy Support Scheme (RESS), the terms and conditions for which were published in February 2020. Both sets of policy are expected to provide the Government requirements on future community benefit funds for renewable energy projects. We will fully take into account these two important policies when finalised as we present the approach to community benefit.

Hibernian Wind Power have confirmed that the existing community benefit fund, established in 2014 for Carnsore Wind Farm, is €11,900 per annum. This current level of funding is set to remain in place during the operational lifetime of the Proposed Development (i.e. for a further 15 years) amounting to €178,500 over the lifespan of the wind farm.

The Community Benefit Fund belongs to the local community. The premise of the fund is that it should be used to bring about significant, positive change in the local area. To make this happen, our first task will be to form a benefit fund development working group that clearly represents both the close neighbours to the project as well as nearby communities. This group will then work on designing the governance and structure of a community entity that would administer the Community Benefit Fund.

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 Land-use

The footprint of the Proposed Development site, including turbines, roads etc., will occupy only a small percentage of the total Study Area defined for the purposes of this EIAR. The main land-use of agriculture (grazing and rough pasture) will continue to co-exist with the wind farm during the operational phase. The Proposed Development will have no impact on other land-uses within the wider area.

5.9.3.5 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. It is also noted that several residential properties have been constructed since the Carnsore Wind Farm was first developed at this site in 2002, and further planning applications for residences in the vicinity of the Proposed Development continue to be lodged.

5.9.3.6 Tourism and Amenity

Pre-Mitigation Impacts

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. Wind farms are an existing feature in the surrounding landscape, which will assist in the assimilation of the proposed development into this environment.

Currently there are no dedicated amenity walkways within the site of the Proposed Development. As outlined in Chapters 1 and 4, and in Sections 5.2.8.3 and 5.3.2 above, the Applicant has entered into discussions with the Local Authority regarding potential access improvements and signage for tourists and the general public. The Applicant acknowledges that there is a significant tourism potential at the site of the Proposed Development, with the potential for walking, educational and heritage related activities being considered. No new public access-ways or related amenity infrastructure is however confirmed, or included, in the current Proposal.

Proposed Mitigation Impacts

None required.

Residual Impact

The Proposed Development will have a long-term neutral effect on tourism.

Significance of Effects

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

5.9.3.7 Shadow Flicker

Pre-Mitigation Impacts

Assuming worst-case conditions, a total of 1 residential dwelling may experience daily shadow flicker in excess of the current DoEHLG guideline threshold of 30 minutes per day. The DoEHLG total annual guideline limit of 30 hours is not exceeded at any occupied residential dwelling. There have been no reports or complaints regarding shadow flicker during the previous 19 year operational history of the wind farm.

Proposed Mitigation Measures

In cases where shadow flicker is reported at any occupied dwelling, a site visit will be undertaken firstly to determine the existing screening and window orientation. This will determine if the dwelling has an actual line of sight to any turbine. Once this is completed and all of the potential dwellings identified, screening or other suitable mitigation measures may 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.

Residual Impact

Shadow flicker could potentially have a long-term slight negative impact. However, as the Applicant has committed to not exceeding the existing daily and annual guideline requirement at occupied residential dwellings, there will be no impact from shadow flicker on human beings.

Significance of Effects

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

5.9.3.8 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 interference with telecommunications. Detailed shadow flicker modelling has 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 the shadow flicker thresholds set out in the 2006 DoEHLG Wind Energy Guidelines.

The visual impact of the Proposed Development is addressed comprehensively in Chapter 13: Landscape and Visual. Chapter 13 concluded that; 'While some visual impacts do arise in locations where there is very little screening, the siting, design and scale of the turbines is considered appropriate, as the turbines are only visible locally and they do not obscure views or vistas of the coast or sea.' In addition, Chapter 13 concluded; 'that visibility is greatly restricted by the surrounding topography and actual visibility is further restricted by the effects of localised screening and changes in local topography. Therefore, the turbine locations and heights are considered appropriate for the Proposed Development and its continued operation will not have significant landscape or visual effects.'

Given the separation distance of the residential properties from the proposed turbines, and the level of existing screening in the area, the Proposed Development will have no significant impact on existing visual amenity at dwellings.

Proposed Mitigation Measures

There will be no turbines within 300 metres (4 times tip height) of any third-party dwellings. 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.

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.

5.9.3.9 Noise

A baseline assessment of the existing background noise conditions was carried out, the results of which are presented in Chapter 11: Noise and Vibration 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 Amplitude Acoustics Ltd. are presented in Chapter 11 of the EIAR. The noise assessment determined that the predicted operational noise effect at the closest noise sensitive location (NSL) to the site (a dwelling located 314m northwest of T13) is of a negative, medium, 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 NSLs assessed, extension of operation of the existing 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 the Proposed Development can be satisfied at all NSLs. A mitigation strategy involving curtailment of relevant turbines is outlined which will ensure compliance during the proposed extended operational phase.

5.9.3.10 Traffic

Traffic and Transport related effects are detailed in Chapter 14: Material Assets. During the operational phase, the direct traffic related effects on the population of the Study Area will be long-term imperceptible, given that there will be approximately two maintenance staff travelling to site at any one time, resulting in typically two visits to the site on any one day, made by a car or light goods vehicle. Due to the very low volumes of traffic forecast to be generated during this stage no mitigation measures are required.

5.9.4 Decommissioning Phase

The Proposed Development includes for the extension of operation of an existing wind farm for a further 15 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. It is proposed that the turbines and all associated above-ground site infrastructure will be removed with sub-grade elements such as turbine foundations to remain in place, to limit environmental impacts, and the site returned to its former use as agricultural land.

The works likely required during the decommissioning phase are described in Section 4.8 of Chapter 4 of this EIAR. Any impacts and consequential effects that occur during the decommissioning phase will be similar to that which typically occur during the construction phase, however to a lesser extent.

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. Further information on projects considered as part of the cumulative assessment are given in Chapter 2: Background to the Proposed Development, Section 2.7. 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 13) and Traffic (Chapter 14).

5.9.5.1 Health and Safety

The proposed wind farm will have no cumulative impacts in terms of health and safety. There is no credible scientific evidence to link wind turbines with adverse health impacts.

5.9.5.2 Employment and Economic Activity

There are three additional operational wind energy developments identified within 20km of the Proposed Development; Ardcavan Business Park (single turbine), Teagasc Johnstown (single turbine) and Richfield Wind Farm (18 turbines, 27MW capacity). These permitted projects along with the Proposed Development will contribute to long term employment, resulting from operation and maintenance related activities. This results in a long-term, moderate positive impact.

Agricultural activities on the site of the proposed development can continue while the proposed development is operating, resulting in a long-term moderate positive cumulative impact.

5.9.5.3 Tourism and Amenity

As detailed in Section 5.3.2 there are a number of significant tourist attractions within the Study Area however no key identified tourist attractions currently pertain 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.

5.9.5.4 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 concluded that there would be a long-term imperceptible cumulative impact from the Proposed Development and other wind farm developments in the area.

5.9.5.5 Shadow Flicker

As outlined in Section 5.7.6.2 no dwellings will be impacted by shadow flicker from the Proposed Development in combination with other permitted wind farms. Therefore, there are no cumulative shadow flicker effects associated with the Proposed Development and other permitted wind farms.

5.9.5.6 Residential Amenity

Permitted and proposed projects as described in the cumulative assessment in Chapter 2 typically consist of development of housing, agriculture and community facilities. No additional wind energy developments are proposed within 2km of the site. There is therefore no potential for cumulative effects such as shadow flicker, to impact residential amenity, in combination with the Proposed Development.