MWP

Chapter 05 – Population & Human Health

Ballynisky Wind Farm

Ballynisky Green Energy Ltd.

December 2025

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5. Population and Human Health

5.1 Introduction

This chapter considers any likely significant effects of the proposed development on population and human health. A full description of the proposed development, development lands and all associated development elements is provided in Chapter 03 Description of the Proposed Development of this EIAR. The Study Area for the purpose of the population and human health assessment focuses on the local receiving human environment in the vicinity of the proposed development site. The human environment is examined in terms of population and settlement, economic activity, employment, land use, tourism and amenities. Included within the chapter is an assessment of the potential impact from shadow flicker generated by the proposed development during the operational phase.

The chapter has been prepared having regard to information on the local population and land-use and in consideration of any human health impacts via environmental pathways from aspects such as soil, air, water or changes to material assets.

The assessment comprises:

- A description of the existing human environment;
- A discussion of the factors and weather conditions that influence shadow flicker;
- Prediction and characterisation of effects;
- Evaluation of effect significance; and
- Consideration of mitigation measures, where appropriate.

Information has been gathered from publicly available sources, including Local Authority Plans (for Limerick City and County Council), the Central Statistics Office (CSO), Fáilte Ireland and the Met Éireann website.

5.1.1 Competency of Assessor

This assessment was undertaken by Kate Cain and reviewed by Aileen O'Connor. The shadow flicker survey was performed by Jeremy King.

Kate is an experienced Environmental Scientist with MWP. Kate holds a Bachelor of Science (BSc) in Environmental Management and has over 13 years' experience. Kate has authored Environmental Impact Assessment (EIA) Reports, including Population and Human health chapters, EIA Screenings, Detailed Site Assessments, Remediation Plans, Appropriate Assessments, Environmental Reports and Construction and Environmental Management Plans for a wide range of projects.

Jeremy is the lead GIS technician in MWP assisting the Civil and Environmental departments. Jeremy has qualifications in Computer Aided Design (CAD) and Geographical Information Systems (GIS). Jeremy has prepared numerous shadow flicker impact models which form part of the assessments for inclusion in Environmental Impact Assessment Reports.

This assessment has been reviewed by Aileen O'Connor (MWP), BSc (Hons), PGDip, has over 13 years' experience in the environmental field both in industry and consultancy work. Aileen is a Senior Environmental Consultant and holds a BSc (Hons) in Environmental Science and PGDip in Energy Management. Aileen is an experienced and

competent environmental professional with a background in contaminated land assessment, licence compliance and waste management. Aileen has prepared and peer reviewed chapters of EIARs and has coordinated and delivered many environmental assessment reports and consent applications for transmission and power generation projects including the preparation of Resource Waste Management Plans RWMPs and contributed to Material Assets Impact Assessments. More specifically, Aileen has worked on a wide variety of projects during her career to date including renewable energy, marine, quarries, industrial and commercial developments.

5.2 Scope of Assessment

The assessment considers the entirety of the proposed development including the wind turbines, and associated infrastructure, access tracks, on-site substation and grid connection.

The following legislation and published guidance has been complied with and consulted in undertaking this assessment:

- EU Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment as amended by Directive 2014/52/EU (the "EIA Directive");
- EPA, Guidelines on Information to be contained in environmental impact assessment reports, May 2022;
- EU (Planning and Development) (Environmental Impact Assessment) Regulations 2018 (S.I. No. 296 of 2018);
- Guidelines for Planning Authorities and An Bord Pleanála in carrying out Environmental Effect Assessment (Department of Housing, Planning and Local Government, August 2018);
- Planning Guidelines for Wind Energy, DEHLG 2006;
- Draft Revised Wind Energy Development Guidelines, DHPLG 2019;
- EPA Guidelines on the Information to be Contained in Environmental Impact Reports (EPA, May 2022); and
- Revised (draft) EPA Advice Notes for Preparing Environmental Impact Assessments (EPA, September 2015).

The 2015 draft EPA Advice Notes state that:

> *'While most developments by people will affect other people, the section of an EIS dealing with this topic concentrates on those topics which are manifested in the environment, such as employment and housing areas, amenities, extended infrastructure or resource utilisation and associated emissions.'*

Issues such as commercial competition, zoning, property prices, agri-business and other social and economic issues are dealt with by more specific instruments (such as the Planning Acts). Table 5-1 outlines those issues which the EPA guidance suggests may be examined as part of this study.

Table 5-1: Issues Relevant to the Human Environment

Topic Area	Potential Issues
Economic Activity	Will the development stimulate additional development and/or reduce economic activity, and if either, what type, how much and where?
Social Consideration	Will the development change pattern and types of activity and land-use?
Land-use	Will there be severance, loss of rights of way or amenities, conflicts, or other changes likely to ultimately alter the character and use of the surroundings?
Tourism	Will the development affect the tourism profile of the area?
Health and Safety	Vectors through which human health impacts could be caused e.g., will there be risks of death, disease, discomfort or disturbance, such as noise or shadow flicker?

Note: Shadow flicker is defined as the alternating light intensity produced by a wind turbine as the rotating blade casts shadows on the ground and stationary objects, such as the window of a residence. Shadow flicker can only occur if there is an unobstructed direct line of sight from within a dwelling to a turbine. No flicker will occur when the turbine is not rotating or when the sun is obscured by clouds or fog or if blinds or curtains are drawn at the receptor location.

Having regard to the above, the topics considered in this assessment are as follows:

- Population and Settlement Patterns;
- Economic Activity and Employment;
- Land-Use;
- Tourism and Amenities; and
- Human Health and Wellbeing (with reference to environmental aspects).

The assessment also considers the potential effect of Shadow Flicker from the operating turbines.

5.2.1 Methodology

The methodology used for this study included desk-based research of published information and site visits to assemble information on the local receiving environment.

5.2.1.1 Desk Study

A desk study was undertaken to identify potential impacts, either positive or negative, on the human environment that could cause change in the 'quality of life' as a consequence of the construction, operation and decommissioning of the proposed development.

The local human environment is made up of a number of groups. These include those who reside in, work in, visit, or use the local road networks in the area. Whilst no single set of persons can be discerned, the local residential population is deemed to be the most sensitive group in terms of those most likely to experience any identified impacts.

The desk study included the following activities:

- Review of the most recent Central Statistics Office (CSO) Census of Ireland data to establish settlement demographics and economic context of the study area;
- Review of the Agricultural Census and Forestry data for Ireland;
- Review of Ordnance Survey Mapping and aerial photography to establish existing land use and settlement patterns within the study area;

- Review of local and regional development plans and planning policy in order to identify future development and identify any planning allocations within the study area;
- Review of Limerick City and County Council's Planning Register to identify relevant development proposals currently under consideration by the Council;
- Review of planning policy and strategies to identify way-marked walking and cycling routes and other Rights of Ways within the study area, and;
- Review of tourism data including Tourism Ireland, Fáilte Ireland and local websites to identify tourism data and visitor attractions within the study area.

Based on a review of the characteristics of the proposed development, any potential negative impacts on the local human environment are considered to include the following human health/wellbeing and disturbance concerns:

- Dust emissions from construction activities;
- Noise emissions during construction and operation;
- Public safety during construction activities and operation;
- Traffic disturbance during construction and operation, and;
- Visual impacts and shadow flicker during operation.

Each of the above issues has been fully assessed and documented in various chapters of this EIAR as set out in Table 5-2. These assessments were reviewed to inform this study. According to the EPA guidance, neighbouring residents and land users are considered potentially vulnerable receptors (i.e. an entity that is vulnerable to the adverse effect of a hazardous substance (e.g. human health)). In the case of this proposed development, potential vulnerable receptors are those who may be affected by air emissions, water emissions, traffic and noise during the construction phase. They may also be affected visually. Receptors which are community facilities such as schools, churches, hospitals or provide other social services are also considered potentially vulnerable receptors.

Table 5-2: Potential Disturbance & Health and Safety Issues and Relevant EIAR Chapters

Potential Disturbance / Health & Safety Issue	EIAR Chapter
Dust emissions from construction/decommissioning activities	Chapter 10 Air and Climate
Noise emissions during construction/decommissioning and operation	Chapter 11 Noise
Public safety during construction/decommissioning activities and operation	Chapter 03 Description of the Proposed Development
Traffic disturbance during construction/decommissioning and operation	Chapter 14 Material Assets
Visual impacts during operation	Chapter 12 Landscape and Visual
Shadow flicker during operation	Chapter 05 Population and Human Health

The following potential positive impacts were also identified during the review:

- Positive effect of local renewable energy displacing 26,609 million tonnes of CO_2 over the 35-year lifetime of the proposed development;
- Positive effect on local and national targets in relation to renewable energy generation;
- Positive effect on air quality due to displacement of fossil fuel generated electricity;
- Positive effect of creating local construction jobs for duration of 12-16 months;

- Positive effect of significant commercial rates being paid over the 35-year lifetime of the proposed development to the local authority that will be utilised to fund services within the county;
- Positive effect of planning contribution fees that the local authority will utilise to fund services within the county, and;
- Positive effect of community benefit fund circa €150,000/year.

5.2.1.2 Site Visits

Site visits were conducted during 2022, 2023 and 2024 to ascertain land uses in the study area and to identify the location and spatial distribution of residential dwellings.

5.2.1.3 Consultation

Ballynisky Green Energy Ltd. has undertaken a significant consultation process with the local community, with the objective being to ensure that the views and concerns of all members of the local community were considered as part of the proposed development design and the Environmental Impact Assessment process. In line with national policy, Ballynisky Green Energy Ltd. is committed to transparent and meaningful consultation. This facilitates more informed and active engagement with the proposed development. The key elements of this approach are outlined within Chapter 01 Introduction of the EIAR and the Community Report (Appendix 1C, Volume III).

5.2.1.4 Assessment Criteria

Determination of the significance of an effect will be made, where practicable, in accordance with the terminology outlined in Table 3.4 of the 2022 EPA Guidelines on the *Information to be contained in Environmental Impact Reports*, provided in Chapter 01 Introduction (Table 1-2) of this EIAR.

Current assessment criteria for Shadow Flicker are described in the Department of the Environment, Heritage and Local Government, Wind Energy Development Guidelines, 2006. These guidelines are currently under review and replacement Draft Wind Energy Development Guidelines were published in December 2019.

Until the revised guidelines are published in final form, the Government has advised that the current 2006 guidelines remain in force. However, with mitigation measures proposed for shadow flicker employed in full, the criteria in both documents will be achieved.

The 2006 Guidelines recommend that shadow flicker at offices and dwellings within 500m of a turbine should not exceed 30 hours per year or 30 minutes per day, and at distances greater than 10 rotor diameters from a turbine the potential for shadow flicker is very low.

The shadow flicker criteria described in the 2019 Draft Wind Energy Guidelines are as follows:

> *'The planning authority or An Bord Pleanála should impose condition(s) to ensure that no existing dwelling or other affected property will experience shadow flicker as a result of the wind energy development subject of the planning application and the wind energy development shall be installed and operated in accordance with the shadow flicker study submitted to accompany the planning application, including any mitigation measures required.'*

The potential for unmitigated shadow flicker occurrence within a defined 10 rotor diameter study area was modelled. The results for a theoretical worst-case and more realistic scenario are presented and discussed (Section 5.2.1.5) and compared against the guideline shadow flicker criteria in the existing 2006 Wind Energy Development Guidelines and the 2019 Draft Revised Wind Energy Development Guidelines (WEDG).

5.2.1.5 Shadow Flicker

The shadow flicker assessment methodology involves the identification of houses and receptors within a defined study area, which have the potential to be adversely impacted by shadow flicker. In line with best practice guidance, the study area is usually limited to a distance (between a house and wind turbine) equivalent in length to 10 times of the proposed wind turbine rotor diameters. Determining shadow flicker based on the 10 rotor diameter rule has been widely accepted across different European countries and is deemed to be an appropriate assessment area (Parsons Brinckerhoff, 2011).

Computer software is then used to predict the occurrence of shadow flicker at each house within the study area. The results are a theoretical worst case. This is because of the unpredictable variability of weather which greatly impacts shadow flicker occurrence.

The results are compared against assessment criteria designed to minimise any effect which can be caused by shadow flicker. These criteria are the current thresholds described in the 2006 WEDGs. Modern wind turbines allow a great degree of remote and automatic control which can limit the occurrence of shadow flicker to an acceptable level, or none, at a receptor location in line with the draft revised 2019 guidelines.

The key factors related to shadow flicker occurrence include:

- Spatial Relationships

  At distances of greater than approximately 500 metres between a turbine and a receptor, shadow flicker generally occurs only at sunrise or sunset when the cast shadows are extremely long. It is generally considered that the occurrence of shadow flicker is very low "at distances greater than 10 rotor diameters from a turbine"[1] or at a distance greater than 1 kilometre (km). This is because at such separation distance the rotor of a wind turbine will not appear to be chopping light, but the turbine will be regarded as an object with the sun behind it[2].

  Figure 5-1 shows an approximation of the shadow cast by a turbine at various times during the day, where the red shading represents the area where shadow flicker may occur.

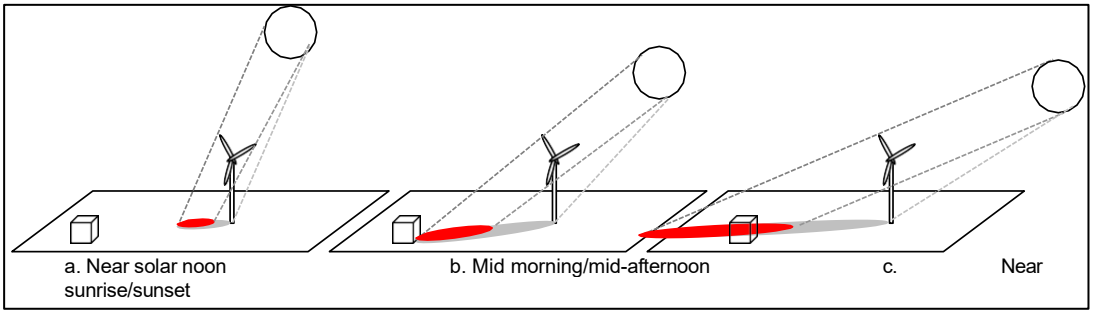

Figure 5-1: Shadow Prone Area as Function of time of day

- Wind Direction

  The angle between the sun and the rotor plane also plays a determining role for both shadow flicker occurrence and intensity. The rotor plane is determined by the direction of the wind: because the turbine rotor continuously yaws to face the wind, the rotor plane will always be perpendicular to the wind direction. Shadow flicker will be most pronounced when the rotor plane is perpendicular to the sun-receptor line of sight.

[1] Extract from the DoEHLG 2006 Guidelines, on occurrence of shadow flicker
[2] http://xn--drmstrre-64ad.dk/wp-content/wind/miller/windpower%20web/en/tour/env/shadow/shadow2.htm

- Sunshine Hours

The shadow flicker analysis assumes the sun is always shining. It is reasonable to factor any results by the percentage of time the sun is actually shining. Ireland normally gets between 1100 and 1600 hours of sunshine each year. The sunniest months are May and June. During these months, sunshine duration averages between 5 and 6.5 hours per day over most of the country. The extreme southeast gets the most sunshine, averaging over 7 hours a day in early summer. December is the dullest month, with average daily sunshine ranging from about 1 hour in the north to almost 2 hours in the extreme southeast. Over the year as a whole, most areas get an average of between 3.25 and 3.75 hours of sunshine each day[3].

It was possible using the 30-year average sunshine data available from Met Éireann for Limerick (Shannon airport being the closest data source to the site) to determine the percentage of time shadow flicker could actually occur. These are presented in Table 5-3. Based on this data, the conditions necessary for shadow flicker (clouds not present) are only predicted to be present for approximately 27% of the day on average.

Table 5-3: Average Hours of Sunshine and Average Hours of Day for Shannon Airport (1981 – 2010)

Month	Mean Daily Duration (Hrs)	Average Length of day	% Proportion of day with sunshine
Jan	1.6	8	20
Feb	2.3	10	23
Mar	3.2	12	27
Apr	5.1	14	36
May	5.8	16	36
Jun	5.2	17	31
Jul	4.5	16	28
Aug	4.5	14	32
Sept	3.9	13	30
Oct	2.9	11	26
Nov	2	9	22
Dec	1.4	8	18
Average		Yearly Average	27%

- Theoretical Model Worst Case Assumptions

Shadow flicker was calculated for the proposed wind turbines using industry-standard simulation software WindFarm, a tool which has been successfully applied to similar studies within Ireland and around the world. The model uses Ordnance Survey Ireland digital height data as its topographical reference. Simulations are run on a 'bare earth scenario' without allowing for the obscuring effect of vegetation being between the location of the residence and the position of the sun in the sky, further contributing to the results a worst-case scenario. Nor does the model consider any obscuring features around residences itself, which would minimise views of the site and hence reduce the potential for shadow flicker. Therefore, the WindFarm model uses a theoretical worst-case scenario when reporting shadow flicker results for the existing environment. The model assumes that:

1. The sun will always be shining during daylight hours, with no cloud cover or fog;

[3] http://met.ie

2. The wind will blow continuously throughout the day and always above cut-in speed, i.e., the turbine will always be rotating;
3. The wind will always be blowing from a direction such that the turbine rotor is aligned with the sun-receptor line. In other words, the rotor will yaw in parallel with the sun such that the rotor blades are always perpendicular to the sun-receptor view line, and;
4. There will be no screening by vegetation or trees, i.e., a bare earth scenario.

An assumption is also made that the windows of the rooms, where the effects may occur, (i) directly face the development, (ii) that the rooms are occupied and (iii) that the curtains or blinds if present are open.

A more realistic simulation would use the following assumptions:

1. The sun will not always be shining therefore, it is only necessary to calculate shadow flicker for the fraction of time when the sun would be shining. Average sunshine hours used in this assessment - are based on average monthly figures from the years 1981 to 2010, from the Shannon Airport Meteorological Station;
2. The rotor will not be turning all the time. For example, a turbine would not be rotating during maintenance works or no wind conditions;
3. The rotor blades will not always be perpendicular to the sun-receptor view line, and;
4. Trees, vegetation, local topography and buildings in the vicinity of the receptor will reduce shadow flicker or eliminate shadow flicker.

- Realistic Scenario

The Best Practice Guidelines for the Irish Wind Energy Industry, Irish Wind Energy Association, 2012 states that calculations for shadow flicker modelling generally assume 100% sunshine and that it is reasonable in Ireland's climate to modify these figures. Therefore, the theoretical maximum shadow flicker as predicted by WindFarm was multiplied by the 'sunniness' factor of 0.27 (27 percent) to evaluate potential impacts of the wind turbines (see Table 5-3).

Table 5-9 presents the Worst Case (Total hours per year) and the Realistic Scenario (modified to reflect cloud cover in the region) in relation to shadow flicker at a receptor. The shadow flicker software provides a conservative estimate as it simulates the worst-case scenario, in terms of the yearly number of hours when the receptors are exposed to shadow flicker. The main assumptions of the model are:

- The sky is always clear. Therefore, cloud cover or fog is not considered;
- The turbine is facing the sun 100% of the time. Changes in wind direction are not considered;
- The turbine is continuously rotating, so that stopping due to low or high wind speed is not considered. Periods of maintenance when the wind turbine is stopped are also not considered, and;
- The shielding effects of close obstacles like trees or buildings are not considered.

In reality the sun is not always visible and often covered by clouds and the actual number of shadow flicker hours that a receptor experience is lower than what the conservative software model simulates. Therefore, the more realistic scenario is 27% of the worst-case scenario predicted by the model (Total hours per year column) and is presented as such in the last column of Table 5-9. However, even this realistic estimate is still expected to overestimate the real case because:

- The orientation of the rotor was assumed to constantly be perpendicular to the sun-turbine axis and follow the sun's diurnal path. In reality the turbines yaw, i.e., turns on the tower, several times per day as the wind changes. As the predominant wind direction is south to southwest, the effect of rotor orientation could be large;
- The rotor was assumed to be rotating constantly, which will not be the case, if the threshold, cut-in wind speeds are not reached, and;
- Vegetation was not considered in the assessment. Trees, shelter belts or other obstacles surrounding the receptor might reduce or cancel the shadow flicker effect.

As a result, the predicted annual shadow flicker effect presented is still conservative.

The shadow flicker assessment described herein will inform the Shadow Flicker Control Measures (SFCM) that will be designed for each turbine to ensure that shadow flicker does not occur at a receptor location.

While shadow flicker could potentially occur if no mitigation measures were implemented, the developer commits to a programme of SFCM which will ensure that shadow flicker can be eliminated at receptor locations. These control measures are described in Section 5.4.2.7.

SFCM is a standard element of commercial wind turbine packages which requires the identified dates and times of day of potential occurrence at dwellings within the shadow flicker study area to be inserted into the SFCM computer program. This software considers factors such as weather conditions, which will then automatically stop each wind turbine at times when shadow flicker would otherwise occur within any of the dwellings. Once the conditions for shadow flicker to occur no longer apply (e.g., when the sun has passed the relevant position in the sky or it has been clouded over), the wind turbine is automatically restarted.

5.3 Existing Environment

5.3.1 Study Area

The Study Area for the purpose of this assessment on Population and Human Health primarily focuses on the local receiving human environment in the vicinity of the site. This includes those who reside, work, visit, or use the local road networks.

Although this chapter predominantly describes the human environment in the vicinity of the proposed development, sensitive human receptors in the broader human environment are considered in the other specialised environmental topics, including the following;

- Landscape and Visual Effect (Chapter 12 Landscape and Visual);
- Cultural Heritage Effect (Chapter 13 Cultural Heritage); and
- Material Assets Effect (including Traffic and Transportation, Telecommunications and Aviation) (Chapter 14 Material Assets).

5.3.2 Site Description and Location

The development will be on a site area of approximately 43.02 hectares (ha). The proposed development is located within a flat landscape that is rural in nature with a low-density population and land-uses comprising mainly agricultural land, farm holdings and residential dwellings in the vicinity of the development area. The site is located in the townlands of Ballynisky, Graigoor, Ballyegny More, Kilbradran, Ballysteen, Dunmoylan, Lisbane,

Lissatotan and Carrons near Coolcappa, Co. Limerick. It lies approximately 9km north of Newcastle West and 6km northwest of Rathkeale. Access to the site will be via the Local Road network. The R521 between Foynes and Newcastle West is located to the west of the site. The R521 links the N21 National Primary Road to the southeast and the N69 to the north. The R521 can also be accessed at Ardagh from the R523 south of Rathkeale. Access to the site will be via the L1219 local road to the northwest of the site.

5.3.3 Surrounding Population Centres

The proposed development is located approximately 9km north of Newcastle West and 6km west of Rathkeale, Co. Limerick (Figure 5-2). Other villages and towns surrounding the proposed development include:

- Coolcappa – located approximately 1km to the southeast;
- Kilcolman – located approximately 3.5km to the west;
- Ardagh – located approximately 4.5km to the southwest;
- Shanagolden – located approximately 6.5km to the northwest;
- Foynes – located approximately 10km to the north; and
- Askeaton – located approximately 8.5km to the northeast.

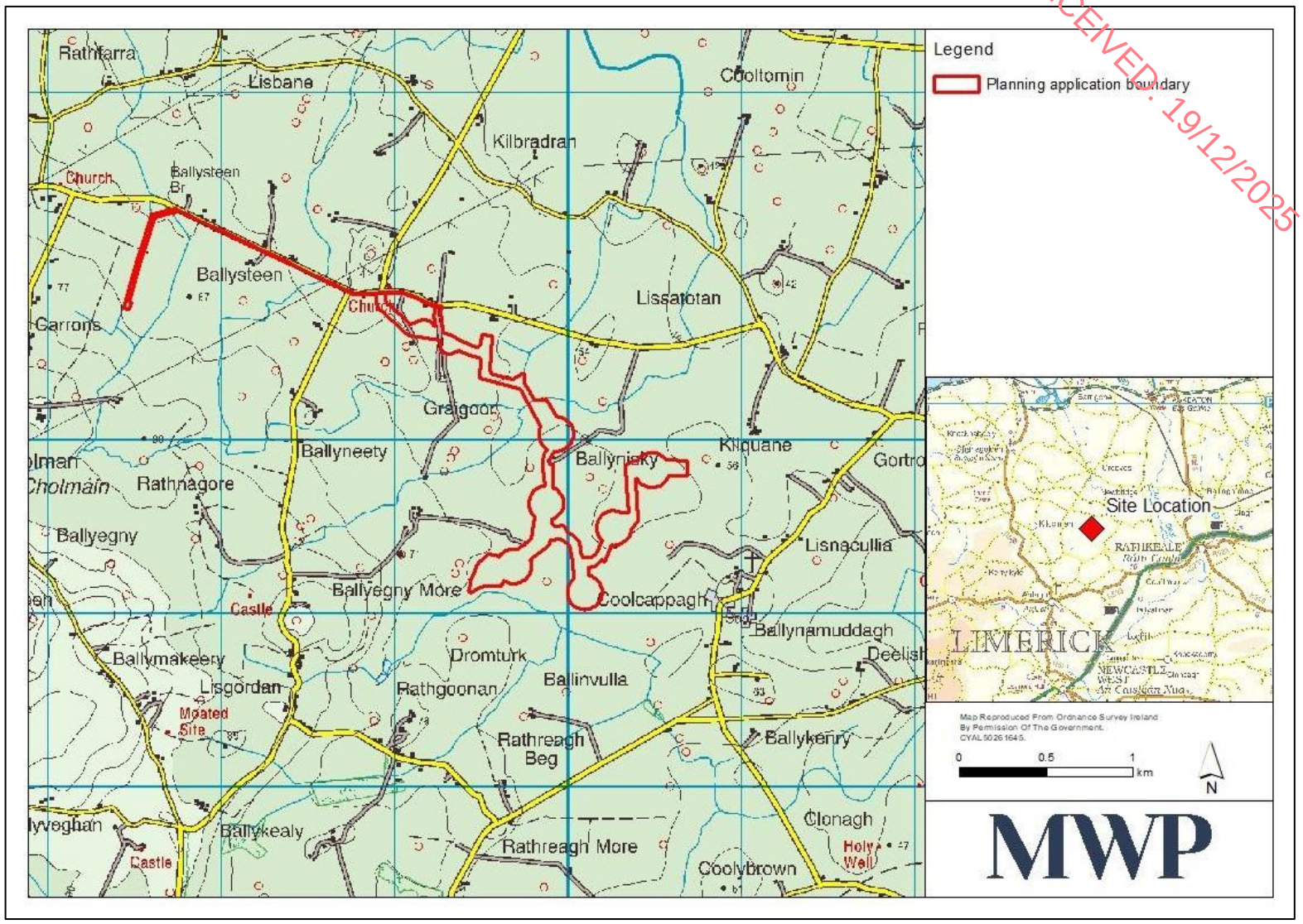

Figure 5-2: Location of Proposed Development

5.3.4 Electoral Divisions and SAPS

Electoral Divisions (EDs) are the smallest legally defined administrative areas in the State for which Small Area Population Statistics (SAPS) are published from the CSO. Therefore, in order to discuss the baseline human environment and other statistics in the vicinity of the site, the Study Area for this assessment has regard to EDs within or located close to the proposed development site. These local statistics are compared against the county and national data to get some perspective on the relative character of the study area (Table 5-5).

The extent of the EDs and SAPS considered for the purposes of this assessment are shown in Figure 5-3 and Figure 5-4 and set out in Table 5-4 and Table 5-5.

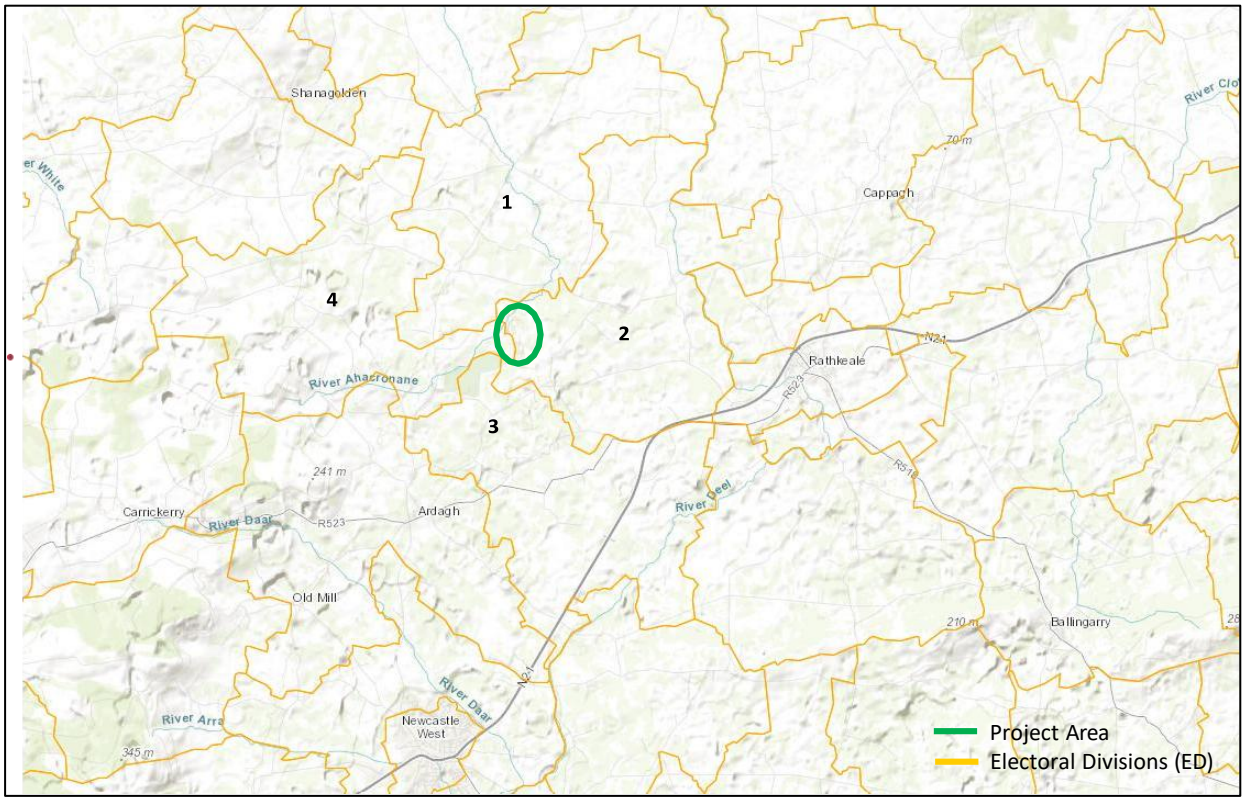

Figure 5-3: Electoral Division Locations

Table 5-4: Electoral Divisions Surrounding Study Area

Map Reference	Electoral Area
1	Lismakeery
2	Riddlestown
3	Kilscannell
4	Dunmoylan East

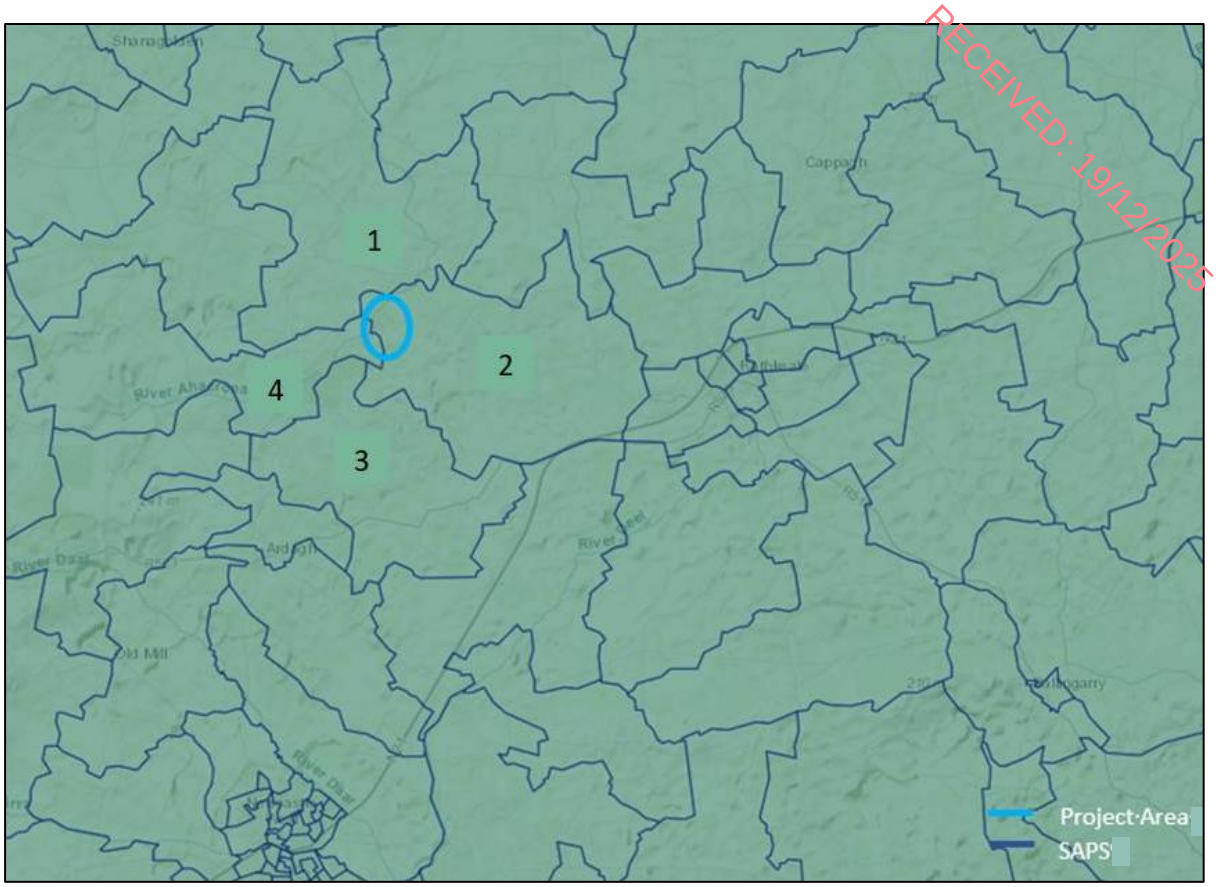

Figure 5-4: SAPS Locations

Table 5-5: Study Area SAPS

Area Ref	Statistical Small Area	Electoral Division
1	127107001	Lismakeery
2	127126001	Riddlestown
3	127099001	Kilscannell
4	127064001	Dunmoylan East

5.3.5 Settlement Patterns

The site is located in the townlands of Ballynisky, Graigoor, Ballyegny More, Kilbradran, Ballysteen, Dunmoylan, Lisbane, Lissatotan and Carrons near Coolcappa, Co. Limerick (Figure 5-5). Settlement patterns in the area surrounding the proposed development are typical of a rural area and primarily consists of farms and one-off residential dwellings along the road networks that encompass the site and serve the area (Figure 5-6). There are no existing residential dwellings within 632m of a proposed turbine (4 times the overall tip height of the turbines). The closest existing residential dwelling is approximately 648m to the north of proposed turbines T1 and T6. Planning permission has been granted for a residential dwelling approximately 750m northwest of T1 (LCCC planning ref 23503).

There is one school (Coolcappa National School) located within a 2km radius of the proposed development site (Figure 5-7). Other schools in the vicinity of the site include the Kilcolman National School and Kilcolman Community Creche 3.5km to the west, the Ardagh National school 4km southwest, and the Start Right Montessori

School and Ardagh Montessori School located 4.5km southwest. There are no hospitals within 2km of the site. The nearest hospital / medical centre is located 6km to the east in Rathkeale.

There are several recreational / leisure facilities and churches within 2km of the development site. The Newcastle West Golf Course Clubhouse is located approximately 1km southwest of Turbine 3. Saint Kyran's Catholic Church and GAA Club (St Kieran's) are located over 850m east of T5 (Figure 5-8).

Other prominent developments in proximity to the proposed development site are Grouse Lodge Wind Farm located 4.5km west and Carrons Wind farm located 2.5km west of the proposed development site. These and other windfarms within 25km of the site are shown on Figure 5-9. The Roadstone, Joseph Hogans (Creeves) Quarry is located 4km north of T1 (Figure 5-10). Other quarries located close to the proposed development area include Knockbowheen Quarry and Michael O'Donovan Quarries.

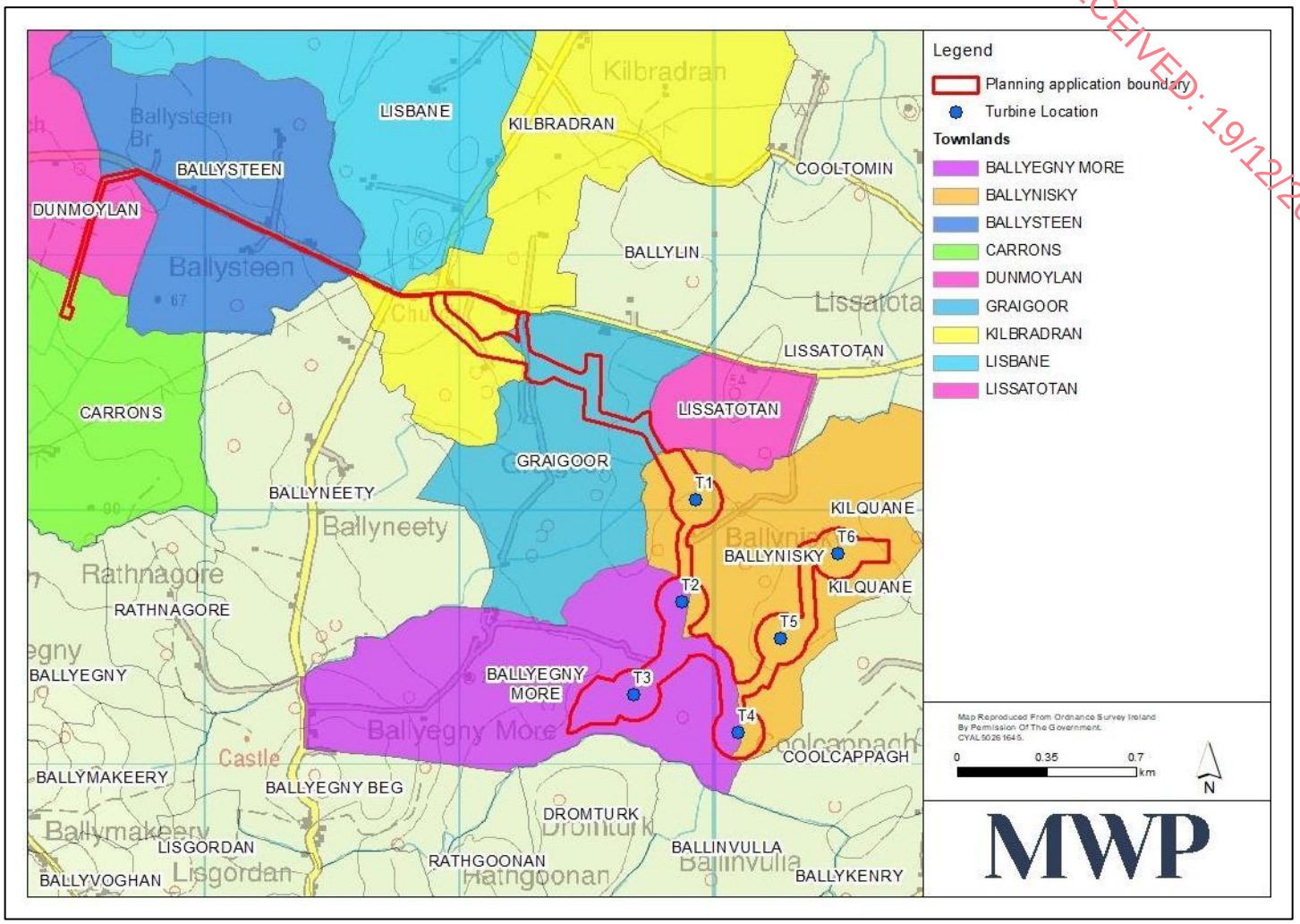

Figure 5-5: Townlands

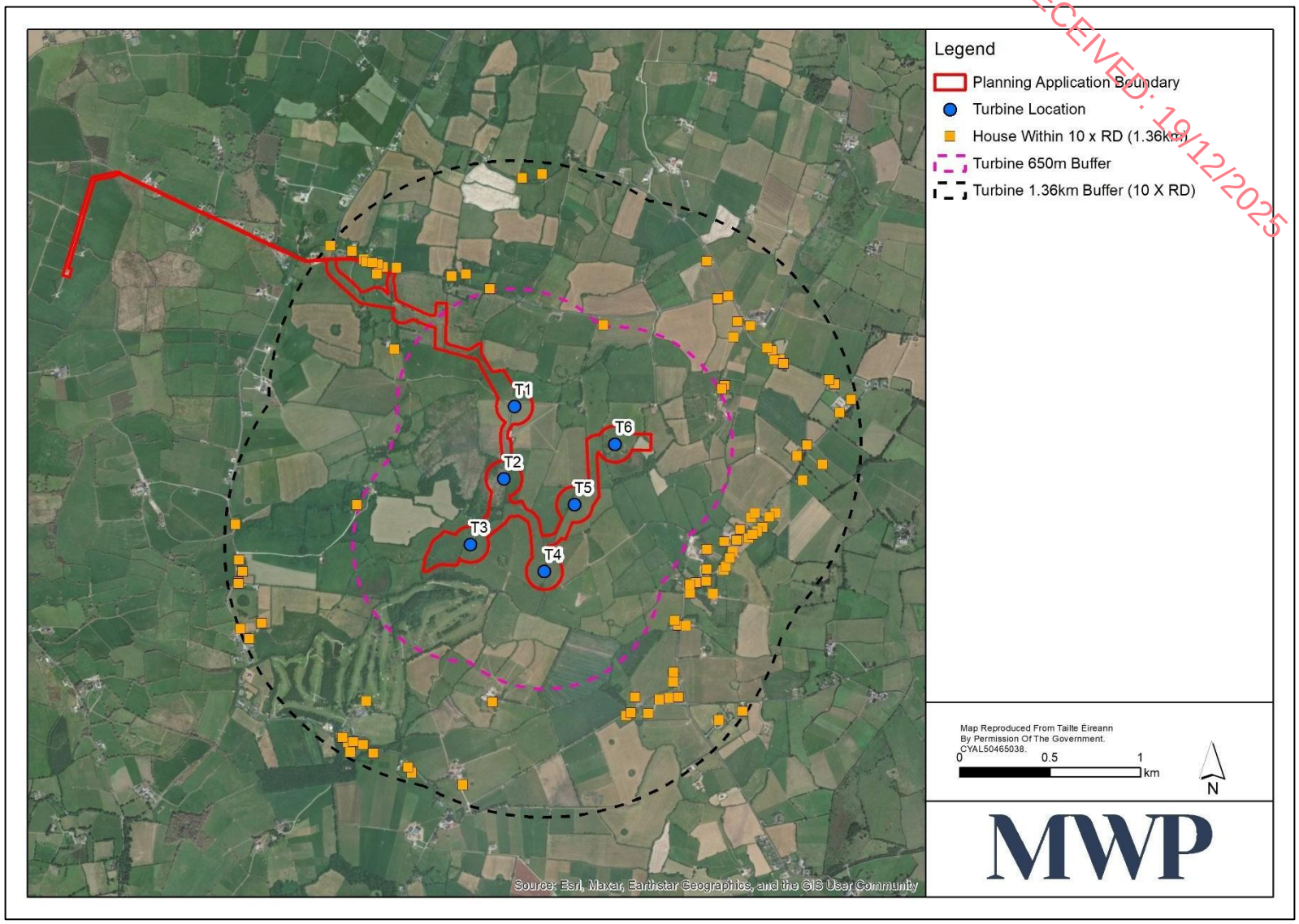

Figure 5-6: Residential Dwellings in the Vicinity of the Proposed Development

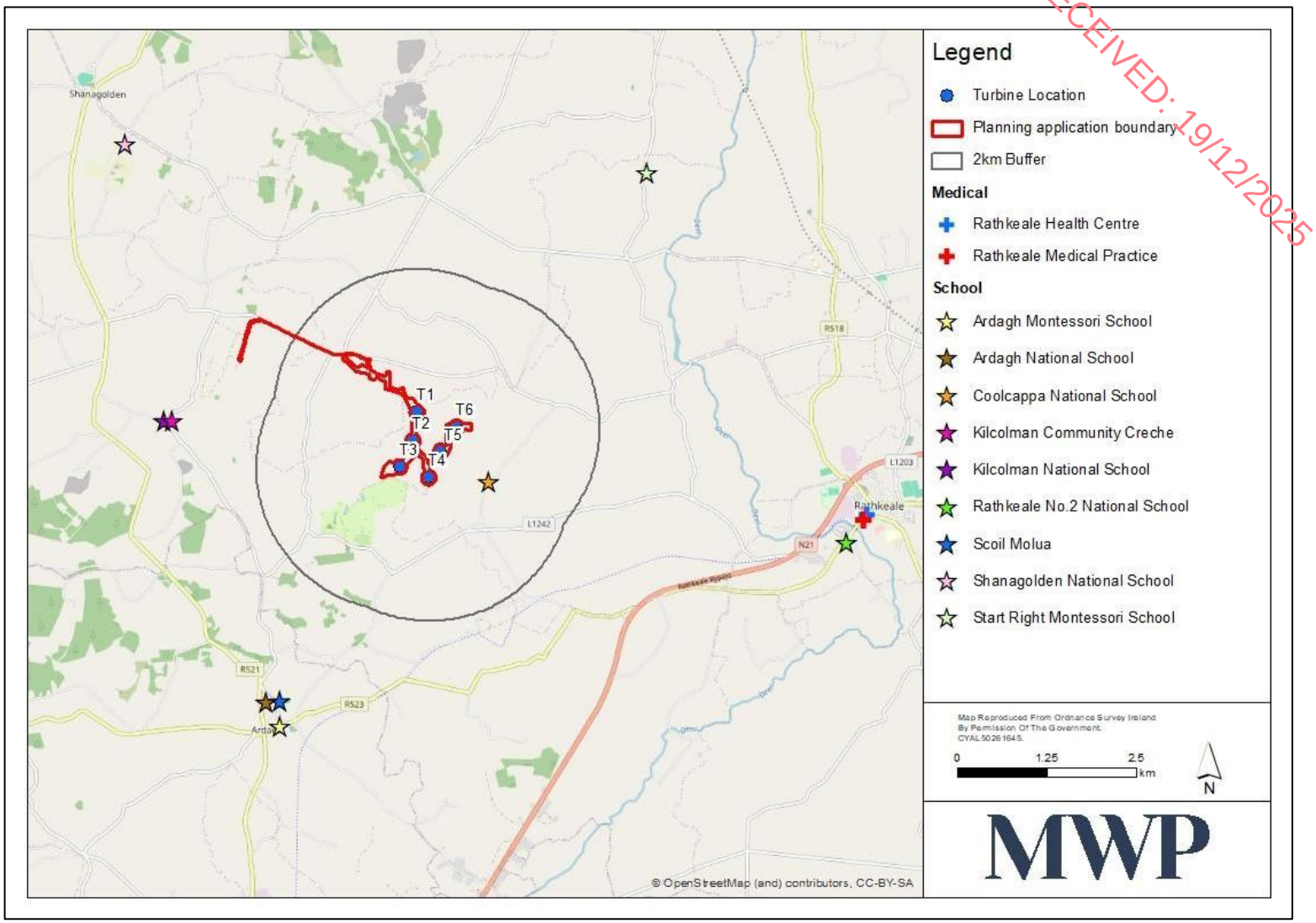

Figure 5-7: Sensitive Receptors (Schools and Medical Services) in the Vicinity of the Proposed Development

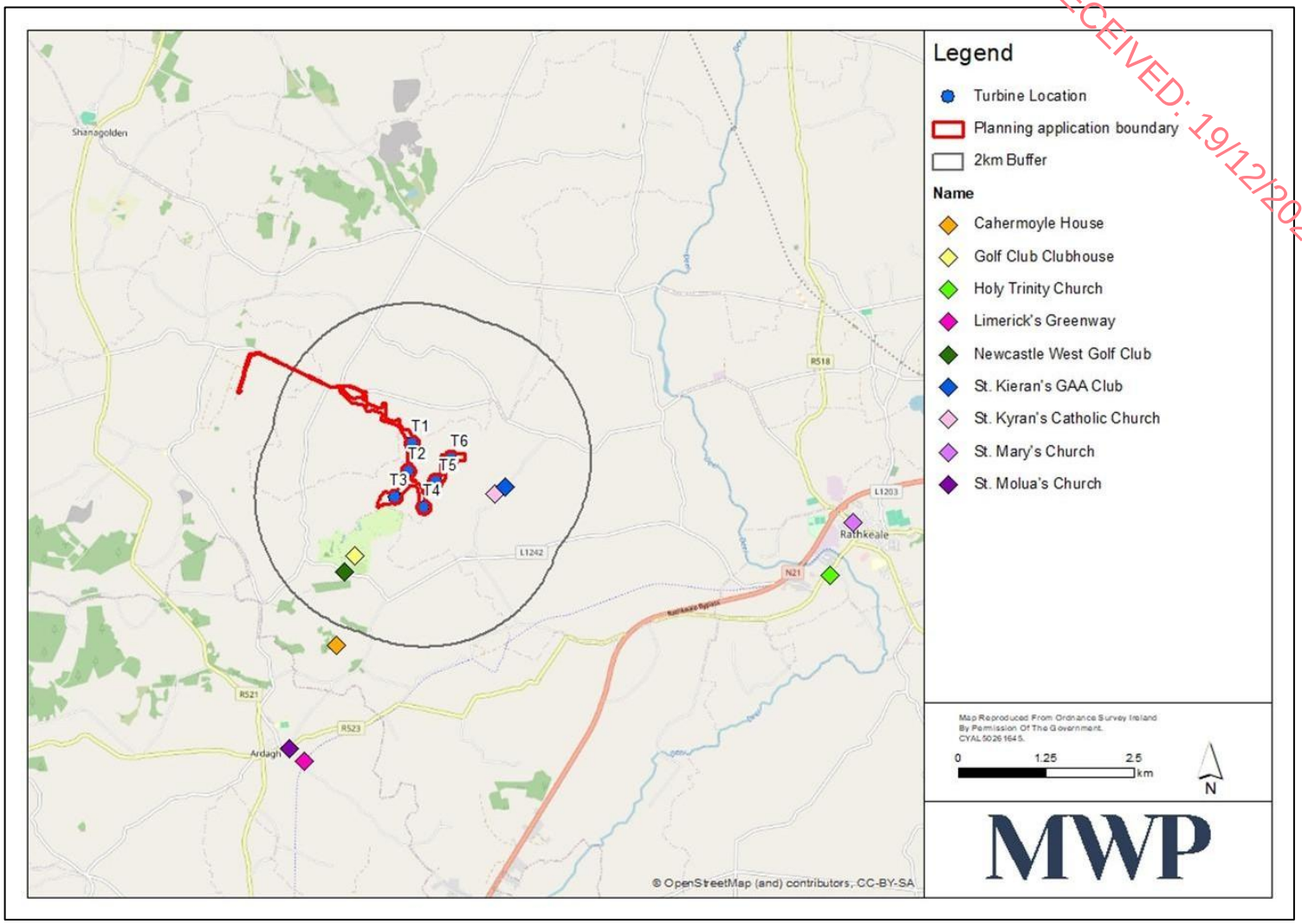

Figure 5-8: Sensitive Receptors (Churches and Leisure Services) in the Vicinity of the Site

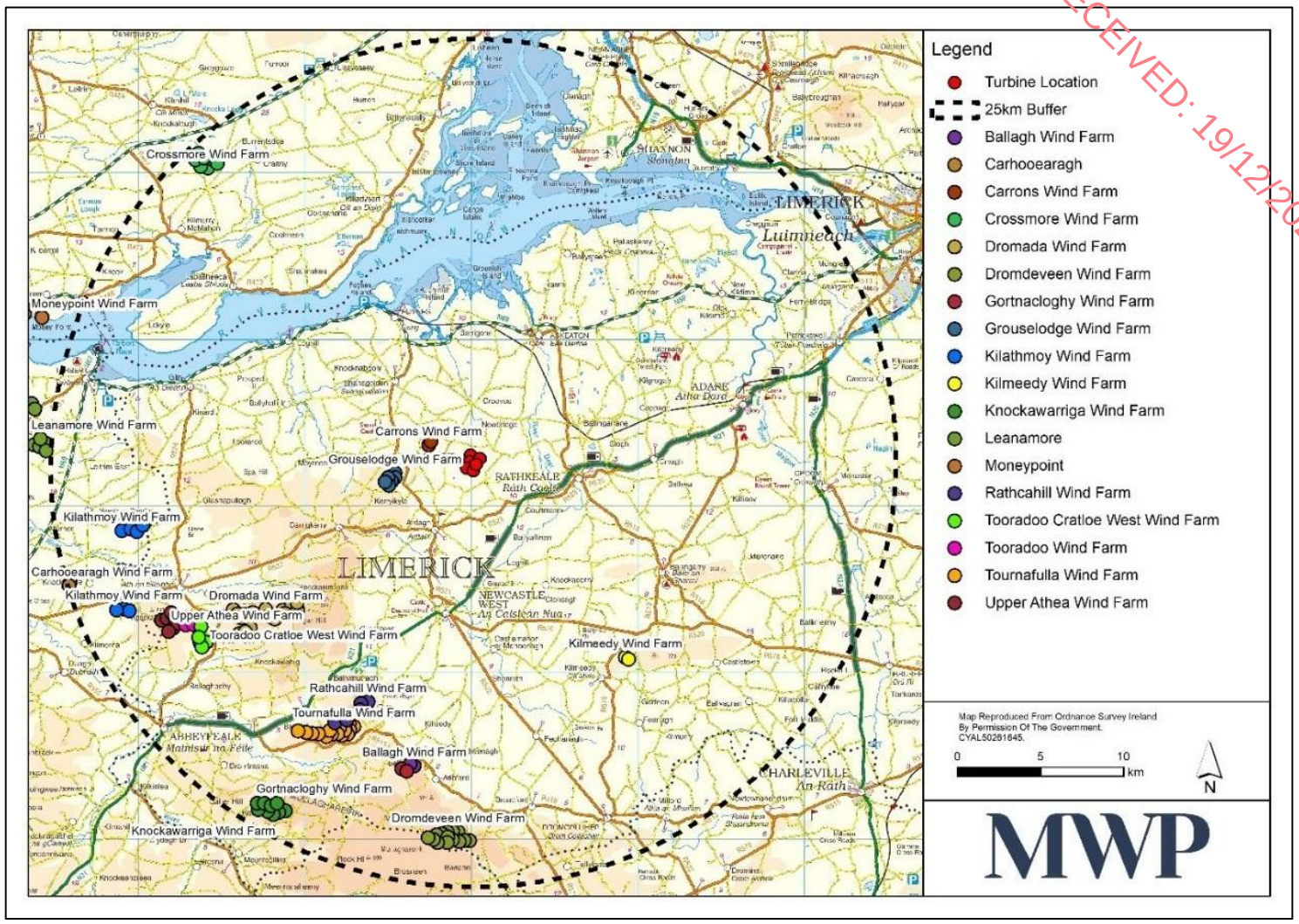

Figure 5-9: Neighbouring Wind Farms

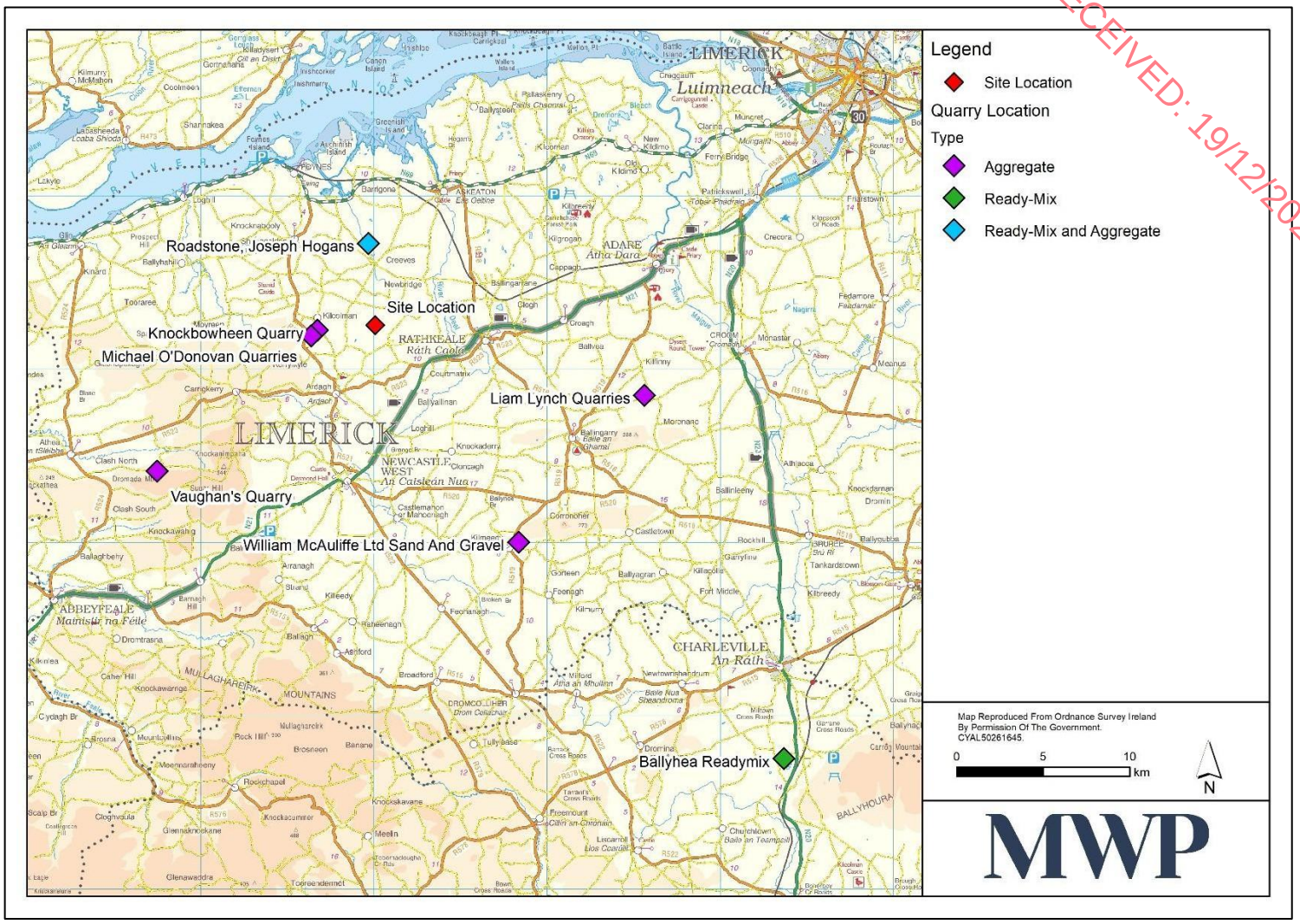

Figure 5-10: Quarry Locations

5.3.6 Shadow Flicker

The Study Area for the purpose of this assessment on Shadow Flicker primarily focuses on the local receiving human environment and residential properties in the vicinity of the proposed wind farm development site (Figure 5-6 and 5-11).

In line with best practice, the scope of this assessment extends to a distance of 10 times the maximum rotor diameter (1.36km). There are 93 No. properties within the 10 x rotor diameter study area. These locations are shown in Figure 5-11 to 5-15.

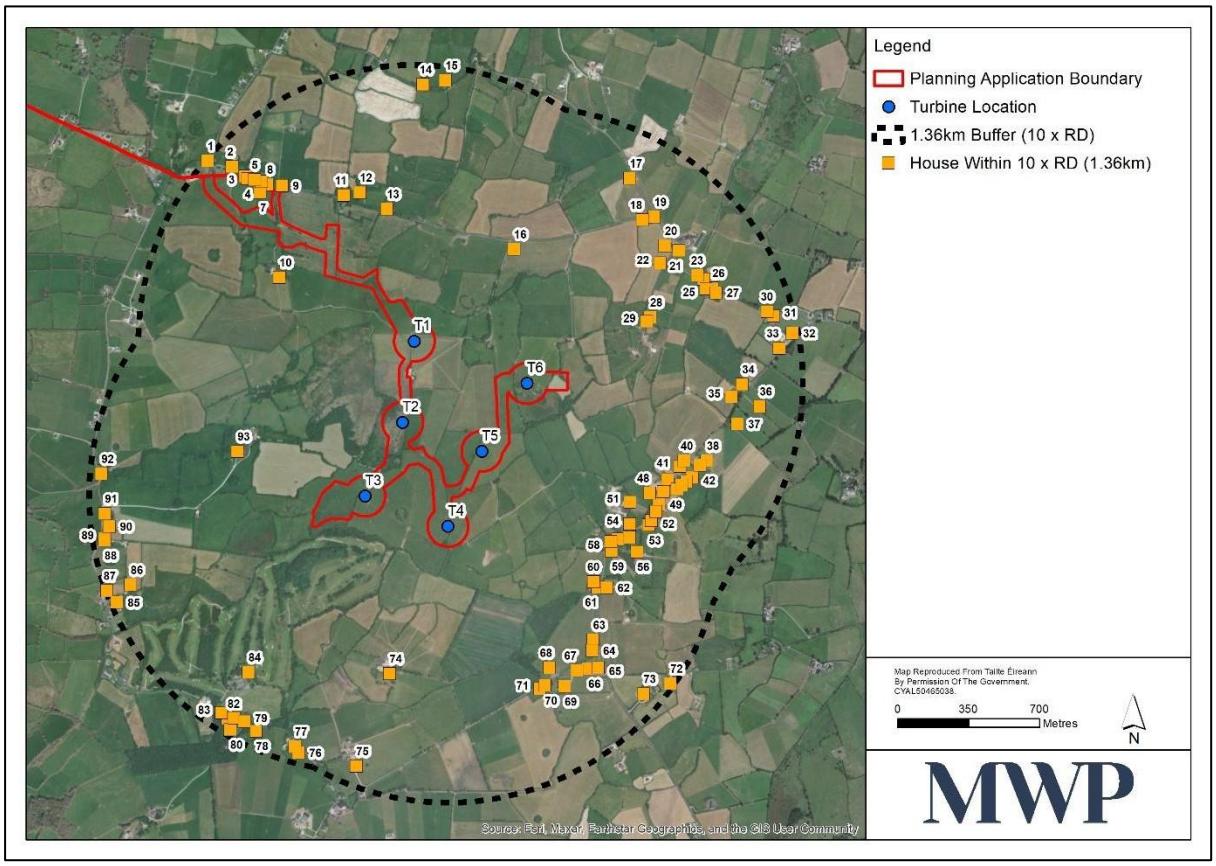

Figure 5-11: Wind Turbines & Residential Properties within 1.36km (10 Rotor Diameters)

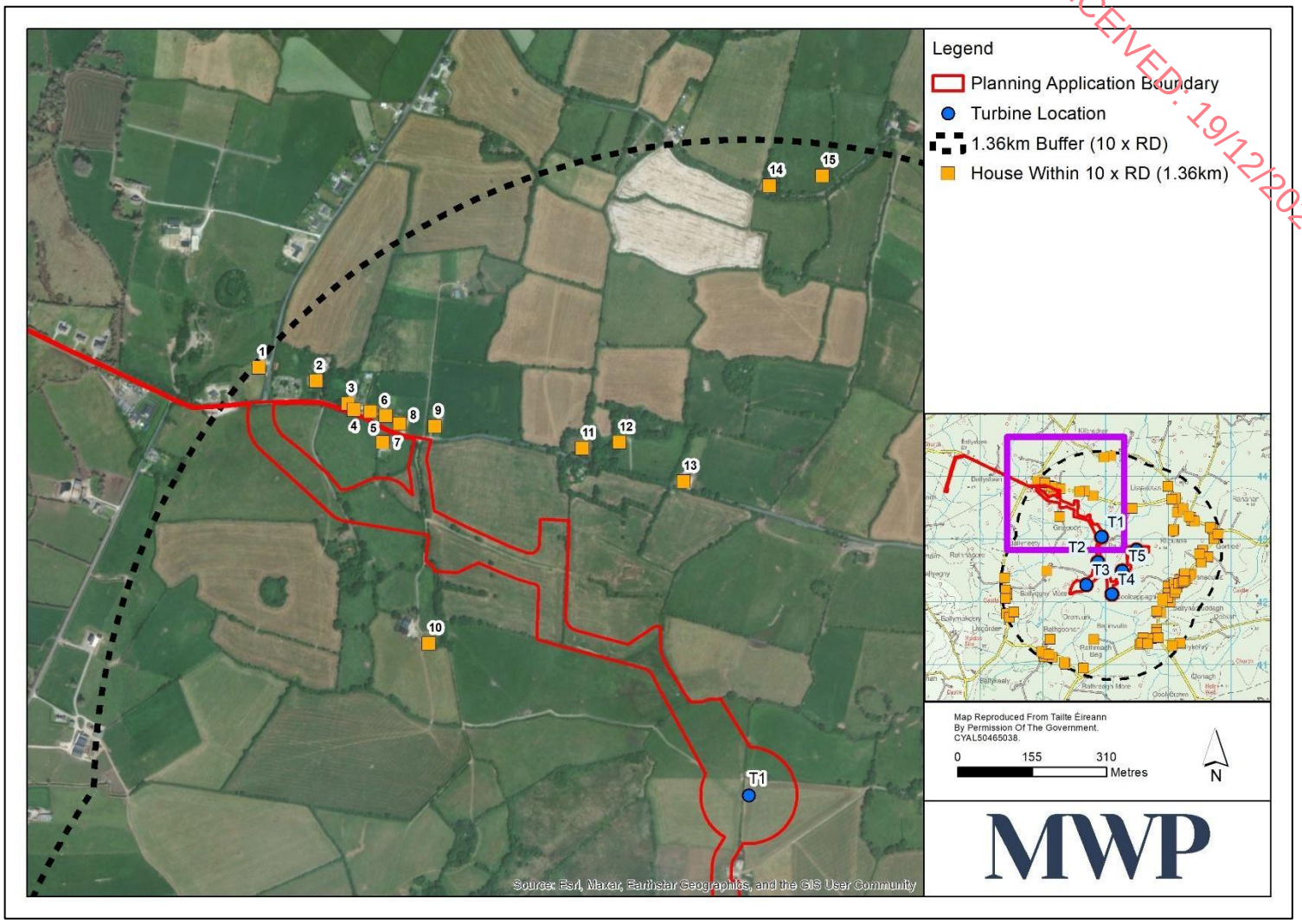

Figure 5-12: Wind Turbine and Property Locations to the North West

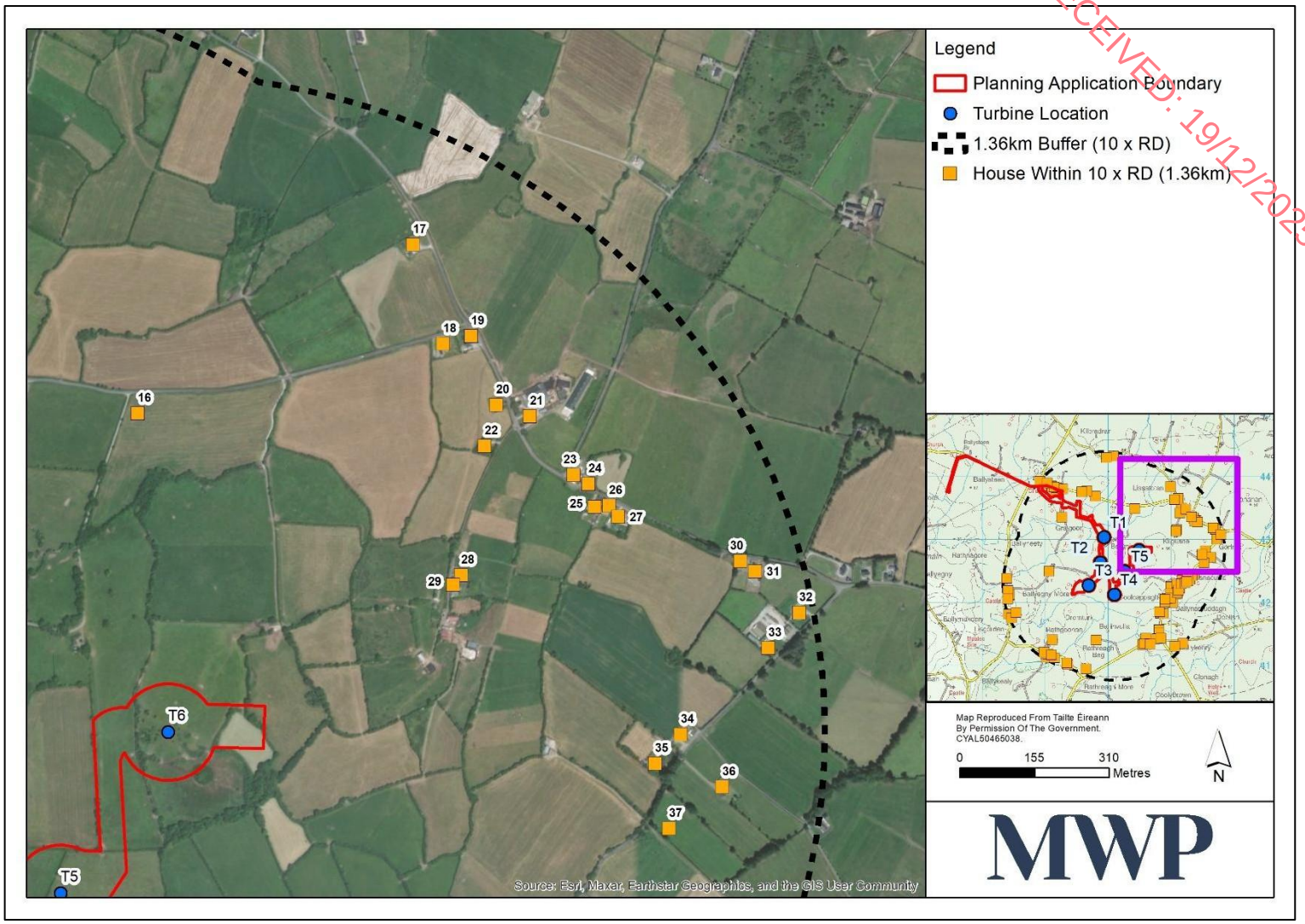

Figure 5-13: Wind Turbine and Property Locations to the North East

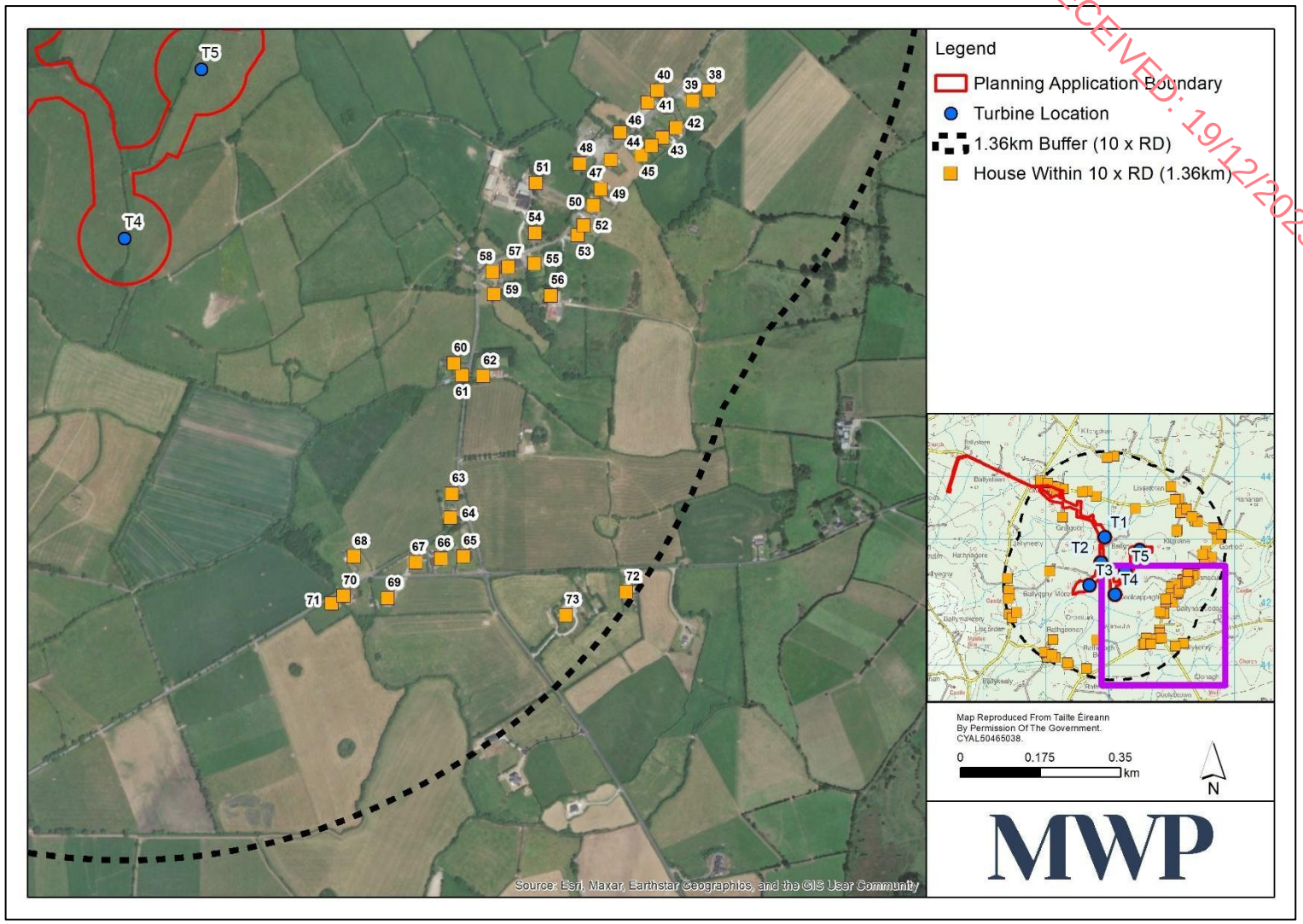

Figure 5-14: Wind Turbine and Property Locations to the South East

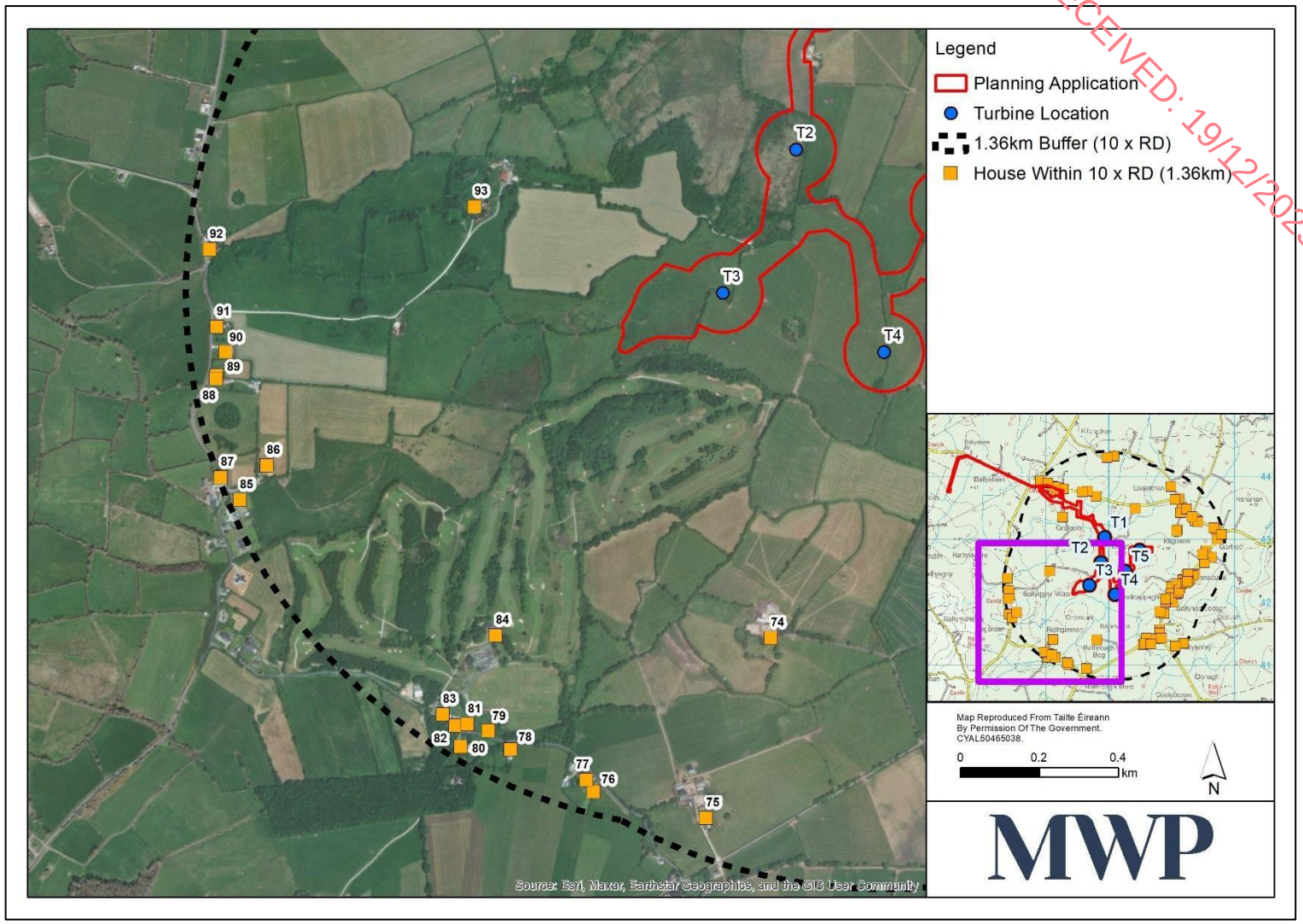

Figure 5-15: Wind Turbine and Property Locations to the South West

5.3.7 Population Trends

Population statistics acquired from the 2011, 2016 and 2022 Census of Population are provided in Table 5-6. Overall, in Co. Limerick, population figures increased slightly between the 2011 and 2016 Census (an increase of 1.6% over 5 years). There was a much larger increase between the 2016 Census and the 2022 results (8% over 6 years). The total population in 2022 was 209,536, up from 194,899 in 2016Approximately 48% of the population is located within Limerick City and suburbs followed by 3.5% of the population located within the second largest town (Newcastle West).

Newcastle West is the largest settlement in proximity to the proposed development. According to figures from the CSO 2022, the total population is 7,209. Newcastle West is described in the Limerick Development Plan (2022-2028) settlement hierarchy as: 'Level 2 Town – Key Town'. Similarly, Newcastle West has been identified as a Key Town in the Southern Region (Southern RSES) and forms part of the Atlantic Economic Corridor. The Council acknowledge the importance of this designation. A Key Town is a settlement with a strong employment base and a broad range of services that serves a wide catchment area.

Newcastle West presents opportunities for future economic development and employment growth. It will play a critical role in ensuring a consolidated spread of growth beyond Limerick City and Suburbs (in Limerick) to the sub-regional level. In this regard, the Core Strategy expects a 30% growth from a population of 6,619 in 2016 to 8,607 in 2028. The RSES also identifies its location as an opportunity for future economic development and employment growth and highlights its strong subregional interdependencies with Listowel, Rathkeale and Abbeyfeale. The role of the key town of Newcastle West is to strengthen the settlement pattern and act as the main driver of economic development and provider of services within this area of Limerick. It will support the development of the Limerick Shannon Metropolitan Area (SMA) and act as a base for high quality transport links to the core in accordance with the RSES. Newcastle West will therefore play a critical role in the development of Limerick and ensure a consolidated spread of growth beyond the cities to the sub-regional level.

Population statistics were acquired from the 2011, 2016 and 2022 Census of Population for Small geographical Areas, defined as areas of population generally comprising between 80 and 120 dwellings (Table 5-6). The proposed wind farm is located within Small Area 127126001 and 127064001, as shown in Figure 5-4. Small Area 127126001 experienced an increase (2.5%) while Small Area 127064001 experienced a substantial increase in population (22.1%) between 2016 and 2022. The ED data shows a significant change from population decline before 2016 to strong growth since 2016, with significant increases following the 2022 census. The growth rate is also generally higher than (and in some cases double) the county and national growth rates but consistent with the growth rates in the local towns of Newcastle and Rathkeale. The high rates of growth are unlikely to be natural population growth. People are moving into this area from elsewhere.

Table 5-6: Population Change from 2011, 2016 and 2022 (CSO)

Location	2011	2016	% change (2011 to 2016)	2022	% change (2016 to 2022)
Republic of Ireland	4,574,900	4,739,600	3.5%	5,149,139	8.0%
Co. Limerick	191,809	194,899	1.6%	209,536	7%
Newcastle West (rural and urban)	6,327	6,619	4.4%	8,093	18.2%
Rathkeale (rural and urban)	1,550	1,441	-7.6%	1,723	16.4%
Lismakeery ED	428	433	1.2%	479	9.6%
Riddlestown ED	593	584	-1.5%	601	2.8%

Location	2011	2016	% change (2011 to 2016)	2022	% change (2016 to 2022)
Kilscannell ED	534	511	-4.5%	612	16.5%
Dunmoylan East ED	467	438	-6.6%	523	16.3%
Small Area 127126001	335	347	3.5%	365	2.5%
Small Area 127064001	225	205	-9.8%	263	22.1%

5.3.8 Economic Activity and Employment

The current Limerick DP states '*The success of economic growth in Limerick is intertwined with maintaining and enhancing its attractiveness as a high-quality place to live, work and visit. It is this wider package, which includes everything from high quality public transport, availability of housing, education infrastructure, quality place-making and heritage, culture, recreational and community facilities, which will ultimately attract business. In spatial terms, the Limerick employment strategy aims to provide for the expansion of employment through the designation of a range of highly accessible employment locations. The Employment Strategy seeks to align strategic employment locations with public transport corridors, increasing the efficiency of land-use, reducing sprawl and minimising carbon footprints and seeks to retain and enhance the important role of employment in the Limerick Shannon Metropolitan Area (in Limerick) and the County's Town Centres. From a sectoral perspective the Plan aims to support and facilitate the economic development of Limerick across a broad range of sectors, while acknowledging in particular the importance of the knowledge economy. The focus on employment creation is based on consolidating the strong job generation capacity of professional services, ICT, advanced manufacturing, life sciences and logistics technology and knowledge-based industries. In addition, the Plan provides for a wide range of employment needs to ensure that people with a diverse range of skill levels can both find and help grow employment opportunities. Furthermore, the Council will seek to work in conjunction with state agencies and the government to support and facilitate education, upskilling and job creation programmes.*

As previously stated, Newcastle West is classified as a Tier 2 Key Service Town. It is anticipated that during the lifetime of the Plan, the Key Service Towns will reinforce their role as key centres within the settlement hierarchy through the provision of employment opportunities, business, industry, education, tourism and infrastructure. Newcastle West is considered to be a key economic regional node by the Midwest Area Strategic Plan (MWASP) – Planning and Transportation Strategy 2012 – 2030.

Newcastle West town is a professional and business service centre for its community and the greater West Limerick area and North Kerry. The largest sectors of employment in the town are commerce and trade, and professional services followed by manufacturing. The key sectors for the town are healthcare, food and beverages and machinery (Newcastle West LAP 2014-2020). The public sector is also a considerable contributor to employment and the economy of the town including the HSE, the Revenue Commissioners, the Department of Social and Family affairs, Teagasc, Department of Education and Science through the number of schools in the town, and Limerick County Council.

5.3.8.1 Employment Statistics

The labour force consists of those who are able to work, i.e., those who are aged 15+, out of full-time education and not performing duties that prevent them from working. According to the 2022 Census Small Area Population Statistics, the workforce in the region is employed in a diverse range of industries/sectors (Table 5-7). The statistics show that the majority of the local population in the project area are employed in professional services, commerce and trade and manufacturing industries. Of the 162 persons going to work in Small Area 127126001, 125 travel by car or van indicating that the majority of residents travel to urban centres for work. Of the 125

persons going to work in Small Area 127064001, 96 travel by car or van indicating that the majority of residents travel to urban centres for work.

Table 5-7: Persons at Work by Industry

Industry	CSO Area Code		Total No. of Persons	%
	Small Area 127126001	Small Area 127064001		
Agriculture, forestry, fishing	21	11	32	11%
Building and construction	12	6	18	6%
Manufacturing industries	17	27	44	15%
Commerce and trade	32	24	56	20%
Transport and communications	16	9	25	9%
Public administration	9	4	13	5%
Professional Services	44	27	71	25%
Other	11	17	28	10%
TOTAL	162	125	287	100%

The lands surrounding the proposed development are mostly agricultural and from site visits to the area, it is evident that agricultural activities are dominant in the wider region. The visual dominance of the agriculture industries are indicated by land use practices (Refer to Section 5.3.9 and Figure 5-16).

5.3.9 Land Uses

The proposed development lands are comprised of agricultural lands in a rural setting. The surrounding land use is a mixture of pastures and land principally occupied by agriculture. Site visits also indicate low density residential dwellings on the surrounding road network. According to the CORINE Land-use classification system (Figure 5-16), the following land uses apply to the wider area of the proposed development site:

- 142 - Sport and Leisure Facility;
- 211 - Non-irrigated arable Land; and
- 231 – Pastures.

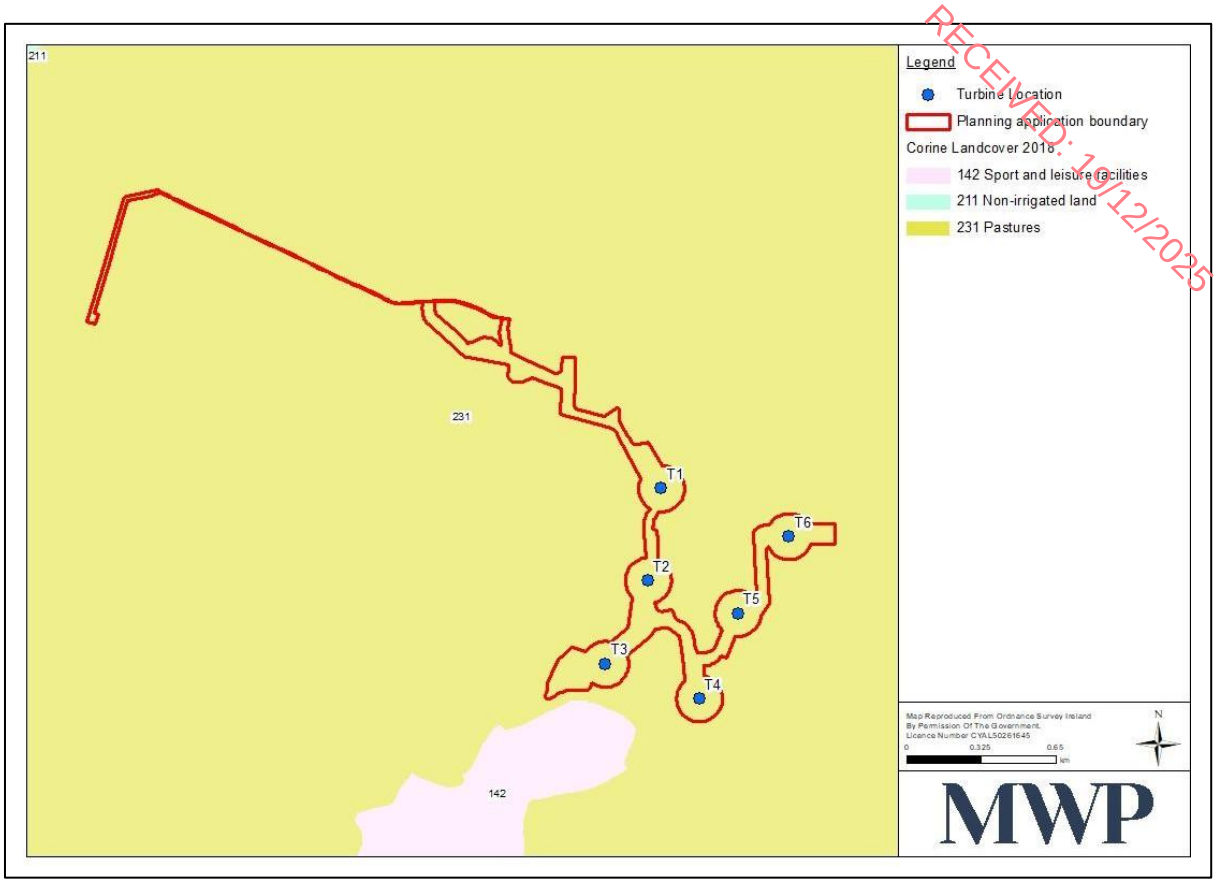

Figure 5-16: CORINE Land Cover

An examination of the 2020 Agricultural Census data for the study area by electoral division indicates that agriculture in the area, where the proposed development will be located, is largely livestock farming with the average size of holdings being circa 50ha (Table 5-8). The standard median value of agricultural output for Limerick County in 2020 was between €15,000 and €20,000 per annum/Ha (Figure 5-17). This is a moderate to low level of output compared to other counties in Ireland. There is no crop cultivation or forestry activities taking place in this area.

Table 5-8: 2020 Agricultural Census Data per Electoral Division (CSO)

Agricultural Census 2020	Electoral Division			
	Lismakeery	Riddlestown	Kilscannell	Dunmoylan East
Number of Holdings	37	44	43	47
Average size of holdings (Ha)	48	60	45	38
Livestock Units (LSU)	2,734	5,404	3,567	3,227
Area Farmed (Ha)	1,758.00	2,632.50	1,915.70	1,799.90

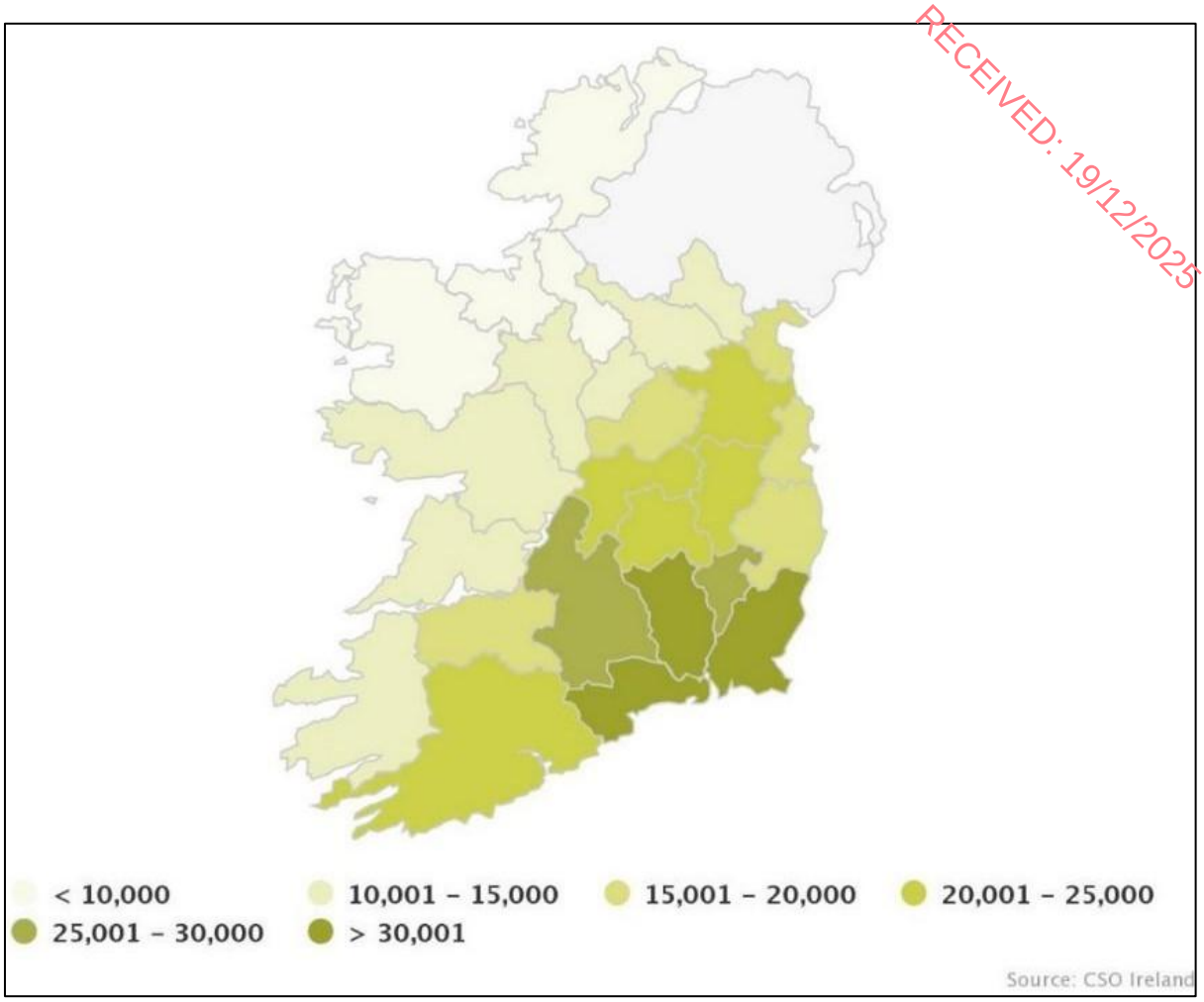

Figure 5-17: Standard Median Agricultural Output per County in 2020 (CSO Agricultural Census)

5.3.10 Tourism and Amenity Resources

Tourism is one of the major contributors to the national economy and is a significant source of full time and seasonal employment. Fáilte Ireland released tourism figures for the Wild Atlantic Way Region for 2023.

There were 2.2 million overseas and 5.8 million domestic tourists to the area generating a combined revenue of €3.6 billion ('Key Tourism Facts 2023', Fáilte Ireland).

The closest attraction to the development site is Desmond Hall (located in Newcastle West) which is located approximately 9.5km from the proposed development.

Amenities located within close proximity to the proposed development include the Newcastle West Golf course and the Limerick Greenway. Newcastle West Golf Course Club House is located approximately 1km south of Turbine 3. The Limerick Greenway is located 2.3km south of the proposed development site at its closest point (Figure 5-18). It is a unique 96km stretch of countryside spanning west Limerick and north Kerry. It is used for walking and cycling and passes through Rathkeale, Ardagh, Newcastle West and Abbeyfeale. Due to the rural nature of the proposed development site, there are limited hotels or B&Bs in the surrounding area.

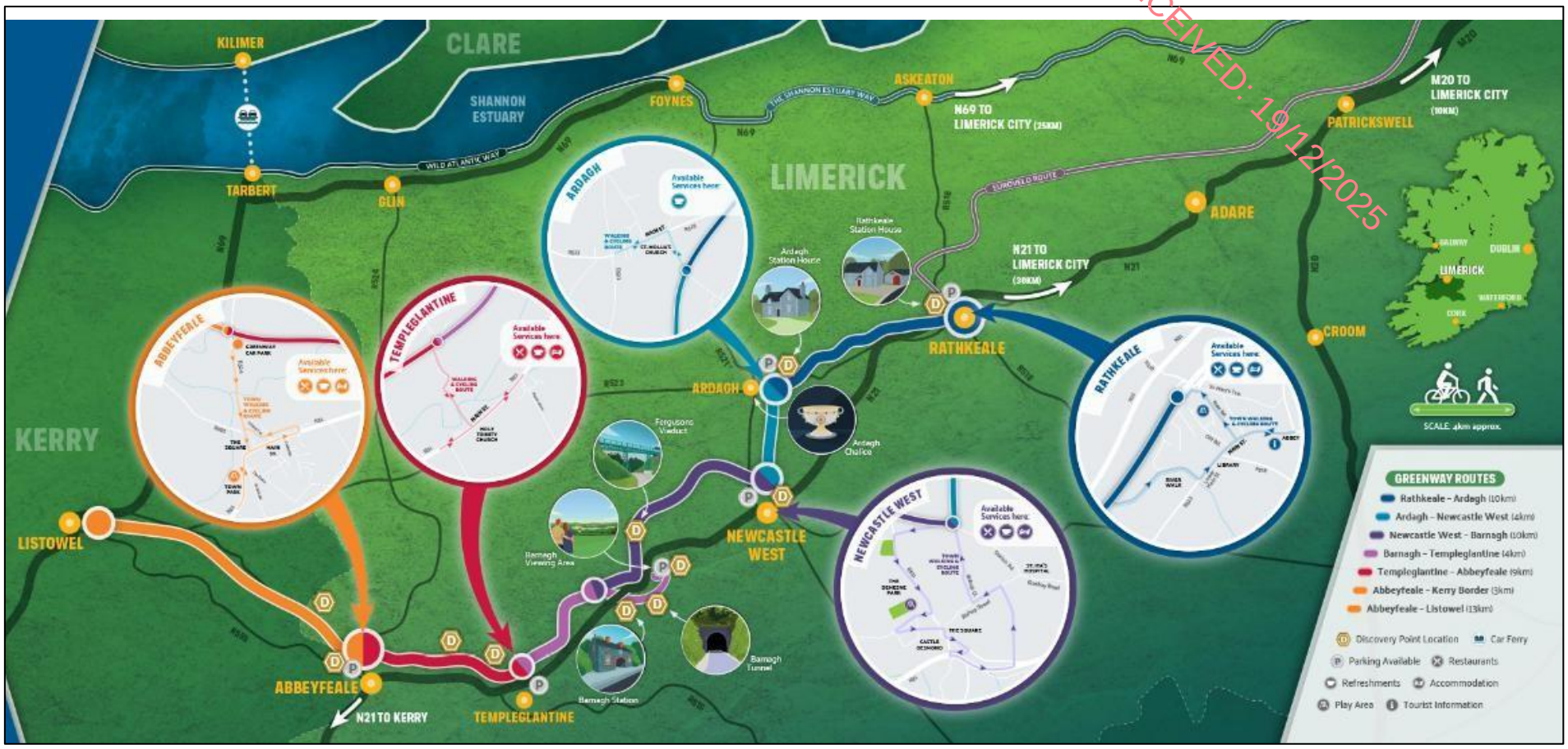

Figure 5-18: Limerick Greenway Location

5.4 Assessment of Effects

This section discusses the likely effects and key issues of the proposed development in relation to the human environment. The impact assessment is qualitative in that the assessment focuses upon whether the impacts on human beings would be positive or adverse.

5.4.1 Construction Phase

5.4.1.1 Population and Settlement Patterns

As it is expected that construction personnel will be locally sourced, it is unlikely that there will be a significant effect on the overall population figures during the construction phase. However, a minor number of key employees involved in the construction, may decide to re-locate in the short-medium term or rent accommodation.

There are no houses adjacent to any of the proposed turbines. There is a dwelling located approximately 215m from the proposed substation location and the proposed grid connection route (Option A) runs along the existing rural road. This serves as an access road for the 21 dwellings adjacent to it. These households may be temporarily affected by the potential disturbance related to traffic accommodation measures and construction noise. Refer to Chapter 11 Noise and Chapter 14 Material Assets of the EIAR for further construction noise and traffic related details.

The proposed grid route (Option A) is approximately 2.54km long with an expected 100m of works to be completed each day over a period of approximately 3 months. In contrast, grid route Option B is shorter in length and follows a more accessible alignment with no interaction with the public road network. This is expected to simplify logistics, minimise traffic management requirements, and allow for a more efficient construction process, thereby significantly reducing the overall construction timeframe.

To minimise the disruptive effect on neighbouring households, the proposed development will ensure haulage traffic shares the same route with local residents, tourists, and other road users. Advance warning will be given to the local residents and other users (i.e. cyclists) for specific times when large volumes of HGV traffic may occur. A well planned and executed delivery programme avoiding peak traffic on typical days will be ensured. These traffic management measures will be developed in consultation with Limerick City and County Council. Local affected residents will also be kept informed and consulted during the construction works. Consequently, the turbines, substation and grid connection are unlikely to have a long-term effect on the population or settlement patterns in the locality.

In the absence of any substantive, peer reviewed Irish studies on the effect of wind farms on property values, recent studies from the United States and Scotland are considered. The largest study of the impact of wind farms on property values was carried out in the United States. '*The Impact of Wind Power Projects on Residential Property Values in the United States: A multiSite Hedonic Analysis*', December 2009, was carried out by the Lawrence Berkley National Laboratory (LBNL) for the U.S Department of Energy. It concluded that "no evidence was found that home prices surrounding wind facilities are consistently, measurably, and significantly affected by either the view of wind facilities or the distance of the home to those facilities".

The study was updated by Lawrence Berkeley National Laboratory (LBNL) who published a further paper entitled "*A Spatial Hedonic Analysis of the Effects of Wind Energy Facilities on Surrounding Property Values in the United States*", in August 2013. It concluded that no statistical evidence was found that "home prices near wind turbines were affected in either the post-construction or post announcement/pre-construction periods".

A more recent study published by Climate exchange in October 2016 titled '*Impact of Wind Turbines on House Prices in Scotland*' concluded that there was "no evidence of a consistent negative effect on house prices".

Taking these studies into consideration, it is not anticipated that the proposed development will have any detrimental effect on the local property values.

The proposed development is likely to have a neutral, localised, short-term effect with imperceptible significance on population numbers and settlement patterns during the construction phase.

5.4.1.2 Economic Activity and Employment

In the construction phase, it is envisaged that resources and labour will be sourced in the region where possible. Aggregates and concrete supply for access track construction and foundations will be obtained from local quarries and suppliers, thus fuelling the local economy. It is the intention of the developer to require the main contractor to use local sub-contractors, drivers, suppliers and materials wherever possible.

The construction phase is expected to take 12-16 months and will employ approximately 30-35 personnel, which will have a positive effect on employment. Additional services required in engineering, consultancy, site investigation, surveying, and environmental assessment and monitoring will provide further short-term employment opportunities.

As a result, the construction phase will have a slight positive short-term effect, at the localised and regional extent on economic activity and employment during the construction phase.

5.4.1.3 Social and Land Use Considerations

It is not anticipated that there will be any significant impacts on land-use in the surrounding area, outside the confines of the proposed development boundary. As far as possible, agricultural and grazing activities will continue in the vicinity of the proposed turbines. The land area required has been kept to a minimum to allow only for installation of wind farm infrastructure, thereby minimising changes in land-use in so far as possible.

Under Option A, the underground grid connection route will comprise a mix of public road and agricultural lands. The majority of the route follows the existing local road, with the final section crossing through agricultural fields, where existing agricultural activities will continue during and after construction. In contrast, Option B is located entirely within agricultural lands and does not require any works along the public road. During construction there will there be no severance, loss of rights of way or amenities, to alter use of the surroundings. In consultation with the local authority, upgrading works on the local road (L1219) may be required to render it more suitable for through traffic. There is however likely to be some temporary disruption along the local public roadways. This is discussed in detail in Chapter 14 Material Assets of the EIAR.

The construction of the proposed development is likely to result in a short-term, neutral effect on land use during the construction phase.

5.4.1.4 Health and Safety

Development works not only can pose safety risks but can give rise to potential impacts on general amenity affecting health and well-being. General amenity is to do with the pleasant, amenable qualities of a place as it is used and perceived by the people who reside, frequent or view it. There are a number of general elements that contribute to or detract from the amenity of an area. Disturbances associated with construction activities such as noise, dust, and traffic are potential factors for devaluation of amenity.

Without the implementation of appropriate mitigation measures the proposed development is likely to result in an adverse, short-term, slight to insignificant localised effect on community health and safety and moderate adverse effect on employee health and safety during the construction phase (short-term). The application of the

proposed health and safety mitigation measures discussed below will reduce the effect/risk to not significant in the case of community health and slight in the case of employees. Mitigation measures to be implemented as detailed in Section 5.5.1.

5.4.1.5 Tourism and Amenity

Given that there are currently no tourism attractions specifically pertaining to the site, there are no impacts associated with the construction phase of the development. With regard to amenity use around the site, some traffic management safety measures may be in place. These measures will be short-term in duration and result in a slight, adverse effect on motorists using the local road network. See traffic impacts discussed above and Chapter 14 Material Assets of the EIAR for proposed mitigation measures.

5.4.1.6 Climate Change

Short term construction traffic-related air emissions have the potential to result in increases in carbon emissions and air pollutants, contribute to climate change, and negatively effect on policy efforts to reduce emissions. More indirect effects on climate change will be related to the emissions associated with the production and supply of materials (e.g. concrete and steel) for the proposed development which will operate on a much broader regional and international spatial scale.

The construction of the proposed development will increase the dust in the air in the locality over some of the construction period (12-16 months). The mitigation measures addressed in the Material Assets and Air and Climate chapters of this EIAR will be implemented.

The proposed development is likely to result in a moderate, adverse, short-term, and localised effect on emissions during the construction phase (short-term) which may contribute to longer-term climate effects. It is however accepted that the proposed development will contribute positively over its lifetime with a CO_2 payback of 0.8 years (Chapter 10 Air and Climate of the EIAR).

5.4.1.7 Shadow Flicker

As the turbines will not be commissioned until the end of the construction phase, no construction phase shadow flicker impacts will occur. The impacts of shadow flicker are only applicable during the operational phase.

5.4.2 Operational Phase

5.4.2.1 Population and Settlement

During the operational phase of the wind farm, it is envisaged that any operators and maintenance personnel will be sourced locally. There will be no in-migration associated with the development. Throughout operation, it is expected that the development will have a neutral, localised, long-term effect with an imperceptible effect on population and settlement patterns.

5.4.2.2 Economic Activity and Employment

During the operational phase, the proposed development is likely to have minimal effect on employment. There is also no known direct or indirect development likely to result from the proposed development. The effect during the operational phase will therefore be imperceptible, neutral, long term and localised on employment.

The proposed development will generate a Community Benefit Fund estimated at approximately €150,000 per annum for the local area. In accordance with the guidelines set out by the Sustainable Energy Authority of Ireland (SEAI), the fund will be administered by a locally formed group/committee, with funds to be allocated to those living in proximity to the proposed development, initiatives and projects that support sustainable development

within the local area and local clubs and societies. This in turn will result in positive, moderate, long term economic benefits to the local area.

5.4.2.3 Social and Land Use Considerations

New development proposals have the potential to effect the local human environment by introducing a new incompatible land use activity, conflicting land use policy for the area, or result in significant land-use impact. It is considered that the proposed wind farm development would not constitute significant adverse impacts in terms of social and land-use considerations for the following reasons:

- There will there be no severance, loss of rights of way or amenities as a result of the proposed wind farm;
- Agricultural activities will be able to continue on the lands immediately adjacent to the main wind farm infrastructure (i.e., Turbines and substation);
- In terms of impacts to neighbouring lands and land-uses, it is considered that the proposed wind farm development does not pose a significant risk to either existing or future land-uses. All existing land-use practices can co-exist with the proposed development;
- The proposed development is unlikely to have an effect on population numbers of the area. There will be no loss of residential dwellings and therefore there will be no displacement of the existing population. The windfarm will also have no significant adverse effect on the quality of life of neighbouring residents that may cause residents to move. There is unlikely to be any in-migration associated with the development. Therefore, the proposed development is considered to have a negligible effect on population numbers; and
- Land and property value may be economic or amenity in nature. The potential for the proposed development to devalue land and residential property in its vicinity is essentially dependent upon public perception of the development and perceived associated impacts. Personal disposition regarding visual intrusion is the only likely implication with regard to land value. The wind farm development will not cause any material damage and does not pose any polluting or hazardous threat that would result in the devaluation of neighbouring properties. The development is thus deemed to have a neutral effect on land and property value.

The proposed development will have no long-term effect on the land uses in the proximity of the proposed site. During the operational phase (long-term), the proposed development is therefore likely to have an imperceptible, neutral effect on land use.

5.4.2.4 Health and Safety

Under normal conditions, access to a wind farm site and turbines is very safe for people and animals. It is not anticipated that the workings of the turbines will present any danger to the public. In addition, the wind turbines are on private lands and therefore public access is not available.

Potential electrical risks are associated with turbine transformers, switches and cabling. With adequate fencing and security, it is not envisaged that these will pose any significant risk, as these will fully meet health and safety regulations relating to high voltages.

Blades can potentially fail through damage sustained in severe weather mainly through lightning strike or due to inadequate upkeep and maintenance. This is extremely rare, and the developer undertakes to operate and maintain all plant safely and in good working order on the site. Modern wind turbine design incorporates a fail-safe mechanism that comes into play under extreme weather conditions. This mechanism causes the turbines to automatically shut down in periods of excessively high wind-speeds.

Overall, the proposed development will have a net benefit on human health in the long term by contributing to the production of clean renewable energy. The operational phase of the development can however give rise to potential impacts on general amenity and human well-being. Disturbances such as noise emissions, shadow flicker effects and visual impacts are principal potential factors for devaluation of amenity. These are discussed in the following sections.

Noise

There are two potential sources of noise from wind turbines: mechanical noise from the gearbox or generator and aerodynamic noise from the rotor blades. However, with the advances in the development of commercial wind turbines, mechanical noise has been significantly reduced. In relation to aerodynamic noise, noise predictions were undertaken at identified sensitive receptor locations closest to the turbines and substation. No significant noise effect on the local population is envisaged. The noise assessment undertaken demonstrates that the noise limits can be achieved at all 3rd party local residential dwellings.

Refer to Chapter 11 Noise of the EIAR which concludes that subject to good working practice as outlined in the EIAR, noise associated with the construction phase is not expected to exceed the recommended limit values from BS5228 and Mineral Policy Statement. The associated noise and vibration are not expected to cause any significant effects.

Visual Impacts

An assessment of the visual and landscape effect of the proposed development, including photomontages, has been undertaken and is presented in Chapter 12 Landscape and Visual of this EIAR. A total of twenty four (24) viewpoints were used to determine the visual effect of the proposed wind farm and associated grid connection. From these viewpoints, photomontages were prepared and a written assessment completed.

Given the size of the turbine structures, a visual consequence is unavoidable. The extent of intrusion will vary in degree and significance according to viewing distance, the numbers and parts of turbines visible, the number of viewers and the perception of the person viewing them.

The proposed position of the turbines will be in a relatively flat area. They will be visible from some views very close to the development and will also be visible from certain elevated long-distance viewpoints. Overall, the development is expected to have a moderate visual effect in that the proposed turbines will be apparent and recognisable as new elements within the landscape.

The visual impact assessment also assessed the cumulative effect of the proposed development along with other planned or operating wind turbines in the area. The cumulative effect was not considered significant owing to the limited number of turbines and compact layout.

Refer to Chapter 12 Landscape and Visual of this EIAR for further details.

Community Fund

An important part of modern wind farm developments is the implementation of community benefit schemes and a commitment to community gain. The concept of directing benefits from wind farms to the local community is promoted by the DCCAE through the new RESS scheme, the National Economic and Social Council (NESC) and Wind Energy Ireland (WEI) among others. The proposed development will result in a community fund estimated at €150,000 per annum for the local area, providing a substantial opportunity for development of the local area.

5.4.2.5 Tourism and Amenity

The Department of the Environment, Heritage and Local Government's Wind Energy Development Guidelines for Planning Authorities 2006 state that "*the results of survey work indicate that tourism and wind energy can co-exist happily*". The draft guidelines (2019) also corroborate this statement.

It is not considered that the proposed development will affect any tourism infrastructure in the wider area. The proposed development will therefore have an imperceptible, neutral effect on tourism.

5.4.2.6 Climate Change

The proposed wind farm will facilitate decarbonisation objectives at local and national levels as set out in the 2025 National Climate Action Plan and the 2022 - 2028 Limerick Development Plan which states that Limerick City and County Council will facilitate the development of energy sources which will achieve low carbon outputs. The wind farm will generate 27MW of renewable energy for the national grid. The proposed development will therefore have a long-term, direct, slight, positive and extensive effect on climate change. Further details are contained in Chapter 10 Air and Climate of this EIAR.

5.4.2.7 Shadow Flicker

The results of the shadow flicker model for all houses within 1.36km (10 rotor diameters) of the proposed turbines are presented in Table 5-9.

Table 5-9: Shadow Flicker Results

House Number	Location		Theoretical Worst Case Scenario			Realistic Scenario	
	Easting	Northing	Days per year	Max hours per day	Mean Minutes per day	Total hours/year	27% of Total Hours (portion of day with sunshine)
1	528881	643972	82	0.45	0.33	26.7	7
2	529000	643944	78	0.49	0.41	31.8	9
3	529066	643897	80	0.52	0.41	32.6	9
4	529079	643885	80	0.52	0.41	32.8	9
5	529113	643880	78	0.52	0.43	33.5	9
6	529146	643871	76	0.53	0.45	34	9
7	529139	643817	86	0.56	0.43	37.3	10
8	529174	643856	76	0.53	0.46	35	9
9	529247	643850	70	0.54	0.48	33.8	9
10	529235	643399	148	1	0.68	101.2	27
11	529553	643804	69	0.88	0.61	42	11
12	529630	643816	60	0.62	0.42	25.3	7
13	529764	643736	60	0.88	0.56	33.4	9
14	529942	644349	0	0	0	0	0
15	530052	644369	0	0	0	0	0
16	530391	643537	119	1.01	0.74	88.4	24
17	530961	643887	51	0.45	0.35	17.9	5
18	531024	643681	95	0.51	0.4	37.6	10
19	531082	643697	96	0.5	0.4	38.1	10

House Number	Location		Theoretical Worst Case Scenario			Realistic Scenario	
	Easting	Northing	Days per year	Max hours per day	Mean Minutes per day	Total hours/year	27% of Total Hours (portion of day with sunshine)
20	531134	643554	124	0.6	0.48	59.3	16
21	531100	643469	86	0.59	0.42	35.8	10
22	531203	643531	137	0.68	0.53	72.5	20
23	531295	643409	54	0.58	0.45	24.3	7
24	531325	643391	51	0.56	0.44	22.6	6
25	531338	643343	50	0.57	0.44	21.9	6
26	531367	643346	48	0.55	0.43	20.7	6
27	531387	643323	46	0.55	0.43	19.9	5
28	531061	643201	156	1.04	0.59	92.3	25
29	531045	643182	158	1.04	0.6	94.7	26
30	531640	643230	36	0.46	0.36	13.1	4
31	531670	643209	35	0.45	0.36	12.5	3
32	531762	643124	32	0.43	0.35	11	3
33	531698	643050	35	0.45	0.35	12.3	3
34	531516	642871	75	0.53	0.38	28.4	8
35	531463	642811	78	0.55	0.4	31.4	8
36	531602	642763	40	0.49	0.38	15.1	4
37	531492	642677	81	0.54	0.38	31.1	8
38	531342	642496	144	0.6	0.41	59.5	16
39	531307	642473	160	0.62	0.43	68.5	18
40	531229	642495	185	0.68	0.48	89.6	24
41	531208	642469	180	0.69	0.51	92.3	25
42	531270	642415	172	0.63	0.48	82.4	22
43	531241	642393	167	0.65	0.49	81.8	22
44	531217	642376	162	0.66	0.49	79.4	21
45	531195	642354	153	0.66	0.48	74	20
46	531148	642404	159	0.76	0.54	86.5	23
47	531128	642344	142	0.71	0.48	67.7	18
48	531060	642336	121	0.73	0.46	55.1	15
49	531106	642280	105	0.65	0.44	46.5	13
50	531090	642245	104	0.63	0.47	48.5	13
51	530964	642293	194	0.88	0.52	101	27
52	531068	642201	114	0.64	0.47	53.8	15
53	531055	642179	125	0.64	0.47	58.5	16
54	530962	642184	170	0.91	0.58	98.5	27
55	530960	642118	156	0.86	0.62	96.5	26
56	530997	642047	144	0.69	0.55	79.1	21

House Number	Location		Theoretical Worst Case Scenario			Realistic Scenario	
	Easting	Northing	Days per year	Max hours per day	Mean Minutes per day	Total hours/year	27% of Total Hours (portion of day with sunshine)
57	530903	642110	152	0.9	0.66	99.6	27
58	530869	642098	147	0.92	0.68	99.2	27
59	530872	642051	141	0.86	0.64	90.9	25
60	530785	641899	123	0.74	0.49	60.7	16
61	530803	641873	121	0.72	0.49	59	16
62	530849	641871	119	0.68	0.46	55.1	15
63	530780	641614	79	0.75	0.59	46.3	13
64	530777	641561	70	0.71	0.49	34.6	9
65	530805	641477	0	0	0	0	0
66	530756	641472	0	0	0	0	0
67	530700	641463	33	0.27	0.19	6.2	2
68	530566	641476	0	0	0	0	0
69	530640	641385	0	0	0	0	0
70	530543	641390	0	0	0	0	0
71	530518	641374	0	0	0	0	0
72	531161	641398	61	0.46	0.39	23.6	6
73	531029	641348	23	0.25	0.2	4.5	1
74	529778	641448	0	0	0	0	0
75	529614	640992	0	0	0	0	0
76	529329	641058	0	0	0	0	0
77	529310	641089	0	0	0	0	0
78	529119	641165	0	0	0	0	0
79	529062	641213	0	0	0	0	0
80	528992	641172	0	0	0	0	0
81	529010	641229	0	0	0	0	0
82	528979	641226	0	0	0	0	0
83	528947	641254	0	0	0	0	0
84	529081	641455	56	0.49	0.41	22.8	6
85	528433	641798	45	0.45	0.34	15.3	4
86	528501	641885	44	0.48	0.38	16.6	4
87	528384	641855	40	0.44	0.34	13.7	4
88	528373	642104	36	0.44	0.35	12.5	3
89	528374	642113	35	0.44	0.36	12.4	3
90	528396	642172	37	0.45	0.34	12.8	3
91	528375	642236	35	0.45	0.35	12.2	3
92	528357	642432	34	0.44	0.34	11.5	3
93	529027	642541	229	0.82	0.55	127.1	34

The results in Table 5-9 show the locations within the study area which may experience shadow flicker. Current shadow flicker thresholds may potentially be exceeded at some locations as indicated in Table 5-9. Without mitigation, the max minutes per day may be reached or exceeded at 49 locations. When sunshine hours are accounted for, the shadow flicker, if unmitigated, reduces to well below the 30 hours per year threshold value at all locations except for H93.

The unmitigated results presented in the table above, although corrected, can still be considered a very conservative overestimate. One of the reasons, as outlined earlier, is that the model does not take into account the hours when the wind is blowing in the direction needed to orientate the turbine perpendicular to the house. This will be considerably less than 100% for any dwelling. Furthermore, when this does happen it will not always coincide with a sunny period. An assumption has also been made that there is a clear line of sight between all dwellings and a wind turbine and that there is a window on the potentially affected wall/gable.

The computer model provides very detailed information, down to the exact times of day when shadow flicker is predicted to occur and from which turbine for each receptor. This information will be used to program the shadow flicker modules to assist in eliminating shadow flicker making sure it does not occur at any dwelling.

Mitigation measures in the form of shadow flicker control modules will be installed on relevant turbines to control the occurrence of shadow flicker by standing the turbine down based on times of day and the relative angle of the sun and turbine, thus eliminating the occurrence of shadow flicker at receptor locations as outlined in Table 5-9. Therefore, shadow flicker effects will not occur at any dwelling. The applicant also commits that shadow flicker shall not occur at any community facilities including St Kieran's GAA facilities, Coolcappa Community Hall, St Kyran's Church and Graveyard, Coolcappa National School, Kilbradran Graveyard and Newcastle West Golf Course alone or cumulatively with any other wind farm developments.

5.4.3 Demolition / Decommissioning Phase

Once the operational period is complete, a detailed Decommissioning Plan will be drawn up to ensure the safety of the public and workforce and the use of best available techniques at the time. The Decommissioning Plan will be agreed with the competent authority at that time.

The wind farm has been designed to have an operational life of 35 years and any further proposals for wind farm development at the site after this time will be subject to a new planning permission application. If planning permission is not sought after 35 years, the site will be decommissioned and reinstated with all wind turbines and towers removed. Upon decommissioning, all that will remain will be the access tracks. The substation will likely remain in place as part of the permanent electrical infrastructure.

When the site is to be decommissioned, cranes of similar size to those used for construction will disassemble each turbine. The towers, blades and all components will then be removed. The turbines and monitoring mast will also be removed from site. It is likely that turbine components where possible will be reused as they have a life span well in excess of the wind farm proposal i.e., greater than 35 years. Wind farm components will also be recycled where possible.

Wastes generated during the decommissioning phase will be taken off site and disposed of appropriately by a licensed waste operator.

Underground cables will likely be cut back and left underground as removal may do more harm than leaving them *in situ*.

Hardstand areas will be remediated to match the existing landscape thus requiring revegetation. Access tracks will be left for use by the landowner. The current view is that the disturbance associated with the removal and disposal of the elements (hard core and sediment) would be more deleterious than leaving them in place.

Any structural materials suitable for recycling will be disposed of in an appropriate manner.

Potential effects from the decommissioning phase will be similar to those from the construction phase. However, given that there will be no significant groundworks required for the decommissioning phase, these effects will be of lower significance than the construction phase of the proposed development. The decommissioning phase will have no significant effects once mitigation measures prescribed for traffic, noise and dust effects are implemented as described in their EIAR relevant chapters.

5.4.4 Do-Nothing

In the Do-Nothing Scenario, the existing public roads, tracks and residents will not be affected by any construction activities and adjacent lands will continue to be utilised for agricultural purposes with no changes in the baseline at the proposed site. The opportunities for local employment and additional economical spend from the proposed development will not be realised.

The local, regional and national benefits which accompany the proposed development associated with the replacement of fossil fuels with renewable energy will be lost, resulting in an adverse effect for reaching the carbon emission reduction objectives. An alternative site (onshore or offshore) would be required to help Ireland meet its carbon targets as outlined in the Climate Action Plan 2025.

5.4.5 Cumulative Impacts and Effects

Construction of the proposed development will result in short-term and temporary increased traffic on the local road network, noise emissions from construction vehicles and equipment and air quality impacts from fugitive dust resulting from ground-disturbance activities.

In considering cumulative effects with other planned or approved projects (including existing wind farms), construction effects will have a cumulative effect on the receiving environment, only if other reasonably foreseeable proposals are constructed in close vicinity to the proposed developments construction and at the same time. At the time of writing, one residential dwelling approximately 750m northwest of T1 has been granted planning (LCCC planning ref 23503) and could potentially be constructed at the same time as the proposed development. In addition, planning permission has been granted to Harmony Solar Rathkeale Ltd for the development on a solar farm approximately 3.5km north-east of the proposed development. This permission is valid for a 10-year period. However, due to the intervening distance and the uncertainty around the timing of its construction, the potential for significant cumulative effects with the solar farm is limited. Both projects will also incorporate a comprehensive range of embedded controls and mitigation measures to ensure the cumulative impact of both projects does not give rise to significant adverse impacts.

Cumulative, traffic and air quality effects have the potential to arise locally when construction activities associated with the proposed development take place at the same time as other developments in a specific location. As only one small scale project, a residential dwelling, is proposed in the immediate vicinity of the proposed development, there is limited potential for significant cumulative noise and air quality effects. Any cumulative traffic effects/impacts on the local road networks due to construction works associated with possible developments would be temporary and short-term.

In addition to other developments, local agricultural activities such as silage making and harvesting campaigns may also contribute to temporary increases in traffic and noise on the rural road network, particularly during peak seasonal periods. While such activities are common and typically short in duration, their overlap with construction of the proposed development could marginally increase cumulative impacts. However, due to their temporary

nature, and the generally dispersed pattern of agricultural activity, these effects are not expected to result in significant adverse impacts.

Overall, it is considered unlikely that any cumulative effects with other projects or agricultural activities due to construction works would result in long term significant impacts on Population and Human Health.

Shadow Flicker control measures will ensure no shadow flicker from the Ballynisky Wind Farm will occur. Therefore, no cumulative effect will occur.

5.5 Mitigation and Monitoring Measures

5.5.1 Mitigation Measures

The potential for impacts on the human environment, which may principally arise during the construction phase from traffic, noise and dust and during the operational phase from noise and shadow flicker require discussion.

Specific mitigation measures are outlined in the respective Chapters of this EIAR as follows:

- Mitigation measures related to air quality and climate effects are detailed in Chapter 10 Air and Climate;
- Mitigation measures related to noise effects are detailed in Chapter 11 Noise and Vibration;
- Mitigation measures related to visual effects are detailed in Chapter 12 Landscape and Visual; and
- Mitigation measures related to traffic effects are detailed in Chapter 14 Material Assets.

A Construction Environmental Management Plan (CEMP) has been prepared for the proposed development (Refer to Appendix 3D of Volume III) and will be implemented for the construction phase to minimise effects on the human environment. No additional mitigation measures for population and human health impacts are proposed in this Chapter.

Public Safety

While there is the potential for construction-related hazards, serious risks to human health and safety are not envisaged. During construction, the site will be managed in accordance with the following safety and health regulations and guidelines which will ensure a high standard of safety both for workers on site and the general public:

- Safety, Health & Welfare at Work (Construction) Regulations 2013;
- Safety, Health & Welfare at Work Act 2005;
- Safety, Health & Welfare at Work (General Applications) Regulations 2007 to 2020; and
- Irish Wind Energy Association (IWEA) Best Practice Guidelines 2012.

A Safety and Health Plan covering all aspects of the construction process will be prepared in advance of construction and will comprehensively deal with safety and health related issues.

Traffic and Road Usage

Potential impacts on the surrounding road network will arise principally during the construction phase, with peak traffic occurring during the 12 – 16-month construction programme. Impacts will therefore be temporary in nature. Peak heavy vehicle traffic volumes generated by the delivery of construction materials will be up to 40 heavy vehicles per day, both to and from the site. Other deliveries to site will be curtailed or stopped during

concrete pours. Highest peak hour heavy vehicle traffic volumes will be up to eight heavy vehicles, both to and from the site.

A traffic impact assessment carried out for the proposed development indicates that while the increased traffic volume on the local road network during the construction phase would be substantial, this increase will be well within the carrying capacity of the local road network and will be of short duration. However, the existence of additional traffic, especially heavy goods vehicle traffic, associated with the construction phase has the potential for local residents and users of these roadways to experience minor disturbances and/or be inconvenienced on encountering site related traffic. The traffic impact assessment included in Chapter 14 Material Assets of this EIAR sets out that construction traffic will occur outside the peak morning and evening peak commuter traffic and that any construction phase impacts would be temporary, requiring no road closures. Under grid connection Option A, construction works between the proposed windfarm site and substation, along the L1219, will require a stop/go alternating direction traffic management arrangement. This will result in short period waiting and delays for traffic during the proposed working hours. Grid connection Option B will be constructed within private lands and therefore will not result in additional traffic impacts.

A Construction-phase Traffic Management Plan has been prepared for the proposed development and will be implemented during construction to address traffic issues (Appendix 14A).

Noise

The construction phase has the potential to generate noise emissions which could cause disturbance to local noise sensitive receptors. The construction noise impact assessment included in Chapter 11 Noise and Vibration of this EIAR found that noise generated during the construction phase of this development will be slight and will not exceed the acceptable construction noise limit (70dBA) at any dwelling location, for the duration of the construction phase.

The noise assessment makes recommendations regarding measures of reducing the amount of noise reaching the noise sensitive receptors in accordance with *BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise*. Best practice will be employed at all times to minimise noise emissions from the construction site. These are detailed in the Construction Environmental Management Plan (CEMP) prepared for the proposed development.

Dust

It is generally accepted that the proposed development will make a positive contribution to air quality once operational. Notwithstanding this, there is the potential for short-term adverse impacts in terms of dust emissions during the construction phase of the development.

Vehicle and fugitive dust emissions would occur primarily during construction. Dust generated during the construction phase is not likely to significantly affect the local air quality. Dust levels are not expected to exceed the recommended TA Luft 350mg/m^3/day guideline limit. There is, however, the possibility of dust occurring in the vicinity of the site entrance and along the local public roads which could affect road user health and visibility. This is considered a temporary slight adverse effect and mitigation will be implemented.

With the effective implementation of standard dust management measures to control and reduce dust, no significant adverse impact, in terms of a community disturbance at nearby houses and other buildings near the site, is likely to occur. These are detailed in the Construction Environmental Management Plan (CEMP) prepared for the proposed development.

5.5.2 Monitoring

As with mitigation, monitoring is prescribed in the relevant Chapters of this EIAR where required. No additional monitoring is proposed here for those particular aspects.

5.6 Residual Impacts and Effects

With the outlined mitigation in place, no significant adverse residual effects on the human environment will occur in relation to dust, traffic, noise and shadow flicker as a result of the following:

- With the installation of wind turbines applying the latest technology, with the potential for mitigation if necessary, noise disturbance will be kept to a minimum and within acceptable noise limits;
- With natural meteorological conditions and the presence of screening, together with shadow flicker analysis and with the implementation of mitigation measures if necessary, shadow flicker effects will be kept to a minimum and within the guide limits on the number of exposure hours per year, with no shadow flicker at receptors or community facilities;
- With the implementation of standard traffic management measures, traffic disturbance will be kept to a minimum;
- With the implementation of the Safety and Health Plan during construction including appropriate mitigation measures, risks to human health and safety are not envisaged;
- With the implementation of standard best management construction activities, dust levels will remain within recommended acceptable guideline limits; and
- As shadow flicker will be eliminated at receptors there will be no significant residual impact.

5.7 References

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