FEHILY TIMONEY

DESIGNING AND DELIVERING A SUSTAINABLE FUTURE

ENVIRONMENTAL IMPACT ASSESSMENT REPORT (EIAR) FOR THE PROPOSED LITTLETON WIND FARM, CO. TIPPERARY

Volume 2 - Main EIAR

Chapter 11 - Noise and Vibration

Prepared for:
Littleton Wind Farm DAC

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11. NOISE AND VIBRATION

11.1 Introduction

This chapter contains an assessment of the likely significant direct effects with respect to noise and vibration from the Proposed Development. The assessment including undertaking of background noise surveys has been carried out by Fehily Timoney and Company (FT), based on information provided by the Applicant and in accordance with current guidance and best practice. Descriptions of the Proposed Development are provided in Chapter 4 Description of the Proposed Development – Volume 2 of the EIAR.

Potential construction noise and vibration impacts have been determined with reference to British Standard 5228-1:2009+A1:2014 Code of Practice for Noise and Vibration Control on Construction and Open Sites - Part 1 -Noise and Part 2: Vibration. This is considered the best practice standard in the assessment of construction noise and vibration.

Operational noise associated with the Proposed Development includes noise from the proposed wind turbines and on-site substation. 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) (IOA GPG). The wind turbine operational noise is compared with noise limits derived in accordance with the Wind Energy Development Guidelines 2006 (DEHLG 2006) currently in force, in accordance with current industry best practice. Substation noise has been assessed in line with BS4142 2014+A1:2019, Methods for rating and assessing industrial and commercial sound.

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

11.1.1 Statement of Authority

Maureen Marsden, Fehily Timoney and Company (FT) is an Acoustic Engineer with a Master of Engineering degree in Acoustics and Vibration and over 20 years' experience, in noise and vibration, in particular in industrial noise, including wind farm and solar farm projects. Maureen is a member of the Institute of Acoustics and the Institute of Engineers Ireland. Maureen has worked with wind farm and renewable energy projects for over six years. She has undertaken baseline noise surveys for wind farms, assessed construction and operational noise for wind farm projects and developed noise curtailment strategies where required. In addition to writing Environmental Impact Assessment Chapters, she has responded to Requests for Information (RFI's) post EIAR submission and provided input to the legal response for Judicial Reviews. Maureen Marsden undertook the baseline noise surveys for the Proposed Development. She has assessed both operational and construction noise for the Proposed Development in preparation of the Noise and Vibration Chapter. The noise data for this development has been compared with best practice criteria, and mitigation has been provided as required.

John Cullen, Fehily Timoney and Company (FT) is an Environmental and Acoustic Engineer with a degree in Agri-Environmental Science, a post Graduate Diploma in Environmental Engineering and a Diploma in Acoustics and Noise Control. John is a member of the Institute of Engineers Ireland, the Institute of Environmental Sciences and the Institute of Acoustics. John has over eight years' experience in the assessment of environmental noise and vibration, and he has worked within renewable energy and wind farm projects for over three years. He has undertaken baseline noise surveys for wind farms, developed computational noise models, assessed construction and operational noise impacts for wind farm projects and provided input to the legal response for Judicial Reviews. John reviewed the noise and vibration chapter in accordance with best practice guidance and criteria.

11.1.2 Study Area

Construction and decommissioning noise have been assessed by comparing predicted construction activities against best practice construction noise criteria , namely BS 5228-1: 2009+A1:2014 Code of practice for noise and vibration control on construction and open sites Part 1: Noise, 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} as defined in the IOA GPG. This 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." The 35 dB L_{A90} is the lowest limit prescribed in the 2006 Department of the Environment, Heritage, and Local Government, Wind Energy Development Guidelines.

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*." Details of wind farms within 20km of the Proposed Wind Farm are outlined in the Cumulative Noise Assessment in Section 11.5.4. Of these wind farms only the following meet the IOA GPG criteria of being within 10 dB of the Proposed Wind Farm:

- Ballincurry Wind Farm, a two turbine wind farm within 5km east of the Proposed Development
- Graigaman Wind Farm, a single turbine just over 4km east of the Proposed Development
- Lisheen Wind Farm 1 and 2, a 30 Turbine wind farm over 10km north of the Proposed Development.

The operational study area is presented in Figure 11.1, Volume 4 of this EIAR. The study area when considering noise from the Proposed Development and the adjacent wind farms within 10 dB of the Proposed Development includes 40 no. noise sensitive locations.

At the closest locations to the wind farms of Ballincurry and Lisheen there is a contribution from the Proposed Wind Farm, but these are not considered in the assessment, as the contribution is more than 10 dB below the noise from the adjacent wind farms. This is in accordance with best practice as specified in the IOA GPG. There are six noise sensitive locations north west of Graigaman Wind Farm that are already within the 35 dB contour due to Graignaman Wind Farm. There is an additional contribution from Littleton at these locations. Cumulative noise is discussed further in Section 11.5.4.

Construction and operational vibration have been scoped out (see Section 11.2.1), and there is no requirement to set study areas for each.

11.2 Description of Noise and Vibration Impacts

The following sections describe the potential noise and vibration impacts associated with the proposed temporary construction and permanent works. For the wind farm operational noise, a summary of the current research on windfarm noise is outlined. For both temporary and permanent works, the noise and vibration criteria are set out, where relevant.

11.2.1 Construction Noise and Vibration

Noise is generated from the construction of the turbine foundations, the erection of the turbines, the excavation of trenches for cables, the construction of associated hard standings and access tracks, the construction of the substations, the on-site borrow pit, electrical grid connection and works associated with the Turbine Delivery Route (TDR).

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 (defined in Table B.1 of BS5228-2 2009+2014, and based on BS6472 Guide to evaluation of human exposure to vibration in buildings) 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. These values relate to transient vibration which are appropriate for construction vibration assessment. For construction activities, including the compaction which is proposed to take place during grid connection works, the vibration generated is considered continuous, and therefore the threshold values for this activity are half of the values in BS5228-2.

Vibration levels generated from the construction activities at the proposed 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)
- Vibration compaction (steady state), during grid connection works (6.6 mm/s at 10m, 0.7 mm/s at 50m)[1]
- Rock breaking at the borrow pit (0.03 mm/s at 100 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.

[1] Based on Table E.1 of BS 5228: Part 2: Vibration, 5% probability of predicted value being exceeded, one vibrating drum with 2m drum width, 1mm maximum drum amplitude,

The nearest vibration sensitive locations are sufficiently distant that vibration from compaction is less than the level where cosmetic damage to buildings is possible, including a caravan just north of the L2111, at Derryhogan approximately 50m west of the main access track and a property over 70m west of the southern site entrance. However, vibration generated from compaction works may result in vibration levels that are perceptible at properties during compaction works. For borrow pit activities, the closest vibration sensitive locations to the south of the edge of the borrow pit is at 90m and 130m to the east of the borrow pit. Given the low level of vibration predicted at 100m, from rock breaking the level at the closest location to the south is unlikely to exceed the range which might just be perceptible, as defined above. The predicted vibration is also less than the values where cosmetic or structural building damage could occur from construction incurred vibration. As such, construction vibration associated with the proposed development will not be considered further in this chapter.

11.2.2 Operational Noise and 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 11.2.6.

11.2.3 Amplitude Modulation

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[2], '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'.

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[2] Note that a draft replacement document to ETSU-R-97 was published for consultation in July 2025, but is unlikely to be formally issued before the submission date of this EIAR. Until this is formally adopted, it is not considered best practice.

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 of the rotor blade.

The UK University of Salford carried out a study on behalf the Department for Business, Enterprise and Regulatory Reform (BERR, 2009) 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.

RenewableUK conducted research into AM, summarised in, '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 OAM 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 Environmental Protection Agency Guidance Note on Noise Assessment of Wind Turbine Operations at EPA Licensed Sites (NG3, 2011) 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'.

The RenewableUK study (2013) '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 and thus 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 and analysing this data to quantify the magnitude of AM.

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 AM 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.*"

The (IOA) Noise working Group (Wind Turbine Noise) Amplitude Modulation Working Group (AMWG) :"A Method for Rating Amplitude Modulation in Wind Turbine Noise (August 2016)" 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.*"

A recent study "A Review of Noise Guidance for Onshore Wind Turbines", WSP, September 2023, Department for Business, Energy & Industrial Strategy considered AM assessment for wind farm developments. It identified control of AM is a priority area of concern with the current guidance. It considered that the IOA Reference Method for AM measurement has been shown to be a robust and practical approach to quantifying AM and of the measurement methods, it offers the best balance between reliability and practicality. The report stated that reliable predictions of AM in the context of development planning and noise assessment guidance are unlikely to be practically feasible in the near future.

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.

Wind Energy Ireland (WEI) published a position paper on Amplitude Modulation Planning Conditions, October 2025. This states that "No AM" conditions should be included in planning permissions, as AM cannot be eliminated and such conditions are unsupported by scientific evidence or best practice. It recommends a complaints based monitoring system, in line with UK good practice.

11.2.4 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.

A draft version of the Assessment and Rating of Wind Turbine Noise was published by the UK Department of Energy Security and Next Zero, in July 2025. This is undergoing a consultation process and does not represent a final position for the UK government. However, this document states that certain potential effects do not require assessment, namely infrasound, ground borne vibration and low frequency sound. The document quotes a scoping report (WSP for the Department for Business, Energy & Industrial Strategy (2022)), "A review of noise guidance for onshore wind turbines", [report reference 70081416 001 03 03] which concludes that "*the findings from the existing evidence base indicate that infrasound from wind turbines at typical exposure levels has no direct adverse effects on physical or mental health*".

In addition, the Institute of Acoustics Statement in Respect of Wind Farm Noise Assessment December 2024 states the following with regard to infrasound and low frequency noise:

"Infrasound:

The IOA is aware that there is some information presented at planning inquiries suggesting the potential for physiological health effects from infrasound from wind turbines. It is current advice to members that there is no need to assess infrasound as part of the noise impact assessment process, as the absolute levels are well below those reported to trigger physiological health effects based on peer reviewed research to date.

Low Frequency Noise

The IOA is aware that there is some information presented at planning inquiries suggesting the potential for physiological health effects from low frequency noise from wind turbines. It is current advice to members that there is no need to assess low frequency noise as part of the noise impact assessment process, as the absolute levels, whilst potentially audible at typical receptor distances, are well below those reported to trigger physiological health effects based on peer reviewed research to date."

Therefore, the assessment of infrasound and low frequency noise are well below the level reported to trigger physiological health effects.

11.2.5 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 typically 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 assumes that no tonal penalty.

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. It is recommended that tonality of wind turbines is considered during the procurement stage The assessment of the wind turbine noise emissions in this EIAR chapter assumes there is no tonal penalty. This is based on analysis of the manufacturers Vestas V162 data. It is recommended that manufacturers data is confirmed at the procurement stage to confirm that the turbines are not tonal in nature, or if the turbines are deemed to be tonal in nature a tonal correction would need to be applied.

11.2.6 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[3] 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[4] 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 825m 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).

Note that the Institute of Acoustics Statement in Respect of Wind Farm Noise Assessment December 2024 states with respect to operational vibration:

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

[4] 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.

"Vibration from operational wind turbines has been measured by extremely sensitive measurement equipment such as seismic arrays. but in terms of human perception, measured vibration levels are well below perception thresholds even on the actual wind turbine sites. There is, therefore, no need to assess vibration affecting people for operational wind turbine developments."

Therefore, operational vibration has been scoped out.

11.2.7 Decommissioning Noise and Vibration

The construction activities during decommissioning are similar to those outlined in the construction section and will be discussed further in section 11.5.5.

11.3 Assessment 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
- Evaluation of noise impacts
- Propose mitigation, as required, and
- Assess residual impacts.

11.3.1 Relevant Policy and 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
- 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: 2024 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 5228-1:2009+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;
- Tipperary County Development Plan 2022 – 2028, July 2022
- Tipperary Renewable Energy Strategy 2016, Appendix 2 of County Development Plan 2022-2028, August 2022.

11.3.2 Evaluation Criteria

11.3.2.1 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 11.1) is dependent on the existing ambient noise levels (rounded to the nearest 5dB).

Table 11-1: 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}. Further information on measured noise levels from the baseline noise survey used to define construction noise criteria are set out in Appendix 11.1. From Appendix 11.1, Table A11.1.6, the $L_{Aeq,\ 10mins}$ during the daytime period ranges from 40 to 49 dB during the daytime construction period, across all measurement locations. Therefore, the nearest residential dwellings to the proposed development are afforded Category A designation (65 dB $L_{Aeq,1hr}$ during daytime periods).

Section 11.4.2 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.

11.3.2.2 Wind Farm Operational Noise Criteria

This section outlines guidelines that have been considered, including the 2019 Draft revised Wind Energy Guidelines and Tipperary County Plan and Renewable Energy Strategy, before the wind farm operational noise limits are summarized (Section 11.3.2.2.3)

11.3.2.2.1 Draft Revised Wind Energy Guidelines

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.

Reference is also made to Parliamentary questions (34th Dail, Houses of the Oireachtas, 15th October 2025), which stated the following in response to the question " if his Department will update the wind turbine guidelines; and when it is expected they will be published." :

"The current 2006 Wind Energy Development Guidelines remain in force, pending the finalisation of the review."

11.3.2.2.2 Tipperary County Development Plan and Renewable Energy Strategy

Currently Tipperary have published a County Development Plan 2022-2028.

The current Tipperary Draft guidelines state:

"*The National Wind Energy Development Guidelines (DEHLG, 2006) are currently under review. The review focuses on several areas including new mechanisms for local community engagement with consideration to investment/benefit, setback from turbines and noise limits. The Council will seek to apply the Wind Energy Development Guidelines, and any review thereof, in assessing proposals for wind energy developments*"

The Tipperary Renewable Energy Strategy 2016 states that: " *In 2006, the Minister of the Environment, Heritage and Local Government issued Wind Energy Guidelines. The Department of Housing, Planning, Community and Local Government in conjunction with the Department of Communications, Climate Action and the Environment is currently undertaking a technical update of the guidelines with respect to the areas of noise and shadow flicker. This update is intended to ensure that the Wind Energy Guidelines are supported by a robust and up to date evidence base on these issues to support wind energy development in a manner which safeguards residential amenity consistent with EU and National Policy.*"

The Renewable Energy Strategy refers to the Irish Wind Energy Association and the

"*The 'Best Practice Guidelines for the Irish Wind Energy Industry' were published by the Irish Wind Energy Association in 2008 with a subsequent update in 2012. These guidelines encourage responsible and sensitive wind farm development and they provide assistance and recommendations for those developing onshore wind projects in Ireland.*"

The "Good Practice for Wind Energy Development Guidelines 2012" does not provide guidance on appropriate noise limits but provides guidelines for community engagement.

The Tipperary renewable energy strategy states "*In relation to individual houses and smaller settlements, impacts on residential amenity, such as noise and shadow flicker, will be considered on a case by case basis in accordance with the development control standards of the County Development Plan (as varied) and the Wind Energy Guidelines.*

Also

"The Council will consider, and will have regard to the impact of developments on the equine industry in assessing applications. The Council may, where appropriate require the submission of an impact statement, with particular with respect to noise and shadow flicker. In many individual instances any adverse impacts may be mitigated.

The Renewable Energy Strategy states that:

Proposals must also demonstrate that the residential amenity will not be impacted by virtue of noise and all applications should be accompanied by a Noise Impact Statement of noise sensitive locations such as occupied dwellings. The Department of the Environment's most up to date Guidelines on Wind Energy shall be adhered to with regard to shadow flicker and noise issues"

11.3.2.2.3 Littleton Wind Farm Project Noise Criteria

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 limited guidance 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 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 is for noise from wind turbines. Ancillary noise sources such as the on-site substation transformer have been assessed in line with BS4142 (See Section 11.3.3).

11.3.3 Substation Noise

The proposed substation has been assessed using the methodology described in the British Standard, BS4142:2014+A1:2019 Methods for rating and assessing industrial and commercial sound.

BS4142 describes a method for rating and assessing sound of an industrial and/or commercial nature and is considered best practice guidance for the assessment of substation noise emissions. The method described in BS 4142 uses outdoor sound levels to assess the likely impact of sound on people inside or outside a dwelling or premises used for residential purposes upon which sound is incident. This standard has a number of descriptors of the sound summarised below:

Ambient sound , L_a=$L_{Aeq,T}$ totally encompassing sound in a given situation at a given time, usually composed of sound from many sources near and far (The ambient sound comprises the residual sound and the specific sound when present)

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 (L_r=$L_{Aeq,T}$) 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 15 minutes 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.

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

- The absolute level of the sound. Where the background noise levels are low, absolute noise levels may be more relevant, particularly at night. The current version of BS4142 does not quantify low background noise levels. However, the 1997 version of BS 4142 defined very low background sound levels as being less than about 30 dB L_{A90}, and low rating levels as being less than about 35 dB $L_{Ar,Tr}$.
- Character and level of residual sound compared to character and level of specific sound.
- 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)

11.3.4 World Health Organisation Criteria (Substation Noise)

World Health Organisation (WHO) Night Noise Guidelines for Europe 2009 define noise criteria for L_{night}, which is the equivalent outdoor sound pressure associated with a particular type of noise during the night (at least 8 hours) over a period of a year, outside. A limit of L_{night}, outside of 40 dB is equivalent to the lowest observed adverse effect level (LOAEL) for night noise. As stated within these guidelines, "these guidelines are applicable to the Member States of the European Region, and may be considered as an extension to, as well as an update of, the previous WHO Guidelines for community noise (1999)"

The WHO Night Noise Guidelines recommend $L_{night,outside}$ of 55 dB as an interim target for countries where the NNG cannot be achieved in the short term for various reasons and where policymakers choose to adopt a stepwise approach.

11.3.5 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 2022'. The EPA guidelines do not quantify the noise 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 11.2 presents the significance of effect criteria from the EPA guidelines and Table 11.3 presents the Duration and Frequency of effects criteria.

Table 11-2: Description of Effects

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

Table 11-3: Duration and Frequency of Effects

Duration and Frequency of Effects/Significance	Description
Momentary	Effects lasting from seconds to minutes
Brief	Effects lasting less than a day
Temporary	Effects lasting less than a year
Short-term	Effects lasting one to seven years
Medium term	Effects lasting seven to fifteen years.
Long term	Effects lasting fifteen to sixty years.
Permanent	Effects lasting over sixty years.
Reversible	Effects that can be undone, for example through remediation or restoration
Frequency of Effects	Describe how often the effect will occur (once, rarely, occasionally, frequently, constantly - or hourly, daily, weekly, monthly, annually

11.3.6 Consultation

Chapter 4.10 of this EIAR refers to scoping consultation. Submissions and comments from various consultees have informed the project's assessment methodology throughout the EIAR. A summary of the consultation issues relating to noise are summarised below.

TII

The EIAR/EIS 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., National Roads Authority, 2004).

In response to the issued raised by TII, the methodology used to assess potential noise from the development are set out earlier in Section 11.3. Noise barriers are normally more appropriate for control of road traffic noise. Mitigation relating to construction noise is detailed in Section 11.6.1.

Failte Ireland

Failte Ireland provided a copy of “EIAR Guidelines for the Consideration of Tourism and Tourism Related Projects” containing requirements pertaining to:

….areas including noise and vibration

The Failte Ireland document “EIAR Guidelines for the Consideration of Tourism and Tourism Related Projects” states the following with respect to noise:

“Public realm supports public interaction, contributes to ‘place making’ and can transform towns into high-quality places to live, visit and invest - encouraging day and evening economies. It has socio-economic, environmental and cultural benefits, including:

Decreased noise/pollution, due to better traffic management"

The Failte Ireland Checklist includes:

"*11.5. Ensure the local population is not adversely affected by tourism, e.g. by too much congestion or noise, and ensure that social benefits are maximised.*"

In response to the issued raised by Failte Ireland, the methodology used to assess potential operational and construction noise from the development are set out earlier in Section 11.3.2. Operational noise is within the noise limits and potential effects from construction noise are summarised in Section 11.6.1 Receiving Environment.

11.3.7 Wind Farm Site

Baseline noise monitoring was undertaken between the 18th November and 7th December 2021, at six receptor locations surrounding the proposed Littleton 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 11.1.2 and shown in Figure 11.1, Volume 4 of this EIAR 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 six locations, shown in Figure 11.2 and details of the noise monitoring locations are presented in Table 11.4. The rationale for the selection of these monitoring locations is described in Appendix 11.1 which presents details on the baseline measurements and data analysis.

Table 11-4: Noise monitoring locations

Location ID	ITM Easting	ITM Northing	Description	Photograph (*See Appendix 11.1)
N1	624078	659047	North of the Proposed Wind Farm, In the front garden of property in direction of wind farm. Screened from traffic noise to the north	Plate A11.1-1*
N2	625689	657056	At side of property at end of cul de sac, near to forested area	Plate A11.1-2*
N3	624825	655721	Behind farm buildings at a property	Plate A11.1-3*
N4	621749	652771	In rear garden of property, with view of Proposed Wind Farm to north. 3.5m from garden fence.	Plate A11.1-4*
N5	622066	650342	Near a track to the front (west of the house), some distance from local road	Plate A11.1-5*
N6	622373	658422	In rear garden of property.	Plate A11.1-6*

11.3.7.1 Analysis of 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 atypical (site specific) noise sources or 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 119m, 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 11.1 presents the results of the data analysis.

The prevailing daytime amenity noise levels, as defined in ETSU-R-97 and Appendix 11.1, and night time prevailing noise are presented in Tables 11.5 and 11.6. The derived prevailing background noise polynomial curve was not extended beyond the range covered by adequate data points. As discussed in Appendix 11.1, there were adequate data points for the range of windspeeds for daytime and night time prevailing background, presented in the Tables below.

Table 11-5: Prevailing background noise during daytime periods

Location	Prevailing Background Noise $L_{A90,10min}$ (dB) at Standardised 10 m Height Wind Speed (m/s)								
	2	3	4	5	6	7	8	9	10
N1	31.1	31.7	32.5	33.6	34.8	36.3	38.0	40.0	42.3
N2	27.0	27.3	28.0	29.0	30.3	31.9	33.7	35.9	38.2
N3	27.0	27.7	28.5	29.3	30.3	31.5	33.0	34.8	37.0
N4	24.0	25.1	26.3	27.6	29.1	30.7	32.4	34.2	36.1
N5	26.7	27.7	28.6	29.5	30.6	31.8	33.4	35.5	38.0
N6	40.3	41.1	41.8	42.4	43.0	43.6	44.3	45.0	45.9

Table 11-6: Prevailing background noise during nightime periods

Location	Prevailing Background Noise $L_{A90,10min}$ (dB) at Standardised 10 m Height Wind Speed (m/s)									
	1	2	3	4	5	6	7	8	9	10
N1	21.8	21.9	22.6	23.9	25.8	28.0	30.6	33.5	36.7	39.9
N2	20.4	20.6	21.2	22.1	23.5	25.3	27.6	30.2	33.4	36.9
N3	21.5	21.6	22.2	23.0	24.2	25.7	27.6	29.7	32.3	35.1
N4	17.5	17.6	18.2	19.3	21.0	23.1	25.8	28.8	32.3	36.2
N5	21.1	21.7	22.4	23.3	24.5	26.1	28.2	30.8	34.0	37.9
N6	27.7	28.3	29.0	29.8	30.8	32.0	33.4	35.0	36.9	39.1

11.3.7.2 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. 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 within the 35 dB L_{A90} study area from the Proposed Wind Farm and adjacent cumulative developments is 40. Four locations are already within the 35 dB study area due to their location close to Graigaman Wind Farm. The Proposed Wind Farm covers a large area, with the northernmost turbine over 6.5 km north of the most southern turbine. As the proposed development covers a large area and the number of properties is relatively low, the higher 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 11 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. In addition, the nearby wind farms of Lisheen, Graigaman and Ballincurry have higher noise limits of 43 dB L_{A90} (refer to Section 11.5.4 for planning Conditions)

The final ETSU factor relates to the duration and level of exposure. The prevailing background noise levels are described in detail in Section 11.4.1.1 of this report and also in Appendix 11.1. There are two main clusters of turbines, a northern section with 8 turbines and a southern section with three turbines. For the northern section of the Proposed Wind Farm, most properties within the study area are located east of the turbines. Approximately half of the noise sensitive locations within the northern study area are downwind of the prevailing wind. For the southern site (cluster of three wind turbines) noise sensitive locations are located in all directions, with fewer located east of the turbines, so fewer properties are located downwind of the prevailing wind direction of from the Proposed Wind Farm. There are a group of properties north of the southern section along a local road between the northern and southern turbines, and two of these properties are within the 35 dB L_{A90} study area. As few properties are affected this would suggest that the limit be increased

For the purpose of this assessment and based on the three criteria above a limit of 40 dB is proposed for quiet areas. For areas above 30dB L_{A90} assessment, a limit of 45 dB is proposed in accordance with the recommendations of WEDG 2006. Table 11-5, above, presents the prevailing daytime noise level across the site, with night time prevailing noise levels in Table 11-6. From these the daytime and night time noise limits are presented in Table 11-7.

Table 11-7: Derived Noise Limits Daytime and night time

Noise Criteria/Location	Derived Noise Limits LA90,10min (dB) at Standardised 10 m Height Wind Speed (m/s)								
	2	3	4	5	6	7	8	9	10
Daytime criteria N1	45	45	45	45	45	45	45	45	45
Daytime criteria N2	40	40	40	40	45	45	45	45	45
Daytime criteria N3	40	40	40	40	45	45	45	45	45
Daytime criteria N4	40	40	40	40	40	45	45	45	45
Daytime criteria N5	40	40	40	40	45	45	45	45	45
Daytime criteria N6	45	45	45	45	45	45	45	45	45
Night time Noise Criteria (All Locations)	43	43	43	43	43	43	43	43	43

11.4 Potential Effects

11.4.1 Do-Nothing Scenario

Please note that irrespective of the consenting of the Proposed Wind Farm the remaining measures outlined in the Rehabilitation Plans, i.e. monitoring of the Littleton, Longfordpass and Lanespark Phase 1 measures and enhanced Phase 2 measures at nearby Ballybeg and Derryvella bogs, will continue to be implemented by BnM in agreement with the EPA. Please see Appendix 2.1 (Volume 3 of the EIAR) and Section 2.2.1 of Chapter 2 of the EIAR for further detail.

Taking account of these described works, in the Do-Nothing Scenario, the noise environment remain will remain largely unchanged.

11.4.2 Construction Noise

11.4.2.1 Wind Farm Site

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 at 10m from 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 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) . 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. Percentage on time 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 wind turbine foundations, installation of wind turbines, on-site borrow pit operation, substation construction, TDR accommodation works and grid connection works.

11.4.2.1.1 On-site Borrow Pit

It is proposed that a of borrow pit will be in the northern section of the site boundary and the extent of the proposed borrow pit area is presented in Volume 4, Figure 11.3. The noise assessment of the borrow pit focuses on the two closest noise sensitive locations, location R302, north east of the borrow pit and location R303 south of the borrow pit (see Figure 11.3). For the location to the north east of the borrow pit (R302), noise from the wider southern section of the borrow pit has been considered in addition to the narrower north western section of the barrow pit.

Table 11.8 presents the likely plant required for the borrow pit construction activities. The borrow pit area is split into two main areas, a north west section and the wider southern section of the borrow pit. The nearest noise sensitive location to the wider southern section of the borrow pit is (R303), which is approximately 90m to the south. In addition, there is a location north east of the borrow pit (R302), approximately 130m north east of the wider southern section of the borrow pit. This latter location is also approximately 190m from the north western part of the borrow pit. Noise has been predicted, without mitigation, and the results are presented in Table 11.8.

Assuming all construction activities required for the borrow pit occur simultaneously, the predicted noise level from borrow pit activities at the closest receptor R303 is 68.9 dB $L_{Aeq,\,1hr}$ which is 4 dB above the 65dB $L_{Aeq,\,1hr}$ $L_{Aeq,1hr}$ noise limit.

For location R302, north east of the site, the predicted noise level from the closest, wider southern section of the borrow pit area is marginally above the noise limit of 65dB $L_{Aeq,\,1hr}$, at 65.5 dB $L_{Aeq,\,1hr}$. From Table 11.8, borrow pit activities from the north west section meet the noise limit at 63.1 dB $L_{Aeq,\,1hr}$

At all locations noise from individual items of plant are below the 65dB $L_{Aeq,\,1hr}$ limit.

With all plant operating simultaneously, without mitigation, noise from the borrow pit construction activity is expected to have a **significant negative** effect that is **temporary** in duration during operation of the borrow pit.

Section 11.6.1 discuss mitigation measures to reduce the effect of the construction noise impact.

Table 11-8: Borrow Pit - Likely Plant and Predicted Levels

Plant	BS 5288 Ref.	Activity	Percentage on-time (%)	Wide Southern section of Borrow Pit		North West section of Borrow Pit
				Predicted Noise Level at R303 (South)	Predicted Noise Level at R302 (East)	Predicted Noise Level at R302 (East)
Diesel Pump	C4.88	Pump water	100	50.8	47.3	44.8
Tracked Hydraulic Excavator (37 t)	C10.1	Face shovel extracting/loading dump trucks	80	60.6	57.2	54.7
Rock Breaker	C9.12	Rock breaking	50	63.9	60.4	57.9
Crusher	C1.14	Crushing material	100	63.5	60	57.5
Tracked Excavator (21t)	C4.65	Trenching	80	52.2	48.8	46.2
Dozer (41t)	C2.10	Ground excavation/earthworks	80	61.1	57.6	55.1
Articulated Dump truck (23t)*	C2.33	Distribution of Material	Maximum 164 two-way trips per day	55.9	53.7	51.8
Cumulative				68.9	65.5	63.1
*Drive by maximum sound level						

11.4.2.1.2 Preparation of Access roads, Hardstands and Drainage

Table 11.11 presents the likely plant required for the preparation of access roads, hardstanding and drainage. Also presented are the predicted noise levels at the nearest dwellings from the access roads near the northern and southern sites. R299 is approximately 150 m away from the access roads north of the site. R61 is approximately 75 m away from the main southern site access road. Assuming all construction activities required for the preparation of the access road occur simultaneously, the highest predicted noise level from the construction activities is 61.5 dB $L_{Aeq,\ 1hr}$ which is below the 65dB $L_{Aeq,\ 1hr}$ noise limit.

There is a caravan approximately 50 m from the access Road at the site, just north of the L2111, at Derryhogan. The noise predicted at this location from use of the access track is predicted to be below the 65dB $L_{Aeq,\ 1hr}$ noise limit.

The preparation of access roads, hardstands and drainage are expected to have a **slight negative** effect that is **temporary** in duration.

Table 11-9: Preparation of Access Roads, Hardstands and Drainage - Likely Plant and Predicted Levels

Plant	BS 5288 Ref.	Activity	Percentage on-time (%)	Predicted Noise Level at R299 (north of site)	Predicted Noise Level at R 61 (south of site)
Tracked Excavator (25t)	C2.19	Ground excavation/ earthworks	80	51.5	57.2
Articulated Dump Truck (23t)	C2.32	Tipping Fill	20	42	47.7
Dozer (14t)	C5.12	Spreading chipping/fill	80	50.7	56.4
Vibratory roller (3t)	C5.27	Rolling and Compaction	80	40.6	46.3
Excavator (21t)	C4.65	Trench for drainage	80	45.3	51
Articulated Dump Truck*	C2.33	Delivery of Material	Maximum 164 two-way trips per day	49	53.6
Cumulative				56.0	61.5

11.4.2.1.3 Preparation of Wind Turbine Foundations

Table 11.12 presents the likely plant required for the preparation of wind turbine foundations. Predicted noise levels at R239 and R67 is presented. These noise sensitive locations are approximately 790m from T6 and 770m from T9, respectively. Assuming all construction activities required for the preparation of the turbine foundations occur simultaneously, the highest predicted noise level from the construction activities is 53.5 dB $L_{Aeq, 1hr}$, below the 65dB $L_{Aeq, 1hr}$ daytime noise limit.

The construction works associated with the preparation of the turbine foundations are expected to have a **slight negative** effect that is **temporary** in duration.

Table 11-10: Preparation of Wind turbine foundations - Likely Plant and Predicted Levels

Plant	BS 5288 Ref.	Activity	Percentage on-time (%)	Predicted Noise Level at R239 (T6)	Predicted Noise Level at R67 (T9)
Tracked Excavator (25t)	C2.19	Ground excavation/earthworks	80	35.7	35.9
Excavator (23t)	C10.8	Loading sand / soil	20	32.4	32.6
Diesel Pump	C4.88	Pump water	100	28	28.2
Mobile telescopic crane	C4.41	Lifting reinforcing steel	80	30.3	30.5
Concrete mixer truck & concrete pump	C4.32	Concrete mixer truck + truck mounted concrete pump + boom arm	100	37	37.2
Precast concrete piles	C3.1	Precast concrete piles	50	44.9	45.1
Lorry*	C11.9	Delivery and removal of material	Maximum 164 two-way trips per day	42.8	52.5
Cumulative				47.9	53.5
* - Drive-by maximum sound level					

11.4.2.1.4 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 11.11. The predicted cumulative noise level at the closest receptor to the turbines is 52.4 dB $L_{Aeq, 1hr}$. The predicted noise levels are below the 65 dB $L_{Aeq, 1hr}$ daytime noise limit.

The construction works associated with the installation of the wind turbines are expected to have a **slight negative** effect that is **temporary** in duration.

Table 11-11: Wind Turbine installation - Likely Plant and Predicted Levels

Plant	BS 5288 Ref.	Activity	Percentage on-time (%)	Predicted Noise Level at R239 (T6)	Predicted Noise Level at R67 (T9)
Mobile telescopic crane (x2)	C4.41	Lifting turbine components	80	29.5	29.5
Lorry *	C11.9	Delivery of Turbine Components	Maximum 164 two-way trips per day	42.7	52.4
Cumulative				42.9	52.4
* - Drive-by maximum sound level					

11.4.2.1.5 Construction of Substation

The construction of the onsite 110kV substation 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 11.12 presents the expected plant required for the different construction phases of the proposed buildings to be constructed on site. The nearest occupied dwelling (R299) will be over 500m from the substation, and location R303 is over 550m from the proposed substation. The highest cumulative predicted noise levels occur during the preparation of hardstanding areas and is predicted to be 48.1 dB $L_{Aeq, 1hr}$ at the nearest occupied dwelling which is below the construction noise daytime limit of 65 dB $L_{Aeq, 1hr}$.

The works associated with the construction of the substation are expected to have a **slight negative** effect that is **temporary** in duration.

Table 11-12: Construction of Substation - Likely Plant and Predicted Levels

Phase	Plant	BS 5288 Ref.	Activity	Percentage on-time (%)	Predicted Noise Level at R299 (north of substation)	Predicted Noise Level at R303 (east of substation)
Site Clearance and Preparation	Tracked excavator (22t)	C2.3	Earthworks/site clearance	80	39.9	39.2
	Tracked excavator 25t	C2.19	Earthworks/site clearance	80	39.4	41.9
	Dozer (11t)	C2.12	Ground excavation/ earthworks	80	42.6	41.4
	Loading Lorry	C10.8	Loading Sand to Lorry	80	42.1	39.4
Cumulative					47.2	46.7
Preparation and pouring of Foundations	Concrete mixer truck + truck mounted concrete pump + boom arm	C4.32	Concrete pumping	80	39.8	39.1
	Lorry*	C11.9	Delivery of material	Maximum of 164 two-way trips per day	42.8	45.9
Cumulative					44.6	46.7
Preparation of hardstanding areas	Articulated Dump Truck (23t)	C2.33	Delivery/Removal of Material	Maximum of 164 two-way trips per day	41	44.0
	Tracked Excavator (25t)	C2.19	Ground excavation/earthworks	80	39.4	38.7
	Articulated Dump Truck (23t)	C2.32	Tipping Fill	20	29.9	29.3
	Dozer (14t)	C5.12	Spreading chipping/fill	80	38.6	37.9
	Vibratory roller (3t)	C5.27	Rolling and Compaction	80	28.5	27.9

Phase	Plant	BS 5288 Ref.	Activity	Percentage on-time (%)	Predicted Noise Level at R299 (north of substation)	Predicted Noise Level at R303 (east of substation)
	Lorry*	C11.9	Delivery of material	Maximum of 164 two-way trips per day	42.9	44.0
Cumulative					47.0	48.1
Erection of blockwork/ installation concrete slabs	Mobile telescopic crane (80t)	C4.39	Lifting concrete slabs	80	38.6	38.0
	Lorry* (32t)	C11.9	Delivery of material	Maximum of 164 two-way trips per day	41	44.0
Cumulative					43.0	45
General Construction including installation of electrical and mechanical plant	Generator	C4.84	Power for site cabins	100	36.6	36.0
	Telescopic handler	C4.54	Lifting Plant	80	40.5	
	Angle grinder (grinding steel)	C4.93	Miscellaneous	80	42.6	39.9
Cumulative					45.3	41.8
* - Drive-by maximum sound level						

11.4.2.2 Grid Connection

It is proposed to construct an onsite electricity substation within the proposed development site as shown in Figure 1-4, Chapter 4 Project Description of this EIAR. This will provide a connection point between the wind farm and the proposed grid connection point at the existing 110/220kV Substation at Ballyragget. Each turbine will be connected to the on-site electricity substation via underground electricity cables. Most of the proposed grid connection route is on public roads. The Grid connection route is underground and extends for 30.9km, with 28.4km located on public roads.

The grid connection works will be carried out over a 16-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 11.13. Total noise from grid connection works has been assessed based on individual items of plant operating at once outside noise sensitive locations.

Table 11-13: Grid connection works

Plant	Activity	$L_{Aeq\ 1\ hr}$ at 10m dB BS 5228	Percentage on-time (%)	A-Weighted Sound Pressure Level, LAeq, dB at facade			
				10m*	25m	50m	100m
Road sweeper (C4.90)	Sweeping and dust suppression	76	10	69	61	54	47
Mini excavator with hydraulic breaker (C5.2)	Breaking Road Surface	83	25	79	72	64	57
Vibratory roller (C5.27)	Rolling and Compaction	67	50	66	59	51	44
Wheeled excavator (C5.34)	Trenching	70	50	70	62	55	48
Hand-held circular saw (petrol) (C5.36)	Cutting Concrete Slabs	87	10	79	72	64	57
Dump truck (tipping fill) (C2.30)	Tipping Fill	79	10	72	64	57	50
Vibratory plate (petrol) (C2.41)	Compaction	80	10	73	65	58	51
*Noise level predicted at 10m from plant and at 4m height, representing first floor predictions, taking account of % on-time, ground absorption. Noise predictions include facade correction (+3dB)							

Table 11.15 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. The noise levels presented are predicted to exceed the site daytime noise limit of 65 dB $L_{Aeq,1hr}$ within 10m of the works and at 25m for certain items of plant. The predicted levels and are expected to occur for only short periods of time at a very limited number of dwellings. There are 5 dwellings within 10m of the grid connection works, an additional 73 residential properties within 25m, 157 residential properties between 25m and 50m and 184 dwellings between 50-100m.

In some instances, the maximum predicted noise levels may be above the daytime 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, as are discussed in Section 11.6.1.

Within 10m of the grid connection construction works are expected to have a **significant negative temporary** effect at 5 properties.

Within 50m of the grid connection construction works are expected to have a **significant negative temporary effect** at 235 properties, during use of the hydraulic breaker and circular saw.

Above 50m of the grid connection construction works are expected to have a **slight to moderate negative temporary** effect during grid connection works.

11.4.2.3 Turbine Delivery Route

As stated in Chapter 4 of this EIAR, Description of the Proposed Development the TDR travels from the port of entry to Junction 4 of the M8 Motorway to the Proposed Wind Farm Site entrance on the R639 at Longford Pass. The TDR passes through the townlands of Urlingford and Longford Pass

Temporary Accommodation Works for the TDR are detailed in Chapter 4 Description of this EIAR, Table 4.4 and in Chapter 15 Material Assets (including Traffic and Transportation). These are summarised below.

- M8 Junction 4 West Roundabout: Minor works (lighting column and vegetation removal). The closest noise sensitive receptor is approximately 240m from the works.
- M8 Junction 4 East Roundabout: Minor works including removal of street furniture signs/lighting columns.. The closest receptor is approximately 150m from the works.
- R693/R639 Roundabout: Minor works - removal of lighting columns and road signs, vegetation removal and laying of load bearing surface. The closest noise sensitive location to the roundabout is over 300m from the works.

Table 11-14: TDR Construction works

Plant	Activity	$L_{Aeq\ 1\ hr}$ at 10m dB BS 5228	Percentage on-time (%)	A-Weighted Sound Pressure Level, LAeq, dB at facade			
				10m*	25m	50m	100m
Road sweeper (C4.90)	Sweeping and dust suppression	76	10	69	61	54	47
Mini excavator with hydraulic breaker (C5.2)	Breaking Road Surface	83	25	79	72	64	57
Vibratory roller (C5.27)	Rolling and Compaction	67	50	66	59	51	44
Wheeled excavator (C5.34)	Trenching	70	50	70	62	55	48

Plant	Activity	$L_{Aeq\ 1\ hr}$ at 10m dB BS 5228	Percentage on-time (%)	A-Weighted Sound Pressure Level, LAeq, dB at facade			
				10m*	25m	50m	100m
Hand-held circular saw (petrol) (C5.36)	Cutting Concrete Slabs	87	10	79	72	64	57
Dump truck (tipping fill) (C2.30)	Tipping Fill	79	10	72	64	57	50
Vibratory plate (petrol) (C2.41)	Compaction	80	10	73	65	58	51
*Noise level predicted at 10m from plant and at 4m height, representing first floor predictions, taking account of % on-time, ground absorption. Noise predictions include facade correction (+3dB)							

Table 11-4 presents the predicted noise from activities used in the TDR works at certain distances from the works. Given that the construction noise criteria is met at a distance of 100m from the works, noise from the TDR works at the closest receptor (at 150m) is below the daytime construction noise limit. In summary, given the minor nature of the proposed temporary accommodation works and the distance from the works to the closest receptors, the noise levels are predicted to be within the project construction noise limits at these locations. Therefore, the temporary accommodation works are predicted to have a **slight negative** effect that is **temporary** in duration.

11.4.2.4 Construction Noise from several On-site Construction Activities

This section considers noise generated from construction activities within the proposed development which have the potential to occur simultaneously.

Based on the proposed program of works, there is potential for noise from several activities during the construction works for Littleton Wind Farm. As detailed in the Construction Program, during month 7 of the proposed works the following on-site construction activities will occur simultaneously:

- Borrow Pit Activities
- Construction of Access tracks and hardstanding
- Turbine foundations
- TDR accommodation works
- On site substation
- Grid connection works

The TDR works have not been included as these are too distant to contribute to on-site construction noise as they take place between Urlingford and the M8 motorway. Grid connection works have not been considered as they are expected to be of very short duration. Of the remaining works, namely access tracks, Turbine foundations and the on-site substation, the total noise from these activities is predicted to be below the daytime noise limit of 65 dB $L_{Aeq, 1hr}$. Therefore , no specific mitigation is required, beyond that specified in Section 11.6.1. With the borrow pit works, there is potential for noise from both the north west section of the borrow pit and the main borrow pit affecting properties north east of the borrow pit. Therefore, borrow pit activities at these locations should not occur simultaneously to prevent potential impacts.

11.4.3 Operational Noise

11.4.3.1 Wind Farm Prediction Methodology

Noise predictions have been carried out using International Standard ISO 9613:2024, Acoustics – Attenuation of Sound during Propagation Outdoors Part 2: Engineering method for the prediction of sound pressure levels outdoors. The corrections for wind turbine noise prediction are based on methodology specified in IOA GPG, rather than the wind turbine annex of ISO 9613-2: 2024. The propagation model described in 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:

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 Vestas 162 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 Tables in Section 11.4.3.2 of this report and Appendix 11.4.

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 x 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 x α

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

Published values of 'α' from ISO9613 Part 1 have been used, corresponding to a temperature of 10^{o}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 11.15:

Table 11-15: 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 for wind turbines than that measured in practice under downwind conditions.

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' Given the topography of the area noise screening from topography is not applied in the calculations.

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.

11.4.3.2 Wind farm 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.

In order to calculate the noise levels at noise sensitive locations, an accurate representation of the source and receiver positions was necessary for the prediction modelling. The turbine locations are presented Chapter 4 of this EIAR and noise sensitive locations within the study area are presented in Appendix 11.3. The closest dwellings to the southern set of three turbines are caravans located approximately 774 m north west of the closest turbine (Turbine 9) and for the northern set of 8 turbines, the closest residential property is a property approximately 778m east of Turbine 6.

The V162 turbine with a hub height of 119m has been used for this assessment.

Manufacturers data for the proposed turbine has been provided at hub height. This has been standardised to a wind height of 10m, for the proposed 119m hub height turbine. The sound power levels standardised to 10m height are presented in Table 11.16, with octave band data in dB(A) presented in Table 11.17. The wind turbine data used as part of the assessment is presented in Appendix 11.4.

Table 11-16: Wind turbine sound power levels, dB WA at hub height 119m, V162.

Turbine	Standardised 10 m Height Wind Speed (m/s)					
	2	3	4	5	6	7*
V162	96.0	96.0	97.7	101.1	104.6	106.3

* maximum sound power achieved at 7m/s

Table 11-17: Wind turbine Octave band Noise levels, sound power levels, dB(A) for a range of Standardised 10m Height Wind Speeds (with trailing edge serrations) 119 m hub height, V162.

Turbine Standardised 10 m Height Wind Speed (m/s)	Octave Band Sound Power Level [dB}							
	63	125	250	500	1000	2000	4000	8000
2	87.3	90.4	88.8	87.6	87.6	85.6	78.9	67.8
3	87.8	90.8	88.6	86.5	87.3	85.9	78.1	65.3
4	89.2	92.0	89.9	88.0	90.1	88.7	81.2	66.9
5	90.3	93.9	93.1	92.4	94.9	93.2	86.4	73.2
6	91.9	95.9	96.6	96.4	99.1	97.5	90.1	74.6
7*	90.4	97.4	98.8	98.6	99.6	99.4	94.8	83.4

* maximum sound power achieved at 7m/s

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 manufacturer sound power level data to account for a margin of uncertainty, in accordance with best practice.

Should it be required, to meet noise limits, 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.

11.4.3.3 Potential Operational Impact -Predicted Noise levels

Noise predictions were performed for the 11-wind turbine layout using the manufacturers noise data at each wind speed, for the proposed turbine model. Noise has been predicted for a range of standardised 10m height wind speeds from 2 m/s up to 7 m/s (to cut-out). 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 11.18 presents predicted noise levels at receptor locations closest to the Proposed Wind Farm. The predicted noise levels at all receptor locations within the 35 dB L_{A90} noise contour are presented in Appendix 11.5. Note: the predicted noise levels assumes that noise sensitive receptors are downwind of the proposed wind farm, which is a worst case scenario. 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 11.18 and Appendix 11.5.

Table 11.18 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.

Based on the predicted noise levels, a new noise source will be introduced into the acoustic environment and it is expected that there will be a **long term slight** to **moderate** effect for dwellings within the 35 dB L_{A90} study area with a **moderate significance** of effect on the closest dwellings to the Proposed Wind Farm.

Table 11-18: Assessment of Littleton Wind Farm noise against noise limits

Representative Noise Monitoring location/Receptor ID	Description	Predicted L_{A90} Sound Pressure Level at 10m Standardised Wind Speed, dB					
		2 m/s	3 m/s	4 m/s	5 m/s	6 m/s	7 m/s
N1/R303	Predicted Level	24.0	24.1	25.6	27.9	30.7	31.9
	Daytime limit	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
	Night-time Excess	-	-	-	-	-	-
N2/R193	Predicted Level	24.3	24.5	25.9	28.2	31.0	32.2
	Daytime limit	40.0	40.0	40.0	40.0	45.0	45.0
	Daytime Excess	-	-	-	-	-	-
	Night-time limit	43.0	43.0	43.0	43.0	43.0	43.0
	Night-time Excess	-	-	-	-	-	-
N3/R168	Predicted Level	27.8	27.9	29.3	31.9	34.8	36.0
	Daytime limit	40.0	40.0	40.0	40.0	45.0	45.0

Representative Noise Monitoring location/Receptor ID	Description	Predicted L_{A90} Sound Pressure Level at 10m Standardised Wind Speed, dB					
		2 m/s	3 m/s	4 m/s	5 m/s	6 m/s	7 m/s
	Daytime Excess	-	-	-	-	-	-
	Night-time limit	43.0	43.0	43.0	43.0	43.0	43.0
	Night-time Excess	-	-	-	-	-	-
N3/R248	Predicted Level	27.8	27.9	29.3	31.8	34.8	36.0
	Daytime limit	40.0	40.0	40.0	40.0	45.0	45.0
	Daytime Excess	-	-	-	-	-	-
	Night-time limit	43.0	43.0	43.0	43.0	43.0	43.0
	Night-time Excess	-	-	-	-	-	-
N3/R239	Predicted Level	29.7	29.8	31.3	33.9	36.9	38.2
	Daytime limit	40.0	40.0	40.0	40.0	45.0	45.0
	Daytime Excess	-	-	-	-	-	-
	Night-time limit	43.0	43.0	43.0	43.0	43.0	43.0

Representative Noise Monitoring location/Receptor ID	Description	Predicted L_{A90} Sound Pressure Level at 10m Standardised Wind Speed, dB					
		2 m/s	3 m/s	4 m/s	5 m/s	6 m/s	7 m/s
	Night-time Excess	-	-	-	-	-	-
N3/R134	Predicted Level	29.3	29.4	30.9	33.5	36.6	37.8
	Daytime limit	40.0	40.0	40.0	40.0	45.0	45.0
	Daytime Excess	-	-	-	-	-	-
	Night-time limit	43.0	43.0	43.0	43.0	43.0	43.0
	Night-time Excess	-	-	-	-	-	-
N4/R155	Predicted Level	26.8	27.0	28.4	30.8	33.7	34.9
	Daytime limit	40.0	40.0	40.0	40.0	40.0	45.0
	Daytime Excess	-	-	-	-	-	-
	Night-time limit	43.0	43.0	43.0	43.0	43.0	43.0
	Night-time Excess	-	-	-	-	-	-
N4/R156	Predicted Level	27.2	27.4	28.8	31.3	34.2	35.4
	Daytime limit	40.0	40.0	40.0	40.0	40.0	45.0

Representative Noise Monitoring location/Receptor ID	Description	Predicted L_{A90} Sound Pressure Level at 10m Standardised Wind Speed, dB					
		2 m/s	3 m/s	4 m/s	5 m/s	6 m/s	7 m/s
	Daytime Excess	-	-	-	-	-	-
	Night-time limit	43.0	43.0	43.0	43.0	43.0	43.0
	Night-time Excess	-	-	-	-	-	-
N4/R157	Predicted Level	27.9	28.1	29.5	32.1	35.1	36.3
	Daytime limit	40.0	40.0	40.0	40.0	40.0	45.0
	Daytime Excess	-	-	-	-	-	-
	Night-time limit	43.0	43.0	43.0	43.0	43.0	43.0
	Night-time Excess	-	-	-	-	-	-
N5/R101	Predicted Level	27.6	27.7	29.2	31.9	35.0	36.2
	Daytime limit	40.0	40.0	40.0	40.0	45.0	45.0
	Daytime Excess	-	-	-	-	-	-
	Night-time limit	43.0	43.0	43.0	43.0	43.0	43.0

Representative Noise Monitoring location/Receptor ID	Description	Predicted L_{A90} Sound Pressure Level at 10m Standardised Wind Speed, dB					
		2 m/s	3 m/s	4 m/s	5 m/s	6 m/s	7 m/s
	Night-time Excess	-	-	-	-	-	-
N5/R117	Predicted Level	27	27.1	28.6	31.2	34.3	35.6
	Daytime limit	40.0	40.0	40.0	40.0	45.0	45.0
	Daytime Excess	-	-	-	-	-	-
	Night-time limit	43.0	43.0	43.0	43.0	43.0	43.0
	Night-time Excess	-	-	-	-	-	-
N5/R1	Predicted Level	30.2	30.3	31.8	34.6	37.8	39.1
	Daytime limit	40.0	40.0	40.0	40.0	45.0	45.0
	Daytime Excess	-	-	-	-	-	-
	Night-time limit	43.0	43.0	43.0	43.0	43.0	43.0
	Night-time Excess	-	-	-	-	-	-
N5/R3	Predicted Level	30.3	30.3	31.9	34.7	37.9	39.1
	Daytime limit	40.0	40.0	40.0	40.0	40.0	45.0

Representative Noise Monitoring location/Receptor ID	Description	Predicted L_{A90} Sound Pressure Level at 10m Standardised Wind Speed, dB					
		2 m/s	3 m/s	4 m/s	5 m/s	6 m/s	7 m/s
	Daytime Excess	-	-	-	-	-	-
	Night-time limit	43.0	43.0	43.0	43.0	43.0	43.0
	Night-time Excess	-	-	-	-	-	-
N5/R67	Predicted Level	28.7	28.7	30.2	33.0	36.0	37.3
	Daytime limit	40.0	40.0	40.0	40.0	45.0	45.0
	Daytime Excess	-	-	-	-	-	-
	Night-time limit	43.0	43.0	43.0	43.0	43.0	43.0
	Night-time Excess	-	-	-	-	-	-
N6/R284	Predicted Level	22.1	22.3	23.7	25.9	28.5	29.7
	Daytime limit	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

Representative Noise Monitoring location/Receptor ID	Description	Predicted L_{A90} Sound Pressure Level at 10m Standardised Wind Speed, dB					
		2 m/s	3 m/s	4 m/s	5 m/s	6 m/s	7 m/s
	Night-time Excess	-	-	-	-	-	-

11.4.3.4 Substation Noise Assessment

Noise from the proposed substation has been assessed in line with BS4142. This standard compares the background noise with the specific noise from the source to be introduced to assess the potential for adverse impacts, as detailed in Section 11.3.3.

The nearest noise sensitive location to the substation is approximately 530m north west of the substation, at a property along the local road at Longfordpass (R299, see Figure 11-4 in Volume 4). The second nearest noise sensitive location is a property (R303) approximately 630 south east of the substation. Noise was monitored at N1, (R302). The noise monitoring location is over 360m north east of the R303. Both the noise monitoring location and R303 are located on a local road, through Longfordpass South. Background noise measured at location N1 has been used to determine the background noise at the closest location to the proposed substation location. This is considered a representative of background noise levels at the closest locations to the substation, as it is slightly farther from the M7 motorway to the north. It also represents the group of four properties at Longfordpass South east of the proposed substation.

Appendix A.11.1 summarises the baseline noise measurements for the BS4142 assessment. The daytime and night time background noise measurements ($L_{A90,\ 10min}$) have been filtered to exclude data for windspeeds above 5m/s (as BS4142 is only applicable for windspeeds up to 5m/s) and any data during which rainfall occurred. BS4142 categorises daytime as 07:00-23:00, with night time between 23:00-07:00. Note that measurements presented are for 10 minute intervals. BS4142 normally requires background periods of 1 hour during the day or 15 minutes at night. The shorter measurement period is compensated for by the fact that the measurements took place over a relatively long, survey time of three weeks.

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), representing an upper noise emission for the proposed transformer. 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 11.19. If an alternative transformer is selected this will not exceed a total sound power level of 93 dB(A) L_W:

Table 11-19: Octave Band Sound Power Level Data

Turbine	A-weighted Octave Band Centre Frequency (Hz)									Overall L_{WA}
	31.5	63	125	250	500	1000	2000	4000	8000	
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 were carried out using International Standard ISO 9613, Acoustics – Attenuation of Sound during Propagation Outdoors. A worst case scenario with plant/equipment producing their highest noise emissions has been assumed. The on-site substation transformer noise has been predicted at the closest noise sensitive location, as described above, in terms of the L_{Aeq}. The BS4142 assessment is summarised in Table 11-20. The assessment is based on the assumption that noise from the transformer is not tonal at the noise sensitive location and therefore no tonal correction or character correction is added.

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.

Table 11-20: BS4142 Assessment of Transformer Noise at nearest noise sensitive location, R299 (See Figure 11.4 and refer to Appendix 11.1 Baseline Noise measurements for BS4142 Assessment)

Results	Daytime	Night time
Residual sound level	41 dB $L_{Aeq, 10mins}$	30 dB $L_{Aeq, 10mins}$
Background sound level (when source not in operation)	36 dB $L_{A90 (10mins)}$	23 dB $L_{A90 (10 mins)}$
Reference period	1 hour	15 minutes
Specific sound level (Predicted level)	29 dB $L_{Aeq, 60mins}$	29 dB $L_{Aeq, 15mins}$
Acoustic character correction (none applied)	-	-
Rating level (no correction applied)	29 dB $L_{A90 (60mins)}$	29 dB $L_{A90 (15mins)}$s
Background sound level	36 dB $L_{A90 (10mins)}$	23 dB $L_{A90, 10mins}$
Excess of rating over background	- 7 dB	+6 dB
Ambient Sound Level	(Residual 41 dB + specific 29 dB=) 41 $L_{Aeq, 60mins}$	(Residual 30 dB + specific 29 dB=) 33 dB $L_{Aeq, 15mins}$
Results	The difference of -7dB is 12 dB below the level where there is an indication of an adverse impact (normally +5dB). The predicted noise level is low and steady in character and significantly below the existing background noise.	The difference of +6 dB is just above the level where there is an indication of an adverse impact (+5dB). However, given the context that the background noise is low (less than 30 dB L_{A90}) and the rating level is less than 35 dB $L_{Ar,T}$, an absolute limit in accordance with the guidance, is more appropriate.
Uncertainty of assessment	The uncertainty of assessment, as described above, is unlikely to change the result.	The uncertainty of assessment, as described above, is unlikely to change the result

Daytime Assessment

From the Table 11-19, during the daytime the difference in the specific level and background is significantly below the level where there is an indication of an adverse effect. The uncertainty is unlikely to affect the outcome of this assessment.

Nightime Assessment

During the nighttime the difference in noise level is 6dB above the level where there is an indication of an adverse impact. Note that BS4142 states that where the background levels are low, the context of noise needs to be considered. The predicted noise at night time is significantly below the 40 dB L_{night}, outside, specified by the World Health Organisation, and therefore there is no indication of a potential adverse effect. The uncertainty is unlikely to affect the outcome of this assessment

In summary, the substation predicted daytime and night time noise levels are **below the level** that would lead to an **adverse effect** at the closest noise sensitive location. Therefore, the substation noise is predicted to be at a level that will not lead to any adverse effects. Therefore, noise from the proposed substation has a **slight effect** that is **not significant** and **long term** in duration.

11.4.4 Decommissioning

The decommissioning works are described within Chapter 4 Description of the Development, Section 4.7 , and in general are similar to the construction phase.

On decommissioning, cranes will disassemble the above ground turbine components which will be removed off site for recycling. All the major component parts are bolted together, so this is a relatively straightforward process.

It is proposed that all internal site access tracks and turbine hard standings will be left in place. Turbine hard standings will be covered using original stripped topsoil, which would have been placed adjacent to the works area and landscaped during the construction stage, and allowed to revegetate naturally.

Leaving the turbine foundations in-situ is considered to have less of an environmental effect as to remove the reinforced concrete associated with each turbine would result in less noise being generated.

The temporary accommodation works along the TDR will not be required for the decommissioning phase as turbine components can be dismantled on site and removed using standard HGVs.

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

It is expected that the decommissioning phase will take no longer than 6 months to complete. The construction works associated with the decommissioning works, described above are less than that for the construction works and are expected to have a **slight negative** effect that is **temporary** in duration.

A detailed decommissioning plan will be agreed in advance of construction with Tipperary County Council.

11.4.5 Cumulative Noise

11.4.5.1 Cumulative Construction Noise

This section considers potential cumulative construction noise from off-site or secondary developments in conjunction with proposed Wind Farm construction noise. The projects considered as part of the cumulative effect are described in Appendix 1.2 Volume 1 of this EIAR.

Potential windfarm developments within 20km of the proposed development that have been granted planning permission but are not yet constructed have the potential to generate cumulative construction noise. The following windfarms are

- Borrisbeg Windfarm, a 7 Turbine development approximately 15km east of the proposed scheme
- Knockroe Wind Farm, a 7 Turbine development approximately 14km south of the proposed scheme
- Farranrory Wind Farm, a 9 Turbine development approximately 10km east of the proposed scheme.
- Brittas windfarm, a 12 Turbine Wind Farm approximately 12 km NW of the proposed scheme.

In addition, there is one proposed windfarm, Brisklagh windfarm a 7 Turbine Wind Farm approximately 15 km east of the proposed development. On the basis that the above listed consented windfarms, and the one unconsented windfarm are at least 10km from the proposed Wind Farm, construction noise from these, should they occur simultaneously with the construction of the proposed development will not contribute to cumulative construction noise at the site.

There are no other proposed construction sites close to the site that are due to be constructed during the construction period of the proposed windfarm and therefore no additional cumulative construction noise has been considered.

Therefore, there is no change to the noise effects identified during the construction phase of the project as detailed in Section 11.4.2.

11.4.5.2 Cumulative Operational Noise

The potential cumulative noise from wind farms has been assessed, in line with the IOA GPG which requires constructed and consented wind farms which are within 10dB of the Proposed Wind Farm are assessed. Potential cumulative noise has been considered from the following wind farms, which are within 20km of the proposed development:

- Knockroe Wind Farm, a 7 Turbine development approximately 14km south of the proposed scheme
- Farranrory Wind Farm, a 9 Turbine development approximately 10km east of the proposed scheme.
- Lisheen 1 and 2 Wind Farm, a 30 Turbine development approximately 7.5km to north of the proposed scheme.
- Lisheen 3 Wind Farm, an 8 Turbine development approximately 13km to north of the proposed scheme.
- Brukana Wind Farm, a 14 Turbine development, approximately 14km north of the proposed scheme.

- Lisdowney Wind Farm, a 4 Turbine development, approximately 19.5km north east of the proposed scheme.
- Foyle Wind Farm, a 4 Turbine development, approximately 13km east of the proposed scheme.
- Ballybay Wind Farm, a 5 Turbine development approximately 9km east of the proposed scheme.
- Cnoc Wind Farm, a 5 Turbine development within approximately 8km east of the proposed scheme.
- Graigaman (Gurteen Lower) Wind Farm, a single turbine approximately 4km east of the proposed scheme.
- Ballincurry Wind Farm, a 2 turbine wind farm, approximately 5km south east of the proposed scheme.
- Kill Hills Wind Farm, a 16 turbine development approximately 10km South west of the proposed scheme.

An initial noise model was generated, based on the Sustainable Energy Authority Ireland (SEAI) data set for wind farm locations. Where predicted noise levels were likely to be close to within 10dB of the Proposed Wind Farm these were assessed in more detail. The following adjacent wind farms were considered in the cumulative wind farm assessment.

- Lisheen 1 and 2 Wind Farm, a 30 Turbine development approximately 7.5km to north of site.
- Graigaman (Gurteen Lower) Wind Farm, a single turbine approximately 4km east of the site.
- Ballincurry Wind Farm, a 2 turbine wind farm, approximately 5km south east of the site.

The planning conditions for the above wind farms need to be considered, as these can set limits on a specific development and potential future wind farms.

For Lisheen Wind Farm, (Planning reference 14/202, KCC) Condition 11 states:

"*Condition 11 (b) During the operational phase of the proposed development, the developer shall ensure that all activities at the site shall not give rise to noise levels off-site at the nearest inhabited dwellings, which exceed the following sound pressure limits: Day: 45dB(A) LA90 (10 minutes) Night: 43dB(A) LA90 (10 minutes)* "

For Graigaman Wind Farm planning condition 12 (Planning Reference 20302, TCC) specifies:

"*The operation of the proposed wind farm shall be carried out so that noise emanating from the development when measured at the nearest noise-sensitive locations, i.e. dwelling houses, shall not exceed 43 dB(A) LA90. Tonal or impulsive qualities in the noise shall be avoided*"

For Ballincurry Wind Farm, (Planning reference 13/231, TCC, condition 6 for Turbine 1 and Ref 15/600561 and 92.245874 with condition 7 for T2) states:

Condition 6 of PL.23.243357 and Condition 7 of PL 92.245874 "*Wind turbine noise arising from the proposed development, by itself or in combination with other existing or permitted wind energy development in the vicinity, shall not exceed the greater of 5 dB()A above the background noise levels of 43 dB ()A L90,10min when measured externally at dwellings or other sensitive receptors.*"

Therefore, only the Ballincurry Wind Farm sets a noise limit that considers noise from Ballincurry Wind Farm in addition to other existing or permitted wind energy in the vicinity.

The IOAGPG states the following with respect to cumulative noise:

"*If existing windfarm has permission to generate noise levels up to ETSU-97 limits, planning permission noise limits for a future windfarm would have to be at least 10 dB lower than the permitted limit at the existing WF so that there is no potential for cumulative noise impact,*"

In determining if a cumulative impact assessment is necessary Section 5.1.4 of the IOAGPG 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.*

5.1.5 Equally, in such cases where noise from the proposed wind farm is predicted to be 10 dB greater than that from the existing wind farm (but compliant with ETSU-R-97 in its own right), then a cumulative noise impact assessment would not be necessary. "

11.4.5.2.1 Determining Sound Power for adjacent Windfarms

For Ballincurry Windfarm, under Planning Reference 15600561, the noise assessment report on the Planning Website is in Appendix 3 of the EIAR. The Table of predicted noise levels in Appendix 3 is not legible. However, the EIAR report states:

"The above map confirms that none of the predicted noise levels exceed the noise limits established in the Wind Energy Guidelines. The highest predicted noise level of 34.9 dB(A) is recorded at Property D which is well within the 35-40 dB(A) range allowed.

A subsequent Noise Survey and Assessment for Compliance report (September 2020, Brendan O'Reilly), identifies the two turbines as Enercon E92 turbines, with serrations, with a maximum sound power at 8m/s. No sound power data is provided in either report for the proposed/installed turbines. For the cumulative assessment, the sound power of the two Ballincurry turbines have been adjusted so that the predicted noise level at the closest residential location is 34.9 dB(A). Details of the sound power assumed for all turbines are summarised in Appendix 11.4.

For Graignaman Windfarm under planning reference 15600839, the Planning Report states with regards to noise "The assessment concluded that noise levels reaching the nearest noise sensitive location will comply with the limits prescribed by the Department of the Environment, Heritage & Local Government in the Wind Energy Development Guidelines (2006). The development will therefore have no appreciable impact on the aural amenity of the area"

Appendix B of the Environmental Impact Assessment Report for Graignaman summarises the Noise Impact Assessment. This states that the proposed turbine is a Vestas V47 with a sound power level of 102dB(A). The report states that a noise level of 43.02 L_{A90} is predicted at the closest noise sensitive location, which (the report states) is approximately 292m from the turbine (ITM coordinates 627753/653612). For the cumulative noise assessment the sound power of the turbine has been adjusted to generate a calculated level at the closest receptor of 43 dB L_{A90}. It is the opinion of the author that this is an overestimation of the sound power of the installed turbine, but represents a conservative assessment. Sound power details are provided for Graignaman in Appendix 11.4 of this report.

For Lisheen Wind Farm reference was made to the Environmental Impact Statement submitted under Tipperary County Council Planning Reference 06/510773. This provides sound power data for an Enercon E-82, which was the basis for the noise assessment. This is reproduced in Appendix 11.4 and has been used for the cumulative noise assessment in this report. The noise report states that "operational control measures on individual turbines will be implemented as required to mitigate noise levels at higher windspeeds. These are required on turbines numbered 6, 10, 11, 12, 13, 17 and 22. " There is no information provided in the EIAR on the noise reduction these mitigation measures might provide and therefore no mitigation has been assumed, which would represent a conservative and worst case scenario.

11.4.5.2.2 Predicted Cumulative Operational Noise

The contribution from Littleton Wind Farm is at least 10 dB below the noise from Lisheen Wind Farm at noise sensitive locations near Lisheen Wind Farm. Therefore receivers close to Lisheen Wind Farm above 35 dB L_{A90}, are not considered for cumulative noise from Littleton Wind Farm as no cumulative effect arise near Lisheen windfarm.

Lisheen Wind Farm slightly increases cumulative noise at properties immediately north of Littleton Wind Farm, but these are all outside the 35 dB contour. Note that predictions are based on downwind assumption and noise sensitive locations between Lisheen Wind Farm and Littleton Wind Farm will not be downwind of both wind farms at the same time. Potential cumulative noise from Lisheen have been considered at locations within the study area north of Littleton Wind Farm. Between Littleton Wind Farm and Graigaman Wind Farm, the noise generated by Littleton Wind Farm contributes to noise at receptors near Graigaman Wind Farm. Some locations near Graigaman Wind Farm are already above the 35 dB contour, due mainly to Graigaman Wind Farm. There are an additional 14 locations near Graignaman above the 35 dB contour due to cumulative noise from Littleton Windfarm. The highest predicted noise from Graiganman with the contribution from Littleton is 37.4. dB. The noise predictions are based on the assumption that both windfarms are downwind of the noise sensitive locations, simultaneously. Only receptors east of Graignaman can potentially be downwind of both windfarms at the same time. The results for six locations near Graigaman are presented in Appendix 11.6. However, the predicted cumulative noise levels at receptors near Graignaman are within the noise criteria specified in the planning conditions for the Graignaman Wind Farm..

Noise sensitive locations close to Ballincurry Wind Farm are above the 35 dB L_{A90} contour, mainly due to noise from Ballincurry Wind Farm. An additional two properties are predicted to be within the 35 dB L_{A90} contour due to cumulative noise from Littleton Windfarm. These properties are approximately 500m to the north of Ballincurry windfarm. However the cumulative predicted noise at these properties is 35 dB, and lower than the noise limit specified in the Ballincurry Wind Farm Planning Conditions.

Table 11-21 presents predicted noise levels at the closest locations to Littleton Wind Farm, which includes noise from the proposed development in addition to the three adjacent wind farms (Lisheen Wind Farm, Graigaman Wind Farm and Ballincurry Wind Farm). There is a slight increase in noise level at some locations, but the predicted noise levels are below both the Littleton Wind Farm noise limits, in addition to the noise limits specified within the adjacent wind farms planning conditions. Full cumulative noise predictions are presented in Appendix 11.6.

Predicted cumulative noise is presented for windspeeds at 10m/s. Predictions at lower windspeeds were not made due to uncertainty about turbine make and models as detailed in the previous section. The predictions at 10m/s should represent the highest noise levels produced by Littleton and adjacent Wind Farms. At 10m/s the highest predicted cumulative noise is less than 40 dB L_{A90}. At lower windspeeds, it would be expected that the sound power of turbines would either remain the same or decrease with windspeed and therefore cumulative noise L_{A90} would be expected to be the same or less than the predicted noise at 10m/s. Therefore, cumulative noise from the Littleton and adjacent windfarms are predicted to meet the Littleton Wind Farm Noise Limits, in addition to noise limits set out planning conditions for existing windfarms across all windspeeds.

Table 11-21: Assessment of cumulative operational noise from Lisheen Wind Farm, Ballincurry Wind Farm, Graignaman Wind Farm and Littleton Wind Farm noise against noise limits

Representative Noise Monitoring locaiton/Receptor ID	Description	10 m/s
N1/R303	Predicted Level	32.2
	Daytime limit	45.0
	Daytime Excess	-
	Night-time limit	43.0
	Night-time Excess	-
N2/R193	Predicted Level	32.6
	Daytime limit	45.0
	Daytime Excess	-
	Night-time limit	43.0
	Night-time Excess	-
N3/R168	Predicted Level	36.3
	Daytime limit	45.0
	Daytime Excess	-
	Night-time limit	43.0
	Night-time Excess	-
N3/R248	Predicted Level	36.2
	Daytime limit	45.0
	Daytime Excess	-

Representative Noise Monitoring locaiton/Recepto r ID	Description	10 m/s
	Night-time limit	43.0
	Night-time Excess	-
N3/R239	Predicted Level	38.3
	Daytime limit	45.0
	Daytime Excess	-
	Night-time limit	43.0
	Night-time Excess	-
N3/R134	Predicted Level	37.9
	Daytime limit	45.0
	Daytime Excess	-
	Night-time limit	43.0
	Night-time Excess	-
N4/R155	Predicted Level	35
	Daytime limit	45.0
	Daytime Excess	-
	Night-time limit	43.0
	Night-time Excess	-
N4/R156	Predicted Level	35.4
	Daytime limit	45.0
	Daytime Excess	-
	Night-time limit	43.0
	Night-time Excess	-
N4/R157	Predicted Level	36.4
	Daytime limit	45.0

Representative Noise Monitoring locaiton/Receptor ID	Description	10 m/s
	Daytime Excess	-
	Night-time limit	43.0
	Night-time Excess	-
N5/R101	Predicted Level	36.4
	Daytime limit	45.0
	Daytime Excess	-
	Night-time limit	43.0
	Night-time Excess	-
N5/R117	Predicted Level	35.7
	Daytime limit	45.0
	Daytime Excess	-
	Night-time limit	43.0
	Night-time Excess	-
N5/R1	Predicted Level	39.1
	Daytime limit	45.0
	Daytime Excess	-
	Night-time limit	43.0
	Night-time Excess	-
N5/R3	Predicted Level	39.2
	Daytime limit	45.0
	Daytime Excess	-
	Night-time limit	43.0
	Night-time Excess	-
N5/R67	Predicted Level	37.3

Representative Noise Monitoring locaiton/Receptor ID	Description	10 m/s
	Daytime limit	45.0
	Daytime Excess	-
	Night-time limit	43.0
	Night-time Excess	-
N6/R284	Predicted Level	30.2
	Daytime limit	45.0
	Daytime Excess	-
	Night-time limit	43.0
	Night-time Excess	-

11.5 Mitigation Measures

11.5.1 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 for most activities. Specific mitigation measures are outlined for the borrow pit area. Nonetheless, several mitigation measures will be employed to minimise any potential impacts from the proposed project, and these are considered good practice in controlling noise from construction sites.

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.

The construction works on site will be carried out in accordance with the guidance set out in BS 5228:2009+A1:2014. 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.

In terms of specific mitigation for Borrow pit activities, the construction noise limit has the potential to be exceeded at 150m from the works, assuming all plant operates at once. In terms of mitigation, a bund and noise barrier to the south of the site is required to mitigate noise from the site (see Figure 11-3). It is proposed that soil from the borrow pit excavation will be placed around the borrow pit for later re-instatement to form a bund 1m high. The combined bund/noise barrier will be required to have a minimum height of 3m above current ground level. This will require a 2m high barrier to be constructed on top of the bund. In addition to the north east of the borrow pit a 3m high combined bund/noise barrier will be installed to screen activities in the southern section of the borrow pit from properties to the north east. Again, this will comprise a 1m high bund and 2m high barrier. This bund with barrier extends between the existing disused quarry area at the centre of the borrow pit and the eastern edge of the borrow pit area. The eastern edge of the main borrow pit area will not be used simultaneously with the north west section of the borrow pit to avoid potential cumulative noise at the properties north east of the borrow pit. The bunds/barrier identified in Figure 11-3 as necessary for noise mitigation will be constructed at the start of the project and will be kept in place until the borrow pit is reinstated.

For the 1m bund with 2m barrier to the south, this is predicted to provide a noise reduction of 7 dB. With this mitigation, noise from the borrow pit is predicted to be 63 dB L_{Aeq}, at R303, which is below the daytime construction noise limit of 65dB $L_{Aeq, 1hr}$,.

For the 1m bund with 2m barrier to the northeast of the borrow, this is predicted to provide a noise reduction of 7 dB. With mitigation, noise from the borrow pit is predicted to be 58 dB L_{Aeq}, at R302, which is below the daytime construction noise limit of 65dB $L_{Aeq, 1hr}$,.

The noise barrier will have a minimum mass per unit surface area of greater than 7kg/m^2, with no gaps at the joints.

11.5.1.1 Grid Connection

As a result of grid connection works the daytime limit will be exceeded when works are passing close to properties on the road. It is recommended that screening is implemented between works and adjacent properties within 50 m of grid connection works. However, these works will be for a short duration at a particular property (i.e. typically less than 3 days).

11.5.1.2 Turbine Delivery Route

Given the nature of the Turbine Delivery Route construction works, other than the good practice measures in 11.6.1, no additional mitigation is required.

11.5.2 Operation

11.5.2.1 Wind Farm Site

The predicted noise from the Proposed Wind Farm meets the daytime and night-time noise limits at the closest locations to the Proposed Wind Farm, and therefore no mitigation is required. Section 11.6.2 details the noise monitoring that will be undertaken in the event of complaints resulting of operational Amplitude Modulation or Tonal Noise.

11.5.2.2 Grid connection

As the grid connection is underground, there is no operational noise from this aspect of the scheme.

11.5.2.3 Turbine Delivery Route

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.

11.5.3 Decommissioning

There is no specific decommissioning noise mitigation required, however, good construction site noise control measures as detailed in BS5228 1:2009+A1:2014 and Section 11.5.1 will be adopted, in addition to updated guidance at the time of decommissioning.

11.5.3.1 Wind Farm Site

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 mitigation 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 at the time of the works.

11.5.3.2 Grid Connection

For the decommissioning works associated with the grid connection, the pulling locations will be selected so they are at least 100m from adjacent properties. If the pulling location cannot be located sufficiently distant from housing, the pulling activity will be screened form the noise sensitive locations.

11.6 Monitoring

11.6.1 Construction

11.6.1.1 Wind Farm Site

During the construction phase noise monitoring will be undertaken at the closest properties south (R303) and east (R302) of the borrow pit, as shown in Figure 11.3, to confirm that the noise criteria are met at the closest properties.

11.6.1.2 Grid Connection

Given the grid connection works are of short duration, it is not proposed to monitor noise during construction works.

11.6.1.3 Turbine Delivery Route

Given the short duration of the turbine delivery route construction works and distance to residential locations, no monitoring is proposed during this phase of the works.

11.6.2 Operation

11.6.2.1 Wind Farm Site

During the operational phase of the wind farm, should any complaints arise following commissioning, the wind farm operator will undertake noise monitoring at the wind farm. The noise monitoring methodology will be agreed with the Local Authority and based on best practice. In addition, the operator will adhere to any other obligations in relation to operational noise detailed in the wind farm planning conditions. Should any non-compliance be identified, a mitigation strategy will be developed and implemented followed by an additional monitoring campaign to verify its effectiveness.

11.6.2.1.1 Operational Amplitude Modulation and Tonal Noise

Should complaints be received relating to amplitude modulation and/or tonal noise, a survey would be carried out. Criteria for the assessment of the significance of these effects will be based on best practice and agreed with the Local Authority.

Should the survey indicate a significant level of amplitude modulation and/or tonal noise, mitigation measures will be implemented. At the EIAR stage, it is not possible to specify what those mitigation measures will be, as it will depend on the sources of the amplitude modulation and/or tonal noise as well as its magnitude. However, steps which will be considered will include:

- Working with the turbine manufacturer to install physical mitigation systems
- Developing and implementing control system changes which apply specific operational modes as required.

Following the implementation of any mitigation to address amplitude modulation and/or tonal noise, a survey to verify the success of the measures will be carried out in accordance with the agreed procedure.

11.6.2.2 Grid Connection

No operational noise is anticipated from operation of the grid connection and therefore no noise monitoring is required.

11.6.2.3 Turbine Delivery Route

The turbine delivery route is only used during the construction phase.

11.7 Residual Effects

11.7.1 Construction

With the mitigation measures detailed in Section 11.5.1, the impact of the proposed construction noise will have a **slight to moderate negative effect** that is **short term**.

For the grid connection works, with the mitigation measures outlined, there is a potential of a **significant negative temporary effect** from grid connection works at 5 properties within 10m of the works.

With mitigation, with screening of noise during use of the hydraulic breaker or circular saw, properties within 55m of the grid connection construction works, are expected to have a **slight to moderate negative temporary effect** at 235 properties. Above 50m from grid connection works, without mitigation, there is expected to be a **slight to moderate negative temporary effect** at noise sensitive locations.

11.7.2 Operation

No mitigation is proposed to control operational noise from the wind farm site. Based on the predicted noise levels, a new noise source will be introduced into the acoustic environment and it is expected that there will be a **long term slight** to **moderate** effect for dwellings within the 35 dB L_{A90} study area with a **moderate** significance of effect on the closest dwellings to the Proposed Wind Farm.

No mitigation is proposed for the substation. Operational noise from the substation is predicted to be below the level that would lead to an adverse effect.

11.7.3 Decommissioning

No specific mitigation is proposed and the impact during the decommissioning phase is anticipated to be less than during the construction phase. The impact of decommissioning works is anticipated to have a **slight** effect that is **short term**.

11.8 Major Accidents

The proposed scheme has been examined with respect to potential noise impact from major accidents and natural disasters. This relates to:

- flooding
- fire
- major incidents involving dangerous substances
- catastrophic events

Should a major accident or natural disaster occur, the potential noise impact is limited to emergency vehicles using local roads near the site and travelling at higher speeds with emergency sirens. There is no anticipated difference in relation to operation noise impacts from major accidents and natural disasters.

11.9 References

1. British Standards, BS 5228:2009+A1:2014: Code of Practice for Noise and Vibration Control on Construction and Open Sites. Part 1 -Noise and Part 2: Vibration.

2. UK Institute of Acoustics', Good Practice Guide to the Application of ETSU-R-97 for the Assessment at Rating of Wind Turbine Noise and supplementary notes, 2013.

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

4. British Standards, BS4142 2014+A1:2019, Methods for rating and assessing industrial and commercial sound.

5. British Standards, BS6472 2008, (both parts) Guide to evaluation of human exposure to vibration in buildings.

6. Oerlemans et al. (2007) 'Location and quantification of noise sources on a wind turbine', Journal of Sound and Vibration

7. UK Department of Trade and Industry (DTI), ETSU-R-97, the Assessment and Rating of Noise from Wind Farms, 1996

8. 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, Report for Renewable UK, December 2013

9. Procedure for the assessment of low-frequency noise complaints, October 2009, The Journal of the Acoustical Society of America, University of Salford

10.. Guidance Note on Noise Assessment of Wind Turbine Operations at EPA Licensed Sites (NG3), 2011

11. Institute of Acoustics, (IOA) Noise Working Group (Wind Turbine Noise), Amplitude Modulation Working Group, A Method for Rating Amplitude Modulation in Wind Turbine Noise (Final Report), 9 August 2016 Version 1

12. "A Review of Noise Guidance for Onshore Wind Turbines", WSP, September 2023, Department for Business, Energy & Industrial Strategy

13. Wind Energy Ireland (WEI) position paper on Amplitude Modulation Planning Conditions, October 2025

14. The Measurement of Low Frequency Noise at Three UK Windfarms, Department of Trade and Industry, 2006

15. Bowdler et al. (2009). Prediction and Assessment of Wind Turbine Noise: Agreement about relevant factors for noise assessment from wind energy projects. Acoustic Bulletin, Vol 34 No2 March/April 2009, Institute of Acoustics

16. Environmental Protection Authority of South Australia, Infrasound levels near windfarms and in other environments, January 2013

17. . 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.

18. . Assessment and Rating of Wind Turbine Noise, Draft Guidance, UK Department of Energy Security & Net Zero, July 2025.

19. A Review of Noise Guidance for Onshore Wind Turbines Project Report, Department or Business, Energy & Industrial Strategy, October 2022.

20. . Guidelines on the information to be contained in Environmental Impact Assessment Reports, Environmental Protection Agency, May 2022

21. 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).

22. International Standard ISO 9613-2: 2024 Attenuation of sound during propagation outdoors, Part 2: Engineering method for the prediction of sound pressure levels outdoors;

23.Irish Wind Energy Association, Best Practice Guidelines for the Irish Wind Energy Industry (2012);

24. Draft Revised Wind Energy Development Guidelines (December 2019), Department of Housing, Planning and Local Government, 2019;

25. Tipperary County Development Plan 2022 – 2028, July 2022

26. Tipperary Renewable Energy Strategy 2016, Appendix 2 of County Development Plan 2022-2028, August 2022.

27. World Health Organization. Night noise guidelines for Europe. (2009)

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