12. NOISE AND VIBRATION

12.1 Introduction

12.1.1 Background & Objectives

This chapter of the EIAR describes the assessment undertaken of the potential noise and vibration impacts and effects associated with the Proposed Development. The Proposed Development includes the provision of 3 no. wind turbines with an overall ground to blade tip height of 156.5 metres. A full description of the Proposed Development is provided in Chapter 4 (Description of the Proposed Development) of this EIAR.

As detailed in Section 1.1.1 in Chapter 1, for the purposes of this EIAR, the various project components are described and assessed using the following references: 'Proposed Development', 'proposed turbines', the 'Site', the ' 2020 Application' and the 'Kealkill Wind Farm'. Please see Section 1.1.1 of this EIAR for further details. A detailed description of the Proposed Development is provided in Chapter 4 (Description of the Proposed Development) of this EIAR.

This Noise and Vibration assessment considers the construction phase, operational phase and decommissioning phase of the Proposed Development on to the nearby noise sensitive locations (NSLs). To inform the noise impact assessment, background noise levels have been measured at four representative locations in the vicinity of the proposed turbines to assess the potential impacts associated with the operation of the Proposed Development.

A glossary of acoustic terms used throughout this chapter is provided in Appendix 12-1.

This chapter is supported by material in the following appendices:

- Appendix 12-1: Glossary of Acoustic Terms
- Appendix 12-2: Noise Study Area
- Appendix 12-3: Background Noise Survey
- Appendix 12-4: Sound Power Levels
- Appendix 12-5: Noise Modelling Parameters
- Appendix 12-6: Predicted Noise Levels
- Appendix 12-7: Predicted Noise Contour

12.1.2 Statement of Authority

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

Mike Simms (Principal Acoustic Consultant) holds a BE and MEngSc in Mechanical Engineering and is a member of the Institute of Acoustics (MIOA) and of the Institution of Engineering and Technology (MIET). 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 (TechIOA) of the Institute of Acoustics. Miguel has worked in the field of acoustics since 2021, where he has contributed to numerous projects related to environmental surveying, noise modelling, and impact assessment for various sectors, including wind energy, industrial, commercial, and residential.

Dermot Blunnie (Associate (Acoustics)) holds a BEng (Hons) in Sound Engineering, MSc in Applied Acoustics and has completed the Institute of Acoustics (IOA) Diploma in Acoustics and Noise Control. He has been working in the field of acoustics since 2008 and is a member of the Institute of Engineers Ireland (MIEI) and the Institute of Acoustics (MIOA). He has extensive knowledge and experience in relation to commissioning noise monitoring and impact assessment of wind farms as well as a detailed knowledge of acoustic standards and proprietary noise modelling software packages. He has commissioned noise surveys and completed noise impact assessments for numerous wind farm projects within Ireland.

12.2 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 vast range of pressure levels that can be detected by the ear, it is convenient to measure sound in terms of a logarithmic ratio of sound pressures. These values are expressed as Sound Pressure Levels (SPL) in decibels (dB).

The human audible range of sounds expressed in terms of Sound Pressure Levels (SPL) is 0 dB (for the threshold of hearing) to 120 dB (for the threshold of pain). In general, a subjective impression of doubling of loudness corresponds to a tenfold increase in sound energy which conveniently 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) increases the SPL by 3 dB.

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. In order to rank the SPL of various noise sources, the measured level has to be adjusted to give comparatively more weight to the frequencies that are readily detected by the human ear. The 'A-weighting' system defined in the international standard, BS ISO 226:2003 Acoustics. Normal Equal-loudness Level Contours has been found to provide the best correlations with human response to perceived loudness. SPLs measured using 'A-weighting' are expressed in terms of dB(A).

An indication of the level of some common sounds on the dB(A) scale is presented in Figure 12-1. A glossary of acoustic terms used throughout this chapter is presented in Appendix 12-1.

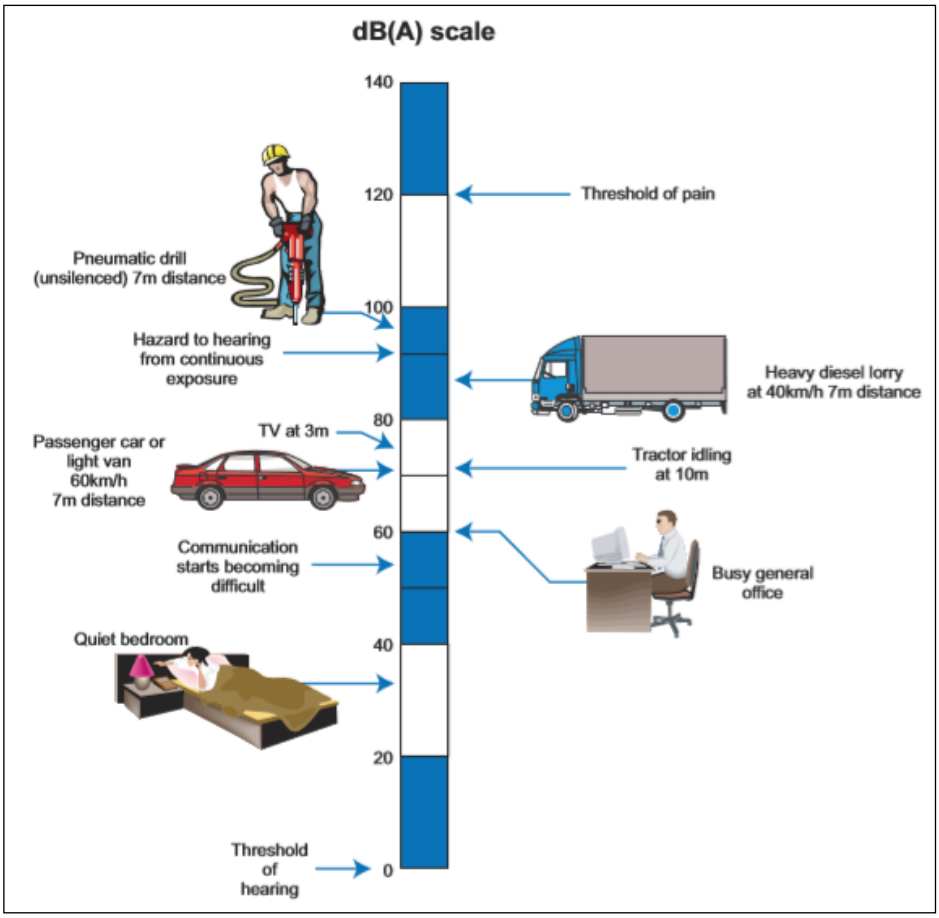


Figure 12-1 The level of typical common sounds on the dB(A) scale (National Roads Authority (NRA) Good Practice Guidance for the Treatment of Noise during the Planning of National Road Schemes (NRA, 2014)

12.3 Assessment Methodology

The assessment of impacts has been undertaken with reference to the most appropriate guidance documents relating to noise and vibration for both the construction, operational and decommissioning associated with the Proposed Development.

In addition to the specific guidance documents outlined below, the Environmental Impact Assessment (EIA) guidelines listed in Chapter 1 (Introduction) were considered and consulted for the purposes of preparing this EIAR chapter.

The methodology adopted for this noise and vibration impact assessment for the Proposed Development is summarised as follows:

- Characterise the receiving environment through noise surveys at various locations in the receiving environment of the Proposed Development;
- Undertake predictive noise calculations to assess the potential impacts associated with the construction, operational and decommissioning phases of the Proposed Development at nearby NSLs;
- Evaluate the potential noise and vibration impacts and describe the effects;
- Specify mitigation measures to reduce, where necessary, the identified potential noise and vibration impacts from the Proposed Development; and
- Describe the significance of the residual noise and vibration effects associated with the Proposed Development, including cumulative effects.

12.3.1 EPA Description of Effects

The significance of effects of the Proposed Development shall be described in accordance with the EPA guidance document '*Guidelines on the information to be contained in Environmental Impact Assessment Reports (EIAR)'* (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 Development are described with respect to EPA,2022 guidance in the relevant sections of this chapter.

12.3.2 Guidance Documents and Assessment Criteria

The following sections review best practice guidance that is commonly adopted in relation to developments such as the one under consideration here. The relevant guidance documents are listed below and are discussed where relevant in the various sections of this chapter.

- *EPA Guidelines on the Information to be contained in Environmental Impact Statements*, (EPA, 2022).
- British Standard Institute (BSI) BS 5228-1:2009 +A1:2014 Code of Practice for noise and vibration control of construction and open sites - Part 1: Noise (hereafter referred to as BS 5228-1) (BSI, 2014)
- British Standard Institute (BSI) BS 5228-2:2009+A:2014 Code of Practice for noise and vibration control of construction and open sites - Part 2: Vibration (BSI, 2014)
- United Kingdom Highways England (now National Highways) (UKHE) Design Manual for Roads and Bridges (DMRB) Sustainability & Environment Appraisal LA 111 Noise and Vibration Revision 2 (hereafter referred to as DMRB) (UKHE, 2020)
- British Standard Institute (BSI) BS 7385: 1993 Evaluation and measurement for vibration in buildings Part 2: Guide to damage levels from ground borne vibration (BSI, 1993)
- Transport Infrastructure Ireland (formerly NRA) (TII) Good Practice Guidance for the Treatment of Noise during the Planning of National Road Schemes (TII, 2014)
- Department of Trade, and Industry (UK) Energy Technology Support Unit (ETSU) ETSU-R-97 The Assessment and Rating of Noise from Wind Farms (hereafter referred to as ETSU-R-97) (ETSU, 1996)
- Institute of Acoustics (IOA) A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise (hereafter referred to as IOAGPG) (IOA, 2013)
- Institute of Acoustics (IOA) Supplementary Guidance Note 1: Data Collection (IOA, 2014)
- Department of the Environment, Heritage, and Local Government (DoEHLG) Wind Energy Development Guidelines (hereafter referred to as WEDG) (DoEHLG, 2006)
- Department of Housing, Planning and Local Government (DoHPLG) Draft Wind Energy Development Guidelines (hereafter referred to as Draft Guidelines) (DoHPLG, 2006)
- WHO Regional Office for Europe (WHO) Environmental Noise Guidelines for the European Region (WHO, 2018)
- Environmental Protection Agency Office of Environmental Enforcement (OEE) Guidance Note on Noise Assessment of Wind Turbine Operations at EPA Licensed Sites (NG3) (OEE, 2011)
- IOA Noise Working Group (Wind Turbine Noise) Amplitude Modulation Working Group (IOA) A Method for Rating Amplitude Modulation in Wind Turbine Noise (IOA, 2016)
- 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 (IEC, 2024)

- Environmental Protection Agency Office of Environmental Enforcement (OEE) Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4) (hereafter referred to as NG4) (OEE, 2016)
- International Organization for Standardization (ISO) ISO 9613-2:2024 Acoustics – Attenuation of sound during propagation outdoors - Part 2: Engineering method for the prediction of sound pressure levels outdoor (ISO, 2024)
- Acoustics Research Centre, University of Salford Procedure for the assessment of low frequency noise complaints, Revision 1, December 2011, Contract no. NANR45 (Salford, 2011) (hereafter referred to as NANR45)
- Department for Business, Energy & Industrial Strategy Wind Turbine AM Review: Phase 2 Report Project Number: 3514482A Issue: 3 Issued August 2016 (DBEIS, 2016)

12.3.2.1 Construction Phase

12.3.2.1.1 *Construction Phase – Noise*

General Construction

There is no published statutory Irish guidance relating to the maximum permissible noise level that may be generated during the construction phase of a project. Local authorities normally control construction activities by imposing limits on the hours of construction works and may consider noise limits at their discretion.

In the absence of specific noise limits, appropriate criteria relating to permissible construction noise levels for a development of this scale may be found in BS 5228-1 (BSI, 2014).

The approach adopted here calls for the designation of a NSL into a specific category (A, B or C) based on existing ambient noise levels in the absence of construction noise. This then sets a Construction Noise Threshold (CNT) value that, if exceeded (construction noise only) at the façade of residential NSLs, indicates a potential significant noise impact is associated with the construction activities. The threshold values are applicable to both construction and decommissioning noise.

Table 12-1 presents the threshold values which, if exceeded, potentially signify a significant effect as recommended by BS 5228-1 (BSI, 2014). The threshold levels relate to construction noise only.

Table 12-1 Example Threshold of Potential Significant Effect at NSLs

Assessment category and threshold value period (T)	Threshold values, $L_{Aeq,T}$ 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)	65	70	75

Note A Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are less than these values.
Note B Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are the same as category A values.
Note C Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are higher than category A values.
Note D 19:00 – 23:00 weekdays, 13:00 – 23:00 Saturdays and 07:00 – 23:00 Sundays.

It should be noted that this assessment method is only proposed for residential properties. The following method should be applied:

For each period (e.g., daytime) the ambient noise level is determined and rounded to the nearest 5 dB. At some sensitive properties, especially those situated near busy roads, ambient noise levels are anticipated to be relatively high. However, given the rural nature of the site in general, reference has been made to the quietest properties near the development which have daytime ambient noise levels typically in the range of 30 to 50 dB $L_{Aeq,1hr}$. Therefore, for the purposes of this assessment, as a precautionary approach, all properties will be afforded a 'Category A' designation for initial assessing of construction noise impacts.

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 (BSI, 2014).*

Please see Section 12.5.2 for the detailed assessment in relation to the construction of the Proposed Development.

Linear Construction Works

As it is proposed to connect into the existing 38kV overhead line at the Site, there are no linear construction works associated with the grid connection for the Proposed Development.

Interpretation of the CNT

In order to assist with interpretation of CNTs, relative to the CNT. Reference is made to DMRB (UKHE, 2020). Table 3.16 therein is adapted to include the relevant significance effects from EPA EIAR Guidelines (EPA, 2022); Table 12-2 includes guidance as to the likely magnitude of impact associated with construction activities.

Table 12-2 Description of the magnitude of impacts. Adapted from DMRB Table 3.16

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

The adapted DMRB guidance outlined will be used to assess the predicted construction noise levels at NSLs and comment on the likely effects during the construction stages (UKHE, 2020).

12.3.2.1.2 Additional Vehicular Activity on Public Roads - Noise

There are no specific guidelines or limits relating to traffic related sources along the local or surrounding roads. Given that construction traffic from the Proposed Development 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 Proposed Development.

For the assessment of potential noise impacts from construction related traffic along public roads, Table 12-3 below, taken from DMRB, offers guidance as to the likely short-term impact associated with any change in traffic noise level (UKHE, 2020).

Table 12-3 Classification of magnitude of traffic noise changes in the short-term. Source DMRB, UKHE (2020)

Change in Sound Level (dB(A))	Subjective Reaction	DMRB Magnitude of Impact (Short-term)	EPA Significance of Impact
Less than 1 dB	Inaudible	Negligible	Imperceptible
1.0 – 2.9	Barely Perceptible	Minor	Not Significant
3.0 – 4.9	Perceptible	Moderate	Slight, Moderate
≥5	Clearly Audible	Major	Significant

The DMRB guidance will be used to assess the predicted increases in traffic levels on public roads associated with the Proposed Development and comment on the short-term impacts during the construction phase (UKHE, 2020). Where a major or moderate impact is identified due to the change in traffic noise level, reference will be made to the overall predicted noise level from construction traffic in the context of the construction noise criteria outlined in Section 12.3.2.1.

12.3.2.1.3 Consideration of Duration of Effects

Section 3.19 of DMRB states that construction noise shall constitute a significant effect where it is found 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 (UKHE, 2020).

12.3.2.1.4 Construction Phase - Vibration

Vibration standards come in two varieties: those dealing with human comfort and those dealing with cosmetic or structural damage to buildings. With respect to the Proposed Development, 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 documents BS7385 and BS5228.

BS 7385 states that there should typically be no cosmetic damage if transient vibration does not exceed 15 mm/s at low frequencies rising to 20 mm/s at 15 Hz and 50 mm/s at 40 Hz and above (BSI, 1993).

BS 5228-2 recommends that, for soundly constructed residential property 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 than 15 Hz. Below these vibration magnitudes minor damage is unlikely, although

where there is existing damage, these limits may be reduced by up to 50%. In addition, where continuous vibration is generated, the limits discussed above may need to be reduced by 50% (BSI, 2014).

The Transport Infrastructure Ireland (TII) (formerly National Roads Authority (NRA)) document *Guidelines for the Treatment of Noise and Vibration in National Road Schemes* (TII, 2014) also contains information on the permissible construction vibration levels during the construction phase as shown in Table 12-4 (UKHE, 2020).

Table 12-4 Allowable Transient Vibration at Properties

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 BS7385, BS5228-2 and TII, 2014 set out above, the values in Table 12-4 are considered appropriate for this assessment.

12.3.2.2 Operational Phase Noise

12.3.2.2.1 *Wind Turbine Noise*

The noise assessment summarised in the following sections is based on guidance in relation to acceptable levels of noise from wind farms as contained in the Guidelines (DoEHLG,2006). These guidelines are in turn based on detailed recommendations set out in the Department of Trade & Industry (UK) Energy Technology Support Unit (ETSU) publication "*The Assessment and Rating of Noise from Wind Farms"* (ETSU 1996). The ETSU document has been used to supplement the guidance contained within the Guidelines (DoEHLG, 2006) publication where necessary.

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

The core of the noise guidance contained within the Guidelines (DoEHLG,2006) is based Department of Trade, and Industry (UK) Energy Technology Support Unit (ETSU) ETSU-R-97 *The Assessment and Rating of Noise from Wind Farms* (hereafter referred to as ETSU-R-97) (ETSU, 1996).

ETSU-R-97 considers that absolute noise limits applied at all wind speeds are not suited to wind turbine developments and recommends that noise limits should be set relative to the existing background noise levels at NSL. A critical aspect of the noise assessment of wind energy proposals relates to the identification of baseline noise levels through on-site noise surveys.

ETSU-R-97 states on page 58, "*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...".* The potential for other wind farms to contribute to the NSLs in the study area is assessed in Section 12.7.4 and Appendix 12-2.

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.

Institute of Acoustics Good Practice Guide

The guidance contained within the Institute of Acoustics (IOA) *A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise* (hereafter referred to as IOAGPG) (IOA, 2013) and Supplementary Guidance Notes are considered to represent best practice and have been adopted for this assessment. The IOA GPG states, that at a minimum continuous baseline noise monitoring should be carried out at the nearest NSLs for typically a two-week period and should capture a representative sample of wind speeds in the area (i.e. cut in speeds to wind speed of rated sound power of the proposed turbine). 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 then conducted on the data sets to derive background noise levels at various wind speeds to establish the appropriate day and night-time noise criterion curves.

Noise emissions associated with the wind turbine presented in this Chapter have been predicted in accordance with ISO 9613-2:2024 *Acoustics – Attenuation of sound during propagation outdoors - Part 2: Engineering method for the prediction of sound pressure levels outdoor* (ISO, 2024). This is a noise prediction standard that considers noise attenuation offered, amongst others, by distance, ground absorption, directivity and atmospheric absorption. Noise predictions and contours are typically prepared for various wind speeds, and the predicted levels are compared against the relevant noise criterion curve to demonstrate compliance with the appropriate noise criteria.

Where noise predictions indicate that reductions in noise emissions are required in order to satisfy any adopted criteria, consideration can be given to detailed downwind analysis and operating turbines in low noise mode, which is an option on all modern wind turbine units. For guidance on the methodology for the background noise survey and operation impact assessment for wind turbine noise, the IOAGPG has been adopted.

The IOAGPG states that cumulative noise exceedances should be avoided and where existing or permitted development is at the noise limit, any new turbine noise sources should be designed to be 10 dB below the limit value. Reference will be made to this guidance when considering potential cumulative impacts from any other existing permitted or proposed developments in the surrounding environment. In the first instance, it is necessary to determine for each wind farm whether it needs to be included in the wind turbine noise assessment or whether it can be scoped out of the cumulative assessment. Where predicted noise levels from another wind farm have the potential, in combination with the proposed development, to give rise to cumulative noise levels above 35 dB L_{A90}, it is necessary to include the wind farm in the cumulative assessment.

Section 5.1 of the IOAGPG provides criteria to determine whether 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 Development produces*
>
> *5.1.5 Equally, in such cases where noise from the Proposed Development 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."*

Discussion of the study area are presented in Section 12.3.3.

Wind Energy Development Guidelines

Section 5.6 of the Guidelines (DoEHLG,2006) addresses noise and outlines the appropriate noise criteria in relation to wind farm developments. The following extracts from this document are considered:

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

While this comment is noted, it is stated that the Guidelines (DoEHLG,2006) give no specific advice in relation to what constitutes an 'appropriate balance'. In the absence of this, guidance will be taken from alternative and appropriate 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."

As shown the calculations presented in Section 12.5.3.1 of this chapter, the various requirements identified in the extract above have been incorporated in the assessment.

"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 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 locations 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 and represents the commonly adopted night time noise criterion curve in relation to wind farm developments.

In summary, the Guidelines (DoEHLG,2006) outlines the following guidance to identify appropriate wind turbine noise criteria curves at NSLs:

- An appropriate absolute limit level in the range of 35 – 40 dB L_{A90} for quiet daytime environments with background noise levels of less than 30 dB $L_{A90,10min}$;
- 45 dB $L_{A90,10min}$ or a maximum increase of 5 dB above background noise (whichever is higher), for daytime environments with background noise levels 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 current guidance, this is commonly applied in noise assessments prepared and is detailed in numerous examples of planning conditions issued by An Coimisiún Pleanála (ACP). This set of criteria has been chosen as it is in line with the intent of the relevant Irish guidance. The proposed operational noise criteria for wind turbine noise at NSLs are presented in Section 12.4.2, Table 12-9.

Future Potential Guidance Changes for Wind Turbine Noise

In December 2019, the Draft Revised Wind Energy Development Guidelines (hereafter referred to as the Draft Guidelines (DoHPLG, 2019)) were published for consultation and at the time of writing, the final guidelines have yet to be published. It is important to note that during the public consultation on the Draft Guidelines (DoHPLG, 2019), several concerns relating to the proposed approach of the 2019 Draft 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 (ETSU, 1996), IOAGPG (IOA, 2013) and the IOA Amplitude Modulation Working Group (IOA, 2016), which are all referenced extensively in the Draft Guidelines (DoHPLG, 2019). A statement from the group can be reviewed at:

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

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://tneigroup-com.stackstaging.com/wp-content/uploads/2022/05/WEDG-consultation-joint-response-R0.pdf

The following statement was submitted by the Minister for Housing, Local Government and Heritage during a Dail Eireann Debate on 19 June 2025[1]

> *"My Department is currently undertaking a focused review of the 2006 Wind Energy Development Guidelines. The review is addressing a number of key aspects of the Guidelines including noise, setback distance, shadow flicker, community obligation, community dividend and grid connections.*
>
> *My Department, in conjunction with the Department of the Climate, Energy and Environment (DCEE) which has primary responsibility for environmental noise matters, has been working to advance guidance on the noise aspect of the Guidelines, which is highly technical in nature. The two Departments have been engaging on proposals regarding the measurement and assessment of noise from wind turbines to ensure they are robust and fit for purpose having regard to, inter alia, the revised 2030 target to generate up to 80% of our electricity from renewable sources.*
>
> *My Department, in conjunction with DCEE, will make any further changes to the draft Guidelines which are deemed necessary or appropriate in the wake of this work to ensure that the finalised Guidelines, once issued, are fit for purpose to provide guidance in line with renewable energy and climate targets, whilst having appropriate regard to the impacts of wind energy development, including in relation to noise annoyance.*
>
> *The evolving policy and technical context including the new Planning and Development Act 2024, which was signed by the President on 17 October 2024, and the revision of the National*

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

Planning Framework (NPF) reinforces the need to ensure that the finalised Guidelines, once issued, are fit for purpose.

In addition to this work, and in line with EU Directive requirements, a strategic environmental assessment (SEA) is being carried out on the draft Guidelines as part of the review process. In this regard, my Department intends to undertake a public consultation on updated draft Guidelines as part of the SEA process whereby all interested parties will have an opportunity to submit observations on the draft Guidelines. Finalised Guidelines will be prepared following detailed analysis and consideration of the submissions received during the consultation phase.

More generally, with regard to the planning process and ensuring that the views of communities concerning wind energy developments are heard and given appropriate consideration, I wish to highlight that public participation is a crucial element of all substantive decision-making processes under the Planning and Development Act 2000, and the recently enacted Planning and Development Act 2024. As part of the process to review city and county development plans, it is open to members of the public to make an observation or submission on the draft development plan. The development plan sets out land use zoning objectives and outlines the types of potential development, including ancillary developments, which might be suitable for a particular area, and may include objectives for wind energy development. In addition, it is open to any member of the public to make an observation or submission on a planning application, including in relation to a proposed wind energy development, and the planning authority is statutorily obliged to consider such observation or submission before making a decision on the application.

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 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."

The assessment of wind turbine noise presented in this EIAR is based on the guidance outlined in the Guidelines (DoEHLG,2006) and has been supplemented with best practice guidance from ESTU-R-97 (ETSU, 1996) and the IOAGPG (IOA, 2013). If updated Wind Energy Guidelines are published during the application process for the Proposed Development, it is anticipated that any relevant changes affecting the noise will be addressed through an appropriate planning condition, or where a supplementary assessment is necessary, through provision of additional information.

World Health Organisation (WHO) Noise Guidelines for the European Region)

The World Health Organisation (WHO) *Environmental Noise Guidelines for the European Region* (WHO, 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 (WHO, 2018) that was published in October 2018 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 potential for 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 policymakers 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."*

As stated within the WHO document, the quality of evidence used for the research is stated as being 'Low', the recommendations are therefore conditional (WHO, 2018).

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 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.

> *"Even though correlations between noise indicators tend to be high (especially between LAeq-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 outlined above, it is concluded that the conditional WHO recommended average noise exposure level (i.e. 45dB L_{den}) should not currently be applied as target noise criteria for an existing or proposed wind turbine developments in Ireland.

12.3.2.2.2 Infrasound/Low Frequency Noise

Low Frequency Noise is noise that is dominated by frequency components less than approximately 200Hz whereas Infrasound is typically described as sound at frequencies below 20Hz. In relation to Infrasound, the following extract from the EPA document *Guidance Note for Noise Assessment of Wind Turbine Operations at EPA Licensed Sites* (NG3) (EPA, 2011) 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."*

The UK Institute of Acoustics Bulletin in March 2009 included a statement of agreement between acoustic consultants regularly employed on behalf of wind farm developers, and conversely acoustic consultants regularly employed on behalf of community groups campaigning against wind farm developments (IAO JS2009). The intent of the article was to promote consistent assessment practices, and to assist in restricting wind farm noise disputes to legitimate matters of concern. The article notes the following with respect to infrasound:

> *"Infrasound is the term generally used to describe sound at frequencies below 20 Hz. At separation distances from wind turbines which are typical of residential locations the levels of infrasound from wind turbines are well below the human perception level. Infrasound from wind turbines is often at levels below that of the noise generated by wind around buildings and other obstacles.*
>
> *Sounds at frequencies from about 20 Hz to 200 Hz are conventionally referred to as low-frequency sounds. A report for the DTI in 2006 by Hayes McKenzie concluded that neither infrasound nor low frequency noise was a significant factor at the separation distances at which people lived. This was confirmed by a peer review by a number of consultants working in this field. We concur with this view."*

The article concludes that:

> *"from examination of reports of the studies referred to above, and other reports widely available on internet sites, we conclude that there is no robust evidence that low frequency noise (including 'infrasound') or ground-borne vibration from wind farms, generally has adverse effects on wind farm neighbours".*

A report released in January 2013 by the South Australian Environment Protection Authority namely, *Infrasound levels near windfarms and in other environments* (EPA, 2013)[2] found that the level of infrasound from wind turbines is insignificant and no different to any other source of noise, and that the worst contributors to household infrasound are air-conditioners, traffic and noise generated by people.

The EPA's study concluded that the level of infrasound at houses near wind turbines was no greater than in other urban and rural environments, and stated that:

> "*The contribution of wind turbines to the measured infrasound levels is insignificant in comparison with the background level of infrasound in the environment."*

[2] *EPA South Australia, 2013, Wind farms https://www.epa.sa.gov.au/files/477912_infrasound.pdf*

An IOA statement in Respect of Wind Farm Noise Assessment dated December 2024 and published[3] 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 infrasound from wind turbines. It is current advice to members that there is no need to assess infrasound as part of the noise impact assessment process, as the absolute levels are well below those reported to trigger physiological health effects based on peer reviewed research to date.*"

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. The are no criteria proposed to assess low frequency noise or infrasound as part of the EIAR.

12.3.2.2.3 Amplitude Modulation

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

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

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

- 'Normal' AM (described as 'blade swish'), and;
- 'Other' AM (sometimes referred to 'abnormal' or 'enhanced' 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.

[3] https://www.ioa.org.uk/publications/wind-turbine-noise

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 broad conclusions of this report were that aerodynamic modulation was only considered to be an issue at 4, 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 Development site, based either on the site's general characteristics or on the known characteristics of the wind turbines to be installed."*

Concluding Comments on Amplitude Modulation

It is critical to this discussion to recognise that amplitude modulation (AM) 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. Normal AM is typically expected and accounted for in noise assessments, whereas Excessive AM should it occur may require additional mitigation measures due to its potential impact on nearby residents. The term AM is commonly used without these descriptions; however, where AM is

referenced in this chapter, it should be understood to refer to unacceptable or excessive AM with the potential to result in adverse impacts, unless otherwise stated.

Research and guidance in the field of wind turbine noise AM is ongoing with the most notable recent publications discussed here.

Research and Guidance in the field of wind turbine noise AM is ongoing with publications being issued by the Institute of Acoustics (IOA) Noise working Group (Wind Turbine Noise) Amplitude Modulation Working Group (AMWG) namely, *A Method for Rating Amplitude Modulation in Wind Turbine Noise* (IOA, 2016) (The Reference Method). The document proposes an objective method for measuring and rating AM. The AMWG does not propose what level of AM is likely to result in adverse community response or propose any limits for AM. The purpose of the group is simply to use existing research to develop a Reference Methodology for the measurement and rating of amplitude modulation.

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 may be adopted as best practice and incorporated by regulatory authorities in future guidance.

A 2016 report commissioned by the UK government *Wind turbine AM review: Phase 2 report. 3514482A Issue 3. Department for Business, Energy & Industrial Strategy* completed by WSP Parsons Brinckerhoff recommended the use of a penalty scheme as a potential planning condition for AM to cover periods of complaints due to unacceptable AM. 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.*"

To date there is no clear industry consensus on how AM should be regulated or managed through the planning stage. In the absence of an accepted and robust planning conditions to control AM from wind turbines, the commitments outlined in the Section 12.6.2.1.1 are considered to represent best practice to control AM and will be adopted in the event that any complaint relating to excessive AM is reported.

12.3.2.2.4 Human Health Effects from Wind Turbine Noise

There is currently no credible evidence to link wind turbine noise exposure in the environment to adverse health impacts. For further details of potential health impacts effects associated with the Proposed Development, refer to Chapter 5 (Population and Human Health).

12.3.2.2.5 Noise from the continued use of existing onsite 38kV Substation

It is intended to connect the proposed turbines to the national grid via the existing onsite 38kV substation located within the Site. The existing onsite 38kV substation connects via 38kV underground cabling to an existing 38kV ESBN overhead line.

There is no NSL within 1 km of the existing onsite 38kV substation, therefore no operational environmental noise or vibration effects are likely.

The operational noise and vibration, due to the existing onsite 38kV substation is therefore scoped out of this assessment.

12.3.2.3 Operational Phase Vibration

Any vibration generated from the operation of a wind turbine unit will decrease significantly over distance. A recent report from Germany published by the State Office for the Environment, Measurement and Nature Conservation of the Federal State of Baden-Württemberg in 2016, "Low Frequency Noise Incl. Infrasound from Wind Turbines and Other Sources" conducted vibration measurements study for an operational Nordex N117 – 2.4 MW wind turbine. The report concluded that at distances of less than 300 m from the turbine vibration levels had dropped so far that they could no longer be differentiated from the background vibration levels.

An IOA statement in Respect of Wind Farm Noise Assessment dated December 2024 and published[4] on the IOA website 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.*"

The shortest distance from any turbine in the Proposed Development to the nearest NSL is 1 km. 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 Development.

12.3.3 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 Development during the construction, decommissioning, and operational phases.

12.3.3.1 Operational Phase

Initially 95 no. NSLs have been identified within approximately 3.5 km of the proposed turbines.

The nearest NSL is located approximately 1,000 m to the nearest proposed turbine location (i.e. Location H14 from proposed turbine T3). The next closest NSLs are H19 and H21 located at approximately 1,018 m and 1,021 m from T3 respectively.

To confirm if the initial list of NSLs covered the extent of the study area for wind turbine noise assessment consideration was given to the potential cumulative impacts from other wind turbines in the wider area in line with guidance discussed in Section 12.3.2.2.1. An appraisal of the list of wind farm development presented in Chapter 2 (Background to the Proposed Development) identified that the nearest other wind turbine developments (existing, permitted or proposed) are Grousemount Wind Farm and Sillahertane Wind Farm located approximately 3.7km and 7.3km to the North, Maughanaclea Wind Farm located at 3.6km to the South, and Gortloughra Wind Farm, Shehymore Wind Farm located approximately 5.1 and 5.5km and Derragh located approximately 10 km to the northeast from the Proposed Development. An additional 32 NSLs are included in the area to the north of Maughnaclea, thus the total number of NSLs included in the assessment is 127.

In line with guidance discussed in Section 12.3.2.2.1 all the wind farms referenced above have been considered in the cumulative assessment presented in this Chapter; Grousemount, Sillahertane, Maughnaclea, Gortloughra, Shehymore and Derragh have been included in the predicted noise levels. Further detail on this appraisal and the definition of the operational phase noise study area is presented in Appendix 12-2.

[4] https://www.ioa.org.uk/publications/wind-turbine-noise

12.3.3.2 Construction and Decommissioning Phase

During the construction and decommissioning phases, noise could occur at any location within the Site and along public roads where there are increases in traffic associated with the Proposed Development. There is also a potential for noise impacts from HGVs along Turbine Delivery Route (TDR) during the construction and decommissioning phases of the Proposed Development.

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

In respect of the impact of construction traffic noise, the extent of roads assessed aligns with the Traffic and Transport Study.

12.3.4 Background Noise Assessment

A background noise survey was undertaken to establish typical background noise levels at representative NSLs surrounding the Site. The background noise survey was conducted through installing unattended sound level meters at 4 no. representative locations in the surrounding area.

This background noise survey has been carried out in accordance with the IOA GPG discussed in the following sections.

12.3.4.1 Choice of Measurement Locations

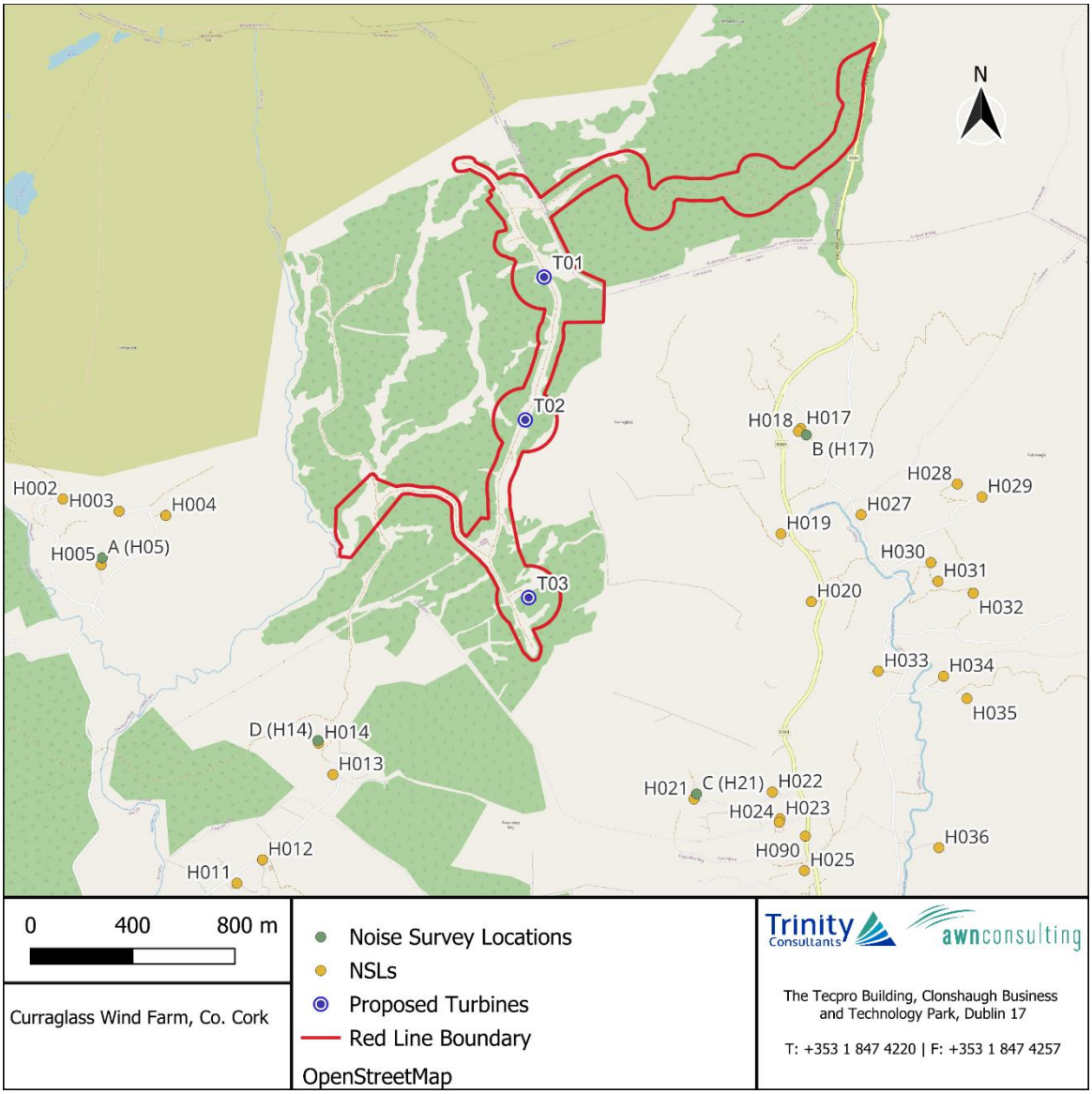
The noise monitoring locations were identified by preparing a preliminary noise model contour at an early stage of the assessment. Any locations that fell inside the predicted 35 dB L_{A90} noise contour were considered for noise monitoring in line with current best practice guidance outlined in the IoA GPG. The selection of the noise monitoring locations was informed by site visits, discussions with locals and supplemented by reviewing of aerial images of the study area and other online sources of information (e.g. Google Earth).

The selected locations for the noise monitoring are outlined in the following sections. Coordinates for the noise monitoring locations are proximate to a number of the sensitive receptors around the Proposed Development as detailed in Table 12-5 and illustrated in Figure 12-2.

Table 12-5 Measurement Location Coordinates

Location	Coordinates – Irish Transverse Mercator (ITM)	
	Easting	Northing
A (H05)	507346	562105
B (H17)	510104	562586
C (H21)	509674	561180
D (H14)	508191	561389

Figure 12-2 Indicative measurement locations (A, B, C, and D).



Significant noise sources in this area were noted to be distant traffic movements, activity in and around the residences and wind generated noise from local foliage and other typical anthropogenic sources typically found in such rural settings. Water flowing was audible to varying degrees at some locations.

There were no perceptible sources of vibration noted at any of the survey locations.

Appendix 12-3 presents full details of the background noise survey methodology instrumentation and results, including the location-specific wind direction filtering applied at each location to derive the background noise levels.

Section 12.4.1 of this chapter presents the results of the background noise survey and Section 12.4.2 presents the derived noise criteria for the operational wind farm.

12.3.4.2 Wind Speed Measurements

Wind speed measurements were provided to AWN for the assessment. The measurements were obtained from the Kealkill 80m Meteorological Mast Located at ITM 508,969E, 562,208N. Further details are provided in Appendix 12-3.

12.3.4.3 Analysis of Background Noise 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 outlined above are in line with the guidance contained in the IOA GPG.

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

- Daytime Amenity hours are:
  - all evenings from 18:00 to 23:00hrs;
  - Saturday afternoons from 13:00 to 18:00hrs, and;
  - all day Sunday from 07:00 to 18:00hrs.
- Night-time hours are 23:00 to 07:00hrs.

12.3.4.3.1 *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 10m height. The standardised equations used to determine the wind speed at standardised 10m above ground are presented in Appendix 12-3. Any reference to wind speed in this chapter should be understood to be at standardised 10 m height unless otherwise stated.

12.3.5 Construction Noise Calculations

A variety of items of plant will be used for the purposes of site preparation, construction, and site works. There will be vehicular movements to and from the Site that will make use of existing roads. There is the potential for generation of significant levels of noise from these activities.

In the absence of specific details on the plant items and methods to be employed during the construction stage, a set of assumptions must be made in order to predict and assess the likely noise emissions from construction activities. The standard best practice approach is to predict typical noise levels at the NSLs using guidance set out in British Standard BS 5228-1 (BSI, 2014).

The methodology adopted for the assessment of construction noise is to analyse the various elements of the construction phase in isolation. For each element, the typical construction noise sources are assessed along with typical sound pressure levels and spectra referenced in BS 5228-1 (BSI, 2014) at various distances from these works.

12.3.6 Turbine Noise Calculations

A series of computer-based prediction models have been prepared to quantify the potential turbine noise level associated with the operational phase of the Proposed Development on the receiving environment. This section discusses the methodology behind the noise modelling process and presents the results of the modelling exercise.

12.3.6.1 Noise Modelling Software

Proprietary noise calculation software was used for the purposes of this impact assessment. The selected software, DGMR iNoise Enterprise, calculates noise levels in accordance with ISO 9613: *Acoustics* –

Attenuation of sound outdoors, Part 2: Engineering method for the prediction of sound pressure levels outdoor, (ISO, 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 general, however, the resultant noise level is calculated considering a range of factors affecting the propagation of sound, including:

- the magnitude of the noise source in terms of A weighted sound power levels (L_{WA});
- the distance between the source and receiver;
- the presence of obstacles such as screens or barriers in the propagation path;
- the presence of reflecting surfaces;
- the hardness of the ground between the source and receiver;
- Attenuation due to atmospheric absorption; and
- Meteorological effects such as wind gradient, temperature gradient and humidity (these have significant impact at distances greater than approximately 400m).

12.3.6.2 Noise Prediction Model - Input Data and Assumptions

The calculation settings, input data and any assumptions made in the assessment are described in the following sections.

12.3.6.2.1 *Proposed Turbine Details*

Table 12-6 details the co-ordinates of the 3 No. proposed turbines that are being considered in this assessment.

Table 12-6 Proposed Turbines Co-ordinates

Turbine	ITM Easting	ITM Northing
T01	509,077	563,204
T02	509,002	562,644
T03	509,016	561,949

The turbine noise assessment has been undertaken for a turbine hub height of 90 m, a rotor diameter of 133 m and a ground to blade tip height of 156.5m. The following section presents details of the sound power level data for the turbine unit that has been used for the operational turbine noise prediction modelling assessment.

The turbine unit is considered representative of the type of turbine that would be installed on the Site taking into consideration the proposed specifications and the nominal generation capacity.

The turbine noise levels have been predicted at NSLs for a range of operational wind speeds based on noise emission data for the Nordex N133 turbine at a hub height of 90 m.

While the noise profiles of the Nordex N133 wind turbine has been used for the purposes of this assessment, the exact make and model of the turbine installed on the Site will be dictated by a competitive procurement process but will adhere to the specifications and parameters set out above.

The wind turbine eventually selected for installation on site will not give rise to noise levels of greater significance than that used for the purposes of this assessment, to ensure the findings of this assessment remain valid. Any references to the Nordex N133 turbines in this assessment must be considered in the

context of the above statements and should not be interpreted as meaning it is the only make or model of wind turbine that could be installed on the site.

Table 12-7 details the turbine noise data used in the noise predictions models for the Proposed Development, the noise data is for turbines without Serrated Trailing Edge (STE) blades which is worst case scenario. In accordance with the IOA GPG, sound power levels referred to wind speeds at standardised 10 m height.

Table 12-7 Sound Power Level for Nordex N133 without STE Blades at 90m Hub Height

Wind Speed (m/s)	Sound Power Level dB L_{WA}
3	95.0
4	96.3
5	101.3
6	105.5
7	107.3
8	107.5
9	107.5

The turbine sound power levels outlined in Table 12-7 are presented in terms of the L_{Aeq} parameter. As per best practice guidance contained within the IOA GPG, an allowance for uncertainty in the measurement of turbine source levels of +2 dB is applied in modelling to all turbine sound power levels presented in the tables above.

As explained in Section 12.3.2.4, the criteria are couched in terms of a L_{A90} criterion. Best practice guidance in the IOA GPG states that "*L_{A90} levels should be determined from calculated L_{Aeq} levels by subtraction of 2 dB*". A 2 dB reduction has therefore been applied in the noise model calculation. All predicted noise levels in this chapter are presented in terms of L_{A90} parameter, i.e., this reduction of 2 dB is applied in the noise prediction modelling.

Best practice specifies that should any tonal component be present, a penalty shall be added to the predicted noise levels. The level of this penalty is described in ETSU-R-97 and is related to the level by which any tonal components exceed audibility. For the purposes of this assessment a tonal penalty has not been included within the predicted noise levels. A warranty will be provided by the manufacturers of the selected turbine to ensure that the noise output will not require a tonal noise correction under best practice guidance.

Sound power levels for all the cumulative turbine types included in the assessment are presented in Appendix 12-4.

12.3.6.2.2 Modelling Calculation Parameters

Prediction calculations for turbine noise have been conducted in accordance with ISO 9613: *Acoustics – Attenuation of sound outdoors, Part 2: Engineering method for the prediction of sound pressure levels outdoors, 2024.* Comprehensive details of noise prediction calculation settings are included Appendix 12-5.

12.3.6.3 Assessment of Turbine Noise Levels

The predicted cumulative turbine noise levels will be compared against the derived turbine noise criteria set out in Section 12.4.2, and any exceedances of the limits will be identified and assessed. Where necessary, appropriate mitigation measures will be discussed.

12.4 Receiving Environment

12.4.1 Background Noise Levels

Appendix 12-3 presents the details of the background noise surveys. Table 12-8 presents the various derived $L_{A90,10min}$ noise levels for each of the monitoring locations for daytime quiet periods and night-time periods. These levels have been derived using analysis carried out on the data sets in line with guidance contained the IOA *GPG* and its SGN No. 2 *Data Collection.*

In accordance with IOA GPG Supplementary Guidance Note 2: *Data Processing & Derivation of ETSU-R-97 Background Curves*, paragraph 2.9.1: "*Where background noise data has not been collected for higher wind speeds it may be appropriate to cap the background noise curve (and therefore the associated noise limit)*".

Table 12-8 Derived Background Noise Levels of $L_{A90,10min}$ for Various Wind Speeds

Location	Period	Derived $L_{A90,10\,min}$ Levels (dB) at various Standaridsed10m Height Wind Speed (m/s)							
		3	4	5	6	7	8	9	10
A (H05)	Day	32.4	33.1	34.5	36.4	38.7	41.1	43.6	45.9
	Night	32.4	33.9	35.4	36.9	38.4	40.0	41.7	43.4
B (H17)	Day	33.7	34.8	35.9	37.0	38.1	39.2	40.3	41.5
	Night	34.1	34.6	35.3	36.1	37.0	38.0	39.1	40.4
C (H21)	Day	29.4	30.3	31.5	32.8	34.4	36.2	38.1	40.3
	Night	28.3	29.4	30.7	32.2	33.8	35.6	37.5	39.7
D (H14)	Day	29.7	31.5	33.4	35.3	37.4	39.6	41.9	44.2
	Night	28.8	30.9	33.1	35.3	37.5	39.8	42.1	44.5

12.4.2 Wind Turbine Noise Criteria

In accordance with the Guidelines (DoEHLG,2006) described in Section 12.3.2.2.1, noise criteria curves have been identified for the Proposed Development. The criteria curves have been derived following a detailed review of the background noise data conducted at the nearest NSLs.

It is proposed to adopt a lower daytime threshold of 40 dB $L_{A90,10\text{-}min}$ for low noise environments where the background noise is less than 30 dB(A). This follows a review of the prevailing background noise levels and is considered appropriate in light of the following:

- The EPA document 'Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4)' (OEE, 2016) proposes a daytime noise criterion of 45 dB L_{Aeq} in 'areas of low background noise'. Turbine noise limits are detailed in terms of the L_{A90} parameter while the NG4 daytime limit is detailed in terms of the L_{Aeq}. The accepted difference between the L_{Aeq} and L_{A90} for wind turbine noise assessments is 2 dB, i.e., 45 dB L_{Aeq} equates to 43 L_{A90}. This approach accounts for the 3 dB difference when comparing the NG4 limits and the 2006 limits (DoEHLG, 2006). The proposed lower threshold daytime criterion for

wind turbine noise here is 3 dB more stringent than the equivalent daytime noise limit for areas of low background noise outlined in NG4 (OEE, 2016).

- A lower threshold of 40 is commonly adopted in planning conditions for similar wind energy developments that have been granted planning permission by ACP and local planning authorities in recent years for example Derrinlough Wind Farm (ABP Ref: 306706-20) Derryadd Wind Farm (ABP Ref: PL14.303592[5]), Coole Wind Farm (ABP Ref: PL25M.300686) Cloncreen Wind Farm (ABP Ref: PA0047), Meenbog Wind Farm (ABP Ref: PL05E.300460), Borrisbeg Wind Farm (ABP-318704-23) Ballivor Wind Farm (ABP-316212-23) and Carrig Renewables Wind Farm (Planning Ref: 318689-23).

Based on the guidance listed above, the proposed operational limits in $L_{A90,10min}$ for the Proposed Development 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 quiet daytime environments of less than 30 dB $L_{A90,10min}$;*
- *45 dB $L_{A90,10min}$ for daytime environments greater than 30 dB $L_{A90,10min}$ or a maximum increase of 5 dB above background noise (whichever is higher), and;*
- *43 dB $L_{A90,10min}$ or a maximum increase of 5 dB above background noise (whichever is higher) for night-time periods.*

A noise criteria envelope, based on the lowest turbine noise limits derived across Locations A, B, C, and D at the various wind speeds has been derived for daytime and night-time and used as assessment criteria at all other non-surveyed Sensitive Receptors as a conservative approach to the assessment.

Table 12-9 outlines the derived noise criteria curves which are based on the background noise levels derived and presented in Table 12-8. With reference to Table 12-7, the sound power level of the turbine reaches is understood to reach a maximum level at 8 m/s. It is sufficient therefore to consider wind speed up to at least 8 m/s for this assessment, in line with the best with practice guidance.

Table 12-9 Noise Criteria Curves

Location	Period	Derived $L_{A90,\ 10\ min}$ Levels (dB) at various Standaridsed 10m Height Wind Speed (m/s)							
		3	4	5	6	7	8	9	10
A (H05)	Day	45.0	45.0	45.0	45.0	45.0	46.1	48.6	50.9
	Night	43.0	43.0	43.0	43.0	43.4	45.0	46.7	48.4
B (H17)	Day	45.0	45.0	45.0	45.0	45.0	45.0	45.3	46.5
	Night	43.0	43.0	43.0	43.0	43.0	43.0	44.1	45.4
C (H21)	Day	40.0	45.0	45.0	45.0	45.0	45.0	45.0	45.3
	Night	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.7
D (H14)	Day	40.0	45.0	45.0	45.0	45.0	45.0	46.9	49.2

[5] *Derryadd decision subsequently quashed*

Location	Period	Derived $L_{A90,\ 10\ min}$ Levels (dB) at various Standaridsed 10m Height Wind Speed (m/s)							
		3	4	5	6	7	8	9	10
	Night	43.0	43.0	43.0	43.0	43.0	44.8	47.1	49.5

12.5 Likely Significant Effects

12.5.1 Do-Nothing Effect

If the Proposed Development were not to proceed, there would be no change to noise and vibration in the area.

The opportunity to capture part of Cork's valuable renewable energy resource would be lost, as would the opportunity to contribute to meeting Government and EU targets for the production and consumption of electricity from renewable resources and the reduction of greenhouse gas emissions. An alternative land use option to developing a renewable energy project at the Site would be to leave the Site as it is, with no changes made to the current land use compromises of commercial forestry, agricultural land and unutilised existing wind farm infrastructure that remains at the Site from the previous wind farm development. The opportunity to generate local employment and investment and to diversify the local economy would be lost.

12.5.2 Construction Phase Potential Impacts

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

A variety of items of plant equipment will be in use for the various elements of the construction activities. There will be vehicular movements to and from the Site that will make use of existing roads. Due to the nature of these activities, there is potential for generation of levels of noise at NSLs. This is discussed in the following Sections.

Construction noise prediction calculations have been conducted using the assessment methodology outlined in Section 12.3.5. Noise levels are predicted at the nearest NSL to each element of the works and compared against the construction noise thresholds and criteria confirmed in Section 12.3.2.1.

In general, the distances between the construction activities associated with the Proposed Development and the nearest NSLs are such that there will be no significant noise and vibration impacts at NSLs. The following sections present an assessment of the main stages of the construction phase that have the potential for associated noise and vibration impacts, all other stages and elements, such as the Biodiversity Management and Enhancement Plan (Appendix 6-5), including the enhancement areas and the tree felling and replanting, and the peat and spoil management areas are considered unlikely to have any significant noise and vibration impacts due to the nature of the works and distance from the nearest NSLs (approximately 693 m from the Biodiversity Area nearest point to H004, and 837 m from the peat and spoil management areas to H021).

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

- Install safety signage, upgrade entrances, and prepare areas for site offices and compounds.
- Construct roads, crane pads, drainage systems, and
- Build turbine foundations, including excavation, reinforcement, concrete works, and backfilling.
- Install electrical infrastructure: site cabling, ducting, internal networks, and connection to existing substation.
- Erect turbines and met mast, commission systems, reinstate site, and remove temporary facilities.

Construction activities will be carried out during normal daytime working hours (i.e., 0700 – 1900 Monday to Saturday). However, to ensure that optimal use is made of good weather periods or at critical periods within the programme (e.g., concrete pours, erection of turbines) or to accommodate delivery of large turbine components along public routes it could be necessary on occasion to work outside of these hours. Any such out of hours working will be notified in advance to the Local Authority.

12.5.2.1 General Construction – Proposed Turbines, Hardstanding, and Met Mast

12.5.2.1.1 *Noise*

Turbines and Hardstanding

Turbine foundation works are anticipated at a significant distance from the closest noise sensitive receptors, with works (T3) being approximately 1000m from the nearest NSL (H14). The second nearest NSL is H19 approximately 1013m from T3.

One permanent meteorological mast is proposed as part of the Proposed Development. The meteorological mast will be equipped with wind monitoring equipment at various heights. The mast will be located at E509109, N562918(ITM) as shown on the site layout drawing in Figure 4-1. The mast will be a slender structure 30m in height. The nearest NSL to the mast is H18 at a distance of approximately 1010m.

Several indicative sources that would be expected on a site of this nature have been identified and noise predictions of their potential impacts prepared to nearby houses. The assessment is representative of a worst-case and construction noise levels will be lower at properties located further from the works.

Table 12-10 outlines the noise levels associated with typical construction noise sources assessed in this instance along with typical sound pressure levels and spectra from BS 5228 – 1: 2009. Calculations have assumed an on-time of 66% for each item of plant i.e. 8 hours over a 12-hour assessment period.

Table 12-10 Typical Construction Noise Emission Levels – Turbines and Hardstanding, Internal cabling and Met Mast

Item (BS 5228 Ref.)	Activity/ Notes	Plant Noise Level at 10m Distance (dB $L_{Aeq,T}$) [6]
HGV Movement (C.2.30)	Removing soil and transporting fill and other materials.	79
Tracked Excavator (C.4.64)	Removing soil and rubble in preparation for foundation.	75
Excavator Mounted Rock Breaker (C9.12)	Excavation in rocky areas	85
General Construction (Various)	All general activities plus deliveries of materials and plant.	84
Concrete Mixer Truck and Concrete Pump (C.4.27)	Turbine Foundations	79
Dumper Truck (C.4.39)	Backfilling Turbine Foundations	76
Mobile Telescopic Crane (C.4.39)	Turbine Erection	77
Dewatering Pumps (D.7.70)	If required.	80
JCB (D.8.13)	For services, drainage and landscaping.	82
Vibrating Rollers (D.8.29)	Road surfacing.	77

The nearest NSLs to the proposed turbines and meteorological mast are H14 at a distance of 1001 m and H13 at a distance of 1013 m. Assuming as a worst-case that all turbines and hardstands were to be constructed simultaneously along with the met mast, the predicted noise levels for these NSL are presented in Table 12-11. The values are well below the construction noise criteria in Table 12-1.

Table 12-11 Worst-case predicted noise levels for Turbines and Hardstanding, Internal cabling and Met Mast

NSL Ref	Predicted Noise Level (dB $L_{Aeq,T}$)
H14	36
H18	36

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

NSL Ref	Predicted Noise Level (dB $L_{Aeq,T}$)
H19	36

It is concluded that there will be no significant noise impact associated with the construction of the proposed turbines, hardstanding and meteorological mast therefore no specific mitigation measures are required.

12.5.2.1.2 *Vibration*

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

- Three tonne hydraulic breaker on small CAT tracked excavator
- 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 10m to 50m 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 10m to 50m 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 50m from the activity are significantly the assessment threshold set out in Table 12-4.

Accounting for to the distance from proposed works to the nearest NSL there will be no significant vibration impacts associated with the construction phase of the Proposed Development and therefore no specific mitigation measures will be required.

12.5.2.2 Proposed Access Roads and Existing Road Upgrades

It is proposed to upgrade existing internal roads and also to construct new internal roads as part of the Proposed Development. Review of the road layout has identified that the nearest NSL to any point along the proposed roads is approximately 975m to H14. All other locations are at greater distances with the majority at significantly greater distances. The full description of the new roads is outlined in Chapter 4 (Description of the Proposed Development) of the EIAR.

12.5.2.2.1 *Noise*

Table 12-12 outlines the typical 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.

Table 12-12 Typical Construction Noise Emission Levels – Internal Roads

Item (BS 5228 Ref.)	Plant Noise Level at 10m Distance (dB $L_{Aeq,T}$) [7]	Highest Predicted Noise Level at Stated Distance from Edge of Works (dB LAeq,T)
		975m
HGV Movement (C.2.30)	79	25
Tracked Excavator (C.4.64)	75	21
Dumper Truck (C.4.39)	77	23
Excavator Mounted Rock Breaker (C9.12)	85	31
Vibrating Rollers (D.8.29)	77	23
Total Construction Noise (cumulative for all activities)		**33**

At the nearest noise sensitive location, the predicted noise levels from construction activities are of the order of 33 dB $L_{Aeq,T}$, below the significance threshold of 65dB $L_{Aeq,1hr}$.

12.5.2.2.2 *Vibration*

Which reference to the discussion on vibration presented in Section 12.5.2.1.2 there will be no significant vibration impacts associated with the construction phase of the Proposed Development and therefore no specific mitigation measures will be required.

12.5.2.3 Turbine Component Turning Area

12.5.2.3.1 *Noise*

As described in Chapter 4 (Description of the Proposed Development), the proposed turbine delivery route includes a turbine component turning area along the R584 and approximately 2.2 km northeast of the main Site entrance. Construction of this turning areafrom the site will require removal of fencing, upgrade of existing track and temporary placement of hardcore, so the area can be used during the delivery of large turbine components as indicated in Chapter 4 (Description of the Proposed Development). Once the proposed turbine components have been delivered, this area will be reinstated.

The nearest NSL to these works is the H076 which is lies approximately 10m from the works area. For the purpose of the assessment, it is understood that some NSLs are located alongside the road and the minimum distance from works are 10 m, however, the majority of the NSLs are located at further distances from these works. Typical construction plant items and their associated noise levels at 10, 50 and 100 m distance are presented in Table 12-17, where again, an on-time of 66% for each item has been assumed.

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

Table 12-17 Typical Construction Noise Levels for the Turbine Component Turning Area

Item (BS 5228 Ref.)	Plant Noise Level at 10m Distance (dB $L_{Aeq,T}$) [8]	Highest Predicted Noise Level at Stated Distance from Edge of Works (dB $L_{Aeq,T}$) at 66% on-time		
		10m	50	100
Tracked Excavator (C.4.64)	75	73	54	46
HGV Movement (C.2.30)	79	77	58	50
Dumper Truck (C.4.4)	76	74	55	47
Vibrating Rollers (D.8.29)	77	75	56	48
Cumulative Predicted Construction Noise Level _		81	62	54

Noise levels at distances of 10m are exceeding the 65dB L_{Aeq} noise threshold outlined in Section 12.3.2.1.1, however, considering the short duration of these works it can be considered that the effects are Not Significant (Section 12.3.2.1.3). Noise levels at further distances are within the criteria and no consideration of the duration is required.

The construction noise impact of the proposed turbine component turning area is therefore considered Negative, Not Significant, and Temporary.

12.5.2.3.2 Vibration

Given the distance of the proposed works from sensitive locations, and the absence of construction activity likely to generate significant ground-borne vibration, significant vibration effects are not expected.

It is concluded that there will be no significant vibration impacts associated with this construction phase of the Proposed Development and therefore no specific mitigation measures will be required.

12.5.2.4 Borrow Pits

12.5.2.4.1 *Noise*

A borrow pit is proposed at the coordinates E508967, N563526. The nearest NSLs to the borrow pit are H17 and H18, both at a distance of approximately 1377m. To inform this aspect of the proposal a comparative noise assessment has been prepared and is outlined in the following paragraphs. Two situations have been considered as follows:

- Scenario A Blasting operation
- Scenario B Rock breaking operation

In terms of these activities please note the following:

- A mobile crusher will operate on site for both options.

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

- In Scenario B that two rock breakers will be in use on Site during daytime periods for a short period of time.
- Table 12-13 outlines the assumed noise levels for the plant items as extracted from BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise.

Table 12-13 Typical Borrow Pit Plant Noise Levels

Item	BS 5228 Ref:	dB L_w Levels per Octave Band (Hz)								dB(A)
		63	125	250	500	1k	2k	4k	8k	
Crusher	Table C1.14	121	114	107	109	103	99	94	87	110
Rock Breaker	Table C9.11	119	117	113	117	115	115	112	108	121
Dozer	Table C8.9	78	90	97	95	99	94	89	82	103
Dewatering	Table D7.70	90	95	102	102	104	100	97	83	109
Generator	Table C6.39	81	86	93	89	83	80	74	67	96

A construction noise model has been prepared to consider the expected noise emissions from the proposed construction works for the two scenarios outlined above. A percentage on-time of 66% has been assumed for the noise calculations. The predicted levels are detailed in Table 12-14, at the 10 no. closest NSL's to the borrow pit acting together.

Table 12-14 Typical Plant Noise Levels Borrow Pits

Borrow Pit 1			
Loc.	Predicted Construction Noise Level $L_{Aeq,1hr}$		Diff. dB(A)
	Scenario		
	A (Blasting)	B (Rock breaking)	
H017	35	43	-8
H018	35	43	-8
H001	34	41	-7
H019	33	41	-8
H027	32	40	-8
H004	32	40	-8
H020	31	39	-8
H003	31	39	-8

Borrow Pit 1			
Loc.	Predicted Construction Noise Level $L_{Aeq,1hr}$ Scenario		Diff. dB(A)
	A (Blasting)	B (Rock breaking)	
H028	31	38	-7
H002	30	38	-8

Review of the data contained in Table 12-14 confirms the following:

- Predicted construction noise levels for both Scenario A and B at the borrow pit are well within the best practice construction noise criteria outlined in Table 12-1. It is assumed that construction works at the borrow pits will only occur during daytime periods only (07:00 to 19:00hrs).
- The blasting proposal results in lower levels of construction noise since the use of the rock breaking plant is not required in this instance. Predicted noise levels are lower at all assessed locations for Scenario A.
- It is accepted that the individual blast events will be audible at some locations. Blast events will be designed and controlled such that the best practice noise and vibration limit values outlined in section 12.4 of this chapter are not exceeded.

12.5.2.4.2 *Vibration*

With reference to the discussion on vibration presented in Section 12.5.2.1.2 there will be no significant vibration impacts associated with the construction phase of the Proposed Development and therefore no specific mitigation measures will be required.

12.5.2.5 Construction Traffic

This section has been prepared in order to review potential noise impacts associated with construction traffic on the local road network. The information presented in Chapter 15 (Material Assets) has been used to inform the assessment here. The following situations are commented upon here:

- Stage 1a – Site Preparation – Concrete Pouring
- Stage 1b – Site Preparation & Ground Works,
- Stage 2a – Turbine Construction Stage – Extended Artic Deliveries
- Stage 2b – Turbine Construction Stage – Other Conventional Deliveries

The proposed turbine delivery route is detailed in Section 4.5 of Chapter 4 (Description of the Proposed Development).

Table 12-15 Assumptions for Construction Traffic Noise Assessment (Background + Proposed Development)

Route	Stage	Traffic Units (vehicles)	%HGV
N22 at Castlemore	Existing	16,355	4.5
	1b	16,639	5.7
	1a	16,432	4.5

	2a	16,406	4.5
	2b	16,408	4.5
R484 north of Crookstown	Existing	5,233	4.6
	1b	5,517	8.2
	1a	5,310	4.7
	2a	5,284	4.7
	2b	5,286	4.7
R585 at Gloun	Existing	5,827	4.7
	1b	6,111	8.0
	1a	5,903	4.8
	2a	5,878	4.8
	2b	5,880	4.8
R584 south of site	Existing	888	3.0
	1b	1,172	20.6
	1a	964	3.5
	2a	939	3.5
	2b	941	3.7
R584 north of site	Existing	888	3.0
	1b	1,172	20.6
	1a	964	3.5
	2a	939	3.5
	2b	941	3.7

Based on the assumptions presented above changes in noise level based on the existing flows have been estimated and is presented in Table 12-16.

Table 12-16 Estimated Changes in Traffic Noise Levels

Route	Stage	Change in Traffic Noise Level dB(A)	DMRB Magnitude of Impact	Estimated Number of Days
N22 at Castlemore	1a	0.7	Negligible	3
	1b	0.0	Negligible	178
	2a	0.0	Negligible	8
	2b	0.0	Negligible	3
R484 north of Crookstown	1a	1.9	Minor	3
	1b	0.1	Negligible	178
	2a	0.1	Negligible	8
	2b	0.1	Negligible	3
R585 at Gloun	1a	1.7	Minor	3
	1b	0.1	Negligible	178
	2a	0.1	Negligible	8
	2b	0.1	Negligible	3
R584 south of site	1a	7.0	Major	3
	1b	0.7	Negligible	178
	2a	0.6	Negligible	8
	2b	0.7	Negligible	3
R584 north of site	1a	7.0	Major	3
	1b	0.7	Negligible	178
	2a	0.6	Negligible	8
	2b	0.7	Negligible	3

With exception of the two links (R584 North of site and R584 South of site) during Stage 1a the predicted increases in traffic noise levels during each of the construction stages are less than 3 dB along all links, with reference to the DMRB magnitude of impact set out in Section 12.3.2.1.2 the potential impacts are classified as 'negligible' to 'minor' and the potential effects range from imperceptible to not significant.

During Stage 1a, along both the R584 North and South of the site, the potential impact is classified as 'major' with reference to the DMRB magnitude of impact. However, the estimated duration of the corresponding phases is only three days, which does not constitute a significant effect, as the threshold of 10 or more days or nights within any 15 consecutive days or nights as described in Section 12.3.2.1.3 is not exceeded. Therefore, the potential effects range from imperceptible to not significant.

12.5.2.6 Cumulative Construction Noise and Vibration Effects

The list of cumulative projects from Appendix 2-3 of the EIAR have been reviewed. 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 contractor for the Proposed Development will coordinate construction schedules with other contractors to ensure that significant cumulative noise impacts do not occur.

12.5.3 Operational Phase Potential Impacts

This section presents an assessment of the elements of the Proposed Development that are likely to generate operational noise with the potential for adverse effects on NSLs.

12.5.3.1 Turbine Noise Assessment

The noise levels for the proposed turbines have been calculated for all NSLs identified the noise study area.

A worst-case assessment has been completed assuming all noise locations are downwind of the proposed turbines at the same time. The predicted levels have been compared against the adopted noise criteria curves as detailed in Table 12-18 presents the details of the exercise at the five closest houses to any of the proposed turbines (H13, H14, H18, H19, H21). Results for the full set of houses are presented in Appendix 12-6.

Table 12-18 Review of Cumulative Predicted Turbine Noise Levels against Relevant Criteria

House ID	Description	Predicted Noise Level dB L_{A90} at Standardised Wind Speed at 10m A.G.L. at wind speed at standardised 10m height							
		3	4	5	6	7	8	9	≥10
H13	Predicted	24.1	25.5	30.2	34.4	36.1	35.7	35.7	35.7
	Daytime Limits	40	45	45	45	45	45	45	45
	Potential Daytime Exceedance	–	–	–	–	–	–	–	–
	Night Limits	43	43	43	43	43	43	43	44
	Potential Night time Exceedance	–	–	–	–	–	–	–	–
H14	Predicted	24.5	25.9	30.6	34.8	36.5	36.1	36.1	36.1
	Daytime Limits	40	45	45	45	45	45	45	45
	Potential Daytime Exceedance	–	–	–	–	–	–	–	–
	Night Limits	43	43	43	43	43	43	43	44
	Potential Night time Exceedance	–	–	–	–	–	–	–	–

House ID	Description	Predicted Noise Level dB L_{A90} at Standardised Wind Speed at 10m A.G.L. at wind speed at standardised 10m height							
		3	4	5	6	7	8	9	≥10
H18	Predicted	25.6	27.0	31.8	36.0	37.6	37.2	37.2	37.2
	Daytime Limits	40	45	45	45	45	45	45	45
	Potential Daytime Exceedance	–	–	–	–	–	–	–	–
	Night Limits	43	43	43	43	43	43	43	44
	Potential Night time Exceedance	–	–	–	–	–	–	–	–
H19	Predicted	24.9	26.3	31.1	35.3	36.9	36.5	36.5	36.5
	Daytime Limits	40	45	45	45	45	45	45	45
	Potential Daytime Exceedance	–	–	–	–	–	–	–	–
	Night Limits	43	43	43	43	43	43	43	44
	Potential Night time Exceedance	–	–	–	–	–	–	–	–
H21	Predicted	24.3	25.9	30.7	34.9	36.4	36.0	36.0	36.0
	Daytime Limits	40	45	45	45	45	45	45	45
	Potential Daytime Exceedance	–	–	–	–	–	–	–	–
	Night Limits	43	43	43	43	43	43	43	44
	Potential Night time Exceedance	–	–	–	–	–	–	–	–

A noise contour for standard mode operation rated power wind speed (i.e. highest noise emission) has been presented in Appendix 12-7.

The cumulative predicted noise levels at various wind speeds have been compared against the noise criteria curves outlined in Table 12-9. The predicted omni-directional noise levels for all turbines operating in standard mode are below the day and night-time criteria in all cases.

For the purposes of this assessment, a specific turbine model, as detailed in Section 12.3.5.2.1 was selected. The actual turbine to be installed on the Site will be the subject of a competitive tender process and could include other turbines models (including models not currently available). Regardless of the make or model of the turbine eventually selected for installation on site, the noise emission of the selected turbine will be of no greater significance than that used for the purposes of this assessment and will ensure the required noise limits are achieved at all NSLs. The turbines will be capable of achieving the limits set by the relevant guidance or planning permission conditions.

Assuming the implementation of the above or similar, it is not considered that a significant effect is associated with the operation of this development, since the predicted noise levels associated with the Proposed Development will comply with the relevant best practice noise criteria curves for wind energy developments discussed in detail in Section 12.3.2.2.1.

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

12.5.3.2 Site Roads

Considering that there is no significant traffic expected on site roads during the operational phase and the significant distances from any site road to the nearest NSL; there are no noise and vibration impacts anticipated from site roads during the operational phase.

12.5.4 Decommissioning Phase

No specific mitigation measures are required for decommissioning. To ameliorate any potential noise impacts that may present during the decommissioning phase, a schedule of noise control measures has been formulated in accordance with best practice guidance. These are outlined in the Construction and Environmental Management Plan (CEMP) (Appendix 4-3) that has been prepared for the Proposed Development.

12.6 Mitigation Measures

12.6.1 Construction Phase

Regarding construction activities, reference will be made to BS 5228-1:2009+A1:2014 which offers detailed guidance on the control of noise & vibration from demolition and construction activities.

12.6.1.1 Construction Phase Mitigation Measures – Noise

The assessment of potential impacts present in Section 12.5.2 has demonstrated that the Proposed Development is expected to comply with the criteria during the construction phase and therefore no specific mitigation measures are required.

The contract documents will specify that the Contractor undertaking the works will be obliged to take specific noise abatement measures and comply with the recommendations of British Standard BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise. 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. These are outlined in the Construction and Environmental Management Plan (CEMP) that has been prepared for the Proposed Development. The following list of measures will be considered, where necessary, to ensure compliance with the relevant construction noise criteria:

- Limiting the hours during which site activities likely to create high levels of noise or vibration are permitted;
- Establishing channels of communication between the contractor/developer, Local Authority and residents;
- Monitoring typical levels of noise and vibration during critical periods and at sensitive locations;
- Selection of plant with low inherent potential for generation of noise and/ or vibration where practical;
- Placing of noise generating / vibratory plant as far away from sensitive properties as practical within the site constraints, and;

- The hours of construction activity will be limited to avoid unsociable hours where possible. Construction operations shall generally be restricted to between 7:00hrs and 19:00hrs Monday to Saturday. However, to ensure that optimal use is made of good weather periods or at critical periods within the programme (i.e. concrete pours, turbine component deliveries) it could occasionally be necessary to work out of these hours.

Where rock breaking is employed in relation to the proposed borrow pit location or other locations across the Site, the following are examples of measures that will be employed, where necessary, to mitigate noise emissions from these activities:

- Fit suitably designed muffler or sound reduction equipment to the rock breaking tool to reduce noise without impairing machine efficiency.
- Ensure all leaks in air lines are sealed.
- Use a dampened bit to eliminate ringing.

Air overpressure from a blast is difficult to control, however, because of its variability much can be done to reduce the effect. A reduction in the amount of primer cord used, together with the adequate burial of any that is above the ground, can give dramatic reduction to air overpressure intensities especially in the audible frequency range. Most complaints are likely to be received from an area downwind of the blast site, and therefore, if air blast complaints are a continual problem, it would be advisable to postpone blasting during unfavourable weather conditions if possible. As air blast intensity is a function of total charge weight, then a reduction in the total amount of explosives used can also reduce the air overpressure value.

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

The methods used to minimise impacts will consist of the following:

- Restriction of hours within which blasting can be conducted (e.g. 09:00 – 18:00hrs).
- The firing of blasts at similar times to reduce the 'startle' effect.
- On-going circulars informing people of the progress of the works.
- The implementation of an onsite documented complaints procedure.
- The use of independent monitoring for verification of results.
- Trial blasts in less sensitive areas to assist in blast designs and identify potential zones of influence.

12.6.1.2 Construction Phase Mitigation Measures – Vibration

The assessment presented in Section 12.5.2 has demonstrated that there will be no significant vibration impacts associated with the construction of the Proposed Development and that no specific mitigation measures are required, it is recommended that vibration from construction activities will be limited to the values set out in Section 12.3.2.1.4.

It should be noted that these limits are not absolute but provide guidance as to magnitudes of vibration that are very unlikely to cause cosmetic damage. Magnitudes of vibration slightly greater than those in the table are normally unlikely to cause cosmetic damage, but construction work creating such magnitudes should proceed with caution. Where there is existing damage, these limits may need to be reduced by up to 50%.

If blasting is undertaken as part of the Proposed Development, a detailed assessment will be undertaken by a specialist blast design engineer to determine the blast design parameters; all mitigation measures specified by the blast design engineer to keep vibration values within the criteria in 12.3.2.1.4 will be implemented.

12.6.2 Operational Phase

An assessment of the operation noise levels has been undertaken in accordance with best practice guidelines and procedures as outlined in Section 12.3.2.2.1 of this Chapter. The findings of the assessment confirmed that the predicted operational noise levels will be within the relevant best practice noise criteria curves for wind farms at all locations, are not significant and therefore no mitigation measures are required.

If alternative turbine technologies are considered for the Site an updated noise assessment will be prepared to confirm that the noise emissions associated with the selected turbines will comply with the noise criteria curves as per best practice guidance outlined in Section 12.3.2.2.1 and/or the relevant operational criteria associated with the grant of planning for the Proposed Development. If necessary suitable curtailment strategies will be designed and implemented for alternative technologies to ensure compliance with the relevant noise criteria curves, should detailed assessment conclude that this is necessary.

In the unlikely event that an issue with low frequency noise is associated with the Proposed Development, it is recommended that an appropriate detailed investigation be undertaken. Due consideration should be given to guidance on conducting such an investigation which is outlined in Appendix VI of NG4 (EPA, 2016). This guidance is based on the threshold values outlined in NANR45 (Salford, 2011).

12.6.2.1.1 *Amplitude Modulation*

In the event that a complaint which indicates potential excessive amplitude modulation (AM) associated with the Proposed Development, the operator will fully investigate the complaint in collaboration with the turbine manufacturer, through review of the meteorological periods and conditions during which the reported AM occurs. If an ongoing issue with excessive AM is identified, a mitigation strategy to reduce the level of AM will be implemented through engineering methods and/or curtailment of specific turbines. The operator may appoint a qualified acoustic consultant to objectively assess the level of AM in accordance with the methods outlined in the Institute of Acoustics IOA Noise Working Group (Wind Turbine Noise) Amplitude Modulation Working Group Final Report: *A Method for Rating Amplitude Modulation in Wind Turbine Noise* (9 August 2016) or subsequent revisions.

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

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

12.6.2.1.2 *Monitoring*

Commissioning noise surveys will be undertaken to ensure compliance with any noise conditions applied to the development. It is common practice to commence surveys within six months of a wind farm being commissioned.

In the unlikely event that an exceedance of the noise criteria is identified as part of the commissioning assessment, the guidance outlined in the IOA GPG and Supplementary Guidance Note 5: Post

Completion Measurements (IOA, July 2014, hereafter referred to as SGN5) will be followed, 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 curves/planning conditions limits. Such curtailment can be applied using the wind farm SCADA system without undue effect on the wind turbine performance. Following implementation of these measures, noise surveys will be repeated to confirm compliance with the noise criteria. Once compliance is demonstrated through the methodology in SGN5, it is not normally necessary to repeat the noise compliance exercise over the life of the wind farm.

The commissioning survey will include a review for the presence of audible tones associated with the operation of the wind turbine farm in accordance with Annex C of ISO 1996-2:2017 *Acoustics — Description, measurement and assessment of environmental noise Part 2: Determination of sound pressure levels*.

12.7 Description of Residual Effects

12.7.1 Construction Phase

During the construction phase of the Proposed Development there will be some effect on nearby noise sensitive properties due to noise emissions from site traffic and other construction activities. However, given the distances between the main construction works and nearby noise sensitive properties and the fact that the construction phase of the Proposed Development is temporary in nature, it is expected that the various noise sources will not be excessively intrusive. Furthermore, the application of binding noise limits and hours of operation, along with implementation of appropriate noise and vibration control measures, will ensure that noise and vibration effect is kept within the guidance limits and is not significant.

With respect to the EPA, 2022 criteria for description of effects, in terms of these construction activities, the potential worst-case associated effects at the nearest NSLs associated with the various elements of the construction phase are described below.

12.7.1.1 General Construction – Turbines and Hardstanding and Met Mast

The predicted construction noise and vibration effects associated with on-site construction activities are short-term, slight, not significant and are summarised as follows:

Quality	Significance	Duration
Negative	Not Significant	Short-term

12.7.1.2 Proposed Access Roads and Existing Road Upgrades

"The predicted worst-case construction noise and vibration effects associated with proposed upgrades to existing roads, at NSL's, are not significant and are summarised as follows:"

Quality	Significance	Duration

Negative	Not Significant	Temporary

12.7.1.3 Proposed Turbine Component Turning Area

The predicted worst-case noise and vibration effects associated with construction of the proposed turbine component turning area at NSLs are not significant and are summarised as follows:

Quality	Significance	Duration
Negative	Slight	Temporary

The above effects should be considered in terms that the effect is variable and that this assessment considers one location with the greatest potential impact.

At all other NSLs, the following effect is associated with the internal construction of roads and is not significant:

Quality	Significance	Duration
Negative	Not Significant	Temporary

12.7.1.4 Borrow Pit

The predicted worst-case noise and vibration effects associated with proposed borrow pit construction at NSL's is not significant and are summarised as follows:

Quality	Significance	Duration
Negative	Not Significant	Temporary

12.7.1.5 Construction Traffic

The effects associated with the overall noise levels from construction traffic is not significant and summarised as follows, for the worst-case phase of the construction:

Quality	Significance	Duration
Negative	Not Significant	Temporary

12.7.2 Operational Phase

12.7.2.1 Noise

12.7.2.1.1 *Wind Turbine Noise*

The predicted noise levels associated with the Proposed Development will be within best practice noise criteria curves recommended in Irish guidance '*Wind Energy Development Guidelines for Planning*

Authorities' therefore, it is not considered that a significant effect is associated with the Proposed Development.

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

The predicted residual operational turbine noise effects are not significant and summarised as follows at the closest NSLs to the site:

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 periods of the greatest potential effect.

12.7.2.2 Vibration

There are no expected sources of vibration associated with the operational phase of the Proposed Development. In relation to of vibration the associated effect is not significant and summarised as follows:

Quality	Significance	Duration
Negative	Imperceptible	Long-term

12.7.3 Decommissioning Phase

During the decommissioning phase of the Proposed Development, there will be some effect on nearby noise sensitive properties due to noise emissions from site traffic and other on-site activities. Similar overall noise levels as those calculated for the construction phase would be expected, as similar tools and equipment will be used. The noise and vibration impacts associated with any decommissioning of the Site are considered to be comparable to those outlined in relation to the construction of the Proposed Development.

With respect to the EPA, 2022 criteria for description of effects, the anticipated associated effects at the nearest NSLs associated with the decommissioning phase is not significant and are described below.

Quality	Significance	Duration
Negative	Slight	Short-term

12.7.4 Cumulative Effects

12.7.4.1 Other Wind Farms

The above operational noise assessment has considered the potential cumulative impacts of the Proposed Development in combination with other wind energy developments in the area as required by best practice guidance discussed in Section 12.3.2.2.1 and as detailed in Section 12.5.3.1.

As noted in Section 12.5.3.1, the predicted noise levels associated with the Proposed Development, which takes into account other wind energy developments in the area, will be within best practice noise criteria curves recommended in Irish guidance '*Wind Energy Development Guidelines for Planning Authorities'*

It is therefore considered that the effect on the noise environment associated with the Proposed Development in combination with other wind farm developments is not significant.

12.8 Conclusion

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

The assessment of construction noise and vibration and has been conducted in accordance with best practice guidance contained in BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise and BS 5228-2:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Vibration. Subject to good working practice as recommended in the EIAR Chapter, noise associated with the construction phase is not expected to exceed the recommended limit values. The associated noise and vibration is not significant and will not cause any significant effects.

Based on detailed information on the proposed turbine locations, turbine noise emission levels and turbine height, worst-case turbine noise levels have been predicted at NSLs for a range of operational wind speeds. The predicted noise levels associated with the Proposed Development will be within best practice noise limits recommended in the Guidelines (DoEHLG, 2006), therefore a significant effect is not associated with the Proposed Development.

Noise from the continued operation of the existing onsite 38kV substation has also been assessed and is expected to be inaudible at NSLs and there is no potential for any significant effects.

No significant vibration effects are associated with the operation of the Proposed Development.

In summary, the noise and vibration impact of the Proposed Development is not significant.