9. NOISE AND VIBRATION

9.1 INTRODUCTION

This chapter of the EIAR describes the assessment undertaken of the likely noise and vibration effects associated with the proposed project.

The proposed project comprises:

- A wind farm containing fourteen (14) wind turbines, an on-site 110kV electrical substation and other ancillary infrastructure including access roads and drainage;
- A 110kV underground grid connection to connect the wind farm to the National Grid at the existing ESBN Srananagh substation in Co. Sligo; and
- Accommodations required along the public road network between Killybegs, Co. Donegal and the site to facilitate turbine and construction material delivery.

A full description of the proposed project is provided in Chapter 2 - Description of the Proposed Project.

Noise and vibration impact assessments have been prepared for the operational, construction, and decommissioning phases of the proposed project on the identified noise sensitive locations (NSLs). To inform this assessment, baseline noise levels have been measured at eleven representative NSLs surrounding the proposed wind farm site. 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.

For a glossary of terms used in this chapter please refer to Appendix 9-1.

9.1.1 Statement of Authority

This chapter of the EIAR has been prepared by Mike Simms of AWN Consulting, and reviewed by Miguel Cartuyvels.

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.

Miguel Cartuyvels (Acoustic Consultant) holds a BEng (Hons) in Industrial Engineering and is a member (MIOA) of the Institute of Acoustics. Miguel previously worked in the construction industry and 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.

9.1.2 Fundamentals of Acoustics

A sound wave travelling through the air is a regular disturbance of the atmospheric pressure. These pressure fluctuations are detected by the human ear, producing the sensation of hearing. To take account of the 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 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 9-1.

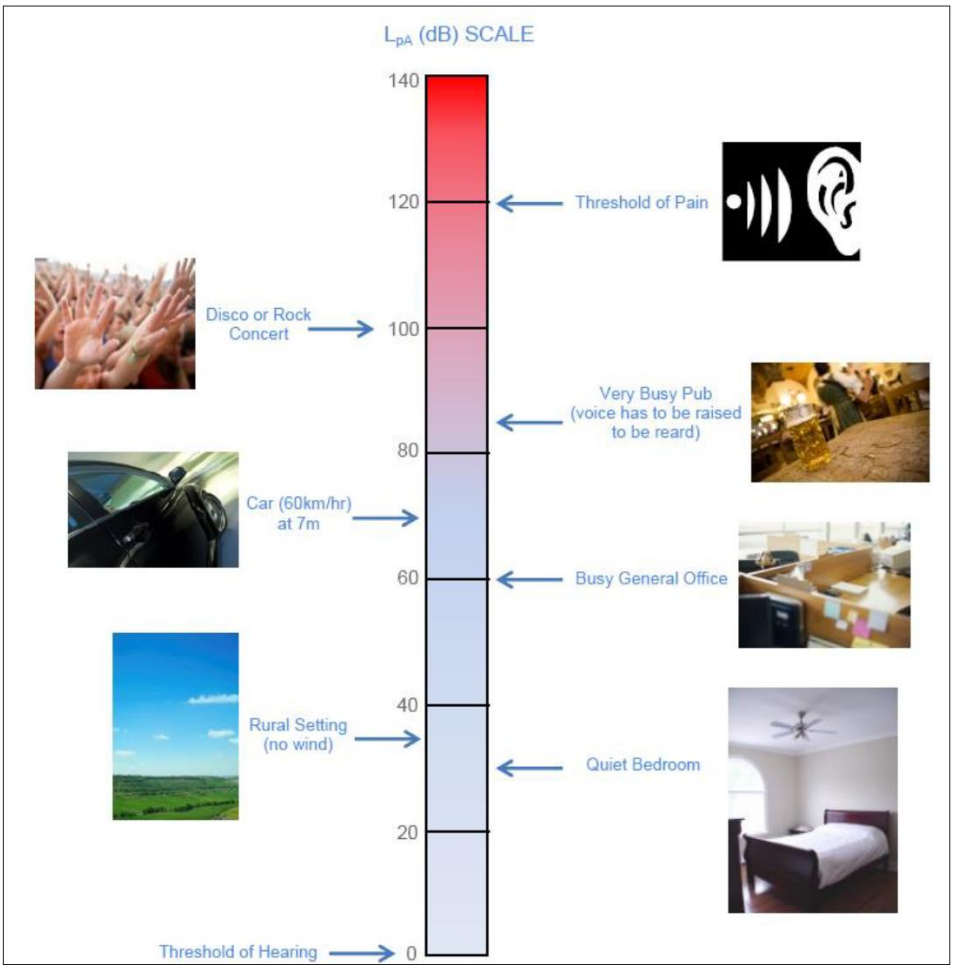


Figure 9-1: dB(A) Scale & Indicative Noise Levels – (EPA: Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4 – 2016))

9.2 CONSULTATIONS

Refer to Chapter 1 - Introduction for full details of consultations undertaken. This Noise and Vibration Chapter addresses Section 15 of the consultation response provided by Leitrim County Council dated 04/12/2024.

Consultee	Topic	Response
Leitrim County Council	15. Noise & Vibration The EIAR shall be informed by comprehensive noise and vibration impact assessments for the construction, operational and decommissioning phases of the proposed development utilising a robust representation of sensitive receptors in the vicinity of the subject site to determine the likely significant effects of the proposed development, individually and cumulatively with other projects, such as other wind farms, on the receiving environment. Any such noise impact assessments shall be in accordance with the 2006 Wind Energy Development Guidelines, pending their replacement, and should have regard to the more detailed methodology set out in the 'Good Practice Guide [GPG] to the application of ETSU-R-97 for the Assessment and Rating of Wind Turbine	Construction noise and vibration assessed in Section 9.6.2. Operational noise and vibration assessed in Section 9.6.3. Decommissioning noise and vibration assessed in Section 9.6.4. Operational noise assessments carried out in accordance with 2006 Wind Energy Development Guidelines and the GPG, as presented in section 9.3.4.
ACP-323353-25	Design Flexibility	Effects of Design Flexibility on noise assessment presented Section 9.4.3.2.
ACP-323048	Noise Limits	Rationale for Noise Limits presented in Section 9.5.2.
ACP-323048	Plan for operational noise issues	Noise Management Protocol discussed in Section 9.7.4 and presented in Appendix 9-10.

9.3 GUIDANCE, STANDARDS AND ASSESSMENT CRITERIA

The assessment of effects for the proposed project has been undertaken in compliance with to the applicable guidance documents relating to environmental noise and vibration. The following guidance documents have been complied with when preparing this chapter of the EIAR:

- 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);
- *Draft Revised Wind Energy Development Guidelines* 2019 Department of Housing, Local Government and Heritage (Hereafter Draft WEDG19);

- *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);
- *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 groundborne 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* (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)
- World Health Organisation (WHO) *Environmental Noise Guidelines for the European Region* 2018 (Hereafter WHO 2018);
- 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);
- 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); 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).

The following sections review best practice guidance that has been adopted in the assessment of the proposed project.

9.3.1 Environmental Protection Agency (EPA) Description of Effects

The significance of effects of the proposed project are described in accordance with the guidelines set out in EPA 2022. Details of the methodology for describing the significance of the effects are provided in Chapter 1 - Introduction.

The effects associated with the proposed project are described in the relevant sections of this chapter in accordance with the aforementioned EPA 2022 guidance.

9.3.2 Construction and Decommissioning Phase – Noise

There is no published statutory Irish legislation or 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.

9.3.2.1 BS 5528-1 Code of Practice for Noise and Vibration Control on Construction and Open Sites – Noise

In the absence of specific noise limits, appropriate criteria relating to permissible construction noise levels were adopted from the BS5528-1. This is considered best practice in Ireland.

An approach in BS5528-1 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 9-1. The CNT values are applicable to both construction and decommissioning noise. This assessment method is proposed for residential receptors only.

Table 9-1: Example Threshold of Potential Significant Effect at Dwellings

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 should be followed 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 anticipated to be relatively high. However, given the rural nature of the site in general, the existing daytime ambient noise levels are anticipated to be 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 $L_{Aeq,T,}$ which is the lowest of all categories.

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 or decommissioning 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 9.3.2.4.

9.3.2.2 Linear Construction Works

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

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

This approach is considered appropriate because 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 shorter periods of potential noise impact. 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;*
> - *75 decibels (dBA) in urban areas near main roads in heavy industrial areas."*

The TII 2004 guidance proposes a daytime period (Monday to Friday 0700 – 1900 hrs) with a construction noise limit of 70 dB $L_{Aeq,1hr}$.

In accordance with the above guidance, for the purposed of this assessment, a CNT of 70 dB $L_{Aeq,1hr}$ is proposed for linear construction activities.

Noise levels above 70 dB $L_{Aeq,1hr}$ may indicate a significant impact depending on the duration and frequency of occurrence.

9.3.2.3 Additional Vehicular Activity on Public Roads Construction Phase

There are no specific guidelines or limits relating to traffic related sources of noise along the local or surrounding roads. Given that traffic from the proposed project will make use of existing 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.

For the assessment of potential noise impacts from construction related traffic along public roads it is proposed to adopt guidance from DMRB, which is best practice in Ireland. Table 9-2 taken from DMRB offers guidance as to the likely short-term impact associated with any change in traffic noise level.

Table 9-2: Likely Impacts Associated with Change in Traffic Noise Level (Source: DMRB)

Change in Sound Level (dB L_{A10})	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 noise levels on public roads associated with the proposed project and the likely 'short-term' impacts during the construction phase. Where a major or moderate impact or an initial significance rating of 'Significant' is identified, the overall predicted noise level from construction traffic will be assessed against the construction noise threshold values outlined in this Section 9.3.2.

9.3.2.4 Factors to Consider when Assessing Construction Noise Impacts

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 and been adapted by AWN to include the relevant significance effects criteria from EPA 2022. The adapted guidance to assess the likely magnitude of impact associated with construction activities is presented in Table 9-3.

Table 9-3: 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	Not Significant to Slight	
Above CNT and below or equal to CNT + 5dB	Moderate	Moderate to Significant	
Above CNT + 5dB	Major	Significant to Very Significant	

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 6 consecutive months.

9.3.3 Construction and Decommissioning Phase – Vibration

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

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

- BS 7385
- BS 5228-2

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 excited 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 9-4.

Table 9-4: 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

Following review of the suggested vibration criteria discussed above from BS7385, BS5228-2 and TII 2004, the values in Table 9-4 are considered appropriate for this assessment of impact.

9.3.4 Operational Phase Noise – Wind Turbines

The noise assessment documented in this chapter complies with guidance in relation to acceptable levels of noise from wind farms as contained in WEDG06. The WED06 guidelines are based on detailed recommendations set out in ETSU-R-97. The ETSU-R-97 document has been used to supplement the guidance contained within the WEDG06, where appropriate and necessary.

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

The core of the noise guidance contained within the WEDG06 is based on ETSU-R-97.

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 were 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.

9.3.4.2 *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 6 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.

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.

Noise Prediction Calculations

The noise levels associated with the wind turbines should be calculated in accordance with ISO 9613-2. This is a noise prediction standard 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.

For guidance on the methodology for operational impact assessment for wind turbine noise, the IOA GPG has been adopted.

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.

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 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 below the fixed lower threshold for turbine noise proposed for the proposed project.

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, in accordance with the above guidance, a cumulative turbine noise impact assessment is required, is presented Section 9.4.1.2.

9.3.4.3 *Wind Energy Development Guidelines for Planning Authorities*

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

The following extracts from this document should be considered:

> *"An appropriate balance must be achieved between power generation and noise impact."*

While this comment is noted it should be stated that the Guidelines give no specific advice in relation to what constitutes an 'appropriate balance'. In the absence of this, guidance will be taken from appropriate best practice guidance publications.

> *"In the case of wind energy development, a noise sensitive location includes any occupied house, hostel, health building or place of worship and may include areas of particular scenic quality or special recreational importance. Noise limits should apply only to those areas frequently used for relaxation of activities for which a quiet environment is highly desirable. Noise limits should be applied to external locations and should reflect the variation in both turbine source noise and background noise with wind speed." (WEDG06)*

The issues identified in this extract have been incorporated into the assessment to determine the applicable turbine noise limits in Section 9.5.2.

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

This represents the commonly adopted and best-practice daytime noise criterion curve in relation to wind farm developments. However, an important caveat should be noted as detailed in the following extract.

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

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

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

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

In summary, the WEDG06 guidelines outline 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 of not less than 30 dB $L_{A90,10min}$ and;

- 43 dB $L_{A90,10min}$ for night time periods.

While the caveat of an increase of 5dB(A) above background for night-time operation is not explicit within the 2006 WEDGs, an allowance for same is commonly applied in noise assessments prepared and considered best-practice and is accepted as detailed in numerous examples of planning conditions issued by An Coimisiún Pleanála.

9.3.4.4 Future Potential Guidance Changes

In December 2019, the Draft WEDG19 were published for consultation and at the time of writing, the final guidelines have yet to be published and there is and no confirmed timeframe for their release. It is important to note that during the public consultation on the 2019 draft WEDGs, several concerns relating to the proposed approach of the Draft WEDG19 have been 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[1]

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

The following statements was submitted by the Minister for Housing, Local Government and Heritage during a Dail Eireann Debates on 19 June 2025[2]

> *My Department notes the commitment in the recently published Programme for Government 2025 – Securing Ireland's Future to prioritise the publication of the Wind Energy Development Guidelines, having regard to international best practice and standards. In light of this commitment, my Department is working towards concluding the finalisation of review of the Guidelines as a matter of priority, having regard to the intended public consultation and the finalisation of associated reforms and reviews including the revision of the NPF. When finalised, the revised Guidelines will be issued under section 28 of the Planning and Development Act 2000, as amended or, subject to*

[1] Accessed 2 April 2026

[2] https://www.oireachtas.ie/en/debates/question/2025-06-19/308/

> *commencement of the Planning and Development Act 2024, as a National Planning Statement, as appropriate. The current 2006 Wind Energy Development Guidelines remain in force, pending the finalisation of the review."*

It is also noted that the consultation response from Leitrim County Council states that "*Any such noise impact assessments shall be in accordance with the 2006 Wind Energy Development Guidelines, pending their replacement, and should have regard to the more detailed methodology set out in the 'Good Practice Guide [GPG] to the application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise' (Institute of Acoustics, 2013) with respect to the baseline survey methodology.*"

In accordance with the above, 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 ESTU-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 changes relevant to noise effects will be addressed through an appropriate planning condition, or where a supplementary assessment is necessary, through provision of additional information.

9.3.4.5 World Health Organisation (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."

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

The WHO Environmental Noise Guidelines aim to support the legislation and policy-making process on local, national, and international level, 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."

Based upon the review set out above, and in our professional opinion, the conditional WHO recommended average noise exposure level (i.e. 45 dB L_{den}), should not currently be applied as target noise criteria for an existing or proposed wind turbine development in Ireland.

9.3.4.6 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."

An IOA statement in Respect of Wind Farm Noise Assessment dated December 2024 and published on the IOA website stated the following in relation to Infrasound and Low Frequency noise:

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

In conclusion, low frequency noise and infrasound associated with wind turbines is expected to be below perceptibility thresholds and are not likely to result in any significant effects at NSLs. There are no criteria proposed for assessing low-frequency noise or infrasound as part of the EIAR; this approach is standard practice in Ireland when assessing wind turbine noise at planning stage.

9.3.4.7 Amplitude Modulation

In the context of the assessment of operational noise from wind turbines, amplitude modulation (AM) is defined in the IOA AMWG document 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)."

It is now generally accepted that there are two mechanisms which can cause amplitude modulation:

- 'Normal' AM, and;
- 'Other' AM (sometimes referred to 'Excessive' AM).

In both cases, 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.

'Normal' AM

An observer at ground level close to a wind turbine will experience 'blade swish' because of the directional characteristics of the noise radiated from the trailing edge of the blades as it rotates towards and then away from the observer.

This effect is reduced for an observer on or close to the turbine axis and therefore would not generally be expected to be significant at typical separation distances, at least on relatively level sites.

The RenewableUK AM project (RenewableUK, 2013) has coined the term 'normal' AM (NAM) for this inherent characteristic of wind turbine noise, which has long been recognised and was discussed in ETSU-R-97 in 1996.

'Other' AM

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

On sites where it has been reported, occurrences appear to be occasional, although they can persist for several hours under some conditions, dependent on atmospheric factors, including wind speed and direction.

It was proposed in the RenewableUK 2013 study that the fundamental cause of this type of AM is transient stall conditions occurring as the blades rotate, giving rise to the periodic thumping at the blade passing frequency.

Transient stall represents a fundamentally different mechanism from blade swish and can be heard at relatively large distances, primarily downwind of the rotor blade.

The RenewableUK AM project report adopted the term 'Other AM' (OAM) for this characteristic. The terms 'enhanced' or 'excess' AM (EAM) have been used by others, although such definitions do not distinguish between the source mechanisms and presuppose a 'normal' level of AM, presumably relating back to blade swish as described in ETSU-R-97.

Frequency of Occurrence of AM

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 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. While OAM can occur, it is noted that the research has shown that it is a rare event associated with a limited number of wind farms.

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.*"

Based on the above, it is critical in the discussion of amplitude modulation (AM) to recognise that it is an inherent characteristic of wind turbine noise. A distinction must be made between 'Normal' AM, which is a regular fluctuation in noise levels, and 'Other' or 'Excessive' AM, which can be more pronounced and potentially disruptive. The term AM is commonly used without these descriptions; however, where AM is referenced in this chapter, it should be understood to refer to other or excessive AM with the potential to result in significant impacts, unless otherwise stated.

Research and Guidance in the field of wind turbine noise AM is ongoing with publications being issued by the Institute of Acoustics in IOA AMWG in 2016. The IOA AMWG proposes an objective method for measuring and rating AM known as the Reference Method. The IOA AMWG does not propose what level of AM is likely to result in adverse community response or propose any limits for AM. The purpose of the group is simply to use existing research to develop a Reference Methodology for the measurement and rating of AM.

The 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 (IEC, 2024). This document introduces a standardised methodology for measuring and rating AM at receptor locations. The method aligns with the AMWG approach but includes several enhancements. While not formal guidance, it represents best practice and incorporated by regulatory authorities in future guidance.

A 2016 report commissioned by the UK government BEIS AM Review Phase 2 recommended the use of a penalty scheme as a potential planning condition for AM to cover periods of complaints due to unacceptable AM. 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.*"

The commitments outlined in the Section 9.7.4.2 are considered to represent best practice to control AM and will be adopted in the event that an complaint relating to excessive AM being reported from the proposed project.

9.3.4.8 Factors to Consider when Assessing Operational Noise Effects

The applicable guidelines (WEDG06), along with additional best practice guidance discussed in Section 9.3.4, 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.

9.3.5 Operational Phase Noise – Fixed Plant

For the proposed Substation (fixed and electrical plant), it is proposed to set fixed noise limits in accordance with guidance outlined in the following sections, which is considered best practice.

9.3.5.1 EPA NG4

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 satisfy all of the following criteria:

- Arithmetic Average of L_{A90} During Daytime Period ≤40 dB L_{A90}, and;
- 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 9-5 outlines the noise emission limit criteria detailed in the NG4 document.

Table 9-5: 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: *Methods for rating and assessing industrial and commercial sound* that can be used to assess the likelihood of complaints from specific plant noise sources.

9.3.5.2 BS 4142

British Standard 4142:2014+A1:2019 Methods for Rating and Assessing Industrial and Commercial Sound describes methods for rating and assessing the impact of sound from an industrial and/or commercial development to a residential receptor. The methods described in this 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. The results of baseline surveys of the prevailing background sound level (LA90) allow for the noise impact associated with the development to be assessed. With reference to BS 4142:2014, it is noted that, depending on context, adverse impacts are likely to occur when the rated specific sound level exceeds the prevailing background sound level by +5 dB, with a significant adverse impact occurring at +10 dB or more. Where the rating level does not exceed the background sound level, BS 4142 comments that this is an indication of the specific sound source having a low impact, again depending on the context.

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 4142:2014+A1:2019 advises 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 BS 4142:2014+A1:2019 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 4142:2014+A1:2019 recommends that if the intermittency is readily distinctive against the residual acoustic environment, a penalty of 3 dB can be applied where it is just perceptible at the receptor location to 9 dB where it is highly perceptible.

In terms of this proposed project, in accordance with the guidance provided in BS4142:2014+A1:2019, if the noise from the fixed plant alone does not exceed the existing background noise level then this is an indication of the noise emissions from the facility having a low impact. Adverse impacts are predicted to occur when the background noise level is exceeded by more than 5 dB.

9.3.5.3 Factors to Consider when Assessing Operational Noise Effects

The guidance discussed in Section 9.3.5 provides a framework in line with national guidelines for identifying appropriate noise limits at nearby NSLs.

Baseline noise levels during night time periods are expected to 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 turbines will contribute new sound sources to the existing soundscape.

9.3.6 Operational Phase Vibration

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:

"*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.*"

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.

The shortest distance from any turbine in the proposed project to the nearest NSL is more than 750 m (distance from turbine T14 to NSL ref. H1113 is 763 m). 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.

9.4 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 (Section 9.3);

3 https://www.ioa.org.uk/sites/default/files/IOA%20Statement%20-%20Wind%20Farm%20Noise%20Assessment%20Dec%202024.pdf, accessed 11 Feb 2026

- Characterise the receiving environment through baseline noise surveys at NSLs surrounding the proposed project;
- Undertake predictive calculations to assess the potential effects associated with the construction phase of the proposed project;
- Undertake predictive calculations to assess the potential effects associated with the operation of the proposed project at NSLs, including cumulative effects, as required by the guidance;
- Undertake cumulative predictive calculations to assess the potential effects associated with the decommissioning of the proposed project at NSLs;
- Specify mitigation measures to reduce, where necessary, the identified potential outward effects relating to noise and vibration from the proposed project; and,
- Describe the significance of the residual noise and vibration effects associated with the proposed project.

9.4.1 Determination of 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..

9.4.1.1 Construction and Decommissioning Phase Noise and Vibration

During the construction and decommissioning phases, noise could occur at any location where activities occur as part of the proposed wind farm site, TDR, 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 GCR route 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 of this chapter and representative of the closest identified NSL, or at defined set back distances from the proposed activities.

9.4.1.2 Operational Phase Noise

As described in Section 9.3.4, the operational phase study area should cover, at a minimum, the area predicted to exceed 35 dB L_{A90} from all existing, permitted, and proposed wind turbines. In this instance the noise study area is defined as the cumulative 35 dB L_{A90} noise contour due to the proposed wind turbines along with the operational Faughary wind turbines to the west. Refer to Appendix 9-2 which displays the relevant noise contours maps which identify this area.

The NSLs identified within this study area have also been considered in the assessment of operational noise from the proposed fixed plant items i.e. the substation.

9.4.2 Background Noise Survey

A background noise survey was undertaken in 2021 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 eleven representative locations in the surrounding area.

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

Although the survey was carried out in 2021, it remains valid for deriving the wind turbine noise criteria, which are based on the background noise levels. It is not considered that any significant change in the noise environment has occurred since the survey.

Full details of the background noise survey instrumentation and results are provided in Appendix 9-3.

A background noise survey at selected locations along the grid connection route was carried out in 2025 – full details of this survey are presented in Appendix 9-4.

As there are no sources of vibration in the baseline environment, measurement of vibration was scoped out of the assessment.

9.4.2.1 Choice of Measurement Locations

The noise monitoring locations (NML's) were identified by preparing a preliminary noise model contour at an early stage of the assessment. The selection of the NML's 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).

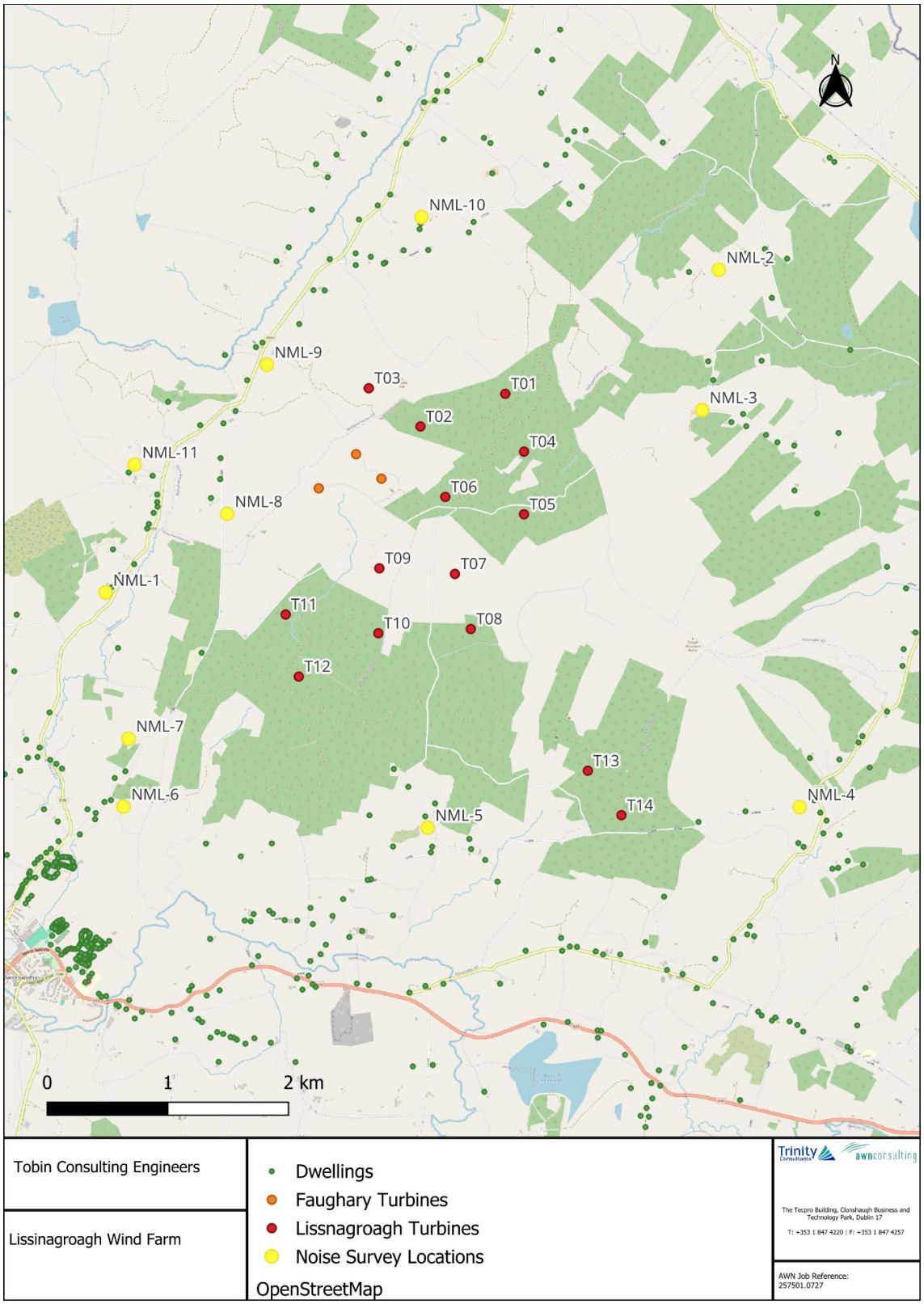
The co-ordinates for the selected NML's are provided in Table 9-6 along with the NSL references in the noise assessment. The locations are identified on a map in Figure 9-2.

Table 9-6: Noise Measurement Coordinates

Location Reference (Closest NSL)	Co-ordinates (ITM)	
	Easting	Northing
NML-1 (H443)	589332	842725
NML-2 (H016)	594119	845340
NML-3 (H521)	594212	844226
NML-4 (H051)	595036	840903
NML-5 (H117)	591954	840734
NML-6 (H413)	589433	840908
NML-7 (H418)	589474	841471
NML-8 (H457)	590291	843336
NML-9 (H487)	591901	845796
NML-10 (H456)	589523	843746
NML-11 (H468)	590621	844573

*H = House reference number

Figure 9-2: Noise Monitoring Locations (NML)



9.4.2.2 Wind Measurements

Average wind speed and direction was measured in 10-minute intervals at an on-site LIDAR unit and provided to AWN. Wind speed measurements made at 80 m and 65 m were used to correct

the wind speed up to a provisional assessment hub height (HH) as per the methodology described in the IOA GPG. A HH of 103.5 m, was used in the derivation of prevailing background noise levels, this being the HH of the turbine with the highest sound power level. The calculated HH wind speeds were then corrected to the 'standardised' 10 m wind speed in accordance with the IOA GPG. The 'standardised' wind speed is the industry standard in the UK and Ireland for referencing for wind speed with respect to wind turbines.

9.4.2.3 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. The assessment methods o0utlined above are in line with the guidance contained in the IOA GPG.

The results presented Appendix 9-3 and summarised in the following sections refer to the noise data collated during 'quiet periods' of the day and night as defined in the IOA GPG.

9.4.2.4 Noise from Existing Operational Turbines within the Study Area

The existing Faughary Wind Farm is located to the west of the proposed wind farm site. In line with the guidance outlined in Section 9.3.4, contributions to measured noise levels from existing wind turbines were excluded 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. Additional details are provided in Appendix 9-3.

9.4.2.5 Consideration of Wind Shear

Wind shear is defined as the change of wind speed with height above ground. Any reference to wind speed in this chapter should be understood to be at standardised 10 m height. The standardised equations used to determine the wind speed at standardised 10 m above ground is presented in Appendix 9-3. Any reference to wind speed in this chapter should be understood to be the standardised wind speed at 10 m above ground level unless otherwise stated.

9.4.3 Noise Calculations

9.4.3.1 Construction Noise

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.

Assumptions have been made regarding likely plant items and construction methods to predict and assess the likely noise emissions from these activities in accordance with the standard best practice approach to predict anticipated 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 element, the anticipated construction noise sources are assessed along with anticipated sound pressure levels from BS5228-1 at various distances from these works.

9.4.3.2 Operational Noise

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.

Noise Prediction Software

The selected software, DGMR iNoise Enterprise (Version 2024.3) calculates noise levels in accordance with ISO 9613-2 2024.

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 9613-2:2024. The calculation setting applied will depend on the type of source under assessment. For wind turbine noise the calculation settings recommended in IOA GPG have been applied.

Noise Prediction Model - Input Data and Assumptions

The settings applied in the calculations depend on the type of source under assessment; For wind turbine noise, the calculation settings recommended in IOA GPG have been applied. Full details of the calculation settings, input data and any assumptions made in the assessment are provided in Appendix 9-5.

Proposed Wind Turbine Details

Table 2-1, Chapter 2 lists the proposed turbine co-ordinates. The turbine noise assessment has been undertaken considering three turbine types. A summary of the turbine details is presented in Table 9-7. The dimensions of these turbines are within the proposed range of dimensions as described in Chapter 2 - Description of the Proposed Project.

Table 9-7: Details of turbine types considered in the assessment

Turbine Model	Details		
	Rotor Diameter (m)	Tower Hub Height (m)	Tip height (m)
Vestas V150	150	110	185
Vestas V162	162	104	185
Nordex N149	149	110.5	185
Nordex N163	163	103.5	185
General Electric GE-158	158	106	185

The turbine types and specifications in Table 9-7 are representative of the type of turbine that would be installed on the site taking into consideration the proposed dimensions and the nominal generation capacity.

As presented in Chapter 1, the Design Flexibility allows for the turbines with a blade tip height of 185 m at the upper end of the range, and 179.5 m at the lower end of the range.

In this noise assessment, the upper end of the turbine range is described by modelling using at each wind speed, the highest sound power levels, at the hub height corresponding to the upper end of the range of tip heights, as follows: Sound power levels for each of the turbines listed above referenced to wind speeds at standardised 10 m height (calculated in accordance with the

IOA GPG), are presented in Table 9-8. The highest sound power level for each wind speed is shown in boldface.

Table 9-8: L_{WA} Levels for various the proposed range of hub heights (HH)

Wind Speed (m/s)	dB L_{WA} of Turbine Model at Stated Hub Height (m)					
	V150 (110 m HH)	V162 (104 m HH)	N149 (110.5 m HH)	N163 (103.5 m)	GE-158 (106 m HH)	Highest
3	92.6	**96.0**	94.0	95.5	95.5	**96.0**
4	96.4	97.5	95.3	97.7	**100.3**	**100.3**
5	100.7	100.8	100.0	102.4	**104.4**	**104.4**
6	103.6	104.3	104.3	**106.7**	106.0	**106.7**
7	104.2	106.3	105.6	**107.2**	106.0	**107.2**
8	104.9	106.3	105.6	**107.2**	106.0	**107.2**
≥9	104.9	106.3	105.6	**107.2**	106.0	**107.2**

Figure 9-3 presents a graph of the noise emissions for the turbines listed in Table 9-8.

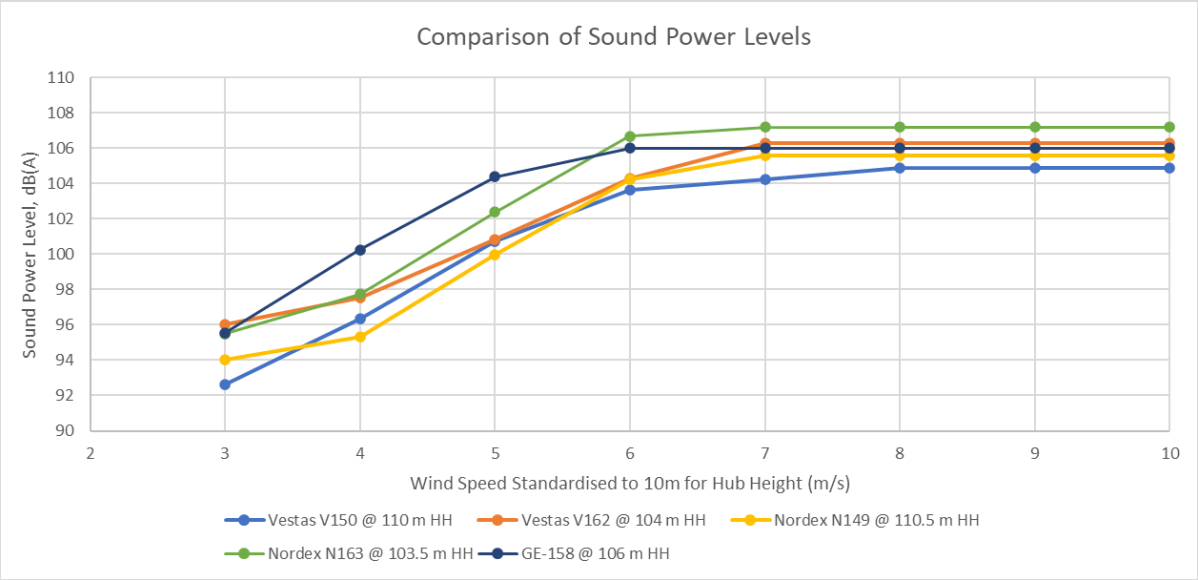


Figure 9-3: Sound Power Level of each of the 6 turbine types under consideration

Considering each wind speed, the turbine models with the highest sound power levels are, for each wind speed:

- 3 m/s: the Vestas V162 at 104m hub height;
- 4 m/s: the General Electric GE-158 at 106 m hub height;
- 5 m/s: the General Electric GE-158 at 106 m hub height;
- 6 m/s: the Nordex N163 at 103.5 m hub height;
- 7 m/s: the Nordex N163 at 103.5 m hub height;
- 8 m/s: the Nordex N163 at 103.5 m hub height and
- ≥9 m/s: the Nordex N163 at 103.5 m hub height.

The noise levels at NSLs will be predicted using the above combination of sound power levels at each wind speed. Therefore, the noise impact assessment is representative of all candidate turbines in terms of the maximum potential turbine noise impact. This combination of turbines forms the input to the noise modelling and predictions and will be referred to in this chapter as the Assessment Turbine. Sound power levels for the assessment turbine are presented in Appendix 9-6.

The lower end of the tip height range is 179.5 m. The lower end of the range is assessed by using the same turbine as the upper end of the range, but with the hub height reduced such that the tip height is 179.5 m. For example, in the case of the N163 this corresponds to a hub height of 98 m.

The manufacturer's turbine sound power levels (dB L_{wA}) are provided in terms of L_{Aeq} parameter. 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.

Best practice dictates that if any tonal component is present, a penalty must be applied to the predicted noise levels. The magnitude of this penalty, as outlined in ETSU-R-97, corresponds to the extent by which the tonal component exceeds the threshold of audibility. In this assessment, no tonal penalty has been applied to the predicted noise levels. However, the selected turbine manufacturer will provide a warranty confirming that the turbine's noise output will not necessitate a tonal correction under best practice guidance.

Cumulative Noise from Other Wind Turbine Developments

An appraisal of the study area has identified the following operational wind turbine development with the potential for cumulative noise impacts within the study area:

- Faughary (Leitrim County Council Planning Ref. 04550): Existing operational wind farm consisting of three (3) Enercon E82 turbines with a Hub Height of 105 m, Rotor Diameter of 82 m and Tip Height of 146 m.

Following best practice guidance discussed in Section 9.3.4, cumulative turbine noise from the existing operational Faughary Wind Farm has been included in the noise assessment. The sound power levels and coordinates of the Faughry wind turbines used in the assessment are presented in Appendix 9-6 and summarised in Table 9-9.

Table 9-9: L_{WA} Levels for Faughary turbines

Wind Speed (m/s)	dB L_{WA} of Enercon E82 2MW for 105 m Hub Height
3	96.3
4	96.3
5	96.3
6	100.7
7	103.3
8	104.0
≥9	104.0

The planning condition in respect of noise for the operational Faughary Wind Farm (Leitrim County Council Ref. 04550) is as follows:

> *At the critical wind speed (that is, the speed at which the noise of wind turbines and blades is most in excess of ambient noise levels), the noise from the proposed development shall not, when measured externally at the nearest occupied house, exceed 45 dB(A)Leq when measured over any five minute period.*

This condition is less strict than the WEDG06 noise criteria, therefore the approach in this assessment is to apply the same noise criteria as those for the proposed project to the cumulative wind turbine noise levels at all receptors; the criteria are based on background noise levels measured at representative Noise Monitoring Locations (NMLs).

Effects of Propagation from Wind Directions

As discussed in Section 9.3.4.2, when considering noise impacts of wind turbines, the effects of propagation in different wind directions have been considered. The day-to-day operations of the optimised development will not result in a worst-case condition of all noise locations being downwind of all turbines at the same time i.e. omni-directional predictions. Therefore, to address this issue, a review of expected noise levels downwind of the turbines has been prepared for various wind directions in accordance with the IOA GPG.

For any given wind direction, a property can be assigned one of the following classifications in relation to turbine noise propagation:

- Downwind (i.e. 0° ±80°): no reduction in noise levels;
- Crosswind (i.e. 90° ±10° and 270° ±10°): reduction of 2 dB, and
- Upwind (i.e. 180° ±80°): typically, up to 10 dB reduction depending on distance from turbine.

Table 9-10 presents the directivity attenuation factor that has been applied to turbines when considering noise propagation in downwind conditions (full downwind is represented by 0° and full upwind is 180°).

Table 9-10: Turbine Directivity Attenuation with Consideration of Wind Direction

Wind Direction Sector	Degrees (°)	Attenuation (dB)
Downwind	280 – 360 & 0 - 80	0
Crosswind	260 – 280 & 80 - 100	2
Upwind	230 - 250	5
	220	5.5
	210	6
	200	6.5
	190	7
	180	7.5

9.5 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 9-6. Appendix 9-3 presents the additional details and results of the background noise surveys undertaken in accordance with the methodology in Section 9.4.1.2.

9.5.1 Summary of 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 Section 9.5.1. The scatter graphs of each of each location is displayed in Appendix 9-3.

Table 9-11 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 9-11: Derived Background Noise Levels of LA90,10-min for Various Wind Speeds

Location	Period	Derived $L_{A90,\ 10min}$ Levels (dB) at Various Standardised 10m Height Wind Speeds m/s for 103.5 m Hub Height						
		3	4	5	6	7	8	≥9
NML-1	Day	26.8	27.7	29.2	31.2	33.4	35.8	38.0
	Night	23.5	24.3	25.7	27.7	30.1	32.8	35.7
NML-2	Day	23.7	25.6	27.9	30.5	33.4	36.4	39.5
	Night	25.6	27.6	29.7	31.9	34.3	37.0	39.9
NML-3	Day	29.1	30.2	32.0	34.3	36.8	39.1	41.0
	Night	29.6	31.0	32.7	34.5	36.6	38.8	41.3
NML-4	Day	26.4	27.1	28.1	29.4	30.8	32.2	33.6
	Night	25.3	26.2	27.0	27.8	28.7	29.8	31.1
NML-5	Day	35.3	35.1	36.1	37.8	39.9	42.1	44.1
	Night	34.0	34.8	35.9	37.3	38.8	40.5	42.2
NML-6	Day	30.9	31.7	32.6	33.8	35.1	36.5	38.1
	Night	29.0	29.6	30.4	31.4	32.8	34.4	36.5
NML-7	Day	30.1	31.0	32.2	33.6	35.1	36.8	38.6
	Night	28.3	29.1	30.2	31.8	33.7	35.9	38.3
NML-8	Day	26.0	27.6	29.7	31.1	33.2	35.9	38.4
	Night	22.4	24.5	26.8	27.9	29.8	33.3	36.5
NML-9	Day	30.7	32.0	33.8	35.8	38.0	40.1	41.8
	Night	29.6	31.4	33.4	35.1	36.4	36.9	36.9
NML-10	Day	39.2	39.6	40.3	41.4	42.7	44.3	46.2
	Night	38.9	39.2	39.8	40.6	41.8	43.1	44.7
NML-11	Day	28.6	29.8	31.1	32.6	34.3	36.1	38.0
	Night	27.2	28.8	30.4	31.9	33.4	35.1	36.9

9.5.2 Proposed Wind Turbine Noise Limits

With respect to the relevant guidance documents outlined in Section 9.3.4.3 noise criteria have been established for the proposed project using the derived background level measured at representative NMLs and summarised in **Table *9-11***.

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

For the proposed project, it is considered that 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), applicable to the subject site, 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),, Borrisbeg (ACP ref: 318704-23), Castlebanny Wind Farm (Planning Ref: 309306-21), Ballivor (ACP-31629-23) 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, it is important to bear in mind that where an existing wind turbine development is the dominant source of turbine noise at a given NSL, this must be considered in the context of the appropriate noise criteria for noise under which that development operates.

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 proposed project is the dominant wind turbine source or has a significant contribution to the cumulative turbine noise level at a given NSL. The operational noise limits proposed for the proposed project at 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 in quiet environments with typical background noise of less than 30 dB $L_{A90,10min}$.*
- *45 dB $L_{A90,10min}$ for daytime (0700 – 2300hrs) in environments with typical background noise greater than or equal to 30 dB $L_{A90,10min}$ or a maximum increase of 5 dB(A) above background noise (whichever is the higher); and*
- *43 dB $L_{A90,10min}$ for night-time periods (2300 – 0700hrs).*

9.5.2.1 Assigning Representative Background Noise Levels

Table 9-12 outlines the operational noise criteria that will apply to this assessment. The criteria derived at 9 m/s have been applied to higher wind speeds for the purposes of this assessment. It should be noted that as wind speeds increase beyond 9 m/s, background noise levels are also expected to rise.

Table 9-12: Proposed Noise Criteria Curves

Location	Period	Derived $L_{A90,10min}$ Levels (dB) at Various Standardised 10m Height Wind Speeds m/s for 103.5 m Hub Height						
		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	45	45	45	45
	Night	43	43	43	43	43	43	44.9
NML-3	Day	40	45	45	45	45	45	46
	Night	43	43	43	43	43	43.8	46.3
NML-4	Day	40	40	40	40	45	45	45
	Night	43	43	43	43	43	43	43
NML-5	Day	45	45	45	45	45	47.1	49.1
	Night	43	43	43	43	43.8	45.5	47.2

Location	Period	Derived $L_{A90,10min}$ Levels (dB) at Various Standardised 10m Height Wind Speeds m/s for 103.5 m Hub Height						
		3	4	5	6	7	8	≥9
NML-6	Day	45	45	45	45	45	45	45
	Night	43	43	43	43	43	43	43
NML-7	Day	45	45	45	45	45	45	45
	Night	43	43	43	43	43	43	43.3
NML-8	Day	40	40	40	45	45	45	45
	Night	43	43	43	43	43	43	43
NML-9	Day	45	45	45	45	45	45.1	46.8
	Night	43	43	43	43	43	43	43
NML-10	Day	45	45	45.3	46.4	47.7	49.3	51.2
	Night	43.9	44.2	44.8	45.6	46.8	48.1	49.7
NML-11	Day	40	40	45	45	45	45	45
	Night	43	43	43	43	43	43	43

The derived turbine noise limits have been assigned to the various NSLs where noise monitoring has been undertaken. Where background noise measurements have been conducted in the vicinity and/or are judged to be typical/indicative of the background noise levels at other locations, these have been assigned to the nearby representative location for the purposes of setting appropriate turbine noise limits for the assessment. That approach is in line with best practice guidance set out in the IOA GPG. **Table *9-13*** presents these assignments

Table 9-13: Assignment of background noise curves to other locations

NSL Reference	Assigned Background Noise Location
H051	NML-4
H117	NML-5
H413	NML-6
H443	NML-1
H456	NML-11
H457	NML-8
H521	NML-3
All other locations	NML-4, this being the location with the lowest measured baseline noise levels.

9.5.2.2 Proposed Noise Limits for Fixed Plant

Based on a review of the measured noise from the background noise survey described in Section 9.4.1.2, the NSLs in the vicinity of the site can be defined as areas of low background noise as per the NG4 guidance. 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 threshold of 35 dB L_{Aeq} is proposed for fixed plant. During the detailed design, 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 will 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.

9.5.3 Baseline Noise Survey for Grid Connection

An environmental noise survey was conducted in the environs of the proposed grid connection cabling route, in order to quantify the existing noise environment. The survey was conducted in accordance with ISO 1996: 2017: Acoustics – Description, measurement and assessment of environmental noise. Full details of the baseline noise survey for the grid connection route are given in Appendix 9-4.

The locations selected for the noise monitoring locations are presented in Table 9-14 and Figure 9-4.

Table 9-14: Baseline Noise Measurement locations for Grid Connection

Location Reference	Coordinates	
	Easting	Northing
AT1	587305	840371
AT2	587045	839908
AT3	584146	834482
AT4	581889	830173
AT5	580095	828169
AT6	577239	824989

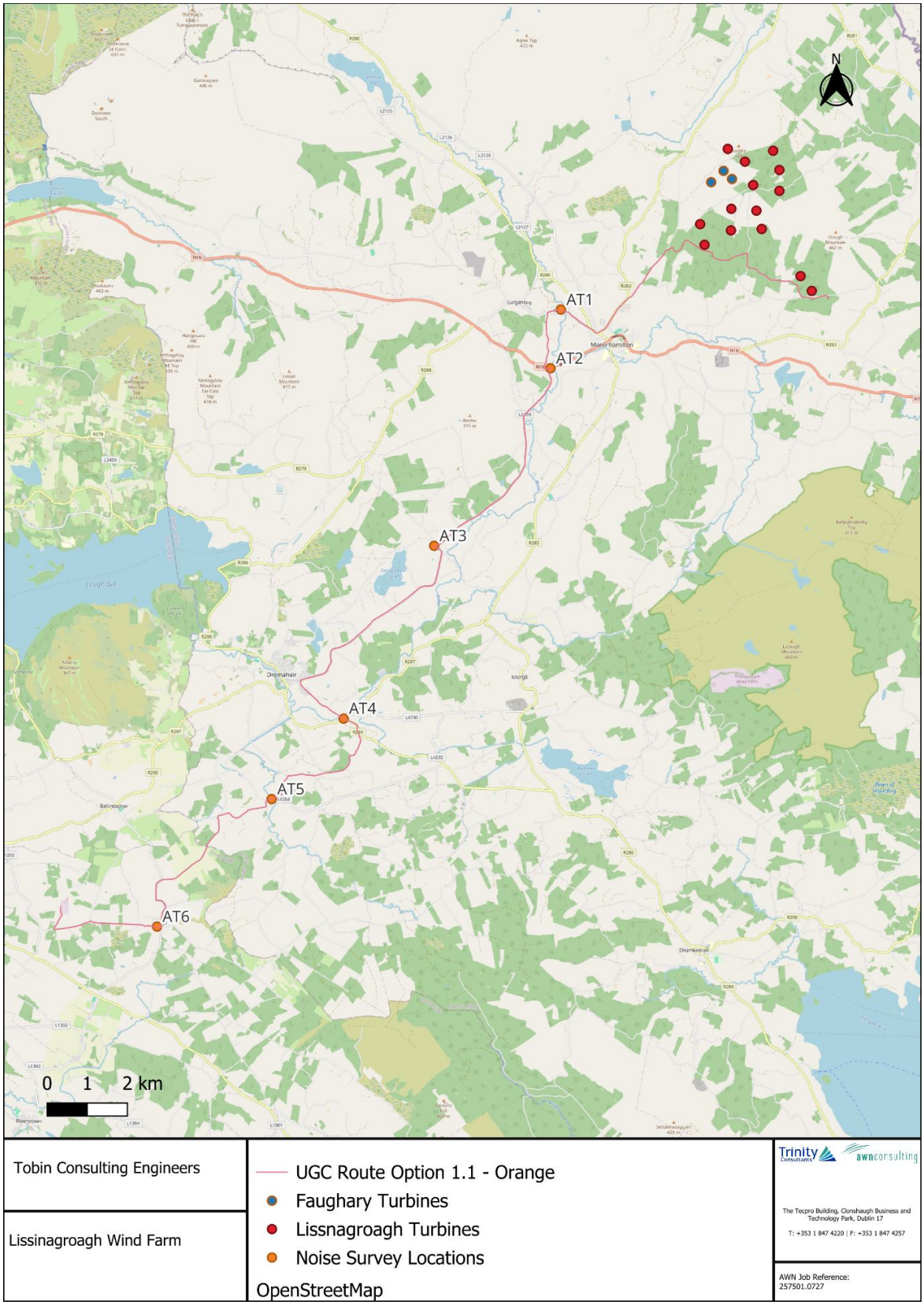


Figure 9-4: Noise Measurement Locations for Grid Connection Route

The measured noise levels are summarised in Table 9-15.

Table 9-15: Baseline Noise Measurements for Grid Connection

Location Reference	Measured Noise Levels (dB re.2x10^{-5}Pa)	
	L_{Aeq}	L_{A90}
AT1	53-57	50-52
AT2	65-68	37-41
AT3	49-55	34-35
AT4	58-62	31-43
AT5	57-60	40
AT6	39-43	32-34

9.6 ASSESSMENT OF EFFECTS

9.6.1 Do-nothing Scenario

If the proposed project is not progressed, the existing noise environment is expected to remain unchanged. Any increases in traffic volumes on the local road network would not be expected to result in a significant change to the overall ambient and background noise levels within the study area.

9.6.2 Construction Phase

Construction noise prediction calculations have been conducted using the assessment methodology outlined in Section 9.4.3. 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 internal site tracks;
- Upgrading of existing forestry/site tracks;
- Construction of on-site substation;
- Construction of cabling and grid connection including horizontal directional drilling;
- Construction of the meteorological mast
- Forestry Felling
- Operation of Borrow Pits
- Operation of Temporary construction compound;
- TDR accommodation areas, and
- Construction traffic.

Chapter 2 - Description of the Proposed Project contains detailed information on each of the above 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 or vibration impacts

at the NSLs. The following sections present an assessment of the stages of the construction phase that have the potential for associated noise and vibration effects.

Construction activities will be carried out during normal daytime working hours (i.e., 07:00 – 19:00hrs Mondays to Fridays and 07:00hrs – 14:00hrs 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. Any such out of hours working will be agreed in advance with the Local Authority.

9.6.2.1 Turbines and Hardstand Areas

Noise

Anticipated noise sources 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 H1113, which is situated approximately 734 m from the hardstand at proposed turbine T14.

Table 9-16 outlines the anticipated construction noise levels associated with the proposed works for this element of the construction. 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 9-hour assessment period.

Table 9-16: Anticipated Wind Farm Turbine Construction Noise Emission Levels

Item (BS 5228 Ref.)	Activity/Notes	Plant Noise level at 10m Distance (dB $L_{Aeq,T}$)[4]	Predicted Noise Level (dB $L_{Aeq,T}$) at distance (m)
			734 m
HGV Movement (C.2.30)	Removing spoil and transporting fill and other materials	79	28
Tracked Excavator (C.4.64)	Removing soil and rubble in preparation for foundation	75	24
Excavator Mounted Rock Breaker (C9.12)	Rock Breaking	85	34
/Piling Operations (C.3.3)	Piling Foundations (if required)	88	37
General Construction (Various)	All general activities plus deliveries of materials and plant	84	33
Concrete Mixer Truck and Concrete Pump (C.4.27)	Pouring turbine bases	79	28
Dumper Truck (C.4.4)	Distribution of materials	76	25

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

Item (BS 5228 Ref.)	Activity/Notes	Plant Noise level at 10m Distance (dB $L_{Aeq,T}$)[4]	Predicted Noise Level (dB $L_{Aeq,T}$) at distance (m)
			734 m
Mobile Telescopic Crane (C.4.39)	Turbine Component Lifting	77	26
Dewatering Pumps (C.6.41)	If required	78	27
Vibrating Rollers (C.5.28)	Road Surfacing	77	26
Petrol-driven chain saw (D.2.14)	Forestry Felling	86	35
Cumulative Construction Noise Level		--	41

At 734 m from the works, the predicted noise levels from construction activities are in the range of 26 to 39 dB $L_{Aeq,T}$ with a total 'worst-case' cumulative construction level of the order of 43 dB $L_{Aeq,T}$. In all instances the predicted noise levels at the nearest NSLs are below the adopted significance threshold outlined in Table 9-1 (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 9-1 and this finding is valid should all items of plant operate simultaneously. No specific mitigation measures are required.

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 professional judgement and 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
- 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 9-4.

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

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 construction of turbines and hardstanding areas are described as follows:

Quality	Significance	Duration
Negative	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.

9.6.2.2 New Internal Site Tracks

It is proposed to construct new internal site tracks to access the various parts of the proposed wind farm. The nearest NSL to any point along a proposed track is approximately 25 m to H135, near the proposed site entrance to the south of the site, in the townland of Cherrybrook. All other locations are at greater distances with the majority at significantly greater distances. A detailed description of the new road design and construction methodology is provided in Chapter 2 - Description of the Proposed Project.

Noise

Table 9-17 outlines the predicted construction noise levels associated with the proposed works for this element of the construction. 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 9-hour assessment period.

Table 9-17: Predicted Noise Levels from Construction Plant at Various Distances from the New Internal Site Roads

Item (BS 5228 Ref.)	Plant Noise level at 10m Distance (dB LAeq,T)	Predicted Noise Level (dB $L_{Aeq,T}$) at distance (m)				
		25 m	40 m	60 m	80 m	100 m
Tracked Excavator (C.4.64)	75	61	56	52	48	46
HGV Movement (C.2.30)	79	65	60	56	52	50
Dumper Truck (C.4.4)	76	62	57	53	49	47
Excavator Mounted Rock Breaker (C9.12)	85	71	66	62	58	56
Vibrating Rollers (C.5.28)	77	63	58	54	50	48
Cumulative Construction Noise Level	--	73	68	64	60	58

At any NSL within 25 m of the proposed works, the predicted noise levels are in excess of the linear construction noise limit of 70 dB $L_{Aeq,1hr}$ as set out in Section 9.3.2.2. At 40 m and any beyond, the predicted noise level is below 70 dB $L_{Aeq,1hr}$.

However, given the progressive nature of the construction methodology, it is anticipated that works will be in close proximity to the nearest NSLs for a limited duration. The predicted noise levels presented in Table 9-17 are expected to occur for a period of less than 10 days. Applying the guidance outlined in Section 9.3.2.4, it is concluded that the likely noise impacts are not significant.

Vibration

With reference to the discussion on vibration presented in Section 9.6.2.1, and the duration of the works in proximity to any specific NSL, there will be no significant vibration impacts associated with the construction of internal site tracks and therefore no specific mitigation measures are required.

Description of Effects

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 roads are described below.

Quality	Significance	Duration
Negative	Not Significant	Temporary

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.

9.6.2.3 Upgrade of Existing Forestry/Site Tracks and Public Roads

It is proposed to carry out upgrades to sections of existing forestry tracks and the L6184 local road to access the various parts of the proposed wind farm. The nearest NSL to any point along the proposed track is approximately 260 m to H511, to the west of T11 and T12. All other locations are at greater distances with the majority at significantly greater distances. A detailed description of the design and construction methodology for the upgraded tracks/public road is provided in Chapter 2 - Description of the Proposed Project.

Noise

Using the same assumed plant items in Table 9-17 for the upgrade of existing tracks and L6184 road, the predicted noise level at 260 m from the proposed works is 57 dB $L_{Aeq,1hr}$, which is within the linear construction noise limit of 70 dB $L_{Aeq,1hr}$ as set out in Section 9.3.2.2.

Applying the guidance outlined in Section 9.3.2.4, it is concluded that the likely noise impacts are not significant.

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 9-1. No specific mitigation measures are required.

Vibration

With reference to the discussion on vibration presented in Section 9.3.3, there will be no significant vibration impacts associated with the construction of internal site roads and therefore no specific mitigation measures are required.

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 upgrade of existing tracks and public road are described below.

Quality	Significance	Duration
Negative	Not Significant	Temporary

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.

9.6.2.4 On-site Substation

Noise

The nearest NSL to the proposed substation is H0448, which is approximately 827 m to the closest point of the substation. Based on the same construction activities as outlined in Table 9-16, it is predicted that the likely noise levels from construction activities associated with the substation will be in the order of 41 dB $L_{Aeq,T}$ H0448, 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.

Vibration

Which reference to the discussion on vibration presented in Section 9.3.3, there will be no significant vibration impacts associated with the construction of the proposed substation and therefore no specific mitigation measures will be required.

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 substation are described below.

Quality	Significance	Duration
Negative	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.

9.6.2.5 Grid Connection

The Grid Connection Route (GCR) spans 36.5 km, running from the proposed 110kV substation to the existing Srananagh 110 kV substation in Co. Sligo. The majority of the route follows public roads, with a short section being within the proposed wind farm site, and the remainder being located within Coillte and other private lands.

The associated construction works will occur for short durations at varying distances from Noise Sensitive Locations (NSLs). The nearest NSLs are located at approximately 10 m from the nearest point. In addition to the main construction works involving the laying of cables in subsurface trenches, the proposed GCR requires undercrossing watercourses for which Horizontal Directional Drilling (HDD) this element is assessed separately in Section 9.6.2.6.

There are joint bay pits proposed at every 650 m – 850 m along the GCR to facilitate jointing of two lengths of cabling. It is expected that excavations for these pits will require an element of rock breaking.

Noise

Table 9-18 outlines the predicted construction noise levels associated with the proposed works for this element of the construction. 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 9-hour assessment period.

Table 9-18: Predicted Noise Levels for Construction Plant at Various Distances from the Grid Connection Works

Plant Item (BS 5228 Ref.)	Plant Noise Level at 10m Distance (dB $L_{Aeq,12hr}$) [5]	Calculated Construction Noise Levels dB $L_{Aeq,12hr}$ at reference distance from works			
		10 m	15 m	25 m	50 m
Tracked Excavator (C.2.7)	70	68	64	60	54
Vibrating Rollers (C.2.40)	73	71	67	63	57
Wheeled Loader (C.2.8)	68	66	62	58	52
Cumulative Predicted Construction Noise Level (No Rock Breaking)		74	70	66	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 Vibration rolling will occur simultaneously*

For standard grid connection works, any NSL set back at 15 m or more from the proposed works is predicted to experience noise levels within the linear construction noise limit of 70 dB $L_{Aeq,1hr}$ as set out in Section 9.3.2.2.

NSLs located closer than 15 m to the works may experience construction noise levels slightly above 70 dB $L_{Aeq,1hr}$. 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 9-18 are expected to occur for less than two days in a worst-case scenario, with works anticipated to progress at a rate of 100 metres per day along the route.

Based on the guidance in Section 9.3.2.4, the likely noise impacts are considered not significant, and no specific mitigation measures are required.

Where rock breaking is required at joint bay pits, 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 $L_{Aeq,1hr}$ as set out in Section 9.3.2.2. NSLs close than 25 m may experience construction noise levels

[5] All plant noise levels are derived from BS 5228: Part 1

above 70 dB $L_{Aeq,1hr.}$ Nevertheless, it is anticipated that rock breaking will only occur at each location for less than 5 days.

In line with the guidance in Section 9.3.2.4, the likely noise impacts are considered not significant, and no specific mitigation measures are required.

Vibration

With reference to the discussion on vibration presented in Section 9.3.3, 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.

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, however once the duration of the impacts is taken into consideration, the impacts 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 and underground cabling are described below.

Quality	Significance	Duration
Negative	Slight	Temporary

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.

9.6.2.6 Horizontal Directional Drilling (HDD)

Noise

There are 11 no. locations where Horizontal Directional Drilling (HDD) for watercourse crossing is required to facilitate grid connection. Refer to Chapter 2, Section 2.6.5.2 for further detail on the construction methodologies for the HDD crossings.

Table 9-19 outlines the predicted construction noise levels associated with the proposed works and the predicted noise levels at a range of distances from the works. 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.

Table 9-19: Predicted Noise Levels for HDD Activities at Various Distances

Item (BS 5228 Ref.)	Plant Noise level at 10m Distance (dB $L_{Aeq,1hr}$)	Calculated Construction Noise Levels dB $L_{Aeq,12hr}$ at reference distance from works				
		10 m	20 m	30 m	50 m	70 m
Directional drill (Vermeer	76	74	68	64	60	57

Item (BS 5228 Ref.)	Plant Noise level at 10m Distance (dB $L_{Aeq,1hr}$)	Calculated Construction Noise Levels dB $L_{Aeq,12hr}$ at reference distance from works				
		10 m	20 m	30 m	50 m	70 m
D40x55 or similar)						
Tracked Excavator (C.4.17)	71	69	63	59	55	52
Cumulative Predicted Construction Noise Level		75	69	65	61	58

Review of the 11 no. HDD locations[6] shows that the closest locations to any NSLs are as follows:

- Bridge 2: Killanummery Community Centre at 35 m
- Bridge 3: a dwelling along the R287 at near Dromahair Creamery at 30 m
- Bridge 5: Kilcoosey National School at 35 m
- Bridge 9: dwellings at Sheila Mór in Manorhamilton at 30 m.

Thus, there is no NSL within 30 m of a HDD location; all other HDD locations are at greater distances to NSLs.

As shown in Table 9-19, at distances of 30 m and greater, the predicted construction noise levels are below the adopted significance threshold outlined in Table 9-1 (Category A – 65 dB $L_{Aeq,T}$ during daytime periods) and the likely noise impacts are not significant.

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 9-1. No specific mitigation measures are required.

Vibration

Due to the distance of the proposed works from the identified NSL's, and with reference to the discussion on vibration presented in Section 9.3.3, there will be no significant vibration impacts associated with HDD works and no specific mitigation measures are required.

Description of Effects

The likely predicted noise and vibration impacts are below the limits and/or thresholds identified. With respect to the EPA's criteria for description of effects, the potential effects at the nearest NSLs associated with the proposed HDD crossing works are described below.

Quality	*Significance*	*Duration*
Negative	Not Significant	Temporary

[6] See Construction Methodology 110kV Grid Connection – Lissinagroagh Wind Farm

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.

9.6.2.7 Meteorological Mast

Noise

The nearest NSL to the proposed meteorological mast is House H511, which is approximately 423 m to the closest point of the met mast area. Based on the same construction activities as outlined in Table 9-16 , it is predicted that the likely noise levels from construction activities associated with the proposed met mast will be in the order of 48 dB $L_{Aeq,T}$ H511, 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.

Vibration

Which reference to the discussion on vibration presented in Section 9.3.3 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.

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 meteorological mast are described below.

Quality	Significance	Duration
Negative	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.

9.6.2.8 Forestry Felling

Noise

As part of the construction of the proposed project, there will be a requirement to fell forestry in the areas immediately around the footprint of the wind farm infrastructure. Considering the distances to NSLs, there is no additional noise effect over and above that presented in Section 9.6.2.

Vibration

Which reference to the discussion on vibration presented in Section 9.3.3 there will be no significant vibration impacts associated with the proposed forestry felling and therefore no specific mitigation measures will be required.

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 forestry felling are described below.

Quality	Significance	Duration
Negative	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.

9.6.2.9 Borrow Pits

Noise

It is proposed to excavate three (3) borrow pits within the proposed wind farm site to provide construction material and temporary storage of excavated material. To inform this aspect of the proposal, a noise assessment has been based on the following assumptions:

- One mobile crusher and one rock breaker will be used at each borrow pit location;
- The plant will operate simultaneously in the vicinity of all proposed borrow pit locations (listed in Table 9-20); and
- The noise emissions for the relevant plant have been extracted from BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise (refer to Table 9-21).

Table 9-20: Proposed Borrow Pit Locations

Borrow Pit Ref	Co-ordinates (ITM)	
	Easting	Northing
BP-01	592690	841022
BP-02	592172	841756
BP-03	592279	844262

Table 9-21: 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
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 (each of 3 no)	77	88	95	93	93	92	86	76	99

A noise model prediction model has been prepared to consider the expected noise emissions from the proposed construction works at borrow pits as outlined above. A percentage on-time of 66% has been used for the noise calculations.

The nearest NSL to any of the borrow pit locations is at a distance of over 450 m from any 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 assuming all borrow pits operate simultaneously are presented in Table 9-22.

Table 9-22: Predicted Noise Levels from Borrow Pit Activity at Nearest NSLs

Location Ref.	dB $L_{Aeq,T}$
H114	56
H113	56
H121	54
H117	54
H112	53
H120	53
H116	53
H519	53
H118	52
H115	52

Review of the results contained in Table 9-22 confirms that the predicted construction noise levels are almost 20 dB below the relevant daytime construction noise criteria (65 dB $L_{Aeq,T}$). Construction works at the borrow pits will only occur during daytime periods only.

Vibration

With reference to the discussion on vibration presented in Section 9.3.3, 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.

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
Negative	Not Significant	Short Term

9.6.2.10 Temporary Construction Compounds

Noise

Two temporary compound areas will be constructed to provide office space, welfare facilities, car parking and hardstands for storing materials. One will be located at the southern end of the site (south of T11), while the second will be at the northern end (north of T6).

The nearest NSL to the either compound is H0448, at a distance of 1152 m to the closest point of the southern compound. Based on the same construction activities as outlined in Table 9-17 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 44 dB $L_{Aeq,T}$ H0448, 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. The nearest NSL to the northern compound is over 1.7 km therefore the expected construction noise levels will be lower.

Vibration

With reference to the discussion on vibration presented in Section 9.3.3 there will be no significant vibration impacts associated with the construction of the proposed compounds and therefore no specific mitigation measures will be required.

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 compounds are described below.

Quality	Significance	Duration
Negative	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.

9.6.2.11 TDR Accommodation Areas

At locations described in Chapter 2 - Project Description, Section 2.6.3 there are areas where accommodations may be required to allow the delivery of the turbine blades to the site. These accommodations include reducing the height of hedges, removal of lampposts, road signs and other obstructions.

The associated accommodations will occur for short durations at any one location, at varying distances from Noise Sensitive Locations (NSLs).

Similar to the grid connection, the due to the progressive nature of the accommodations, it is anticipated that noise sources will remain in close proximity to the nearest NSLs only for a limited duration. Taking into account the durations discussed in Section 9.3.2.4, no significant noise effects are anticipated.

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 compounds are described below.

Quality	Significance	Duration
Negative	Not Significant	Short Term

9.6.2.12 *Construction Traffic*

This section has been prepared to review potential noise impacts associated with construction traffic along the local road network. The information presented in Chapter 16 - Traffic and Transportation has been used to inform the assessment presented in this chapter.

Changes in the traffic noise levels associated with the construction traffic for 'peak construction' have been calculated on based on information in Chapter 16. Table 9-23 presents the details of the assessment and the calculated change in traffic noise levels due to the proposed project.

Table 9-23: Estimated Changes in Traffic Noise Levels (Peak Construction Period)

Location	Period	Base AADT 2028 (Hourly Flow)	Base AADT 2028 + Peak Construction (Hourly Flow)	Change in Traffic Noise Level dB(A) from Construction Traffic
Junction 1 - L6184/N16	AM: 08:15-09:15	255	270	+0.4
	PM: 16:45-17:45	295	310	+0.7
Junction 2 -Upper Main Street/N16	AM: 08:15-09:15	681	706	+0.5
	PM: 16:45-17:45	673	698	+0.5
Junction 3 - Park Road/ N16 Sligo Road	AM: 08:15-09:15	599	642	+0.7
	PM: 16:45-17:45	596	637	+1.0
Junction 4 - Cluain Oir/Castle View/R282 Park Road	AM: 08:15-09:15	269	311	+1.6
	PM: 16:45-17:45	271	312	+3.1

The calculated increases in the noise predicted increases in traffic noise levels due to the additional construction generated traffic during the peak construction periods will be less than 3 dB on at Junctions 1 to 3 and at Junction 4 for AM periods. With reference to the DMRB magnitude of impact set out in Section 9.3.2.3 the potential impacts are classified as 'minor' and the significance rating is 'not significant'

At Junction 4 for PM periods, the predicted increase in noise level +3.1 dB. However, the predicted noise levels of existing and construction traffic is 62 dB, $L_{Aeq,1hr}$ which is within the Construction Noise Threshold of 65 dB $L_{Aeq,1hr}$ presented in Section 9.3.2.1, and therefore the noise effect of construction traffic is considered not significant.

Description of Effects

The likely predicted effects are below the thresholds identified for a significant effect to occur. With respect to the EPA's criteria for description of effects, the potential associated effects at the nearest NSLs associated with additional traffic generated during the construction phase are described below.

Quality	*Significance*	*Duration*
Negative	Not Significant	Short Term

9.6.3 Operational Phase

9.6.3.1 Assessment of Wind Turbine Noise

Upper End of Turbine Design Flexibility

Using the assessment methodology described in Section 9.4.3.2 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 9613-2:2024 calculation standard and best practice guidance for turbine noise prediction contained in the IOA GPG. For the upper end of the turbine design flexibility, the sound power levels are as described in the 'Highest' column in Table 9-8, at a hub height of 103.5 m and a tip height of 185 m.

The initial noise predictions 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.

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 Table 9-12 in Section 9.5.2 which in turn have been derived in accordance with the applicable criteria described in detail in Section 9.3.4.

Appendix 9-7 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 9-8.

At all NSLs the worst omni-directional cumulative turbine noise levels are below the noise criterion curves.It is reiterated that the noise prediction calculations have been made using the ISO 9613-2:2024 standard and relate to conditions favourable to noise propagation (typically downwind propagation from source to receiver and/or downward refraction under temperature inversions). A +2 dB uncertainty has been applied to turbine emissions in line with the IOA GPG.

Lower End of Turbine Design Flexibility

The lower end of the design flexibility is assessed by using the same turbine noise emissions as the upper end, but at a hub height of 98 m to give a tip height of 179.5 m in the case of the N163 which has the highest sound power levels across the majority of the wind speed range.

In order to understand the potential difference in noise levels at NSLs and whether there are any differences in the potential effects with respect to the upper end of the range, Appendix 9-9 compares the predicted levels at the 10 closest NSLs for both scenarios and tabulates the results. Most locations have the same predicted noise levels for each end of the design range. Where there are differences, they are of the order of +/- 0.1 dB L_{A90}.

Description of Effects

It is considered that no significant effect is associated with the operation of the proposed wind farm, since the predicted cumulative turbine noise levels associated with the wind farm will be within the relevant best practice noise criteria for wind farms contained in the applicable guidance in WEDG06.

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 to the soundscape.

With respect to the EPA's criteria for description of effects, 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
Negative	Not Significant	Long-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.

9.6.3.2 Fixed Plant Noise

Substation

Details of the proposed 110kV substation are described in Chapter 2 - Description of the Proposed Project. The substation is likely to be operating continuously, and the noise impact at the nearest NSL has been assessed to identify the potential greatest impact associated with the operation of the substation at the nearest NSL.

The noise emission level predicted to arise from the operation of the proposed 110kV substation is 90 dB(A) L_w.

Noise prediction model calculations for the operation of the substation have been undertaken in accordance with ISO 9613:2024. The predicted noise level at the nearest NSL (H511 at approximately 166 m to the nearest point of the substation compound) is 29 dB $L_{Aeq,T}$. This level of noise is low, and it is concluded that there will be no significant noise emissions 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 9.3.5 and will not result in any adverse impacts at nearby NSLs. At the detailed design stage, substation plant will be selected and designed to ensure that there are no tonal or impulsive characteristics form the plant audible at any NSLs during night-time periods.

9.6.4 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 considered to be comparable to those outlined in relation to the construction phase (as per Section 9.6.2) albeit less works will be required as only above-ground structures will be

removed. Turbine and mast foundations would remain underground, and cable ducting will remain in situ. The underground cabling and on-site substation will remain in place.

Refer to Chapter 2 Description of Proposed Project for full details. 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, the impact is not significant.

Description of Effects

The likely predicted noise and vibration impacts are 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 and vibration sensitive locations associated with decommissioning are described below.

Quality	Significance	Duration
Negative	Not Significant	Short Term

9.7 MITIGATION MEASURES

The assessment of potential effects has demonstrated that the proposed project is expected to comply with the identified criteria for the construction, operational and decommissioning phases and therefore no specific mitigation measures are required. However, the mitigation measures detailed below will be implemented for good practice

9.7.1 Embedded Mitigation

At project design stage all noise sensitive locations in the vicinity of the proposed wind farm were identified. In order to minimise potential effects on residential properties, it was decided early in the design process that a minimum set-back of 740m would be ensured (4 x the highest potential tip height of 185m). This is in line with the setback requirements in the 2006 and Draft Revised WEDGs (2019).

9.7.2 Construction and Decommissioning Phases

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 impacts 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 (see Appendix 2-4).

9.7.3 Operational Phase

9.7.3.1 Wind Turbine Noise

An assessment of the operational turbine noise levels has been undertaken in accordance with best practice guidelines and procedures as outlined in Section 9.3.4 of this Chapter.

The findings of the assessment, presented in Section 9.6.3.1 confirmed that the predicted operational noise levels will be within the relevant best practice noise criteria curves at all NSLs.

9.7.3.2 Fixed Plant

The assessment of noise from the operation of the substation is predicted to comply with the proposed criteria in Section 9.3.5. Therefore, no specific mitigation measures are required.

However, during the operational phase the following measures will be employed to ensure the noise levels at NSL are within the proposed criterion and any potential for noise disturbance is minimised:

- all mechanical plant items e.g. fans, pumps etc. shall be regularly maintained to ensure that excessive noise generated any worn or rattling components is minimised.
- there will be no tonal or impulsive characteristics from the plant operation audible at any NSL during night time periods.

9.7.4 Monitoring

9.7.4.1 Noise 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 wind farm, 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 Noise 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 implemented.

In the unlikely event that an exceedance of the noise criteria is identified as part of the commissioning assessment and relevant corrective actions taken. For example, implementation of noise reduced operational modes resulting in curtailment of turbine operation can be implemented for specific turbines in specific wind conditions to ensure turbine noise levels are within the relevant noise criterion or conditions turbine noise limits. Such curtailment can be applied using the wind farm SCADA system with a marginal reduction of the wind turbine performance. Following the implementation of the measures, the commissioning noise survey will be repeated.

9.7.4.2 Noise 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 Noise Management Protocol for addressing amplitude modulation and tonality is presented in Appendix 9-10. A final version of this protocol, which will reflect any relevant planning conditions, will be contained within the NCMP to be agreed the relevant Local Authority and/or Authorities.

9.8 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.

9.8.1 Construction Phase

During the construction phase of the project, there will be some impacts 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 impacts will not be significant.

With respect to the EPA's criteria for description of effects, in terms of these construction activities, the potential associated effects at the nearest NSLs associated with the various elements of the construction phase are described in Table 9-24.

Table 9-24: Summary of Residual Effects for Construction Phase

Construction Activity	Quality	Significance	Duration	Conclusion
Turbines and Hardstand Areas	Negative	Not Significant	Short Term	Not Significant
New Internal Site Tracks	Negative	Not Significant	Temporary	Not Significant
Upgrade of Existing Site Tracks/Public Roads	Negative	Not Significant	Temporary	Not Significant
TDR Accommodation Areas	Negative	Not Significant	Temporary	Not Significant
Substation	Negative	Not Significant	Temporary	Not Significant
Grid Connection	Negative	Not Significant	Temporary	Not Significant
HDD	Negative	Not Significant	Short Term	Not Significant
Met Mast	Negative	Not Significant	Temporary	Not Significant
Forestry Felling	Negative	Not Significant	Temporary	Not Significant
Borrow Pits	Negative	Not Significant	Short Term	Not Significant
Temp Construction Compounds	Negative	Not Significant	Short Term	Not Significant
Construction Traffic	Negative	Not Significant	Short Term	Not Significant

The likely predicted noise and vibration effects are below the limits and/or thresholds identified. The described effects should be considered in terms that the effect is variable, and that this assessment considers the locations of the greatest potential impact.

9.8.2 Operational Phase

9.8.2.1 Wind Turbine Noise

The predicted noise levels associated with the proposed turbines will be within best practice noise criteria curves recommended in the WEDG06, therefore it is considered that effect associated with the operation of the proposed turbines is not significant.

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

The predicted residual operational turbine noise effects are summarised as follows at the nearest NSLs.

Quality	Significance	Duration
Negative	Not Significant	Long-term

9.8.2.2 Substation Operation

Quality	Significance	Duration
Negative	Not Significant	Long-term

9.9 CUMULATIVE EFFECTS

9.9.1 Construction and Decommissioning

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

In order for cumulative noise levels to increase, the contribution of noise from the proposed development be within 10 dB of the other source of noise. The predicted noise level from con construction activity would need to be in well in excess of 55 dB $L_{Aeq,T}$, at an NSL, this value being 10 dB below 65 dB $L_{Aeq,T}$, the threshold for potential significant construction noise effects, for a potential cumulative construction noise to exceed the noise thresholds.

The assessment in Section 9.6.2 and 9.6.4 confirms that the predicted noise levels from activities at static construction sites at any NSL are less than 55 dB $L_{Aeq,T}$, in the majority of cases, and 56 dB $L_{Aeq,T}$ in the case of the borrow pits, therefore the potential for any cumulative noise effect from all of the proposed activities occurring simultaneously or with construction activities from other developments is unlikely and not significant.

For grid connection and underground cabling construction work the likelihood of any significant cumulative effects are considered low. In the unlikely event that the works associated with the proposed project occurred in proximity to construction and or decommissioning works at another development any cumulative effects would be brief.

The potential for any cumulative noise effect from all of the proposed activities occurring simultaneously or with construction activities from other developments is unlikely and not significant.

9.9.2 Operation of Wind Turbines

Existing permitted and proposed wind farm developments with the potential for cumulative impacts have been considered as part of the turbine noise impact assessment. A review of existing, proposed and permitted wind turbine developments in the wider study has been undertaken in accordance with the guidance contained in the IOA GPG. Therefore, the operational noise assessment is inherently a cumulative assessment; once the mitigation measures in Section 9.7.3.1, are implemented, cumulative noise effects will not be significant.

9.9.3 Operation of Fixed Plant

There are no other industrial noise sources of fixed mechanical and electrical plant in the vicinity of the nearest NSLs to the proposed substation that are expected to give rise to any cumulative noise impacts at NSLs. The background noise survey (refer to Section 9.4.1.2 and 0) 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.

9.9.3.1 Grid Connection

It is not considered that there will be any significant cumulative operational noise or vibration effects are in relation to the proposed GCR. The electrical cabling will not generate any noise during the operational phase.

9.10 DIFFICULTIES ENCOUNTERED DURING PREPARATION OF THIS CHAPTER

There were no difficulties or limitations encountered when undertaking this assessment.

9.11 TRANSBOUNDARY EFFECTS

This section considers the potential transboundary impact of the proposed project.

With regards to noise sensitive locations in Northern Ireland, the ETSU-R-97 Guidelines are pertinent as the Guidelines (DoEHLG, 2006) are not applicable in this jurisdiction.

NSL reference H1249, being the closest to the border at distance of approximately 400 m from the border, has a cumulative predicted noise level of less than 24 dB L_{A90}, therefore the lowest and most conservative ETSU noise criteria are met.

It follows that as the proposed project does not have the potential for a significant transboundary effect.

9.12 INTERACTIONS

The potential interaction between noise and vibration and other specialist chapters in the EIAR is primarily limited to Chapter 5 - Population & Human Health), Chapter 6 - Biodiversity) and Chapter 15 - Traffic and Transportation. This chapter has been prepared in consideration of and in conjunction with the relevant elements of these chapters. For example, noise and vibration impacts associated with the proposed project have been fully considered within this Chapter.

Commentary on the impact assessment and related noise levels are also summarised specifically with respect to potential human health impacts in Chapter 5 and Chapter 6. The traffic flow projections associated with the development provided in Chapter 15 - Traffic and Transportation have been utilised in the calculations in Section 9.6.2.12 of this Chapter.

9.13 CONCLUSION

When considering a project 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 phases, and the long-term operational phase.

The assessment of construction and decommissioning noise and vibration and has been conducted in accordance with best practice guidance outlined above.

Residual noise associated with the construction and decommissioned phases have been predicted to be below the proposed threshold values. The associated noise and vibration levels are not likely to cause significant effect at any NSL.

The assessment of operational noise and vibration has been conducted in accordance with best practice guidance presented in Sections 9.3.4 and 9.3.5.

Based on detailed information on the site layout, turbine noise emission levels and turbine hub height, turbine noise levels have been predicted at NSLs for a range of operational wind speeds. The predicted noise levels associated with the proposed project will be within the noise criteria stated in the applicable WEDG06 guidelines. Therefore, it is not considered that a significant effect is associated with the development.

Operational noise from the proposed substation has been assessed and found to be within the proposed criteria based on review of the applicable guidelines and standards.

A commitment has been provided that prior to the commissioning of the wind farm, the operator will submit a Noise Compliance Monitoring Programme (NCMP) to the planning authority for written agreement. The NCMP will include a detailed methodology for all noise measurements, including frequency or monitoring procedures for recording results and a protocol for managing complaints.

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

It is therefore concluded that there are no significant noise or vibration effects associated with the construction, operation and decommissioning of the proposed project.

Similarly, there are no significant cumulative noise or vibration effects associated with the construction, operation and decommissioning of the proposed project.

9.14 REFERENCES

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