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ENVIRONMENTAL IMPACT ASSESSMENT REPORT (EIAR) FOR THE PROPOSED FAHY BEG WIND FARM, CO. CLARE

Volume 2 – Main EIAR

Chapter 7 – Noise and Vibration

Prepared for: RWE Renewables

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7. NOISE AND VIBRATION

7.1 Introduction

This chapter contains an assessment of the potential noise and vibration impacts associated with the proposed Fahybeg Wind Farm. The assessment including undertaking of background noise surveys has been carried out by Fehily Timoney and Company, based on information provided by RWE Renewables and in accordance with current guidance and best practice. Descriptions of the proposed development are provided in Chapter 3 – Volume 2 of the EIAR.

Potential construction noise and vibration impacts have been determined with reference to British Standard 5228:2009+A1:2014 Code of Practice for Noise and Vibration Control on Construction and Open Sites - Part 1 - Noise.

Potential operational noise impacts associated with the proposed development have been determined with reference to the UK Institute of Acoustics', A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise (2013). Operational noise associated with the proposed development includes noise from the proposed wind turbines and on-site substation. The operational noise is compared with noise limits derived in accordance with the Wind Energy Development Guidelines 2006 currently in force and in accordance with current industry best practice.

Decommissioning noise and vibration impacts have been assessed in accordance with the same standards used to determine the construction noise and vibration impacts.

As discussed in Chapter 3, the exact turbine make and model will be dictated by competitive process, but it will fall within the range for which consent is sought

The hub height range is the only element of the turbine dimensions that influence the operational noise impact of the project. A range of tip heights ranging from 169m to 176.5m has been considered, corresponding to a hub height of between 102.5 to 110 m. This assessment demonstrates that all scenarios within the Turbine Range have been comprehensively considered.

7.2 Description of Noise and Vibration Impacts

7.2.1 Construction Noise & Vibration

Noise is generated from the construction of the turbine foundations, the erection of the turbines, the excavation of trenches for cables, and the construction of associated hard standings and access tracks, and construction of the substations.

Noise from vehicles on local roads and access tracks is also generated from the delivery of the turbine components and construction materials, notably aggregates, concrete and steel reinforcement.

Vibration is generated by construction activities such as rock breaking and passing heavy goods vehicles. The threshold of human perception of vibration is in the range of 0.14mm/s to 0.3mm/s, described as "might just be perceptible".

The guideline values for damage to buildings from vibration are 15mm/s at 4Hz increasing to 20mm/s at 15Hz and 50mm/s at 40Hz and above , as summarised in BS 5228 Control of Noise and Vibration on Open and Construction Sites- Part 2: Vibration.

Vibration levels generated from the construction activities proposed at Fahybeg Wind Farm are calculated as:

- Tracked excavators and disc cutters from cable trenching (0.8 mm/s at 4m)
- Pneumatic breakers for cable trenching (0.7 mm/s at 10 m)
- Excavation of turbine foundations (0.06 mm/s at 100 m)
- HGV traffic on normal road surfaces (0.01 to 0.5 mm/s) at footings of buildings located 20 m from roadway.

The nearest noise sensitive locations are sufficiently distant, and less than the values above such that vibration will not be perceivable by residents at their dwellings and building damage will not occur from construction incurred vibration. As such, construction vibration will not be considered further in this chapter.

7.2.2 Operational Noise & Vibration

Noise is generated by wind turbines as they rotate to generate power. This only occurs above the 'cut-in' wind speed and below the 'cut-out' wind speed. Below the cut-in wind speed there is insufficient strength in the wind to generate efficiently and above the cut-out wind speed the turbine is automatically shut down to prevent any malfunctions from occurring. The cut-in speed at the turbine hub-height is approximately 3 m/s and the cut-out wind speed is approximately 25 m/s.

The principal sources of noise are from the blades rotating in the air (aerodynamic noise) and from internal machinery, normally the gearbox and, to a lesser extent, the generator (mechanical noise).

The blades are carefully designed to minimize noise whilst optimising power transfer from the wind. See Oerlemans et al. (2008) 'Location and quantification of noise sources on a wind turbine' for further details on the principal sources of noise from a wind turbine.

Noise may also be generated from ancillary equipment such as transformers at on-site substations. However, these generally have low source noise levels compared to wind turbines themselves and, provided they are not located within the immediate vicinity of a residential dwelling, are unlikely to cause disturbance in the context of the other noise sources. Noise from the substation has been considered as part of this assessment and is discussed further in section 7.5.3. Noise from the proposed substation has been assessed in line with BS4142 Methods for rating and assessing industrial and commercial sound.

7.2.3 Blade Swish (Amplitude Modulation of Aerodynamic Noise)

This is the periodic variation in noise level associated with turbine operation, at the rate of the blade passing frequency (rotational speed multiplied by number of blades). It is often referred to as blade swish or amplitude / aerodynamic modulation (AM). This effect is discussed in ETSU-R-97, 'The Assessment and Rating of Noise from Wind Farms' (1996), which states that *'… modulation of blade noise may result in variation of the overall A-Weighted noise level by as much as 3 dB(A) (peak to trough) when measured close to a wind turbine... '* and that at distances further from the turbine where there are *'… more than two hard, reflective surfaces, then the* *increase in modulation depth may be as much as 6 dB(A) (peak to trough)'*. It concludes that *'the noise levels (i.e. limits) recommended in this report take into account the character of noise described ... as blade swish'.*

An observer close to a wind turbine will experience *'blade swish'* because of the directional characteristics of the noise radiated from the trailing edge of the blades as it rotates towards and then away from them. This effect is reduced for an observer on or close to the (horizontal) turbine axis, and therefore would not generally be expected to be significant at typical separation distances, at least on relatively level sites.

In some cases amplitude modulation is observed at large distances from a wind turbine (or turbines). The sound is generally heard as a periodic *'thumping'* or *'whoomphing'* at relatively low frequencies. This is known as *'Other AM or OAM'.*

It was proposed in the RenewableUK 2013 study that the fundamental cause of OAM is transient stall conditions occurring as the blades rotate, giving rise to the periodic thumping at the blade passing frequency. Transient stall represents a fundamentally different mechanism from blade swish and can be heard at relatively large distances, primarily downwind[1] of the rotor blade.

The University of Salford carried out a study on behalf the Department for Business, Enterprise and Regulatory Reform (BERR) to investigate the prevalence of amplitude modulation of aerodynamic noise on UK wind farm sites. The study concluded that AM has occurred at 4 out of 133 wind farms in the UK. A further investigation of the four sites by the Local Authority showed that the conditions associated with AM might occur between 7% and 15% of the time.

The most recent research into AM was conducted by RenewableUK, 'Wind Turbine Amplitude Modulation: Research to Improve Understanding as to its Cause and Effect' (December 2013).

This research focused on the less understood *'Other AM or OAM'* where reported incidents are relatively limited and infrequent but is a recognised phenomenon. However, the occurrence and intensity of Other AM is specific to a location and its likelihood of occurrence cannot be reliably predicted.

Section 6 of the 'Summary of Research into Amplitude Modulation of Aerodynamic Noise from Wind Turbines - Wind Turbine Amplitude Modulation: Research to Improve Understanding as to its Cause and Effect' states that *'At present there is no way of predicting OAM at any particular location before turbines begin operation due to the general features of a site or the known attributes of a particular turbine.'*

However, the Guidance Note on Noise Assessment of Wind Turbine Operations at EPA Licensed Sites (NG3) states…

> *'features which are thought to enhance this effect are:*
>
> - *close spacing of turbines in linear rows;*
> - *tower height to rotor diameter ratio less than approximately 0.75;*
> - *stable atmospheric conditions;*
> - *topography leading to different wind directions being seen by the blades at different points in their rotation'.*

[1] The stall source mechanism radiates equally upwind and downwind, but propagation effects reduce noise levels upwind.

The RenewableUK study *'has found that by minimising the onset of blade stall, the occurrence of OAM is also likely to be minimised.'* It goes on to discuss *'the future involvement of turbine manufacturers in developing methods of avoiding or minimising the partial stall mechanism identified as a primary cause of OAM; and suggests that in future changes to blade design and the way in which the blade pitch (the angle of attack of the blade to the incoming air flow) is controlled are likely to have a role to play in achieving better management of the phenomenon.'* Ultimately, further work is required to identify the exact on-blade conditions required for OAM to occur. The further work will aid in the development of a measure to fully mitigate the OAM. If OAM occurs from the proposed project, the wind turbine(s) will be operated in a manner to address this by way of implementation of blade pitch regulation, vortex generators or shut downs.

In 2016, the IoA published 'A Method for Rating Amplitude Modulation in Wind Turbine Noise'. It sets out a procedure for obtaining input noise data.

The procedure proposed in the IoA guidance document is recommended by the Department of Business, Energy & Industrial Strategy (BEIS) who have published a study on amplitude modulation.

At present there is no method for predicting OAM at any particular location before turbines begin operation based on the general features of a site or the known attributes of a particular turbine. Therefore, it is not possible to predict an occurrence of AM at the planning stage. It should also be noted that it is a rare event associated with a limited number of wind farms. While it can occur, it is the exception rather than the rule. The RenewableUK study states that "even on those limited sites where it has been reported, its frequency of occurrence appears to be at best infrequent and intermittent.", and "There is nothing at the planning stage that can presently be used to indicate a positive likelihood of OAM occurring at any given proposed wind farm site, based either on the site's general characteristics or on the known characteristics of the wind turbines to be installed."

Assessment of AM Research and Guidance is ongoing, with recent publications being issued by the Institute of Acoustics (IoA) Noise working Group (Wind Turbine Noise) Amplitude Modulation Working Group (AMWG) :"A Method for Rating Amplitude Modulation in Wind Turbine Noise (August 2016)". The document proposes an objective method for measuring and rating AM. The AMWG does not propose what level of AM is likely to result in adverse community response or propose any limits for AM. The purpose of the group is simply to use existing research to develop a Reference Methodology for the measurement and rating of AM. The definition of any limits of acceptability for AM, or consideration of how such limits might be incorporated into a wind farm planning condition, is outside the scope of the AMWG's work. There has been no adoption of endorsement of an AM 'penalty' scheme by any government. The IOA GPG states "The evidence in relation to "Excess" or "Other" Amplitude Modulation (AM) is still developing. At the time of writing, current practice is not to assign a planning condition to deal with AM."

Where it occurs, AM is typically an intermittent occurrence, therefore assessment may involve long-term measurements. The 'Reference Method' for measuring AM outlined in the IoA AMWG document will provide a robust and reliable indicator of AM and yield important information on the frequency and duration of occurrence, which can be used to evaluate different operational conditions which will be implemented to avoid the occurrence.

7.2.4 Infrasound & Low Frequency Noise

The definition of low frequency noise can vary, but it is generally accepted that low frequency noise is noise that occurs within the frequency range of 10 Hz to 160 Hz as defined in NANR45: Procedure for assessment of low frequency noise, Salford University Report.

Infrasound is noise occurring at frequencies below that at which sound is normally audible, that is, less than about 20 Hz, owning to the significantly reduced sensitivity of the ear at such frequencies. In this frequency range, for sound to be perceptible, it must be at very high amplitude, and it is generally considered that when such sounds are perceptible then they can cause considerable annoyance. However, wind turbines do not produce infrasound at amplitudes capable of causing annoyance as outlined in the following paragraphs.
The UK Department of Trade and Industry study, 'The Measurement of Low Frequency Noise at Three UK Windfarms', concluded that:

> *infrasound noise emissions from wind turbines are significantly below the recognised threshold of perception for acoustic energy within this frequency range. Even assuming that the most sensitive members of the population have a hearing threshold which is 12 dB lower than the median hearing threshold, measured infrasound levels are well below this criterion.*

It goes on to state that, based on information from the World Health Organisation, 'there is no reliable evidence that infrasound below the hearing threshold produce physiological or psychological effects' and that 'it may therefore be concluded that infrasound associated with modern wind turbines is not a source which may be injurious to the health of a wind farm neighbour'.

The study reports that low frequency noise is measurable but below the DEFRA low frequency noise criterion. The study also assessed low frequency measurements against the Danish criterion of LpA,LF = 20 dB. It was found that internal levels do not exceed 20dB when measurements are undertaken within rooms with the windows closed. However, the study acknowledges that wind turbine noise (low frequency) may result in an internal noise level that is just above the threshold of audibility as defined in ISO 226. The study goes on to say… *'However, at all the measurement sites, low frequency noise associated with traffic movement along local roads has been found to be greater than that from the neighbouring wind farm.'*

Bowdler et al. (2009) concludes that *'there is no robust evidence that low frequency noise (including 'infrasound') or ground-borne vibration from wind farms generally has adverse effects on wind farm neighbours'.*

In January 2013, the Environmental Protection Authority of South Australia published the results of a study into infrasound levels near wind farms. Measurements were undertaken at seven locations in urban areas and four locations in rural areas including two residences approximately 1.5 km from the wind turbines. The study concluded *'that the level of infrasound at houses near the wind turbines … is no greater than that experienced in other urban and rural environments and is also significantly below the human perception threshold.'*

In 2016, the State Office for the Environment, Measurement and Nature Conservation of the Federal State of Baden-Württemberg in Germany published a report entitled *'Low-frequency noise incl. infrasound from wind turbines and other sources.'* It assessed infrasound and low frequency sound from wind turbines and other sources. It found that for *'the measurements carried out even at close range, the infrasound levels in the vicinity of wind turbines – at distances between 150 and 300 m – were well below the threshold of what humans can perceive in accordance with DIN 45680 (2013).'*

We conclude that infrasound noise emissions from wind turbines are significantly below the recognised threshold of perception for acoustic energy within this frequency range. Infrasound is not a source which may be injurious to the health of a wind farm neighbour.

Wind turbines may produce low frequency noise at levels above the threshold of audibility. However, there is no evidence of health effects arising from low frequency noise generated by wind turbines. Given the evidence described above, an assessment of infrasound and low frequency noise from the wind farm has been scoped out.

7.2.5 Tonal Noise

ETSU-R-97 describes tonal noise as *'noise containing a discrete frequency component most often of mechanical origin'*. Wind turbine sound can be tonal in some cases, for example if there is a defect in a turbine blade or a fault in the mechanical equipment such as the gearbox. Tonality from wind turbines is generally caused by structural resonances in the mechanical parts of the turbine and thus is highly specific not only to the turbine model but the specific components used, including tower height. However, a correctly operating wind turbine is not considered to have tonal sound emission. In the event of tonal noise being present and following establishment of the likely cause, this can be addressed by turbine manufacturers and/or operator as and when it occurs. The assessment of the wind turbine noise assumed that a tonal penalty is 0 dB.

7.2.6 BS4142 Methodology

The proposed substation has been assessed using the methodology in BS4142:2014+A1:2019 Methods for rating industrial and commercial sound has been used to assess the impact of the sound.

This standard has a number of descriptors of the sound summarised below:

Background sound level, $L_{A90,T}$ This is the A-weighted sound pressure level that is exceeded by the residual sound at the assessment location for 90% of a given time interval, T, measured with a Fast time weighting.

Residual sound This is the ambient sound remaining at the assessment location when the specific sound (i.e the source being assessed), is suppressed to such a degree that it does not contribute to the ambient sound.

Specific Sound Level, (L_S=$L_{Aeq,Tr}$) This is the equivalent continuous A-weighted sound pressure level of the specific sound source (i.e. the source being assessed) at the assessment location over a given reference time interval T_r. The reference time interval is 1 hour during the day(07:00 to 23:00) or 15minutes at night (23:00 to 07:00).

Rating Level ($L_{ar,Tr}$) This is the specific sound plus any adjustment for the characteristic features of the sound.

The significance of a sound of an industrial or commercial source depends on the difference between the rating level of the specific source and the background noise level and the context under which the sound occurs. Generally, the greater the difference the greater the magnitude of the impact.

- A difference of +10dB or more is likely to be an indication of a significant adverse impact, depending on the context.
- A difference of +5dB is likely to be an indication of an adverse impact, depending on the context.

BS4142 notes that where the initial estimate of the impact needs to be modified due to the context the following needs to be considered:

1. The absolute level of the sound. Where the absolute noise levels are low, absolute noise levels may be more relevant, particularly at night.
2. Character and level of residual sound compared to character and level of specific sound.
3. Sensitivity of receptor to sound and whether design measures that improve the acoustic environment can be considered (e.g. façade insulation, ventilation or acoustic screening)

7.2.7 Vibration

Vibration from operational wind turbines is low and will not result in perceptible levels at nearby sensitive receptors nor will the levels of vibration result in any structural damage. Research undertaken by Snow[2] found that levels of ground-borne vibration 100 m from the nearest wind turbine were significantly below criteria for 'critical working areas' given by British Standard BS 6472:1992 Evaluation of human exposure to vibration in buildings (1 Hz to 80 Hz) and were lower than limits specified for residential premises by an even greater margin. Hence, the level of vibration produced by wind turbines at this distance is low and does not pose a risk to human health.

More recently, the Low Frequency Noise Report[3] published by the Federal State of Baden-Württemberg simultaneously measured vibration at several locations, ranging from directly at the wind turbine tower to up to 285m distance from an operational Nordex N117 – 2.4 MW wind turbine with a hub height of 140.6m. The report concluded that at less than 300m from the turbine, the vibration levels had reduced such that they could no longer be differentiated from the background vibration levels.

Considering that the curtilage of the nearest sensitive receptor is over 711m from the nearest turbine, the level of vibration is significantly below any thresholds of perceptibility. Vibration from the turbines is too low to be perceived at neighbouring residential dwellings.

Vibration levels will also be significantly below levels that would result in damage to the nearest buildings (including farm buildings). Therefore, operational vibration has been scoped out.

7.2.8 Decommissioning Noise & Vibration

The impacts associated with decommissioning of the project are comparable to those described for the construction phase.

[2] ETSU (1997), Low Frequency Noise and Vibrations Measurement at a Modern Wind Farm, prepared by D J Snow.

[3] Low-frequency noise incl. infrasound from wind turbines and other sources', State Office for the Environment, Measurement and Nature Conservation of the Federal State of Baden-Württemberg in Germany, 2016.

7.3 Methodology

The methodology adopted for this noise and vibration assessment is as follows:

- Review of appropriate guidance and specification of suitable construction and operational noise / vibration criteria;
- Characterisation of the receiving noise environment;
- Prediction of the noise impact associated with the proposed development, and;
- Evaluation of noise impacts;
- Propose mitigation, and;
- Assess residual impacts.

7.3.1 Relevant Guidance

A list of relevant guidance documents is provided below. These have been referred to where referenced or applied in the sections hereafter.

EIA Guidance:

- Guidelines on the information to be contained in Environmental Impact Assessment Reports, Environmental Protection Agency, May 2022
- Advice Notes on Current Practice, Environmental Protection Agency, Draft 2015
- Environmental Impact Assessment of Projects - Guidance on the preparation of the Environmental Impact Assessment Report (Directive 2011/92/EU as amended by 2014/52/EU).

Noise Modelling Standards and Technical Advice:

- International Standard *ISO 9613-2: 1996 Attenuation of sound during propagation outdoors, Part 2: General method of calculation;*
- UK Institute of Acoustics', *A Good Practice Guide to the Application of ETSU-R-97 for the Assessment at Rating of Wind Turbine Noise* (2013) and supplementary notes;
- British Standard *BS 5228 Part 1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites Part 1: Noise;*
- Irish Wind Energy Association, *Best Practice Guidelines for the Irish Wind Energy Industry* (2012);
- UK Department of Trade and Industry (DTI), ETSU-R-97, *The Assessment and Rating of Noise from Wind Farms* (1996);
- British Standard 4142:2014+A1:2019, *Methods for rating and assessing industrial and commercial sound.*

Guideline Noise Levels:

- Wind Energy Development Planning Guidelines, Department of the Environment, Heritage and Local Government (2006);

- Draft Revised Wind Energy Development Guidelines (December 2019), Department of Housing, Planning and Local Government, 2019;
- Clare County Development Plan 2017 – 2023 (as varied);
- Clare Renewable Energy Strategy 2017-2023.

7.3.2 Study Area

Construction and decommissioning noise have been assessed by comparing predicted construction activities against best practice construction noise criteria at the nearest residential dwellings to the construction activities. As such, if the construction noise meets the relevant noise limits at the nearest locations, it will also be below the relevant noise limits at more distant residential locations.

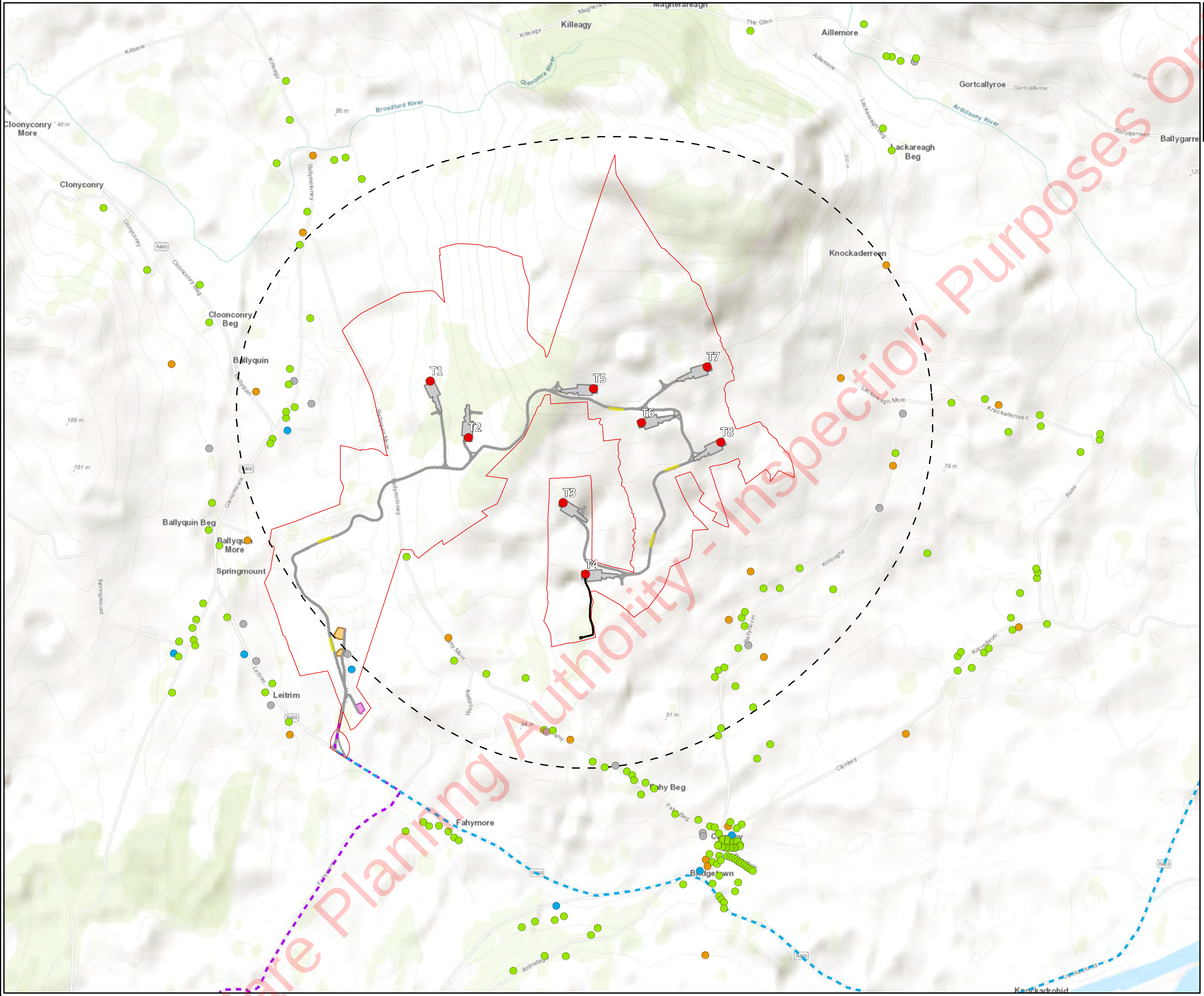
The operational noise study area includes all residential dwellings with a predicted noise level greater than 35 dB L_{A90} (which is the lowest limit prescribed in the 2006 Department of the Environment, Heritage, and Local Government, *Wind Energy Development Guidelines*). The study area is also in accordance with the UK Institute of Acoustics', *A Good Practice Guide to the Application of ETSU-R-97 for the Assessment at Rating of Wind Turbine Noise* (2013) whereby the guidance document defines the study area as "*the area within which noise levels from the proposed, consented and existing wind turbine(s) may exceed 35dB L_{A90} at up to 10 m/s wind speed*."

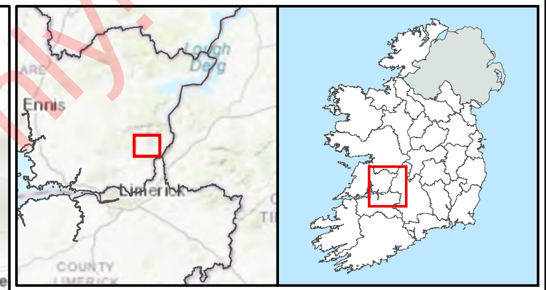
As discussed in Chapter 3, the exact turbine make and model will be dictated by competitive process, but it will not exceed the hub height range for which consent is sought. The hub height range and the choice of turbine are the main elements that influence the operational noise impact of the project. Any influence on the variation of blade length is accounted from by the turbine manufacturer in their sound power data which is used for the purpose of modelling the proposed turbine layout using the representative turbine. Therefore noise has been modelled at a maximum hub height of 110m.

The IOA guidance documents also states… *"During scoping of a new wind farm development consideration should be given to cumulative noise impacts from any other wind farms in the locality. If the proposed wind farm produces noise levels within 10 dB of any existing wind farm/s at the same receptor location, then a cumulative noise impact assessment is necessary."* As the proposed windfarm is sufficiently distant from adjacent windfarms, no cumulative noise from adjacent windfarms has been considered as part of this assessment. The operational study area is presented in Figure 7.1. The study area includes 41 no. noise sensitive locations.

As construction and operational vibration have been scoped out (see Section 7.2.1) there is no requirement to set study areas for each.

Path: R:\Map Production\2020\P20-003\Workspace\EIAR\P20-003_GIS_Fig7-1_Noise_Sensitive_Locations_A3.mxd





Legend

- Wind Farm Site Boundary
- Permanent Met Mast
- 35db LA90 Study Area
- Onsite Access Roads
- Turbine Delivery Route
- Grid Connection Route
- Substation Compound
- Construction Compound
- Turbine Hardstanding Area
- Passing Bays
- Proposed Turbine Layout

Receivers

Building Use

- Residential
- Commercial
- Residential and Commercial
- Unknown

TITLE:	Noise Sensitive Locations within the Study Area
PROJECT:	Fahy Beg Wind Farm, Co. Clare
FIGURE NO:	7.1
CLIENT:	RWE Renewables Ireland Ltd.
SCALE: 1:20000	REVISION: 0
DATE: 01/09/2022	PAGE SIZE: A3

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7.3.3 Evaluation Criteria

7.3.3.1 Construction Noise Criteria

There is no 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 emission criteria relating to permissible construction noise levels for a project 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.*

BS 5228-1:2009+A1:2014 contains several methods for the assessment of the potential significance of noise effects. The ABC Method was used to derive appropriate noise limits for the proposed project. The threshold limit to be applied (as defined in Table 7.1) is dependent on the existing ambient noise levels (rounded to the nearest 5dB).

Table 7-1: Threshold of Potential Significant Effect during Construction and Decommissioning

Threshold value period (L_{Aeq})	Threshold Value, in decibels (dB)		
	Category A	Category B	Category C
Night-time (23:00 - 07:00hrs)	45	50	55
Evenings (19:00 – 23:00 hrs) and weekends (13:00 – 22:00 Saturdays) and (07:00 – 19:00 hrs Sundays)	55	60	65
Daytime (07:00 – 19:00) and Saturdays (08:00 – 16:30)	65	70	75

Note

Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are less than these values.

Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are the same as category A values.

Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are higher than category A values.

The approach adopted here 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. For the appropriate period (e.g. daytime), the ambient noise level is determined and rounded to the nearest 5dB.

The baseline noise survey results ambient (free-field) noise levels were analysed. A correction of +3dB was added to the noise levels to convert free-field noise levels to façade noise levels. The ambient façade noise level when rounded to the nearest 5dB varies, but for the most part it is less than 60 dB L_{Aeq}. The nearest residential dwellings to the proposed development are afforded Category A designation (65 dB $L_{Aeq,1hr}$ during daytime periods).

Section 7.5.2 provides the detailed assessment of construction activity in relation to this site.

If the modelled construction noise level exceeds the appropriate category value (e.g. 65 dB $L_{Aeq,1hr}$ during daytime periods) then a potential significant effect is predicted and mitigation measures may be required to reduce the noise levels below the $L_{Aeq,1hr}$ daytime noise limit.

7.3.3.2 Wind Farm Operational Noise Criteria

The operational noise assessment summarised in the following sections has been based on guidance in relation to acceptable levels of noise from wind farms as contained in the document Wind Energy Development Guidelines published by the Department of the Environment, Heritage and Local Government (2006).

ETSU-R-97, The Assessment and Rating of Noise from Wind Farms (1996) published by the Department of Trade & Industry (UK) Energy Technology Support Unit (ETSU) and Institute of Acoustics' A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise, (May 2013) has been used to supplement the guidance contained within the 'Wind Energy Development Guidelines' publication where necessary.

Currently Clare have published a Draft County Development Plan 2023-2029 which is currently undergoing public consultation.

The existing Clare Wind Energy Strategy 2017-2023 has not been reviewed by Clare County Council due to the current advice to local authorities, which is that the Wind Energy Strategy should not be amended until national policy review processes have concluded in relation to the Wind Energy Development Guidelines.

The current guidance states that the proposed site is in an area that is classed Open to consideration for Wind Energy Developments. These developments *"will be assessed on a case by case basis, subject to viable wind speeds, environmental resources and constraints and cumulative impacts."*

The "Good Practice for Wind Energy Development Guidelines 2016" does not provide guidance on appropriate noise limits but provides guidelines for community engagement.

The noise criteria used to assess operational noise from the proposed development is based on a Best Practice Approach, currently used by the acoustics industry. This best practice approach is based on:

- Wind Energy Development Guidelines published by the Department of the Environment, Heritage and Local Government (2006);
- ETSU-R-97, The Assessment and Rating of Noise from Wind Farms (1996);
- Institute of Acoustics' A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise, (May 2013).

The DoEHLG guidelines (2006) contain recommended noise limits to control operational noise from wind farms and state...

> *In general, a lower fixed limit of 45 dB(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. 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 30 dB(A), it is recommended that the daytime level of the LA90,10min of the wind energy development noise be limited to an absolute level within the range of 35-40 dB(A).

Separate noise limits should apply for day-time and for night-time. During the night, the protection of external amenity becomes less important and the emphasis should be on preventing sleep disturbance. A fixed limit of 43dB(A) will protect sleep inside properties during the night.

In the absence of detailed guidance from the Wind Energy Development Guidelines 2006, best practice has typically been to consider the guidance contained in ETSU-R-97 and more recently the detailed guidance contained in the Institute of Acoustics 'A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise' (May 2013) and its six supplementary guidance notes.

Where background noise is less than 30 dB(A), an absolute level within the range of 35-40 dB(A) is applicable. However, there is no appropriate approach in relation to the identification of low noise environments *"where background noise is less than 30dB(A)"* nor is there details on the application of *"an absolute level within the range of 35-40 dB(A)."* In the absence of detailed guidance from the Wind Energy Development Guidelines 2006, on what range of *35-40 dB* to use, we have referred to guidance from ETSU-R-97[4] which states...

"The actual value chosen for the day-time lower limit, within the range of 35-40dB(A), should depend upon a number of factors:

- *Number of dwellings in the neighbourhood of the wind farm.*
- *The effect of noise limits on the number of kWh generated.*
- *Duration and level of exposure."*

The 2006 DoEHLG Wind Energy Development Guidelines do not provide the specific periods which are represented by daytime and night-time hours, therefore the definitions from ETSU-R-97 are taken as 07:00 to 23:00 hrs for daytime and 23:00 to 07:00 hrs for night-time.

The operational noise criteria include noise from wind turbines and any other ancillary noise sources such as the on-site substation transformer.

The Supreme Court decision in Balz and Heubach v An Bord Pleanála and others [2018] IEHC 309 does not change the legal position of the Wind Energy Development Guidelines, 2006 (WEDGs). It has however clarified the extent of the duty on planning authorities to consider submissions in relation to the continued relevance of the WEDGs. The EIAR considered the application of other noise guidelines. However, the Draft Revised Wind Energy Development Guidelines, published in December 2019 which is the most recent publication from the Department of Housing, Planning and Local Government have a number of technical errors, ambiguities and inconsistencies and requires further detailed review and amendment. This is a fact supported by several acoustic consultants from Ireland and the UK. In assessing the draft Guidelines, the WHO 45 dB L_{den} noise criterion was considered. The WHO document is based on a very limited data set, which only estimated the L_{den} for the sites studied, rather than assessing it directly from wind statistics. Furthermore, the WHO recommendation is "conditional".

[4] See Page 65 of *The Assessment and rating of noise from wind farms (ETSU-R-97)*: ETSU (Energy Technology Support Unit) for more details.

The guidelines also state… *"it may be concluded that the acoustical description of wind turbine noise by means of Lden or Lnight may be a poor characterization of wind turbine noise and may limit the ability to observe associations between wind turbine noise and health outcomes."* A conditional recommendation, before it becomes folded into any legislative context, would require substantial debate of stakeholders (such as, but not limited to the Public, government bodies, wind farm developers and operators as well as turbine manufacturers). A conditional recommendation is based on low quality evidence that this chosen noise level is effective. Therefore, it would be premature to adopt the WHO recommendations without further careful and detailed consideration and therefore this has not been adopted. The best practice guidance contained in ETSU-R-97 together with the detailed guidance contained in the Institute of Acoustics 'A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise' (May 2013) and its six supplementary guidance notes haves been considered and applied to ensure a robust and best practice approach to the assessment.

7.3.4 Significance of Impact

The criteria for determining the significance of impacts and the effects are set out in the EPAs 'Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (Draft), August 2017'. The EPA guidelines do not quantify the impacts in decibel terms. In absence of such information, reference is made to relevant standards and guidance documents noise limits. If the predicted impact from the construction or operational phase are below the respective noise limits, it is considered that no significant effect occurs.

For this assessment, it has been assumed that dwellings have a medium to high sensitivity. Table 7.2 presents the impact significance criteria from the EPA guidelines:

Table 7-2: Impact Significance Criteria

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

7.3.5 Consultation Requirements

Chapter 5 of the EIAR refers to scoping consultation. Submissions and comments from various consultees have informed the project's assessment methodology throughout the EIAR.

The following response has been received in relation to noise during the scoping process:

Clare County Council Planning advises that the following be considered in the preparation of the EIAR:

- Consideration of Acoustics and Vibration in relation to noise and vibration arising from proposed development. Noise assessed in the context of site preparation, ongoing operation and any restoration required. Baseline readings at all noise-sensitive locations (e.g. houses, schools etc) should be obtained.

The TII response to the scoping consultation stated that:

- The EIAR should consider the 'Environmental Noise Regulations 2006' (SI 140 of 2006) and, in particular, how the development will affect future action plans by the relevant competent authority. The developer may need to consider the incorporation of noise barriers to reduce noise impacts (see 'Guidelines for the Treatment of Noise and Vibration in National Road Schemes' (1st Rev., NRA, 2004)).

Following door to door consultation with residents, noise was raised as one of three key questions that people raised with the RWE team. Concerns were raised regarding both turbine noise from operation of the development, in addition to potential construction noise from the development.

7.4 Existing Environment

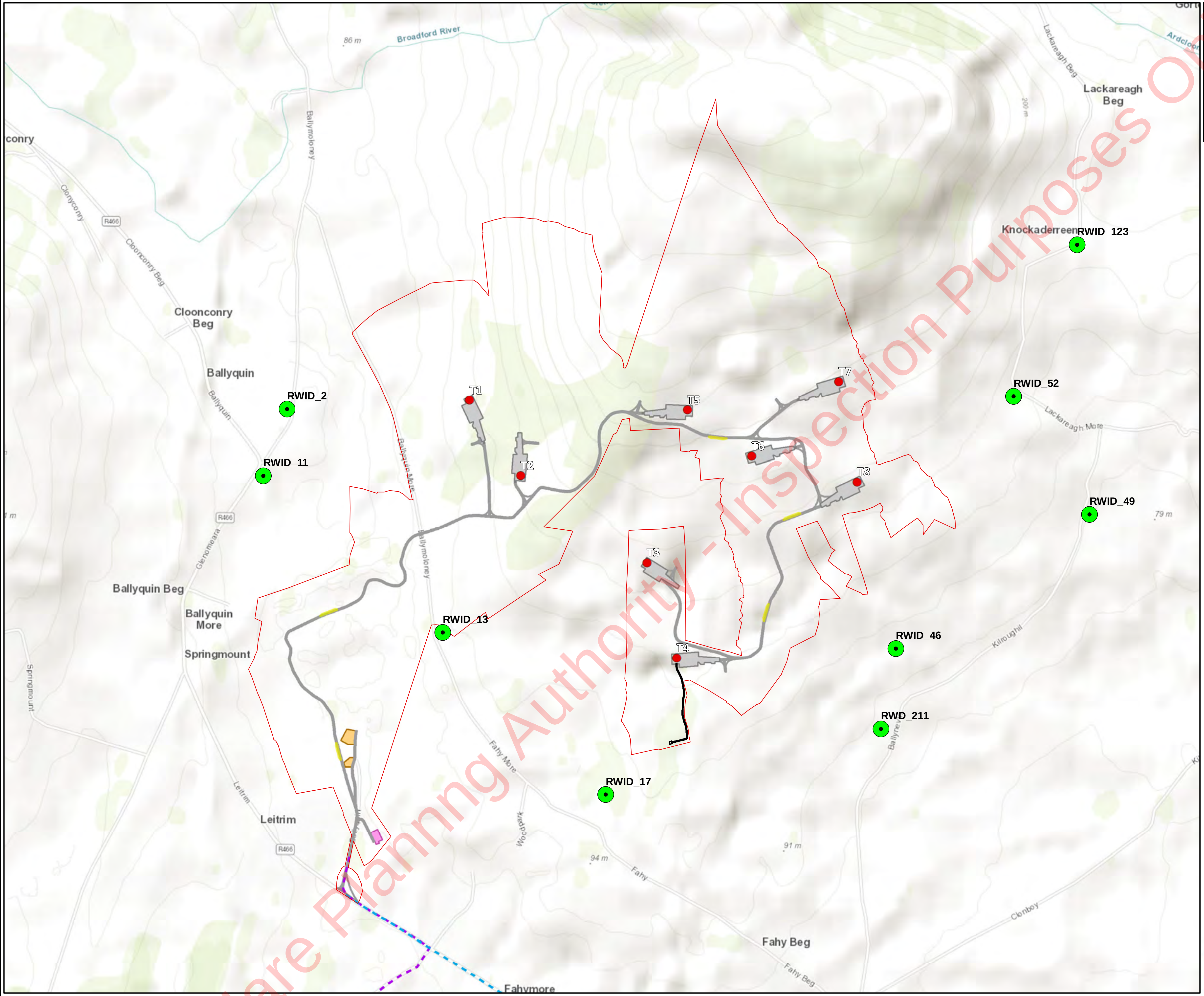
Baseline noise monitoring was undertaken at nine receptor locations surrounding the proposed Fahybeg Wind Farm to establish the existing background noise levels in the vicinity of the proposed development. These are some of the closest locations to the proposed development as well as representing different noise environments in the vicinity of the proposed development.

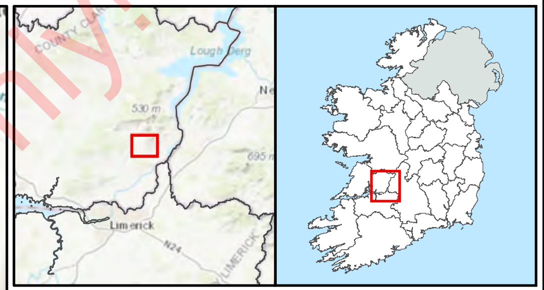
The 35 dB L_{A90} study area as described in Section 7.3.2 and Figure 7.1 was reviewed to determine receivers to be considered for noise monitoring. Permission to access the noise measurement locations was arranged by the applicant, with Fehily Timoney & Company setting up the noise monitoring equipment. Baseline noise data was collected at the nine locations, shown in Figure 7.2 and details of the noise monitoring locations are presented in Table 7.3. The rationale for the selection of these monitoring locations is described in Appendix 7.1 which presents details on the baseline measurements and data analysis.

Table 7-3: Noise monitoring location details

Location ID	ITM Easting	ITM Northing	Description	Photograph* (see Appendix 7.1)
RWID_2	562309	670578	Meter set up to front of property overlooking proposed windfarm	Plate 7.1-1*
RWID_11	562214	670310	Meter set up on gravel to rear of property overlooking proposed windfarm	Plate 7.1-2*
RWID_13	562934	669681	Meter was set up at rear of property to screen potential noise from sand and gravel site.	Plate 7.1-3*
RWID_17	563588	669030	This location was to the rear of the property in the direction of proposed windfarm and north of the adjacent sand and gravel quarry.	Plate 7.1-4*
RWID_46	564753	669616	Meter set up on grassed area north of property overlooking proposed windfarm	Plate 7.1-5*
RWID_49	565531	670155	Located within courtyard area of house.	Plate 7.1-6*
RWID_52	565226	670629	Located on slope west of property in direction of windfarm	Plate 7.1-7*
RWID_123	565481	671237	Located on embankment between cottage and field next to road.	Plate 7.1-8*
RWD_211	564694	669294	Located to rear of property near fence near cul de sac	Plate 7.1-9*

*Photographs provided in Appendix 7.1





Legend

- Wind Farm Site Boundary
- Noise Monitoring Locations
- Proposed Turbine Layout
- Permanent Met Mast
- Onsite Access Roads
- Turbine Delivery Route
- Grid Connection Route
- Substation Compound
- Construction Compound
- Turbine Hardstanding Area
- Passing Bays

TITLE:	Noise Monitoring Locations		
PROJECT:	Fahy Beg Wind Farm, Co. Clare		
FIGURE NO:	7.2		
CLIENT:	RWE Renewables Ireland Ltd.		
SCALE:	1:15000	REVISION:	0
DATE:	01/09/2022	PAGE SIZE:	A3

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7.4.1 Analysis of the Background Noise Data

The raw background L_{A90} noise data was reviewed to determine whether there are any periods of non-consistent noise level owing to equipment malfunction. Any inconsistent data points were removed from the raw noise level data. The raw noise level data was then correlated with the time synchronised 10 m standardised wind speed, based on a hub height of 110m, and rainfall data, . Periods of rainfall, data affected by dawn chorus and atypical data was removed from the analysis. Once the remaining data sets were found to be representative of the noise environment, they were analysed to ensure that sufficient data sets remained to provide sufficient data coverage over the necessary wind speeds. A "best-fitting polynomial" (not higher than a fourth order) was determined to present the prevailing background noise level at each monitoring location. Appendix 7.1 presents the results of the data analysis.

The prevailing daytime amenity noise levels at the nine noise monitoring locations are presented in Table 7.4. The derived prevailing background noise polynomial curve was not extended beyond the range covered by adequate data points. Where a noise limit is required at higher wind speeds; it was restricted to the highest derived point.

Table 7-4: Prevailing Background Noise during Daytime Periods (110m hub height)

Location	Prevailing Background Noise $L_{A90,10min}$ (dB) at Standardised 10 m Height Wind Speed (m/s)									
	3	4	5	6	7	8	9	10	11	12
RWID_2	34.1	34.7	35.5	36.5	37.7	39.0	40.5	42.1	43.9	43.9§
RWID_11	31.7	32.5	33.5	34.7	36.2	37.9	39.8	42.0	44.4	44.4§
RWID_13	25.8	27.0	28.3	29.8	31.6	33.5	35.7	38.0	38.0§	38.0§
RWID_17	27.5	27.9	28.6	29.8	31.5	33.5	35.9	38.8	42.1	42.1§
RWID_46	33.5	34.1	34.9	35.9	37.1	38.4	39.9	41.5	41.5	41.5§
RWID_49	28.3	28.3	28.6	29.4	30.5	32.1	34.0	36.3	36.3§	36.3§
RWID_52	29.9	30.1	30.5	31.2	32.1	33.3	34.6	36.2	36.2§	36.2§
RWID_123	28.6	29.0	29.6	30.7	32.0	33.7	35.7	38.1	38.1§	38.1§
RWID_211	33.8	34.1	34.7	35.5	36.5	37.8	39.3	41.0	43.0	43.0§
§ - noise level restricted to the highest derived point										

Table 7-5: Prevailing Background Noise during Nighttime Periods (110m hub height)

Location	Prevailing Background Noise $L_{A90,10min}$ (dB) at Standardised 10 m Height Wind Speed (m/s)									
	3	4	5	6	7	8	9	10	11	12
RWID_2	18.5	19.5	21.3	23.9	27.2	31.3	36.1	41.7	41.7§	41.7§
RWID_11	17.8	19.0	21.0	23.8	27.5	31.9	37.2	43.3	43.3§	43.3§
RWID_13	15.5	17.0	19.4	22.6	26.7	31.6	31.6§	31.6§	31.6§	31.6§
RWID_17	20.5	21.3	22.4	23.7	25.4	27.4	27.4§	27.4§	27.4§	27.4§

Location	Prevailing Background Noise $L_{A90,10min}$ (dB) at Standardised 10 m Height Wind Speed (m/s)									
	3	4	5	6	7	8	9	10	11	12
RWID_46	17.6	18.5	20.1	22.3	25.1	28.7	32.9	37.7	37.7§	37.7§
RWID_49	22.1	22.5	23.1	24.1	25.5	27.2	27.2§	27.2§	27.2§	27.2§
RWID_52	21.3	22.4	24.0	26.2	28.9	32.3	32.3§	32.3§	32.3§	32.3§
RWID_123	24.9	26.2	27.4	28.7	30.0	31.3	31.3§	31.3§	31.3§	31.3§
RWID_211	18.9	19.6	20.9	22.9	25.5	28.8	32.8	37.4	37.4§	37.4§
§ - noise level restricted to the highest derived point										

7.4.2 Derived Wind Farm Noise Limits

The standard approach (outlined in the IoA GPG) to derivation of noise limits is to carry out background measurements at several locations representative of different noise environments around the proposed site. As it is not usually possible to carry out measurements at every noise sensitive location (NSL), NSLs near to the measurement location are then assigned the same limits as the measurement location. The operational impact at each of the measurement locations was assessed in accordance with the IoA GPG.

As detailed in previous sections the noise criteria used to assess operational noise from the proposed development is based on a Best Practice Approach, currently used by the acoustics fraternity. This best practice approach is based on:

- Wind Energy Development Guidelines published by the Department of the Environment, Heritage and Local Government (2006);
- ETSU-R-97, The Assessment and Rating of Noise from Wind Farms (1996);
- Institute of Acoustics' A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise, (May 2013).

The 2006 guidelines state that a fixed limit of 43 dB L_{A90} applies during night-time periods. In this case a limit of 43 dB L_{A90} has been assumed or +5dB above background, whichever is the greater. However, the derivation of the daytime noise limit uses the prevailing daytime amenity background noise data. Where low background noise levels are found, the 2006 guidelines recommend a limit of 35 to 40 dB L_{A90}. There is no advice within the guidelines on how to choose the noise limit from within this range. For this project for low noise areas (<30 dB L_{A90}) a limit of 40 dB L_{A90} has been adopted. There is no further detail provided on which to determine how the appropriate noise limit be derived as stated previously above. However, the guidelines state… "An appropriate balance must be achieved between power generation and noise impact." Reference has also been made to planning permissions for adjacent wind farms. Finally, reference is also made to ETSU-R-97 which recommends that the following three factors be considered when determining the fixed limit:

1) *Number of dwellings in neighbourhood of the wind farm.*
2) *The effect of noise limits on the kWh.*
3) *Duration and level of exposure.*

The IOA GPG states the following with respect to the ETSU-R-97 criteria… *"It can be argued that assessing these factors do not represent an acoustic consideration but ultimately a planning consideration."*

The first factor to be considered is the "*Number of dwellings in neighbourhood of the wind farm*". ETSU-R-97 describes this factor as balancing the benefits from a wind energy project with the local environment impact, "*The more dwellings that are in the vicinity of a wind farm the tighter the limits should be as the total environmental impact will be greater. Conversely if only a few dwellings are affected, then the environmental impact is less and noise limits towards the upper end of the range may be appropriate.*" The number of noise sensitive locations (includes planning permissions) within the 35dB L_{A90} study area is 41. A noise limit of 40 dB L_{A90} is appropriate.

The second factor is the effect of noise limits on the power output of the wind farm. Similarly, to the first factor, this balances the planning merit of the project against the local impact. The proposed project has 8 turbines. If the limit is lowered, then, based on the noise modelling results, curtailment would be required. Since this project is considered to have merit in assisting Ireland in meeting its renewable energy targets, the upper end of the limit range is appropriate.

The final ETSU factor relates to the duration and level of exposure. The prevailing background noise levels are described in detail in Section 7.4.1 and Appendix 7.1. In terms of the location of the properties within the study area, these are mainly located east, south and west of the proposed site. There is one property located downwind of the prevailing, south westerly wind.

Table 7-6: Derived Noise Limits

Location	Period	Prevailing Background Noise $L_{A90,10min}$ (dB) at Standardised 10 m Height Wind Speed (m/s)									
		3	4	5	6	7	8	9	10	11	12
RWID_2	Daytime	45	45	45	45	45	45	45.5	47.1	47.1	47.1
	Night-time	43.0	43.0	43.0	43.0	43.0	43.0	43.0	46.7	46.7	46.7
RWID_11	Daytime	45	45	45	45	45	45	45.0	47.0	47.0	47.0
	Night-time	43.0	43.0	43.0	43.0	43.0	43.0	43.0	48.3	48.3	48.3
RWID_13	Daytime	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
	Night-time	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
RWID_17	Daytime	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
	Night-time	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
RWID_46	Daytime	45.0	45.0	45.0	45.0	45.0	45.0	45.0	46.5	46.5	46.5
	Night-time	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
RWID_49	Daytime	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
	Night-time	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0

Location	Period	Prevailing Background Noise $L_{A90,10min}$ (dB) at Standardised 10 m Height Wind Speed (m/s)									
		3	4	5	6	7	8	9	10	11	12
RWID_52	Daytime	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
	Night-time	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
RWID_123	Daytime	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
	Night-time	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
RWID_211	Daytime	45.0	45.0	45.0	45.0	45.0	45.0	45.0	46.0	46.0	46.0
	Night-time	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0

7.5 Potential Impacts

7.5.1 Do Nothing Scenario

Under the Do-Nothing scenario, the proposed development is not constructed or operated. The noise environment remains largely unchanged.

7.5.2 Potential Impacts during Construction

Noise predictions were undertaken to determine the likely impact during the construction works. BS 5228-1:2009+A1:2014 sets out sound power levels and L_{Aeq} noise levels of plant items normally encountered on construction sites, which in turn enables the prediction of noise levels at selected locations.

Construction noise modelling is based on the details presented in Section 3.4 of this EIAR as well as a review of other chapters of the EIAR. Noise modelling was carried out using guidance and plant noise data from BS 5228:2009+A1:2014. The ground cover is predominately acoustically soft (G=1)[5]. The noise model assumes that the ground cover is a mix between acoustically hard and soft ground with a ground cover of G=0.75 to allow for pockets of acoustically hard ground. The ground area in the vicinity of the quarry, has been assumed to be acoustically hard (G=0). Percentage on time[6] for plant is outlined for each of the plant items used during construction.

The construction noise model assessed several tasks with the potential to generate noise. These tasks included: deliveries and/or removal of material to and from site, preparation of access roads, preparation of hardstands and drainage, pouring of foundations, installation of wind turbines and works associated with grid connection.

[5] G denotes the ground cover from an acoustic perspective. G=0 refers to acoustically hard or reflective surface and G=1 refers to acoustic soft or absorptive surface.

[6] Percentage on-time refers to the percentage of the assessment period for which the activity takes place.

Site Traffic

Detailed information on construction traffic is presented in Chapter 13. To summarise, additional light goods vehicles travelling to and from the site during the construction phase would be expected to peak during the morning (arrival of contractors at the site) and evening (departure of contractors from the site) and are envisaged not to be a continuous source of noise emissions from the site during a typical working day. The noise impact from construction personnel movements to and from the site is expected to be low.

All deliveries of turbine components to the site will only be by way of the proposed transport route outlined in Chapter 13. The construction period is expected to take between 12 and 18 months. The most intensive period of the works programme will be Month 6. The busiest period is when Internal access tracks, hardstanding works, preparation of turbine foundations, turbine installation and substation works will be ongoing in parallel. The noise impact for construction works traffic will be mitigated by generally restricting movements along access routes to the standard working hours and exclude Sundays, unless specifically agreed otherwise. For example, during turbine erection and foundation pours, an extension to the working day may be required, i.e. 05:00 to 21:00, but this would be necessary only on a relatively small number of occasions. If turbine deliveries are required at night it will be subject to agreement with the relevant planning authority and it would be ensured that vehicles on local roads do not wait outside residential properties with their engines idling, and that the local residents will be informed of any activities likely to occur outside of normal working hours.

Preparation of Access roads, Hardstands and Drainage

Table 7.7 presents the likely plant required for the preparation of access roads, hardstanding and drainage. Also presented are the predicted noise levels at the nearest dwelling (R67), approximately 250 m away from one of the access roads. Assuming all construction activities required for the preparation of the access road occur simultaneously, the predicted noise level from the construction activities is 52.1 dB $L_{Aeq,1hr}$ which is below the 65dB $L_{Aeq,1hr}$ noise limit. The preparation of access roads, hardstands and drainage are expected to have a slight impact and temporary in duration.

Table 7-7 Preparation of Access roads, Hardstands and Drainage - Likely Plant and Predicted Levels

Plant	BS 5228 Ref.	Activity	Percentage on-time (%)	Predicted Noise Level at R67
Tracked excavator 25t	C2.19	Ground excavations/earthworks	80	45.4
Articulated dump truck 23t	C2.33	Moving Fill	Maximum 114 two-way trips per day	48.7
Articulated dump truck (tipping) 23t	C2.32	Tipping Fill	20	36.7
Dozer (14t)	C5.12	Spread Chipping/Fill	80	45.3
Vibratory roller (3t)	C5.27	Rolling & Compaction	80	35.7
Tracked excavator 21t	C4.65	Trench for drainage	80	39.9
Cumulative				52.1

Preparation of Wind Turbine Foundations

Table 7.8 presents the likely plant required for the preparation of wind turbine foundations. Predicted noise levels at R13 is presented. This is the closest dwelling to wind turbines approximately 900 m from turbine T4. Assuming all construction activities required for the preparation of the turbine foundations occur simultaneously, the predicted noise level from the construction activities is 56.5 dB $L_{Aeq,1hr}$. The predicted noise levels are below the 65dB $L_{Aeq,1hr}$ noise limit. The construction works associated with the preparation of the turbine foundations are expected to have a slight impact and temporary in duration.

Table 7-8 Preparation of Wind Turbine Foundations - Likely Plant and Predicted Levels

Plant	BS 5228 Ref.	Activity	Percentage on-time (%)	Predicted Noise Level at R13
Tracked Excavator (25t)	C2.19	Ground excavation/earthworks	80	33.0
Excavator (23t)	C10.8	Loading sand / soil	20	35.8
Diesel Pump	C4.88	Pump water	100	25.9
Mobile telescopic crane	C4.41	Lifting reinforcing steel	80	26.9
Concrete mixer truck & concrete pump	C4.32	Concrete mixer truck + truck mounted concrete pump + boom arm	100	34.6
Lorry*	C11.9	Delivery and removal of material	Maximum 114 two-way trips per day	56.4
Cumulative				56.5
* - Drive-by maximum sound level				

Installation of Wind Turbines

Turbine components will be delivered to site and a mobile telescopic crane will lift the turbine components into place. A worst case of the two cranes lifting turbine components 80% of the time is assumed along with delivery of turbine components. The predicted noise levels are presented in Table 7.9. The predicted cumulative noise level at receptor R13 is 56.2 dB $L_{Aeq,1hr}$. The predicted noise levels are below the 65 dB $L_{Aeq,1hr}$ noise limit. The construction works associated with the installation of the wind turbines are expected to have a slight impact and temporary in duration.

Table 7-9 Installation of Wind Turbines - Likely Plant and Predicted Levels

Plant	BS 5228 Ref.	Activity	Percentage on-time (%)	Predicted Noise Level at R13
Mobile telescopic crane (x2)	C4.41	Lifting turbine components	80	29.9
Lorry *	C11.9	Delivery of Turbine Components	Maximum 114 two-way trips per day	56.2
Cumulative				56.2
* - Drive-by maximum sound level				

Construction of Substation

The construction of two substation buildings will occur during the construction phase of the proposed development. The construction works will be progressed in a number of phases:

- Site clearance and Preparation
- Preparation and pouring of foundations and floor areas
- Preparation of hardstanding areas
- Erection of blockwork/ installation concrete slabs
- General Construction including installation of electrical and mechanical plant

Table 7.10 presents the assumed plant required for the different construction phases of the proposed buildings to be constructed on site. The nearest occupied dwelling (R141) will be over 190m from the substation. The highest cumulative predicted noise levels for both the Site Clearance and Preparation works and the preparation of hardstanding areas is predicted to be 55.2 dB $L_{Aeq,1hr}$ at the nearest occupied dwelling which is below the construction noise limit of 65 dB $L_{Aeq,1hr}$. The works associated with the construction of the substation are expected to have a slight impact and temporary in duration.

Table 7-10: Construction of Substation - Likely Plant and Predicted Levels

Phase	Plant	BS 5228 Ref.	Activity	Percentage on-time (%)	Predicted Noise Level at R141
Site Clearance and Preparation	Tracked excavator (22t)	C2.3	Earthworks/site clearance	80	48
	Tracked excavator 25t	C2.19	Earthworks/site clearance	80	47.1
	Dozer (11t)	C2.12	Ground excavation/ earthworks	80	50.9

Phase	Plant	BS 5228 Ref.	Activity	Percentage on-time (%)	Predicted Noise Level at R141
	Loading Lorry	C10.8	Loading Sand to Lorry	80	49.7
	Cumulative				55.2
Preparation and pouring of Foundations	Concrete mixer truck + truck mounted concrete pump + boom arm	C4.32	Concrete pumping	80	49.4
	Lorry*	C11.9	Delivery of material	Maximum of 114 two-way trips per day	51.1
	Cumulative				53.3
Preparation of hardstanding areas	Articulated Dump Truck (23t)	C2.33	Delivery/Removal of Material	Maximum of 114 two-way trips per day	46.2
	Tracked Excavator (25t)	C2.19	Ground excavation/earthworks	80	47.5
	Articulated Dump Truck (23t)	C2.32	Tipping Fill	20	38.4
	Dozer (14t)	C5.12	Spreading chipping/fill	80	47.3
	Vibratory roller (3t)	C5.27	Rolling and Compaction	80	37.1
	Lorry*	C11.9	Delivery of material	Maximum of 114 two-way trips per day	51.1
	Cumulative				52.7
Erection of blockwork/ installation concrete slabs	Mobile telescopic crane (80t)	C4.39	Lifting concrete slabs	80	47.6
	Lorry* (32t)	C11.9	Delivery of material	Maximum of 114 two-way trips per day	51.1
	Cumulative				52.7
General Construction including installation of electrical and mechanical plant	Generator	C4.84	Power for site cabins	100	44.4
	Telescopic handler	C4.54	Lifting Plant	80	50
	Angle grinder (grinding steel)	C4.93	Miscellaneous	80	51.3
	Cumulative				54.2
* Drive-by maximum sound level					

Grid Connection Works including Link between Onsite Substation

It is proposed to construct an onsite electricity substation within the proposed development site as shown in Figure 3-4 in Chapter 3 of this EIAR. This will provide a connection point between the wind farm and the proposed grid connection point at the existing Ardnacrusha substation. Each turbine will be connected to the on-site electricity substation via underground electricity cables. The cable route will follow the proposed access tracks between each turbine. Most of the proposed grid connection route is on public roads.

The grid connection works will be carried out over a 6-month period and 'rolling road closures' will be implemented, whereby the site will progress each day along a road, which will have the effect of reducing the impact for residents. The likely plant required during the construction works are presented in Table 7.11.

Table 7-11: Grid Connection Works – Likely Plant and Predicted Noise Levels

Plant	Activity	Percentage on-time (%)	A-Weighted Sound Pressure Level, L_{Aeq}, dB			
			10m	25m	50m	100m
Road sweeper (C4.90)	Sweeping and dust suppression	10	49.5	41.6	35.6	29.6
Mini excavator with hydraulic breaker (C5.2)	Breaking Road Surface	25	78.9	71.4	65.5	59.5
Vibratory roller (C5.27)	Rolling and Compaction	50	66.3	58.6	52.6	46.6
Wheeled excavator (C5.34)	Trenching	50	69.9	62	56	50
Hand-held circular saw (petrol) (C5.36)	Cutting Concrete Slabs	10	79	71.6	65.6	59.6
Dump truck (tipping fill) (C2.30)	Tipping Fill	10	71.8	64.1	58.1	52.1
Vibratory plate (petrol) (C2.41)	Compaction	10	72.7	65.1	59.1	53.1

Table 7.11 also presents predicted noise level for a range of construction activities at distances of 10 m, 25 m, 50 m and 100 m from the works. There are no dwellings within 10m of the grid connection works, 19 residential properties within 25m, 58 residential properties between 25m and 50m and 49 dwellings between 50-100m. The noise levels presented are predicted maximum expected levels and are expected to occur for only short periods of time at a very limited number of dwellings.

In some instances, the maximum predicted noise levels may be above the noise limit of 65 dB $L_{Aeq,1hr}$. However, these elevated noise levels will only occur for short durations at a limited number of dwellings. Given the nature of the grid connection works, construction activities will not occur over an extended period at any one location.

Mitigation measures will be employed to reduce any potential impacts. Mitigation measures are discussed in Section 7.6.1. With mitigation measures, there is potential for temporary elevated noise levels owing to the grid connection works. However, these works will be for a short duration at a particular property (i.e. typically less than 3 days) and where the works are to occur over an extended period, a temporary barrier or screen will be used to reduce noise level below the noise limit. The works are expected to have a significant temporary impact.

Potential Cumulative impacts are detailed in Section 7.5.5.

7.5.3 Potential Impacts during Operation

Noise predictions have been carried out using International Standard ISO 9613, *Acoustics – Attenuation of Sound during Propagation Outdoors*. The propagation model described in Part 2 of this standard provides for the prediction of sound pressure levels based on either short-term downwind (i.e. worst case) conditions or long-term overall averages.

Only the worst-case downwind condition has been considered in this assessment, that is – for wind blowing from the proposed turbines towards the nearby houses. When the wind is blowing in the opposite direction noise levels may be significantly lower, especially where there is any shielding between the turbines and the houses.

The ISO propagation model calculates the predicted sound pressure level by taking the source sound power level for each turbine in separate octave bands and subtracting a number of attenuation factors according to the following:

$$\text{Predicted Octave Band Noise Level} = L_W + D - A_{geo} - A_{atm} - A_{gr} - A_{bar} - A_{misc}$$

These factors are discussed in detail below.

The predicted octave band levels from the turbine are summed together to give the overall 'A' weighted predicted sound level.

L_W - Source Sound Power Level

The sound power level of a noise source is normally expressed in dB re:1pW. Sound power level data for Nordex 133 turbine to be installed as part of the proposed development has been modelled. Further details on the wind turbine are provided later in this section. Sound Power Level data is presented in Appendix 7.4.

D – Directivity Factor

The directivity factor allows for an adjustment to be made where the sound radiated in the direction of interest is higher than that for which the sound power level is specified. In this case the sound power level is measured in a downwind direction, corresponding to the worst-case propagation conditions considered here and needs no further adjustment, and therefore a directivity factor of 0 has been assumed.

A_{geo} – Geometrical Divergence

The geometrical divergence accounts for spherical spreading in the free-field from a point sound source resulting in attenuation depending on distance according to the following:

$$A_{geo} = 20 \times \log(d) + 11$$

where, d = distance from the turbine

A wind turbine may be considered as a point source beyond distances corresponding to one rotor diameter.

A_{atm} - Atmospheric Absorption

The atmospheric absorption accounts for the frequency dependant linear attenuation with distance of sound power over the frequency spectrum according to:

$A_{atm} = d \times \alpha$

where, α = the atmospheric absorption coefficient of the relevant frequency band

Published values of 'α' from ISO9613 Part 1[7] have been used, corresponding to a temperature of 10^{0}C and a relative humidity of 70%, the values specified in the IoA GPG, which give relatively low levels of atmospheric attenuation, and subsequently conservative noise predictions as given in Table 7.12:

Table 7-12: Atmospheric Octave Band Attenuation coefficients, dB/m

Octave Band Centre Frequency (Hz)							
63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz
0.00012	0.00041	0.00104	0.00193	0.00366	0.00966	0.03280	0.11700

A_{gr} - Ground Effect

Ground effect is the interference of sound reflected by the ground with the sound propagating directly from source to receiver. The prediction of ground effects is inherently complex and depends on the source height, receiver height, propagation height between the source and receiver and the ground conditions.

The ground conditions are described according to a variable G which varies between 0 for 'hard' ground (includes paving, water, ice, concrete and any sites with low porosity) and 1 for 'soft' ground (includes ground covered by grass, trees or other vegetation). The IoA GPG states that use of G = 0.5 and a receptor height of 4 m should be used to predict the resultant turbine noise level at dwellings neighbouring a proposed development provided that an appropriate allowance for measurement uncertainty is accounted for within the stated source noise levels. Therefore, predictions in this report are based on G = 0.5 with a receptor height of 4 m and, due to the inclusion of the assumed uncertainty (see 'Overview of Input Datasets' for more details) within the source noise levels, these predictions are considered to be worst case.

A_{bar} - Barrier Attenuation

The effect of any barrier between the noise source and the receiver position is that noise will be reduced according to the relative heights of the source, receiver and barrier and the frequency spectrum of the noise. The barrier attenuations predicted by the ISO 9613 model have, however, been shown to be significantly greater than that measured in practice under downwind conditions.

The results of a study of propagation of noise from wind farm sites carried out for ETSU concludes that an attenuation of just 2 dB(A) should be allowed where the direct line of site between the source and receiver is just interrupted by a landform, such as a hill and that 10 dB(A) should be allowed where a barrier lies within 5 m of a receiver and provides a significant interruption to the line of site.

[7] ISO 9613-1, Acoustics - Attenuation of sound during propagation outdoors, Part 1: Method of calculation of the attenuation of sound by atmospheric absorption, International Organization for Standardization, 1992

The IoA GPG states that *'Topographic screening effects of the terrain (ISO 9613-2, Equation 2) should be limited to a reduction of no more than 2 dB, and then only if there is no direct line of sight between the highest point on the turbine rotor and the receiver location'*. As a conservative approach, this has not been accounted for in the noise model predictions.

A_{misc} – Miscellaneous Other Effects

ISO 9613 includes effects of propagation through foliage and industrial plants as additional attenuation effects. The attenuation due to forestry has not been included here and any such effects are unlikely to significantly reduce noise levels below those predicted.

The site topography was also analysed to determine if there is a valley correction (+3 dB) for concave ground profile, or where the ground falls away significantly, between the turbine and the receiver location. The IoA guidelines provide a criterion of application and it was determined that no valley correction is applicable.

Predicted Noise Levels

The predicted turbine noise L_{Aeq} has been adjusted by subtracting 2 dB to give the equivalent L_{A90} as suggested in the IoA GPG.

Overview of Input Datasets

In order to calculate the noise levels at noise sensitive locations, an accurate representation of the source and receiver positions (See Appendix 7.3 for details) was necessary for the prediction modelling. The turbine locations are presented in Table 3.1 in Section 3.3.3 of Chapter 3 of this EIAR and noise sensitive locations are presented in Appendix 7.3. The closest dwellings are at least 711 m from the nearest turbine.

The turbine that is the basis of this assessment is the Nordex 133/4.8 turbine.

The assessment has considered the range of turbine design elements. From a noise perspective when following 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 the hub height range is the only element of the turbine dimensions that influence the operational noise impact assessment in the EIAR chapter. Any influence from the variation of blade length is accounted for by the turbine manufacturer in their sound power data, which was provided and used for the purpose of modelling the proposed turbine layout using the candidate turbine.

For the purpose of this assessment the upper and lower limits of the proposed hub heights have been considered. In general, the hub height has a small effect on the predicted noise levels as the range of potential heights is small. Therefore for the purpose of this assessment the upper (110m) and lower hub heights (102.5m) have been used as the basis for the assessment.

Manufacturers data for the proposed turbine has been provided standardised to a wind height of 10m, based on data from a 110m high turbine. The sound power level and octave band values for the turbine are based on the noise levels provided by the manufacturers. The sound power levels at standardised 10 m height wind speeds are presented in Table 7.13 and 7.14 for the upper and lower hub heights, with octave band data in dB(A) presented in Tables 7.15-7.16. The wind turbine data used as part of the assessment is presented in Appendix 7.4.

Table 7-13: Wind Turbine (Nordex 133) Sound Power Levels, dB L_{WA} at hub height 110m and 102.5m(with trailing edge serrations)

Turbine	Standardised 10 m Height Wind Speed (m/s)						
	3	4	5	6	7	8	9 – Cut-out
Nordex 133 (110m Hub height)	93.0	95.0	100.6	104.3	104.5	104.5	104.5
Nordex 133 (102.5m Hub height)*	93.0	95.0	100.6	103.9	104.5	104.5	104.5

*The sound power at 102.5m was calculated as per the guidance in IOA supplementary guidance note 3: Sound Power Level Data, Section 5.

Table 7-14: Wind Turbine (Nordex 133) Octave Band Noise Levels, dB(A) for a range of Standardised 10m Height Wind Speeds (with trailing edge serrations) 110m hub height

Standardised 10 m Height Wind Speed (m/s)	Octave Band Level Centre Frequency in Hz							
	63	125	250	500	1000	2000	4000	8000
3	74.7	81.7	85.5	86.4	86.9	85.6	81.3	72.1
4	76.7	83.7	87.5	88.4	88.9	87.6	83.3	74.1
5	82.3	89.3	93.1	94	94.5	93.2	88.9	79.7
6	86	93	96.8	97.7	98.2	96.9	92.6	83.4
7	86.3	93.3	97.1	98	98.4	97.2	92.9	83.7
8	86.2	93.2	97	97.9	98.4	97.1	92.8	83.6
9	86.2	93.2	97	97.9	98.4	97.1	92.8	83.6
10	86.2	93.2	97	97.9	98.4	97.1	92.8	83.6
11	86.2	93.2	97	97.9	98.4	97.1	92.8	83.6
12	74.7	81.7	85.5	86.4	86.9	85.6	81.3	72.1

Table 7-15: Wind Turbine (Nordex 133) Octave Band Noise Levels, dB(A) for a range of Standardised 10 m Height Wind Speeds (with trailing edge serrations) 102.5m hub height. These were derived based on IOA supplementary guidance note 3 Section 5 and interpolating the results for the correct windspeed.

Standardised 10 m Height Wind Speed (m/s)	Octave Band Level Centre Frequency in Hz							
	63	125	250	500	1000	2000	4000	8000
3	74.7	81.7	85.5	86.4	86.9	85.6	81.3	72.1
4	76.7	83.7	87.5	88.4	88.9	87.6	83.3	74.1
5	82.3	89.3	93.1	94	94.5	93.2	88.9	79.7
6	86	93	96.8	97.7	98.2	96.9	92.6	83.4
7	86.3	93.3	97.1	98	98.4	97.2	92.9	83.7
8	86.2	93.2	97	97.9	98.4	97.1	92.8	83.6
9	86.2	93.2	97	97.9	98.4	97.1	92.8	83.6
10	86.2	93.2	97	97.9	98.4	97.1	92.8	83.6
11	86.2	93.2	97	97.9	98.4	97.1	92.8	83.6
12	74.7	81.7	85.5	86.4	86.9	85.6	81.3	72.1

The IoA GPG states that it should be ensured that a margin of uncertainty is included within source wind turbine noise data used in noise predictions. A 2 dB correction is added to the sound power level to account for a margin of uncertainty.

It is possible to run the proposed turbine model in a noise reduced mode of operation whereby the noise level is lessened by reducing the rotational speed of the turbines, with a resultant loss of electrical energy production.

This assessment includes the cumulative noise from all on-site noise sources from the proposed project. In addition to the noise from wind turbines, noise will be produced by the transformer located in the substation. The noise level is likely to depend on the load on the transformer which is dependent on the wind speed (as the wind turbines producing more energy in high wind speeds).

In addition noise from the proposed substation has been assessed in line with BS4142. This standard a comparison of the background noise with the specific noise from the source to be introduced to assess the likelihood of complaints, as detailed in Section 7.2.6.

The background noise at the nearest locations to the proposed substation has been determined from the long term noise monitoring at location RWID17, which is east of the proposed transformer location. This is considered appropriate as it is on the R446 road and the closest noise sensitive locations are along the R446 regional road. The location was screened by the house from the nearby quarry and was some distance from the local road.

The daytime and night time background noise measurements ($L_{A90,\ 10min}$) have been filtered to exclude data for windspeeds above 5m/s and any data during which rainfall occurred. BS4142 categorises daytime as 0700-2300, with night time between 2300-0700. Note that measurements presented are for 10 minute intervals whereas normally BS4142 requires the background period is 1 hour during the day or 15 minutes at night.

Predictions have been carried out based on an example transformer; the Siemens TLPN7747 40000 / 50000 kVA. The sound power level for the transformer is 93 dB(A). The octave band profile for the transformer has been sourced from 'An Introduction to Sound Level Data for Mechanical and Electrical Equipment' published by CED Engineering. The A-weighted octave band data is presented in Table 7.16. If an alternative transformer is selected this will not exceed a sound power level of 93 dB(A):

Table 7-16: Octave Band Sound Power Level Data

Equipment	A-weighted Octave Band Centre Frequency (Hz)									Overall
	31.5	63	125	250	500	1k	2k	4k	8k	L_{WA}
Transformer Ω	81.0	87.0	89.0	84.0	84.0	78.0	73.0	68.0	61.0	93.0
Ω - Manufacturer's datasheet provided information on overall sound power levels. Octave band data was sourced from 'An Introduction to Sound Level Data for Mechanical and Electrical Equipment' CED Engineering										

Noise predictions have been carried out using International Standard ISO 9613, *Acoustics – Attenuation of Sound during Propagation Outdoors*. A worst case with plant producing their highest noise emissions has been assumed. The on-site substation transformer noise has been predicted in terms of the L_{Aeq}.

Table 7-17 summarises the basis of the BS4142 assessment of the transformer noise.

Table 7-17: BS4142 Assessment of Transformer Noise

Results		
	Daytime	Night time
Measured ambient plus predicted noise from transformer	(Residual 40 dB + specific 35 dB=) 41 $L_{Aeq,\ 60mins}$	(Residual 23 dB + specific 35=) 35 $L_{Aeq,\ 15mins}$
Residual sound level	40 dB $L_{Aeq,\ 60min}$	23 dB $L_{Aeq,\ 15min}$
Background sound level (when source not in operation)	29 dB $L_{A90\ (60mins)}$	18 dB $L_{A90\ (15\ mins)}$
Reference period	1 hour	15 minutes
Specific sound level	35 dB $L_{Aeq,\ 60mins}$	35 dB $L_{Aeq,\ 15mins}$
Acoustic character correction (none applied)	-	-
Rating level (no correction applied)	35 dB $L_{A90,\ 60mins}$	35 dB $L_{A90,\ 15mins}$

Results		
	Daytime	Night time
Background sound level	29 dB $L_{A90,\ 10mins}$	18 dB $L_{A90,\ 10mins}$
Excess of rating over background	+6 dB	+17 dB
Results	The difference is 6dB. A difference of around 5 dB is likely to be an indication of an adverse impact, depending on the context.	The difference is 17 dB. A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.
Uncertainty of assessment	As the difference is just above the 5dB criteria, so the uncertainty of the measurement may influence the outcome of the assessment.	As the difference is well above the criteria indicating a significant adverse impact, depending on the context, the uncertainty is unlikely to influence the outcome of this assessment.

Daytime Assessment
From the table above during the daytime there is a possibility of an adverse impact during the daytime. However the uncertainty may influence the outcome of the assessment. There is some uncertainty or variability in the noise level assumed for the transformer compared with that which will ultimately be installed. As measurements were conducted over 10 minute intervals, as opposed to the reference interval of 1 hour the background may also change slightly. The measurement period was for a long time and measurements which could be influenced by wind or rain have been removed which would minimise the uncertainty.

Nightime Assessment
During the night time the difference in noise level indicates a potentially significant adverse impact, depending on the context, which is clearly set out as follows

BS4142 does indicate that the initial estimate of the impact needs to be modified due to the context in the case that the absolute noise levels are low, particularly at night.

The noise level (ambient plus transformer noise) is predicted to be 35 $L_{Aeq,\ 15mins}$ at the nearest noise sensitive location.

World Health Organisation Night Noise Guidelines for Europe 2009 define a noise limit for L_{night} , which is the equivalent outdoor sound pressure associated with a particular type of noise during the night (at least 8 hours) a period of a year, outside. A limit of Lnight, outside of 40 dB is equivalent to the lowest observed adverse effect level (LOAEL) for night noise. As the noise predicted from the transformer is 5dB below this then there is no anticipated adverse health effect from night time operation of the proposed substation.

7.5.3.1 Potential Operational Impact – Predicted Noise Levels

Noise predictions were performed for the 8-wind turbine layout using the highest noise levels at each wind speed, for the proposed turbine models have been selected for a range of standardised 10m height wind speeds from 3 m/s up to 9 m/s (to cut-out[8]). Receptors included those within the 35 dB L_{A90} noise contour of the turbines were modelled. Predicted noise levels from other on-site noise sources were also modelled and cumulative noise from all on-site noise sources from the proposed project are assessed against the derived noise limits.

Table 7.17 presents predicted noise levels for the 110m hub height option at 16 receptor locations that include the highest predicted noise levels, in addition to controlling locations close to the proposed windfarm. The predicted noise levels at all receptor locations are presented in Appendix 7.5. Note: the predicted noise levels assumes that noise sensitive receptors are downwind of the proposed wind farm.

In practice, receptor locations will not be downwind of all noise sources and the actual noise levels will be lower than those presented in Table 7.17 and Appendix 7.5.

Table 7.17 also presents derived daytime and night-time noise limits at each of these locations. The predicted noise levels from the proposed project are below the daytime and night-time noise limits.

Table 7.18 presents the predicted noise for a hub height of 102.5m at 16 receptor locations. The predicted noise levels from the proposed project are below the daytime and night-time noise limits.

At some receptor locations, a new source of noise will be introduced into the soundscape and it is expected that there will be a long-term moderate significance of impact on the closest dwellings to the proposed wind farm.

In order to protect residents, the cumulative impact from other nearby operational and consented wind farm developments must also be considered and this is assessed in Section 7.5.5.

[8] Noise emissions from the wind turbines plateau at wind speeds above 9 m/s

Table 7-18: Assessment of Predicted LA90 Noise Levels for Fahybeg Wind Farm against Noise Limits 110m

Receptor ID	Description	Predicted L_{A90} Sound Pressure Level at 10m Standardised Wind Speed, dB									
		3 m/s	4 m/s	5 m/s	6 m/s	7 m/s	8 m/s	9 m/s	10 m/s	11 m/s	12 m/s
R13/RWID13	Predicted Level	28.4	30.4	36.0	39.7	39.9	39.9	39.9	39.9	39.9	39.9
	Daytime limit	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
	Daytime Excess	-	-	-	-	-	-	-	-		
	Night-time limit	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
	Night-time Excess	-	-	-	-	-	-	-	-	-	-
R52/RWID_RWID_52	Predicted Level	28.2	30.1	35.6	39.3	39.5	39.5	39.5	39.5	39.5	39.5
	Daytime limit	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
	Daytime Excess	-	-	-	-	-	-	-	-	-	-
	Night-time limit	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
	Night-time Excess	-	-	-	-	-	-	-	-	-	-
R17/RWID_17	Predicted Level	28.8	30.4	35.5	39.0	39.2	39.2	39.2	39.2	39.2	39.2
	Daytime limit	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
	Daytime Excess	-	-	-	-	-	-	-	-	-	-
	Night-time limit	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
	Night-time Excess	-	-	-	-	-	-	-	-	-	-
R45/RWID 46	Predicted Level	27.7	29.6	35.0	38.7	38.9	38.9	38.9	38.9	38.9	38.9
	Daytime limit	45.0	45.0	45.0	45.0	45.0	45.0	45.0	46.5	46.5	46.5

Receptor ID	Description	Predicted L_{A90} Sound Pressure Level at 10m Standardised Wind Speed, dB									
		3 m/s	4 m/s	5 m/s	6 m/s	7 m/s	8 m/s	9 m/s	10 m/s	11 m/s	12 m/s
	Daytime Excess	-	-	-	-	-	-	-	-	-	-
	Night-time limit	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
	Night-time Excess	-	-	-	-	-	-	-	-	-	-
R40/RWID_211	Predicted Level	27.7	29.6	35.0	38.7	38.9	38.9	38.9	38.9	38.9	38.9
	Daytime limit										
	Daytime Excess	-	-	-	-	-	-	-	-	-	-
	Night-time limit										
	Night-time Excess	-	-	-	-	-	-	-	-	-	-
R42_A/RWID 46	Predicted Level	27.5	29.3	34.8	38.5	38.7	38.7	38.7	38.7	38.7	38.7
	Daytime limit										
	Daytime Excess	-	-	-	-	-	-	-	-	-	-
	Night-time limit										
	Night-time Excess	-	-	-	-	-	-	-	-	-	-
R41/RWID 46	Predicted Level	27.4	29.2	34.7	38.4	38.6	38.6	38.6	38.6	38.6	38.6
	Daytime limit										
	Daytime Excess	-	-	-	-	-	-	-	-	-	-
	Night-time limit										
	Night-time Excess	-	-	-	-	-	-	-	-	-	-

Receptor ID	Description	Predicted L_{A90} Sound Pressure Level at 10m Standardised Wind Speed, dB									
		3 m/s	4 m/s	5 m/s	6 m/s	7 m/s	8 m/s	9 m/s	10 m/s	11 m/s	12 m/s
R16/RWID_17	Predicted Level	28.7	30.1	34.7	38.2	38.4	38.4	38.4	38.4	38.4	38.4
	Daytime limit										
	Daytime Excess	-	-	-	-	-	-	-	-	-	-
	Night-time limit										
	Night-time Excess	-	-	-	-	-	-	-	-	-	-
R47_A/RWID_46	Predicted Level	27.1	29.0	34.5	38.2	38.4	38.4	38.4	38.4	38.4	38.4
	Daytime limit	45.0	45.0	45.0	45.0	45.0	45.0	45.0	46.5	46.5	46.5
	Daytime Excess	-	-	-	-	-	-	-	-	-	-
	Night-time limit	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
	Night-time Excess	-	-	-	-	-	-	-	-	-	-
R44/RWID_46	Predicted Level	27.2	29.0	34.5	38.2	38.4	38.4	38.4	38.4	38.4	38.4
	Daytime limit	45.0	45.0	45.0	45.0	45.0	45.0	45.0	46.5	46.5	46.5
	Daytime Excess	-	-	-	-	-	-	-	-	-	-
	Night-time limit	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
	Night-time Excess	-	-	-	-	-	-	-	-	-	-
R39/RWID211	Predicted Level	27.0	28.9	34.3	38.0	38.2	38.2	38.2	38.2	38.2	38.2
	Daytime limit	45.0	45.0	45.0	45.0	45.0	45.0	45.0	46.0	46.0	46.0
	Daytime Excess	-	-	-	-	-	-	-	-	-	-

Receptor ID	Description	Predicted L_{A90} Sound Pressure Level at 10m Standardised Wind Speed, dB									
		3 m/s	4 m/s	5 m/s	6 m/s	7 m/s	8 m/s	9 m/s	10 m/s	11 m/s	12 m/s
	Night-time limit	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
	Night-time Excess	-	-	-	-	-	-	-	-	-	-
R8/RWID_2	Predicted Level	27.6	29.2	34.3	37.8	38.0	38.0	38.0	38.0	38.0	38.0
	Daytime limit	45	45	45	45	45	45	45.5	47.1	47.1	47.1
	Daytime Excess	-	-	-	-	-	-	-	-	-	-
	Night-time limit	43.0	43.0	43.0	43.0	43.0	43.0	43.0	46.7	46.7	46.7
	Night-time Excess	-	-	-	-	-	-	-	-	-	-
R5/RWID_2	Predicted Level	27.1	28.8	33.9	37.5	37.7	37.7	37.7	37.7	37.7	37.7
	Daytime limit	45	45	45	45	45	45	45.5	47.1	47.1	47.1
	Daytime Excess	-	-	-	-	-	-	-	-	-	-
	Night-time limit	43.0	43.0	43.0	43.0	43.0	43.0	43.0	46.7	46.7	46.7
	Night-time Excess	-	-	-	-	-	-	-	-	-	-
R37/RWID_211	Predicted Level	26.5	28.3	33.7	37.4	37.6	37.6	37.6	37.6	37.6	37.6
	Daytime limit	45.0	45.0	45.0	45.0	45.0	45.0	45.0	46.0	46.0	46.0
	Daytime Excess	-	-	-	-	-	-	-	-	-	-
	Night-time limit	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
	Night-time Excess	-	-	-	-	-	-	-	-	-	-

Receptor ID	Description	Predicted L_{A90} Sound Pressure Level at 10m Standardised Wind Speed, dB									
		3 m/s	4 m/s	5 m/s	6 m/s	7 m/s	8 m/s	9 m/s	10 m/s	11 m/s	12 m/s
R53/RWID_11/2	Predicted Level	27.2	28.8	33.8	37.4	37.6	37.6	37.6	37.6	37.6	37.6
	Daytime limit	45	45	45	45	45	45	45.0	47.0	47.0	47.0
	Daytime Excess	-	-	-	-	-	-	-	-	-	-
	Night-time limit	43.0	43.0	43.0	43.0	43.0	43.0	43.0	48.3	48.3	48.3
	Night-time Excess	-	-	-	-	-	-	-	-	-	-
R9/RWID_RWID_11	Predicted Level	27.2	28.8	33.8	37.3	37.5	37.5	37.5	37.5	37.5	37.5
	Daytime limit	45	45	45	45	45	45	45.0	47.0	47.0	47.0
	Daytime Excess	-	-	-	-	-	-	-	-	-	-
	Night-time limit	43.0	43.0	43.0	43.0	43.0	43.0	43.0	48.3	48.3	48.3
	Night-time Excess	-	-	-	-	-	-	-	-	-	-

Table 7-19: Assessment of Predicted L_{A90} Noise Levels for Fahybeg Wind Farm against Noise Limits 102.5m

Receptor ID	Description	Predicted L_{A90} Sound Pressure Level at 10m Standardised Wind Speed, dB									
		3 m/s	4 m/s	5 m/s	6 m/s	7 m/s	8 m/s	9 m/s	10 m/s	11 m/s	12 m/s
R13/RWID13	Predicted Level	30.5	31.8	36.5	39.6	40.1	40.1	40.1	40.1	40.1	40.1
	Daytime limit	40.0	40.0	40.0	40.0	45.0	45.0	45.0	45.0	45.0	445.0
	Daytime Excess	-	-	-	-	-	-	-	-	-	-
	Night-time limit	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
	Night-time Excess	-	-	-	-	-	-	-	-	-	-
R52/ RWID_52	Predicted Level	28.2	30.1	35.6	39.0	39.5	39.5	39.5	39.5	39.5	39.5
	Daytime limit	40.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.5
	Daytime Excess	-	-	-	-	-	-	-	-	-	-
	Night-time limit	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
	Night-time Excess	-	-	-	-	-	-	-	-	-	-
R17/RWID_17	Predicted Level	28.8	30.4	35.5	38.7	39.2	39.2	39.2	39.2	39.2	39.2
	Daytime limit	40.0	40.0	40.0	40.0	45.0	45.0	45.0	45.0	47.5	51.2
	Daytime Excess	-	-	-	-	-	-	-	-	-	-
	Night-time limit	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
	Night-time Excess	-	-	-	-	-	-	-	-	-	-
R45/RWID 46	Predicted Level	27.7	29.6	35.1	38.4	38.9	38.9	38.9	38.9	38.9	38.9
	Daytime limit	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.6	47.6	47.6
	Daytime Excess	-	-	-	-	-	-	-	-	-	-
	Night-time limit	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
	Night-time Excess	-	-		-	-	-	-	-	-	-

Receptor ID	Description	Predicted L_{A90} Sound Pressure Level at 10m Standardised Wind Speed, dB									
		3 m/s	4 m/s	5 m/s	6 m/s	7 m/s	8 m/s	9 m/s	10 m/s	11 m/s	12 m/s
R40/RWID_211	Predicted Level	27.7	29.6	35.0	38.4	38.9	38.9	38.9	38.9	38.9	38.9
	Daytime limit	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.3	47.3	47.3
	Daytime Excess	-	-	-	-	-	-	-	-	-	-
	Night-time limit	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
	Night-time Excess	-	-	-	-	-	-	-	-	-	-
R42_A/RWID 46	Predicted Level	27.5	29.3	34.8	38.1	38.7	38.7	38.7	38.7	38.7	38.7
	Daytime limit	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.6	47.6	47.6
	Daytime Excess	-	-	-	-	-	-	-	-	-	-
	Night-time limit	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
	Night-time Excess	-	-	-	-	-	-	-	-	-	-
R41/RWID 46	Predicted Level	27.4	29.2	34.7	38.0	38.6	38.6	38.6	38.6	38.6	38.6
	Daytime limit	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.6	47.6	47.6
	Daytime Excess	-	-	-	-	-	-	-	-	-	-
	Night-time limit	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
	Night-time Excess	-	-	-	-	-	-	-	-	-	-
R16/RWID_17	Predicted Level	28.7	30.1	34.7	37.9	38.4	38.4	38.4	38.4	38.4	38.4
	Daytime limit	40.0	40.0	40.0	40.0	45.0	45.0	45.0	45.0	45.0	45.0
	Daytime Excess	-	-	-	-	-	-	-	-	-	-
	Night-time limit	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
	Night-time Excess	-	-	-	-	-	-	-	-	-	-

Receptor ID	Description	Predicted L_{A90} Sound Pressure Level at 10m Standardised Wind Speed, dB									
		3 m/s	4 m/s	5 m/s	6 m/s	7 m/s	8 m/s	9 m/s	10 m/s	11 m/s	12 m/s
R47_A/RWID_46	Predicted Level	27.1	29.0	34.5	37.9	38.4	38.4	38.4	38.4	38.4	38.4
	Daytime limit	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.6	47.6	47.6
	Daytime Excess	-	-	-	-	-	-	-	-	-	-
	Night-time limit	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
	Night-time Excess	-	-	-	-	-	-	-	-	-	-
R44/RWID_46	Predicted Level	27.2	29.0	34.5	37.8	38.4	38.4	38.4	38.4	38.4	38.4
	Daytime limit	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.6	47.6	47.6
	Daytime Excess	-	-	-	-	-	-	-	-	-	-
	Night-time limit	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
	Night-time Excess	-	-	-	-	-	-	-	-	-	-
R39/RWID211	Predicted Level	27.0	28.9	34.3	37.6	38.2	38.2	38.2	38.2	38.2	38.2
	Daytime limit	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.3	47.3	47.3
	Daytime Excess	-	-	-	-	-	-	-	-	-	-
	Night-time limit	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
	Night-time Excess	-	-	-	-	-	-	-	-	-	-
R8/RWID_2	Predicted Level	27.6	29.2	34.3	37.5	38.0	38.0	38.0	38.0	38.0	38.0
	Daytime limit	45.0	45.0	45.0	45.0	45.0	45.0	45.1	46.8	48.5	48.5
	Daytime Excess	-	-	-	-	-	-	-	-	-	-
	Night-time limit	43.0	43.0	43.0	43.0	43.0	43.0	43.0	46.9	46.9	46.9
	Night-time Excess	-	-	-	-	-	-	-	-	-	-

Receptor ID	Description	Predicted L_{A90} Sound Pressure Level at 10m Standardised Wind Speed, dB									
		3 m/s	4 m/s	5 m/s	6 m/s	7 m/s	8 m/s	9 m/s	10 m/s	11 m/s	12 m/s
R5/RWID_2	Predicted Level	27.1	28.8	33.9	37.1	37.7	37.7	37.7	37.7	37.7	37.7
	Daytime limit	45.0	45.0	45.0	45.0	45.0	45.0	45.1	46.8	48.5	48.5
	Daytime Excess	-	-	-	-	-	-	-	-	-	-
	Night-time limit	43.0	43.0	43.0	43.0	43.0	43.0	43.0	46.9	46.9	46.9
	Night-time Excess	-	-	-	-	-	-	-	-	-	-
R37/RWID_211	Predicted Level	26.5	28.3	33.7	37.1	37.6	37.6	37.6	37.6	37.6	37.6
	Daytime limit	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.3	47.3	47.3
	Daytime Excess	-	-	-	-	-	-	-	-	-	-
	Night-time limit	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
	Night-time Excess	-	-	-	-	-	-	-	-	-	-
R53/RWID_11/2	Predicted Level	27.2	28.8	33.8	37.0	37.6	37.6	37.6	37.6	37.6	37.6
	Daytime limit	45.0	45.0	45.0	45.0	45.0	45.0	45.1	46.8	48.5	48.5
	Daytime Excess	-	-	-	-	-	-	-	-	-	-
	Night-time limit	43.0	43.0	43.0	43.0	43.0	43.0	43.0	46.9	46.9	46.9
	Night-time Excess	-	-	-	-	-	-	-	-	-	-
R9/RWID_ 11	Predicted Level	27.3	28.8	33.8	37.0	37.6	37.6	37.6	37.6	37.6	37.6
	Daytime limit	45.0	45.0	45.0	45.0	45.0	45.0	45.0	47.1	49.5	49.5
	Daytime Excess	-	-	-	-	-	-	-	-	-	-
	Night-time limit	43.0	43.0	43.0	43.0	43.0	43.0	43.0	48.4	48.4	48.4
	Night-time Excess	-	-	-	-	-	-	-	-	-	-

7.5.4 Potential Impacts during Decommissioning

On decommissioning, cranes will disassemble the above ground turbine components which would be removed off site for recycling. All the major component parts are bolted together, so this is a relatively straightforward process. The foundations will be covered over and allowed to re-vegetate naturally. It is proposed that the internal site access tracks will be left in place.

Grid connection infrastructure including substations and ancillary electrical equipment shall form part of the national grid and will be left in situ.

These activities will be undertaken during daytime hours, and noise, which will be of a lesser impact than for construction, will be controlled through the relevant guidance and standards in place at the time of decommissioning.

A detailed decommissioning plan will be agreed in advance of construction with Clare County Council. A decommissioning plan is contained in the CEMP in Appendix 3-1.

7.5.5 Potential Cumulative Impacts

7.5.5.1 Construction Phase

There is a proposed wind farm at Carrownagowan approximately 5.5 km north of Fahybeg Wind Farm. It is not expected that there will be cumulative impacts with other large or small scale developments in the vicinity of the proposed wind farm given the distance between the developments and nature of the works proposed as part of these developments.

7.5.5.2 Operational Phase

There is a proposed windfarm at Carrownagowan, now consented, north west of the proposed Fahybeg windfarm at approximately 5.5km from the proposed Fahybeg Wind Farm, comprising 19 no. of turbines. Using the IOA GPG criteria, the cumulative noise from this wind farms has not been considered as the predicted noise from this wind farm more than 10 dB less than the predicted levels of the proposed Fahybeg Wind Farm, and will therefore have a negligible cumulative impact.

Table 7.16 presents predicted noise levels adjacent to 16 receptor locations closest to the proposed wind farm. The predicted cumulative noise levels at all receptor locations are presented in Appendix 7.6. Note: the predicted noise levels are for a worst-case scenario with noise sensitive receptors downwind of the proposed wind farm. In practice, receptor locations will not be downwind of all noise sources and the actual noise levels will be lower than those presented in Table 7.16 and Appendix 7.6.

The predicted noise levels comply with the daytime and night-time limits at the majority of noise sensitive locations. However, an exceedance is observed at receptors south east of the site, the nearest of which is R13 during daytime periods at standardised 10m height wind speeds 6m/s for both the upper and lower envelopes. The noise modelling assumed that this receptor is downwind of all wind turbines. In practice, this will not occur all the time and the actual noise levels at the receptor will be lower when the receptor is upwind or cross wind of the wind farm. The receptors where the exceedance occurs are south east and so upwind of the prevailing wind. Mitigation measures are outlined in Section 7.6.2.

7.6 Mitigation Measures

7.6.1 Mitigation Measures During Construction

The predicted noise levels from on-site activity from the proposed project is below the noise limits in BS 5228-1:2009+A1:2014. Nonetheless, several mitigation measures will be employed to minimise any potential impacts from the proposed project.

The noise impact for construction works traffic will be mitigated by generally restricting movements along access routes to the standard working hours and exclude Sundays, unless specifically agreed otherwise. For example, during turbine erection, an extension to the working day may be required, i.e. 05:00 to 21:00, but this would be necessary only on a relatively small number of occasions. If turbine deliveries are required at night it will be ensured that vehicles on local roads do not wait outside residential properties with their engines idling, and that the local residents will be informed of any activities likely to occur outside of normal working hours.

Consultation with the local community is important in minimising the impacts and therefore construction will be undertaken in consultation with the local authority as well as the residents being informed of construction activities through the Community Liaison Officer.

The construction works on site will be carried out in accordance with the guidance set out in BS 5228:2009+A1:2014, and the noise control measures set out Section 4.3.2 of the Construction Environmental Management Plan (CEMP) which is included in Appendix 3.1 of this EIAR. Proper maintenance of plant will be employed to minimise the noise produced by any 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 project. Machinery that is used intermittently will be shut down or throttled back to a minimum during periods when not in use.

The hours of construction activity will be limited to avoid unsociable hours where possible. Construction operations shall generally be restricted to between 07:00 - 19:00 hours Monday to Friday and 07:00 - 13:00 hours on Saturdays. However, to ensure that optimal use is made of fair-weather windows, or at critical periods within the programme, it could occasionally be necessary to work outside these hours. Any such out of hours working would be agreed in advance with the local planning authority.

The on-site construction and decommissioning noise levels will be below the relevant noise limit of 65 dB $L_{Aeq,1hr}$ for operations exceeding one month, and therefore construction noise impacts are not considered to be significant. However, there is potential for temporary elevated noise levels due to the grid connection works. However, the impact of these works at any particular receptor will be for a short duration (i.e. less than 3 days). Where the works at elevated noise levels are required over an extended period at a given location, a temporary barrier or screen will be used to reduce noise levels below the noise limit where required. The noise impact will also be minimised by limiting the number of plant items operating simultaneously where reasonably practicable.

7.6.2 Mitigation Measures during Wind Farm Operation

The predicted noise from the proposed wind farm meets the daytime and night-time noise limits at the closest locations to the proposed windfarm, and therefore no mitigation is required..

Based on the predicted noise levels, for some receptors sufficiently far from adjacent wind farms, a new source of noise will be introduced into the soundscape and it is expected that there will be a long-term slight to moderate significance of impact for dwellings within the 35 dB L_{A90} study area with a moderate significance of impact on the closest dwellings to the proposed wind farm.

Should the project be granted permission, an operational noise survey will be undertaken to ensure the project complies with the noise limits once the windfarm is operational. If an exceedance in the noise limit occurs, mitigation measures will be refined to ensure compliance with the noise limits is achieved at all noise sensitive locations. In the event of an exceedance noise mitigation could be provided by running the turbines in noise reduced modes of operation (NROs). The noise level can be lessened by reducing the rotational speed of the turbines, with a resultant loss of electrical energy production.

7.6.3 Mitigation Measures during Decommissioning

The noise impact for construction works traffic will be mitigated by restricting movements along access routes to the standard working hours and exclude working on Sundays, unless specifically agreed otherwise with the local authority.

The decommissioning works, which will be of a lower impact than construction works, will be carried out in accordance with the policies and guidance required at the time of the works, and restricted to normal working hours, 07:00 - 19:00 hours Monday to Friday and 07:00 - 13:00 on Saturdays in accordance with best practice.

7.7 Residual Impacts

Construction and decommissioning on-site activities with a duration longer than one month will be below the construction noise limit of 65 dB $L_{Aeq,1hr}$ at residential dwellings. As a result, residual construction impacts range between not significant to slight impact with the duration of impact described as temporary.

There is potential for elevated noise levels due to the grid connection works resulting in a temporary significant impact. However, these works will be for a short duration at a particular property (i.e. typically less than 3 days at any particular receptor) and where the works are to occur over an extended period at a given location, a temporary barrier or screen will be used to reduce noise level below the noise limit and reduce any potential impact resulting in a moderate short-term residual impact.

The operational wind farm noise levels meet the daytime and night-time noise limits derived using the Wind Energy Development Guidelines 2006. As detailed in the criteria section this is considered to be a current best practice approach. The predicted noise from the proposed wind farm is below the noise limits at all noise sensitive locations. Cumulative operational noise levels from the proposed wind farm within the range of turbine heights considered and adjacent wind farms meet the daytime and night-time noise limit derived using the Wind Energy Development Guidelines 2006 which is not considered to be a significant impact. However, for some receptors a new source of noise will be introduced into the soundscape and it is expected that there will be a slight to moderate significance of impact, with dwellings closest to the project with a long-term moderate significance of impact.

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