12. NOISE AND VIBRATION

12.1 INTRODUCTION

This chapter of the EIAR describes the assessment undertaken of the likely significant noise and vibration from the proposed project. A full description of the proposed project is provided in Chapter 2 of this EIAR.

Noise and vibration impact assessments have been prepared for the operational, construction, and decommissioning phases of the proposed project on the nearby noise sensitive locations (NSLs). To inform this assessment, baseline noise levels have been measured at eight representative NSLs surrounding the proposed wind farm site and was carried out in accordance with A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise 2013, and its Supplementary Guidance Notes 2024 (see Section 12.4.2). Noise predictions for the nearest NSLs have been prepared for all key elements of the proposed project that have the potential for noise and vibration impacts and effects in accordance with the guidance presented in this chapter.

For a glossary of terms used in this chapter please refer to Appendix 12-1.

This chapter is supported by the material presented in the following appendices:

- Appendix 12-1: Glossary of Acoustic Terms;
- Appendix 12-2: Noise Modelling Parameters;
- Appendix 12-3: Background Noise Survey;
- Appendix 12-4: LIDAR Installation Report.
- Appendix 12-5: Noise Contour Map;
- Appendix 12-6: Predicted Noise Levels;
- Appendix 12-7: Draft Noise Complaint Management Protocol

12.1.1 Statement of Authority

This chapter of the EIAR has been prepared by Miguel Cartuyvels, with input from Mike Simms and Dermot Blunnie of AWN Consulting.

Miguel Cartuyvels (Acoustic Consultant) holds a BEng (Hons) in Industrial Engineering and is an associate member (AMIOA) of the Institute of Acoustics. Miguel has worked in the field of acoustics since 2021, where he has contributed to numerous projects related to environmental surveying, noise modelling, and impact assessment for various sectors, including wind energy, industrial, commercial, and residential. Experience in environmental projects include Richfield Wind Farm, Grousemount Wind Farm Derrinlough Wind Farm, Upperchurch Wind Farm and Knockraha 220kV Celtic Interconnector Substation.

Mike Simms (Principal Acoustic Consultant) holds a BE and MEngSc in Mechanical Engineering and is a member of the Institute of Acoustics (MIOA). Mike has worked in the field of acoustics for over 20 years. He has extensive experience in all aspects of environmental surveying, noise modelling and impact assessment for various sectors including, wind energy, industrial,

commercial, and residential. Experience in wind farm projects include Ballivor Wind Farm, Bracklyn Wind Farm, Cahermurphy Wind Farm, Cleanrath Wind Farm, Curraglass Wind farm, Cloghercor Wind Farm, Derragh Wind Farm, Drumlins Park Wind Farm and many others.

Dermot Blunnie (Associate Director) holds a BEng (Hons) in Sound Engineering, MSc in Applied Acoustics and has completed the Institute of Acoustics (IOA) Diploma in Acoustics and Noise Control. He has been working in the field of acoustics since 2008 and is a member of the Institute of Engineers Ireland (MIEI) and the Institute of Acoustics (MIOA). He has extensive knowledge and experience in relation to commissioning noise monitoring and impact assessment of wind farms. He has commissioned noise surveys and completed noise impact assessments for numerous wind farm projects within Ireland including Oweninny Phase 3 Wind Farm, Garracummer Wind Farm, Meenbog Wind Farm, Lettergull Wind Farm, Ardderroo Wind Farm, Derryadd Wind Farm, Lisheen Wind Farm, Knockalough Wind Farm, Carrickaduff Wind Farm, Knockacummer Wind Farm, Derrinlough Wind Farm, Kill Hill Wind Farm, Upperchurch Wind Farm.

12.1.2 Fundamentals of Acoustics

A sound wave travelling through the air is a regular disturbance of atmospheric pressure. These pressure fluctuations are detected by the human ear, producing the sensation of hearing. To take account of the enormous range of pressure levels that can be detected by the ear, it is widely accepted that sound levels are measured and expressed using a decibel scale i.e., a logarithmic ratio of sound pressures. These values are expressed as Sound Pressure Levels (SPL) in decibels (dB).

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

The frequency of sound is the rate at which a sound wave oscillates and is expressed in Hertz (Hz). The sensitivity of the human ear to different frequencies in the audible range is not uniform. For example, hearing sensitivity decreases markedly as frequency falls below 250 Hz. To rank the SPL of various noise sources, the measured level must be adjusted to give comparatively more weight to the frequencies that are readily detected by the human ear. The 'A-weighting' system defined in the international standard, BS ISO 226:2003 Acoustics Normal Equal-loudness Level Contours has been found to provide the best correlations with human response to perceived loudness. SPLs measured using 'A-weighting' are expressed in terms of dB(A).

An indication of the level of some common sounds on the dB(A) scale is presented in Figure 12-1 below.

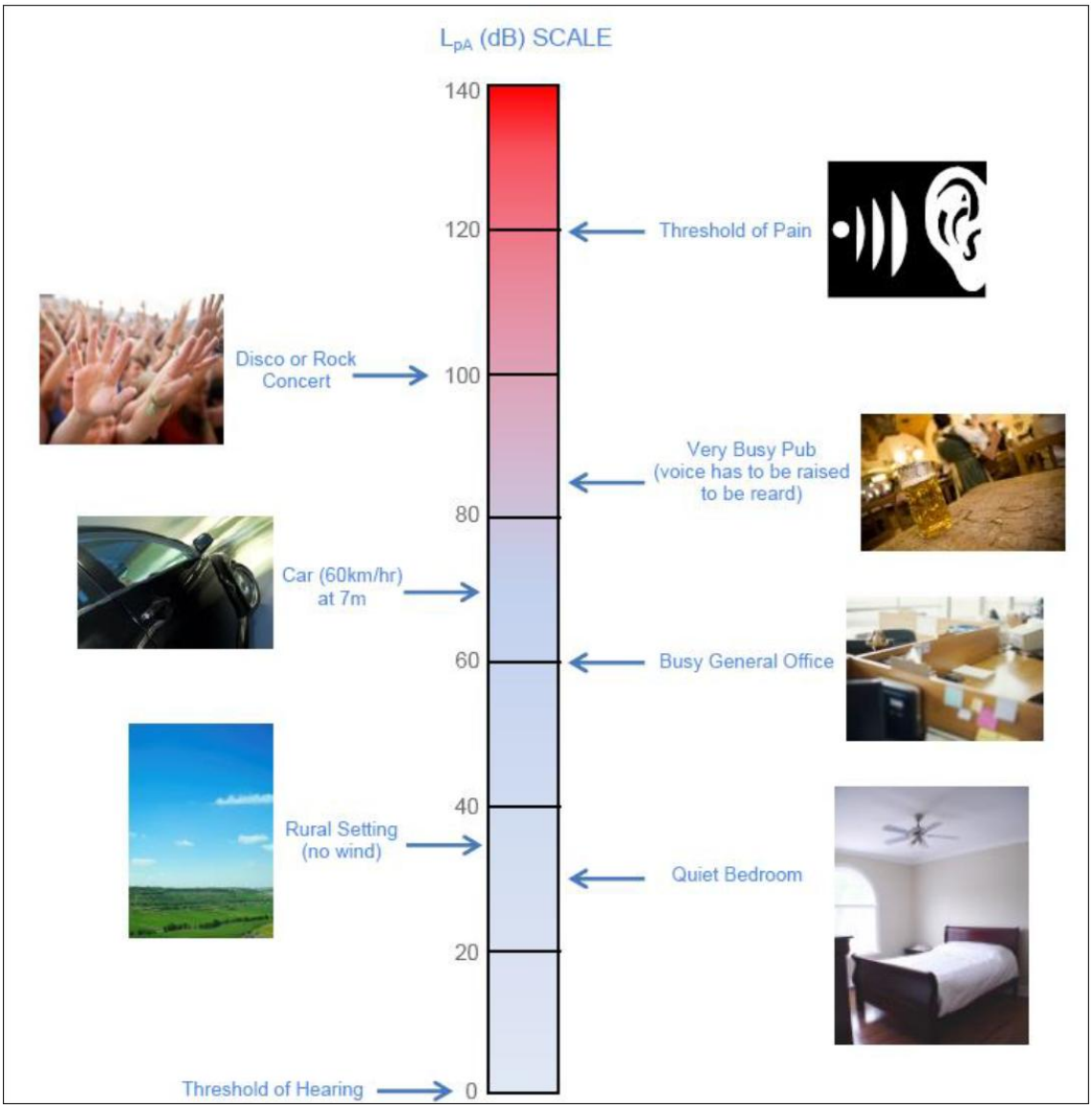


Figure 12-1: dB(A) Scale & Indicative Noise Levels – (EPA: Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4 – 2016))

12.1.3 Limitations Encountered in Compiling Information

There were no difficulties or limitations encountered when assessing the likely noise and vibration effects of the proposed project.

12.2 CONSULTATION

During the consultation process there were no concerns or issues in relation to noise raised by Local Authorities, Government Departments, Non-Governmental Organisations (NGOs) or Stakeholders that affected the assessment and preparation of the Noise and Vibration assessment for this EIAR. Refer to Chapter 1 for full details of consultations.

12.3 LEGISLATION, POLICY AND GUIDANCE

The assessment of effects for the Proposed Project has been undertaken with reference to the guidance documents that are applicable to the development and/or considered to represent best practice for the assessment of environmental noise and vibration impacts.

The following guidance documents have been consulted when preparing this chapter of the EIAR and the specific details are presented where relevant in Section 12.3.2:

- European Commission, EIA Guidance – EIA Report, 2017
- EPA Guidelines on the Information to be contained in Environmental Impact Statements, Environmental Protection Agency, 2022 (Hereafter EPA 2022);
- *Wind Energy Development Guidelines for Planning Authorities*, Department of the Environment, Heritage, and Local Government 2006 (Hereafter WEDG06);
- *The Assessment and Rating of Noise from Wind Farms*, Department of Trade, and Industry (UK) Energy Technology Support Unit 1996 (Hereafter ETSU-R-97);
- *Assessment and Rating of Wind Turbine Noise, Department for Energy Security and Net Zero (UK), (ARWTN, 2026)*;
- A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise 2013 and its Supplementary Guidance Notes 2024 (Hereafter IOA GPG);
- *Guidelines for the Treatment of Noise and Vibration in National Road Schemes*, Transport Infrastructure Ireland (TII) (formerly National Roads Authority 2004 (Hereafter TII 2004);
- *Good Practice Guidance for the Treatment of Noise during the Planning of National Road Schemes*, Transport Infrastructure Ireland (TII) (formerly National Roads Authority (NRA) 2014 (Hereafter TII 2014);
- British Standard BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise (Hereafter BS5228-1);
- British Standard BS 5228-2:2009+A1:2014 Code of practice for vibration control on construction and open sites – Vibration (Hereafter BS5228-2);
- British Standard BS 7385 – Evaluation and measurement for vibration in buildings – Part 2: Guide to damage levels from ground borne vibration BSI, 1993 (Hereafter BS7385);
- *Design Manual for Roads and Bridges* Sustainability & Environment Appraisal LA 111 Noise and Vibration Revision 2 (National England (now National Highways)) 2020 (Hereafter DMRB);
- ISO 1996: 2017: Acoustics – Description, measurement, and assessment of environmental noise (Hereafter ISO-1996:2017);
- EPA document Guidance Note for Noise Assessment of Wind Turbine Operations at EPA Licensed Sites NG3 EPA, 2011 (Hereafter NG3);
- EPA document 'Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities NG4 EPA, 2016 (Hereafter NG4);
- BS 4142:2014: Methods for rating and assessing industrial and commercial sound (Hereafter BS4142);
- Institute of Acoustics Noise Working Group (Wind Turbine Noise) Amplitude Modulation Working Group (AMWG) document *A Method for Rating Amplitude Modulation in Wind Turbine 2016* (IOA AMWG); and

- ISO 9613-2:1996 Acoustics – Attenuation of sound during propagation outdoors - Part 2: General method of calculation (ISO 9613-2, 1996); and
- ISO 9613-2:2024 Acoustics – Attenuation of sound during propagation outdoors - Part 2: Engineering method for the prediction of sound pressure levels outdoors (ISO 9613-2, 2024).

General context guidance in the following documents has also been considered but not directly applied:

- World Health Organisation (WHO) *Environmental Noise Guidelines for the European Region* 2018 (Hereafter WHO 2018);
- *Draft Revised Wind Energy Development Guidelines* 2019 Department of Housing, Local Government and Heritage (Hereafter Draft WEDG19);
- Department for Business, Energy & Industrial Strategy Wind Turbine AM Review: Phase 2 Report Project Number: 3514482A Issue: 3 Issued August 2016 (Hereafter BEIS AM Review Phase 2); and
- International Electrotechnical Commission (IEC) Technical Specification 61400-11-2 (Edition 1.0, 2024) Wind Energy Generation Systems – Part 11-2: Acoustic noise measurement techniques – Measurement of wind turbine sound characteristics in receptor position (Hereafter TS 61400-11-2).

12.3.1 Environmental Protection Agency (EPA) Description of Effects

The significance of effects of the proposed project shall be described in accordance with the EPA 2022 guidance document. Details of the methodology for describing the significance of the effects are provided in Chapter 1 of this EIAR.

The effects associated with the proposed project are described in the relevant sections of this chapter in accordance with the EPA guidance.

12.3.2 Guidance Documents and Assessment Criteria

The following sections review best practice guidance that is commonly adopted in relation to wind energy developments and confirms the proposed criteria and assessment thresholds for noise and vibration.

12.3.2.1 Construction and Decommissioning Phase – Noise

There is no published statutory Irish guidance relating to the maximum permissible noise level that may be generated during the construction phase of a project. Local authorities typically control construction activities by restricting the hours during which construction activities can take place and may consider noise limits at their discretion.

In the absence of specific noise limits, appropriate criteria relating to permissible construction noise levels can be found in the BS5228-1. This standard is commonly accepted and used in Ireland.

An approach in BS5228-1 calls for the designation of receptors into a specific category (A, B or C) based on the existing ambient noise levels at the receptor in the absence of construction noise. A threshold noise value is applied to each category. An exceedance of the construction noise threshold (CNT) at the façade of a noise sensitive location (NSL) during construction may indicate a potentially significant noise impact associated with the construction activities. The

CNT values recommended by BS5228-1 are depicted in Table 12-1. The CNT values are applicable to both construction and decommissioning noise. This assessment method is proposed for residential receptors only.

Table 12-1: Example Threshold of Potential Significant Effect at Dwelling

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

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

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

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

Note D 19:00 – 23:00 weekdays, 13:00 – 23:00 Saturdays and 07:00 – 23:00 Sundays.

The following steps are applied to implement the A B C method from BS5228-1:

For each period (e.g., daytime) the ambient noise level is determined and rounded to the nearest 5 dB. At some NSLs, particularly those located close to a busy road network, the existing ambient noise levels are expected to be relatively high. However, given the rural nature of the site in general, the measured daytime ambient noise levels are generally in the range of 30 to 55 dB $L_{Aeq,1hr}$. Therefore, for the purposes of this assessment and to adopt a conservative approach, all properties will be assigned a Category A designation, setting the initial CNT for daytime periods at 65 dB $L_{Aeq,T}$.

BS 5228-1 states that:

> *"If the site noise level exceeds the appropriate category value [the CNT], then a potential significant effect is indicated. The assessor then needs to consider other project-specific factors, such as the number of receptors affected and the duration and character of the impact, to determine if there is a significant effect."*

If the specific construction noise level exceeds the CNT, then a potential significant impact is identified. To determine the significance of effects, it is important to consider the duration and magnitude of the impacts as described in Section 12.3.2.4.2 below.

12.3.2.2Linear Construction Works

A fixed noise limit is proposed for elements of the construction that are linear and progressive in nature, including:

- The Grid Connection Route (GCR);
- Internal underground cabling; and
- Construction and upgrade of site access tracks.

This approach is deemed appropriate as noise from these activities is variable, typically short in duration, and only at its highest when closest to the NSL. As the works progress, the distance between the construction activities and the NSL increases, resulting in reduced noise levels and

a shorter duration of exposure to noise impacts. To set an appropriate fixed noise limit, reference is made to paragraph E.2, BS 5228-1.

> *General Principle:*
>
> "*Noise from construction and demolition sites should not exceed the level at which conversation in the nearest building would be difficult with the windows shut.*"

Recommended Daytime Limits (07.00 and 19.00 hours):

> "*…outside the nearest window of the occupied room closest to the site boundary should not exceed:*
>
> - 70 decibels (dBA) in rural, suburban areas away from main road traffic and industrial noise; and
> - 75 decibels (dBA) in urban areas near main roads in heavy industrial areas."

TII 2004 guidance proposes a daytime period (Monday to Friday 0700 – 1900 hrs) with a construction noise limit of 70 dB $L_{Aeq,12hr}$.

Considering the above guidance, a construction noise limit of 70 dB $L_{Aeq,12hr}$ is proposed for linear construction activities.

Noise levels above 70 dB $L_{Aeq,12hr}$ may indicate a significant impact depending on the duration and frequency of occurrence.

12.3.2.3Additional Vehicular Activity on Public Roads Construction Phase

There are no specific guidelines or limits relating to traffic-related sources along the local or surrounding roads. Given that traffic from the proposed project will make use of existing public roads already carrying traffic volumes, it is appropriate to assess the calculated increase in traffic noise levels that will arise because of vehicular movements associated with the development.

In the absence of any national guidelines in Ireland, for the assessment of potential noise impacts from construction related traffic along public roads, it is proposed to adopt guidance from DMRB. The DMRB guidance is considered appropriate and best practice as it provides a well-established, internationally recognised framework with objective criteria for assessing construction noise and vibration impacts, which align closely with eh relevant significance of effects from EPA 2022. Table 12-2 taken from DMRB offers guidance as to the likely short-term impact associated with any change in traffic noise level.

Table 12-2: Likely Impacts Associated with Change in Traffic Noise Level (Source: DMRB)

Change in Sound Level (dB $L_{A10, 18hr}$)	Magnitude of Impact	Initial Significance Rating
Less than 1.0	Negligible	Not significant
1 – 2.9	Minor	
3 – 4.9	Moderate	Significant
Greater than or equal to 5.0	Major	

The DMRB guidance will be used to assess the predicted increases in traffic levels on public roads associated with the proposed project and comment on the likely 'short-term' impacts during the construction phase. Where a major or moderate impact or an initial significance rating of 'Significant' is identified, reference will be made to the overall predicted noise level

from construction traffic in the context of the construction noise threshold values outlined in this Section 12.3.2.1.

12.3.2.4 Factors to Consider when Assessing Construction Noise Impacts

12.3.2.4.1 Interpretation of the CNT

To assist with interpretation of a predicted construction noise level (CNL), relative to the CNT, reference is made to Table 3.16 in DMRB which forms the basis of the assessment and has been adapted by AWN to include the relevant significance effects from EPA 2022 to assess the likely magnitude of impact associated with construction activities is presented in Table 12-3.

Table 12-3: Description of the magnitude of Impacts. Adapted from DMRB Table 3.16

Construction Noise Level (CNL)	Magnitude of Impact (DMRB)	Determined EPA Significance of Effect	Determination
Below or equal Baseline Noise Level	Negligible	Not Significant	Depending on range of the CNL, the baseline noise level and the duration of the impact
Above Baseline and below or equal to CNT	Minor	Slight to Moderate	
Above CNT and below or equal to CNT + 5dB	Moderate	Moderate to Significant	
Above CNT + 5dB	Major	Significant to Very Significant	

The DMRB guidance in conjunction with the EPA 2022 will be used to assess the predicted construction noise levels at NSLs and comment on the likely effects during the construction stages.

12.3.2.4.2 Consideration of Duration When Assessing Effects

Section 3.19 of DMRB states that construction noise and construction traffic noise shall constitute a significant effect where it is determined that a major or moderate magnitude of impact will occur for a duration exceeding:

- 10 or more days or nights in any 15 consecutive days or nights; or
- A total number of days exceeding 40 in any six consecutive months.

12.3.2.5 Construction Phase – Vibration

With respect to this development, the range of relevant criteria used for building protection is expressed in terms of Peak Particle Velocity (PPV) in mm/s.

In the absence of statutory Irish guidelines for the assessment of construction-related vibration, the following published standards and guidance have been considered in this assessment. These documents provide industry-recognised thresholds and assessment methodologies that align with EIAR requirements. Guidance relevant to acceptable vibration within buildings is contained in the following standards:

- BS 7385;
- BS 5228-2; and,
- TII 2004.

BS7385 states that there should typically be no cosmetic damage if transient vibration does not exceed 15 mm/s at 4 Hz rising to 20 mm/s at 15 Hz and 50 mm/s at 40 Hz and above. These

guidelines relate to relatively modern buildings and should be reduced to 50% or less for more critical buildings.

BS5228-2 recommends that, for soundly constructed residential properties and similar structures that are generally in good repair, a threshold for minor or cosmetic (i.e., non-structural) damage should be taken as a peak particle velocity of 15 mm/s for transient vibration at frequencies below 15 Hz and 20 mm/s at frequencies above 15 Hz. Below these vibration magnitudes minor damage is unlikely, although the standard notes that where there is existing damage these limits may be reduced by up to 50%. In addition, where continuous vibration is such that resonances are exceeded within structures, the limits discussed above may need to be reduced by 50%.

TII 2004 also contains information on the permissible construction vibration levels during the construction phase as shown in Table 12-4.

Table 12-4: Allowable Vibration at Sensitive Properties (TII 2004)

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

In accordance with the suggested vibration criteria discussed above from BS 7385, BS 5228-2 and TII 2004, the values in Table 12-4 are considered appropriate for this assessment as they provide a nationally recognised, conservative PPV thresholds specifically developed for Irish infrastructure and construction works, ensuring a robust and defensible assessment in the absence of statutory Irish vibration limits.

12.3.2.6 Operational Phase Noise – Wind Turbines

The noise assessment described in this chapter complies with Guidance in relation to acceptable levels of noise from wind farms as contained in Wind Energy Development Guidelines 2006 (DoEHLG, 2006) (i.e., WEDG06 hereafter). The WEDG06 guidelines are broadly in line with the recommendations set out in ETSU-R-97, which has been superseded by the ARWTN in June 2026. The ARWTN document has been used to supplement the guidance contained within the Guidelines (DoEHLG, 2006), where appropriate and necessary, as discussed in Section 12.3.2.6.3

12.3.2.6.1 Wind Energy Development Guidelines for Planning Authorities

Section 5.6 of the *Wind Energy Development Guidelines for Planning Authorities* published by the Department of Housing, Local Government and Heritage (DoHLGH, 2006) addresses noise and outlines the appropriate noise criteria in relation to wind farm developments.

This following statement from WEDG06 represents the widely accepted daytime noise criterion curve in relation to wind farm developments.

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

An important caveat should be noted as detailed in the following extract.

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

In relation to nighttime periods the following guidance is given:

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

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

In summary, the WEDGs outlines the following guidance to identify appropriate wind turbine noise criteria curves at NSLs:

- An appropriate absolute limit level in the range of 35 – 40 dB L_{A90} for quiet daytime environments with background noise levels of less than 30 dB $L_{A90,10min}$;
- 45 dB $L_{A90,10min}$ or a maximum increase of 5 dB above background noise (whichever is higher), for daytime environments with background noise levels equal to or greater than 30 dB $L_{A90,10min}$; and
- 43 dB $L_{A90,10min}$ for night time periods or a maximum increase of 5 dB above background noise (whichever is higher).

While the caveat of an increase of 5 dB(A) above background for night-time operation is not explicit within the WEDGs, an allowance for same is commonly applied in noise assessments prepared and is accepted as detailed in numerous examples of planning conditions issued by An Coimisiún Pleanála (ACP). This is supported by the guidance in ETSU-R-97 and the IOA GPG and has been retained in ARWTN. It is based on the principle that when background noise levels are sufficiently elevated, the potential impact of wind turbine noise is less significant, provided it does not exceed 5 dB above the background level. This approach is also consistent with the daytime criteria in WEDG06, which allow the limit to increase by up to 5 dB above background where this exceeds the fixed threshold level.

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

The core of the noise guidance contained within the WEDG06 is broadly based on ETSU-R-97, however the turbine noise limits values vary.

ETSU-R-97 advises regulating wind turbine noise by establishing noise limits at the properties most sensitive to noise. The document suggests that applying fixed noise limits across all wind speeds may not be appropriate for wind turbine projects. Instead, it recommends setting noise limits in relation to the prevailing background noise levels at sensitive locations. A crucial step in assessing noise for wind energy projects involves identifying the existing background noise levels through on-site surveys.

Page 58 of ETSU-R-97 states: "*...absolute noise limits and margins above background should relate to the cumulative effect of all wind turbines in the area which contribute to the noise received at the properties in question...*". Therefore, the cumulative noise contribution from all wind turbine development in the area should be considered for inclusion in the assessment.

The ETSU-R-97 guidance allows for a higher level of turbine noise operation at properties that have an involvement in the development, both as a higher fixed level of 45 dB L_{A90} and/or a higher level above the prevailing background noise level.

12.3.2.6.3 Key updates introduced by the Assessment and Rating of Wind Turbine Noise – ARWTN

ETSU-R-97, ARWTN and the IOA GPG have been applied in the methodology supporting the assessment, including background noise analysis, cumulative assessment, use of standardised wind speeds and parameters of noise propagation, among other topics discussed in this chapter.

The ARWTN (2026) replaces ETSU-R-97 and provides updated technical guidance for the assessment and control of operational wind turbine noise. The ARWTN retains the fundamental principles of ETSU-R-97, including the methodology for the assessment of wind turbine noise at noise sensitive receptors and the use of background noise measurements to inform noise limits.

ARWTN also provides updated procedures for operational compliance monitoring, including refined methodologies for the assessment of tonal noise and amplitude modulation (AM). These characteristics are intended to be addressed through post-construction compliance monitoring and planning conditions, rather than through the application of penalties at the planning assessment stage unless there is clear evidence that such characteristics are likely to occur.

A notable update within ARWTN is the confirmation that certain acoustical characteristics do not require specific assessment during the planning process: namely infrasound, ground-borne vibration and low-frequency noise. The guidance confirms that infrasound generated by modern wind turbines is below the threshold of perception at typical receptor distances, that ground-borne vibration levels are significantly below those detectable by humans, and that low-frequency noise is adequately controlled through the standard A-weighted noise assessment criteria and tonal assessment procedures. Consequently, assessment of these characteristics is scoped out of the operational noise assessment for the Proposed Project.

12.3.2.6.4 Institute of Acoustics Good Practice Guide

The original ETSU-R-97 concepts underwent a thorough standardisation and modernisation in 2013 with publication of the IOA GPG including six Supplementary Guidance Notes published in 2014. These documents bring together the combined experience of acoustic consultants in the UK and Ireland in the application of the assessment methods. Numerous improvements in the accuracy and robustness are described including the treatment of wind shear and the general adaptation to larger wind turbines. The guidance contained within IOA GPG is considered to represent best practice and has been adopted in this assessment.

12.3.2.6.5 Background Noise Surveys

The IOA GPG provided guidance on the duration and requirements for background noise surveys and states that at a minimum, continuous background noise monitoring should be carried out for typically a two-week period and should capture a representative sample of wind speeds in the area (i.e., from cut in speeds to the wind speed that generate the highest sound power output from the proposed turbine(s)). Background noise measurements (i.e., $L_{A90,10min}$) should be related to wind speed measurements that are collated at the site of the wind turbine development. Regression analysis is used on the data sets to calculate background noise levels

at different wind speeds; the resulting background noise curve can be used to establish appropriate turbine noise criteria at each location.

For guidance on the methodology for the background noise survey, the IOA GPG has been adopted.

12.3.2.6.6 Noise Prediction Calculations

The noise levels associated with the wind turbines have been calculated in accordance with ISO 9613-2, 1996 including IOA's GPG parameter settings for wind turbine screening limit and wind turbine valley correction settings. A new version of ISO 9613 was published in 2024 that include a more generic definition of the parameters indicated. However, IOA GPG includes a more conservative approach for terrain screening and are only applicable when using the ISO 9613-2, 1996. Therefore, the noise prediction calculations are made with the ISO 9613-2, 1996 with the IOA parameters. The IOA is undertaking a review of the GPG to clarify the use of the superseded standard with respect to the newest one.

This is a standardised methodology for noise prediction that considers noise attenuation offered, amongst others, by distance, ground absorption, directivity, and atmospheric absorption. The IOA GPG states that when considering cumulative noise impacts, the effects of propagation in different wind directions can be considered. Any such direction attenuation factors, if used, should be clearly stated in any assessment.

Additional details on the noise prediction calculation settings are provided in Appendix 12-2.

12.3.2.6.7 Cumulative Assessment Screening

Existing, permitted and proposed wind turbine developments must be considered cumulatively in the noise impact assessment. To determine where a particular wind farm development needs to be included in the assessment or whether it can be scoped out, a '10 dB rule' is applied. The '10 dB rule,' is grounded in scientific principles and supported by best-practice guidance. It states that if the contribution from another noise source is 10 dB below the total noise level, its contribution is insignificant to the total cumulative noise level, therefore, the other source is not significant and can be scoped out of the cumulative assessment.

Section 5.1 of the IOA GPG provides criteria to determine if a cumulative turbine noise assessment is necessary:

> *"5.1.4 During scoping of a new wind farm development consideration should be given to cumulative noise impacts from any other wind farms in the locality. If the proposed wind farm produces noise levels within 10 dB of any existing wind farm/s at the same receptor location, then a cumulative noise impact assessment is necessary.*
>
> *5.1.5 Equally, in such cases where noise from the proposed wind farm is predicted to be 10 dB greater than that from the existing wind farm (but compliant with ETSU-R-97 in its own right), then a cumulative noise impact assessment would not be necessary."*

In the first instance the study area must be defined, the IOA GPG states that the 'study area' for background noise surveys (and noise assessment) should, as a minimum, be the area within which noise levels from the proposed, consented and existing wind turbines is greater than 35 dB L_{A90}.

In some circumstances the cumulative 35 dB L_{A90} area may extend beyond the area where the proposed turbines will have any significant effect. This initial study area can be refined by applying the '10 dB rule' such that the following statement is true:

The study area for operational turbine noise can be defined as the area within which the predicted turbine noise levels from the proposed, consented, and existing wind turbines is greater than 35 dB $L_{A90,}$ and the predicted noise from the proposed turbines in isolation is within 10 dB of the proposed fixed lower threshold for turbine noise.

For example, where a fixed lower threshold of 40 dB applies, the maximum extent of the study area for the proposed project will correspond to the 30 dB L_{A90} noise contour of the proposed turbines in isolation.

An appraisal of the study area to determine whether a cumulative turbine noise impact assessment is required is presented Section 12.4.1.

12.3.2.6.8 Future Potential Guidance Changes

In December 2019, the Draft Wind Energy Development Guidelines (DoHLGH, 2019) were published for consultation and at the time of writing this EIAR Chapter, no updated guidelines have been published. It is important to note that during the public consultation on the 2019 draft WEDGs, several concerns relating to the proposed approach of the 2019 draft WEDGs were expressed by various parties. Specific concerns expressed by a group of acoustic professionals working in the field are most relevant. The group was made up of acousticians who act for wind farm developers, Councils, Government bodies and residents' groups (all of whom are members of the Institute of Acoustics, IOA). The group contained several of the authors / contributors to ETSU-R-97, the IOA Good Practice Guide (IOA GPG) and the IOA Amplitude Modulation Working Group, which are all referenced extensively in the draft Guidelines. Comment on the statement from the party group can be reviewed at:

https://pub.ioa.org.uk/blogs/wind-energy-development-guidelines-wedg-consultation-irish-department-housing-planning-community

Wherein it is stated that:

"*a number of acousticians working in the field have raised serious concerns over the significant amount of technical errors, ambiguities and inconsistencies in the content of the draft WEDG and these were highlighted during the consultation process by a group of acousticians*"

A copy of the group's consultation response in full can be viewed at:

https://awnconsulting.com/wp-content/uploads/2026/03/WEDG-consultation-joint-response-R0.pdf

In a written answer to Parliamentary Question on 19 June 2025, the Minister for Housing, Local Government and Heritage stated that the review of the 2006 Wind Energy Development Guidelines is ongoing and that, when finalised, the revised Guidelines "*will be issued under section 28 of the Planning and Development Act 2000, as amended or, subject to commencement of the Planning and Development Act 2024, as a National Planning Statement, as appropriate*". The Minister further stated that "*The current 2006 Wind Energy Development Guidelines remain in force, pending the finalisation of the review.*" The full written answer is

available from the Houses of the Oireachtas: Wind Energy Guidelines, Dáil Éireann Debate, 19 June 2025[1].

The assessment of wind turbine noise presented in this EIAR is based on the guidance outlined in WEDG06 and has been supplemented with best practice guidance from ETSU-R-97 and the IOA GPG. If updated Wind Energy Guidelines are published during the application process for the proposed project it is anticipated that any relevant changes affecting the noise will be addressed through an appropriate planning condition, or where a supplementary assessment is necessary, through provision of additional information.

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

The WHO Environmental Noise Guidelines for the European Region (2018) provide guidance on protecting human health from exposure to environmental noise. They set health-based recommendations based on average environmental noise exposure of several sources of environmental noise, including wind turbine noise. Recommendations are rated as either 'strong' or 'conditional'.

A strong recommendation, "can be adopted as policy in most situations" whereas a conditional recommendation, "requires a policy-making process with substantial debate and involvement of various stakeholders. There is less certainty of its efficacy owing to lower quality of evidence of a net benefit, opposing values and preferences of individuals and populations affected or the high resource implications of the recommendation, meaning there may be circumstances or settings in which it will not apply".

The objective of the WHO Environmental Noise Guidelines for the European Region is to provide recommendations for protecting human health from exposure to environmental noise from transportation, wind farm and leisure sources of noise. The guidelines present recommendations for each noise source type in terms of L_{den} and L_{night} levels above which there is risk of adverse health risks.

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

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

[1] https://www.oireachtas.ie/en/debates/question/2025-06-19/308/ accessed 13 April 2026

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

The WHO *Environmental Noise Guidelines for the European Region* (2018) aim to support the legislation and policy-making process on local, national, and international level, thus shall be considered by Irish policy makers for any future revisions of Irish National Guidelines.

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

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

The WHO-recommended average noise exposure level (i.e. 45 dB L_{den}) is not an appropriate target noise criterion for an existing or proposed wind turbine development in Ireland. It is not industry best practice to implement an L_{den} limit for wind turbine noise, as it is considered a poor characterisation of wind turbine noise. The WHO 2018 recommendation for average noise exposure of 45 dB L_{den} is conditional, meaning that the available scientific data for wind turbine noise was not strong enough to justify a strong recommendation.

12.3.2.6.10 Low Frequency Noise and Infrasound

Low Frequency Noise is noise that is dominated by frequency components less than approximately 200 Hz whereas infrasound is typically described as sound at frequencies below 20 Hz. In relation to infrasound, the following extract from the EPA's NG3 document is noted here:

> *"There is similarly no significant infrasound from wind turbines. Infrasound is high level sound at frequencies below 20 Hz. This was a prominent feature of passive yaw "downwind" turbines where the blades were positioned downwind of the tower which*

resulted in a characteristic "thump" as each blade passed through the wake caused by the turbine tower. With modern active yaw turbines (i.e. the blades are upwind of the tower and the turbine is turned to face into the wind by a wind direction sensor on the nacelle activating a yaw motor) this is no longer a significant feature."

As stated in the ARWTN and discussed in Section 12.3.2.6.3, low frequency noise and infrasound do not require specific assessment as they are generally below the threshold of perception at typical receptor distances and are not expected to result in any significant effect at the NSLs. Consequently, no assessment criteria for low-frequency noise or infrasound have been adopted as part of this EIAR.

12.3.2.6.11 Tonality

A tone is the concentration of acoustic energy into a very narrow frequency range, with a noticeable character (such as a "hum" or "whine" for example). The audibility of any tones can be assessed by comparing the narrow band level of such tones with the masking level contained in a band of frequencies around the tone. Several objective methodologies to assess tonal audibility are available, such as the one included in ARWTN or that of ISO 1996-2 (2017)[2].

Mechanical noise may emanate from components within the nacelle of a wind turbine. This is a less natural sounding noise which can be characterised in some cases by its tonal content, particularly if resonances in the mechanical noise are not suitably controlled. However, modern turbine designs have evolved to minimise mechanical noise radiation and resonances are normally minimised through design.

Wind farm noise guidelines such as those of ARWTN assume that the wind turbine noise does not normally contain clearly audible tones. It is not possible to predict the occurrence of tonality on a project reliably at the planning stage. The unlikely occurrence of tonality in the wind turbines of the proposed project will be managed through the commitments provided by the Applicant in Section 12.7.2.

12.3.2.6.12 Amplitude Modulation

In the context of this assessment, amplitude modulation (AM) is defined in the IOA Noise Working Group (Wind Turbine Noise) Amplitude Modulation Working Group (AMWG) document '*A Method for Rating Amplitude Modulation in Wind Turbine*' (IOA, 2016) as:

"Periodic fluctuations in the level of audible noise from a wind turbine (or wind turbines), the frequency of the fluctuations being related to the blade passing frequency (BPF) of the turbine rotor(s)."

The result is a regular fluctuation in amplitude at the Blade Passing Frequency (BPF) of the wind turbine blades (the rate at which the blades of the turbine pass a fixed point). For a three-bladed turbine rotating at 20 rpm, this equates to a modulation frequency of 1 Hz.

Previous definitions for AM distinguished between two distinct types:

'Normal' AM — An inherent characteristic of wind turbine noise, often described as "blade swish." This effect is typically observed relatively close to the turbine and is

[1] https://www.oireachtas.ie/en/debates/question/2025-06-19/308/ accessed 13 April 2026

produced as the trailing edge of the blade rotates toward and then away from the observer.

'Other' AM — A more pronounced form of AM, generally observed at greater distances from the turbine or turbines. It is often perceived as a periodic low-frequency "thumping" or "whoomphing.

While AM is acknowledged as an intrinsic feature of wind turbine noise, the earlier terms Normal AM and Other AM were used to distinguish between the typical (expected AM), and the more pronounced form that may cause disturbance. Normal AM is accounted for in noise impact assessments, whereas Other AM may require additional mitigation if it presents at NSL during turbine operation.

The IOA AMWG now provides a clear, objective definition and rating method for AM, reducing the need for the older terminology.

12.3.2.6.13 Frequency of Occurrence of AM

UK research by Salford University commissioned by the Department of Environment Food and Rural Affairs (DEFRA), the Department of Business, Enterprise and Regulatory Reform (BERR) and the Department of Communities and Local Government (CLG) investigated the issue of AM associated with wind turbine noise. The results were reviewed and published in the report 'Research into Aerodynamic Modulation of Wind Turbine Noise' (2007). The conclusions of this report were that aerodynamic modulation was only considered to be an issue at four, and a possible issue at a further eight, of 133 sites in the UK that were operational at the time of the study and considered within the review. At the four sites where AM was confirmed as an issue, it was considered that conditions associated with this AM might occur between about 7 and 15% of the time. It also emerged that for three out of the four sites the complaints have subsided, in one case due to the introduction of a turbine control system.

It is not possible to predict an occurrence of AM at the planning stage. The RenewableUK Research Document states the following in relation to matter:

Page 68 Module F — "*even on those limited sites where it has been reported, its frequency of occurrence appears to be at best infrequent and intermittent.*"

Page 6 Module F — "*It has also been the experience of the project team that, even at those wind farm sites where AM has been reported or identified to be an issue, its occurrence may be relatively infrequent. Thus, the capture of time periods when subjectively significant AM occurs may involve elapsed periods of several weeks or even months.*"

Page 61 Module F — "*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.*"

12.3.2.6.14 Concluding Comments on AM

Current research and guidance relating to wind turbine noise AM are ongoing. Among the most recent notable contributions is the IOA AMWG's 2016 publication, which outlines an objective measurement and rating approach known as the Reference Method. The IOA AMWG does not

propose thresholds for adverse community response or recommend specific limits for AM. The purpose of the group is to consolidate existing research and to establish a consistent methodology for the objective measurement and rating of AM.

A 2016 report commissioned by the UK government BEIS AM Review Phase 2, completed by WSP Parsons Brinckerhoff, recommended the use of a penalty scheme as a potential planning condition for AM to cover periods of complaints due to unacceptable AM. This penalty scheme is based on the AMWG method and other potential AM rating methods were dismissed as not sufficiently robust and was not adopted by the UK or devolved Governments. The report included the following caveat:

> *"Any condition developed using the elements proposed in this study should be subject to a period of testing and review. The period should cover a number of sites where the condition has been implemented and would be typically in the order of 2-5 years from planning approval being granted."*
>
> *It is noted that the WSP report recommended that AM be controlled specifically during period of complaints. The key point is that while excessive amplitude modulation (AM) may occur during the operation of the wind farm, it may not necessarily result in any adverse impacts. The WSP report states "at present it is not possible to predict whether AM will or will not be prevalent on a site".*

As per the discussion on the research presented previously in this Section, excessive/other AM is considered an atypical phenomenon, and the duration, conditions and specific location or locations at which it presents cannot be predicted in the planning stage. For these reasons, the assessment of AM is typically triggered in response to complaints where the contributing factors aligning to the period of the complaint such as meteorological conditions and turbine operations can be investigated.

ARWTN confirms that the Reference Method as the relevant methodology for quantifying AM and describes the application of a noise level rating to account for the presence of AM in line with that developed in the WSP Parsons Brinckerhoff document. This rating level is only applied in the context of compliance monitoring only. There is no requirement in ARWTN to assess AM at the planning stage.

The International Electrotechnical Commission (IEC) published "Technical Specification 61400-11-2 (Edition 1.0, 2024) Wind Energy Generation Systems – Part 11-2: Acoustic noise measurement techniques – Measurement of wind turbine sound characteristics in receptor position", in 2024. This document introduces a standardised methodology for measuring and rating AM at receptor locations. The method broadly aligns with the AMWG approach but includes some minor differences.

To date there is no clear industry and Governmental consensus on how AM should be regulated or managed through the planning and operational stage. Planning conditions imposing AM limits are therefore not considered best practice. In the absence of clear policy in Ireland to control AM from wind turbines, the commitments outlined in the Section 12.7.2.1 are considered to represent best practice to control AM and will be adopted in the event that an complaint relating to excessive AM is reported.

12.3.2.7 Operational Phase Noise – Fixed Plant Items

There is no published statutory Irish guidance relating to the maximum permissible noise level from fixed mechanical and electrical plant that would be associated with the proposed on site control building or proposed substation. In the absence of specific noise limits, appropriate criteria relating to fixed mechanical and electrical plant, reference is made to best practice guidance contained in the following published guidelines and standards. It is also confirmed that there are no likely significant noise effects due to the proposed overhead line and towers.

12.3.2.7.1 EPA NG4

NG4 is used in Ireland to determine suitable noise thresholds for EPA licensed industrial sites. While not directly applicable to other sites, in the absence of applicable published threshold it is considered as best practice guidance to inform fixed plant noise criteria. The NG4 approach to determining suitable noise thresholds is presented below.

In order to establish whether the NSLs would be considered 'low background noise' areas as defined in the EPA'S NG4 guidance, the noise levels measured during the environmental noise survey need to fall within each of the following criteria:

- Arithmetic Average of L_{A90} During Daytime Period ≤40 dB L_{A90};
- Arithmetic Average of L_{A90} During Evening Period ≤35 dB L_{A90}; and
- Arithmetic Average of L_{A90} During Night-time Period ≤30 dB L_{A90}.

Table 12-5 outlines the noise emission limit criteria detailed in the NG4 document.

Table 12-5: NG4 Approach for Determining Appropriate Noise Criteria

Scenario	Daytime Noise Criterion, dB $L_{Ar,T}$ (07:00 to 19:00hrs)	Evening Noise Criterion, dB $L_{Ar,T}$ (19:00 to 23:00hrs)	Night Noise Criterion, dB $L_{Aeq,T}$ (23:00 to 07:00hrs)
Areas of Low Background Noise	45	40	35
All other Areas	55	50	45

It is important to consider the likelihood of adverse noise impacts when assessing noise from fixed plant. The NG4 refers to the assessment method prescribed in BS 4142:2014+A1:2019: *Methods for rating and assessing industrial and commercial sound* (BS 4142) that can be used to assess the likelihood of complaints from specific plant noise sources.

12.3.2.7.2 BS 4142

BS 4142 is the industry standard method for analysing fixed plant sound emissions to residential receptors. BS 4142 describes methods for rating and assessing sound of an industrial and/or commercial nature. The methods described in this British Standard use outdoor sound levels to assess the likely effects of sound on people who might be inside or outside a dwelling or premises used for residential purposes upon which sound is incident.

For a BS 4142 assessment it is necessary to compare the measured external background sound level (i.e. the $L_{A90,T}$ level measured in the absence of plant items) to the rating level ($L_{Ar,T}$) of the various plant items, when operational. Where sound emissions are found to be tonal, impulsive, intermittent or to have other sound characteristics that are readily distinctive against the

residual acoustic environment, BS 4142 recommends that penalties be applied to the specific level to arrive at the rating level.

The subjective method for applying a penalty for tonal sound characteristics outlined in BS4142 recommends the application of a 2 dB penalty for a tone which is just perceptible at the receptor, 4 dB where it is clearly perceptible, and 6 dB where it is highly perceptible. In relation to intermittency, BS 4142 recommends that if the intermittency is readily distinctive against the residual acoustic environment, a penalty of 3 dB can be applied. The following definitions as discussed in BS 4142 as summarised below:

"*ambient sound level, $L_{Aeq,T}$*	*equivalent continuous A-weighted sound pressure level of the totally encompassing sound in a given situation at any given time, usually from many sources near and far, at the assessment location over a given time interval, T.*
residual sound level, $L_{Aeq,T}$	*equivalent continuous A-weighted sound pressure level of the residual sound (i.e. ambient sound remaining at the assessment location when the specific sound source is suppressed to such a degree that it does not contribute to the ambient sound) at the assessment location over a given time interval, T.*
specific sound level, $L_{Aeq,T}$	*equivalent continuous A-weighted sound pressure level produced by the specific sound source at the assessment location over a given reference time interval, Tr.*
Rating level, $L_{Ar,T}$	*specific sound level plus any adjustment for the characteristic features of the sound.*
background sound level, $L_{A90,T}$	*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 using time weighting F and quoted to the nearest whole number of decibels.*"

To establish an initial estimate of impact, BS 4142 states the following:

> "*Obtain an initial estimate of the impact of the specific sound by subtracting the measured background sound level from the rating level and consider the following.*
>
> *a. Typically, the greater this difference, the greater the magnitude of the impact.*
>
> *b. A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.*
>
> *c. A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context.*
>
> *d. The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context.*"

Note Adverse impacts include, but are not limited to, annoyance and sleep disturbance. Not all adverse impacts will lead to complaints and not every complaint is proof of an adverse impact."

BS4142 contains the following pertinent factor that must be considered with respect to the context of the sound, which is relevant to this assessment as the background noise levels are typically low at NSLs during periods of low wind speeds:

"The absolute level of sound. For a given difference between the rating level and the background sound level, the magnitude of the overall impact might be greater for an acoustic environment where the residual sound level is high than for an acoustic environment where the residual sound level is low.

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 assessment methodology described above (i.e. comparison of rated sound level to background sound level) is quoted in BS 4142 as representing a methodology to 'obtain an initial estimate' of impact. It is important to note that BS 4142 also comments that 'Where the initial estimate of the impact needs to be modified due to the context, take all pertinent factors into consideration'. BS 4142 provides a list of potential pertinent factors that can influence the 'initial estimate'.

The proposed criteria for noise from the proposed substation are confirmed in Section 12.5.3. The criteria have been derived in general accordance with the EPA NG4 guidelines and the BS4142 standard.

12.3.2.8 Operational Phase Vibration

Vibration generated from the operation of a wind turbine unit will decrease rapidly with distance. Typically, at 100 m from a 1 MW turbine unit the level of vibration associated with a turbine is the order of 10^{-5} mm/s.

A report from Germany published by the State Office for the Environment, Measurement and Nature Conservation of the Federal State of Baden-Württemberg in 2016, "*low frequency noise incl. infrasound from wind turbines and other sources*" conducted vibration measurements study for an operational Nordex N117 – 2.4 MW wind turbine. The report concluded that at distances of less than 300 m from the turbine, vibration levels had dropped so far that they could no longer be differentiated from the background vibration levels.

The shortest distance from any turbine in the proposed project to the nearest NSL is more than 580 m (distance from turbine T08 to NSL ref. 377). At that distance, the level of vibration will be significantly below any thresholds for perceptibility. Therefore, vibration criteria are not specified for the operational phase of the proposed project.

An IOA statement in Respect of Wind Farm Noise Assessment dated December 2024 and published on the IOA website[3] stated the following in relation to Vibration:

[3] IOA Statement accessed 2 April 2026

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

The above is also confirmed in the ARWTN guidance. There are no other sources likely to give rise to any perceptible vibration at NSLs during the operation of the proposed project. The assessment of operational phase vibration has therefore been scoped out of this assessment as there are no likely significant vibration effects associated with the development.

12.3.2.9 Factors to Consider when Assessing Operational Noise Effects

12.3.2.9.1 Wind Turbine Noise

The applicable guidelines (WEDG06), along with additional best practice guidance discussed in Section 12.3.2.6, provide a framework for identifying appropriate noise limits at nearby NSLs. The turbines to be installed will be selected and designed to operate within these limits during the operational phase of the proposed project. Where predicted turbine noise levels remain within best practice thresholds, the effect can be considered not significant.

Baseline noise levels at low wind speeds are expected to increase at certain Noise Sensitive Locations (NSLs) with the operation of the proposed project. However, it is acknowledged that the introduction of turbines will contribute new sound sources to the existing soundscape.

12.3.2.9.2 Fixed-Plant Items

The guidance discussed in Section 12.3.2.7 provides a framework in line with national guidelines for identifying appropriate noise limits at nearby NSLs.

All fixed plant will be designed and selected to operate within the proposed limit values and therefore the effect can be described as not significant.

Ambient noise levels during night-time periods may increase at certain Noise Sensitive Locations (NSLs) with the operation of the proposed project. However, the resulting noise will be at a relatively low level. It is acknowledged that the introduction of the proposed project will contribute new sound sources to the existing soundscape.

12.4 ASSESSMENT METHODOLOGY

The outline methodology adopted for this assessment is summarised as follows:

- Review of best practice guidance to identify appropriate noise and vibration criteria for the construction, operational and decommissioning phases;
- Characterise the receiving environment through baseline noise surveys at various NSLs surrounding the proposed project;
- Undertake predictive calculations to assess the likely significant effects associated with the construction phase of the proposed project;
- Undertake predictive calculations to assess the likely significant effects associated with the operation of the proposed project at NSLs, including other wind farm developments in the cumulative assessment;

- Undertake predictive calculations to assess the likely significant effects associated with the decommissioning of the proposed project at NSLs;
- Specify mitigation measures to reduce, where necessary, the identified likely significant effects relating to noise and vibration from the proposed project; and,
- Assess the significance of the cumulative residual noise and vibration effects associated with the proposed project.

12.4.1 Study Area

The study area for the noise and vibration impact assessment was defined by the area where there is potential for noise and vibration impacts at NSLs associated with the proposed project during the construction, decommissioning, and operational phases.

12.4.1.1 Operational Phase Noise

The method to define the study area is described in Section 12.3.2.6.7. The study area for the operational phase was determined as the area predicted to exceed 35 dB L_{A90} at the maximum predicted turbine noise emission level from the proposed project in isolation, i.e. the predicted noise from the proposed turbines in isolation is within 10 dB below the proposed fixed lower threshold for turbine noise. 433 noise-sensitive locations were identified within the study area. Refer to Appendix 12-5 Noise Contour Map, which displays the relevant noise contours maps which identify this area.

The NSLs identified at proximity of the proposed substation area have been considered in the assessment of operational noise from the proposed fixed plant items i.e. the substation.

12.4.1.2 Construction and Decommissioning

During the construction and decommissioning phases, noise could occur at any location where activities occur as part of the wind farm site, such as the GCR and along public roads where there are increases in traffic associated with the proposed project.

NSLs in proximity to specific construction activities and those situated along haul routes have the most potential to experience noise and vibration from the proposed project. Taking account of the works associated with the construction and decommissioning phases, the study area is based on the nearest NSLs to the working areas, these distances are confirmed in the relevant sections and representative of the closest identified NSL, or at defined set back distances from the proposed activities.

12.4.2 Background Noise Survey

A summary outlining key information of the background survey is presented in this section; full details of the background noise survey methodology, instrumentation, and results is provided in Appendix 12-3 of this EIAR.

A background noise survey was undertaken to establish typical background noise levels at representative NSLs surrounding the proposed wind farm site. The background noise survey was conducted through installing unattended sound level meters at eight representative locations in the surrounding area between 13 November and 18 December 2024.

All measurement data collected during the background noise surveys has been carried out in accordance with the IOA GPG and accompanying *Supplementary Guidance Note 1: Data Collection* (2014) discussed in the following sections.

12.4.2.1 Choice of Measurement Locations

The noise monitoring locations were identified by preparing a preliminary noise model contour, the distribution of nearby dwellings and the nature of their surroundings at an early stage of the assessment. The selection of the noise monitoring locations was informed by a site visit and supplemented by reviewing aerial images of the study area and other online sources of information (e.g., Google Earth and OSI Maps). Together, the locations provide representative coverage of the operational study area and form a robust basis for deriving background noise levels and turbine noise criteria.

The co-ordinates for the selected noise monitoring locations are outlined in Table 12-6 and identified on a map in Figure 12-2.

Table 12-6: Noise Measurement Coordinates

Location Reference (Closest NSL)	Co-ordinates (ITM)	
	Easting	Northing
NML 1	524,051	752,079
NML 2	525,146	751,948
NML 3	526,255	751,252
NML 4	524,967	750,258
NML 5	524,430	750,194
NML 6	523,283	749,292
NML 7	521,413	750,020
NML 8	523,692	750,695

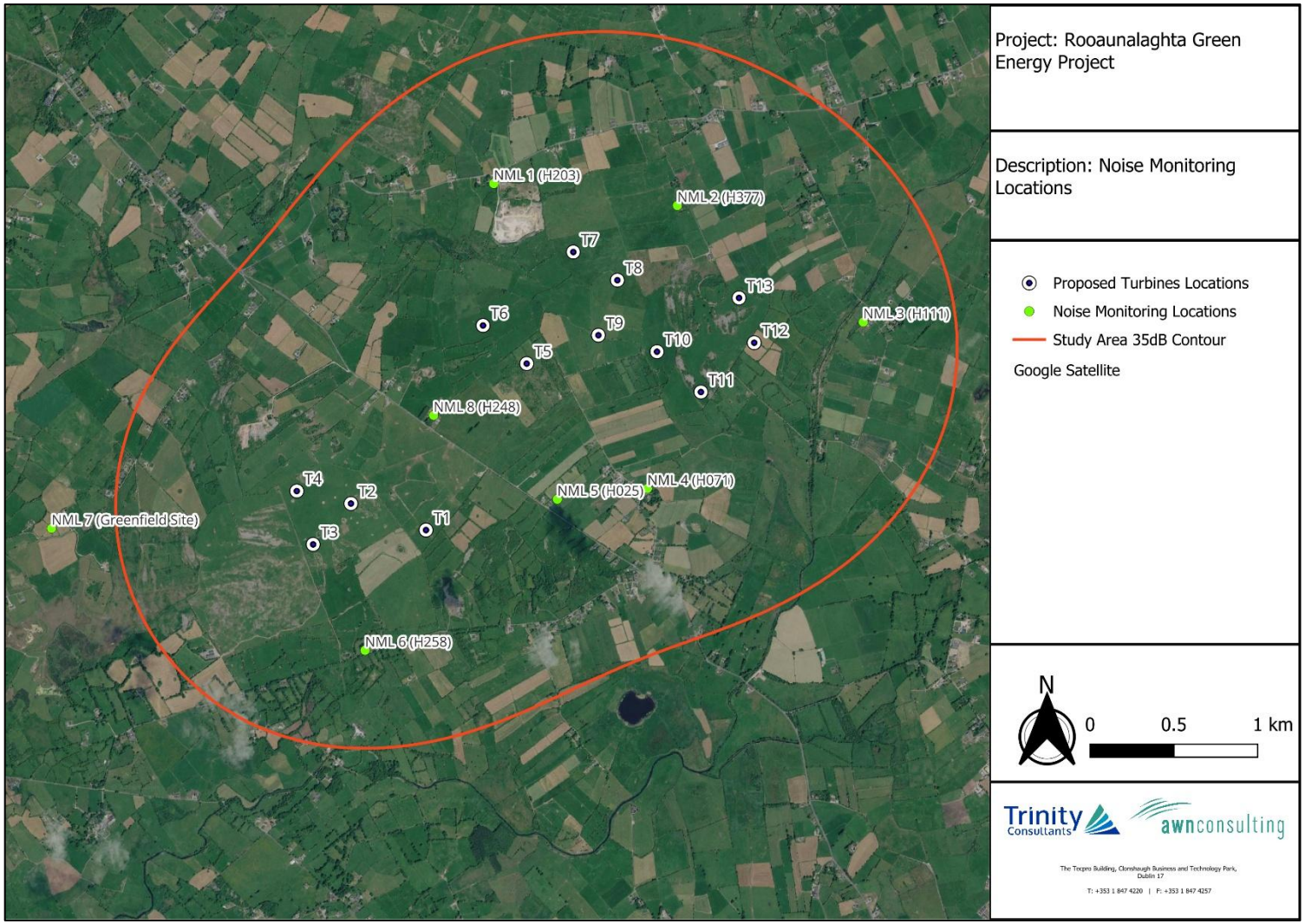


Figure 12-2: Noise Survey Locations

12.4.2.2 Wind Measurements

Average wind speed and direction was measured in 10-minute intervals at an on-site Lidar and provided to AWN. Wind speed measurements made at 80 m and 65 m were used as per the Method B methodology described in the IOA GPG, the measured wind speeds were then corrected to the 'standardised' 10 m wind speed. The 'standardised' wind speed is the industry standard in the UK and Ireland for referencing for wind speed with respect to wind turbines.

12.4.2.3 Rainfall Measurements

Rainfall loggers measured rainfall levels in 10-minute intervals for the duration of the survey. Additional details are provided in Appendix 12-3 of this EIAR.

12.4.3 Analysis of Survey Data

As well as the location-specific filtering, the data sets have been filtered to remove issues such as the dawn chorus and the influence of other atypical noise sources. An example of atypical sources would be short, isolated periods of raised noise levels attributable to local sources, agricultural activity, boiler flues, operation of gardening equipment etc. In addition, sample periods affected by rainfall or when rainfall resulted in prolonged periods of atypical noise levels have also been screened from the data sets. In this instance, periods comprising 10 minutes before and after the rain was logged have been excluded. The assessment methods outlined above are in line with the guidance contained in the IOA GPG.

The results presented Appendix 12-3 and summarised in the following sections refers to the noise data collated during 'quiet periods' of the day and night as defined in the IOA GPG.

12.4.3.1 Noise from Existing Turbines

There were no other operational wind farms located at proximity of the proposed wind farm site (see Study Area, defined by noise contours, in Appendix 12-5). In line with the guidance outlined in Section 12.3.2.6, contributions to measured noise levels from existing wind turbines must be considered from the dataset when determining background noise levels. This ensures that the noise criteria are correctly applied to establish the permissible noise limits for the new wind turbine development. This has been accounted for in the assessment and additional details are provided in Appendix 12-3.

12.4.3.2 Consideration of Wind Shear

Wind shear is defined as the change of wind speed with height above ground. Site specific wind shear is captured in the background noise assessment through simultaneous measurement of deriving wind speeds adjusted to hub height using the one of three methods described in the IOA GPG.

To ensure clearly and consistently defined wind speeds, it is standard industry practice to convert and reference wind speeds to the 'Standardised Wind Speed'.

The Standardised Wind Speed is a wind speed measured at a height different than 10 m (generally measured at the turbine hub height) which is expressed to a reference height of 10 m in accordance with the IEC 61400-11 standard. The standardised equations used to determine the wind speed at standardised 10 m above ground is presented in Appendix 12-3.

Any reference to wind speed in this chapter should be understood to be standardised 10m wind speed unless otherwise stated.

12.4.4 Construction Noise Calculations

A variety of plant items will be used for site preparation, construction, and associated works. Vehicular movements to and from the site will make use of existing roads. These activities have the potential to generate significant levels of noise.

In the absence of specific details on the plant items and construction methods to be employed, a set of assumptions must be made to predict and assess the likely noise emissions from these activities. The standard best practice approach is to predict typical noise levels at the NSLs using the guidance set out in BS5228-1.

The methodology adopted for the assessment of construction noise involves analysing the various elements of the construction phase in isolation. For each of the elements assessed in section 12.6.2, anticipated construction noise sources are assessed along with typical sound pressure levels from BS5228-1 at various distances from these works.

12.4.5 Operational Noise Calculations

A series of prediction models have been prepared to quantify the potential turbine noise level associated with the operational phase of the proposed project on the receiving environment. This section discusses the methodology used in the noise prediction modelling process.

12.4.5.1 Noise Prediction Software

The selected software, DGMR iNoise Enterprise (Version 2024.3) calculates noise levels in accordance with ISO 9613-2:1996.

iNoise is a proprietary noise calculation package for computing noise levels and propagation of noise sources. iNoise calculates noise levels in different ways depending on the selected prediction standard, in this case, ISO 9613-2:1996. The calculation setting applied will depend on the type of source under assessment.

12.4.5.2 Noise Prediction Model - Input Data and Assumptions

The settings applied in the calculations depend on the type of source under assessment. Full details of the calculation settings, input data and any assumptions made in the assessment are provided in Appendix 12-2. The assumptions made do not prevent the assessment from reaching an accurate conclusion regarding the likely significant effects.

12.4.5.2.1 Proposed Wind Turbine Details

Chapter 2 details the co-ordinates of the thirteen no. turbines of the proposed project.

The turbine noise assessment has been undertaken considering the sound emissions of the Vestas V136 turbine working condition PO4 and serrated trailing edges at a HH of 82 m, and the tip height of 150 m.

Sound power levels for each of the turbines listed above referenced to wind speeds at standardised 10 m height (calculated in accordance with the IOAGPG), are presented in Table 12-7.

Table 12-7: Sound Power Levels (L_{WA}) for Proposed Turbines

Wind Speed (m/s)	Sound Emissions, dB re 10^{-5} PA, at Octave band centre frequency, Hz								Overall dB(A)
	63	125	250	500	1000	2000	4000	8000	
3	69.2	77.2	82.7	86.0	86.7	85.1	81.1	74.6	92.1
4	74.0	82.3	87.6	89.8	89.0	85.1	78.3	68.4	94.6
5	78.9	87.1	92.3	94.6	93.9	90.0	83.3	73.5	99.5
6	82.6	91.0	96.2	98.4	97.5	93.6	86.8	76.7	103.2
7	83.2	91.5	96.7	99.0	98.3	94.6	87.9	78.2	103.9
8	83.0	91.2	96.5	98.9	98.4	94.9	88.5	79.2	103.9
9	81.9	89.9	95.4	98.3	98.6	96.3	91.4	83.8	103.9

The manufacturer's turbine noise emission data are provided in terms of sound power levels (dB L_{WA}) which allow L_{Aeq} values at NSLs to be predicted. However, turbine noise criteria are expressed in terms of the L_{A90} parameter. According to best practice guidance in the IOA GPG, "*L_{A90} levels should be determined from calculated L_{Aeq} levels by subtraction of 2 dB*". This 2 dB adjustment is applied within the noise model calculations. All turbine noise predictions presented in this chapter are expressed using the L_{A90} parameter.

In accordance with guidance from the IOA GPG, an uncertainty factor should be considered in all turbine noise predictions. A +2 dB uncertainty correction has been applied in the modelling to all turbine sound power levels unless otherwise stated.

Best practice states that should any audible tonal component be present at an NSL from the operation of wind turbines, a penalty shall be added to the measured noise levels. The level of this penalty is described in ETSU-R-97 and relates to the extent by which tonal components exceed the threshold of audibility.

Current good practice recommends that tonal issues at wind farms are best addressed through appropriate planning conditions. A tonal penalty has not been included in the predicted noise levels for this assessment. A warranty will be provided by the manufacturer of the selected turbine to ensure that the noise output, including tonality, is controlled.

12.5 Existing Environment

This section of the chapter documents the typical background noise levels measured at NMLs representative of the nearest NSLs to the wind farm site. The NMLs locations are presented in Table 12-6. Appendix 12-3 presents the additional details and results of the background noise surveys undertaken in accordance with the methodology in Section 12.4.2.

12.5.1 Derived Background Noise Levels

The following section presents the various derived $L_{A90,10min}$ noise levels for each of the monitoring locations for daytime quiet periods and night-time periods. These levels have been derived using regression analysis carried out on the data sets measured in line with best practice

guidance and presented in Section 12.5.1. The scatter graphs of each location are displayed in Appendix 12-3.

12.5.1.1 Summary of Derived Background Noise Levels

Table 12-8 presents the various derived $L_{A90,10min}$ noise levels for each of the monitoring locations for daytime quiet periods and night-time periods. These levels have been derived using regression analysis carried out on the data sets measured in line with guidance contained in the IOA GPG.

Values in parenthesis are used where, for higher wind speeds during day and night-time periods, the measurement obtained during the survey did not have sufficient data points at these wind speeds. In accordance with IOA GPG Supplementary Guidance Note 2: Data Processing & Derivation of ETSU-R-97 Background Curves, paragraph 2.9.1: "*Where background noise data has not been collected for higher wind speeds it may be appropriate to cap the background noise curve (and therefore the associated noise limit)*".

Table 12-8: Derived Background Noise Levels of $LA_{90,10-min}$ for Various Wind Speeds

Location	Period	Derived $L_{A90,10min}$ Levels (dB) at Various Standardised 10m Height Wind Speeds m/s for 82 m Hub Height						
		3	4	5	6	7	8	≥9
NML 1	Day	26	27.2	28.9	31	33.5	36.3	39.4
	Night	19.3	19.9	21.8	24.7	28.3	32.4	36.9
NML 2	Day	24	25.4	27.1	29	31.3	33.8	36.5
	Night	18.1	18.9	20.6	23.1	26.1	29.7	33.5
NML 3	Day	25.8	26.7	27.8	29.3	31	33	35.2
	Night	19.6	20.2	21.6	23.6	26.1	29	32.3
NML 4	Day	30.8	31.9	33	34.2	35.4	36.8	38.4
	Night	24.5	24.8	25.6	26.9	28.7	30.9	33.4
NML 5	Day	34	34.8	35.5	36.3	37.1	38.1	39.3
	Night	20.6	21	22.2	24	26.4	29.2	32.3
NML 6	Day	26	27.5	29.2	31.2	33.3	35.8	38.5
	Night	22.4	23.4	25.1	27.6	30.6	34	37.6
NML 7	Day	23.3	24.4	26	28.1	30.5	33.3	36.3
	Night	18.5	19.7	21.7	24.6	28	31.8	35.8
NML 8	Day	32	33	34.6	36.5	38.8	41.3	44
	Night	19.7	21.2	23.9	27.3	31.4	35.9	40.5

12.5.2 Wind Turbine Noise Limits

With respect to the relevant guidance documents outlined in Section 12.3.2.6.1 noise criteria have been established for the proposed project using the derived background level measured at representative NMLs and summarised in Table 12-8.

The turbine noise limits proposed are in line with the applicable WEDG06 guidelines and noise conditions applied to similar sites previously granted planning permission by ACP (previously An Bord Pleanála).

For the proposed project a lower daytime threshold of 40 dB L_{A90} is appropriate for low noise environments where the background noise is less than 30 dB(A), based on the following considerations:

- The EPA NG4 Guidance proposes a daytime noise criterion of 45 dB(A) in 'areas of low background noise'. Turbine noise limits are stated in terms of the L_{A90} parameter while the NG4 daytime limit an L_{Aeq}. The accepted difference between L_{Aeq} and L_{A90} in wind turbine noise assessments is 2 dB; for example, 45 dB L_{Aeq} corresponds to 43 dB L_{A90}. This approach implies a 3 dB difference when comparing the parameter definitions used in NG4 and WEDG06. Accordingly, the proposed lower daytime threshold of 40 dB L_{A90} is 3 dB more stringent than the equivalent daytime noise limit for low background noise areas as outlined in NG4.
- A lower threshold of 40 dB is commonly adopted in planning conditions for similar developments that have been granted planning permission by ACP in recent years for example, Derrinlough Wind Farm (ACP Ref: 306706-20), Coole Wind Farm (ACP Ref: PL25M.300686) Cloncreen (ACP Ref: PA0047), Meenbog (ACP Ref: PL05E.300460), Borrisbeg (ACP ref: 318704-23), Castlebanny Wind Farm (Planning Ref: 309306-21), Ballivor (ACP-316212-23) and the Carrig Renewables Wind Farm (ACP Ref: 318689-23).

Best practice for setting wind turbine noise limits at NSLs is that the limits should relate to the cumulative turbine noise level from all turbines. Therefore, the proposed noise limits shall be cumulative, accounting for all operational wind turbines. When setting appropriate turbine noise limits in accordance with the criteria from WEDG06 guidelines and best practice guidance.

The proposed turbine noise criteria should apply to the nearest NSLs where it can be reasonably determined that the noise contribution from the operation of the proposed project is the dominant wind turbine source. The operational noise limits proposed for the proposed project are:

> Noise levels generated by the windfarm following commissioning by itself or in combination with other existing or permitted wind energy development in the vicinity when measured externally at noise sensitive locations, shall not exceed:
>
> - 40 dB $L_{A90,10min}$ for daytime (0700 – 2300hrs) in quiet environments with typical background noise of less than 30 dB $L_{A90,10min}$;
> - 45 dB $L_{A90,10min}$ or a maximum increase of 5 dB(A) above background noise (whichever is the higher), for daytime (0700 – 2300hrs) in environments with typical background noise greater than or equal to 30 dB $L_{A90,10min}$; and,
> - 43 dB $L_{A90,10min}$ for night-time periods (2300 – 0700hrs) or a maximum increase of 5 dB above background noise (whichever is higher).

In line with ETSU-R-97 guidance (see Section 12.3.2.6.2), a fixed lower threshold of 45 dB L_{A90} or a maximum increase of 5 dB above background noise (whichever is the higher) is proposed for NSLs involved in the project.

12.5.2.1 Proposed Noise Criteria

Table 12-9 below outlines the operational noise limits derived for the assessment in accordance with applicable criteria. Turbine noise limits have been established for wind speeds between 3 and 9 m/s, covering the range from turbine cut-in up to the point where the turbine reaches its maximum sound power level.

In the absence of measured background noise data above 9 m/s, a conservative approach assumes that the background noise levels derived at 9 m/s apply at higher wind speeds, in line with guidance, and criteria set accordingly. However, it is expected that as wind speeds increase beyond 9 m/s, background noise levels will also rise.

Table 12-9: Proposed Noise Criteria Curves

Location	Period	Turbine Noise Limits $L_{A90, 10min}$ Levels (dB) at Various Standardised 10m Height Wind Speeds)						
		3	4	5	6	7	8	≥9
NML 1	Day	40	40	40	45	45	45	45
	Night	43	43	43	43	43	43	43
NML 2	Day	40	40	40	40	45	45	45
	Night	43	43	43	43	43	43	43
NML 3	Day	40	40	40	40	45	45	45
	Night	43	43	43	43	43	43	43
NML 4	Day	45	45	45	45	45	45	45
	Night	43	43	43	43	43	43	43
NML 5	Day	45	45	45	45	45	45	45
	Night	43	43	43	43	43	43	43
NML 6	Day	40	40	40	45	45	45	45
	Night	43	43	43	43	43	43	43
NML 7	Day	40	40	40	40	45	45	45
	Night	43	43	43	43	43	43	43
NML 8	Day	45	45	45	45	45	46.3	49
	Night	43	43	43	43	43	43	45.5

12.5.2.2Assigning Turbine Noise Limits

The derived background noise levels have been assigned to other NSL's which are deemed to be representative of the measurement locations. Where background noise measurements have been conducted in the vicinity and/or are judged to be typical/indicative of the background noise levels of the area at the measurement location, the background noise levels can be used for deriving turbine noise thresholds at other locations.

Table 12-10 below shows where representative background noise levels have been assigned to each of the relevant NSL's for the purpose of setting noise limits for the assessment of turbine noise. These levels have been assigned based on professional judgement in line with best practice guidance of representative background noise levels measured as part of the survey. Derelict receptors are not included in the table below.

Table 12-10 Assignment of Representative Background Noise Levels

Representative Background Noise Levels	Noise Sensitive Location (NSL)
NML 1	184, 185, 186, 187, 191, 192, 193, 194, 195, 196, 197, 198, 200, 201, 202, 203, 204, 205, 232, 233, 234, 235, 236, 237, 238, 239, 240, 242, 243, 244, 245, 246, 247, 269, 270, 271, 272, 273, 274, 275, 276, 280, 290, 292, 293, 295, 366, 390, 391, 392, 393, 394, 395, 423, 424, 425, 426, 427, 428, 429, 430, 431, 432

NML 2	115, 128, 129, 130, 131, 132, 133, 134, 135, 136, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 159, 160, 161, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 180, 181, 182, 183, 188, 189, 190, 199, 215, 216, 217, 218, 364, 365, 373, 374, 375
NML 3	1, 2, 79, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 137, 138, 139, 140, 206, 207, 208, 213, 214, 352, 358, 359, 360, 361, 362, 370, 371
NML 4	15, 16, 17, 18, 21, 22, 26, 39, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 71, 73, 74, 75, 76, 77, 78, 209, 210, 211, 212, 369, 376, 386
NML 5	4, 5, 6, 7, 8, 9, 10, 25, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 40
NML 6	3, 11, 12, 13, 14, 19, 20, 255, 256, 257, 258, 259, 260, 261, 262, 263, 264, 265, 266, 311, 312, 313, 314, 315, 316, 317, 318, 321, 322, 324, 325, 336, 337, 338, 339, 340, 341, 342, 343, 344, 345, 346, 347, 348, 349, 353, 396, 397, 398, 399, 400, 401, 402, 403, 404, 405, 406, 407, 408, 409, 410, 411, 412
NML 7	219, 220, 221, 222, 223, 224, 225, 226, 227, 228, 229, 230, 231, 267, 268, 288, 294, 296, 297, 307, 308, 309, 310, 319, 320, 323, 326, 327, 328, 329, 330, 331, 335, 350, 351, 354, 367, 414, 415, 416, 417, 418, 419, 420, 421, 422
NML 8	23, 248, 249, 250, 251, 252, 253, 254, 281, 282, 283, 284, 285, 286, 287, 289, 298, 299, 300, 301, 302, 303, 304, 305, 306, 332, 333, 334
Involved Landowners	41, 50, 71, 218, 248, 258, 311, 377

12.5.3 Noise Limits for Fixed Plant

Based on a review of the measured noise from the background noise survey described in Section 12.4.2, in scenarios where the wind speeds are very low, the NSLs in the vicinity of the site can be defined as areas of low background noise. As the proposed substation will operate at a consistent noise output on a 24-hour basis, the potential impact during night-time periods is the primary consideration in this assessment.

An absolute noise threshold of 35 dB L_{Aeq} at NSLs is proposed for fixed plant. As the design progresses, acoustic features such as tonality, impulsivity and intermittency, will be considered in the context of the character assessment framework contained in BS 4142. Where these acoustic features are present, the Rating Level should be controlled to avoid adverse impacts at NSLs in accordance with BS 4142. Where background noise levels are elevated at specific NSLs,

i.e. greater than 30 dB L_{A90}, a higher absolute threshold, of up to 5 dB above the background level, may be acceptable.

With respect to the guidance from the BS4142 standard, as discussed in Section 12.3.2.7.2, it is considered that the proposed criteria are robust and are expected to prevent adverse impacts at NSLs.

12.6 Assessment of Likely Significant Effects

12.6.1 Future Baseline/ Do Nothing Scenario

If the proposed project does not proceed, the existing noise environment is expected to remain unchanged. The likely future receiving environment is anticipated to experience a gradual increase in traffic volumes on the local road network; however, this is not expected to result in a significant change to the overall ambient or background noise levels within the receiving environment.

12.6.2 Construction Phase

Construction noise prediction calculations have been conducted using the assessment methodology outlined in Section 12.4.4. The source noise levels referred to in this section are indicative of the type of plant items and activities associated with the construction of the proposed project.

The highest predicted noise levels are expected to occur for only short periods of time at a very limited number of properties. Construction noise levels will be lower than these levels for most of the time at most properties in the vicinity of the proposed wind farm site.

There are several stages and elements associated with the construction phase of the proposed project which will include but are not limited to the following:

- Construction of turbines and hardstand areas;
- Construction of the Lidar unit;
- Construction of internal site access tracks;
- Operation of borrow pits;
- Construction of substation;
- Use of temporary construction compound;
- Use of the spoil and deposition area;
- Cabling and grid connection; and

EIAR Chapter 2 has detailed information on each of these elements.

In general, the distances between the construction activities associated with the proposed project and the nearest NSLs are such that there will be no significant noise, and vibration impacts at the NSLs. The following sections present an assessment of the main stages of the construction phase that have the potential for associated noise and vibration effects, all other stages and elements are considered unlikely to have any significant noise and vibration effects due to the distances to NSLs.

Construction activities will be carried out during normal daytime working hours (i.e. 7:00 hrs - 19:00 hrs Monday to Friday (excluding public holidays) and 07:00 hrs - 14:00 hrs on Saturdays). However, to ensure that optimal use is made of good weather periods or at critical periods

within the programme (e.g., concrete pours) or to accommodate delivery of large turbine components along public routes it could be necessary on occasion to work outside of these hours. Work on Sundays or public holidays will only be carried out under exceptional circumstances, and any such out of hours working will be agreed in advance with the Local Authority.

12.6.2.1 General Construction of Turbines and Hardstand Areas

12.6.2.1.1 Noise

Several noise sources that would be expected on a construction site of this nature have been identified and predictions of the potential noise emissions have been calculated at the nearest NSL. In this instance the closest noise sensitive receptor is Location 377, which is situated approximately 583 m from the edge of the proposed hardstands at turbine T8.

It is understood that if piling is required, rock breaking, with similar sound levels, will not be required at the same time and location. Table 12-11 outlines the expected construction noise levels associated with the proposed works for this element of the construction. Turbines T2, T6, T7 and T10 may possibly require piling as part of the construction of the foundations. The nearest NSL to any of these turbines is NSL 248 at approximately 610 m from T6. Assuming a high noise level of 88 dB L_{Aeq} at 10 m distance for a vibratory piling rig (BS5228-1 C.3.8), the expected noise level at the nearest receptor is 28 dB $L_{Aeq,16hrs}$ which is substantially below the threshold outlined in Table 12-1.

Table 12-11: Expected Wind Farm Turbine Construction Noise Emission Levels

Item (BS 5228 Ref.)	Activity/Notes	Plant Noise level at 10m Distance (dB $L_{Aeq,T}$)	Predicted Noise Level (dB $L_{Aeq,T}$) at distance (m)
			583 m
HGV Movement (C.2.30)	Removing spoil and transporting fill and other materials.	79	31
Tracked Excavator (C.4.64)	Removing soil and rubble in preparation for foundation.	75	27
Excavator Mounted Rock Breaker (C9.12)	Rock Breaking.	85	37
General Construction (Various)	All general activities plus deliveries of materials and plant	84	36
Concrete Mixer Truck and Concrete Pump (C.4.27)	Foundations	79	31
Dumper Truck (C.4.4)	Removing spoil and transporting fill and other materials.	76	28

[4] All plant noise levels are derived from BS5228: Part 1

Item (BS 5228 Ref.)	Activity/Notes	Plant Noise level at 10m Distance (dB $L_{Aeq,T}$)	Predicted Noise Level (dB $L_{Aeq,T}$) at distance (m)
			583 m
Mobile Telescopic Crane (C.4.39)	Transporting materials	77	29
JCB (D.8.13)	For services, drainage and landscaping.	82	29
Vibrating Rollers (D.8.29)	Road surfacing.	77	34
Cumulative Construction Noise Level		--	42

At 583 m from the works the predicted noise levels from construction activities are in the range of 27 to 37 dB $L_{Aeq,T}$ with a total 'worst-case' construction level of the order of 42 dB $L_{Aeq,T}$. In all instances the predicted noise levels at the nearest NSLs are below the adopted significance threshold outlined in Table 12-1 (Category A – 65 dB $L_{Aeq,T}$ during daytime periods). This assessment is considered representative of worst-case construction noise levels at NSLs.

There is no item of plant that would be expected to give rise to noise levels that would be considered out of the ordinary or in exceedance of the thresholds outlined in Table 12-1 and this finding is valid should all items of plant operate simultaneously. No specific mitigation measures are required.

12.6.2.1.2 Vibration

Rock breaking activity will likely generate the highest levels of vibrations through the ground. Empirical data for this activity is not provided in BS 5228-2, however the likely level of vibration from this activity is expected to be substantially below the vibration criteria for building damage based on experience from other sites. AWN Consulting Ltd (the author of this chapter) has previously conducted vibration measurements under controlled conditions, during trial construction works on a sample site where breaking was carried out. The trial construction works consisted of the use of the following plant and equipment when measured at various distances:

- Three tonne hydraulic breaker on small CAT tracked excavator; and
- Six tonne hydraulic breaker on large Liebherr tracked excavator.

Vibration measurements were conducted during various staged activities and at various distances. Peak vibration levels during staged activities using the three-tonne breaker ranged from 0.48 PPV (mm/s) to 0.25 PPV (mm/s) at distances of 10 m to 50 m respectively from the breaking activities. Using a six-tonne breaker, measured vibration levels ranged between 1.49 PPV (mm/s) to 0.24 PPV (mm/s) at distances of 10 m to 50 m respectively. While these measurements relate to breaking of concrete, the range of values recorded provides some context in relation to typical ranges of vibration generated by construction-breaking activity. The levels measured at up to 50 m from the activity are significantly below the assessment threshold set out in Table 12-4.

Accounting for the distance from proposed works to the nearest NSLs, vibration effects are not likely at any NSL.

12.6.2.1.3 Description of Effects

The likely predicted noise and vibration effects are below the limits and/or thresholds identified. With respect to the EPA's criteria for description of effects, the likely potential worst-case associated effects at the nearest noise sensitive locations associated with the construction of turbines and hardstanding areas are described as follows:

Quality	Significance	Duration
Adverse	Not Significant	Short Term

The above effect should be considered in terms that the effect is variable, and that this assessment considers the locations of the greatest potential impact. There are no likely significant noise or vibration effects from the construction of turbines and hardstands.

12.6.2.2 Operational Lidar Unit

12.6.2.2.1 Noise

The nearest NSL to the proposed Lidar foundation and hardstand is House 023, which is approximately 412 m to the closest point of the Lidar area. Based on the same construction activities as outlined in Table 12-11, it is predicted that the likely noise levels from construction activities associated with the proposed Lidar will be in the order of 46 dB $L_{Aeq,T}$ at 023. This level of noise is well below the significance threshold of 65 dB $L_{Aeq,T}$, therefore no specific mitigation measures are required.

12.6.2.2.2 Vibration

With reference to the discussion on vibration presented in Section 12.6.2.1.2 there will be no significant vibration impacts associated with this phase of the proposed project and therefore no specific mitigation measures will be required.

12.6.2.2.3 Description of Effects

The likely predicted noise and vibration effects are below the limits and/or thresholds identified. With respect to the EPA's criteria for description of effects, the potential worst-case associated effects at the nearest noise sensitive locations associated with construction of Lidar foundation and hardstand are described below.

Quality	Significance	Duration
Adverse	Not Significant	Short Term

The above effect should be considered in terms that the effect is variable, and that this assessment considers the locations of the greatest potential effect. There are no likely significant noise or vibration effects from the construction of Lidar unit.

12.6.2.3 Construction of Internal Site Access Tracks

It is proposed to use the existing site access tracks as much as possible; however, new internal site access tracks will also be required to access the various parts of the proposed wind farm. A review of the tracks in the final site layout has identified that the nearest NSL to any point along

the proposed track is 56 m to 248. All other locations are at greater distances with the majority at significantly greater distances. The full description of the new road is outlined in Chapter 2 (Description of the Proposed Project).

12.6.2.3.1 Noise

Table 12-12 outlines the typical construction noise levels associated with the proposed works for this element of the construction.

Table 12-12: Predicted Noise Levels from Construction Plant at Various Distances from the New Internal Site access Tracks

Item (BS 5228 Ref.)	Plant Noise level at 10m Distance (dB $L_{Aeq,T}$)	Predicted Noise Level (dB $L_{Aeq,T}$) at distance (m)			
		56 m	75 m	100 m	125 m
Tracked Excavator (C.4.64)	75	58	55	53	51
HGV Movement (C.2.30)	79	62	59	57	55
Dumper Truck (C.4.4)	76	59	56	54	52
Vibrating Rollers (D.8.29)	77	60	57	55	53
Cumulative Construction Noise Level	--	66	63	61	59

At 56 m from the proposed works, which is the shortest distance to any NSL, the predicted noise levels are within the linear works construction noise limit of 70 dB $L_{Aeq,12hr}$ as set out in Section 12.3.2.2.

There are no items of plant or construction activities that are likely to give rise to noise levels that would be considered out of the ordinary or in exceedance of the thresholds outlined in Table 12-1. No specific mitigation measures are required.

12.6.2.3.2 Vibration

With reference to the discussion on vibration presented in Section 12.6.2.1.2 there will be no significant vibration impacts associated with the construction of internal site access tracks and therefore no specific mitigation measures are required.

12.6.2.3.3 Description of Effects

The likely predicted noise and vibration effects are below the limits and/or thresholds identified. With respect to the EPA's criteria for description of effects, the potential worst-case associated effects at the nearest noise sensitive locations associated with construction of internal site access tracks are described below.

Quality	Significance	Duration
Adverse	Not Significant	Temporary

The above effects are variable, and this assessment considers the locations of the greatest potential effect(s). There are no likely significant noise or vibration effects from the construction of internal site access tracks.

12.6.2.4 Borrow Pits

12.6.2.4.1 Noise

One borrow pit is proposed at the coordinates in Table 12-13. To inform this aspect of the proposal, a comparative noise assessment has been prepared and is outlined in the following paragraphs. Two situations have been considered as follows:

- Scenario A Blasting operation
- Scenario B Rock breaking operation

In terms of these activities please note the following:

- One mobile crusher will operate at the pit for both options;
- In Scenario B, two rock breakers will be used at each borrow pit;
- The plant will operate simultaneously in the vicinity of the proposed borrow pit location indicated in Table 12-13; and
- Table 12-14 outlines the assumed noise levels for the plant items as extracted from BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise.

Table 12-13: Proposed Borrow Pit Locations

Borrow Pit Ref	Co-ordinates (ITM)		Distance to nearest NSL
	Easting	Northing	
BP-01	524403	751565	601 m from 203

Table 12-14: Plant Noise Emissions

Item	dB(A) L_w Levels per Octave Band (Hz)								dB(A)
	63	125	250	500	1k	2k	4k	8k	
Crusher	95	98	98	106	103	100	95	86	110
Rock Breaker	93	101	104	114	115	116	113	106	121
HGV Movement	77	88	95	93	93	92	86	76	98
Dump Truck	87	92	99	97	102	99	94	85	105
Semi-mobile screen / stockpiler	69	82	96	99	103	101	99	88	107
Tracked Excavator	77	88	95	93	93	92	86	76	99
Generator	81	86	93	89	83	80	74	67	95

A construction noise model has been prepared to consider the expected noise emissions from the proposed construction works at borrow pits for the two scenarios as outlined above.

The nearest NSL to any of the borrow pit locations is at a distance of 601 m from the borrow pit area. Consequently, the resulting noise levels at the NSLs are well below the daytime construction noise criterion. The predicted levels at the ten NSLs with the highest predicted noise levels when all plant operate simultaneously are presented in Table 12-15.

Table 12-15: Prediction Noise Levels from Borrow Pit Activity at Nearest NSLs

Location Ref.	Predicted Construction Noise Level, dB $L_{Aeq,12hr}$	
	Scenario A	Scenario B
203	39	49
202	38	48
356	38	48
184	37	47
366	37	47
185	37	47
23	37	43
204	37	47
186	36	46
201	36	46

Review of the results contained in Table 12-15 confirms the following:

- Predicted construction noise levels for both Scenario A and B at the borrow pit are well within the best practice construction noise criteria outlined in Table 12 1. It is confirmed that construction works at the borrow pit will only occur during daytime periods only (07:00 to 19:00hrs).
- The blasting proposal results in lower levels of construction noise since the use of the rock breaking plant is not required in this instance. Predicted noise levels are lower at all assessed locations for Scenario A.
- It is accepted that the individual blast events will be audible at some locations. Blasting activities, should they be required, will be designed and managed by a suitably qualified blasting specialist. Blast design parameters including charge weight, delay sequencing and blast geometry will be selected to ensure compliance with criteria. Monitoring will be undertaken during blasting activities and blast designs will be adjusted where necessary to maintain compliance with the adopted criteria outlined in Section 12.3.2.1. Mitigation measures in relation to cumulative effects with the existing quarry are described in Section 12-9.

12.6.2.4.2 Vibration

With reference to the discussion on vibration presented in Section 12.6.2.1.2, there will be no significant vibration impacts associated with the construction phase of the proposed project and therefore no specific mitigation measures will be required.

12.6.2.4.3 Description of Effects

The predicted noise and vibration effects are below the limits and/or thresholds identified. With respect to the EPA's criteria for description of effects, the potential worst-case associated effects at the nearest noise sensitive locations associated with operation of borrow pits are described follows:

Quality	Significance	Duration
Adverse	Not Significant	Short Term

There are no likely significant noise or vibration effects from the operation of the borrow pit.

12.6.2.5 Onsite Control Building Construction

12.6.2.5.1 Noise

The nearest NSL to the proposed onsite control building is 377, which is 371 m to the closest point of the building. As a worst-case example assuming the same construction activities as outlined in Table 12-11, it is predicted that the likely worst-case potential noise levels from construction activities associated with the building will be in the order of 52 dB $L_{Aeq,T}$ at 377, the nearest NSL. This level of noise is well below the significance threshold of 65 dB $L_{Aeq,T}$, therefore no specific mitigation measures are required.

12.6.2.5.2 Vibration

With reference to the discussion on vibration presented in Section 12.6.2.1.2 there will be no significant vibration impacts associated with the construction phase of the proposed project and therefore no specific mitigation measures will be required.

12.6.2.5.3 Description of Effects

The likely predicted noise and vibration effects are below the limits and/or thresholds identified. With respect to the EPA's criteria for description of effects, the potential worst-case associated effects at the nearest noise sensitive locations associated with construction of the onsite control building are described below.

Quality	Significance	Duration
Adverse	Not Significant	Short Term

The above effects are variable, and this assessment considers the locations of the greatest potential effect. There are no likely significant noise or vibration effects from the construction of onsite control building.

12.6.2.6 Offsite 110kV Substation

12.6.2.6.1 Noise

The nearest NSL to the proposed Offsite 110kV Substation is approximately 470 m to the closest point of the substation. As a worst-case example assuming the same construction activities as outlined in Table 12-11, it is predicted that the likely worst-case potential noise levels from construction activities associated with the substation will be in the order of 49 dB $L_{Aeq,T}$ at the nearest NSL. This level of noise is well below the significance threshold of 65 dB $L_{Aeq,T}$, therefore no specific mitigation measures are required.

12.6.2.6.2 Vibration

With reference to the discussion on vibration presented in Section 12.6.2.1.2 there will be no significant vibration impacts associated with the construction phase of the proposed project and therefore no specific mitigation measures will be required.

12.6.2.6.3 Description of Effects

The likely predicted noise and vibration effects are below the limits and/or thresholds identified. With respect to the EPA's criteria for description of effects, the potential worst-case associated effects at the nearest noise sensitive locations associated with construction of the substation are described below.

Quality	Significance	Duration
Adverse	Not Significant	Short Term

The above effects are variable, and this assessment considers the locations of the greatest potential effect. There are no likely significant noise or vibration effects from the construction of the Offsite 110kV Substation.

12.6.2.7 Temporary Construction Compound

12.6.2.7.1 Noise

A temporary compound will be constructed to provide office space, welfare facilities, car parking and hardstands for storing materials. The nearest NSL to the compound is 023, at a distance of 210 m. Based on the same construction activities as outlined in Table 12-12 for new site tracks, it is predicted that the likely noise levels from construction activities associated with the compounds will be in the order of 53 dB $L_{Aeq,T}$ at 023, the nearest NSL. This level of noise is well below the significance threshold of 65 dB $L_{Aeq,T}$, therefore no specific mitigation measures are required.

12.6.2.7.2 Vibration

With reference to the discussion on vibration presented in Section 12.6.2.1.2 there will be no significant vibration impacts associated with the construction phase of the proposed project and therefore no specific mitigation measures will be required.

12.6.2.7.3 Description of Effects

The likely predicted noise and vibration effects are below the limits and/or thresholds identified. With respect to the EPA's criteria for description of effects, the potential worst-case associated effects at the nearest noise sensitive locations associated with construction of the temporary construction compound are described below.

Quality	Significance	Duration
Adverse	Not Significant	Short Term

The above effects are variable, and this assessment considers the locations of the greatest potential effect. There are no likely significant noise or vibration effects from the temporary construction compound.

12.6.2.8 Habitat Management Plan

12.6.2.8.1 Noise

The habitat management plan (HMP) detailed in Appendix 6.6 (Chapter 6 Biodiversity) will include a vegetation clearance and habitat creation/enhancement as part of the biodiversity enhancement measures. These works will be conducted at proximity of the wind turbines, and at least approximately 300 m from the nearest NSL. Based on the same construction activities as outlined in Table 12-12 for new site tracks, it is predicted that the likely noise levels from vegetation clearance and habitat creation/enhancement will be Not Significant.

12.6.2.8.2 Vibration

With reference to the discussion on vibration presented in Section 12.6.2.1.2 there will be no significant vibration impacts associated with the construction phase of the proposed project and therefore no specific mitigation measures will be required.

12.6.2.8.3 Description of Effects

The likely predicted noise and vibration effects are below the limits and/or thresholds identified. With respect to the EPA's criteria for description of effects, the potential worst-case associated effects at the nearest noise sensitive locations associated with vegetation clearance and habitat creation/enhancement are described below.

Quality	Significance	Duration
Adverse	Not Significant	Short Term

The above effects are variable, and this assessment considers the locations of the greatest potential effect. There are no likely significant noise or vibration effects from the habitat management plan.

12.6.2.9 Deposition Area

12.6.2.9.1 Noise

Two deposition areas will be constructed to allow spoil to be stored temporarily. The nearest NSLs to the deposition areas are 023 at a distance of 453 m, and 203 at a distance of 600 m. Based on the same construction activities as outlined in Table 12-12 for new site tracks, it is predicted that the likely noise levels from construction activities associated with the area will be in the order of 46 dB $L_{Aeq,T}$ at 023, and 43 dB $L_{Aeq,T}$ at 203. This level of noise is well below the construction noise threshold of 65 dB $L_{Aeq,T}$, therefore no specific mitigation measures are required.

12.6.2.9.2 Vibration

With reference to the discussion on vibration presented in Section 12.6.2.1.2 there will be no significant vibration impacts associated with the construction phase of the proposed project and therefore no specific mitigation measures will be required.

12.6.2.9.3 Description of Effects

The likely predicted noise and vibration effects are below the limits and/or thresholds identified. With respect to the EPA's criteria for description of effects, the potential worst-case associated effects at the nearest noise sensitive locations associated with construction of the deposition area are described below.

Quality	Significance	Duration
Adverse	Not Significant	Short Term

The above effects are variable, and this assessment considers the locations of the greatest potential effect. There are no likely significant noise or vibration effects from the deposition area.

12.6.2.10 Grid Connection Construction

It is proposed to construct a 33 kV private grid connection cable (circa 8.7 km in length) from the on-site control building to a proposed new loop-in 110 kV substation. The associated construction works will occur for short durations at varying distances from NSLs. Review of the grid connection route has identified that the nearest NSLs to the proposed underground cable route, along local roads, are located at approximately 10 m from the nearest point.

12.6.2.10.1 Noise

The associated construction works will occur for short durations (rolling construction method, approximately 100 – 150 m per day) at varying distances from NSLs.

Table 12-16 presents outline noise calculations, considering the typical anticipated methods of construction, at varying distances from the construction works. The calculations assume that there is no acoustic screening (i.e. barriers) in place between the site works and the NSL and that plant items are operating at nominal on-times noted. Calculations have assumed an on-time of 66% for each item of plant i.e., that the item is operational for 8 hours over a 12-hour assessment period. Note the plant items and activities are indicative and based on assumption to be representative of a reasonable conservative assessment.

The nearest NSL to the Proposed Grid Connection underground cabling is H049 and is located at approximately 10 m.

Table 12-16 Indicative Noise Levels for Typical Construction Plant at nearest distance from the Proposed Grid Connection Works

Plant Item (BS 5228 Ref.)	Plant Noise Level at 10m Distance (dB L_{Aeq})	Calculated Construction Noise Levels dB $L_{Aeq,12hr}$ at given distance from works			
		10 m	15 m	25 m	50 m
Tracked Excavator (C.2.7)	70	68	64	58	51
Vibrating Rollers (C.2.40)	73	71	67	61	54
Wheeled Loader (C.2.8)	68	66	62	56	49
Dumper Truck (C.4.4)	76	74	70	64	57
Cumulative Predicted Construction Noise Level (No Rock Breaking)		77	73	67	60
Excavator Mounted Rock Breaker (C9.12)[a]	85	78	74	70	64
Cumulative Predicted Construction Noise Level (with Rock Breaking)[b]		78	74	70	64

A - Assumed 20% on time for rock breaking
B - Only one tracked excavator considered in cumulative calculations. Rock breaking and Vibratory rolling will occur simultaneously.

For standard grid connection works, any NSL set back at 20 m or more from the proposed works is predicted to experience noise levels within the linear construction noise limit of 70 dB $L_{Aeq,12hr}$ as set out in Section 12.3.2.2.

NSLs located closer than 20 m to the works may experience construction noise levels slightly above 70 dB $L_{Aeq,12hr.}$ However, due to the progressive nature of the construction methodology, it is anticipated that works will remain in close proximity to the nearest NSLs only for a limited duration. The predicted noise levels shown in

Table 12-16 are expected to occur for less than one day in a worst-case scenario, with works typically progressing at a rate of 100 to 150 metres per day along the route.

Based on the consideration of duration guidance in Section 12.3.2.4.2, the likely noise impacts are considered not significant, and no specific mitigation measures are required.

Where rock breaking is required along the route, any NSL set back 25 metres or more from the proposed works is predicted to remain within the linear construction noise limit of 70 dB $L_{Aeq,12hr}$ as set out in Section 12.3.2.4.2. The assessment is assuming that rock breaking activities will be required along the grid connection route at the point closest to these NSLs. This assumption is very conservative.

In line with the guidance in Section 12.3.2.2 the likely noise impacts are considered not significant, and no specific mitigation measures are required.

12.6.2.10.2 Vibration

With reference to the discussion on vibration presented in Section 12.6.2.1.2 there will be no significant vibration impacts associated with the construction phase of the proposed project and therefore no specific mitigation measures will be required.

12.6.2.10.3 Description of Effects

For NSLs within 15 m of the grid connection works and 25 m from rock breaking activities anticipated at the joint bay locations, the likely predicted noise levels will potentially exceed the construction noise criterion as shown in 12.3.2.2. However, once the duration of the effects are taken into consideration, the likely noise and vibration effects are not significant.

With respect to the EPA's criteria for description of effects, the potential worst-case associated effects at the nearest noise sensitive locations associated with construction of the grid connection, including underground cabling and overhead lines, are described below.

Quality	Significance	Duration
Adverse	Slight	Temporary

The above effects are variable, and this assessment considers the locations of the greatest potential effect. There are no likely significant noise or vibration effects from the construction of the grid connection.

12.6.2.11 Construction Traffic

This section has been prepared to review potential noise impacts associated with construction traffic on the local road network. The information presented in Chapter 15 (Traffic and Transportation) has been used to inform the assessment presented in this chapter. Table 12-17 and Table 12-18 present the predicted traffic figures during the construction year 2029, as well as the predicted change in noise levels.

Table 12-17 AADT figures in 2029

Link	2029 AADT Do Nothing	%HGV	2029 AADT Do Something	%HGV

R334	4333	8.31%	4573	11.02%

Table 12-18 Change of Noise Level due to Construction Traffic and effect

Link	Change in Noise Level	DMRB Impact	Significance
R334	1.3	Minor	Not Significant

12.6.2.11.1 Description of Effects

Based on the above results, the likely noise and vibration effects are not significant at all NSLs.

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

Quality	*Significance*	*Duration*
Adverse	Not Significant	Short-Term

12.6.3 Decommissioning Phase

In relation to the decommissioning phase, similar overall noise levels as those calculated for the construction phase are expected, as similar tools and equipment will be used. The noise and vibration impacts associated with any decommissioning of the proposed project can be comparable to those outlined in relation to the construction phase (as per Section 12.6.2) albeit less works will be required as only above-ground structures will be removed. Turbine foundations will remain in place underground and hardstands will be covered in topsoil and reseeded, the plinth will be removed, and the foundation will be reinstated to grassland. The underground cabling and on-site substation will remain in place. The predicted noise levels are expected to be below the appropriate Category A value (i.e. 65 dB $L_{Aeq,T}$) at all NSLs for the decommissioning phase, therefore no likely significant effects arise.

12.6.3.1.1 Description of Effects

The likely predicted noise and vibration impacts will be below the limits and/or thresholds identified. With respect to the EPA's criteria for description of effects, the likely potential associated effects at the nearest noise sensitive locations associated with decommissioning are described herein.

Quality	Significance	Duration
Adverse	Not Significant	Short Term

There are no likely significant noise or vibration effects from the decommissioning phase.

12.6.4 Operational Phase

12.6.4.1 Assessment of Wind Turbine Noise

Using the assessment methodology described in Section 12.4.5 the predicted turbine noise levels have been calculated at all NSLs within the study area of the proposed wind farm site. A

worst-case omni-directional turbine noise prediction assessment has been carried out using the ISO 9613-2:1996 calculation standard and best practice guidance for turbine noise prediction contained in the IOA GPG.

The initial noise prediction calculations are based on 'worst-case' conditions favourable to noise propagation, i.e., downwind propagation from source to receiver and/or downward refraction under temperature inversions.

Appendix 12-6 presents the predicted omni-directional turbine results at all NSLs in tabulated form and Noise contours for the omni-directional rated power wind speed (i.e., highest noise emission) are presented in Appendix 12-5.

Table 12-19 presents the predicted noise levels at different wind speeds for the receivers that present exceedances with the V136 turbine.

The results of the noise prediction models have been compared against the turbine noise limits that have been assigned to each of the NSL's as presented in Section 12.5.2 which in turn have been derived in accordance with the applicable criteria described in detail in Section 12.3.2.6.

Table 12-19 Predicted Noise Levels at the receivers presenting exceedances

House	NML Representative Location for Criterion	Parameter	Standardised Wind Speed, m/s						
			3	4	5	6	7	8	9
23	NML 8	Predicted	30.8	34.2	39.0	42.8	43.4	43.4	42.9
		Daytime Criterion	45.0	45.0	45.0	45.0	45.0	46.3	49.0
		Daytime Excess	--	--	--	--	--	--	--
		Night-time Criterion	43.0	43.0	43.0	43.0	43.0	43.0	45.5
		Night-time Excess	--	--	--	--	0.4	0.4	--
26	NML 4	Predicted	30.9	34.3	39.2	42.9	43.5	43.5	43.0
		Daytime Criterion	45.0	45.0	45.0	45.0	45.0	45.0	45.0
		Daytime Excess	--	--	--	--	--	--	--
		Night-time Criterion	43.0	43.0	43.0	43.0	43.0	43.0	43.0

House	NML Representative Location for Criterion	Parameter	Standardised Wind Speed, m/s						
			3	4	5	6	7	8	9
		Night-time Excess	--	--	--	--	0.5	0.5	--
163	NML 2	Predicted	29.2	32.6	37.5	41.2	41.8	41.8	41.3
		Daytime Criterion	40.0	40.0	40.0	40.0	45.0	45.0	45.0
		Daytime Excess	--	--	--	1.2	--	--	--
		Night-time Criterion	43.0	43.0	43.0	43.0	43.0	43.0	43.0
		Night-time Excess	--	--	--	--	--	--	--
381	NML 3	Predicted	28.9	32.3	37.2	40.9	41.5	41.5	41.0
		Daytime Criterion	40.0	40.0	40.0	40.0	45.0	45.0	45.0
		Daytime Excess	--	--	--	0.9	--	--	--
		Night-time Criterion	43.0	43.0	43.0	43.0	43.0	43.0	43.0
		Night-time Excess	--	--	--	--	--	--	--

At most of the NSLs, the worst omni-directional cumulative turbine noise levels are below the noise criteria. However, 4 no. NSLs present potential exceedances for the worst-case omni-directional scenario at 6, 7 and 8 m/s, and therefore, it is necessary to consider wind direction for the noise prediction at these. The directional results at these houses are presented in Table 12-20. It can be seen that at location 23, no exceedances remain once directional propagation is taken into account.

Table 12-20 Predicted exceedances review for directional scenario

NSL	Period	Wind Speed	Predicted Exceedance in L_{A90}, 10-min Levels (dB) in Wind Direction Sector							
			N	NE	E	SE	S	SW	W	NW
23	Night	7 & 8	--	--	--	--	--	--	--	--

NSL	Period	Wind Speed	Predicted Exceedance in L_{A90}, 10-min Levels (dB) in Wind Direction Sector							
			N	NE	E	SE	S	SW	W	NW
26	Night	7 & 8	0.3	--	--	--	--	--	--	--
163	Day	6	--	--	--	0.4	1.2	1.1	0.2	--
381	Day	6	0.9	--	--	--	--	--	0.9	0.9

The exceedances that are predicted are limited to specific wind speeds and wind directions. To ensure compliance with the turbine noise criteria and address the exceedances, mitigation measures in the form of a turbine curtailment strategy are described in Section 12.7.2.

Excessive amplitude modulation is recognised as a potential operational characteristic of wind turbine noise. However, current industry guidance confirms that the occurrence, location and duration of excessive AM cannot be reliably predicted at the planning stage. Consequently, in accordance with ARWTN, no AM correction has been applied to the predicted noise levels presented in this assessment. Notwithstanding this uncertainty, a structured monitoring, investigation and mitigation framework is provided in Sections 12.7.2.1.1 and 12.7.3 to identify and address any occurrence of excessive AM should it arise during operation.

12.6.4.1.1 Description of Effects

With the exception of the NSLs 26, 163 and 381, the assessment shows that there are no significant effects associated with the operation of the wind turbines of the proposed project as the predicted cumulative turbine noise levels are within the turbine noise criteria as presented in Section 12.5.2.

While noise levels at low wind speeds will increase due to the development, specifically the operation of the turbines, the predicted levels will remain low, albeit a new source of noise will be introduced into the soundscape.

The exceedances at locations 26, 163 and 381 are slightly above the applicable wind turbine noise criteria; on that basis, the significance of the effect before mitigation can be described as significant.

Quality	Significance	Duration
Adverse	Significant	Long-term

At all other NSLs, the potential worst-case associated effects at the most impacted noise sensitive locations associated with operation of the wind turbine of the proposed project are described as follows:

Quality	Significance	Duration
Adverse	Not Significant	Long-term

The above effect is variable, and this assessment considers the locations of the greatest potential impact.

12.6.4.2 Fixed Plant Noise

12.6.4.2.1 Onsite Control Building

Details of the proposed Onsite Control Building are described in Chapter 2. The nearest NSL to the proposed control building is NLS 377, which is at a distance of 371 m. The proposed onsite control building does not have any outdoor plant that could give rise to noise at NSLs, and operational noise from the proposed building is scoped out of this assessment.

12.6.4.2.2 Offsite 110kV Substation

Details of the proposed 110 kV substation are described in Chapter 2. The substation is likely to be operating continuously, and the noise effects at the nearest NSL have been assessed to identify the potential greatest effects.

The noise emission level associated with a typical 110 kV substation is within the order of 92 dB(A) L_w.

Noise prediction model calculations for the operation of the substation have been undertaken in accordance with ISO 9613:2024. Figure 12-3 shows the location of the proposed 110kV Substation with regards to the nearest NSLs (loc A and Loc B) in the townlands of Bellanagarraun and Killamanagh, respectively.

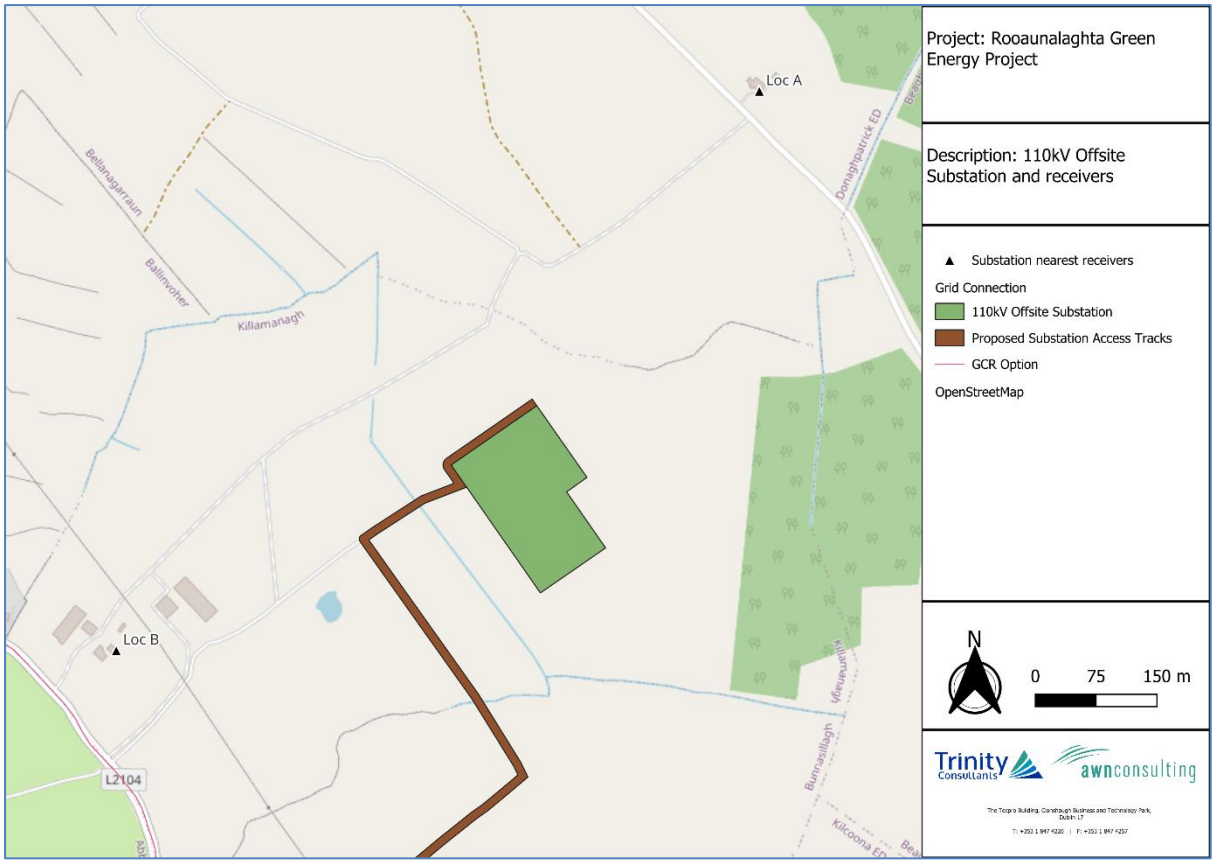


Figure 12-3 Offsite Substation location with regards to nearest NSL

Both locations are approximately at 470 m to the nearest point of the substation compound. The predicted noise level from the operation of the substation at these NSLs is 23 dB $L_{Aeq,T}$. This level of noise is below the criteria in Section 12.5.3 and hence there will be no significant noise effects

from the operation of the substation at any NSL. Furthermore, the predicted noise level is well below the criterion for fixed mechanical plant outlined in Section 12.3.2.7 and unlikely to result in any adverse effects at NSLs.

12.6.4.2.3 Description of Effects

With respect to the EPA's criteria for description of effects, the potential worst-case associated effects at the nearest NSLs associated with the operation of the fixed mechanical and electrical plant at the proposed substation is described herein.

Quality	Significance	Duration
Adverse	Not Significant	Long-term

12.7 Mitigation Measures

Regarding construction activities, BS 5228-1 and BS5228-2 are the industry best practice and offer detailed guidance on the control of noise & vibration from demolition and construction activities.

12.7.1 Construction Phase Mitigation

The assessment of potential impacts presented in Section 12.6.2 has demonstrated that the proposed project will comply with the noise and vibration criteria during the construction phase and therefore no specific mitigation measures are required. However, as a matter of best practice, the following described below will be implemented.

The contract documents will specify that the Contractor undertaking the construction works will be obliged to adopt best practice noise abatement measures contained in British Standard BS 5228-1:2009+A1:2014 *Code of practice for noise and vibration control on construction and open sites – Noise* and BS 5228-2:2009+A1:2014 *Code of practice for noise and vibration control on construction and open sites – Vibration*.

To ameliorate any potential noise effects that may present during the construction phase, a schedule of noise control measures has been formulated in accordance with best practice guidance, and the contract documents will require the Contractor to implement these measures. These are outlined in the Construction and Environmental Management Plan (CEMP) that has been prepared for the proposed project.

For blasting associated with borrow pits, the guidance documents discussed in BS 5228-2:2009+A1:2014 – *Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration* and The Transport Infrastructure Ireland (TII) (formerly National Roads Authority (NRA)) publication *Guidelines for the Treatment of Noise and Vibration in National Road Schemes* (2004) contain appropriate criteria for blasting activities and a detailed assessment will be undertaken by a specialist blast design engineer to determine the blast design parameters.

Recommendations contained within BS 5228: Part 1 and the European Communities (Construction Plant and Equipment) (Permissible Noise Levels) Regulations 1988 will be implemented in relation to blasting operations.

12.7.2 Operational Phase

12.7.2.1 Wind Turbine Noise

An assessment of the operational wind turbine noise levels has been undertaken in accordance with best practice guidelines and procedures as outlined in Section 12.3.2.6. The findings of the assessment, presented in Section 12.6.4.1, have determined that the predicted operational noise levels associated with the proposed project will be within best practice turbine noise criteria at most locations with no significant impacts or effects. However, there are slight exceedances at three locations (26, 163 and 381) in the absence of mitigation.

Mitigation in the form of turbine curtailment can ensure that the residual turbine noise levels will be within the turbine noise criteria in specific wind conditions (i.e., wind speed and direction).

To address the potential exceedances predicted, the Vestas V136 turbine in this assessment can be programmed to operate in low noise modes for specific wind speed bins and periods. The V136 turbines can be configured for up to 3 different operating modes (SO11, SO12 and SO13) and all modern wind turbines will have similar controls to reduce the noise emission of the turbine in certain conditions.

For any turbine curtailment strategy that is developed, consideration must be given to the practical benefits. Such curtailment may unnecessarily reduce the electrical power generating capacity of a wind farm, for an imperceptible change to the overall turbine noise levels. When curtailing for exceedance of the night-time criterion consideration should be given to the background noise at the specific NSL to avoid unnecessarily curtailing turbine noise when the result would yield an imperceptible change to the overall turbine noise levels.

The outline curtailment strategy presented in Table 12-21 demonstrates the extent of turbine curtailment required for the V136 in order to comply with the noise criteria in Table 12-9.

Table 12-21 Outline Curtailment Strategy for V136 Turbine to Address Potential Exceedances

Period	Wind Speed	Predicted Exceedance in L_{A90}, 10-min Levels (dB) in Wind Direction Sector							
		N	NE	E	SE	S	SW	W	NW
Day	6	T12 at SO12	--	--	T8 at SO12	T7 & T8 at SO12	T7 & T8 at SO12	T8 & T11 at SO12	T11 at SO12
Night	7 & 8	T5 at SO11	--	--	--	--	--	--	--

The predicted noise levels at NSLs 26, 163 and 381, with these mitigation measures applied, are presented in Table 12-22.

Table 12-22 Predicted Noise Levels with mitigation applied

NSL	Period	Wind Speed	Predicted Exceedance in L_{A90}, 10-min Levels (dB) in Wind Direction Sector							
			N	NE	E	SE	S	SW	W	NW
26	Night	7 & 8	42.7	42.8	41.7	41.7	41.4	39.7	41.5	41.3
163	Day	6	35.4	35.5	38.3	39.7	39.8	39.6	39.2	37.6
381	Day	6	39.8	39.1	35.3	34.5	35.6	39.0	39.9	40.0

All predicted noise levels for NSLs 163 and 381 are within the criterion of 40 dB L_{A90} for 6 m/s for daytime periods.

Similarly, all predicted noise levels for NSL 26 are within the criterion of 43 dB L_{A90} for 7 and 8 m/s for night-time periods.

The principles outlined in this section for addressing potential exceedances at a limited range of operational wind speeds and directions will be applied to all turbines considered in this assessment, if required, to ensure compliance with noise limits. Table 12-22 represents the worst-case scenario in terms of magnitude of exceedances to be addressed through mitigation in the form of turbine curtailment.

With curtailment in place the operation of proposed project will be within the proposed turbine noise limits at all locations.

This would be controlled in practice through a planning condition imposing noise limits on operational noise from the wind turbines at neighbouring residential properties, in line with the noise criteria outlined in Section 12.5.2 and/or the relevant operational criteria associated with the grant of planning for the proposed project.

12.7.2.1.1 Amplitude Modulation and Tonality

In the event that a complaint which indicates potential excessive amplitude modulation (AM) associated with the proposed project, the operator will fully investigate the complaint in collaboration with the turbine manufacturer, through review of the meteorological periods and conditions during which the reported AM occurs. If an ongoing issue with excessive AM is identified, a mitigation strategy to reduce the level of AM will be implemented through engineering methods and/or curtailment of specific turbines. The operator may appoint a qualified acoustic consultant to objectively assess the level of AM in accordance with the methods outlined in the IOA AMWG or subsequent revisions.

The measurement method outlined in the IOA AMWG document, known as the 'Reference Method', will provide a robust and reliable indicator of AM and yield important objective information on the frequency and duration of occurrence, which can be used to evaluate different operational conditions including methods to mitigate any excessive AM. These mitigation measures, if required, will consist of the implementation of operational controls for the relevant turbine type, which will include turbine curtailment under specific operational conditions and may in very unlikely circumstance require turning specific turbine off under

certain conditions to minimise adverse impacts from excessive AM associated with the proposed project.

If the complaints suggest the potential occurrence of clearly audible tonality in the wind turbine noise, the audibility of the tones will be investigated from measured data with a robust, objective method such as that included in ISO 1996-2:2017 with modifications in IEC 61400-11-2. If the rated level of the wind farm is above the limit, then the operator would liaise with the turbine manufacturer to investigate and implement measures to reduce the rated level to below the limit. This may involve engineering methods, operational changes and/or (in very unlikely circumstance) curtailment of specific turbines.

The commitment outlined to control AM from wind turbines are considered best practice. The proposed approach will ensure that any adverse impacts from excessive amplitude modulation (AM) associated with the operation of the proposed project are effectively managed by the operator.

12.7.2.2Fixed Plant

The assessment of noise from the operation of fixed plant at the substation is predicted to comply with the recommendations contained in best practice discussed in Section 12.3.2.7 and the proposed criteria in Section 12.5.3, and that no likely significant effects are expected. Therefore, no specific mitigation measures are required. As described in Section 12.5.3, as the design progresses, consideration will be given to controlling and minimising any potential impacts at NSLs arising from acoustic features associated with the operation of the selected plant.

12.7.3 Monitoring

12.7.3.1Noise Compliance Monitoring Programme

Noise Compliance Monitoring refers to testing the wind turbine noise levels due to the Proposed Project against the planning conditions, in terms of overall noise levels.

Prior to the commissioning of the project, the developer will submit a Noise Compliance Monitoring Programme (NCMP) to the planning authority for written agreement. The NCMP will include a detailed methodology for noise measurements, procedures for recording results and locations at which noise is to be monitored.

The NCMP will include both commissioning noise surveys to test compliance with the noise levels in the planning condition, and also a Complaint Management Protocol with a clear path to address any noise complaint.

Under the NCMP, compliance noise surveys will be undertaken to verify compliance with any noise conditions applied to the development. Surveys will commence within six months of a wind farm being commissioned. The guidance outlined in the IOA GPG and Supplementary Guidance Note 5: Post Completion Measurements (July 2014) will be complied with.

In the unlikely event that an exceedance of the noise criteria is identified as part of the commissioning assessment, detailed mitigation strategy will be followed in the form of curtailment. Following the implementation of the measures, the commissioning noise survey will be repeated.

12.7.3.2Noise Complaint Management Protocol

In the event of a noise-related complaint associated with the operation of the Proposed Project, the Operator will fully investigate the complaint in accordance with the agreed NCMP.

In the event of a complaint associated with noise tonality or amplitude modulation associated with the proposed project, the operator will fully investigate the complaint in accordance with the agreed NCMP.

A Draft Noise Complaint Management Protocol for addressing amplitude modulation and tonality is presented in Appendix 12-7. A final version of this protocol will be contained within the NCMP to be agreed the relevant Local Authority and/or Authorities.

12.7.4 Decommissioning Phase Mitigation

Decommissioning will involve similar noise sources to the Construction Phase, though the intensity will be reduced. On the basis that the potential construction impacts presented in Section 12.6.2 has demonstrated that the proposed project will comply with the noise and vibration criteria, no specific mitigation measures are required. Prior to the decommissioning phase, a decommissioning plan will be agreed with the local authority and implemented by the contractor during the works.

12.8 Residual Effects

This section summarises the likely residual noise and vibration effects associated with the proposed project following the implementation of mitigation measures. The effects described consider the locations of the greatest potential impact unless otherwise stated.

12.8.1 Construction Phase

During the construction phase of the project, there will be some effects on nearby NSLs due to noise emissions from site traffic and other construction activities. However, given the distances between the main construction works and the NSLs, the short-term duration of the construction phase, and the assessment's findings that the expected noise and vibration emissions will be below the identified threshold and limit values, the effects will not be significant.

With respect to the EPA's criteria for description of effects, in terms of these construction activities, the potential worst-case associated effects at the nearest NSLs associated with the various elements of the construction phase are described in Table 12-23.

Table 12-23: Residual Effects of the Construction Phase

Construction Element	Quality	Significance	Duration
Turbines and Hardstand Areas	Adverse	Not Significant	Short Term
Lidar	Adverse	Not Significant	Short Term
Internal Site access tracks	Adverse	Not Significant	Temporary
Borrow Pits	Adverse	Not Significant	Short Term

Onsite Control Building	Adverse	Not Significant	Short Term
Temporary Construction Compound	Adverse	Not Significant	Short Term
Habitat Management Plan	Adverse	Not Significant	Short Term
Deposition Area	Adverse	Not Significant	Short Term
Grid Connection and underground cabling	Adverse	Not Significant	Short Term
Construction Traffic	Adverse	Not Significant	Short Term
110kV Substation	Adverse	Not Significant	Short Term

The likely predicted noise and vibration effects are below the limits and/or thresholds identified. The described effects should be considered as variable, and this assessment considers the locations of the greatest potential effect. There are no residual significant noise or vibration effects from the construction phase.

12.8.2 Operational Phase

12.8.2.1 Wind Turbine Noise

The residual turbine noise levels associated with the proposed project will be within best practice noise criteria curves recommended in line with Irish guidance 'Wind Energy Development Guidelines for Planning Authorities' (DoEHLG, 2006), and significant effects are not expected with this project.

While noise levels at low wind speeds will increase due to the development and specifically the operation of the turbines, the predicted levels will remain low, albeit new sources of noise will be introduced into the soundscape.

With respect to the EPA's criteria for description of effects, the potential worst-case associated effects at the nearest NSLs associated with operational turbine noise are summarised as follows:

Quality	Significance	Duration
Adverse	Not Significant	Long-term

12.8.2.2 Fixed Plant

The noise from fixed plant items is predicted to comply with the recommendations contained in best practice discussed in Section 12.3.2.7 and with the proposed criteria in Section 12.5.3, and that no adverse impacts are expected. Therefore, no significant effects are expected.

With respect to the EPA's criteria for description of effects, the potential worst-case associated effects at the nearest NSLs associated with fixed plant noise are summarised in as follows.

Quality	Significance	Duration

Adverse	Not Significant	Long-term

12.8.3 Decommissioning Phase

During the decommissioning phase of the project, there will be some effects on nearby NSLs due to noise emissions from site traffic and other activities. However, given the distances between the works and the NSLs, the short-term duration of the decommissioning phase, and the assessment's findings that the expected noise and vibration emissions will be below the identified threshold and limit values, the effects will not be significant.

With respect to the EPA's criteria for description of effects, in terms of these construction activities, the potential worst-case associated effects at the nearest NSLs associated with the decommissioning phase are summarised in as follows.

Quality	Significance	Duration
Adverse	Not Significant	Short-term

12.8.4 Summary of Effects

Table 12-24: Summary of Effects

Potential Impact	Receptor	Significance of effect	Additional Mitigation	Residual significance of effect
Construction Phase				
Turbines and hardstands	Nearest noise-sensitive locations (NSLs)	Adverse, Not Significant, Short-Term	No specific mitigation is required. Best-practice noise and vibration controls in BS 5228-1 and BS 5228-2 will be implemented through the CEMP and contract documents.	Adverse, Not Significant, Short-Term
Lidar unit, onsite control building, offsite 110 kV substation, temporary compound, and deposition areas	Nearest NSLs to each work area	Adverse, Not Significant, Short-Term	No specific mitigation is required. Best-practice construction noise and vibration controls will be implemented through the CEMP and contract documents.	Adverse, Not Significant, Short-Term
Habitat Management Plan	Nearest NSLs to each applicable area	Adverse, Not Significant, Short-Term	No specific mitigation is required. Best-practice construction noise and vibration controls will be implemented through the CEMP and contract documents.	Adverse, Not Significant, Short-Term

Internal site access tracks	NSLs adjoining proposed internal access tracks	Adverse, Not Significant, Temporary	No specific mitigation is required. Best-practice construction noise and vibration controls will be implemented.	Adverse, Not Significant, Temporary
Borrow-pit operation, including rock breaking or blasting	Nearest NSLs	Adverse, Not Significant, Short-Term	Best-practice controls will be implemented. Blasting will be designed by a specialist blast design engineer in accordance with BS 5228-2 and TII guidance. As a good practice measure, the Developer will liaise with the neighbouring quarry operator to coordinate activities and minimise the impacts.	Adverse, Not Significant, Short-Term
Grid connection and underground cabling works	NSLs along the grid connection route, including properties close to the works	Adverse, Slight, Temporary (Not Significant in EIA Terms)	No specific mitigation is required due to the short-duration, progressive nature of the works. Best-practice controls will be implemented through the CEMP.	Adverse, Slight, Temporary (Not Significant in EIA Terms)
Operational Phase				
Operational wind turbine noise	Noise-sensitive locations within the operational study area; potential exceedances at NSLs 26, 163 and 381	Adverse, Significant, Long-Term at NSLs 26, 163 and 381; Adverse, Not Significant, Long-Term at all other NSLs	A directional, wind-speed-dependent turbine curtailment strategy will be implemented. Relevant turbines will operate in reduced modes under the identified conditions to achieve the applicable turbine noise criteria.	Adverse, Not Significant, Long-Term
Offsite 110 kV substation and other fixed plant	Nearest noise-sensitive locations to the offsite substation	Adverse, Not Significant, Permanent	No specific mitigation is required. Fixed plant will be designed and selected to comply with the applicable fixed-plant noise criteria, with acoustic characteristics controlled where necessary.	Adverse, Not Significant, Permanent
Decommissioning Phase				

Decommissioning activities	Noise-sensitive locations nearest to decommissioning works and associated traffic routes	Adverse, Not Significant, Short-Term	A decommissioning plan will be agreed with the local authority and implemented by the contractor. Best-practice noise and vibration controls comparable to those for construction will apply.	Adverse, Not Significant, Short-Term

12.9 CUMULATIVE EFFECTS

A review of the planning applications submitted in proximity to the proposed project (see Section 12.3.2.6.7 and Appendix 12-5 which define the study area for this assessment, which is based on noise contours) has been undertaken and these projects were considered in the noise and vibration cumulative assessments.

12.9.1 Construction and Decommissioning

It is not expected there will be any other activities that would give rise to significant cumulative effects during the construction phase. The predicted noise and vibration for the proposed project are not of enough magnitude to cause an increase in the cumulative construction noise emissions that would exceed the threshold for significant effects at any NSL.

In order for cumulative noise levels to increase, the contribution of noise from the proposed project must be within 10 dB of the other source of noise. The predicted noise levels from construction activity would therefore need to be well in excess of 55 dB $L_{Aeq,T}$ at an NSL in order for a potential cumulative construction noise increase to exceed the noise thresholds outlined in Sections 12.3.2.1 and 12.3.2.2. The assessment in Section 12.6.2 and 12.6.3 confirms that the predicted noise levels from construction and decommissioning activities at static works sites NSL are ≤55 dB $L_{Aeq,T}$ and therefore the potential for any cumulative noise effects from all of the proposed activities occurring simultaneously or with construction activities from other developments is unlikely and not significant.

Construction works associated with the grid connection and underground cabling would be temporary, localised and progressive in nature, with activities moving along the cable route as works advance. As a result, any overlap with construction or decommissioning activities associated with other developments would be limited in both geographic extent and duration. Furthermore, construction noise effects from the Proposed Development have been assessed as being within the applicable assessment criteria and not significant. Therefore, even where concurrent works occur in proximity to another development, any cumulative construction noise effects would be temporary, short-term and not significant.

The potential for any cumulative noise effect from all of the proposed activities occurring simultaneously or in combination with construction activities from other developments is considered limited due to the temporary, localised and progressive nature of the works. Construction activities would not occur concurrently across the entire site and the predicted construction noise effects are themselves assessed as not significant, as indicated in Section 12.6.2.

12.9.1.1 Cumulative Effects of Proposed Development Blasting with Existing Quarry

With regard to cumulative vibration effects associated with blasting activities at nearby quarries, quarry blasting is understood to be infrequent, occurring typically approximately four times per year at the nearest quarry to Turbine T7 (refer to Chapter 2, Section 2.7.9.1). Blasting activities also have the potential to give rise to short-duration noise events. However, given their infrequent occurrence and the substantial separation distances involved, significant cumulative noise or vibration effects are not anticipated.

In addition, there are no residential receptors located between the quarry boundary and the Proposed Development boundary, such that receptors potentially affected by quarry blasting are not the same receptors closest to blasting activities within the Proposed Development. Given the substantial separation distances between the potential blasting sources and surrounding receptors, the simultaneous occurrence of quarry blasting and blasting within the proposed borrow pit would not be expected to result in significant cumulative vibration levels at any receptor. As a good practice measure, the Developer will seek to liaise with the quarry operator, where practicable, during periods when blasting is proposed within the borrow pit to minimise the potential for concurrent blasting events.

The neighbouring quarry operates under a licence placing conditions on noise and vibration at the closest residential receptors; these receptors are closer to the quarry boundary than the proposed wind turbines. Given these distances and that the quarry has been operating for a number of years, no significant effect is expected on the proposed turbines due to blasting at the quarry.

Therefore, no significant cumulative vibration effects are predicted.

12.9.2 Wind Turbine Noise

There are no other existing, permitted and proposed wind farms in the areas that would interact with the operational study area and therefore, a cumulative wind farm assessment has not been undertaken.

12.9.3 Noise from Fixed Plant Operation

There are no other industrial noise sources of fixed mechanical and electrical plant in the vicinity of the nearest NSLs to the either the proposed on-site control building or the proposed offsite substation that would be expected to contribute to any cumulative noise effects at NSLs. The proposed onsite control building is not expected to produce noise, therefore, the quarry to the north of T7 will not have a cumulative impact at any receiver. The background noise survey (refer to Section 12.4.2 and 12.5) that was undertaken in the vicinity of the windfarm site did not identify any steady industrial plant noise sources in the receiving environment. Therefore, the potential for any cumulative noise effects is not significant.

12.9.3.1 Proposed GCR

There will not be any significant cumulative operational noise or vibration effects in relation to the proposed GCR. The electrical cabling will not generate any noise during the operational phase therefore no cumulative effects can arise.

12.10 Conclusion

When considering a development of this nature, the potential noise and vibration effects on the surroundings must be considered for three stages: the short-term construction phase and decommissioning phase, and the long-term operational phase.

The assessment of construction noise and vibration have been conducted in accordance with best practice guidance contained in BS 5228-1:2009+A1:2014 *Code of practice for noise and vibration control on construction and open sites* – Noise and BS 5228-2:2009+A1:2014 *Code of practice for noise and vibration control on construction and open sites – Vibration*.

Residual noise associated with the construction and decommissioning phases are predicted to be below the proposed threshold values presented in Sections 12.3.2.1 to 12.3.2.5. The associated noise and vibration levels are not likely to cause significant effects at any NSL.

Based on the proposed site layout and the details of turbine noise emissions, hub height, and tip height for turbine type considered in the assessment, turbine noise levels have been predicted at NSLs across a range of operational wind speeds.

Having applied relevant industry standards, Guidance and best practice, and the outlined mitigation strategy, the assessment found that the V136 turbine remains within the best practice noise limits recommended in WEDG06 guidelines. Therefore, the proposed project will not result in a significant noise effect following mitigation.

A commitment has been provided that prior to the commissioning of the wind farm; the developer will submit a NCMP to the planning authority for written agreement. The NCMP will include a detailed methodology for all noise measurements, the frequency of monitoring, procedures for recording results and a protocol for managing complaints.

Operational noise from the proposed onsite control building and proposed 110kV substation has been assessed and found to be within the proposed criteria based on a review of the most appropriate guidelines and standards.

No significant vibration effects are associated with the operation of the proposed project.

In summary, no significant noise or vibration effects are likely from the proposed project.

12.11 REFERENCES

- EPA Guidelines on the Information to be contained in Environmental Impact Statements, Environmental Protection Agency, 2022 (Hereafter EPA 2022);
- *Wind Energy Development Guidelines for Planning Authorities*, Department of the Environment, Heritage, and Local Government 2006 (Hereafter WEDG06);
- *The Assessment and Rating of Noise from Wind Farms*, Department of Trade, and Industry (UK) Energy Technology Support Unit 1996 (Hereafter ETSU-R-97);
- A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise 2013 and its Supplementary Guidance Notes 2024 (Hereafter IOA GPG);
- Assessment and Rating of Wind Turbine Noise, Department for Energy Security and Net Zero (UK), (ARWTN, 2026);
- *Guidelines for the Treatment of Noise and Vibration in National Road Schemes*, Transport Infrastructure Ireland (TII) (formerly National Roads Authority 2004 (Hereafter TII 2004);
- *Good Practice Guidance for the Treatment of Noise during the Planning of National Road Schemes*, Transport Infrastructure Ireland (TII) (formerly National Roads Authority (NRA) 2014 (Hereafter TII 2014);
- British Standard BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise (Hereafter BS5228-1);
- British Standard BS 5228-2:2009+A1:2014 Code of practice for vibration control on construction and open sites – Vibration (Hereafter BS5228-2);
- British Standard BS 7385 – Evaluation and measurement for vibration in buildings – Part 2: Guide to damage levels from ground borne vibration BSI, 1993 (Hereafter BS7385);
- *Design Manual for Roads and Bridges* Sustainability & Environment Appraisal LA 111 Noise and Vibration Revision 2 (National England (now National Highways)) 2020 (Hereafter DMRB);
- ISO 1996: 2017: Acoustics – Description, measurement, and assessment of environmental noise (Hereafter ISO-1996:2017);
- EPA document Guidance Note for Noise Assessment of Wind Turbine Operations at EPA Licensed Sites NG3 EPA, 2011 (Hereafter NG3);
- EPA document 'Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities NG4 EPA, 2016 (Hereafter NG4);
- BS 4142:2014: Methods for rating and assessing industrial and commercial sound (Hereafter BS4142);
- Institute of Acoustics Noise Working Group (Wind Turbine Noise) Amplitude Modulation Working Group (AMWG) document *A Method for Rating Amplitude Modulation in Wind Turbine 2016* (IOA AMWG); and
- ISO 9613-2:2024: Acoustics — Attenuation of sound during propagation outdoors Part 2: Engineering method for the prediction of sound pressure levels outdoors (Hereafter ISO-9613-2, 2024).
- ISO 9613-2:1996: Acoustics — Attenuation of sound during propagation outdoors Part 2: General method of calculation (Hereafter ISO-9613-2, 1996).

- World Health Organisation (WHO) *Environmental Noise Guidelines for the European Region* 2018 (Hereafter WHO 2018);
- *Draft Revised Wind Energy Development Guidelines* 2019 Department of Housing, Local Government and Heritage (Hereafter Draft WEDG19);
- Department for Business, Energy & Industrial Strategy Wind Turbine AM Review: Phase 2 Report Project Number: 3514482A Issue: 3 Issued August 2016 (Hereafter BEIS AM Review Phase 2); and
- International Electrotechnical Commission (IEC) Technical Specification 61400-11-2 (Edition 1.0, 2024) Wind Energy Generation Systems – Part 11-2: Acoustic noise measurement techniques – Measurement of wind turbine sound characteristics in receptor position (Hereafter TS 61400-11-2).