Planning and Environmental Consultants



# Environmental Impact Assessment Report (EIAR)

## Gannow Renewable Energy Development, Co. Galway

### Chapter 12 – Noise and Vibration

# Contents



## TABLE OF TABLES

## TABLE OF FIGURES

# 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 associated with the proposed Gannow Renewable Energy Development (the 'Proposed Project'). The Proposed Project includes for the provision of 8 no. wind turbines with an overall ground to blade tip height of between 178 and 185 metres. For the purposes of this EIAR, the various project components are described and assessed using the following references: 'Proposed Project', 'Proposed Wind Farm', 'proposed turbines', 'Proposed Grid Connection', 'Site' and 'Proposed Wind Farm site'. Please see Section 1.1.1 of this EIAR for further details. A detailed description of the Proposed Project is provided in Chapter 4 Description of the Proposed Project of this EIAR.

A full description of the Proposed Project is provided in Chapter 4 of this EIAR.

This Noise and Vibration assessment considers the construction phase, operational phase and decommissioning phase of the Proposed Wind Farm on the nearest NSLs. To inform the noise impact assessment, background noise levels have been measured at 5 no. representative noise sensitive locations in the vicinity of the Proposed Wind Farm site to assess the potential impacts associated with the operation of the Proposed Wind Farm.

The effects of the Proposed Grid Connection are also considered. A daytime baseline noise survey has been carried out along the Proposed Grid Connection and is presented in Appendix 12-9. This chapter considers the potential construction noise and vibration effects of the Proposed Grid Connection. There is no operational noise associated with the Proposed Grid Connection and therefore no operational noise effects. It is not intended to decommission the Proposed Grid Connection, therefore no decommissioning phase noise effects will arise.

This chapter is supported by material in the following appendices:

- Appendix 12-1: Glossary of Acoustic Terms
- Appendix 12-2: Assessment of Turbine Range
- Appendix 12-3: Noise Study Area
- Appendix 12-4: Background Noise Survey
- Appendix 12-5: LIDAR Installation Report
- Appendix 12-6: Noise Modelling Parameters
- Appendix 12-7: Predicted Noise Levels
- Appendix 12-8: Predicted Noise Contour

### 12.1.2 Statement of Authority

This chapter of the EIAR has been prepared by Mike Simms of AWN Consulting.

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.

This chapter has been reviewed by Dermot Blunnie of AWN Consulting.

Dermot Blunnie (Associate) holds a BEng (Hons) in Sound Engineering, an MSc in Applied Acoustics and has completed the Institute of Acoustics Diploma in Acoustics and Noise Control. He has been working in the field of acoustics since 2008 and as a consultant since 2014. He is a member of both Engineers Ireland and the Institute of Acoustics. He is experienced in environmental, building and architectural acoustics. He has extensive knowledge of all aspects of surveying, computer modelling, impact assessment of environmental noise and architectural acoustic assessments for various sectors including, energy, industrial, commercial, and residential.



## 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 226:2023 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.

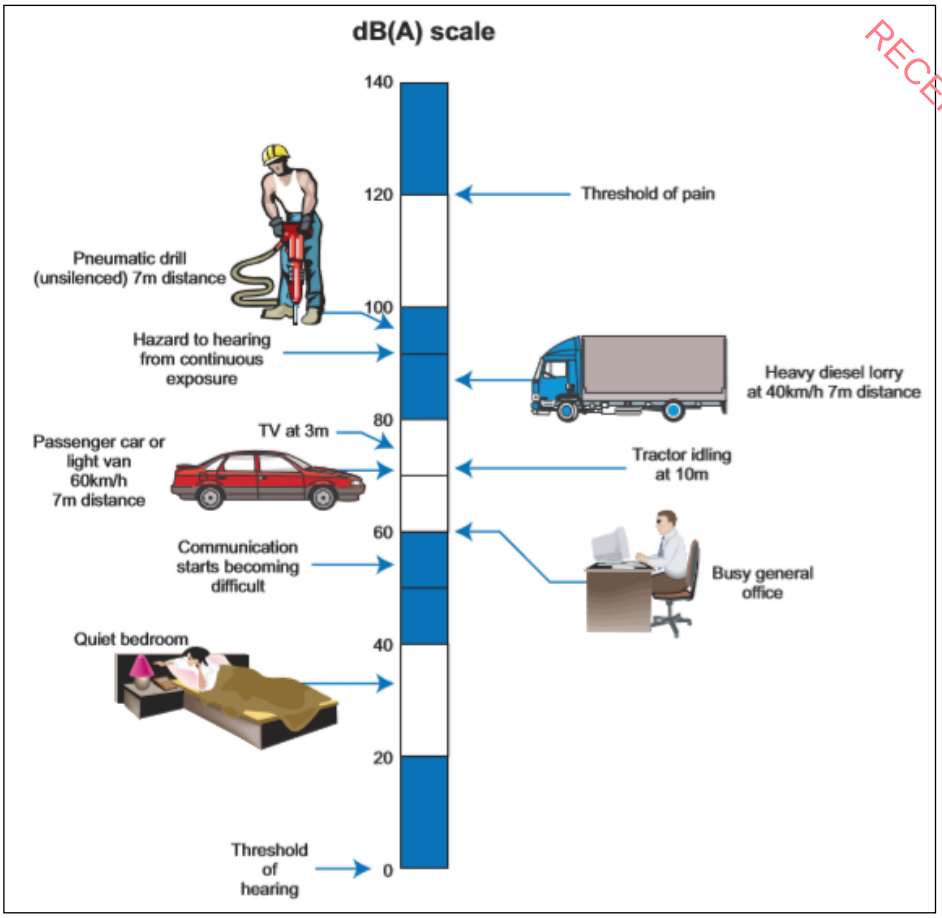



*Figure 12-1 The level of typical common sounds on the dB(A) scale (National Roads Authority (NRA) Good Practice Guidance for the Treatment of Noise during the Planning of National Road Schemes (NRA, 2014)*

## 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 Project.

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 Project is summarised as follows:

- Characterise the receiving environment through noise surveys at various locations in the receiving environment of the proposed turbines;
- Undertake predictive noise calculations to assess the potential impacts associated with the construction, operational and decommissioning phases of the Proposed Project at 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 Project; and
- Describe the significance of the residual noise and vibration effects associated with the Proposed Project, including cumulative effects.

## 12.3.1 EPA Description of Effects



The significance of effects of the Proposed Project 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 Section 1.7.2 of Chapter 1.

The effects associated with the Proposed Project are described with respect to EPA, 2022 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).
- *Wind Energy Development Guidelines for Planning Authorities*, Department of the Environment, Heritage, and Local Government, 2006 (the Guidelines (DoEHLG, 2006)), with cognisance of *Draft Revised Wind Energy Development Guidelines* 2019 Department of Housing, Local Government and Heritage (Draft Guidelines (DoHPLG, 2019)).
- *The Assessment and Rating of Noise from Wind Farms*, Department of Trade, and Industry (UK) Energy Technology Support Unit (ETSU) (1996).
- *A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise* (IOA GPG) (2013).
- *Good Practice Guidance for the Treatment of Noise during the Planning of National Road Schemes, Transport Infrastructure Ireland* (TII) (formerly National Roads Authority (NRA) (2014).
- British Standard BS 5228-1:2009+A1:2014 *Code of practice for noise and vibration control on construction and open sites – Noise.*
- British Standard BS 5228-2:2009+A1:2014 *Code of practice for vibration control on construction and open sites – Vibration.*
- British Standard BS 7385 – *Evaluation and measurement for vibration in buildings – Part 2: Guide to damage levels from groundborne vibration* (BSI, 1993).
- International Organization for Standardization ISO 9613-2:2024 Acoustics – Attenuation of sound during propagation outdoors - Part 2: General method of calculation (ISO, 2024)
- *Design Manual for Roads and Bridges* Sustainability & Environment Appraisal LA 111 Noise and Vibration Revision 2 (National England (now National Highways) 2020)
- Transport Infrastructure Ireland (formerly NRA) (TII) *Good Practice Guidance for the Treatment of Noise during the Planning of National Road Schemes (TII, 2014)*
- International Organization for Standardization ISO 1996: 2017: *Acoustics – Description, measurement, and assessment of environmental noise.*
- *Guidance Note for Noise Assessment of Wind Turbine Operations at EPA Licensed Sites* (NG3) (EPA, 2011).
- *Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4),* EPA, 2016 (NG4).
- World Health Organisation (WHO) *Environmental Noise Guidelines for the European Region* (2018).

## 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 the *British Standard 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise* (BS 5228-1).

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. The threshold levels relate to construction noise only.

*Table 12-1 Example Threshold of Potential Significant Effect at Noise Sensitive Locations*

| 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.*

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

### Linear Construction Works

Due to the linear progressive nature of the construction works associated with the Proposed Grid Connection, a fixed noise limit is proposed. This is deemed appropriate in that noise from associated construction activities is variable and typically occurs for a short period of time only and is at its highest when closest to the NSL. As the works progress, construction noise levels at the NSL will reduce due to the works taking place at greater distances, resulting overall in shorter periods of exposure to noise impacts.

In relation to an appropriate fixed noise limit value, BS 5228-1 paragraph E.2 states:

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

Paragraph E.2 goes on to state:

> *"Noise levels, between say 07.00 and 19.00 hours, outside the nearest window of the occupied room closest to the site boundary should not exceed:*
>
> - 70 decibels (dBA) in rural, suburban areas away from main road traffic and industrial noise;
> - 75 decibels (dBA) in urban areas near main roads in heavy industrial areas".

Transport Infrastructure Ireland (formerly NRA) (TII) *Good Practice Guidance for the Treatment of Noise during the Planning of National Road Schemes* (TII, 2014)

The Transport Infrastructure Ireland (TII) (formerly National Roads Authority (NRA)) document '*Good Practice Guidance for the Treatment of Noise and Vibration in National Road Schemes'* (NRA, 2014) proposes daytime period (Monday to Friday 0700 – 1900 hrs) construction noise limits of 70 dB $L_{Aeq,1hr}$ and 65 dB $L_{Aeq,1hr}$ for Saturdays between 0800 – 16:30hrs.

Considering the above guidance, a construction noise threshold of 70 dB $L_{Aeq,1hr}$ is proposed for linear construction activities on weekdays (i.e. Proposed Grid Connection). Noise levels above 70 dB $L_{Aeq,1hr}$ would indicate a potential significant impact depending on the duration and frequency of occurrence (Section 12.3.2.1.3 below).

### Interpretation of the CNT

In order to assist with interpretation of the CNT, Table 12-2 includes guidance as to the likely magnitude of impact associated with construction activities, relative to the CNT. This guidance is derived from guidance in the document published by Highways England (now National Highways) *Design Manual for Roads and Bridges Sustainability & Environment Appraisal LA 111 Noise and Vibration* (Revision 2) (hereafter referred to as DMRB). Table 3.16 therein has been and adapted to include the relevant significance effects from EPA, 2022.

*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 CNT 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 phase.

#### 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 Project will make use of existing roads already carrying traffic volumes, it is appropriate to assess the calculated increase in traffic noise levels that will arise because of vehicular movements associated with the Proposed Project.

Table 12-3 below, taken from DMRB, offers guidance as to the likely short-term impact associated with any change in traffic noise level.

*Table 12-3 Classification of magnitude of traffic noise changes in the short-term (Source DMRB, 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 | Up to a doubling of loudness | Major | Significant |

The DMRB will be used to assess the predicted increases in traffic levels on public roads associated with the Proposed Project and comment on the short-term impacts during the construction phase. 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.



This is of particular relevance to the assessment of construction noise from linear works.

#### 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 Project, the range of relevant criteria used for building protection is expressed in terms of Peak Particle Velocity (PPV) in mm/s.

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

- BS 7385 – *Evaluation and measurement for vibration in buildings – Part 2: Guide to damage levels from groundborne vibration* (1993); and
- BS 5228 – *Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration* (2009+A1:2014).

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.

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%.

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

*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 guidance documents 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"* (1996). The ETSU document has been used to supplement the guidance contained within the Guidelines (DoEHLG, 2006) publication where necessary.

In this instance, a range of four candidate turbine models is assessed, as described in Chapter 4 Description of the Proposed Project. Appendix 12-2 presents the methodology of how the range of turbine models proposed are assessed in this EIAR Chapter.

## 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 on the 1996 ETSU publication *The Assessment and Rating of Noise from Wind Farms (ETSU-R-97).*

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 12-3.

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) document '*A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise'* (2013) (IOA GPG) 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 measurement should be carried out at the nearest NSL 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 a proposed turbine). Background noise measurements (i.e. $L_{A90,10min}$) should be related to wind speed measurements that are collated at the site of a wind farm. 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 9613:2024 *Acoustics – Attenuation of sound outdoors, Part 2: General method of calculation* (2004). 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 IOA GPG has been adopted.

The IOA GPG 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 wind farms in the surrounding environment and the need to considered other development in the wind turbine noise assessment.

Section 5.1 of the IOA GPG 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 a proposed wind farm produces noise levels within 10 dB of any existing wind farm/s at the same receptor location, then a cumulative noise impact assessment is necessary*
>
> *5.1.5 Equally, in such cases where noise from a proposed wind farm is predicted to be 10 dB greater than that from a existing wind farm (but compliant with ETSU-R-97 in its own right), then a cumulative noise impact assessment would not be necessary."*

An appraisal of the study area to determine whether a cumulative turbine noise impact assessment is required is presented in Section 12.3.3 and Appendix 12-2.

## 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 below 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 Guidelines (DoEHLG, 2006), this is commonly applied in noise assessments prepared and is detailed in numerous examples of planning conditions issued by An Coimisiún Pleanála (ACP) (formerly An Bord Pleanála). 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 proposed turbine noise at NSLs are presented in Section 12.4.2.

### Future Potential Guidance Changes for Wind Turbine Noise

In December 2019, 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 to noise assessments of wind farms in the Draft Guidelines (DoHPLG, 2019) have been expressed by various parties. Specific concerns expressed by a group of acoustic professionals working in the field are most relevant. The group was made up of acousticians who act for wind farm developers, Councils, Government bodies and residents' groups (all of whom are members of the Institute of Acoustics, IOA). The group contained several of the authors / contributors to ETSU-R-97, the IOA Good Practice Guide (IOA GPG) and the IOA Amplitude Modulation Working Group, which are all referenced extensively in the Draft Guidelines (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

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

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

The following comment from the above response is of note:

> *"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"*

The following statements was submitted by the Minister for Housing, Local Government and Heritage during a Dail Eireann Debates on 13 June 2023[1]

[1] https://www.oireachtas.ie/en/debates/question/2023-06-13/780/

*"My Department is currently undertaking a focused review of the 2006 Wind Energy Development Guidelines. The review is addressing a number of key aspects including noise, setback distance, shadow flicker, community obligation, community dividend and grid connections.*

*Guidance on the noise aspect, which is highly technical in nature, is currently being finalised by my Department in conjunction with the Department of the Environment, Climate and Communications (DECC), which has primary responsibility for environmental noise matters. Both Departments are 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.*

*In this connection, DECC has recently appointed an acoustic expert, who has commenced work to inform any amendments to the noise aspect of the Guidelines. My Department in conjunction with DECC will make any further changes to the draft Guidelines which are deemed necessary or appropriate in the wake of this work, with a view to bringing the review of the Guidelines to a conclusion. My Department will be in a better position to provide an update on the expected publication date of the revised Guidelines once this process has concluded.*

*It should be noted that Action EL/23/4 of the Climate Action Plan 2023 Annex of Actions contains a commitment to having new draft Guidelines prepared by the end of Q4 2023, with revised Guidelines to be published in 2024.*

*When finalised, the revised Guidelines will be issued under section 28 of the Planning and Development Act 2000, as amended. Planning authorities and, where applicable, An Bord Pleanála, must have regard to guidelines issued under section 28 in the performance of their functions generally under the Planning Acts. In the meantime, the current 2006 Wind Energy Development Guidelines remain in force."*

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 and the IOA GPG. If the Draft Guidelines (DoHPLG, 2019) are published during the application process for the Proposed Project, it is anticipated that any relevant changes affecting the noise will be addressed through an appropriate planning condition and that the proposed turbines are capable of adhering to such a condition.

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

The World Health Organisation (WHO) *Environmental Noise Guidelines for the European Region* (2018) provide guidance on protecting human health from exposure to environmental noise. They set health-based recommendations based on average environmental noise exposure of several sources of environmental noise, including wind turbine noise. Recommendations are rated as either 'strong' or 'conditional'. A strong recommendation, "*can be adopted as policy in most situations*" whereas a conditional recommendation, "*requires a policy-making process with substantial debate and involvement of various stakeholders. There is less certainty of its efficacy owing to lower quality of evidence of a net benefit, opposing values and preferences of individuals and populations affected or the high resource implications of the recommendation, meaning there may be circumstances or settings in which it will not apply*".

The objective of the WHO Environmental Noise Guidelines for the European Region 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 WHO Environmental Noise 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 Environmental Noise Guidelines, the quality of evidence used for the research is stated as being 'Low', the recommendations are therefore conditional.

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

There is potential 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 200 Hz whereas Infrasound is typically described as sound at frequencies below 20 Hz. 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."*

With respect to infrasonic noise levels below the hearing threshold, the World Health Organisation (WHO) document Community Noise (WHO, 1995) has stated that:

> *"There is no reliable evidence that infrasounds below the hearing threshold produce physiological or psychological effects."*

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".*

In 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*

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.

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 8, of 133 sites in the UK that were operational at the time of the study and considered within the review. At the 4 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 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.

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* (August 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.

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 context of a site seeking permission to continue operation, reference is made to the mitigation measures in respect of AM described in Section 12.6.2.1.1 below.

#### 12.3.2.2.4 Human Health Effects from Wind Turbine Noise

The peer-reviewed research outlined in the proceeding sections supports that there are no direct negative health effects on people with long term exposure to wind turbine noise in the environment. For further details of potential health impacts effects associated with the Proposed Project, refer to Chapter 5: Population and Human Health, Section 5.6.

#### 12.3.2.2.5 Noise from the Proposed Onsite 38kV Substation

For the proposed onsite 38kV substation, it is proposed to set fixed noise limits and consideration has been given to the following best practice guidance.

##### EPA NG4

In order to establish whether the NSLs in the vicinity of the proposed onsite 38kV substation would be considered 'low background noise' areas as defined in the Environmental Protection Agency (EPA) publication '*Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities'* (NG4) guidance, the noise levels measured during the environmental noise survey need to satisfy the following criteria:

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

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

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

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

Based on a review of the measured noise from the background noise survey (Appendix 12-4), the NSL in the vicinity of the Proposed Wind Farm site are defined as areas of low background noise as per the NG4 guidance. As the proposed onsite 38kV substation will run on a 24-hour basis, the potential impact during night-time periods governs this assessment. A night time criterion of 35 dB $L_{Aeq,T}$ is considered appropriate for the operation of the proposed onsite 38kV substation. The design must ensure that the noise emissions do not contain audible tones or impulsive characteristics at the nearest NSLs.

An ambient noise level of 35 dB $L_{Aeq,T}$ is considered a low level of noise. However, it is important to consider the likelihood of adverse noise impacts when assessing noise from fixed plant. The NG4 guidance refers to the assessment method prescribed in BS 4142:2014: *Methods for rating and assessing industrial and commercial sound* that can be used to assess the likelihood of complaints from specific plant noise sources.

## Other Guidance – BS 4142



BS 4142:2014: *Methods for rating and assessing industrial and commercial sound* is the industry standard method for analysing fixed plant sound emissions to residential receptors. BS 4142 describes methods for rating and assessing sound of an industrial and/or commercial nature. The methods described in this British Standard use outdoor sound levels to assess the likely effects of sound on people who might be inside or outside a dwelling or premises used for residential purposes upon which sound is incident.

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

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

| | |
|---|---|
| "*ambient sound level, $L_{Aeq,T}$* | *equivalent continuous A-weighted sound pressure level of the totally encompassing sound in a given situation at any given time, usually from many sources near and far, at the assessment location over a given time interval, T.* |
| *residual sound level, $L_{Aeq,T}$* | *equivalent continuous A-weighted sound pressure level of the residual sound (i.e. ambient sound remaining at the assessment location when the specific sound source is suppressed to such a degree that it does not contribute to the ambient sound) at the assessment location over a given time interval, T.* |
| *specific sound level, $L_{Aeq,\ T}$* | *equivalent continuous A-weighted sound pressure level produced by the specific sound source at the assessment location over a given reference time interval, T.* |
| *Rating level, $L_{Ar,T}$* | *specific sound level plus any adjustment for the characteristic features of the sound.* |
| *background sound level, $L_{A90,T}$* | *A-weighted sound pressure level that is exceeded by the residual sound at the assessment location for 90% of a given time interval, T, measured using time weighting F and quoted to the nearest whole number of decibels.*" |

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

"*Obtain an initial estimate of the impact of the specific sound by subtracting the measured background sound level from the rating level and consider the following*:

a. *Typically, the greater this difference, the greater the magnitude of the impact.*

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

c. *A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context.*

d. *The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context.*

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

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

> *"The absolute level of sound. For a given difference between the rating level and the background sound level, the magnitude of the overall impact might be greater for an acoustic environment where the residual sound level is high than for an acoustic environment where the residual sound level is low.*
>
> *Where background sound levels and rating levels are low, absolute levels might be as, or more, relevant than the margin by which the rating level exceeds the background. This is especially true at night."*

In light of the above guidance from EPA's NG4 and BS4142, is it considered that the proposed absolute criterion of 35 dB $L_{Aeq,T}$ at the NSL for noise from the existing onsite 38kV substation is robust to prevent adverse impacts at NSLs.

#### 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.

The shortest distance from the proposed turbines to the nearest NSL is 543m (H031 to T03). At that distance, the level of vibration will be significantly below any thresholds for perceptibility. Therefore, vibration criteria are not specified for the operational phase of the Proposed Project.

### 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 Project during the construction, operational, and decommissioning phases.

For the operational phase the study area should cover, at a minimum, the area where the proposed turbines has the potential to cause a cumulative noise level exceeding 35 dB $L_{A90}$.

With reference to the Cumulative List (See Appendix 2-3) the following wind energy developments were considered for inclusion in the cumulative noise assessment:

- The operational Cloonlusk Wind Farm (ACP Ref: PL 07.232902) at over 20 km,

- The permitted Derrybrien Wind Farm (ACP Ref: SU07.308019), at over 23 km,
- The existing Sonnagh Old Wind Farm (Galway County Council Ref 00/3234) at over 20 km,
- The permitted Cloonascragh Wind Turbine, (Galway County Council Ref 221175) at over 23 km,
- The proposed Cooloo Wind Farm (ACP Ref: PC07.316466), at over 18 km,
- The proposed Derryfadda Wind Farm at over 20 km, and
- The proposed Killuremore Wind Farm (ACP Ref: PC07.314212) at over 15 km.

Due to the distances of the above permitted and proposed projects from the proposed turbines, no cumulative noise effects are likely. Cumulative effects in combination with single domestic turbines are not considered due to the closest single domestic turbine being located over 10km away from the proposed turbines. For the purposes of this assessment, single domestic turbines with a tip height of less than 50 metres which are located at distances greater than 5km from the proposed turbines, are deemed to have no significant cumulative effects in combination with the proposed turbines.

The extent of the study area used in this assessment is presented in Appendix 12-3.

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 Project. There is also a potential for noise impacts from HGVs along the Turbine Delivery Route (TDR) during the construction and decommissioning phases of the Proposed Wind Farm.

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.

The study area assessment of construction traffic noise aligns with the routes assessed in Chapter 15, Section 15.1, Traffic and Transport.

### 12.3.4 Background Noise Assessment

A background noise survey was undertaken to establish typical background noise levels at representative NSLs surrounding the Proposed Wind Farm site. The background noise survey was conducted through installing unattended sound level meters at 5 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 measurement locations were identified by preparing a preliminary noise model contour at an early stage of the assessment. Any NSLs that were located inside the predicted 35 dB $L_{A90}$ noise contour were considered for noise measurement, in line with current best practice guidance outlined in the IOA GPG. The selection of the noise measurement 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 and OSI Maps).

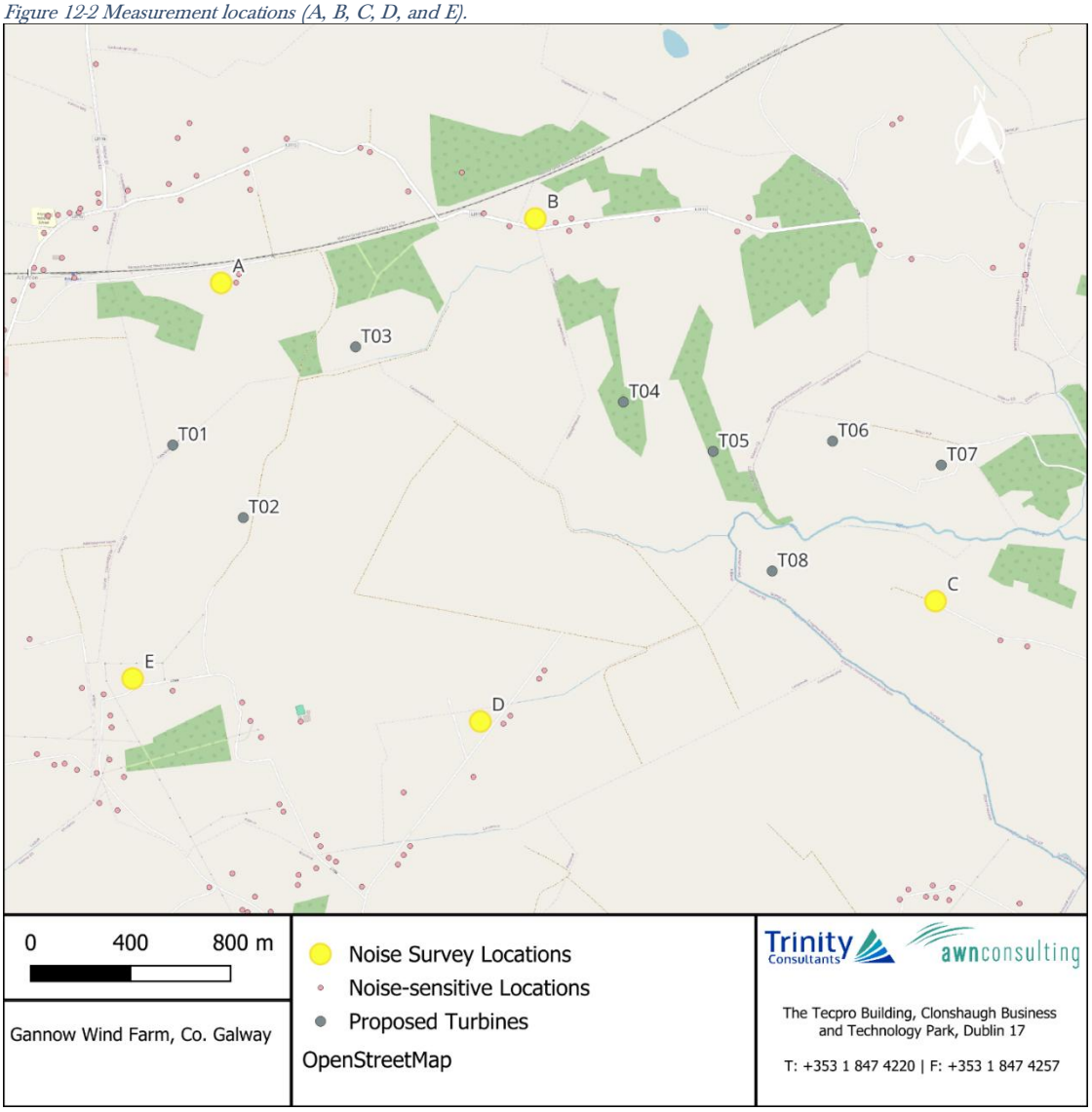
The selected locations for the noise measurement are outlined in the following sections. Coordinates for the noise measurement locations are proximate to a number of the sensitive receptors around the Proposed Project as detailed in Table 12-6 and Figure 12-2.

*Table 12-6 Measurement Location Coordinates*

| Location | Coordinates – Irish Transverse Mercator (ITM) | |
|---|---|---|
| | Easting | Northing |
| A (H032) | 560,199 | 730,248 |
| B (H020) | 561,456 | 730,506 |
| C (H001) | 563,057 | 728,973 |
| D (H310) | 561,236 | 728,491 |
| E (H054) | 559,845 | 728,663 |



*Figure 12-2 Measurement locations (A, B, C, D, and E).*




Site visits by survey personnel were carried out during the morning and afternoon time; during these visits, 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 at some locations.

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

Appendix 12-4 presents full details of the background noise survey methodology and results, including the survey dates and durations, instrumentation used, personnel and procedure.

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 obtained from Metrologic Lab. A copy of the Lidar installation report is included in Appendix 12-5 (Lidar Installation Report).

#### 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 12-4. Any reference to wind speed in this chapter should be understood to be at standardised 10m height unless otherwise stated.

### 12.3.5 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 turbines on the receiving environment. This section discusses the methodology behind the noise modelling process and presents the results of the modelling exercise.

#### 12.3.5.1 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: General method of calculation*, (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 400 m).

## 12.3.5.2 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.

### 12.3.5.2.1 *Proposed Turbine Coordinates*

Table 12-7 details the co-ordinates of the 8 No. proposed turbines that are being considered in this assessment.

*Table 12-7 Proposed Project Turbine Co-ordinates*

| Turbine | ITM Easting | ITM Northing |
|---|---|---|
| T1 | 560,006 | 729,599 |
| T2 | 560,288 | 729,308 |
| T3 | 560,737 | 729,992 |
| T4 | 561,808 | 729,771 |
| T5 | 562,167 | 729,573 |
| T6 | 562,645 | 729,614 |
| T7 | 563,080 | 729,518 |
| T8 | 562,403 | 729093 |

### 12.3.5.2.2 *Range of Turbine Models*

The exact model of turbine to be installed as part of the Proposed Wind Farm will be the result of a future tendering process and within the dimensions prescribed in this planning application should planning permission be granted. Achievement of the noise limits determined by this assessment will be a key determining requirement in the final choice of turbine for the Proposed Wind Farm. Whichever turbine model is ultimately selected will need to adhere to the limits set within this assessment and any conditions set out as part of a successful grant of permission. This can be achieved through implementation of mitigation measures, such as low-noise modes, where required.

There are four candidate turbines considered in this assessment, as follows:

- Scenario 1: Nordex N163 at hub height (HH) of 103.5 m and tip height (TH) of 185m;
- Scenario 2: Vestas V162 at HH of 104 m at TH of 185 m;
- Scenario 3: General Electric GE158 at HH of 101 m and TH of 180 m;
- Scenario 4: Nordex N149 at HH of 103.5 m and TH of 178 m.

The purpose of this noise assessment is to demonstrate that with any one of the candidate turbines, the environmental noise criteria can be complied with.

The approach taken to include each scenario in the noise assessment is as follows:

- To predict a set of noise levels at each NSL over the wind speed range for each of Scenarios 1, 2, 3, and 4, resulting in four tables of noise levels;
- To combine these four sets of results into one table by taking, the highest of the four sets of results for each NSL and wind speed, and
- To compare the resulting table against the criteria.

Full details of this methodology are presented in Appendix 12-2.

The overall sound power levels for each of the four scenarios are presented in

Table 12-8. In accordance with the IOA GPG, sound power levels referred to wind speeds at standardised 10 m height.

*Table 12-8 Sound Power Level for Scenario 1, Scenario 2, Scenario 3 and Scenario 4*

| Wind Speed (m/s) | Sound Power Level dB $L_{WA}$ | | | |
|---|---|---|---|---|
| | Scenario 1: N163 at 103.5 m HH | Scenario 2: V162 at 104 m HH | Scenario 3: GE158 at 101 m HH | Scenario 4: N149 at 103.5 m HH |
| 3 | 95.0 | 94.2 | 94.0 | 94.0 |
| 4 | 96.5 | 95.8 | 96.8 | 95.2 |
| 5 | 101.0 | 99.8 | 101.5 | 99.6 |
| 6 | 105.4 | 103.4 | 105.3 | 104.0 |
| 7 | 106.5 | 104.3 | 107.0 | 105.5 |
| 8 | 106.6 | 104.3 | 107.0 | 105.6 |
| 9 | 106.6 | 104.3 | 107.0 | 105.6 |

The wind turbine eventually selected for installation on the Proposed Wind Farm 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.

The turbine sound power levels outlined in

Table 12-8 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.

The environmental noise criteria are expressed 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.

#### 12.3.5.2.3 *Modelling Calculation Parameters*

Prediction calculations for turbine noise have been conducted in accordance with ISO 9613: *Acoustics – Attenuation of sound outdoors, Part 2: General method of calculation*, 2024. Comprehensive details of noise prediction calculation settings are included Appendix 12-6.

### 12.3.5.3 Assessment of Turbine Noise Levels

The predicted cumulative turbine noise levels will be compared against the derived turbine noise criteria set out in Section 12.7.2, and any exceedances of the limits will be identified and assessed. Where necessary, appropriate mitigation measures will be discussed.

## 12.4 Receiving Environment

This stage of the assessment was to determine typical background noise levels at representative NSLs surrounding the Proposed Wind Farm site. The background noise survey was conducted through installing unattended sound level meters at six locations in the surrounding area as presented in Section 12.3.4 above.

Noise sensitive locations (NSL)s were identified within the surrounding area of the Proposed Wind Farm site; there are 349 no. NSLs identified for assessment. The nearest NSL involved in the proposed development is located approximately 543 m to the nearest proposed turbine location (i.e. Location H031 from proposed turbine T03).

### 12.4.1 Background Noise Levels

Appendix 12.4 presents the details of the background noise surveys.

Table 12-9 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 12-9 Derived Background Noise Levels of $L_{A90,10min}$ for Various Wind Speeds, based on a hub height of 104 m*

| Location | Period | Derived $L_{A90,10\,min}$ Levels (dB) at various Standardised 10m Height Wind Speed (m/s) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| NSL - A (H032) | Day | 24.2 | 24.8 | 26.3 | 28.7 | 31.5 | 34.8 | 38.1 |
| | Night | 17.1 | 17.4 | 19.2 | 22.2 | 26.1 | 30.6 | 35.5 |
| NSL - B (H020) | Day | 22.8 | 23.7 | 25.5 | 27.9 | 30.8 | 34.1 | 37.4 |
| | Night | 17.4 | 17.8 | 19.8 | 22.9 | 26.9 | 31.5 | 36.5 |
| NSL - C (H001) | Day | 22.2 | 23.4 | 25.6 | 28.5 | 31.9 | 35.7 | 39.6 |
| | Night | 18.1 | 18.7 | 20.8 | 23.9 | 27.9 | 32.4 | 37.3 |
| NSL - D (H310) | Day | 35.3 | 35.2 | 35.5 | 36.2 | 37.2 | 38.6 | 40.3 |
| | Night | 33.0 | 33.2 | 33.8 | 34.8 | 36.1 | 37.8 | 39.8 |
| NSL - E (H054) | Day | 33.3 | 33.2 | 33.7 | 34.5 | 35.7 | 37.3 | 39.2 |
| | Night | 30.6 | 30.6 | 31.1 | 32.1 | 33.5 | 35.4 | 37.8 |



The background noise data is utilised to establish suitable noise criteria curves for each of the NSLs where measurements were undertaken. For all other locations, in the absence of specific background noise measured a background noise envelope based on the lowest levels derived from the various survey locations has been employed for the purpose of this assessment. This is a conservative approach to the assessment and is applied separately for daytime and night-time periods. The actual wind turbine noise limits for a given NSL shall be defined relative to the background noise levels at each NSL as discussed in detail in Section 12.4.2 in accordance with the Guidelines (DoEHLG, 2006).

## 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 Wind Farm. The criteria curves have been derived following a detailed review of the background noise data conducted at the nearest NSLs.

This set of criteria adopted is in line with the intent of the applicable Irish guidelines for wind turbine noise and is comparable to noise planning conditions applied to similar sites previously granted planning permission by ACP and local planning authorities in Ireland. For the Proposed Wind Farm, 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)' 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 Guidelines (DoEHLG, 2006) limits. 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.

- A lower threshold of 40 or 43 dB is commonly adopted in planning conditions for similar wind energy developments that have been granted planning permission by An Coimisiún Pleanála (ACP) and local planning authorities in recent years for example Derrinlough Wind Farm (ACP Ref: 306706-20), Derryadd Wind Farm (ACP Ref: PL14.303592[3]), Coole Wind Farm (ACP Ref: PL25M.300686) Cloncreen Wind Farm (ACP Ref: PA0047), Meenbog Wind Farm (ACP Ref: PL05E.300460), Borrisbeg Wind Farm (ABP-318704-23) and Ballivor Wind Farm (ABP-316212-23).
- The Guidelines (DoEHLG, 2006) state that "*An appropriate balance must be achieved between power generation and noise impact.*" Based on a review of other national guidance in relation to acceptable noise levels in areas of low background noise it is considered that the criteria adopted as part of this assessment are robust.

Based on the guidance listed above, the proposed operational limits in $L_{A90,10min}$ for the Proposed Project are:

- 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, D, and E 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 12-10 outlines the derived noise criteria curves which are based on the background noise levels derived and presented in Table 12-9. With reference to Appendix 12-2 the sound power levels of the of the candidate turbines considered reach their maximum sound power levels at 8 m/s in the case of Scenario 1 at 7 m/s in the case of Scenarios 2, 3 and 4. Therefore, it is sufficient to consider wind speed up to 8 m/s for this assessment, in line with the best with practice guidance.

*Table 12-10 Noise Criteria Curves*

| Location | Period | Derived $L_{A90, 10\ min}$ Levels (dB) at various Standardised 10m Height Wind Speed (m/s) | | | | | |
|---|---|---|---|---|---|---|---|
| | | 3 | 4 | 5 | 6 | 7 | ≥8 |
| NML - A (H032) | Day | 40 | 40 | 40 | 40 | 45 | 45 |
| | Night | 43 | 43 | 43 | 43 | 43 | 43 |
| NML - B (H020) | Day | 40 | 40 | 40 | 40 | 45 | 45 |
| | Night | 43 | 43 | 43 | 43 | 43 | 43 |
| | Day | 40 | 40 | 40 | 40 | 45 | 45 |

[3] *Derryadd decision subsequently quashed*

| Location | Period | Derived $L_{A90,\ 10\ min}$ Levels (dB) at various Standardised 10m Height Wind Speed (m/s) | | | | | |
|---|---|---|---|---|---|---|---|
| | | 3 | 4 | 5 | 6 | 7 | >8 |
| NML - C (H001) | Night | 43 | 43 | 43 | 43 | 43 | 43 |
| NML - D (H310) | Day | 45 | 45 | 45 | 45 | 45 | 45 |
| | Night | 43 | 43 | 43 | 43 | 43 | 43 |
| NML - E (H054) | Day | 45 | 45 | 45 | 45 | 45 | 45 |
| | Night | 43 | 43 | 43 | 43 | 43 | 43 |



# 12.5 Likely Significant Effects

## 12.5.1 Do-Nothing Effect

If the Proposed Project is not progressed, the existing noise environment will remain unchanged. Traffic noise is currently a noise source in the vicinity of some road networks in the area.

In the absence of the Proposed Project any increases in traffic volumes on the local road network over time would not be expected to result in a significant change to the overall ambient and background noise levels in the receiving environment.

If the Proposed Project were not to proceed, the opportunity to capture part of Galway'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.

Furthermore, as this application includes a Biodiversity Management and Enhancement Plan (Appendix 6-4) to be implemented during the development's operation, the opportunity to enhance the site for biodiversity, at a local scale, would also be lost.

## 12.5.2 Construction Phase Potential Impacts

The noise levels referred to in this section are indicative only and are intended to demonstrate that it will be possible for the contractor to comply with current best-practice guidance. The highest predicted noise levels are expected to occur for only short periods of time at a very limited number of properties. Construction noise levels will be lower than these levels for most of the time at the properties in the vicinity of the Proposed Project.

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 12.3.2.1. Noise levels are predicted at the nearest NSL to each element of the works and compared against the construction noise thresholds.

In general, the distances between the construction activities associated with the Proposed Project and the nearest NSLs are such that there will be no significant noise or vibration impacts at 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 are considered unlikely to have any significant noise and vibration impacts.

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 component 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.

In this section the Proposed Project is considered in two parts: the Proposed Wind Farm and Proposed Grid Connection. Please see Chapter 4 for a description of these elements.

## 12.5.2.1 Proposed Wind Farm

### 12.5.2.1.1 *Turbines and Hardstanding*

Turbine foundation works are anticipated at a significant distance from the closest NSL, with the nearest NSL being H031 at a distance of 543m from proposed turbine T03. 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 highly conservative scenario and construction noise levels will be lower at properties located further from the works.

Table 12-11 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. 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*

| Item (BS 5228 Ref.) | Activity/ Notes | Plant Noise Level at 10m Distance (dB $L_{Aeq,T}$) [4] | Predicted Noise Level at 542 m | Predicted Noise Level at 713 m |
|---|---|---|---|---|
| HGV Movement (C.2.30) | Removing soil and transporting fill and other materials. | 79 | 32 | 29 |
| Tracked Excavator (C.4.64) | Removing soil and rubble in preparation for foundation. | 77 | 30 | 27 |

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

| Item (BS 5228 Ref.) | Activity/ Notes | Plant Noise Level at 10m Distance (dB $L_{Aeq,T}$) [4] | Predicted Noise Level at 542 m | Predicted Noise Level at 713 m |
|---|---|---|---|---|
| Excavator Mounted Rock Breaker (C9.12) | Excavation in rocky areas | 85 | 38 | 35 |
| Piling Operations (C.12.14) | Drilling cores for the installation of concrete piles | 88 | 41 | 38 |
| General Construction (Various) | All general activities plus deliveries of materials and plant. | 84 | 37 | 34 |
| Concrete Mixer Truck and Concrete Pump (C.4.27) | Turbine Foundations | 75 | 28 | 25 |
| Dumper Truck (C.4.39) | Backfilling Turbine Foundations | 76 | 29 | 26 |
| Mobile Telescopic Crane (C.4.39) | Turbine Erection | 77 | 30 | 27 |
| Dewatering Pumps (D.7.70) | If required. | 80 | 33 | 30 |
| JCB (D.8.13) | For services, drainage and landscaping. | 82 | 35 | 31 |
| Vibrating Rollers (D.8.29) | Road surfacing. | 77 | 30 | 27 |
| **Total Construction Noise Level** | | | **45** | **42** |

At the nearest NSL (H031) the predicted noise levels from construction activities are in the range of 28 to 35 dB $L_{Aeq,T}$ with a total cumulative construction level of the order of 45 dB $L_{Aeq,T}$.

At the nearest non-involved NSL (H349) the predicted noise levels from construction activities are in the range of 25 to 38 dB $L_{Aeq,T}$ with a total cumulative construction level of the order of 42 dB $L_{Aeq,T}$.

The predicted noise levels at the nearest NSLs are below the adopted significance threshold outlined in Table 12-1 (Category A – 65 dB $L_{Aeq,T}$ during daytime periods). This assessment is considered representative of highly conservative construction noise levels at NSLs.

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

#### Description of Effects

The likely predicted noise and vibration impacts are below the limits and/or thresholds identified. With respect to the EPA, 2022 criteria for description of effects, the likely potential associated effects at the nearest NSLs associated with construction of the proposed turbines and associated hardstanding areas are as described below:

| *Quality* | *Significance* | *Duration* |
|---|---|---|
| Negative | Slight | Short-term |

### 12.5.2.1.2 Onsite 38kV Substation

It is proposed to construction an onsite 38kV substation at ITM coordinates E559550, N729946. The nearest NSL is H041 at a distance of 180m. Assuming that the same construction plant items are uses as shown in Table 12-11, except for piling, which is not applicable to the substation construction, the predicted noise level at H041 is 56 dB $L_{Aeq,T}$, which is below the adopted significance threshold outlined in Table 12-1 above (Category A – 65 dB $L_{Aeq,T}$ during daytime periods). Again, this finding is valid should all items of plant operate simultaneously. No specific mitigation measures are required.

#### Description of Effects

The likely predicted noise and vibration impacts are below the limits and/or thresholds identified. With respect to the EPA, 2022 criteria for description of effects, the likely potential associated effects at the nearest NSLs associated with the proposed onsite 38kV substation are as described below:

| *Quality* | *Significance* | *Duration* |
|---|---|---|
| Negative | Moderate | Temporary |

### 12.5.2.1.3 Met Mast

It is proposed to construct a meteorological mast at ITM coordinates E561635, N730029. The nearest NSL is H018 at a distance if 428m. Assuming that the same construction plant items are used as shown in Table 12-11, the predicted noise level at H018 is 46 dB $L_{Aeq,T}$, which is below the adopted significance threshold outlined in Table 12-1 above (Category A – 65 dB $L_{Aeq,T}$ during daytime periods). Again, this finding is valid should all items of plant operate simultaneously. No specific mitigation measures are required.

Description of Effects

The likely predicted noise and vibration impacts are below the limits and/or thresholds identified. With respect to the EPA, 2022 criteria for description of effects, the likely potential associated effects at the nearest NSLs associated with construction of the proposed met mast are as described below.

| *Quality* | *Significance* | *Duration* |
|---|---|---|
| Negative | Slight | Temporary |

### 12.5.2.1.4 Proposed Access Roads and Existing Road Upgrades

It is proposed to upgrade existing internal roads and also to construct new internal roads within the Proposed Wind Farm site as part of the Proposed Wind Farm. Review of the road layout has identified that the nearest NSL to any point along the proposed roads is approximately 46 m to H039. All other locations are at greater distances with the majority at significantly greater distances. The full description of proposed new roads and the upgrade to existing roads is outlined in Chapter 4 of the EIAR.

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 and propagation over mixed ground.

*Table 12-11 Typical Construction Noise Emission Levels – Internal Roads*

| Item (BS 5228 Ref.) | Plant Noise Level at 10m Distance (dB $L_{Aeq,T}$) [5] | Highest Predicted Noise Level at Stated Distance from Edge of Works (dB $L_{Aeq,T}$) | | | |
|---|---|---|---|---|---|
| | | 46 m | 60 m | 100 m | 150 m |
| HGV Movement (C.2.30) | 79 | 62 | 59 | 55 | 51 |
| Tracked Excavator (C.4.64) | 77 | 64 | 61 | 57 | 53 |
| Dumper Truck (C.4.39) | 76 | 61 | 58 | 54 | 50 |
| Excavator Mounted Rock Breaker (C9.12) | 83 | 70 | 67 | 63 | 59 |
| Vibrating Rollers (D.8.29) | 77 | 62 | 59 | 55 | 51 |
| **Total Construction Noise (cumulative for all activities)** | | 72 | 69 | 65 | 61 |

At the nearest noise sensitive location from the proposed site entrance, namely H039, H040 and H041 at a distance of approximately 46m, 62m and 66m, the predicted noise levels from construction activities are of the order of 72 dB $L_{Aeq,T}$. As shown in Table 12-12, at distances greater than 100m,

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

predicted noise levels from construction activities are 65 dB $L_{Aeq,T}$ or less, which is below the significance threshold of 65 dB $L_{Aeq,1hr}$.

Therefore, there is the potential for a significant noise impact at H039, H040 and H041, during the period while construction works are at the proposed site entrance and the initial section the proposed internal roads. Taking into account that this section of the works will last only 5 days, after which the works are at greater distance and therefore the construction noise levels at H039, H040 and H041 will be lower; with reference to the time periods in Section 12.3.2.1.3, it is not considered that a significant noise effect is associated with the construction of this element of the proposed works.

Note that the noise effects of construction traffic throughout the construction phase are assessed in Section 12.5.2.4 below.



#### Description of Effects

The likely predicted noise and vibration impacts are below the limits and/or thresholds identified. With respect to the EPA, 2022 criteria for description of effects, the likely potential associated effects at the nearest NSLs associated with the construction of the proposed roads within the Proposed Wind Farm site are as described below.

| *Quality* | *Significance* | *Duration* |
|---|---|---|
| Negative | Slight to Moderate | Brief to Temporary |

### 12.5.2.1.5 Temporary Construction Compounds

As part of the Proposed Wind Farm there will be 2 no. temporary construction compounds. These compounds are located:

- Adjacent to the proposed onsite 38kV substation, at a distance of 200 m from H041; and
- At the proposed met mast location at a distance of 387 m from H018.

As a highly conservative example assuming the same construction activities as for the proposed access roads, outlined in 12.5.2.1.4, it is predicted that the potential noise levels from construction activities associated with the temporary construction compounds will be:

- 59 dB $L_{Aeq,T}$ at H041
- 53 dB $L_{Aeq,T}$ at H018

These levels of noise are within the construction noise criterion outlined in Table 12-1, (Category A – 65 dB $L_{Aeq,T}$ during daytime periods) therefore it is concluded that there will be no significant noise impact associated with the construction of the temporary construction compounds, therefore no specific mitigation measures are required.

### Description of Effects

The likely predicted noise and vibration impacts are below the limits and/or thresholds identified. With respect to the EPA, 2022 criteria for description of effects, the likely potential associated effects at the nearest NSLs associated with the 2 no. temporary construction compounds are as described below:

| *Quality* | *Significance* | *Duration* |
|---|---|---|
| Negative | Not significant | Temporary |

#### 12.5.2.1.6 Peat and Spoil Management Areas

Areas of peat and spoil management are also proposed as part of the Proposed Wind Farm. The nearest NSL to any of the proposed peat and spoil management areas is H021 at a distance of 330m from the peat and spoil management area located south of the road between T03 and T04. The construction machinery to be used in these areas presented in Table 12-13.

*Table 12-12 Typical Construction Noise Emission Levels – Peat and Spoil Management Areas*

| Item (BS 5228 Ref.) | Plant Noise Level at 10m Distance (dB $L_{Aeq,T}$) [6] | Predicted Noise Level at 330 m |
|---|---|---|
| Tracked Excavator (C.4.64) | 77 | 45 |
| Dumper Truck (C.4.39) | 76 | 44 |
| **Total Construction Noise (cumulative for all activities)** | | **48** |

These levels of noise are within the construction noise criterion outlined in Table 12-1, (Category A – 65 dB $L_{Aeq,T}$ during daytime periods) therefore it is concluded that there will be no significant noise impact associated with the peat and spoil management areas, therefore no specific mitigation measures are required.

### Description of Effects

The likely predicted noise and vibration impacts are below the limits and/or thresholds identified. With respect to the EPA, 2022 criteria for description of effects, the likely potential associated effects at the nearest NSLs associated with the proposed peat and spoil management areas are described are as described below:

| *Quality* | *Significance* | *Duration* |
|---|---|---|
| Negative | Not significant | Short-term |

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

## 12.5.2.1.7 Biodiversity Enhancement Areas and Tree Felling

### Enhancement

Areas within the Proposed Wind Farm site for biodiversity enhancement are proposed, as described in Section 4.3.1.7 of Chapter 4. The closest NSL to a proposed enhancement area (not including native woodland replanting) is H001 at a distance of 200 m from the proposed enhancement area east of T08 (Block J – please see Figure 3-1 in Appendix 6-4 for details). The closest NSL to a proposed native woodland replanting area is H018 at a distance of 66 m from the proposed native woodland planting area north of the met mast (Block P – please see Figure 3-1 in Appendix 6-4 for details). In terms of noise sources, there will be limited use of a machinery and the noise generated from proposed biodiversity enhancement measures will be similar to normal agricultural activity. It is not considered that this element of the works will result in a significant noise effect at any NSL. Therefore, no mitigation measures are required.

### Tree Felling

Tree felling will be required within and around the Proposed Wind Farm infrastructure footprint to allow for the construction of the proposed turbines, access roads underground cabling, and the other ancillary infrastructure. The nearest NSL to any of the proposed coniferous felling areas is H018 at a distance of 250m from the felling area located to the north of T04.

The construction machinery to be used in these areas presented in Table 12-14.

*Table 12-13 Typical Construction Noise Emission Levels – Tree Felling*

| Item (BS 5228 Ref.) | Plant Noise Level at 10m Distance (dB $L_{Aeq,T}$) [7] | Predicted Noise Level at 250 m |
|---|---|---|
| HGV Movement (C.2.30) | 79 | 49 |
| Petrol-driven chain saw (D.2.14) | 86 | 56 |
| Tracked Excavator (C.4.64) | 77 | 47 |
| **Total Construction Noise (cumulative for all activities)** | | **57** |

These levels of noise are within the construction noise criterion outlined in Table 12-1, (Category A – 65 dB $L_{Aeq,T}$ during daytime periods) therefore it is concluded that there will be no significant noise impact associated with the peat and spoil management areas, therefore no specific mitigation measures are required.

### Description of Effects

The likely predicted noise and vibration impacts are below the limits and/or thresholds identified. With respect to the EPA, 2022 criteria for description of effects, the likely potential associated effects at the nearest NSLs associated with proposed tree felling, are as described below:

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

| *Quality* | *Significance* | *Duration* |
|---|---|---|
| Negative | Moderate | Short-term |



## 12.5.2.2 Proposed Grid Connection

### 12.5.2.2.1 *Underground Electrical (38kV) Cabling*

Underground 38kV cabling between the proposed 38kV onsite substation and the existing Cashla 220kV substation at Barrettspark, County Galway will be necessary to export the electricity generated by the Proposed Wind Farm. Details of the proposed underground 38kV electrical cabling route are presented in Section 4.3.2 of Chapter 4.

The associated construction works will occur for short durations (rolling construction method, approximately 100 – 150 m per day) at varying distances from NSLs. As the Proposed Grid Connection is approximately 21.8km in length, it will take an estimated 218 days to construct the full length of the route. Review of the Proposed Grid Connection has identified that the nearest NSLs to the proposed underground cabling route, are at distances of the order of 10 to 30m.

As described, construction activity will vary and will not be continuous in nature. The assessment sets out that the various activities that will contribute noise levels that, over a standard workday will be above the significance criteria, the noise levels are not predicted to exceed these criteria continuously.

*Table 12-14 Indicative noise calculations for construction – Underground Electrical (38kV) Cabling*

| Plant Item (BS 5228 Ref.) | Plant Noise Level at 10m Distance (dB $L_{Aeq,12hr}$) | Calculated Construction Noise Levels dB $L_{Aeq,12hr}$ at reference distance from works | | | |
|---|---|---|---|---|---|
| | | 10 m | 20 m | 30 m | 40 m |
| Mini Tracked Excavator with Rock Breaker (C5.2) | 83 | 81 | 75 | 69 | 66 |
| Dumper Truck (C.4.4) | 76 | 74 | 68 | 62 | 59 |
| Wheeled Loader Lorry (C.2.28) | 76 | 74 | 68 | 62 | 59 |
| HGV Movement (C.2.30) | 79 | 77 | 71 | 65 | 62 |
| Vibrating Rollers (D.8.29) | 77 | 75 | 69 | 63 | 60 |
| **Total Construction Noise (cumulative for all activities)** | | **84** | **78** | **72** | **69** |

It is important to note that the works for the construction of the Proposed Grid Connection will progress along the Proposed Grid Connection in 100 – 150 m sections per day. Works will therefore be in proximity to the closest NSLs for limited amount of time, i.e. less than one day.

The predicted construction phase noise levels at the closest NSLs, at distances of 40m and greater from works, are within the construction noise criterion of 70 dB $L_{Aeq,12hr}$ set out in Section 12.3.2.1.1. At shorter distances this criterion is exceeded; this would indicate a potential significant effect, however, taking into account that the Proposed Grid Connection underground electrical cabling works will be undertaken in a rolling construction method with 100 – 150 m of road constructed and back filled each day, the works will by close to any individual NSL for less than one day, after which the works are at greater distance from the NSL and therefore construction noise levels will be lower. With reference to the time periods in Section 12.3.2.1.3, it is not considered that a significant noise effect is associated with the construction of this element of the proposed works.

### Description of Effects

With respect to the EPA, 2022 guidance for description of effects as referenced in Section 12.3.2.1.1, the potential noise construction effect at the nearest NSL associated with the construction of the Proposed Grid Connection underground electrical cabling route are as described below.

| *Quality* | *Significance* | *Duration* |
|---|---|---|
| Negative | Moderate | Brief |

### Existing Road Upgrade at Carnaun, Co. Galway

In order to facilitate the construction of the Proposed Grid Connection, it is proposed to upgrade approximately 0.6km of private road in the townland on Carnaun, County Galway as shown in Figure 12-3 below.

*Figure 12-3 Proposed upgrade to existing private road at Carnaun, County Galway*


There is 1 no. NSL near the southwest end of this section of private road, at a distance of 10m from the edge of the road upgrade works.

Table 12-16 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 12-15 Typical Construction Noise Levels – Carnaun Road Upgrade*

| 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 $L_{Aeq,T}$) | | | | |
|---|---|---|---|---|---|---|
| | | 15 m | 25 m | 35 m | 45 m | 55 m |
| HGV Movement (C.2.30) | 79 | 71 | 63 | 59 | 57 | 54 |
| Tracked Excavator (C.4.64) | 77 | 73 | 65 | 61 | 59 | 56 |
| Dumper Truck (C.4.39) | 76 | 70 | 62 | 58 | 56 | 53 |

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

| | | | | | | |
|---|---|---|---|---|---|---|
| Vibrating Rollers (D.8.29) | 77 | 71 | 63 | 59 | 57 | 54 |
| **Total Construction Noise (cumulative for all activities)** | | 77 | 69 | 65 | 63 | 60 |



The values in Table 12-16 show that when proposed road works are within 35m of a NSL, a potential significant construction noise impact is indicated. Taking into account that the works at these distances with only require approximately 1 day after which they are at greater distance and therefore the construction noise levels at the NSL will be lower, with reference to the time periods in Section 12.3.2.1.3, it is not considered that a significant noise effect is associated with the construction of this element of the proposed works.

### Description of Effects

The likely predicted noise and vibration impacts are below the limits and/or thresholds identified. With respect to the EPA, 2022 criteria for description of effects, the likely potential associated effects at the nearest NSLs associated with the construction of the proposed upgrade of approximately 0.6km of existing private road in Carnaun, County Galway are as described below:

| *Quality* | *Significance* | *Duration* |
|---|---|---|
| Negative | Moderate | Brief to Temporary |

### Existing Road Upgrade and Construction of New road at Caherbriskaun, Co. Galway

Similarly, it is proposed to upgrade approximately 1km of existing private road and construct approximately 0.5km of new road in Caherbriskaun, County Galway, as shown in Figure 12-4 below. The nearest NSL is at a distance of the order of 60 m, to the south of the edge of the works.

Based on the predicted noise levels in Table 12-16, the predicted noise levels at the nearest NSLs are below the adopted significance threshold outlined in Table 12-1 (Category A – 65 dB $L_{Aeq,T}$ during daytime periods).

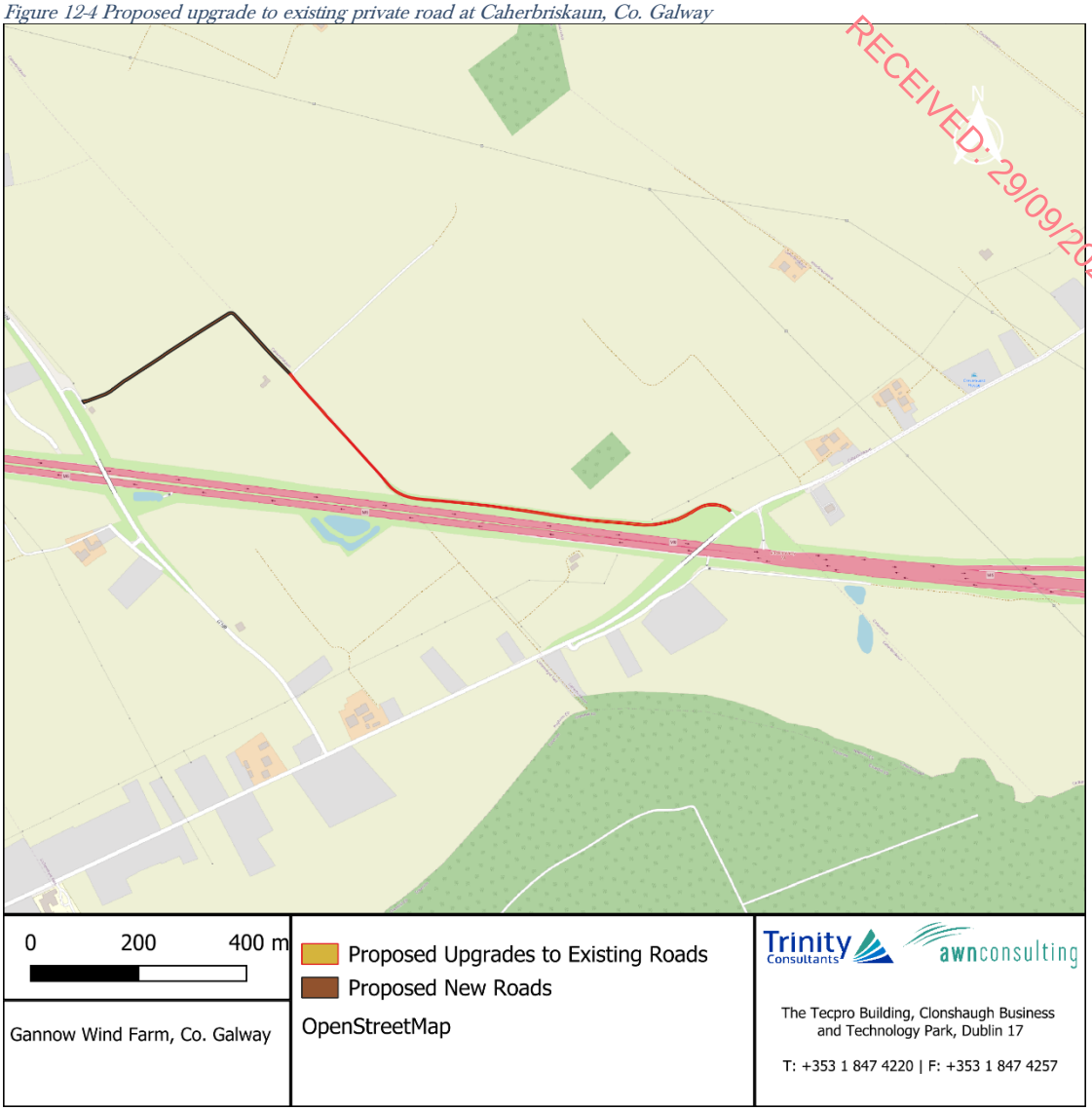
In the context of ambient noise from the existing motorway and the duration of these works of 5 days, it is not considered this element of the works will lead to a significant construction noise effect

### Description of Effects

The likely predicted noise and vibration impacts are below the limits and/or thresholds identified. With respect to the EPA, 2022 criteria for description of effects, the likely potential associated effects at the nearest NSLs associated with construction of the proposed upgrade to existing private road and construction of proposed new road at Caherbriskaun, Co. Galway are described are as described below:

| *Quality* | *Significance* | *Duration* |
|---|---|---|
| Negative | Moderate | Brief to Temporary |

*Figure 12-4 Proposed upgrade to existing private road at Caherbriskaun, Co. Galway*




### 12.5.2.3 Vibration

Given the distances from NSLs to the elements of construction works discussed in previous sections, (i.e. turbines, on-site substation, met mast, access roads, construction compounds, peat and spoil management, biodiversity enhancement, tree felling, and the underground cabling) no significant vibration effects are likely.

#### Description of Effects

With respect to the EPA, 2022 guidance for description of effects and the criteria in Section 12.3.2.1.4, the potential construction vibration effects are as described below.

| *Quality* | *Significance* | *Duration* |
|---|---|---|
| Negative | Not significant | Short-term |

### 12.5.2.4 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 – Traffic and Transportation has been used to inform the assessment here. The following situations are commented upon here:

- Stage 1: General Construction
- Stage 2: Turbine Delivery – Standard HGVs
- Stage 3: Concrete Foundation Delivery
- Stage 4: Turbine Delivery – Abnormal Loads
- Stage 5: Grid Connection Construction

Changes in the traffic noise levels associated with the additional traffic for each of the construction stages listed above have been calculated for several routes.

*Table 12-16* presents a summary of the data used for the calculations in this assessment. The traffic figures have been derived from the traffic data in Chapter 15 with conversions applied for the passenger car unit (PCU) factors.

*Table 12-16 Assumptions for Construction Traffic Noise Assessment*

| Route | Stage | LGV | HGV |
|---|---|---|---|
| 1 - R348 - between M6 and Baunmore Roundabout | Existing | 9,947 | 415 |
| | Existing + 1 | 10,017 | 541 |
| | Existing + 2 | 9,992 | 423 |
| | Existing + 3 | 10,017 | 629 |
| | Existing + 4 | 9,992 | 421 |
| | Existing + 5 | 9,963 | 423 |
| 2 - R347 - north of Baunmore Roundabout | Existing | 8,619 | 322 |
| | Existing + 1 | 8,689 | 448 |
| | Existing + 2 | 8,664 | 330 |
| | Existing + 3 | 8,689 | 536 |
| | Existing + 4 | 8,664 | 328 |
| | Existing + 5 | 8,635 | 331 |
| 3 - R348 - south of Baunmore Roundabout | Existing | 6,393 | 280 |
| | Existing + 1 | 6,463 | 407 |

| | | | |
|---|---|---|---|
| | Existing + 2 | 6,438 | 288 |
| | Existing + 3 | 6,463 | 495 |
| | Existing + 4 | 6,438 | 286 |
| | Existing + 5 | 6,409 | 289 |
| 4 - R348 - north of Kiltullagh | Existing | 2,566 | 93 |
| | Existing + 1 | 2,636 | 219 |
| | Existing + 2 | 2,611 | 101 |
| | Existing + 3 | 2,636 | 307 |
| | Existing + 4 | 2,611 | 99 |
| | Existing + 5 | 2,582 | 102 |
| 5 - L3115 - leading to site | Existing | 2,079 | 55 |
| | Existing + 1 | 2,149 | 182 |
| | Existing + 2 | 2,124 | 63 |
| | Existing + 3 | 2,149 | 270 |
| | Existing + 4 | 2,124 | 61 |
| | Existing + 5 | 2,095 | 64 |
| 6 - R348 - east of Kiltullagh | Existing | 1,214 | 50 |
| | Existing + 1 | 1,284 | 177 |
| | Existing + 2 | 1,259 | 58 |
| | Existing + 3 | 1,284 | 265 |
| | Existing + 4 | 1,259 | 56 |
| | Existing + 5 | 1,230 | 59 |

*Based on the assumptions presented above changes in noise level based on the existing flows have been estimated and is presented in*

Table 12-17.

*Table 12-17 Estimated Changes in Traffic Noise Levels*

| Route | Stage | Change in Traffic Noise Level dB(A) | Potential Significance of Effect |
|---|---|---|---|
| 1 - R348 - between M6 and Baunmore Roundabout | 1 | +0.9 | Imperceptible |
| | 2 | +0.1 | Imperceptible |
| | 3 | +1.4 | Not Significant |
| | 4 | +0.1 | Imperceptible |
| | 5 | +0.1 | Imperceptible |
| 2 - R347 - north of Baunmore Roundabout | 1 | +1.1 | Not Significant |
| | 2 | +0.1 | Imperceptible |
| | 3 | +1.7 | Not Significant |
| | 4 | +0.1 | Imperceptible |
| | 5 | +0.1 | Imperceptible |
| 3 - R348 - south of Baunmore Roundabout | 1 | +1.3 | Not Significant |
| | 2 | +0.1 | Imperceptible |
| | 3 | +1.9 | Not Significant |
| | 4 | +0.1 | Imperceptible |
| | 5 | +0.1 | Imperceptible |
| 4 - R348 - north of Kiltullagh | 1 | +2.9 | Not Significant |
| | 2 | +0.3 | Imperceptible |
| | 3 | +4.2 | Slight/Moderate |
| | 4 | +0.2 | Imperceptible |
| | 5 | +0.3 | Imperceptible |
| | 1 | +3.9 | Slight/Moderate |
| | 2 | +0.4 | Imperceptible |

| | | | |
|---|---|---|---|
| 5 - L3115 - leading to site | 3 | +5.4 | Significant |
| | 4 | +0.3 | Imperceptible |
| | 5 | +0.4 | Imperceptible |
| 6 - R348 - east of Kiltullagh | 1 | +4.5 | Slight/Moderate |
| | 2 | +1.4 | Not Significant |
| | 3 | +6.1 | Significant |
| | 4 | +0.4 | Imperceptible |
| | 5 | +0.5 | Imperceptible |

The increase in noise levels due to additional construction traffic on each of the routes is predicted to be less than 2 dB or less the majority of routes and stages. The following comments are made on a number of routes where the predicted change is higher than 2 dB:

During Stage 1, the predicted changes in noise levels at road links 4, 5 and 6 are in the range +2.9 to +4.5 dB $L_{Aeq,1hr}$. However, the predicted noise levels of existing and construction traffic are in the range 62 to 63 dB, $L_{Aeq,1hr}$.

During Stage 3, the predicted changes in noise levels at road links 4, 5 and 6 are in the range +4.2 to +6.1 dB $L_{Aeq,1hr}$. However, the predicted noise levels of existing and construction traffic are in the range 63 to 64 dB $L_{Aeq,1hr}$.

These predicted noise levels are within the Construction Noise Threshold of 65 dB $L_{Aeq,1hr}$ presented in Section 12.3.2.1.1 and therefore the noise effect of construction traffic is considered not significant.

#### 12.5.2.4.1 Description of Effects

With respect to the EPA criteria for description of effects, the potential effects at the NSL associated with the additional traffic generated during the construction phase are as described below.

| *Quality* | *Significance* | *Duration* |
|---|---|---|
| Negative | Not significant | Short-term |

## 12.5.3 Operational Phase Potential Impacts

This section presents an assessment of the elements of the Proposed Project 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 noise sensitive receivers identified for assessment, i.e out to 3km from the proposed turbines, which as discussed in Appendix 12-3, is sufficient to cover the noise study area.

As discussed in Section 12.3.5.2.2, the predicted noise levels for the four candidate turbines and associated scenarios have been predicted and for each NSL and windspeed the highest predicted levels among the scenarios are used in the assessment against wind turbine noise criteria.

The levels are conservative in that omni-directional noise propagation has been assumed, in which each NSL is downwind of all turbines at the same time, which will not always be the case.

The predicted noise levels at various wind speeds have been compared against the noise criteria curves outlined in Table 12-10 and are below the day and night-time criteria in all cases. Predicted noise levels are presented in Appendix 12-7.

At rated power wind speed, that is, where the highest noise emissions are reached, Scenario 1 Nordex N163 has the highest predicted noise levels. A noise contour for Scenario 1 at 9 m/s is presented in Appendix 12-8.

#### 12.5.3.1.1 Description of Effects

It is considered that no significant effect is associated with the operation of the Proposed Wind Farm, since the predicted noise levels associated with the Proposed Wind Farm will be within the relevant best practice noise criteria curves for wind farms according to current guidelines

A new source of noise will be introduced to the receiving environment. While ambient noise levels will increase by varying degrees, depending on receptor location, and turbine operating conditions typically dictated by the wind speed, the predicted noise levels are within criteria.

With respect to the EPA criteria for description of effects, the potential effects at the nearest NSLs associated with the operation of the proposed turbines are described below.

| *Quality* | *Significance* | *Duration* |
|---|---|---|
| Negative | Not significant | Long-term |

### 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.

### 12.5.3.3 Onsite 38kV Substation

As previously stated, the proposed onsite 38kV substation is located approximately 200 m from H041, at the coordinates E559550, N729946.

The proposed onsite 38kV substation will be operational on a '24/7' basis and the noise impact at the nearest NSL has been assessed to identify the potential greatest impact associated with the operation of the proposed onsite 38kV substation.

The noise emission level associated with a typical substation that would support a development of this nature is the order of 92 dB(A) $L_W$. Noise prediction calculations for the operation of the 38kV substation have been undertaken in accordance with ISO 9613:2024. The predicted noise level from the operation of the substation at the nearest NSL, H041, is 35 dB $L_{Aeq,T}$. This level of noise is considered low and is within the criterion stated in Section 12.3.2.2.5. It is concluded that there will be no significant noise emissions from the operation of the substation at any NSL. At the detailed design stage

plant will be selected to ensure that there are no tonal or impulsive characteristics from the plant audible at any NSL.

It is therefore concluded that noise emissions from the operation of the proposed onsite 38kV substation will be negligible as the noise from the proposed onsite 38kV substation will not be significant at the nearest NSL.



#### 12.5.3.3.1 Description of Effects

With respect to the EPA, 2022 criteria for description of effects, the potential effects at the nearest NSLs associated with the operation of the proposed substation is described below.

| *Quality* | *Significance* | *Duration* |
|---|---|---|
| Negative | Not significant | Long-term |

## 12.5.4 Decommissioning Phase

In relation to the decommissioning phase, similar overall noise levels as those calculated for the construction phase of the Proposed Wind Farm would arise, as similar tools and equipment will be used. It is not intended to decommission the proposed onsite 38kV substation or the Proposed Grid Connection. Considering that in all aspects of the construction phase, the predicted noise levels are expected to be below the appropriate criteria at all NSLs, it can be concluded that for the decommissioning phase, the impact is not significant and therefore 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) that has been prepared for the Proposed Project and is included as Appendix 4-5 to the EIAR.

# 12.6 Mitigation Measures

## 12.6.1 Construction Phase

Regarding construction activities, reference will be made to BS 5228-1:2009+A1:2014 *Code of practice for noise and vibration control on construction and open sites – Noise*, which offers detailed guidance on the control of noise & vibration from demolition and construction activities. It is proposed that various practices be adopted during construction, including:

- limiting the hours, according to the CEMP (Appendix 4-5), 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;
- appointing a site representative responsible for matters relating to noise and vibration;
- monitoring typical levels of noise and vibration during critical periods and at sensitive locations;

Furthermore, a variety of practicable noise control measures will be employed. These include:

- selection of plant with low inherent potential for generation of noise and/ or vibration;
- placing of noisy / vibratory plant as far away from sensitive properties as permitted by site constraints, and;
- regular maintenance and servicing of plant items.

### 12.6.1.1 Construction Phase Mitigation Measures – Noise

While it was concluded above that there will be no significant noise impact associated with the construction of the Proposed Project and that no specific mitigation measures were required, the contract documents will clearly specify that the Contractor undertaking the construction of 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.* The following list of measures will be considered, where necessary, to ensure compliance with the relevant construction noise criteria:

- No plant used on site will be permitted to cause an on-going public nuisance due to noise.
- The best means practicable, including proper maintenance of plant, will be employed to minimise the noise produced by on site operations.
- All vehicles and mechanical plant will be fitted with effective exhaust silencers and maintained in good working order for the duration of the contract.
- Compressors will be attenuated models fitted with properly lined and sealed acoustic covers which will be kept closed whenever the machines are in use and all ancillary pneumatic tools shall be fitted with suitable silencers.
- Machinery that is used intermittently will be shut down or throttled back to a minimum during periods when not in use.
- Any plant, such as generators or pumps, which is required to operate outside of general construction hours will be surrounded by an acoustic enclosure or portable screen as appropriate.
- During the course of the construction programme, supervision of the works will include ensuring compliance with the limits detailed in Table 12-1 using methods outlined in British Standard BS 5228-1:2009+A1:2014 *Code of practice for noise and vibration control on construction and open sites – Noise.*
- 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.

### 12.6.1.2 Construction Phase Mitigation Measures – Vibration

While it was concluded in Section 12.5.2.3 that there will be no significant vibration impacts associated with the construction of the Proposed Project 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%.

## 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.

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 Project. 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 Project, 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 the EPA document entitled *Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities* (NG4) (EPA, 2016). This guidance is based on the threshold values outlined in the Salford University document *Procedure for the assessment of low frequency noise complaints, Revision 1, December 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 Project, the operator will employ a qualified acoustic consultant to 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) (IOA AMWG) or subsequent revisions.

The measurement method outlined in the IOA AMWG document, known as the 'Reference Method', will provide a robust and reliable indicator of AM and yield important 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.

In the absence of widely accepted and robust planning conditions to control amplitude modulation (AM) from wind turbines, the commitments outlined in this EIAR are considered best practice. The proposed approach will ensure that any negative impacts arising from AM associated with the operation of the Proposed Project will be effectively addressed by the operator.

#### 12.6.2.1.2 Monitoring

As discussed above, operational noise surveys will be undertaken to ensure compliance with any noise conditions applied to the Proposed Wind Farm. It is common practice to commence surveys within six months of a wind farm being fully commissioned. If 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* (July 2014) will be followed, and relevant corrective actions taken. 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.*

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 can be repeated to confirm compliance with the noise criteria. Once compliance has been demonstrated, further surveys will not be necessary

As an example of this turbine control capability, Table 12-19 shows the sound power levels for the Nordex N163 turbine for Normal Operation and should be read as augmenting the 'Scenario 1: N163' column in Table 12-8, along with the sound power levels for the various operational modes that can be applied to this turbine. As can be seen at mid to higher wind speeds a reduction in the noise level of the order of 5dB can be achieved dependent on the operational mode set on the specific turbines.



*Table 12-18 Sound Power Levels at Reduced Modes*

| Wind Speed m/s | Sound Power Levels, dB $L_{WA}$ | | | | | |
|---|---|---|---|---|---|---|
| | Mode 0 | Mode 1 | Mode 3 | Mode 5 | Mode 7 | Mode 9 |
| 3 | 95.0 | 95.0 | 95.0 | 95.0 | 95.0 | 95.0 |
| 4 | 96.5 | 96.5 | 96.5 | 96.6 | 96.6 | 96.6 |
| 5 | 101.0 | 101.0 | 101.0 | 101.0 | 101.0 | 100.5 |
| 6 | 105.4 | 105.4 | 104.9 | 104.2 | 103.3 | 101.0 |
| 7 | 106.5 | 106.3 | 105.5 | 104.5 | 103.5 | 101.0 |
| 8 | 106.6 | 106.4 | 105.5 | 104.5 | 103.5 | 101.0 |
| 9 | 106.6 | 106.4 | 105.5 | 104.5 | 103.5 | 101.0 |

All modern turbines have the ability to control their power and noise levels in a similar manner, and the suitability of any turbine for the site will be dependent on whether it can operate in an efficient manner while also remaining within any noise limits that may be conditioned in the event of favourable consideration.

### 12.6.3 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 CEMP (Appendix 4-5) that has been prepared for the Proposed Project.

## 12.7 Description of Residual Effects

### 12.7.1 Construction Phase

During the construction phase of the Proposed Project there will be some short-term effects on nearby NSLs due to noise emissions from site traffic and other construction activities. However, given the distances between the main construction works and nearby NSLs and the fact that the construction phase of the Proposed Project 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 highly conservative associated effects at the nearest noise sensitive locations 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 the turbines, hardstands and met mast are not significant and are summarised as follows:

| Quality | Significance | Duration |
|---|---|---|
| Negative | Slight | Short-term |

#### 12.7.1.2 Onsite 38 kV Substation

The predicted construction noise and vibration effects associated with the onsite 38 kV substation are not significant and are summarised as follows:

| Quality | Significance | Duration |
|---|---|---|
| Negative | Moderate | Short-term |

#### 12.7.1.3 Proposed Access Roads and Existing Road Upgrades

The predicted construction noise and vibration effects associated with the construction of the proposed access road and existing road upgrades, including the proposed new road and existing road upgrades in the townlands of Carnaun and Caherbriskaun, are not significant and are summarised as follows:

| Quality | Significance | Duration |
|---|---|---|
| Negative | Slight to Moderate | Brief to Temporary |

#### 12.7.1.4 Temporary Construction Compounds

The predicted construction noise and vibration effects associated with the construction of the proposed temporary construction compounds are not significant and are summarised as follows:

| Quality | Significance | Duration |
|---|---|---|
| Negative | Slight | Short-term |

#### 12.7.1.5 Peat and Spoil Management Areas

The predicted construction noise and vibration effects associated with the proposed peat and spoil management areas are not significant and are summarised as follows:

| Quality | Significance | Duration |
|---|---|---|
| Negative | Slight | Short-term |

#### 12.7.1.6 Proposed Biodiversity Enhancement and Tree Felling

In terms of noise sources, construction of proposed biodiversity enhancement areas will be limited use of a machinery and the noise generated from proposed biodiversity enhancement measures will be similar to normal agricultural activity. It is not considered that this element of the works will result in a significant noise effect at any NSL.

The predicted construction noise and vibration effects associated with the commercial forestry felling are not significant and are summarised as follows:

| Quality | Significance | Duration |
|---|---|---|
| Negative | Moderate | Short-term |

#### 12.7.1.7 Proposed Grid Connection

##### 12.7.1.7.1 *Underground Electrical (38kV) Cabling*

The predicted construction noise and vibration effects associated with the construction of the Proposed Grid Connection are not significant and are summarised as follows:

| Quality | Significance | Duration |
|---|---|---|
| Negative | Slight to Moderate | Brief to Temporary |

#### 12.7.1.8 Construction Traffic

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

| Quality | Significance | Duration |
|---|---|---|
| Negative | Not significant | Short-term |

#### 12.7.1.9 Vibration

The effects associated with the vibration from construction is not significant and summarised as follows:

| Quality | Significance | Duration |
|---|---|---|
| Negative | Not Significant | Short-term |

### 12.7.2 Operational Phase

#### 12.7.2.1 Noise

With respect to the EPA, 2022 criteria for description of effects, the potential associated effects at the nearest NSLs associated with the various elements of the operational phase are described below.

#### 12.7.2.1.1 *Wind Turbine Noise*

The predicted noise levels associated with the Proposed Project will be within best practice noise criteria curves recommended in the Guidelines (DoEHLG, 2006) therefore, it is not considered that a significant effect is associated with the Proposed Project.

While noise levels at low wind speeds will increase due to the Proposed Project 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.

#### 12.7.2.1.2 *Onsite 38kV Substation Noise*

The associated effect from the day to day operation of the proposed onsite 38kV substation is not significant and summarised as follows:

| Quality | Significance | Duration |
|---|---|---|
| Negative | Not significant | Long-term |

### 12.7.2.2 Vibration

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

| Quality | Significance | Duration |
|---|---|---|
| Neu | Imperceptible | Long-term |

## 12.7.3 Decommissioning Phase

During the decommissioning phase of the Proposed Project, there will be some effect on nearby NSLs 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 Project.

With respect to the EPA, 2022 criteria for description of effects, the anticipated associated effects at the nearest noise sensitive locations 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 Construction Phase

The list of cumulative projects detailed in 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. With the implementation of mitigation measures described in Section 12.6.1, the predicted noise emissions for the Proposed Project are not of enough magnitude to cause an increase in the cumulative construction noise emissions exceeding the threshold for significant impacts at any NSL.

For the Proposed Grid Connection underground cabling route, construction activities may occur near NSLs. The following comments are presented with respect to potential cumulative impacts associated with these works in combination with noise from other construction sites. The construction activities along the Proposed Grid Connection which is closest to the NSL is expected to be the dominant noise source, with a lower contribution expected from sites farther away from the NSL. In most cases, the setback distances to the NSLs will ensure no significant cumulative impacts. In the unlikely event that works from other sites also occur near a receptor (within approximately 30 meters), it is assumed that the maximum increase in predicted construction noise levels due to cumulative contributions would be no more than 3 dB. While a 3 dB increase represents a doubling of sound energy, subjectively, any change in noise level below 3 dB would be barely perceptible. Additionally, as noted in Section 12.5.2.2.1, the works associated with the Proposed Grid Connection underground cabling route will occur for short durations and are expected to be near the closest NSLs for a limited amount of time, i.e., less than one day. Works will be coordinated with other projects so that there is no potential for cumulative noise of vibration effects.

With respect to the EPA, 2022 criteria for description of effects, the anticipated associated effects at the nearest NSLs associated with cumulative impacts during the construction phase of the Proposed Project are described as:

| Quality | Significance | Duration |
|---|---|---|
| Negative | Slight to Moderate | Short-term |

### 12.7.4.2 Operational Phase

#### 12.7.4.2.1 *Wind Turbine Noise*

A review of existing, proposed and permitted wind turbine developments in the wider study area has been undertaken in accordance with the guidance contained in the IOA GPG. As discussed in Section 12.3.3 and Appendix 12-3, there is no requirement to include any other wind farm in the cumulative noise assessment.

With respect to the EPA, 2022 criteria for description of effects, the anticipated associated effects at the nearest NSLs associated with cumulative impacts from the Proposed Wind Farm are described as:

| Quality | Significance | Duration |
|---|---|---|
| Negative | Not Significant | Long-term |



#### 12.7.4.2.2 Onsite 38kV Substation

The predicted operational noise levels at the nearest NSL from the operation of the onsite 38kV substation are well below the noise criteria. With respect to the EPA, 2022 criteria for description of effects, the anticipated associated effects at the nearest NSLs associated with cumulative impacts from the substation are described as:

| Quality | Significance | Duration |
|---|---|---|
| Negative | Imperceptible | Long-term |

#### 12.7.4.2.3 Proposed Grid Connection

It is not considered that any significant cumulative operational noise or vibration effects are likely in relation to the Proposed Grid Connection infrastructure. The underground cabling route will not generate any noise during the operational phase. Furthermore, the distance to any other developments will ensure that any contribution to cumulative noise will not be significant.

With respect to the EPA, 2022 criteria for description of effects, the anticipated associated effects at the nearest NSLs associated with cumulative impacts from the Proposed Grid Connection are described as:

| Quality | Significance | Duration |
|---|---|---|
| Neutral | Imperceptible | Long-term |

## 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, conservative turbine noise levels have been predicted at NSLs for a range of operational wind speeds. The predicted noise levels associated with the Proposed Project will be within best practice noise limits recommended in Guidelines (DoEHLG, 2006) capable of adhering to the Draft Guidelines (DoHPLG, 2019). Therefore, no significant noise effect is associated with the Proposed Project.

Noise from the operation of the proposed substation has also been assessed and is within the adopted criteria based on the NG4 (EPA, 2016).

No significant vibration effects are associated with the construction, operation or decommissioning of the Proposed Project.

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