FEHILY TIMONEY

DESIGNING AND DELIVERING A SUSTAINABLE FUTURE

ENVIRONMENTAL IMPACT ASSESSMENT REPORT FOR THE PROPOSED SHANCLOON WIND FARM, CO GALWAY

Volume 2 - Main EIAR

Chapter 8 - Noise and Vibration

Prepared for:

RWE Renewables

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8. NOISE AND VIBRATION

8.1 Introduction

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

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

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

As discussed in Chapter 2, the exact turbine make and model will be dictated by a competitive tender process, of various turbines available on the market at the time. This assessment has considered three candidate turbines, with a hub height ranging between 102.5 to 105m.

8.2 Statement of Authority

This Chapter has been prepared by Maureen Marsden. Maureen is an Acoustic Engineer with a Master of Engineering in Acoustics and Vibration and over 20 years' experience in noise and vibration assessment. Maureen Marsden is a member of the Institute of Acoustics and Engineers Ireland. Maureen Marsden was responsible for undertaking the baseline noise survey, construction and operational noise assessment and preparation of the noise and vibration chapter.

John Cullen is an Environmental & Acoustic Engineer with over seven years' experience in the assessment of noise and vibration. John Cullen has a Diploma in Acoustics and Noise Control, in addition to a post graduate diploma in Environmental Engineering and an Agri Environmental Science degree. John Cullen is a member of the Institute of Acoustics and Engineers Ireland. John Cullen was responsible for undertaking the baseline noise survey.

8.3 Description of Noise and Vibration Impacts

8.3.1 Construction Noise & Vibration

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

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

Vibration is generated by construction activities such as rock breaking, piling and passing heavy goods vehicles. British Standard 6472-1:2008 Guide to evaluation of human exposure to vibration in buildings. Vibration sources other than blasting, provides threshold values that provide vibration levels in terms of human sensitivity. This is referenced and summarised in BS 5228: Part 2:2009+A2014. Code of practice for noise and vibration control on construction and open sites –Part 2: Vibration. These standards state that the threshold of human perception of vibration is in the range of 0.14mm/s to 0.3mm/s, described as “might just be perceptible”

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

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

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

The pressed-in steel sheet piling method will be used on site. The vibration levels arising from pressed-in piling are minimal, as the process does not involve rapid acceleration or deceleration of tools in contact with the ground, but rely to a large extent on steady motions.

Vibration sensitive receptors were determined from Eircode information identifying residential properties near the site. Construction works that take place near the proposed wind turbine locations are sufficiently distant (more than 700m) and the proposed substation works (over 400m) from the vibration sensitive locations so that vibration will not be perceivable by residents at their dwellings and building damage will not occur from construction incurred vibration.

Access road construction are 35m from the closest residential location at Derrymore. The proposed Grid connection route is also at this location. Based on the vibration values set out above, works associated with the grid connection route would be expected to be below the level where building damage will not occur. The predicted vibration levels are also anticipated to be below the level that would be perceptible. Note also that if construction vehicles are using this access road during the construction phase for delivery and removal of materials, the National Road Authority states in the Guidelines for treatment of noise and vibration in national road schemes, (2004) that "It has been found that ground vibrations produced by road traffic are unlikely to cause perceptible structural vibration in properties located near to well-maintained and smooth road surfaces. The Authority does not therefore consider it necessary to set limits for vibration during the operational phase of a road scheme". Therefore, provided these access roads are maintained, vibration from vehicle movements on site are not anticipated to be perceptible at the closest properties.

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

8.3.2 Operational Noise

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 8.6.3. Noise from the proposed substation has been assessed in line with BS4142 Methods for rating and assessing industrial and commercial sound. BS4142 sets criteria for determining the likely impact of noise. The guidance in NG4 (Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities, Environmental Protection Agency, January 2016) is often used in Ireland to set noise limits for sites, although it applies to setting noise limits for licensed sites. Normally compliance with the NG4 criteria would also need to be demonstrated. NG4 does make reference to BS4142 and therefore BS4142 is considered best practice.

8.3.3 Blade Swish (Amplitude Modulation of Aerodynamic Noise)

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

As detailed in ETSU-R-97, 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 (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) 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 downwind1 of the rotor blade.

The University of Salford carried out a study (Research into aerodynamic modulation of wind turbine noise: final report, Moorhouse, AT, Hayes, M, von Hünerbein, S, Piper BJ and Adams, MD, 2007) on behalf the Department for Business, Enterprise and Regulatory Reform (BERR) to investigate the prevalence of amplitude modulation of aerodynamic noise on UK wind farm sites. The study concluded that AM has occurred at 4 out of 133 wind farms in the UK. A further investigation of the four sites by the Local Authority showed that the conditions associated with AM might occur between 7% and 15% of the time.

The more recent research into AM conducted by RenewableUK (2013, referenced above) focused on the less understood 'Other AM or OAM' where reported incidents are relatively limited and infrequent but is a recognised phenomenon. However, the occurrence and intensity of Other AM is specific to a location and its likelihood of occurrence cannot be reliably predicted.

Section 6 of this study 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.'

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

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

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

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

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

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

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

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.

8.3.4 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, owing 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.

8.3.5 Tonal Noise

ETSU-R-97 describes tonal noise as 'noise containing a discrete frequency component most often of mechanical origin'. Wind turbine sound can be tonal in some cases, for example if there is a defect in a turbine blade or a fault in the mechanical equipment such as the gearbox. Tonality from wind turbines is generally caused by structural resonances in the mechanical parts of the turbine and thus is highly specific not only to the turbine model but the specific components used, including tower height. However, a correctly operating wind turbine is not considered to have tonal sound emission. In the event of tonal noise being present and following establishment of the likely cause, this can be addressed by turbine manufacturers and/or operator as and when it occurs. The assessment of the wind turbine noise assumed that a tonal penalty is 0 dB and that tonal noise will not occur. Therefore no correction has been made for tonal characteristics of the wind turbine and it has been assumed that 1/3 octave band information will be obtained from the supplier to confirm that the proposed turbine is not tonal.

8.3.6 Operational 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 (ETSU (1997), Low Frequency Noise and Vibrations Measurement at a Modern Wind Farm, prepared by D J Snow) 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. BS6472 is considered best practice for evaluation of human response to vibration and is referred to in the construction noise and vibration standards BS5228)

More recently, the Low Frequency Noise Report (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.) 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 720m from the nearest turbine, the level of vibration is significantly below any thresholds of perceptibility. Vibration from the turbines is too low to be perceived at neighbouring residential dwellings.

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

8.3.7 Decommissioning Noise & Vibration

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

8.4 Methodology

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

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

8.4.1 Relevant Guidance

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

EIA Guidance:

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

Noise Modelling Standards and Technical Advice:

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

Guideline Noise Levels:

- Wind Energy Development Planning Guidelines, Department of the Environment, Heritage and Local Government (2006);
- Draft Revised Wind Energy Development Guidelines (December 2019), Department of Housing, Planning and Local Government, 2019; The final version of these guidelines have never been published, and they are not considered best practice. They are discussed, but not used in this assessment as they do not reflect current best practice.
- Galway County Development Plan 2022-2028;
- Galway Renewable Energy Strategy, Appendix 1, Galway County Development Plan 2022-2028.

8.4.2 Study Area

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

The operational noise study area includes all residential dwellings with a predicted noise level greater than 35 dB LA90 (which is the lowest limit prescribed in the 2006 Department of the Environment, Heritage, and Local Government, Wind Energy Development Guidelines). The study area is also in accordance with the UK Institute of Acoustics', A Good Practice Guide to the Application of ETSU-R-97 for the Assessment at Rating of Wind Turbine Noise (2013) whereby the guidance document defines the study area as "the area within which noise levels from the proposed, consented and existing wind turbine(s) may exceed 35dB LA90 at up to 10 m/s wind speed."

As discussed in Chapter 2, the exact turbine make and model will be dictated by competitive process. A turbine range has been assessed in this chapter in line with An Bord Pleanála's design flexibility opinion made on 13th June 2025 (case ref. ABP-321495-24) i.e. a hub height range of 102.5 m to 105 m has been considered in this assessment.

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." The proposed and operational windfarms (operational Cloonlusk Wind Farm and proposed Laurclavagh and Clonberne Windfarms), close to the proposed Shancloon windfarm would not be expected to contribute to noise at noise sensitive locations, and therefore cumulative noise from these) has not been considered in defining the study area. Potential Cumulative noise during operation is discussed in more detail in Section 8.6.3. . The operational study area is presented in Figure 8.1, Volume IV. The study area includes 93 no. noise sensitive locations.

As construction, decommissioning and operational vibration have been scoped out (see Sections and 8.3.1 and 8.3.6) there is no requirement to set study areas for each.

8.4.3 Evaluation Criteria

8.4.3.1 Construction and Decommissioning 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 ABC method considers existing ambient noise levels and is therefore considered suitable for setting construction noise criteria within a rural area, where the ambient noise levels are relatively low. The threshold limit to be applied (as defined in Table 8.1) is dependent on the existing ambient noise levels (rounded to the nearest 5dB).

The construction and decommissioning noise criteria represent current best practice. The decommissioning noise criteria will also consider up to date noise guidance applicable at the time of decommissioning works.

Table 8-1: Threshold of Potential Significant Effect during Construction and Decommissioning

Threshold value period (LAeq)	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/decommissioning 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 LAeq. The nearest residential dwellings to the proposed development are afforded Category A designation (65 dB LAeq,1hr during daytime periods).

Section 8.5.2 provides the detailed assessment of construction activity in relation to this site.

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

8.4.3.2 Wind Farm Operational Noise Criteria

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

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

Currently Galway County Development Plan 2022-2028 policy objective Local Authority Renewable Energy Strategy (LARES), CC6 policy is:

"To support the implementation of the Renewable Energy Strategy contained in Appendix 1 of the Galway County Development Plan to facilitate the transition to a low carbon county…….

The Galway LARES, (Appendix 1 of the Galway County Development Plan 2022-2028), states:

"Other common constraints are limits due to noise, shadow flicker and setback distances from homes. These constraints are addressed through the national Wind Energy Guidelines."

The Appendix identifies area open to consideration for windfarms, which includes Shancloon.

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

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

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

In general, a lower fixed limit of 45 dB(A) or a maximum increase of 5dB(A) above background noise at nearby noise sensitive locations is considered appropriate to provide protection to wind energy development neighbours. However, in very quiet areas, the use of a margin of 5dB(A) above background noise at nearby noise sensitive properties is not necessary to offer a reasonable degree of protection and may unduly restrict wind energy developments which should be recognised as having wider national and global benefits. Instead, in low noise environments where background noise is less than 30 dB(A), it is recommended that the daytime level of the LA90,10min of the wind energy development noise be limited to an absolute level within the range of 35-40 dB(A).

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

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

Where background noise is less than 30 dB(A), an absolute level within the range of 35-40 dB(A) is applicable. However, there is no appropriate approach in relation to the identification of low noise environments "where background noise is less than 30dB(A)" nor is there details on the application of "an absolute level within the range of 35-40 dB(A)." In the absence of detailed guidance from the Wind Energy Development Guidelines 2006, on what range of 35-40 dB to use, we have referred to guidance from ETSU-R-9-72 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 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 widely accepted by noise experts in Ireland. The final version of this document has not been published, at this time. In assessing the draft Guidelines, the WHO 45 dB Lden noise criterion was considered. The WHO document is based on a very limited data set, which only estimated the Lden for the sites studied, rather than assessing it directly from wind statistics. Furthermore, the WHO recommendation is "conditional".

The guidelines also state… "it may be concluded that the acoustical description of wind turbine noise by means of Lden or Lnight may be a poor characterization of wind turbine noise and may limit the ability to observe associations between wind turbine noise and health outcomes." A conditional recommendation, before it becomes folded into any legislative context, would require substantial debate of stakeholders (such as, but not limited to the Public, government bodies, wind farm developers and operators as well as turbine manufacturers). A conditional recommendation is based on low quality evidence that this chosen noise level is effective. Therefore, the WHO recommendations are not currently accepted as best practice for Wind Turbine noise.The best practice guidance contained in ETSU-R-97 together with the detailed guidance contained in the Institute of Acoustics 'A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise' (May 2013) and its six supplementary guidance notes haves been considered and applied to ensure a robust and best practice approach to the assessment.

8.4.4 Substation Operational Noise: BS4142 Methodology

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

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

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

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

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

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

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

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

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

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

8.4.5 Technical difficulties or limitations

There are a number of factors that can affect the results of the measurement survey. These include variability of the acoustic environment over time due to varying noise sources, range of weather conditions. The noise survey was conducted over the period of time recommended by the IOA good practice guide, as discussed in Appendix 8.1. As detailed in Appendix 8.1, the night time baseline at two of the monitoring locations was affected by the noise floor of the equipment which was different for different periods of measurement. However this did not affect the night time noise limit at these locations.

In terms of uncertainty in calculations, the prediction methodologies used are validated prediction methodologies BS5228 for construction noise and ISO9613 for operational noise predictions. Operational noise predictions have assumed worst case weather conditions (10◦C and 70% humidity), as specified by the IOA GPG. Also a turbine uncertainty of 2dB has been used in turbine operational predictions, as specified by the IOA GPG. The only difficulty encountered in the baseline survey was the change in baseline at two measurement locations outlined above and Appendix 8.1 Baseline Noise Measurements. This did not affect the night time noise limit at these locations. No other difficulties were identified that would affect this assessment.

Also there is a potential for uncertainty in the operation or sound emission characteristics of the specific sound source and any assumed power levels. Sound power data used for the turbine operational calculations have included a 2 dB uncertainty. As one-third octave band information was not available at the time of the calculations and no tonal correction has been made, as detailed in description of the calculation methodology.

8.4.6 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, May 2022'. The EPA guidelines do not quantify the impacts in decibel terms. In absence of such information, reference is made to relevant standards and guidance documents noise limits. If the predicted impact from the construction or operational phase are below the respective noise limits, it is considered that no significant effect occurs.

For this assessment, it has been assumed that dwellings have a medium to high sensitivity. This is on the basis that the properties are residential. A non permanent residence, such as a hotel, might be considered as having less sensitivity to noise. Table 8.2 presents the impact significance criteria from the EPA guidelines:

Table 8-2: Impact Significance Criteria

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

8.4.7 Consultation Requirements

A summary of the consultation process for this project is detailed in Chapter 5 Scoping and Consultation of this EIAR. The issues raised with respect to noise are summarised below.

Consultation with Transport Infrastructure Ireland (TII) requested the following be considered with respect to noise (see Scoping and Consultation Chapter Section 5.2:

"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., NRA, 2004))."

Section 5.2.2 of Chapter 5 of this EIAR, summarises consultation with County Councils.

Galway County Council requested that the EIAR should have regard to the 2019 Draft Wind Energy Guidelines.

Mayo County Council had the following requests with regard to noise:

- As stated in Chapter 5, "The Council stated that they require great consideration to be given to potential noise ………. as well as any haul route within Mayo….with regard to the Proposed Development. "
- the EIAR noise assessment should have regard to the 2019 Draft Wind Energy Guidelines.
- The EIAR should provide a robust assessment of aspects such as noise, shadow flicker and visual impact.

The TII recommendation is that the EIAR should consider the Environmental Noise regulations 2006, which is a requirement for noise mapping of transportation and industrial sources. Noise is predicted in line with current methodology for industrial noise ISO 9613. It is noted that the noise criteria for Wind farms are generally significantly lower than that for industrial facilities.The County Council requests both refer to the 2019 Draft Wind Energy Guidelines. The final version of these have never been issued and are not considered best practice issued as discussed in more detail in section 8.4.3.2. Therefore the current assessment is based on the current 2006 WEDG guidelines.

Potential construction noise from the proposed turbine delivery route is addressed in Section 8.6.2.

8.5 Existing Environment

Baseline noise monitoring was undertaken at twelve receptor locations surrounding the proposed Shancloon 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 LA90 study area as described in Section 8.3.2 and Figure 8.1 was reviewed to determine receivers to be considered for noise monitoring. Permission to access the noise measurement locations was arranged by the applicant, with Fehily Timoney & Company setting up the noise monitoring equipment. Baseline noise data was collected at the twelve locations, shown in Figure 8.2, Volume IV and details of the noise monitoring locations are presented in Table 8.3. The rationale for the selection of these monitoring locations is described in Appendix 8.1 which presents details on the baseline measurements and data analysis.

Table 8-3: Noise monitoring location details

Location ID	ITM Easting	ITM Northing	Description	Photograph* (see Appendix 7.1)
N1	533526	756517	Located north of proposed wind farm in front garden of dwelling adjacent to local road.	Plate 7.1-1*
N2	534984	756026	Located in rear garden of dwelling adjoining agricultural lands. North-east of proposed wind farm.	Plate 7.1-2*
N3	535647	754932	Located east of proposed wind farm, within curtilage of dwelling adjoining agricultural lands and stables.	Plate 7.1-3*

Location ID	ITM Easting	ITM Northing	Description	Photograph* (see Appendix 7.1)
N4	534240	753750	Located southeast of proposed windfarm in agricultural field approximately 20m from farm dwelling. Positioned away from trees and agricultural machinery/sheds.	Plate 7.1-4*
N5	532749	753685	Located south of proposed windfarm, in side garden of dwelling set back approximately 10m from local road.	Plate 7.1-5*
N6	532083	753732	Positioned in agricultural field approximately 10m from façade of landowner dwelling on working farm.	Plate 7.1-6*
N7	532179	752681	Located south of proposed windfarm on raised garden within curtilage of dwelling of working farm.	Plate 7.1-7*
N8	530831	753314	Southwest of proposed windfarm on grass area/side garden of dwelling approximately 20m from dwelling façade.	Plate 7.1-8*
N9	533030	754906	At edge of gravel driveway approximately 15m from dwelling, adjacent to agricultural fields and set back from public road with clear line of site to proposed turbines.	Plate 7.1-9*
N10	532159	755038	Northwest of proposed windfarm positioned within rear garden of farm dwelling with mature treeline present. Approximately 15m from dwelling and set back from trees.	Plate 7.1-10*
N11	532362	755760	Located northwest of proposed windfarm in rear garden of farm dwelling adjacent to working farm	Plate 7.1-11*
N12	532959	756712	North of proposed windfarm within curtilage of dwelling approximately 20m from façade and adjacent to public road.	Plate 7.1-12*

*Photographs provided in Appendix 8.1

8.5.1 Analysis of the Background Noise Data

The raw background LA90 noise data was reviewed to determine whether there are any periods of non-consistent noise level owing to equipment malfunction. Any inconsistent data points were removed from the raw noise level data. The raw noise level data was then correlated with the time synchronised 10 m standardised wind speed, based on a hub height of 105m, and rainfall data. Periods of data affected by rainfall, 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 8.1 presents the results of the data analysis.

The prevailing daytime amenity noise levels at the twelve noise monitoring locations are presented in Table 8.4. The derived prevailing background noise polynomial curve was not extended beyond the range covered by adequate data points. Where a noise limit is required at higher wind speeds; it was restricted to the highest derived point.

In general the background noise measured across the site was similar, and this is reflected in the derived noise limits, discussed in section 8.4.2. Location N3, was slightly quieter. This location represents three properties east of the site, on Cloonaglasha Road, which runs through the Shancloon bog area, but is not a through road. Locations N7 and N10 reached 30dB at 6m/s and again this is reflected in the noise limits in the following section.

Table 8-4: Prevailing Background Noise during Daytime Periods (105m hub height)

Location	Prevailing Background Noise LA90,10min (dB) at Standardised 10 m Height Wind Speed (m/s)										
	2	3	4	5	6	7	8	9	10	11	12
N1	25.9*	25.9*	25.9	26.5	27.9	30.1	33.1	36.9	41.6	47	53.2
N2	24.3	24.7	25.5	26.7	28.3	30.3	32.7	35.5	38.6	42.2	46.1
N3	22.5	23.1	24.1	25.4	27.1	29.2	31.6	34.4	37.5	41	44.9
N4	23.3	23.9	24.9	26.4	28.4	30.8	33.8	37.2	41.2	45.6	50.5
N5	23.3	24	25.2	26.8	29	31.6	34.8	38.4	42.5	47.1	52.3
N6	23.8*	23.8	24.5	25.8	27.9	30.6	34.1	38.3	43.2	48.7	55
N7	25.9	26.4	27.4	29.1	31.3	34.3	37.8	41.9	46.7	52.1	58.1
N8	25.6	25.8	26.5	27.9	29.9	32.5	35.7	39.6	44.1	49.2	49.2§
N9	24.5*	24.5	24.9	26.1	28.1	31	34.6	39	44.2	50.2	57.1
N10	24.4	25.7	27.3	29.3	31.5	34	36.8	39.8	43.2	43.2§	43.2§
N11	25.5*	25.5	25.6	26.5	28.4	31.1	34.7	39.1	44.5	50.7	57.8
N12	25.7*	25.7	26.2	27.1	28.4	30.2	32.5	35.2	38.4	42.1	46.2

§ - noise level restricted to the highest derived point
* - noise level restricted to lowest derived point

Table 8-5: Prevailing Background Noise during Nighttime Periods (105m hub height)

Location	Prevailing Background Noise LA90,10min (dB) at Standardised 10 m Height Wind Speed (m/s)										
	2	3	4	5	6	7	8	9	10	11	12
N1	21.6*	21.6	21.6	22.6	24.4	27.1	30.6	35.0	40.3	46.5	53.6
N2	18.6	18.7	19.4	20.8	22.7	25.3	28.4	32.2	36.6	41.5	47.1
N3	17.0	17.3	18.2	19.7	21.7	24.4	27.8	31.7	36.2	41.3	47.1
N4	16.4	16.7	17.8	19.7	22.3	25.7	29.9	34.8	40.5	47.0	54.2
N5	16.4	17.2	18.7	20.8	23.7	27.3	31.6	36.6	42.3	48.7	55.8
N6	23.8*	23.8	24.5	25.8	27.9	30.6	34.1	38.3	43.2	48.7	55.0
N7	17.3	18.0	19.4	21.6	24.6	28.5	33.1	38.6	44.8	51.9	59.8
N8	17.4	17.5	18.5	20.4	23.2	26.9	31.4	36.9	43.3	50.5	58.7
N9	19.6*	19.6	19.9	21.2	23.5	26.8	31.2	36.6	43.0	50.4	58.8
N10	16.5	17.4	19.1	21.8	25.3	29.8	35.2	41.4	48.6	48.6§	48.6§
N11	19.9	20.2	21.3	23.1	25.8	29.2	33.4	38.4	44.2	50.8	58.2
N12	19.4*	19.4	19.8	20.9	22.7	25.2	28.3	32.2	36.8	42.1	48.1

§ - noise level restricted to the highest derived point
* - noise level restricted to lowest derived point

8.5.2 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 LA90 applies during night-time periods. In this case a limit of 43 dB LA90 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 LA90. There is no advice within the guidelines on how to choose the noise limit from within this range. For this project for low noise areas (<30 dB LA90) a limit of 40 dB LA90 has been adopted. There is no further detail provided within the guidance on which to determine how the appropriate noise limit be derived as stated previously above. However, the guidelines state… "An appropriate balance must be achieved between power generation and noise impact." Reference has also been made to planning permissions for adjacent wind farms. Finally, reference is also made to ETSU-R-97 which recommends that the following three factors be considered when determining the fixed limit:

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

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

The first factor to be considered is the "Number of dwellings in neighbourhood of the wind farm". ETSU-R-97 describes this factor as balancing the benefits from a wind energy project with the local environment impact, "The more dwellings that are in the vicinity of a wind farm the tighter the limits should be as the total environmental impact will be greater. Conversely if only a few dwellings are affected, then the environmental impact is less and noise limits towards the upper end of the range may be appropriate." The number of noise sensitive locations (includes planning permissions) within the 35dB LA90 study area is 93. A noise limit of 40 dB LA90 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, as detailed in section 8.7.2. Since this project is considered to have merit in assisting Ireland in meeting its renewable energy targets, the upper end of the limit range is appropriate.

The final ETSU factor relates to the duration and level of exposure. The prevailing background noise levels are described in detail in Section 8.4.1 and Appendix 8.1.

In terms of the location of the properties within the study area, as the proposed windfarm is located across a wide area, there are properties located in all directions from the proposed windfarm. To the east and north east of the site, there are properties in the study area. The main population is along roads that run north south of the centre of the proposed development in the townlands of Toberoe and Beag More.

The noise limit of 40 dB L_{A90} for daytime limit in low noise environments is consistent with limits applied to windfarms in the area, in addition to limits applied by An Bord Pleanala to windfarm developments.

Table 8-6: Prevailing Daytime and Nightime noise levels

Location	Period	Prevailing Background Noise LA90,10min (dB) at Standardised 10 m Height Wind Speed (m/s)										
		2	3	4	5	6	7	8	9	10	11	12
N1	Daytime	25.9*	25.9	25.9	26.5	27.9	30.1	33.1	36.9	41.6	47	53.2
	Night-time	21.6*	21.6	21.6	22.6	24.4	27.1	30.6	35.0	40.3	46.5	53.6
N2	Daytime	24.3	24.7	25.5	26.7	28.3	30.3	32.7	35.5	38.6	42.2	46.1
	Night-time	18.6	18.7	19.4	20.8	22.7	25.3	28.4	32.2	36.6	41.5	47.1
N3	Daytime	22.5	23.1	24.1	25.4	27.1	29.2	31.6	34.4	37.5	41	44.9
	Night-time	17.0	17.3	18.2	19.7	21.7	24.4	27.8	31.7	36.2	41.3	47.1
N4	Daytime	23.3	23.9	24.9	26.4	28.4	30.8	33.8	37.2	41.2	45.6	50.5
	Night-time	16.4	16.7	17.8	19.7	22.3	25.7	29.9	34.8	40.5	47.0	54.2
N5	Daytime	23.3	24	25.2	26.8	29	31.6	34.8	38.4	42.5	47.1	52.3
	Night-time	16.4	17.2	18.7	20.8	23.7	27.3	31.6	36.6	42.3	48.7	55.8
N6	Daytime	23.8*	23.8	24.5	25.8	27.9	30.6	34.1	38.3	43.2	48.7	55
	Night-time	23.8*	23.8	24.5	25.8	27.9	30.6	34.1	38.3	43.2	48.7	55.0
N7	Daytime	25.9	26.4	27.4	29.1	31.3	34.3	37.8	41.9	46.7	52.1	58.1
	Night-time	17.3	18.0	19.4	21.6	24.6	28.5	33.1	38.6	44.8	51.9	59.8

Location	Period	Prevailing Background Noise LA90,10min (dB) at Standardised 10 m Height Wind Speed (m/s)										
		2	3	4	5	6	7	8	9	10	11	12
N8	Daytime	25.6	25.8	26.5	27.9	29.9	32.5	35.7	39.6	44.1	49.2	49.2§
	Night-time	17.4	17.5	18.5	20.4	23.2	26.9	31.4	36.9	43.3	50.5	58.7
N9	Daytime	24.5*	24.5	24.9	26.1	28.1	31	34.6	39	44.2	50.2	57.1
	Night-time	19.6*	19.6	19.9	21.2	23.5	26.8	31.2	36.6	43.0	50.4	58.8
N10	Daytime	24.4	25.7	27.3	29.3	31.5	34	36.8	39.8	43.2	43.2§	43.2§
	Night-time	16.5	17.4	19.1	21.8	25.3	29.8	35.2	41.4	48.6	48.6§	48.6§
N11	Daytime	25.5*	25.5	25.6	26.5	28.4	31.1	34.7	39.1	44.5	50.7	57.8
	Night-time	19.9	20.2	21.3	23.1	25.8	29.2	33.4	38.4	44.2	50.8	58.2
N12	Daytime	25.7*	25.7	26.2	27.1	28.4	30.2	32.5	35.2	38.4	42.1	46.2
	Night-time	19.4*	19.4	19.8	20.9	22.7	25.2	28.3	32.2	36.8	42.1	48.1
		§ - noise level restricted to the highest derived point * - noise level restricted to lowest derived point										

Table 8-7: Derived Noise Limits

Location	Period		Prevailing Background Noise LA90,10min (dB) at Standardised 10 m Height Wind Speed (m/s)									
		2	3	4	5	6	7	8	9	10	11	12
N1	Daytime	40	40	40	40	40	45	45	45	46.6	52	58.2
	Night-time	43	43	43	43	43	43	43	43	43	51.5	58.6
N2	Daytime	40	40	40	40	40	45	45	45	45	47.2	51.1
	Night-time	43	43	43	43	43	43	43	43	43	43	52.1
N3	Daytime	40	40	40	40	40	40	45	45	45	51	49.9
	Night-time	43	43	43	43	43	43	43	43	43	43	52.1
N4	Daytime	40	40	40	40	40	45	45	45	46.2	50.6	55.5
	Night-time	43	43	43	43	43	43	43	43	43	52	59.2
N5	Daytime	40	40	40	40	40	45	45	45	47.5	52.1	57.3
	Night-time	43	43	43	43	43	43	43	43	43	53.7	60.8
N6	Daytime	40	40	40	40	40	45	45	45	48.2	53.7	60
	Night-time	43	43	43	43	43	43	43	43	48.2	53.7	60.0
N7	Daytime	40	40	40	40	45	45	45	46.9	51.7	57.1	63.1
	Night-time	43	43	43	43	43	43	43	43	49.8	56.9	64.8

Location	Period	Prevailing Background Noise LA90,10min (dB) at Standardised 10 m Height Wind Speed (m/s)										
		2	3	4	5	6	7	8	9	10	11	12
N8	Daytime	40	40	40	40	40	45	45	45	49.1	54.2	54.2
	Night-time	43	43	43	43	43	43	43	43	48.3	55.5	63.7
N9	Daytime	40	40	40	40	40	45	45	45	49.2	55.2	62.1
	Night-time	43	43	43	43	43	43	43	43	48	55.4	63.8
N10	Daytime	40	40	40	40	40	45	45	45	48.2	48.2	48.2
	Night-time	43	43	43	43	43	43	43	43	53.6	53.6	53.6
N11	Daytime	40	40	40	40	40	45	45	45	49.5	55.7	62.8
	Night-time	43	43	43	43	43	43	43	43	49.2	55.8	63.2
N12	Daytime	40	40	40	40	40	45	45	45	45	47.1	51.2
	Night-time	43	43	43	43	43	43	43	43	43	43	43

8.6 Potential Impacts

8.6.1 Do Nothing Scenario

Under the Do-Nothing scenario, the proposed development is not constructed or operated. The noise environment remains largely unchanged. The area is predominantly rural with the main noise sources from road traffic and agricultural machinery. There may be more residential development over time, without the proposed scheme. In addition, the area is in an area that Galway County Council have designated as open to consideration for windfarm development. Considering both potential increased residential and potential windfarm developments, it would be expected to be a negligible increase in baseline noise over time.

8.6.2 Potential Impacts during Construction

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

Construction noise modelling is based on the details presented in Chapter 15 Traffic and Transportation 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)2. 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 time3 for plant is outlined for each of the plant items used during construction.

The construction noise model assessed all tasks with the potential to generate high noise levels. These tasks included:

- tree felling
- deliveries and/or removal of material to and from site
- preparation of access roads, preparation of hardstands and drainage
- Pressed-in steel sheet piling
- pouring of foundations
- installation of wind turbines and
- works associated with grid connection.

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

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

Site Traffic

Detailed information on construction traffic is presented in Chapter 15 (Traffic and Transportation) of this EIAR. To summarise, additional light goods vehicles travelling to and from the site during the construction phase would be expected to peak during the morning (arrival of contractors at the site) and evening (departure of contractors from the site) and are envisaged not to be a continuous source of noise emissions from the site during a typical working day. The noise impact from construction personnel movements to and from the site is expected to be low. Traffic as a result of deliveries to and from the site are addressed in later sections within the main construction activities.

All deliveries of turbine components to the site will only be by way of the proposed transport route outlined in Chapter 2 of this EIAR Description of the Proposed Development. Accommodation works associated with the Turbine Delivery Route (TDR) and provision of passing opportunities is not being sought within the current application. Therefore construction noise from potential road widening works along the TDR do not need to be considered within this EIAR. Construction noise associated with the TDR Accommodation works are limited to access road works located within the site boundary. Therefore on-site construction noise from works associated with the TDR are considered within the construction activity “Preparation of access roads, hardstands and drainage”.

The construction period is expected to take up to 24 months. The most intensive period of the works programme will be Months 8 to 10. The busiest period is when Internal access tracks, hardstanding works, preparation of turbine foundations and turbine installation works will be ongoing in parallel. The noise impact for construction works traffic will be mitigated by generally restricting movements along access routes to the standard working hours (08:00 to 19:00 Monday to Saturday) and exclude Sundays, unless specifically agreed otherwise. For example, during turbine erection and foundation pours, an extension to the working day may be required, i.e. 05:00 to 21:00, but this would be necessary only on a relatively small number of occasions. If turbine deliveries are required at night this would be subject to agreement with the relevant planning authority and it would be ensured that vehicles on local roads do not wait outside residential properties with their engines idling, and that the local residents will be informed of any activities likely to occur outside of normal working hours.

Tree Felling

Tree felling is proposed at two main locations, west of the site, west of Turbine 3 and at the access road at the north east entrance to the site. Tree felling is required to accommodate access tracks. These works will occur over a four month period at the start of the project and is likely to occur before other works commence.

Table 8-8 presents the predicted noise at the nearest dwellings, R289 located on the near the Ballinrobe Road, northeast of the site and R233, located at distances of 50m and 620m from the tree felling area, respectively. Assuming all plant associated with tree felling is operating, the predicted cumulative noise at noise sensitive location R289 is 61.7 dB LAeq,1hr. Therefore, the predicted noise at the nearest noise sensitive location is below the daytime noise limit of 65 dB LAeq,1hr. The noise associated with the felling activity is expected to have a slight impact and temporary in duration.

Table 8-8: Tree Felling- Likely Plant and Predicted Levels

Plant	BS 5228 Ref.	Activity	Percentage on-time (%)	Predicted Noise Level at R289	Predicted Noise Level at R233
Harvester §	C2.5	Harvesting trees	80	55.9	35.7
Forwarder µ	C4.53	Moving felled trees	80	56.5	36.1
Lorry *	C11.9	Transporting timber and brash off site	Two trips per hour.	49.7	55.1
Cumulative				61.7	60.6

* Drive-by maximum sound pressure level
§ - Excavator BS 5228 Ref C2.5
µ - Lorry with lifting boom – C4.53

Preparation of Access roads, Hardstands and Drainage

Table 8.9 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 (R187 and R234), approximately 35m and 90maway from one of the access roads. Assuming all construction activities required for the preparation of the access road occur simultaneously, the predicted noise level from the construction activities is 61.7 dB LAeq,1hr and 60.6 dB LAeq,1hr , respectively, which is below the 65dB LAeq,1hr noise limit. The preparation of access roads, hardstands and drainage are expected to have a slight impact and temporary in duration.

Table 8-9: Preparation of Access roads, Hardstands and Drainage - Likely Plant and Predicted Levels

Plant	BS 5228 Ref.	Activity	Percentage on-time (%)	Predicted Noise Level at R187	Predicted Noise Level at R234
Tracked excavator 25t	C2.19	Ground excavations/ earthworks	80	52.6	56.5
Articulated dump truck 23t	C2.33	Moving Fill	Maximum 92 two-way trips per day	60.3	51.7
Articulated dump truck (tipping) 23t	C2.32	Tipping Fill	20	43.1	47
Dozer (14t)	C5.12	Spread Chipping/Fill	80	51.8	55.7
Vibratory roller (3t)	C5.27	Rolling & Compaction	80	41.7	45.6
Tracked excavator 21t	C4.65	Trench for drainage	80	46.4	50.3
Cumulative				61.7	60.6

Pressed-in Steel Sheet Piling

Pressed in steel sheet piling is proposed on site at the floated access road in Cloonbar Bog. Table 8-10 presents the predicted noise levels during this activity at the nearest dwelling R215 over 400m to the south east of the raised access road. The predicted cumulative noise level at noise sensitive location R215 is 32 dB LAeq,1hr. Therefore, the predicted noise at the nearest noise sensitive location is below the daytime noise limit of 65 dB LAeq,1hr.

Table 8-10: Pressed-in Steel Sheet Piling - Likely Plant and Predicted Levels

Plant	BS 5228 Ref.	Activity	Percentage on-time (%)	Predicted Noise Level at R215
Sheet steel piling – hydraulic jacking	C3.9	Piling	100	30.9
Sheet steel piling - Power pack	C3.10	Piling	100	26.9
Cumulative				32.4

Preparation of Wind Turbine Foundations

Two options are being considered for construction of the wind turbine foundations:

- Option 1 is a gravity foundation
- Option 2 is of a Continuous Flight Augured (CFA) construction

Table 8.11 presents the likely plant required for the preparation of wind turbine foundations for Option 1. Predicted noise levels at two locations with the highest generated noise levels, R187 and R233 are presented. R187 is approximately 650m from the turbine works (closer to access track), R233 is over 2.5km from the turbine works but close to the access road (35m). The turbines where noise are predicted are Turbines 5 and Turbines 11, the closest locations to noise sensitive locations. Assuming all construction activities required for the preparation of the turbine foundations occur simultaneously, the predicted noise level from the construction activities is 62.5 dB $_{LAeq,1hr}$ at R187 and 64.7 dB $_{LAeq,1hr}$ at R233. The predicted noise levels are below the 65dB $L_{Aeq,1hr}$ noise limit. The main source of noise is from vehicle movements along the access tracks, as these are close to the noise sensitive locations. The construction works associated with the preparation of the turbine foundations are expected to have a slight impact and temporary in duration.

Table 8-11: Preparation of Wind Turbine Foundations Option 1- Likely Plant and Predicted Levels

Plant	BS 5228 Ref.	Activity	Percentage on-time (%)	Predicted Noise Level at R187	Predicted Noise Level at R233
Tracked Excavator (25t)	C2.19	Ground excavation/earthworks	80	36.4	17.4
Excavator (23t)	C10.8	Loading sand / soil	20	39.1	20
Diesel Pump	C4.88	Pump water	100	28.7	8
Mobile telescopic crane	C4.41	Lifting reinforcing steel	80	30.1	11.4
Concrete mixer truck & concrete pump	C4.32	Concrete mixer truck + truck mounted concrete pump + boom arm	100	37.7	18.6
Lorry*	C11.9	Delivery and removal of material	Maximum 92 two-way trips per day	62.5	64.4
Cumulative				62.5	64.4
* - Drive-by maximum sound level					

Table 8.12 presents the likely plant required for the preparation of wind turbine foundations for Option 2. Predicted noise levels at two locations with the highest generated noise levels, R187 and R233 are presented. R187 is approximately 650m from the turbine works (closer to access track), R233 is over 2.5km from the turbine works but close to the access road (35m). The turbines where noise are predicted are Turbines 5 and Turbines 11, the closest locations to noise sensitive locations. Assuming all construction activities required for the preparation of the turbine foundations occur simultaneously, the predicted noise level from the construction activities is 62.5 dB $_{LAeq,1hr}$ at R187 and 64.7 dB $_{LAeq,1hr}$ at R233. The predicted noise levels are below the 65dB $L_{Aeq,1hr}$ noise limit. As the main source of noise is from vehicle movements along the access tracks, as these are close to the noise sensitive locations, the choice of Option 1 or Option 2 does not change the overall predicted noise level. The construction works associated with the preparation of the turbine foundations are expected to have a slight impact and temporary in duration.

Table 8-12: Preparation of Wind Turbine Foundations Option 2- Likely Plant and Predicted Levels

Plant	BS 5228 Ref.	Activity	Percentage on-time (%)	Predicted Noise Level at R187	Predicted Noise Level at R233
Crawler mounted rig	C3.22	Operation of CFA mounted rig	100%	39.7	20.7
Tracked excavator	C3.24	Ground excavation/earthworks	100%	33.6	14.1
Concrete pump	C3.25	Pumping concrete	100%	37.7	18.4
Lorry*	C11.9	Delivery and removal of material	Maximum 92 two-way trips per day	62.5	64.4
Cumulative				62.5	64.4
* - Drive-by maximum sound level					

Installation of Wind Turbines

Turbine components will be delivered to site and a mobile telescopic crane will lift the turbine components into place. A worst case of the two cranes lifting turbine components 80% of the time is assumed along with delivery of turbine components. The predicted noise levels are presented in Table 8.13. The predicted cumulative noise level at receptor R187 is 62.5 dB LAeq,1hr and at receptor R215 is 39.7 dB LAeq,1hr The predicted noise levels are below the 65 dB LAeq,1hr noise limit. The construction works associated with the installation of the wind turbines are expected to have a slight impact and temporary in duration.

Table 8-13: Installation of Wind Turbines - Likely Plant and Predicted Levels

Plant	BS 5228 Ref.	Activity	Percentage on-time (%)	Predicted Noise Level at R187	Predicted Noise Level at R215
Mobile telescopic crane (x2)	C4.41	Lifting turbine components	80	30.3	30.9
Lorry *	C11.9	Delivery of Turbine Components	Maximum 92 two-way trips per day	62.5	39.1
Cumulative				62.5	39.7
* - Drive-by maximum sound level					

Construction of Substation

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

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

Table 8.14 presents the assumed plant required for the different construction phases of the proposed buildings to be constructed on site. The nearest occupied dwelling (R288) will be over 480m from the substation. The highest cumulative predicted noise levels for both the Site Clearance and Preparation works and the preparation of hardstanding areas is predicted to be 48.1 dB LAeq,1hr at the nearest occupied dwelling which is below the construction noise limit of 65 dB LAeq,1hr. The works associated with the construction of the substation are expected to have a slight impact and temporary in duration.

Table 8-14: Construction of Substation - Likely Plant and Predicted Levels

Phase	Plant	BS 5228 Ref.	Activity	Percentage on-time (%)	Predicted Noise Level at R288
Site Clearance and Preparation	Tracked excavator (22t)	C2.3	Earthworks/site clearance	80	43
	Tracked excavator 25t	C2.19	Earthworks/site clearance	80	42.7
	Dozer (11t)	C2.12	Ground excavation/ earthworks	80	42.2
	Loading Lorry	C10.8	Loading Sand to Lorry	80	39.5
	Cumulative				48.1
Preparation and pouring of Foundations	Concrete mixer truck + truck mounted concrete pump + boom arm	C4.32	Concrete pumping	80	40
	Lorry*	C11.9	Delivery of material	Maximum of 92 two-way trips per day	40.3
	Cumulative				43.2
Preparation of hardstanding areas	Articulated Dump Truck (23t)	C2.33	Delivery/Removal of Material	Maximum of 92 two-way trips per day	38.6
	Tracked Excavator (25t)	C2.19	Ground excavation/earth works	80	39.6
	Articulated Dump Truck (23t)	C2.32	Tipping Fill	20	30.1
	Dozer (14t)	C5.12	Spreading chipping/fill	80	38.8
	Vibratory roller (3t)	C5.27	Rolling and Compaction	80	28.7
	Lorry*	C11.9	Delivery of material	Maximum of 92 two-way trips per day	40.2
	Cumulative				45.6
Phase	Plant	BS 5228 Ref.	Activity	Percentage on-time (%)	Predicted Noise Level at R288

Erection of blockwork/ installation concrete slabs	Mobile telescopic crane (80t)	C4.39	Lifting concrete slabs	80	38.8
	Lorry* (32t)	C11.9	Delivery of material	Maximum of 92 two-way trips per day	40.2
	Cumulative				42.6
General Construction including installation of electrical and mechanical plant	Generator	C4.84	Power for site cabins	100	36.8
	Telescopic handler	C4.54	Lifting Plant	80	41.6
	Angle grinder (grinding steel)	C4.93	Miscellaneous	80	42.8
Cumulative					45.8
* Drive-by maximum sound level					

Grid Connection Works including Link between Onsite Substation

It is proposed to construct an onsite electricity substation within the proposed development site as detailed in section 2.42, Chapter 2 Description of the Proposed Development of this EIAR. The 33kV cable runs from the western most turbine to the on-site substation along internal access tracks and then onto the substation for the site. The 110kV cable runs south west of the substation as detailed in Chapter 2. Each turbine will be connected to the on-site electricity substation via underground electricity cables. The cable route will follow the proposed access tracks between each turbine. Most of the proposed grid connection route is on private lands with only a short section on public roads (see Chapter 2 – Development Description).

The likely plant required during the grid construction works are presented in Table 8.15.

Table 8-15: Grid Connection Works – Likely Plant and Predicted Noise Levels

Plant	Activity	Percentage on-time (%)	A-Weighted Sound Pressure Level, LAeq, dB			
			10m	25m	50m	100m
Road sweeper (C4.90)	Sweeping and dust suppression	10	49.5	41.6	35.6	29.6
Mini excavator with hydraulic breaker (C5.2)	Breaking Road Surface	25	78.9	71.4	65.5	59.5
Vibratory roller (C5.27)	Rolling and Compaction	50	66.3	58.6	52.6	46.6
Wheeled excavator (C5.34)	Trenching	50	69.9	62	56	50
Hand-held circular saw (petrol) (C5.36)	Cutting Concrete Slabs	10	79	71.6	65.6	59.6

Plant	Activity	Percentage on-time (%)	A-Weighted Sound Pressure Level, LAeq, dB			
			10m	25m	50m	100m
Dump truck (tipping fill) (C2.30)	Tipping Fill	10	71.8	64.1	58.1	52.1
Vibratory plate (petrol) (C2.41)	Compaction	10	72.7	65.1	59.1	53.1

Table 8.13 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. For the 33kV cable construction works, there is one dwelling within 25m of the grid connection works, and three residential properties within 50m. For the 110kv cable works, there are two properties within 10m of the works, three properties within 25m of the works and one property within 50m of the works. The noise levels presented are predicted maximum expected levels and are expected to occur for only short periods of time at a very limited number of dwellings. Given the nature of the grid connection works, construction activities will not occur over an extended period at any one location.

Mitigation measures will be employed to reduce any potential impacts. Mitigation measures are discussed in Section 8.6.1. With mitigation measures, there is potential for temporary elevated noise levels owing to the grid connection works. However, these works will be for a short duration at a particular property (i.e. typically less than 3 days) and where the works are to occur over an extended period, a temporary barrier or screen will be used to reduce noise level below the noise limit. The works are expected to have a significant temporary impact.

Potential Cumulative impacts are detailed in Section 8.5.6.4-0

8.6.3 Potential Impacts during Operation

8.6.3.1 Range of factors considered in Noise Assessment

The following sets out the range of factors that have been considered within the operational noise assessment for this project in line with the design flexibility opinion of An Board Pleanála:

- Hub heights:
    - minimum:102.5m
    - average 103.75m
    - maximum 105m.

The manufacturers sound power data of three candidate turbines are detailed in Table 8-16 and have been used for the purpose of this assessment given that these are the models available on the market which could feasibly be considered within the design range under consideration:

- Nordex 149 5.7MW
- Siemens Gamesa SG 6.6-155
- Vestas V150 5.6MW

The Nordex N149 generates the highest overall noise level, and this has been chosen as the candidate turbine for the noise assessment. The Siemens Gamesa SG155 generates the highest noise level at windspeeds of 4-6m/s. Below 4m/s, the Nordex N149 again generates the highest noise level. Therefore, within this chapter results for the Nordex N149 are presented. In addition, a summary of results for the Siemens Gamesa SG155 are presented, with full results contained within the Appendix of this chapter. The Vestas V150 does not generate the highest noise level at any windspeed of the three turbines considered. Therefore the SG155 and N149 represent the worst case scenario and therefore the V150 is not assessed here.

The hub height can change the predicted noise level and also the noise criteria derived from the background noise. The background noise data has been analysed in terms of a proposed hub height of 105m. The hub height can affect the background noise data, as the data is standardised to 10m from the hub height. The effect of changing the hub height to 102.5 was assessed to determine the effect of the height change on the prevailing noise and therefore the noise criteria. This has been undertaken in order to assess the range of parameters fully. The change in hub height did not affect the noise criteria, and therefore the baseline noise for the 105m data is presented in this chapter.

Table 8-16: Candidate turbines

		Sound Power standardised to 10m at Windspeed (m/s)						
Turbine Type	**Hub Height**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Nordex N149/5.7	**104.7**	-	94.0	95.2	99.8	104.2	105.6	105.6
Siemens Gamesa SG 6.6-155	**102.5**	92.0	92.9	97.9	102.7	105.0	105.0	105.0
Vestas V150 5.6MW	**105**	91.3	92.6	96.3	100.6	103.6	104.2	104.9

8.6.3.2 Operational Noise Predictions

Noise predictions have been carried out using International Standard ISO 9613:1996, Acoustics – Attenuation of Sound during Propagation Outdoors. The propagation model described in Part 2 of this standard provides for the prediction of sound pressure levels based on either short-term downwind (i.e. worst case) conditions or long-term overall averages. Note that ISO-9613 was update in 2024. The noise predictions are based on the ISO9613:1996 version. This was due to the fact the software for implementation of the new standard has only recently been implemented to conform with ISO 17534 Acoustics — Software for the calculation of sound outdoors Part 1: Quality requirements and quality assurance. The predictions as assessed in this report are considered a worst case scenario.

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

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

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

These factors are discussed in detail below.

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

L_W - Source Sound Power Level

The sound power level of a noise source is normally expressed in dB re:1pW. Further details on the wind turbine are provided later in this section. Sound Power Level data is presented in Appendix 8.4.

D – Directivity Factor

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

A_{geo} – Geometrical Divergence

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

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

where, d = distance from the turbine

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

Aatm - Atmospheric Absorption

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

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

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

Published values of 'α' from ISO9613 Part 14 have been used, corresponding to a temperature of 10ºC 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 8.16:

Table 8-17: Atmospheric Octave Band Attenuation coefficients, dB/m

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

A_{gr} - Ground Effect

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

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

A_{bar} - Barrier Attenuation

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

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

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

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

A_{misc} – Miscellaneous Other Effects

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

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

Predicted Noise Levels

The predicted turbine noise LAeq has been adjusted by subtracting 2 dB to give the equivalent LA90 as suggested in the IoA GPG.

Overview of Input Datasets

In order to calculate the noise levels at noise sensitive locations, an accurate representation of the source and receiver positions (See Appendix 8.3 for details) was necessary for the prediction modelling. The turbine locations are presented in Table 2.1 in Section 2.4.1.1 of Chapter 2 of this EIAR and noise sensitive locations are presented in Appendix 8.3. The closest dwellings are at least 720 m from the nearest turbine. This assessment has excluded consideration of the noise impact on a landowner property (R183) located between Turbines 1 and 4, on the basis that this property will not be occupied during operation of the proposed windfarm, in accordance with an agreement made between the developer and the relevant landowner.

As discussed above/ in the range of factors that affect the noise predictions, the Nordex 149 is the basis of the noise assessment This represents a worst case scenario at most windspeeds in terms of overall noise levels.

The Nordex 149 turbine noise data is provided at a hub height of 105m, at standardised windspeeds. . The sound power levels at standardised 10 m windspeeds for the Nordex 149 is provided below in Table 8.18 and octave band data in dB(A) presented in Tables 8.19.

Table 8-18: Wind Turbine (Nordex 149 5.7MW) Sound Power Levels, dB LWA at standardized windspeeds, 105m hub height (with trailing edge serrations)

Turbine	Standardised 10 m Height Wind Speed (m/s)						
	2	3	4	5	6	7	8 – Cut-out
Nordex149 (105m Hub height)	94	95.2	99.8	104.2	105.6	105.6	105.6
*Data from turbine supplier information.							

Table 8-19: Wind Turbine (Nordex 149 5.7MW) Octave Band Sound Power Levels, dB(A) for a range of Standardised 10m Height Wind Speeds (with trailing edge serrations) 105m hub height

Standardised 10 m Height Wind Speed (m/s)	Octave Band Level Centre Frequency in Hz							
	63	125	250	500	1000	2000	4000	8000
3	78.3	84.9	87.8	88.8	89.2	87.4	81.7	72.5
4	81.1	87.7	91.4	93.5	94.8	92.9	83.3	75.4
5	85.5	92.1	95.8	97.9	99.2	97.3	87.7	79.8
6	86.9	93.5	97.2	99.3	100.6	98.7	89.1	81.2
7	87.3	93.5	97.2	99.8	100.5	98.0	90.4	82.4
8 m/s and above	77.1	83.7	86.6	87.6	88.0	86.2	80.5	71.3

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

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

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

In addition, noise from the proposed substation has been assessed in line with BS4142. This standard a comparison of the background noise with the specific noise from the source to be introduced to assess the likely impact of noise, as detailed in Section 8.6.3.

The background noise at the nearest location to the proposed substation has been determined from the long term noise monitoring at location N8, which is east of the proposed transformer location. This is considered appropriate as it is close to a local road, and the closest properties which are east of the substation are also close to this road.

The daytime and night time background noise measurements (LA90, 10min) have been filtered to exclude data for windspeeds above 5m/s and any data during which rainfall occurred. BS4142 categorises daytime as 0700-2300, with night time between 2300-0700. Note that measurements presented are for 10 minute intervals whereas normally BS4142 requires the background period is 1 hour during the day or 15 minutes at night.

Predictions have been carried out based on an example transformer; the Siemens TLPN7747 40000 / 50000 kVA. The sound power level for the transformer is 93 dB(A). The octave band profile for the transformer has been sourced from 'An Introduction to Sound Level Data for Mechanical and Electrical Equipment' published by CED Engineering. The A-weighted octave band data is presented in Table 8.20. If an alternative transformer is selected this will not exceed a sound power level of 93 dB(A):

Table 8-20: Octave Band Sound Power Level Data

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

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

Table 8-21 summarises the basis of the BS4142 assessment of the transformer noise.

Table 8-21: BS4142 assessment of Substation Transformer Noise

Results	Daytime	Night time
Measured ambient plus predicted noise from transformer	(Residual 36 dB + specific 29 dB=) 37 $L_{Aeq, 60mins}$	(Residual 23 dB + specific 29=) 30 $L_{Aeq, 15mins}$
Residual sound level	35 dB $L_{Aeq, 60min}$	29 dB $L_{Aeq, 15min}$
Background sound level (when source not in operation)	26 dB $L_{A90\ 60mins}$	20 dB $L_{A90\ 15\ mins}$
Reference period	1 hour	15 minutes
Specific sound 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 $L_{A90, 15mins}$
Background sound level	26 dB $L_{A90, 10mins}$	20 dB $L_{A90, 10mins}$
Excess of rating over background	+3 dB	+9 dB
Results	The difference is 3dB. A difference of around 5 dB is likely to be an indication of an adverse impact, depending on the context. So the predicted level is below that which would lead to an adverse impact.	The difference is 9 dB. A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context. A difference of +5 dB is likely to be an indication of an adverse impact, depending on the context.

Results	Daytime	Night time
Uncertainty of assessment	As the difference is close to (that is 2 dB below) the 5dB criteria therefore the uncertainty of the measurement may influence the outcome of the assessment.	As the difference is just below the criteria indicating a significant adverse impact, depending on the context, the uncertainty may influence the outcome of this assessment.

From the table above, during the daytime the rating level is 3 dB above the background noise. A difference of 5 dB indicates an adverse impact, depending on the context. Therefore no adverse impact is likely during the daytime. The uncertainty of the assessment may affect the result, as detailed in BS4142 and discussed in section 8.4.5.

During the night time, the Rating level is +9 dB above the background noise level. A difference of +5 dB indicates an adverse impact, depending on the context. A difference of +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context, as outlined below.

BS4142 indicates that the initial estimate of the impact needs to be modified due to the context in the case that the absolute noise levels are low, particularly at night. BS4142 states "Where background sound levels and rating levels are low, absolute levels might be as, or more, relevant than the margin by which the rating level exceeds the background. This is especially true at night."

The current version of BS4142 does not define low noise levels that might apply during the daytime. 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 LAr,Tr. This is in agreement with other guidance such as the EPA NG4 guidance and the 2006 Wind Energy Guidelines. As the daytime background noise and the daytime rating noise level are below these values, then it is considered that an adverse impact is not likely during the daytime.

World Health Organisation Night Noise Guidelines for Europe 2009 define a noise limit for Lnight , which is the equivalent outdoor sound pressure associated with a particular type of noise during the night (at least 8 hours) a period of a year, outside. A limit of Lnight, outside of 40 dB is equivalent to the lowest observed adverse effect level (LOAEL) for night noise. The noise predicted from the transformer (29 dB) added to the ambient noise (23 dB) is 30 dB L_{Aeq}. As the transformer and ambient noise is 10 dB below the Lnight, outside of 40 dB, then there is no anticipated adverse health effect from night time operation of the proposed substation.

Based on the above assessment, no adverse impact is likely from the substation during the daytime or night time period

8.6.4 Potential Operational Impact – Predicted Noise Levels

Noise predictions were performed for the 11-wind turbine layout using the highest noise levels at each wind speed, for the proposed turbine models have been selected for a range of standardised 10m height wind speeds from 3 m/s up to 14 m/s. The highest noise level is reached at 8m/s.

Table 8.21 presents the predicted noise level for the Nordex N149 candidate turbine at 12 residential locations, which represent the locations closest to the proposed windfarm. The table also presents the nearest noise monitoring location to the residential location. The predicted noise levels at all receptor locations within the 32 dB LA90 noise contour are presented in Appendix 8.5. Note: the predicted noise levels assume that noise sensitive receptors are downwind of the proposed wind farm. In practice, receptor locations will not be downwind of all noise sources and the actual noise levels will be lower than those presented in Table 8.18 and Appendix 8.5.

Table 8.21 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 at all except for three noise sensitive locations. Location R183 is an involved landowner, located close to Turbine 1 and Turbine 4. This property is predicted to experience a noise level that exceeds the daytime noise limit by up to 5.1 dB and the night time limit by up to 3.6 dB. Locations R184 and R185 are marginally above the daytime limit at 6m/s (the limit is exceeded by 1.0 dB at R184 and by 0.3 dB at R185). These two locations are located north and centre of the proposed windfarm. Note that R183 will be vacated upon operation of the windfarm, and therefore this receiver will not be present during operation of the windfarm.

Table 8-22: Assessment of Predicted LA90 noise levels for Shancloon Windfarm for the N149 turbine

Noise Monitoring Location/Receptor ID	Description	Predicted LA90 Sound Pressure Level at 10m Standardised Wind Speed, dB					
		3 m/s	4 m/s	5 m/s	6 m/s	7 m/s	8 m/s
N1/R210	Predicted Level	27.5	28.7	33.1	37.4	38.9	39
	Daytime limit	40	40	40	40	45	45
	Daytime Excess	-	-	-	-	-	-
	Night-time limit	43	43	43	43	43	43
	Night-time Excess	-	-	-	-	-	-
N2/R226	Predicted Level	25.7	26.9	31.2	35.7	37	37.2
	Daytime limit	40	40	40	40	45	45
	Daytime Excess	-	-	-	-	-	-
	Night-time limit	43	43	43	43	43	43
	Night-time Excess	-	-	-	-	-	-
N3/R215	Predicted Level	26.6	27.8	32.2	36.6	38	38.2
	Daytime limit	40	40	40	40	40	45
	Daytime Excess	-	-	-	-	-	-
	Night-time limit	43	43	43	43	43	43
	Night-time Excess	-	-	-	-	-	-
N4/R198	Predicted Level	28.3	29.5	33.9	38.2	39.7	39.8
	Daytime limit	40	40	40	40	45	45
	Daytime Excess	-	-	-	-	-	-

Noise Monitoring Location/Receptor ID	Description	Predicted LA90 Sound Pressure Level at 10m Standardised Wind Speed, dB					
		3 m/s	4 m/s	5 m/s	6 m/s	7 m/s	8 m/s
	Night-time limit	43	43	43	43	43	43
	Night-time Excess	-	-	-	-	-	-
N5/R187	Predicted Level	29.9	31.1	35.6	39.8	41.4	41.5
	Daytime limit	40	40	40	40	45	45
	Daytime Excess	-	-	-	-	-	-
	Night-time limit	43	43	43	43	43	43
	Night-time Excess	-	-	-	-	-	-
N6/R183 (landowner)	Predicted Level	35.4	36.6	41.2	45.1	47	47.1
	Daytime limit	40	40	40	40	45	45
	Daytime Excess	-	-	1.2	5.1	2.0	2.1
	Night-time limit	43	43	43	43	43	43
	Night-time Excess	-	-	-	2.1-	4.0	4.1
N7/R217	Predicted Level	26.4	27.6	32	36.4	37.8	37.9
	Daytime limit	40	40	40	45	45	45
	Daytime Excess	-	-	-	-	-	-
	Night-time limit	43	43	43	43	43	43
	Night-time Excess	-	-	-	-	-	-
N8/R222	Predicted Level	26	27.2	31.6	36	37.4	37.5
	Daytime limit	40	40	40	40	45	45

Noise Monitoring Location/Receptor ID	Description	Predicted LA90 Sound Pressure Level at 10m Standardised Wind Speed, dB					
		3 m/s	4 m/s	5 m/s	6 m/s	7 m/s	8 m/s
	Daytime Excess	-	-	-	-	-	-
	Night-time limit	43	43	43	43	43	43
	Night-time Excess	-	-	-	-	-	-
N9/R184	Predicted Level	31	32.2	36.7	41	42.5	42.6
	Daytime limit	40	40	40	40	45	45
	Daytime Excess	-	-	-	1	-	-
	Night-time limit	43	43	43	43	43	43
	Night-time Excess	-	-	-	-	-	-
N9/R185	Predicted Level	30.3	31.5	36	40.3	41.8	41.9
	Daytime limit	40	40	40	40	45	45
	Daytime Excess	-	-	-	0.3	-	-
	Night-time limit	43	43	43	43	43	43
	Night-time Excess	-	-	-	-	-	-
N10/R196	Predicted Level	28.5	29.7	34.0	38.4	39.8	40.0
	Daytime limit	40	40	40	45	45	45
	Daytime Excess	-	-	-	-	-	-
	Night-time limit	43	43	43	43	43	43
	Night-time Excess	-	-	-	-	-	-
	Predicted Level	27.6	28.8	33.2	37.6	39	39.1

Noise Monitoring Location/Receptor ID	Description	Predicted LA90 Sound Pressure Level at 10m Standardised Wind Speed, dB					
		3 m/s	4 m/s	5 m/s	6 m/s	7 m/s	8 m/s
N11/R207	Daytime limit	40	40	40	40	45	45
	Daytime Excess	-	-	-	-	-	-
	Night-time limit	43	43	43	43	43	43
	Night-time Excess	-	-	-	-	-	-
N12/R232	Predicted Level	25.5	26.7	31	35.5	36.8	37
	Daytime limit	40	40	40	40	45	45
	Daytime Excess	-	-	-	-	-	-
	Night-time limit	43	43	43	43	43	43
	Night-time Excess	-	-	-	-	-	-

8.6.5 Potential Impacts during Decommissioning

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

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

These activities will be undertaken during daytime hours, and noise is anticipated to be no greater impact than that during the construction phase. The noise impact during decommissioning works is anticipated to have a slight impact that is temporary in duration. Noise will be controlled through the relevant guidance and standards in place at the time of decommissioning. A decommissioning plan will be agreed in advance of decommissioning works with Galway County Council.

8.6.6 Potential Cumulative Impacts

8.6.6.1 Construction Phase

Details of proposed windfarms and operational and permitted Wind Energy Developments are detailed in Chapter 2 of this EIAR Description of the Proposed Development.

Laurclavagh Windfarm is a proposed 8 turbine windfarm approximately 10.5km south east of the proposed Shancloon. Clonberne windfarm is a proposed 11 turbine windfarm over 20km northeast of the proposed Shancloon windfarm. The proposed windfarms (Laurclavagh and Clonberne Windfarms) are sufficiently distant that cumulative construction noise does not need to be considered. Should construction activities occur simultaneously with the proposed Shancloon Wind Farm, they are sufficiently distant that cumulative noise does not need to be considered.

The proposed refurbishment of the EirGrid Castlebar-Cloon 110kV overhead line is 4km east of the site at the nearest point. Should construction works occur simultaneously with the proposed Shancloon Windfarm, this is considered sufficiently distant that cumulative impacts are unlikely, on the basis that standard good practice noise control measures are adopted at both sites.

8.6.6.2 Operational Phase

Potential cumulative noise from adjacent windfarms (operational Cloonlusk Wind Farm (2 Turbine windfarm at approximately 15km) and proposed Laurclavagh (8-Turbine windfarm at 10.5km) and Clonberne Windfarm (11 turbine windfarm at over 20km) have been considered. However, on the basis that they are sufficiently distant, and are predicted to be more than 10 dB below noise from the proposed Shancloon Windfarm, operational noise will not contribute to noise at noise sensitive locations near to the proposed Shancloon Windfarm. This is based on the IOA GPG guidance which states that cumulative noise assessment from adjacent windfarms only need be considered if they generate noise within 10dB of the proposed development.

8.7 Mitigation Measures

8.7.1 Mitigation Measures During Construction

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

The noise impact for construction works traffic will be mitigated by generally restricting movements along access routes to the standard working hours (08:00 to 19:00 Monday to Saturday), unless specifically agreed otherwise. For example, during turbine base concrete pours, works may need to start earlier due to the curing process. Consultation with the local community is important in minimising the impacts and therefore any out of hours working would be agreed in advance with the local planning authority. In addition, residents will be informed of construction activities through the Community Liaison Officer.

The construction works on site will be carried out in accordance with the guidance set out in BS 5228:2009+A1:2014, and the noise control measures set out in Section 2.5.2, Chapter 2 Development Description and Appendix 2.1 Construction Environmental Management Plan (CEMP), of this EIAR.

Proper maintenance of plant will be employed to minimise the noise produced by any site operations. All vehicles and mechanical plant will be fitted with effective exhaust silencers and maintained in good working order for the duration of the project. Machinery that is used intermittently will be shut down or throttled back to a minimum during periods when not in use.

The hours of construction activity will be limited to avoid unsociable hours where possible. Construction operations shall generally be restricted to between 08:00 - 19:00 hours Monday to Saturday. However, to ensure that optimal use is made of fair-weather windows, or at critical periods within the programme, it could occasionally be necessary to work outside these hours. Any such out of hours working would be agreed in advance with the local planning authority.

The on-site construction noise levels will be below the relevant noise limit of 65 dB LAeq,1hr for operations exceeding one month, and therefore construction noise impacts are not considered to be significant. However, there is potential for temporary elevated noise levels due to the grid connection works that has the potential to affect up to 10 properties. However, the impact of these works at any particular receptor will be for a short duration (i.e. less than 3 days). Where the works at elevated noise levels are required over an extended period, greater than 3 days, at a given location, a temporary barrier or screen will be used to reduce noise levels below the noise limit where required. The noise impact will also be minimised by limiting the number of plant items operating simultaneously where reasonably practicable.

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

8.7.2 Mitigation Measures during Wind Farm Operation

The predicted operational noise from the proposed windfarm exceeds the daytime noise limit at one property, R183, at 5m/s and above. The night time limit is exceeded at R183 at 6m/s to 8m/s and above. R183 is located between T1 and T4. In addition, two further locations (R184 and R185) exceed the 40 dB daytime noise limit marginally (by up to 1 dB) at 6m/s, north and centre of the proposed windfarm. The predicted noise level at R184 and R185 are 41.0 and 40.3 L_{A90} dB, respectively. Mitigation of operational noise has not been considered for the involved landowner, R183, because the relevant property will not be occupied during the operation of the wind farm as per the agreement between the landowner and the developer. For location R184 and R185, mitigation is specified below. At all other locations the day time noise limit is met. All residential noise sensitive locations (excluding the involved landowner), meet the night time noise limits.

The Nordex 149 (and indeed all of the candidate turbines considered) has quiet modes of operation. Table 8-22 sets out the sound power for the N149 turbine for the quiet modes, used to provide mitigation. There are seventeen available quiet modes -Mode 1 to Mode 17. The mitigation required to meet the daytime noise limits is summarised in Table 8-23. The noise reducing mode, Mode 7 is required at turbines T5 and T8 and Mode Mode 8 at turbine T9, at 6m/s to meet the daytime noise limit at property R184 and R185. With this mitigation, all non-landowner properties are within the daytime noise limits for the site. The predicted noise levels with mitigation at the closest properties to the site are presented in Table 8-24. Predicted levels at all properties with mitigation are presented in the Appendix. Note that noise mitigation can be provided in different ways, and the mitigation presented here is an example of how this might be implemented for the candidate turbine. The developer is committed to providing mitigation so that the project noise limits are met.

For the second turbine that is considered (Siemens Gamesa SG155-6.6), details of predicted noise levels without noise mitigation are provided in Appendix 8.5. The noise criteria are met at all locations, with the exception of the landowner property R183, which will remain unoccupied during operation of the windfarm. Therefore no mitigation is required for the proposed SG155 candidate turbine. This conclusion is not changed for the range of turbine heights assessed, (102.5m, 103.75 and 105m). The Vestas 150 turbine has not been assessed, but the noise levels are lower and therefore no mitigation is required for this candidate turbine also.

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

Should the project be granted permission, an operational noise survey will be undertaken to ensure the project complies with the noise limits once the windfarm is operational. It has been predicted that the noise limits will not be breached with the quiet mode applied. However, in the unlikely event of an exceedance, mitigation measures will be refined to ensure compliance with the noise limits is achieved at all noise sensitive locations. In the event of an exceedance noise mitigation will be provided by running the turbines in noise reduced modes of operation. The noise level can be lessened by reducing the rotational speed of the turbines, with a resultant loss of electrical energy production.

It is not currently possible to predict AM during the planning stage and this occurs on small proportion of windfarms. Should AM be found to occur, or should complaints about AM be received post construction, a noise monitoring programme will be agreed with the Planning Authority and undertaken using the current best guidance document (The 'Reference Method' for measuring AM outlined in the IoA AMWG document), If mitigation is required at this point, mitigation measures that may be appropriate include operation of reduced modes of operation, blade pitch regulation, vortex generators or shut downs.

Table 8-23: Wind Turbine (Nordex 149) Typical Octave Band Sound Power Levels, dB(A) for a reduced modes of operation at a Windspeed of 6m/s, referenced to hub height

Standardised 10 m Height Wind Speed (m/s)	Mode	Octave Band Level Centre Frequency in Hz								
		63	125	250	500	1000	2000	4000	8000	dBA
6m/s	7	83.3	89.9	93.6	95.7	97.0	95.1	85.5	77.6	102.5
6m/s	8	73.3	83.3	89.9	93.6	95.7	97.0	95.1	85.5	102.0

Table 8-24: Noise mitigation at 6m/s (Mode 0 is the unmitigated turbine)

Noise Mitigation	
Turbine	Mode
T1	Mode 0
T2	Mode 0
T3	Mode 0
T4	Mode 0
T5	Mode 7
T6	Mode 0
T7	Mode 0
T8	Mode 7
T9	Mode 8
T10	Mode 0
T11	Mode 0

Table 8-25: Assessment of Predicted L_{A90} noise levels for Shancloon Windfarm for the N149turbine with mitigation at 6m/s

Noise Monitoring Location/Receptor ID	Description	Predicted LA90 Sound Pressure Level at 10m Standardised Wind Speed, dB					
		3 m/s	4 m/s	5 m/s	6 m/s	7 m/s	8 m/s
N1/R210	Predicted Level	27.5	28.7	33.1	36.5	38.9	39
	Daytime limit	40	40	40	40	45	45
	Daytime Excess	-	-	-	-	-	-
	Night-time limit	43	43	43	43	43	43
	Night-time Excess	-	-	-	-	-	-
N2/R226	Predicted Level	25.7	26.9	31.2	35.0	37	37.2
	Daytime limit	40	40	40	40	45	45
	Daytime Excess	-	-	-	-	-	-
	Night-time limit	43	43	43	43	43	43
	Night-time Excess	-	-	-	-	-	-
N3/R215	Predicted Level	26.6	27.8	32.2	36.3	38	38.2
	Daytime limit	40	40	40	40	40	45
	Daytime Excess	-	-	-	-	-	-
	Night-time limit	43	43	43	43	43	43
	Night-time Excess	-	-	-	-	-	-
N4/R198	Predicted Level	28.3	29.5	33.9	37.4	39.7	39.8
	Daytime limit	40	40	40	40	45	45
	Daytime Excess	-	-	-	-	-	-

Noise Monitoring Location/Receptor ID	Description	Predicted LA90 Sound Pressure Level at 10m Standardised Wind Speed, dB					
		3 m/s	4 m/s	5 m/s	6 m/s	7 m/s	8 m/s
	Night-time limit	43	43	43	43	43	43
	Night-time Excess	-	-	-	-	-	-
N5/R187	Predicted Level	29.9	31.1	35.6	38.9	41.4	41.5
	Daytime limit	40	40	40	40	45	45
	Daytime Excess	-	-	-	-	-	-
	Night-time limit	43	43	43	43	43	43
	Night-time Excess	-	-	-	-	-	-
N6/R183 (landowner)	Predicted Level	35.4	36.6	41.2	45.0	47	47.1
	Daytime limit	40	40	40	40	45	45
	Daytime Excess	-	-	1.2	5.0	2.0	2.1
	Night-time limit	43	43	43	43	43	43
	Night-time Excess	-	-	-	2.0-	4.0	4.1
N7/R217	Predicted Level	26.4	27.6	32	36.1	37.8	37.9
	Daytime limit	40	40	40	45	45	45
	Daytime Excess	-	-	-	-	-	-
	Night-time limit	43	43	43	43	43	43
	Night-time Excess	-	-	-	-	-	-
N8/R222	Predicted Level	26	27.2	31.6	35.9	37.4	37.5
	Daytime limit	40	40	40	40	45	45

Noise Monitoring Location/Receptor ID	Description	Predicted LA90 Sound Pressure Level at 10m Standardised Wind Speed, dB					
		3 m/s	4 m/s	5 m/s	6 m/s	7 m/s	8 m/s
	Daytime Excess	-	-	-	-	-	-
	Night-time limit	43	43	43	43	43	43
	Night-time Excess	-	-	-	-	-	-
N9/R184	Predicted Level	31	32.2	36.7	39.4	42.5	42.6
	Daytime limit	40	40	40	40	45	45
	Daytime Excess	-	-	-	-	-	-
	Night-time limit	43	43	43	43	43	43
	Night-time Excess	-	-	-	-	-	-
N9/R185	Predicted Level	30.3	31.5	36	38.8	41.8	41.9
	Daytime limit	40	40	40	40	45	45
	Daytime Excess	-	-	-	-	-	-
	Night-time limit	43	43	43		43	43
	Night-time Excess	-	-	-	43	-	-
N10/R196	Predicted Level	28.5	29.7	34.0	-	39.8	40.0
	Daytime limit	40	40	40	37.9	45	45
	Daytime Excess	-	-	-	45	-	-
	Night-time limit	43	43	43	-	43	43
	Night-time Excess	-	-	-	43	-	-
	Predicted Level	27.6	28.8	33.2	-	39	39.1

Noise Monitoring Location/Receptor ID	Description	Predicted LA90 Sound Pressure Level at 10m Standardised Wind Speed, dB					
		3 m/s	4 m/s	5 m/s	6 m/s	7 m/s	8 m/s
N11/R207	Daytime limit	40	40	40	36.8	45	45
	Daytime Excess	-	-	-	40	-	-
	Night-time limit	43	43	43	-	43	43
	Night-time Excess	-	-	-	43	-	-
N12/R232	Predicted Level	25.5	26.7	31	-	36.8	37
	Daytime limit	40	40	40	34.7	45	45
	Daytime Excess	-	-	-	40	-	-
	Night-time limit	43	43	43	-	43	43
	Night-time Excess	-	-	-	43	-	-

8.7.3 Mitigation Measures during decommissioning

Decommissioning works are predicted to be below the relevant noise limit of of 65 dB LAeq,1hr for construction noise. Grid connection infrastructure have been assumed to stay in situ. The noise impact during decommissioning works are expected to be slight and temporary in duration. As good practice, the noise control measures outlined in the Appendix 2.1 Construction Environmental Management Plan and in section 8.7.1 will be implemented.

8.8 Residual Impacts

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

The operational wind farm noise levels meet the daytime and night-time noise limits derived using the Wind Energy Development Guidelines 2006. As detailed in the criteria section this is considered to be a current best practice approach. The predicted noise from the proposed wind farm with mitigation, that is, operation of reduced noise modes, is below the noise limits at all noise sensitive locations. Noise predicted at the closest landowner is above the noise criteria. However this dwelling will not be occupied for the operational period of the wind farm as per the agreement between the relevant landowner and the developer. With mitigation, for receptors at the site, a new source of noise will be introduced into the soundscape and it is expected that there will be a slight to moderate significance of impact, with dwellings closest to the project with a long-term moderate significance of impact.

8.9 References

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