5.0 POPULATION AND HUMAN HEALTH

5.1 INTRODUCTION

This Chapter examines the existing environment and addresses the potential impacts on population and human health arising from the proposed Castlebanny Wind Farm.

5.1.1 Background

The two environmental factors of population and human health are addressed under separate headings throughout this Chapter. The assessment on population considers the current land use of the proposed site, the current activities occurring within and in the vicinity of the site, local population information, employment profiles, tourism, visitor attractions and community gain opportunities. The assessment on human health includes a detailed literature review of studies and research carried out on the potential effects of wind farm developments on human health.

The study area for population and human health includes review of relevant information on a county and national scale but is mainly concentrated on the Electoral Districts (ED) within which the proposed project is located.

The potential impacts of the proposed development on other environmental factors which may also have an impact on human beings, as set out in Chapter 8 (Land, Soils and Geology); Chapter 9 (Hydrology and Hydrogeology); Chapter 10 (Shadow Flicker); Chapter 11 (Aviation and Telecommunication); Chapter 12 (Noise and Vibration); Chapter 13 (Landscape and Visual Impact Assessment); Chapter 14 (Air Quality and Climate) and Chapter 16 (Traffic and Transport), are addressed in this Chapter and discussed in more detail in the relevant Chapters of this EIAR. A separate section setting out the likely interactions between this assessment and other technical assessments is presented in Chapter 17 (Interaction of the Foregoing).

This assessment has been carried out in accordance with the following guidelines:

- Department of Housing, Planning and Local Government (DoHPLG), *Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment* (2018)
- Environmental Protection Agency (EPA), *Guidelines on the Information to be contained in Environmental Impact Assessment Reports (Draft)* (2017)
- European Commission (EC), *Environmental Impact Assessment of Projects: Guidance on the preparation of the Environmental Impact Assessment Report* (2017)
- Department of the Environment, Heritage and Local Government *Wind Energy Development Guidelines* (2006)
- DoHPLG, *Draft Revised Wind Energy Development Guidelines* (2019)

5.1.2 Proposed Development

The proposed development will comprise 21 no. wind turbines and all associated infrastructure as described in Chapter 2 of this EIAR (Description of the Proposed Development).

5.1.3 Statement of Authority

This assessment has been carried out by Robert Hunt, Senior Project Manager and Environmental Engineer in TOBIN Consulting Engineers. Robert has more than eleven years'

experience in building and environmental consulting including environmental impact assessment. Robert has considerable experience in the preparation of various impact assessments including those related to population and human health (human beings). Robert has a BEng in Civil Engineering from the University of Dundee, an MSc in Environmental Engineering from Queens University Belfast and is a Chartered Engineer.

This Chapter has been reviewed by Dr John Staunton, Senior Project Manager and Environmental Scientist in TOBIN. John has more than eleven years' postgraduate experience in both research and environmental consultancy. John holds a BSc and PhD in Environmental Science and has considerable experience in project managing wind energy developments and carrying out associated impact assessments including in preparing assessments in relation to population and human health (human beings) .

5.2 METHODOLOGY

5.2.1 Population

A desktop study and a site visit were carried out in order to examine relevant information pertaining to this population impact assessment. The site visit was used to verify descriptions and information of the local area, and thus inform the impact assessment. Maps from Ordnance Survey Ireland (OSI) were used to identify current and historical land use in the area as well as relevant amenity facilities surrounding the proposed wind farm site and within the main settlement areas around the proposed project.

Information on population statistics, employment and social data for the areas surrounding the proposed project have been obtained from the Central Statistics Office (CSO) and predominantly from the 2016 and 2011 Census records. Data has been captured on an ED basis as this is the most appropriate scale for collated census data and is commonly used for defining the existing population profile. The ED's within which the proposed project is located comprise the study area for this assessment.

Fáilte Ireland tourist literature for County Kilkenny was examined in relation to tourism amenity in conjunction with the websites of relevant tourism assets, locations and amenities in the area. County Kilkenny is located in Ireland's Ancient East, a branding initiative developed by Fáilte Ireland to make the area *"the most personally engaging cultural destination in Europe by harnessing the authentic character of the real Ireland, its living culture, lush landscapes and hidden history, opening it up for everyone".* Information on other tourist attractions and initiatives in the area have been sourced from relevant websites, such as Discover Ireland, Visit Kilkenny, Tourism Ireland, those hosted by the Kilkenny Tourism Board and published literature.

A consultation letter on the proposed development was sent to Fáilte Ireland on 20 February 2020 and a response was received on 30 March 2020. A summary of the response is provided in Table 1.4 of this EIAR and a copy of the response is provided in Appendix 1-3. The response included a copy of Fáilte Ireland's *EIAR Guidelines for the Consideration of Tourism and Tourism Related Projects* and these guidelines have been consulted in the completion of this assessment.

The Fáilte Ireland Guidelines state that *"the character of an area from a tourism perspective should be described and the principal types of tourism in the area. Where relevant, the specific environmental resources or attributes in the existing environment which each group uses or values should be stated and where relevant, indicate the time, duration or seasonality of any of*

those activities". The Guidelines also note that *"Where possible the value of the contribution of such tourism assets and activities to the local economy should be provided"*. These aspects are described in Section 5.3.1.

The Castlebanny Wind Farm Community Benefit Proposal is set out in Section 2.2 of Chapter 2 of this EIAR and has been developed in accordance with the terms and conditions of the Government's Renewable Energy Support Scheme (RESS). The provisions of the Community Benefit Proposal which will have an impact on the local population are discussed in Section 5.3.1.

The following key information sources and guidance have been used in the completion of the population aspect of this Chapter:

- CSO – 2016 and 2011 Census and associated data;
- Fáilte Ireland website – https://www.failteireland.ie/
- Fáilte Ireland, *EIAR Guidelines for the Consideration of Tourism and Tourism Related Projects;*
- Ireland's Ancient East website - https://www.irelandsancienteast.com/
- KCC, Kilkenny County Development Plan 2014 – 2020;
- OSI – Mapping and aerial photography; and
- Walking trails - https://www.sportireland.ie/outdoors and http://trails.ie/index.php

The effects of the proposed development on the human environment are assessed in compliance with the EIAR Guidelines as outlined in Chapter 1 (Introduction).

5.2.2 Human Health

This section has been carried out from a review of published literature on the effects of wind energy developments on human health. Aspects examined in this section primarily relate to impacts from the proposed development on socio-economic activities and on local community health. These two themes are discussed primarily in this chapter but may be further addressed in other technical chapters, where relevant.

The following specific guidance documents have been consulted in the completion of the human health impact aspect of this Chapter:

- Institute of Environmental Management and Assessment (IEMA), *Health in Environmental Impact Assessment - A Primer for a Proportionate Approach* (2017);
- Institute of Public Health Ireland, *Health Impact Assessment* (2009);
- US Environmental Protection Agency, *Health Impact Assessment Resource and Tool Compilation* (September 2016);
- World Health Organisation (WHO), *Environmental Noise Guidelines for the European Region* (2018); and
- WHO, *Night-time Noise Guidelines for Europe* (2009).

EIA Directive

The 2014 amendment to the 2011 EIA Directive (2014/52/EU) directs that population and human health factors be assessed in an EIAR. The EIA Directive does not define the term 'human health', however the 2017 EC Guidance on the preparation of the EIAR states that *"human health is a very broad factor that would be highly project dependent. The notion of human health should be considered in the context of the other factors in Article 3(1) of the EIA Directive and thus environmentally related health issues (such as health effects caused by the release of toxic substances to the environment, health risks arising from major hazards associated with the*

Project, effects caused by changes in disease vectors caused by the Project, changes in living conditions, effects on vulnerable groups, exposure to traffic noise or air pollutants) are obvious aspects to study. In addition, these would concern the commissioning, operation and decommissioning of a Project in relation to workers on the Project and surrounding population".

EPA EIAR Guidelines (2002 and 2017)

The 2017 Draft EIAR Guidelines published by the EPA state that *"while no specific guidance on the meaning of the term Human Health has been issued in the context of Directive 2014/52/EU, the same term was used in 3.3.6 the SEA Directive (2001/42/EC). The Commission's SEA Implementation Guidance states 'The notion of human health should be considered in the context of the other issues mentioned in paragraph (f)'"*. Paragraph (f) (of Annex I of the SEA Directive) lists the environmental factors including soils, water, landscape, air etc.).

The 2017 Draft EPA Guidelines also state that the above health assessment approach is *"consistent with the approach set out in the 2002 EPA Guidelines where health was considered through assessment of the environmental pathways through which it could be affected, such as air, water or soil"*. The 2002 EPA Guidelines state *"The evaluation of effects on these pathways is carried out by reference to accepted standards (usually international) of safety in dose, exposure or risk. These standards are in turn based upon medical and scientific investigation of the direct effects on health of the individual substance, effect or risk. This practice of reliance upon limits, doses and thresholds for environmental pathways, such as air, water or soil, provides robust and reliable health protectors* [protection criteria] *for analysis relating to the environment"*.

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

IEMA Discussion Document (2017)

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

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

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

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

HSE Position Paper on Wind Turbines and Public Health (2017)

The Public Health Medicine, Environment and Health Group of the HSE were tasked with investigating the potential public health issues involved with wind farm development, given the increase in wind farm development in Ireland in recent years. The issues often cited in terms of health impacts are considered, including noise, shadow flicker and electromagnetic frequency.

The paper has reviewed the scientific basis for reports on negative heath impact resulting from wind farms. Its findings conclude that the evidence is weak, where present, and in many cases, is lacking. The paper states that *"Published scientific evidence is inconsistent and does not support adverse effects of wind turbines on health"* and that *"adequate setback distances and meaningful engagement with local communities are recommended in order to address public concern"*. In respect of the proposed project, there is a minimum setback distance of 750m from the proposed turbine locations to sensitive receptors which is in excess of the minimum setback requirements in the 2006 and Draft 2019 WEDGs.

The position paper states that *"Further research is required to investigate the effects of wind farms on public health. Large-scale prospective cohort studies would be most informative for identifying potential health effects of exposure to wind turbine noise; further cross-sectional studies are unlikely to contribute meaningfully to the current limited evidence base."*

The paper recommends the use of relevant national planning guidelines (which would include the 2006 WEDGs) in order to determine applicable limits for noise, shadow flicker and setback distances from sensitive properties.

Therefore, health protection and health improvement are considered in this Chapter. The methodology for assessing health protection is considered further below.

5.2.2.1 Health Impact Assessment and Environmental Impact Assessment

The 2017 IEMA Discussion Document notes that Health Impact Assessment (HIA) and EIA are separate processes and that whilst a HIA can inform EIA practice in relation to human health, a

HIA alone will not necessarily meet the EIA human health requirement. HIA is not routinely carried out for major infrastructure schemes in Ireland.

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

The 2017 IEMA Discussion document also notes that the WHO provides an overview of health in different types of impact assessment (WHO, 2014) and presents the WHO perspective on the relationship of HIA to other types of impact assessment as follows:

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

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

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

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

5.2.2.2 Health Protection

The assessment of human health for the proposed development, in terms of health protection, follows the approach set out in the 2017 EIAR Draft Guidelines and in the EC's Guidance on the preparation of the EIAR. It is also similar in nature to the US Environmental Protection Agency (USEPA) Guidance, entitled *Health Impact Assessment Resource and Tool Compilation* (USEPA, 2016). Human health protection is considered through the assessment of the environmental

factors (pathways) through which health could be affected such as air, noise, water and soils. The USEPA Guidance includes a four-step approach which is represented graphically below.

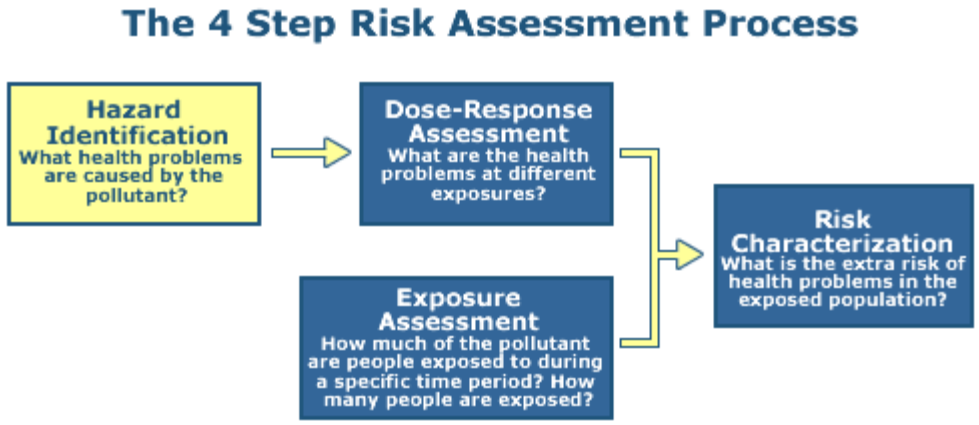


Figure 5-1: Four-step Risk Assessment Process (Source: USEPA, 2016)

This USEPA risk assessment process is similar to the Irish 2017 EIAR Draft Guidelines in that the potential noise, air, soils and water impacts which could affect human health are identified (Hazard Identification), the scale of these potential impacts (Dose-Response Assessment) and their duration (Exposure Assessment) are assessed and the significance of the potential impact on human health is determined (Risk Characterisation).

It should be noted that the identification of individual environmental hazards and the associated potential impacts and duration are undertaken in other chapters of this EIAR namely, Noise, Shadow Flicker, Material Assets, Air Quality and Climate. The associated significance in terms of the potential impact on human health is then considered in this chapter.

5.3 EXISTING ENVIRONMENT

5.3.1 Population

Land Use

The proposed wind farm site (see Figure 1-2 of this EIAR) is approximately 7.3km long in the north/south direction and is approximately 2.7km wide in an east/west direction at the widest point. The site lies between the settlements of Mullinavat, Inistioge and Ballyhale, which are located approximately 4.1km southwest, 5.7km northeast and 1.9km northwest of the site of the proposed wind farm. The main urban centres in the region are Waterford City, located approximately 15.5km to the south of the proposed wind farm site and Kilkenny City, located approximately 20km to the north.

The proposed wind farm site is located within the townlands of Castlecosker, Derrynahinch, Kiltorcan, Coolroe Beg, Baunskeha, Castlebanny, Kilvinoge, Cappagh, Coolnahau, Ballytarsna, Mullennakill, Glenpipe, Ballymartin, Ballyvatheen, Ballynoony West and Derrylacky in County Kilkenny. The proposed grid connection infrastructure is located within the townlands of Castlebanny (proposed substation also located here), Cappagh, Coolnahau, Garrandarragh, Ballygegan and Ballyvool (proposed connection with existing 110kV overhead line is located here) in County Kilkenny. There are a number of locations which require temporary additional

works to accommodate oversize load delivery to site (i.e. turbine components). As part of this planning application, temporary works are required at two locations in the townland of Ballynoony West in County Kilkenny. A number of other temporary works areas are not forming part of the current planning application but are assessed as part of this EIAR. These areas are located within the townlands of Garrandarragh, Granny, Kilmurry, and Rathpatrick, in County Kilkenny and Ballyduff East in County Waterford. Further detail on the turbine delivery route is provided in Section 2.6.3.1 of Chapter 2 (Description of the Proposed Development).

The land use/activities on the proposed wind farm site are primarily commercial forestry, with some areas of pastoral agriculture. The surrounding landscape is a mixture of agricultural land and forestry, with existing wind farms, Ballymartin Wind Farm and Rahora Wind Farm, located to the south and south-east of the proposed wind farm site. The landscape is predominately undulating in the wider area, with the proposed wind farm site being located on an elevated area with a topography of between 145m and 265mOD. A number of other areas to the east and south of the site are also elevated. The most significant features in the surrounding landscape are the River Arrigle valley, the upland areas containing the proposed wind farm and the upland areas to the east of the proposed wind farm site towards Inistioge.

The site of the proposed wind farm has an area of approximately 1,434 hectares and comprises a single elongated land parcel. These lands lie between the M9 and the River Nore, and just north of the R704 Regional Road. which runs from Mullinavat in the west to New Ross in the east. The site runs in a north-south direction. The River Arrigle is located approximately 1.1km to the east of the proposed wind farm site at its nearest point, while the proposed grid connection route crosses this river at one location. The River Nore is located approximately 5.5km east of the proposed wind farm site at its nearest point, and approximately 3.9km east of the proposed grid connection route at its nearest point.

The South Leinster Way walking/hiking trail, running from Kildavin in County Carlow to Carrick-on-Suir in County Tipperary, which is almost 105km in length, crosses the southern portion of the site. This is designated as a National Waymarked Trail by the National Trails Office of the Irish Sports Council and is jointly managed by Carlow County Council, Kilkenny County Council, Tipperary County Council, Carlow Local Sports Partnership, Kilkenny Trails and Coillte.

The current land use for the grid connection route is predominantly pastoral agriculture with some areas of forestry cover. A short section of the grid connection route (c. 0.3km) will be installed in the public road network. Temporary works on lands required to facilitate turbine component deliveries currently comprise boundary walls and pastoral agriculture, as well as transport (road corridors).

The nearest primary school to the proposed wind farm site is Scoil Phádraig in Ballyhale, while the nearest post-primary school is Scoil Aireagail, also in Ballyhale. The nearest large third level campus is Waterford Institute of Technology located in Waterford City, while Ormonde College of Further Education is the nearest third level college located in Kilkenny City.

Public transportation is available in the wider area around the proposed wind farm site. Trains are available from Thomastown, located on the Dublin to Waterford line. Busses are available from Ballyhale to a number of destinations including Dublin and Waterford. The M9 Dublin to Waterford motorway provides excellent access to the area around the site.

A number of community facilities and amenities are available in the locality, with Ballyhale providing those nearest the proposed wind farm site. The village is home to an active GAA club (Ballyhale Shamrocks), shops, health centre, community hall and churches. Mountain View Golf

Course is located near Ballyhale, to the west of the proposed wind farm site, while Mount Juliet Estate is located near Thomastown to the north of the proposed wind farm. Further amenities and services are available in Kilkenny City and Waterford City.

Further detailed description of the proposed project is provided in Chapter 2 (Description of the Proposed Development) of this EIAR.

Population Trends

An examination of the existing population in the study area has been carried out to identify population trends, density and to define the properties/receptors surrounding the proposed wind farm site. Census data from the period 2006 – 2016 available from the CSO[1] has been summarised in Table 5-1 and Table 5-2. The proposed development works are located in the local authority area of Kilkenny County Council and within the ED's of Castlebanny (07066), Kiltorcan (07079), Ballyvool (07063), Pleberstown (07081), Castlegannon (07067), Jerpoint West (07035) and Kilbeacon (07103). The ED of Ballyhale (07062) extends close to the north-west perimeter of the wind farm site boundary and is included in defining the existing population study area.

Table 5-1: Population Trends 2006 – 2016 (Proposed Development Works)

Area	Population 2006	Population 2011	Population 2016	% Change from 2006 - 2016
State	4,239,848	4,588,252	4,761,865	+12%
Kilkenny County	87,558	95,419	99,232	+13%
Castlebanny (07066)	154	127	150	-3%
Kiltorcan (07079)	151	159	175	+16%
Ballyvool (07063)	167	174	189	+13%
Pleberstown (07081)	171	178	200	+17%
Castlegannon (07067)	115	124	118	+3%
Jerpoint West (07035)	186	259	269	+45%
Kilbeacon (07103)	180	194	200	+11%
Ballyhale (07062)	329	368	424	+29%
Study Area (total)	**1453**	**1583**	**1725**	**+19%**

During the period of 2006 to 2016, the population nationally increased by approximately 12% and the population of County Kilkenny increased by approximately 13% while the population of the ED's within which the proposed development is located increased by approximately 19%. This illustrates that the population of the local area is increasing at a rate that is slightly greater than the County or National rates.

The temporary ancillary works in the public road network which are required as part of the turbine delivery works are located in the ED's of Killahy (07107), Aglish (07099) and Rathpatrick (07111) in County Kilkenny and Kilmeadan (25078) in County Waterford.

[1] https://www.cso.ie/en/census/ (Accessed on 09 November 2020)

Table 5-2:Population Trends 2006 – 2016 (Ancillary Works)

Area	Population 2006	Population 2011	Population 2016	% Change from 2006 - 2016
Killahy (07107)	703	708	651	-7%
Aglish (07099)	920	871	883	-4%
Rathpatrick (07111)	1,173	1,140	1,095	-7%
Kilmeadan (25078)	831	787	757	-9%
Study Area (total)	**3,627**	**3,506**	**3,386**	**-7%**

The population trend in the areas surrounding the proposed ancillary works, primarily located on the outskirts of Waterford City, is decreasing. It is noted however, that the proposed ancillary works are minor in the overall context of the proposed project.

The location of the proposed project in the context of the above ED's is shown in Figure 5-2: .

Population density is a useful indicator of the settlement patterns in the area surrounding the proposed project and Kilkenny County overall. Table 5-3 shows population density for the study area as well as Kilkenny County and shows a generally sparser population in the study area compared with the overall county. The 2016 census identified that the average rural population density in Ireland is 27 persons/km^2 showing that the population density in the area surrounding the proposed development is well below the national average while including the remote TDR improvement works increases the average bringing it in line with the national average.

As noted above, the proposed works located in the EDs of Aglish, Rathpatrick and Kilmeadan are minor in the context of the proposed project and constitute temporary works in the public road to facilitate the turbine deliveries.

Table 5-3: Population Density 2016

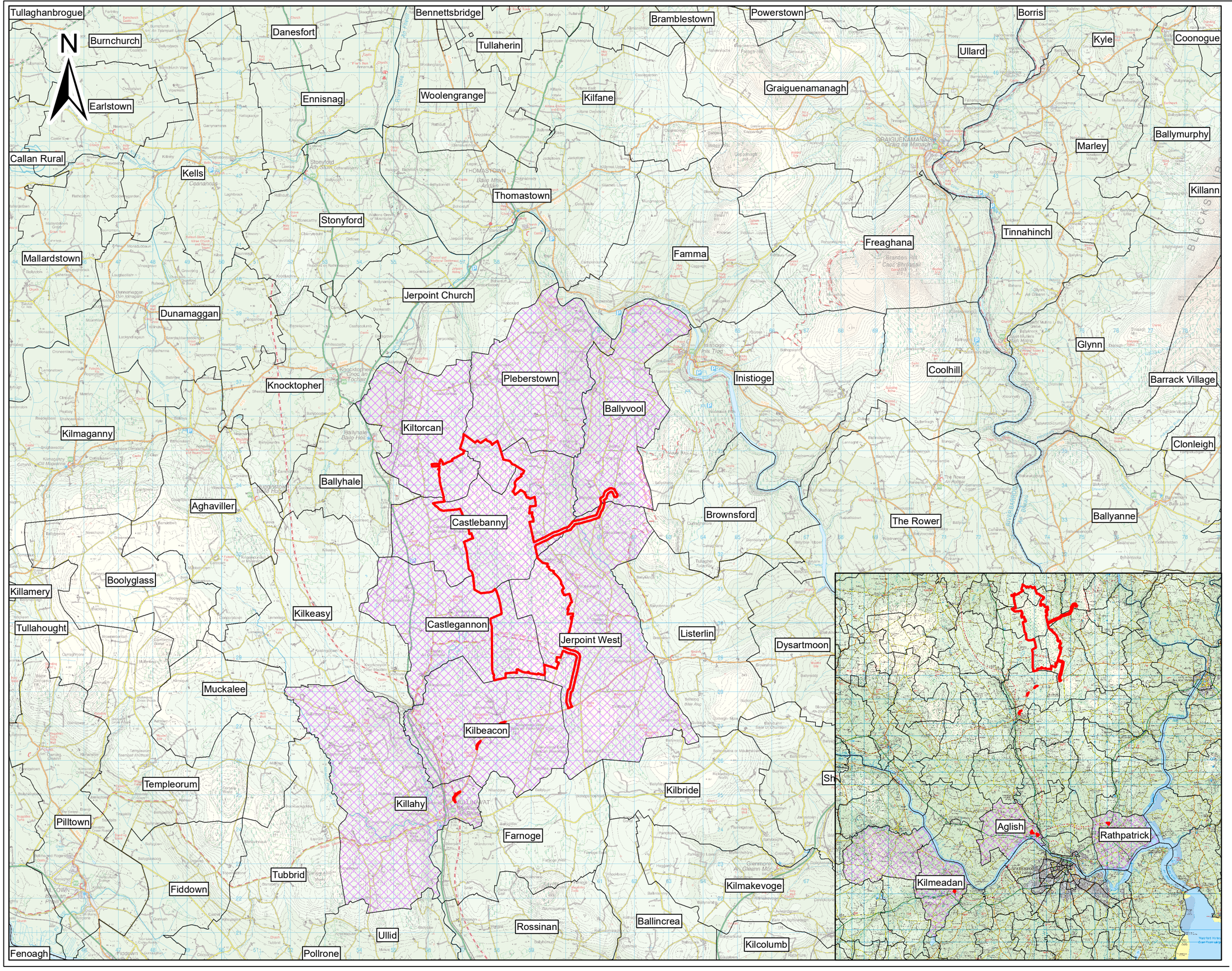
Area	Population Density 2016 (persons/km^2)
Kilkenny County	47.9
Castlebanny (07066)	10.9
Kiltorcan (07079)	17.7
Ballyvool (07063)	16.1
Pleberstown (07081)	13.6
Castlegannon (07067)	9.7
Jerpoint West (07035)	12.1
Kilbeacon (07103)	15.2
Ballyhale (07062)	50.1
Proposed Development EDs (average)	18.2
Killahy (07107) (TDR improvement works)	33.8
Aglish (07099) (TDR improvement works)	53.6
Rathpatrick (07111) (TDR improvement works)	58.8

Kilmeadan (25078) (TDR improvement works)	38.1
Study Area (average)	**27.48**

Property/Receptors

The locations of properties and buildings (referred to as receptors) in the vicinity of the proposed wind farm site have been identified using address data from the Geodirectory database which is used to populate Eircodes. The validity of the Geodirectory data has been confirmed by way of publicly available mapping, aerial imagery, street-level imagery and a ground truthing survey carried out in July 2019. All receptors within 1km of the site boundary have been identified and verified by means of the above desktop reviews and site surveys. This information is used to inform assessments within this EIAR, in particular for shadow flicker analysis (Chapter 10) and noise modelling (Chapter 12). A 1km buffer from the wind farm site boundary was used to ensure that those properties within reasonable proximity of the main wind farm infrastructure are defined. The locations of these receptors in relation to the proposed development are shown in Figure 5-3. In addition, a search of planning applications within 1km of the wind farm site boundary was carried out (most recently in November 2020) to identify proposed developments and consented, but as yet not built, developments.

A total of 128 no. receptors from the Geodirectory database, ground truthing exercise and planning search were identified and are presented in Table 5-4. Each receptor identified has been assigned an ID number (i.e. Pxxx) for reference.



Legend

- EIAR Study Boundary
- Electoral Districts
- Project Electoral Districts

Issue	Date	Description	By	Chkd.
A	08/12/2020	Final Issue	F.H.	R.H.

0 0.5 1
Kilometres

Client: COILLTE

Project: Castlebanny Wind Farm

Title: Population & Human Health Study Area

Scale @ A3: 1:100,000

Prepared by:	Checked:	Date:
F. Healy	R.Hunt	December 2020

Project Director: J.Staunton

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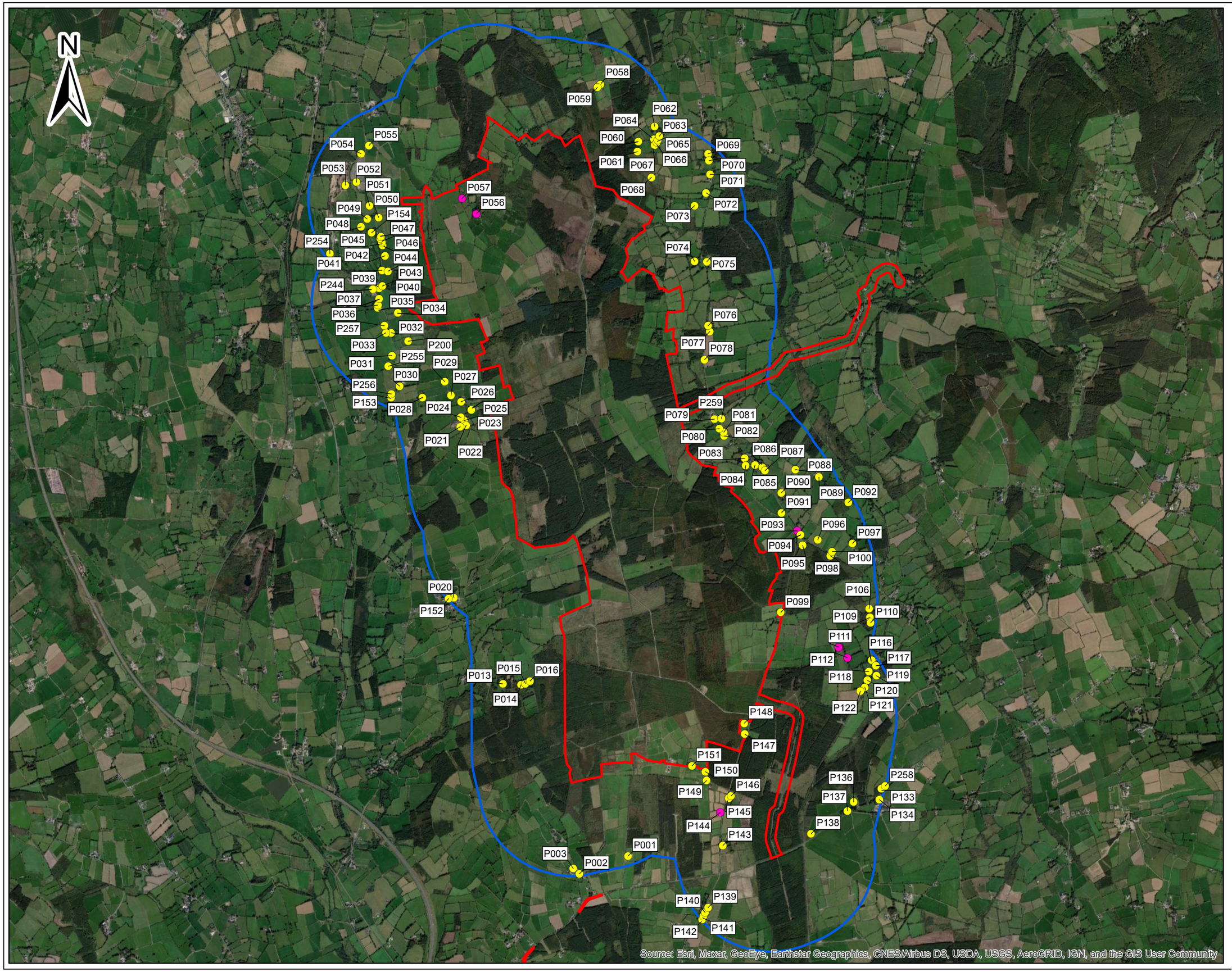
Drawing No.: Figure 5-2

Issue: A



Legend

- Proposed Development Boundary
- 1km Buffer From Site Boundary
- Sensitive Receptors
- Non-Sensitive Receptors

Issue	Date	Description	By	Chkd.
A	08/12/2020	Final Issue	F.H.	R.H.

0 0.5 1
Kilometres

Client: COILLTE

Project:

Castlebanny Wind Farm

Title:

Receptors Within 1km of Wind Farm Site Boundary

Scale @ A3: 1:37,000

Prepared by:	Checked:	Date:
F. Healy	R.Hunt	November 2020

Project Director: J.Staunton

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TOBIN CONSULTING ENGINEERS

Drawing No.: Figure 5-3

Issue: A

During the verification process, properties/buildings that would not be considered sensitive receptors (i.e. farm sheds, garages, commercial buildings, etc.) or that were not deemed habitable without requiring planning permission to remedy were identified. Any developments submitted for planning or consented (but as yet unbuilt) developments were included, but any such properties that would not be considered sensitive as described above were omitted. From the planning search, any invalidated planning applications or consented (but unbuilt) developments where the expiry period for development had elapsed were excluded.

A more extensive planning summary in the context of potential cumulative impacts was also carried out and is described in Chapter 4 (Policy, Planning and Development Context).

Table 5-4: Identified Receptors Within 1km of Wind Farm Site Boundary

Property/ Receptor No. *	Description	ITM Co-Ordinates	
		Easting	Northing
P001	Sensitive Receptor (Dwelling)	658486	627593
P002	Sensitive Receptor (Dwelling)	657962	627403
P003	Sensitive Receptor (Dwelling)	657896	627456
P013	Sensitive Receptor (Dwelling)	657143	629440
P014	Sensitive Receptor (Dwelling)	657338	629431
P015	Sensitive Receptor (Dwelling)	657383	629446
P016	Sensitive Receptor (Dwelling)	657432	629472
P020	Sensitive Receptor (Dwelling)	656615	630366
P021	Sensitive Receptor (Dwelling)	656686	632204
P022	Sensitive Receptor (Dwelling)	656746	632219
P023	Sensitive Receptor (Dwelling)	656726	632272
P024	Sensitive Receptor (Dwelling)	656691	632304
P025	Sensitive Receptor (Dwelling)	656805	632388
P026	Sensitive Receptor (Dwelling)	656696	632474
P027	Sensitive Receptor (Dwelling)	656584	632539
P028	Sensitive Receptor (Dwelling)	656277	632519
P029	Sensitive Receptor (Dwelling)	656519	632688
P030	Sensitive Receptor (Dwelling)	656033	632639
P031	Sensitive Receptor (Dwelling)	655951	632970
P032	Sensitive Receptor (Dwelling)	655942	633213
P033	Sensitive Receptor (Dwelling)	655885	633215
P034	Sensitive Receptor (Dwelling)	656015	633428
P035	Sensitive Receptor (Dwelling)	655797	633480
P036	Sensitive Receptor (Dwelling)	655803	633511
P037	Sensitive Receptor (Dwelling)	655815	633576
P039	Sensitive Receptor (Dwelling)	655813	633693
P040	Sensitive Receptor (Dwelling)	655849	633716
P041	Sensitive Receptor (Dwelling)	655845	633883
P042	Sensitive Receptor (Dwelling)	655876	634041
P043	Sensitive Receptor (Dwelling)	655906	633876
P044	Sensitive Receptor (Dwelling)	655852	634153
P045	Sensitive Receptor (Dwelling)	655841	634187
P046	Sensitive Receptor (Dwelling)	655826	634225
P047	Sensitive Receptor (Dwelling)	655833	634249
P048	Sensitive Receptor (Dwelling)	655619	634351
P049	Sensitive Receptor (Dwelling)	655686	634437
P050	Sensitive Receptor (Dwelling)	655808	634450
P051	Sensitive Receptor (Dwelling)	655712	634580
P052	Sensitive Receptor (Kiltorcan Raceway)	655569	634830
P053	Sensitive Receptor (Dwelling)	655450	634798
P054	Sensitive Receptor (Dwelling)	655620	635136
P055	Sensitive Receptor (Dwelling)	655703	635226

Property/ Receptor No. *	Description	ITM Co-Ordinates	
		Easting	Northing
P056	Omitted (Not Habitable)	656857	634493
P057	Non-Sensitive (Commercial Buildings)	656702	634658
P058	Sensitive Receptor (Dwelling)	658188	635881
P059	Sensitive Receptor (Dwelling)	658158	635848
P060	Sensitive Receptor (Dwelling)	658596	635268
P061	Sensitive Receptor (Dwelling)	658587	635160
P062	Sensitive Receptor (Dwelling)	658772	635431
P063	Sensitive Receptor (Dwelling)	658820	635325
P064	Sensitive Receptor (Dwelling)	658765	635292
P065	Sensitive Receptor (Dwelling)	658805	635283
P066	Sensitive Receptor (Chapel of Ease)	658793	635260
P067	Sensitive Receptor (Dwelling)	658770	635230
P068	Sensitive Receptor (Dwelling)	658737	634884
P069	Sensitive Receptor (Dwelling)	659344	635139
P070	Sensitive Receptor (Dwelling)	659355	635063
P071	Sensitive Receptor (Dwelling)	659366	634916
P072	Sensitive Receptor (Dwelling)	659324	634716
P073	Sensitive Receptor (Dwelling)	659201	634581
P074	Sensitive Receptor (Dwelling)	659200	633980
P075	Sensitive Receptor (Dwelling)	659331	633980
P076	Sensitive Receptor (Dwelling)	659346	633288
P077	Sensitive Receptor (Dwelling)	659364	633225
P078	Sensitive Receptor (Dwelling)	659307	632926
P079	Sensitive Receptor (Dwelling)	659414	632287
P080	Sensitive Receptor (Dwelling)	659467	632182
P081	Sensitive Receptor (Dwelling)	659515	632144
P082	Sensitive Receptor (Dwelling)	659518	632105
P083	Sensitive Receptor (Dwelling)	659739	631864
P084	Sensitive Receptor (Dwelling)	659749	631789
P085	Sensitive Receptor (Dwelling)	659851	631794
P086	Sensitive Receptor (Dwelling)	659928	631770
P087	Sensitive Receptor (Dwelling)	659957	631733
P088	Sensitive Receptor (Dwelling)	660282	631745
P089	Sensitive Receptor (Dwelling)	660534	631662
P090	Sensitive Receptor (Dwelling)	660132	631495
P091	Sensitive Receptor (Dwelling)	660134	631280
P092	Sensitive Receptor (Dwelling)	660851	631390
P093	Non-Sensitive (Commercial Buildings)	660304	631087
P094	Sensitive Receptor (Dwelling)	660339	631045
P095	Sensitive Receptor (Dwelling)	660360	630930
P096	Sensitive Receptor (Dwelling)	660523	630990
P097	Sensitive Receptor (Dwelling)	660896	630951
P098	Sensitive Receptor (Dwelling)	660658	630816
P099	Sensitive Receptor (Dwelling)	660124	630207
P100	Sensitive Receptor (Dwelling)	660676	630864
P106	Sensitive Receptor (Dwelling)	661075	630251
P109	Sensitive Receptor (Dwelling)	661083	630157
P110	Sensitive Receptor (Dwelling)	661090	630099
P111	Non-Sensitive (Commercial Buildings)	660747	629836
P112	Non-Sensitive (Commercial Buildings)	660842	629723
P116	Sensitive Receptor (Dwelling)	661101	629698
P117	Sensitive Receptor (Dwelling)	661147	629638
P118	Sensitive Receptor (Dwelling)	661070	629573
P119	Sensitive Receptor (Dwelling)	661153	629530
P120	Sensitive Receptor (Dwelling)	661056	629479
P121	Sensitive Receptor (Dwelling)	661027	629404

Property/ Receptor No. *	Description	ITM Co-Ordinates	
		Easting	Northing
P122	Sensitive Receptor (Dwelling)	660981	629362
P133	Sensitive Receptor (Dwelling)	661207	628316
P134	Sensitive Receptor (Dwelling)	661183	628198
P136	Sensitive Receptor (Dwelling)	660909	628173
P137	Sensitive Receptor (Dwelling)	660843	628079
P138	Sensitive Receptor (Dwelling)	660449	627832
P139	Sensitive Receptor (Dwelling)	659343	627037
P140	Sensitive Receptor (Dwelling)	659315	626986
P141	Sensitive Receptor (Dwelling)	659296	626948
P142	Sensitive Receptor (Dwelling)	659281	626914
P143	Sensitive Receptor (Dwelling)	659505	627706
P144	Omitted (Planning Permission Expired)	659477	628059
P145	Sensitive Receptor (Dwelling)	659568	628212
P146	Sensitive Receptor (Dwelling)	659593	628238
P147	Sensitive Receptor (Dwelling)	659739	628901
P148	Sensitive Receptor (Dwelling)	659732	629019
P149	Sensitive Receptor (Dwelling)	659328	628403
P150	Sensitive Receptor (Dwelling)	659316	628498
P151	Sensitive Receptor (Dwelling)	659172	628561
P152	Sensitive Receptor (Dwelling)	656559	630359
P153	Sensitive Receptor (Dwelling)	655942	632516
P154	Sensitive Receptor (Dwelling)	655733	634289
P200	Planning Permission for Dwelling (KCC Reg. Ref. 19130) (Granted)	656125	633124
P244	Sensitive Receptor (Dwelling)	655747	633683
P254	Planning Permission for Camping Park (KCC Reg. Ref. 19666) (Granted)	655284	634061
P255	Planning Permission for Dwelling (KCC Reg. Ref. 20320) (Pending)	655910	632853
P256	Planning Permission for Dwelling (KCC Reg. Ref. 20580) (Pending)	655947	632557
P257	Planning Permission for Dwelling (KCC Reg. Ref. 20614) (Pending)	655871	633288
P258	Planning Permission for Dwelling (KCC Reg. Ref. 20734) (Pending)	661246	628346
P259	Planning Permission for Dwelling (KCC Reg. Ref. 20737) (Pending)	659489	632294

Table 5-5 presents a summary of the identified receptors. The closest sensitive receptor is located more than 750m from the nearest proposed turbine location which is in excess of the minimum setback requirement of 500m set out in the 2006 WEDGs. The 2019 Draft WEDGs recommend a minimum setback distance from a turbine to the curtilage of a residential property equal to 4 times the turbine tip height or 500m, whichever is largest. The proposed development includes for the installation of turbines with a maximum height of up to 185m, therefore the minimum setback distance required in accordance with the 2019 Draft WEDGs is 740m. The proposed development exceeds this requirement.

Table 5-5: Summary of Receptors Within 1km of Wind Farm Site Boundary

Receptor Type	No. Within 1km of Wind Farm Site Boundary
Sensitive Receptors (incl. planning submitted and granted)	122
Non-Habitable Buildings	1
Expired Planning Permission	1
Commercial Buildings	4
Total	**128**

As part of the community engagement process and public consultation, the sensitive receptors identified in Table 5-4, as well as other local residents up to 2km from the proposed development, were the main focus of initial project engagement to inform them of the proposed development and to gather their feedback on the project. Further information on the public consultation process is provided in Chapter 1 (Introduction).

Property Values

Data available from the CSO on property values is presented in terms of Eircode Routing Key areas. The proposed wind farm site is located within two Eircode Routing Key boundaries, namely R95: Kilkenny (covering the northern part of the site and including Kilkenny City) and X91: Waterford (covering the central and southern part of the site and including Waterford City). The CSO data for the year to September 2020[2] show that the median price of residential properties sold across the two areas is €196,435 (based on R95 median price of €202,870 and X91 median price of €190,000). The national median house price is €257,290.

Employment/Economy

Employment is an important indicator of the economic standing of an area. This section examines employment status and unemployment levels in the region of the proposed development. The Labour Force Survey undertaken by the CSO provides details of unemployment on a regional level. As Kilkenny is located in the South-East Region (IE052)[3], data for this region is used to illustrate unemployment in the area.

Table 5-6 illustrates the findings from the Q4 2019 Labour Force Survey published by the CSO[4]. The first case of Covid-19 was reported in Ireland at the end of February 2020 and measures required in accordance with the public health guidance were introduced on 12 March 2020. As a result, the Labour Force Survey statistics from Q1 2020 to present are affected by the crisis and, therefore, employment statistics pre-crisis have been used a more representative indicator.

The unemployment rate in Table 5-6 is the number of unemployed persons expressed as a percentage of the total labour force (aged 15 – 74). The unemployment rate for the State in Q4

[2] https://www.cso.ie/en/interactivezone/visualisationtools/housepricesbyeircode/ (Accessed on 07 December 2020)
[3] NUTS 3 – Nomenclature of Territorial Units for Statistics (NUTS) created by Eurostat
[4] https://www.cso.ie/en/releasesandpublications/er/lfs/labourforcesurveylfsquarter42019/ (Accessed on 10 November 2020)

2019 was 4.5% while the unemployment rate for the South-East Region was 6.8% showing that unemployment in the region (in Q4 2019) was higher than the State.

The participation rate is the number of persons available to the labour force (i.e. persons from 15 – 74 years old either working or looking for work) expressed as a percentage of the total population. In Q4 2019, the participation rate in the State was 62.7% compared with 60.6% in the South-East Region so these rates are comparable.

Table 5-6: Labour Force Survey (Q4 2019)

Location	Unemployment Rate	Participation Rate
State	4.5%	62.7%
South-East Region	6.8%	60.6%

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

The figures in Table 5-7 show that over the period of December 2018 – December 2019, there was an 8.9% decrease in the number of persons on the Live Register in the State as a whole and a 5.6% decrease in the number of persons on the Live Register in the South-East Region[5]. Despite a decreasing trend in Live Register figures (pre-COVID-19 crisis), the overall trend indicates a need for further employment in the South-East Region including County Kilkenny.

Table 5-7: Live Register Figures (December 2018 – December 2019)

Location	December 2018	December 2019	% Change
State	199,669	181,996	-8.9%
South-East Region	22,847	21,558	-5.6%

Section 4 of the Kilkenny CDP 2014-2020 sets out the Economic Development strategic aim for Kilkenny County which is *"To provide a framework for the implementation of the Council's economic strategy and the protection of the environment and heritage, to position the county for sustainable economic growth and employment".*

At a strategic level within the City and County of Kilkenny, five sectors were identified for specific development initiatives by the Local Authorities. These are:

- Third and Fourth Level Education and Research Development;
- Agri-Food;
- Services Development;
- Tourism, Arts and Leisure; and
- Life Sciences (including pharma with specific focus on Belview Port).

[5] https://www.cso.ie/en/releasesandpublications/er/lr/liveregisterdecember2019/ (Accessed on 10 November 2020)

Some of the relevant policy objectives identified in the Kilkenny CDP in support of the above development initiatives are:

- **Objective 4A:** To increase co-operation between Kilkenny Local Authorities, existing third level institutions and the proposed Technological University for the South East to support employment creation, innovation and lifelong learning;
- **Objective 4B:** To ensure the highest standards of environmental protection in the assessment of planning applications for all development proposals; and
- **Objective 4E:** To continue the development of major flagship tourism projects within the county to enhance the tourism product for the county.

The Kilkenny CDP acknowledges that the green economy will provide opportunities for investment and employment creation in emerging sectors such as renewable energy, energy efficiency and waste and water management. In addition, the CDP states…… "*this sustainable approach to economic development complements the core strength of the economy in the use of natural resources in the agriculture, forestry, fisheries, tourism and energy sectors. Key drivers of the growth of the Green Economy globally include emissions reduction targets, increasing fossil fuel prices, diminishing natural resources, the impact of climate change, environmental legislation and consumer preferences*".

Tourism

The National Tourism Development Authority (Fáilte Ireland) periodically collates statistics on overseas visitors to Ireland and regions within the country. Table 5-8 shows the most recent overseas tourism statistics from 2018[6] and 2019[7] (preliminary) for the country and the South East region, which includes County Kilkenny.

Table 5-8: Overseas Tourism Statistics 2018 & 2019

Location Travelled To	Tourist No.'s	Revenue Generated
Ireland (2019 – preliminary)	9,691,000	€5,170 million
Ireland (2018)	9,609,000	€5,217 million
South East Region (2018)	1,028,000	€261 million

In relation to domestic tourism (tourism involving residents of one country traveling only within that country), the Fáilte Ireland 2018 data reports 10.9 million domestic trips in 2018, an increase of over 13% on 2017. The majority (40%) of these domestic trips were recorded as short (1-3 days) holiday trips with trips to visit friends/relatives reported at 34% of all domestic trips. Most of these trips are shown to occur in the late summer period (July – September) with the majority of domestic holidaymakers engaging in hiking/walking (26%).

6 http://www.failteireland.ie/FailteIreland/media/WebsiteStructure/Documents/3_Research_Insights/Key-Tourism-Facts-2018.pdf?ext=.pdf (Accessed on 10 November 2020)

7 https://www.failteireland.ie/FailteIreland/media/WebsiteStructure/Documents/3_Research_Insights/4_Visitor_Insights/Preliminary-Tourism-Facts-2019-August-2020.pdf?ext=.pdf (Accessed on 10 November 2020)

Fáilte Ireland statistics for 2017[8] show that County Kilkenny attracted 315,00,000 overseas visitors making the county the 8th most popular county for overseas visitors. The county supported 298,000[9] domestic trips in that year. Kilkenny Castle Parklands was named as number one by visitor numbers in a list of twenty free and fee-charging popular visitor attractions in Ireland in 2018[10] and was the only tourist attraction in Kilkenny on the list. There was a total of 799,032 visits which eclipsed other notable national attractions including the National Gallery of Ireland in Dublin, Glendalough in Wicklow and many more. This tourist attraction is c. 20km north of the proposed development site.

The Kilkenny CDP includes amongst its strategic aims "*To protect and improve recreational, tourism and arts facilities for the benefit of residents and for the promotion of tourism*".

To achieve this aim, the Council is committed to the protection and sustainable development of the amenities of the county for recreational purposes to benefit the residents of the County and to aid in the promotion of tourism. Objective 7A states that: "*The Council shall seek the preservation and improvement of amenities and recreational amenity facilities, and shall facilitate and provide for the extension of recreational amenities in the county where appropriate, subject to environmental and heritage considerations*".

The Kilkenny CDP supports the on-going development of walking and cycling routes and trails in the county. Objective 7C is to "*To develop a walking and cycling strategy within the life of this plan*". In addition, the CDP states there is a number of walks developed through Coillte forestry lands that are open to the public and will facilitate further development of such walks where feasible.

Fáilte Ireland has launched a tourism initiative called Ireland's Ancient East, which incorporates County Kilkenny, with a goal to make the region *"the most personally engaging cultural destination in Europe by harnessing the authentic character of the real Ireland, its living culture, lush landscapes and hidden history, opening it up for everyone"*. The nearest attractions to the proposed development as indicated on the Ireland's Ancient East 'Cultural County Kilkenny' website[11] are in Thomastown in County Kilkenny which is c. 7km north of the proposed development. Attractions here include Jerpoint Abbey, a medieval Cistercian Abbey, and Jerpoint Park. Jerpoint Park has guided heritage tours of a deserted 12th Century medieval town (the Lost Town of Newtown Jerpoint) and a 14th century medieval tomb. Goatsbridge Trout Farm is located next to Jerpoint Park and organises tours where visitors can learn about traditional trout farming system, the art of smoking and processing, as well as the family history and the heritage behind the park. Knocktopher Abbey is located c. 4km north-west of the proposed development and was home to the first Carmelite order in Ireland.

Mount Juliet Estate is located just north of Jerpoint Park and c. 6km north the proposed development boundary. Mount Juliet offers a range of activities including golf, equestrian, falconry, fishing and archery. Dunbrody Famine Ship in New Ross in County Wexford is c. 11km

8 http://www.failteireland.ie/FailteIreland/media/WebsiteStructure/Documents/3_Research_Insights/2_Regional_SurveysReports/2017-topline-regional-performance-(003).pdf?ext=.pdf (Accessed on 10 November 2020)

9 https://statbank.cso.ie/px/pxeirestat/Statire/SelectVarVal/saveselections.asp

10 https://www.failteireland.ie/Utility/News-Library/Ireland%E2%80%99s-Top-Visitor-Attractions-Revealed-(1).aspx (Accessed on 10 November 2020)

11 Discover Ireland – Cultural County Kilkenny. www.discoverireland.ie/kilkenny

to the east of the proposed development and provides tour guides on the Irish emigrant experience including an authentic reproduction of an 1840's emigrant vessel, a visitor centre and the Irish America Hall of Fame.

The South Leinster Way walking/hiking trail, running from Kildavin in County Carlow to Carrick-on-Suir in County Tipperary, crosses the southern portion of the site. This is designated as a National Waymarked Trail by the National Trails Office. There are several other nearby trails/walks which are in the general vicinity of the proposed development. These are the Nore Valley Walk (Thomastown to Inistioge), Castlemorris – Fern Loop, the Castlemorris Wood - Holly Loop and the Castlemorris – Pheasant loop. The closest of these trails/walks to the proposed development site is c. 4.5km.

The East Kilkenny Cycle Route is a scenic cycling route linking the most historic and culturally significant towns in east Kilkenny. The route uses quiet roads and laneways and provides views of Brandon Hill, the River Barrow and the River Nore. The Cycle Route, where it passes through the village of Inistioge, is c. 6km from the proposed development at its closest point.

5.3.2 Human Health

Evidence shows that different communities have varying susceptibilities to health impacts both positive and negative as a result of social and demographic structure, behaviour and relative economic circumstance. Whilst specific health data for individuals in the vicinity of the proposed development is confidential and difficult to establish, as has been detailed in Section 5.2.2, a community profile has been identified to establish the baseline health profile of the area and compare this profile to the rest of the country.

A group made up of the Health Services Executive (HSE) and the Irish Health Repository (IHP), known as Lenus, have published separate health profiles for all the Local Authorities areas in Ireland. The most recent County Health Profiles published are from 2015[12] (Lenus, 2015) and have been used to establish a community health profile for the County Kilkenny area in which the proposed development is situated.

The key facts in the 2015 Health Profile relating to County Kilkenny are:

- Kilkenny has a low level of diversity in the population with 89% of the population being white Irish (National 84.5%);
- Breast feeding rates are above average at 51.9% (National 46.6%);
- Female cancer rates were below the national average except for colorectal cancer. Male prostate cancer rate was higher than the national average; and
- Rates of mortality for all causes and for the main causes of death are average or below average.

It is important to realise when viewing these figures that they relate to the entire administrative area of County Kilkenny and a population of 95,419 in the 2011 Census. While we can take this published data as being correct, it may not necessarily accurately reflect the health profile of smaller areas which are within the study area and close to the proposed development. The map of deprivation included in the County Health Profile shows that the area in which the proposed development is situated is marginally above/marginally below average as shown in Figure 5-4:

12 https://www.lenus.ie/bitstream/handle/10147/584041/Kilkenny.pdf;jsessionid=C4EE8B22F493495D35EAE8F5B0E72D78?sequence=1 (Accessed on 11 November 2020)

Map of Levels of Deprivation in County Kilkenny (Source: Extract from Health Profile 2015 Kilkenny). It is therefore neither particularly affluent nor particularly deprived and is distinctly average in comparison with the county overall. There are, nevertheless, likely to be localised areas of deprivation where the county-level statistics simply do not apply. As outlined previously, it is not possible to get reliable baseline information on small scale populations. Nevertheless, the data in Table 5-4, qualified in this manner, does give a valuable insight into the general area.

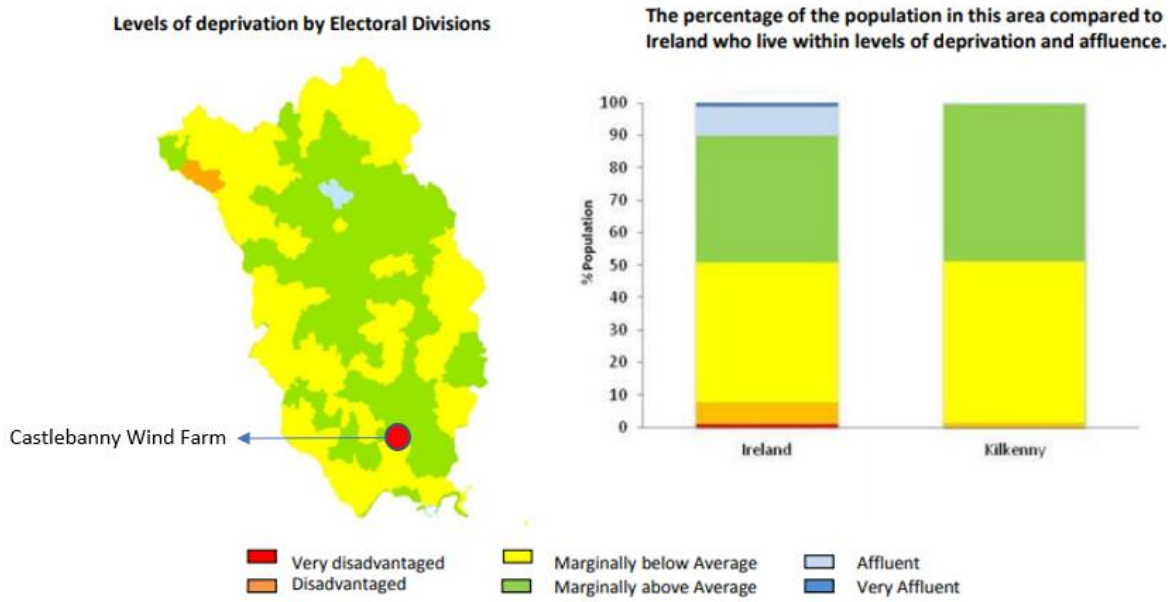

Figure 5-4: Map of Levels of Deprivation in County Kilkenny (Source: Extract from Health Profile 2015 Kilkenny)

As outlined previously, it is not possible or necessary to identify every vulnerable individual. However, every human community contains vulnerable individuals; be those the old, the very young or because they have conditions which may make them more susceptible. Examples are as diverse as humans themselves but can include asthma, autism, and those with psychological illness. It is important to note that Health Standards are set for the vulnerable and not for the robust.

The emergence of the Covid-19 virus in Ireland in the early part of 2020 has presented a new human health risk and concern amongst the general public across the country and within the proposed development study area. Public health measures, including varying levels of restrictions, are being actively implemented at this time (November 2020) and the medium to long term effects of the virus on national and local human health is not currently known. The existing environment in terms of Covid-19 impact is in flux and the public health advice requires cognisance to be taken of potential restrictions and all measures required to prevent the spread of the disease.

5.4 POTENTIAL IMPACTS

5.4.1 Population

5.4.1.1 Construction Phase

Land Use

The construction of the proposed development will involve short-term land use change primarily for the excavation of borrow pits and the construction of access roads, turbine hardstandings, site compounds and substation. This will result in a short-term, negative effect but the borrow pit areas and northern compound will be returned to forestry use while the southern compound will be re-purposed as a public car park for the amenity facility on completion of the construction works which is anticipated to last for c. 24 months. The access roads and substation will remain in place indefinitely while the hardstandings will be reinstated after the operational phase.

Population Trends

A report by Pöyry in 2014 (*Value of Wind Energy to Ireland*) identified that the wind energy sector could support 12,390 (person-years) direct jobs during construction to deliver on Ireland's 2020 renewable target (as it was at the time when the report was published). The effect of these jobs is likely to be a short-term increase in construction workers staying in local accommodation in the area over the period of c. 24 months which will add value to the local economy. This would be a positive direct effect as a result of the proposed development being constructed.

Property/Receptors

Access to the proposed wind farm site will be via a new site entrance from the R704 regional road. The potential traffic impacts are discussed in detail in Chapter 16 (Traffic and Transportation).

Negative effects on residential properties and the local population as a result of the construction works, including traffic movements, could include noise and air quality as well as potential for the works to impact on local residents enjoyment of their homes (i.e. residential amenity) . The haul roads proposed are existing public roads which are already used by heavy goods vehicles (HGVs), however there will be a short-term increase in effects during the construction phase. The design of the proposed development has included a minimum set-back distance of 750m from the curtilage of a residential receptor to the proposed turbine locations which will reduce the potential for the wind turbine infrastructure to have a significant effect on residential amenity. The closest borrow pit location is c. 725m from a residential property and access road works will take place at a minimum distance of c. 250m from the nearest residential building. These effects are assessed in detail in the Chapter 9 (Air Quality and Climate) and Chapter 12 (Noise and Vibration).

It is also noted that the properties located along the R704 which will experience an increase in construction traffic movements are located a considerable distance from the nearest turbine installation construction works (distance from T1 to nearest residential property along the R704 is c. 1.6km) and borrow pits. Upgrade works at the site entrance on the R704 are located c. 370m from the closest residential building.

The construction phase will likely have a slight, negative effect on the local population and will be short-term in nature.

Property Value

It is not anticipated that the construction works for the proposed development will have any significant impact on the local property values. A major UK study entitled *The Effect of Wind Farms on House Prices* carried out in March 2014, discussed in more detail in Section 5.4.1.2, noted that *"The econometric analysis established that construction of wind farms at the sites examined across England and Wales has not had a detectable negative impact on house price growth within a 5km radius of the sites"*.

Although there have been no similar studies carried out in Ireland regarding the effects of wind farm construction on property value, it is reasonable to make the above assumption, based on the available published studies presented in Section 5.4.1.2.

Construction works for the wind farm will be carried out within the site boundary and construction traffic travelling to the site will use existing public roads. The grid connection from the site to the existing overhead 110kV line in Ballyvool will be underground and will be located within both Coillte and other third-party land.

Employment/Economy

The proposed development will create and support direct and indirect employment during the construction phase at local level, primarily through local construction workforce on site, and at a national level, through more specialised construction services and supply of building materials. It is anticipated that the wind farm will have the following effects locally:

- Development activities such as site monitoring/surveys, site investigations, legal fees, consultancy studies during pre-construction and construction works, etc.;
- Spending locally by construction employees; and
- Accommodation and sustenance will be required in the locality for those workers on site.

Guidance from a 2009 IWEA study[13] states "*Our analysis has shown that the wind energy sector in Ireland can support 1.50 jobs per MW to be installed on the island*". Based on the proposed development capacity of between 105-126MW, this equates to approximately 157-189 jobs across a number of different sectors. The study (from 2009) estimated that 68% of the Irish jobs created are in the construction industry. It is estimated that up to 100 persons will be directly employed during the peak construction period.

The area will experience a benefit from secondary investment associated with increased visitors and spend within the area. An ESRI report entitled *An Enterprising Wind: An Economic Analysis of the Job Creation Potential of the Wind Sector in Ireland* (2014) estimates the level of indirect job creation to be between 0.15 and 0.55 jobs per direct job created. Construction materials such as quarried products and concrete supplies can be sourced locally and will support local business. Throughout the construction phase, there is potential that plant, equipment and associated operatives can be sourced locally. Indirect employment opportunities will be created in the region through increased quarrying activity and off-site concrete batching as well as potential increased employment in the local hospitality and café/restaurant industries driven by use of the facilities by construction staff.

[13] IWEA and Deloitte, *Jobs and Investment in Irish Wind Energy: Powering Ireland's Economy* (2009)

The *Value of Wind Energy to Ireland* (Pöyry, 2014) report states that *"the wind industry would make a valuable contribution to the Irish economy by meeting the 2020 renewable target and provide a good platform for continued growth during the 2020s compounding the benefit to the economy".* It also states that wind farm developments in Ireland, such as the proposed development, have the combined potential to support 12,390 jobs (person-years) during construction to deliver the 2020 renewable target and a further 10,120 jobs (person-years) would be supported during construction through to 2030.

The Castlebanny Wind Farm will also make a valuable contribution to Kilkenny County Council's economic aims for further development of its green economy.

The construction of Castlebanny Wind Farm will have an estimated capital cost in the region of €140 million[14] and an estimated 15 -20% of the total capital cost will relate to site works[15] which has the potential to support local contractors and suppliers. The *Life-cycle of an Onshore Wind Farm* published by IWEA in March 2019 stated that *"One recent 169MW windfarm project estimated that €20 million was spent with local suppliers and contractors within 30 kilometres of the site during construction".*

As a result, the construction phase of the proposed development will have a short-term, slight and positive effect on employment and the economy in the local area and the South-East Region.

Tourism

As set out in Section 5.3.1, there are a number of relevant tourism attractions and public amenities within the study area including the South Leinster Way walking/hiking trail which crosses the southern portion of the site.

It is considered that the construction works will only have a direct impact on the South Leinster Way where access to a short section of the walking trail (c. 3.9km) during the construction phase of development will not be permitted. However, this will be a short-term impact for the duration of construction and a temporary alternative marked route through the forest will be available for users. The alternative route is shown in Table 5-5. A notice and accompanying map to this effect will be provided at either end of the walking trail where it crosses the construction site. As outlined in Table 1-4 of Chapter 1 (Introduction), the (former) Department of Transport, Tourism and Sport was consulted with during the completion of this assessment but no response was received. Fáilte Ireland was also consulted with and no specific recommendations for addressing the impact on the South Leinster Way trail were issued.

It is also considered that the effect will be more significant for local recreational users than tourists as the extent of the potential effects is only for a short section (c. 3.9km) of the total length of the walking trail which is 105km in overall length (i.e. <4% of the trail length). It should be noted the other walking/hiking trails referred to in Section 5.3.1 (some of which link up with the South Leinster Way) would be expected to be available to the public during the construction works and could be used as short-term alternatives. No other direct or indirect impacts on tourist or recreational attractions are predicted. Measures to be employed by the appointed Contractor during the construction works to ensure the health and safety of tourists and the

[14] Using an average investment cost of €1.3 million per MW – SEAI, *A Macroeconomic Analysis of Onshore Wind Development to 2020* (2015)

[15] Irish Wind Farmers Association - FAQ | Meitheal na Gaoithe Irish Wind Farmers Association (mnag.ie)

general public are outlined in the Construction Environmental Management Plan (CEMP) in Appendix 2-7.

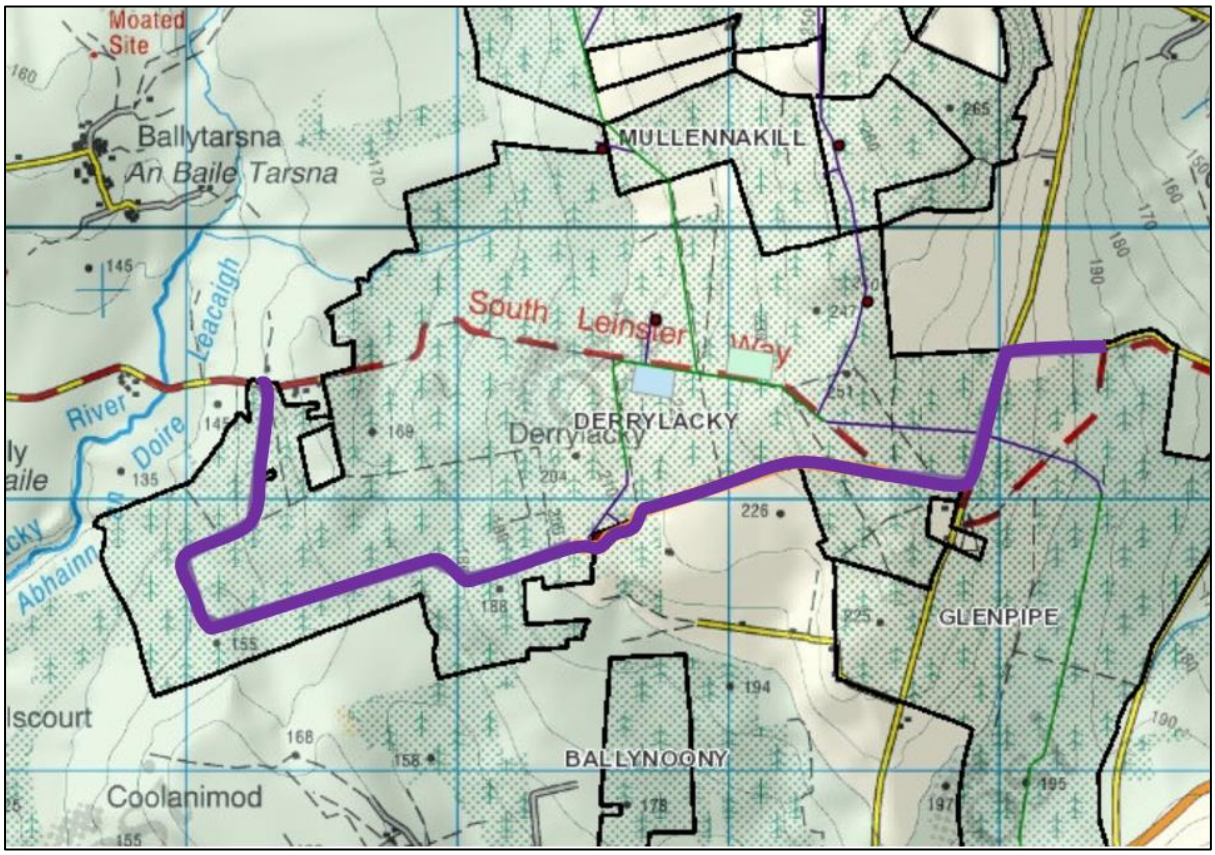

Figure 5-5 Temporary Alternative Marked Walkway Route (outlined in purple)

The proposed development will have a slight, short-term and negative effect on tourism during construction.

5.4.1.2 Operational Phase

Land Use

The proposed development will involve permanent works on the existing land primarily including turbine foundations, hardstand areas at turbines, internal roads and an on-site substation. The proposed infrastructure will cover an area of 36.3 ha within the proposed wind farm site area of 1434 ha, which represents only 2.5% of the total. The agricultural and forestry land use within the infrastructure area will be lost, however replacement forestry lands will be planted as set out in Appendix 2-5. The proposed development will have a slight to moderate, long-term and negative effect on the existing land use at the site.

Population Trends

It is not anticipated that the proposed development will have any significant impact on the current population trend in County Kilkenny or locally as there are no notable studies that support this. The improved facilities within the wind farm site and surrounding the proposed development which will be supported by the significant community benefit fund could make the local area attractive for people to move to.

A survey of the public perception of wind power in Scotland and Ireland carried out in 2003/2004 by researchers at the School of Geography & Geosciences, University of St. Andrews, Fife and The Macaulay Institute, Aberdeen (2005) found that large majorities of people are strongly in favour of their local wind farm and that positive attitudes to wind power increase through time and with proximity to wind farms. Retrospective questioning regarding pre- and post-construction attitudes at existing wind farms noted that those who changed to a more positive attitude following construction of the wind farm, gave reasons 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%)"*.

Property/Receptors

The turbine layout at the proposed development has been designed with cognisance of the local population and receptor locations. In accordance with the 2006 WEDGs, there are no turbines located within 500m of a residential property. The draft 2019 WEDGs recommend a minimum setback distance of four times the tip height (185m x 4 = 740m) from a proposed turbine to the curtilage of any residential property and the proposed development complies with this recommendation.

Potential impacts on receptors with regard to noise, telecommunications and visual appearance are assessed in the relevant chapters of this EIAR.

Shadow Flicker

Chapter 10 (Shadow Flicker) discusses the shadow flicker phenomenon in detail and sets out the criteria which determine the occurrence of shadow flicker, which is summarised as:

- The presence of screening;
- The location and orientation of the property;
- The distance of the property from turbines;
- The presence of direct sunlight;
- The time of day and year;
- Wind speed;
- Direction of wind; and
- The presence of people.

Given the above requirements for the presence of a shadow flicker impact, it could be said that for the vast majority of the time at any given property, shadow flicker should not cause any issues from any given turbine.

Modelling of predicted shadow flicker occurrence is presented in Chapter 10 (Shadow Flicker) and assessed against the current 2006 WEDGs. Springfield is committed to exceeding the current guidelines requirements and ensuring there is no shadow flicker occurrence at any sensitive receptor in the vicinity of the site. This will be ensured through the design stage considerations and mitigation measures set out in Chapter 10 (Shadow Flicker).

On this basis, following the implementation of the mitigation measures, there will be no shadow flicker occurrence at any sensitive receptor and, therefore, there will be no potential for an effect on residential amenity due to shadow flicker.

Property Value

A UK study, entitled *The effect of wind farms on house prices*, was carried out by the Centre of Economics and Business Research (Cebr) in March 2014. The key findings of the study were:

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

However, a similar study published in April 2014 by the London School of Economics (LSE) Spatial Economic Research Centre found an average reduction in the value of houses (based on 125,000 house sales between 2000 and 2012) of between 5% and 6% within 2km of very large wind farms.

These contradicting studies led to further research in Scotland in 2016 [16] which was based on analysis of over 500,000 property sales in Scotland between 1990 and 2014. This study, again, found no evidence of a negative impact from wind turbines on house prices and suggests that *"generally speaking the effect is either positive…or not distinguishable from zero"*.

The authors of the report tried to explain why the research carried out in Scotland found a very different result to that carried out in England even though the approach was very similar to that used in the LSE study. The suggested a number of possibilities including:

- Attitudes towards wind farms may be different in Scotland than in other parts of the UK;
- In Scotland, a much higher proportion of turbines are likely to be located on moors and mountains and in more remote areas than in England and Wales; and
- Some wind farms, especially in Scotland, enhance the local area by providing tracks for walkers, cyclists, horse riders and other members of the community, as well as substantial community benefit funds.

The proposed development will include for the creation of recreational amenities within the wind farm site and will provide a significant community benefit fund for the local area.

Large scale studies in United States have indicated that there is no conclusive evidence of any effect on property values located in close proximity to wind farms. A study entitled *A Spatial Hedonic Analysis of the Effects of Wind Energy Facilities on Surrounding Property Values in the United States* by Lawrence Berkley National Laboratory in 2013, carried out sampling in over 51,000 homes across nine US states. The range of distances examined accounted for as far as 10 miles away (c. 16km), but also took into account 1,198 homes within 1 mile (c. 1.6km) of turbines.

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

The proposed development will have a neutral effect on property values during its operational phase.

[16] ClimateXChange, *The impact of wind turbines on house prices in Scotland* (October 2016)

Employment/Economy

Economic benefits from operational activities will include ongoing purchases of local materials, services and equipment required for the operational phase of the wind farm as well as local spend generated from technical operational staff. The wind farm is expected to support 2-3 high quality technical full-time jobs in operation and maintenance as well as a number of jobs in ancillary functions. Some local employment or contract opportunities may develop over the lifetime of the wind farm from occasional less specialised activities.

According to the 2014 Pöyry Report, wind growth is expected to support €3.5 billion of direct investment to 2020, 1.2% of total Irish investment, and an additional €4.8 billion to 2030. The Pöyry Report was produced in 2014 and subsequent commitments in the Government's *Climate Action Plan*, published in 2019, suggest that the investment in renewable energies, including wind, will be in excess of the above estimates.

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

The impact of the community benefit scheme is likely to significantly enhance the local economy, with potential for substantial funding for local projects in support of relevant UN Sustainable Development Goals, clubs, charities and near neighbours, which will be invested in the local area. The Renewable Energy Support Scheme also proposes a community investment opportunity although this was not realised in the first RESS scheme. The community benefit associated with the proposed development is discussed in Chapter 2 (Description of the Proposed Development).

Positive economic effects will also be felt in the wider area due to the ongoing benefits of renewable electricity generation. The energy generated will feed directly into the national electricity transmission system, providing a sustainable electricity source and an increasingly competitive, low impact, energy supply to the county's domestic and industrial consumers. This is a significant, positive long-term effect for electricity consumers.

Tourism

The Fáilte Ireland Guidelines state that *"The impact upon tourism can be considered within this section through the sensitivities of hospitality, safety and pace of life. Changes in population can impact the perception of pace of life or safety in a particular location".* The Guidelines also note that *"Impacts upon these issues in areas which rely heavily on tourism or have a particular sensitive tourism generator should be considered in this section".*

In 2007, a collaboration between Fáilte Ireland and the Northern Ireland Tourist Board surveyed tourists' perceptions in relation to wind farms in the Irish landscape. A follow up survey in 2012, *Visitor Attitudes on the Environment: Wind Farms – Update on 2007 Research'* provided more recent information for the tourism and energy sectors. The results were positive, with 80% of tourists considering the presence of wind farms to have no impact or a positive impact on their sightseeing. In addition, when asked if further wind farm development in Ireland would influence their decision to holiday in Ireland again, over 70% of responses cited no impact or a positive impact on their return to Ireland.

Similarly, a 2016 study carried out by BiGGAR Economics '*Wind Farms and Tourist Trends in Scotland*' examined the link, if any, between onshore wind energy development and the sustainable tourism sector in Scotland. The report did not find a direct relationship between tourism and the wind energy sector in itself, however it did conclude that the increase in wind farm development did not negatively impact employment in the sustainable tourism industry in Scotland.

As noted previously, there are a number of relevant tourism attractions and public amenities within the study area including the South Leinster Way walking/hiking trail which crosses the southern portion of the site. As part of the proposed development, it is proposed to convert the southernmost construction compound to a permanent public car park on completion of the main development works. The car park will provide improved access to the South Leinster Way which will be reopened to the public following completion of construction works. It is also proposed that waymarking and public information signage will be installed to facilitate the public use of existing routes in and around the wind farm site. Further detail on the proposed amenity developments are included in Section 2.6.11 of Chapter 2 (Description of the Proposed Development).

The reopening of the South Leinster Way, development of a public car park and enhancement of access to walking routes within the site will encourage more use of the public open spaces and provide information to the general public on wind energy. A *Recreation Development Plan* has been prepared for the forestry lands owned by Coillte and is included as Appendix 2-6. Local community consultation has taken place to inform the Plan and will continue to help guide the provision of amenities and services in the local area.

In this regard, it is considered that the proposed development will have a long-term, slight, positive impact on the tourism experience and numbers in the vicinity of the site given that the current South Leinster Way amenity will be enhanced by the project and additional waymarked trails will be available to the public.

5.4.1.3 Decommissioning Phase

In terms of land use, the decommissioning of the wind farm after its operational life of 35 years will allow for the return of a portion of the lands to agricultural grassland, arable crops and forestry in line with the prevailing uses adjacent to the site at that time.

Works required for decommissioning the wind farm will have similar short-term benefits (for the duration of the decommissioning works) to the local economy in terms of employment opportunities for local contractors and an influx of construction workers to the area contributing to the local economy. The activities required to facilitate wind turbine decommissioning and removal from site will be similar to those outlined for the construction phase in terms of potential noise and air quality as well as increased construction traffic movements although these will be significantly lower than during the construction stage.

It is not anticipated that the decommissioning works will have any significant effect on local population trends, property value or tourism.

It is not envisioned that all elements of the proposed development would be removed – turbine bases in particular may be left in-situ, and simply covered in topsoil to revegetate, as this would be considered to have the least potential for environmental impact. Similarly, the substation will be retained, as it will form part of the transmission network, along with the internal access tracks

which will be part of the future recreational uses and may be useful for access to other land uses (e.g. agriculture, forestry, etc.) following decommissioning of the wind farm.

5.4.2 Human Health

This assessment of the potential impact of the proposed development on human health is based on a comprehensive review of the relevant published literature on the subject. In this regard, it is important to assess the quality of available information reviewed. In general, studies which are published in peer-reviewed journals are the most authoritative. Peer-reviewed means that only those with reasonable scientific substance which meets the scientific criteria of experts in the field are published. Even within peer-reviewed journals, there are different qualities of studies. Studies which are merely based on questionnaires or other reporting of symptoms are of less value but may be useful in identifying areas for further study, particularly if they are linked with scientific measurements. Occasionally, opinion is published, without necessarily strong back-up, to stimulate discussion.

Wind (and renewable) energy is a subject on which there is a lot of opinion available on the internet, with wide ranging and often contradictory information. The following sections provide a summary of some of the available material in relation to potential effects of wind turbines on human health and an analysis of its scientific robustness.

5.4.2.1 Construction Phase

5.4.2.1.1 Air Quality and Dust Emissions

The construction of the turbine infrastructure and erection of the turbines will take place away from residential properties with at least 750m distance from the proposed turbines to all properties. Dust is typically predictable in its dispersion and studies show that the majority of dust deposition occurs close to its creation. The nature of dust creation and deposition depends on the type of works, ground conditions and weather conditions.

Good construction practice and mitigation measures in terms of dust control will minimise any potential effects and are discussed in more detail in Chapter 14 (Air Quality and Climate) and the Construction Environmental Management Plan (CEMP). While in a construction project of this scale it is inevitable that there will be occasional dust generated, this is likely to be very localised in place and time. As detailed in Chapter 14, it is extremely unlikely that the construction activities will result in air quality standards being exceeded over any significant period of time in the environment outside of the construction site. It can, therefore, be stated with confidence that there will be no significant human health effects arising from emissions to air including dust generation.

By replacing fossil fuel burning power generation stations with clean renewable energy such as from the proposed development, there will be a positive overall impact on air quality in the country as a whole, and particularly in the regions where peat burning power stations are currently operational, as compared to a Do Nothing scenario (i.e. where the wind farm is not built).

5.4.2.1.2 Health and Safety

All activities carried out by the appointed Contractor on the proposed development will be in accordance with the requirements of the *Safety, Health and Welfare at Work Act 2005* as amended and Regulations made under this Act. The CEMP sets out the Health and Safety

requirements for the project including the erection of fencing, signage and notification of commencement of works to the Health and Safety Authority (HSA).

5.4.2.2 Operational Phase

5.4.2.2.1 Wind Turbine Health Effects

The term *Wind Turbine Syndrome* first appeared in 2009, when a New York Paediatrician, Dr Nina Pierpont (Pierpont, 2009), published a pamphlet she called *Wind Turbine Syndrome: A Report on a Natural Experiment*. The experiment comprised speaking on the telephone with 23 people who answered her advertisement asking if they lived near a wind turbine and if they ever felt sick. Fifteen of them said they had family members who would probably answer the question posed in the affirmative. Based on these personal assessments, Dr Pierpont claimed science proved her belief that wind turbines cause a vast array of maladies. This pamphlet was not published in a peer-reviewed journal and would be considered to more closely resemble a relatively unscientific opinion poll.

Entering the term *Wind Turbine Syndrome* into PubMed, a free resource providing access to life sciences and biomedical literature including a database which includes more than 30 million citations and abstracts of biomedical literature, there are only nine reported references[17]. Using key words *Wind Turbine Health* in the PubMed search engine, 175 articles were found[18]. This is still a relatively small number, but it is clear an increased number of medics/academics have studied this particular topic rather than attributing the term *Wind Turbine Syndrome* to their studies. A large number of these articles are concentrated on the potential impacts of the sound/infrasound of the turbines which is discussed further in subsequent sections.

In terms of research on the health effects of wind turbines generally, a review of the existing literature was performed in 2011 by Knopper (Knopper, 2011). The results of this study were stated as follows:

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

A further study was carried out by Knopper in 2014 (Knopper et al, 2014) which provides a *"bibliographic-like summary and analysis of the science around the issue* [of wind turbines and human health] *specifically in terms of noise (including audible, LFN* [low frequency noise] *and infrasound), EMF and shadow flicker"*. The study states that *"There is also a growing body of research that suggests that nocebo effects may play a role in a number of self-reported health impacts related to the presence of wind turbines. Negative attitudes and worries of individuals about perceived environmental risks have been shown to be associated with adverse health-*

[17] https://pubmed.ncbi.nlm.nih.gov/?term=wind%20turbine%20syndrome&pos=5 (Accessed on 07 December 2020)
[18] https://pubmed.ncbi.nlm.nih.gov/?term=wind+turbine+health (Accessed on 07 December 2020)

related symptoms such as headache, nausea, dizziness, agitation, and depression, even in the absence of an identifiable cause." The study abstract states that *"Based on the findings and scientific merit of the available studies, the weight of evidence suggests that when sited properly, wind turbines are not related to adverse health."*

The National Health and Medical Research Council (NHMRC) of Australia published *Wind Turbines and Health: A Rapid Review of the Evidence* in 2010 (NHMRC, 2010), which concluded that *"This review of the available evidence, including journal articles, surveys, literature reviews and government reports, supports the statement that: There are no direct pathological effects from wind farms and that any potential impact on humans can be minimised by following existing planning guidelines."*

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

A 2014 study by Health Canada on the impacts of wind turbine noise on health and well-being (Health Canada, 2014) had the following key findings:

- No evidence found to support a link between exposure to wind turbine noise and any of the self-reported illnesses (such as dizziness, tinnitus, migraines) and chronic conditions (such as heart disease, high blood pressure, diabetes);
- No association was found between the multiple measures of stress (such as hair cortisol, blood pressure, heart rate, self-reported stress) and exposure to wind turbine noise;
- The results of this study do not support an association between wind turbine noise and self-reported or measured sleep quality;
- An association was found between increasing levels of wind turbine noise and individuals reporting to be very or extremely annoyed. No association was found with any significant changes in reported quality of life, or with overall quality of life and satisfaction with health. This was assessed using the abbreviated version of the World Health Organization's Quality of Life Scale; and
- Calculated noise levels were found to be below levels that would be expected to directly affect health (World Health Organization— Community Noise Guidelines [1999]). This finding is consistent with self-reported and measured results of the study.

In 2015, the NHMRC in Australia published a systemic review of the health effects of wind farms (Merlin et al., 2015) which was performed by the University of Adelaide. This was an extremely thorough follow on to the *Rapid Review* referred to previously. It was completely independent with no relationship to either wind farm developers, anti-wind groups or objectors. It looked extensively at all the reported effects and systematically looked at all the evidence. The review concluded that *"The evidence considered does not support the conclusion that wind turbines have direct adverse effects on human health, as the criteria for causation have not been fulfilled".*

There was a commentary on *Wind Turbine Noise* published in the British Medical Journal (The BMJ) in March 2012 (Hanning and Evans, 2008) which was not an evidence-based study but merely an opinion piece. The piece identified that wind turbine noise seems to affect sleep and that an independent review of evidence is necessary. Professor Simon Chapman responded in a letter published in a subsequent issue of The BMJ (Chapman, 2012) stating *"Hanning and Evans,*

who declare histories of anti-wind farm activity, say that a large body of evidence now exists that wind turbines within permissible distances from housing disturb sleep and impair health. They are correct about a large body of evidence, but not in their interpretation of its conclusions. There are 17 reviews of the evidence, nearly all with an "independent" provenance. None are referenced in the editorial. These reviews strongly state that the evidence that wind turbines themselves cause problems is poor. They conclude that:

- *Small minorities of exposed people claim to be adversely affected by turbines.*
- *Negative attitudes to turbines are more predictive of reported adverse health effects and annoyance than are objective measures of exposure.*
- *Deriving income from hosting wind turbines may have a "protective effect" against annoyance and health symptoms. Opponents claim that turbine hosts sign "gag" clauses that prevent them from complaining. I have seen contracts from different Australian firms and none say anything about gags. No contract could preclude citizens from pursuing negligence claims in common law."*

Furthermore, a critical review of the scientific literature published in the Journal of Occupational and Environmental Medicine (JOEM) in 2014 (McCunney, 2014) concluded that:

1. *"Infrasound sound near wind turbines does not exceed audibility thresholds.*
2. *Epidemiological studies have shown associations between living near wind turbines and annoyance.*
3. *Infrasound and low-frequency sound do not present unique health risks.*
4. *Annoyance seems more strongly related to individual characteristics than noise from turbines."*

A recent study published in Environment International Journal (Bräuner et. al, 2018) examined the association between long-term exposure to wind turbine noise and the incidence of myocardial infraction (MI). The study concluded that *"the results of this comprehensive cohort study lend little support to a causal association between outdoor long-term wind-turbine noise exposure and MI. However, there were only few cases in the highest exposure groups and our findings need reproduction."*

A more recent study published in the Journal of American Heart Association (Bräuner et. al, 2019) investigated the association between long-term exposure to wind turbine noise and the risk of stroke and concluded that *"this comprehensive cohort study lends no support to an association between long-term WTN* [wind turbine noise] *exposure and stroke risk"*.

Another recent article published in the Environmental Research Journal (Poulsen et. al, 2018) examined the potential link between wind turbine noise and adverse birth outcomes and found no associations between the two.

In conclusion, there appears little scientific evidence of effects of *Wind Turbine Syndrome* and so significant health effects in this regard are not anticipated.

5.4.2.2.2 Noise Induced Hearing Loss

During the construction, operational and decommissioning phases of the proposed development, environmental noise levels sufficient to cause noise induced hearing loss will not occur. The detailed assessment presented in Chapter 12 (Noise and Vibration) assesses the potential for noise impacts from the proposed development and concludes that the greatest potential noise impact from the operation of the wind farm is moderate in terms of its significance and also notes that the impact is variable. It is therefore concluded that there is no

risk of noise induced hearing loss due to noise from environmental exposure as a result of the proposed development.

5.4.2.2.3 Sleep Disturbance

In 2009, the WHO issued *Night-time Noise Guidelines for Europe* (WHO, 2009). The report stated that in two European countries studied (Switzerland and The Netherlands) almost 50% of the population are exposed to night-time noise in excess of 45dB L_{night}. It quotes some impacts at quite low night-time levels and proposed an ideal noise level of 40dB L_{night} outside residences. This, however, is a yearly average. It does accept that this is essentially unachievable and suggests an interim value of 45dB L_{night} outside, again a yearly average.

The current Irish WEDGs (2006) state that *"A fixed limit of 43dB(A) will protect sleep inside properties during the night"*. The Draft 2019 WEDGs (Ireland) propose a change to the approach in applying limits on noise from wind turbines, including during night-time. This is currently the subject of consultation and is discussed in further detail in Chapter 12 (Noise and Vibration).

The WHO also carried out a review on environmental noise in 2018 (Basner and McGuire, 2018). While the review mainly concentrated on road, rail and aircraft noise, it did briefly discuss wind turbine noise and concluded that *"The results of the six identified studies that measured self-reported sleep disturbance are consistent, four of the studies found an association between wind turbine noise levels and increased sleep disturbance. However, the evidence that wind turbine noise affects sleep is still limited. This finding is supported by other recent reviews on wind turbine noise and sleep disturbance. Three of the studies referred to noise specifically in the questions which could have led to a bias in the results. Also, while the results from four out of the six studies suggest that sleep disturbance due to wind turbine may occur when noise levels are above 40 or 45 dBA, for two of the studies less than ten percent of the participants were exposed to these higher noise levels. Therefore, it is difficult to make conclusions on populations exposed to these higher levels. In addition, noise levels were calculated using different methods and different noise metrics were reported in the studies."*

In October 2018, the WHO published the *Environmental Noise Guidelines for the European Region* (WHO, 2018) as a follow on from the above and noted the following:

"For the relationship between wind turbine noise and prevalence of hypertension, three cross-sectional studies were identified, with a total of 1830 participants (van den Berg et al., 2008; Pedersen, 2011; Pedersen & Larsman, 2008; Pedersen & Persson Waye, 2004; 2007). The number of cases was not reported. All studies found a positive association between exposure to wind turbine noise and the prevalence of hypertension, but none was statistically significant. The lowest levels in studies were either <30 or <32.5 L_{den}. No meta-analysis was performed, since too many parameters were unknown and/or unclear. Due to very serious risk of bias and imprecision in the results, this evidence was rated very low quality".

"The same studies also looked at exposure to wind turbine noise and self-reported cardiovascular disease, but none found an association. No evidence was available for other measures of cardiovascular disease. As a result, only evidence rated very low quality was available for no considerable effect of audible noise (greater than 20 Hz) from wind turbines or wind farms on self-reported cardiovascular disease".

The Guidelines also state that *"For average noise exposure, the GDG* [Guideline Development Group] *conditionally recommends reducing noise levels produced by wind turbines below 45 dB L_{den} as wind turbine noise above this level is associated with adverse health effects"*. The GDG

do note however that aside from a potential for annoyance, the evidence relating to any health effects associated with wind turbine noise is either absent or of poor quality. There is therefore a possibility that the effects caused by attitudes towards wind farms may be difficult to tell apart from any potential effects from wind turbine noise. The GDG also note that there are more people exposed to noise from sources such as road traffic than from wind turbines and any benefits associated with reducing exposure to wind turbine noise may be unclear. Taking account of the above, the GDG recommends that the development of any policies for wind energy development ensure that noise exposure is kept below guideline values. They note that this can be achieved via multiple methods, but they don't specify that any particular methods should be used.

Further discussion with regard to noise impacts is presented in Chapter 12 (Noise and Vibration).

5.4.2.2.4 Infra-sound

Infra-sound is sound below the audible human frequency which is normally taken as being 20 Hz or less. Human ears cannot respond to this, however it can be associated with vibration and is sometimes an issue discussed with, for example, large tunnelling projects. Infra-sound is also an everyday event with everyday sources.

Many of the people who cite human health problems with wind turbines relate these to infra-sound and reported symptoms can include nausea, disturbance of sleep, tinnitus (ringing in the ear) as well as others. Two professionals that have studied and expressed concerns about infra-sound in relation to wind turbines are Dr Alec Salt of the Washington School of Medicine and Dr Marianna Alves Pereira, Associate Professor at Lusófona University, Portugal.

In a 2013 study by the South Australian Environment Protection Authority entitled *Infrasound levels near wind farms and in other environments,* the authors objectively measured infra-sound in a number of the different environments including urban and rural as well as in houses adjacent to windfarms and those further away. Among its conclusions were that *"Infrasound levels of between 60 and 70dB(G) commonly occur in the urban environment"* and that *"Noise generated by people and associated activities within a space was one of the most significant contributors to measured infrasound levels, with measured infrasound levels typically 10 to 15dB(G) higher when a space was occupied. Infrasound levels up to approximately 70dB(G) were measured in occupied spaces".*

When discussing the specific locations that were tested, the report stated *"At two locations, the EPA* [South Australian Environment Protection Authority] *offices and an office with a low frequency noise complaint, building air conditioning systems were identified as significant sources of infrasound. These locations exhibited some of the highest levels of infrasound measured during the study"*. For rural environments, the report concluded that while infra-sound levels were lower than urban areas, that *"Infrasound levels at houses adjacent to wind farms are no higher than those at houses located a considerable distance from wind farms"*.

Another relatively recent publication from Ministry of the Environment in the Federal State of Baden Wuerttemberg, Germany (Ratzel, 2016) states in the conclusion that *"Infrasound is caused by a large number of different natural and technical sources. It is an everyday part of our environment that can be found everywhere. Wind turbines make no considerable contribution to it. The infrasound levels generated by them lie clearly below the limits of human perception. There is no scientifically proven evidence of adverse effects in this level range.*

The measurement results of wind turbines also show no acoustic abnormalities for the frequency range of audible sound. Wind turbines can thus be assessed like other installations according to the specifications of the TA Lärm [noise prevention regulations]*. It can be concluded that, given the respective compliance with legal and professional technical requirements for planning and approval, harmful effects of noise from wind turbines cannot be deduced".*

The referenced publications and studies above outline that windfarms are not a significant source of infra-sound and that traffic and everyday human activity are likely to be more relevant. It is therefore concluded that there will be no significant adverse effect on human health as a result of infra-sound.

Further discussion on infra-sound is presented in Chapter 12 (Noise and Vibration).

5.4.2.2.5 Electromagnetic Interference

When electric current flows, both electric and magnetic fields are produced. The electromagnetic fields (EMF) from electricity are in the extremely low frequency end of the electro-magnetic spectrum. EMF occurs in the home, in the workplace or anywhere that electricity is used. EMF is also naturally generated from earth's geomagnetic field and electric fields from storm clouds.

Guidance from the WHO states that EMF is sometimes cited for potential health effects (WHO, 2007). Concerns expressed in the past include childhood leukaemia, brain tumours and other cancers. Laboratory experiments have provided no reliable evidence that EMF are capable of producing cancer, nor do human epidemiological studies suggest that they cause cancer in general.

Some non-cancerous adverse health effects are also claimed to be associated with EMF. These include miscarriages, reproductive and developmental abnormalities, depression and suicide, allergy and neurological disease. However, the Health Promotion Agency in the UK stated, in November 2007, that *"there is little scientific evidence to support these claims and the current body of evidence does not show that exposure to EMF below guideline levels presents a human health hazard"*.

The aforementioned Australian NHMRC study (Merlin, 2015) concluded in relation to EMF that *"There is no direct evidence on whether there is an association between electromagnetic radiation produced by wind farms and health outcomes. Extremely low-frequency electromagnetic radiation is the only potentially important electromagnetic emission from wind turbines. Limited evidence suggests that the level of extremely low-frequency electromagnetic radiation close to wind farms is less than average levels measured inside and outside Australian suburban homes. There is no consistent evidence of human health effects from exposure to extremely low-frequency electromagnetic radiation at much higher levels than is present near wind farms."*

EirGrid produced a publication entitled *EMF and You* in July 2014 which provides more information on EMF and electricity. This publication states that *"Recent studies conducted in the UK, France, Denmark and the US have not established associations between a home near transmission lines and childhood leukaemia"* and that *"Based on this history and its own review of research, the World Health Organization states there is no evidence to conclude that exposure to low-level EMFs is harmful to human health"*.

The proposed underground electrical cables will adhere to the international guidelines for ELF-EMF which are described by the International Commission on Non-Ionizing Radiation Protection (ICNIRP). This is a formal advisory agency to the World Health Organisation. The proposed project will also adhere to the EU guidelines for human exposure to EMF. As the ICNIRP guidelines will not be exceeded, even directly above the underground cables, there will be no associated operational effects on Human Health.

The on-site substation to be built as part of the proposed development will be located as shown in Figure 2-1 of this EIAR. The distance from the nearest sensitive receptor to this on-site substation is approximately 1.2km. It is noted that a considerable number of existing electrical substations are located much closer than 1.2km from nearby sensitive receptors. The proposed substation will be constructed in accordance with national standards for electrical infrastructure and as set out in the EirGrid publication referred above, no health agency has concluded that exposure to EMF from power lines and other electrical sources is a cause of any long-term adverse effects on human, plant or animal health.

For these reasons, this assessment concludes that there will be no significant human health effects as a result of electromagnetic radiation.

5.4.2.2.6 Shadow Flicker

'Shadow flicker' is an effect that occurs when the rotating blades of a wind turbine cast a moving shadow over an observer or a building. The effect is predominantly experienced indoors where a moving shadow passes over a window in a nearby property and results in a rapid change or flicker in the incoming sunlight. Shadow flicker is predominantly an annoyance, but concerns have been raised that the flicker can trigger seizures in persons with photosensitive epilepsy.

The Wind Energy Guidance Note prepared in the UK for the Renewables Advisory Board and Department for Business, Enterprise and Regulatory Reform (BERR) in 2007 states that *"The operating frequency of a wind turbine will be relevant in determining whether or not shadow flicker can cause health effects in human beings. The National Society for Epilepsy advises that only 3.5 % of the 1 in 200 people in the UK who have epilepsy suffer from photosensitive epilepsy. The frequency at which photosensitive epilepsy may be triggered varies from person to person but generally it is between 2.5 and 30 flashes per second (hertz). Most commercial wind turbines in the UK rotate much more slowly than this, at between 0.3 and 1.0 hertz. Therefore, health effects arising from shadow flicker will not have the potential to occur unless the operating frequency of a particular turbine is between 2.5 and 30 hertz and all other pre-conditions for shadow flicker effects to occur exist." The note also states that "Shadow flicker is therefore more likely to be relevant in considering the potential effects on residential amenity [than human health]"*.

Similarly, the aforementioned Australian NHMRC study (Merlin, 2015) discusses shadow flicker and states that *"The Environment Protection and Heritage Council of Australia (EPHC; 2010) notes that the risk of seizures from modern wind turbines is negligible, given that less than 0.5% of the population are subject to epilepsy at any point in time and, of this proportion, 5% are vulnerable to strobe lighting (light flashes). In the majority of circumstances (>95% of the time), the frequency threshold for individuals susceptible to strobe lighting is >8 Hz, with the remainder affected by frequencies >2.5 Hz. The EPHC estimates that the probability of conventional horizontal-axis wind turbines causing an epileptic seizure for an individual experiencing shadow flicker is <1 in 10 million in the general population."*

Following the above information and based on the fact that there will be no shadow flicker occurrence at any sensitive receptor, it can be determined that there will be no potential for an effect on human health due to shadow flicker.

5.4.2.2.7 Psychological Effects

The potential for adverse effects on psychological health, such as anxiety and stress, caused by concern in relation to visual appearance, noise emissions, shadow flicker and other issues, is often highlighted in relation to wind farms. The community may also experience annoyance arising from increased traffic or noise from the construction works.

The potential effects on a person's overall psychological well-being is difficult to assess as there are no direct measurements that can be used. While it is possible to predict noise emissions and shadow flicker, for example, the same scientific certainty cannot be used in predicting psychological impacts. The 2014 Health Canada report referenced in Section 5.4.2.2.1 looked at a number of measures of stress (such as hair cortisol, blood pressure, heart rate, self-reported stress) and noted no association with exposure to wind turbine noise.

The potential degree of psychological impact can be both positive and negative. There can be a positive impact, whereby people may look forward to better employment opportunities generated by a major infrastructure project in a rural area or the benefits that may be gained from the Community Benefit Funds. In terms of negative impacts, this can be where somebody is annoyed by for example, the visual appearance of the wind turbines. This annoyance is not a medical health impact, as such. If a person were to develop a psychological illness, such as anxiety or depression, this would be a medical health impact.

In this case, it is useful to look at experience from other operational windfarms to determine if significant psychological effects are reported and published. If this was the case, it would be expected to find recorded evidence of increased levels of depression or anxiety in the vicinity of other windfarms, however there are no such findings in the peer-reviewed literature referenced above.

On that basis, it is considered that no significant adverse effects on psychological health will occur as a result of the proposed development.

5.4.2.2.8 Health Benefits

Aside from the potential socio-economic benefits previously discussed, there are significant environmental benefits to the proposed development. The current and historical practice of fossil fuel combustion with the associated release of a range of pollutants including particulate matter, oxides of nitrogen, sulphur dioxide, carbon dioxide and many others is well documented. The release of these pollutants from the power generation sector is also a major contributor to global warming and the resulting changing effects on our climate.

The phasing out of coal, gas and peat burning power stations in Ireland is a key step in achieving Ireland's 2030 decarbonisation ambition as set out in the Climate Action Plan 2019 and the placement of fossil fuels in electricity generation by clean renewable wind energy will have significant benefits for air quality and slowing down global warming.

The contribution of the proposed development to a decrease in reliance on fossil fuel combustion will have a moderate to significant positive long-term effect on the health and well-being of the general population.

5.4.2.2.9 Residential Amenity

Residential amenity relates to the human experience of a person'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 at the residence.

The land use/activities on the site are primarily commercial forestry, with some areas of pastoral agriculture. The surrounding landscape is a mixture of agricultural land and forestry. The nearest residential receptors are over 750m from the proposed turbine locations. The nearest large settlements are Mullinavat, Inistioge and Ballyhale, which are located approximately 4.1km southwest, 5.7km northeast and 1.9km northwest of the site of the proposed wind farm, respectively. The surrounding area includes the M9 and the R704 Regional Road. As such, there is a current and historical context for agricultural activity in the area in terms of forestry and transportation.

Extensive consideration has been given to the layout of the site and the positions of the turbines in ensuring sufficient set-back distances from sensitive receptors and adjustment for noise, shadow flicker, visual impact and telecommunication impacts. These considerations during the design, planning and EIA phase, in accordance with the relevant guidelines, are designed to minimise the potential effects on residential amenity from the proposed development. The potential effects on human beings at their residences are assessed in the following chapters; Chapter 10 (Shadow Flicker), Chapter 11 (Material Assets: Aviation and Telecommunication), Chapter 12 (Noise and Vibration), Chapter 13 (Landscape and Visual Impact Assessment), Chapter 14 (Air Quality and Climate) and Chapter 16 (Traffic and Transport).

Based on a combined consideration of the above factors in determining the potential impacts on residential amenity, it is considered that there will be a slight negative effect on residential amenity which will be short-term for the construction phase and long-term for the operational phase. For the small number of the nearest noise sensitive locations, as described in Chapter 12 (Noise and Vibration), the significance of the effect may be considered as moderate and variable in the worst-case noise conditions.

5.4.3 Major Accidents/Disasters

The vulnerability of the project to risk of major accidents and/or disasters, such as extreme flooding or peat/soil instability, is discussed primarily in Chapter 8 (Land, Soils and Geology) and Chapter 9 (Hydrology and Hydrogeology). The potential for climate change to impact future flood events is considered as part of the site-specific Flood Risk Assessment (FRA) in Chapter 9.

In the context of potential human health risk from major accidents/disasters, potential risks as set out Section 2. 11.1 of Chapter 2 (Description of the Proposed Development) are presented by turbine/substation fires or turbine collapse. There are no dwellings located within 750m of the proposed turbine or substation locations, therefore the risk to residential receptors from fires or turbine collapse is not considered significant. The maximum tip height of the turbines is 185m, therefore all residential dwellings are significantly removed from area of a potential turbine collapse.

The draft 2019 WEDGs refer to the very remote possibility of injury to people (or animals) from flying fragments of ice or from a damaged blade but note that most blades are composite structures with no bolts or separate components and that most turbines are fitted with anti-

vibration sensors, which will detect any imbalance caused by icing of the blades and prevent start-up. Neither the draft 2019 WEDGs or the current 2006 WEDGs refer to the likelihood of fires from turbines and it is considered that the potential risk of a fire is very low. Similarly, the risk of turbine collapse is very low on the basis of comprehensive turbine base design considerations, safety checks throughout the turbine installation process and turbine suppliers many years of experience in developing and innovating safety in the wind energy industry.

The proposed development will not come under the *Control of Major Accident Hazards (COMAH) Regulations*, therefore there is no potential human health risk from activities associated with COMAH sites. Additionally, there are no COMAH sites located in proximity to the proposed wind farm.

It is therefore considered that the potential for an impact on the local population and human health from a major accident or disaster is low.

5.4.4 Do Nothing Effects

In the Do-Nothing Scenario, the existing lands will continue to be utilised for agricultural and forestry purposes with little or no changes in the baseline at the site. Agricultural activities and periodic tree felling will continue with the movement of equipment and personnel associated with same.

The opportunities for local employment and additional economical spend from the proposed development will not be realised.

In the Do-Nothing Scenario, there will be no emissions generated from construction works and no potential for noise, shadow flicker or visual effects associated with wind turbines at this site.

The health benefits to the country associated with replacing fossil fuels with renewable wind energy from the proposed development will be lost and alternative candidate sites will need to be identified, either onshore or offshore, to ensure Ireland meets it commitments to reducing carbon emissions.

5.4.5 Cumulative Effect

In the assessment of cumulative impacts, any other existing, permitted or proposed developments in the surrounding area have been considered where they have the potential to generate in-combination or cumulative impacts with the proposed development. The potential for cumulative impacts on the local population and human health, in particular noise, shadow flicker, traffic and visual impacts are discussed in the relevant chapters.

There is potential for an operational phase cumulative effect on noise, shadow flicker and visual impacts associated with the two existing wind farms at Ballymartin/Smithstown and Rahora. In terms of traffic, the potential for cumulative effects will occur primarily during the construction phase where construction traffic associated with the proposed development could overlap with construction or operations of other projects, which are currently permitted but not yet constructed, as identified in Section 16.1.1 of Chapter 16 (Traffic and Transport).

5.4.6 Effect of Covid-19

The emergence of Covid-19 requires cognisance to be taken of potential restrictions and their impact on the proposed development as well as measures amongst the population to prevent

the spread of the disease. Public health guidance, such as sanitising, social distancing and assessment of workers health as well as any future measures advised by the authorities, will be implemented during construction and operational phases, as required. All measures will be in line with relevant government guidelines at the time, but it is anticipated that the following guidelines, at a minimum, would apply should Covid-19 restrictions still be in place:

- All persons are required to complete Construction Industry Federation (CIF) Covid-19 Online Induction prior to working on site;
- All staff are required to notify management if they are experiencing any of the Covid-19 symptoms, and self-isolate without coming to site;
- On-site facilities should allow for adherence to the social distancing guidance at the time of construction. Staff management (e.g. staggering of lunch breaks, eating alone) should also support social distancing;
- Hand sanitiser, disinfecting wipes and appropriate PPE should be made available to staff in all site compounds. Hand sanitiser should be carried by all staff, and PPE such as face masks used as required;
- Staff temperatures should be non-invasively checked regularly (as per CIF guidance);
- All staff to comply with government advice for minimising personal contacts and keep note of any close contacts; and
- Staff should use the Covid Tracker phone app.

5.5 MITIGATION MEASURES

5.5.1 Construction Phase

Best practice construction methodology and measures to minimise impacts from excavation works, as described in Chapter 8 (Land, Soils and Geology), will keep the development area to a minimum and reduce land use changes.

The proposed development is not anticipated to have a significant effect on the local or regional population, therefore no mitigation measures in respect of population trend impacts are required.

From an economic perspective, the proposed development will provide employment opportunities to the local community and wider region during construction, operations and decommissioning. The project, primarily at construction stage, is also likely to increase spend in local businesses as persons involved in the project stay locally or purchase goods. Overall, there will be a positive impact on the local economy and no mitigation measures are required.

To reduce the effect on tourists and local users of the South Leinster Way during the construction phase of the development, signage and maps of alternative routes will be erected at either end of the trail where access will be blocked as a result of construction activity.

5.5.2 Operational Phase

Fáilte Ireland has been consulted to identify any potential concerns for adverse tourism impacts. Fáilte Ireland has provided a guidance document for considering the potential impacts of projects on tourism and this guidance document has been considered in the completion of this assessment. A *Recreation Development Plan* for provision of amenity facilities at the site has been developed and is included in Appendix 2-6. The Community Benefit Fund will provide an opportunity for the local community to invest in local facilities and infrastructure and support local clubs/societies and near neighbours.

Where required, specific mitigation measures for other environmental factors discussed previously which may interact with human health, such as landscape and visual effects, shadow flicker, air quality, water quality, noise & vibration and transport, are discussed in the relevant chapters of this EIAR. A cross reference of environmental factors is also presented in Chapter 17 (Interactions of the Foregoing).

5.5.3 Decommissioning Phase

Internal access roads, substation and wind turbine bases will be retained in place after decommissioning of the wind turbines to maintain access for forestry and recreation, minimise disruption to the electricity grid infrastructure and reduce the impact of construction activities (such as noise, air quality and traffic movements) on the local population associated with their removal. Turbine hardstandings will be covered with topsoil and revegetated.

No mitigation is proposed for the decommissioning phase in respect of effects on population trends, property value or tourism.

5.6 RESIDUAL IMPACTS

5.6.1 Construction Phase

The Castlebanny Wind Farm will have a slight positive residual impact on the local population through an influx of construction workers in the short-term. This influx is likely to cause a slight increase in local population over a short period of time resulting in a boost to the local economy through accommodation and spend in local shops and restaurants.

It is considered likely that there will be a short-term, not significant, negative impact on tourism and recreation amenity associated with the use of the South Leinster Way during the construction phase following the installation of guidance and information to the public on alternative available routes.

5.6.2 Operational Phase

The proposed development will provide clean energy from a renewable resource and help to achieve targets in national energy and climate change policies. This is a direct positive long-term residual effect for the country which will benefit the local population and communities.

The establishment of a Community Benefit Fund is considered to be a long-term positive effect on the local community in general. This in turn would have a positive effect on the individuals living in this community and have a positive effect on their individual psychological health through the development of community led projects and maximising the level of local involvement in terms of influencing how the funds are spent.

Overall, it is considered likely that there will be a long-term, slight, positive impact on the local population and human health as a result of the proposed development.

Based on the cumulative impact assessments carried out for shadow flicker, noise, traffic and visual impact, it is considered that there will not be any significant effects on the local population or human health during the operational phase of the proposed development following the implementation of the mitigation measures as set out in the relevant chapters.

5.6.3 Decommissioning Phase

It is considered that there will be a short-term, imperceptible, negative effect associated with the works required to decommission the wind turbines at the end of their operational lifetime.

5.7 CONCLUSION

There is currently no credible evidence to link wind turbines to adverse health impacts. Emission limits, such as for noise or dust, are set to protect the most vulnerable in a community rather than the robust. Compliance with the limits set out in best practice guidelines (described in the relevant chapters on noise and vibration, air quality, shadow flicker) will ensure that individuals and communities are protected. Design stage considerations, such as turbine locations, and the mitigation measures outlined in Section 5.5 and in specific technical chapters will be put in place to ensure that the emissions and effects from the proposed development are in compliance with the standards to ensure that there will be no significant adverse effects on health, even amongst the most vulnerable.

Following consideration of the residual impacts as set out in Section 5.6, it is considered that that proposed development will not result in a significant negative impact on population and human health in the local and regional area.

References:

Basner and McGuire, *WHO Environmental Noise Guidelines for the European Region: A Systematic Review on Environmental Noise and Effects on Sleep* Int. J. Environ. Res. Public Health. 2018 Mar; 15(3): 519 (2018)

Bräuner et. al, *Long-term wind turbine noise exposure and incidence of myocardial infarction in the Danish nurse cohort. Environment International Journal, Vol. 121 Part 1* (December, 2018)

Bräuner et. al, *Association Between Long-Term Exposure to Wind Turbine Noise and the Risk of Stroke: Data From the Danish Nurse Cohort.* Journal of American Heart Association, Vol. 8 Issue 14 (July, 2019)

CEBR, *The effect of wind farms on house prices* (March 2014)

Chapman, *The sickening truth about wind farm syndrome* New Scientist (2012)

Chapman, *Wind Turbine Noise* BMJ 2012;344:e3366 (2012)

ClimateXChange, *The impact of wind turbines on house prices in Scotland* (October 2016)

Central Statistics Office – 2016 and 2011 Census and associated data

DoCCAE, *Code of Practice for Wind Energy Development in Ireland Guidelines for Community Engagement* (December 2016)

Evans, *Infrasound levels near Windfarms and other environments* (2013)

Fáilte Ireland, *EIAR Guidelines for the Consideration of Tourism and Tourism Related Projects*

Fáilte Ireland website – https://www.failteireland.ie/

Hanning and Evans, *Wind Turbine Noise* BMJ 2012;344:e1527 (2012)

Health Canada, *Wind Turbine Noise and Health Study: Key Findings* (2014)

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

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

Ireland's Ancient East website - https://www.irelandsancienteast.com/

IWEA, *Life-cycle of an Onshore Wind Farm* (March 2019)

IWEA, *An Enterprising Wind: An economic analysis of the job creation potential of the wind sector in Ireland* (2014)

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

Knopper LD and Ollson CA, *Health effects and wind turbines: a review of the literature* Environ Health. 2011; 10:78. Published 2011 Sep 14. doi:10.1186/1476-069X-10-78

Lenus, *Health Profile 2015 Kilkeny* (2015)

McCunney, *Wind Turbines and Health. A critical review of the Scientific Literature* Massachusetts Institute of Technology Nov 2014. Journal of Occupational and Environmental Medicine Vol 56, No. 11 (2014)

Merlin, T. et al, *Systematic review of the human health effects of wind farms*, National Health and Medical Research Council, Canberra (2015)

National Health and Medical Research Council (Australia), *Wind Turbines and Health: A Rapid Review of the Evidence* (July 2010)

OSI – Mapping and aerial photography

Pierpont, *Wind Turbine Syndrome: A Report on a Natural Experiment* (2009)

Poulsen et. al, Pregnancy exposure to wind turbine noise and adverse birth outcomes: a nationwide cohort study. Environmental Research Journal, Volume 167 (November 2018)

Pöyry, *The Value of Wind Energy to Ireland - A Report to Irish Wind Energy Association* (March 2014)

Ratzel, *Low-frequency noise incl. infrasound from wind turbines and other sources.* State of Baden Wuertmberg (2016)

Sport Ireland Outdoors website (walking trails) - https://www.sportireland.ie/outdoors

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)

US Environmental Protection Agency, *Health Impact Assessment Resource and Tool Compilation* (September 2016);

World Health Organisation, *Electromagnetic Fields and Public Health* (2007)

World Health Organisation, *Environmental Noise Guidelines for the European Region* (2018)

World Health Organisation, *Health in Impact Assessments: Opportunities not to be Missed* (2014)

World Health Organisation, *Night-time Noise Guidelines for Europe* (2009)