EIAR Volume II

Main Report

Chapter 10: Land, Soils and Geology

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10 LAND, SOILS AND GEOLOGY

10.1 Introduction

This chapter of the Environmental Impact Assessment Report (EIAR) for the proposed Tullacondra Green Energy Project (‘the Project’) presents an assessment of the effects of the Project on the land, soils and geology features, receptors or attributes in the receiving environment. The Project refers to all elements as detailed in EIAR **Chapter 5 Project Description**. This chapter also includes an assessment of the likely significant effects from both Grid Connection Route (GCR) Options and both Turbine Delivery Routes (TDR) Options. The assessment considers the potential effects during the following phases of the development:

- Construction of the Project
- Operation of the Project
- Decommissioning of the Project

Where significant effects are likely, this chapter identifies appropriate mitigation measures and describes the residual effects post mitigation. Findings are presented and reported in a clear and logical format that complies with EIAR reporting requirements.

A Construction and Environmental Management Plan (CEMP) is appended to the EIAR **Volume III, Appendix 5.1**. This document will be a key construction contract document, which will ensure that the mitigation measures are implemented. In the event that planning permission is granted for the development, the CEMP will be updated to include any condition(s) which may be attached by the local authority to such a permission, and the measures will be implemented in accordance with the requirements of the condition.

10.1.1 Assessment structure

In line with the EIA Directive (Directive 2014/52/EU), European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018 (S.I. No 296/2018) and current EPA guidelines on the information to be contained in Environmental Impact Assessment Reports (2022), the structure of this chapter is:

- Assessment Methodology and significance criteria.
- Description of baseline conditions at the site.
- Identification and assessment of effects to land, soils and geology associated with the Project, during the construction, operational and decommissioning phases of the Project.
- Mitigation measures to avoid or reduce the effects identified.
- Identification and assessment of residual effects of the Project considering mitigation measures.
- Identification and assessment of cumulative effects if and where applicable.

10.1.2 Project description

The Project is the construction, operation and decommissioning of a wind energy development consisting of nine wind turbines with foundations and crane pad hardstanding areas; a permanent meteorological mast; an on-site 38kV substation, underground cabling connecting the turbines to the on-site substation; and underground grid connection to the boundary of the Mallow 110kV substation; along with all associated site works including site clearance, temporary compounds and storage areas; a new temporary entrance and upgrade of an existing entrance; upgrade of existing site tracks and construction of new site tracks; site drainage; and ancillary developments including security gates and fencing, lighting and signage; and biodiversity mitigations and enhancements.

The site layout plan of the proposed wind farm is shown in **Figure 1.4**, in EIAR **Chapter 1 Introduction**. Further details of the Project, the construction programme and sequencing of works which are used as the basis for assessments in this EIAR are provided in EIAR **Chapter 5 Project Description**.

10.1.3 Statement of authority

The principal members of the RSK EIA team involved in this assessment include the following persons;

- Project Manager & Lead Author: Sven Klinkenbergh – B.Sc. (Environmental Science), P.G.Dip. (Environmental Protection). Sven's current workflow consists primarily of Environmental Impact Assessment (EIA) Hydrology, Hydrogeology, Land, Soils and Geology assessments for a range of projects, a large proportion of which is in renewable energy i.e. wind farms on peatlands. Sven has c. 10 years industry experience in the preparation of environmental, geological, hydrological and hydrogeological reports.
- Technical Advisor Dr. Chris Fennell - B.A (mod) Environmental Science, PhD (Environmental Protection Agency Studentship) "The impact of domestic wastewater treatment system effluent on private water wells: An evaluation of contamination fingerprinting techniques". Role Principal Hydrogeologist Consultant at RSK with over 6 years' experience.
- Project Scientist: Deirdre Walsh – B.A.Mod (Geology), M.Sc. (Geoscience), PhD (Geomodelling). Deirdre has a background in exploration geology (c. 2 years) and geoscience research (c. 8 years). Since joining RSK Ireland, Deirdre has worked on a variety of projects including renewable energy and urban developments, preparing Environmental Impact Assessment Report chapters and Stability Risk Assessments.

10.2 Assessment methodologies and significance criteria

10.2.1 Assessment methodologies

The stepped approach to impact assessment proposed in the Institute of Geologists of Ireland (IGI) guidelines[1] and EPA guidelines[2] is adopted for the evaluation of potential effects on the receiving environment.

The following calculations and assessments were undertaken in order to evaluate the potential significant effects of the Project in respect of soils, geology and ground stability:

- Characterise the topographical, geological and geomorphological regime of the site from the data acquired through desk study and onsite surveys.
- Undertake preliminary materials budget calculations in terms of subsoil excavation and removal associated with Project design.
- Consider ground stability issues as a result of the Project, its design and methodology of construction.
- Assess the combined data acquired and evaluate any likely effects on land, soils, geology and ground stability.
- If effects are identified, consider measures that would mitigate the identified effect.
- Present and report these findings that complies with EIAR reporting requirements.

10.2.2 Relevant legislation and guidance

Relevant legislation and guidance used is included in EIAR **Volume III**, **Appendix 10.4.**

10.2.3 Study area

The study area or zone of influence for soils and geology is typically localised to the red line planning boundary (wind farm and GCR) and its immediate surrounds (minimum 2km as outlined in the IGI guidelines[1]). The study area at the wind farm location extends to 2km with consideration of large-scale geological structures, karstic features and stability assessments. The study area for the GCR and TDR options extends 250m from the centre line of each route as per the National Road Authority (NRA) Guidance (2008)[3].

The interconnection with hydrology, hydrogeology and other environmental factors (e.g., ecology) and their associated study areas are also considered as part of the assessment of potential effects and mitigation measures due to the potential secondary or indirect effects.

[1] IGI (2013) Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Effect Statements

[2] EPA (2022) Guidelines on the Information to be Contained in Environmental Effect Assessment Reports

[3] NRA (2008a) Guidelines on Procedures for the Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes

10.2.4 Source-Pathway-Receptor

When considering the source, pathway, receptor model for potential contamination or pollution effects all three must be present. Land, soils and geology can be a source, pathway and receptor for the potential release of contaminants. For example,

- Direct contamination from construction or operational activities can lead to the contamination of soil (the receptor).
- A potential contaminant can leach or migrate through soil (pathway) into another sensitive receptor such as groundwater.
- Potentially contaminated soil may be the source of contamination for previously uncontaminated soil, or any soil may be the source of contamination entrained in runoff and having effects to water quality.

10.2.5 Desk study

A desk study was undertaken to collate and review background information in advance of the site survey and involved the following:

- Examination of the Geological Survey of Ireland (GSI) datasets pertaining to geological and extractive industry data.
- Examination of Environmental Protection Agency (EPA) soil and subsoils datasets.
- Examination of National Parks and Wildlife Service (NPWS) nature conservation designations.
- Examination of Historic 25 Inch maps (GeoHive MapGenie 25 Inch).
- Preparation of site maps and suitable field sheets for the site survey.

10.2.6 Consultations

A scoping exercise was undertaken for the Project. A full list of consultations and responses can be found in EIAR **Chapter 3 Scoping, Consultations, Community Engagement and Key Issues**. Consultation with various state agencies and other bodies was undertaken to inform preparation of the EIA Report. This included consultations with the Development Applications Unit of the Department of Housing, Local Government, and Heritage, the Geological Survey Ireland and the Department of the Environment, Climate, and Communications.

10.2.7 Field work

Field inspections were carried out during June, September and October 2022. These works consisted of the following:

- Bedrock and mineral subsoil outcrop logging and characterisation.
- Confirmation of the presence of peat at or near any proposed development locations.
- Commissioning of a geophysical survey consisting of 2D-Resistivity at 10 locations within the site boundary.
- Slope measurements at proposed turbine locations to determine slope gradient.

- Identification and digital photography of significant features, including karst features, drainage and significant landforms noted within the site.

Land, soils and geology are unlikely to have changed since the survey work was carried out.

10.2.8 Evaluation of potential effects

The significance of effect is determined by the sensitivity of the receptor, the magnitude of the potential effect and the likelihood of the effect which are addressed in the following sections.

10.2.8.1 Sensitivity of receptor

Sensitivity is defined as the potential for a receptor, feature or attribute to be significantly affected by a proposed development (EPA, 2022).

The geological sensitivity criteria are set out by NRA (Box 4.1, NRA, 2008), see **Table 10.1**.

Table 10.1: Estimation of the Importance of Soil and Geological Attributes

Importance / Sensitivity	Criteria	Typical Example
Very High	Attribute has a high quality, significance or value on a regional or national scale. Degree or extent of soil contamination is significant on a national or regional scale. Volume of peat and / or soft organic soil underlying route is significant on a national or regional scale.	Geological feature rare on a regional or national scale (NHA). Large existing quarry or pit. Proven economically extractable mineral resource.
High	Attribute has a high quality, significance or value on a local scale. Degree or extent of soil contamination is significant on a local scale. Volume of peat and / or soft organic soil underlying site is significant on a local scale.	Contaminated soil on site with previous heavy industrial usage (i.e., fuel farm). Large recent landfill site for mixed wastes. Geologically feature of high value on a local scale (County Geological Site). Well drained and / or high fertility soils. Moderately sized existing quarry or pit. Marginally economic extractable mineral resource.
Medium	Attribute has a medium quality, significance or value on a local scale. Degree or extent of soil contamination is moderate on a local scale. Volume of peat and / or soft organic soil underlying site is moderate on a local scale.	Contaminated soil on site with previous light industrial usage. Small recent landfill site for mixed wastes. Moderately drained and / or moderate fertility soils. Small existing quarry or pit.

Importance / Sensitivity	Criteria	Typical Example
		Sub-economic extractable mineral resource.
Low	Attribute has a low quality, significance or value on a local scale. Degree or extent of soil contamination is minor on a local scale. Volume of peat and / or soft organic soil underlying site is small on a local scale.	Large historical and / or recent site for construction and demolition wastes. Small historical and / or recent site for construction and demolition wastes. Poorly drained and / or low fertility soils. Uneconomically extractable mineral resource.

10.2.8.2 Magnitude of potential effects

The potential effects may have an adverse, negligible or beneficial effect on the land, soils and geology as outlined below in **Table 10.2 (NRA, 2008; Box 5.1)**.

Table 10.2: Qualifying the Magnitude of Effect on Soil and Geological Attributes

Magnitude of Effect	Description	Example
Large Adverse	Results in a loss of attribute.	Loss of high proportion of future quarry or pit reserves. Irreversible loss of high proportion of local high fertility soils. Removal of majority of geological heritage feature (>50%). Requirement to excavate / remediate entire waste site. Requirement to excavate and replace high proportion of peat, organic soils and/or soft mineral soils beneath alignment.
Moderate Adverse	Results in effect on integrity of attribute or loss of part of attribute.	Loss of moderate proportion of future quarry or pit reserves. Removal of part of geological heritage feature (15-50%). Irreversible loss of moderate proportion of local high fertility soils. Requirement to excavate / remediate significant proportion of waste site. Requirement to excavate and replace moderate proportion of peat, organic soils and/or soft mineral soils beneath alignment.
Small Adverse	Results in minor effect on integrity of attribute or loss of small part of attribute.	Loss of small proportion of future quarry or pit reserves. Removal of small part of geological heritage feature (<15%).

Magnitude of Effect	Description	Example
		Irreversible loss of small proportion of local high fertility soils and/or high proportion of local low fertility soils. Requirement to excavate / remediate small proportion of waste site. Requirement to excavate and replace small proportion of peat, organic soils and/or soft mineral soils beneath alignment.
Negligible	Results in an effect on attribute but of insufficient magnitude to affect either use or integrity.	No measurable changes in attributes.
Minor Beneficial	Results in minor improvement of attribute quality.	Minor enhancement of geological heritage feature. Remediation of a small, contaminated site (<1ha)
Moderate Beneficial	Results in moderate improvement of attribute quality.	Moderate enhancement of geological heritage feature. Remediation of a medium, contaminated site (<2.5ha)
Major Beneficial	Results in major improvement of attribute quality.	Major enhancement of geological heritage feature. Remediation of a large, contaminated site (>2.5 ha)

10.2.8.3 The significance of potential effects

The significance of potential effects arising as a result of the Project are defined in accordance with the criteria provided by the EPA (2022). The description of the significance of effects are presented in **Table 10.3.** Only likely or possible potential effects are assessed.

Based on the defined significance, where an effect has been classified as Moderate, Significant, Very Significant or Profound it is considered Significant. An effect is considered Not significant if the significance level is Imperceptible, Not Significant or Slight.

Table 10.3: Describing the Significance of Effects

Significance of Effect	Description
Imperceptible	An effect capable of measurement but without significant consequences.
Not Significant	An effect which causes noticeable changes in the character of the environment but without significant consequences.
Slight Effects	An effect which causes noticeable changes in the character of the environment without affecting its sensitivities.
Moderate Effects	An effect that alters the character of the environment in a manner that is consistent with existing and emerging baseline trends.
Significant Effects	An effect which, by its character, magnitude, duration or intensity, alters a sensitive aspect of the environment.
Very Significant	An effect which, by its character, magnitude, duration or intensity, significantly alters most of a sensitive aspect of the environment.
Profound Effects	An effect which obliterates sensitive characteristics.

Considering the above definitions (**Table 10.3**) and rating structures associated with sensitivity and magnitude of potential effects (**Tables 10.1** and **10.2**), rating of significance of environmental effects is assigned in accordance with relevant guidance as presented in **Table 10.4 (NRA, 2008; EPA, 2022)** below and using professional judgement.

Table 10.4: Rating of significance of effects based on sensitivity and magnitude of effect

Sensitivity (Importance of Attribute)	Magnitude of Effect			
	Negligible (Imperceptible)	**Small Adverse (Slight)**	**Moderate Adverse (Moderate)**	**Large Adverse (Significant to Profound)**
Extremely High	Imperceptible / Not Significant	Significant	Profound	Profound
Very High	Imperceptible / Not Significant	Significant / Moderate	Very Significant / Significant	Profound
High	Imperceptible / Not Significant	Moderate / Slight	Significant / Moderate	Very Significant / Significant
Medium	Imperceptible / Not Significant	Slight	Moderate	Significant
Low	Imperceptible	Imperceptible / Not Significant	Slight	Slight / Moderate

10.2.9 Assumptions and limitations

2D resistivity surveys were undertaken in September 2022 to inform the design of the wind farm. Since the survey was undertaken a few turbines and the substation location have since changed slightly. Therefore, some of the baseline assessment in section 10.3.6 and 10.3.10 was extrapolated to the current locations. Data gaps will be assessed during the detailed design phase. Where routine assumptions have been made in the course of undertaking the assessment, these are noted in the following sections.

10.3 Baseline description

10.3.1 Site description and location

The proposed wind farm is located approximately 2km south of Lisgriffin Cross, Co. Cork. The townlands in which the wind farm site is located include Polnareagha and Ardskeagh (Templemary E.D.); and Tullacondra and Croughta (Kilmaclenine E.D.). The wind farm site is located within an agricultural landscape, classified as pastures and arable land. The proposed turbine locations are shown in **Figure 10.1a.** The area in which the turbines will be located, within the setback buffer, ranges in elevation from 120m AOD in the north rising to 133m AOD in the south.

The GCR from the wind farm site to the substation will be approximately 13.5km via a 38kV cable which will be underground and constructed primarily within the existing public road corridor (**Figure 10.1b**)**.** A baseline database for the GCR options is included in EIAR **Volume III**, **Appendix 10.2a-b.**

Two TDR options have been identified and a baseline database included in EIAR **Volume III**, **Appendix 10.3a-b**. The first TDR option (Option 1 TDR) is from the port of delivery at Foynes, Limerick to the site via the N69 and N20 and the L5302. The second TDR option (Option 2 TDR) is from the port of Ringaskiddy, Cork, via the N28, N40, N8, N20, L1200 and the L5302.

10.3.2 Land use

Mapped land use for the wind farm and grid connection option routes is presented in **Figure 10.2**.

The Corine (2018)[4] Land Use maps (EPA) indicate the landcover at the proposed wind farm site is predominantly ‘agricultural pastures’ and ‘non-irrigated arable lands’. Similar land cover exists along the GCR options which also traverses areas of ‘discontinuous urban fabric’.

[4] Copernicus Programme (Corine) (2018) Land Use Europe Map Viewer [Online] - Available at: https://land.copernicus.eu/pan-european/corine-land-cover/clc2018 [Accessed May 2023]

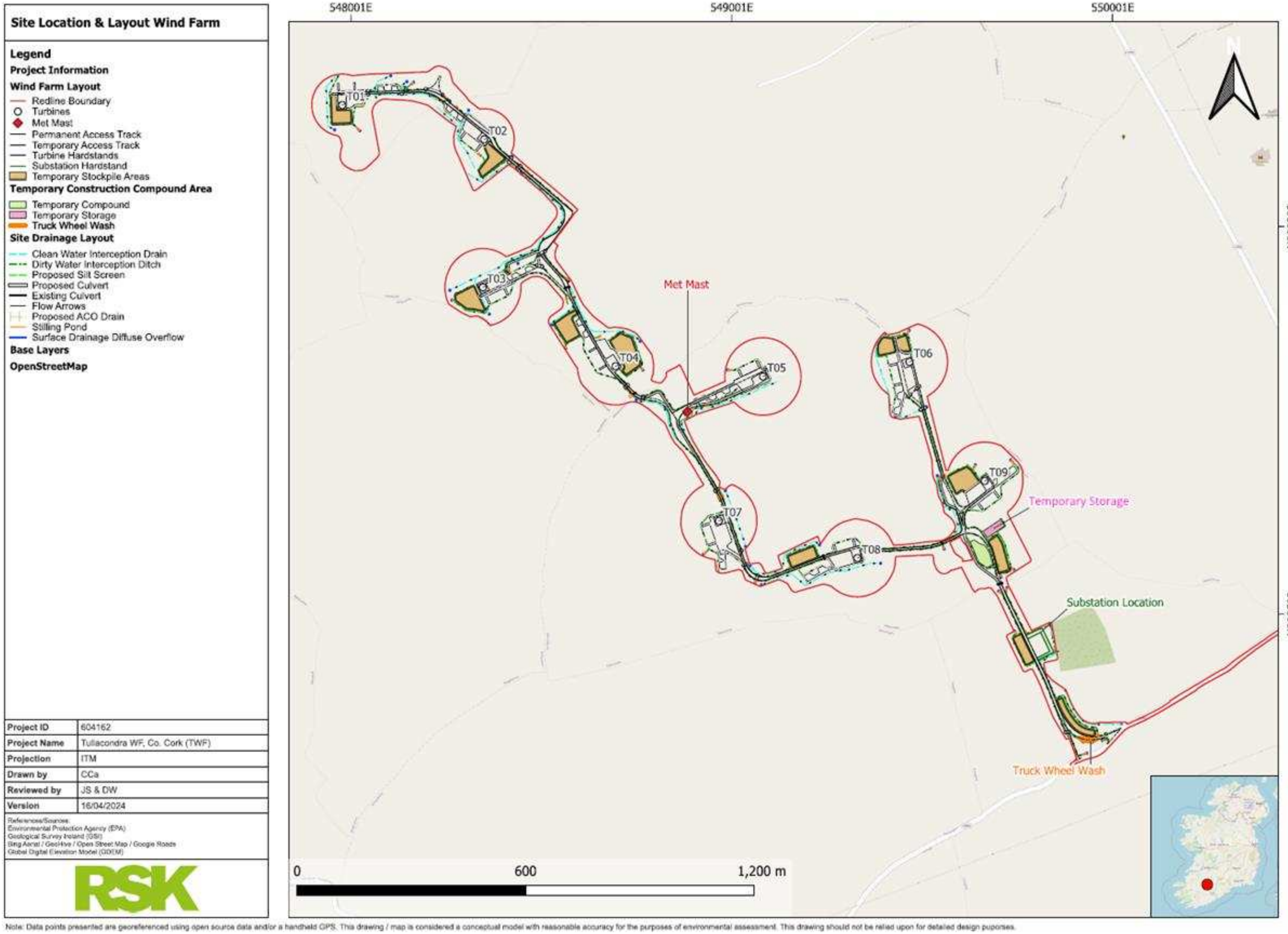


Figure 10.1a: Site location and layout wind farm

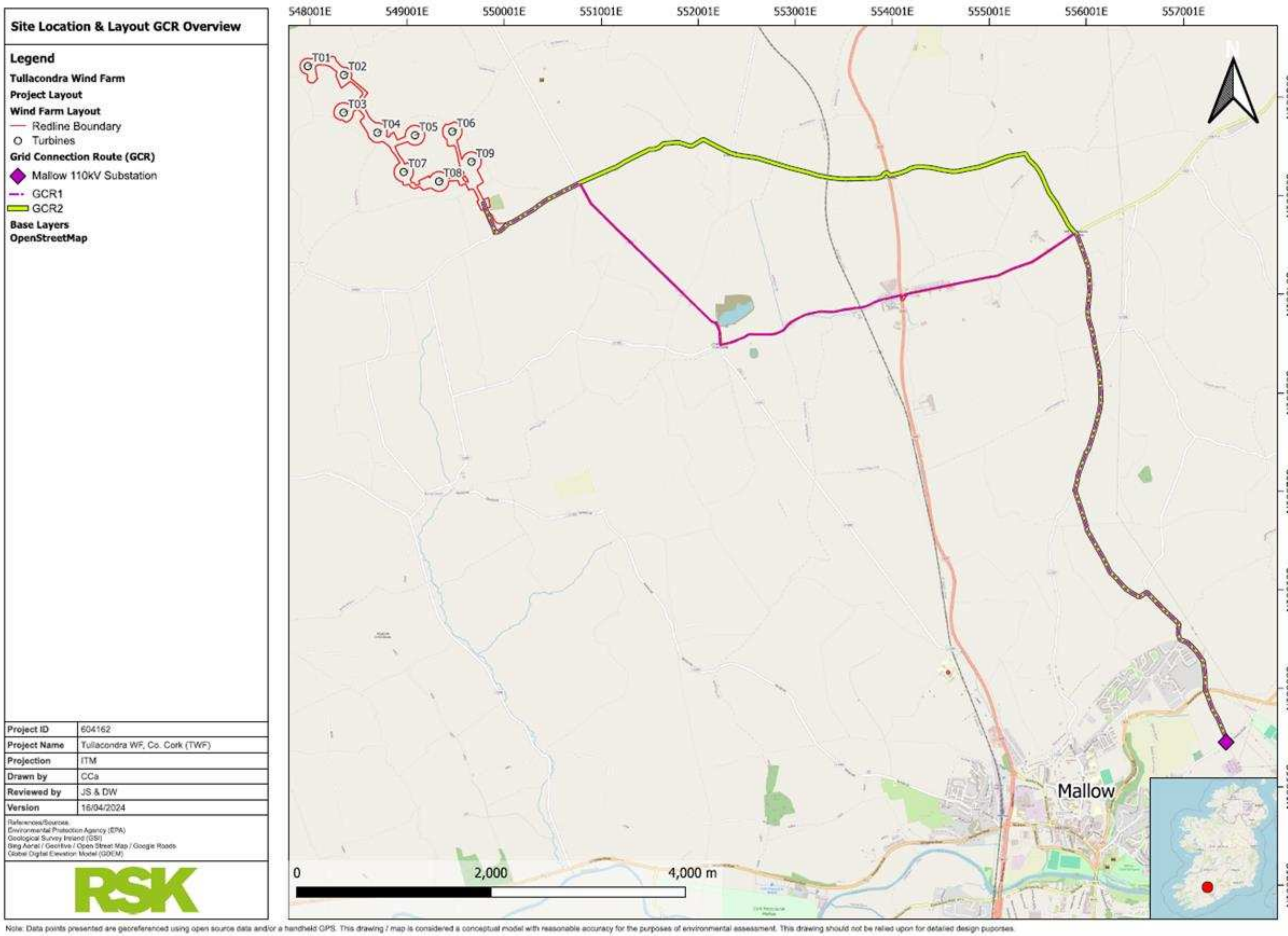
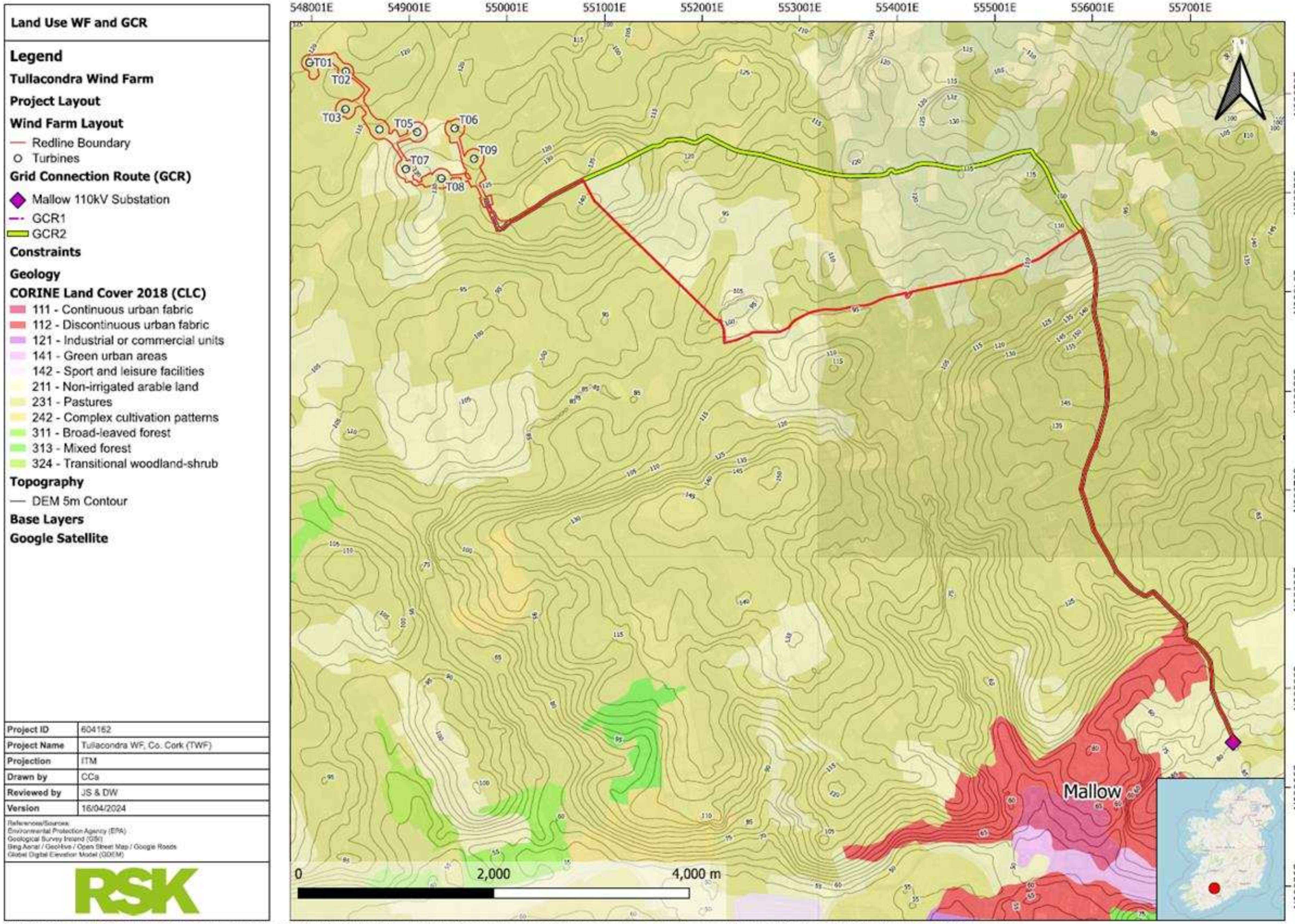


Figure 10.1b: Site location and overview GCR



Note: Data points presented are georeferenced using open source data and/or a handheld GPS. This drawing / map is considered a conceptual model with reasonable accuracy for the purposes of environmental assessment. This drawing should not be relied upon for detailed design puposes

Figure 10.2: Land use windfarm and GCR option 1 and 2

10.3.3 Soils

10.3.3.1 Wind farm site

The Teagasc Soils Data Maps (GSI Map Viewer[5]) indicates that the proposed wind farm site is predominantly covered by deep, well drained mainly acidic mineral soils (**Figure 10.3a**). The main soil type is 'Acid Brown Earths, Brown Podzolics' with a description of 'Acid Deep Well Drained Mineral Drained Mineral' - Derived from mainly non-calcareous parent materials (AMINDW). A small pocket of 'Shallow well drained mineral (Mainly acidic) soil AminSW underlies the area proposed for the substation.

According to the National Soil Survey[6][7], the topsoil in the area of the wind farm site ranges between 0.25m and 0.4m thick. Based on walkover site surveys, the estimated topsoil thickness across the site is taken as 0.3m. During the field work a trial hole was hand dug to 0.15mbGL close to the location for T7 (EIAR **Volume III, Appendix 9.1** - **Tile 9**). Sandy / silty topsoil to gravel and cobbles was recorded, consistent with the national soils database (Teagasc), with a shear strength value of 185 kPa.

10.3.3.2 Grid connection option routes

The dominant soil types underlying both options of the GCR are deep well drained mineral (mainly acidic), AminDW made up of Acid Brown Earths and Brown Podzolics and mineral poorly drained (mainly acidic), AminPD made up of Surface water Gleys and Ground water Gleys. There are some smaller pockets of basic shallow well drained mineral (BminSW), which is derived from mainly calcareous parent materials and made up of renzinas and lithosols. There are also areas of acid shallow well drained mineral (AminSW), derived from mainly non-calcareous parent materials and made up of lithosols and regosols.

There is a small pocket of 'made' ground along GCR Option 1 at the crossing with the N20 at New Twopothouse (**Figure 10.3b**). Made ground refers to artificially modified ground, is an area where the pre-existing (natural) land surface or geological succession is modified by processes of material removal or deposition and may include made ground, worked ground, disturbed ground, landscaped ground and infilled ground[8].

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[5] Geological Survey Ireland Spatial Resources. Available at: https://dcenr.maps.arcgis.com/apps/MapSeries/index.html?appid=a30af518e87a4c0ab2fbde2aaac3c228 [Accessed April 2024]

[6] Gardiner M J (1980) "Soil Associations of Ireland and their land use potential": *National Soil Survey*. Available at: <https://www.teagasc.ie/media/website/environment/soil/General.pdf.

[7] Gardiner M J (1980) "General Soil Map": *National Soil Survey*. - Available at: <https://www.teagasc.ie/media/website/environment/soil/General-Map.pdf

[8] British Geological Survey 'The BGS Lexicon of Named Rock Unit'. Available at: https://webapps.bgs.ac.uk/lexicon/lexicon.cfm?pub=ARTU [Accessed April 2024]

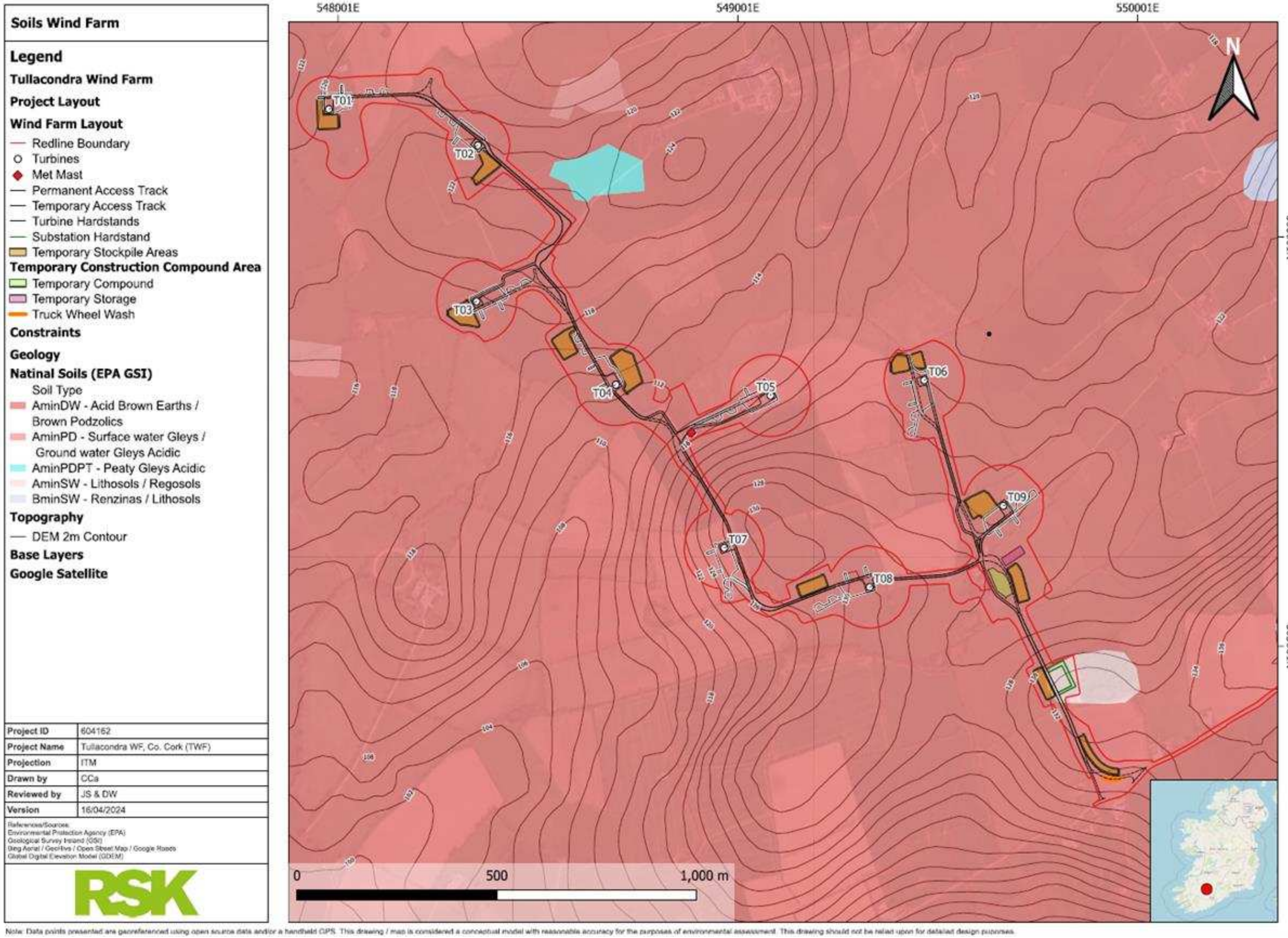
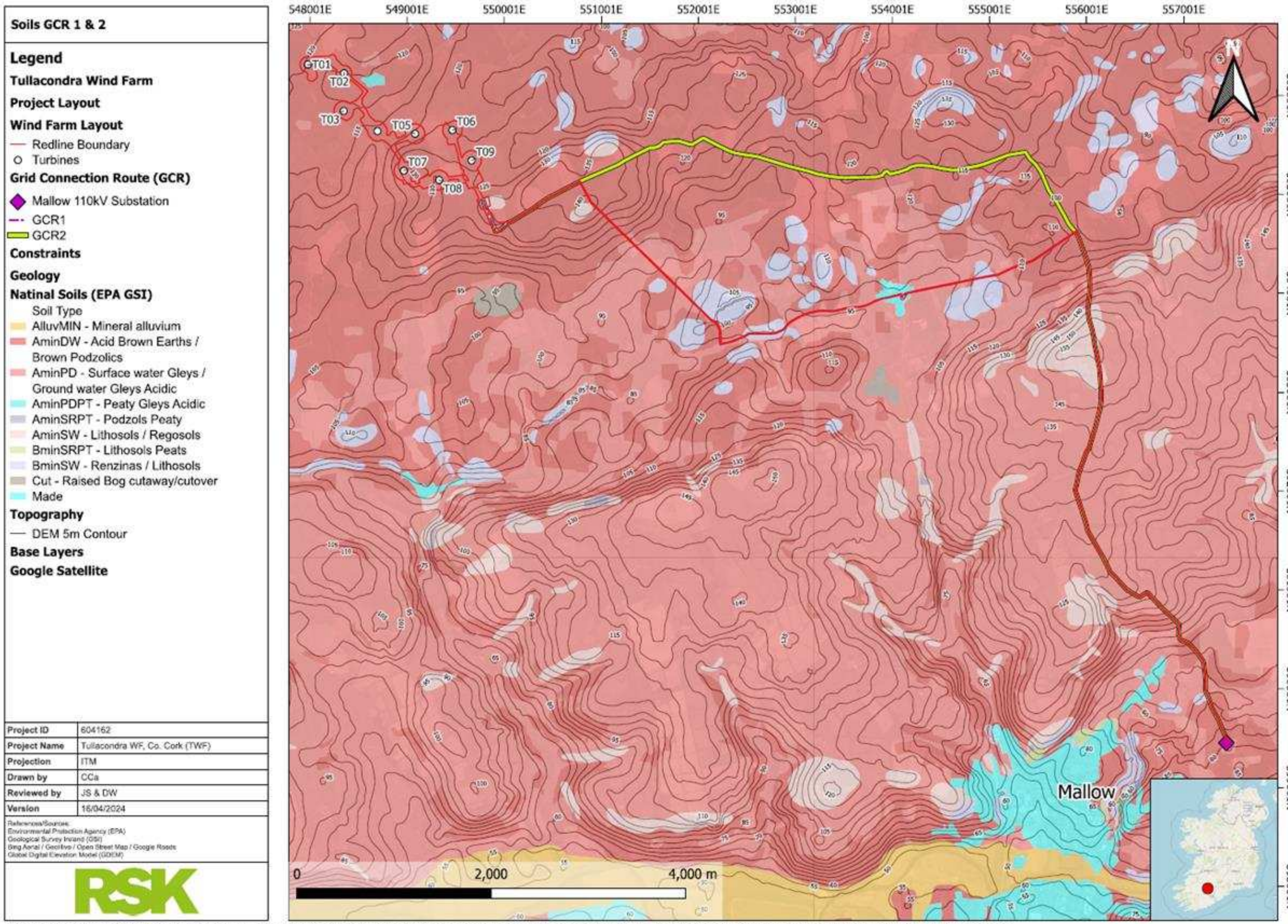


Figure 10.3a: Soils wind farm



Note: Data points presented are georeferenced using open source data and/or a handheld GPS. This drawing / map is considered a conceptual model with reasonable accuracy for the purposes of environmental assessment. This drawing should not be relied upon for detailed design purposes.

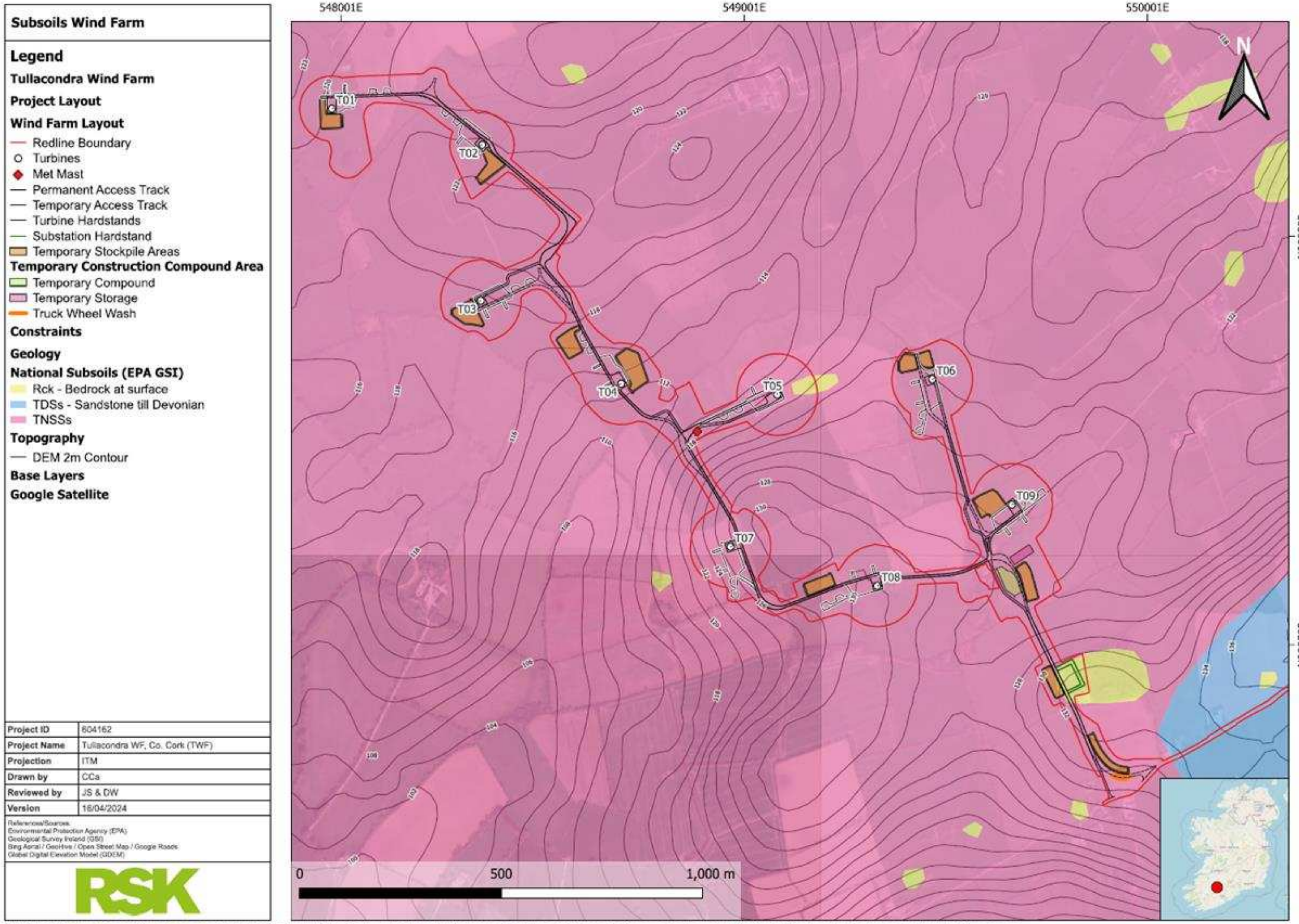
Figure 10.3b Soils GCR option 1 and 2

10.3.4 Subsoils

Mapped subsoils for the wind farm and GCR are presented in **Figure 10.4a-b,** (EPA Map Viewer[9], Subsoils).

The predominant subsoil underlying the wind farm site are shales and sandstones tills (Namurian) (TNSSs) which have a CLAYEY texture (**Figure 10.4a**). There are small areas identified bedrock at or close to surface (Rck). The majority of the GCR also underlain by Namurian shale and sandstone till, with some sandstone till (Devonian) (TDSs) which has a SANDY texture (**Figure 10.4b**). Areas of bedrock at or close to surface also occur along the GCR.

[9] Environmental Protection Agency (EPA) EPA Map Viewer [Online] - Available at: https://gis.epa.ie/EPAMaps/ [Accessed May 2023]



Note: Data points presented are georeferenced using open source data and/or a handheld GPS. This drawing / map is considered a conceptual model with reasonable accuracy for the purposes of environmental assessment. This drawing should not be relied upon for detailed design purposes.

Figure 10.4a: Subsoils wind farm site

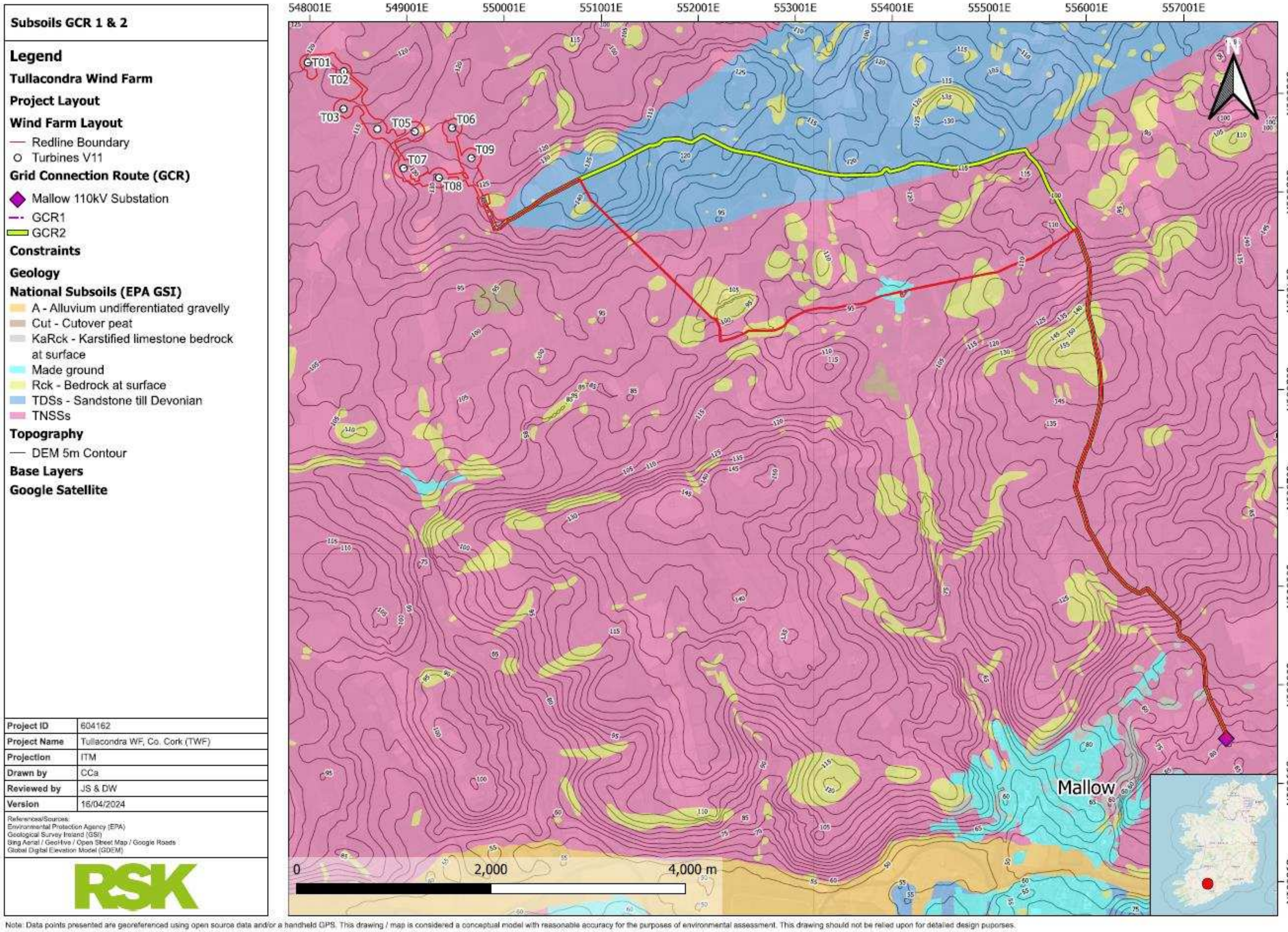


Figure 10.4b: Subsoil GCR option 1 and 2.

10.3.5 Bedrock geology

10.3.5.1 Wind farm site

The underlying bedrock (GSI, Bedrock 100K[10]) of the proposed wind farm site consists of several lithologies:

- The locations for T1, T2 and T3 are underlain by the Carboniferous Waulsortian Limestone Formation (WA), which comprises unbedded lime-MUDSTONE, dominantly pale grey, crudely bedded or massive LIMESTONE.
- The locations for T4, T5 and T6 are underlain by the Carboniferous Ballysteen Formation (BA), described as dark muddy LIMESTONE and SHALE, comprising irregularly bedded and nodular bedded argillaceous bioclastic limestones (wackestones and packstones), interbedded with fossiliferous calcareous shales.
- The Carboniferous Lower Limestone Shale Formation (LLS), described as SANDSTONE, MUDSTONE and thin LIMESTONE, close to the locations for T6 and T8.
- The locations for T7, T8 and T9 as well as the substation are underlain by Devonian-Carboniferous Old Red Sandstone (ORS), described as red CONGLOMERATE, SANDSTONE and MUDSTONE.

The limestones overlie the Old Red Sandstone which is exposed in the middle of the Kilmaclenine anticline (**Figure 10.5** and **10.6a**). There are parallel thrust and reverse faults shown in the GSI regional cross section (**Figure 10.5**). This cross section runs through the wind farm site and to the west of the GCR, see **Figure 10.6a-b** for location. The regional structural geology shows a series of folds trending E-W to ENE-WSW with faults striking roughly NNW-SSE and WSW-ENE (**Figure 10.6a-b**). A number of mapped faults are located within the wind farm site.

Both the Ballysteen and Waulsortian Limestones are karstified (**Figure 10.6a**). The GSI karst database indicates a relatively high concentration of karstification on outcrops to the south and east of the wind farm site, however, karstification within the survey area was not included in the database (see EIAR **Chapter 9 Hydrology and Hydrogeology** for details of karst databases). In 2023, the GSI database was updated and there are a number of mapped karst features in the vicinity of the site as shown in **Figure 10.6a**.

Observation during site surveys included several potential karst features (at the time of the survey) such as depressions that were dry with reeds/marshy and others that had standing water. A swallow hole was recorded 0.2km northeast of the location of T1 and another enclosed depression 0.1km east of the location of T5, both of which are now included in the GSI karst database [IE_GSI_Karst_40K_16481 and IE_GSI_Karst_40K_16482]. See **Figure 10.6a**. It is noted on the GSI database the enclosed depression to the east of T5 was 'not field checked but seen from aerial photos'. The karst feature to the east of T5 corresponds to the location of historical quarry as identified on the 25-inch historical maps. This feature is anecdotally known by the landowners as a former quarry.

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[10] Geological Survey of Ireland (GSI) (ND) Geological Survey Ireland Spatial Resources [Online] - Available at:http://dcenr.maps.arcgis.com/apps/MapSeries/index.html?appid=a30af518e87a4c0ab2fbde2aaac3c228 [Accessed May 2023]

The presence of karst provides a potential pathway to groundwater (EIAR **Chapter 9 Hydrology and Hydrogeology**) and potential for ground stability issues during construction (refer to section 10.3.10).

10.3.5.2 Grid Connection option routes

The underlying geology of the GCR Option 1 is similar to that of the wind farm site, with a number of geological formations comprised of limestones, siltstones, mudstone and sandstones. Various karst features (i.e., enclosed depressions and swallow holes) have been identified by the GSI (2023) in the vicinity of both GCR options in the mapped limestones **Figure 10.6b**. No karst features or 25m karst buffers intersect either of the GCR routes. The closest mapped karst feature to GCR Option 1 is c. 260m [IE_GSI_Karst_40K_2968] and to GCR Option 2 is c. 38m [IE_GSI_Karst_40K_16585] (see EIAR **Volume III, Appendix 9.7** for the full database). There is the potential for additional non mapped karst features. However both GCR option routes are predominantly within the public road, therefore the risk of encountering a karst feature is low.

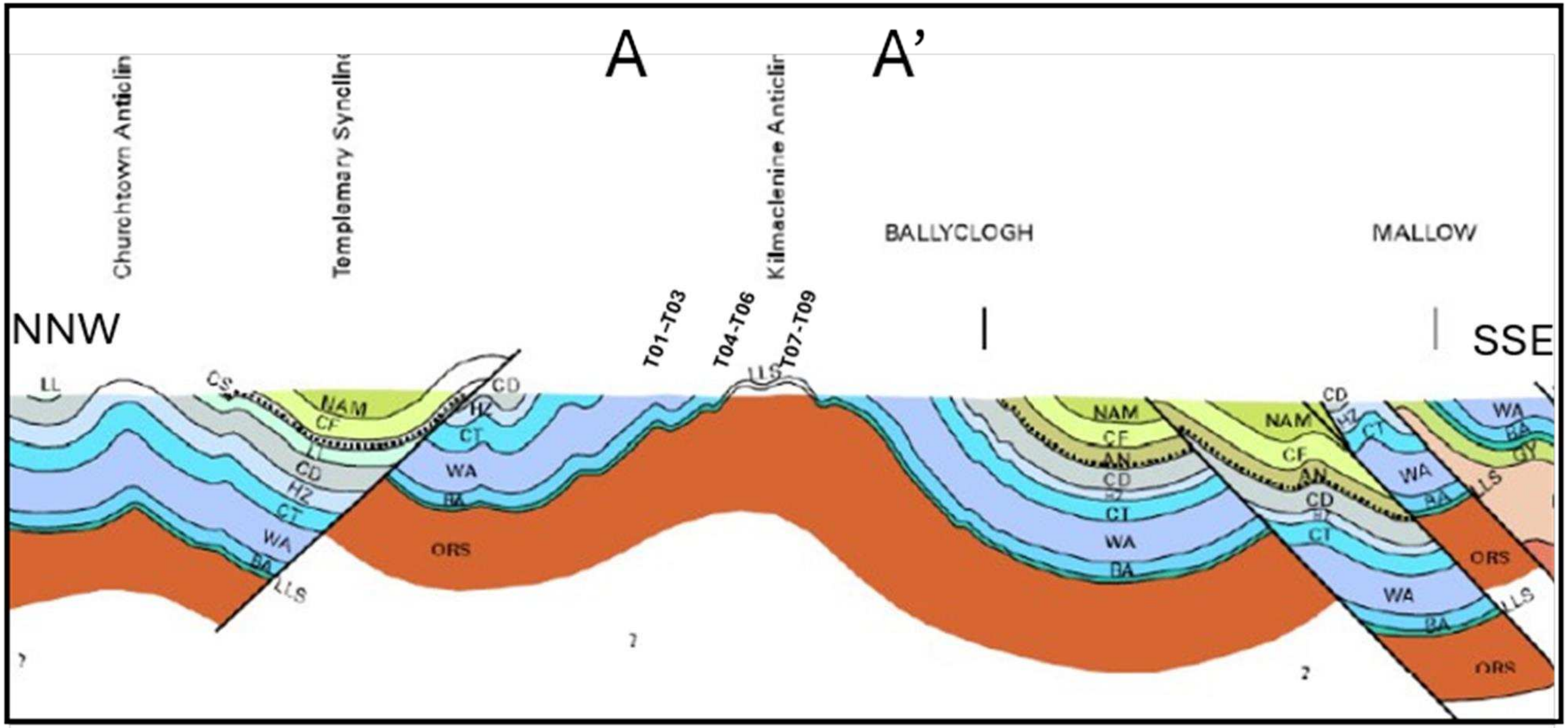


Figure 10.5: Portion of GSI regional cross section [Sheet21AB[11]] which passes through the wind farm site and to the west of the GCR (turbine location included for reference).

[11] Geological Survey of Ireland (GSI) (ND) Geological Survey Ireland Sections [Online] – Available at: https://secure.dccae.gov.ie/GSI_DOWNLOAD/Bedrock/Logs/GSI_Sections_2019/Sheet21AB.pdf

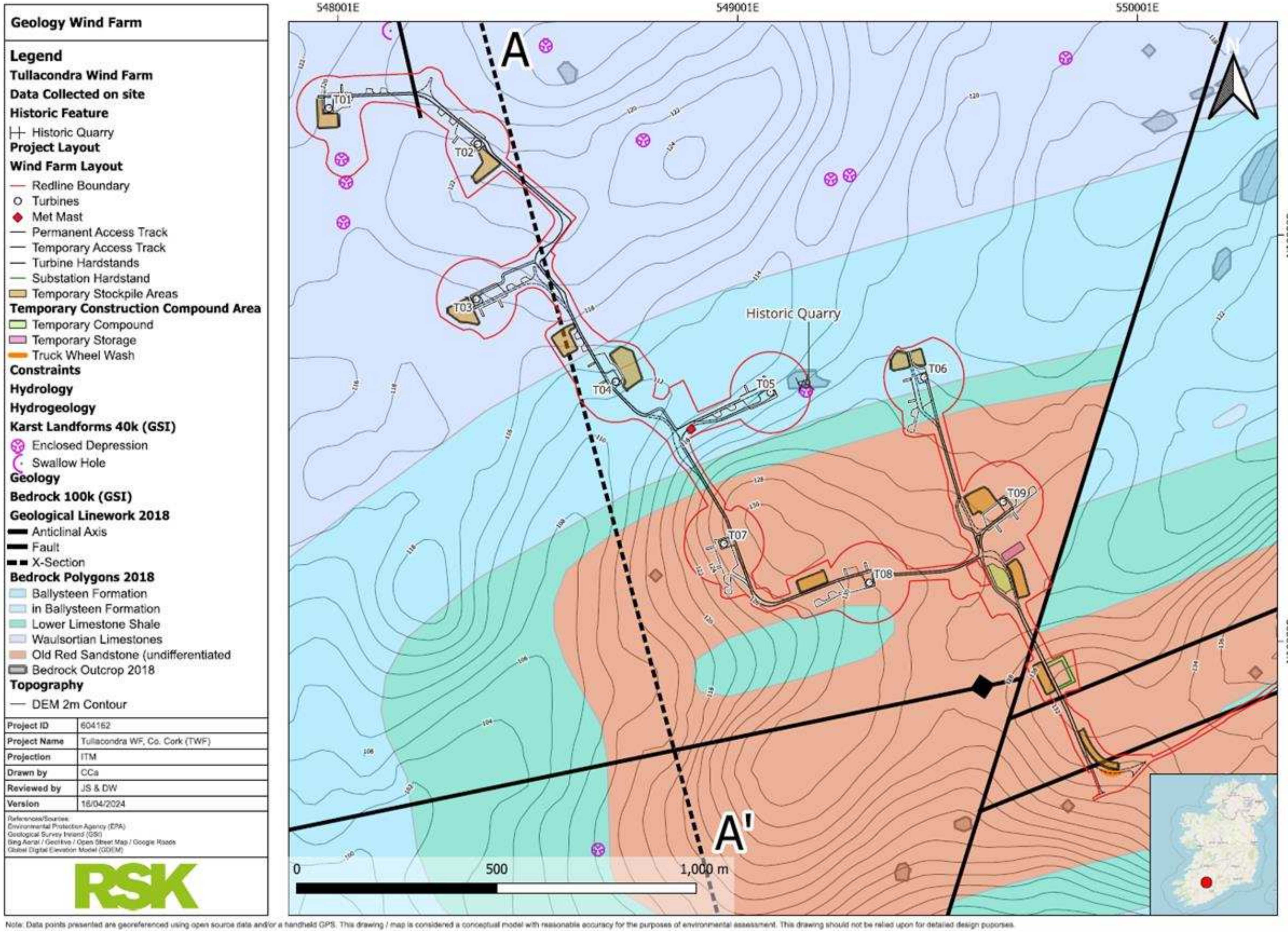
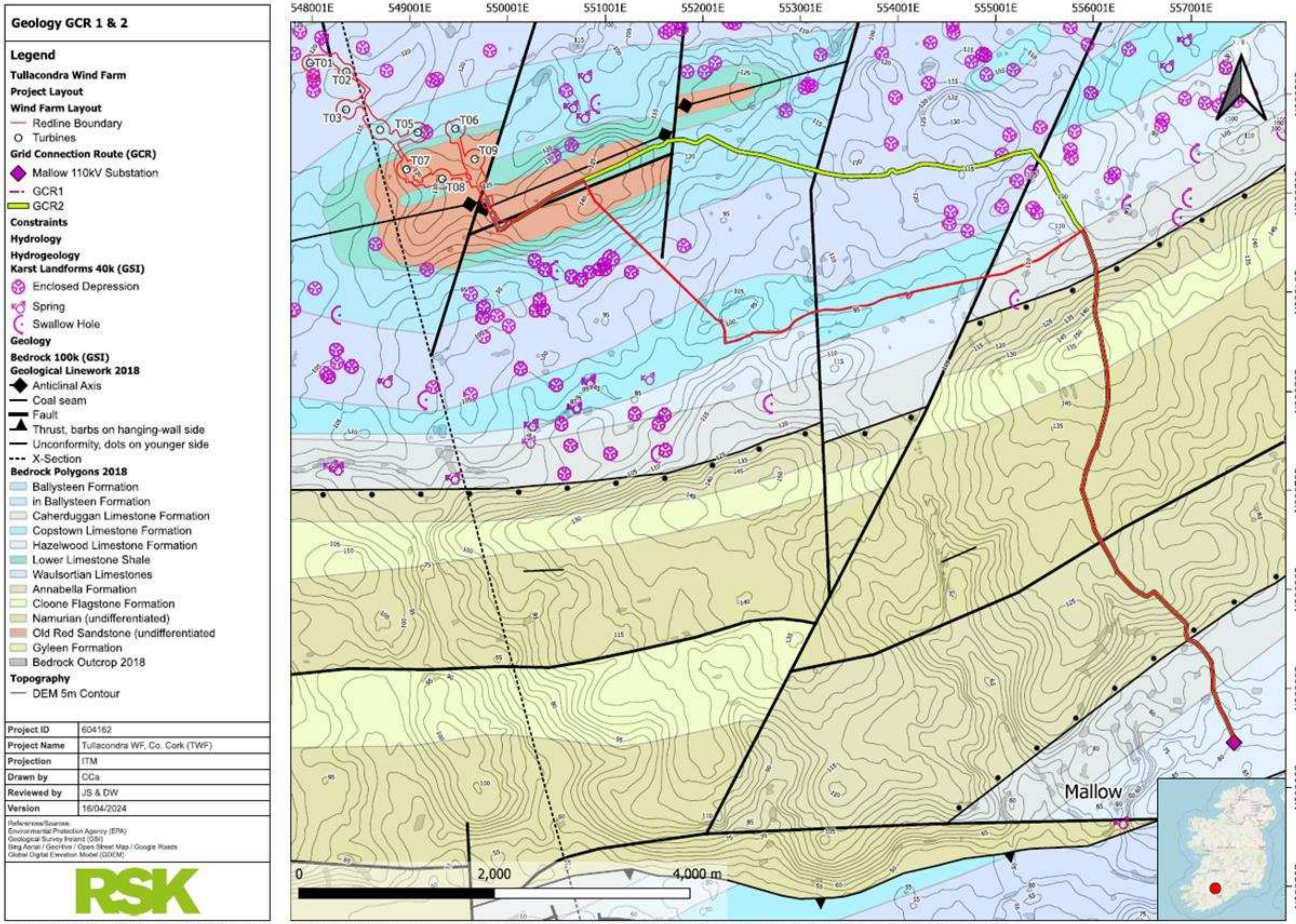


Figure 10.6a: Bedrock geology wind farm site



Note: Data points presented are georeferenced using open source data and/or a handheld GPS. This drawing / map is considered a conceptual model with reasonable accuracy for the purposes of environmental assessment. This drawing should not be relied upon for detailed design purposes.

Figure 10.6b: Bedrock geology GCR option 1 and 2

10.3.6 Geophysical survey results

The underlying bedrock geology at the wind farm site includes karstified limestone. There are multiple mapped (GSI) karst features in the vicinity of the wind farm site (**Figure 10.6a**). In order to screen the wind farm site for significant subterranean anomalies in the vicinity of proposed infrastructure units, including proposed turbine foundations and hardstands, geophysical 2D resistivity surveys were completed by Minerex Geophysics (September 2022). The location of the surveys is summarised in **Table 10.5** and the 2D survey lines are shown in **Figure 10.7** (see EIAR **Volume III, Appendix 10.1** for full report).

Table 10.5: Location of 2D geophysical survey line crossing points (ITM)

Infrastructure location close to survey lines	X (ITM)	Y (ITM)
T1	547981	606313.7
T2	548311.7	606266.1
T3	548346.2	605846.7
T4	548696.4	605643.1
T5	549094.7	605594.4
T6	549495.8	605668.6
T7	548968.8	605241.1
T8	549289.4	605094.3
T9	549678.4	605330.9
Substation	549866.3	605019.6

The 2D-resistivity surveys aimed to determine the ground conditions under the site and identify any possible karst features at the surveyed locations; the following are the geophysics interpretations:

- Possible karst features were identified at locations T1 and T5 underlying the proposed turbine locations. These features are likely infilled limestone. There may be some small voids or cavities within this limestone as well which would be typical of limestone bedrock.
- A possible karst feature was identified underlying the proposed location T1. The resistivities indicate weathered or infilled limestone, at approximately 10m. The geophysics line was extended south to target possible karstification. Geophysical results show no indication of karst or weathered limestone beneath the surface along the line 100m south of the turbine location under the enclosed depression [IE_GSI_Karst_40K_16860]. The resistivity showed rock becoming deeper towards the south, in addition to being clay rich which would prevent water draining.
- At location T2, limestone was interpreted at a depth of 8 – 14mbGL (metres below Ground Level). The top of rock was interpreted at 9mbGL at the turbine location and becomes deeper to the south and northeast.
- Location T3, T4, T6 and T8 were interpreted as being underlain by thick sandy gravelly clay and silt over 15m thick, with the possibility of mudstone.

- A possible karst feature, likely weathered or infilled limestone was interpreted underlying the proposed location T5. The depth to the top of rock at this location rises from 11m in the west to 3.5m in the east with a potential karst feature which extends approximately 7m into the rock in the east. Under the turbine location and to the west, a sharp change in resistivities with depth was interpreted as karstified limestone. The karst feature at the surface is at the same location as a historic quarry (see **Figure 10.8**). The resistivities indicate a possible karst zone extending to the south or southwest rather than towards the north.
- Locations T7, T9 and the substation were interpreted as being underlain by sandstone. The bedrock was determined to be 2 – 3mbGL at T7, 10mbGL at T9 and 2 – 6mbGL at the substation location. Weathered sandstone was noted at all three locations.

Subsoils have been classified as clayey silty sand and gravel or weathered / karstified limestone, sandstone and weathered sandstone. These results are based on resistivity surveys.

A geological log for a mineral exploration borehole drilled approximately 50m east of location T5 has been assessed. The drill report and log indicate the following;

- Subsoil overburden to 5m;
- Weathered limestone (7.0 – 13.0m) with calcite veining (<15cm).

These limestones are interpreted to be the Kilmaclenine Limestone, which is equivalent to the Middle Ballysteen Formation, the bedrock underlying location T4, T5 and T6.

The 2D geophysics survey lines at location T5 are interpreted as overburden between 3.5 to 7.0m and weather / karstified limestone from 7.0m, similar to the material encountered in the nearby borehole.

A summary for each proposed turbine location and substation and expected material based on both the desktop study (SIS, Teagasc, GSI, EPA) and the 2D geophysical survey (EIAR **Volume III, Appendix 10.1**) is presented below in **Table 10.6.** Where the locations of the turbines and substation have been moved since the time of the geophysics surveys, the results are interpolated to the new locations.

Additional site investigation will be carried out as part of the detailed design stage to verify the results of the 2D geophysical survey.

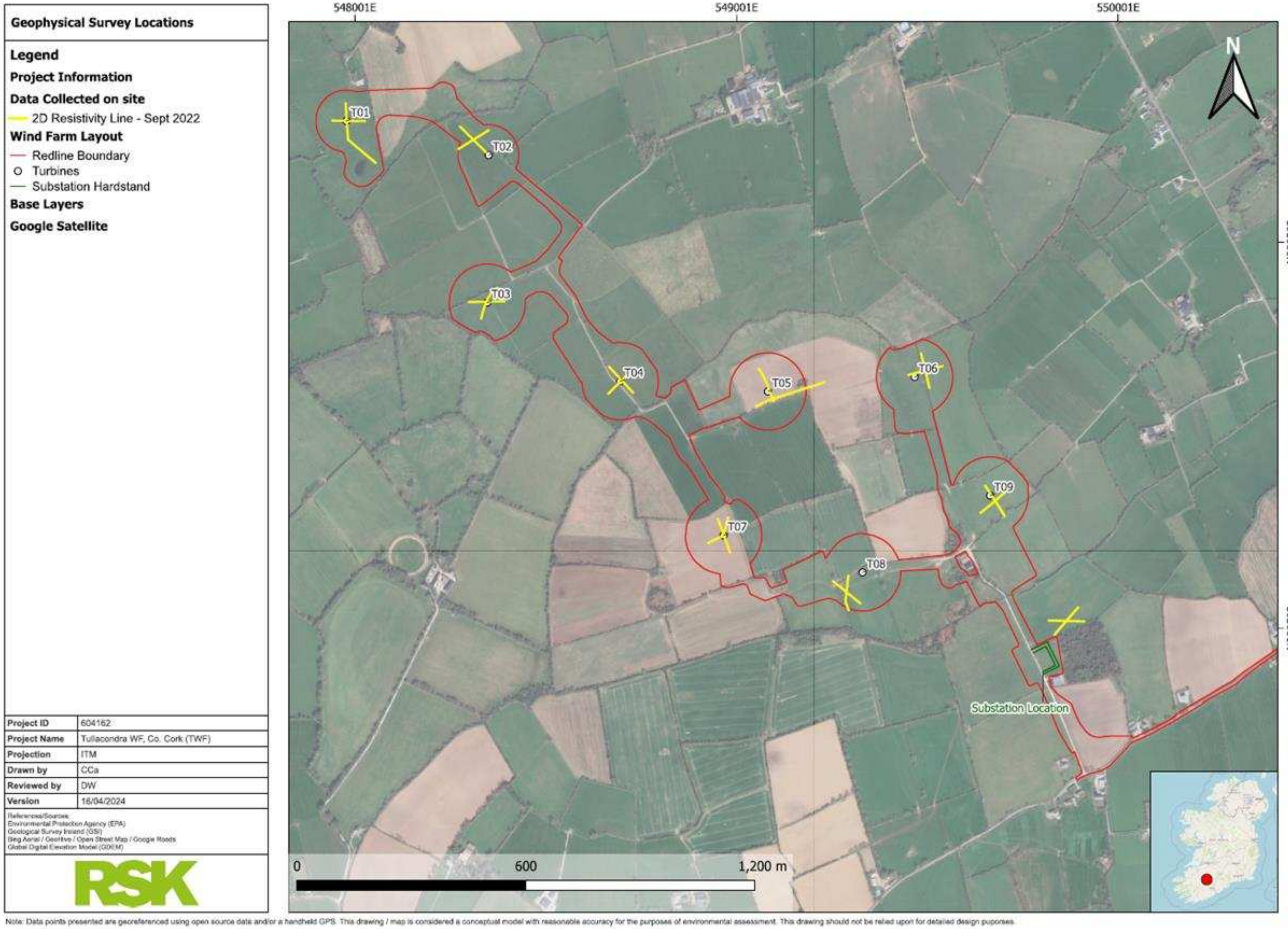


Figure 10.7: 2D geophysical survey locations

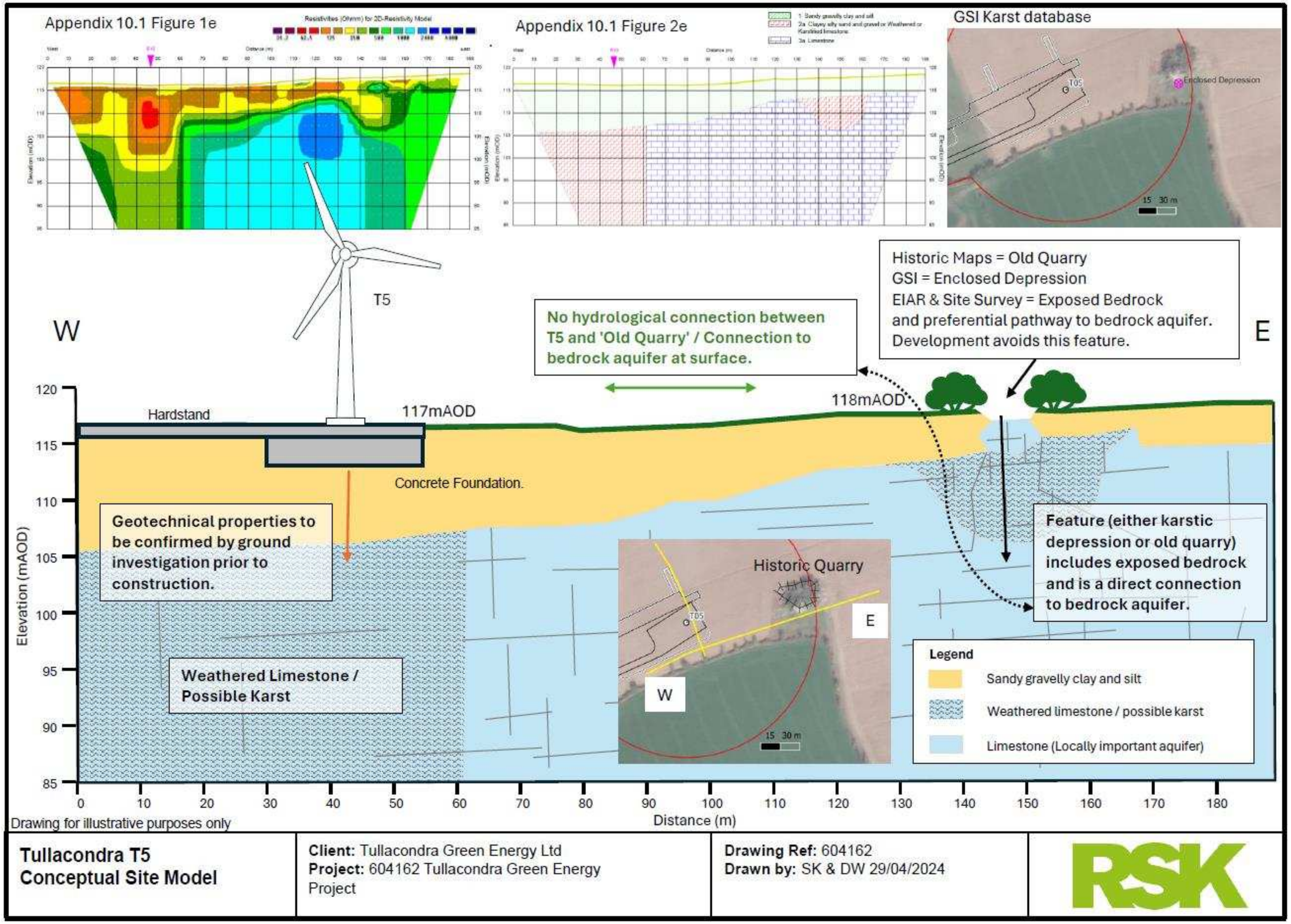


Figure 10.8 T5 conceptual site model

Table 10.6: Summary of bedrock, soil, subsoil from the desk study and geophysical 2D survey for each of the turbines.

Turbine No. / Unit	Desk Study (GSI, EPA)				Geophysical Survey (Appendix 10.1)				
	Bedrock type	Soil	Subsoil	Groundwater vulnerability	Soil	Subsoil	Subsoil / bedrock	Bedrock	Depth to bedrock (m)
T1	Waulsortian Limestone	AminDW	TNSSs	High	thin topsoil layer	sandy, gravelly clay and silt	clayey silty sand and gravel or weathered karstified limestone in the bedrock	Limestone	10.0
T2*	Waulsortian Limestone	AminDW	TNSSs	Extreme	thin topsoil layer	sandy, gravelly clay and silt		Limestone	9.0
T3	Waulsortian Limestone	AminDW	TNSSs	High	thin topsoil layer	sandy, gravelly clay and silt		Limestone	>15.0
T4	Ballysteen Formation	AminDW	TNSSs	Moderate / High	thin topsoil layer	sandy, gravelly clay and silt		Limestone	>15.0
T5	Ballysteen Formation	AminDW	TNSSs	High	thin topsoil layer	sandy, gravelly clay and silt	clayey silty sand and gravel or weathered karstified limestone in the bedrock	Limestone	3.5-7.0
T6*	Ballysteen Formation	AminDW	TNSSs	Moderate	thin topsoil layer	sandy, gravelly clay and silt		Limestone	>15.0
T7	Old Red Sandstone	AminDW	TNSSs	Extreme	thin topsoil layer	sandy, gravelly clay and silt		Sandstone with areas of weathered Sandstone	2.0 - 3.0
T8*	Old Red Sandstone	AminDW	TNSSs	High	thin topsoil layer	sandy, gravelly clay and silt		Sandstone	>15.0

Turbine No. / Unit	Desk Study (GSI, EPA)				Geophysical Survey (Appendix 10.1)				
	Bedrock type	Soil	Subsoil	Groundwater vulnerability	Soil	Subsoil	Subsoil / bedrock	Bedrock	Depth to bedrock (m)
T9	Old Red Sandstone	AminDW	TNSSs	Moderate	thin topsoil layer	Clayey silty sand and gravel with areas of sandy, gravelly slay and silt		Sandstone with areas of weathered Sandstone	10.0
Substation*	Old Red Sandstone	AminSW	Rck	Rock at or near surface	thin topsoil layer	sandy, gravelly clay and silt		Sandstone with areas of weathered Sandstone	2.0 - 6.0

* Location of turbines and substation have been moved since the geophysical survey was completed in 2022

10.3.7 Economic geology

There is one unaudited site within the wind farm site boundary (ITM: 548961, 605055) which is classified as a 'County Geological Site' (CGS), as recognised by the National Heritage Plan (2002). This site is located close to T5 and T6. This unaudited site (Site Name: Mallow (Tullacondra) [site: Cu, Ag]) has been given the description of ‘Mineralization within faulted monocline structure in Lower Carboniferous limestones’. While the location of the mineralisation is known since the 1970s, no mineral extraction has occurred. This site falls under the IGH 15 theme related to Economic Geology. There is no surface expression of this mineralisation and there are no likely significant effects to the CGS.

The GSI database has identified some mineral localities within the wind farm site. These mapped features include outcrops of non-metallic dolomite (dolostone) to the east of T2 as well as significant silver and copper metallic mineralization within faulted monocline structure in Lower Carboniferous limestones (1973) located directly south of T7.

A number of active and disused quarries are located within 5km of the site including Ballybeg Quarry, Ballygiblin Quarry, Subulter Quarry and Ballyclogh Quarry. There are no active quarries on the site. According to the Historic 25-inch (1915-1923) map, a small (disused) quarry is located to the east of T5 (**Figure 10.6a**). A rock face was marked to east of the quarry. In addition, a Lime Kiln is also marked to the south of T7. Anecdotally neither the quarry nor the lime kiln is known to be in use since the 1960s but is known locally as the quarry. The feature corresponds to the location of an enclosed depression (GSI, karst database). This feature was mapped as a possible karst feature during the field survey, which predated the GSI mapping.

10.3.8 Geological heritage

Upon review of the GSI Geological Heritage Sites database there are no audited or unaudited geological heritage sites identified within 2km of the red line planning boundary. The difference between the two types of sites is that the audited sites have undergone the County Geological Heritage Audit process[12].

10.3.9 Designated & protected areas

The proposed wind farm site and GCR are not within any designated or protected areas (Special Protection Area (SPA) / Special Area of Conservation (SAC) / Natural Heritage Area (NHA)). Any potential effects to soils or geology are not considered to have direct effects on designated sites. See EIAR **Chapter 9 Hydrology and Hydrogeology** for more detail.

10.3.10 Geohazards

10.3.10.1 Seismic activity

The island of Ireland does experience, monitor, and record seismic activity, although the magnitude of such occurrences is generally low and do not generally pose as a risk to infrastructure or human health. Although earthquakes are considered a triggering

[12] GSI, Geoheritage, Data & Maps. Available at: https://www.gsi.ie/en-ie/programmes-and-projects/geoheritage/Pages/Data-and-Maps.aspx [Accessed April 2024].

mechanism for landslides, given the low magnitude experienced in Ireland, earthquakes are not considered an important triggering factor in terms of stability risk[13].

10.3.10.2 Subsoils & slope stability

Landslide risk susceptibility (GSI Map Viewer[14], Landslide Susceptibility Classification) is 'low' at the wind farm site. The wind farm site is relatively low-lying, there are no steep slopes or peat, therefore the risk of stability issues is low. No recorded landslide events are found within the red line planning boundary.

The entire length of both GCR options traverses' areas of 'low' landslide risk susceptibility (**Figure 10.9**). Considering works necessary for the cable trenching will consist of excavations (1.5mbGL, with the potential for deeper excavations up to 2.0mbGL), and that works will be carried out along existing road infrastructure, the risk of ground stability issues arising is considered low.

[13] Creighton, R., Doyle, A., Farrell, E. R., Fealy, R., Gavin, K., Henry, T., Johnston, T., Long, M., McKeown, C., Pellicer, X., Verbruggen, K. (2006) "Landslides in Ireland" *Geological Survey Ireland: Irish Landslides Working Group.*

[14] Geological Survey of Ireland (GSI) Geological Survey Ireland Spatial Resources [Online] - Available at:http://dcenr.maps.arcgis.com/apps/MapSeries/index.html?appid=a30af518e87a4c0ab2fbde2aaac3c228 [Accessed May 2023]

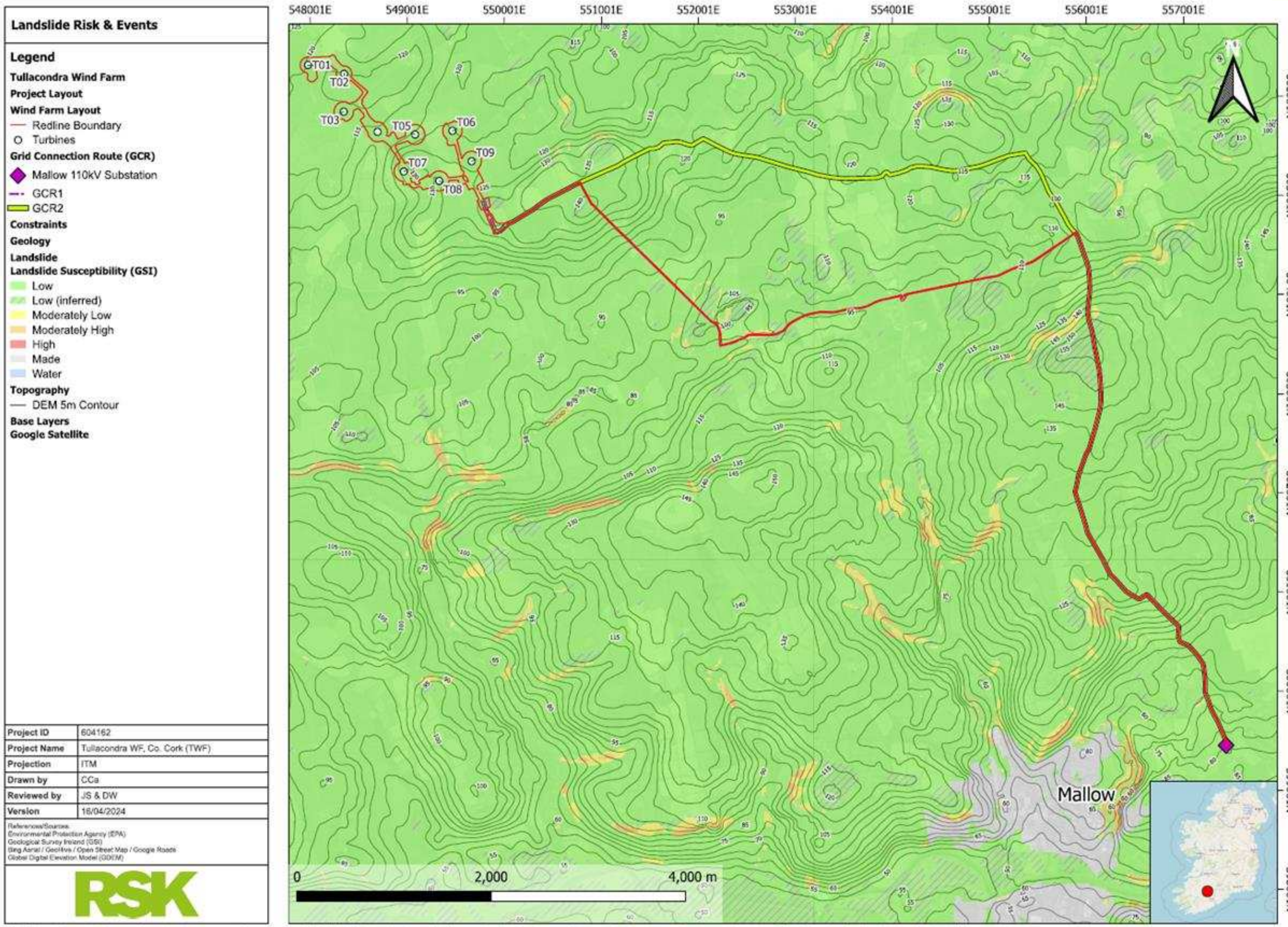


Figure 10.9: Landslide risk and events wind farm and GCR option 1 and 2

10.3.10.3 Geological stability and karst

There are a number of karst features mapped in the Ballysteen and Waulsortian limestone formations. Karst features have the potential to cause stability issues during construction activities and also provide a potential pathway to sensitive groundwater receptors (see EIAR **Chapter 9 Hydrology and Hydrogeology**).

2D resistivity surveys were completed at the location of the turbines and substation to determine ground conditions and screen for possible karstified rock. Limestone was interpreted as underlying T1, T2 and T5 locations with possible karst features underlying T1 and T5 turbine locations. These features are likely infilled limestones and there may be some voids or cavities within this limestone.

Prior to the construction phase commencing, site investigation including rotary core drilling and geotechnical testing will be undertaken at each of the turbine locations to inform the detailed design phase of the Project. This will confirm the ground conditions and reduce the potential effects related to geological stability.

10.3.10.4 Soil contamination

The proposed wind farm site is greenfield agricultural land. It is possible that there may have been a fuel spill in the past from the equipment associated with these practices. There are existing tracks through the site indicating a potential for minor fuel leaks into the upper soils.

Consultation with waste facility maps (EPA, Waste Facility) indicates that there are no licenced waste facilities or Integrated Pollution Prevention Control (IPPC) licenced facilities on or within the immediate surrounds of the wind farm site which could be a potential for contaminated soil.

There are no historic mines on or within the immediate surrounds of the wind farm site that could potentially have contaminated soil from tailings.

Apart from the areas identified with non-native invasive species (see EIAR **Chapter 7 Biodiversity**) whereby the surrounding soil may be contaminated with plant material, there are no other known areas of soil contamination on the proposed wind farm site.

10.3.11 Receptor sensitivity

The importance/sensitivity of the geological receptors was assessed on completion of the baseline assessment (**Table 10.7**). Given the condition of the site in terms of land use practices, soil, subsoil and bedrock quality are considered to be of low to high sensitivity.

Table 10.7: Sensitivity of attributes

Attribute	Type	Sensitivity
Land / land Use	The land is used for agriculture (pasture and non-irrigated arable). Land along the GCR and TDR options is mainly public roads.	Low to medium
Soil	Topsoil is a non-renewable resource.	High

Attribute	Type	Sensitivity
Subsoil	Subsoil has moderate permeability. Glacial till is widespread.	Low
Bedrock	Formations underlying the development are common.	Low
Economic Geology	The wind farm site is in an area with a history of mineral exploration. An unaudited heritage site located in the red line planning boundary [Cu, Ag]. It is a County Geological Site which is under the Economic Geology theme.	High
Heritage Areas	No audited Geological Heritage Areas are close to the wind farm site.	Low
Geohazards	The risk of landslides is low. There is mapped karst at the wind farm site and the underlying bedrock has to potential for karst. Weathered limestone / karst has been interpreted beneath T1 and T5. No mapped karst along the GCR but underlying bedrock has karst features.	Low to High

10.4 Assessment of likely significant effects

The environmental effects of the Project are discussed and assessed in the following sections. The 'do-nothing' scenario is reviewed, and likely significant effects are assessed for three phases of the Project life cycle (i.e., construction, operation, and decommissioning). A summary of the assessment of likely significant effects is included in EIAR **Volume III – Appendix 10.5**.

10.4.1 Do nothing effect

The existing land-use is agricultural and should the Project not proceed the existing baseline conditions will remain the same and there would be no additional effects on the land, soils or geology.

10.4.2 Construction phase likely effects

The potential direct and indirect effects of the proposed construction activities and their expected duration and the effect on land use, soils and geology are now discussed.

10.4.2.1 Land take

Land take will be required during construction of the wind farm (**Table 10.8**).

Table 10.8: Land take quantities during construction, development footprint (15.42 hectares)

Wind Farm Component	Land Take (ha) both permanent and temporary	Description of Land
Site Tracks (including passing bays and reversing bays)	3.51	Pastures / non-irrigated arable land
Compound	0.16	Pastures / non-irrigated arable land
Drainage	1.89	Pastures / non-irrigated arable land
Hardstands	4.46	Pastures / non-irrigated arable land
Turbine Foundations	0.41	Pastures / non-irrigated arable land
Substation	0.33	Pastures / non-irrigated arable land
Met mast	0.01	Pastures / non-irrigated arable land
Internal Grid	0.32	Pastures / non-irrigated arable land
Grid Connection	0.87	Pastures / non-irrigated arable land
Spoil Deposition Areas	3.46	Pastures / non-irrigated arable land

The Project will lead to a temporary change in land use during the construction phase, therefore there will be a loss of agricultural land at the wind farm location. The effect of the Project will be to alter the baseline, natural soil profile within the red line planning boundary.

The area of the red line boundary planning (wind farm and GCR) is approximately 58.6ha, and the area of the proposed development footprint during construction (both temporary and permanent) is approximately 15.42ha (**Table 10.8**), which is approximately 26% of the area of the proposed wind farm site.

Land take is an unavoidable effect of the Project which is considered to have a moderate disturbance affecting the land, an attribute of medium sensitivity. In the absence of mitigation, the likely effects are direct, short to long-term (temporary or permanent land take) and moderate adverse effect with a significance level of **moderate**. These effects are reversible through reinstatement. With appropriate mitigation measures, planning and management, this effect and disturbance can be minimised. Long-term land take associated with the wind farm development is covered in section 10.4.3.

Land take on the TDR options

Both of the TDR options will require minimal land take, considering that the majority of the routes will traverse already existing roadways (i.e., existing public road networks). Some temporary accommodation works for access in the form of strengthening / hardcoring of road margins/verges and roundabout islands will be necessary (see EIAR **Chapter 16 Traffic and Transport**). Considering the small scale of disturbance (superficial paving) on the land surrounding the existing road infrastructure, an attribute of low sensitivity the effect is considered localised, direct, temporary and small adverse with a significance level of **not significant**. Following the delivery of turbine components, reinstatement of temporary accommodation will occur.

Land take GCR

Minimal land take is required for the GCR as it will principally be buried in or directly adjacent to existing roadways. A small portion of the GCR will traverse greenfield / green verge areas in private lands. The GCR works will involve installation of ducting, joint bays, drainage and ancillary infrastructure. The trenches will be reinstated following excavation and laying of cables, and there will no permanent changes in land use practices or character at ground level. Considering the small scale of disturbance affecting attributes of low sensitivity, shallow cable trench (c. 1.25mbGL), the effect is considered localised, direct, temporary, and small adverse with a significance level of **not significant**. Reinstatement of trenches will occur following the installation.

10.4.2.2 Ground or soil sealing

Ground or soil sealing is the covering of a soil with an impermeable material which in turn changes the geotechnical and hydrogeological attributes. The use of impermeable and semi permeable material is inevitable to some extent of most types of construction particularly in greenfield sites.

Soil sealing can have an effect on soil quality, an attribute of medium sensitivity. The unmitigated effects are direct, localised, long-term, small adverse with a significance level of **slight**.

10.4.2.3 Compaction, erosion and degradation of soils

Compaction

Compaction of soils will occur during construction and to a limited extent during operation and decommissioning. Compaction of soil leads to a reduction of pore spaces and leads to soil degradation. The rate of compaction or subsidence in subsoils is dependent on the soil/subsoil geotechnical properties. Subsoils at the wind farm site (sandy gravelly CLAY, and clay silty GRAVEL) are likely to have varying degrees of load bearing capacity, however, in situ subsoils are likely to be well consolidated and possess relatively favourable geotechnical properties.

Compaction or subsidence of soils as a result of depositing fill material for site tracks and hardstands, or for temporary works along the TDR is small in magnitude but can lead to reduction in soil quality, an attribute with medium to high sensitivity. The unmitigated likely effect of compaction on soil quality is localised, direct, irreversible, and small adverse with a significance level of **slight to moderate**.

Erosion

Erosion of exposed soils will also occur, primarily during construction. The effect of soil erosion is the loss of subsoil or topsoil as a resource, an attribute with medium to high sensitivity. The effect is small in magnitude. Erosion of the exposed or stockpiled soils may result in the generation of dust and or the increase in sediment laden run off (interactions with Air Quality (EIAR **Chapter 17 Air Quality**) and Hydrology and Hydrogeology (EIAR **Chapter 9 Hydrology and Hydrogeology**)).

The unmitigated likely effects of erosion on the land and soils are considered to be direct, irreversible and small adverse effect with a significance level of **slight to moderate**.

10.4.2.4 *Subsoil and bedrock removal*

Groundworks investigation will be carried out prior to development. This investigation will verify the precise composition and depth to bedrock at turbine locations, determine the exact depth of excavation, and will determine the quality and strength of the bedrock, and if the material will be suitable for re-use after crushing and screening. Excavated rock will be reused on site, where possible.

The amounts of subsoil and bedrock to be removed will depend on specific construction and excavation plans which are specified in **Table 10.9** below and in EIAR **Chapter 5 Project Description**. The expected total volume of excavated material amounts to 76,251m³ (95,962m³ with bulking factors applied) on the wind farm site and a further 10,875 m³ along the GCR. It is estimated that 530m³ of bedrock will be excavated from the wind farm site.

Table 10.9: Soil, subsoil and bedrock excavation quantities from the wind farm site (95,962 m³)

Wind Farm Component	Total Excavated Topsoil (m³)	Total Excavated Subsoil (m³)	Total Excavated Rock (m³)
Tracks (includes passing bays and reversing bays)	23,077	6,178	
Compound	495		
Drainage	3,784	3,784	
Hardstands	12,508		
Wind Turbine Foundations	1,790	15,776	331
Substation	679	4,598	
Meteorological Mast	12	84	
Internal grid	946	2,208	
Total	43,291	32,629	331
Total with Bulking Factor	56,278	39,154	530
Bulking Factor	1.3	1.2	1.6

Wind farm

- The depth of the excavation required for the turbine foundations is 3mbGL the expected material to be excavated at each location is summarised in **Table 10.10**.
- The substation will require strip foundations poured concrete with depth of excavation up to 2.5mbGL.
- The temporary construction compound area will be constructed by stripping the topsoil, laying a permeable geotextile (depending on ground conditions) and layering and compacting stone material, similar to the site access track build-up.
- Site tracks are required to accommodate the construction works and to provide access to the turbine locations for the whole life cycle of the wind farm. The tracks consist of a volume of c. 15,445m³ (including passing bays and reversing bays).

- Site access tracks will consist of approximately 4.5km of permanent access tracks and 2km of temporary access tracks. All access tracks will require excavation of approximately 300mm of existing ground (topsoil and subsoil) and will be constructed to a finished level close to existing ground level. The tracks will be constructed using a permeable geotextile layer, which is then generally infilled with crushed rock and dressed with finer grained material.
- Site drainage will be constructed along site tracks, hardstanding areas and temporary storage areas. The trenches for drainage will be approximately 10.5km long, 1.8m wide and 0.6m deep and will require the excavation of topsoil and subsoil.
- Cable trenches (5.25km long and 0.6m wide) throughout the wind farm site will be excavated to an anticipated depth of approximately 1m. Excavation of topsoil, tills and potentially bedrock will be required. Granular material and lean mix concrete will be used to surround the cables. The majority of the excavated soils will be used for backfilling with only minor amounts being removed and used elsewhere for berm landscaping.

Grid Connection installation

Grid connection trenches and underground cabling along the option routes will be predominantly within roads and verges, to an anticipated depth of 1.2m, and to a width of 0.6m (with an additional 1m width and 0.05m depth for joint bays). Depending on the detailed design and agreement with ESBN, excavation of road aggregates, soils, bedrock and inferred locally glacial till will be required. The trenches will be backfilled using granular material. Surplus material will be disposed of offsite as inert landfill at a licenced facility or recycled for use elsewhere.

Identified constraints along the GCR option routes are identified in EIAR **Volume III, Appendix 10.2,** highlighting vulnerable areas along the routes including: surface water features, designated and protect(ed)s areas, karst features, abstraction points and aquifer vulnerability.

Table 10.10: Depth of underlying subsoils at main infrastructure locations

		DATA INFERRED FROM MGX 2D RESISTIVITY INTERPRETATION							Wind Turbine Foundation (3m deep)			
Hardstand	**Depth of Excavation mbGL (APPROX.)**	**Topsoil** (Low accuracy in 2D res data, assume 0.3m for all) **mbGL (APPROX.)**	**Depth of Subsoil / Depth to Bedrock Interface mbGL (APPROX.)**	**Minerex GX 2D Res. Line**	**Comment (Assumed Subsoil Depth)**	**Horizon A**	**Horizon B**	**Horizon C**	**Topsoil Excavation Volume (m^3)**	**Subsoil Excavated Volume (m^3)**	**Rock Excavated Volume (m^3)**	**Hardstand Area (m^2)**
T1	**3**	**0.3**	**6 to 9**	**R13 R14**	**7.5**	Thin topsoil layer	Clayey, silty sand and gravel	Weathered karstified limestone	**198.86**	**1,789.71**	**0**	**4,478.62**
T2	**3**	**0.3**	**10 to 14**	**R15 R16**	**12**	Thin topsoil layer	Sandy, gravelly clay and silt	Limestone	**198.86**	**1,789.71**	**0**	**4,715.36**
T3	**3**	**0.3**	**>20**	**R17 R18**	**22**	Thin topsoil layer	Sandy, gravelly clay and silt	Limestone	**198.86**	**1,789.71**	**0**	**4,959.15**
T4	**3**	**0.3**	**>15**	**R19 R20**	**17**	Thin topsoil layer	Sandy, gravelly clay and silt	Limestone	**198.86**	**1,789.71**	**0**	**5,105.14**
T5	**3**	**0.3**	**5 to 11**	**R09 R10**	**8**	Thin topsoil layer	Clayey, silty sand and gravel	Weathered karstified limestone	**198.86**	**1,789.71**	**0**	**4,969.12**
T6	**3**	**0.3**	**>16**	**R3 R4**	**18**	Thin topsoil layer	Sandy, gravelly clay and silt	Limestone	**198.86**	**1,789.71**	**0**	**5,262.58**
T7	**3**	**0.3**	**1 to 4**	**R7 R8**	**2.5**	Thin topsoil layer	Sandy, gravelly clay and silt	Sandstone with areas of weathered sandstone	**198.86**	**1,458.28**	**331.43**	**5,630.67**
T8	**3**	**0.3**	**12 to 20**	**R5 R6**	**16**	Thin topsoil layer	Sandy, gravelly clay and silt	Sandstone	**198.86**	**1,789.71**	**0**	**4,622.35**
T9	**3**	**0.3**	**6 to 12**	**R1 R2**	**9**	Thin topsoil layer	Sandy, gravelly clay and silt	Sandstone with areas of weathered sandstone	**198.86**	**1,789.71**	**0**	**4,807.79**
SS	**2.5**	**0.3**	**3 to 12**	**R11 R12**	**7.5**	Thin topsoil layer	Sandy, gravelly clay and silt	Sandstone with areas of weathered sandstone	**627.00**	**4,597.99**	**0**	**2,474.82**
Total									**2,416.71**	**20,373.98**	**331.43**	**46,640.77**
Total with bulking factors									**3,141.72**	**24,448.78**	**530.29**	

Removal of soils

The soil stripping, excavation and removal of soils or bedrock for the construction of the wind farm will alter the natural soil profile which can be partially reversed during the decommissioning and reinstatement phase of the development. Topsoil is non-renewable therefore the damage or loss of topsoil, an attribute with high importance, can potentially lead a reduction in agricultural yield. Removal of soil will be moderate in scale. When segregated and managed, topsoils and subsoils can be reinstated similar to baseline conditions.

The likely effects of removal and replacement of topsoils and subsoil is considered, localised, direct, short to long-term (depending on if temporary or permanent infrastructure) and moderate adverse with a significance level of **moderate to significant**. These effects are reversible through reinstatement.

Removal of bedrock

The excavation of the limestone bedrock, an attribute with low sensitivity, will be localised and therefore small in magnitude. Breaking of competent bedrock cannot be reinstated to baseline conditions and is therefore a permanent effect.

The likely effects of removal of bedrock are localised, direct, permanent, small adverse with a significance level of **slight**.

Soil removal along existing infrastructure

In areas associated with excavation along the route for the grid installation works for the GCR is within existing infrastructure, therefore the sensitivity is low, and the effect is localised and therefore small in magnitude. The likely effects will be direct, temporary, small adverse effect and **not significant**. The likely effects are reversible through reinstatement.

10.4.2.5 Stockpiles

Excavation material arising during construction of the wind farm will be stored in temporary storage areas with drainage (**Figure 10.1a**). These temporary storage areas are proposed at Turbines T1, T2, T3, T4, T6, T8, and T9, and at the construction compound, substation and site entrance. It is expected that the majority of spoil generated on site will be of subsoils and topsoil with some rock excavated at foundation locations. Spoil deposition area sizes have been calculated with consideration of using topsoil to construct roadside berms along the majority of the site track length. The division of the spoil deposition areas for the overall excavated quantities within the site are outlined in **Table 10.11** below.

A total volume of 47,809m^3 requires temporary storage which means that the minimum storage area required is 35,059m^2. The temporary storage locations are distributed in 10 areas and have a total footprint of 34,032m^2 with a storage capacity of 45,072m^3 (at a height not exceeding 1.5m for topsoil or 2m for subsoil). Material will be reused throughout the construction phase including the use of 14,420m^3 of topsoil as roadside berms; therefore, it is not envisaged that the full capacity will be needed at any one time.

Table 10.11: Distribution and capacity of stockpiles across the wind farm site

Location	Volume required (m^3)	Minimum Area required (m^2)	Area provided (m^2)	Storage capacity (m^3)	Stockpile distribution proportions
Near T1	4,376	3,209	2,668	3,456	0.08
Near T2	4,376	3,209	2,898	3,806	0.08
Near T3	5,744	4,212	3,252	4,377	0.10
Near T4	13,675	10,028	8,137	11,024	0.24
Near T6	4,376	3,209	3,128	4,054	0.09
Near T8	4,376	3,209	2,570	3,393	0.08
Near T9	5,744	4,212	3,671	4,987	0.11
Near Compound	4,376	3,209	3,027	4,004	0.09
Near Substation	383	281	2,129	2,833	0.06
Near Site entrance	383	281	2,552	3,138	0.07
Total	47,809	35,059	34,032	45,072	1.00

The potential for soil erosion or soil stability issues to arise from the stockpiling of spoil material during the construction phase of the Project is largely dependent on site design, site management, vehicular movement and operation during excavation works, and weather conditions. The potential indirect effect of erosion or soil stability issues related to the unmitigated storage of material includes the release of suspended solids and dust.

Should pile foundations be needed, arising from this activity will be a mixture of different underlying materials including soils and bedrock. This mixed material may not be suitable for reuse on site and therefore will have to be stored separately to other material. Soil is an attribute with medium to high sensitivity and the likely effects from the unmitigated storage of materials are direct, short-term, small adverse with a significance level of **slight to moderate**, but reversible through reinstatement with appropriate mitigation.

10.4.2.6 Soil contamination

There is the potential for soil to be contaminated during the construction phase of the Project. Soil can be either a source, pathway or receptor to potential contamination.

Potential sources of contamination include:

- Hydrocarbons.
- Imported soils or aggregate.
- Soil contaminated by invasive species.

Hydrocarbons

The planning red line boundary has relatively high recharge rates, particularly in areas where the underlying geology is karst limestone, and the permeability of subsoils at the site are moderately permeable, particularly in terms of sands and gravels. The efficiency of contaminant migration is limited by site geological properties, for example; infiltration, permeability, and recharge rates of soils.

There is a potential for hydrocarbon contamination from plant use which can directly and adversely affect the health of the soils and therefore effect the environment they support. Should a hydrocarbon pollution event occur and reach the underlying soils these soils can act as a pathway for the hydrocarbon contamination to reach sensitive receptors including groundwater or surface water.

Soil is an attribute with medium to high importance and depending on the scale of the hydrocarbon spill the magnitude may vary between small and moderate. The unmitigated likely effects to soil quality from an accidental spillage would be localised, direct, long-term, small to moderate adverse effect with a significance level of **slight to significant**. However, this likely effect is considered to be naturally reversible (natural attenuation over a relatively medium to long term period of time), or theoretically reversible (through remediation and reinstatement activities over a relatively short to medium term period of time). With appropriate environmental engineering controls and measures, this potential risk can be significantly reduced.

Imported aggregate

A total of 31,351m^3 of imported aggregate is needed for the construction of tracks, hardstands, substation, temporary compound and turbine foundations in the wind farm site. The granular fill material will be obtained from a suitable quarry (i.e., maintaining local geological and hydrological chemistry). The potential sources of aggregate for the proposed Project are outlined in EIAR **Chapter 16 Traffic and Transport**.

There is potential risk that if contaminated or unsuitable material is brought to site and used as fill, it could contaminate previously uncontaminated material. This is an unlikely potential effect as any imported material will be fully tested in accordance with industry standards. Only verified clean, inert material will used.

The unmitigated effect to soil quality, an attribute with medium to high importance, from contamination by imported aggregates although unlikely would be direct, short to long-term, small adverse effect with a significance level of **slight to moderate** and only reversible after remediation. This effect is avoidable with appropriate mitigation.

Invasive species

There are two isolated invasive species areas present on the windfarm site (EIAR **Chapter 7 Biodiversity**). Japanese knotweed was identified in a field boundary to the west of T9 and in the field adjacent to the substation. It was also recorded at Boherash Cross on TDR Option 1 and near to the turn off after Mallow Hospital on TDR Option 2.

Because there is invasive species close to construction works, it is possible that activities (site and vegetation clearing, moving of soils, machinery movement) could disturb the plants and or soils which are contaminated with invasive plant material such as saplings or offshoots which could spread on site.

The unmitigated likely effect to soil quality, an attribute with medium to high importance, from the spread of soils contaminated with an invasive species could range in magnitude from small to moderate. The likely effects would be direct or indirect, short to long-term, small to moderate adverse effect and a significance level of **slight to significant**. The effect may be reversible through remediation. With appropriate environmental engineering controls and mitigation measures these potential effects associated with soil contamination can be significantly reduced.

10.4.2.7 Material and waste management

The construction phase of the Project has the potential to generate various waste streams from construction activities such as soil waste which includes excess soil, subsoil and bedrock and/or contaminated soil arisings at the site.

The excavated material anticipated is summarised in **Table 10.9** and how this material will be reused on site as summarised below in **Table 10.12**. The balance of material is summarised below inclusive of bulking factors applied to the total excavated material. The total surplus material with bulking factors is anticipated to be approximately 647m^3.

Table 10.12: Summary of reuse of excavated materials and balance following reinstatement.

Wind Farm Component	Topsoil (m^3)	Subsoil (m^3)	Aggregate / Rock (m^3)
Roadside Berms	14,420	2,730	
Hardstands	1,343	2,687	530
Hardstand Berms	6,200	4,006	
Wind Turbine Foundations		5,485	
Internal grid		3,035	
Soil spreading	34,099	20,779	
Total reused during construction	56,063	38,722	530
Total excavated with bulking factors	56,278	39,154	530
Surplus material with bulking factors	215	432	0

If any soil or bedrock is not reused on site it will have to be removed to a licensed facility as waste or reused as a by-product. The Circular Economy and Miscellaneous Provisions Act 2022 requires any potential by-product to be notified under Article 27 and it is to be considered a by-product or treated to comply with End of Waste (Article 28) if practicable. Any excavated materials containing invasive species will be appropriately managed in accordance with the NRA guidelines[15] and sent to authorised facilities.

[15] National Roads Authority (2010) Guideline of The Management of Noxious Weeds and Non-Native Invasive Plant Species on National Roads.

The potential effects associated with surplus soil material includes the requirement for additional stockpiles leading to the potential for additional erosion of exposed soils and subsoils and additional compaction. Surplus material would also lead to the increase of vehicular movement to move material around the site and to a licenced facility. If the material which is excavated is not appropriately managed, including appropriate segregation soil / subsoil types or isolating and removing potentially contaminated soil this has the potential to contaminate previously uncontaminated soils adding to waste material that needs to be appropriately disposed of.

The likely effects of unmitigated wastes and poor waste management to the land and soils, attributes of medium to high importance, would be small in magnitude. The effects are considered localised, direct, short-term, small adverse effect with a significance level of **slight** and reversible through remediation.

10.4.2.8 Ground stability

The risk of slope, ground and geological stability issues arising at the wind farm site is very low (section 10.3.10). The maximum slope angle identified on site, using DEM data analysed in GIS software, is 7 degrees. No peat was encountered on site.

The results of the geophysical 2D resistivity screening survey (EIAR **Volume III, Appendix 10.1**) indicates that no subterranean anomalies were detected, therefore the risk of stability issues arising at the survey locations is very low. The possible karst features interpreted to be underlying the proposed turbine locations at T1 and T5 are likely weathered limestone infilled by overburden material. There is potential for buried small voids and cavities / cavernous karst features within the rock as well.

There remains a risk of localised stability issues occurring with a broad range in severity including minor side wall collapse with no significant effect, to relatively significant areas of bedrock being affected by excavation activities, or in worst case scenarios including stability issues relating to karst features. Shallow excavations are proposed on the wind farm site, (i.e., <3m).

While the risk of slope, ground and geological stability issues arising at the wind farm site is very low, there is a risk of localised stability issues. The potential for geological stability issues to arise during the construction phase of the Project is largely dependent on excavations and heavy plant machinery movement and operation during excavation works.

Small scale soil stability issues are associated with medium attribute importance. The likely unmitigated effects are localised, direct or indirect, short-term, small adverse effect with a significance level of **slight** and reversible through remediation.

In the absence of mitigation, a worst-case stability issue, while unlikely, could affect attributes of high to very high importance. The effects would be considered direct or indirect, potentially permanent, moderate adverse effect with a significance level of **moderate to very significant**.

However, with additional detailed geotechnical assessment, engineering controls and application of mitigation measures the risk of stability issues arising or affecting the Project will be reduced.

10.4.3 Operational phase likely effects

10.4.3.1 Land take

Land take will be required during the construction and operation of the wind farm. Once the wind farm becomes fully operational, no further construction other than minor landscaping and maintenance activities will be required. The permanent footprint of the wind farm will remain in place, and this will continue to impact on land, soils and geology during the operational phase. On completion of the construction phase, reinstatement works will be undertaken which will reduce the land take as shown on planning **Drawing No. 20910-NOD-XX-XX-DR_C_08305** and **Drawing No. 20910-NOD-XX-XX-DR_C_08306** (**Part 2** of the Planning Application Documentation). Temporary facilities will be removed and the ground within the contractor's compound will be reinstated with landscaped topsoil. The temporary works/assembly areas needed for the construction period will be reinstated using the original spoil material removed and stockpiled close to the location from where it was excavated. Any temporary site tracks and the temporary entrance will be reinstated following construction. Land take associated with the GCR and TDR will be reinstated following construction phase.

Reinstatement works following construction will reduce the operational land take to approximately 3.49ha, around 6% of the red line planning boundary (58.6ha) and therefore the magnitude of effect on the land, soil and geology under the footprint of the permanent access tracks, permanent hardstanding areas, substation and turbine foundations is small adverse, and the attribute has medium importance. The likely effect of permanent land take associated with Project is the loss of agricultural land. This effect is considered to be localised, direct, long-term, small adverse effect with a significance level of **slight** and reversible after decommissioning.

10.4.3.2 Soil compaction & subsidence

Soils under the permanent footprint of the wind farm, over time have the potential to be compacted, leading to subsidence. Soil quality is considered to have medium to high importance and the magnitude of potential compaction is small. The overall likely effects are considered to be localised, direct, permanent, small adverse effect with a significance level of **slight to moderate**, but with appropriate monitoring, mitigation and maintenance these potential effects can be minimised.

10.4.3.3 Soil contamination

Occasional access necessary for maintenance of the Project (access tracks, substations and turbines) during the operational phase could result in minor accidental leaks or spills of fuels/ oils adversely affecting the underlying soil. The bunded transformer in the substation and transformers in each turbine are oil cooled. There is potential for spills and leaks of oils from this equipment resulting in contamination of soils, which has the potential to be a pathway for the contamination of surface and or groundwater. Soil quality is considered to have medium to high importance and the magnitude of potential contamination is small.

The unmitigated likely effects of soil contamination related to hydrocarbon or oil spills during the operational phase of the Project is considered to be localised, direct, small adverse effect with a significance level of **slight to moderate**, but reversible through remediation.

10.4.4 Decommissioning phase likely effects

In general, the potential effects associated with the decommissioning phase will be similar to those associated with the construction phase but will be of reduced magnitude because excavations will be limited, and wet concrete handling will not be required. The potential environmental effects of soil storage and stockpiling and contamination by fuel leaks will remain during decommissioning.

No new effects are anticipated during the decommissioning phase of the Project in comparison to the construction phase, as stated above, therefore, no new mitigation measures are required. However, the decommissioning of major infrastructure including turbines poses similar hazards and risks to the environment compared to that of the construction phase.

Reinstatement of the site following decommissioning of the proposed infrastructure has the potential to be disruptive and hazardous to the environment, to the point that a 'benefit analysis' will likely be required to evaluate any such activity before it is permitted.

Examples of likely difficulties impeding reinstatement highlighted by means of 'benefit analysis' in terms of land, soil and geology include the following:

- Vibration caused, particularly in relation to the breaking of concrete, may result in an effect on subsoil or geological stability locally.
- Removal of hardstand / site tracks – disturbance to the land, soils and due to operations associated with excavation and removal of hardstand materials.
- The reinstatement of construction access tracks and hardstands.

The material required to reinstate any areas where infrastructure is removed will need to be sourced from elsewhere on the site. A similar construction process will be required at decommissioning (i.e., rebuild hardstand and remove topsoil) given that the condition of the environment will likely change over the course of the operational phase of the development.

The land and soils are considered to be medium to high importance and the magnitude of change is anticipated to be similar to that of the construction phase and therefore medium. The likely effects to the land, soils and geology during the decommissioning phase are considered to be direct, localised, short-term, moderate adverse effect with a significance level of **slight to moderate**.

10.5 Mitigation measures and residual effects

This section outlines the main mitigation measures which will be applied to the Project in order to reduce the potential effects outlined in section 10.4.

Specific mitigation measures will be applicable to varying degrees depending on environmental conditions at any particular location. Therefore, it is important to refer to referenced appended figures and databases (Conceptual Information Graphics) when tailoring and applying mitigation.

10.5.1 Design phase

A process of "mitigation by avoidance" was undertaken by the EIA team during the design of the turbine and associated infrastructure layout. Arising from the results of this study, a constraints map was produced that identified areas where geotechnical constraints (potential for karst features) could make parts of the site less suitable for development. The infrastructure design sought to avoid those areas as much as possible. The layout plan was reviewed and the best layout design available for protecting the site's existing geotechnical (and hydrological) regime was identified, while also incorporating engineering constraints and avoiding other environmental and ecological constraints. There are some risks that cannot be mitigated through design and need to be managed during construction.

10.5.2 Construction phase

10.5.2.1 Construction Environmental Management Plan (CEMP)

All construction works will be managed and carried out in accordance with the Construction Environmental Management Plan (CEMP) (EIAR **Volume III, Appendix 5.1**), which will be updated by the civil engineering contractor and agreed prior to any works commencing on site. All management plans will be 'live' documents, so that lessons learned, and improvements will be made over the course of the construction phase.

Potential emergencies and respective emergency responses are assessed in the Emergency Response Plan of the CEMP. Emergency contact numbers for the Local Authority Environmental Section, Inland Fisheries Ireland, the Environmental Protection Agency and the National Parks and Wildlife Service will be displayed in a prominent position within the vicinity of works.

Best practice will be applied during construction which will minimise double handling of material which will help reduce the site traffic. The management, movement, and temporary stockpiling of material on site, including a materials balance assessment and plan is detailed in the CEMP. Earthwork activities will not be scheduled to be carried out during severe weather conditions.

The CEMP will be developed to include the scheduled daily checks (plant, vehicles, fuel bowsers) during the construction phase of the Project. The purpose of this management control is to ensure that the measures in place are operating effectively, prevent accidental leakages, and identify potential breaches to constraints areas or the protective retention and attenuation network during earthwork operations.

10.5.2.2 Engineering controls

Pending consent for the Project, confirmatory geotechnical testing will be carried out to tailor the engineering controls, such as use of geotextile membranes, required for each individual element.

If required, piling will be undertaken in areas of weathered rock to ensure stability of foundations. A geotechnical risk register will be completed and maintained as part of the construction works. Ground settlement, horizontal movement and vibration monitoring will be implemented during construction activities to ensure that the construction does not exceed the design limitations.

10.5.2.3 *Land take*

The turbines and infrastructure layout were dictated to a large degree by the existing infrastructure (farm tracks), geophysical surveying and topography. Turbines are located in areas where the existing infrastructure is utilised, and the topography and geology are favourable. Similarly, infrastructure has been designed that the areas of land take are being located outside of buffer zones for sensitive receptors and constraints areas.

Following construction, the areas where hardstand, crane pads, etc. are in place, will be covered over in topsoil and will be used for agriculture. This will reduce the land take during the operational phase.

The mitigated residual effects associated with land take for the construction phase have a significance level of slight and based on the criteria outlined in section 10.2.8.3 is considered **not significant**.

10.5.2.4 *Ground or soil sealing*

There is potential for soil sealing due to the use of impermeable material in certain locations typical of most types of construction particularly in greenfield sites.

The effect of soil sealing will be mitigated by reducing the area where impermeable material is used and by the use of semi permeable gravel access tracks to allow water to pass through, therefore reducing runoff. The use of a geotextile membrane on top of soils will likely lead to a degree of subsidence with time. The use of semi permeable material will reduce changes to the geotechnical and hydrogeological attributes compared to impermeable material.

Following construction, temporary construction areas will be covered over in topsoil and will be reintroduced for current agricultural practices. Refer to planning **Drawing No. 20910-NOD-XX-XX-DR_C_08305** and **Drawing No. 20910-NOD-XX-XX-DR_C_08306** (**Part 2** of the Planning Application Documentation).

The mitigated residual effects associated with ground or soil sealing is considered to have a significance level of slight and therefore **not significant**.

10.5.2.5 *Erosion and degradation*

Erosion and degradation of exposed soils will occur primarily during the construction phase. Mitigation against the potential effects, includes:

- Limiting the amount of exposed soil at any one time.
- Limiting vehicular movement to established infrastructure as far as practicable.
- Ceasing construction activities during periods of sustained significant rainfall events, or directly after such events.
- Covering exposed temporary stockpiles with plastic sheeting during periods where works have temporarily ceased (e.g., weekends / overnight) and ahead of heavy rainfall / storm alerts.
- Reusing soils and subsoils as quickly as possible.
- Any areas not required for operation will be reinstated including drainage to minimise future erosion of the soils.

The mitigated residual effects associated with erosion and degradation of soils during construction have a significance level of slight and are therefore **not significant**.

10.5.2.6 Subsoils and bedrock removal

The effect on the land, soils and geology associated with the removal of subsoils and bedrock will be minimised using the following practices.

Mitigation by avoidance

The proposed turbines and infrastructure layout was dictated to a large degree by the existing infrastructure (tracks), geophysical surveying and the topography. Similarly, engineered cut and fill extents which have been designed to minimise the volumes of subsoils to be removed either directly by excavation (turbine foundations) or as a function of cut and fill requirements (hardstands).

Mitigation by reuse

Subsoil and bedrock which are excavated as part of the construction phase will be reused onsite wherever possible. The inferred bedrock at the site based on the 2D resistivity is a mixture of sandstone, weathered sandstone, limestone, and clayey silty sand and gravel/weathered or karstified limestone (EIAR **Volume III, Appendix 10.1**) and will be reused as hardstand subbase.

Mitigation by remediation

On completion of the construction phase, any areas not required for operation will be reinstated. Therefore, the effect of required excavation works will be remediated and limited to the extent of the actual proposed infrastructure. Granular material will be removed as required and reinstated with soils in keeping with the adjacent soils. Drainage will be reinstated as required to minimise future erosion of the soils. This will be carried out at the designated reinstatement locations, with material in identified soil horizons (**Table 10.6**) to revert these areas to near baseline levels were practical.

Mitigation measures outlined will ensure the effects arising from excavation activities are minimised to the footprint of the development.

The mitigated residual effects on soils and bedrock associated with excavations is considered to have a significance level of slight and is therefore **not significant**.

10.5.2.7 Stockpiles

Given that excavations are unavoidable, so too are temporary stockpiles. However, if managed appropriately, the potential effects associated with stockpiles can be minimised. The management of geological materials is an important component of controlling dust, erosion and sediment.

The temporary stockpiles are outlined in **Figure 10.1a**, are within the development footprint and avoid geo-constraints. Temporary set down / stockpile areas which are close to most of the main infrastructure units apart from T5 and T7. The stockpile near T5 was removed due to the identified karst feature / historic quarry and was removed from T7 due to the topography.

Mitigation measures for stockpiles related to construction of the wind farm are as follows:

- Storage of excavated soils will be kept outside of any sensitive buffers (see EIAR **Chapter 9 Hydrology and Hydrogeology** and **Chapter 15 Archaeology & Cultural Heritage**).
- Temporary stockpiles will be limited in height (1.5m for topsoil and 2m for subsoil) and shall have side slopes battered back to a safe angle of repose.
- Exposed temporary stockpiles will be covered in plastic sheeting during periods where works have temporarily ceased (e.g., weekends / overnight) and ahead of heavy rainfall / storm alerts.
- Temporary stockpile areas will be managed to facilitate the orderly segregation of material types. Separate temporary stockpiles will be designated so as to not mix individual soils horizons which will, in turn will facilitate reuse on site.
- Excavated topsoil, subsoil and rock will be re-used on the site as soon as possible, thereby reducing the need for double handling, reducing the need for stockpiling, and reducing the potential for soil erosion.
- Materials will be managed by the contractor in accordance with the CEMP (EIAR **Volume III, Appendix 5.1 CEMP**).
- No stockpiles will remain on site following the construction phase of the development and are therefore both temporary and reversible.
- Mitigation measures for stockpiles related to the grid connection installation include reusing excavated material to backfill the trench where appropriate. Any surplus material will be managed in accordance with the relevant waste management legislation.

The mitigated residual effects on the soils associated with storage of stockpiles is considered to be **not significant.**

10.5.2.8 Vehicular movements

Excavation volumes have been minimised through the design phase, by avoiding excessive cut and fill during construction. This will result in reduced site traffic. The mitigation measures to reduce the potential effects to land, soils and geology including erosion and soil stability from vehicular movements include:

- Excavated material will only be moved short distances from the point of extraction (as far as practicable) and will be used locally for reinstatement, landscaping of improvement areas, thereby reducing the on-site traffic.
- Ancillary machinery will be kept on established turbine hardstands. As far as practicable vehicles will be limited to the footprint of the development and will not move onto land that is not proposed for the development. For example, excavation ahead of established hardstands will be in line with expected phases of turbine hardstand and site track construction in terms of both delivery and installation of material and site activity periods.
- No vehicular movement will be permitted in archaeological buffers (refer also to EIAR **Chapter 15 Archaeology & Cultural Heritage**).

- For the GCR, before starting construction, the area around the edge of each joint bay which will be used by heavy vehicles will be surfaced with a terram cover (if required) and stone aggregate to minimise ground damage.

The mitigated residual effects associated with vehicular movements is considered to be **not significant.**

10.5.2.9 Soil contamination

Soil contamination, or the potential for contamination, is an inherent risk associated with any development. Protecting soils from contamination from construction materials such as hydrocarbons, drilling fluids and other contaminants will in turn mitigate against the potential for contaminants reaching the hydrological network associated with the site and therefore additional sensitive receptors.

- As discussed, construction activities will be restricted to the footprint of the development, therefore the potential for contaminants reaching soils is likely limited to the footprint of the development or construction area.
- Dedicated, bunded storage areas will be used for all fuels or hazardous substances.
- Any and all contaminants including any contaminated soil will be removed from the site in an appropriate manner if and when they should be produced or observed, and suitable remediation work undertaken.
- In the event of a significant contamination or pollution incident e.g., discharge or accidental release of hydrocarbons / fuel, contamination occurrences will be addressed immediately, this includes the cessation of works in the area of the spillage until the issue is resolved. If necessary, the relevant authorities will be notified, and stakeholders will also be promptly informed.

Release of hydrocarbons

Any vehicles coming onto the wind farm site will be required to be inspected and cleaned before leaving the temporary construction compound and advancing to the construction area.

In the event of an accidental spill of hydrocarbons, contamination occurrences will be addressed immediately (EIAR **Volume III, Appendix 5.1 CEMP)**. This includes the cessation of works in the area of the spillage until the issue is resolved. No materials contaminated including soils will be left on the wind farm site.

Imported aggregate

To mitigate against the potential effects of importing contaminated aggregate to the land and soils, only verified clean, inert material will be used.

Imported rock will be locally sourced and conform to relevant standards, will not change the baseline conditions. The nearest suppliers of quarry stone (TII Class 6 products) are identified in EIAR **Chapter 16 Traffic and Transport**.

Invasive species

Areas which have been identified as containing non-native invasive species (see EIAR **Chapter 7 Biodiversity, Figure 7.4**) will be avoided and fenced off. There is still the possibility that soils in areas in close proximity to invasive species may be contaminated with invasive plant material. If these potentially contaminated soils are not handled correctly it could lead to the contamination of previously uncontaminated soils and spread across the wind farm site.

The removal, treatment and disposal of any identified invasive non-native plants including contaminated soils will be undertaken in accordance with the latest guidance by the Appointed Contractor to prevent further growth or spread beyond the wind farm site.

The mitigated residual effects on soil quality associated with soil contamination is considered to have a significance level of slight and therefore **not significant**.

10.5.2.10 Material and waste management

A Resource and Waste Management Plan has been prepared as part of the CEMP. All excavated earth materials, wherever possible, will either be re-used in an environmentally appropriate and safe manner (e.g., reinstatement, landscaping) or removed from the wind farm site at the end of the construction phase.

Any surplus of natural materials (e.g., soils) will be used as backfill or deposited elsewhere in the wind farm site and will not be deposited above the existing / original ground level for the area in question. Surplus natural materials may be utilised to aid in the development of habitat enhancements, see EIAR **Chapter 7 Biodiversity**.

Excavated materials onsite will be reused and recycled according to the Waste Hierarchy. Where it is not possible to reuse onsite, any excess materials will be taken offsite and reused as a by-product where appropriate or disposed of at a licensed facility at the end of the construction phase in accordance with the Waste Management Act 1996 (as amended), the Waste Management (Collection Permit) Regulations 2007 (as amended) and the Waste Management (Facility Permit & Registration) Regulations 2007 (as amended). Waste streams will vary and will include the following potential categories:

- Inert / Non-Hazardous Soils & Stones (EWC Code: 17 05 04) – greenfield subsoils and bedrock is likely to be Inert. This could include surplus coarse / hardcore aggregate contaminated with soils remaining at the end of the construction phase of the Project.
- Hazardous Soils & Stones (EWC Code: 17 05 03*) or oily waste (spill kit consumables) – Soils or any materials with significant hydrocarbon contamination will likely be hazardous due to Total Petroleum Hydrocarbon concentrations. Soils affected by significantly cementitious material contamination (potentially arising from piling foundation excavations) will likely be hazardous due to elevated pH concentrations.
- Invasive species or soil potentially contaminated with invasive species.

Any surplus excavated material from roadways will be disposed of to a licenced facility in line with The Circular Economy Act and the Best Practice Guidelines[16].

The mitigated residual effects associated with materials and waste management is considered to be **not significant.**

[16] Environmental Protection Agency (EPA) Best Practice Guidelines for the preparation of resource and waste management plans for construction and demolition projects - Available at: https://www.epa.ie/publications/circular-economy/resources/CDWasteGuidelines.pdf

10.5.2.11 Ground stability

A geotechnical engineer / engineering geologist will be employed during the construction phase to monitor excavation activities, to verify that safety standards are being met and monitor for any potential stability issues, particularly in areas of deeper excavations, and areas with the potential to encounter weathered limestone or karst features.

Slope stability investigations and screening (section 10.3.10) at the site indicate that the site has a generally low risk probability with respect to ground stability and slope failure under the footprint of the development. A geotechnical investigation will be carried out at each proposed infrastructure unit location prior to works commencing. Surveying will include the drilling of boreholes by rotary core to depth within competent bedrock to determine the strength of rock and assess the potential for karst or weathered rock at each location by a qualified geotechnical engineer to inform foundation design. Piling will be undertaken in areas of weak rock to ensure long term stability.

There remains a low risk of stability issues arising as a result of excavation activities, particularly at a localised scale. With a view to applying the precautionary principle, the following procedures will be adopted as best practice mitigation measures at the wind farm site to mitigate against potential ground stability effects:

- The Contractor’s methodology statement and risk assessment will be in line with the CEMP and will be reviewed and approved by a suitably qualified geotechnical engineer/engineering geologist prior to site operations.
- Particular attention and pre-construction assessment (developer / sub-contractor site specific risk assessment and method statement (RAMS) and on-site toolbox talks etc.)
- An emergency response system will be developed for the construction phase of the Project, particularly during the early excavation phase.
- Construction activities will not occur during periods of sustained significant rainfall events, or directly after such events to allow time for work areas to drain.
- Vehicular movements will be restricted to the footprint of the proposed development.
- Temporary stockpiles will be restricted to the footprint of the proposed development and adhere to mitigation measures outlined in section 10.5.2.7.
- In the event that soil stability issues arise during construction activities, all ongoing construction activities at the particular area of the site will cease immediately, the assigned geotechnical supervisor will inspect and characterise the issue at hand, corrective measures will be prescribed.

Adhering to the mitigation measures described will minimise the adverse effects posed by stability issues.

The mitigated residual effects associated with ground stability on the land, soils and geology are considered to have a significance level of slight and therefore **not significant.**

10.5.2.12 Construction phase residual effects

Mitigation measures outlined in this report lay down the framework to reduce all potential effects of the Project on geological receptors. The mitigation laid out in this chapter provides mitigation by avoidance measures for land, soils and geology. The mitigated potential effects lay down the achievable benchmarks provided measures are considered and implemented adequately.

The unavoidable residual effects on the soils and geology environment as a function of the Project, is that there will be a change in ground conditions at the wind farm site with natural materials such as soil, subsoil and bedrock being replaced by concrete, subgrade and surfacing materials.

The residual effects after implementation of all mitigation measures for the construction phase of the Project on the land, soils and geology are considered to be generally short-term (length of construction) to long-term, localised to the footprint of the development and partially reversible through reinstatement. The mitigated residual effects are considered to have a significance level of slight and therefore are **not significant**.

10.5.2.13 Reinstatement phase residual effects

On completion of reinstatement works following the construction phase, it is expected that the wind farm will be returned as close to its present condition as possible and will continue to be used for farming. With the passage of time the site will be reinstated and left to revegetate naturally over and revert to a more natural drainage regime. It is expected that the long-term residual effects associated with the wind farm development will therefore have a significance level of slight and therefore **not significant**.

10.5.3 Operational phase

No further effects are anticipated during the operational phase of the Project on the geological, geomorphological and geotechnical environment therefore no additional mitigation measures are required.

Maintenance and monitoring during the operational phase of the Project pose similar potential effects associated with the construction phase but to a far lesser extent. The operational team will carry out maintenance works (to site tracks, onsite substation and turbines) and will put in place control measures to mitigate the risk of hydrocarbon or oil spills during the operational phase of the wind farm. Any vehicles utilised during the operational phase will be maintained on a weekly basis and checked daily to ensure any damage or leakages are corrected.

The likely effects on the land, soil and geology during the operational phase of the Project will be mitigated through good site practice, management of vehicular movements, hydrocarbon controls. The mitigated residual effects from the operational phase are considered to have a significance level of slight and are therefore **not significant.**

10.5.4 Development decommissioning and reinstatement phase

10.5.4.1 Decommissioning of infrastructure

Following the permitted lifespan of the wind farm (35 years), it will be decommissioned. All physical infrastructure (turbines, substation, mast etc.) will be removed, re-used or recycled as appropriate. Turbine foundations will be left in situ and covered in topsoil and allowed to revegetate.

Mitigation measures for the decommissioning phase are the same as those outlined for the construction phase (section 10.5.2).

Residual effects after the decommissioning phase are complete include all effects classified as being long-term to permanent effects of the development, that is, there will remain a change in ground conditions at the site with the replacement of natural materials such as subsoil and bedrock by concrete, subgrade and surfacing materials.

Following reinstatement and decommissioning the land will continue to be used for farming.

10.5.4.2 Decommissioning phase residual effects

The mitigated residual effects associated with decommissioning includes waste generation, potential hydrocarbon leakage and erosion of soil and rock. In general, effects will be similar to those at construction and operation, but of a greatly reduced magnitude and are therefore considered to have a significance level of slight and therefore **not significant**.

10.5.5 Cumulative effects

On a national scale the importance of land and soils in terms of ecological value must be considered. Aims and objectives for soil quality and soil health have been outlined in the *EU Soil Strategy* (EC, 2021). To name a few:

- All EU soil ecosystems are healthy and more resilient and can therefore continue to provide their crucial services.
- No net land take and reduction in soil pollution.
- Protecting and reducing degradation of soils, as well as sustainable management practices.

Mitigation measures installed on site would also 'restore degraded soils' and 'reduce erosion'.

Cumulative effects as defined by the EPA (2022), is the addition of many minor or insignificant effects, including effects of other projects, to create larger, more significant effects. Considering the discipline under investigation, land, soils and geology, and the fact that potential effects of the Project are localised, the cumulative effects of the Project are not considered to vary dramatically or behave synergistically when considering the site as a unit, or indeed when considering in conjunction with other developments in the vicinity.

To assess the cumulative effects, planning research was conducted in relation to all relevant projects and wind farms within the surrounding area. Of the scoped in projects outlined in **Table 2.2**, EIAR **Chapter 2 EIA Methodology,** three projects have been considered here, the remaining have not been considered due to distance from the Project. The potential effects for these omitted projects are also likely to be localised in terms of land, soils and geology and are not likely to lead to larger, more significant effects.

Residual effects with N/M20 Cork to Limerick improvement scheme have been considered with regard to the land take and can be determined to have a slight residual effect provided mitigation measures are followed. The road improvement is a linear development with a presumed tight red line planning boundary and therefore a small, localised land take relative to the size of the area. Both of the proposed TDR routes will cross the proposed N/M20 corridor in certain areas. The preferred route for this national road proposal was considered in the project design. While the residual effects associated with land take along TDR are slight, if the road was to be upgraded prior to works along the TDR this may reduce some of the land take needs along the TDR. The cumulative effects anticipated from the improvement to the N/M20 corridor, and the proposed TDR are **not significant**.

Residual effects from housing developments in Mallow (Hazelbrook Housing Development and Clonmore Housing Development) would also lead to slight residual effects on the land, soils and geology environment with the replacement of natural materials such as soil with construction materials such as concrete similarly to the Project. As these construction projects are close to GCR Option 1 (within 200m) therefore the cumulative effects would be considered to have a significance level of slight and therefore **not significant.**

EIAR Volume II

Main Report

Chapter 11: Material Assets

CONTENTS

TABLES

APPENDICES (EIAR Volume III)

11 MATERIAL ASSETS

11.1 Introduction

This chapter of the Environmental Impact Assessment Report (EIAR) for the proposed Tullacondra Green Energy Project ('the Project') presents an assessment of the likely significant effects of the Project on material assets (*i.e*., waste, utilities, telecommunications and aviation) during the following phases of the Project:

- Construction of the Project.
- Operation of the Project.
- Decommissioning of the Project.

This chapter of the EIAR is supported by the following Appendices provided in **Volume III** of this EIAR:

- **Appendix 11.1 Ai Bridges Telecommunications Impact Study.**
- **Appendix 11.2 Ai Bridges Aviation Review Statement**.

The Project includes the construction, operation and decommissioning of a wind energy development consisting of nine wind turbine generators with foundations and crane pad hardstanding areas; a permanent meteorological mast; an on-site 38kV substation, underground cabling connecting the turbines to the on-site substation; and underground grid connection to the boundary of the Mallow 110kV substation; along with all associated site works including site clearance, temporary compounds and storage areas; a new temporary entrance and upgrade of an existing entrance; upgrade of existing site tracks and construction of new site tracks; site drainage; and ancillary developments including security gates and fencing, lighting and signage; and biodiversity mitigations and enhancements. This chapter includes an assessment of the likely significant effects from both Grid Connection Route (GCR) Options and both Turbine Delivery Routes (TDR) Options.

The site layout plan of the proposed wind farm is shown in **Figure 1.4**, in EIAR **Chapter 1 Introduction**. Further details of the Project, the construction programme and sequencing of works which are used as the basis for assessments in this EIAR are provided in **Chapter 5 Project Description**.

11.1.1 Statement of Authority

This chapter was prepared by Ursula Daly, Senior Environmental Consultant with Nicholas O'Dwyer Ltd (part of the RSK Group). Ursula has a BSc in Land Use and Environmental Management with Professional Studies from Queen's University Belfast. Ursula has over seven years' experience in the environmental consultancy sector and is a member of the Chartered Institute of Water and Environmental Management (CIWEM). Ursula has prepared numerous environmental impact assessment report chapters for various developments such as major infrastructural developments, mixed use developments and renewable energy development projects.

Kevin Hayes is the Founding Director and Engineering Contracts Manager in Ai Bridges Ltd. Kevin has over 20 years' experience in telecommunications network design, aviation impact studies and project management. Kevin has a B.Eng Hons in Electronic Engineering – Communications & Industrial Automation and M.Eng Hons in Electronic Engineering- Communications & Communications Engineering. He also managed and designed the software prediction model for the TVI & Broadband EMI Interference Studies for wind farms.

11.2 Methodology

The legislation and guidance documents, as detailed in EIAR **Chapter 2 EIA Methodology** were considered and applied as part of the preparation of this assessment.

The EIA Directive defines material assets as 'resources that are valued and that are intrinsic to specific places; they may be of either human or natural origin'. The Environmental Protection Agency (EPA) Guidelines[1] state that material assets are taken to mean "built services and infrastructure, roads and traffic and waste management". The European Commission Guidance[2] refers to several examples of material assets including buildings, other structures, mineral resources, and water resources.

In this EIAR, the impacts on some of the material assets described in the above guidance have already been considered in the following EIAR chapters and therefore these aspects will not be addressed in specific detail within this chapter:

- **Chapter 6 Population and Human Health**
- **Chapter 9 Hydrology & Hydrogeology**
- **Chapter 10 Land, Soils & Geology**
- **Chapter 15 Archaeological, Architectural and Cultural Heritage**
- **Chapter 16 Traffic & Transport**
- **Chapter 17 Air Quality**
- **Chapter 18 Climate**

The material assets considered in this chapter, thus include waste management and built services that include:

- Utilities (gas, electricity, water and waste)
- Telecommunications
- Aviation

The Zone of Influence (ZoI) includes the red line boundary (refer to EIAR **Chapter 1 Introduction, Figure 1.3**) with the addition of a 50m buffer along the TDR options. The

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[1] Environmental Protection Agency. 2022. Guidelines on the Information to be contained in Environmental Impact Assessment Reports.

[2] European Commission. 2017. Environmental impact assessment of projects – Guidance on the preparation of the environmental impact assessment report (Directive 2011/92/EU as amended by 2014/52/EU).

expansive study area extends to the availability of construction materials, and capacity of waste management infrastructure.

11.2.1 Materials and Waste

The assessment of the effects of the Project, arising from the consumption of resources and the generation of waste materials, was carried out taking into account the methodology specified in relevant guidance documents, along with an extensive document review to assist in identifying current and future requirements for waste management; including national and regional waste policy, waste strategies, management plans, legislative requirements and relevant reports.

This chapter is based on the Project, as described in EIAR **Chapter 5 Project Description** and considers the following aspects:

- Legislative context
- Construction phase (including site preparation, excavation, and construction)
- Operational phase
- Decommissioning phase

A desktop study was carried out which included the following:

- Review of applicable policy and legislation which creates the legal framework for resource and waste management in Ireland.
- Identification of the typical waste materials that will be generated during the construction, operational and decommissioning phases of the Project.
- Identification of operational permitted waste management facilities in the vicinity.

Mitigation measures are proposed for the construction, operational and decommissioning phases to promote efficient waste segregation and to reduce the quantity of waste requiring disposal. This information is presented in section 11.5.

Waste management in Ireland is subject to EU, national and regional waste legislation and control, which defines how waste materials must be managed, transported and treated. The overarching EU legislation is the Waste Framework Directive[3] (2008/98/EC) which is transposed into national legislation in Ireland. The cornerstone of Irish waste legislation is the Waste Management Act 1996 (as amended)[4]. European and national waste management policy is based on the concept of the 'waste hierarchy', which sets out an order of preference for managing waste (prevention > preparing for reuse > recycling > recovery > disposal).

EU and Irish National waste policy also aims to contribute to the circular economy by extracting high-quality resources from waste as much as possible. The Circular Economy (CE) is a sustainable alternative to the traditional linear (take-make-dispose) economic model, reducing waste to a minimum by reusing, repairing, refurbishing, and recycling

[3] European Parliament. 2018. Waste Framework Directive (WFD) 2018/851.

[4] Government of Ireland. 1996. Waste Management Act 1996 (as amended).

existing materials and products. The Circular Economy and Miscellaneous Provisions Act 2022[5] underpins this shift in Ireland.

The Irish government has issued policy documents which outline measures to improve waste management practices in Ireland and help the country achieve EU targets in respect of recycling and disposal of waste. The most recent policy document, Waste Action Plan for a Circular Economy (WAPCE) – Waste Management Policy in Ireland[6], was published in 2020 and shifts focus away from waste disposal and moves it back up the production chain. The move away from national waste targets is due to the Irish and international waste context changing in the years since the launch of the previous waste management plan, A Resource Opportunity[7], in 2012.

One of the first actions to be taken from the WAPCE was the development of the Whole of Government Circular Economy Strategy 2022-2023 'Living More, Using Less'[8] to set a course for Ireland to transition across all sectors and at all levels of Government toward circularity and was issued in December 2021. As detailed above, the Circular Economy and Miscellaneous Provisions Act 2022 underpins this shift in Ireland.

The strategy for the management of waste from the construction phase is in line with the requirements of the EPA's 'Best Practice Guidelines for the Preparation of Resource & Waste Management Plans for Construction & Demolition Projects[9]. The guidance document, Best Practice Guidelines for the Preparation of Waste Management Plans for Construction and Demolition Projects and Construction and Demolition Waste Management: A Handbook for Contractors and Site Managers[10], was also consulted in the preparation of this assessment.

Guidance is taken from industry guidelines, plans and reports including the Southern Region Waste Management Plan 2015 – 2021[11], BS 5906:2005 Waste Management in Buildings – Code of Practice[12], the EPA National Waste Database Reports 1998 – 2020[13] and the EPA National Waste Statistics Web Resource[14].

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[5] Government of Ireland. 2022. Circular Economy and Miscellaneous Provisions Act 26 of 2022.

[6] Government of Ireland. 2020. Waste Action Plan for a Circular Economy.

[7] Department of the Environment, Heritage and Local Government. 2012. A Resource Opportunity- Waste Management Policy in Ireland.

[8] Government of Ireland. 2021. Living More, Using Less: Ireland's first national circular economy strategy

[9] Environmental Protection Agency. 2021, Best Practice Guidelines for the Preparation of Resource and Waste Management Plans for Construction & Demolition Projects.

[10] FÁS & Construction Industry Federation. 2002, Practice Guidelines for the Preparation of Waste Management Plans for Construction and Demolition Projects and Construction and Demolition Waste Management: A Handbook for Contractors and Site Managers.

[11] Southern Region Waste Region. 2015. Southern Region Waste Management Plan 2015 – 2021.

[12] British Standard, BS 5906:2005. Waste Management in Buildings – Code of Practice.

[13] Environmental Protection Agency. 2020. National Waste Database Reports 1998 – 2020.

[14] EPA. National Waste Statistics. https://www.epa.ie/our-services/monitoring--assessment/waste/national-waste-statistics/, accessed 18/01/2024.

11.2.2 Utilities

In order to assess the likely significant effects on gas, electricity, water infrastructure and waste services, a scoping exercise was carried out with a number of key consultees, including ESB Networks (ESBN), Uisce Éireann (formerly Irish Water) and Local Authorities. Full details of the scoping exercise that was carried out is provided in EIAR **Chapter 3 Scoping, Consultations, Community Engagement and Key Issues**.

In order to assess the likely significant effects on utilities (gas, electricity, water and waste management infrastructure) in the vicinity of the Project, an engineering assessment was undertaken on the proposed GCR options displayed on EIAR **Chapter 1 Introduction, Figure 1.1**. This included field survey and engagement with the Cork County Roads Authority, the Cork National Roads Office, Transport Infrastructure Ireland and Iarnród Éireann to determine the best engineering solution for crossings of National Roads, bridges and watercourses. Refer to EIAR **Chapter 5 Project Description** for a summary of the GCR crossing points and proposed solutions for each option assessed.

11.2.3 Telecommunications

Ai Bridges was commissioned to undertake a telecommunications impact assessment of the operational phase of the Project which is presented in **Volume III Appendix 11.1**.

There are four primary stages in preparing and compiling a communication impact study:

- Telecom operator consultations
- Field surveys
- Desktop survey network modelling and analysis
- Report generation.

Ai Bridges assessed the impact of the Project on three communication links, one ENET Network link, one Virgin Media Network link and one Vodafone Ireland Network link using radio 3D network modelling.

A review of relevant planning and policy documents was undertaken to identify relevant objectives in relation to telecommunication. The following documents have been reviewed:

- Cork County Development Plan (2022 – 2028)[15]
- Best Practice Guidelines for the Irish Wind Energy Industry (2012)[16]
- Information on Electric and Magnetic Fields (2014)[17]
- Wind Energy Development Guidelines, Department of Environment, Heritage and Local Government (2006)[18]

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[15] Cork County Council. 2022. Cork County Development Plan 2022-2028.

[16] Irish Wind Energy Association. 2012. Best Practice Guidelines for the Irish Wind Energy Industry.

[17] Eirgrid. 2014. Information on Electric and Magnetic Fields.

[18] Department of Housing, Planning and Local Government. 2006. Wind Energy Development Guidelines.

- Draft Revised Wind Energy Development Guidelines (2019)[19]

11.2.4 Aviation

Following scoping (refer to EIAR **Chapter 3 Scoping, Consultations, Community Engagement and Key Issues** for aviation scoping responses), Ai Bridges were commissioned to undertake an Aviation Review Statement of the operational phase of the Project, which is presented in **Volume III Appendix 11.2**. As part of the review, the following subjects were considered:

- Annex 14 - Obstacle limitation surfaces (OLS)
- Annex 15 – Aerodrome surfaces
- Minimum sector altitudes (MSA)
- Instrument flight procedures
- Permitted wind farms in vicinity of the Project
- Communications, navigation and radar surveillance systems safeguarding
- Flight inspection and calibration
- Aeronautical obstacle warning light scheme

11.2.5 Description and Significance of Effects

Effects are described in accordance with the EPA Guidance as presented in EIAR **Chapter 2 EIA Methodology**.

The significance criteria are summarised in **Table 11.1**.

Table 11.1: Significance criteria

Significance level	Criteria
Imperceptible	An effect capable of measurement but without significant consequences.
Not significant	An effect which causes noticeable changes in the character of the environment but without significant consequences.
Slight	An effect which causes noticeable changes in the character of the environment without affecting its sensitivities.
Moderate	An effect that alters the character of the environment in a manner that is consistent with existing and emerging baseline trends.

[19] Department of Housing, Planning and Local Government. Draft Revised Wind Energy Development Guidelines. 2019

Significance level	Criteria
Significant	An effect which, by its character, magnitude, duration or intensity alters a sensitive aspect of the environment.
Very Significant	An effect which, by its character, magnitude, duration or intensity significantly alters most of a sensitive aspect of the environment.
Profound	An effect which obliterates sensitive characteristics.

Based on the defined criteria, where an effect has been classified as Significant, Very Significant or Profound, it is considered Significant in accordance with the EIA Directive. Where an effect has been classified as Imperceptible, Not significant, Slight or Moderate, it is considered Not Significant in accordance with the EIA Directive.

11.3 The Baseline Environment

11.3.1 Waste

Cork County Council (CCC) is the Local Authority responsible for setting and administering waste management activities in the area. This is governed by the requirements set out in the Southern Region Waste Management Plan 2015 – 2021[11] and the WAPCE[6].

The Southern Region Waste Management Plan sets out the strategic targets for waste management in the region:

- A 1% reduction per annum in the quantity of household waste generated per capita over the period of the plan.
- Achieve a recycling rate of 50% of managed municipal waste by 2020.
- Reduce to 0% the direct disposal of unprocessed residual municipal waste to landfill (from 2016 onwards) in favour of higher value pre-treatment processes and indigenous recovery practices.

The EC (Waste Directive) Regulations 2011, as amended[20] set a 70% target for the reuse, recycling and recovery of Construction and Demolition (C&D) waste in Ireland by December 2020. The EPA reported in the National Waste Report 2012, that Ireland surpassed this target, with a recovery rate of 97%. As mentioned in the plan, there is significant potential for recycling C&D given its characteristics. Articles 27 and 28 of the EC (Waste Directive) Regulations 2011[20], as amended set out the grounds by which a material can be deemed to be a by-product rather than a waste (Article 27) and the grounds for deeming a material to no longer be a waste (Article 28). The National Waste Statistics update published by the EPA in November 2021 identifies that Ireland's current target of "Preparing for reuse and recycling of 50% by weight of household derived paper,

[20] Government of Ireland. S.I. No. 323 of 2020. European Union (Waste Directive) Regulations 2020.

metal, plastic & glass (includes metal and plastic estimates from household waste electrical and electronic equipment (WEEE))" was met for 2020 at 51%; however, they are currently not in line with the 2025 target (55%).

A desktop study was undertaken to review the licensed waste facilities in proximity of the Project. Facilities in Ireland carrying out waste activities are required to obtain authorisation in accordance with the Waste Management Act 1996, as amended[4]. Depending on the type of waste activities carried out at the facility these may be exempt or require either a waste licence, waste facility permit (WFP) or a certificate of registration (COR).

The EPA database and the National Waste Collection Permit Office (NWCPO) database were reviewed for permitted waste facilities in proximity to the Project.

Table 11.2 presents the permitted waste facilities in proximity to the Project and the type of waste they accept.

Table 11.2: Permitted Waste Facilities in proximity to the Project

Facility Name	Permit No.	Location	Waste Accepted
John O'Connor (Trading as: Glenanore Carton)	WFP-CK-09-0008-03	Ballygrellihan Castletownroche Co Cork P51 KV76	paper and cardboard packaging plastic packaging
Greenvalley Plant Hire & Land Reclamation Ltd	COR-CK-18-0118-01	Ballyheen South Kanturk Co Cork	soil and stones other than those mentioned in 17 05 03
Mallow Contracts Limited	WFP-CK-21-0218-01	Ballymorisheen Grenagh Co Cork	soil and stones other than those mentioned in 17 05 03
Enva Organics Ltd	COR-CK-19-0126-01	Ballynageehy Mallow Co. Cork	sludges from treatment of urban wastewater
John O'Flynn	WFP-CK-19-0199-01	Baltydaniel East Mallow Co. Cork	soil and stones other than those mentioned in 17 05 03
Crossmore Transport Ltd	WFP-CK-11-0099-03	Carrigdownane Upper Rockmills, Kildorrery Co Cork P67 YC99	end-of-life tyres
Joe O'Sullivan.	WFP-CK-11-0091-06	Cloonbannin West Dernagree Mallow Co Cork P51 NY07	end-of-life vehicles end-of-life vehicles, containing neither liquids nor other hazardous components
Enva Organics Ltd	COR-CK-13-0060-02	Fiddane North Mallow Co Cork	sludges from treatment of urban wastewater
John Shanahan	WFP-CK-18-0184-01	Killuragh Ballygriffin Mallow Co Cork	end-of-life vehicles

Facility Name	Permit No.	Location	Waste Accepted
			end-of-life vehicles, containing neither liquids nor other hazardous components
Christy O'Leary Plant Hire Ltd	WFP-CK-19-0198-01	Lower Road Knocknagree Mallow Co Cork P51 V12D	soil and stones other than those mentioned in 17 05 03
Abbeyross Manufacturing Company Limited t/a Munster Waste Management	WFP-CK-09-0032-04	Spa Road Mallow Co Cork	waste plastics (except packaging) materials unsuitable for consumption or processing wastes not otherwise specified. sawdust, shavings, cuttings, wood, particle board and veneer other than those mentioned in 03 01 04 paper and cardboard, plastic, glass, wooden, metallic and mixed packaging concrete and bricks tiles and ceramics mixture of concrete, bricks, tiles and ceramics other than those mentioned in 17 01 06 wood, glass and plastic copper, bronze, brass, aluminium, lead, zinc, iron and steel mixed metals cables other than those mentioned in 17 04 10 soil and stones other than those mentioned in 17 05 03 gypsum-based construction materials other than those mentioned in 17 08 01 mixed construction and demolition wastes other than those mentioned in 17 09 01, 17 09 02 and 17 09 03 other wastes (including mixtures of materials) from mechanical treatment of wastes other than those mentioned in 19 12 11 paper and cardboard biodegradable kitchen and canteen waste clothes and textiles wood other than that mentioned in 20 01 37

Facility Name	Permit No.	Location	Waste Accepted
			biodegradable waste other non-biodegradable wastes mixed municipal waste waste from markets street-cleaning residues waste from sewage cleaning bulky waste
Irohaul Limited	WFP-CK-15-0153-02	Unit 1 Intertrade House Kilvealaton West Newberry, Mallow, Co Cork P51 DE22	metallic and glass packaging glass metals

11.3.2 Utilities

Desktop and on-site surveys have been carried out to identify utility services. Within the wind farm site, there are electricity and water services present to the southeast within the blue line boundary, in close proximity to the landowner's house and farmstead. No other utilities have been identified within the blue line boundary. The engineering assessment undertaken for the proposed GCR options identified several points where existing services such as gas and water mains intersect the GCR options. Refer to EIAR **Chapter 5 Project Description**.

11.3.3 Telecommunications

As part of the Telecommunications Impact Study (**Volume III Appendix 11.1**), Ai Bridges identified five telecommunications mast-sites as sites with network infrastructure that could potentially be impacted by the Project and a field survey of each of these mast-sites was carried out. During the field surveys, radio antennas with bearings in the direction of the wind farm were recorded. Details of the five telecommunications mast-sites assessed are detailed below:

- Bweeng – located ca. 12km south of Project.
- Mount Hillary – located ca. 11km southwest of Project.
- Banteer – located ca. 12km southwest of Project.
- Shinanagh – located ca. 10km northeast of Project.
- Lidl Charleville – located ca. 14km northeast of Project.

11.3.4 Aviation

As part of the Aviation Review Statement (**Volume III Appendix 11.2**), Ai Bridges identified Cork international airport as the closest to the wind farm site (located ca. 42km to the south-east).

11.4 Potential Effects of the Project

11.4.1 "Do-nothing" Scenario

11.4.1.1 Waste

If the Project were not to proceed, there would be no effect on waste infrastructure.

11.4.1.2 Utilities

If the Project were not to proceed, there would be no effect on existing utilities.

11.4.1.3 Telecommunications & Aviation

If the Project were not to proceed, there would be no effect on existing telecommunication and aviation operations.

11.4.2 Construction Phase

11.4.2.1 Waste

There will be no demolition associated with the Project.

During the construction phase, waste will be produced from surplus materials such as packaging materials, canteen and domestic waste. The appointed contractor will be required to ensure that oversupply of materials is kept to a minimum and opportunities for reuse of suitable materials is maximised.

Significant groundworks are required for the formation of access tracks, the substation area and turbine foundations, and installation of underground cabling within the wind farm site; and the installation of cabling for the GCR from the wind farm site to the boundary of Mallow 110kV substation.

The volume of excavation for construction of the wind farm site will be approximately 95,963m^3. It is envisaged that all excavated material will be reused within the wind farm site. The volume of excavation for construction of the GCR will be approximately 13,995m^3.

Where any material is removed from the construction works within the wind farm site or the GCR works is deemed waste, its removal and reuse / recycling / recovery / disposal will be carried out in accordance with the Waste Management Act 1996 (as amended)[4], the Waste Management (Collection Permit) Regulations 2007 (as amended)[21] and the Waste Management (Facility Permit & Registration) Regulations 2007 (as amended)[22]. The volume of waste requiring recovery / disposal will dictate whether a Certificate of Registration (COR), permit or licence is required for the receiving facility. Alternatively, the material may be classed as by-product under Regulation 15 (By-products) (an

[21] Government of Ireland. 2007, S.I. No. 820/2007 - Waste Management (Collection Permit) Regulations 2007 (as amended).

[22] Government of Ireland. 2007. S.I. No. 821/2007 - Waste Management (Facility Permit and Registration) Regulations 2007 (as amended).

amendment to Article 27 of the European Communities (Waste Directive) Regulations 2011) of S.I. No. 323/2020 - European Union (Waste Directive) Regulations 2020[20].

In order to establish the appropriate reuse, recovery and / or disposal route for the waste materials, it will first need to be classified. Waste material will initially need to be classified as hazardous or non-hazardous in accordance with the EPA publication Waste Classification – List of Waste & Determining if Waste is Hazardous or Non-Hazardous[23].

Waste which will be generated from construction phase workers is municipal waste, (e.g., organic / food waste, dry mixed recyclables such as wastepaper, newspaper, plastic bottles, packaging, aluminium cans, tins and Tetra Pak cartons), and mixed non-recyclables and sewage sludge from temporary welfare facilities provided on-site during the construction phase. Waste printer / toner cartridges, WEEE and waste batteries may also be generated in small volumes from site offices.

The Project will generate a range of non-hazardous and hazardous waste materials during site excavation and construction. As mentioned, general housekeeping and packaging will also generate waste materials, as well as typical municipal wastes generated by construction employees, including food waste. Waste materials will be required to be temporarily stored in the temporary site compound or adjacent to it, on-site, pending collection by a waste contractor. If waste material is not managed and stored correctly, it is likely to lead to litter or pollution issues (e.g., water / ground pollution or risks to biodiversity) at the wind farm site and in adjacent areas. In the absence of mitigation, the effect on the local and regional environment is likely to be **short-term, significant and adverse**.

Wastes arising will need to be taken to suitably registered / permitted / licenced waste facilities for processing and segregation, reuse, recycling, recovery, and / or disposal, as appropriate. There are numerous permitted waste facilities in the area which can accept hazardous and non-hazardous waste materials, and acceptance of waste from the Project would be in line with daily activities at these facilities. The majority of construction materials are either recyclable or recoverable. However, in the absence of mitigation to reduce waste generated and ensure waste management as high up the hierarchy as possible, the effect on the local and regional waste infrastructure is likely to be **short-term, moderate and adverse**.

11.4.2.2 Utilities

During construction, contractors will require power for onsite offices, and construction equipment/plant. A temporary power supply will be established via generators. All waste waters will be collected in an enclosed holding tank and removed from site on a regular basis for final wastewater treatment by a licensed contractor. The source of a water supply will be non-potable water for the site office and service area which will be delivered and stored on the wind farm site for use in the welfare facilities. Potable water will be supplied by bottled water or water cooler. Therefore, the effect on utilities will be **neutral and not significant**.

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[23] Environmental Protection Agency. 2019. Determining if waste is hazardous or non-hazardous

Ahead of the transport of turbine components, the applicant will liaise with the relevant utility providers to ensure that appropriate mitigation measures are applied to ensure there is minimal disruption to utility services (refer to EIAR **Chapter 16 Traffic and Transport**). Therefore, the effect on utilities will be **neutral and not significant**.

11.4.2.3 Telecommunications

The potential for electromagnetic interference from wind turbines occurs only during the commissioning and operational phases of the Project. There are no potential electromagnetic interference effects associated with the construction phase of the Project on telecommunications and broadcasting in the area. The effect will be **neutral and not significant**.

Ahead of the transport of turbine components, the applicant will liaise with the relevant telecommunications providers to ensure that appropriate mitigation measures are applied to ensure there is minimal disruption to telecommunication services (refer to EIAR **Chapter 16 Traffic and Transport**). Therefore, the effect on telecommunications will be **neutral and not significant**.

11.4.2.4 Aviation

During the later phases of construction and prior to commissioning, the constructed turbines could be considered to be an obstacle to low flying aircraft. The closest airport to the wind farm site is Cork Airport, located ca. 42km southeast. The Aviation Review Statement prepared by Ai Bridges (**Volume III Appendix 11.2**) shows that the wind farm site would be located outside the Outer Horizontal Surface of the Cork Airport Runway Obstacle Limitation Surfaces, as defined in ICAO (International Civil Aviation Organization) Annex 14. It is considered that there will be **no significant effects** on aviation during the construction phase. The potential effect on aviation for the construction phase is **neutral, imperceptible and short-term**.

11.4.3 Operational Phase

11.4.3.1 Waste

Once operational, it is anticipated that very small amounts of waste will be generated from staff during inspections and maintenance works. These wastes may include organic/food waste, dry mixed recyclables (waste paper, newspaper, plastic bottles, packaging, aluminium cans, tins, and Tetra Pak cartons) and non-recyclable waste. Waste fuels/oils, WEEE and waste batteries may also be generated infrequently. All such waste will be stored appropriately and safely from wind, rain and wild animals that often tear apart rubbish bags.

Wastewater from the staff welfare facilities will be collected in a sealed storage tank. All wastewater will be tankered off-site by an authorised waste collector to a wastewater treatment plant.

The potential effects on waste infrastructure for the operational phase is **neutral, imperceptible, and long-term**.

11.4.3.2 *Utilities*

No impact is anticipated on utilities for the operational phase of the Project as there will be no significant requirement for gas or electricity services. The potential effects on utilities for the operational phase is **neutral, imperceptible, and long-term**.

11.4.3.3 *Telecommunications*

Radio waves and microwaves are used for a wide variety of communication purposes. The rotating blades of wind turbines can occasionally scatter electromagnetic signals causing interference to a range of communication systems. Impacts can include reflection, diffraction, blocking and radio frequency interference. The types of communication, which may be affected, include the following:

- Satellite communications
- RADAR
- Cellular radio communications
- Aircraft instrument landing systems
- Air traffic control
- Terrestrial telecommunication links
- Television broadcasts

The Telecommunications Impact Assessment indicates that one microwave link (Vodafone Ireland licenced PTP microwave radio link from Mt Hillary to Shinanagh) would be impacted by the Project. There are no anticipated impacts to the other links assessed. In the absence of mitigation, the effect on telecommunications is likely to be **long-term, significant and negative**.

11.4.3.4 *Aviation*

Operating wind farms have the potential to cause a variety of adverse effects on aviation. Rotating wind turbine blades may have an impact on certain aviation operations, particularly those involving radar.

The siting and physical height of wind turbines can also cause an obstruction to aviation and the overall performance of communications, navigation and surveillance equipment. All structures over 150m in height are required to have lighting to warn aviation traffic. The ground to blade tip height of the wind turbines will be 175m during the operation phase.

Should planning consent be granted for the Project, liaison will be undertaken with the Irish Aviation Authority (as noted in the scoping response) to ensure all aviation requirements, such as a warning lighting scheme, are implemented. There will be no significant impact on aviation from the Project during the operational phase. Therefore, the potential effect on aviation for the operational phase is **neutral, imperceptible and long-term**.

11.4.4 Decommissioning Phase

11.4.4.1 Waste

During decommissioning of the Project, effects will be similar to those assessed for the construction phase. Turbine foundation plinths will be dismantled to below existing ground level and covered over with topsoil, the underground sections will be left in place during decommissioning and allowed to naturally revegetate over time. This is the least impactful process of decommissioning. As the wind farm site will have already been altered, the impacts are **neutral, imperceptible, and long-term**.

All infrastructure including turbine components will be separated and removed off-site for re-use and recycling where practicable or disposed of in accordance with waste legislation and best practice guidelines at the time of decommissioning. Waste produced during the decommissioning phase will likely have a **moderate adverse effect** on the capacity of the licenced waste facilities used at the time of decommissioning.

11.4.4.2 Utilities

No significant effects are anticipated on utilities for the decommissioning phase of the Project as there will be no significant requirement for water, wastewater, gas or electricity services.

11.4.4.3 Telecommunications

No significant effects are anticipated on telecommunications for the decommissioning phase of the Project.

11.4.4.4 Aviation

No significant effects are anticipated on aviation for the decommissioning phase of the Project.

11.5 Mitigation Measures

11.5.1.1 Waste

As outlined in EIAR **Chapter 5 Project Description**, a Resource and Waste Management Plan (RWMP) will be prepared for the construction phase which will cover all aspects of waste management during the construction phase and will include the following mitigation measures:

- The objective will be to maximise the reuse of materials either onsite or offsite.
- All waste generated during the construction phase will be managed in accordance with the relevant waste management legislation.
- Waste generation on-site during construction works will be properly supervised with designated waste storage and segregation areas.
- Materials required will be ordered only as needed to reduce excess materials leading to waste.

- Where excess materials do arise, these will be returned to the supplier where possible.
- Hazardous waste during construction, such as waste oils and lubricants, it will be segregated, stored appropriately, classified, transported and disposed of by appropriately permitted waste contractors in accordance with all relevant national and international waste legislation.

The mitigation measures presented in the RWMP will ensure effective waste management and minimisation, reuse, recycling, recovery and disposal of waste material generated during the excavation and construction phases of the Project. Refer to the Construction Environmental Management Plan (CEMP) in EIAR **Volume III, Appendix 5.1**.

11.5.1.2 Utilities

Ongoing consultation with Uisce Éireann, Bord Gáis EirGrid, ESBN and other relevant service providers within the locality will continue, and all works will comply with any requirements or guidelines they may have. The works contractor will be obliged to ensure there are no interruptions to these utility services unless this has been agreed in advance. Coordination and consultation will be had between the project team and ESBN and Uisce Éireann, and other relevant service providers within the locality, as the design of the Project progresses.

11.5.1.3 Telecommunications

Extensive field survey and software modelling analysis was carried out to determine viable mitigation measures to offset the impact on the delivery of service to the Vodafone base station site at Shinanagh. A mitigation measure of re-routing the service into Shinanagh from an alternative Vodafone Feeder/POP site was put forward to Vodafone, who agreed to the proposal. As part of the proposal, it was agreed that the developer will cover the mitigation cost should planning consent be granted. Refer to **Volume III Appendix 11.1 Telecommunications Impact Study**.

11.5.1.4 Aviation

As noted in section 11.4.3.4, should planning consent be granted for the Project, the applicant will liaise with the Irish Aviation Authority (as noted in the scoping response contained in **Volume III Appendix 3.2**) to ensure all aviation requirements, such as a warning lighting scheme, are implemented.

11.6 Potential Cumulative Effects

All known existing and proposed projects within the study area that could potentially generate a cumulative effect with the Project during construction, operation and decommissioning phases were identified and examined as part of this assessment. The full list of projects is contained in EIAR **Chapter 2 EIA Methodology**.

Should several of the proposed projects coincide with the Project, there is the potential for short-term, slight and adverse effects on telecommunications and utilities. However, during the development of any large project that holds the potential to impact utilities or telecommunications, each developer is responsible for engaging with all relevant service providers to ensure their proposals will not result in cumulative effects. In the event of any potential effect, the developer for each individual project is responsible for ensuring that the necessary mitigation measures are in place. Therefore, as each project is designed and built to avoid impacts arising, cumulative effects are unlikely to arise.

11.7 Residual Effects

11.7.1.1 Waste

Following the implementation of the mitigation measures outlined in section 11.5, there will be a moderate adverse residual effect associated with the production of waste during the decommissioning phase. **No significant adverse residual effect** to waste is anticipated as a result of the Project.

11.7.1.2 Utilities

Following the implementation of the mitigation measures outlined in section 11.5, it is considered that there will be **no significant adverse residual effect** on utilities anticipated as a result of the Project.

11.7.1.3 Telecommunications

Following the implementation of the mitigation measure outlined in section 11.5, it is considered that there will be **no significant adverse residual effect** on telecommunications anticipated as a result of the Project.

11.7.1.4 Aviation

Following the implementation of the mitigation measure outlined in section 11.5, it is considered that there will be **no significant adverse residual effect** on aviation anticipated as a result of the Project.

EIAR Volume II

Main Report

Chapter 12: Shadow Flicker

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12 SHADOW FLICKER

12.1 Introduction

This chapter of the Environmental Impact Assessment Report (EIAR) for the proposed Tullacondra Green Energy Project ('the Project') presents an assessment of the likely significant effects that may arise from shadow flicker resulting from operation of the Project. The objectives of the chapter are to describe:

- The background of the assessment and relevant guidance considered.
- The assessment methodology used.
- The potential for shadow flicker effects, including direct, indirect and cumulative effects.
- The need for and operation of any shadow flicker mitigation measures.
- Introduction of the control of turbines to eliminate shadow flicker (allowing for a short period for shadow flicker conditions to be confirmed and for the turbine to come to a stop)
- Potential remaining effects following the implementation of such mitigation measures.

The Project includes the construction, operation and decommissioning of a wind energy development consisting of nine wind turbine generators with foundations and crane pad hardstanding areas; a permanent meteorological mast; an on-site 38kV substation, underground cabling connecting the turbines to the on-site substation; and underground grid connection to the boundary of the Mallow 110 kV substation; along with all associated site works including site clearance, temporary compounds and storage areas; a new temporary entrance and upgrade of an existing entrance; upgrade of existing site tracks and construction of new site tracks; site drainage; and ancillary developments including security gates and fencing, lighting and signage; and biodiversity mitigations and enhancements.

The shadow flicker assessment only considers the wind farm aspect of the Project (i.e., the wind turbines). The site layout plan of the proposed wind farm is shown in **Figure 1.4**, in EIAR **Chapter 1 Introduction.**

The Department of the Environment, Heritage and Local Government (DoEHLG) Wind Energy Development Guidelines (2006)[1] state:

> *"the effect known as shadow flicker occurs where the blades of a wind turbine cast a shadow over a window in a nearby house and the rotation of the blades causes the shadow to flick on and off. This effect lasts only for a short period and happens only in certain specific combined circumstances, such as when:*

[1] Department of Environment, Heritage and Local Government, 2006. Wind Energy Development Guidelines.

- The sun is shining and is at a low angle (after dawn and before sunset), **and**
- The turbine is directly between the sun and the affected property, **and**
- There is enough wind energy to ensure that the turbine blades are moving."

If any of the above conditions are not present, shadow flicker cannot occur.

The Wind Energy Development Guidelines (2006)[1] note that at distances greater than 10 rotor diameters from the turbine, the potential for shadow flicker is very low.

12.2 Statement of authority

This assessment has been undertaken by Dr Thomas Burke and reviewed by Ben Hockridge, both of RSK ADAS Ltd. Thomas Burke is a GIS (Geographic Information Systems) Consultant with expertise in the evaluation, analysis, and visualisation of geospatial data to investigate and solve environmental management issues. Thomas uses these skills and experience to manage and deliver projects for a range of clients, particularly in the area of onshore renewables development. Thomas joined ADAS in 2022, prior to which he spent four years as a graduate researcher in geography and GIS following completion of his MSci in Earth and Environmental Science.

Ben Hockridge is principal GIS and Remote Sensing Consultant at RSK ADAS. He has over 10 years' experience in providing GIS and Remote Sensing expertise in a range of projects and services. Ben first joined ADAS in 2012 following his studies in Physical Geography (BSc) and Environmental Monitoring, Modelling and Management (MSc). Ben returned to work for RSK ADAS in 2017 after spending a year providing GIS solutions for the Ministry for Primary Industries in New Zealand. This range of experience has provided him with an in depth understanding on the use of GIS and Remote Sensing and their application in environmental management.

12.3 Policy and guidance

The following documents were considered in the shadow flicker assessment methodology and scope:

- Wind Energy Development Guidelines (2006)[1]
- Draft Wind Energy Development Guidelines (2019)[2]
- Cork County Development Plan 2022 - 2028 (2022)[3]
- Irish Wind Energy Association (IWEA) Best Practice Guidelines for the Irish Wind Energy Industry (2012)[4]

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[2] Department of Housing, Local Government and Heritage. 2019. Draft Revised Wind Energy Development Guidelines, https://www.gov.ie/en/publication/9d0f66-draft-revised-wind-energy-development-guidelines-december-2019/.

[3] Cork County Council, 2022. Cork County Development Plan 2022 - 2028.

[4] Irish Wind Energy Association, 2012. Best Practice Guidelines for the Irish Wind Energy Industry.

- Environmental Protection Agency Guidelines on the information to be contained in Environmental Impact Assessment Reports (2022)[5],

The Wind Energy Development Guidelines (2006)[1] are the current guidance, and state that:

> *"Careful site selection, design and planning, and good use of relevant software, can help avoid the possibility of shadow flicker in the first instance. It is recommended that shadow flicker at neighbouring offices and dwellings within 500m should not exceed 30 hours per year or 30 minutes per day."*
>
> *"At distances greater than 10 rotor diameters from a turbine, the potential for shadow flicker is very low. Where shadow flicker could be a problem, developers should provide calculations to quantify the effect and where appropriate take measures to prevent or ameliorate the potential effect, such as by turning off a particular turbine at certain times."*

The Draft Revised Wind Energy Development Guidelines (2019), published by the DoEHLG in December 2019 and considered in this assessment, state that:

> *"Generally, only properties within 130 degrees either side of north, relative to the turbines, can be affected at these latitudes in the UK and Ireland- turbines do not cast long shadows on their southern side."*
>
> *"if shadow flicker is not eliminated for any dwelling or other potentially affected property then clearly specified measures which provide for automated turbine shut down to eliminate shadow flicker should be required as a condition of a grant of permission."*
>
> *"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 Cork County Council Wind Energy Strategy[1], as contained in the Cork County Development Plan 2022-2028[6], has designated the capacity of areas for wind energy development outside urban areas as either 'Open to Consideration', 'Acceptable in Principle' or 'Normally Discouraged'. The site of the proposed wind farm development is located entirely within an area designated in the Cork County Development Plan 2022-2028[6] as 'Open to Consideration' for wind energy development.

Regarding shadow flicker, County Development Plan Objective ET 13-7 states that:

> *"Commercial wind energy development is open to consideration in these areas where proposals can avoid adverse impacts on …:*
>
> *• Residential amenity particularly in respect of noise, shadow flicker and visual impact;…"*

---

[5] Environmental Protection Agency. 2022, Guidelines on the information to be contained in Environmental Impact Assessment Reports.

[6] Cork County Council. 2022. Cork County Development Plan 2022-2028.

With regards to the calculation of shadow flicker, IWEA's (now Wind Energy Ireland) Best Practice Guidelines for the Irish Wind Energy Industry (2012)[4] state that:

> *"Calculations for shadow flicker modelling generally assume 100 % sunshine conditions. It is reasonable in Ireland's climate to modify these figures. Some attention can also be given to the wind rose which indicates the percentage of winds from each direction. If winds rarely come from the sectors which would give rise to the greatest shadow flicker effects on a dwelling, this can be taken into account."*
>
> *"The assessment of potentially sensitive locations or receptors within a distance of ten rotor diameters from proposed turbine locations will normally be suitable for EIA purposes. The DoEHLG's Wind Energy Development Guidelines set recommended limits for shadow flicker which are 30 hours per year or 30 minutes per day for receptors within 500 m."*
>
> *"It is important to determine if there are other existing and/or permitted but not constructed wind farms in the vicinity of the proposed development which could contribute towards a cumulative shadow flicker impact on any receptors. Any such wind farm developments within 2 km of the proposed development should be considered in a separate cumulative shadow flicker assessment."*

12.4 Consultation

A pre-planning meeting was held online with Cork County Council on Thursday 17th November 2022 (Ref. PPN 22/687), attended by officers of Cork County Council Planning Authority and the Environmental Section. The Planning Authority followed up via email dated 25th November 2022 to provide notes from the pre-planning meeting. This included a note that the proposal should "*avoid adverse impacts on residential amenity particularly in respect of noise, shadow flicker and visual impact*", citing objective ET 13-7 of the Cork County Development Plan (outlined above). Full details of the consultation are provided in EIAR **Chapter 3 Scoping, Consultations, Community Engagement and Key Issues**.

12.5 Scope of assessment

Considering the policy and guidance and the pre-planning consultation with the Cork County Council Planning Authority outlined above, this section describes the methodology for assessment of shadow flicker for the Project.

12.5.1 Study area

A study area of 1,500m around each of the nine wind turbines has been defined for this assessment, a distance equal to ten times the maximum rotor diameter of 150m for the proposed turbines. This is based upon the Wind Energy Development Guidelines (2006)[1] that at distances greater than 10 rotor diameters from a turbine, the potential for shadow flicker is very low. It also follows IWEA Best Practice Guidelines (2012)[4], which state that the assessment of potentially sensitive locations or receptors within a distance of ten rotor diameters from proposed turbine locations will normally be suitable for EIA purposes.

12.5.2 Identification of sensitive receptors

The assessment considers all identified potential shadow flicker sensitive receptors within the study area. Refer to EIAR **Chapter 2 EIA Methodology**, and EIAR **Volume III, Appendix 2.1** which describes the methodology applied in compiling the database of potential sensitive receptors. This database, which is provided in EIAR **Volume III, Appendix 2.2**, lists the sensitive receptors within 2km of each of the proposed turbines, and therefore covers the 10 times rotor diameter (1,500m) study area defined for this assessment. The sensitive receptors identified within the study area include occupied and unoccupied dwellings (excluding dilapidated properties), planning permission sites (validated and granted up to the cut-off date of 20th March 2024), and a school, and are displayed on EIAR **Chapter 2 EIA Methodology**, **Figure 2.3**.

12.5.3 Assessment of effects

This chapter presents predicted shadow flicker effects at all identified receptors. These results quantify the theoretical maximum number of hours per year and per day during which shadow flicker effects may occur.

Significance of effects has been determined with reference to the EPA Guidelines on the information to be contained in Environmental Impact Assessment Reports (2022)[3]. The EIA Guidelines present the approach to describing environmental effects as applied to this EIAR. In determining significance of effects, magnitude of change is considered in relation to the sensitivity of the receiving environment. Further information is provided in EIAR **Chapter 2 EIA Methodology**.

The Wind Energy Development Guidelines (2006)[1] recommend that shadow flicker at neighbouring offices and dwellings within 500m should not exceed 30 hours per year or 30 minutes per day. For this assessment, it is considered that exceedance of this threshold at any receptor within the 1,500m study area, unmitigated, constitutes a significant, and adverse effect.

The modelling results are a 'worst-case' scenario, where the conditions required for shadow flicker to occur are present for all daylight hours through the year. The potential annual hours of shadow flicker are presented for a 'likely' scenario, taking into account average annual sunshine hours, following guidance in the IWEA Best Practice Guidelines for the Irish Wind Energy Industry[3]. Full details of these scenarios are provided in section 12.6.

12.5.4 Identification of measures to avoid and mitigate effects

Where predicted shadow flicker for the Project at neighbouring offices and dwellings within 1,500m occurs, turbines will be controlled to eliminate shadow flicker (allowing for a short period for shadow flicker conditions to be confirmed and for the turbine to come to a stop).This will be achieved through curtailment of turbine operation when conditions in which shadow flicker are predicted to occur are detected by a software shut down module installed in the turbines.

This approach is in accordance with the Wind Energy Development Planning Guidelines (2006)[1], and aligns with the Draft Revised Wind Energy Development Guidelines (2019)[2] and best practice as described in section 12.3.

12.6 Assessment methodology

Shadow flicker calculations have been undertaken using the Shadow Flicker module of ReSoft WindFarm, a specific wind farm design tool package that is commonly used throughout the industry.

Following the design of the proposed Project, each turbine was modelled in the WindFarm software and assigned a hub height of 100m, and rotor diameter of 150m. A study area and maximum distance of shadow influence of 10 times the rotor diameter (1,500m) was defined. In the absence of specific information on windows at properties within the assessment study area, each property was assumed to have a North, South, East and West facing window, 1m x 1m in dimension, and with a height of 2m above the ground. These were placed at the centroid of the property. A full list of sensitive receptors is provided in EIAR **Volume III, Appendix 12.1**.

The ReSoft WindFarm model used also assumes that:

- The sun is shining from sunrise to sunset (cloudless sky).
- The turbine blades are turning 100% of the time.
- The turbine rotor is oriented directly between the sun and the sensitive receptor.
- There is no screening between the turbine and the receptor (excluding topography).

The inclusion of the above factors results in a 'worst-case' scenario being reported in this assessment. As quoted from guidance above, for shadow flicker to occur, all of the above listed conditions must be met at any one time. In real life conditions, therefore, the actual shadow flicker durations will be less than the theoretical predicted levels from the model.

12.6.1 Sunshine hours

Shadow flicker can only occur when the sun is shining. Historical weather data was therefore used to provide a more realistic prediction of potential annual shadow flicker duration when taking into account the frequency of clear skies when shadows may be cast. This is reported in this assessment as the 'likely' theoretic hours of shadow flicker per year.

Average monthly sunshine data was obtained from the Met Éireann Cork Airport station[7], the nearest long-term weather station, located approximately 40km from the proposed Project. Data for 1981 – 2010, the most recent 30-year time period available was used. Monthly daylight hours were obtained for Mallow[8], the nearest location with data available, located approximately 10km from the proposed Project. These are presented in **Table 12.1.**

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[7] Cork Aiport 1981–2010 averages. Available at: https://www.met.ie/climate-ireland/1981-2010/cork.html.

[8] Sunrise and sunset Mallow 2022. Available at: https://www.sunrise-and-sunset.com/en/sun/ireland/mallow/2022.

Table 12.1: Average hours of sunshine (Cork Airport Meteorological Station, 1981 – 2010) and average hours of daylight (Mallow) for the proposed Project

	Mean Daily Sunshine Hrs (Cork Airport)	Mean Daily Daylight Hrs (Mallow)	% Sunshine
Jan	1.8	8.3	22
Feb	2.4	9.9	24
Mar	3.3	11.9	28
Apr	5.3	13.9	38
May	6.2	15.7	40
Jun	5.8	16.6	35
Jul	5.4	16.1	33
Aug	5.2	14.6	36
Sep	4.3	12.6	34
Oct	3	10.6	28
Nov	2.3	8.8	26
Dec	1.7	7.8	22
Avg	**3.9**	**12.2**	**32**

The average monthly sunshine hours were divided by the corresponding monthly daylight hours to obtain an estimate of the percentage average sunshine hours each month. These were used to calculate an annual average sunshine hours percentage of 32%. Based on this, a correction factor of 32% can be applied to the annual total theoretical predicted levels of shadow flicker to provide an estimate of the amount of time when the correct meteorological conditions would be present for shadow flicker to occur. These shadow flicker durations however are still likely to be conservative as no account is taken of when turbine blades are not turning, orientation of the turbine rotor or the presence of screening between the receptor and turbine.

12.7 Baseline conditions

The database of potential sensitive receptors as identified by the RSK Project Team was used in the shadow flicker model. This database identifies all sensitive receptors within 2km of the proposed turbines. EIAR **Volume III, Appendix 2.1** describes the methodology applied in compiling the database of potential sensitive receptors. Properties which were identified as dilapidated are excluded from the assessment. These properties were confirmed to be uninhabited and could not be inhabited without substantial renovation works (which may require planning permission). These properties were monitored throughout the course of the design of the Project for any change to their status or for any validated planning permission applications (i.e., for replacement, extensions or alterations) up to the cutoff date of 20th March 2024.

Occupied and unoccupied properties (including one primary school), and sites where planning permission has been granted for a new dwelling which has not yet completed construction up to the cutoff date, within the 10 times rotor diameter (1,500m) of a proposed turbine are included in the shadow flicker assessment.

There are no sensitive receptors within 500m of the Project. There are 87 sensitive receptors within the 10-rotor diameter (1,500m) study area. One further sensitive receptor (ID 88) was found approximately 7.5m outside the 10-rotor diameter (1,500m) study area. A conservative approach was adopted such that the point representing this receptor in the modelling software was moved west to lie within the 10-rotor diameter (1,500m) study area so that it was included in the assessment. These 88 sensitive receptors were modelled in the shadow flicker assessment.

Figure 12.1 presents the study area (1,500m buffer around the proposed nine turbines based on the turbine rotor diameter of 150m), and the sensitive receptors identified within this area.

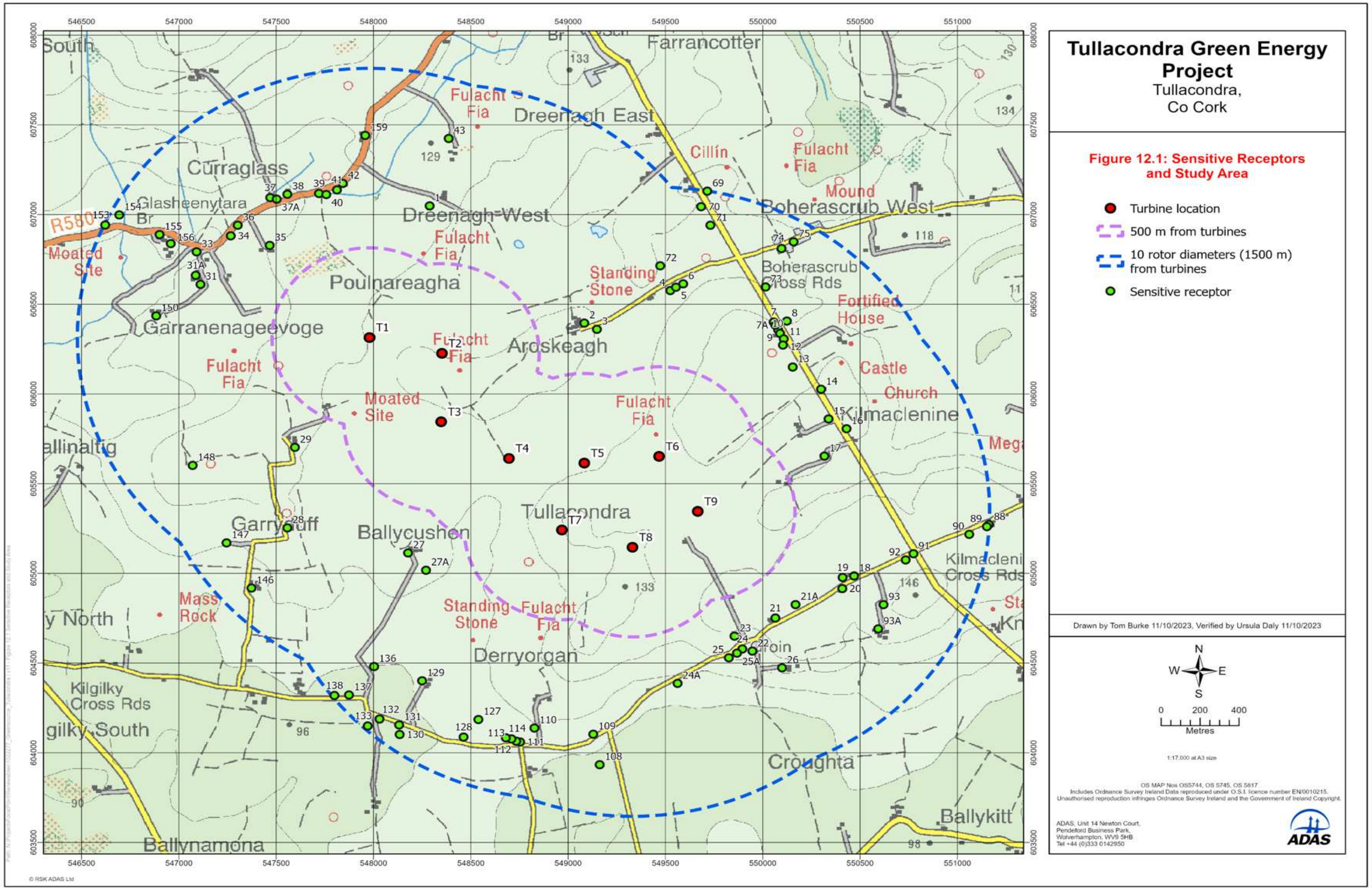

Figure 12.1: Sensitive receptors and study area

12.8 Assessment of effects

12.8.1 Do-nothing scenario

In the 'do-nothing' scenario, the Project would not be consented, and no turbines would be constructed. Therefore, there would be no shadow flicker.

12.8.2 Construction phase effects

As outlined in section 12.1, shadow flicker can only occur when the turbine blades are moving. This requires the turbine to be operational. As such, there will be no shadow flicker effects during the construction phase of the Project.

12.8.3 Operational phase effects

12.8.3.1 Modelled shadow flicker

Table 12.2 presents the modelled 'worst-case' scenario shadow flicker durations at the identified properties. The table also presents the 'likely' scenario shadow flicker durations when taking into account estimated sunshine probability. Shaded cells indicate exceedances of Wind Energy Development Guidelines (2006)[1] thresholds of 30 hours per year or 30 minutes per day. The locations of each receptor and their corresponding Receptor ID are shown in **Figure 12.1**.

The modelled area over which shadow flicker is predicted to occur is shown in **Figure 12.2**. As can be seen in the figure, this is largely to the east and west of the Project.

Table 12.2: Shadow flicker assessment results by receptor

Receptor ID	Days per year	Max hours per day	Mean hours per day	Total hours per year	'Likely' Hours Per Year (32% sunshine hrs)	Turbine(s) contributing to shadow flicker
1	32	0.46	0.35	11.3	3.6	T1
2*	185	1.19	0.72	133.3	42.7	T1, T2, T3, T4, T6
3*	182	1.26	0.75	136	43.5	T1, T2, T3, T4, T6
4	146	0.51	0.4	58.2	18.6	T2, T3, T4
5	145	0.49	0.39	56.2	18.0	T2, T3, T4
6	142	0.48	0.38	54.2	17.3	T2, T3, T4

Recept or ID	Days per year	Max hours per day	Mean hours per day	Total hours per year	'Likely' Hours Per Year (32% sunshine hrs)	Turbine(s) contributing to shadow flicker
7	94	1.03	0.7	66	21.1	T5, T6
7A	97	1.04	0.7	67.5	21.6	T5, T6
8	97	0.99	0.65	63.5	20.3	T5, T6
9	102	1.05	0.69	70.3	22.5	T5, T6
10	105	1.06	0.69	72.3	23.1	T5, T6
11	111	1.08	0.68	76	24.3	T5, T6, T8
12	116	1.11	0.71	82.1	26.3	T5, T6, T8
13	135	1.18	0.82	110.1	35.2	T5, T6, T7, T8, T9
14	145	0.95	0.78	113.3	36.3	T5, T6, T8, T9
15	132	0.82	0.6	79.1	25.3	T5, T6, T8, T9
16	110	0.69	0.53	58.8	18.8	T5, T6, T8, T9
17	139	1.23	0.67	93.2	29.8	T5, T6, T7, T8, T9
18	157	1.14	0.74	115.7	37.0	T6, T8, T9
19	155	1.24	0.81	125.5	40.2	T5, T6, T7, T8, T9
20	148	1.18	0.71	104.4	33.4	T5, T6, T7, T8, T9
21*	111	0.98	0.71	79.1	25.3	T5, T7, T8
21A*	129	0.77	0.58	74.4	23.8	T5, T7, T8
22	63	0.56	0.47	29.4	9.4	T7
23	68	0.62	0.53	36	11.5	T7
24	57	0.55	0.46	25.9	8.3	T7

Receptor ID	Days per year	Max hours per day	Mean hours per day	Total hours per year	'Likely' Hours Per Year (32% sunshine hrs)	Turbine(s) contributing to shadow flicker
24A	0	0	0	0	0.0	
25	17	0.2	0.16	2.6	0.8	T7
25A	44	0.48	0.38	16.8	5.4	T7
26	64	0.5	0.43	27.6	8.8	T7
27	177	1	0.68	121	38.7	T5, T6, T7, T8
27A	160	1.35	1.01	161	51.5	T5, T6, T7, T8, T9
28	131	0.53	0.4	52	16.6	T3, T4, T7
29	208	0.8	0.51	106.2	34.0	T2, T3, T4, T5, T7
31	94	0.73	0.47	43.7	14.0	T1, T2, T3
31A	51	0.74	0.56	28.6	9.2	T1, T2
33	53	0.82	0.62	32.6	10.4	T1, T2
34	124	1.07	0.63	78.1	25.0	T1, T2, T3
35	120	1.39	0.84	101.1	32.4	T1, T2, T3
36	114	1.14	0.59	67.4	21.6	T1, T2
37	82	1.03	0.8	65.3	20.9	T1, T2
37A	80	1.02	0.8	64.3	20.6	T1, T2
38	70	1	0.71	49.8	15.9	T1, T2
39	50	0.49	0.42	21.1	6.8	T2
40	46	0.48	0.4	18.3	5.9	T2
41	30	0.38	0.29	8.8	2.8	T2
42	0	0	0	0	0.0	

Receptor ID	Days per year	Max hours per day	Mean hours per day	Total hours per year	'Likely' Hours Per Year (32% sunshine hrs)	Turbine(s) contributing to shadow flicker
43	0	0	0	0	0.0	
69	0	0	0	0	0.0	
70	0	0	0	0	0.0	
71	0	0	0	0	0.0	
72	130	0.51	0.35	45.5	14.6	T2, T3, T4
73	63	0.65	0.45	28.4	9.1	T5, T6
74	0	0	0	0	0.0	
75	0	0	0	0	0.0	
88	33	0.42	0.33	10.9	3.5	T9
89	33	0.42	0.33	11	3.5	T9
90	36	0.45	0.35	12.5	4.0	T9
91	115	0.67	0.43	48.9	15.6	T6, T8, T9
92	122	0.74	0.44	53.7	17.2	T6, T8, T9
93	136	0.97	0.66	89.2	28.5	T6, T8, T9
93A	110	0.8	0.49	53.6	17.2	T6, T8, T9
108	0	0	0	0	0.0	
109	0	0	0	0	0.0	
110	0	0	0	0	0.0	
111	0	0	0	0	0.0	
112	0	0	0	0	0.0	
113	0	0	0	0	0.0	
114	0	0	0	0	0.0	

Receptor ID	Days per year	Max hours per day	Mean hours per day	Total hours per year	'Likely' Hours Per Year (32% sunshine hrs)	Turbine(s) contributing to shadow flicker
127	0	0	0	0	0.0	
128	0	0	0	0	0.0	
129	45	0.44	0.36	16.1	5.2	T8
130	0	0	0	0	0.0	
131	0	0	0	0	0.0	
132	0	0	0	0	0.0	
133	0	0	0	0	0.0	
136	88	0.45	0.32	27.9	8.9	T8
137	0	0	0	0	0.0	
138	0	0	0	0	0.0	
146	0	0	0	0	0.0	
147	72	0.52	0.46	33.2	10.6	T3
148	140	0.49	0.35	49.6	15.9	T1, T2, T3
150	49	0.56	0.43	21	6.7	T1, T2
153	36	0.43	0.33	12	3.8	T1
154	38	0.44	0.35	13.3	4.3	T1
155	44	0.52	0.41	18	5.8	T1
156	46	0.55	0.43	19.8	6.3	T1
159	0	0	0	0	0.0	

Note: *Denotes Project involved landowner.

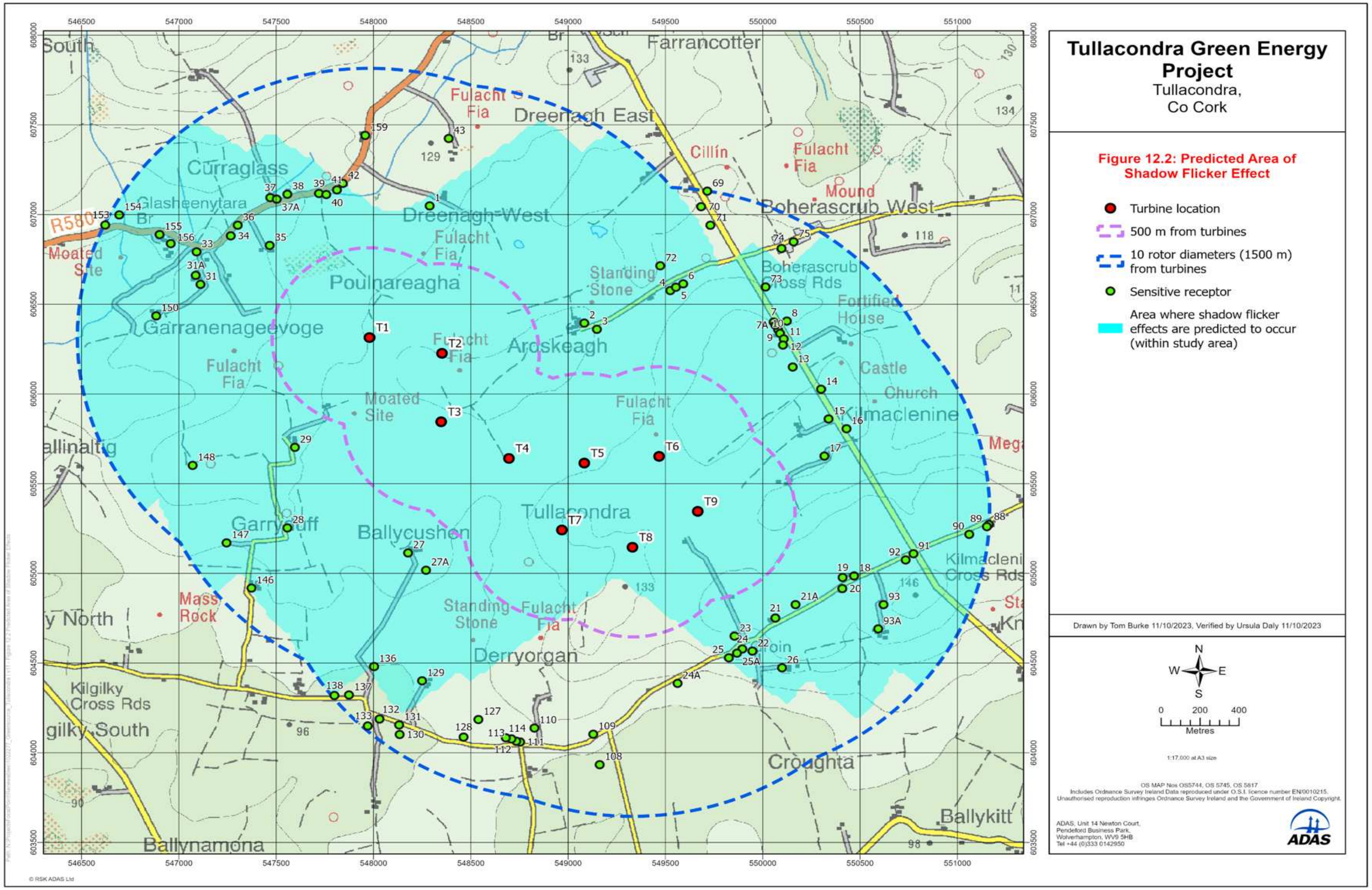

Figure 12.2: Predicted area of shadow flicker effect

The results of the analysis for the 'worst-case' scenario show that of the 88 sensitive receptors within the (1,500m) study area, 25 are predicted to experience no shadow flicker and 49 are predicted to experience shadow flicker that exceeds the thresholds of 30 hours per year or 30 minutes per day. A detailed list of shadow events grouped by turbine and receptor is given in EIAR **Volume III, Appendix 12.2** and EIAR **Volume III, Appendix 12.3** respectively.

In the worst-case scenario, the predicted shadow flicker is greatest at properties closest to the turbines to the east and west. Clusters of potentially affected properties can be seen around Boherascrub to the east, Curraglass to the north-west, and Groine to the south-east, along with individual properties at other locations within the study area.

With the incorporation of average annual sunshine data to identify the more 'likely' hours per year, the number of sensitive receptors that exceed the guideline of 30 hours per year is 11. This correction has not been applied to the daily totals, as historical monthly sunshine averages cannot be used to predict daily sunshine hours with sufficient accuracy.

IWEA Best Practice Guidelines for the Irish Wind Energy Industry (2012)[4] note that shadow flicker "would not generally have any effect on health or safety but could on limited occasions present a brief nuisance effect for some neighbours".

Criteria for significance is outlined in section 12.5.3. Predicted shadow flicker effects in the worst case scenario exceed 30 minutes per day or 30 hours per year at 49 sensitive receptors. It is considered that in the absence of mitigation, the shadow flicker that would be experienced at these sensitive receptors is **significant and adverse**.

As noted previously, the worst-case results from the modelling do not take into consideration that there will be times in the year when the turbine blades are not turning due to low wind speeds or during scheduled and unscheduled maintenance activities, and that the turbine rotor will not always be facing the receptor. The modelling results also do not account for the fact that the walls facing the turbine may not all have windows, or that some windows may be screened by vegetation or other structures in the intervening landscape, thereby preventing a line of sight between the window and turbines.

12.8.4 Decommissioning phase effects

As outlined in section 12.1, shadow flicker can only occur when the turbine blades are moving. This requires the turbine to be operational. As such, there will be no shadow flicker effects during decommissioning.

12.8.5 Cumulative effects

Annex IV, point 5 (e) of the EU EIA Directive requires that the cumulation of effects with other existing and/or approved projects are described in the EIAR. **Table 2.3** in EIAR **Chapter 2 EIA Methodology** lists existing and proposed wind farms within a 20km radius of the proposed wind farm site. These have been considered in relation to potential cumulative effects of shadow flicker (namely, the potential for shadow flicker effects on receptors from multiple developments, which could result in increased incidences of shadow flicker). The following wind farms were identified:

- Kilberehert wind farm (operational) 9km to the northwest, comprising 3 turbines with a tip height of 125m.
- Boolard wind farm (operational) 12.8km to the north, comprising 2 turbines with a tip height of 150.5m.
- Knocknatallig wind farm (operational) 13.8km to the northeast, comprising 6 turbines with a tip height of 135m.
- Esk wind farm (operational) 13.8km to the southwest, comprising 14 turbines with a tip height of 136.5m.
- Rathnacally wind farm (operational) 14.2km to the north, comprising 2 turbines with a tip height of 150.5m.
- Castlepook wind farm (operational) 15km to the northeast, comprising 14 turbines with a tip height of 126m.
- Carrigcannon wind farm (operational) 17.1km to the southwest, comprising 10 turbines with a tip height of 100m.
- Boggeragh 1 and 2 (operational) 17.4km to the southwest, comprising 43 turbines with a tip height of 136.5m.
- Coom wind park (consented) 19.1km to the southeast, comprising 22 turbines with a tip height of 172m.
- Ballinagree wind farm (in planning) 20.6km to the southwest, comprising 20 turbines with a tip height of 185m. Annagh wind farm (in planning, appeal) 10.9km to the north, comprising 6 turbines with a tip height of 175m.

The 10 times rotor diameter (1,500m) study area of the Project does not overlap with the 10 times rotor diameter study areas of any of these wind farms. It can therefore be concluded that there is no potential for cumulative shadow flicker effects with the existing and proposed wind farms within a 20km radius of the Project.

12.9 Mitigation of effects

Unless otherwise required by a condition of planning, the turbines will be controlled to eliminate shadow flicker at sensitive receptors. To mitigate shadow flicker effects, a shadow flicker control system will be used to shut down responsible turbines when shadow flicker has the potential to occur. In this system, one or more light sensors measure the intensity of sunlight and in combination with a calculation of the position of the sun, the wind turbine(s) are curtailed when the conditions for shadow flicker are met. When the conditions for shutdown are identified, the turbine will come to a stop, thereby eliminating adverse shadow flicker (allowing for a short period of time before the turbine(s) stop rotating once the conditions above are met).

A detailed listing of ‘worst-case’ scenario shadow flicker events that may require curtailment for each turbine is given in EIAR **Volume III, Appendix 12.2**. As shown in these results, the frequency and duration of shadow flicker events (if any) varies daily, and over the course of a year.

Potential 'worst-case' total durations of curtailment due to shadow flicker required for individual turbines are between 112 hours (Turbine T4) and 339 hours (Turbine T6) per year. With the incorporation of average annual sunshine data (32%) to estimate the more 'likely' hours per year, potential total durations of curtailment due to shadow flicker required for individual turbines are between 36 hours (Turbine T4) and 124 hours (Turbine T6) per year.

12.10 Residual effects

During the operational phase, a shadow flicker control system will be implemented to mitigate shadow flicker effects at all sensitive receptors within the study area. As described in section 12.9 the mitigation measure proposed is to use light sensors and specialised software to automatically control turbines to eliminate shadow flicker (allowing for a short period for shadow flicker conditions to be confirmed and for the turbine to come to a stop).

Following application of the proposed shadow flicker mitigation measure during the operational phase, it is concluded that residual shadow flicker effects would avoid adverse impacts on residential amenity in respect of shadow flicker (in accordance with objective ET 13-7 of the Cork County Development Plan), align with the requirements of the Draft Revised Wind Energy Development Guidelines 2019 and would be well below the Wind Energy Guidelines (2006) threshold limits, and would therefore be **not significant**.

EIAR Volume II

Main Report

Chapter 13: Noise and Vibration

CONTENTS

TABLES

FIGURES

APPENDICES (EIAR Volume III)

13 NOISE AND VIBRATION

13.1 Introduction

This chapter of the Environmental Impact Assessment Report (EIAR) for the proposed Tullacondra Green Energy Project ('the Project') presents an assessment of the potential noise and vibration effects of the Project on nearby sensitive receptors during construction, operation and decommissioning phases.

The Project includes the construction, operation and decommissioning of a wind energy development consisting of nine wind turbine generators with foundations and crane pad hardstanding areas; a permanent meteorological mast; an on-site 38kV substation, underground cabling connecting the turbines to the on-site substation; and underground grid connection to the boundary of the Mallow 110 kV substation; along with all associated site works including site clearance, temporary compounds and storage areas; a new temporary entrance and upgrade of an existing entrance; upgrade of existing site tracks and construction of new site tracks; site drainage; and ancillary developments including security gates and fencing, lighting and signage; and biodiversity mitigations and enhancements. This chapter also includes an assessment of the noise and vibration impacts from both Grid Connection Route (GCR) Options.

The site layout plan of the proposed wind farm is shown in **Figure 1.4**, in EIAR **Chapter 1 Introduction.** Further details of the proposed Project, the construction programme and sequencing of works which are used as the basis for assessments in this EIAR is provided in **Volume II**, **Part 1**, **Chapter 5 Project Description**.

13.2 Statement of authority

This section of the EIAR has been prepared by James Mangan (RSK Ireland Limited) and has been reviewed by Daniel Clare (RSK Acoustics Limited).

James Mangan is Associate Director of RSK Ireland Limited and leads the acoustics team in Ireland. James has completed the Institute of Acoustics (IoA) Diploma in Acoustics and Noise Control and is a Member of the Institute of Acoustics (MIOA). He has over 20 years' experience working in the field of acoustics, sixteen years of which working in Ireland. He has prepared numerous environmental impact assessment report chapters for various developments such as major infrastructural developments, mixed use developments and wind energy development projects. James is the current Chair of the Irish Branch of the IoA.

Daniel Clare is Managing Director of RSK Acoustics Limited. Daniel holds a BSc (Hons) in Environmental Science, has completed the IoA Diploma in Acoustics and Noise Control and is a Member of the Institute of Acoustics (MIOA). He has worked on a wide variety of projects in the public and private sectors, including nationally significant infrastructure projects; renewable energy developments (wind, solar, tidal and hydrogen), educational, industrial and recreational building design; transport and infrastructure; construction (design, building and compliance); urban regeneration and industrial design; permitting; and compliance. Daniel has been the technical lead for several acoustic and vibration projects and project manager for various multidisciplinary projects. Daniel has also spent three years in New South Wales, Australia, working on various large-scale industrial, mining and linear infrastructure projects.

13.3 Consultations

RSK has consulted with Cork County Council at a pre-planning meeting and with local residents at the public consultation event (attended by James Mangan) (as reported in EIAR **Chapter 3 Scoping, Consultations, Community Engagement and Key Issues**) and with other members of the wider design and planning team in preparation of this Noise & Vibration EIAR chapter.

13.4 Noise and vibration criteria

Reference is made herein to the Standards and Guidelines as applied to the assessment of noise and vibration effects from the Project at construction / decommissioning and operation phases.

13.4.1 Construction/decommissioning phase

Plant/machinery that will be used to construct the Project include (but are not limited to) excavators, dump trucks, dozers, generators, lorries, pumps, compressors, mobile cranes, rock breakers, piles, road rollers and hand tools. There will also be vehicular movements to and from the site that will make use of existing public roads. All of these activities will generate construction noise and/or vibration to some degree.

Noise/vibration effects during decommissioning will be less than for the construction phase as, although involving similar plant and equipment with similar noise and/or vibration ratings, the decommissioning phase will be over a shorter duration. Additionally, concrete foundations and the substation and grid connection cabling will typically remain in place.

13.4.1.1 Noise

In the absence of Irish statutory construction noise limits, appropriate construction/decommissioning phase noise criteria for a development of this scale may be found in the British Standard BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise[1] (hereafter referred to as BS 5228-1).

Annex E of BS 5228-1 provides guidance on how to assess the significance of construction noise on dwellings and other sensitive receptors.

Section E.3.2 details the 'ABC Method' of determining the potential significance of noise effects based upon noise change for dwellings. There are other sensitive receptors (including schools and childcare facilities) that could potentially be impacted during construction, and these have also been assessed using the 'ABC Method'. This method

[1] British Standards Institute (BSI). BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise.

requires the quantification of the existing baseline climate and the assessment of construction noise, in isolation, against the existing ambient levels.

To determine the significance of potential noise effects at sensitive receptors, firstly the baseline environment is quantified for the appropriate assessment period (daytime, evening/weekends or night) and rounded to the nearest 5dB. This is then compared to the measured or predicted site noise level. If the site noise level exceeds the appropriate category value listed in **Table 13.1** a potential significant effect is indicated. However, other factors such as the duration of the impacts should be taken into account to conclude if an effect is significant or not significant.

Table 13.1: Threshold of significance of effect at sensitive receptors

Assessment category and threshold value period (L_{Aeq})	Threshold value in decibels (dB $L_{Aeq,T}$)		
	Category A [A]	Category B [B]	Category C [C]
Night-time (23.00 – 07.00)	45	50	55
Evening and weekends [D]	55	60	65
Daytime (07.00 – 19.00) and Sat (07.00 – 13.00)	65	70	75
NOTE 1 A potential significant effect is indicated if the $L_{Aeq,T}$ noise level arising from the site exceeds the threshold level for the category appropriate to the ambient noise level. NOTE 2 If the ambient noise level exceeds the Category C threshold values given in the table (i.e., the ambient noise level is higher than the above values), then a potential significant effect is indicated if the total $L_{Aeq,T}$ noise level for the period increases by more than 3dB due to site noise.			
[A] Category A: Threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are less than these values [B] Category B: Threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are the same as the category A values [C] Category C: Threshold values to use when the ambient noise levels (when rounded to the nearest 5dB) are higher than category A values. [D] 19.00 – 23.00 weekdays, 13.00-22.00 Saturdays and 07.00 – 23.00 Sundays.			

In this instance, with the rural nature of the wind farm site, all sensitive receptors in the vicinity of the Project have ambient noise levels that typically range from 45 to 55dB $L_{Aeq,T}$. Therefore, all noise sensitive receptors will be afforded a Category A designation. It is noted that baseline noise levels along parts of the Grid Connection routes are likely to exceed Category A values, particularly where the routes cross the N20. However, as a conservative approach to capture all potential impacts, all sensitive receptors have been considered Category A, in line with best practice.

Therefore, if the construction noise level exceeds the appropriate category value (e.g., 65dB $L_{Aeq,T}$ during daytime periods), a potential significant effect is indicated. In addition, the duration of the impact has also been considered in order to determine if a significant effect is likely. See section 13.8.1 for the detailed assessment in relation to this wind farm site.

13.4.1.2 Vibration

BS 5228-2: 2009+A1:2014 Code of practice for noise and vibration control on construction and open site – Part 2: Vibration[2] (hereafter referred to as BS 5228-2) is commonly used in the assessment of construction vibration levels. This standard details the response limits of buildings in relation to ground borne vibration levels, as well as providing guidance on the human effects of vibration, based on human perception and disturbance.

With regards to the response limits of buildings, BS 5228-2 references previously published guidance BS 7385-2[3] and BS ISO 4866:2010[4], which prescribe methodologies for vibration measurements, data analysis and reporting, as well as building classification and guide values for building damage. When defining damage to residential type structures, BS 7385-2 quotes the damage categories in **Table 13.2**.

Table 13.2: Damage criteria

Damage Category	Description
Cosmetic	The formation of hairline cracks on drywall surfaces, or the growth of existing cracks in plaster or drywall surfaces; in addition, the formation of hairline cracks in mortar joints of brick/concrete block construction
Minor	The formation of large cracks or loosening and failing of plaster or drywall surfaces, or cracks through bricks/concrete blocks
Major	Damage to structural elements of the building, cracks in support columns, loosening of joints, splaying of masonry cracks etc.

With regards to building damage, BS 5228-2 provides guide values to prevent cosmetic damage to property. For transient vibration between 4Hz and 15Hz, a guide value of 15 - 20 mms^{-1} is recommended for unreinforced and residential property, whist above 40Hz the guide value is 50 mms^{-1}. In the lower frequency region strains associated with a given vibration are higher and therefore result in a lowering of the threshold criteria.

Table 13.3 and **Figure 13.1** show the relationship between the type of building which is being subject to vibration and the vibration levels, in terms of component peak particle velocity (PPV) and the frequency range of predominant pulse (Hz), at which there is potential for building damage.

[2] BS 5228-2: 2009+A1:2014 'Code of practice for noise and vibration control on construction and open site – Part 2: Vibration

[3] BS 7385 Evaluation and measurement for vibration in buildings – Part 2: Guide to damage levels from groundborne vibration (1993)

[4] BS ISO 4866:2010 Mechanical vibration and shock — Vibration of fixed structures — Guidelines for the measurement of vibrations and evaluation of their effects on structures.

Table 13.3: Transient vibration guide values for cosmetic damage

Line	Type of Building	Peak component particle velocity in frequency range of predominant pulse	
		4 Hz to 15 Hz	15 Hz and above
1	Reinforced or framed structures Industrial and heavy commercial buildings	50 mms^{-1} at 4Hz and above	
2	Unreinforced or light framed structures Residential or light commercial buildings	15 mms^{-1} at 4 Hz increasing to 20 mms^{-1} at 15 Hz	20 mms^{-1} at 15 Hz increasing to 50 mms^{-1} at 40 Hz and above

Note 1 – values referred to are at the base of the building;
Note 2 – for line 2, at frequencies below 4 Hz, a maximum displacement of 0.6 mm (zero to peak) is not to be exceeded.

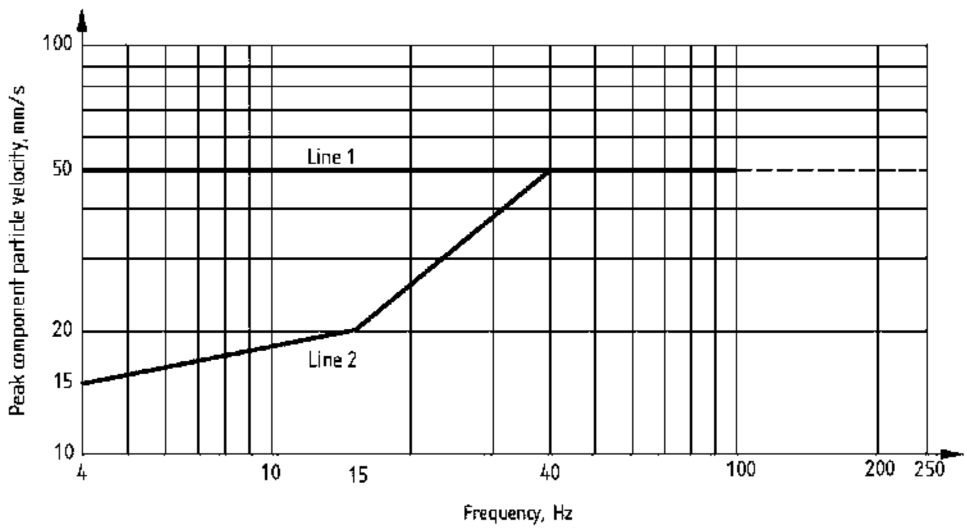

Figure 13.1: Transient vibration guide values for cosmetic damage

According to BS 5228-2, where the dynamic loading caused by continuous vibration is such that it would give rise to dynamic magnification due to resonance, especially at the lower frequencies where lower guide values apply, then the guide values might need to be reduced by up to 50%.

In terms of the likely vibration levels at which further damage may be caused, BS 5228-2 suggests that minor damage is possible at vibration magnitudes which are greater than twice those given for cosmetic damage, and major damage to a building structure may occur at values greater than four times the tabulated values.

When assessing human response to construction vibration, BS:5228-2 states that Peak Particle Velocity (PPV) is the most appropriate assessment parameter, as this is more routinely measured based upon associated concerns with potential building damage. The use of this parameter is further supported for this assessment, as vibration predictions have been conducted, which also yield results presented in terms of PPV.

Guidance on the human effects of vibration based on human perception and disturbance are detailed below in **Table 13.4**.

Table 13.4: Guidance on effects of vibration levels (Table B.1 – BS5228-2: 2009)

Vibration Level	Effect
0.14 $mm.s^{-1}$	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration.
0.3 $mm.s^{-1}$	Vibration might be just perceptible in residential environments
1.0 $mm.s^{-1}$	It is likely that vibration of this level in residential environments will cause complaint but can be tolerated if prior warning and explanation has been given to residents.
10 $mm.s^{-1}$	Vibration is likely to be intolerable for any more than a very brief exposure to this level, in most building environments

An assessment of the likely effects of construction phase vibration is provided in the relevant sections of this chapter.

13.4.2 Operational phase

13.4.2.1 Noise

Wind Energy Development Guidelines

Section 5.6 of the “Wind Energy Development Guidelines” (2006)[5] (WEDG06) outlines the appropriate noise criteria in relation wind farm developments. The following relevant extracts from this document are reproduced below:

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

WEDG06 provides a description and definition of a noise sensitive receptor, as follows:

> *“In the case of wind energy development, a noise sensitive receptor includes any occupied house, hostel, health building or place of worship and may include areas of particular scenic quality or special recreational importance. Noise limits should apply only to those areas frequently used for relaxation of activities for which a quiet environment is highly desirable. Noise limits should be applied to external locations and should reflect the variation in both turbine source noise and background noise with wind speed.”*

[5] Department of the Environment, Heritage and Local Government “Wind Energy Development Guidelines” (2006)

Noise limits have been applied to appropriately selected receptors, and external noise limits reflecting the variation in turbine and background noise levels, have been incorporated into this assessment. WEDG06 states the following in relation to general daytime wind farm noise limits:

> *"In general, a lower fixed limit of 45dB(A) or a maximum increase of 5dB(A) above background noise at nearby noise sensitive locations is considered appropriate to provide protection to wind energy development neighbours."*

This represents the commonly adopted daytime noise criteria in relation to wind farm developments. However, in "very quiet areas", WEDG06 advises the following:

> *"However, in very quiet areas, the use of a margin of 5dB(A) above background noise at nearby noise sensitive properties is not necessary to offer a reasonable degree of protection and may unduly restrict wind energy developments which should be recognised as having wider national and global benefits. Instead, in low noise environments where background noise is less than 30dB(A), it is recommended that the daytime level of the L_{A90}, 10min of the wind energy development be limited to an absolute level within the range of 35 – 40dB(A)."*

Section 3.2 of the IoA GPG provides the following comments in relation to the methods for "Determining the Fixed Part of the Daytime Amenity Noise Limit "(i.e., the 35 to 40dB(A) range), where the following is stated:

> *"ETSU-R-97 describes three criteria to consider when determining the fixed part of the limit in the range of 35dB to 40dB L_{A90}, all of which should be considered. They are:*
>
> *1) the number of noise-affected properties;*
>
> *2) the potential impact on the power output of the wind farm; and*
>
> *3) the likely duration and level of exposure".*

In relation to the IoA GPG consideration **1)**, (i.e., the number of affected receptors), noise calculations indicate that there are 56 noise sensitive receptors where noise levels are calculated to potentially exceed 35dB L_{A90}, thus may be affected by the decision on the fixed part of the daytime amenity noise limit.

In relation to IoA GPG consideration **2)**, it has been found that some degree of turbine curtailment, to reduce noise emissions to 26 receptors, would potentially be required if a 35dB L_{A90} lower limit was selected vs.1 receptor at a 37.5dB L_{A90} lower limit; and no receptors potentially requiring curtailment if a 40dB L_{A90} lower limit were selected. As such, the implementation of a 35dB lower limit would have a more significant *"potential impact on the power output of the wind farm"*, in comparison to a 37.5dB or 40 dB L_{A90} lower limit. As the difference in subjective terms between a turbine noise level of 35dB L_{A90} vs 37.5dB L_{A90} (i.e., a difference of 2.5dB) is small and would be typically imperceptible, it is considered that the selection of 37.5dB L_{A90} as the "Fixed Part of the Daytime Amenity Noise Limit" provides an appropriate balance between power generation and noise impact of the Project.

In relation to the IoA GPG consideration no. **3)**, i.e., *"the likely duration and level of exposure*" the IoA GPG acknowledges that *"This last test is more difficult to formulate. But ETSU-R-97 notes that the likely excess of turbine noise relative to background noise* *levels should be a relevant consideration. In rural areas, this will often be determined by the sheltering of the property relative to the wind farm site. Account can also be taken of the effects of wind directions (including prevailing ones at the site) and likely directional effects*". In relation to "*the likely excess of turbine noise relative to background noise levels"* at the wind speeds where the selection of the *Fixed Part of the Daytime Amenity Noise Limit* influences the *potential impact on the power output of the wind farm* (i.e., 5 - 6 m/s v_{10}), daytime baseline noise levels have been measured at 28.5dB to 29.9dB L_{A90}. Therefore, implementation of a 35dB L_{A90} lower limit would result in a potential increase in turbine noise relative to background noise level of up to 6.5dB vs a potential increase in turbine noise relative to background noise level of up to 9dB if a 37.5dB L_{A90} lower limit is selected. In relation to *the effects of wind direction*; the majority of receptors that would be impacted by the selection of the *Fixed Part of the Daytime Amenity Noise Limit* lower limit are located to the east of the site (i.e., predominantly in the direction of prevailing winds).

In low-noise areas, a daytime criterion of 37.5dB(A) has therefore been adopted for the Project. This represents the mid-point of the WEDG06 stated 35 to 40dB(A) range. This is considered appropriate in light of the following:

- Items 1 to 3 of the IoA GPG methods for "Determining the Fixed Part of the Daytime Amenity Noise Limit".
- The EPA document 'Guidance Note on Noise Assessment of Wind Turbine Operations at EPA Licensed Sites' (NG3) which states that "Wind turbine noise not to exceed 45dB L_{Aeq} at any time, or to contain any significant tonal components". The proposed lower threshold is therefore more stringent than this level.
- Criteria proposed in other similar scale wind farm development in the Co. Cork region[6], which have adopted 37.5dB $L_{A90,10min}$ as the daytime criteria to apply to low noise areas.

For night-time periods, WEDG06 advises the following:

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

This limit is defined in terms of the $L_{A90,10min}$ parameter, and 43dB(A) represents the commonly adopted night-time noise criterion for wind farm developments.

The WEDG06 state that "*An appropriate balance must be achieved between power generation and noise impact."* Based on a review of other national guidance in relation to acceptable noise levels in areas of low background noise, it is considered that the criteria adopted as part of this assessment are robust.

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

The core of the noise guidance contained within WEDG06 is based on the 1996 ETSU publication The Assessment and Rating of Noise from Wind Farms[7] (ETSU-R-97).

[6] Planning Ref. 308/308885 "Coom Green Energy Park Limited"

[7] Department of Trade & Industry (UK) Energy Technology Support Unit (ETSU) publication The Assessment and Rating of Noise from Wind Farms (1996).

ETSU-R-97 calls for the control of wind turbine noise by the application of noise limits at the nearest noise sensitive receptors. It considers that absolute noise levels applied at all wind speeds are not suited to wind turbine developments and therefore best practice is to adopt noise limits relative to background noise levels at receptors. A critical aspect of the noise assessment of wind energy proposals therefore relates to the establishment of representative baseline noise levels through on-site noise surveys.

Institute of Acoustics Good Practice Guide (IoA GPG)

The guidance contained within the institute of Acoustics (IoA) document 'A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise' (2013) (IoA GPG) and 'Supplementary Guidance Notes' are considered to represent best practice and have been adopted for this assessment.

The IoA GPG states, that as a minimum, continuous baseline noise monitoring should be carried out at the nearest noise sensitive receptors for a representative period and should capture a representative sample of wind speeds in the area (i.e., cut in speeds to wind speed of rated sound power of the proposed turbine). Background noise measurements (i.e., $L_{A90,10min}$) should be related to wind speed measurements that are collated at the site of the wind turbine development.

Regression analysis is then applied to the data set to derive background noise levels at various wind speeds, and from this, the appropriate noise criterion curves are established.

Noise emissions associated with the wind turbine are predicted in accordance with ISO 9613: Acoustics – Attenuation of sound outdoors, Part 2: General method of calculation[8], with input parameters as outlined in the IoA GPG. This is a noise prediction standard that calculates noise levels from an initial Sound Power Level (dB L_w) to a receptor, taking into account the noise attenuation offered by distance, ground absorption, directivity, barrier screening and atmospheric absorption, amongst others.

For wind farm noise calculations, noise predictions and visual noise contours are prepared for various wind speeds and the predicted levels are compared against the relevant noise criteria. This assessment has identified where the appropriate noise criteria are met and where potential exceedances may occur.

Where noise predictions indicate that reductions in noise emissions are required to satisfy any criteria, directional analysis can be carried out in order to establish under which wind directions the exceedances are likely to occur. This then leads to the specification of mitigation measures which typically consist of the operation of one or a number of turbines in a reduced power output, often described as a 'low noise' mode, under specific wind speeds and directions.

Proposed criteria for Project

Based on the foregoing, the proposed operational phase noise limits ($L_{A90,10min}$) for the Project at nearby noise sensitive receptors, are as follows:

Daytime (07:00 – 23:00hrs):

[8] ISO 9613: Acoustics – Attenuation of sound outdoors, Part 2: General method of calculation (1996)

- 37.5dB $L_{A90,10min}$ for quiet daytime environments of less than 30dB $L_{A90,10min}$. [9]
- 45dB $L_{A90,10min}$ for daytime environments greater than 30dB $L_{A90,10min}$, or a maximum increase of 5dB(A) above background noise (whichever is higher).

Night-time (23:00 – 07:00hrs):

- 43dB $L_{A90,10min}$.

In relation to receptors where the landowner has an interest in the development, the IoA GPG allows for the fixed limits to be increased to 45dB $L_{A90,10min}$ or 5dB(A) above background noise (whichever is higher) for both day and night time periods.

Based on the baseline noise monitoring carried out and reviewed in this assessment (Ref **Table 13.6**), day and night-time noise criteria curves have been derived for noise sensitive receptors surrounding the Project (Ref **Table 13.7**).

Future potential guidance changes

The noise assessment has been undertaken on the basis of the extant WEDG06. Draft Revised Wind Energy Development Guidelines (WEDG) were issued in December 2019[10]. The Draft Revised WEDG have been subject to significant criticism and are considered unsuitable for application as a result of a number of identified technical errors, ambiguities and inconsistencies that are considered to require further detailed review and amendment. The specific details and identified reasons can be viewed within the consultation response issued in February 2020 by a group of acousticians who advise wind farm developers, Councils, government bodies and resident groups.[11]

The Cork County Development Plan[12] outlines the following objective in relation to the development of onshore wind:

> *"Objective ET 13-9 National Wind Energy Guidelines: Development of on-shore wind should be designed and developed in line with the 'Planning Guidelines for Wind Farm Development 2006' and 'Draft Wind Energy Development Guidelines 2019' and any relevant update of these guidelines"*.

The Project complies with three of the four core components of the Draft Revised WEDG. Given (a) the acousticians' joint consultation response in respect of the Draft Revised WEDG; (b) the industry expectation that the WEDG will change; and (c) the fact that the government has not to date issued replacement WEDG, it is not considered appropriate to comply fully with the Draft Revised WEDG, especially where other guidance exists in this regard (i.e., ETSU R-97 and IoA GPG).

[9] Reference to Table 13.7 & Figure 13.16 confirms this lower 37.5 dB daytime criteria has been applied to all dwellings within Zone BN1 (broadly west of site) at wind speeds 2-5 m/s (v_{10}), Zones BN2 & BN3 (broadly north and east of site) at wind speeds 2-6 m/s (v_{10}), and dwellings within Zone BN4 (broadly south of site) at wind speeds 2-3 m/s (v_{10}).

[10] Department of Housing, Local Government and Heritage Draft Revised Wind Energy Development Guidelines, (December 2019).

[11] WEDG Consultation Response (Noise) 19th February 2020 , Joint Consultation Response, https://tneigroup-com.stackstaging.com/wp-content/uploads/2022/05/WEDG-consultation-joint-response-R0.pdf

[12] Cork County Council, 2022. Cork County Development Plan 2022 - 2028.

13.4.2.2 Vibration and Special characteristics of turbine noise

Vibration emissions from operational turbines will not be significant or perceptible at distances representative of nearby sensitive receptors.

Potential special sound characteristics of turbine noise, such as Infrasound, Low Frequency Noise, Amplitude Modulation and Tonality, are discussed in EIAR **Volume III, Appendix 13.2**. These characteristics are rare and are not factors that can be foreseen at planning stage, but their presence can be measured and rated, typically in the event of a complaint, post construction. It is therefore standard practice for special sound characteristics to be investigated, only in the event of complaint, and, where the investigation verifies their presence, mitigation measures put in place to address any identified significant adverse turbine noise characteristics. Any monitoring that may be required by the Planning Authority, as a condition of a grant of planning permission, in relation to noise will be complied with.

13.5 Methodology

13.5.1 Introduction

The methodology adopted for this noise impact assessment is as follows:

- Review of relevant guidance and setting of suitable construction, operational and decommissioning phase noise & vibration criteria.
- Characterisation of the receiving noise and vibration environment, via site visits and baseline noise surveys.
- Prediction of noise and vibration effects and cumulative impacts of the Project.
- Assessment of potential significant effects.
- Specification of mitigation measures.
- Evaluation of residual noise and vibration effects.

13.5.2 Baseline noise

Baseline noise levels have been measured at four locations representative of the nearest noise sensitive receptors to the north, east, south and west of the wind farm site. The rationale for the selection of these locations is provided in section 13.6.3.5. Noise predictions have been made for construction and operational phases of the proposed wind farm development (wind turbine, substation and grid connection) at nearby receptors.

13.5.3 Construction noise

With regards to construction noise/vibration, the closest receptors to the various works locations (i.e., turbine construction, substation and grid connection) have been considered in respect of this EIAR Chapter. These receptors are typically the same as those considered in the operational phase noise assessment.

With regards to the grid connection construction works, the study area includes receptors along the public roads where trenching works occur between the on-site substation and the grid connection point at Mallow 110kV substation. This study area is based upon a review of GCR options and online mapping/photography showing location of receptors in respect of GCRs, using professional judgement.

13.5.4 Operational noise

The operational phase relates solely to the wind farm element of the Project. A study area was chosen at scoping stage following the recommendations outlined in the institute of Acoustics (IoA) document A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise[13] (IoA GPG) with regard to the "Definition of Study Area", which is advised as the area within which the noise levels from the proposed Project may exceed 35dB L_{A90}, at the wind speed where turbines reach their maximum sound output. All 157 noise sensitive receptors within this '35dB' zone were taken into consideration in the operational phase noise impact assessment, with additional receptors outside of the '35dB zone' to include all receptors included in the sensitive receptor survey. A list of receptors and coordinates is provided in EIAR **Volume III**, **Appendix 13.1**. The receptors identified include occupied and unoccupied dwellings (excluding dilapidated properties), planning permission sites (validated and granted up to the cut-off date of 20th March 2024), and a school.

13.5.4.1 Noise model

A series of computer-based calculation models have been prepared to predict operational noise levels for the Project.

SoundPlan (v8.2) noise calculation software has been used for the purposes of this impact assessment. The selected software, SoundPlan, calculates noise levels in accordance with ISO 9613[8].

SoundPlan is a proprietary calculation package for computing sound levels in the vicinity of sound sources. SoundPlan calculates noise levels in different ways depending on the selected prediction standard and parameters. In general, however, the resultant noise level is calculated taking into account a range of factors affecting the propagation of sound, including:

- the magnitude of the noise source in terms of Sound Power Levels (dB L_{wA}).
- the distance between the source (turbines) and receptors.
- the presence of obstacles such as screens or barriers in the propagation path.
- the hardness of the ground between the source and receptors.
- Attenuation due to atmospheric absorption.
- Meteorological effects such as wind gradient, temperature gradient and humidity.

[13] Institute of Acoustics (IoA) A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise (2013).

13.5.4.2 *Turbine input data*

Contour and information available for the wind farm site has been input into noise modelling software and noise levels have been calculated in accordance with ISO 9613-2:1996[8]. The model has considered the operation of nine wind turbine units on the site as detailed in EIAR **Chapter 5 Project Description.**

Table 13.5 details the co-ordinates of the turbines that are proposed as part of this assessment.

Table 13.5: Proposed turbine co-ordinates

Ref	Co-ordinates (ITM)	
	Easting	Northing
T1	547,979	606,315
T2	548,351	606,226
T3	548,348	605,844
T4	548,696	605,641
T5	549,083	605,614
T6	549,468	605,652
T7	548,967	605,241
T8	549,331	605,146
T9	549,665	605,345

The turbine model proposed for the Project is the Vestas V150–4.5MW Mode P04. Should an alternative model be considered for installation on site, sound power levels should be no greater than that used for the purposes of this assessment, to ensure the required noise limits are achieved.

Sound power levels (L_{wA}) have been supplied for the turbine under consideration. Predictions have assumed a turbine Hub Height of 100m.

The noise assessment is presented in terms of $L_{A90,10min}$ criterion. The provided turbine noise data, in terms of L_{wA} (used to calculate L_{Aeq}) has been adjusted by subtracting 2dB to give a representative L_{A90} as outlined in best practice guidance (IoA GPG):

> *"The Noise Working Group is agreed that the $L_{A90(10\ minutes)}$ descriptor should be used for both the background noise and the wind farm noise and that when setting limits, it should be borne in mind that the $L_{A90(10\ minutes)}$ from the wind farm is likely to be 1.5 – 2.5dB(A) less than the L_{Aeq} measured over the same period."*

In order to account for uncertainties in the measurement of turbine source levels, a +2dB uncertainty factor has been added to the values in line with best practice from the IoA GPG.

Table 13.6 details the noise spectra used for noise modelling purposes for the Project, extracted from Section 6.2 of the Vestas performance specifications document[14] with Octave Band Levels extracted from Table 3 of the Vestas Third octave noise emission specification document[15].

Table 13.6: Turbine sound power L_{WA} spectra used for prediction model (Vestas V150–4.5MW Mode P04-0S)

Wind Speed (m/s) at Hub Height	Sound Power Level at Hub Height [dBA] Mode PO4-0S (Blades with serrated trailing edge) dB L_{wA}	Octave Band Sound Power Level at Hub Height							
		63	125	250	500	1k	2k	4k	8k
3	91.1	69.2	78.2	83.8	86.3	85.6	81.6	74.5	64.0
4	91.3	68.9	78.4	84.3	86.8	85.7	81.2	73.3	61.7
5	93.2	71.2	80.3	86.1	88.6	87.6	83.4	75.8	64.7
6	96.4	74.8	83.6	89.2	91.6	90.9	86.9	79.7	69.3
7	100.0	78.7	87.2	92.7	95.1	94.5	90.8	84.0	74.1
8	103.4	82.4	90.7	96.0	98.4	97.9	94.4	88.0	78.5
9+	105.0	84.1	92.2	97.5	99.9	99.5	96.1	90.0	80.9

Vestas have provided sound power data at wind speed representing hub height. The corresponding Sound Power levels at wind speeds referenced to standardised 10m height have been established as per Section 5 of the Vestas Third octave noise emission specification document detailed in the following section.

Recalculation to 10m wind speeds

In case 10m height wind speed references are required, recalculation of the stated values can be made using the following procedure:

1. *The stated hub height wind speeds are recalculated to 10 m reference height.*
2. *Integer 10m height wind speed related sound power levels are calculated using linear interpolation between the nearest non- integer values.3.Recalculation is made using procedures as defined in IEC 61400-11 ed.3. Appendix D.*

The Vestas V150–4.5MW Mode P04-0S can be programmed to run in reduced modes of operation (or low noise modes) in order to achieve noise criteria during certain periods (i.e., day or night) and in specific wind conditions (i.e., wind speed and direction). The requirement for this is dependent on the results of the noise impact assessment. Details of which are presented in section 13.10.2.

[14] Document no.: 0067-7057.V04 2021-12-03 Performance Specification V150–4.5MW 50/60 Hz

[15] Document DMS 0071-7258_02 V150-4.5MW Third octave noise emission

13.5.4.3 Calculation parameters

Calculations have been conducted in accordance with ISO 9613[8], with input parameters as outlined in the IoA Good Practice Guides.

A ground attenuation (GA) factor of 0.5 and no metrological correction has been assumed for all calculations. The atmospheric attenuation outlined in **Table 13.7** has been assumed for all calculations.

Table 13.7: Atmospheric attenuation assumed for noise calculations (dB per km)

Temp (ºC)	% Humidity	Octave Centre Frequencies (Hz)							
		63	125	250	500	1k	2k	4k	8k
10	70	0.12	0.41	1.04	1.93	3.66	9.66	32.77	116.88

13.5.4.4 Additional noise model features

The coordinates of noise sensitive receptors and ground topography have been taken from survey information supplied by the wider design team. Receptor coordinates are presented in EIAR **Volume III**, **Appendix 13.1.**

13.6 Receiving environment

This stage of the assessment was to determine typical background noise levels in the vicinity of the noise sensitive receptors in closest proximity to the wind farm site. This has been undertaken by installing unattended sound level meters at four locations in the surrounding area for an approximate four-week period, with consent from the relevant property owners.

13.6.1 Equipment and choice of measurement locations

The noise sensitive receptors have been identified by preparing a preliminary noise contour at an early stage of the assessment. The selection of monitoring locations has been supplemented by reviewing aerial images of the study area and other online sources of information (e.g., Google Earth) and verified on the ground in a preliminary site walkover, conducted by James Mangan and Thomas Dalton of RSK on 22nd and 23rd June 2022.

The IoA GPG recommends that the study area for the background noise surveys and noise assessment should, as a minimum, be the area within which noise levels from the proposed, consented and existing wind turbines may exceed 35dB L_{A90}. This study area relates to potential impacts from this Project only as there are no other existing wind turbines in the area.

The selected locations for the noise monitoring are shown in **Figure 13.2** with photographs of each location provided in **Figure 13.3- Figure 13.6**. **Table 13.8** provides specific details of the noise sensitive receptors.

Table 13.8: Survey locations

Ref.	Equipment	Approximate Coordinates (GPS)		Notes
		Easting	Northing	
BN1	Brüel and Kjaer 2250 S/N 3007000	52.200447	-8.766538	House Ref. 29 Rain gauge installed at this location
BN2	Brüel and Kjaer 2250 S/N 3010911	52.211569	-8.764276	Proxy Location mid-way between houses Ref. 1 and 35
BN3	Brüel and Kjaer 2250 S/N 3002365	52.210054	-8.739695	House Ref. 72
BN4	Brüel and Kjaer 2250 S/N 2567756	52.192553	-8.730032	House Ref 21
Met Mast	ZephIR Zx300 LIDAR Unit S/N 1420	52.195920	-8.738240	Installed and operated by Galetech

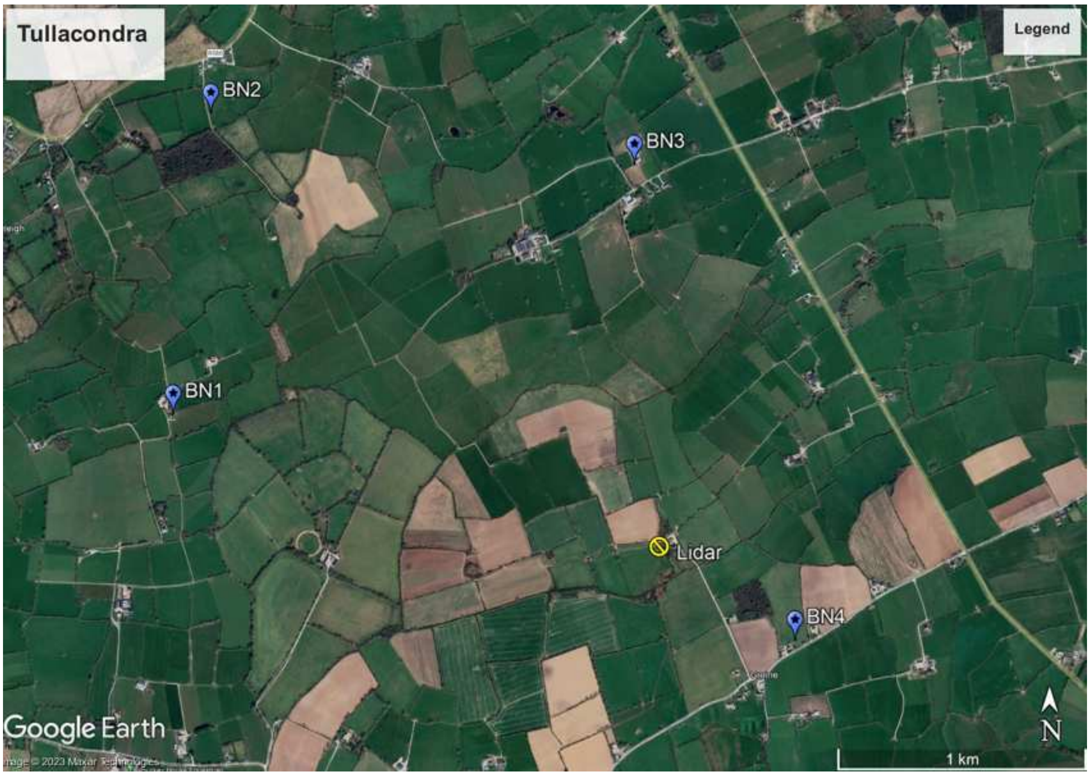

Figure 13.2: Baseline noise monitoring locations BN1 - BN4

Figure 13.3: Photograph of baseline noise monitoring location BN1 (H29)

Figure 13.4: Photograph of baseline noise monitoring location BN2 (H1/H35)

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Figure 13.5: Photograph of baseline noise monitoring location BN3 (H72)

Figure 13.6: Photograph of baseline noise monitoring location BN4 (H21)

13.6.2 Measurement periods and procedure

Noise measurements were conducted on site between 10:30hrs on 28th June and 12:20hrs on 27th July 2022.

Best practice (IoA GPG) requires that "*The survey duration is determined entirely by the requirement to collect sufficient valid data over an adequate range of wind speeds. For pitch-regulated turbines, data should cover the range of wind speeds between cut-in and the speed at which maximum sound power level is achieved.*

As a guideline, the survey should be of sufficient duration to acquire no fewer than 200 valid data points for each of the amenity hours and night periods in the wind speed range required and no fewer than 5 valid data points in any 1 m/s wind speed 'bin' within this range".

In relation to the timing of baseline surveys regarding potential seasonal variations in baseline noise levels, the IoA GPG comments that *"Background noise levels at any location may be subject to seasonal variations and (for a given reference wind speed) will be expected to vary with atmospheric factors including wind shear and, at some locations, wind direction. However, there is no compelling evidence that it is necessary to carry out background noise surveys at any particular time of year, or over two or more separate periods. The only common exception is when a measurement position is close to a running watercourse which is a significant noise source".*

The baseline noise surveys have been conducted with consideration of these factors. The data collected, and timing of surveys, are considered robust in this context.

Upon review of the proposed turbine sound power data, it is noted that the proposed turbines cut-in at approx. 2m/s and reach their maximum sound power level at approx. 7m/s, at standardised 10-metre (v_{10}) height.

A sufficient variety of wind speed and weather conditions was encountered over the survey periods in question. **Figure 13.7** illustrates the distributions of wind speed and wind direction standardised to 10 metre height over the survey period.

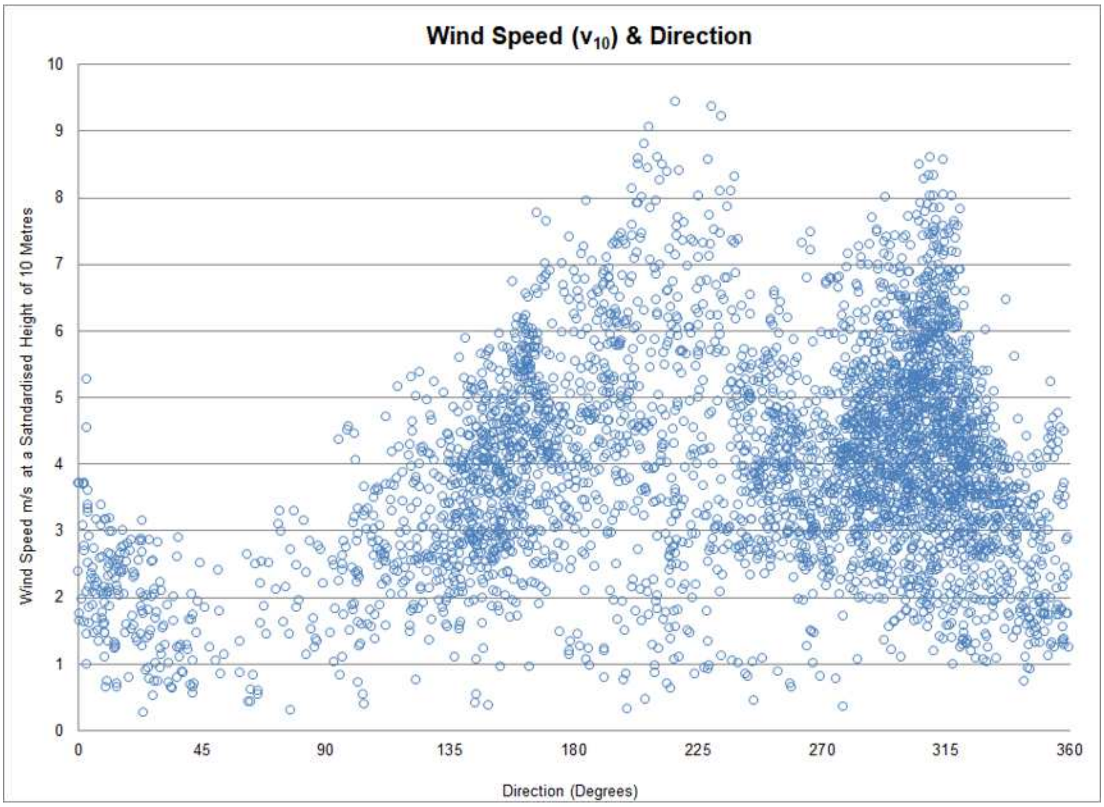


Figure 13.7: Distribution of wind speed and direction during survey 28 Jun – 27 July 2022

Measurements have been conducted at the four locations over the survey period in 10-minute sample periods during both the daytime and night-time periods. The results were saved to the instrument for post-analysis. Survey personnel noted potential primary noise sources contributing to noise build-up during the installation and removal of the sound level meters (e.g., identified significant noise sources in the area such as local traffic or farmyard activities). An attended site walkover was also carried out on the evening of 28th June 2022 by James Mangan and Thomas Dalton (RSK) to observe typical baseline noise sources, characteristics and general soundscape where observations indicated that baseline noise levels are relatively low, with typical background sound sources being those associated with distant traffic, birdsong, distant farming activities, livestock and wind noise in nearby foliage.

At the time of the baseline noise surveys, COVID-19 restrictions had generally eased in Ireland, whereby Ireland entered stage three of the government's roadmap of easing COVID-19 restrictions on 29th June 2020, with remaining businesses reopening, including all pubs serving food, cafés, restaurants, hotels, hairdressers, beauty salons and tourist attractions. Traffic flows on the surrounding road network are likely to have been lower than those pre- and post-COVID-19, however with consideration of the relatively rural location of the wind farm site, combined with the general easing of COVID-19 restrictions at the time of baseline noise surveys, it is considered that the baseline noise levels remained typical. In the event that the baseline noise levels were slightly lower than may have been measured pre- or post-COVID-19, this would be worst-case, in the context of this noise impact assessment (i.e., the collection of lower than typical baseline noise levels would result in the application of a more stringent noise criteria for noise emissions).

Lidar wind monitoring has been conducted throughout the noise survey by Galetech, at various heights including that of the proposed hub height. The hub height wind speeds have been standardised to 10m height using the following equation:

Roughness Length Shear Profile (Ref. IoA GPG):

$$U_1 = U_2 \times [(\ln(H_1 \div z))/ (\ln(H_2 \div z))]$$

Where:

H_1	The height of the wind speed to be calculated (10m)
H_2	The height of the measured or calculated HH wind speed.
U_1	The wind speed to be calculated.
U_2	The measured or calculated HH wind speed.
z	The roughness length.

Note: A roughness length of 0.05m is used to standardise hub height wind speeds to 10m height in the IEC 61400-11 standard, regardless of the actual roughness length on a site. This 'normalisation' procedure was adopted for comparability between test results for different turbines as outlined in the IoA GPG.

13.6.3 Baseline noise measurement results

The statistical analysis on which the daytime noise criteria are based, is referenced to noise data collated during 'quiet periods' of the day as defined in ETSU-R-97 and the IoA GPG, defined as follows:

- All evenings from 18:00 to 23:00hrs.
- Saturday afternoons from 13:00 to 18:00hrs.
- All day Sunday from 07:00 to 18:00hrs.

Night-time, as defined in the IoA GPG, is Monday to Sunday 23:00 to 07:00hrs.

The collated baseline noise data at each location is presented in the following sections.

13.6.3.1 Location BN1

Daytime period

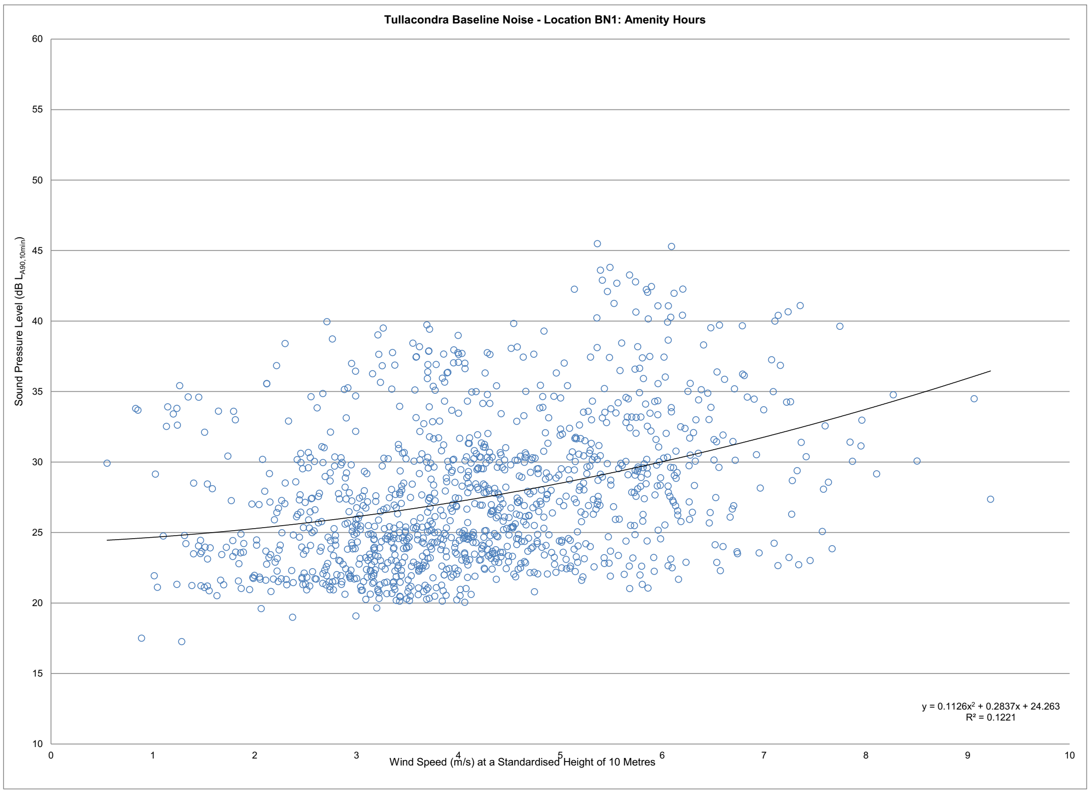


Figure 13.8: BN1 Quiet daytime periods

Night-time period

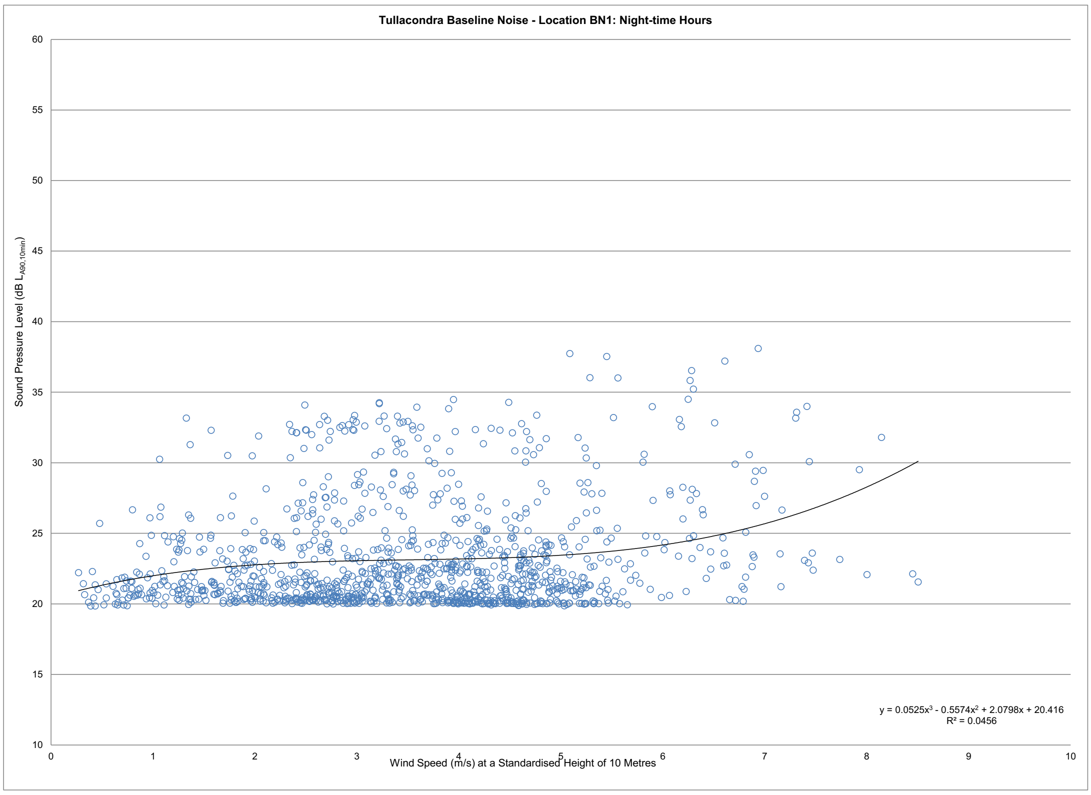


Figure 13.9: BN1 Night-time periods

13.6.3.2 Location BN2

Daytime period

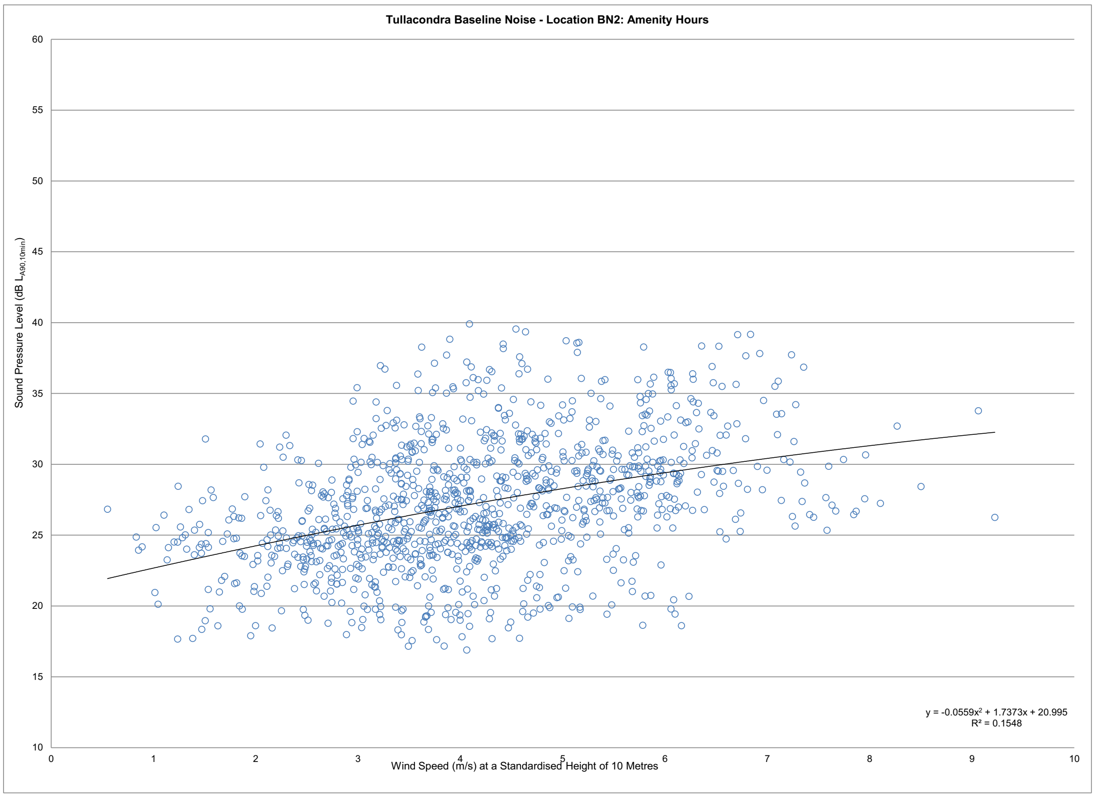


Figure 13.10: BN2 Quiet daytime periods

Night-time period

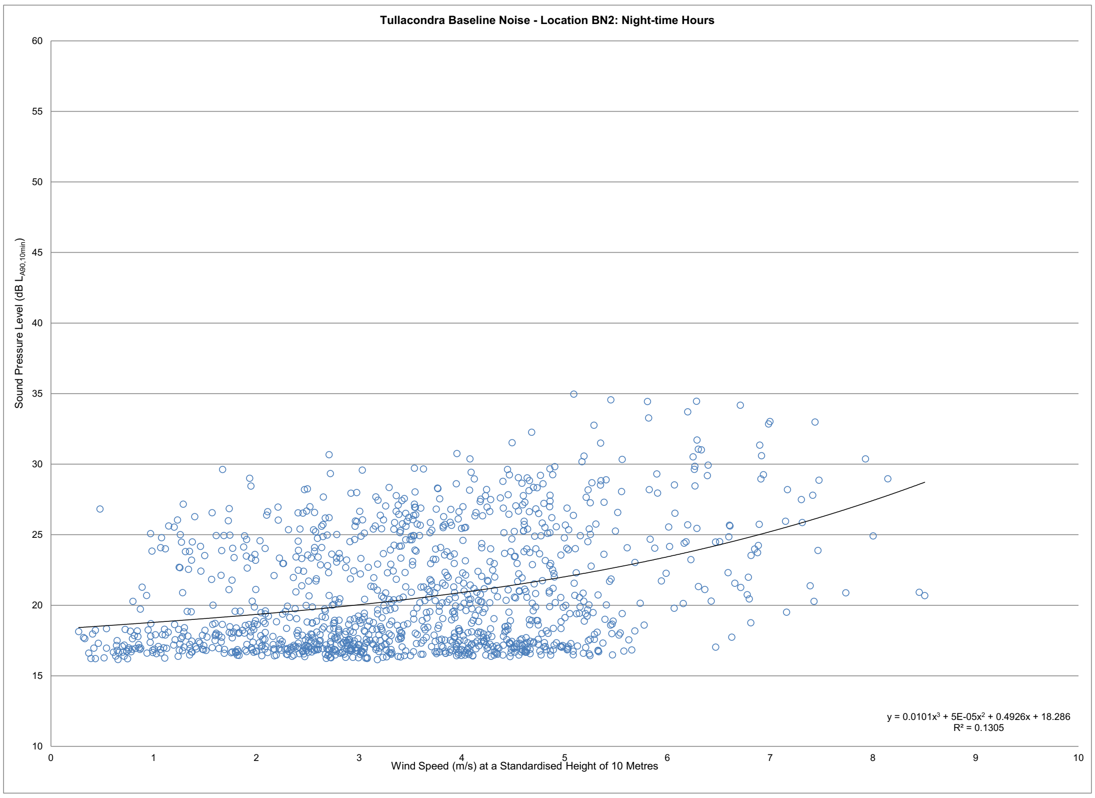


Figure 13.11: BN2 Night-time periods

13.6.3.3 *Location BN3*

Daytime period

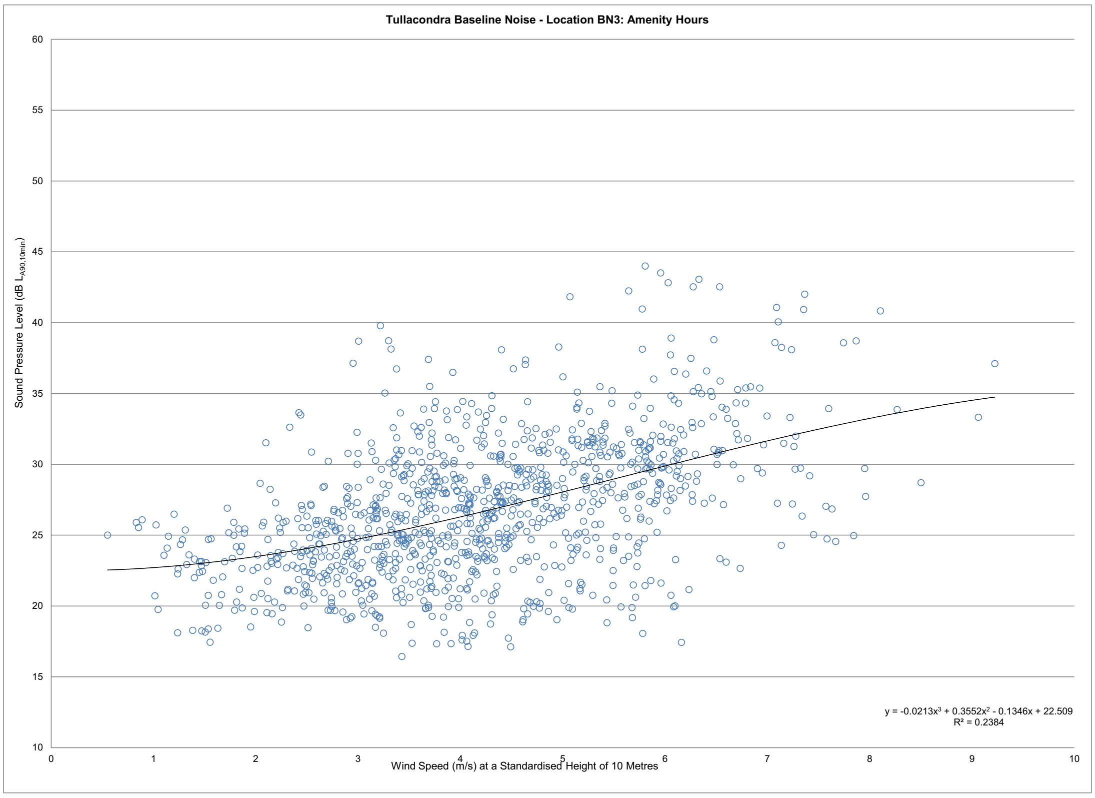


Figure 13.12: BN3 Quiet daytime periods

Night-time period

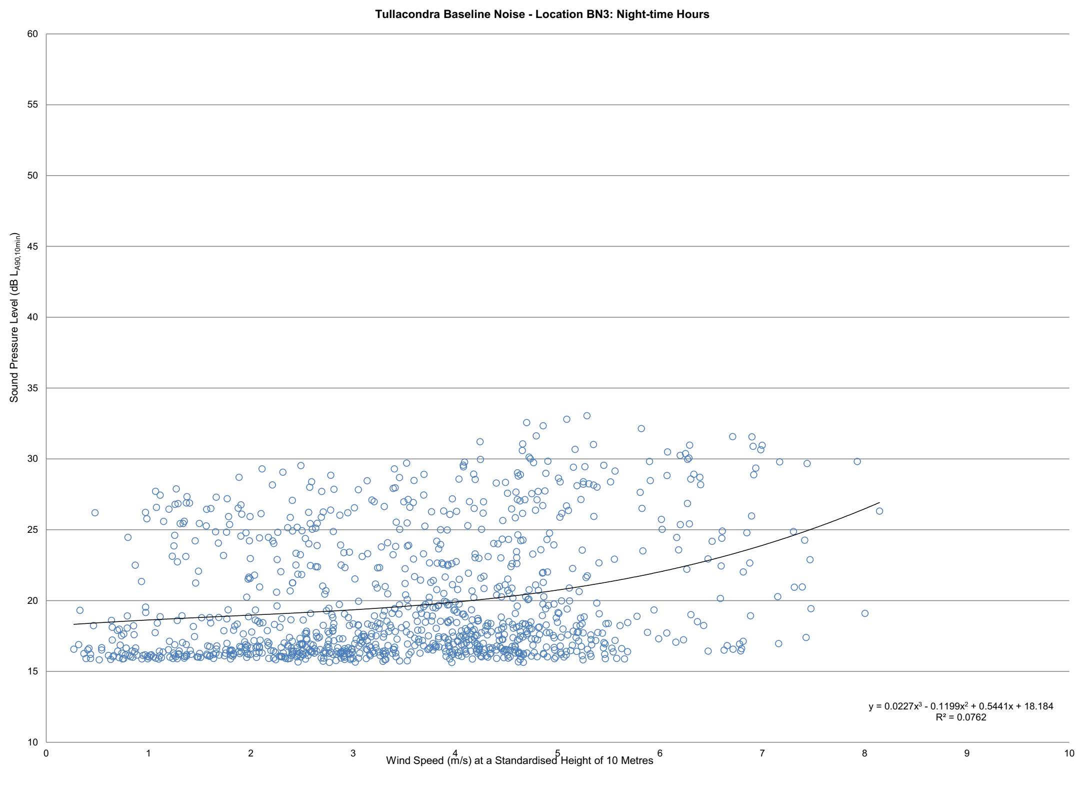


Figure 13.13: BN3 Night-time periods

13.6.3.4 Location BN4

Daytime period

Figure 13.14: BN4 Quiet daytime periods

Night-time period

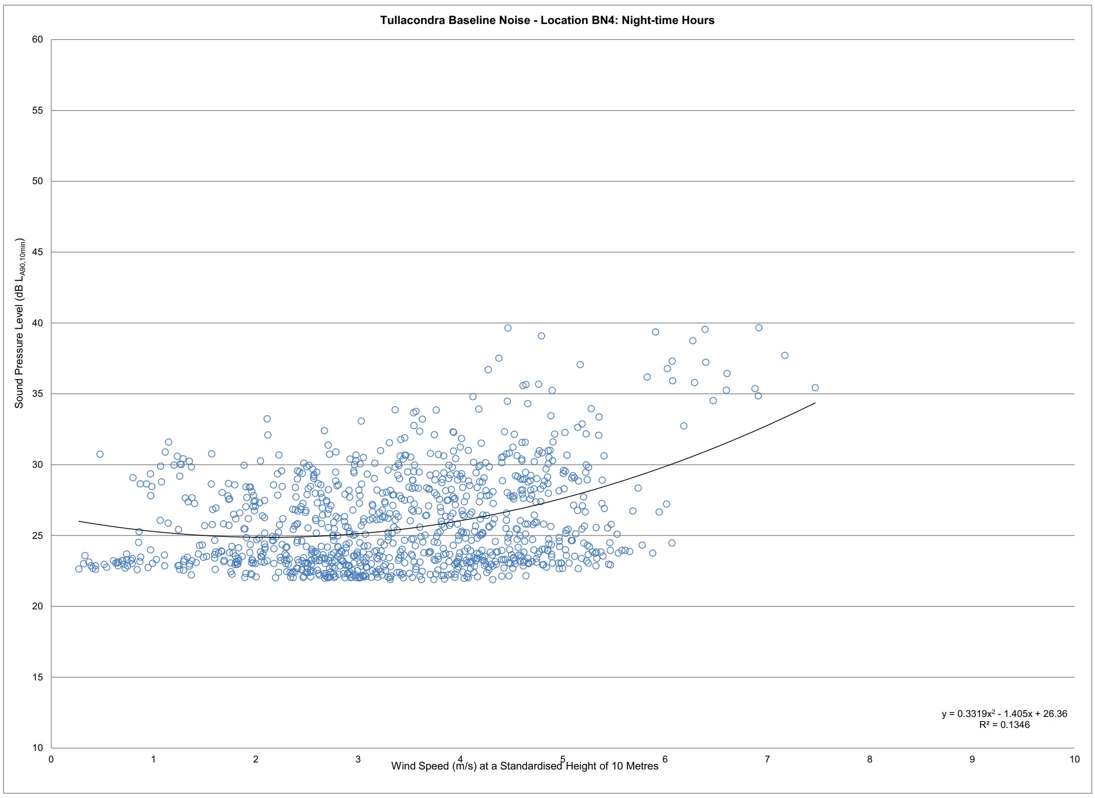


Figure 13.15: BN4 Night-time periods

13.6.3.4 Summary of baseline noise levels

The baseline noise levels at each integer wind speed (standardised 10 metre height), are presented in **Table 13.9**.

Table 13.9: Summary of baseline background sound levels, dB

Location	Period	Derived $L_{A90,\,10\,min}$ Baseline Sound Levels (dB) at Standardised 10m Height Above Ground Wind Speed (m/s) (Calculated via Baseline Regression Curve Equation)								
		2	3	4	5	6	7	8	9	10
BN1	Day	25.3	26.1	27.2	28.5	30.0	31.8	33.7	35.9	38.4
	Night	22.8	23.1	23.2	23.4	24.2	25.7	28.3	32.3	38.0
BN2	Day	24.2	25.7	27.0	28.3	29.4	30.4	31.3	32.1	32.8
	Night	19.4	20.0	20.9	22.0	23.4	25.2	27.4	30.1	33.3
BN3	Day	23.5	24.7	26.3	28.1	29.9	31.7	33.3	34.5	35.4
	Night	19.0	19.4	19.9	20.7	22.0	23.9	26.5	29.9	34.3
BN4	Day	26.8	28.5	30.3	32.2	34.3	36.4	38.6	41.0	43.4
	Night	24.9	25.1	26.1	27.6	29.9	32.8	36.4	40.6	45.5

Baseline noise data has been used to derive appropriate noise limits for each of the receptors, and associated proxy receptors listed, per the following section.

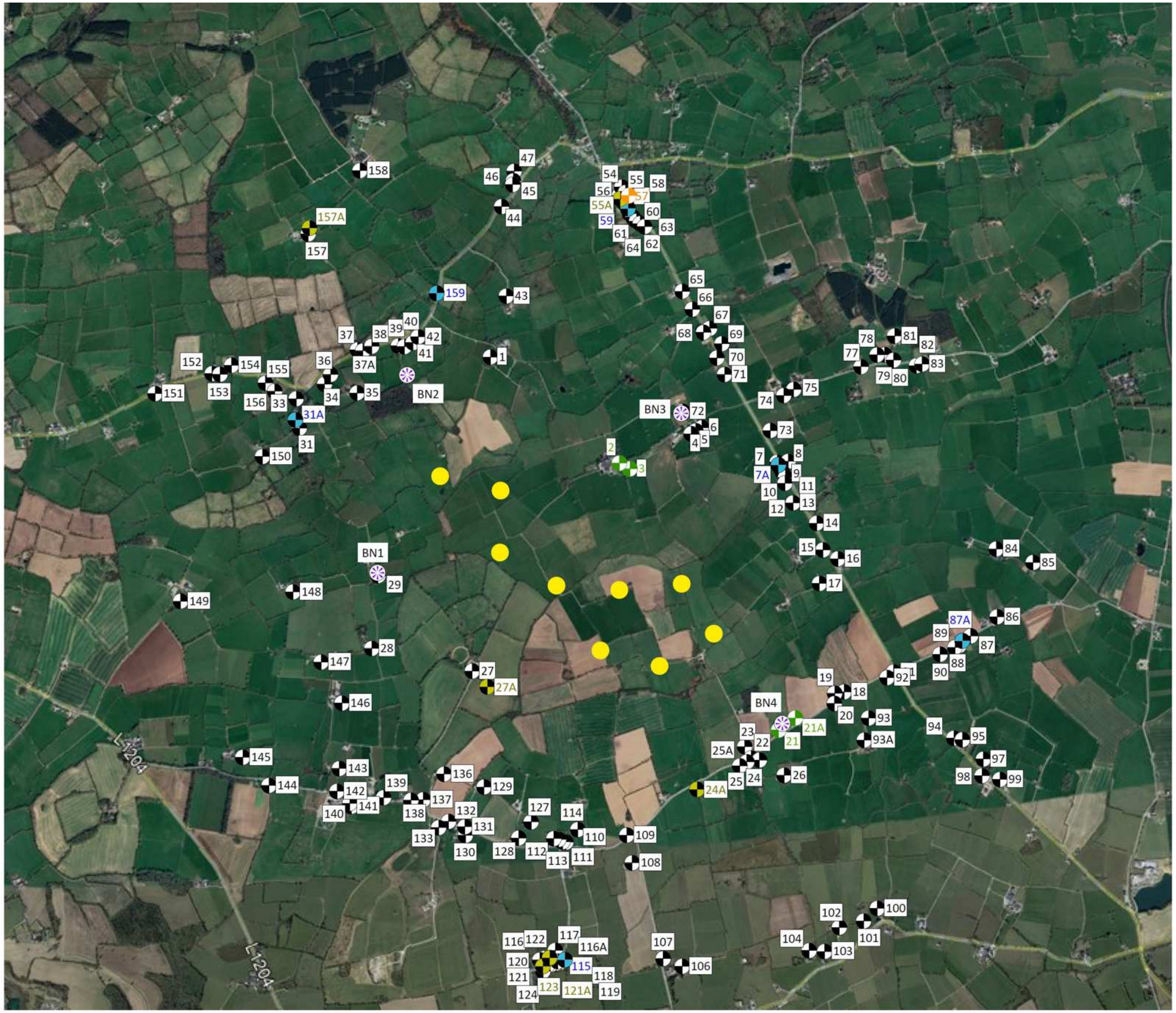
13.6.3.5 Application of baseline noise levels to noise sensitive receptors

The IoA GPG states that *"Background noise measurements should preferably be made in the vicinity of noise-sensitive receptors."*

The document also states *that "A common situation is where there are groups of houses and the objective is to identify, for each group, a 'representative' location within the curtilage of one property such that the background noise levels measured there can be reliably assigned to all other houses in the group. At the survey planning stage, it may not be possible to gain access to gardens, but candidate locations can usually be identified from roadside views, supported by aerial images on website map pages".*

The document goes on to comment that *"When choosing a location that will serve as a proxy for others, the basis for selection is that it can reasonably be claimed, from inspection and observation, to be representative of the non-surveyed locations, in line with the criteria of Section 2.5. Measurement locations outside a property's curtilage (such as an adjacent field) may be used when access to a representative property cannot be obtained, provided that such a location can be justified as being representative. No general guidance can therefore be given on the number of measurement locations as this will be site-specific".*

In line with the IoA GPG, representative groups of noise sensitive receptors that have been zoned and assigned to each of the four-baseline noise monitoring location (i.e., locations where *"it can reasonably be claimed, from inspection and observation, to be representative of the non-surveyed locations").* **Figure 13.16** shows the baseline noise survey locations (BN1 to BN4) along with the noise sensitive receptor locations that have been assessed.



Symbols

- Wind turbine
- Road
- Line
- Road axis
- Emission line
- Geometry bitmap
- Occupied
- School
- Unoccupied
- Associated Dwelling
- Planning Approved
- Monitoring Location

Client:
Tullacondra Green Energy Limited

Project:
Tullacondra Green Energy Project

Project figure number:
13.16

Date: 20 November 2023
Revision: -

Scale: 0 100 200 400 600 800 1000 m

Figure 13.16: Aerial map showing turbine, receptor and noise monitoring positions

13.7 Significance/sensitivity

The potential significant effects of the proposed Project before and after mitigation on the noise sensitive receptors in the study area are assessed with respect to the limits specified in the guidance and summarised in the following section.

13.7.1 Construction/decommissioning phase

Upon review of baseline noise levels and the relevant construction noise guidelines, a potential significant construction/decommissioning phase noise effect may occur in the vicinity of the wind farm if noise levels exceed 65dB $L_{Aeq,T}$ during daytime periods, at nearby receptors. However, other factors should be considered (such as duration of the impacts) to determine if a significant effect is likely to occur.

A significant construction/decommissioning vibration effect will occur if vibration emissions exceed the "Line 2" values outlined in **Table 13.3**.

13.7.2 Operational phase

Upon review of baseline noise levels and the relevant wind turbine noise guidelines, a significant operational phase noise effect will occur if the turbine noise levels exceed the values in **Table 13.10** at nearby noise sensitive receptors[16].

Table 13.10: Proposed operational phase noise criteria, dB

Location	Period	Derived $L_{A90,\ 10\ min}$ Baseline Noise Levels (dB) at Standardised 10m Height Above Ground Wind Speed (m/s)								
		2	3	4	5	6	7	8	9	10
BN1 & Proxy Locations	Day	37.5	37.5	37.5	37.5	45.0	45.0	45.0	45.0	45.0
	Night	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
BN2 & Proxy Locations	Day	37.5	37.5	37.5	37.5	37.5	45.0	45.0	45.0	45.0
	Night	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
BN3 & Proxy Locations	Day	37.5	37.5	37.5	37.5	37.5	45.0	45.0	45.0	45.0
	Night	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
BN4 & Proxy Locations	Day	37.5	37.5	45.0	45.0	45.0	45.0	45.0	46.0	48.4
	Night	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
Financially Involved Properties (H35, H36, H63 and H71)	Day and Night	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0

[16] Based upon WEDG criteria as per Section 13.5.2.1 i.e.: Daytime (07:00 – 23:00hrs): 37.5dB $L_{A90,10min}$ for quiet daytime environments of less than 30dB $L_{A90,10min}$. 45dB $L_{A90,10min}$ for daytime environments greater than 30dB $L_{A90,10min}$, or a maximum increase of 5dB(A) above background noise (whichever is higher). Night-time (23:00 – 07:00hrs): 43dB $L_{A90,10min}$.

13.8 Likely significant effects (including cumulative effects)

Noise effects, like any other, can be direct or indirect. Direct effects can cause a physiological stress due to a noise source, which is known to potentially disturb sleep and/or cause annoyance. Indirect effects can cause an emotional stress reaction among persons due to a perceived discomfort. The first symptom of an indirect effect is noise annoyance, which can be followed by a stress response which, if prolonged, can lead to different stress-related symptoms and, with continued exposure, to indirect heath related effects.

Regarding wind turbine noise, sleep disturbance and/or annoyance is the primary risk, in the event that a significant effect occurs.

13.8.1 Construction/decommissioning phase

It is possible to estimate the typical construction noise levels using guidance set out in British Standard BS 5228-1. The noise sensitive receptors surrounding the wind farm site are located at varying distances from the proposed wind farm infrastructure. Receptor (H21) nearest to a turbine is located approximately 700m from the proposed turbine T9, and receptor H23 is located 235m from the substation.

An assessment of the typical construction noise sources that would be expected on a wind farm site, by project element and types are discussed in the sections following. The assessment is considered representative of a typical worst-case scenario, with construction noise at slightly lower levels at receptors which are located further from the works.

13.8.1.1 Turbine construction

Table 13.11 outlines the noise levels associated with typical turbine construction noise sources along with sound pressure levels as outlined in BS 5228–1.

Table 13.11: Typical turbine construction plant items and noise emission values, dB

Phase	Item of Plant (BS 5228-1 Ref.)	Reference Sound Power Level dB L_{wA}	Reference Sound Pressure Level at Distance (10m) dB $L_{Aeq,1hr}$	Calculated Sound Pressure Level at Receptor Distance (700m) dB $L_{Aeq,1hr}$
(i) Site Preparation	Wheeled Loader Lorry (C2 28)	104	76	36
	Diesel Generator (C4.76)	89	61	
	Track Excavator (C2 22)	100	72	
	Dozer (C2.13)	106	78	

Phase	Item of Plant (BS 5228-1 Ref.)	Reference Sound Power Level dB L_{wA}	Reference Sound Pressure Level at Distance (10m) dB $L_{Aeq,1hr}$	Calculated Sound Pressure Level at Receptor Distance (700m) dB $L_{Aeq,1hr}$
	Dump Truck (C4.2)	106	78	
(ii) Ground works/Piling	Bored Pile (0.75 dia 10m depth Cast in Place), Crane Mounted Auger (D4:39)	112	82	41
(ii) Ground works/Piling	Rock Breaking (at T7), Excavator mounted breaker 23t	113	85	41
(ii) Ground works/Piling	Track Excavator (C2 22)	100	72	41
(ii) Ground works/Piling	Wheeled Loader Lorry (C2 28)	105	76	41
(ii) Ground works/Piling	Pump (C3.25)	106	78	41
(ii) Ground works/Piling	Compressor (C3 19)	103	75	41
(iii) General Turbine Construction	Tracked Mobile Crane (C4.50)	99	71	46
(iii) General Turbine Construction	Articulated lorry (C11.6)	111	83	46
(iii) General Turbine Construction	Hand tool (per tool x 6)	109	81	46
(iv) Road Surfacing/Landscaping	Dozer (C2.13)	106	78	35
(iv) Road Surfacing/Landscaping	Dump Truck (C4.2)	106	78	35
(iv) Road Surfacing/Landscaping	Road Roller (D8.27)	104	76	35

The calculated noise levels associated with turbine construction are therefore in the range of 35 to 46dB $L_{Aeq,T}$ at the closest receptors. During all phases of construction, the calculated noise levels are well below the daytime construction noise threshold of 65dB $L_{Aeq,T}$, therefore the noise effects from construction related to turbine installation at the Tullacondra wind farm site are not considered significant.

13.8.1.2 Substation construction

Table 13.12 outlines the noise levels associated with typical substation construction noise sources assessed in this instance along with calculated sound pressure levels as outlined in BS 5228 – 1.

Table 13.12: Typical substation construction plant items and noise emission values, dB

Phase	Item of Plant (BS 5228-1 Ref.)	Reference Sound Power Level dB L_{wA}	Reference Sound Pressure Level at Distance (10m) dB $L_{Aeq,1hr}$	Calculated Sound Pressure Level at Receptor Distance (235m) dB $L_{Aeq,1hr}$
(i) Site Preparation	Wheeled Loader Lorry (C2. 28)	104	76	47
	Diesel Generator (C4.76)	89	61	
	Track Excavator (C2 22)	100	72	
	Dozer (C2.13)	106	78	
	Dump Truck (C4.2)	106	78	
(ii) Ground works	Track Excavator (C2 22)	100	72	47
	Wheeled Loader Lorry (C2 28)	105	76	
	Pump (C3.25)	106	78	
	Compressor (C3 19)	103	75	
(iii) General Construction	Articulated lorry (C11.6)	111	83	54
	Hand tools (per tool x 3)	109	81	
(iv) Road Surfacing/Landscaping	Dozer (C2.13)	106	78	46
	Dump Truck (C4.2)	106	78	
	Road Roller (D8.27)	104	76	

The calculated noise levels from construction phases associated with substation construction are in the range of 46 to 54dB $L_{Aeq,T}$ at the closest receptors. During all phases of construction, the calculated noise level is below the daytime construction noise threshold of 65 dB $L_{Aeq,T}$, therefore the noise effects from construction of the substation at the Tullacondra wind farm site are not considered significant.

13.8.1.3 Grid Connection construction

Two GCR options are presented in this EIAR. GCR Option 1 is included in the application for planning permission, with Option 2 having been assessed as a potential alternative route. The potential noise and vibration impacts of both routes have been reviewed and considered in this chapter. The two potential connection options are shown in **Figure 13.17**.

Figure 13.17: Aerial map showing grid connection route options

The proposed 38kV grid connection extends from the on-site substation to the boundary of the existing 110kV substation at Mallow. The proposed grid connection will be via underground cabling installed within a trench which will be approximately 600mm wide and 1200mm deep. Where the proposed GCR encounters minor culverts, the ducts will be installed above or below the culvert depending on its depth in accordance with construction methodologies outlined in the CEMP.

Excavation will take place with a tracked excavator / mini digger. Other equipment and machinery that will be required for the cable installation include a concrete vibrator, wheeled dumper and a soil compactor / road roller.

In our experience, the excavation, installation and reinstatement process will take on average of one day to complete a 100m section and typically no more than a 100-metre section of trench will be opened at any one time.

There are a number of noise sensitive receptors in the vicinity of both route options that are likely to be affected by noise during the construction works. To assess the likelihood of significance of effects occurring at these receptors, Geographic Information System (GIS) files outlining the cable route options were imported into Google Earth. The distance of the receptor nearest to the routes of the proposed grid installation works has been estimated using the Google Earth measurement tool (i.e., the distance between the trenching location to the façades of the receptors closest to the route). These receptors are typically around 20m from the trenching work locations, with some receptors located approximately 10m from trenching work locations.

Table 13.13 outlines the noise levels associated with typical construction noise sources from the grid installation works, along with calculated sound pressure levels as outlined in BS 5228–1.

Table 13.13: Typical grid connection construction plant items and noise emission values, dB

Phase	Item of Plant (BS 5228-1 Ref.)	Reference Sound Power Level dB L_{wA}	Reference Sound Pressure Level at Distance (10m) dB $L_{Aeq,1hr}$	Calculated Sound Pressure Level at Receptor Distance (20m) dB $L_{Aeq,1hr}$
(i) Grid Connection Trenching	Track Excavator (C2 22)	100	72	71
	Concrete Poker Vibrator (C4.34)	97	69	
	Dump Truck (C4.2)	106	78	
	Road Roller (D8.27)	104	76	

The calculated construction noise levels from grid connection trenching is approx. 71dB $L_{Aeq,T}$ at the nearest noise sensitive receptors. This calculated noise level exceeds the daytime construction noise threshold of 65 dB $L_{Aeq,T}$. However, the duration of exposure of trenching is brief, with works occurring directly outside of any single receptor typically for less than a day. The potential effect of this noise would be not significant due to the short duration of exposure.

A review of the number of receptors in the vicinity of each route option indicates that GCR Option 1 passes slightly more receptors than Option 2, so would have a slightly higher impact due to the number of affected receptors.

13.8.1.4 Vibration

Given the distances from turbine construction activities to nearby receptors, it is expected that construction vibration from turbine construction works will not be perceptible at nearby sensitive receptors. This conclusion is based upon a review of the vibration source levels presented in BS 5228-2 database of construction vibration sources, along with a review of the distances from turbine locations to nearby receptors, and professional judgement. Construction vibration will also be well below the criteria (as outlined in **Table 13.3**) that would indicate potential risk of cosmetic damage at nearby building foundations.

It is noted that rotary piling may be required on the wind farm site during turbine construction, reference to BS5228-2 (Table D.6) indicates vibration levels <1.2mm/s PPV at a distance of 10 metres from a typical rotary bored pile. Considering the distances between potential piling locations (at all turbine locations in the worst-case scenario) and nearby receptors, vibration from piling would not be perceptible and would be orders of magnitude below levels where cosmetic or structural damage would occur.

Considering the distances between construction activities associated with turbine, grid connection and substation works, and nearby receptors, vibration from construction activities would be orders of magnitude below levels where cosmetic or structural damage would occur. The associated effect of construction vibration, when described in accordance with the EPA tables of significance, can be deemed **neutral, not significant** and **temporary**.

13.8.1.5 *Summary of likely significant effects*

The associated worst-case effect of noise and/or vibration from construction works is shown in **Table 13.14.** In EIA terms the noise effect during turbine and substation construction is considered **not significant** because the calculated noise levels are below the thresholds for significance. For the Grid Connection Routes, the calculated noise levels exceed the threshold levels for significance but the guidance states that other factors should be considered, including duration, before concluding a significant effect. The elevated noise levels at any one receptor will last less than a day before moving along the route so the impact will be brief and therefore **Not Significant.**

Table 13.14: Summary of likely significant construction noise/vibration effects

Works	Summary of Effects (ref EPA Tables of Significance)		
	Quality	Significance	Duration
Turbine + Substation Construction	Adverse	**Not Significant**	Temporary
Grid Connection	Adverse	**Not Significant**	Brief

13.8.1.6 *Cumulative effects*

The proposed N/M20 upgrade works will consist of the construction of a new dual carriageway which will bypass the towns of Mallow and Buttevant. This new dual carriageway will be constructed approximately 6km to the east of the wind farm site, also to the east of the existing N20. It is not expected that there will be any significant cumulative effects of the proposed N/M20 upgrade and the Project, at noise sensitive receptors in the vicinity of the Project.

The Scart Quarry and the Ballyhest Quarry are located to the west of the wind farm site, at distances of approximately 2.9km and 3.9km from the closest proposed turbines, respectively. At these distances, there will not be any significant cumulative noise effects as a result of quarries and the Project, at receptors in the vicinity of the Project.

13.8.2 Operational phase

This section and presents the results of the modelling exercise undertaken in accordance with the methodology described in section 13.5.4 to determine the likely significant effects of the Project during operation.

13.8.2.1 Turbine noise predictions

Noise calculations presented in **Table 13.15** assume that all receptors are downwind of all turbines at the same time. This represents the calculated worst-case potential noise level for each receptor. In real terms the noise level will vary with wind direction, with noise levels being slightly lower during crosswind conditions and significantly lower at receptors which are upwind of turbines. This table presents the omnidirectional results of the exercise at all receptors.

Table 13.15: Calculated turbine noise levels (omni-directional), dB

Receptor	Baseline Group	dB $L_{A90,10min}$ at various Standardised 10 metre height (v_{10}) Wind Speeds (m/s)					
		2m/s	3m/s	4m/s	5m/s	6m/s	7m/s and above
1	BN2	24.2	25.2	28.6	33.6	37.3	38.0
2	BN3 (A)	27.3	28.3	31.8	36.7	40.5	41.2
3	BN3 (A)	27.4	28.4	31.8	36.8	40.5	41.2
4	BN3	24.2	25.2	28.7	33.6	37.4	38.1
5	BN3	24.0	25.0	28.4	33.4	37.1	37.8
6	BN3	23.7	24.7	28.1	33.1	36.8	37.5
7	BN3	23.0	24.0	27.4	32.4	36.1	36.8
7A	BN3	23.1	24.1	27.5	32.5	36.2	36.9
8	BN3	22.6	23.6	27.0	32.0	35.7	36.4
9	BN3	23.1	24.1	27.6	32.6	36.3	37.0
10	BN3	23.2	24.2	27.6	32.6	36.3	37.0
11	BN3	23.3	24.3	27.7	32.7	36.4	37.1
12	BN3	23.6	24.6	28.0	33.0	36.7	37.4
13	BN3	24.0	25.0	28.4	33.4	37.1	37.8
14	BN3	23.5	24.5	27.9	32.9	36.6	37.3
15	BN3	23.9	24.9	28.4	33.3	37.1	37.8
16	BN3	23.3	24.3	27.7	32.7	36.4	37.1
17	BN3	24.9	25.9	29.3	34.3	38.0	38.7
18	BN4	22.8	23.8	27.2	32.2	35.9	36.6
19	BN4	23.3	24.3	27.7	32.7	36.4	37.1
20	BN4	23.0	24.0	27.5	32.4	36.2	36.9
21	BN4 (A)	25.1	26.1	29.5	34.5	38.2	38.9
21A	BN4 (A)	24.7	25.7	29.2	34.2	37.9	38.6
22	BN4	24.4	25.3	28.8	33.8	37.5	38.2
23	BN4	25.7	26.7	30.2	35.1	38.9	39.6
24	BN4	24.8	25.8	29.2	34.2	37.9	38.6
24A	BN4 (P)	24.4	25.4	28.8	33.8	37.5	38.2

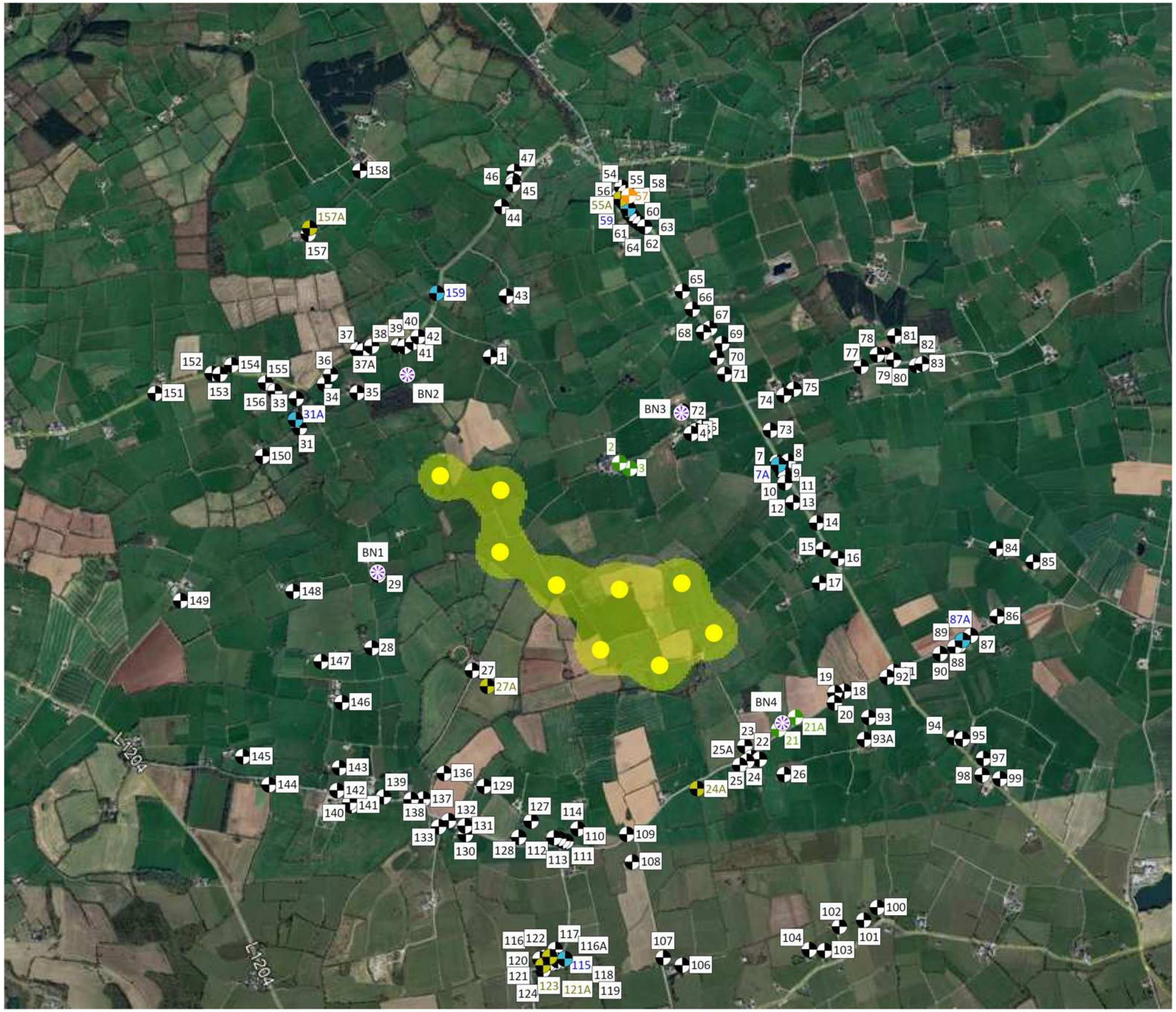
Receptor	Baseline Group	dB $L_{A90,10min}$ at various Standardised 10 metre height (v_{10}) Wind Speeds (m/s)					
		2m/s	3m/s	4m/s	5m/s	6m/s	7m/s and above
25	BN4	24.7	25.7	29.1	34.1	37.9	38.6
25A	BN4	24.7	25.7	29.1	34.1	37.8	38.5
26	BN4	22.7	23.7	27.1	32.1	35.8	36.5
27	BN1	26.8	27.8	31.2	36.2	40.0	40.7
27A	BN1 (P)	26.8	27.8	31.2	36.2	39.9	40.6
28	BN1	23.2	24.2	27.6	32.6	36.3	37.0
29	BN1	25.7	26.7	30.2	35.1	38.9	39.6
31	BN2	21.3	22.3	25.8	30.7	34.5	35.2
31A	BN2	21.0	22.0	25.4	30.4	34.1	34.8
33	BN2	20.5	21.5	24.9	29.9	33.6	34.3
34	BN2	21.4	22.4	25.8	30.8	34.5	35.2
35	BN2	23.3	24.3	27.8	32.7	36.5	37.2
36	BN2	21.3	22.3	25.7	30.7	34.4	35.1
37	BN2	21.3	22.3	25.7	30.7	34.4	35.1
37A	BN2	21.5	22.5	26.0	30.9	34.7	35.4
38	BN2	21.6	22.6	26.0	31.0	34.7	35.4
39	BN2	22.4	23.4	26.8	31.8	35.5	36.2
40	BN2	22.6	23.6	27.0	32.0	35.7	36.4
41	BN2	22.6	23.6	27.0	32.0	35.7	36.4
42	BN2	22.3	23.3	26.7	31.7	35.4	36.1
43	BN2	20.7	21.7	25.2	30.1	33.8	34.5
44	BN2	17.0	18.0	21.4	26.4	30.1	30.8
45	BN2	16.2	17.2	20.6	25.6	29.3	30.0
46	BN2	16.1	17.1	20.5	25.5	29.2	29.9
47	BN2	15.7	16.8	20.2	25.2	28.9	29.6
54	BN3	15.9	16.9	20.3	25.3	29.0	29.7
55	BN3	16.2	17.2	20.6	25.6	29.3	30.0
55A	BN3 (P)	16.3	17.3	20.7	25.7	29.4	30.1
56	BN3	16.0	17.1	20.5	25.5	29.2	29.9
57	BN3	16.1	17.1	20.6	25.5	29.2	29.9
58	BN3	16.4	17.4	20.8	25.8	29.5	30.2
59	BN3	16.5	17.6	21.0	26.0	29.7	30.4
60	BN3	16.7	17.7	21.1	26.1	29.8	30.5
61	BN3	16.8	17.8	21.2	26.2	29.9	30.6
62	BN3	16.9	17.9	21.3	26.3	30.0	30.7
63	BN3	16.9	18.0	21.4	26.3	30.1	30.8
64	BN3	17.0	18.0	21.4	26.4	30.1	30.8
65	BN3	18.7	19.7	23.2	28.1	31.8	32.5
66	BN3	19.2	20.2	23.6	28.6	32.3	33.0
67	BN3	19.6	20.6	24.0	29.0	32.7	33.4
68	BN3	19.8	20.8	24.3	29.2	32.9	33.6

Receptor	Baseline Group	dB $L_{A90,10min}$ at various Standardised 10 metre height (v_{10}) Wind Speeds (m/s)					
		2m/s	3m/s	4m/s	5m/s	6m/s	7m/s and above
69	BN3	19.9	20.9	24.3	29.3	33.0	33.7
70	BN3	20.5	21.5	24.9	29.9	33.6	34.3
71	BN3	21.0	22.0	25.4	30.4	34.1	34.8
72	BN3	23.4	24.4	27.8	32.8	36.5	37.2
73	BN3	22.0	23.0	26.4	31.4	35.1	35.8
74	BN3	20.3	21.3	24.7	29.7	33.4	34.1
75	BN3	19.8	20.9	24.3	29.3	33.0	33.7
77	BN3	17.4	18.5	21.9	26.8	30.5	31.2
78	BN3	16.7	17.8	21.2	26.1	29.9	30.6
79	BN3	16.5	17.6	21.0	25.9	29.7	30.4
80	BN3	16.4	17.5	20.9	25.8	29.6	30.3
81	BN3	15.9	16.9	20.3	25.3	29.0	29.7
82	BN3	16.0	17.0	20.4	25.4	29.1	29.8
83	BN3	15.8	16.8	20.2	25.2	28.9	29.6
84	BN3	16.2	17.2	20.6	25.6	29.3	30.0
85	BN3	15.0	16.1	19.5	24.5	28.2	28.9
86	BN4	16.4	17.4	20.8	25.8	29.5	30.2
87	BN4	17.4	18.4	21.8	26.8	30.5	31.2
87A	BN4	17.7	18.7	22.1	27.1	30.8	31.5
88	BN4	17.8	18.8	22.2	27.2	30.9	31.6
89	BN4	18.0	19.0	22.4	27.4	31.1	31.8
90	BN4	18.5	19.6	23.0	27.9	31.7	32.4
91	BN4	20.5	21.5	24.9	29.9	33.6	34.3
92	BN4	20.8	21.8	25.2	30.2	33.9	34.6
93	BN4	20.9	22.0	25.4	30.4	34.1	34.8
93A	BN4	20.6	21.6	25.1	30.0	33.7	34.4
94	BN4	17.0	18.0	21.4	26.4	30.1	30.8
95	BN4	16.7	17.7	21.2	26.1	29.8	30.5
97	BN4	15.7	16.8	20.2	25.1	28.9	29.6
98	BN4	15.5	16.6	20.0	25.0	28.7	29.4
99	BN4	15.0	16.0	19.5	24.4	28.1	28.8
100	BN4	15.6	16.7	20.1	25.0	28.8	29.5
101	BN4	15.6	16.6	20.0	25.0	28.7	29.4
102	BN4	15.8	16.9	20.3	25.3	29.0	29.7
103	BN4	15.4	16.4	19.8	24.8	28.5	29.2
104	BN4	15.7	16.7	20.1	25.1	28.8	29.5
106	BN4	16.5	17.5	20.9	25.9	29.6	30.3
107	BN4	16.8	17.8	21.2	26.2	29.9	30.6
108	BN4	20.8	21.8	25.2	30.2	33.9	34.6
109	BN4	22.2	23.2	26.6	31.6	35.3	36.0
110	BN1	22.1	23.1	26.5	31.5	35.2	35.9

Receptor	Baseline Group	dB $L_{A90,10min}$ at various Standardised 10 metre height (v_{10}) Wind Speeds (m/s)					
		2m/s	3m/s	4m/s	5m/s	6m/s	7m/s and above
111	BN1	21.3	22.4	25.8	30.8	34.5	35.2
112	BN1	21.3	22.3	25.8	30.7	34.4	35.1
113	BN1	21.4	22.4	25.8	30.8	34.5	35.2
114	BN1	21.4	22.4	25.8	30.8	34.5	35.2
115	BN4	16.6	17.7	21.1	26.0	29.8	30.5
116	BN4	16.5	17.6	21.0	25.9	29.7	30.4
116A	BN4	16.5	17.6	21.0	26.0	29.7	30.4
117	BN4	16.9	17.9	21.3	26.3	30.0	30.7
118	BN4	16.5	17.5	20.9	25.9	29.6	30.3
119	BN4	16.4	17.4	20.8	25.8	29.5	30.2
120	BN4	16.3	17.4	20.8	25.7	29.5	30.2
121	BN4	16.6	17.6	21.0	26.0	29.7	30.4
121A	BN4 (P)	16.6	17.6	21.1	26.0	29.7	30.4
122	BN4	16.5	17.5	20.9	25.9	29.6	30.3
123	BN4 (P)	16.3	17.3	20.7	25.7	29.4	30.1
124	BN4	16.1	17.1	20.6	25.5	29.2	29.9
127	BN1	21.7	22.8	26.2	31.2	34.9	35.6
128	BN1	20.8	21.8	25.3	30.2	33.9	34.6
129	BN1	22.2	23.2	26.6	31.6	35.3	36.0
130	BN1	19.9	20.9	24.3	29.3	33.0	33.7
131	BN1	20.2	21.2	24.6	29.6	33.3	34.0
132	BN1	20.0	21.0	24.4	29.4	33.1	33.8
133	BN1	19.6	20.6	24.0	29.0	32.7	33.4
136	BN1	21.6	22.6	26.0	31.0	34.7	35.4
137	BN1	20.1	21.1	24.6	29.5	33.2	33.9
138	BN1	19.8	20.8	24.2	29.2	32.9	33.6
139	BN1	19.1	20.2	23.6	28.6	32.3	33.0
140	BN1	18.1	19.1	22.5	27.5	31.2	31.9
141	BN1	18.1	19.1	22.5	27.5	31.2	31.9
142	BN1	18.1	19.1	22.5	27.5	31.2	31.9
143	BN1	18.7	19.7	23.2	28.1	31.8	32.5
144	BN1	16.4	17.4	20.8	25.8	29.5	30.2
145	BN1	16.2	17.2	20.7	25.6	29.3	30.0
146	BN1	20.5	21.5	24.9	29.9	33.6	34.3
147	BN1	20.7	21.7	25.1	30.1	33.8	34.5
148	BN1	20.9	21.9	25.3	30.3	34.0	34.7
149	BN1	16.3	17.4	20.8	25.8	29.5	30.2
150	BN2	19.9	20.9	24.3	29.3	33.0	33.7
151	BN2	15.0	16.0	19.4	24.4	28.1	28.8
152	BN2	16.6	17.6	21.0	26.0	29.7	30.4
153	BN2	16.9	17.9	21.3	26.3	30.0	30.7

Receptor	Baseline Group	dB $L_{A90,10min}$ at various Standardised 10 metre height (v_{10}) Wind Speeds (m/s)					
		2m/s	3m/s	4m/s	5m/s	6m/s	7m/s and above
154	BN2	17.1	18.1	21.6	26.5	30.2	30.9
155	BN2	18.7	19.8	23.2	28.2	31.9	32.6
156	BN2	19.3	20.3	23.8	28.7	32.4	33.1
157	BN2	15.8	16.8	20.3	25.2	28.9	29.6
157A	BN2 (P)	15.7	16.7	20.1	25.1	28.8	29.5
158	BN2	14.7	15.8	19.2	24.1	27.9	28.6
159	BN2	20.3	21.3	24.7	29.7	33.4	34.1

Figures 13.18 to **13.23** present the turbine operational noise model contours, for the range of wind speeds from turbine cut-in to rated power.



Symbols

- Wind turbine
- Road
- Line
- Road axis
- Emission line
- Geometry bitmap
- Occupied
- School
- Unoccupied
- Associated Dwelling
- Planning Approved
- Monitoring Location

Noise level
Lday
in dB(A)

- 37
- 43
- 45

Client:
Tullacondra Green Energy Limited

Project:
Tullacondra Green Energy Project

Project figure number:
13.18

Date: 20 November 2023
Revision: -

Scale:
0 100 200 400 600 800 1000 m

Figure 13.18: Turbine operational noise contour map (2m/s (v_{10}))

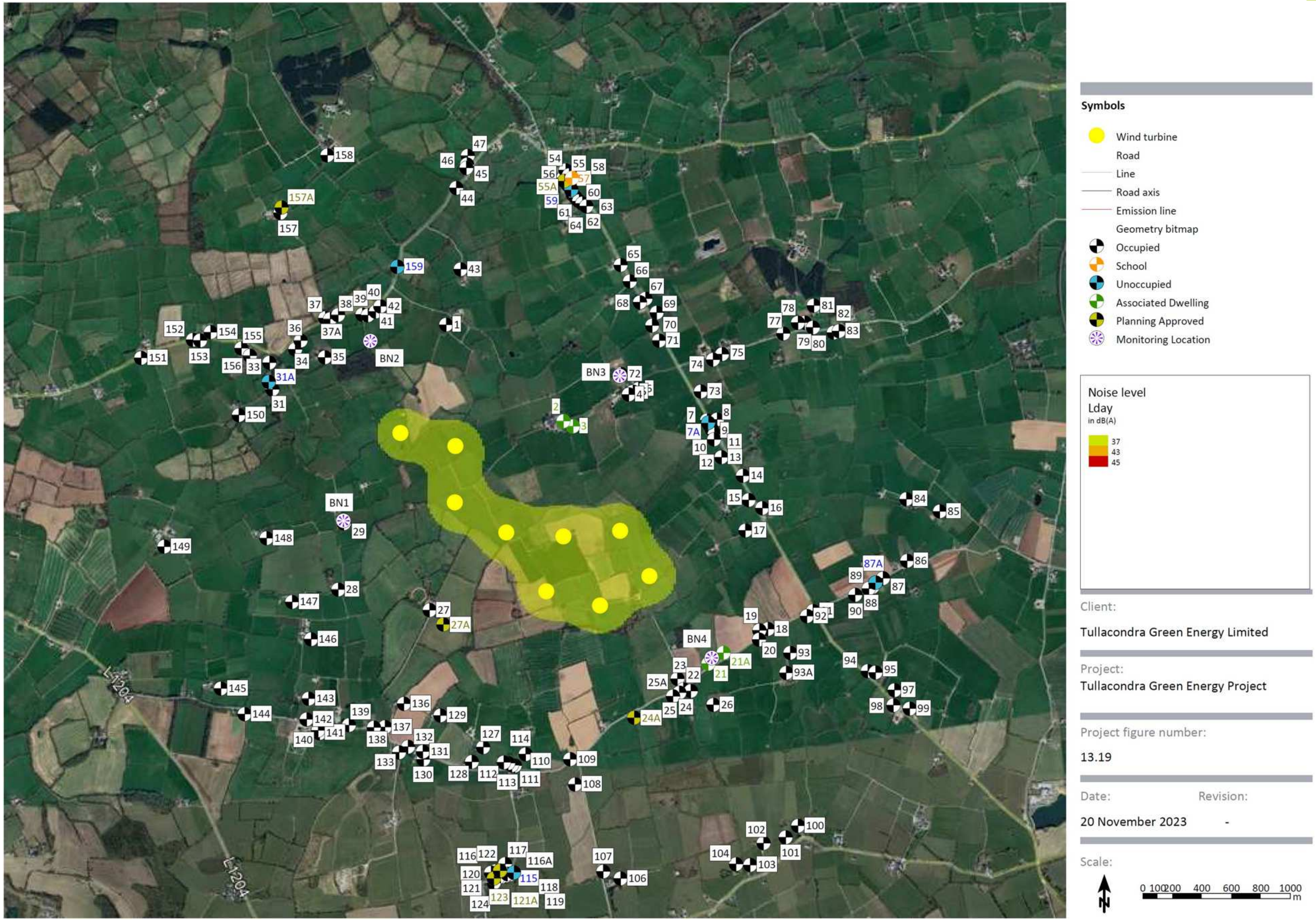
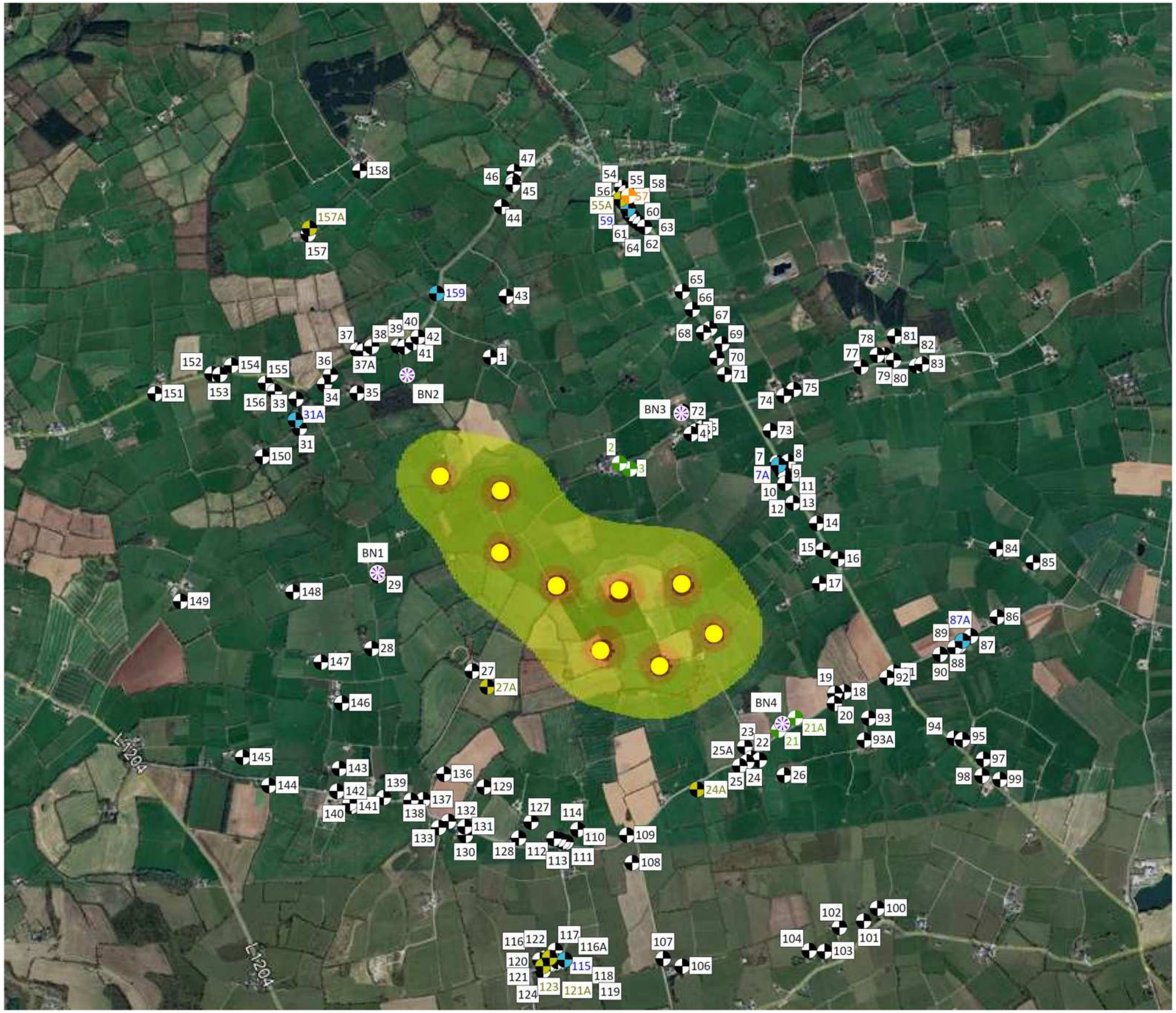


Figure 13.19: Turbine operational noise contour map (3m/s (v_{10}))



Symbols

- Wind turbine
- Road
- Line
- Road axis
- Emission line
- Geometry bitmap
- Occupied
- School
- Unoccupied
- Associated Dwelling
- Planning Approved
- Monitoring Location

Noise level
Lday
in dB(A)
37
43
45

Client:
Tullacondra Green Energy Limited

Project:
Tullacondra Green Energy Project

Project figure number:
13.20

Date: 20 November 2023
Revision: -

Scale:
0 100 200 400 600 800 1000 m

Figure 13.20: Turbine operational noise contour map (4m/s (v_{10}))

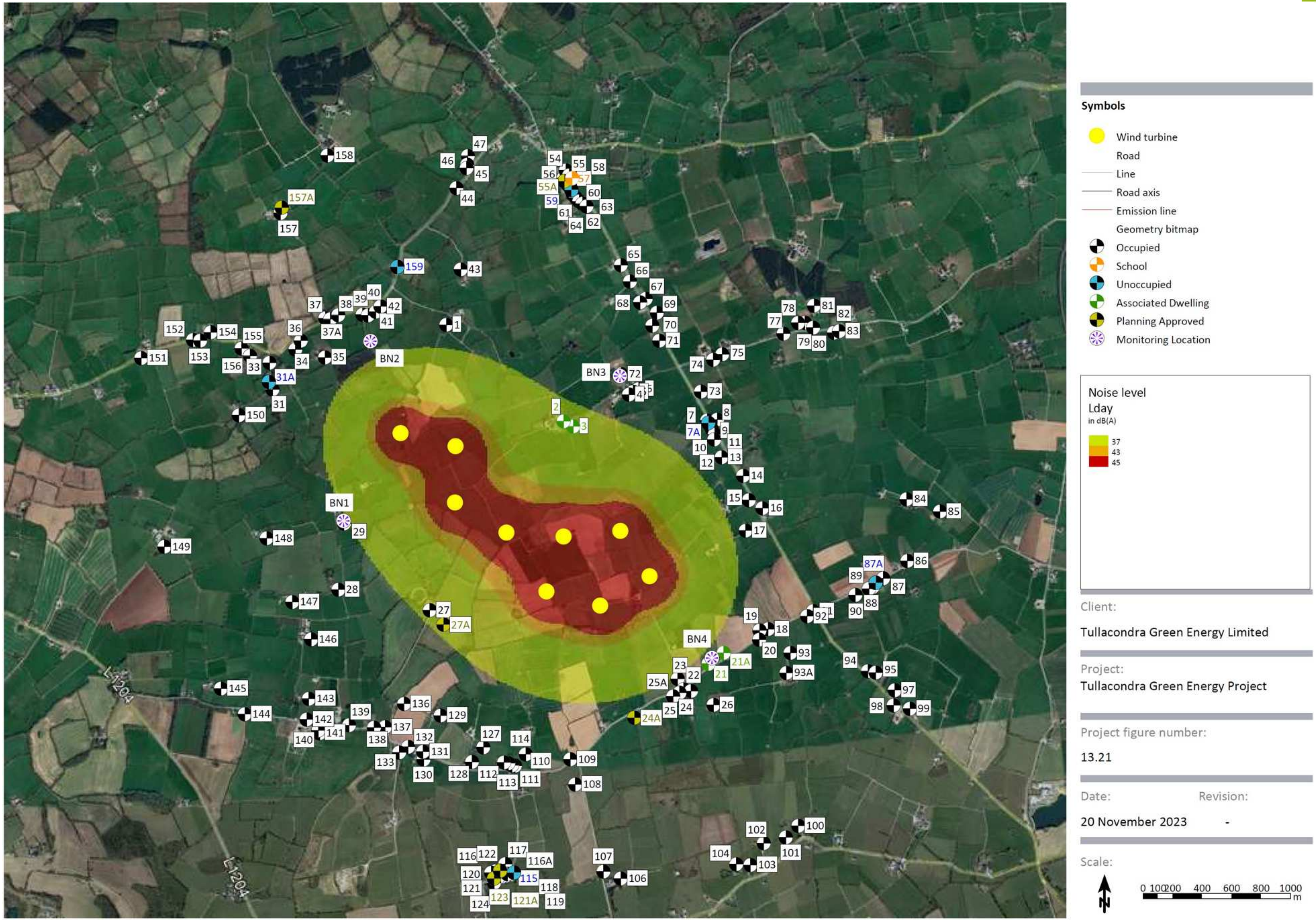


Figure 13.21: Turbine operational noise contour map (5m/s (v_{10}))

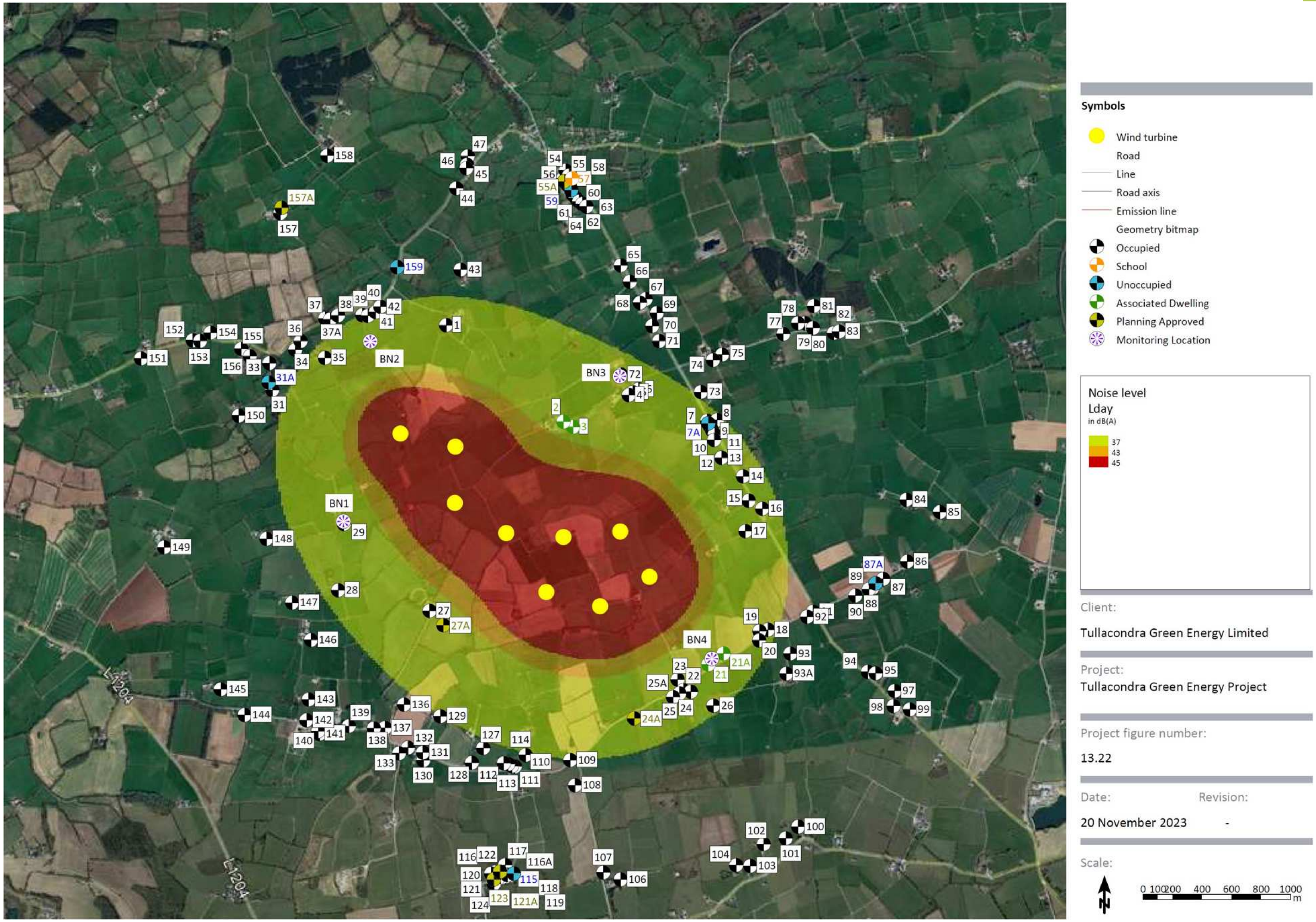


Figure 13.22: Turbine operational noise contour map (6m/s (v_{10}))

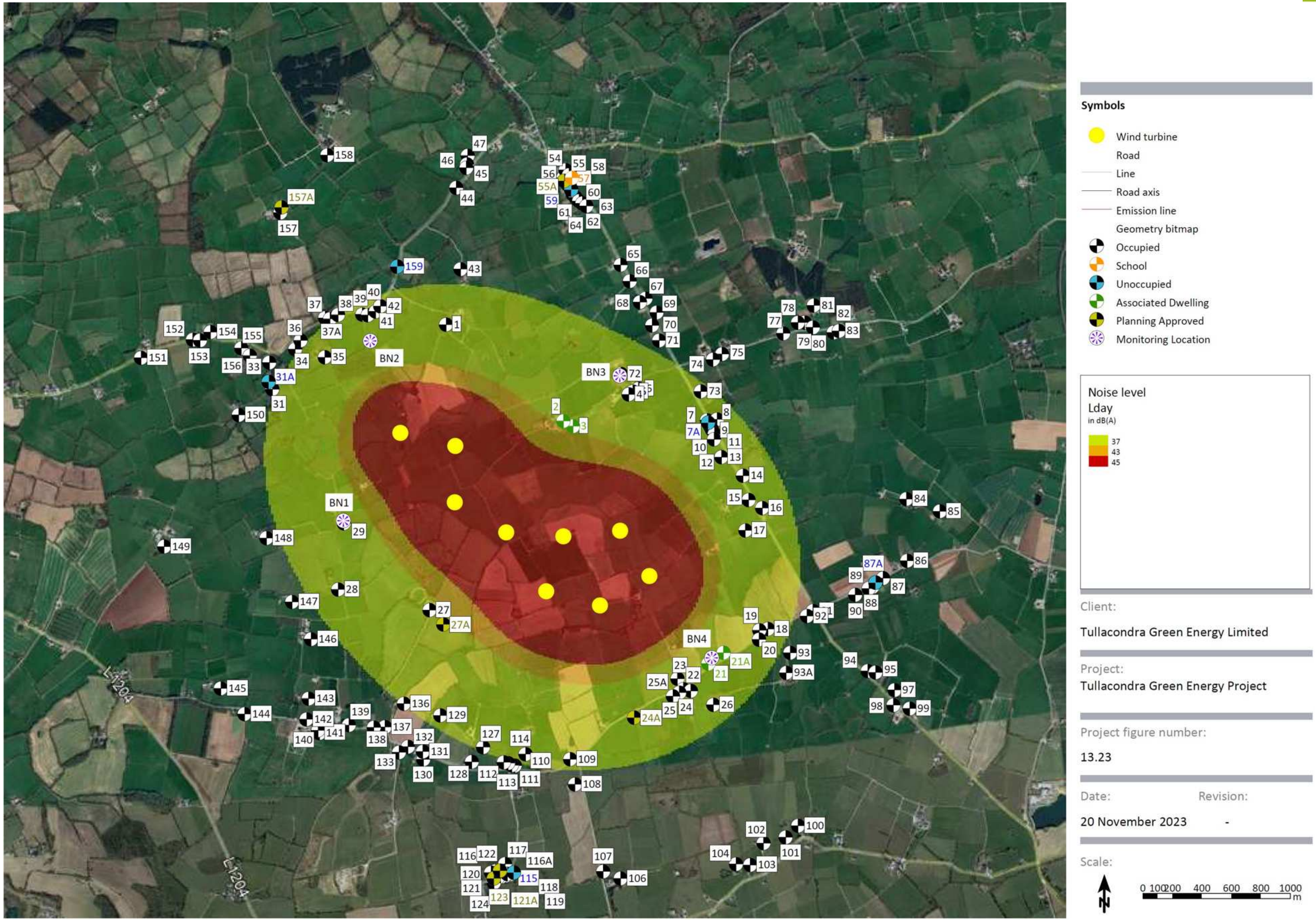


Figure 13.23: Turbine operational noise contour map (7m/s (v_{10}))

13.8.2.2 Assessment of turbine noise levels

A worst-case noise assessment has been completed assuming all turbines are operating in normal mode of operation and that all receptors are downwind of all turbines at the same time. **Table 13.16** presents the predicted levels compared against the adopted noise criteria for selected receptors closest to the turbines. Results for all receptors are shown in Appendix 13.3.

Table 13.16: Assessment of predicted 'downwind' turbine noise levels against criteria for selected noise sensitive receptors.

Receptor Ref.	Description	dB $L_{A90,10min}$ at various Standardised 10 metre height (v_{10}) Wind Speeds (m/s)					
		2m/s	3m/s	4m/s	5m/s	6m/s	7m/s and above
1	**Predicted**	24.2	25.2	28.6	33.6	37.3	38
	Daytime Criterion	37.5	37.5	37.5	37.5	37.5	45.0
	Daytime Excess	-13.3	-12.3	-8.9	-3.9	-0.2	-7.0
	Night-time Criterion	43.0	43.0	43.0	43.0	43.0	43.0
	Night-time Excess	-18.8	-17.8	-14.4	-9.4	-5.7	-5.0
2	**Predicted**	27.3	28.3	31.8	36.7	40.5	41.2
	Daytime Criterion	45.0	45.0	45.0	45.0	45.0	45.0
	Daytime Excess	-17.7	-16.7	-13.2	-8.3	-4.5	-3.8
	Night-time Criterion	45.0	45.0	45.0	45.0	45.0	45.0
	Night-time Excess	-17.7	-16.7	-13.2	-8.3	-4.5	-3.8
3	**Predicted**	27.4	28.4	31.8	36.8	40.5	41.2
	Daytime Criterion	45.0	45.0	45.0	45.0	45.0	45.0
	Daytime Excess	-17.6	-16.6	-13.2	-8.2	-4.5	-3.8
	Night-time Criterion	45.0	45.0	45.0	45.0	45.0	45.0
	Night-time Excess	-17.6	-16.6	-13.2	-8.2	-4.5	-3.8
12	**Predicted**	23.6	24.6	28	33	36.7	37.4
	Daytime Criterion	37.5	37.5	37.5	37.5	37.5	45.0
	Daytime Excess	-13.9	-12.9	-9.5	-4.5	-0.8	-7.6
	Night-time Criterion	43.0	43.0	43.0	43.0	43.0	43.0
	Night-time Excess	-19.4	-18.4	-15.0	-10.0	-6.3	-5.6
15	**Predicted**	23.9	24.9	28.4	33.3	37.1	37.8

Receptor Ref.	Description	dB $L_{A90,10min}$ at various Standardised 10 metre height (v_{10}) Wind Speeds (m/s)					
		2m/s	3m/s	4m/s	5m/s	6m/s	7m/s and above
	Daytime Criterion	37.5	37.5	37.5	37.5	37.5	45.0
	Daytime Excess	-13.6	-12.6	-9.1	-4.2	-0.4	-7.2
	Night-time Criterion	43.0	43.0	43.0	43.0	43.0	43.0
	Night-time Excess	-19.1	-18.1	-14.6	-9.7	-5.9	-5.2
17	**Predicted**	24.9	25.9	29.3	34.3	38	38.7
	Daytime Criterion	37.5	37.5	37.5	37.5	37.5	45.0
	Daytime Excess	-12.6	-11.6	-8.2	-3.2	**0.5**	-6.3
	Night-time Criterion	43.0	43.0	43.0	43.0	43.0	43.0
	Night-time Excess	-18.1	-17.1	-13.7	-8.7	-5.0	-4.3
19	**Predicted**	23.3	24.3	27.7	32.7	36.4	37.1
	Daytime Criterion	37.5	37.5	45.0	45.0	45.0	45.0
	Daytime Excess	-14.2	-13.2	-17.3	-12.3	-8.6	-7.9
	Night-time Criterion	43.0	43.0	43.0	43.0	43.0	43.0
	Night-time Excess	-19.7	-18.7	-15.3	-10.3	-6.6	-5.9
23	**Predicted**	25.7	26.7	30.2	35.1	38.9	39.6
	Daytime Criterion	37.5	37.5	45.0	45.0	45.0	45.0
	Daytime Excess	-11.8	-10.8	-14.8	-9.9	-6.1	-5.4
	Night-time Criterion	43.0	43.0	43.0	43.0	43.0	43.0
	Night-time Excess	-17.3	-16.3	-12.8	-7.9	-4.1	-3.4
27	**Predicted**	26.8	27.8	31.2	36.2	40	40.7
	Daytime Criterion	37.5	37.5	37.5	37.5	45.0	45.0
	Daytime Excess	-10.7	-9.7	-6.3	-1.3	-5.0	-4.3
	Night-time Criterion	43.0	43.0	43.0	43.0	43.0	43.0
	Night-time Excess	-16.2	-15.2	-11.8	-6.8	-3.0	-2.3
27A	**Predicted**	26.8	27.8	31.2	36.2	39.9	40.6
	Daytime Criterion	37.5	37.5	37.5	37.5	45.0	45.0
	Daytime Excess	-10.7	-9.7	-6.3	-1.3	-5.1	-4.4

Receptor Ref.	Description	dB $L_{A90,10min}$ at various Standardised 10 metre height (v_{10}) Wind Speeds (m/s)					
		2m/s	3m/s	4m/s	5m/s	6m/s	7m/s and above
	Night-time Criterion	43.0	43.0	43.0	43.0	43.0	43.0
	Night-time Excess	-16.2	-15.2	-11.8	-6.8	-3.1	-2.4
29	**Predicted**	25.7	26.7	30.2	35.1	38.9	39.6
	Daytime Criterion	37.5	37.5	37.5	37.5	45.0	45.0
	Daytime Excess	-11.8	-10.8	-7.3	-2.4	-6.1	-5.4
	Night-time Criterion	43.0	43.0	43.0	43.0	43.0	43.0
	Night-time Excess	-17.3	-16.3	-12.8	-7.9	-4.1	-3.4
35	**Predicted**	23.3	24.3	27.8	32.7	36.5	37.2
	Daytime Criterion	37.5	37.5	37.5	37.5	37.5	45.0
	Daytime Excess	-14.2	-13.2	-9.7	-4.8	-1.0	-7.8
	Night-time Criterion	43.0	43.0	43.0	43.0	43.0	43.0
	Night-time Excess	-19.7	-18.7	-15.2	-10.3	-6.5	-5.8
114	**Predicted**	21.4	22.4	25.8	30.8	34.5	35.2
	Daytime Criterion	37.5	37.5	37.5	37.5	45.0	45.0
	Daytime Excess	-16.1	-15.1	-11.7	-6.7	-10.5	-9.8
	Night-time Criterion	43.0	43.0	43.0	43.0	43.0	43.0
	Night-time Excess	-21.6	-20.6	-17.2	-12.2	-8.5	-7.8

The predicted noise levels at various wind speeds have been compared against the noise criteria curves outlined in the table above. The predicted downwind noise levels for all turbines operating in standard mode indicate that noise levels will comply with the criteria, with the exception of one receptor (H17), where there will be a slight exceedance of the criteria at 6m/s (v_{10}) wind speed, during daytime periods, as summarised below:

- **H17**: 0.5dB exceedance of criteria, at 6m/s, under downwind conditions, during daytime periods (07:00 to 23:00hrs).

The next stage of the assessment is to identify the wind directions these exceedances are calculated to occur, as it is well established that turbine noise levels will vary under downwind, crosswind and upwind conditions.

For the directional assessment to receptor H17, an additional model with varying turbine noise directivity corrections has been created, representing different wind directions. Calculations have been carried out with consideration of the directivity corrections outlined in Section 4.4 of the IoA GPG Guidance. The directional noise propagation has been applied as follows:

- Downwind (±80°): no correction.
- Crosswind (90°±10°) and 270°±10°: -2dB(A) reduction.
- Upwind (180°±70°): up to -7.5dB(A) reduction.

A 10° separation between each of the various wind sectors has been applied.

The directional noise modelling has identified that the directions that result in the calculated 0.5dB exceedance are when winds are blowing 220 to 340 degrees from north (i.e., broadly westerly winds).

In summary therefore, a potential **Significant**, **adverse, long-term** effect is calculated to occur at one receptor (H17), during daytime hours (07:00 to 23:00hrs), at 6m/s (v_{10}) wind speed, and when the wind is blowing 220 to 340 degrees from north (i.e., broadly westerly winds).

Mitigation measures are outlined in section 13.10.2 to ensure that turbine noise levels will comply with the criteria at this receptor.

At all other noise sensitive receptors, the associated impacts are predicted to be, at worst-case, **adverse, Not Significant and long term**, as the calculated noise levels comply with the criteria.

13.8.2.3 Substation noise assessment

The location of the proposed substation is shown in **Figure 13.24**. The nearest receptor to the substation is the dwelling H23, at a distance of approximately 235m.

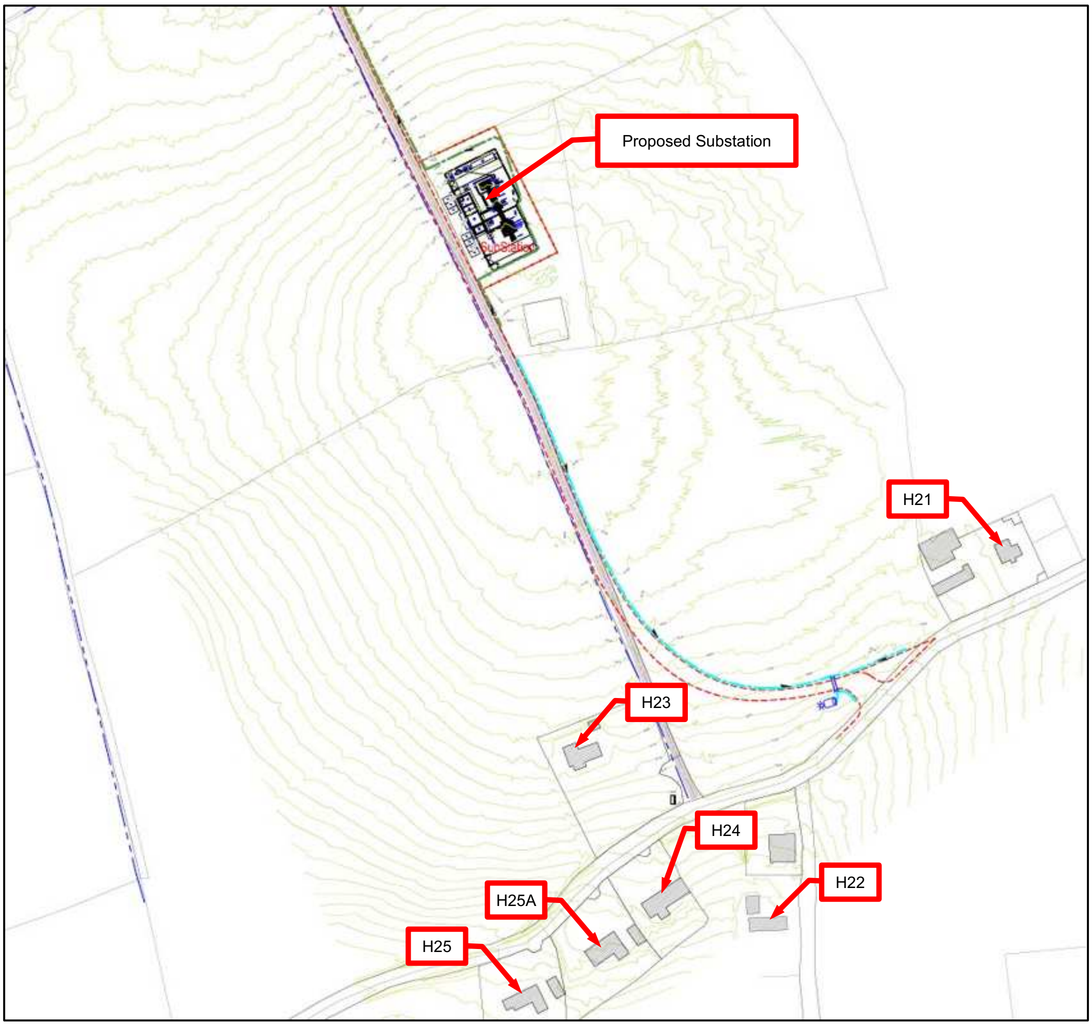


Figure 13.24: Proposed substation location

The operational noise emission level associated with a typical substation that would support a development of this nature is the order of 93dB L_{wA}. The selection and specification of the proposed substation shall be carried out on the basis of 93dB L_{wA} being the maximum permissible sound power level.

On this basis, the calculated noise level from the substation to the nearest noise sensitive receptor is 35dB $L_{Aeq,T}$ at H23. For all other receptors the noise level predicted is lower, due to distance.

The expected noise emissions from the proposed substation have been assessed in relation to existing baseline noise levels and related guidance such as the EPA Guidance Note for Noise: License Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4)[17]. The EPA guidelines in particular set out a series of stringent noise limits for commercial/industrial type noise of 35 to 45dB L_{ArT}, for night and day-time periods respectively, in areas of low background noise.

[17] EPA Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4) (2016).

The expected noise level from the substation (assuming it meets the target sound power) is therefore within typical guidelines for industrial plant noise emissions to sensitive receptors and will not contribute significantly to the overall noise levels associated with the operation of the proposed turbines.

The associated impacts are predicted to be, at worst-case, **adverse, Not Significant** and **long term**[18].

13.8.2.4 Summary of likely significant effects

Significant effects are not calculated to occur at 156 out of the 157 receptors assessed, as the predicted turbine noise levels comply with the noise criteria. The predicted operational noise effects are therefore summarised in **Table 13.17.**

Table 13.17: Summary of likely significant operational effects (downwind)

Summary of Effects (Ref EPA Tables of Significance)		
Quality	**Significance**	**Duration**
Adverse	**Not Significant**	Long Term

A 'Not Significant' effect description (ref. EPA EIAR Guidelines) is described as " *An effect which causes noticeable changes in the character of the environment but without significant consequences*".

The above effect should be considered in terms that the effect is variable, and that this assessment considers periods of the greatest potential effect (i.e., downwind conditions). In instances where receptors are upwind of turbines, the effect of the operational turbines is shown in **Table 13.18**.

Table 13.18: Summary of likely significant operational effects (upwind)

Summary of Effects (Ref EPA Tables of Significance)		
Quality	**Significance**	**Duration**
Adverse	**Not Significant**	Long Term

Whilst background noise levels will increase due to the wind farm development, the predicted levels will remain low, (highest calculated 'downwind' turbine noise level of 41.2dB $L_{A90,T}$ at non-financially involved receptor). As a new source of noise will be introduced into the local environment there will be a general change in the background soundscape and background noise levels will increase at nearby noise sensitive receptors.

At receptor H17, likely significant effects have been identified at 6m/s (v_{10}) wind speed, during daytime periods (07:00 to 23:00hrs), when wind directions are 220 to 340 degrees from north (i.e., broadly westerly winds). Noise mitigation measures are outlined in

18 When described in accordance with the EPA tables of significance.

section 13.10.2 to address the effects, and to ensure that turbine noise levels will comply with the criteria at this receptor, thus a significant effect will not occur.

Vibration emissions from turbine operation will not be perceptible at nearby receptors, the associated effect of operational vibration is therefore **neutral, Not Significant** and **long term**[19].

13.8.2.5 Cumulative effects

There are no operational or permitted wind turbines in the vicinity of the proposed wind farm site that would be expected to result in cumulative noise and/or vibration impacts. The closest proposed wind farm to the Project is the Annagh Wind Farm (Planning Ref. 217246) which is approximately 12km from the Project. At this distance, cumulative noise effects will not occur (i.e., the Annagh wind farm will be inaudible to noise sensitive receptors in the vicinity of the Project, and vice versa). In this regard there are no receptors where the 35dB noise contour from the Annagh Wind Farm encroaches upon the 35dB noise contour from the Project, therefore there are no cumulative operational noise effects.

13.9 Do Nothing scenario

In the Do-Nothing scenario, no development will take place and the previously identified predicted impacts and effects will not occur. The ambient noise environment will remain as per the baseline and will change in accordance with trends within the wider area (including influences from new developments in the surrounding area and changes in nearby traffic volumes). Therefore, the do-nothing scenario can be considered **neutral** in terms noise and vibration effects.

13.10 Mitigation and monitoring measures

13.10.1 Construction/decommissioning phase

Given the proposed works activities, durations and distances to nearby receptors, construction/decommissioning noise and vibration levels are calculated to comply with the criteria and thus significant effects are not expected. Nevertheless, good construction practices as set out below should be followed in order to reduce noise and vibration levels to as low as reasonably practicable.

13.10.1.1 Best Practicable Means (BPM)

Best Practicable Means as defined in BS 5228-1 should be employed at all times to reduce noise and vibration to a minimum. The client and the chosen contractor will ensure that the following guidelines will be applied where applicable:

- The quietest reasonably available equipment will be selected for use on site. The methods of works will be carefully considered, and appropriate noise and vibration control measures put in place to ensure that the relevant noise/vibration criteria are achieved.

[19] When described in accordance with the EPA tables of significance.

- As far as reasonably practicable, the noise from reversing alarms will be controlled or limited through the following measures:
  - Banksmen will be utilised to avoid so far as reasonably practicable the use of reversing alarms.
  - Reversing alarms will incorporate where reasonably practicable features such as broadband signals or 'smart alarms' to reduce the level of noise.
- Where an enclosure is in place it should be used.
- Where reasonably practicable, vehicles and mechanical plant associated with the construction works will be fitted with effective exhaust silencers and shall be maintained in good working order.
- Machines and vehicles in intermittent use will be shut down or throttled down to a minimum during periods between works.
- The movement of delivery materials outside of normal working hours will be kept to a minimum and handled in a manner that minimises noise.
- All plant, equipment and noise control measures applied to plant and equipment will be maintained in good working order and operated such that noise emissions are minimised as far as reasonably practicable.
- All employees will be provided with an appropriate induction and ongoing briefings regarding the management of environmental issues. This will involve emphasising the need for employees to show consideration to nearby sensitive receptors, including residential neighbours. They will be briefed on not generating unnecessary noise when on site or when leaving and arriving to the wind farm site.
- The hours of construction activity will be limited to avoid unsociable hours where possible. Construction operations shall generally be restricted to between 07:00hrs and 19:00hrs weekdays and between 08:00hrs and 14:00hrs on Saturdays. However, to ensure that optimal use is made of good weather periods or at critical periods within the programme (i.e., concrete pours and turbine assembly) it may occasionally be necessary to work out of these hours.

The above Best Practice will be briefed to all parties via:

- Site Induction;
- Toolbox talks;
- Start of Shift briefings.

13.10.2 Operational phase

Noise mitigation measures are outlined below to ensure that turbine noise levels will comply with the criteria at receptor H17. The mitigation measures proposed shall be implemented at 6m/s (v_{10}) wind speed, during daytime periods (07:00 to 23:00hrs), when wind directions are 220 to 340 degrees from north (i.e., broadly westerly winds).

Table 13.19 details the sound power spectra used for noise modelling of a number of turbines in a reduced mode of operation (Load Mode LO2), for the purposes of achieving compliance with the noise criteria at H17.

This sound power data has been extracted from Section 9.3 of the Vestas performance specifications document[20] with Octave Band Levels extracted from Table 3 of the Vestas Third octave noise emission specification document[21], adjusted to equate to the stated total sound power levels of mode LO2.

Table 13.19: Turbine sound power L_{wA} spectra used for prediction model (Vestas V150–4.5MW Mode L02)

Wind Speed (m/s) at Hub Height	Sound Power Level at Hub Height [dBA] Mode L02 (Blades with serrated trailing edge) dB L_{wA}	Octave Band Sound Power Level at Hub Height							
		63	125	250	500	1k	2k	4k	8k
3	91.1	69.2	78.2	83.8	86.3	85.6	81.6	74.5	64.0
4	91.3	68.9	78.4	84.3	86.8	85.7	81.2	73.3	61.7
5	93.2	71.2	80.3	86.1	88.6	87.6	83.4	75.8	64.7
6	96.4	74.8	83.6	89.2	91.6	90.9	86.9	79.7	69.3
7	99.9	78.6	87.1	92.6	95.0	94.4	90.7	83.9	74.0
8	103.1	82.1	90.4	95.7	98.1	97.6	94.1	87.7	78.2
9+	103.7	82.8	90.9	96.2	98.6	98.2	94.8	88.7	79.6

Additional noise modelling has been carried out to establish the extent of turbine curtailment that is required to comply with the criteria.

Table 13.20 presents the proposed turbine curtailment strategy. The turbine curtailment strategy is designed to ensure a reduction in noise output by the level of the potential exceedances identified at H17.

The required curtailment referenced to a standardised wind speed height of 10 metres (V_{10}) that have been derived from the supplied data relative to hub height (HH) wind speeds. The stated exceedance wind speed of 6m/s (V_{10}) has been assessed as the wind speed range 5.6 – 6.4m/s which has been calculated to equate to the range wind speed range 8.0 - 9.2m/s at hub height).

[20] Document no.: 0067-7057.V04 2021-12-03 Performance Specification V150–4.5MW 50/60 Hz

[21] Document DMS 0071-7258_02 V150-4.5MW Third octave noise emission

Table 13.20: Turbine noise curtailment strategy, dB

Turbine	Wind Sector (° from North)	Time	Turbine Power Mode (Referenced to V_{10}, Standardised 10m Height Wind Speed)[22]					
			2m/s	3m/s	4m/s	5m/s	6m/s	7m/s and above
T1	-	-	-	-	-	-	-	-
T2	-	-	-	-	-	-	-	-
T3	-	-	-	-	-	-	-	-
T4	-	-	-	-	-	-	-	-
T5	-	-	-	-	-	-	-	-
T6	220 - 340	07:00 – 23:00	-	-	-	-	Mode LO2	-
T7	-	-	-	-	-	-	-	-
T8	220 - 340	07:00 – 23:00	-	-	-	-	Mode LO2	-
T9	220 - 340	07:00 – 23:00	-	-	-	-	Mode LO2	-

Considering the operation of Turbines T6, T8 and T9 in the reduced power "Mode LO2", at 6m/s (V_{10}), during daytime periods (07:00 – 23:00hrs), and under wind directions 220 to 340 degrees, the calculated downwind noise level at H17 is as follows:

- Location H17: 37.4dB $L_{A90,T}$, at 6m/s (v10).

Taking into account the proposed noise mitigation measures the calculated turbine noise levels will comply with the noise criteria at all properties.

The degree of proposed turbine curtailment is considered minor, insofar as it is proposed during daytime periods only (07:00 – 23:00hrs), during particular wind directions only (220 -340 degrees from north) and at a single wind speed (6m/s $_{v10}$) and to 3 turbines only (T6, T8 and T9).

At all noise sensitive receptors there will be changes with regards to the baseline noise environment due to the operation of the wind farm. As a new source of noise will be introduced into the local environment, there will be a general change in the background soundscape and background noise levels will increase at nearby receptors. The increases/changes will be variable in terms of wind speed, wind direction and time of the day/night. Whilst in general terms, background noise levels will increase due to the wind farm development, the highest predicted absolute noise levels will remain low and within relevant Guideline limits.

[22] The stated exceedance wind speed of 6m/s (V_{10}) has been assessed as the wind speed range 5.6 – 6.4m/s which has been calculated to equate to the range wind speed range 8.0 - 9.2m/s at Hub Height).

13.11 Residual effects

13.11.1 Construction / decommissioning phase

Table 13.21 summarises the associated residual effect of noise and/or vibration from construction/ decommissioning works in EIA terms.

Table 13.21: Summary of likely significant construction/decommissioning noise/vibration effects

Works	Summary of Effects (Ref EPA Tables of Significance)		
	Quality	Significance	Duration
Turbine + Substation Construction	Adverse	**Not Significant**	Temporary
Grid Connection	Adverse	**Not Significant**	Brief

13.11.2 Operational phase

Table 13.22 presents the results of the noise modelling at the receptor where the stated exceedance was calculated, taking into account the proposed mitigation measures (i.e., turbine curtailment).

Table 13.22: Residual assessment of predicted 'downwind' turbine noise levels against criteria

Receptor Ref.	Description	dB $L_{A90,10min}$ at various Standardised 10 metre height (v_{10}) Wind Speeds (m/s)					
		2m/s	3m/s	4m/s	5m/s	6m/s	7m/s and above
17	**Predicted**	25	26	29.4	34.4	37.4	38.8
	Daytime Criterion	37.5	37.5	37.5	37.5	37.5	45.0
	Daytime Excess	-	-	-	-	-	-
	Night-time Criterion	43.0	43.0	43.0	43.0	43.0	43.0
	Night-time Excess	-	-	-	-	-	-

Significant residual effects are therefore not considered likely at any of the receptors assessed, as the predicted turbine noise levels comply with the noise criteria. However, the Project will introduce a new noise source into the environment. Therefore, the predicted operational phase residual downwind noise effects are summarised in **Table 13.23.**

Table 13.23: Summary of likely residual operational effects (downwind)

Summary of Effects (Ref EPA Tables of Significance)		
Quality	**Significance**	**Duration**
Adverse	**Not Significant**	Long Term

A 'Not Significant' effect description (ref. EPA EIAR Guidelines) is described as "*An effect which causes noticeable changes in the character of the environment but without significant consequences*".

The above effect should be considered in terms that the effect is variable, and that this assessment considers periods of the greatest potential effect (i.e., downwind conditions). In instances where receptors are upwind of turbines, the effect (in EIA terms) of the operational turbines is shown in **Table 13.24**.

Table 13.24: Summary of likely residual operational effects (upwind)

Summary of Effects (Ref EPA Tables of Significance)		
Quality	**Significance**	**Duration**
Adverse	**Not Significant**	Long Term

Whilst background noise levels will increase due to the wind farm development, the predicted levels will remain low, (highest calculated 'downwind' turbine noise level of 41.2dB $L_{A90,T}$ at non-financially involved receptor). As a new source of noise will be introduced into the local environment there will be a general change in the background soundscape and background noise levels will increase at nearby noise sensitive receptors.

13.12 Conclusion of Significance

A noise and vibration assessment on the construction, decommissioning and operational effects of the Project has been undertaken in line with relevant guidance.

The assessment of the construction and decommissioning phases of the Project has shown that noise and vibration effects on nearby sensitive receptors are considered **not significant.**

An assessment of the operational phase of the Project has included predictions of turbine noise levels at noise sensitive receptors for a range of operational wind speeds. Mitigation measures will ensure that the predicted operational noise levels will be in accordance with the guidelines. Therefore, effects associated with the operational phase of the Project are considered **not significant**.

EIAR Volume II

Main Report

Chapter 14: Landscape and Visual

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FIGURES

APPENDICES (EIAR Volume III)

VISUALISATIONS (EIAR Volume IV)

14 LANDSCAPE AND VISUAL

14.1 Introduction

14.1.1 Background

This chapter of the Environmental Impact Assessment Report (EIAR) for the proposed Tullacondra Green Energy Project ('the Project') presents the Landscape and Visual Impact Assessment (LVIA) assesses the likely significant effects of the Project on the receiving environment during construction, operation and decommissioning phases. In relation to LVIA, the assessment only considers the wind farm aspect of the Project and not the grid connection. The grid connection will be buried, mainly beneath the existing road network, and it is not considered further in this LVIA. The LVIA has been undertaken in accordance with established methodology and guidance, including Guidelines for Landscape and Visual Impact Assessment, 3rd Edition (GLVIA3), prepared by the Landscape Institute and the Institute for Environmental Management and Assessment[1] , and the Guidelines on the Information to be Contained in Environmental Impact Assessment Reports, Environmental Protection Agency[2].

14.1.2 The site and proposals

Figure 14.1 – Figure 14.7 contained within this chapter place the Project within its local context. The wind farm site is located in north Cork approximately 5.2km west of the N20 between Buttevant and New Twopothouse. The wind farm site lies to the south of the R580 and to the west of L1200 that runs between Mallow and Liscarroll via Lisgriffin. To the south of the wind farm site the L5302 runs east west and will provide access.

Topography is gradually undulating across the site in a series of broad ridges. Landcover includes a mixture of pasture and arable land with medium to large field sizes. Hedge field boundaries are more prevalent in the south of the wind farm site where the field size and shape is irregular compared to the north of the wind farm site. There is a network of tracks within the wind farm site providing access to the land and fields. There are agricultural buildings and sheds in the south where there are also small areas of woodland.

The Project includes the construction, operation and decommissioning phases of a wind energy development consisting of nine wind turbines with foundations and crane pad hardstanding areas; a permanent meteorological mast; an on-site 38kV substation, underground cabling connecting the turbines to the on-site substation; and underground grid connection to the boundary of the Mallow 110kV substation; along with all associated site works including site clearance, temporary compounds and storage areas; a new temporary entrance and upgrade of an existing entrance; upgrade of existing site tracks and construction of new site tracks; site drainage; and ancillary developments including

[1] Landscape Institute (LI) and the Institute for Environmental Management and Assessment (IEMA) (2013), Guidelines for Landscape and Visual Impact Assessment, 3rd Edition (GLVIA 3).

[2] Guidelines on the Information to be Contained in Environmental Impact Assessment Reports, May 2022, Environmental Protection Agency

security gates and fencing, lighting and signage; and biodiversity mitigations and enhancements.

The site layout plan of the proposed wind farm is shown in **Figure 1.4**, in EIAR **Chapter 1 Introduction**. Further details of the Project, the construction programme and sequencing of works which are used as the basis for assessments in this EIAR are provided in **Chapter 5 Project Description**.

14.1.3 Statement of authority

This LVIA chapter was prepared by Chartered Landscape Architects at Stephenson Halliday on behalf of Tullacondra Green Energy Limited (the 'Applicant'). Ken Halliday (CMLI) has over 28 years of experience of LVIA and is the lead author. Ken has advised on over 200 wind farm projects. Ken is supported by Kelly Anderson (CMLI) with over 20 years of experience of LVIA relating to applications for over 75 onshore wind energy developments including over 20 large scale projects. Stephenson Halliday provides specialist landscape, planning, EIA, and graphics services. The Practice is Landscape Institute Registered, and senior staff have prepared LVIA for over 200 onshore wind farm projects throughout the UK and Ireland.

14.1.4 Chapter structure and terminology

This chapter is structured as set out in the table of contents. It is supported by:

- **Figure 14.1 - Figure 14.11.**
- Technical Appendices, presented in **Volume III**
- Visualisations for **Viewpoints 1 – 21**, presented in **Volume IV**

The appendices are important to the assessment and should be read alongside this chapter.

Key terms used within the assessment are described in section 14.3 and EIAR **Volume III, Appendix 14.1** which sets out the methodology and provides a glossary of terms. The methodology used for this LVIA is in accordance with current best practice and guidance as contained in the Guidelines for Landscape and Visual Impact Assessment Third Edition[1].

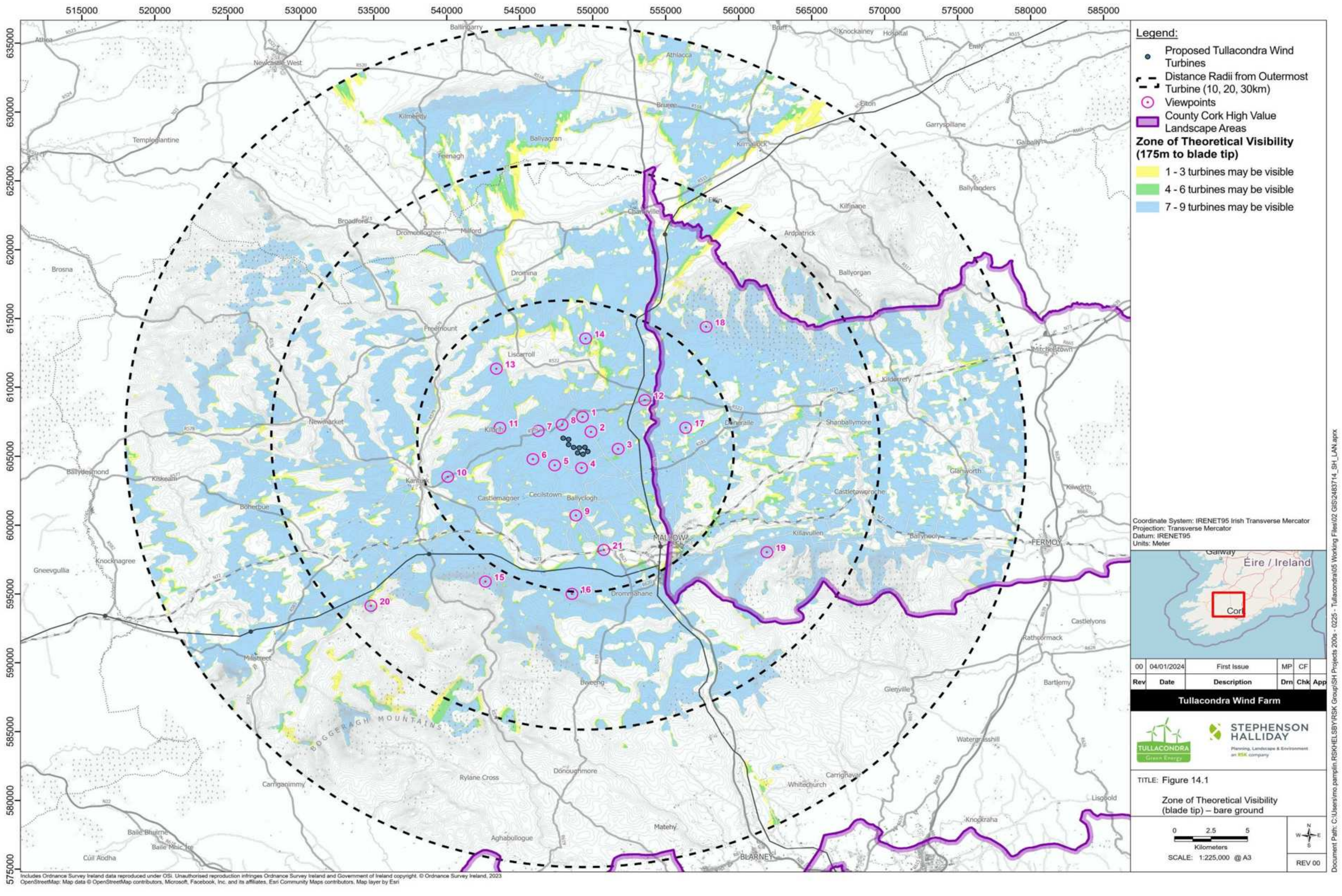

Figure 14.1: Zone of Theoretical Visibility (blade tip) – bare ground

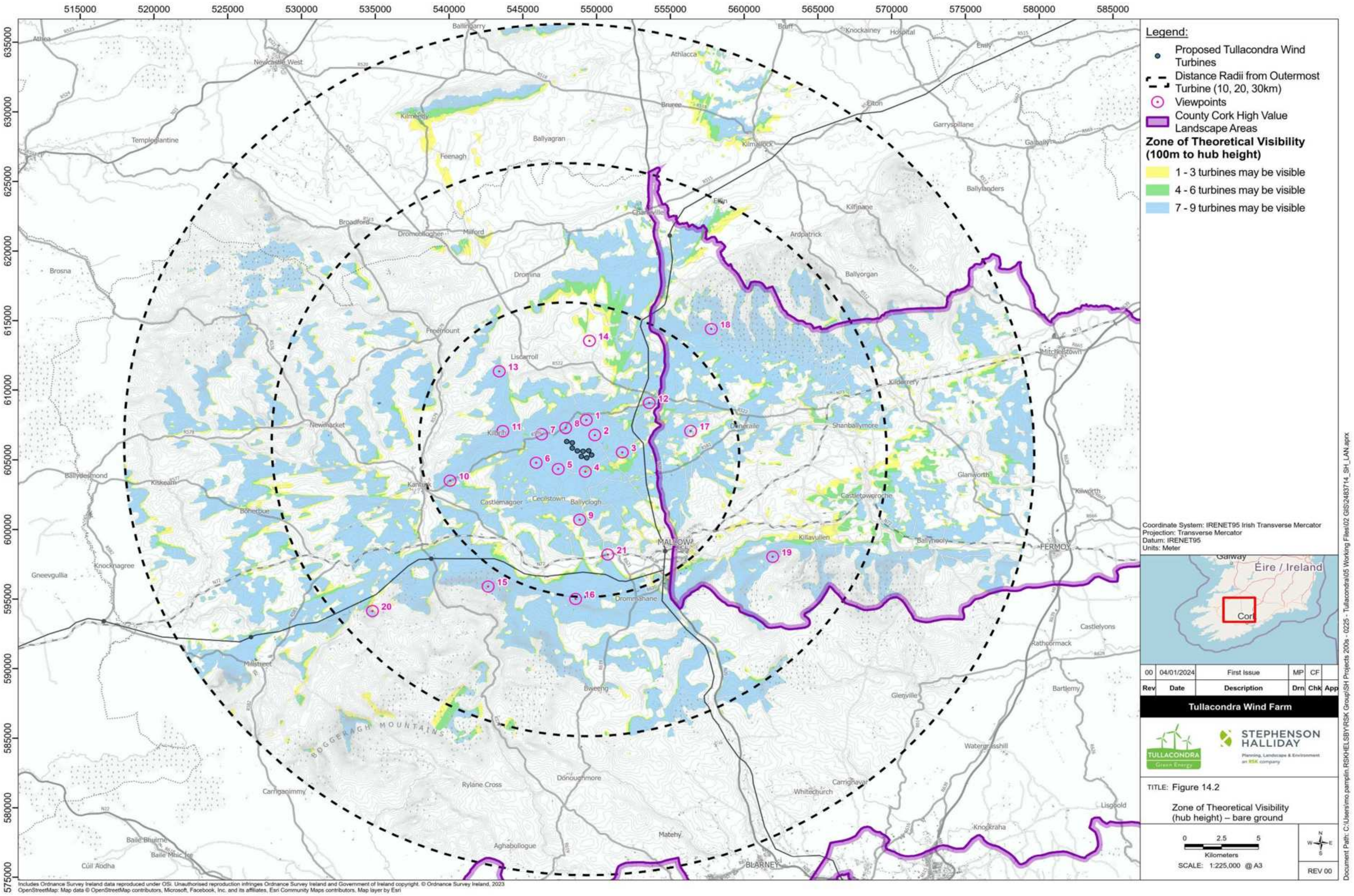

Figure 14.2: Zone of Theoretical Visibility (hub) – bare ground

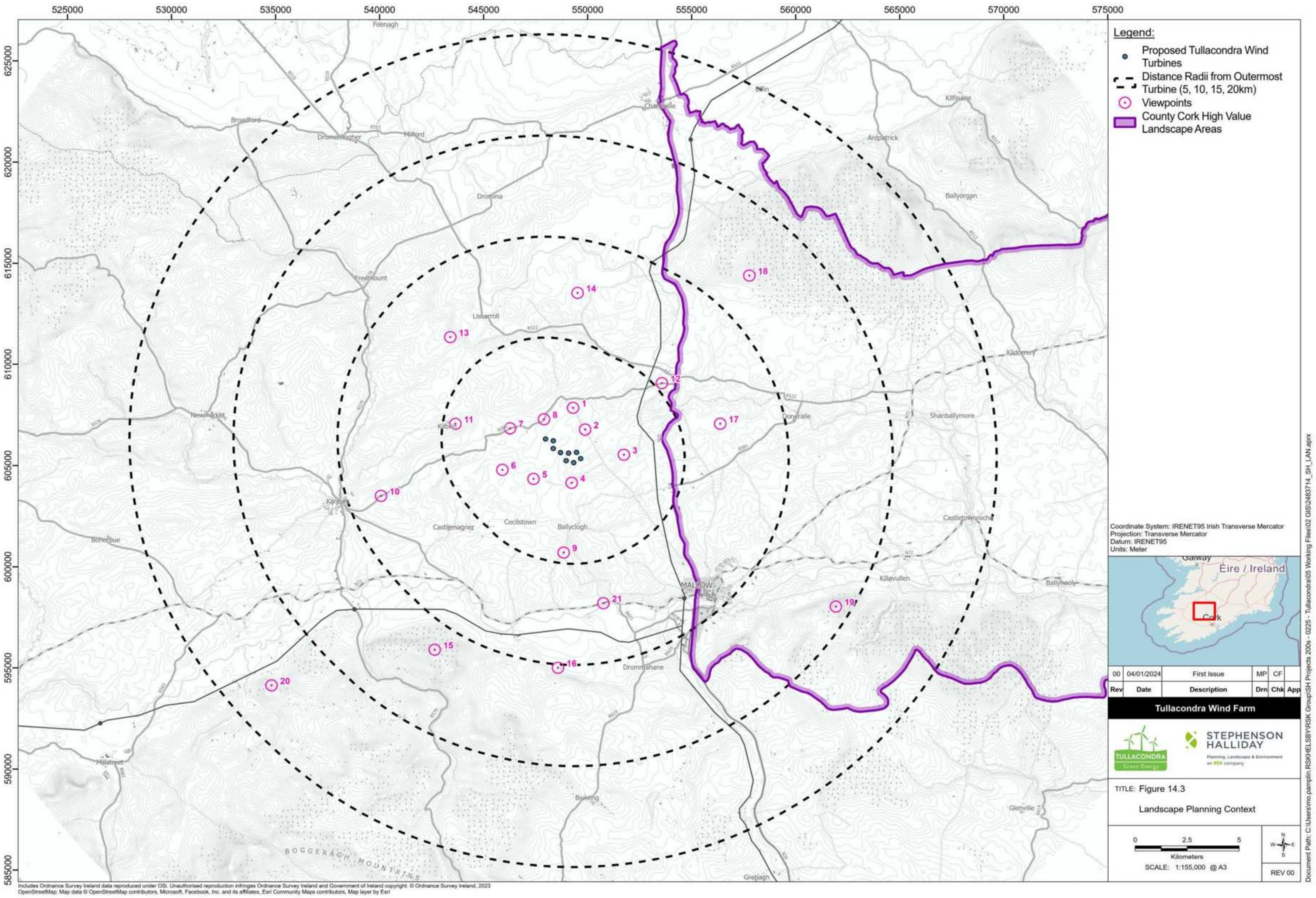

Figure 14.3: Landscape planning context

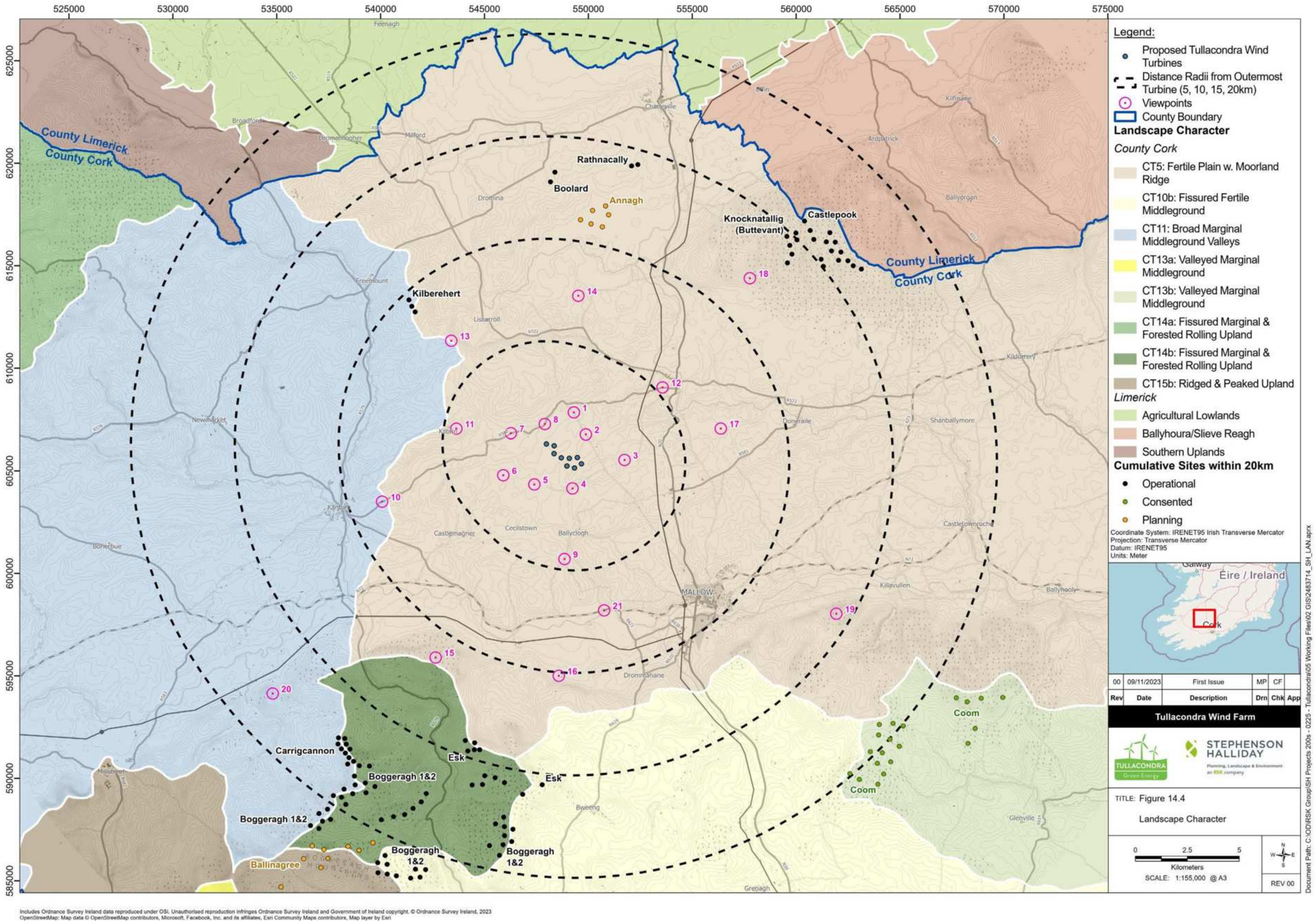

Figure 14.4: Landscape character

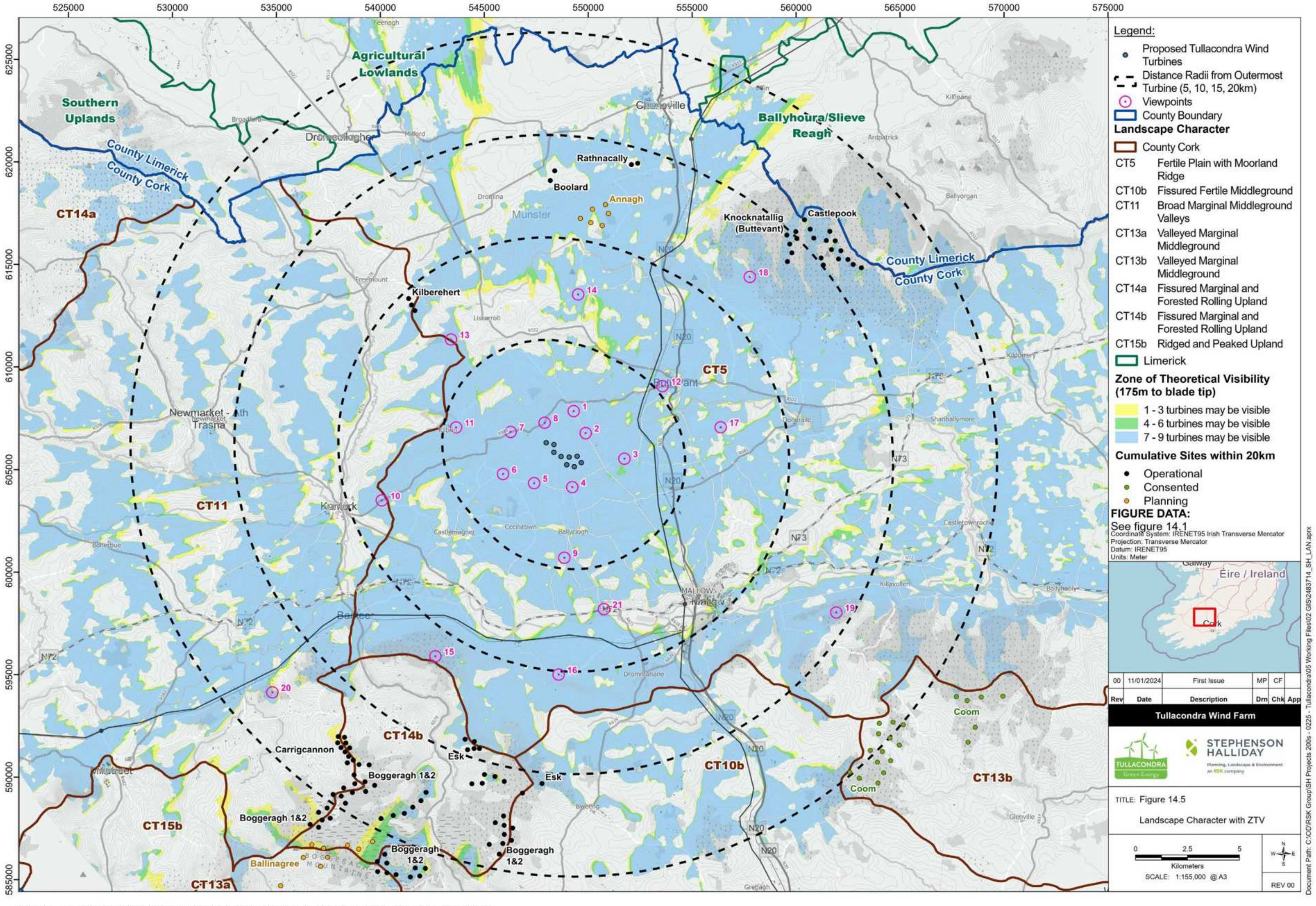

Figure 14.5: Landscape character with ZTV

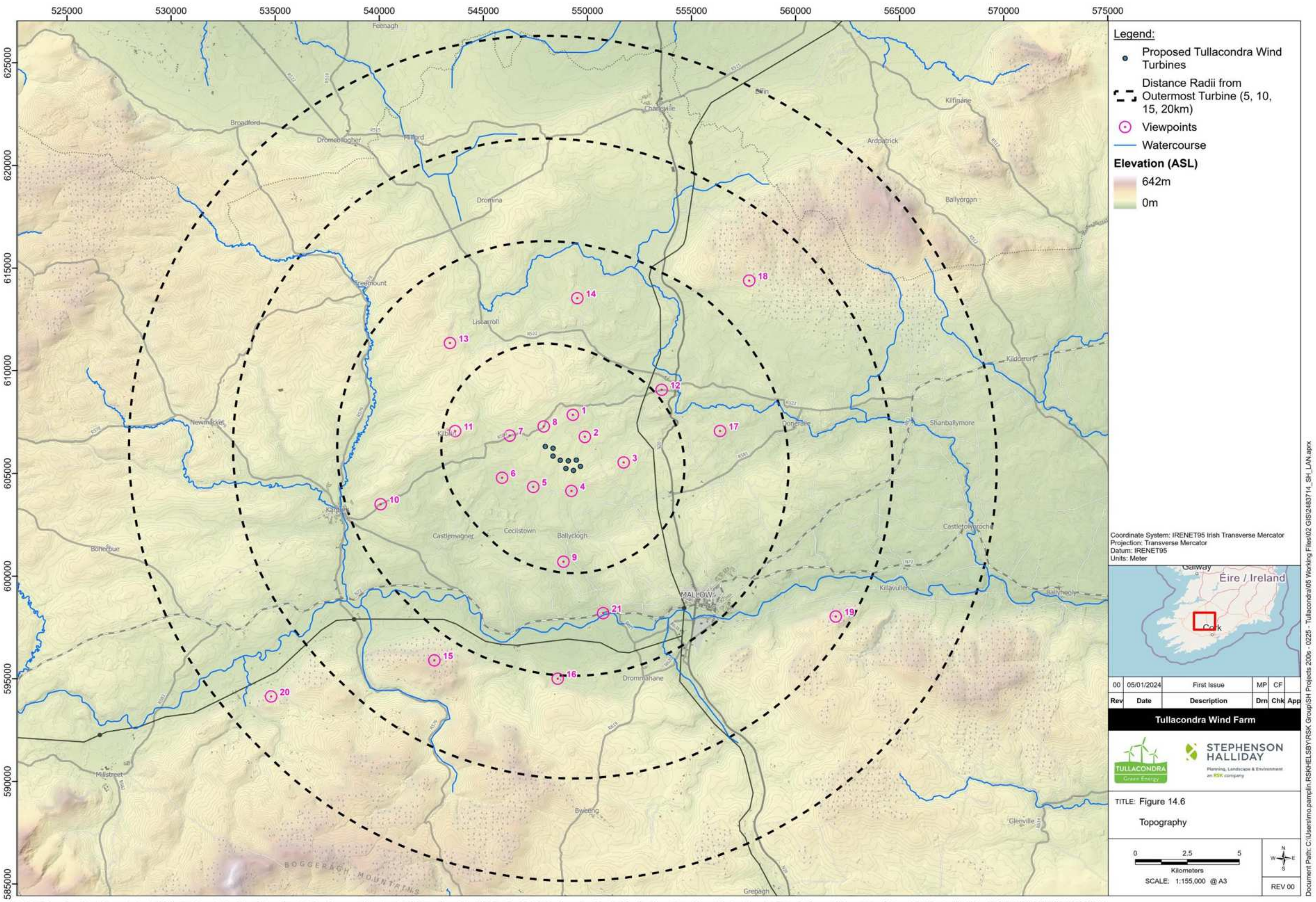

Figure 14.6: Topography

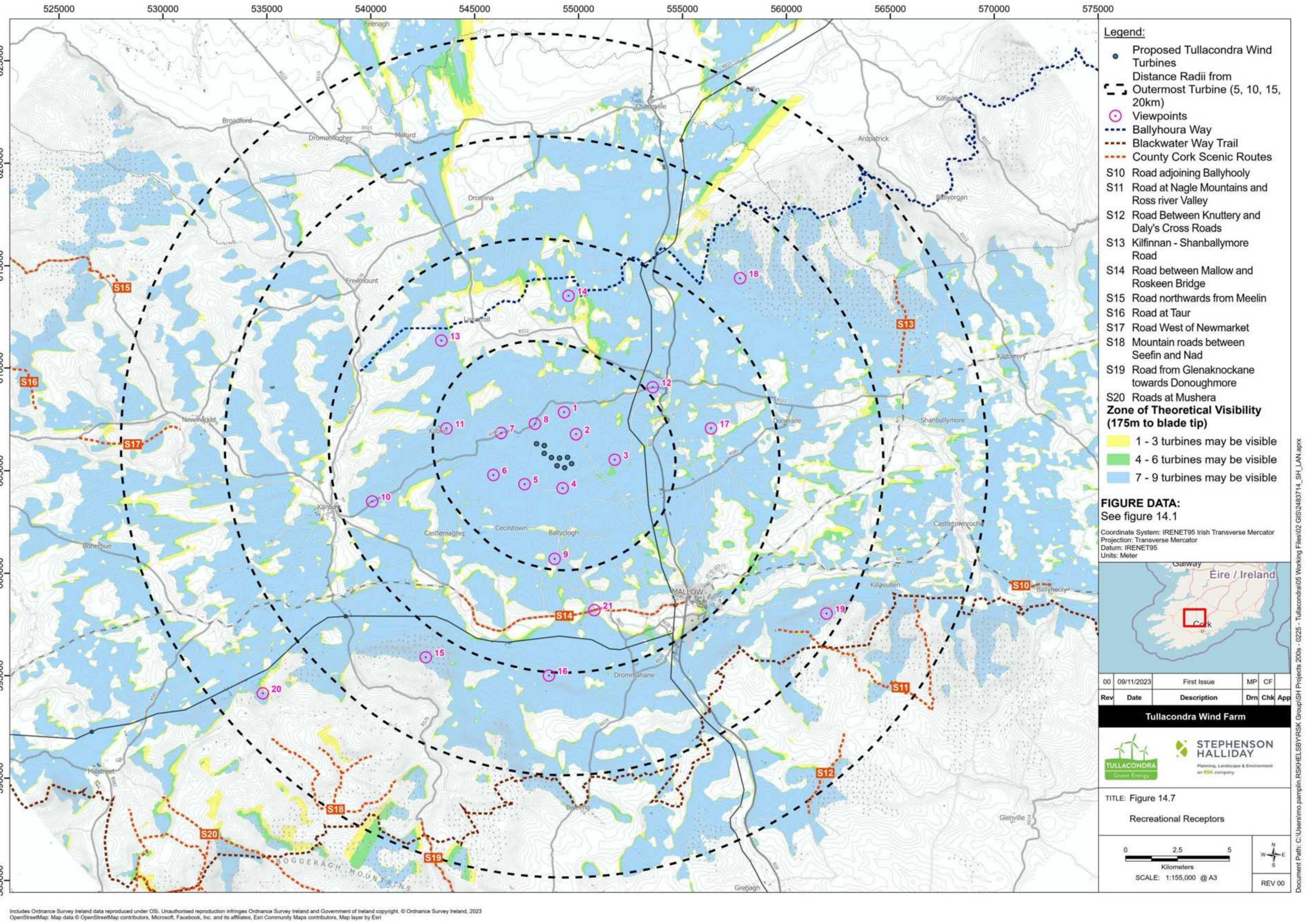

Figure 14.7: Recreational receptors

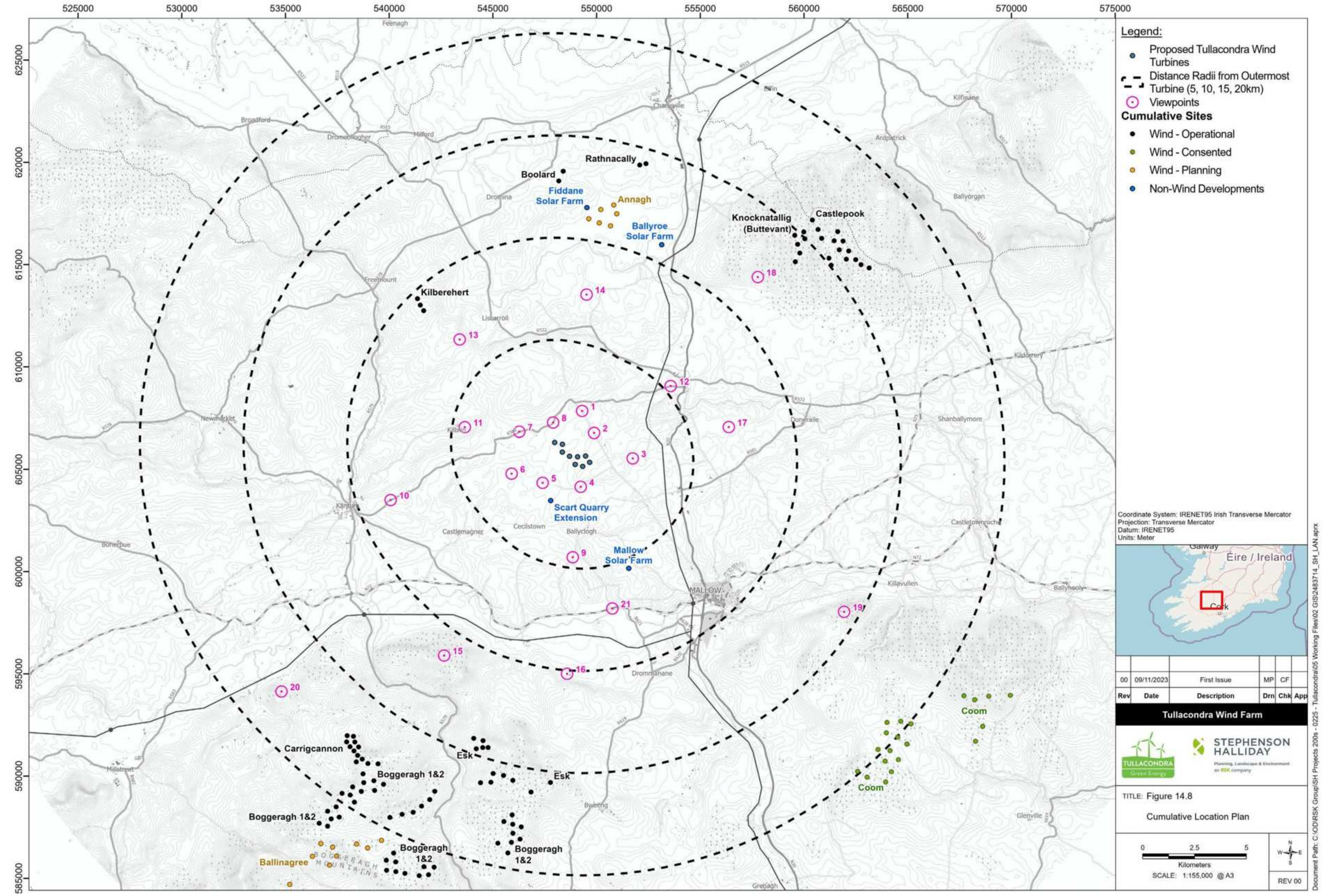

Figure 14.8: Cumulative location plan

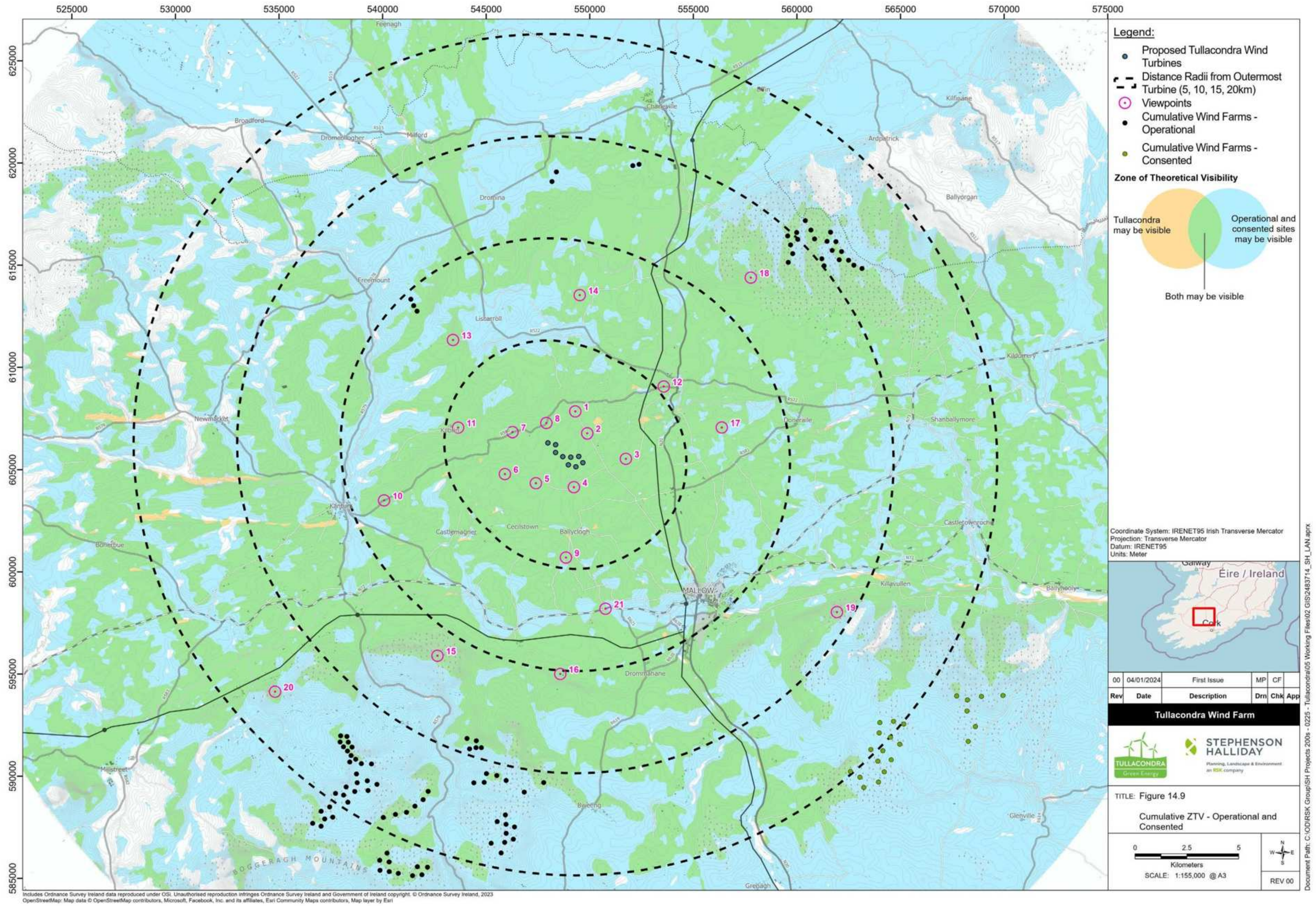

Figure 14.9: Cumulative ZTV – operational and consented

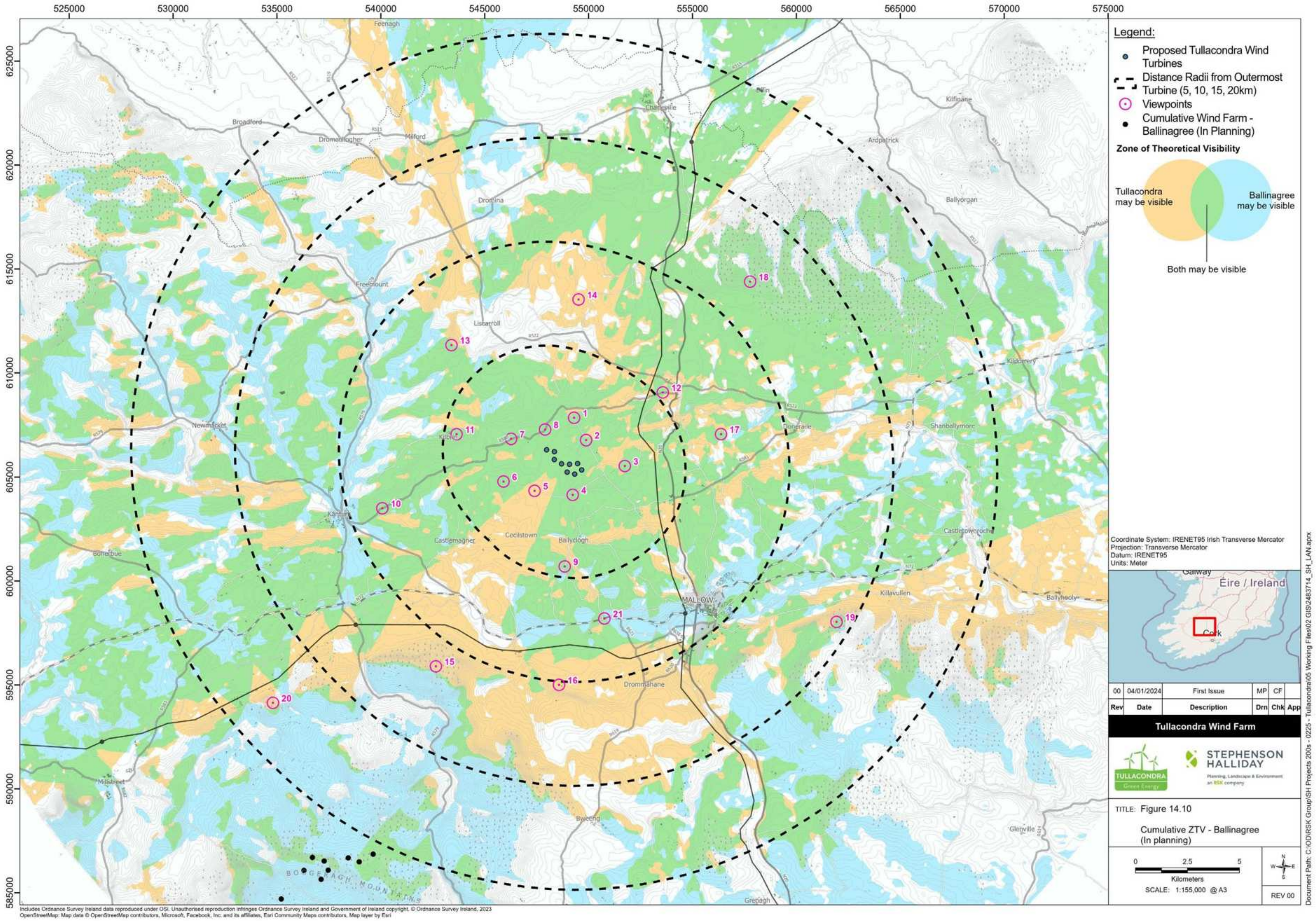

Figure 14.10: Cumulative ZTV – Ballinagree (in planning)

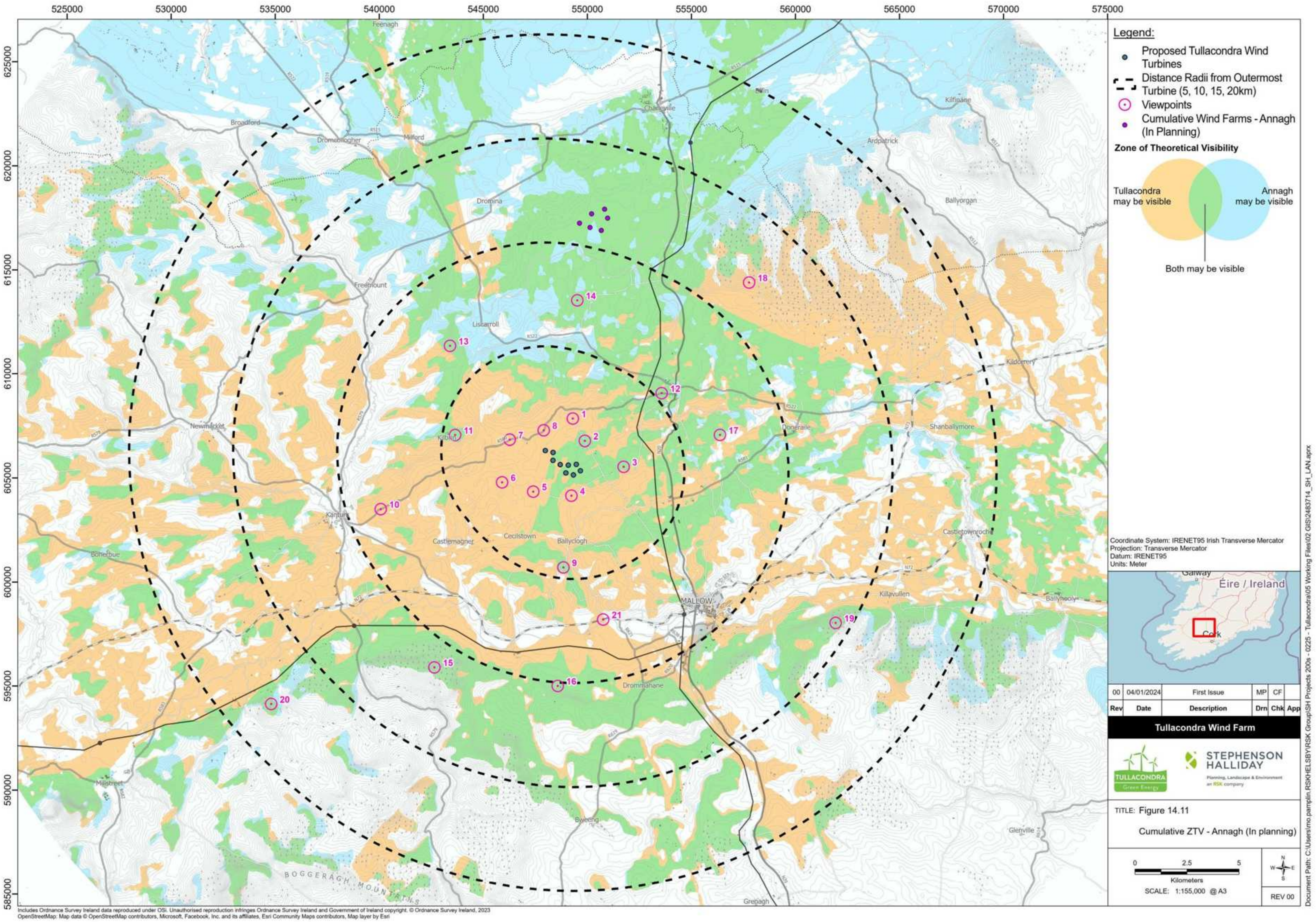

Figure 14.11: Cumulative ZTV– Annagh (in planning)

14.2 Statutory and planning context

Relevant national planning policy is set out in EIAR **Chapter 4 Project Need and Assessment of Alternatives**: This LVIA is in accordance with The Wind Energy Development Guidelines[3] and Draft Wind Energy Development Guidelines[4].

The Wind Energy Development Guidelines provide advice on general siting and design for six different national landscape character types (NLCT). The site of the proposed wind farm is in an area typical of the Hilly and Flat Farmland NLCT and the guidance provides the following general advice on siting and design in this NLCT:

"Sufficient distance should be maintained from farmsteads, houses and centres of population in order to ensure that wind energy developments do not visually dominate them.

Sufficient distance from buildings, most likely to be critical at lower elevations, must be established in order to avoid dominance by the wind energy development.

The optimum spacing pattern is likely to be regular, responding to the underlying field pattern. The fields comprising the site might provide the structure for spacing of turbines."

Section 14.6 of this LVIA describes design considerations and mitigation taken into account in the Project.

14.2.1 Local planning policy – County Cork

Local development planning policy is described in the Cork County Development Plan 2022 - 2028[5] (the CDP), which is consistent with the National Planning Framework[6] and the Regional Spatial and Economic Strategy[7].

The CDP is divided into six volumes. The most pertinent of these in relation to the Project and landscape and visual issues are:

- Volume 1 Main Policy Material;
- Volume 2 Heritage and Amenity
- Volume 6 Maps

Within this section, reference is made to policies and guidance contained in Volume 1 and maps contained in Volume 6 of the CDP. Volume 2 provides technical information that is used in this LVIA to evaluate the visual effects on designated scenic routes.

14.2.1.1 Landscape

In terms of landscape, the CDP states that *"Landscape is the context in which all changes take place… The challenge we face is to manage our landscapes so that change is*

[3] Department of Environment, Heritage and Local Government (2006), Wind Energy Development Guidelines.

[4] Department of Housing, Planning and Local Government (2019), Draft Revised Wind Energy Development Guidelines.

[5] Cork County Council (2022), Cork County Development Plan 2022 - 2028.

[6] Government of Ireland. 2020. Project Ireland 2040 National Planning Framework.

[7] Southern Regional Spatial & Economic Strategy (RSES) for the Southern Region, 2020.

positive in its effects, so that the landscapes which we value are protected and those which have been degraded are enhanced. Meeting this challenge is a key element in achieving sustainable development. Landscape Character Assessment is designed to assist in achieving this goal." The Landscape Character Assessment of Cork classifies the landscapes of the county by type and assigns levels of sensitivity to each based on their ability to accommodate development.

The Project will be located in Landscape Character Type (LCT) 5 Fertile Plain with Moorland Ridge which is described in more detail in section 14.5 of this LVIA. A large proportion of the LCT coincides with an area identified on the Wind Energy Strategy in CDP as Policy ET13-7 Open to Consideration indicating that wind energy development may be considered acceptable subject to the criteria listed under the policy and as set out in the section below.

LCT5 and other LCT coinciding with the LVIA study area are shown on **Figure 14.4** and **Figure 14.5.**

The CDP indicates the value of the County's landscape character assessment, published in the interim Draft Landscape Strategy[8], in recognising "… *the importance of landscape and visual amenity and the role of planning in its protection."*

CDP Objectives relating to landscape are:

GI 14-9: Landscape

- *"Protect the visual and scenic amenities of County Cork's built and natural environment.*
- *Landscape issues will be an important factor in all land-use proposals, ensuring that a pro-active view of development is undertaken while protecting the environment and heritage generally in line with the principle of sustainability.*
- *Ensure that new development meets high standards of siting and design.*
- *Protect skylines and ridgelines from development.*
- *Discourage proposals necessitating the removal of extensive amounts of trees, hedgerows and historic walls or other distinctive boundary treatments."*

GI 14-10: Draft Landscape Strategy

"*Ensure that the management of development throughout the County will have regard for the value of the landscape, its character, distinctiveness and sensitivity as recognised in the Cork County Draft Landscape Strategy and its recommendations, in order to minimize the visual and environmental impact of development, particularly in areas designated as High Value Landscapes where higher development standards (layout, design, landscaping, materials used) will be required."*

The Project will not be located within a High Value Landscape (HVL) as defined in the Landscape Strategy. The nearest HVL is located approximately 4km to the east of the Project and extends beyond the study area. The CDP Wind Energy Strategy map indicates that the HVL coincides with an area defined as 'Normally Discouraged' in relation to its suitability for wind energy development.

[8] Cork County Council (2007), Cork County Draft Landscape Strategy.

GI 14-11: Draft Landscape Strategy, Land Use Plans and Policy Guidance

"*Have regard to the Draft Cork County Landscape Strategy (2007) in the preparation of plans and other policy guidance being prepared during the lifetime of the Plan… Whilst advocating the protection of such scenic resources the Plan also recognises the fact that all landscapes are living and changing, and therefore in principle it is not proposed that this should give rise to the prohibition of development along these routes, but development, where permitted, should not hinder or obstruct these views and prospects and should be designed and located to minimise their impact. This principle will encourage appropriate landscaping and screen planting of developments along scenic routes."*

Further information on the County's landscape character assessment and HVL is provided at section 14.8.

14.2.1.2 Landscape views and prospects

It is the Council's intention to seek to protect views and prospects, stating that "*The County contains many vantage points and prospects of great natural beauty may be obtained over both seascape and rural landscape. This scenery and landscape are of enormous amenity value to residents and tourists and constitutes a valuable economic asset. The protection of this asset is therefore of primary importance in developing the potential of the County. Therefore, the Plan identifies specific Scenic Routes consisting of important and valued views and prospects within the County."*

CDP Objectives relating to landscape views and prospects are:

GI 14-12: General Views and Prospects

"*Preserve the character of all important views and prospects, particularly sea views, river or lake views, views of unspoilt mountains, upland or coastal landscapes, views of historical or cultural significance (including buildings and townscapes) and views of natural beauty as recognized in the Draft Landscape Strategy."*

GI 14-13: Scenic Routes

"*Protect the character of those views and prospects obtainable from scenic routes and in particular stretches of scenic routes that have very special views and prospects identified in this Plan. The scenic routes identified in this Plan are shown on the scenic amenity maps in the CDP Map Browser and are listed in 'Volume 2 Heritage and Amenity Chapter 5, Scenic Routes of this Plan'."*

Figure 14.7 indicates that there are five scenic routes that coincide with the 20km study area for the LVIA of the proposed wind farm. The nearest of these scenic routes is S14 which runs along part of the N72 approximately 7km to the south of the Project and is considered in detail in this LVIA. Scenic routes are discussed at section 14.8.6.2.

GI 14-14: Development on Scenic Routes

"*Require those seeking to carry out development in the environs of a scenic route and/or an area with important views and prospects, to demonstrate that there will be no adverse obstruction or degradation of the views towards and from vulnerable landscape features. In such areas, the appropriateness of the design, site layout, and landscaping of the* *proposed development must be demonstrated along with mitigation measures to prevent significant alterations to the appearance or character of the area.*

Encourage appropriate landscaping and screen planting of developments along scenic routes (See Chapter 16 Built and Cultural Heritage).”

GI 14-15: Development on the Approaches to Towns and Villages

“*Ensure that the approach roads to towns and villages are protected from inappropriate development, which would detract from the setting and historic character of these settlements.”*

14.2.1.3 Public Rights of Way (PRoW)

The CDP Objective for rights of way (GI 14-8: Rights of Way) concerns the Council’s own work in identifying and mapping PRoW over the lifetime of the CDP. The Chapter provides the following statement on policy:

“Public rights of way are an important amenity, economic and tourism asset to the County. The Council recognises the importance of maintaining established rights of way and supporting initiatives for establishing walking routes and general accessibility. It is also noted that routes such as pilgrim routes or mass paths can have a unique and local cultural heritage value”, while referring to Section 10(2)(o) of the Planning and Development Acts 2000 as amended.

14.2.1.4 Chapter 13: Energy and Telecommunications

This chapter notes how carbon-based energy sources are *“…one of the major contributors to climate change and a ‘radical transformation’ of our energy system is required to meet National, European, and international climate policy objectives.”*

With regard to wind energy, Cork County Council’s wind energy strategy (published in the ‘County Development Plan 2014[9]’) utilises national guidance contained in ‘Planning for Wind Energy Development Guidelines 2006[3]’ and the Sustainable Energy Authority of Ireland (SEAI) manual: ‘A Methodology for Local Authority Renewable Energy Strategies’[10]. This has enabled a sieve analysis to identify suitable locations for wind energy development, taking into account:

- *“The approach taken by other adjoining Local Authorities (Kerry, Limerick, South Tipperary, and Waterford) to Wind Energy in their respective County Development Plans. Of particular importance are the instances where adjoining. Counties have adopted a policy discouraging wind energy projects.*
- *The location of all existing and proposed wind energy developments and their cumulative impacts.*
- *The pattern of population distribution, so that the main centres of population can be avoided.*
- *Accessibility to the electricity distribution grid.*

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[9] Cork County Council (2014), Cork County Development Plan 2014.

[10] Sustainable Energy Authority of Ireland (SEAI) (April 2013), Methodology for Local Authority Renewable Energy Strategies.

- *Important or high value landscapes.*
- *Nature conservations sites and in particular Natura 2000 sites (SPA and SAC).*
- *The Water Framework Directive River Basin Management Plans for the County, so that impacts on the rivers, lakes and other waterbodies of the County could be avoided.*
- *The Sustainable Energy Ireland (SEI) Wind Atlas, 2003 was utilised to identify areas with viable wind speeds."*

Figures 13.2 and 13.3 in the CDP identify, respectively, key constraints and three categories of scale of wind development:

- Acceptable in Principle.
- Open to Consideration.
- Normally Discouraged.

The site is located in an area of 'Open to Consideration'. This category is defined as being where:

"…wind energy development is open to consideration… where proposals can avoid adverse impacts on:

- *Residential amenity particularly in respect of noise, shadow flicker and visual impact;*
- *Urban areas and Metropolitan/Town Green Belts;*
- *Natura 2000 Sites (SPA's and SAC's), Natural Heritage Areas (NHA's), proposed Natural Heritage Areas and other sites and locations of significant ecological value;*
- *Architectural and archaeological heritage;*
- *Visual quality of the landscape and the degree to which impacts are highly visible over wider areas."*

14.2.2 Local planning policy – County Limerick

While the Project will not be situated in County Limerick, parts of the County are coincident with the 20km LVIA study area and **Figure 14.5** indicates theoretical visibility of the Project. This section sets out relevant policies of Limerick County Development Plan 2022-2028[11].

14.2.2.1 Policy EH P8 Landscape Character Areas

The policy states that the Council will *"…promote the distinctiveness and where necessary safeguard the sensitivity of Limerick's landscape types, through the landscape characterisation process…"*

[11] Limerick County Council (2022), Limerick Development Plan 2022-2028.

Ten LCA are identified in the Development Plan, three of which are coincident with the LVIA study area and are summarised below noting Specific Objectives related wind farm development.

LCA 01 Agricultural Lowlands

"*This is the largest of the Landscape Character Areas in Limerick and comprises almost the entire central plain. This landscape is a farming landscape and is defined by a series of regular field boundaries, often allowed to grow to maturity. This well-developed hedgerow system is one of its main characteristics. In terms of topography, the landscape is generally rather flat with some locally prominent hills and ridges. The pastoral nature of the landscape is reinforced by the presence of farmyards."*

Specific Objectives related to wind farm development: "*Encourage the regular arrangement of turbines with equal spacing in proposed wind farm developments, which take field boundaries into account."*

LCA 02 Ballyhoura/ Slieve Reagh

"*This is a locally dominant range of hills running along the Cork boundary. The lowland component of this landscape character area is generally a farmed landscape, but the range of hills provides an upland backdrop. The lower reaches of Ballyhoura are pastoral in character, but this changes as altitude increases and the vegetation cover changes to commercial forestry, interspersed with upland grassland and the remnants of peat bogs. Much of the Ballyhoura's are within a Special Area of Conservation."*

There are no Specific Objectives related to wind farm development.

LCA 07 Southern Uplands

"The Mullaghareirk range of hills, which straddles the County Limerick, Cork and Kerry boundaries, is the principal defining feature of this landscape character area. This is a gently undulating range of hills, which rises to almost a plateau near the Cork border. Vegetation cover ranges from improved hill grassland, which tends to be wet in nature to disturbed peatland habitats, such as blanket bog, dry and wet heath. Few of these habitats are intact, occurring only in patches interrupted by commercial forestry and improved grassland. Commercial forestry, most of which is nearing maturity, is a dominant feature of this area."

Specific Objectives related to wind farm development:

- "*This area is open to consideration for wind energy development.*
- *Where wind farms are permitted, a random spacing with random layout shall be considered in proposed wind farm developments, to limit the visual and landscape impact."*

As set out in Limerick County Development Plan 2022-2028[11], Limerick landscape character areas (LCA) have incorporated the scenic views and prospects of Limerick County Development Plan 2010-2016, and these are discussed in relation to Objective EH O31 below.

14.2.2.2 Objective EH O31

"It is an objective of the Council to:

a) Preserve, protect and encourage the enjoyment of views and prospects of special amenity value or special interests and to prevent development, which would block or otherwise interfere with views and/or prospects.

b) In areas where scenic views and prospects are listed in the Plan, there will be a presumption against development, except that required to facilitate farming and appropriate tourism and related activities. The development must be appropriately designed so that it can be integrated into the landscape."

Map 6.2 in the Limerick Development Plan indicates there are scenic views and prospects running north-south and located on the east side of the Ballyhoura Mountains at a distance of over 15km from the Project. Given the separation distance to the Project, the orientation of the scenic views and prospects and their immediate forested context, it is considered that impacts would be negligible and **Not Significant,** and they are not considered further in this LVIA.

14.3 Methodology

14.3.1 Study area

It is accepted practice in landscape and visual assessment work that the extent of the study area for a development proposal is broadly defined by the visual envelope of the proposed development. An initial study area of 30km has been used (as shown by **Figure 14.1** and **Figure 14.2**) and a detailed study area of 20km as shown by **Figure 14.4 - Figure 14.11).** This meets the requirements advised by Wind Energy Development Guidelines and Draft Revised Wind Energy Guidelines. Potential visibility of the Project would become relatively limited and intermittent beyond this area.

14.3.2 Methodology

The detail of the methodology is described in EIAR **Volume III**, **Appendix 14.1**. A summary of the primary judgements is provided below.

14.3.2.1 Sensitivity

Sensitivity is judged taking into account the component judgments about the value and susceptibility of the receptor as illustrated by **Table 14.1.**

Where sensitivity is judged to lie between levels, an intermediate assessment will be adopted. A slightly greater weight is given to susceptibility in judging sensitivity of visual receptors as indicated below:

Table 14.1: Landscape sensitivity

Landscape Receptors		Susceptibility		
		High	**Medium**	**Low**
Value	**National**	High	High/Medium	Medium
	Regional	High/Medium	Medium	Medium/Low
	Community	Medium	Medium/Low	Low

Table 14.2: Visual sensitivity

Visual Receptors		Susceptibility		
		High	**Medium**	**Low**
Value	**National**	High	High/Medium	Medium
	Regional	High/Medium	High/Medium	Medium/Low
	Community	High/Medium	Medium	Low

14.3.2.2 Magnitude

Scale of effect is the primary factor in determining magnitude; which may be higher if the effect is particularly widespread and/or long lasting, or lower if it is constrained in geographic extent and/or timescale. The table below illustrates how this judgement is considered as a two-step process.

Table 14.3: Magnitude – scale and extent

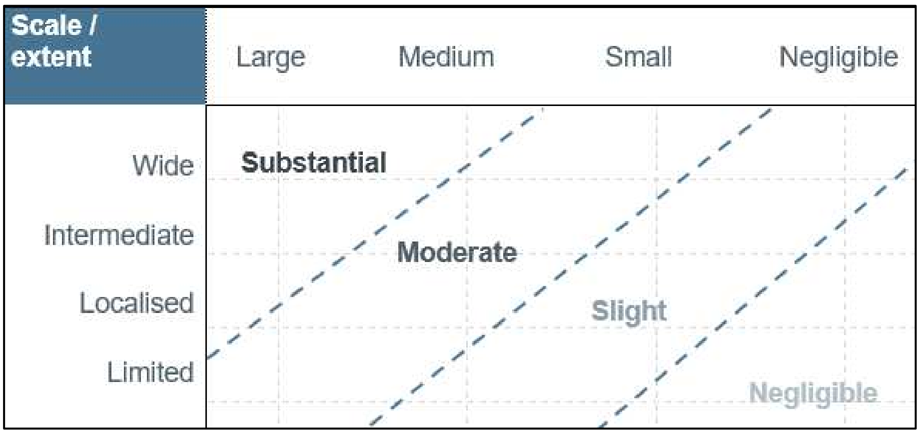
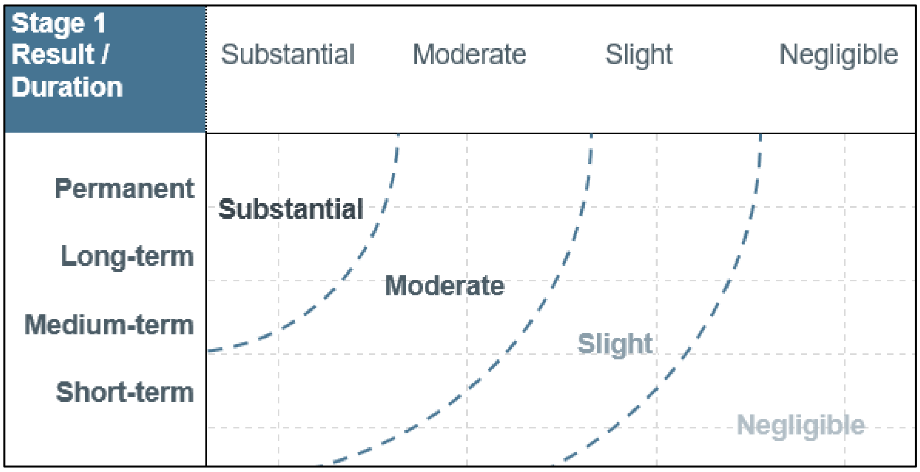


Table 14.4: Magnitude – influence of duration



Where magnitude is judged to lie between levels, an intermediate assessment will be adopted.

14.3.2.3 Significance of Effects

The significance of any identified landscape or visual effect is assessed as major, moderate, minor or negligible. These categories are based on the consideration of sensitivity with the predicted magnitude of change. **Table 14.5** is not used as a prescriptive tool and illustrates the typical outcomes, allowing for the exercise of professional judgement. In some instances, a particular parameter may be considered as having a determining effect on the analysis.

Table 14.5: Significance

		Magnitude of Change			
		Substantial	**Moderate**	**Slight**	**Negligible**
Receptor Sensitivity	**High**	Major	Major/ Moderate	Moderate	Minor
	Medium	Major/ Moderate	Moderate	Moderate/ Minor	Minor/ Negligible
	Low	Moderate	Moderate/ Minor	Minor	Negligible

Where the effect has been classified as Major or Major/Moderate, this is considered to be equivalent to likely significant effects referred to in the EIA Directive.

Landscape and visual effects can be positive or adverse and, in some instances, may be considered neutral. Neutral effects are those which overall are neither adverse nor positive but may incorporate a combination of both.

Taking a precautionary stance, changes to rural landscapes involving construction of man-made objects of a large scale are generally considered to be adverse.

With regard to the visual effects of wind farms, it is important to recognise the differing views revealed by extensive available research and to take into account that, for the same development, some may view the impact as adverse, some as positive and yet others as neutral. This depends to some extent on the viewer's predisposition towards landscape change but also their opinions regarding climate change and the principle of renewable energy development including wind farms in the landscape. Taking a precautionary approach in assessing the 'worst case scenario', the assessment considers that all effects on views which would result from the construction and operation of the Project to be adverse, unless specified otherwise in the text. It should be noted, however, that not all people would consider the effects to be adverse.

14.3.3 Cumulative assessment

As recommended by the NatureScot cumulative guidance, this assessment focusses on the "additional cumulative change which would be brought about by the Project"[12].

In this case, operational and consented wind farm developments are considered part of the landscape and visual baseline and included within the main assessment, as illustrated in **Figure 14.8** and **Figure 14.9.**

Figure 14.8 shows the location of other operational, consented and proposed wind farms within the 20km study area, as required by the 2006 Guidelines and Draft 2019 Guidelines, along with parameters for those schemes to be included. Details of these developments are set out in **Table 14.6**.

Table 14.6: Cumulative wind farm developments within 20km

Development	Status	Distance/ Direction[13]	Number of Turbines	Tip Height
Kilberehert wind farm	Operational	9km, NW	3	125m
Boolard wind farm	Operational	12.8km, N	2	150.5m
Knocknatallig wind farm	Operational	13.8km, NE	6	135m
Esk wind farm	Operational	13.8km, SW	14	136.5m
Rathnacally wind farm	Operational	14.2km, N	2	150.5m
Castlepook wind farm	Operational	15km, NE	14	126m
Carrigcannon wind farm	Operational	17.1km, SW	10	100m

[12] Assessing the Cumulative Impact of Onshore Wind Energy Developments, NatureScot, 2021

[13] From nearest turbine of the proposed development.

Development	Status	Distance/ Direction[13]	Number of Turbines	Tip Height
Boggeragh 1 and 2	Operational	17.4km, SW	43	136.5m
Coom wind park	Consented	19.1km, SE	22	172m
Ballinagree wind farm	In planning	20.6km, SW	20	185m
Annagh wind farm	In planning (appeal)	10.9km, N	6	175m

The assessment is based on the same landscape and visual baseline and receptor groups as the main LVIA, and the methodology is also the same in terms of forming and expressing judgements.

Cumulative effects on landscape receptors arise from combined direct and/or indirect effects on the same receptor – such as two developments within the same character area; or one development within, and one visible from, a designated area.

Cumulative effects on visual receptors arise either from two (or more) developments both being visible from the same place; or from sequential views as people travel.

The approach to cumulative LVIA is described in detail in EIAR **Volume III, Appendix 14.1**. Operational and consented wind farms are included as part of the landscape and visual baseline and are considered within the assessment of effects set out in the following sections of this chapter. Ballinagree wind farm is in planning and over 20km from the Project but forms part of a larger cluster of operational wind farms and is therefore included in this assessment. Annagh wind farm has been refused planning permission by the local authority, however this decision is currently in the appeals process to An Bord Pleanála and is located 10.9km to the north, therefore is also considered in the cumulative assessment. There are no other proposed wind farms that have been identified within the study area that require further cumulative assessment.

Table 2.2 in **Chapter 2 EIA Methodology** of the EIAR identifies other planned and proposed projects excluding wind farms, scoped into the EIAR.

Of these developments the Dublin to Cork Railway Line upgrades is scoped out of the detailed LVIA cumulative assessment. The upgrades are to level crossings involving the creation of bridges and short sections of new road. These would have very localised effects and given the distance to the Project the potential for significant cumulative effects is negligible and **Not Significant**. In addition, Spa Glen Residential Development, Coláiste Pobail Naomh Mhuire, and Cois Sruthain are scoped out. These developments would have relatively localised impacts and there would be no intervisibility with the Project. Given the localised effects of these developments and the widespread screening effect of vegetation the cumulative effects would be no greater than the effects of the Project alone or cumulatively with other wind farm developments. Cumulative effects would be **Not Significant.**

The cumulative effects of the Project in addition to the other developments listed above is described in section 14.8.88.

14.3.4 Distances

Where distances are given in the assessment, these are approximate distances between the nearest proposed turbine and the nearest part of the receptor in question, unless explicitly stated otherwise.

14.3.5 Site visits

To inform the assessment, site visits were made to various locations within the study area, including but not restricted to representative viewpoints, by Stephenson Halliday's assessment team between June 2022 and February 2023.

14.3.6 Visual aids

Photographs of the existing views, along with wirelines and photomontages showing the Project are included within **Volume IV**. The method of visualisation selected has been informed by Landscape Institute (LI) Technical Guidance Note 06/19 'Visual Representation of Development Proposals'[14] and NatureScot's 'Visual Representation of Wind Farms – Guidance'[15]. The methodology of production for the visualisations is described in EIAR **Volume III, Appendix 14.2**.

The proposed substation is not modelled in the visualisations. The substation has been sited at a location where an adjacent block of woodland would screen it in views from the east, southeast and northeast. An existing agricultural building immediately to the south would also provide screening as would intervening landform to the south and southwest. There are no nearby visual receptors to the north and northwest likely to be affected by the substation and it would not be a prominent or notable feature in wider views.

Where no/ negligible visibility is obtained (Viewpoints 10 and 21), the visualisations are limited to accurately scaled wirelines, as photomontages would show no/negligible change. In the case of Viewpoint 10, a Photowire has been included to accurately illustrate the position of the proposed wind turbines which would not be visible given the screening effect of landform and tree cover. This is in accordance with the guidance issued by NatureScot[15] which notes that: "*wirelines are valuable tools which allow the assessor to compare the position and scale of the turbines to the existing view of a landscape. They can also reveal what would be visible if an existing screening element, for example vegetation or building, were removed.*"

14.4 Consultation undertaken

A pre-application meeting was held with the Cork County Council Planning Authority on 17th November 2022. The Applicant, Cork County Council, and specialists from the RSK project team including Stephenson Halliday were present. Landscape and visual matters were discussed at the meeting and the meeting notes from the Council identify the following of relevance to the landscape and visual factor:

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[14] Landscape Institute -Technical Guidance Note: Visual Representation of Development Proposals, Technical Guidance Note 06/19 (September 2019).

[15] Scottish Natural Heritage (SNH): Visual Representation of Wind Farms – Guidance (February 2017).

- *“Landscape: applicant should be cognisant of views from Scenic routes when assessing visual impact. Objective GI 14-13 and GI 14-9 refers.”* – The LVIA considers potential effects on Scenic Routes and provides a viewpoint from the N72 (SE14) scenic route that passes within 7km to the south of the Project.
- *“Residential amenity: it was noted that this is a working landscape with a high level of one-off housing. The proposal should avoid adverse impacts on residential amenity particularly in respect of noise, shadow flicker and visual impact. Note Objective ET 13-7.”* – The turbines are set back 4 x tip height, which in this case is 700m, in accordance with the 2019 Draft Guidelines[4]. The effects of the Project on residential visual amenity of nearby communities are assessed in the LVIA.
- EIAR **Chapter 3 Scoping**, **Consultations, Community Engagement and Key Issues** summarises the EIAR scoping and pre-application consultations which were undertaken by the RSK team and the Applicant. The only EIAR scoping consultation response relevant to the landscape and visual factor is that received from Fáilte Ireland dated 18th October 2022 which included its Guidelines for the Treatment of Tourism in an EIA. These provide guidance for those compiling EIAR, or those assessing EIARs, where the project involves tourism or may have an impact upon tourism. These guidelines are non-statutory and act as supplementary advice to the EPA EIAR Guidelines. The effects of the Project on tourism receptors is assessed in the LVIA.

14.5 Existing landscape and visual context

14.5.1 Introduction

An overview of the baseline study results is provided in this section, with the full baseline description of the individual landscape and visual receptors being provided alongside the assessment in section 14.58 for ease of reference.

This section identifies those landscape and visual receptors which merit detailed consideration in the assessment of effects, and those which are not taken forward for further assessment as effects “*have been judged unlikely to occur or so insignificant that it is not essential to consider them further”* (GLVIA3, para. 3.19[1]).

Both this baseline section and the effects section describe landscape character and visual receptors before considering designated areas as it is common for designations to encompass both character and visual considerations within their special qualities or purposes of designation.

14.5.2 Landscape character

The landscape character of the study area is described in the Draft Cork County Landscape Strategy 2007 (CCLS) as identified in section 14.5. As mentioned in section 14.5, effects on Limerick Landscape Character Areas are scoped out of this LVIA due to the very limited theoretical visibility indicated on **Figure 14.5** and distance to the Project.

The strategy identifies sixteen Landscape Character Types (LCT), which have been subdivided into landscape character areas. For each is provided the following information:

- An evaluation of landscape character, focussing on landscape value, landscape sensitivity and landscape importance.
- A description of the landscape type, including key characteristics and pressures for change. Where relevant, statutory designations and scenic routes are also described in terms of their contribution to landscape character.
- Recommendations (e.g., in directing future development, promoted actions including development design considerations, and protections against harm to landscape character).

LCTs are defined as:

Large *“generic units with similar physical and visual characteristics. The physical characteristics concern physical elements and components that are principally based on landform and landcover.”*

Landscape Character Areas (LCAs) are defined as:

“represent smaller physical units with more detail in their physical description.”

Regarding landscape value and sensitivity, the CCLS provides the following classifications:

Landscape Value is defined as generally representing *“… aesthetic, ecological, historical, socio-cultural, religious and other characteristics.”*

The CCLS further defines these characteristics as:

- Natural value indicators which include; proposed Natural Heritage Areas, candidate Special Areas of Conservation, Special Protection Areas, Areas of Geological Interest, landform and landcover characteristics.
- Scenic Value indicators which include; scenic landscapes and scenic route.
- Cultural Indicators which include; Architectural Conservation Areas, Archaeological sites and Gaeltacht areas.

Landscape Value is ranked as follows:

- <u>Very low value</u>: Deteriorating landscapes without scenic quality and without any natural and cultural heritage elements.
- <u>Low value</u>: Monotonous landscapes without particular scenic quality, local level of natural or cultural heritage.
- <u>Medium value</u>: Landscapes with positive characters and with local or county importance.
- <u>High value</u>: Picturesque landscapes with scenic routes, natural and cultural heritage of county or national importance.
- <u>Very high value</u>: Scenic landscapes with highest natural and cultural quality, areas with conservation interest and of national importance.

Landscape Sensitivity is defined through a combination of landscape resource sensitivity and visual sensitivity of the landscape.

These sensitivities are defined as follows:

"Landscape Character Sensitivity identifies the possibility of a landscapes [sic] ability to accommodate change without adverse impact on its character. Landscape Character Sensitivity assessment of [a] LCT is based on the evaluation of pressure types (forces for changes) and vulnerability of the landscape elements to these changes."

Visual Sensitivity is about identifying the visual effect which some development pressure can have on the landscape. The Visual Sensitivity assessment method used is based on the visual value of the LCT and their importance

Overall Landscape Type Sensitivity is the result of the assessment of Landscape Character Sensitivity and Visual Sensitivity."

Landscape Sensitivity is ranked as follows:

"<u>Low sensitivity</u> landscapes are robust landscapes, which are tolerant to change, and which have the ability to accommodate development pressure.

<u>Medium sensitivity</u> landscapes can accommodate development pressure, but with limitations in the scale and magnitude of the development. In this rank of sensitivity, the landscape can accept some changes while others are more vulnerable to change. If pressure exceeds the landscapes limitation the character of the landscape may change.

<u>High sensitivity</u> landscapes are vulnerable landscapes with the ability to accommodate limited development pressure. In this rank landscape quality is at a high level with landscape elements, which are highly sensitive to certain types of change.

<u>Very high sensitivity</u> landscapes are extra vulnerable landscapes (for example, seascape area with national importance) likely to be fragile and susceptible to change."

The following County Cork LCTs (and LCAs) are located within the study area and LCT are shown on **Figure 14.4**:

- LCT5 Fertile Plain with Moorland Ridge (Mallow-Mitchelstown-Fermoy) (LCAs 62, 69 and 30).
- LCT10b Fissured Fertile Middleground (Rylane East to Waterford) (LCAs 4 and 41).
- LCT11 Broad Marginal Middleground Valleys (LCAs 29 and 75).
- LCT13a Valleyed Marginal Middleground (Macroom and Environs) (LCAs 60, 64 and 66).
- LCT13b Valleyed Marginal Middleground (Glenville and Environs) (LCAs 5 and 6).
- LCT 14b Fissured Marginal and Forested Rolling Upland (Lyre and and) (LCA 3).

The following County Limerick LCTs are located within the study area:

- Agricultural Lowlands

- Ballyhoura/Slieve Reagh
- Southern Uplands

Table 14.7 shows which landscape character types/areas are included in the assessment. Those that are assessed have relatively extensive areas of theoretical visibility of the Project, as shown by the ZTV study on **Figure 14.5.** Those that are scoped out show no or Negligible theoretical visibility. A small area of the LCT coinciding with the study area or the LCT is already or will be strongly influenced by operational and consented wind farm development.

Table 14.7: Landscape character types included in the assessment of landscape effects

LCT	LCA	Included
LCT5	LCA 62	Yes
LCT5	LCA 69	Yes
LCT10b	LCA 41	Yes
LCT11	LCA 29	Yes
LCT11	LCA 75	Yes

The following types/areas have potential visibility of the Project, but are excluded from further detailed assessment on the basis that effects would be Negligible, and **Not Significant**:

- LCT10b (LCA 4)
- LCT13b (LCAs 5 and 6)
- LCT 14b (LCA 3)

14.5.3 Visual receptors

Visual receptors are *"the different groups of people who may experience views of the development"* (GLVIA, 3rd edition, para 6.3[1]). In order to identify those groups who may be significantly affected, the ZTV study, baseline desk study and site visits have been used.

The different types of groups assessed within this report encompass local communities; people using key routes such as roads; cycle ways, people using Rights of Way; or people visiting key viewpoints.

Representative viewpoints have been selected to aid the assessment of visual effects.

14.5.3.1 Baseline visual environment

As illustrated on **Figure 14.1 - Figure 14.11.** the Project is located in agricultural land 8km to the north-west of Mallow. The wind farm site is a mixture of arable and pasture fields with mature hedge field boundaries. There are small areas of woodland in and around the wind farm site. The wider area surrounding the site has a gradually undulating topography with landcover mainly of arable and pasture fields bounded by mature hedges. There is a network of minor roads crossing the landscape with varying outlooks and longer distance views of hills at the edge of the 20km study area.

The nearest operational wind farm is Kilberehert approximately 9km to the north-west. Boolard and Rathnacally operational wind farms are 12.8km and 14.2km to the north and Knocknatallig is 13.8km to the north-east. All other operational wind farms are at distances of 15km or greater and tend to be grouped on outlying hills at the edge of the 20km study area.

Visual receptors considered within the LVIA include:

- Residents in communities and settlements
- Road users
- Users of long-distance recreational routes
- Recreational destinations and heritage sites within 10km

The ZTV (**Figure 14.1** and **Figure 14.2)** indicate theoretical visibility at:

- Lisgriffin, 2km north.
- Limited parts of Ballclough 2.8km south.
- Buttevant, 5km north-east.
- Limited parts of Mallow 10km south-east.
- Drommahane, 11km south.
- Limited parts of Doneraile 11km east.
- Limited parts of Charleville, 18km north.

14.5.3.2 Road users

Roads from where theoretical visibility occurs include (distances are the shortest distance between the section of road within the ZTV and the nearest proposed turbine):

- N20, 4.2km east.
- N72, 7km south.
- R580, 1km north.
- The local road network.

14.5.4 Recreational receptors

Recreational routes within the study area are illustrated on EIAR **Figure 14.7** and include:

- Ballyhoura Way within 7km north.
- Blackwater Way Trail within 11.5km south-east.

Taking into account the visual baseline described above, a number of viewpoints were selected to represent and assess the visual impacts of the Project that would be experienced by various groups of people (visual receptors) within the study area. The viewpoints are selected in accordance with guidance and informed by professional judgement.

14.5.5 Recreational facilities and heritage sites

These include the sites within 10km listed below and as identified on EIAR **Figure 6.10** in EIAR **Chapter 6 Population and Human Health**. The distance and direction to the nearest wind turbine of the proposed development is shown:

- Kilguilkey House Equestrian Centre, 1.8km NE.
- Ballyhass Adventure Sports Centre, 4.5km NE.
- Ballybeg Augustinian Priory, 5.1km W.
- Cork Racecourse, Mallow, 7.7km N.
- Mallow Castle, 9.5km NW.
- Kanturk Castle, 10km E.
- Mount Hillary Loop Walks, 10km NE.
- Mallow Golf Course, 10.5km NW.

The selected viewpoints are representative of the views experienced at different distances and directions from the wind farm site, and from a variety of LCAs in the study area from which the Project would be visible. These viewpoints are all publicly accessible and are listed in **Table 14.8** and shown on all Figures.

Table 14.8: Viewpoints

Viewpoint number	Location	Distance/ Direction[16]	Visual Receptor
1	Lisgriffin	1.9km, NE	Settlement
2a / 2b	Mallow Road, Boherascrub	1.2km, NNE	Community, motorists
3	East of Kilmaclenine Crossroads	2.1km, E	Community
4	L5523 west of Groine	1km, S	Community
5	East of Kilgilky Crossroads	1.8km, SW	Community
6	Kilgilky area	2.6km, SW	Community
7	R580 West Curraglass	1.8km, NW	Community, motorists
8	R580 East Curraglass	1km, NNW	Community, motorists
9	Ballyclogh area	4.5km, S	Community
10	R580 nr Sally's Cross	8.4km, WSW	Motorists
11	Kilbrin	4.4km, W	Community
12	R580, Buttevant	5.4km, NE	Community, motorists
13	Knockcloona area	6.8km, NW	Community

[16] To nearest visible turbine.

Viewpoint number	Location	Distance/ Direction[16]	Visual Receptor
14	Churchtown	7.4km, N	Community
15	Mount Hillary	11.3km, SW	Recreation
16	Glantane/Drommahane area	10.2km, S	Community
17	Lag	6.9km, W	Community
18	Caroline Mountain	12.0km, NE	Recreation
19	Rahan Mountain	14.3km, SE	Recreation
20	Rathcool area	17.9km SW	Recreation
21	N72 S14 Scenic Route, L1206 Junction	7.1km, S	Recreation, motorists

14.5.6 Landscape designations and value

14.5.6.1 High value landscape (HVL)

These areas are based on the CCLS classification of LCTs, where the LCT is judged to be of a *"very high or high landscape value and high or very high landscape sensitivity and are of county or national importance."*

The only HVLs located within the 20km study area are those associated with LCTs 5 and 8 (see **Figure 14.3**). LCT5 occupies a large proportion of the study area to the east of the Project, located approximately 4km from the nearest proposed turbine. Only a small portion of LCT8 falls within the study area and is located approximately 29km from the nearest proposed turbine.

The ZTV indicates that there will be no visibility of the Project from the HVL associated with LCT8. Accordingly, HVL (LCT8) has been scoped out of the assessment.

LCT5 is evaluated in the CCLS as being of County importance. The HVL that coincides with LCT5 is therefore evaluated as being of Regional value in this LVIA.

14.6 Design considerations and embedded mitigation

The description of the Project including the site selection rationale and the iterative design process is described in EIAR **Chapter 5 Project Description**. The Wind Energy Development Guidelines have also informed design of the Project with consideration also of the Draft Wind Energy Development Guidelines. With regard to Hilly and Flat Farmland NLCT, the 2006 guidance advises that:

"Sufficient distance should be maintained from farmsteads, houses and centres of population in order to ensure that wind energy developments do not visually dominate them.

Sufficient distance from buildings, most likely to be critical at lower elevations, must be established in order to avoid dominance by the wind energy development.

The optimum spacing pattern is likely to be regular, responding to the underlying field pattern. The fields comprising the site might provide the structure for spacing of turbines."

The design of the Project has been an iterative process with the aim of arriving at an optimal design configuration in respect of landscape and visual effects and a range of other environmental and technical factors specific to the wind farm site.

The final layout incorporates the following landscape and visual design considerations which relate to the Wind Energy Development Guidelines and the specific issues at the wind farm site:

- In complying with the Draft Wind Energy Development Guidelines, all turbines are located over 4 x tip height (700m) from residential dwellings in order to protect residential amenity.
- The turbines have been designed to create a legible linear array with consistent spacing and minimal overlapping turbines.
- The route of existing tracks is utilised where practicable to minimise the creation of new tracks.
- Positioning of substation at a location where there are existing farm sheds and associated woodland.
- Positioning of the meteorological mast in the central part of the wind farm site associated with the turbine envelope and set back from residential properties.

14.7 Visibility analysis

14.7.1 ZTV analysis

Zone of Theoretical Visibility (ZTV) studies were generated based on the proposed turbine layout. These are shown on **Figure 14.1** and **Figure 14.2** and indicate areas of potential visibility. The analysis was carried out using a topographic model only.

There are some commercial forestry areas within the study area and some areas may be felled during the operational phase of the Project. Over time, this will result in localised variation in potential visibility, although it is unlikely that long-term land use of forested areas would change. Where areas of forestry are felled, they are likely to be restocked and new trees would grow. As such, while there would be temporary localised variations, the overall pattern of potential visibility is unlikely to fundamentally change.

The ZTV study was used to aid the identification of those receptors that are likely to be most affected by the Project and those that do not require detailed consideration. It should be noted that some areas shown as having potential visibility may have visibility of the development screened by forestry growth or new buildings, and some new views may have been opened up by felling or demolitions.

The ZTV does not include for the potential screening effects of forestry, woodland or hedges. Given the agricultural character of the landscape in which the Project would be located, the prevalence of hedges and trees in the wider landscape, combined with the undulating topography actual visibility of the Project at ground level will be far less than that indicated by the bare earth ZTV.

The ZTVs indicate that theoretical visibility would be relatively widespread within 5km of the turbines although actual visibility in this area would be variable due to screening by hedges and woodland. Within 5-10km theoretical visibility becomes more fragmented particularly to the south along the route of the N72 and in the Mallow area. Theoretical visibility is also reduced to the north in the Liscarroll area and in the west and northwest between Kanturk and Liscarroll.

Beyond 10km the ZTVs indicate that theoretical visibility would occur mainly to the west and east although the pattern is shown as fragmented due to screening by landform and actual visibility would be considerably less due to screening by hedges and woodland. Beyond 10km to the north there is limited theoretical visibility and to the south it is also limited with almost none beyond 20km.

The ZTV indicates that areas of theoretical visibility would be very limited or distant from most of the settlements in the 20km detailed study area. Where theoretical visibility is shown, such as at Doneraile 11km to the east, and Charleville 18km the north, actual visibility would be restricted by intervening vegetation, buildings and distance to the Project.

14.7.2 Viewpoint assessment summary

Viewpoint analysis has been undertaken from a total of 21 viewpoints. The viewpoint locations are illustrated on **Figure 14.1 - Figure 14.11.** The visualisations (including photographs of the existing view, wirelines and photomontages) are provided in EIAR **Volume IV**.

The full viewpoint analysis is contained within EIAR **Volume III, Appendix 14.3**. The findings are summarised below in **Table 14.9.** In each case, distances are listed in relation to the nearest turbine.

Please note that EIAR **Volume III, Appendix 14.3** considers the nature and the scale of changes to character and views at each viewpoint location only. The sensitivity of receptors and wider extent of the effect (beyond the individual viewpoint location) and its duration are considered in the main body of the assessment text below as part of the consideration of the magnitude and significance of effects.

Table 14.9: Viewpoint analysis summary

VP	Location	Distance/ Direction[17]	Scale of Landscape Effect	Scale of Visual Effect
1	Lisgriffin	1.9km, NE	Medium/small	Medium
2a / 2b	Mallow Road, Boherascrub	1.2km, NNE	Medium	Medium
3	East of Kilmaclenine Crossroads	2.1km, E	Small	Small
4	L5523 west of Groine	1km, S	Medium/small	Medium
5	East of Kilgilky Crossroads	1.8km, SW	Medium/small	Medium
6	Kilgilky area	2.6km, SW	Medium	Medium
7	R580 West Curraglass	1.8km, NW	Small	Medium/small

[17] To nearest visible turbine.

VP	Location	Distance/ Direction[17]	Scale of Landscape Effect	Scale of Visual Effect
8	R580 East Curraglass	1km, NNW	Medium	Medium
9	Ballyclogh area	4.5km, S	Small	Small
10	R580 nr Sally's Cross	8.4km, WSW	Negligible	Negligible
11	Kilbrin	4.4km, W	Small	Small
12	R580, Buttevant	5.4km, NE	Negligible	Small
13	Knockcloona area	6.8km, NW	Small/Negligible	Small
14	Churchtown	7.4km, N	Negligible	Negligible
15	Mount Hillary	11.3km, SW	Small/Negligible	Small
16	Glantaine/Drommahane area	10.2km, S	Small/Negligible	Small
17	Lag	6.9km, W	Small	Small
18	Caroline Mountain	12.0km, NE	Small/Negligible	Small
19	Rahan Mountain	14.3km, SE	Negligible	Negligible
20	Rathcool area	17.9km SW	Negligible	Negligible
21	N72 S14 Scenic Route, L1206 Junction	7.1km, S	Negligible	Negligible

Each of the viewpoints is a 'sample' of the potential effects, representing a wide range of receptors – including not only those actually at the viewpoint, but also those nearby, at a similar distance and/or direction. From these viewpoints, it can be seen that the distribution of effects would be as follows:

Effects on character:

- would be very limited and no greater than Medium scale, given the large scale landscape and intermittent visibility throughout the study area.
- Small scale effects would extend up to around 7km from the proposed turbines.
- would be Small/negligible beyond 9 – 10km from the proposed turbines.

Visual effects:

- would be no greater than Medium scale, extending up to approximately 2km in all directions.
- between 2km and approximately 5km would be Medium/small and considerably less than that in others.
- Small scale effects would extend up to approximately 12km from the turbines, rapidly diminishing to Negligible scale beyond this.

14.8 Assessment of landscape and visual effects

14.8.1 Introduction

This section sets out the effects that the Project would have on landscape and visual receptors both during construction, operation and decommissioning phases.

The operational life of the wind farm is proposed to be 35 years, after which it would be decommissioned. The duration of effect would therefore be long term as defined by EPA Guidelines and as set out in EIAR **Volume III, Appendix 14.1**.

14.8.2 Do-nothing scenario

In the do-nothing scenario, the Project would not be consented. There would be no construction activities associated with installation of access tracks, the substation, wind turbines and all other ancillary development. None of the Project would be constructed and no new features would be introduced into the landscape and no new features would be visible. Therefore, there would be no change or alteration to landscape fabric and landscape character and there would be no change to views and visual amenity.

14.8.3 Construction and decommissioning phase effects

Construction and decommissioning phase effects would be substantively the same. Activities occurring during these phases and their anticipated durations are described in detail in EIAR **Chapter 5 Project Description.** The activities and temporary features with the potential to cause an effect on landscape and visual amenity include:

- Construction of the temporary and permanent access into the site from the L5302.
- Construction and upgrading of site access tracks and hard standings.
- Installation and use of a temporary site compounds and spoil storage areas.
- HGV deliveries and abnormal load deliveries to site and movement of vehicles on site.
- Installation of electrical infrastructure.
- Construction of control building/sub-station.
- Construction of wind turbine foundations and crane pads.
- Erection using cranes and commissioning.
- Introduction of mitigation and enhancement measures.
- Decommissioning.

The location and management of these features have been carefully considered to limit the transitory effects of the construction phase.

The grid connection will be buried, mainly beneath the existing road network, and it is considered that the scale of change would be Small at most and occurring in a limited area. These effects will occur during construction only and are therefore not considered further in this LVIA.

14.8.4 Effects on site fabric

14.8.4.1 Effects of construction

Effects on landscape fabric within the site would occur mainly during construction. During the 18 months of construction, landscape features would be altered or removed to allow for the activities listed above to take place.

There will be loss of hedge on the north side of the L5302 at the proposed wind farm site entrance to allow creation of a bell mouth and visibility splays. While the internal site track layout largely follows existing tracks, these will need to be upgraded and widened. Where the tracks cross field boundaries there will be loss of short sections of hedge. There will also be loss of some hedge to construct crane pads at T3, T5, T6, T7, T8 and T9. The substation will utilise existing woodland to provide screening with loss of a short stretch of hedge.

There will be loss of parts of open fields at the substation and at the turbine locations. The terrain will be altered at the fields in which the substation and turbines will be located in order to accommodate a level foundation and hardstanding for the substation and crane pads for the turbines.

The changes to site fabric would be permanent although some hedges could be replanted after construction is completed providing these would not impede operation and maintenance of the Project. The effects on landscape fabric would, however, not be widespread occurring only within the wind farm site boundary.

Scale and extent of landscape change - Medium across a Limited area

Magnitude of change – Moderate

Significance of effect – **Moderate and Adverse (Not Significant**)

14.8.4.2 Effects of operation

After construction is completed there would be no further loss or alteration of landscape fabric within the site boundary and any landscape effects would be on landscape character which are discussed below.

14.8.5 Effects on landscape character

14.8.5.1 Effects of construction

As discussed above, construction effects on landscape fabric would occur mainly within the wind farm site boundary and would be of short duration. Effects on landscape character would also be largely confined to areas within the site boundary. Construction activities would be visible from areas in the surrounding landscape and there would be an influence on landscape character for the short duration of the construction period. The effects would occur mainly on LCT5 Fertile Plain with Moorland Ridge with very limited effects on LCT11 Broad Marginal Middle ground Valleys and LCT in the wider study area. The effects would relate mainly to visibility of construction activities and for the wider area this would be mainly the standing turbines, large cranes used to erect the turbines, during the final phases of construction – by which point the effects would be the same as for those during operation, as set out in the following sections.

Scale and extent of landscape change - Small across a Limited area

Magnitude of change – Slight

Significance of effect – **Moderate/minor and Adverse (Not Significant)**

The remainder of this section focusses on the operational effects of the Project on landscape character.

14.8.5.2 Effects of operation

LCT5 Fertile Plain with Moorland Ridge

As shown on **Figure 14.4** and **Figure 14.5** the LCT covers a large proportion of the study area extending from east of Kanturk to beyond the study area in the east and from the boundary with Limerick in the north to the northern edge of the Boggeragh Mountains in the south. The Cork Landscape Strategy identifies three landscape character areas (LCA) within LCT5, two of which coincide with the LVIA study area. These are considered in this assessment where there is a notable difference in potential effects of the Project.

The key characteristics of LCT5 are described in the Cork Landscape Strategy as:

"Land use, field, boundaries, trees and wildlife

- *Broad plain defined by the River Blackwater with moorland ridges to the north and south*
- *Highly intensive dairying and tillage region.*
- *Mature broadleaf hedgerows on plain with patches of coniferous forestry on higher ground*
- *Good range and diversity of habitats many of which are contained along the Rivers Blackwater and Awbeg.*
- *The main natural features of the Rivers Blackwater and Awbeg have largely remained intact and their preservation in the future is vital for the developing tourism sector in the region.*

Built Environment

- *Several large urban settlements and numerous villages in the area.*
- *High quality vernacular built environment, and this is portrayed by the high concentration of Protected Structures that are evident throughout the landscape.*
- *Strong vernacular quality in terms of range and quality of estate homes and farmsteads.*
- *Numerous attractive villages and towns in terms of setting and built environment e.g. Castletownroche and Mitchelstown.*
- *The town centres in many of the main towns have maintained their architectural heritage.*
- *Farmsteads are spread throughout the landscape, and these consist of large houses and traditional barns. They have a logical relationship with the landscape and their buildings were sited to maximise opportunities for shelter and*

cultivation. The key visual relationship is between the siting of structures and the width, length and orientation of plots.

Socio Economic

- *Relatively strong economic base due to the strong urban character of the area and diversity of economic activities.*
- *Several large urban centres in the area, all of which developed on the basis of the high agricultural productivity of the surrounding countryside.*
- *Highly intensive farming has shaped the landscape.*
- *Fishing and attractive walks are associated with this landscape type."*

The two LCAs are LCA62 and LCA69:

- LCA62 covers the majority of LCT5 within the study area and is described in the Cork Landscape Strategy as follows:
    - *"The human influence on this landscape is more keenly felt than in the other two landscape character areas and it provides a mastering of nature through the ordered and formal layout of field patterns."*
- LCA69 coincides with the northern part of the LVIA study area and is described in the Landscape Strategy as follows:
    - *"While lands remain predominately fertile, there is more evidence of scrub on the plain than the Golden Vale [LCA62]. The main settlement is Charleville and the scattered villages in the vicinity, gravitate towards it."*

LCT5 is evaluated as being of Very High sensitivity and County importance in the Landscape Strategy. Using the criteria in this LVIA methodology and as set out in EIAR **Volume III, Appendix 14.4**, sensitivity to the Project is evaluated as High/medium.

The Project would introduce movement into the landscape and would alter its relatively undeveloped character. As indicated in **Table 14.9** within 2km of the Project the scale of change would be up to Medium, and these effects would occur across a Limited area. Beyond 2km and up to approximately 7km the scale of change would be Small as the distance to the turbines increases and the screening effect of hedges and woodland becomes more prevalent. The substation would be well screened by woodland adjacent to it or would be seen against the backdrop of this woodland. The lattice meteorological mast would be a less noticeable feature than the turbines due to its visually permeable structure, lower height and absence of movement. These effects would occur in a Localised area. Beyond 7km the scale of change would reduce to Small/negligible or Negligible and the Project would be seen as a noticeable addition to the working farmland landscape fitting its immediate context. It would be seen as a linear array of regularly spaced turbines presenting a well-defined and legible development readily accommodated in the large-scale landscape of the farmland plain. The substation and meteorological mast would barely be discernible and would have a very limited influence on landscape character. These effects would occur across an Intermediate area.

Considering these effects together, the magnitude of change on LCT5 in a small area would be Moderate/slight and the effects would be of **Moderate** significance and **Adverse (Not Significant).** These effects would occur within 2km of the Project with effects on landscape character diminishing markedly with increasing distance from the wind turbines.

LCT10b Fissured Fertile Middleground

As shown on **Figure 14.4** and **Figure 14.5** the LCT coincides with the southern part of the study area extending from the Boggeragh Mountains in the west to the Nagle Mountains in the east and beyond the study area to the south. The Cork Landscape Strategy identifies two LCAs within LCT10b, one of which (LCA41) coincides with the LVIA study area.

The key characteristics of LCT10b are described in the Cork Landscape Strategy as:

"Land use, field, boundaries, trees and wildlife

- *This landscape type has characteristics of both the flatter fertile farmland areas and the higher marginal hilly farmland.*
- *Many of the rivers in the western parts extend beyond this landscape type and feed into the River Lee and Bandon River while those to the east head southwards to the sea.*
- *This is an elevated landscape, which is fissured by fairly gentle slopes, with reasonably fertile agricultural land comprising a mosaic of small to medium sized fields with broadleaf hedgerows.*
- *Three sites have been identified to be worthy of designation for protection within this landscape type. All three are woodlands that have retained a strong native character and a good diversity of species both in the canopy and in the ground layer.*

Built Environment

- *Houses, farmsteads and sheds are dispersed across this landscape, while villages and hamlets nestle against hillsides, spreading up from valley bottoms, taking advantage of the shelter provided by the fissured topography.*

Socio Economic

- *Used predominantly for dairy as well as some arable production.*
- *Settlements include Donoughmore, Carrignavar and Ballincurrig.*

Ecology

- *Leamlara Wood lies in a steep sided valley. The dominant tree species is Oak with Hazel and Willow frequent. The relatively rare Hay-scented Buckler Fern has been recorded here.*
- *Oak and Birch are dominant at Ardamadane, while the Shournagh Valley has a wetter type of woodland with Hazel and Oak and old mixed estate woodland where Beech is co-dominant with Oak."*

LCT10b is evaluated as being of High sensitivity and County importance in the Landscape Strategy. In terms of this LVIA it is evaluated as being of Medium sensitivity to the Project due to the varying contained and open views from the LCT, the undulating topography and the presence of operational wind farms to the west which influence landscape character to a degree. The Project would be located outside of the LCT with the potential to affect only aesthetic and perceptual aspect of landscape character.

The ZTV shown on **Figure 14.5** indicates patchy theoretical visibility of the Project from the LCT. Actual visibility would be considerably less due to the screening effects of hedges in the farmland plain and forestry in the upland areas of this LCT. The substation and meteorological mast would barely be discernible and would have a very limited influence on landscape character. Boggeragh wind farm influences the western part of the LCT coinciding with the study area and two turbines of consented Esk wind farm would be located in that part of the LCT within the study area.

Given the distance to the Project and the intermittent nature of visibility, the scale of change to landscape character would be Small/negligible and these effects would occur across a Localised area. The magnitude of change would be Slight, and the effects would be of **Moderate/minor** significance and **Adverse (Not Significant).** The magnitude of change would decrease to Negligible towards the edge of the study area between 15-20km from the Project and the effects would be of **Negligible** significance and **Adverse (Not Significant).**

LCT11 Broad Marginal Middleground Valleys

As shown on **Figure 14.4** and **Figure 14.5** the LCT coincides with the western part of the study area extending from the Kanturk in the east and beyond the study area to the west. It extends from the Boggeragh Mountains in the south of the study area to the boundary with County Limerick in the north. The Cork Landscape Strategy identifies two LCAs within LCT11, both of which coincide with the LVIA study area. These are considered in this assessment where there is a notable difference in potential effects of the Project.

The key characteristics of LCT11 are described in the Cork Landscape Strategy as:

"Land use, field, boundaries, trees and wildlife

- *The main agricultural land use is dairy farming.*
- *Small to medium size fields bounded by mixed broadleaf hedgerows.*
- *The hedgerows and vegetation that forms the road boundaries is of medium height and in some areas it restricts views of the surrounding landscape.*
- *Relative evenness of terrain across the broad shallow valley of the River Blackwater, fed by several tributaries draining the higher ground to the north and south.*
- *At higher altitudes, the ground rises relatively steeply to meet a more mountainous landscape, while lower down the ground spreads out into gently sloping fertile land.*
- *There are very few designated sites, i.e. SACs, NHAs, SPAs within this landscape area.*

Built Environment

- *Buildings comprising farmsteads, barrel roofed metal sheds, slatted sheds and individual houses are dispersed throughout the landscape. The older farmhouses* *are generally located a significant distance from the main road and are well screened.*

- *Building materials include plaster and blue black tiles.*
- *A lot of the newer dwellings display non-traditional features like Dutch gables and their front boundaries have not retained any part of the hedgerow. These new houses usually are located in a linear fashion, and some are sited so as to maximise views of the surrounding landscape.*
- *The built heritage of the area is important within County Cork, with notable concentrations at Kanturk and Drishane. The old Convent in Newmarket and its surrounding grounds is an attractive landmark in the town.*

Socio Economic

- *Land is generally of marginal agricultural quality however dairy farming is the main land use.*
- *The main towns include Newmarket and Kanturk.*

Ecology

- *Some Natural Heritage Areas include the Priory wood in Lismire and the Banteer Ponds."*

LCA29 is to the north of Kanturk and is described as fissured and hilly mosaic farmland.

LCA75 is to the south of Kanturk and is described as moorland ridge and undulating mosaic farmland.

LCT11 is evaluated as being of High sensitivity and Local importance in the Landscape Strategy. In terms of this LVIA it is evaluated as being of Medium sensitivity to the Project due to the evenness of terrain and restricted views to the surrounding landscape due to hedges and limited natural heritage sites. The Project would be located outside of the LCT with the potential to affect only aesthetic and perceptual aspect of landscape character.

The ZTV shown on **Figure 14.5** indicates patchy theoretical visibility of the Project from the northern part of the LCT in LCA29. Actual visibility would be considerably less due to the screening effects of hedges. In the southern half of LCT11 coinciding with LCA75, theoretical visibility is slightly more uniform although patchy in the west.

Within approximately 7-10km of the Project the scale of change would be Small as visibility of turbines would be intermittent due to the screening effect of hedges. The substation and meteorological mast would barely be discernible and would have a very limited influence on landscape character. The Project would therefore have a limited influence on landscape character. These effects would occur in a Limited area.

Beyond 10km the scale of change would reduce to Small/negligible or Negligible and the Project would be seen intermittently as a noticeable addition to the working farmland landscape fitting its immediate context. It would be seen as a linear array of regularly spaced turbines presenting a well-defined and legible development readily accommodated in the large-scale landscape. These effects would occur across an Intermediate area.

Considering these effects together, the magnitude of change would be Slight, and the effects would be of **Moderate/minor** significance and **Adverse (Not Significant).**

14.8.6 Visual effects

This section describes the potential effects on visual receptors including communities and settlement, key routes and recreational routes in the 20km study area. The assessment is based on fieldwork undertaken during August 2022 and February 2023 and uses visualisation for the **21 viewpoints** shown in EIAR **Volume IV**. As mentioned in section 14.5.4 viewpoints are selected in accordance with guidance and informed by professional judgement. As mentioned in EIAR **Volume III Appendix 14.1**, the representative viewpoints shown in **Volume IV** and listed in the summary **Table 14.9** are used as 'samples' on which to base judgements of the scale of effects on visual receptors. The wider extent of the effect and its duration are not captured in the viewpoint analysis and instead are described in this assessment of visual receptors.

14.8.6.1 Visual receptors

As mentioned in section 14.6 of this chapter the wind turbines have been set back 4 x tip height or 700m from the nearest residential properties. This section therefore describes potential effects on communities and settlements beyond the 700m set back distance. Communities and settlements are evaluated as being of Medium susceptibility to visual change with views being of Community value. Sensitivity of communities and settlements is therefore judged to be Medium.

Settlements and communities within 2km

Within 2km of the Project there are a number of dispersed and low-density communities situated along the minor roads to the east and south and the R580 to the north and including the village of Lisgriffin. The outlook from communities in this area varies considerably due to the screening effects of hedges, woodland and landform. When considered in the round the outlook from communities allows views in a number of different directions.

Communities to the south along the L5302 are situated on a broad ridge or on south facing slopes and have main views to the south which are elevated and provide open vistas. Views to the north towards the site tend to be partially restricted by landform and vegetation to varying degrees.

Communities to the east are mainly situated along Mallow Road (L1200) which rises and falls as it passes over broad ridges. North of Boherascrub Crossroads there are open views to the north, west and east. South of Boherascrub Crossroads there is a greater degree of screening by vegetation with views mainly to the west and east. South of Kilmaclenine Crossroad views are mainly to the south. East of Boherascrub Crossroads views are mainly to the north and south.

Communities to the north are focussed on Lisgriffin and Curraglass and surrounding area. Views from Lisgriffin would occur mainly on the southern fringes and from locations along the R580. The Curraglass area is well wooded and there is a higher proportion of hedged field boundaries in this area which curtails views to the south to a degree. There are views to the north and west from this area.

Views of the Project would be varied with parts of some communities having no view, some having intermittent views and with some areas having more open views where turbines would be highly visible although not overly dominant. The slender, lattice meteorological mast would be visible although less noticeable and have less influence than the wind turbines. The substation is unlikely to be readily discernible for most communities due to layers of intervening vegetation and the siting of the substation adjacent to a block of woodland. Given that the general outlook from communities affords views in different directions to the Project, while noticeable would not be the sole focal point in views and would not be overly dominant. Where visible it would be seen as a well ordered and regularly spaced linear array of turbines. Considered in the round visual amenity in the direction of the Project would be affected and where visible the turbines would be noticeable new features in the working farmland landscape. There would be no effects on the wider visual amenity of communities within 2km.

Scale and extent of visual change - Medium across a Limited area

Magnitude of change – Moderate/slight where there are intermittent or glimpsed views. Moderate where there are uninterrupted short-range views for communities within 1km or where there are uninterrupted or elevated views within 1-2km such as the area between Kilmaclenine Crossroads and Boherascrub and the Kilgilky area.

Significance of effect – **Moderate/minor (Not Significant)** where there are intermittent or glimpsed views and **Moderate (Not Significant)** where there uninterrupted views.

Settlements and communities within 2-5km

The pattern of settlement is similar to that within 2km with dispersed, low density communities of scattered dwellings and farmsteads with occasional small villages and groups of dwellings. The villages include Ballyclogh (Viewpoint 9) to the south, Kilbrin (Viewpoint 11) to the northwest and New Twopothouse to the southeast. While the ZTV indicates theoretical visibility from New Twopothouse, actual visibility will be negligible due to the combined screening effects of buildings, vegetation and landform.

Existing views from communities in this area vary considerably from elevated views such as those experienced at Kilbrin to views with an enclosed or inward character such as those experienced at New Twopothouse and Ballyclogh.

The undulating topography and prevalence of mature hedges and woodland means that views of the Project would largely be intermittent and on occasion would be clearly visible although not overly dominant. The Project would be seen as a well-ordered linear array of regularly spaced wind turbines. The meteorological mast would be seen as part of the array and a minor influence on overall effects. The substation would not be readily discernible to most communities due to screening by woodland or being seen against a backdrop of woodland and landform. Considered in the round visual amenity in the direction of the Project would be affected and the turbines would be noticeable new features although the wider visual amenity of communities within 2-5km would not be affected.

Scale and extent of visual change – Medium/small across a Localised area.

Magnitude of change – Moderate/slight where views are intermittent or glimpsed views. Moderate where there are clearer relatively uninterrupted views from more elevated locations in the farmland plain such as the elevated area between Lisgriffin in the east and Ballygrady in the west.

Significance of effect – **Moderate/minor (Not Significant)** where there are intermittent or glimpsed views and **Moderate (Not Significant)** where there are uninterrupted views from elevated areas.

Settlements and communities within 5-10km

The pattern of settlement is similar to that within 5km across the majority of this area with dispersed, low-density communities of scattered dwellings and farmsteads with occasional small villages and groups of dwellings. There are larger settlements such as Buttevant to the east, Mallow to the southeast and Kanturk to the west. Smaller villages include Liscarroll to the northwest and Churchtown (Viewpoint 14) to the north.

Existing views are influenced mainly by the mosaic of farmland and woodland found across the majority of the area and vary considerably. There are areas of forestry in the northwest of the area and transport corridors in the Blackwater Valley (N72) to the south, the N20 to the east and R579 to the west which influence visual amenity and views in those localities.

The ZTV shown on **Figure 14.1** indicates that theoretical visibility within 5-10km of the Project becomes patchier due to landform screening. There is limited theoretical visibility from Mallow and the screening effect of buildings means actual visibility will be considerably less than shown on **Figure 14.1**. The ZTV also indicates no visibility from Kanturk and Liscarroll. While theoretical visibility is indicated at Buttevant, actual visibility would be considerably less due to screening by buildings and vegetation with limited views from the edge of the settlement (Viewpoint 12).

The Project would be visible across the farmland plain with views interrupted by hedges and woodland. Visibility would largely be intermittent and where visible it would be seen in the context of the large scale, expansive, working farmland landscape. The meteorological mast and substation would potentially be discernible although they would have a limited influence on views from communities. While the Project would be noticeable and would introduce movement into an otherwise static landscape, it would not result in widespread or intensive effects. The linear design of the array and the regular spacing of turbines reduces the degree of overlapping turbines presenting a loose and visually permeable appearance in most views.

Scale and extent of visual change – Small across an Intermediate area

Magnitude of change – Slight

Significance of effect – **Minor (Not Significant)**

Settlements and communities within 10-20km

Within 10-20km of the Project the settlement pattern is similar to that within 10km with dispersed and low density communities. The notable difference is the presence of large areas of forested upland that are largely devoid of habitation. These areas are in the northeast, southeast and south of this area. Notable settlements include Newmarket in the west, Charleville to the north and Doneraile to the east.

Existing views are characterised by the mosaic of farmland with woodland and forested hills influencing the extent of views across the area and in places provide vantage points looking towards the wind farm site.

The ZTV shown on **Figure 14.1** indicates that theoretical visibility becomes patchy due to screening landform and coincides mainly with the more elevated land at the edges of the upland areas and on the ridges and summits of hills. Actual visibility of the Project from low lying areas will be considerably less due to screening afforded by hedges and woodland throughout this area. From more elevated areas the turbines would appear as distant elements in an expansive and large-scale landscape as evidenced by **viewpoints 15, 18, 19 and 20.** The meteorological mast and substation would not be readily discernible.

The Project would be intermittently visible in views from communities and settlements within 10-20km. Where visible it would be read as a visually permeable linear array of regularly spaced turbines.

Scale and extent of visual change – Small/negligible across a Wide area

Magnitude of change – Slight/negligible

Significance of effect – **Minor/negligible (Not Significant)**

14.8.6.2 Key routes

The key routes passing through the study area are the N72 and N20. Regional and local roads have been considered in the assessment of effects on settlements and communities described above. Motorists using the N72 and N20 are considered to be of Low susceptibility to change due to these routes being fast moving trunk roads for most of their length outside of settlements and communities. Where a key route coincides with a designated Scenic Route susceptibility is evaluated as Medium. The value of views is evaluated to be Community where the routes are not identified as Scenic Routes and Regional where a Scenic Route is identified. Sensitivity is therefore Low outside of Scenic Routes and High/medium at Scenic Routes.

Other scenic routes in the study area are located at distances of greater than 12km from the nearest turbine as shown on **Figure 14.7.** The Project would have no or very limited influence on visual amenity from these routes due to the distance to the turbines and the screening effects of vegetation alongside these routes in addition to the routes not being orientated in the direction of the Project.

N72 (S14 scenic route)

The N72 runs between Killarney and Mallow passing within 7km of the site to the south. It also runs east from Mallow to Fermoy beyond the study area. The route largely follows the River Blackwater valley and consequently views out from the route are relatively truncated by the valley sides with intermittent long distance views. Land to the north of the route rises gradually towards the Project, rising more steeply to the south. Part of the N72 is identified by Cork County Council as a Scenic Route (S14) which is shown on **Figure 14.7.**

The ZTV shown on **Figure 14.1 and Figure 14.7** indicates very limited theoretical visibility of the Project from the N72 within 10km. The hub height ZTV shown on **Figure**

14.2 shows less visibility than the tip height ZTV within 10km indicating that theoretically views of tips are more likely. Beyond 10km to the east there is very limited theoretical visibility. Beyond 10km to the west there is a short stretch of theoretical visibility to the east of the village of Dromagh approximately 15km from the Project and outside of the S14 Scenic Route.

Actual visibility of the Project would be limited due to the screening effects of woodland on the north side of the road and by intervening vegetation in the wider landscape. The meteorological mast and substation would not be readily discernible. Viewpoint 21 is a typical view in the direction of the Project where there are two short instances of theoretical visibility to the west of Mallow on the N72 (S14) Scenic Route.

At distance of 10-20km views of the Project are unlikely due to screening by roadside woodland and by intervening vegetation. The meteorological mast and substation would not be discernible.

Scale and extent of visual change – Negligible across a Wide area

Magnitude of change – Negligible

Significance of effect – **Negligible (Not Significant)**

N20

The N20 runs between Mallow and Charleville and beyond to Limerick outside the study area. It passes within 4.5km of the site to the east. From Mallow the route crosses undulating farmland passing through scattered communities and small villages with ribbon development.

The ZTV shown on **Figure 14.1** indicates theoretical visibility at a point to the south of New Twopothouse, south of Buttevant. Actual visibility would be considerably less due to screening by intervening vegetation. There would be clearer visibility of turbines on a more elevated stretch of the road to the south and north of Boherash Cross where there is less roadside vegetation and open views across level fields. There would be oblique views of the Project which would be seen as a compact layout occupying a small proportion of the expansive views across the working farmland landscape. The meteorological mast and substation would not be readily discernible.

At New Twopothouse and Buttevant and on the approach to these two settlements views of the Project would be screened by vegetation and buildings. To the north of Buttevant there would be intermittent views with visibility limited due to screening by roadside woodland and trees.

The Project would be seen when travelling at speed on the N20, in oblique views to the direction of travel. The array would be seen as a compact group of turbines with limited influence on the visual amenity of motorists using the N20.

Scale and extent of visual change – Small/negligible across a Wide area

Magnitude of change – Slight/negligible

Significance of effect – **Minor (Not Significant)**

14.8.6.3 Recreational receptors

This section considers potential effects on the two main recreational routes in the study area. Effects on public rights of way in the study area are considered in the assessment of effects on settlements and communities with users of those routes having the same sensitivity to the Project as communities and settlements.

Views from the long distance recreational routes are considered to be of Regional value with High susceptibility to change. These routes are therefore of High/medium sensitivity.

Ballyhoura Way

The Ballyhoura Way stretches 90km from John’s Bridge approximately 9km northwest of the site to Limerick Junction in Co. Tipperary beyond the study area. Users of the route are of High sensitivity to change. The ZTV shown on **Figure 14.7** indicates there would be theoretical visibility of the Project from short stretches of the route to the west of Liscarroll, east of Churchtown and in the Ballyhoura Mountains. **Viewpoints 13, 14 and 18** are representative of views that may be experienced in the area through which the route passes and provide an indication of the scale of change and magnitude of change that would be experienced from the route.

The Project would be visible in oblique intermittent views from the route where it passes through farmland. **Viewpoints 13 and 14** indicate that the turbines would be seen as a compact array or blade tips would be visible due to screening by landform. On more elevated and exposed stretches of the route at Ballyhoura Mountain the Project would be seen as a minor element in a large-scale landscape as indicated by Viewpoint 18. The meteorological mast and substation would not be readily discernible.

Scale and extent of visual change – Small across an Intermediate area due to screening by vegetation and forestry

Magnitude of change – Slight

Significance of effect – **Moderate (Not Significant)**

Blackwater Way Trail

The Blackwater Way is a 168km linear long distance walking route that stretches from the borders of west County Waterford across north County Cork and into County Kerry, following the valley of the River Blackwater. It passes through the southern part of the study area at distances of 11.5km, and greater, from the Project. The route passes through forested uplands and lowland farmland where there is substantial screening by woodland and hedges.

The ZTV shown on **Figure 14.7** indicates limited theoretical visibility mainly at distances of greater than 15km from the Project. There would be relatively open views from Clara Mountain and Mushera Mountain 25km from the turbines and outside of the study area. There is a short stretch of theoretical visibility in the Boggeragh Mountains 15-20km from the turbines and in an area already influenced by operational wind farms of Boggeragh 1 and 2 and that would be influenced further by the operational Esk wind farm. To the east of the Boggeragh Mountains in lowland farmland the ZTV indicates theoretical visibility at a distance of approximately 15km near Ballynamona. However, actual visibility would be considerably reduced due to the effects of distance and screening by intervening vegetation. Theoretical visibility is indicated along a short stretch of the route to the southeast of Mallow where it passes over a forested hill near Rahan Mountain (Viewpoint 19) at 13-15km. Here distance to the wind turbines would reduce effects and they would be seen as minor features in a large-scale landscape. Theoretical visibility is indicated to the east of Kilavullen in the farmed valley of the River Blackwater. Actual visibility from this area would be very limited or none, due to the effects of distance and screening by intervening vegetation. The meteorological mast and substation would not be readily discernible.

Scale and extent of visual change – Small/negligible across an Intermediate area due to screening by vegetation and forestry

Magnitude of change – Slight/negligible

Significance of effect – **Moderate/minor (Not Significant)**

14.8.6.4 Recreational facilities and heritage sites

This section concerns those recreational facilities and heritage sites within 10km of the Project as identified in section 14.5.4 of this LVIA and in EIAR **Chapter 6 Population and Human Health, Figure 6.10**. In accordance with the methodology described in EIAR **Volume III, Appendix 14.1** value, susceptibility and sensitivity of these receptors is evaluated and described separately.

Kilguilkey House Equestrian Centre

Kilguilkey House Equestrian Centre is focussed on equestrian sport including Hunter Trials, Eventing, Show Jumping, Dressage and Cross Country. The facilities are situated to the south of the road behind a tall hedge and include a number of agricultural sheds beyond which is a riding arena. The value of views is evaluated as Community and susceptibility as Medium as visitors will be focussed on equestrian activities rather than views of the surrounding landscape. Sensitivity is therefore Medium at this location.

Figure 14.1 and **Figure 14.2** indicate there would be theoretical visibility of blades and hubs from the facility. **Viewpoint 5** is situated on the minor road immediately to the north of the northern boundary hedge of the facility. The viewpoint indicates that the hedge growing on the north side of the road would interrupt views of the Project. Views from the equestrian facility would be interrupted by buildings at the facility and by vegetation on its northern boundary.

Scale and extent of visual change – Medium/small across a Limited area due to screening by vegetation and buildings

Magnitude of change – Moderate/Slight

Significance of effect – **Moderate/minor (Not Significant)**

Balyhass Adventure Sports Centre

Ballhass Adventure Sports Centre is focussed on water sports and activities at Ballyhass Lake which is situated in a disused quarry and therefore below the level of the surrounding terrain. The value of views is evaluated as Community and susceptibility as Medium as visitors will be focussed on sports activities rather than views of the surrounding landscape. Sensitivity is therefore Medium at this location.

Figure 14.1 and **Figure 14.2** indicate there would be theoretical visibility of blades from parts of the Lake with visibility of hubs from the western part of the facility where visitors would arrive. There would be views of the Project which would be seen as a well ordered and regularly spaced linear array of turbines. The meteorological mast and substation would not be readily discernible. Visitors are likely to be focussed on sports and activities with views to the surrounding area being incidental to enjoyment of the facility.

Scale and extent of visual change – Small/negligible across a Limited area due to screening by vegetation and landform

Magnitude of change – Slight

Significance of effect – **Moderate/minor (Not Significant)**

Ballybeg Augustinian Priory

Ballybeg Augustinian Priory is situated approximately 1km to the south of Buttevant and 5.1km to the east of the Project. The value of views is evaluated as Regional as the feature is of historic importance. Susceptibility of receptors at this location is evaluated as High as the feature would be perceived in the context of the surrounding landscape. Sensitivity is therefore High/medium at this location.

Vegetation and landform on the west side of the N20 to the southwest of the Priory would screen most of the Project from view. Turbines T1-T3 in the north of the proposed development would be partly visible and would have a limited influence of the composition of views to and from the Priory. The meteorological mast and substation would not be discernible.

Scale and extent of visual change – Small/negligible across a Limited area due to screening by vegetation and landform

Magnitude of change – Slight

Significance of effect – **Moderate (Not Significant)**

Cork Racecourse, Mallow

The ZTV shown on **Figure 14.1** indicates the Project would not be visible from Cork Racecourse, Mallow.

Mallow Castle

Mallow Castle is situated on the north side of the River Blackwater and to the east of the N72 where it passes through Mallow. The Castle is set slightly above the surrounding area and the grounds are enclosed by mature trees on the western and eastern side. The Castle is approximately 9.5km from the Project. The value of views is evaluated as Regional as the feature is of historic importance. Susceptibility of receptors at this location is evaluated as High as the feature would be perceived in the context of the surrounding landscape. Sensitivity is therefore High/medium at this location.

The ZTV shown on **Figure 14.1** and **Figure 14.2** indicates that only blades only of the Project would theoretically be visible. Intervening landform and vegetation would screen the Project; it is unlikely to be discernible.

Scale and extent of visual change – Negligible across a Limited area due to screening by vegetation and landform

Magnitude of change – Negligible

Significance of effect – **Negligible (Not Significant)**

Kanturk Castle

The ZTV shown on **Figure 14.1** indicates the Project would not be visible from Kanturk Castle.

Mount Hillary Loop Walks

There are a number of loop walks centred on Mount Hillary which is represented by Viewpoint 15 at distances of more than 10.5km from the Project. Receptors at this location are evaluated as being of High/medium sensitivity as their attention is likely to be focussed on views of the surrounding landscape. The outlook varies from the loop walks which pass through forestry and across open hillsides where forestry has been felled.

Viewpoint 15 indicates that the Project would be visible as an array of regularly spaced turbines at a similar height above ground. The turbines would be seen against a backdrop of farmland plain and hills receding into the distance. The array would occupy a small proportion of the view. While the movement of the rotors would be noticeable, the distance to the turbines and the expansive and diverse nature of the view means that the effects of movement on the composition of views would be limited. The meteorological mast and substation would not be readily discernible.

Scale and extent of visual change – Small across a Localised area at a distance of more than 10.5km

Magnitude of change – Slight

Significance of effect – **Moderate (Not Significant)**

Mallow Golf Course

Mallow Golf Course is situated on the southeastern fringe of Mallow on elevated north facing slopes. Views at this location are evaluated as being of Regional value and Medium susceptibility as the golf course is likely to attract visitors from outside the immediate locality and visitors will be focussed on sport with the landscape forming a backdrop to their main activity. Sensitivity is therefore High/medium at this location.

The Project would be discernible at a distance of approximately 10.5km and the movement rotors is likely to be noticeable. However, views would be intermittent from the golf course due to screening by vegetation at the golf course and its boundaries in addition to low level screening of turbines by intervening landform and vegetation. The meteorological mast and substation would not be readily discernible.

Scale and extent of visual change – Small/negligible across a Limited area

Magnitude of change – Slight/negligible

Significance of effect – **Minor (Not Significant)**

14.8.7 Designated landscapes

As indicated in section 14.5.6 there is a High Value Landscape (HVL) area that coincides with the eastern part of LCT5 extending beyond the study area. The HVL is evaluated as being of Regional value and High susceptibility meaning it is of High/medium sensitivity in the context of this LVIA.

Effects on LCT5 including the area that coincides with the HVL are described in section 14.8.5. **Viewpoints 17, 18 and 19** are located in the HVL and the scale of change at these viewpoints is summarised in **Table 14.9** and described in EIAR **Volume III, Appendix 14.4.**

The Project will be located approximately 4km to the west of the HVL. The Project would introduce movement into views from the HVL. However, the proposed development would not be in the immediate environs of the HVL and would be separated from the designated area by undulating farmland with hedgerow and woodland enclosure, in part restricting views towards the proposed development, which would be intermittent from the lowland areas of the HVL as indicated by Viewpoint 17.

There would be uninterrupted views of the proposed development from more elevated areas of the HVL in the north-east and south-east of the study area. In views from these areas the proposed development would be seen as a minor feature within a large-scale landscape and would sit well into its immediate context. The layout would appear compact in longer distance views with the proposed development occupying a discrete well-defined area and would be readily accommodated in the large-scale farmland plain that is contiguous with the HVL. The meteorological mast and substation would not be readily discernible. Within 4-7km of the Project the scale of change would be Small due to the screening effect of hedges. These effects would occur in a Localised area. Beyond 7km the scale of change would reduce to Small/negligible or Negligible and the Project would be seen as a noticeable addition to the working farmland landscape fitting its immediate context. These effects would occur across and Intermediate area.

Considering these effects together, the magnitude of change would be Slight, and the effects would be of **Moderate/minor** significance and **Adverse (Not Significant).**

14.8.8 Cumulative effects

In line with GLVIA3 (paragraph 7.5) and SNH guidance on Assessing the Cumulative Impact of Onshore Wind Energy Developments (paragraph 33), the assessment of cumulative effects should focus on whether there are any likely significant cumulative impacts which are reasonably foreseeable and which are likely to influence the decision making of the proposed development, rather than an assessment of every potential cumulative effect. As recommended by the SNH cumulative guidance, this assessment considers the "*additional cumulative change which would be brought about by the proposed development"* (paragraph 70), assuming other schemes in the scenario are already present.

Figures 14.8 and **14.9 – 14.11** show the location of other operational, consented and proposed wind farms within the 20km study area. Details of these developments are set out in **Table 14.6**.

As set out in EIAR **Volume III, Appendix 14.1** operational and consented wind farms are included as part of the landscape and visual baseline and are considered within the assessment of effects set out in the preceding sections of this chapter. There is one wind farm in planning: Ballinagree, 20.6km to the south-west. Annagh, 10.9km to the north was refused and is currently subject to Appeal. For the purposes of this cumulative assessment Annagh wind farm is considered as a site in planning.

By nature of their height and degree of potential intervisibility the cumulative effects of wind farms are considered separately to the cumulative effects of the other developments listed in section 14.3.3. Other developments are considered in section 14.8.8.6 taking into account the findings of the cumulative wind farm assessment.

14.8.8.1 Assessment scenarios

Scenarios considered within this cumulative assessment are:

- Scenario 1 – The Project with operational and consented development – i.e., the effects of the Project compared to the current baseline – as described in the main LVIA.
- Scenario 2A – The Project with operational and consented development and Annagh wind farm.
- Scenario 2B – The Project with operational and consented development and Ballinagree wind farm.
- Scenario 3 – The Project with operational, consented development, Annagh wind farm and Ballinagree wind farm.

Cumulative effects are assessed on the same landscape and visual receptors as assessed for the main scheme. Landscape and visual receptors that are considered to receive effects of slight-negligible or negligible magnitude (both localised and overall) from the Project are not included in this cumulative assessment, as effects of such low magnitude manifestly adds nothing or very little regardless of the effects of other developments and would be considered **Not Significant**. If significant cumulative effects arise on those receptors, they would be as a result of other developments and as such are not relevant for consideration as part of this application.

14.8.8.2 Cumulative ZTV studies

Scenario 1 – The Project with operational and consented development

The ZTV shown on **Figure 14.9** indicates that the Project would be visible with operational and consented development mainly within a 10km radius with visibility becoming patchier beyond 10km and similar to the pattern of theoretical visibility of the Project alone. The Project would result in very limited new areas of wind farm visibility with these occurring mainly to the west of Kanturk and east of Killavullen.

Scenario 2A – The Project with operational and consented development and Annagh wind farm.

Figure 14.11 indicates that Annagh is likely to contribute mostly to theoretical visibility in the northernmost part of the study area while the Project would contribute more to central and western parts. Both would be theoretically visible to the east and north and in the south of the study area.

Scenario 2B – The Project with operational and consented development and Ballinagree wind farm.

Figure 14.10 indicates that Ballinagree wind farm is likely to contribute mostly to theoretical visibility in the southern part of the study area while the Project would contribute limited additional areas of visibility.

Scenario 3 – The Project with operational, consented development, Annagh wind farm, and Ballinagree wind farm.

Figure 14.10 and **Figure 14.11** together indicate where Annagh wind farm and Ballinagree wind farm are visible and where there would be combined visibility with the Project as described in Scenario 2A and Scenario 2B.

14.8.8.3 Cumulative viewpoint analysis

The scale of effect at viewpoints arising from adding the Project to a baseline including the relevant wind farm for each scenario is set out in **Table 14.10** and **Table 14.11**. Only viewpoints where the effects of the Project are small or greater are considered for the reasons set out above.

Table 14.10: Cumulative viewpoint analysis – landscape effects

	Scale of Landscape Effect			
VP	**Scenario 1**	**Scenario 2A**	**Scenario 2B**	**Scenario 3**
1	Medium/small	Medium/small	Medium/small	Medium/small
2	Medium	Medium/small	Medium/small	Medium/small
3	Small	Small	Small	Small
4	Medium/small	Medium	Medium	Medium
5	Medium/small	Small	Small	Small
6	Medium	Medium	Medium	Medium
7	Small	Medium	Medium	Medium
8	Medium	Small	Small	Small
9	Small	Small	Small	Small
11	Small	Small	Small	Small
12	Negligible	Negligible	Negligible	Negligible
13	Small/Negligible	Small/Negligible	Small/Negligible	Small/Negligible
17	Small	Small	Small	Small

Table 14.11: Cumulative viewpoint analysis – visual effects

	Scale of Visual Effect			
VP	**Scenario 1**	**Scenario 2A**	**Scenario 2B**	**Scenario 3**
1	Medium	Medium	Medium	Medium
2	Medium	Medium	Medium	Medium
3	Small	Small	Small	Small
4	Medium	Medium	Medium	Medium
5	Medium	Medium/small	Medium/small	Medium/small
6	Medium	Medium	Medium	Medium
7	Medium/small	Medium	Medium	Medium
8	Medium	Medium/small	Medium/small	Medium/small
9	Small	Small	Small	Small
10	Negligible	Negligible	Negligible	Negligible
11	Small	Small	Small	Small
12	Small	Small	Small	Small
13	Small	Small	Small	Small
15	Small	Small	Small/negligible	Small/negligible
16	Small	Small	Small	Small
17	Small	Small	Small	Small
18	Small	Small	Small	Small

14.8.8.4 Cumulative effects on landscape character

Based on the above viewpoint analysis there would be no change in scenarios 2A and 2B and 3 when compared to Scenario 1. Annagh wind farm is 10.9km to the north of the Project and while it is in the same LCT, the scale of change resulting from the Project occurs mainly within 2km reducing to Small at distances of up to 7km, and beyond 7km reducing to Small/negligible. The separation distance between the Project and Annagh wind farm means that there would not be a perception of wind energy development becoming a prominent new characteristic of the landscape. The operational wind farms of Kilberehert wind farm, Rathnacally wind farm and Boolard wind farm are relatively small scale and the influence of these wind farms on landscape character of LCT5 occurs within a localised area around each development. Other operational wind farms are at distances of over 15km. Therefore, a scenario in which the Project is added to all operational and consented wind farms and Annagh wind farm leads to no difference in effect to that compared to Scenario 1 for the LCTs assessed.

In Scenario 2B Ballinagree wind farm is over 20km from the Project. Landscape character effects of Ballinagree wind farm would occur mainly in a localised area around the site. The addition of the Project would result in very limited cumulative effects on landscape character in a scenario in which the Project is added to all operational and consented wind farms and Ballinagree wind farm. There would be no difference in effect to that compared to Scenario 1 for the LCTs assessed.

There would also be no difference in effect to that compared to Scenario 1 for the HLV area that coincides with LCT5.

By the same reasoning described for Scenarios 2A and 2B, in Scenario 3 the addition of the Project would result in very limited cumulative effects on landscape character in a scenario in which the Project is added to all operational and consented wind farms, Annagh wind farm and Ballinagree wind farm. This is on account of the main effects of Annagh wind farm and Ballinagree wind farm on landscape character occurring in a localised area around each of these sites and in a localised area around the Project. Therefore, there is no potential for cumulative interaction of significant effects arising from each development.

Cumulative effects on landscape character would be **Not Significant.**

14.8.8.5 Cumulative visual effects

This assessment considers two types of cumulative visual effect:

- Combined views which "*occur where the observer is able to see two or more developments from one viewpoint".* Combined visibility may either be in combination (where several developments are within the observer's arc of vision at the same time) or in succession (where the observer has to turn to see the various developments).
- Sequential views which "*occur when the observer has to move to another viewpoint to see different developments."*

This section assesses the anticipated cumulative visual effects arising from the proposal in combination with the existing and consented developments, other proposed developments and the Project. The main linear routes that share combined intervisibility in the study area are then summarised to anticipate the likely sequential views.

Cumulative viewpoint analysis

Based on the above viewpoint analysis the only change in scenarios 2A, 2B and 3 when compared to Scenario 1 would be in Scenario 2B and Scenario 3 at Viewpoint 15. The cumulative effects resulting from the addition of the Project would reduce at Viewpoint 15 due to the greater influence of Ballinagree wind farm and would be **Not Significant.**

Cumulative effects on communities

Cumulative effects on communities are predicted to be very limited due to the long distance between the Project and the nearest other cumulative site. Another factor is the limited intervisibility between communities and the Project in combination or sequentially with other wind farms. A combination of hedges, woodland and undulating topography are mitigating factors in limiting instances of combined or sequential visibility. The viewpoints indicate that where the Project is noticeable cumulative development tends to be imperceptible or distant.

There would be no difference in effect on communities compared to Scenario 1. Cumulative effects would be **Not Significant.**

Cumulative effects on recreational routes

Cumulative effects on recreational routes have the potential to be both combined and sequential as users of the route travel through the landscape and experience views of the Project with one or more cumulative sites in the same field of view or as a series of separate developments visible along a route.

Figure 14.9 indicates theoretical visibility of the Project and operational sites from stretches of the Ballyhoura Way. Kilberehert wind farm is within 1km of the route and would have a greater influence on views in the western part of the route. The Project would potentially be glimpsed in the opposite direction from Kilberehert wind farm at a greater distance of 7km. Given the screening effects of hedges and woodland instances of combined and sequential visibility would be very limited. In the eastern part of the route Knocknatallig wind farm and Castlepook wind farm would have more of an influence on view particular from more elevated sections of the route. Boolard wind farm and Rathnacally wind farm would also be visible although more distant. The Project will be over 13km from these sites. There would be limited cumulative combined and sequential visibility and where combined visibility is likely in the Ballyhoura Mountains it is Knocknatallig wind farm and Castlepook wind farm that would have a greater influence on views and the addition of the Project would result in limited cumulative effects.

In Scenario 2A, Annagh wind farm would have a greater influence on views from the eastern part of the route in combination with Boolard wind farm and Rathnacally wind farm and sequentially with Knocknatallig wind farm and Castlepook wind farm. There would be limited cumulative combined and sequential visibility of the Project with Annagh wind farm from the route. In Scenario B, Ballinagree wind farm is over 20km from the Project and any instances of combined visibility would result in cumulative effects no greater than those assessed for Scenario 1.

There would be no difference in effect on the Ballyhoura Way compared to Scenario 1.

Figure 14.11 indicates limited combined theoretical visibility of the Project with Annagh wind farm from the Blackwater Way Trail. Annagh wind farm is over 25km from the route and while it would be visible it would have a limited effect due to distance. The Project would potentially be glimpsed in combination with Annagh wind farm. Given the separation distance between the Project and Annagh and between the route and the two sites there would be no difference in effect on the Blackwater Way Trail Way compared to Scenario 1. In Scenario 2B and Scenario 3 Ballinagree wind farm would have a greater influence on views from the route. The addition of the Project in this scenario would result in limited combined and sequential visibility and there would be no difference in effect on the Blackwater Way Trail compared to Scenario 1.

Cumulative effects on recreational routes would be **Not Significant.**

Cumulative effects on key routes

In terms of cumulative effects on key routes, the ZTV shown on **Figure 14.9** indicates that the Project would not introduce any new areas of visibility along the N72 and N20 in Scenario 1. In terms of sequential visibility of the Project in addition to other operational wind farms, it would be visible along the route of the N20 before Rathnacally wind farm and is visible with Knocknatallig wind farm and Castlepook wind farm being more distant features. The separation distance between the Project and these cumulative sites and the distance of the Project from the N20 means there would not be a perception of travelling through a landscape where wind farms frequently occur and become a characterising influence on views from the route.

In Scenario 2A, the Project would be seen sequentially with Annagh wind farm and while Annagh wind farm would include larger turbines and be more apparent than Rathnacally wind farm the sequential effects would be no greater than in Scenario 1 due to separation distance between the Project and Annagh wind farm.

In Scenario 2B and Scenario 3, Ballinagree wind farm would be a distant feature on the horizon in views and there would be no difference in effect on the N20 compared to Scenario 1.

The Project would barely be discernible from the N72 and therefore sequential effects in Scenario 1 would be very limited. The separation distance between the Project and cumulative sites in Scenario 2A, 2B and 3, means there would be no difference in effect on the N20 compared to Scenario 1.

Cumulative effects on key routes would be **Not Significant.**

Cumulative effects on recreational facilities and heritage sites

Section 14.8.6 indicates that the Project would not be visible from Cork Racecourse, Mallow and from Kanturk Castle. There would be no cumulative effects on receptors at these locations.

Kilguilkey House Equestrian Centre

Figure 14.10 and **Figure 14.11** indicate that Ballinagree wind farm and Annagh wind farm would not be visible from Kilguilkey House Equestrian Centre. There would be no difference in effect compared to Scenario 1. Cumulative effects would be **Not Significant.**

Ballyhass Adventure Sports Centre

Figure 14.10 and **Figure 14.11** indicate that Ballinagree wind farm and Annagh wind farm would not be visible from Ballyhass Adventure Sports Centre. There would be no difference in effect compared to Scenario 1. Cumulative effects would be **Not Significant.**

Ballybeg Augustinian Priory

Figure 14.10 and **Figure 14.11** indicate that Ballinagree wind farm and Annagh wind farm would not be visible from Ballybeg Augustinian Priory. There would be no difference in effect compared to Scenario 1. Cumulative effects would be **Not Significant.**

Mallow Castle

Figure 14.10 indicates that the Project would be theoretically visible in addition to Ballinagree wind farm at Mallow Castle. Ballinagree wind farm would be 20km to the southwest of Mallow Castle and unlikely to be readily discernible due to screening by vegetation. The cumulative effects would therefore be no greater than those assessed for Scenario 1. **Figure 14.11** indicates that Annagh wind farm would not be visible from Mallow Castle. Cumulative effects would be **Not Significant.**

Mount Hillary Loop Walks

Figure 14.10 indicates that the Project would result in additional areas of theoretical visibility coinciding with the loop walks on the north side of Mount Hillary. The ZTV indicates that the Project only would be theoretically visible from a large proportion of the loop walks with combined theoretical visibility mainly from the summit area of Mount Hillary. From the summit area the group of wind farms to the south including operational Esk wind farm, Boggerah 1 and 2 wind farms, Carrigcannon wind farm and proposed Ballinagree wind farm, would have a greater influence. While the Project alone would be visible from parts of the loop walk there would be no difference compared to Scenario 1, when Ballinagree wind farm is added. **Figure 14.11** indicates that the Project and Annagh wind farm would be visible from most of the loop walks. However, given the screening effect of forestry and the long distance, over 22km, to Annagh wind farm there would be no difference in effect compared to Scenario 1. Cumulative effects would be **Not Significant.**

Mallow Golf Course

As indicated in section 14.8.6 there would be intermittent visibility of the Project from Mallow Golf Course and where visible the scale of change would be no greater than Small/negligible.

The ZTV shown on **Figure 14.10** indicates the Project would be theoretically visible in addition to Ballinagree wind farm. Ballinagree wind farm will be 20km to the southwest of Mallow Golf Course and unlikely to be readily discernible due to screening by vegetation. The cumulative effects would therefore be no greater than those assessed for Scenario 1.

Figure 14.11 indicates that Annagh wind farm would be visible from a limited part of Mallow Golf Course at a distance of 21km. Given the separation distance to Annagh wind farm it is unlikely to be readily discernible and the cumulative effects arising from the addition of the Project would be no different to those assessed for Scenario 1. Cumulative effects would be **Not Significant.**

14.8.8.6 Cumulative effects with other development

This section describes the cumulative effects arising from the addition of the Project to other development listed in EIAR **Chapter 2 EIA Methodology,** the locations of which are shown on **Figure 14.8.** As indicated in EIAR **Chapter 2 EIA Methodology**, **Table 2.2** the N/M20 upgrade is not considered in the EIAR due to the long timeframes for achieving consent and developing this project. At this stage the N/M20 design is at the preferred option stage and will be subject to further design and consultation. The development is also beyond the main area of influence of the Project in terms of impacts on landscape character and visual amenity.

Scart Limestone Quarry Extension

The extension to Scart Limestone Quarry would include an area approximately 5 hectares (ha) adjacent to the western part of the existing quarry which extends to 2ha. The existing quarry is not readily discernible from the surrounding area and is partly screened by vegetation and landform particularly from the south. The proposed extension would follow gradually downward sloping land to the west. The land coinciding with the proposed extension is currently a pasture field bounded by mature hedges.

The effects of the quarry extension on landscape character and visual amenity would be very localised. The proposed extension would not be readily discernible from nearby locations due to the relatively gentle topography in the immediate environs. Mature hedges and trees would restrict views from residential properties and roads.

Where visible, the quarry extension would be seen as separate from the Project and the cumulative effects would be no greater than the effects of the Project alone or cumulatively with other wind farm developments. Cumulative effects would be **Not Significant.**

Ballyroe Solar Farm

Ballyroe Solar Farm is situated approximately 11km to the north of the Project. The effects of Ballyroe Solar Farm would be localised due to the low height of the development and the screening effect of hedges and woodland that are prevalent in the surrounding landscape. The assessment of the Project indicates that the scale of effects on landscape character would be Small/negligible beyond 9-10km from the Project and that Small scale visual effects would occur up to 12km from the Project. The cumulative assessment of Scenario A and Scenario B indicate there would be no difference in effects from either of those scenarios compared to Scenario 1. Given the localised effects of Ballyroe Solar Farm and the widespread screening effect of vegetation, the cumulative effects would be no greater than the effects of the Project alone or cumulatively with other wind farm developments. Cumulative effects would be **Not Significant.**

Fiddane Solar Farm

Fiddane Solar Farm is situated approximately 10.8km to the north of the Project and approximately 3.5km northwest of Ballyroe Solar Farm. It is also located 1.5km southeast of Boolard wind farm and adjacent to the proposed Annagh wind farm. The effects of Fiddane Solar Farm would be localised due to the low height of the development and the screening effects of hedges and woodland that are prevalent in the surrounding landscape. Cumulative effects of Fiddane would arise mainly in combination with Boolard wind farm, Ballyroe Solar Farm and Annagh wind farm. The Project would not influence the area in which Fiddane Solar Farm is located and there would be no cumulative interaction with other developments in that locality. Given the localised effects of Fiddane Solar Farm and the widespread screening effect of vegetation the cumulative effects would be no greater than the effects of the Project alone or cumulatively with other wind farm developments. Cumulative effects would be **Not Significant.**

Mallow Solar Farm

Mallow Solar Farm is situated approximately 4.6km to the southeast of the Project. The solar farm would be situated on south facing slopes angled away from the Project and largely screened by hedges and woodland from the wider area. The effects of Mallow Solar Farm would be localised and while it would increase the amount of development in an area of rural character there would be very limited cumulative interaction with the Project due to the low height of the solar array, the screening effects of vegetation and the separation distance to the Project. Given the localised effects of Mallow Solar Farm and the widespread screening effects of vegetation the cumulative effects would be no greater than the effects of the Project alone or cumulatively with other wind farm developments. Cumulative effects would be **Not Significant**.

14.8.9 Summary of effects

This assessment defines the existing landscape and visual baseline environments; assesses their sensitivity to change; describes the key landscape and visual related aspects of the Project; describes the nature of the anticipated changes and assesses the effects arising during construction and once operational. The assessment findings have been informed by desk study, visualisations and ZTV studies and a number of site visits.

The Project will introduce wind turbines, a meteorological mast and a substation into a large-scale working landscape of farmland with undulating topography, dispersed and low density settlement pattern and a prevalence of hedges and woodland throughout the study area.

Construction and decommissioning phase effects would be substantively the same. They would involve short-term activities and effects which would not be significant. The greatest effects during the construction phase would arise from the standing turbines, and large cranes used to erect these, during the final phases of construction – by which point the effects would be the same as for those during operation.

No significant effects on landscape character would arise given the limited effects on landscape fabric, the large-scale landscape and its characteristic working farmland context. The effects of the Project on landscape character would occur within a localised area of LCT5 Fertile Plain with Moorland Ridge. Effects on other character types would be Small or less and Not Significant due to limited potential visibility and/or the existing influence of operational and consented wind energy developments.

The turbines will be positioned more than 4 x tip height from the nearest residential properties. Beyond this distance communities have a low density, dispersed settlement pattern. Mature hedges and woodland are prevalent throughout the farmland plain in which the majority of communities are located and provide screening such that views of the Project would vary being largely intermittent and on occasion highly visible although not overly dominant. In the round, when the available existing views from communities are considered and the nature of likely views of the Project, no significant effects area predicted on communities.

The key recreational routes of the Ballyhoura Way and the Blackwater Way Trail are influenced by operational wind farms. While the Project would be visible from both routes, the separation distance to the Project and screening by intervening vegetation are mitigating factors that reduce effects and no significant effects are predicted on these routes.

From recreational facilities and heritage sites the effects of the Project would be limited due to the effects of distance or screening by vegetation and landform. In the case of Ballyhass Adventure Sports Centre while the Project would be noticeable from elevated parts of the facility, visitors would be focussed on sports activities and views of the surrounding landscape would be incidental to enjoyment of these activities. In the case of Kilguilkey House Equestrian Centre, while the Project would be noticeable, participants at the Centre would be focussed on equestrian activities and would experience intermittent views interrupted by intervening buildings and vegetation.

From the key route of the N72 Scenic Route 14 the Project would barely be discernible due to the screening effects of landform and vegetation and no significant effects are predicted on this route. There would be no significant effects on other Scenic Routes due to the distance to the Project and the screening effects of intervening vegetation. The Project would be visible from the short stretches of the N20 and would be seen in the large-scale farmland plain landscape fitting its immediate context. It would be seen for a short duration in oblique views and effects would not be significant.

There would be no significant effects on designated landscapes.

Cumulative effects have been considered with all operational, consented and proposed wind farms within the 20km study area. Operational and consented developments are included as part of the landscape and visual baseline and considered within the main assessment of effects. The two developments at planning stage: Annagh wind farm and Ballinagree wind farm are at distances of greater than 10km. These sites would affect mainly the locality in which they are situated and cumulative effects resulting from the addition of the Project would be very limited and no greater than the effects assessed for the Project in the baseline of operational and consented sites. The assessment has also considered the cumulative effects arising from the addition of the Project to other development: Scart Limestone Quarry Extension, Ballyroe Solar Farm, Fiddane Solar Farm and Mallow Solar Farm. Given the localised effects of these other developments and the separation distance to the Project, cumulative effects resulting from the addition of the Project would be very limited and no greater than the effects assessed for the Project in the baseline of operational and consented wind farm sites and proposed wind farm developments. Consequently, no significant cumulative effects are predicted.

A summary of the operational effects of the Project is set out in **Table 14.12.** Only effects greater than Negligible are included in the table.

Table 14.12: Summary of operational effects

Receptor	Sensitivity	Magnitude	Significance	Beneficial/ Neutral/ Adverse
Landscape Character				
LCT5 Fertile Plain with Moorland Ridge	High/medium	Moderate/slight	Moderate **Not Significant**	Adverse
LCT10b Fissured Fertile Middleground	Medium	Slight	Moderate/minor **Not Significant**	Adverse
LCT11 Broad Marginal Middleground Valley	Medium	Slight	Moderate/minor **Not Significant**	Adverse
Visual Receptors				
Settlements and Communities				
Within 2km	Medium	Moderate/slight to Moderate	Moderate/minor to Moderate **Not Significant**	Adverse
Within 2-5km	Medium	Moderate/slight to Moderate	Moderate/minor to Moderate **Not Significant**	Adverse
Within 5-10km	Medium	Slight	Minor **Not Significant**	Adverse
Within 10-20km	Medium	Slight/negligible	Minor/negligible **Not Significant**	Adverse
Key Routes				
N72 (S14 Scenic Route)	High/medium	Negligible	Negligible **Not Significant**	Adverse
N20	Low	Slight/negligible	Minor **Not Significant**	Adverse

Receptor	Sensitivity	Magnitude	Significance	Beneficial/ Neutral/ Adverse
Recreational Routes				
Ballyhoura Way	High/medium	Slight	Moderate **Not Significant**	Adverse
Blackwater Way Trail	High/medium	Slight/negligible	Moderate/minor **Not Significant**	Adverse
Recreational facilities and heritage sites				
Kilguilkey House Equestrian Centre	Medium	Moderate/slight	Moderate/minor **Not Significant**	Adverse
Ballyhass Adventure Sports Centre	Medium	Slight	Moderate/minor **Not Significant**	Adverse
Ballybeg Augustinian Priory	High/medium	Slight	Moderate **Not Significant**	Adverse
Mount Hillary Loop Walks	High/medium	Slight	Moderate **Not Significant**	Adverse
Mallow Golf Course	High/medium	Slight/negligible	Minor **Not Significant**	Adverse
Designations				
LCT5 High Value Landscape Area	High/medium	Slight	Moderate/minor **Not Significant**	Adverse