Energy for generations

Derrybrien Wind Farm Project

Gort Wind Farm Ltd

Remedial Environmental Impact Assessment Report
Chapter 5 - Noise & Vibration

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5.1 Introduction

5.1.1 Chapter Scope

This chapter provides an assessment of the impact of the Derrybrien Wind Farm Project (the Project) from the baseline date prior to construction through construction, operation and ultimate decommissioning, with respect to noise and vibration. The Project comprises the wind farm, grid connection (overhead line and Agannygal Substation) and the works undertaken as a result of the peat slide.

There are some 41 noise sensitive receivers located within 2.5 kilometres of the turbine locations which all bar one fall outside the omni-directional 35dB(A) noise contour developed for the assessment. A list of receivers and their co-ordinates is provided in Appendix 5.1. The closest noise sensitive locations (NSLs), are residential dwellings, located approximately 2.1 kilometres from the nearest turbine locations. The derelict building (R39) is situated some 1.3 kilometres from the nearest turbine location.

Baseline noise levels have been measured at locations representative of the nearest noise sensitive properties including sample locations in the proximity of overhead lines and substations associated with the development. Noise predictions have been prepared for construction and wind turbine operation activities in relation to the nearest properties to the Project.

Operational noise measurements have also been measured during worst-case down-wind conditions to verify that the operational noise criteria outlined in this assessment have been achieved.

Finally, assessment on potential impacts associated with the decommissioning of the site have been presented.

For a glossary of terms used in this chapter please refer to Appendix 5.2.

Figures are contained in A4 format as they are referenced within the chapter. Where necessary for clarity these are reproduced at A3 in Appendix 5.8

5.1.2 Statement of Authority

This chapter of the rEIAR has been prepared by AWN Consulting.

Damian Kelly (Acoustics Director) holds a BSc from DCU and an MSc from QUB. He has extensive experience as an acoustic consultant working in the field since 1997 and is a member of the Institute of Acoustics. He is currently a sitting member of the

Irish committee of this organisation. He has extensive knowledge in the field of noise modelling and prediction, having developed many of the largest and most complex examples of proprietary noise models prepared in Ireland to date.

Donal Heavey (Acoustic Technician) holds a BEng in Video and Sound technology and a Diploma in Acoustics and Noise Control and is an associate member of the Institute of Acoustics (IOA.) He has experience in the measurement, modelling and assessment of environmental noise, including transport, commercial and industry, and building acoustics surveying. He has been involved in many environmental noise monitoring projects that have included noise and vibration impact assessments, noise monitoring equipment installation and onsite monitoring.

5.2 Methodology

The assessment of impacts has been undertaken with reference to the most appropriate guidance documents relating to environmental noise and vibration for the project which are set out within the relevant sections of this chapter. These can be summarised as follows:

- British Standard BS 5228-1:2009+A1:2014 “Code of practice for noise and vibration control on construction and open sites – Noise”;
- BS 7385 – “Evaluation and measurement for vibration in buildings – Part 2: Guide to damage levels from groundborne vibration” (1993);
- BS 5228-2: 2009+A1:2014 – “Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration”;
- Wind Energy Development Guidelines for Planning Authorities published by the Department of the Environment, Heritage and Local Government in 2006;
- Department of Trade and Industry (UK) Energy Technology Support Unit (ETSU) publication The Assessment and Rating of Noise from Wind Farms (1996);
- 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;
- **Guidance Note for Noise Assessment of Wind Turbine Operations at EPA Licensed Sites (NG3) (EPA, 2011);**
- **WHO Environmental Noise Guidelines for the European Region (2018), and;**
- **Department of Housing, Planning & Local Government – Draft Revised Wind Energy Development Guidelines (2019).**

In addition to the specific guidance documents stated in the relevant sections, the following guidelines were considered and consulted for the purposes of this chapter:

- EPA Guidelines on the Information to be contained in Environmental Impact Statements, (EPA, 2002);
- EPA Advice Notes on Current Practice (in the preparation of Environmental Impact Statements), (EPA, 2003);

- EPA Guidelines on the Information to be contained in Environmental Impact Assessment Reports Draft August 2017 (EPA, 2017); and
- EPA Advice Notes for Preparing Environmental Impact Statements, (Draft, September 2015)

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

- Review of appropriate guidance and specification of suitable construction and operational noise / vibration criteria;
- Characterisation of the receiving noise and vibration environment;
- Characterisation of the Project
- Prediction of the noise impact associated with the Project
- Evaluation of noise and vibration impacts and effects; and,
- Assessment of cumulative impacts.

In relation to construction noise and vibration relevant standards have been reviewed to identify appropriate criteria in relation to these activities that would typically apply to Projects of this nature. Any historical monitoring data to hand has been reviewed and commented upon in order to comment on any likely impacts associated with the construction of the Project or works associated with the peat slide. In addition, noise predictions have been prepared to review the likely noise impacts that would have arisen, if any, in relation to the construction, peat slide and in the future, in relation to the decommissioning of the Project.

In relation to noise impacts associated with the wind turbines developed on the site the approach adopted here can be summarised as follows:

- Preliminary noise modelling to identify and recommended strategic locations for background noise monitoring. While it is acknowledged that the Project is in operation, best practice methodologies have been applied to baseline noise monitoring data in order to estimate the prevailing background noise levels that would be expected at the nearest noise sensitive locations in the absence of wind turbine developments in the area.
- Noise monitoring at noise sensitive locations (NSL's) confirm background noise levels across a range of wind speeds in the vicinity of the site.
- Derive appropriate noise criteria curves for day and night time periods in line with the Wind Energy Development Guidelines 2006 or more recent revision (if applicable).
- Assess the turbine layout and technology type against the derived noise criteria through preparation of 3D models (using Predictor software) and prediction of noise levels at all NSL's, with consideration of the prediction parameters outlined in the associated good practice publications issued by the Institute of Acoustics (IoA).

- Predict the cumulative noise emissions from the Project along with other existing wind farm developments (e.g. Sonnagh Old).
- Comparison of the predicted noise levels against the derived noise criteria curves as mentioned above.
- Any exceedances of the criteria have been identified and clearly highlighted. A detailed review has been undertaken in relation to the variation in expected levels due to wind direction and the individual wind turbine units that are contributing to noise levels at a particular location have been identified, where required.
- If the assessment finds that mitigation measures are required, consideration will be given to attenuation of turbine noise emissions in certain wind directions and wind speeds and any 'worst' case assumptions made during the prediction assessments.
- Prepare detailed noise impact calculations for various elements of the proposed development on the surrounding area for the construction phase.
- Present all relevant details of the impact assessment in this rEIAR Chapter.

In addition to the above, consideration has also been given to special characteristics associated with wind turbine operations, namely, low frequency noise, amplitude modulation and tonality. When considering these issues, it is important to note that the Project has been in operation for some 16 years and it is advised that in that time no complaints of alleged special characteristics in terms of site noise emissions have been received. With that in mind, the approach adopted here has to outline clear strategies that will be adopted to assess any such issues if they were to arise in the future and outline measures that would be undertaken in the unlikely event that they were to occur.

In terms of difficulties encountered in relation to the preparation of this chapter the following should be noted:

- It was not possible to undertake baseline noise surveys to capture the receiving environment prior to the construction of the Project. That issue aside, monitoring programmes were developed in order to establish an estimate of baseline levels in the absence of turbine noise considered best practice approaches outlined in the 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.
- In relation to the construction phase and peat slide works associated with the Project, as these have passed the majority of the assessment presented here is based on predicted noise levels that would be expected from activities that have been outlined for various aspects of the works.

5.3 Fundamentals of Acoustics

A sound wave travelling through the air is a regular disturbance of the atmospheric pressure. These pressure fluctuations are detected by the human ear, producing the sensation of hearing. To take account of the vast range of pressure levels that can be detected by the ear, it is convenient to measure sound in terms of a logarithmic ratio of sound pressures. These values are expressed as Sound Pressure Levels (SPL) in decibels (dB).

The audible range of sounds expressed in terms of Sound Pressure Levels is 0dB (for the threshold of hearing) to 120dB (for the threshold of pain). In general, a subjective impression of doubling of loudness corresponds to a tenfold increase in sound energy which conveniently equates to a 10dB increase in SPL. It should be noted that a doubling in sound energy (such as may be caused by a doubling of traffic flows) increases the SPL by 3dB.

The frequency of sound is the rate at which a sound wave oscillates and is expressed in Hertz (Hz). The sensitivity of the human ear to different frequencies in the audible range is not uniform. For example, hearing sensitivity decreases markedly as frequency falls below 250Hz. In order to rank the SPL of various noise sources, the measured level has to be adjusted to give comparatively more weight to the frequencies that are readily detected by the human ear. Several weighting mechanisms have been proposed but the ‘A-weighting’ system has been found to provide one of the best correlations with perceived loudness. SPL’s measured using ‘A-weighting’ are expressed in terms of dB(A).

An indication of the level of some common sounds on the dB(A) scale is presented in Figure 5.1, which shows a quiet bedroom at around 35 dB(A), a nearby noisy HGV at 90 dB(A) and a pneumatic drill at about 100 dB(A).

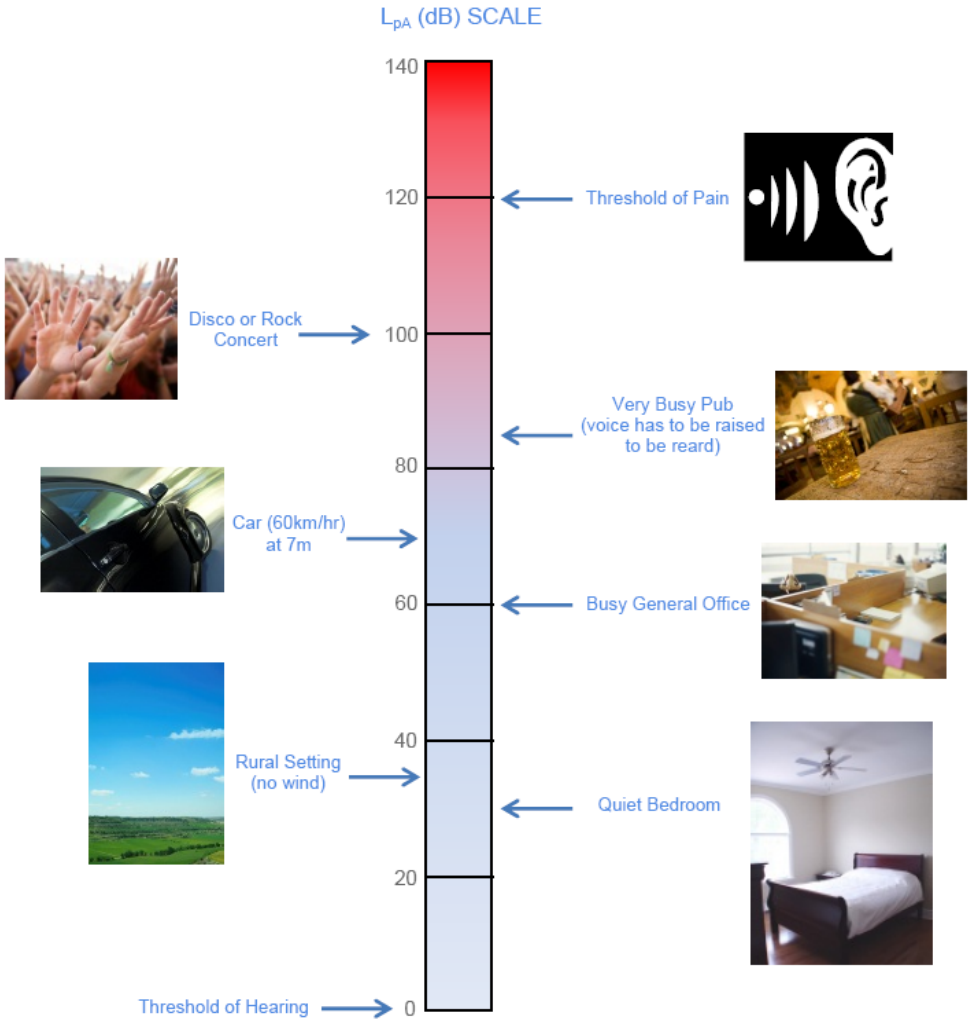


Figure 5.1 dB(A) Scale & Indicative Noise Levels – (EPA: Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4 – 2016))

5.4 Guidance Documents & Adopted Criteria

The following sections review best practice guidance that is commonly adopted in relation to developments such as the one under consideration here.

5.4.1 Construction Phase

5.4.1.1 Noise

There is no published statutory Irish guidance relating to the maximum permissible noise level that may be generated during the construction phase of a project.

In the absence of specific noise limits, appropriate criteria relating to permissible construction noise levels 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.

The approach adopted in the BS Standard calls for the designation of a noise sensitive location into a specific category (A, B or C) based on existing ambient noise levels in the absence of construction noise. This then sets a threshold noise value that, if exceeded, indicates a significant noise impact is associated with the construction activities.

Table 5.1 sets out the values which, when exceeded, potentially signify a significant effect at the facades of residential receptors as recommended by BS 5228 – 1. These levels relate to construction noise only.

Table 5.1 Example Threshold of Potential Significant Effect at Dwellings

Assessment category and threshold value period ($L_{Aeq,T}$)	Threshold value, in decibels (dB)		
	Category A Note A	Category B Note B	Category C Note C
Night-time (23:00 to 07:00hrs)	45	50	55
Evenings and weekends Note D	55	60	65
Daytime (07:00 – 19:00hrs) and Saturdays (07:00 – 13:00hrs)	65	70	75

Note A Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are less than these values.
Note B Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are the same as category A values.
Note C Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are higher than category A values.
Note D 19:00 – 23:00 weekdays, 13:00 – 23:00 Saturdays and 07:00 – 23:00 Sundays.

It should be noted that this assessment method is only valid for residential properties. The following method should be followed:

For the appropriate period (e.g. daytime) the ambient noise level is determined and rounded to the nearest 5dB. In this instance, with the rural nature of the site, all properties in the vicinity of the development have ambient noise levels in the range of 40 to 50dB $L_{Aeq,1hr}$. Therefore, all properties having been afforded a Category A designation.

See Section 5.6.1 for the detailed assessment in relation to this site. If the specific construction noise level exceeds the appropriate category value (e.g. 65dB $L_{Aeq,1hr}$ during daytime periods) then a potential significant effect is deemed to occur.

The construction noise guidance was also applied in relation to works associated with the peat slide. In relation to peat slide works that would have been carried out on a 24 hour basis, the relevant construction noise criteria for a potential significant

effect for night time would have been 45dB $L_{Aeq,1hr}$ and for evening and weekends the relevant threshold would have been 55dB $L_{Aeq,1hr}$.

5.4.1.2 Vibration

Vibration standards come in two varieties: those dealing with human comfort and those dealing with cosmetic or structural damage to buildings. With respect to this development, the range of relevant criteria used for building protection is expressed in terms of Peak Particle Velocity (PPV) in mm/s.

Guidance relevant to acceptable vibration within buildings is contained in the following documents:

- *BS 7385 – "Evaluation and measurement for vibration in buildings – Part 2: Guide to damage levels from groundborne vibration" (1993)*; and
- *BS 5228 – "Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration" (2009+A1:2014).*

BS 7385 states that there should typically be no cosmetic damage if transient vibration does not exceed 15 mm/s at low frequencies rising to 20 mm/s at 15 Hz and 50 mm/s at 40 Hz and above. These guidelines relate to relatively modern buildings and should be reduced to 50% or less for more critical buildings.

BS 5228 recommends that, for soundly constructed residential property and similar structures that are generally in good repair, a threshold for minor or cosmetic (i.e. non-structural) damage should be taken as a peak particle velocity of 15 mm/s for transient vibration at frequencies below 15 Hz and 20 mm/s at frequencies above than 15 Hz. Below these vibration magnitudes minor damage is unlikely, although where there is existing damage these limits may be reduced by up to 50%. In addition, where continuous vibration is such that resonances are excited within structures the limits discussed above may need to be reduced by 50%.

Allowable vibration (in terms of peak particle velocity) at the closest part of sensitive property to the source of vibration, at a frequency of:

Table 5.2 Allowable Vibration at Properties

Allowable vibration (in terms of peak particle velocity) at the closest part of sensitive property to the source of vibration, at a frequency of		
Less than 10Hz	10 to 50Hz	50 to 100Hz (and above)
8 mm/s	12.5 mm/s	20 mm/s

The construction vibration guidance will also be commented upon in relation to works associated with the peat slide.

5.4.2 Operational Phase

5.4.2.1 Wind Turbine Noise Assessment

The wind turbine noise assessment documented in this chapter is based on guidance in relation to acceptable levels of noise from wind farms as contained in the document *Wind Energy Development Guidelines for Planning Authorities* published by the Department of the Environment, Heritage and Local Government in 2006. These guidelines are in turn based on detailed recommendations set out in the Department of Trade and Industry (UK) *Energy Technology Support Unit (ETSU)* publication *The Assessment and Rating of Noise from Wind Farms (1996)*. The ETSU document has been used to supplement the guidance contained within the *Wind Energy Development Guidelines* publication where necessary.

5.4.2.1.1 Wind Energy Development Guidelines

Section 5.6 of the *Wind Energy Development Guidelines* published by the Department of the Environment, Heritage and Local Government (2006) outlines the appropriate noise criteria in relation wind farm developments.

The following extracts from the 2006 Guidelines should be considered:

A noise sensitive location is identified as the following in relation to the guidance:

> *"In the case of wind energy development, a noise sensitive location 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."*

As can be seen from the calculations presented later in this document the various issues identified in this extract have been incorporated into our assessment.

> *"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 criterion curve in relation to wind farm developments. However, an important caveat should be noted as detailed in the following extract.

> *"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 noise be limited to an absolute level within the range of 35 – 40dB(A)."*

In relation to night time periods the following guidance is given:

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

Note again this limit is defined in terms of the $L_{A90,10min}$ parameter. This represents the commonly adopted night time noise criterion curve in relation to wind farm developments.

Reviewing the baseline noise data contained in this assessment and in order to provide a robust approach it is proposed to adopt a daytime threshold of 37.5dB $L_{A90,10min}$ in this instance, this follows a review of the prevailing baseline noise levels measured in the area and on-going developments in terms of Irish guidance on the issue of wind turbine noise and is considered appropriate in light of the following:

- The EPA document '*Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4)*' proposes a daytime noise criterion of 45 dB(A) in 'areas of low background noise'. The proposed lower threshold here is 7.5 dB more stringent than this level.

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

As stated previously the core of the noise guidance contained within the 2006 *Wind Energy Development Guidelines* guidance document is based on the 1996 ETSU publication *The Assessment and Rating of Noise from Wind Farms (ETSU-R-97)*.

5.4.2.1.3 Institute of Acoustics Good Practice Guide

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 at a minimum continuous baseline noise monitoring should be carried out at the nearest noise sensitive locations for typically a two-week 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 turbine under consideration).

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 this data set to derive background noise levels at various wind speeds, and from this, the appropriate day and night time noise criterion curves can be established.

As has been done in the assessment presented here, noise emissions associated with the wind turbine can be predicted in accordance with *ISO 9613: Acoustics – Attenuation of sound outdoors, Part 2: General method of calculation (1996)*. This is a noise prediction standard that considers noise attenuation offered, amongst others, by distance, ground absorption, directivity and atmospheric absorption. Noise predictions and contours are typically prepared for various wind speeds and the predicted levels are compared against the relevant noise criterion curve to demonstrate compliance with the appropriate noise criteria.

Where noise predictions indicate that reductions in noise emissions are required in order to satisfy any adopted criteria, consideration can be given to detailed downwind analysis.

5.4.2.1.4 Special Characteristics

In terms of special characteristics associated with wind turbine noise these can be summarised as follows:

- Low frequency noise / infrasound;
- Amplitude modulation, and;
- Tonality.

Please see Appendix 5.3 for detailed comment on the above issues.

In addition to the above consideration has also been given to special characteristics associated with wind turbine operations, namely, low frequency noise, amplitude modulation and tonality. When considering these issues, it is important to note that the Project has been in operation for some 16 years and it is advised that in that time no complaints of alleged special characteristics in terms of site noise emissions have been received. With that in mind, the approach adopted here is to outline clear

strategies that will be adopted to assess any such issues if they were to arise in the future and outline measures that would be undertaken in the unlikely event that they were to occur.

5.4.2.1.5 World Health Organization (WHO) Noise Guidelines for the European Region

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

In relation to wind turbine noise, the WHO Guideline Development Group (GDG) state the following:

> *"For average noise exposure, the GDG conditionally recommends reducing noise levels produced by wind turbines below 45 dB L_{den}, as wind turbine noise above this level is associated with adverse health effects."*
>
> *"No recommendation is made for average night noise exposure L_{night} of wind turbines. The quality of evidence of night-time exposure to wind turbine noise is too low to allow a recommendation."*
>
> *"To reduce health effects, the GDG conditionally recommends that policy-makers implement suitable measures to reduce noise exposure from wind turbines in the population exposed to levels above the guideline values for average noise exposure. No evidence is available, however, to facilitate the recommendation of one particular type of intervention over another."*

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

The WHO Environmental Noise Guidelines aim to support the legislation and policy-making process on local, national and international level and have been considered by Irish policy makers for the Draft Wind Farm Guidelines (December 2019).

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

> *"Even though correlations between noise indicators tend to be high (especially between L_{Aeq}-like indicators) and conversions between indicators do not normally influence the correlations between the noise indicator and a particular health effect, important assumptions remain when exposure to wind turbine noise in L_{den} is converted from original sound pressure level values. The conversion requires, as variable, the statistical distribution of annual wind speed at a particular height, which depends on the type of wind turbine and meteorological conditions at a particular geographical location. Such input variables may not be directly applicable for use in other sites. They are sometimes used without specific validation for a particular area, however, because of practical limitations or lack of data and resources. This can lead to increased uncertainty in the assessment of the relationship between wind turbine noise exposure and health outcomes. Based on all these factors, it may be concluded that the acoustical description of wind turbine noise by means of L_{den} or L_{night} may be a poor characterization of wind turbine noise and may limit the ability to observe associations between wind turbine noise and health outcomes."*

WHO document goes on to state that:

> *"Further work is required to assess fully the benefits and harms of exposure to environmental noise from wind turbines and to clarify whether the potential benefits associated with reducing exposure to environmental noise for individuals living in the vicinity of wind turbines outweigh the impact on the development of renewable energy policies in the WHO European Region."*

Based upon the above review, it is concluded that the conditional WHO recommended average noise exposure level (i.e. 45dB L_{den}) if applied, as target noise criteria for an existing or proposed wind turbine development in Ireland, should be done with caution. Irrespective of this, based upon predictive noise modelling conducted and operational site measurements (as per Sections 5.6.3.6 and 5.6.4.2), it is clear that noise levels associated with the Derrybrien wind farm site complies with the conditional WHO recommended average noise exposure level.

5.4.2.1.6 Draft Revised Wind Energy Development Guidelines (2019)

The Department of Housing, Planning & Local Government published the Draft Revised Wind Energy Development Guidelines (2019) for consultation. While there are a number of technical issues and contradictions within the document the core intent can be summarised as follows:

Relative rated noise levels ($L_{A\ rated,\ 10min}$) resulting from wind energy development and taking into account the cumulative impact of noise levels resulting from other existing and approved wind energy developments shall not exceed:

(1) Background noise levels by more than 5 dB(A) within the range 35-43dB(A), or
(2) 43 dB(A)

both measured as $L_{90,10\ min}$ outdoors at specified noise sensitive locations.

The rated noise level considers appropriate corrections for special characteristics, which as discussed previously (see Section 5.3), are not considered to be issues associated with the turbines under consideration here.

The draft guidance outlines measures to assign day and evening noise criteria curves based on background night time noise levels. In order to simplify the assessment presented here, if it is demonstrated that the night time criteria are achieved by the wind farm it can be inferred that the relaxed day and evening criteria that are allowed for in the draft guidance will by default also be satisfied.

It is reiterated that this document is in draft form and that significant concern has been expressed[1] in relation to specific issues and the drafting of the document in terms of technical accuracy and the practical implementation of the guidance.

5.4.2.2 Overhead Power Lines

The following extract from *the "EirGrid Evidence Based Environmental Studies Study 8: Noise – Literature review and evidence-based field study on the noise effects of high voltage transmission development (May 2016)* states the following in relation to noise impacts associated with 110kV substation installations:

> *"The noise studies on 110kV and 220kV OHL present a strong database of evidence that indicates that these lines do not produce steady state noise levels that are likely to result in a significant noise impacts at receptors in the vicinity of them. There is no evidence that random corona discharge events are sufficiently regular or loud as to result in significant noise impacts to noise sensitive receptors in their vicinity. On this basis, the planning of 110kV and 220kV OHL should not be significantly constrained on the basis of potential noise issues associated with these types of infrastructure."*

Based on the above, operational noise from overhead lines is not considered to be an issue at noise sensitive locations within the study area of interest.

5.4.2.3 Substations

The following extract from *the "EirGrid Evidence Based Environmental Studies Study 8: Noise – Literature review and evidence-based field study on the noise effects of high voltage transmission development (May 2016)* states the following in relation to noise impacts associated with 110kV substation installations:

> *"The survey on the 110kV substation at Dunfirth indicated that measured noise levels (L_{Aeq}) were less than 40dB(A) at 5m from each of the boundaries of the substation. This is below the WHO night-time free-field threshold limit*

[1] https://www.ioa.org.uk/wind-energy-development-guidelines-wedg-consultation-irish-department-housing-planning-community-and

of 42dB for preventing effects on sleep and well below the WHO daytime threshold limits for serious and moderate annoyance in outdoor living areas (i.e. 55dB and 50dB respectively). Spectral analysis of the data recorded at this site demonstrated that there were no distinct tonal elements to the recorded noise level. To avoid any noise impacts from 110kV substations at sensitive receptors, it is recommended that a minimum distance of 5m is maintained between 110kV substations and the land boundary of any noise sensitive property."

The noise emissions arising from both Derrybrien and Agannygal Substations are comparable to the noise emissions from the 110kV unit discussed above and considering the distance between the 110kV substation and the nearest off-site locations (i.e. >250m) noise from the substations is not considered an issue for the Project.

Considering the above, it is concluded that there will be no significant noise emissions from the operation of the substations. Consequently, there is no requirement to assess any operational noise emissions or ongoing impacts.

5.4.2.4 Vibration

There will be no vibration emissions from the operation of wind turbines, overhead power lines and/or substations that are subject of this assessment. Consequently, there is no requirement to assess any operational vibration emissions.

5.5 Receiving Environment

This stage of the assessment was to determine typical baseline and operational noise levels in the vicinity of the noise sensitive locations (NSL's) in closest proximity to the project site. This was done through installing unattended sound level meters at two representative locations to the south of the site (R21 and R35) for an extended period. Additional attended surveys were completed in the vicinity of the Agannygal substation and in proximity to the borrow pits (see Figures 5.12) that were used for works associated with the peat slide.

5.5.1 Wind Farm Baseline Surveys

5.5.1.1 Preliminary 35dB(A) Noise Contour

In relation to the wind farm, the procedure for selection of baseline noise monitoring locations (as espoused in IoA GPG) is to identify nearby NSL's within the 35dB(A) noise prediction contour and to select appropriate monitoring positions within this zone.

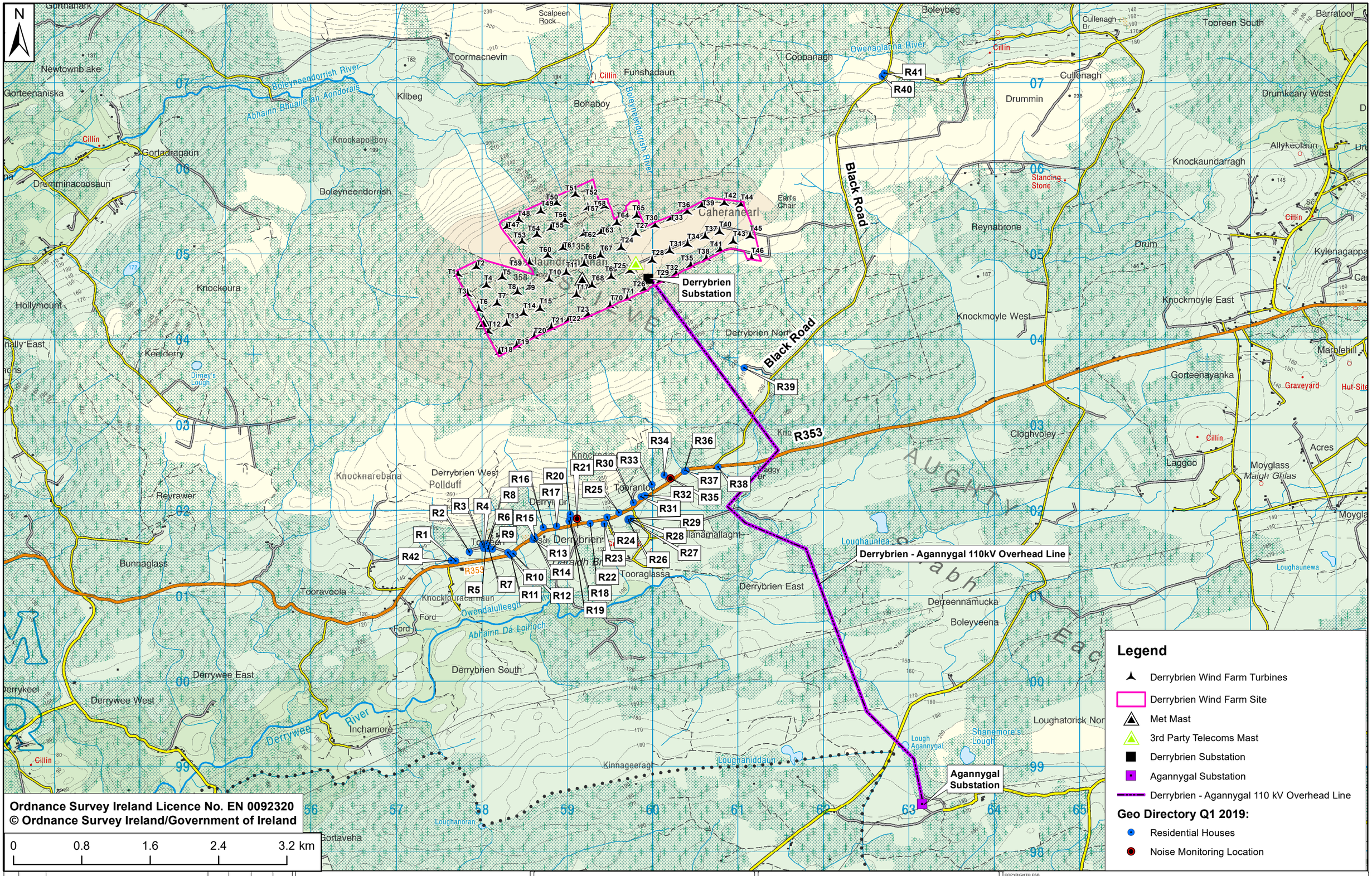
Preliminary noise modelling was therefore required in order to select appropriate monitoring positions. The results of preliminary noise modelling at turbine rated power indicate that worst-case down-wind noise levels are in the range 29 to 35dB at the 40 no. NSL's with a level of some 39.6dB(A) predicted at the long term derelict property (R39).

Figure 5.2 illustrates the noise monitoring locations considered in relation to the wind farm aspect of the project.

There are three NSL's that fall within the 35 – 38dB noise contour, R35, R36 and R37, each with a calculated noise level of the order of 35dB $L_{A90,10min}$ (see Figure 5.3). Note that all predictions and contours presented in this assessment consider the impact of the Derrybrien wind farm along with the cumulative effect of Sonnagh Old wind farm located to the north.

As Location R35, R36 and R37 are neighbouring properties, a single baseline noise monitoring location (R35) was selected to cover these dwellings using the IoA GPG principal of 'proxy'. An additional location was selected at Location R21 to establish noise levels at a dwelling approx. 1.4km to the west of R35, where a worst-case down-wind noise level of 31.6dB L_{A90} is predicted.

In upwind conditions i.e. conditions whereby wind is blowing from the residences towards the turbines, at turbine rated power, the results of the preliminary noise model indicated that noise levels will be 19dB $L_{A90,10m}$ at R21 and 24dB at R36 (see Figure 5.4).



REV	DATE	REVISION DESCRIPTION	DRN	PROD	VER	APP
0	16/07/20	Issued for substitute consent	E.O'S	E.O'S	P.K	J.McL

PURPOSE OF ISSUE - PRELIMINARY UNLESS INDICATED

CLIENT APPROVAL ☐ PLANNING ☒ TENDER ☐ CONSTRUCTION ☐ AS-BUILT ☐

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CLIENT: Gort Windfarms Ltd

PROJECT: Derrybrien Wind Farm, Co. Galway

CONTRACT

PRODUCTION UNIT: Civil & Environmental Engineering

DRAWING TITLE:

Figure 5.2 - Derrybrien Wind Farm - Unattended Noise Monitoring Locations

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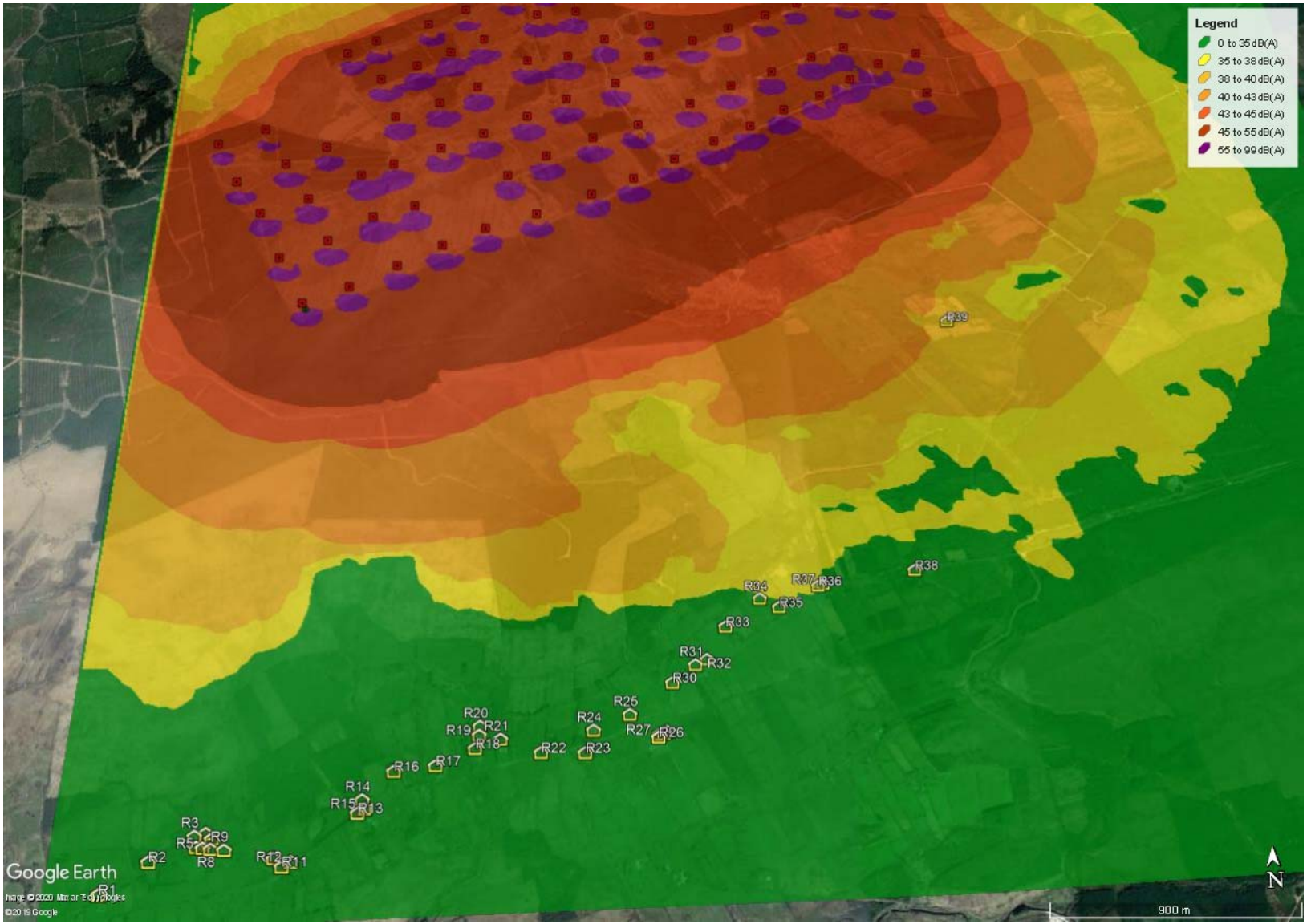


Figure 5.3 35dB(A) Noise Contour, ≥8m-s Wind Speed, Omni-directional (i.e. downwind to all dwellings)

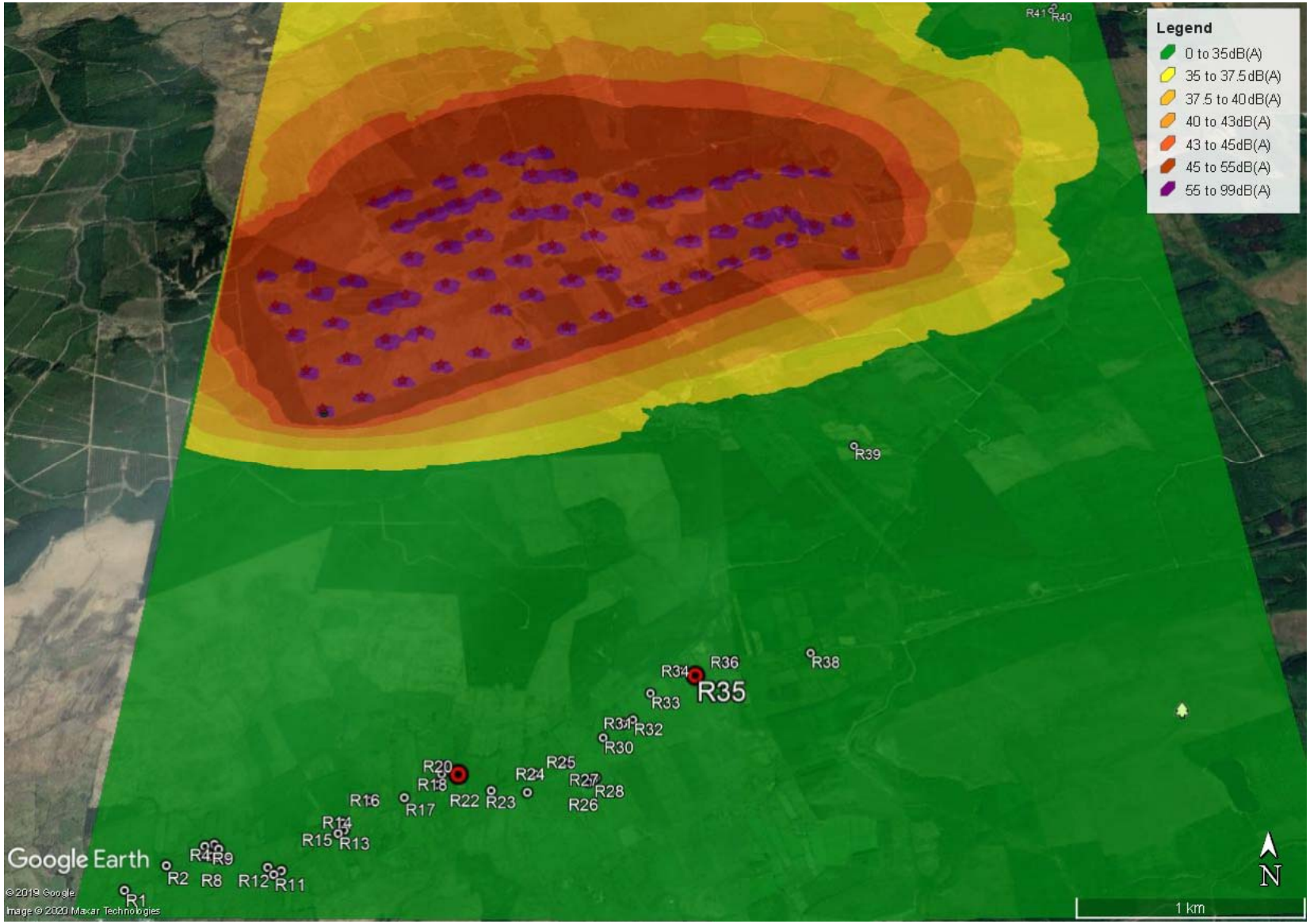


Figure 5.4 35dB(A) Noise Contour, 8m-s Wind Speed, Upwind to R21 and R35 (i.e. Southerly Winds)

5.5.1.2 Derivation of baseline background noise levels

For guidance, reference has been made to the IOA Good Practice document (IoA GPG). This document provides various methods for the derivation of suitable background noise levels without turning off turbines. The approach adopted here is to apply wind directional filtering to the measured data in order to assess background noise data when it is not influenced by the existing turbines e.g. upwind of the receptor.

Based on the results of the preliminary noise modelling the following approach to data collection for the noise impact assessment is provided:

- Due to the distance from the site to the nearby NSL's, preliminary noise modelling indicated that baseline noise can be established at the two monitoring locations in upwind conditions (i.e. wind blowing broadly southerly). Upwind conditions are calculated to be between 150 to 215 degrees for monitoring location R21 and 115 to 200 degrees for monitoring location R35. The selected wind direction ranges are in accordance with Section 2.1.7 of the IoA GPG *Supplementary Guidance Note 5*.
- Operational noise levels can be established at monitoring locations in downwind conditions (i.e. wind blowing from the site to the monitoring location). Downwind conditions are calculated as to be between 300 to 20 degrees for monitoring location R35. Again, the selected wind direction ranges are in accordance the IoA Guidance.

5.5.1.3 Choice of Measurement Locations

The selected locations for the noise monitoring are outlined in further detail in the following sections. Figures 5.5 to 5.6 illustrate the siting of the noise monitoring installations. Coordinates for the noise monitoring locations are detailed in Table 5.3.

Table 5.3 Measurement Location Coordinates

Location	Coordinates - Irish Grid (ITM)	
	Easting	Northing
R21	559,080	701,931
R35	560,173	702,404

Figure 5.5 Location R21

Figure 5.6 Location R35

Noise sources were noted to be local road traffic, distant road traffic, local farm machinery and activity and other anthropological sources. Wind generated noise in local foliage was noted to be contributing to the background noise at both locations and in general at all dwellings in the locality.

It is considered that the background noise monitoring locations give a robust picture of background noise levels experienced at typical residential noise sensitive locations surrounding the site.

5.5.1.4 Measurement Periods

Noise measurements were conducted at each of the monitoring locations over the following periods:

Table 5.4 Noise Measurement Periods

Location	Start Date	End Date
R21	10:00hrs 10th September 2018	12:30hrs on 2nd November 2018
R35	10:20hrs 12th September 2018	13:00hrs on 2nd November 2018

A sufficient variety of wind speed and weather conditions were encountered over the survey periods quoted above to characterise noise levels over a range of wind conditions. Figure 5.7 illustrates the distributions of wind speed and wind direction at standardised 10m height wind speed, over the survey period detailed in Table 5.4.

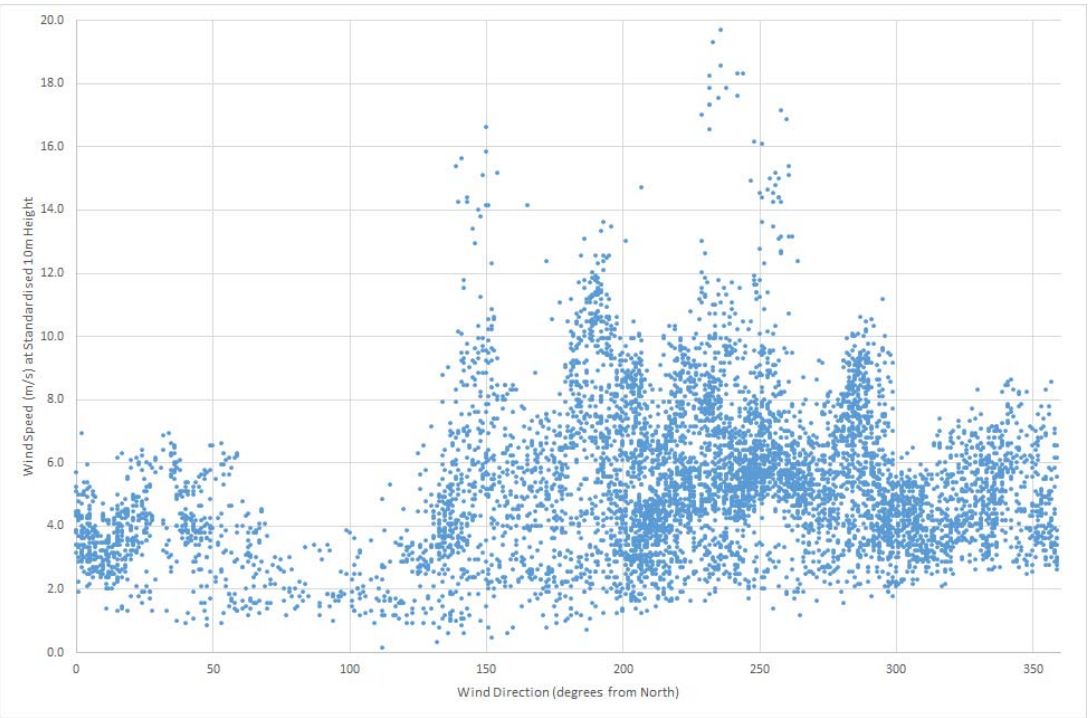


Figure 5.7 Distributions of Wind Speeds & Direction during the Survey

5.5.1.5 Personnel & Instrumentation

AWN Consulting installed and removed the noise monitors at all locations. The following instrumentation was used at the various locations:

Table 5.5 Instrumentation

Location	Equipment	Serial Number
R21	Brüel & Kjaer 2250	3010911
R35	Brüel & Kjaer 2250	2818081

Before and after each phase of the monitoring survey noise measurement equipment was check calibrated using a Brüel & Kjær type 4231 Sound Level Calibrator. A copy of the relevant calibration certification for the instrument is presented in Appendix 5.6.

Rain fall was monitored and logged using a Texas Electronics Rainfall Sensor, Model TR 525. The rainfall data allows for the identification of periods of rainfall so that they can be removed from the noise monitoring data sets, in line with best practice, when calculating the prevailing background noise levels at the various locations. The rainfall monitor was located on site for the duration of the survey.

Wind speed and directional data was obtained from an existing meteorological mast installed in the vicinity of the study area, at a height of 49 metres.

5.5.1.6 Procedure

Sample periods for the noise measurements were 10-minutes during both the daytime and night-time periods. The $L_{A90,10min}$ results were saved to the instrument memory for later analysis. Survey personnel noted primary noise sources contributing to noise build-up during the installation and removal of the sound level meters from site (e.g. identified significant noise sources in the area such as local traffic or farmyard activities).

5.5.1.7 Consideration of Wind Shear

As part of a robust wind farm noise assessment due consideration should be given to the issue of wind shear. It is standard procedure to reference noise data to standardised 10 metre wind speed. The issue of wind shear has been considered in this assessment and followed relevant guidance as outlined in the IoA GPG. This guidance presents the following equations in relation to the derivation of a standardised wind speed at 10m above ground level:

Equation A
Shear Exponent Profile:

this uses the following equation:

$$U = U_{ref} \times (H \div H_{ref})^{m}$$

Where:

U	calculated wind speed.
U_{ref}	measured wind speed.
H	height at which the wind speed will be calculated.
H_{ref}	height at which the wind speed is measured.
m	shear exponent.

Equation B
Roughness Length Shear Profile:

this uses the following equation:

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

Where:

H_1	the height of the wind speed to be calculated (10m)
H_2	the height of the measured wind speed.
U_1	the wind speed to be calculated.
U_2	the measured 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 61400-11:2003 standard, regardless of what the actual roughness length seen on a site may have been. This ‘normalisation’ procedure was adopted for comparability between test results for different turbines.

As outlined previously, wind speed and direction data were obtained from an on-site meteorological mast. Any reference to wind speed in the following sections of this chapter should be understood to be the 10m height standardised wind speed reference unless otherwise stated.

5.5.1.8 Results

The results of the background noise monitoring programme are extensive. The raw data sets are presented in Appendix 5.5, along with the measured and derived [Note E] wind speeds for the survey period. A sufficient range of valid data points was collected in the various wind speed bins.

Note E Derived to a height of 10m above ground based on guidance contained within Institute of Acoustics Acoustic IoA GPG, Supplementary Guidance Note (SGN) 4: Wind Sheer, July 2014.

The following sections present an overview and statistical analysis of the noise monitoring data obtained from the survey programme at each location for both daytime and night time periods.

The results presented in the following sections refer to the noise data collated during ‘quiet periods’ of the day and night as defined in the IoA GPG. These periods are 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 is defined as 23:00 to 07:00hrs.

The data sets have been filtered to remove issues such as periods of rainfall, the dawn chorus, and the influence of other atypical noise sources. An example of atypical sources would be short isolated periods of raised noise levels attributable to local sources, agricultural activity, boiler flues, operation of gardening equipment etc.

5.5.1.8.1 Location R21

Daytime Period

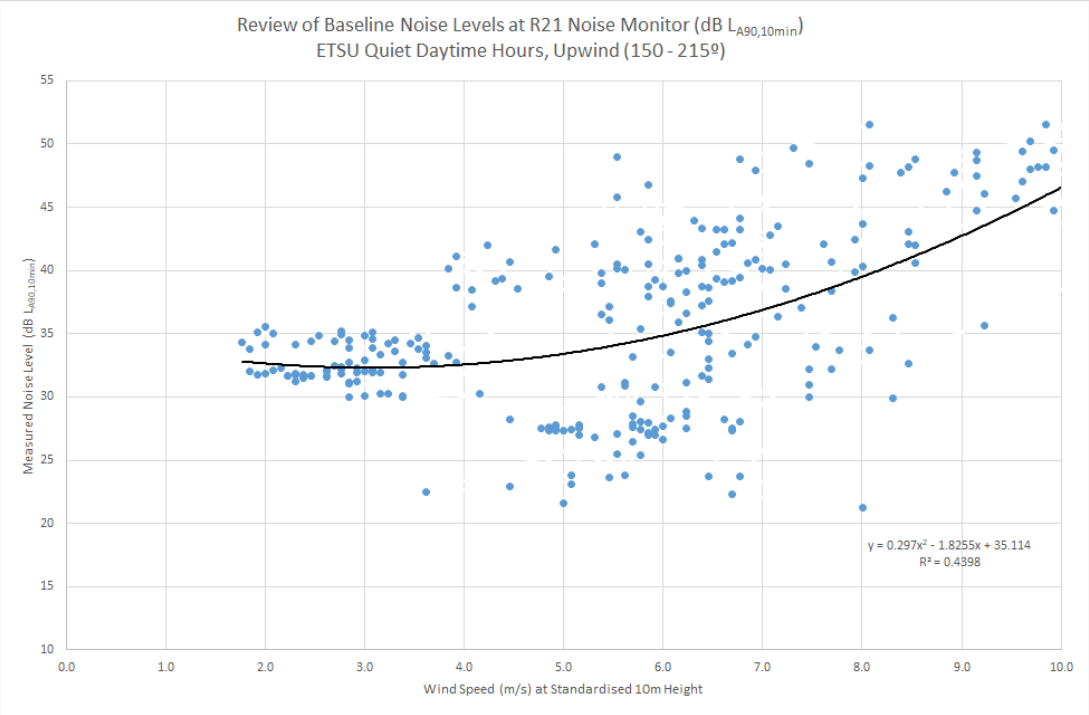


Figure 5.8 Baseline Noise Levels LA90, 10 min dB – Location R21 – Daytime (with Turbines)

Night Time

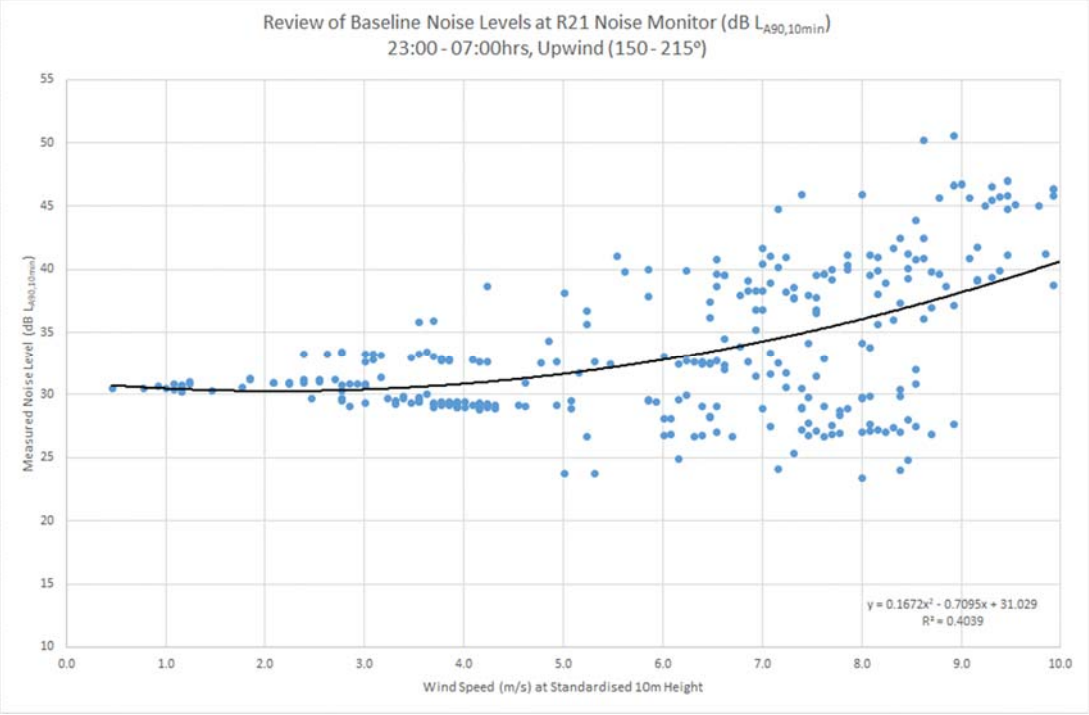


Figure 5.9 Baseline Noise Levels LA90, 10 min dB – Location R21 – Night Time (with Turbines)

5.5.1.8.2 ocation R35

Daytime Period

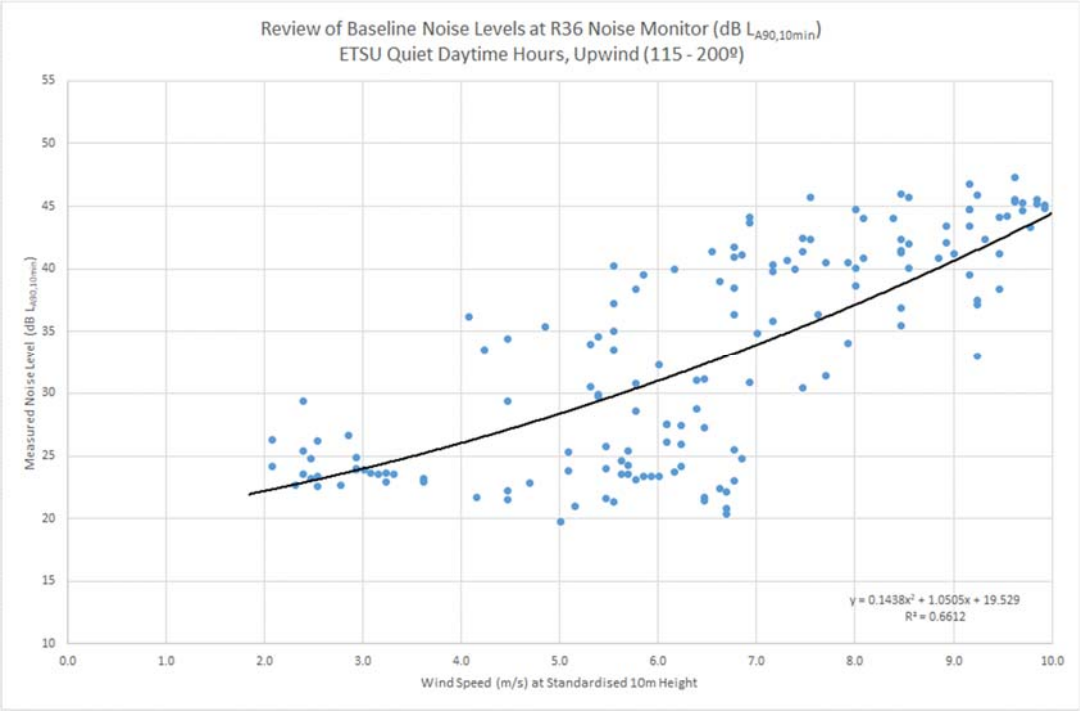


Figure 5.10 Baseline Noise Levels LA90, 10 min dB – Location R35 – Daytime (with Turbines)

Night Time

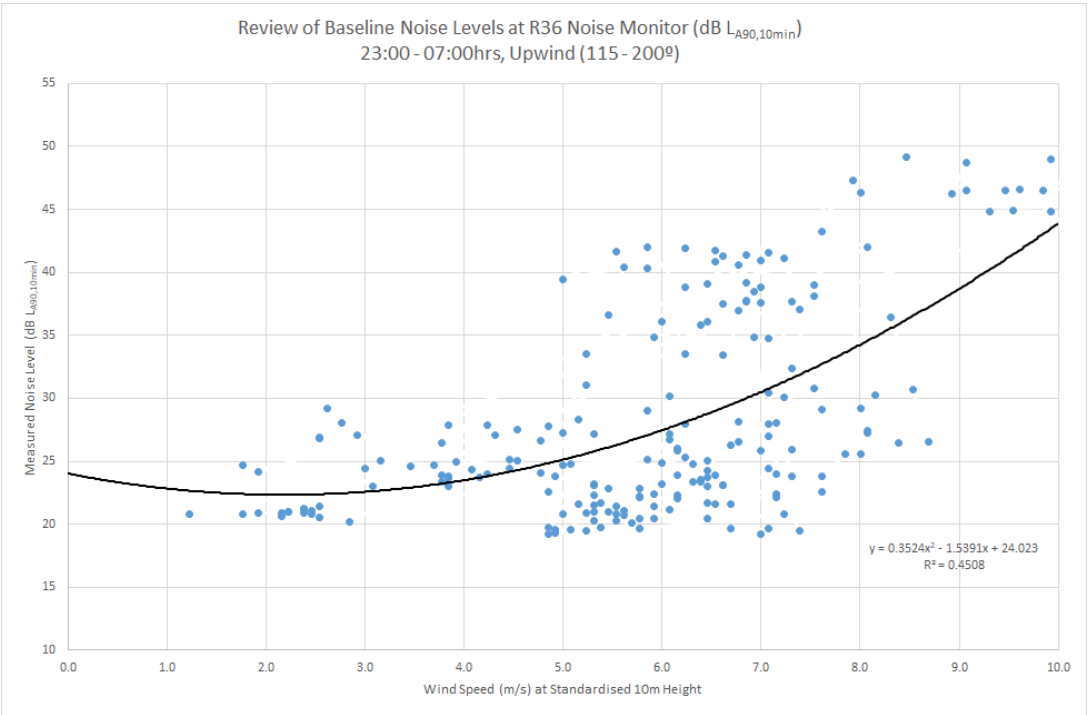


Figure 5.11 Baseline Noise Levels LA90, 10 min dB – Location R35 – Night Time (with Turbines)

5.5.1.8.3 Summary

Table 5.6 presents the various derived $L_{A90,10min}$ baseline noise levels for each of the monitoring locations for daytime quiet periods and night time periods, in upwind conditions with the Derrybrien turbines in operation. These levels have been derived using regression analysis carried out on the directional data sets in line with best practice guidance.

Table 5.6 Derived Levels of LA90, 10 min for Various Wind Speeds (Upwind) for 2019 with turbines

Location	Period	Derived $L_{A90,\ 10\ min}$ Levels (dB) at various Standaridsed10m Height Above Ground Wind Speed (m/s)						
		4	5	6	7	8	9	10
R21	Day	32.6	33.4	34.9	36.9	39.5	42.7	46.6
	Night	30.9	31.7	32.8	34.3	36.1	38.2	40.7
R35	Day	26.0	28.4	31.0	33.9	37.1	40.6	44.4
	Night	23.5	25.1	27.5	30.5	34.3	38.7	43.9

The noise levels presented above are measured under upwind conditions (i.e. when the wind is blowing from the direction of the two dwellings to the turbines). Noise modelling has been used to verify that there is minimal influence from operational turbines on baseline values under these conditions as illustrated in Figure 5.4.

Additional corrections have also been applied to the measured baseline values to account for any potential small influence from operational turbine noise on the baseline data-sets. These corrections (as per IoA GPG Section 5.2.3) consist of the logarithmic subtraction of the noise model results during upwind conditions, from the measured baseline noise levels.

Table 5.7 Location R21 Corrected LA90, 10 min Baseline Noise Levels: Daytime under Upwind Conditions

Location	Ref	$L_{A90,\ 10\ min}$ Levels (dB) at various Standaridsed10m Height Above Ground Wind Speed (m/s)						
		4	5	6	7	8	9	10
R21 Day	Measured Baseline (with Turbines)	32.6	33.4	34.9	36.9	39.5	42.7	46.6
	Noise Model Prediction (Turbines Only)	16.7	16.7	16.7	18.5	18.9	18.9	18.9
	Corrected Baseline Values (Turbines Removed)	**32.4**	**33.3**	**34.8**	**36.8**	**39.5**	**42.7**	**46.6**

Table 5.8 Location R21 Corrected LA90, 10 min Baseline Noise Levels: Night-time under Upwind Conditions

Location	Ref	$L_{A90,\ 10\ min}$ Levels (dB) at various Standaridsed10m Height Above Ground Wind Speed (m/s)						
		4	5	6	7	8	9	10
R21 Night	Measured Baseline (with Turbines)	30.9	31.7	32.8	34.3	36.1	38.2	40.7
	Noise Model Prediction (Turbines Only)	16.7	16.7	16.7	18.5	18.9	18.9	18.9
	Corrected Baseline Values (Turbines Removed)	**30.7**	**31.5**	**32.7**	**34.1**	**36.0**	**38.1**	**40.6**

Table 5.9 Location R35 Corrected LA90, 10 min Baseline Noise Levels: Daytime under Upwind Conditions

Location	Ref	$L_{A90,\ 10\ min}$ Levels (dB) at various Standaridsed10m Height Above Ground Wind Speed (m/s)						
		4	5	6	7	8	9	10
R35 Day	Measured Baseline (with Turbines)	26.0	28.4	31.0	33.9	37.1	40.6	44.4
	Noise Model Prediction (Turbines Only)	21.8	21.8	21.8	23.6	24.0	24.0	24.0
	Corrected Baseline Values (Turbines Removed)	**24.0**	**27.3**	**30.5**	**33.5**	**36.9**	**40.5**	**44.4**

Table 5.10 Location R35 Corrected LA90, 10 min Baseline Noise Levels: Night-time under Upwind Conditions

Location	Ref	$L_{A90,\ 10\ min}$ Levels (dB) at various Standaridsed10m Height Above Ground Wind Speed (m/s)						
		4	5	6	7	8	9	10
R35 Night	Measured Baseline (with Turbines)	23.5	25.1	27.5	30.5	34.3	38.7	43.9
	Noise Model Prediction (Turbines Only)	21.8	21.8	21.8	23.6	24.0	24.0	24.0
	Corrected Baseline Values (Turbines Removed)	**18.6**	**22.4**	**26.1**	**29.5**	**33.8**	**38.6**	**43.8**

The corrected baseline noise data has been used to derive noise limits for noise sensitive locations.

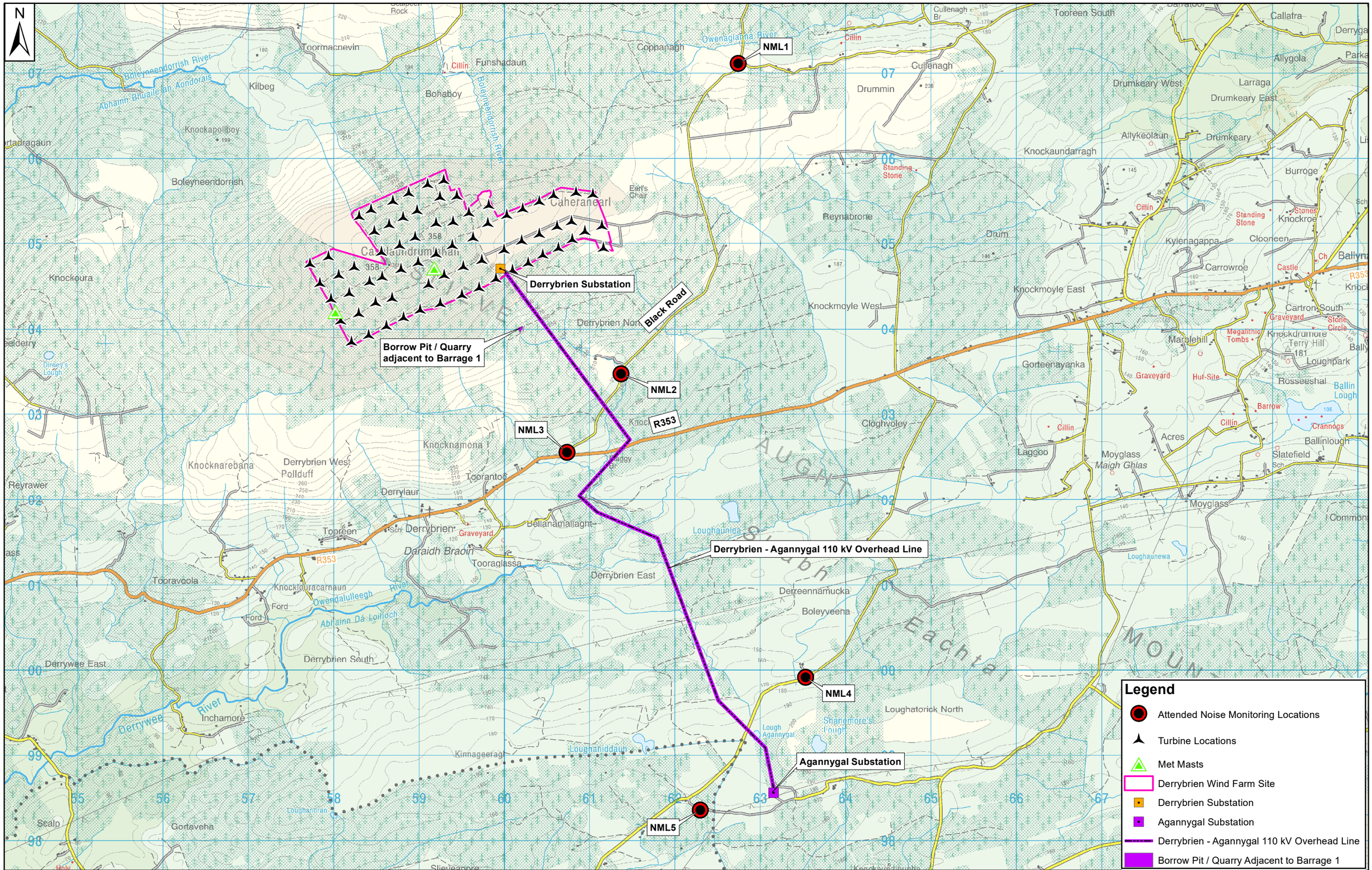
5.5.2 Attended Surveys for Substations

An environmental noise survey was conducted in order to quantify the existing noise environment in the vicinity of the Derrybrien and Agannygal 110kV substations. Additional monitoring locations were identified in order to give a representative picture of the noise environment near the closest noise sensitive locations to the borrow pits used in the peat slide works. The surveys were conducted in general accordance with *ISO1996-2: 2017 Acoustics - Description, Measurement and Assessment of Environmental Noise – Determination of Environmental Noise Levels*. Specific details are set out in the following sections.

5.5.2.1 Choice of Measurement Locations

Attended noise monitoring was completed at five locations as in Figure 5.12.

Locations NML1, NML2 and NML3 were selected in order to give a representation of the noise environment of the Derrybrien substation and the Borrow Pit/Quarry adjacent to Barrage 1 utilised during works completed following the peat slide on the site. Locations NML4 and NML5 were selected to be representative of the nearest noise sensitive locations to the Agannygal Substation.



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PROJECT: **Derrybrien Wind Farm Project**

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Figure 5.12 - Attended Noise Monitoring Locations

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5.5.2.2 Personnel & Instrumentation

Donal Heavey (AWN) conducted the measurements during the survey. The noise measurements were conducted using a Brüel & Kjær Type 2250 Sound Level Meter (S/N 2818091). The measurement apparatus was check calibrated both before and after the measurement survey using a Brüel & Kjær Type 4231 Sound Level Calibrator.

5.5.2.3 Procedure

Measurements were conducted at NML 1 to 5 on a cyclical basis. Sample periods for the noise measurements were 15 minutes during all survey periods. The results were noted onto a Survey Record Sheet immediately following each sample and were also saved to the instrument memory for later analysis where appropriate. Survey personnel noted all primary noise sources contributing to noise build-up.

5.5.2.4 Results

5.5.2.4.1 Location NML1

Table 5.11 Review of Noise Monitoring at Locations NML1

Period	Date Time	Measured Noise Levels (dB re. $2x10^{-5}$ Pa)		
		L_{Aeq}	L_{Amax}	L_{A90}
Night	30/10/2019 22:52	45	67	34
Night	30/10/2019 23:58	35	50	34
Day	31/10/2019 11:06	36	60	31
Day	31/10/2019 12:09	39	61	31
Day	31/10/2019 13:12	49	77	31

Ambient (i.e. L_{Aeq}) daytime and night time noise levels at this location were dictated by occasional road traffic movements, occasional distant residential construction noise, running water, wind generated noise in local foliage and birdsong. Background noise levels were typically dictated by wind generated noise in local foliage. Noise levels were in the range of 36 to 49dB $L_{Aeq,15min}$ and of the order of 31dB $L_{A90,15min}$ during daytime periods and between 35 and 45dB $L_{Aeq,15min}$ and the order of 34dB $L_{A90,15min}$ during night time periods. The slightly higher ambient noise levels were due to a car passing nearby the monitoring position during the monitoring period. The slightly higher background levels noted during night time periods at this location were due to slightly higher wind speeds and associated wind generated noise noted during night time periods compared to the daytime.

5.5.2.4.2 Location NML2

Table 5.12 Review of Noise Monitoring at Locations NML2

Period	Time	Measured Noise Levels (dB re. $2x10^{-5}$ Pa)		
		L_{Aeq}	L_{Amax}	L_{A90}
Night	30/10/2019 23:14	36	52	35
Night	31/10/2019 00:20	36	56	35
Day	31/10/2019 11:28	53	80	35
Day	31/10/2019 12:30	35	56	28
Day	31/10/2019 13:33	49	75	28

Ambient (i.e. L_{Aeq}) daytime and night time noise levels at this location were dictated by occasional road traffic movements, running water, wind generated noise in local foliage and birdsong. Background noise levels were typically dictated by wind generated noise in local foliage. Noise levels were in the range of 35 to 53dB $L_{Aeq,15min}$ and 28 to 35dB $L_{A90,15min}$ during daytime periods and between 35 and 49dB $L_{Aeq,15min}$ and the order of 35dB $L_{A90,15min}$ during night time periods. The slightly higher ambient noise levels were due to a car passing nearby the monitoring position during the monitoring period. The slightly higher background levels noted during night time periods at this location were due to wind speeds and associated wind generated noise noted during night time periods compared to the daytime.

5.5.2.4.3 Location NML3

Table 5.13 Review of Noise Monitoring at Locations NML3

Period	Time	Measured Noise Levels (dB re. $2x10^{-5}$ Pa)		
		L_{Aeq}	L_{Amax}	L_{A90}
Night	30/10/2019 23:34	33	46	31
Night	31/10/2019 00:38	34	53	31
Day	31/10/2019 11:46	55	82	29
Day	31/10/2019 12:49	49	77	27
Day	31/10/2019 14:01	47	71	27

Ambient (i.e. L_{Aeq}) daytime and night time noise levels at this location were dictated by occasional road traffic movements, distant forestry activity (i.e. chainsaws), running water, wind generated noise in local foliage and birdsong. Background noise levels were typically dictated by wind generated noise in local foliage. Noise levels were in the range of 47 to 55dB $L_{Aeq,15min}$ and 27 to 29dB $L_{A90,15min}$ during daytime periods and between 33 and 34dB $L_{Aeq,15min}$ and the order of 31dB $L_{A90,15min}$ during night time periods. The slightly higher ambient noise levels were due to a car passing

nearby the monitoring position during the monitoring period. The slightly higher background levels noted during night time periods at this location were due to slightly higher wind speeds and associated wind generated noise noted during night time periods compared to the daytime.

5.5.2.4.4 Location NML4

Table 5.14 Review of Noise Monitoring at Locations NML4

Period	Time	Measured Noise Levels (dB re. $2x10^{-5}$ Pa)		
		L_{Aeq}	L_{Amax}	L_{A90}
Night	31/10/2019 01:24	38	64	28
Day	31/10/2019 14:30	48	77	21
Day	31/10/2019 15:15	30	53	21
Day	31/10/2019 15:53	39	65	21

Ambient (i.e. L_{Aeq}) daytime and night time noise levels at this location were dictated by occasional road traffic movements, dogs barking, wind generated noise in local foliage and birdsong. Background noise levels were typically dictated by wind generated noise in local foliage. Noise levels were in the range of 30 to 48dB $L_{Aeq,15min}$ and the order of 21dB $L_{A90,15min}$ during daytime periods and the order of 38dB $L_{Aeq,15min}$ and 28dB $L_{A90,15min}$ during night time periods. The slightly higher ambient noise levels were due to passing cars nearby. the monitoring position during the monitoring period. The slightly higher background levels noted during night time periods at this location were due to increased wind speeds and associated wind generated noise noted during night time periods compared to the daytime.

5.5.2.4.5 Location NML5

Table 5.15 Review of Noise Monitoring at Locations NML5

Period	Time	Measured Noise Levels (dB re. $2x10^{-5}$ Pa)		
		L_{Aeq}	L_{Amax}	L_{A90}
Night	31/10/2019 01:50	40	51	36
Day	31/10/2019 14:55	34	57	28
Day	31/10/2019 15:34	37	56	25
Day	31/10/2019 16:13	33	59	26

Ambient (i.e. L_{Aeq}) daytime and night time noise levels at this location were dictated by distant road traffic movements, wind generated noise in local foliage and birdsong. Background noise levels were typically dictated by wind generated noise in local foliage. Noise levels were in the range of 33 to 37dB $L_{Aeq,15min}$ and 25 to 28dB $L_{A90,15min}$ during daytime periods and the order of 40dB $L_{Aeq,15min}$ and 36dB $L_{A90,15min}$ during night

time periods. The slightly higher ambient noise levels were due to a car passing nearby the monitoring position during the monitoring period. The slightly higher background levels noted during night time periods at this location were due to increased wind speeds and associated wind generated noise noted during night time periods comparted to the daytime.

5.6 Impact of the Development

5.6.1 Impacts which have occurred

5.6.1.1 Construction – Phase 1- June 2003 – Oct 2003

A variety of items of plant were used for the purposes of site preparation, construction of turbines, substations, borrow pit operation, grid connection and other site works (Refer Chapter 2 Project Description).

There would have been vehicular movements to and from the site that will make use of existing roads. Due to the nature of these activities, there would have been a potential for generation of significant levels of noise.

It is possible to predict typical noise levels using guidance set out in British Standard *BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise*. In this instance, the noise-sensitive locations surrounding the site are located at varying distances with the closest occupied noise sensitive located approximately 2.1km from the nearest turbine location. There is a derelict, uninhabited building (R39) some 1.2km from the nearest turbine location. This has been included in the construction noise assessment to consider a worst case assessment although it is understood it was not occupied during the duration of the construction works associated with the Project and remains derelict at the time of the preparation of this assessment.

Several indicative sources that would be expected on a site of this nature have been identified and noise predictions of their potential impacts prepared to nearby houses. The assessment is considered representative of a worst-case scenario, with construction noise at slightly lower levels at properties at a further distance from the works.

5.6.1.1.1 Wind Turbine -bases/hard standings

Table 5.16 outlines the noise levels associated with typical construction noise sources assessed in this instance along with typical sound pressure levels and spectra from BS 5228 – 1.

Table 5.16 Typical Wind Farm Turbine Construction Noise Emission Levels

Item (BS 5228 Ref.)	Activity/Notes	Plant Noise Level at 10m Distance (dB $L_{Aeq,1hr}$) Note F	Predicted Noise Level at 1,300m (dB $L_{Aeq,1hr}$)	Predicted Noise Level at 2,100m (dB $L_{Aeq,1hr}$)
HGV Movement (C.2.30)	Removing spoil and transporting fill and other materials.	79	37	33
Tracked Excavator (C.4.64)	Removing soil and rubble in preparation for the foundations.	77	35	31
Piling Operations (C.12.14)	Standard pile driving.	88	46	42
General Construction (Various)	All general activities plus deliveries of materials and plant.	70 – 84	42	38
Dewatering Pumps (D.7.70)	If required.	80	38	34
JCB (D.8.13)	For services, drainage and landscaping.	82	40	36
Vibrating Rollers (D.8.29)	Road surfacing.	77	35	31
Total Construction Noise (cumulative for all activities)			49	45

Note F All plant noise levels are derived from BS 5228: Part 1

The predicted noise levels from construction activities are in the range 35 to 46dB $L_{Aeq,1hr}$ at the nearest derelict, uninhabited house (R39), with a total construction noise level of approximately 49dB $L_{Aeq,1hr}$.

At the nearest occupied dwelling (e.g. R35) the predicted construction noise levels are in the range 31 to 42dB $L_{Aeq,1hr}$ with a total construction noise level of approximately 45dB $L_{Aeq,1hr}$.

The predicted noise levels are below the construction noise criterion identified in Section 5.4.1.1 (i.e. 65dB $L_{Aeq,1hr}$) which indicates that the wind farm construction did not give rise to significant noise impact. It is understood construction works of the Project were carried out during daytime hours. It is noted that the predicted levels of construction noise at the nearest noise sensitive properties are below the evening, night time and weekend criteria outlined in Section 5.4.1.1 also.

Due to the distance of the construction works from noise sensitive locations significant vibration impacts would not have been perceptible and would have been significantly below levels where cosmetic or structural damage would occur.

In terms of these construction activities, the associated likely effect was:

Quality	*Significance*	*Duration*
Negative	Slight	Short-term

5.6.1.1.2 Internal Wind Farm Roads & Temporary Roads

New internal roads and temporary roads were constructed for the Project. Review of the road layout has identified that the nearest NSL to any point along the roads is assumed to be 100m to such activities to present a worst-case assumption. The majority of noise sensitive locations are at significantly greater distances to those reviewed here therefore any associated noise impacts would have been further reduced in these instances.

Table 5.17 outlines the typical construction noise levels associated with the works for this element of the construction. Calculations have assumed an on time 66% for each item of plant i.e. 8-hours over a 12 hours assessment period.

Table 5.17 Indicative Noise Levels from Construction Plant at Various Distances from the Road Works

Item (BS 5228 Ref.)	Activity/Notes	Noise Level (dB $L_{Aeq,1hr}$) Note G			
		100 m	200 m	300 m	400 m
HGV (C.2.30)	Removing spoil and transporting fill and other materials.	50	44	40	37
Mini Tracked Excavator with Rock Breaker (C5.2)	Removing soil and rubble.	54	48	44	41
Vibration Rollers (D.8.29)	--	48	42	38	35
Total Construction Noise (cumulative for all activities)		56	51	46	43

Note G All plant noise levels are derived from BS 5228: Part 1

At the nearest noise sensitive location, the predicted noise levels from construction activities are of the order of 56 dB $L_{Aeq,1hr}$. In all instances the predicted noise levels at the nearest NSL's are below the appropriate criteria outlined in Section 5.4.1.1 (Category A - 65 dB $L_{Aeq,1hr}$ during daytime periods). As these works progressed along the route the worst-case predicted impacts would have reduced. It is envisioned that they would have occurred at the closest position to the nearest NSL for no more than 2 to 3 days.

Due to the distance of these aspects of the construction works from noise sensitive locations significant vibration effects would not have been likely to occur.

With respect to the EPA's criteria for description of effects, the potential worst-case associated effects at the nearest noise sensitive locations associated with this aspect of the construction phase are described below.

Quality	*Significance*	*Duration*
Negative	Slight	Temporary

The above effects should be considered in terms that the effect would have been variable, and that this assessment considers the locations of the greatest potential impact.

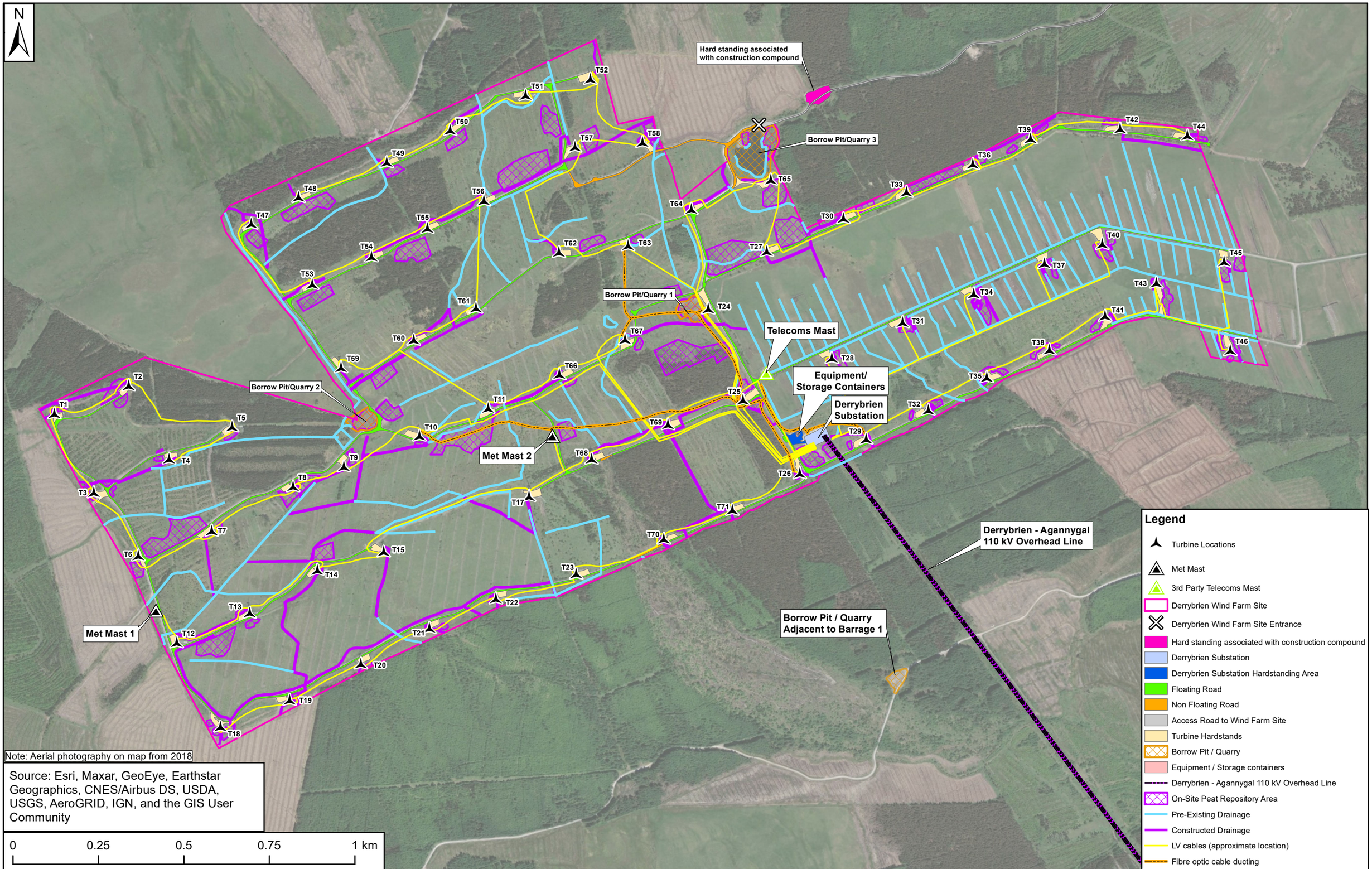
5.6.1.1.3 Borrow Pits

To inform this aspect of the proposal a comparative noise assessment has been prepared and is outlined in the following paragraphs. Two situations have been considered as follows:

- Scenario A Blasting operation
- Scenario B Rock breaking operation

In terms of these activities please note the following:

- A mobile crusher would have operated on site for both options.
- In Scenario B that two rock breakers would have been in use on site during daytime periods.
- For the purposes of this assessment we have assumed the plant was working in the vicinity of the borrow pits location indicated in Figure 5.13.
- The closest noise sensitive location to a borrow pit is circa of 1,200m. (R39).
- Table 15,18 outlines the assumed noise levels for the plant items as extracted from BS 5228-1:2009+A1:2014 *Code of practice for noise and vibration control on construction and open sites – Noise*.
- It is assumed that no more than 1 blast occurred in a single working day.



Note: Aerial photography on map from 2018

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

0 0.25 0.5 0.75 1 km

REV	DATE	REVISION DESCRIPTION	DRN	PROD	VER	APP
0	16/07/20	Issued for substitute consent	E.O'S	E.O'S	P.K	J.McL

PURPOSE OF ISSUE - PRELIMINARY UNLESS INDICATED

CLIENT APPROVAL ☐ PLANNING ☒ TENDER ☐ CONSTRUCTION ☐ AS-BUILT ☐

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CLIENT: **Gort Windfarms Ltd**

PROJECT: **Derrybrien Wind Farm Project**

CONTRACT

PRODUCTION UNIT: **Civil & Environmental Engineering**

DRAWING TITLE: **Figure 5.13 - Borrow Pit Locations**

DRAWN	PRODUCED	VERIFIED	APPROVED	APPROVAL DATE
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00-00	00-00	A3	1:10,000

DRAWING NUMBER: **QS-000280-01-D460-006-003-000**

Table 5.18 Typical Borrow Pit Plant Noise Emissions

Item (BS 5228 Ref.)	dB L_w Levels per Octave Band (Hz)								dB(A)
	63	125	250	500	1k	2k	4k	8k	
Crusher C1.14	121	114	107	108	103	99	94	87	110
Rock Breaker C9.11	119	117	113	117	115	115	112	108	121

A noise model has been prepared to consider the expected noise emissions from typical borrow pit works. A percentage on-time of 66% has been assumed for the noise calculations. The worst-case predicted noise levels from operation of all combinations of borrow pits have been prepared at the NSL with the greatest potential impact for this aspect of the construction phase (i.e. R39 – an unoccupied property). This scenario is based on operation of the nearest borrow pit at some 1,200m distance.

The predicted noise contour from the borrow pit operations is presented in Figure 5.14. which illustrates the construction noise contour associated with the borrow pit activities. The closest noise sensitive properties fall within the 35 to 45dB $L_{Aeq,1hr}$ contour with other locations having predicted noise levels less than 35dB $L_{Aeq,1hr}$ associated with them in relation to borrow pit operations.

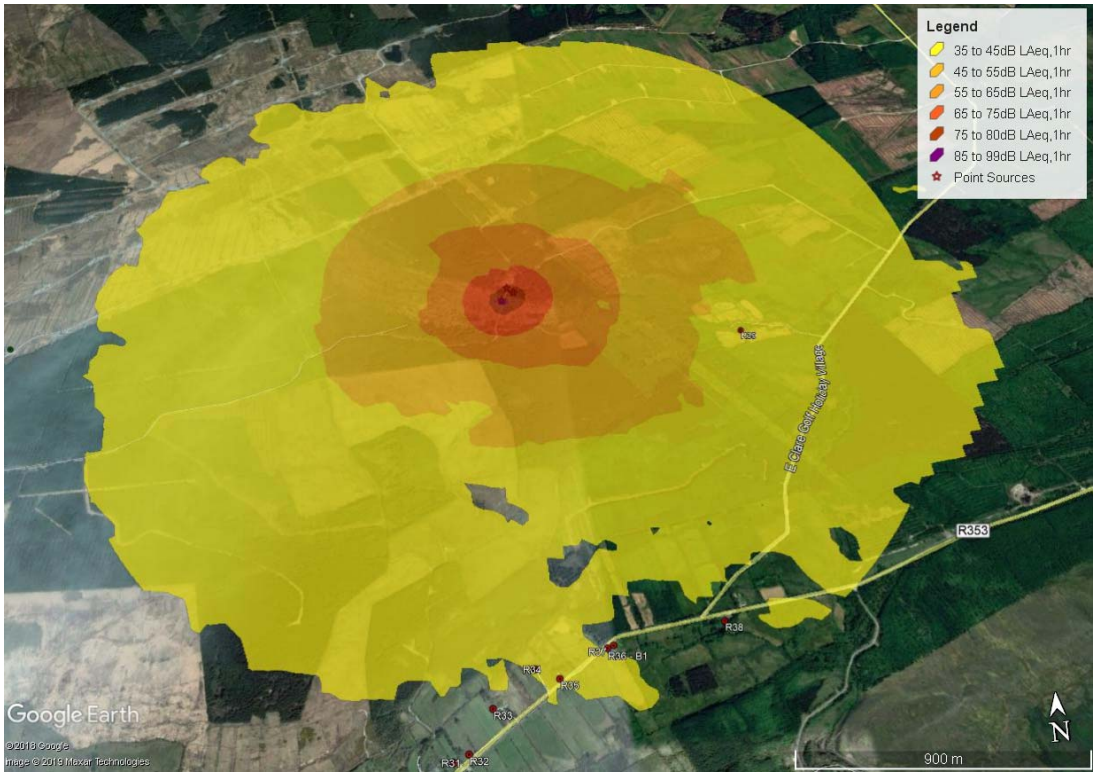


Figure 5.14 Borrow Pit – Construction Noise Contour

The predicted noise levels are below the construction noise criterion identified in Section 5.4.1.1 (i.e. 65dB $L_{Aeq,1hr}$) which indicates that this aspect of construction activity did not give rise to any significant noise impacts. It is understood construction

works of the Project were carried out during daytime hours. It is noted that the predicted levels of construction noise at the nearest noise sensitive properties are below the evening, night time and weekend criteria outlined in Section 5.4.1.1 also.

It is accepted that the individual blast events would be audible at some locations.

With respect to the EPA's criteria for description of effects, the potential worst-case associated effects at the nearest NSL associated with borrow pit activity during the construction phase are described below.

Quality	*Significance*	*Duration*
Negative	Slight	Temporary

The above effects should be considered in terms that the effect is variable, and that this assessment considers the locations of the greatest potential impact.

Due to the distance of the construction works from sensitive locations significant vibration impacts would not have been expected even with isolated blasting events. Vibration from this aspect of construction activities would not be perceptible and would be significantly below levels where cosmetic or structural damage would occur.

5.6.1.1.4 Grid Connection & Overhead Lines

The grid connection for the site requires the connection route to pass from within the site boundary, across private lands, along sections of public road to connect with the Agannygal substation. The full description of the grid connection arrangements for the project is outlined in Chapter 2 of the rEIAR.

Construction activities are assumed to have been carried out during normal daytime working hours (i.e. weekdays 0700 – 1900hrs and Saturdays 0700 – 1300hrs).

Table 5.19 outlines the noise levels associated with typical construction noise sources for the grid connection works, with noise sensitive locations assumed to be situated some 50m from the works along the route of the overhead line. Also presented in the table are the calculated noise levels at varying distances which reflect further distant NSLs.

Table 5.19 Indicative Noise Levels from Construction Plant at Nearest NSL from the Grid Connection Works

Item (BS 5228 Ref.)	Predicted Noise Level ($dB\ L_{Aeq,1hr}$) Note H			
	50m Distance	100m Distance	200m Distance	500m Distance
Mini Excavator with Hydraulic Breaker (C5.2)	62	57	51	45

Item (BS 5228 Ref.)	Predicted Noise Level (dB $L_{Aeq,1hr}$) Note H			
	50m Distance	100m Distance	200m Distance	500m Distance
Wheeled loader (C2.28)	55	50	44	38
Tracked excavator (C2.8)	50	44	38	32
Dozer (C2.13)	57	52	46	40
Dump truck (C2.30)	58	53	47	41
Road Roller (C2.30)	55	49	43	37
HGV Movements (20 per hour)	39	33	27	21
Total Construction Noise	65	59	53	47

Note H All plant noise levels are derived from BS 5228: Part 1

At the nearest distance assessed, the predicted total construction noise levels from overhead line construction activities are of the order of 65dB $L_{Aeq,T}$, which just comply with the significance threshold of 65dB $L_{Aeq,1hr.}$ As these works progressed at distances further from NSLs along the route the worst-case predicted impacts would have reduced as demonstrated above. It is envisioned that they would have been at the closest position to the nearest NSLs for no more than 2 to 3 days. It should be noted the nearest distance from the overhead ling to an occupied dwelling is 380m. Predicted construction noise levels at such a distance are comfortably within the significance threshold of 65dB $L_{Aeq,1hr.}$

With respect to the EPA's criteria for description of effects, the potential worst-case associated effects at the nearest NSL associated with borrow pit activity during the construction phase are described below.

Quality	*Significance*	*Duration*
Negative	Slight	Temporary

The above effects should be considered in terms that the effect would have been variable and that this assessment considered the locations of the greatest potential impact.

5.6.1.1.5 Substations

Table 5.20 outlines the noise levels associated with typical construction noise sources assessed in this instance along with typical sound pressure levels from BS 5228 – 1. The closed noise sensitive location to substation (i.e. Agannygal installation) is some 550m.

Table 5.20 Typical Substation Construction Noise Emission Levels

Item (BS 5228 Ref.)	Activity/Notes	Plant Noise Level at 10m Distance (dB $L_{Aeq,1hr}$) Note F	Predicted Noise Level at 550m (dB $L_{Aeq,1hr}$)
HGV Movement (C.2.30)	Removing spoil and transporting fill and other materials.	79	44
Tracked Excavator (C.4.64)	Removing soil and rubble in preparation for the foundations.	77	42
General Construction (Various)	All general activities plus deliveries of materials and plant.	70 – 84	49
Dewatering Pumps (D.7.70)	If required.	80	45
JCB (D.8.13)	For services, drainage and landscaping.	82	47
Vibrating Rollers (D.8.29)	Road surfacing.	77	42
Total Construction Noise (cumulative for all activities)		54	

Note I All plant noise levels are derived from BS 5228: Part 1

The predicted noise levels from construction activities are in the range 42 to 49dB $L_{Aeq,1hr}$ at the nearest noise sensitive locations, with a total construction noise level of approximately 54dB $L_{Aeq,1hr}$.

The predicted noise levels are below the construction noise criterion identified in Section 5.4.1.1 (i.e. 65dB $L_{Aeq,1hr}$) which indicates that the construction of substations did not give rise to significant noise impact. It is understood construction works of the Project were carried out during daytime hours. It is noted that the predicted levels of construction noise at the nearest noise sensitive properties are below the evening, nighttime and weekend criteria outlined in Section 5.4.1.1 also.

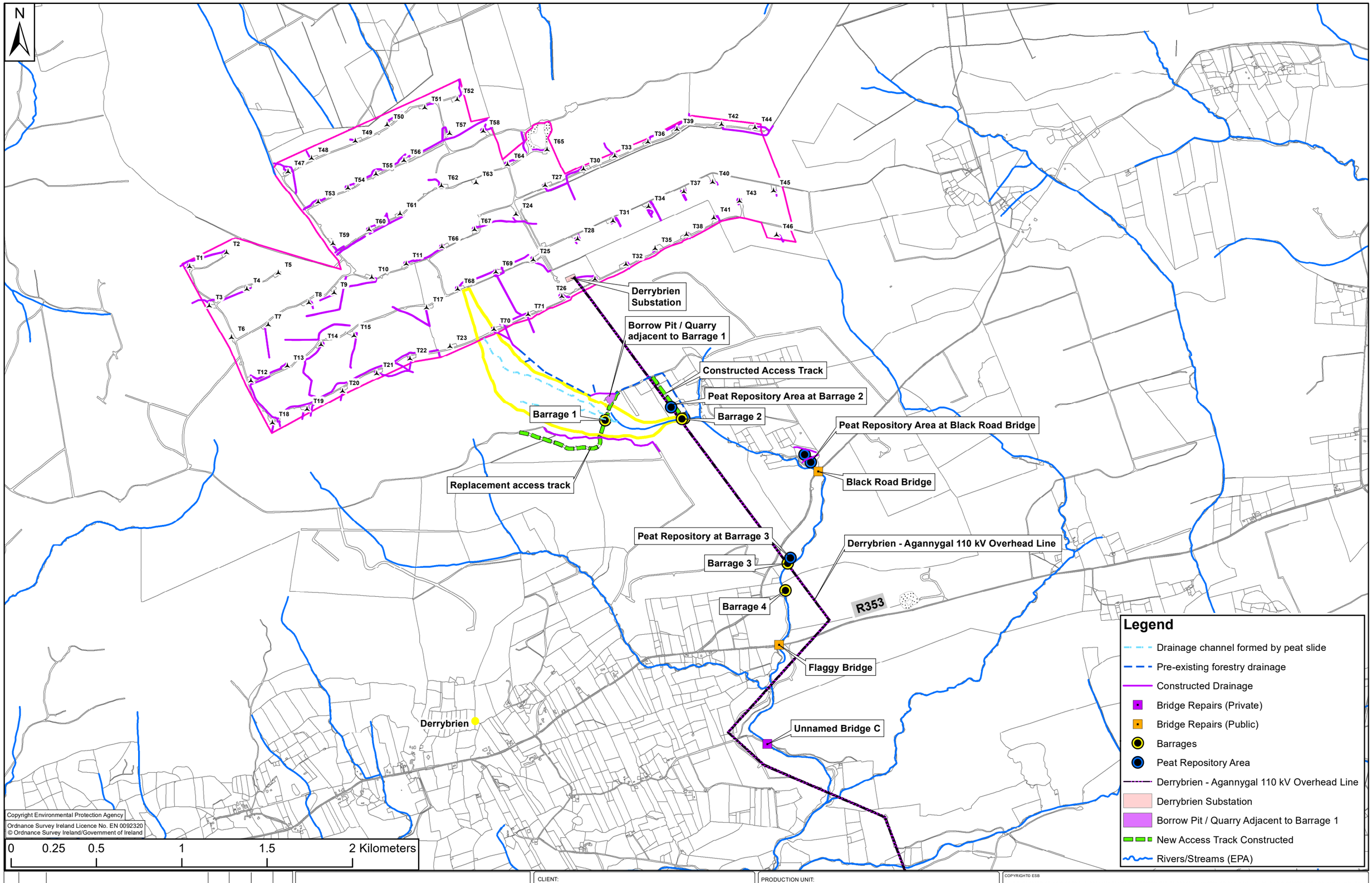
Due to the distance of the construction works from noise sensitive locations significant vibration impacts would not have been perceptible and would have been significantly below levels where cosmetic or structural damage would occur.

In terms of these construction activities, the associated likely effect was:

Quality	*Significance*	*Duration*
Negative	Slight	Short-term

5.6.1.2 Works associated with peat slide 2003/2004

In terms of construction works associated with the peat slide event it is considered that construction of the various barrages illustrated on Figure 5.15 and the extraction of required material from borrow pit 3 within the wind farm site and the borrow pit adjacent to barrage 1 require comment in this instance.



REV	DATE	REVISION DESCRIPTION	DRN	PROD	VER	APP
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PURPOSE OF ISSUE - PRELIMINARY UNLESS INDICATED

CLIENT APPROVAL ☐ PLANNING ☒ TENDER ☐ CONSTRUCTION ☐ AS-BUILT ☐

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CLIENT: Gort Windfarms Ltd

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PROJECT: Derrybrien Wind Farm Project

DRAWING TITLE: Figure 5.15 - Peat Slide Barrage Locations

CONTRACT

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Assuming an excavator operating at each of the barrages at the same time (i.e. a worst-case assumption) and works are ongoing at the borrow pit adjacent to barrage 1 construction noise levels have been predicted to the nearest noise sensitive locations.

The predicted noise contour from the peat slide operations is presented in Figure 5.16. which illustrates the construction noise contour associated with the borrow pit activities. The closest noise sensitive properties fall within the 35 to 45dB $L_{Aeq,1hr}$ contour with other locations having predicted noise levels less than 35dB $L_{Aeq,1hr}$ associated with them in relation to borrow pit operations. The only exception to this statement relates to Locations R38 and R39 which fall within the 45 to 55dB $L_{Aeq,1hr}$ contour.

The predicted noise levels are below the construction noise criterion identified in Section 5.4.1.1 (i.e. 65dB $L_{Aeq,1hr}$) which indicates that these construction activities did not give rise to significant noise impact. It is noted that the predicted levels of construction noise at the nearest noise sensitive properties are below the evening, night time and weekend criteria outlined in Section 5.4.1.1 also.

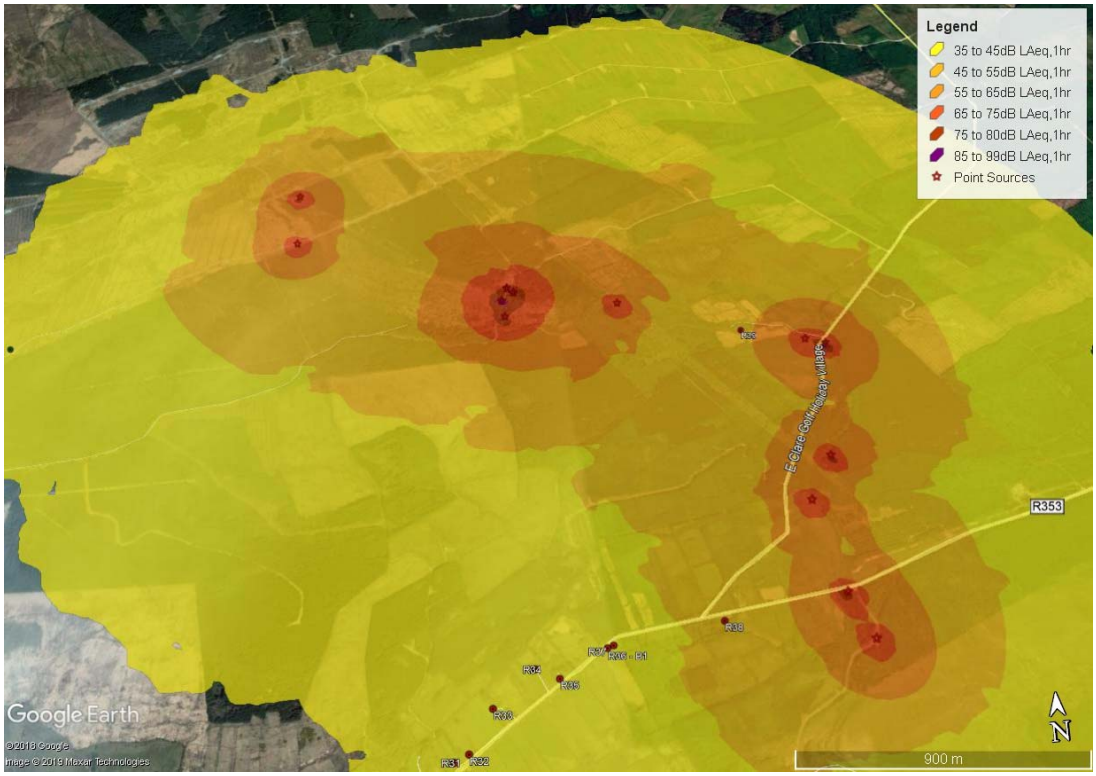

Figure 5.16 Peat Slide – Construction Noise Contour

With respect to the EPA's criteria for description of effects, the potential worst-case associated effects at the nearest NSL associated with works related to the peat slide activity during the construction phase are described below.

Quality	*Significance*	*Duration*

Negative	Slight	Temporary

The above effects should be considered in terms that the effect is variable, and that this assessment considers the locations of the greatest potential impact.
Due to the distance of the works from sensitive locations significant vibration impacts would not have been expected. Vibration from this aspect of construction activities would not be perceptible and would be significantly below levels where cosmetic or structural damage would occur.

5.6.1.3 Construction Phase 2–2004 – 2006

The impacts outlined in Section 5.6.1.1 in relation to construction works carried out in advance of the peat slide would be considered to be representative of the works and associated impacts carried out on site after the peat slide event.

5.6.1.4 Operational phase – March 2006 – 2020

A series of computer-based prediction models have been prepared in order to predict the noise level associated with the operational phase of the Project. This section discusses the methodology behind the noise modelling process and presents the results of the modelling exercise. In terms of day to day noise impacts the operational wind farm is considered.

5.6.1.4.1 Noise Prediction Software

Proprietary noise calculation software was used for the purposes of this impact assessment. The selected software, *Predictor*, calculates noise levels in accordance with ISO 9613*: Acoustics – Attenuation of sound outdoors, Part 2: General method of calculation, 1996*.

Predictor is a proprietary noise calculation package for computing noise levels in the vicinity of noise sources. *Predictor* calculates noise levels in different ways depending on the selected prediction standard. 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 A weighted sound power levels (L_{WA});
- the distance between the source and receiver;
- the presence of obstacles such as screens or barriers in the propagation path;
- the presence of reflecting surfaces;
- the hardness of the ground between the source and receiver;
- Attenuation due to atmospheric absorption; and
- Meteorological effects such as wind gradient, temperature gradient and humidity (these have significant impact at distances greater than approximately 400m).

5.6.1.4.2 Input Data & Assumptions

Contour and information available for the site has been inputted into our *Predictor* noise modelling software using the ISO 9613-2:1996 *Acoustics – Attenuation of sound during propagation outdoors: General method of calculation*. The proposal in question considers the construction of 70 turbine units on the site.

Table 5.21 details the co-ordinates of the turbines at the Derrybrien Wind Farm that are being considered as part of this assessment.

Table 5.21 Turbine Co-Ordinates

Ref.	Co-ordinates ITM		Ref.	Co-ordinates ITM	
	Easting	Northing		Easting	Northing
T1	557,684	704,808	T37	560,580	705,246
T2	557,902	704,889	T38	560,595	704,994
T3	557,800	704,577	T39	560,539	705,611
T4	558,020	704,675	T40	560,749	705,303
T5	558,204	704,769	T41	560,757	705,092
T6	557,930	704,392	T42	560,802	705,640
T7	558,145	704,465	T43	560,907	705,189
T8	558,383	704,594	T44	560,998	705,620
T9	558,532	704,653	T45	561,106	705,251
T10	558,752	704,742	T46	561,123	704,992
T11	558,953	704,823	T47	558,261	705,362
T12	558,043	704,138	T48	558,399	705,440
T13	558,256	704,225	T49	558,656	705,542
T14	558,454	704,350	T50	558,842	705,636
T15	558,648	704,403	T51	559,063	705,738
T17	559,073	704,566	T52	559,252	705,786
T18	558,170	703,891	T53	558,438	705,185
T19	558,373	703,970	T54	558,612	705,266
T20	558,581	704,076	T55	558,776	705,350
T21	558,781	704,180	T56	558,941	705,429
T22	558,976	704,266	T57	559,207	705,587
T23	559,210	704,338	T58	559,404	705,601
T24	559,596	705,114	T59	558,523	704,943
T25	559,699	704,847	T60	558,735	705,022
T26	559,865	704,633	T61	558,917	705,117
T27	559,768	705,282	T62	559,160	705,279
T28	559,958	704,969	T63	559,363	705,300
T29	560,059	704,734	T64	559,547	705,405
T30	559,993	705,378	T65	559,780	705,491
T31	560,165	705,075	T66	559,162	704,922
T32	560,240	704,818	T67	559,353	705,023
T33	560,176	705,455	T68	559,256	704,675
T34	560,373	705,158	T69	559,479	704,775
T35	560,412	704,913	T70	559,467	704,441
T36	560,371	705,537	T71	559,667	704,525

Sound power levels (L_{WA}) have been supplied for the Vestas V52-850kW turbines with a turbine HH of 49m. The turbine noise data has been derived from the Vestas test report ref. WT 2466/02 dated 2004-06-17, as presented in Appendix 5.7.

As outlined, appropriate guidance is couched in terms of $L_{A90,10mim}$ criterion. The provided turbine noise is referenced in terms of the L_{Aeq} parameter, best practice guidance contained within the IoA GPG states that "*L_{A90} levels should be determined from calculated L_{Aeq} levels by subtraction of 2dB*". Therefore, in accordance with best practice guidance, a 2dB reduction has been applied to the predicted results in this assessment.

For the purposes of all predictions presented in this report to account for various uncertainties in the measurement of turbine source levels, an uncertainty factor of 2 dB has been added to the manufacturer's values in line with best practice guidance for wind turbine noise assessment contained in the IOA GPG.

Best practice specifies that a penalty should be added to the predicted noise levels, where any tonal component is present. The level of this penalty is described and is related to the level by which any tonal components exceed audibility. For the purposes of this assessment a tonal penalty has not been included within the predicted noise levels based on data provided by the manufacturers of the selected turbine and operational noise monitoring conducted.

The table below details the noise spectra used for noise modelling purposes for the 70 no. turbines.

Table 5.22 LwA Spectra Used for Prediction Model (Derrybrien)

Wind Speed (m/s)	Octave Band Centre Frequencies (Hz)								dB L_{wA}
	63	125	250	500	1k	2k	4k	8k	
6	84.0	88.8	92.7	94.5	94.6	92.9	86.7	65.9	100.4
7	84.8	90.5	94.8	96.8	96.4	94.2	88.2	71.1	102.3
≥8	84.7	90.4	95.4	97.4	96.9	94.7	88.9	73.8	102.8

The Sonnagh Wind Farm, which comprises 9 no. Vestas V52-850kW turbines, has been included in the predicted operational levels to assess potential cumulative impacts. Note that based on similar units it would be expected that sound power levels associated with the turbines would be the order of 96.4dB(A) at 5m/s and 93.9dB(A) at 4m/s.

Prediction calculations for turbine noise have been conducted in accordance with ISO 9613*: Acoustics – Attenuation of sound outdoors, Part 2: General method of calculation, 1996*.

In terms of calculation a ground attenuation factor (general method) of 0.5 and no metrological correction were assumed for all calculations. The atmospheric attenuation outlined in Table 5.23 was assumed for all calculations.

Table 5.23 Atmospheric Attenuation Assumed for Noise Calculations (dB per km)

Temp (ºC)	% Humidity	Octave Band 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

Noise Sensitive locations, ground topography, geographical features have been taken from survey information supplied by ESB Engineering and Major Projects and from Ordnance Survey maps.

5.6.1.4.3 Assessment of Operational Phase

A worst-case assessment assuming all receptors are downwind of all turbines at the same time, has been completed for all noise sensitive locations identified within 2.5km of the Derrybrien turbines.

Guidance in relation to acceptable levels of noise from wind farms is contained in the documents Department of the Environment, Heritage and Local Government "*Wind Energy Development Guidelines"* and Department of Trade & Industry (UK) Energy Technology Support Unit (ETSU) publication "*The Assessment and Rating of Noise from Wind Farms*" (1996).

The following noise criteria has been adopted for the noise sensitive locations in line with best practice guidance which represents a strict interpretation of the guidance:

- 37.5dB $L_{A90,10min}$ or a maximum increase of 5dB(A) above background noise (whichever is higher) for daytime periods, and;
- 43dB $L_{A90,10min}$ or a maximum increase of 5dB(A) above background noise (whichever is higher) for night time periods.

Based on background noise levels measured as part of this assessment noise criteria increase at 8m/s and above during daytime periods and from 9m/s during night time periods when the 5dB(A) above background caveat in guidance is triggered.

Table 5.24 outlines the derived noise criteria curves based on baseline information contained within Table 5.7 to 5.10.

Table 5.24 Noise Criteria Curves

Location	Period	$L_{A90,\ 10\ min}$ (dB) Limits at various Standardised 10m Height Wind Speed (m/s)						
		4	5	6	7	8	9	10
R21	Day	37.5	37.5	37.5	41.8	44.5	47.7	51.6
	Night	43	43	43	43	43	43.1	45.6
R35	Day	37.5	37.5	37.5	37.5	41.9	45.5	49.4
	Night	43	43	43	43	43	43.6	48.8
Envelope	Day	37.5	37.5	37.5	37.5	41.9	45.5	49.4

Location	Period	$L_{A90,\ 10\ min}$ (dB) Limits at various Standardised 10m Height Wind Speed (m/s)						
		4	5	6	7	8	9	10
	Night	43	43	43	43	43	43.1	45.6

A worst-case criteria envelope has been derived by adopting the lowest limit derived at each wind speed for the locations identified above. These day and night criterion curves have been applied to all 41 NSL's included in this assessment. This is considered a conservative approach.

A worst-case assessment has been completed assuming all turbines are operating in normal mode of operation and that noise locations are downwind of all turbines at the same time. The predicted levels at all locations are show graphically in Figures 5.17 To 5.19.

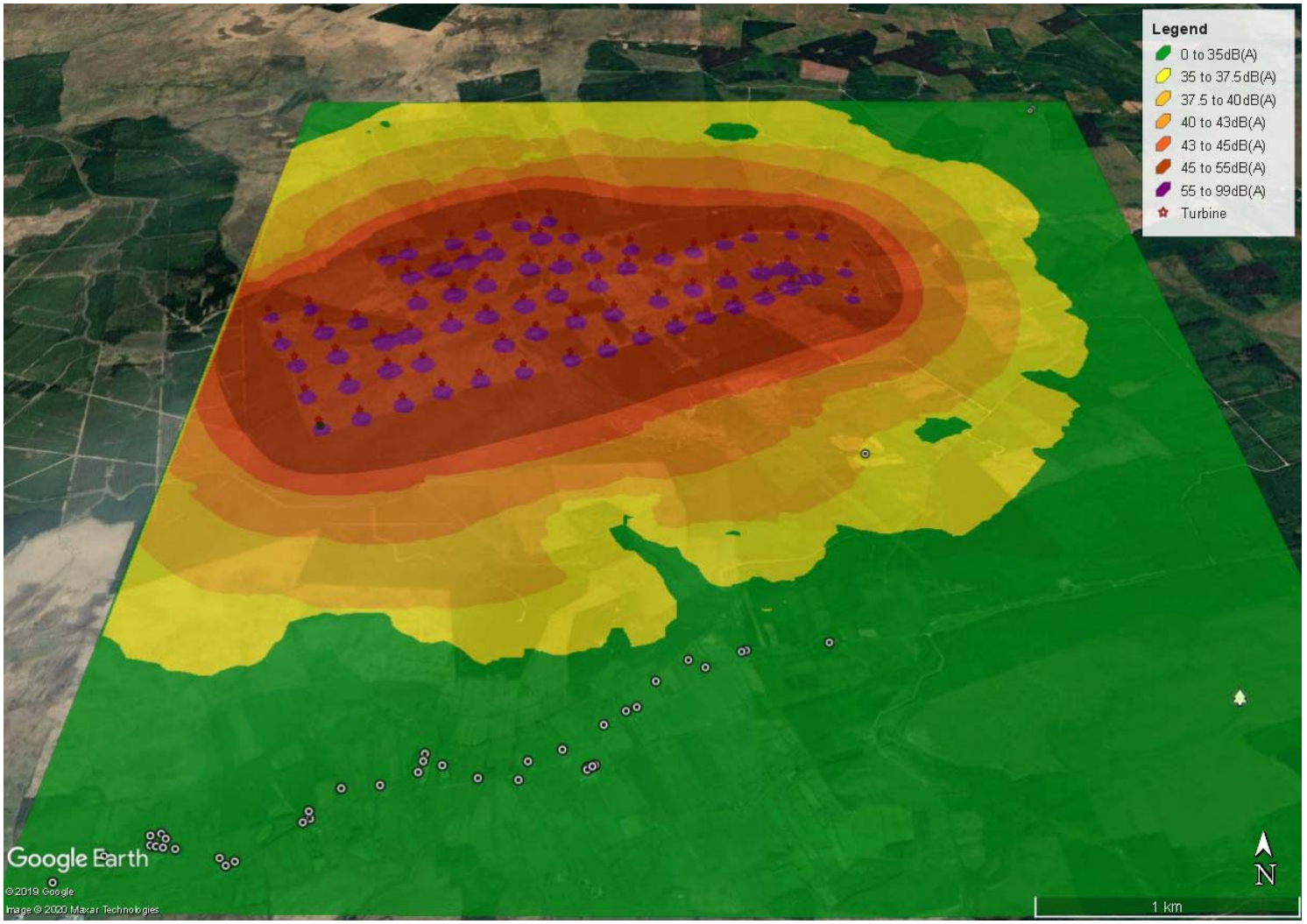

Figure 5.17 6m-s Wind Speed Noise Contour, Omni-directional (i.e. downwind to all dwellings)

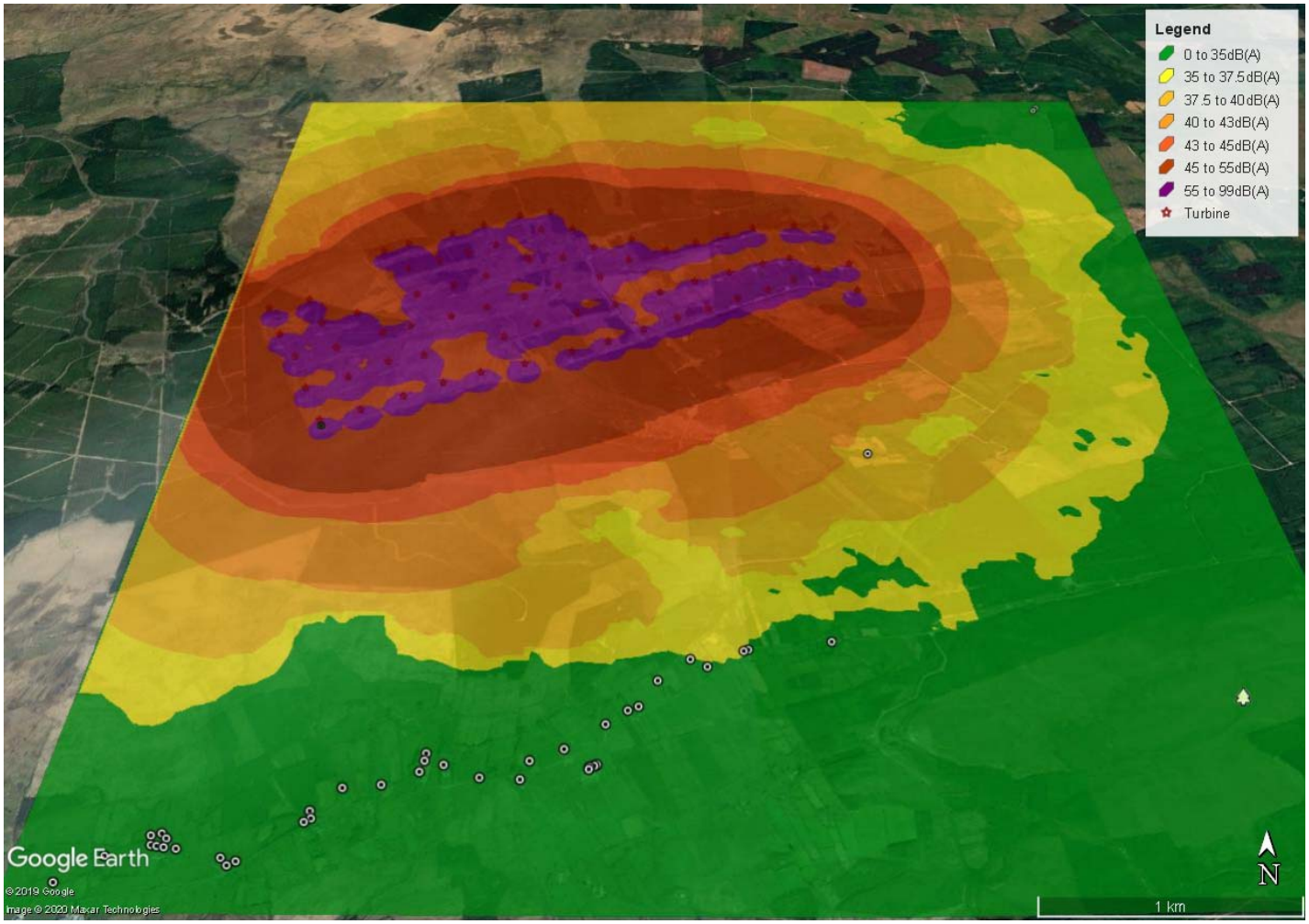

Figure 5.18 7m-s Wind Speed Noise Contour, Omni-directional (i.e. downwind to all dwellings)

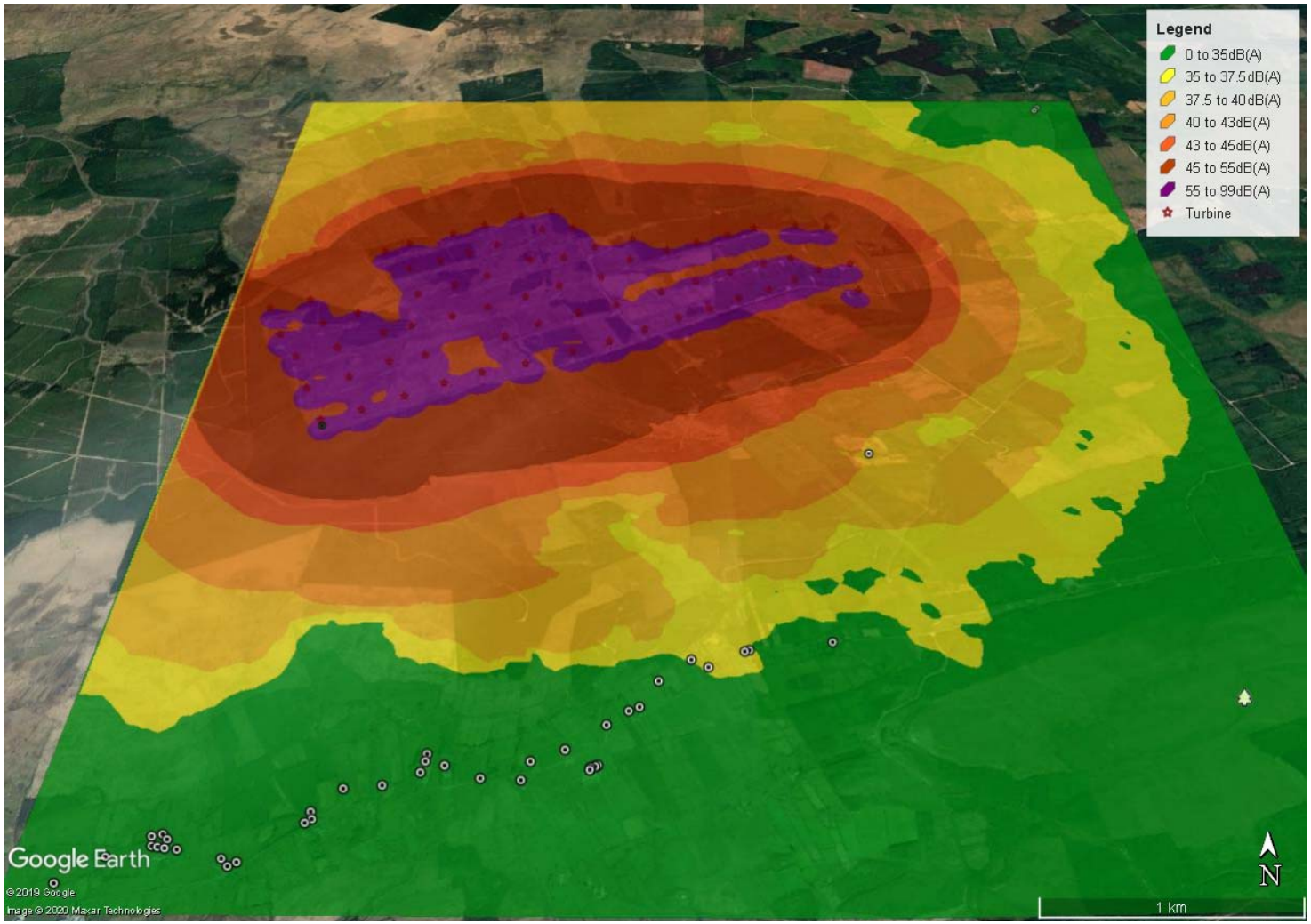

Figure 5.19 ≤8m-s Wind Speed Noise Contour, Omni-directional (i.e. downwind to all dwellings)

The predicted noise levels at various wind speeds have been outlined in Table 5.25 for the 41 noise sensitive locations considered as part of this assessment. These predicted levels have been compared against the adopted noise criteria curves as detailed in Table 5.24 above.

Table 5.25 Assessment of Predicted Operational Noise Levels

Name	Description	dB $L_{A90,10min}$ at Various Standarised Wind Speeds (m/s)						
		4	5	6	7	8	9	10
R1[2]	Predicted	20.4	22.9	26.9	28.7	29.1	29.1	29.1
	Daytime Criterion	37.5	37.5	37.5	37.5	41.9	45.5	49.4
	Daytime Excess	--	--	--	--	--	--	--
	Night time Criterion	43	43	43	43	43	43	43
	Night time Excess	--	--	--	--	--	--	--
R2	Predicted	20.9	23.4	27.4	29.2	29.6	29.6	29.6
	Daytime Criterion	37.5	37.5	37.5	37.5	41.9	45.5	49.4
	Daytime Excess	--	--	--	--	--	--	--
	Night time Criterion	43	43	43	43	43	43	43
	Night time Excess	--	--	--	--	--	--	--
R3	Predicted	21.3	23.8	27.8	29.6	30	30	30
	Daytime Criterion	37.5	37.5	37.5	37.5	41.9	45.5	49.4
	Daytime Excess	--	--	--	--	--	--	--
	Night time Criterion	43	43	43	43	43	43	43
	Night time Excess	--	--	--	--	--	--	--
R4	Predicted	21.2	23.7	27.7	29.5	29.9	29.9	29.9
	Daytime Criterion	37.5	37.5	37.5	37.5	41.9	45.5	49.4
	Daytime Excess	--	--	--	--	--	--	--
	Night time Criterion	43	43	43	43	43	43	43
	Night time Excess	--	--	--	--	--	--	--
R5	Predicted	21.2	23.7	27.7	29.5	29.9	29.9	29.9
	Daytime Criterion	37.5	37.5	37.5	37.5	41.9	45.5	49.4
	Daytime Excess	--	--	--	--	--	--	--
	Night time Criterion	43	43	43	43	43	43	43
	Night time Excess	--	--	--	--	--	--	--
R6	Predicted	21.4	23.9	27.9	29.7	30.1	30.1	30.1
	Daytime Criterion	37.5	37.5	37.5	37.5	41.9	45.5	49.4
	Daytime Excess	--	--	--	--	--	--	--
	Night time Criterion	43	43	43	43	43	43	43
	Night time Excess	--	--	--	--	--	--	--
R7	Predicted	21.4	23.9	27.9	29.6	30	30	30
	Daytime Criterion	37.5	37.5	37.5	37.5	41.9	45.5	49.4
	Daytime Excess	--	--	--	--	--	--	--
	Night time Criterion	43	43	43	43	43	43	43
	Night time Excess	--	--	--	--	--	--	--
R8	Predicted	21.2	23.7	27.7	29.5	29.9	29.9	29.9
	Daytime Criterion	37.5	37.5	37.5	37.5	41.9	45.5	49.4
	Daytime Excess	--	--	--	--	--	--	--
	Night time Criterion	43	43	43	43	43	43	43

[2] Note an additional location has been identified in close proximity to Location R01. This location is identified as R42 (Co-Ordinates 557,604 701,441). The location is to the west of R01. The predicted noise levels presented in relation to Location R01 are directly comparable to those expected at Location R42. The predicted noise levels at Location R01 are comfortably within the noise criteria adopted in this assessment. The same would be the case in relation to Location R42.

Name	Description	dB $L_{A90,10min}$ at Various Standarised Wind Speeds (m/s)						
		4	5	6	7	8	9	10
	Night time Excess	--	--	--	--	--	--	--
R9	Predicted	21.3	23.8	27.8	29.5	29.9	29.9	29.9
	Daytime Criterion	37.5	37.5	37.5	37.5	41.9	45.5	49.4
	Daytime Excess	--	--	--	--	--	--	--
	Night time Criterion	43	43	43	43	43	43	43
	Night time Excess	--	--	--	--	--	--	--
R10	Predicted	21.2	23.7	27.7	29.5	29.9	29.9	29.9
	Daytime Criterion	37.5	37.5	37.5	37.5	41.9	45.5	49.4
	Daytime Excess	--	--	--	--	--	--	--
	Night time Criterion	43	43	43	43	43	43	43
	Night time Excess	--	--	--	--	--	--	--
R11	Predicted	21.2	23.7	27.7	29.4	29.8	29.8	29.8
	Daytime Criterion	37.5	37.5	37.5	37.5	41.9	45.5	49.4
	Daytime Excess	--	--	--	--	--	--	--
	Night time Criterion	43	43	43	43	43	43	43
	Night time Excess	--	--	--	--	--	--	--
R12	Predicted	21.2	23.7	27.7	29.5	29.9	29.9	29.9
	Daytime Criterion	37.5	37.5	37.5	37.5	41.9	45.5	49.4
	Daytime Excess	--	--	--	--	--	--	--
	Night time Criterion	43	43	43	43	43	43	43
	Night time Excess	--	--	--	--	--	--	--
R13	Predicted	21.9	24.4	28.4	30.2	30.6	30.6	30.6
	Daytime Criterion	37.5	37.5	37.5	37.5	41.9	45.5	49.4
	Daytime Excess	--	--	--	--	--	--	--
	Night time Criterion	43	43	43	43	43	43	43
	Night time Excess	--	--	--	--	--	--	--
R14	Predicted	22.1	24.6	28.6	30.4	30.8	30.8	30.8
	Daytime Criterion	37.5	37.5	37.5	37.5	41.9	45.5	49.4
	Daytime Excess	--	--	--	--	--	--	--
	Night time Criterion	43	43	43	43	43	43	43
	Night time Excess	--	--	--	--	--	--	--
R15	Predicted	22	24.5	28.5	30.2	30.7	30.7	30.7
	Daytime Criterion	37.5	37.5	37.5	37.5	41.9	45.5	49.4
	Daytime Excess	--	--	--	--	--	--	--
	Night time Criterion	43	43	43	43	43	43	43
	Night time Excess	--	--	--	--	--	--	--
R16	Predicted	22.5	25	29	30.8	31.2	31.2	31.2
	Daytime Criterion	37.5	37.5	37.5	37.5	41.9	45.5	49.4
	Daytime Excess	--	--	--	--	--	--	--
	Night time Criterion	43	43	43	43	43	43	43
	Night time Excess	--	--	--	--	--	--	--
R17	Predicted	22.5	25	29	30.8	31.3	31.3	31.3
	Daytime Criterion	37.5	37.5	37.5	37.5	41.9	45.5	49.4
	Daytime Excess	--	--	--	--	--	--	--
	Night time Criterion	43	43	43	43	43	43	43
	Night time Excess	--	--	--	--	--	--	--
R18	Predicted	22.7	25.2	29.2	31.1	31.5	31.5	31.5
	Daytime Criterion	37.5	37.5	37.5	37.5	41.9	45.5	49.4
	Daytime Excess	--	--	--	--	--	--	--
	Night time Criterion	43	43	43	43	43	43	43
	Night time Excess	--	--	--	--	--	--	--

Name	Description	dB $L_{A90,10min}$ at Various Standarised Wind Speeds (m/s)						
		4	5	6	7	8	9	10
R19	Predicted	22.9	25.4	29.4	31.2	31.7	31.7	31.7
	Daytime Criterion	37.5	37.5	37.5	37.5	41.9	45.5	49.4
	Daytime Excess	--	--	--	--	--	--	--
	Night time Criterion	43	43	43	43	43	43	43
	Night time Excess	--	--	--	--	--	--	--
R20	Predicted	23.1	25.6	29.6	31.4	31.8	31.8	31.8
	Daytime Criterion	37.5	37.5	37.5	37.5	41.9	45.5	49.4
	Daytime Excess	--	--	--	--	--	--	--
	Night time Criterion	43	43	43	43	43	43	43
	Night time Excess	--	--	--	--	--	--	--
R21	Predicted	22.8	25.3	29.3	31.2	31.6	31.6	31.6
	Daytime Criterion	37.5	37.5	37.5	37.5	41.9	45.5	49.4
	Daytime Excess	--	--	--	--	--	--	--
	Night time Criterion	43	43	43	43	43	43	43
	Night time Excess	--	--	--	--	--	--	--
R22	Predicted	22.6	25.1	29.1	30.9	31.3	31.3	31.3
	Daytime Criterion	37.5	37.5	37.5	37.5	41.9	45.5	49.4
	Daytime Excess	--	--	--	--	--	--	--
	Night time Criterion	43	43	43	43	43	43	43
	Night time Excess	--	--	--	--	--	--	--
R23	Predicted	22.5	25	29	30.8	31.2	31.2	31.2
	Daytime Criterion	37.5	37.5	37.5	37.5	41.9	45.5	49.4
	Daytime Excess	--	--	--	--	--	--	--
	Night time Criterion	43	43	43	43	43	43	43
	Night time Excess	--	--	--	--	--	--	--
R24	Predicted	22.8	25.3	29.3	31.1	31.5	31.5	31.5
	Daytime Criterion	37.5	37.5	37.5	37.5	41.9	45.5	49.4
	Daytime Excess	--	--	--	--	--	--	--
	Night time Criterion	43	43	43	43	43	43	43
	Night time Excess	--	--	--	--	--	--	--
R25	Predicted	22.9	25.4	29.4	31.2	31.6	31.6	31.6
	Daytime Criterion	37.5	37.5	37.5	37.5	41.9	45.5	49.4
	Daytime Excess	--	--	--	--	--	--	--
	Night time Criterion	43	43	43	43	43	43	43
	Night time Excess	--	--	--	--	--	--	--
R26	Predicted	22.5	25	29	30.8	31.2	31.2	31.2
	Daytime Criterion	37.5	37.5	37.5	37.5	41.9	45.5	49.4
	Daytime Excess	--	--	--	--	--	--	--
	Night time Criterion	43	43	43	43	43	43	43
	Night time Excess	--	--	--	--	--	--	--
R27	Predicted	22.5	25	29	30.8	31.3	31.3	31.3
	Daytime Criterion	37.5	37.5	37.5	37.5	41.9	45.5	49.4
	Daytime Excess	--	--	--	--	--	--	--
	Night time Criterion	43	43	43	43	43	43	43
	Night time Excess	--	--	--	--	--	--	--
R28	Predicted	22.5	25	29	30.8	31.3	31.3	31.3
	Daytime Criterion	37.5	37.5	37.5	37.5	41.9	45.5	49.4
	Daytime Excess	--	--	--	--	--	--	--
	Night time Criterion	43	43	43	43	43	43	43
	Night time Excess	--	--	--	--	--	--	--
R29	Predicted	22.6	25.1	29.1	30.9	31.3	31.3	31.3

Name	Description	dB $L_{A90,10min}$ at Various Standarised Wind Speeds (m/s)						
		4	5	6	7	8	9	10
	Daytime Criterion	37.5	37.5	37.5	37.5	41.9	45.5	49.4
	Daytime Excess	--	--	--	--	--	--	--
	Night time Criterion	43	43	43	43	43	43	43
	Night time Excess	--	--	--	--	--	--	--
R30	Predicted	23.2	25.7	29.7	31.5	31.9	31.9	31.9
	Daytime Criterion	37.5	37.5	37.5	37.5	41.9	45.5	49.4
	Daytime Excess	--	--	--	--	--	--	--
	Night time Criterion	43	43	43	43	43	43	43
	Night time Excess	--	--	--	--	--	--	--
R31	Predicted	23.4	25.9	29.9	31.7	32.1	32.1	32.1
	Daytime Criterion	37.5	37.5	37.5	37.5	41.9	45.5	49.4
	Daytime Excess	--	--	--	--	--	--	--
	Night time Criterion	43	43	43	43	43	43	43
	Night time Excess	--	--	--	--	--	--	--
R32	Predicted	23.4	25.9	29.9	31.7	32.1	32.1	32.1
	Daytime Criterion	37.5	37.5	37.5	37.5	41.9	45.5	49.4
	Daytime Excess	--	--	--	--	--	--	--
	Night time Criterion	43	43	43	43	43	43	43
	Night time Excess	--	--	--	--	--	--	--
R33	Predicted	23.8	26.3	30.3	32.1	32.6	32.6	32.6
	Daytime Criterion	37.5	37.5	37.5	37.5	41.9	45.5	49.4
	Daytime Excess	--	--	--	--	--	--	--
	Night time Criterion	43	43	43	43	43	43	43
	Night time Excess	--	--	--	--	--	--	--
R34	Predicted	26	28.5	32.5	34.3	34.8	34.8	34.8
	Daytime Criterion	37.5	37.5	37.5	37.5	41.9	45.5	49.4
	Daytime Excess	--	--	--	--	--	--	--
	Night time Criterion	43	43	43	43	43	43	43
	Night time Excess	--	--	--	--	--	--	--
R35	Predicted	26.2	28.7	32.7	34.6	35	35	35
	Daytime Criterion	37.5	37.5	37.5	37.5	41.9	45.5	49.4
	Daytime Excess	--	--	--	--	--	--	--
	Night time Criterion	43	43	43	43	43	43	43
	Night time Excess	--	--	--	--	--	--	--
R36	Predicted	26.6	29.1	33.1	34.9	35.4	35.4	35.4
	Daytime Criterion	37.5	37.5	37.5	37.5	41.9	45.5	49.4
	Daytime Excess	--	--	--	--	--	--	--
	Night time Criterion	43	43	43	43	43	43	43
	Night time Excess	--	--	--	--	--	--	--
R37	Predicted	26.6	29.1	33.1	34.9	35.4	35.4	35.4
	Daytime Criterion	37.5	37.5	37.5	37.5	41.9	45.5	49.4
	Daytime Excess	--	--	--	--	--	--	--
	Night time Criterion	43	43	43	43	43	43	43
	Night time Excess	--	--	--	--	--	--	--
R38	Predicted	23.4	25.9	29.9	31.7	32.2	32.2	32.2
	Daytime Criterion	37.5	37.5	37.5	37.5	41.9	45.5	49.4
	Daytime Excess	--	--	--	--	--	--	--
	Night time Criterion	43	43	43	43	43	43	43
	Night time Excess	--	--	--	--	--	--	--
R39	Predicted	30.9	33.4	37.4	39.3	39.8	39.8	39.8
	Daytime Criterion	37.5	37.5	37.5	37.5	41.9	45.5	49.4

Name	Description	dB $L_{A90,10min}$ at Various Standarised Wind Speeds (m/s)						
		4	5	6	7	8	9	10
	Daytime Excess	--	--	--	1.8	--	--	--
	Night time Criterion	43	43	43	43	43	43	43
	Night time Excess	--	--	--	--	--	--	--
R40	Predicted	24.7	27.2	31.2	33	33.4	33.4	33.4
	Daytime Criterion	37.5	37.5	37.5	37.5	41.9	45.5	49.4
	Daytime Excess	--	--	--	--	--	--	--
	Night time Criterion	43	43	43	43	43	43	43
	Night time Excess	--	--	--	--	--	--	--
R41	Predicted	24.6	27.1	31.1	32.9	33.3	33.3	33.3
	Daytime Criterion	37.5	37.5	37.5	37.5	41.9	45.5	49.4
	Daytime Excess	--	--	--	--	--	--	--
	Night time Criterion	43	43	43	43	43	43	43
	Night time Excess	--	--	--	--	--	--	--

The assessment of predicted noise levels has identified no exceedances at any occupied noise sensitive locations with consideration of noise criteria curves derived considering the *Wind Energy Development Guidelines* published by the Department of the Environment, Heritage and Local Government (2006). A slight 1.8dB excess is predicted at 7m/s at the long-term derelict property R39 during daytime periods. It is noted this property has not been occupied at any stage during the operational lifetime of the wind farm.

The predicted operational noise effects are summarised as follows at the closest noise sensitive locations to the site:

Quality	*Significance*	*Duration*
Negative	Slight	Long Term

As the Derrybrien site is currently operational, it is also possible to verify the predicted noise levels via measurement of noise at nearby receptors in downwind conditions. The noise measurement location R35 has been chosen for this verification. The results of the operational monitoring are provided and discussed in Section 5.6.2.2.

At this point additional comments are presented in relation to the conclusions of the comparison of the operational wind turbine noise levels against the criteria curves that forms the core of **the** Department of Housing, Planning & Local Government published the Draft Revised Wind Energy Development Guidelines (2019).

As stated, the draft guidance outlines measures to assign day and evening noise criteria curves based on background night time noise levels. In order to simplify the assessment presented here, if it is demonstrated that the night time criteria are achieved by the wind farm it can be inferred that the relaxed day and evening criteria that are allowed for in the draft guidance will by default also be satisfied.

All predicted turbine noise levels are at or below the lower threshold of 35dB(A) espoused for night periods at all locations with the exception of Locations R36, R37 and R39. As noted before R39 is a long-term derelict property. Table 5.26 reviews

the predicted noise levels at these locations against the night time curve outlined in the **Draft Revised Wind Energy Development Guidelines (2019).**

Table 5.26 Assessment of Predicted Operational Noise Levels (2019 Draft Guidance)

Name	Description	dB $L_{A90,10min}$ at Various Standarised Wind Speeds (m/s)						
		4	5	6	7	8	9	10
R36	Predicted	26.6	29.1	33.1	34.9	35.4	35.4	35.4
	Night time Criterion	35.0	35.0	35.0	35.5	39.3	43.0	43.0
	Night time Excess	--	--	--	--	--	--	--
R37	Predicted	26.6	29.1	33.1	34.9	35.4	35.4	35.4
	Night time Criterion	35.0	35.0	35.0	35.5	39.3	43.0	43.0
	Night time Excess	--	--	--	--	--	--	--
R39	Predicted	30.9	33.4	37.4	39.3	39.8	39.8	39.8
	Night time Criterion	35.0	35.0	35.0	35.5	39.3	43.0	43.0
	Night time Excess	--	--	+2.4	+3.8	+0.5	--	--

Review of the night time curve espoused by the **Draft Revised Wind Energy Development Guidelines (2019) confirms that the predicted noise levels at locations R36 and R37 comply at all wind speeds.**

The long term derelict property at location R39 indicates excesses at windspeeds between 6 and to 8m/s. An additional step has been reviewed here in relation to the Draft Revised Wind Energy Development Guidelines (2019) which allows for relaxed criteria curves for evening (19:00 – 23:00) and day time periods (07:00 – 19:00hrs). The evening and night time criteria are relaxed by 5dB and 10dB respectively under the draft guidance while still having lower 35dB(A) and upper 43dB(A) thresholds applied to the curves. Table 5.27 reviews this exercise.

Table 5.27 Assessment of Predicted Operational Noise Levels (2019 Draft Guidance) Day / Evening / Night Criteria for R39

Name	Description	dB $L_{A90,10min}$ at Various Standarised Wind Speeds (m/s)						
		4	5	6	7	8	9	10
R39	Predicted	30.9	33.4	37.4	39.3	39.8	39.8	39.8
	Daytime Criterion	38.5	40.1	42.5	43.0	43.0	43.0	43.0
	Daytime Excess	--	--	--	--	--	--	--
	Evening Criterion	35.0	35.1	37.5	40.5	43.0	43.0	43.0
	Evening Excess	--	--	--	--	--	--	--
	Night time Criterion	35.0	35.0	35.0	35.5	39.3	43.0	43.0
	Night time Excess	--	--	+2.4	+3.8	+0.5	--	--

No exceedances are predicted at the long-term derelict property (R39) during daytime or evening periods.

5.6.2 Impacts which are occurring

5.6.2.1 Construction

Not Applicable.

5.6.2.2 Operation

Guidance provided in the IoA GPG and the GPG Supplementary Guidance Note 5: *Post Completion Measurements* (July 2014) has been followed in order to provide an assessment of compliance with the noise criteria, and to compare measured values to the noise model predictions presented in Table 5.16.

Operational noise levels have been established at the monitoring location R35 in downwind conditions (i.e. wind blowing broadly northerly). Downwind conditions are calculated as 300 to 20 degrees from north to the monitoring location R35. The degrees from north are selected in accordance with Section 2.1.7 of the IoA GPG *Supplementary Guidance Note 5*.

The results presented in the following section refer to the noise data collated during 'quiet periods' of the day and night as defined in the IoA GPG. These periods are as follows:

- All Evenings: 18:00 to 23:00hrs;
- Saturdays: 13:00 to 18:00hrs;
- Sundays: 07:00 to 18:00hrs;
- Night-time: 23:00 to 07:00hrs.

Figure 5.20 Presents the results of operational compliance monitoring at Location R35.

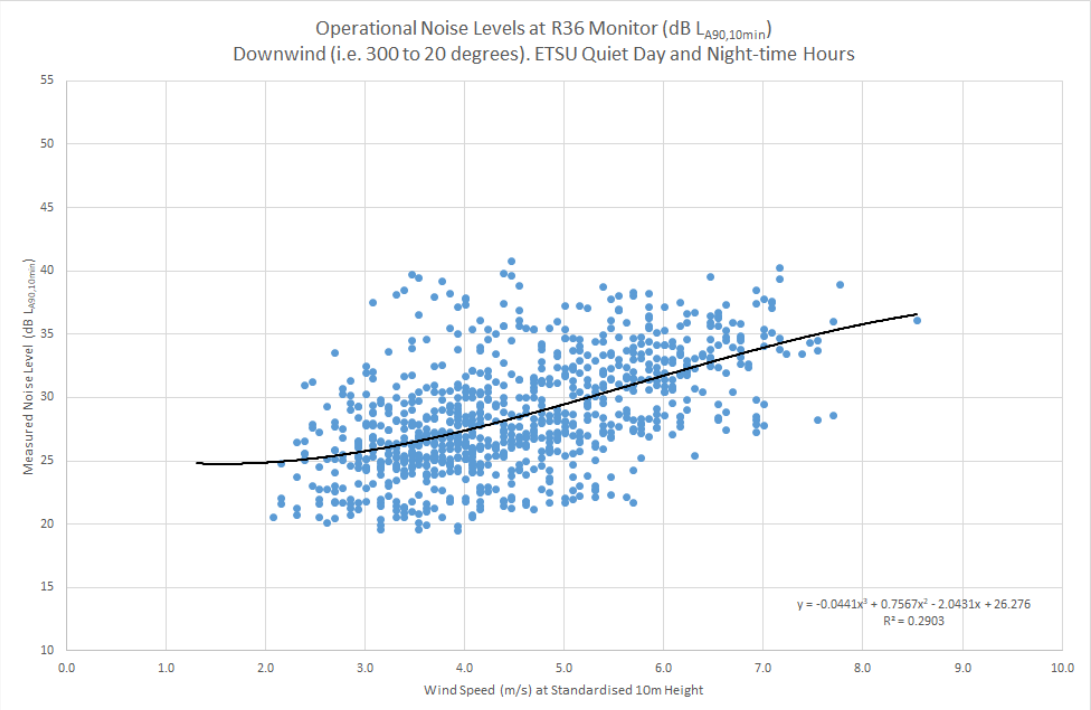

Figure 5.20 Operational Downwind Noise Levels to – Location R35 (LA90, 10 min dB)

Table 5.28 presents the derived operational noise levels in downwind conditions. Operational noise levels are presented for the three wind speeds where turbine sound power levels are variable (i.e. ≤6m/s, 7m/s and the turbine rated power wind speed ≥8m/s). At wind speeds >8m/s, turbine sound power levels do not increase as the turbines reach their rated power wind speed. This is confirmed in the Vestas test report ref. WT 2466/02 dated 2004-06-17 (see Appendix 5.7).

Table 5.28 Assessment of Measured Operational Noise Levels

NSL	Description	dB $L_{A90,10min}$ at Various Standarised Wind Speeds (m/s)		
		≤6	7	≥8
R35	Measured Operational Noise Level	31.7	33.9	35.8
	Daytime Criterion	35.5	38.5	41.9
	Complies?	✓	✓	✓
	Night time Criterion	43.0	43.0	43.0
	Complies?	✓	✓	✓

It is therefore concluded that the site is operating comfortably within the relevant daytime and night-time noise criteria.

Table 5.29 compares the measured operational noise levels at Location R35 to the calculated noise levels presented in Table 5.16 (i.e. the noise model prediction values).

Table 5.29 Comparison of Measured vs. Predicted Operational Noise Levels

NSL	Description	dB $L_{A90,10min}$ at Various Standarised Wind Speeds (m/s)		
		≤6	7	≥8
R35	Measured Operational Noise Level	31.7	33.9	35.8
	Noise Model Predicted Values	33.1	34.9	35.4
	Variation (dB)	-1.4	-1.0	+0.4

The noise model output values show good correlation with the operational noise levels that have been measured. The calculated noise levels to all receptors (as per Table 5.24) are therefore considered to be an accurate representation of operational noise levels at all nearby receptors.

It is therefore also concluded that any variation in site noise emissions due to the 2003 peat slide has not impacted upon compliance with relevant noise criteria.

5.6.3 Impacts which are likely to occur

5.6.3.1 Operational phase – 2020 to project end

See Section 5.6.2.2.

5.6.3.2 Decommissioning

The noise and vibration impacts associated with any decommission of the site are considered to be comparable to those outlined in relation to the construction of the Project (as per Section 5.6.1.1) Regarding decommissioning activities, BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise and BS 5228-2:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Vibration have been taken into account.

The BS5528-1 standard offers detailed guidance on the control of noise from construction activities. The following best practice measures will be adopted:

- limiting the hours during which site activities likely to create high levels of noise or vibration are permitted;
- establishing channels of communication between the contractor/developer, Local Authority and residents;
- appointing a site representative responsible for matters relating to noise and vibration;
- monitoring typical levels of noise and vibration during critical periods and at sensitive locations;
- keeping site access roads even to mitigate the potential for vibration from lorries.

Furthermore, a variety of practicable noise control measures will be employed. These include:

- selection of plant with low inherent potential for generation of noise and/ or vibration;
- placing of noisy / vibratory plant as far away from sensitive properties as permitted by site constraints, and;
- regular maintenance and servicing of plant items.

The contract documents will clearly specify that the Contractor undertaking the construction of the works will be obliged to take specific noise abatement measures and comply with the recommendations of British Standard BS 5228-1:2009+A1:2014 *Code of practice for noise and vibration control on construction and open sites – Noise.* The following list of measures will be implemented on site, to ensure compliance with the relevant construction noise criteria:

- No plant used on site will be permitted to cause an on-going public nuisance due to noise.
- The best means practicable, including proper maintenance of plant, will be employed to minimise the noise produced by on site operations.
- All vehicles and mechanical plant will be fitted with effective exhaust silencers and maintained in good working order for the duration of the contract.
- Compressors will be attenuated models fitted with properly lined and sealed acoustic covers which will be kept closed whenever the machines are in use and all ancillary pneumatic tools shall be fitted with suitable silencers.
- Machinery that is used intermittently will be shut down or throttled back to a minimum during periods when not in use.
- Any plant, such as generators or pumps, which is required to operate outside of general construction hours will be surrounded by an acoustic enclosure or portable screen.
- During the course of the construction programme, supervision of the works will include ensuring compliance with the limits detailed in Section **Error! Reference source not found.Error! Reference source not found.** using methods outlined in British Standard BS 5228-1:2009+A1:2014 *Code of practice for noise and vibration control on construction and open sites – Noise*.

The hours of construction activity will be limited to avoid unsociable hours where possible. Construction operations shall generally be restricted to between 7:00hrs and 19:00hrs weekdays and between 7:00hrs and 14:00hrs on Saturdays. However, to ensure that optimal use is made of good weather periods or at critical periods within the programme it will be necessary on occasion to work outside of these hours.

5.7 Cumulative Impacts

5.7.1 Cumulative impacts which have occurred

The noise levels produced by Sonnagh Old Wind Farm have been assessed cumulatively with the operational noise levels of the Derrybrien Wind Farm and there are no exceedances of the noise criteria as reviewed in Table 5.24.

A review of other potential cumulative impacts is presented in Table 5.30.

The effect of the cumulative operational turbines and other developments in wider study area can be considered to be as follows:

Quality	*Significance*	*Duration*
Negative	Slight	Long Term

5.7.2 Cumulative impacts which are occurring

As per Section 5.7.1.

5.7.3 Cumulative impacts which are likely to occur

As per Section 5.7.1

5.8 Remedial (Mitigation) Measures and Monitoring

5.8.1 Remedial Measures/Monitoring: Significant Effects

Not applicable.

5.8.2 Mitigation Measures: Non-significant effects

The mitigation measures for the management of decommissioning activities are as set out in Section 5.6.3.2.

Table 5.30 Review of Cumulative Impacts (Noise & Vibration)

Projects Noise and Vibration	Cumulative Impact Assessment Criteria & Summary Findings	Turf Cutting Within the Site	Sonnagh Old Wind Farm & Grid Connection	Keeldeery Wind Farm	Turbary Wind Farm	Adjacent coniferous forestry plantations	Moneypoint - Oldstreet 400 kV Overhead Line	Ennis - Shannonbridge 110kV Overhead Line	Tynagh 400MW Power Station	Tynagh 220kV Grid connection	Gort Regional Water Supply Scheme	Local OPW Flood Relief Scheme Gort	Local Flood Relief Works at Kiltartan	Flood Relief Works at Kinvarra	Proposed Gort Lowlands Flood Relief Scheme	M18 Motorway Project	Sand extraction at Cloghvoley	Coillte Quarry	Ballynakill Quarry	Tree-Forestry Planting (Various[3])
Noise Impact during Construction phase	Anticipated cumulative impact assessment.	Minimal based on distance between activity and nearest noise sensitive locations.	Minimal based on distance between project sites, (closest turbines 3.4 km to NW).	Minimal based on distance between project sites, (closest turbines 3km to W).	Minimal based on distance between project sites,	Minimal based on distance between activity and nearest noise sensitive locations.	None, developed prior to Derrybrien	None, developed prior to Derrybrien	None, developed prior to Derrybrien	None, developed prior to Derrybrien	None, developed prior to Derrybrien	None, developed prior to Derrybrien	None, developed after Derrybrien	None, developed after Derrybrien	None, developed after Derrybrien	None, developed after Derrybrien	None.	None, developed prior to Derrybrien	None, developed prior to Derrybrien	None.
	Anticipated Pre-mitigation impact	Short-term, imperceptible, neutral.	Short-term, imperceptible, neutral.	Short-term, imperceptible, neutral.	Short-term, imperceptible, neutral.	Short-term, imperceptible, neutral.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Mitigation required	No	No	No	No	No	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Mitigation possible	Yes, but N/A	Yes, but N/A	Yes, but N/A	Yes, but N/A	Yes, but N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Post-mitigation impact	Short-term, imperceptible, neutral.	Short-term, imperceptible, neutral.	Short-term, imperceptible, neutral.	Short-term, imperceptible, neutral.	Short-term, imperceptible, neutral.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Noise impact during Operational phase	Anticipated cumulative impact assessment.	Minimal based on distance between activity and nearest noise sensitive locations.	Minimal impact due to proximity of site to current proposal, (closest turbines 3.4 km NW)	Minimal impact due to proximity of site to current proposal, (closest turbines 3km W)	Minimal impact due to proximity of site to current proposal,	Minimal based on distance between activity and nearest noise sensitive locations.	None based on distance between project sites and nature of noise emissions associated with overhead lines.	None based on distance between project sites and nature of noise emissions associated with overhead lines.	None based on distance between project sites and nature of noise emissions associated with overhead lines.	None based on distance between project sites and nature of noise emissions associated with overhead lines.	None based on distance between project sites.	None based on distance between project sites.	None based on distance between project sites.	None based on distance between project sites.	None based on distance between project sites.	None based on distance between project sites.	None based on distance between project sites.	None based on distance between project sites.	None based on distance between project sites.	None based on distance between project sites.
	Anticipated Pre-mitigation impact	Long-term, imperceptible, neutral.	Long term imperceptible, neutral	Long term imperceptible, neutral	Long term imperceptible, neutral	Long-term, imperceptible, neutral.	Long-term, imperceptible, neutral.	Long-term, imperceptible, neutral.	Long-term, imperceptible, neutral.	Long-term, imperceptible, neutral.	Long-term, imperceptible, neutral.	Long-term, imperceptible, neutral.	Long-term, imperceptible, neutral.	Long-term, imperceptible, neutral.	Long-term, imperceptible, neutral.	Long-term, imperceptible, neutral.	Long-term, imperceptible, neutral.	Long-term, imperceptible, neutral.	Long-term, imperceptible, neutral.	Long-term, imperceptible, neutral.
	Mitigation required	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
	Mitigation possible	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Post-mitigation (residual) impact	Long-term, imperceptible, neutral.	Long term, imperceptible Neutral	Long term, imperceptible Neutral	Long term, imperceptible Neutral	Long-term, imperceptible, neutral.	Long-term, imperceptible, neutral.	Long-term, imperceptible, neutral.	Long-term, imperceptible, neutral.	Long-term, imperceptible, neutral.	Long-term, imperceptible, neutral.	Long-term, imperceptible, neutral.	Long-term, imperceptible, neutral.	Long-term, imperceptible, neutral.	Long-term, imperceptible, neutral.	Long-term, imperceptible, neutral.	Long-term, imperceptible, neutral.	Long-term, imperceptible, neutral.	Long-term, imperceptible, neutral.	Long-term, imperceptible, neutral.
Vibration	Anticipated cumulative impact assessment.	Minimal based on distance between activity and nearest noise sensitive locations.	Minimal based on distance between project sites, (closest turbines 3.4 km NW).	Minimal based on distance between project sites, (closest turbines 3.4 km NW).	Minimal based on distance between project sites,	Minimal based on distance between activity and nearest noise sensitive locations.	None based on distance between project sites and the fact there are no vibration emissions associated with overhead lines.	None based on distance between project sites and the fact there are no vibration emissions associated with overhead lines.	None based on distance between project sites and the fact there are no vibration emissions associated with overhead lines.	None based on distance between project sites and the fact there are no vibration emissions associated with overhead lines.	None based on distance between project sites	None based on distance between project sites	None based on distance between project sites	None based on distance between project sites	None based on distance between project sites	None based on distance between project sites	None based on distance between project sites	None based on distance between project sites	None based on distance between project sites	None based on distance between project sites
	Anticipated Pre-mitigation impact	Long-term, imperceptible, neutral.	Long-term, imperceptible, neutral.	Long-term, imperceptible, neutral.	Long-term, imperceptible, neutral.	Long-term, imperceptible, neutral.	Long-term, imperceptible, neutral.	Long-term, imperceptible, neutral.	Long-term, imperceptible, neutral.	Long-term, imperceptible, neutral.	Long-term, imperceptible, neutral.	Long-term, imperceptible, neutral.	Long-term, imperceptible, neutral.	Long-term, imperceptible, neutral.	Long-term, imperceptible, neutral.	Long-term, imperceptible, neutral.	Long-term, imperceptible, neutral.	Long-term, imperceptible, neutral.	Long-term, imperceptible, neutral.	Long-term, imperceptible, neutral.
	Mitigation required	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
	Mitigation possible	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Post-mitigation (residual) impact	Long-term, imperceptible, neutral.	Long-term, imperceptible, neutral.	Long-term, imperceptible, neutral.	Long-term, imperceptible, neutral.	Long-term, imperceptible, neutral.	Long-term, imperceptible, neutral.	Long-term, imperceptible, neutral.	Long-term, imperceptible, neutral.	Long-term, imperceptible, neutral.	Long-term, imperceptible, neutral.	Long-term, imperceptible, neutral.	Long-term, imperceptible, neutral.	Long-term, imperceptible, neutral.	Long-term, imperceptible, neutral.	Long-term, imperceptible, neutral.	Long-term, imperceptible, neutral.	Long-term, imperceptible, neutral.	Long-term, imperceptible, neutral.	Long-term, imperceptible, neutral.

3 Considers works associated with Ardcorcoran (Roscommon), Blackloon (Roscommon), Oldtown (Roscommon), Connmore (Tipperary); Foilnahomore (Tippearry) and Knockabansha (Tipperary).

5.9 Residual Impacts

5.9.1 Residual impacts which have occurred

No significant residual on-site construction noise impacts were predicted to have arisen as all noise associated with construction activities are estimated to have been below the relevant construction noise limit.

Due to the distances from works to sensitive locations vibration arising from the construction of the Project is predicted not to have had any significant effects.

No significant decommissioning noise effects are predicted.

As the noise levels associated with the development are comfortably within the noise criteria recommended in *Irish Wind Energy Development Guidelines*, there are no significant impacts associated with the operation of the development and this situation is expected to remain the case.

The residual operational noise effects are summarised as follows at the closest noise sensitive locations to the site:

Quality	*Significance*	*Duration*
Negative	Slight	Long Term

The above effect should be considered in terms that the effect is variable, and that this assessment considers periods of the greatest potential effect.

5.9.2 Residual impacts which are occurring

As per Section 5.9.1 in terms of the operational nature of the Project.

5.9.3 Residual impacts which are likely to occur

As per Section 5.9.1 in terms of the operational nature of the Project.

No significant decommissioning noise effects are predicted.

5.10 References

- EPA Guidelines on the Information to be contained in Environmental Impact Statements, (EPA, 2002).
- EPA Advice Notes on Current Practice (in the preparation of Environmental Impact Statements), (EPA, 2003).
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- British Standard British Standard BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise
- BS 7385 – "Evaluation and measurement for vibration in buildings – Part 2: Guide to damage levels from groundborne vibration" (1993); and
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- ISO 9613-2:1996 *Acoustics – Attenuation of sound during propagation outdoors: General method of calculation*.