

Environmental Impact Assessment Report (EIAR)

Proposed Cahermurphy
West Wind Farm, Co. Clare

Chapter 12: Noise and Vibrations



Contents

12.	NOISE AND VIBRATION.....	12-3
12.1	Introduction.....	12-3
12.1.1	Background & Objectives	12-3
12.1.2	Statement of Authority	12-3
12.2	Fundamentals of Acoustics	12-3
12.3	Assessment Methodology	12-4
12.3.1	EPA Description of Effects	12-5
12.3.2	Guidance Documents and Assessment Criteria	12-5
12.3.3	Study Area.....	12-21
12.3.4	Background Noise Assessment	12-22
12.3.5	Construction Noise Calculations	12-24
12.3.6	Turbine Noise Calculations	12-25
12.4	Receiving Environment.....	12-29
12.4.1	Background Noise Levels	12-29
12.4.2	Wind Turbine Noise Criteria.....	12-29
12.4.3	Grid Connection Cabling Route	12-31
12.5	Likely Significant Effects	12-33
12.5.1	Do-Nothing Effect.....	12-33
12.5.2	Construction Phase Potential Impacts.....	12-33
12.5.3	Operational Phase Potential Impacts.....	12-44
12.5.4	Decommissioning Phase.....	12-52
12.6	Mitigation Measures	12-52
12.6.1	Construction Phase	12-52
12.6.2	Operational Phase	12-54
12.7	Description of Residual Effects.....	12-58
12.7.1	Construction Phase	12-58
12.7.2	Operational Phase	12-59
12.7.3	Decommissioning Phase.....	12-60
12.7.4	Cumulative Effects	12-61
12.8	Conclusion.....	12-61

TABLE OF TABLES

<i>Table 12-1 Example Threshold of Potential Significant Effect at Noise Sensitive Locations.....</i>	<i>12-7</i>
<i>Table 12-2 Description of the magnitude of impacts. Adapted from DMRB Table 3.16.....</i>	<i>12-8</i>
<i>Table 12-3 Classification of magnitude of traffic noise changes in the short-term. Source DMRB, UKHE (2020).....</i>	<i>12-9</i>
<i>Table 12-4 Allowable Transient Vibration at Properties.....</i>	<i>12-10</i>
<i>Table 12-5 NG4 Approach for Determining Appropriate Noise Criteria.....</i>	<i>12-18</i>
<i>Table 12-6 Measurement Location Coordinates.....</i>	<i>12-22</i>
<i>Table 12-7 Sound Power Levels for various turbine options (highest SPL at each wind speed in bold).....</i>	<i>12-26</i>
<i>Table 12-8 Sound Power Level used in assessment, at 103.5 m hub height.....</i>	<i>12-27</i>
<i>Table 12-9 Turbine Directivity Attenuation with Consideration of Wind Direction.....</i>	<i>12-28</i>
<i>Table 12-10 Derived Background Noise Levels of $L_{A90,10min}$ for Various Wind Speeds.....</i>	<i>12-29</i>

<i>Table 12-11 Noise Criteria Curves.....</i>	<i>12-31</i>
<i>Table 12-12 Baseline Noise Levels measured along grid connection cabling route.....</i>	<i>12-32</i>
<i>Table 12-13 Typical Construction Noise Emission Levels – Turbines and Hardstanding, and Met Mast</i>	<i>12-34</i>
<i>Table 12-14 Worst-case predicted noise levels for Turbines and Hardstanding, and Met Mast.....</i>	<i>12-35</i>
<i>Table 12-15 Typical Construction Noise Emission Levels – Internal Roads.....</i>	<i>12-36</i>
<i>Table 12-16 Typical Borrow Pit Plant Noise Levels.....</i>	<i>12-38</i>
<i>Table 12-17 Typical Plant Noise Levels Borrow Pits.....</i>	<i>12-38</i>
<i>Table 12-18 Typical Construction Noise Levels for the Turbine Delivery Route Accommodation Areas</i>	<i>12-40</i>
<i>Table 12-19 Indicative noise calculations for construction – Underground Electrical (38kV) Cabling..</i>	<i>12-41</i>
<i>Table 12-20 Assumptions for Construction Traffic Noise Assessment (Background + Proposed Project)</i>	<i>12-42</i>
<i>Table 12-21 Estimated Changes in Traffic Noise Levels.....</i>	<i>12-43</i>
<i>Table 12-22 Review of Cumulative Predicted Turbine Noise Levels against Relevant Criteria.....</i>	<i>12-44</i>
<i>Table 12-23 Number of NSLs with Exceedances - Daytime.....</i>	<i>12-49</i>
<i>Table 12-24 Number of NSLs with Exceedances - Night.....</i>	<i>12-49</i>
<i>Table 12-25 Comparison of Predicted Noise Levels for upper and lower end of the design flexibility range.....</i>	<i>12-50</i>
<i>Table 12-26 Curtailment Matrix for Daytime Periods.....</i>	<i>12-54</i>
<i>Table 12-27 Curtailment Matrix for Night-time Periods.....</i>	<i>12-55</i>

TABLE OF FIGURES

<i>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).....</i>	<i>12-4</i>
<i>Figure 12-2 Indicative measurement locations (A, B, C, D, and E).....</i>	<i>12-23</i>
<i>Figure 12-3 Comparison of Sound Power Levels for each turbines under consideration.....</i>	<i>12-26</i>
<i>Figure 12-4 Baseline Noise Measurement Locations along grid connection route.....</i>	<i>12-32</i>
<i>Figure 12-5 Exceedances of noise criteria at 7 m/s.....</i>	<i>12-48</i>

12. NOISE AND VIBRATION

12.1 Introduction

12.1.1 Background & Objectives

This chapter of the EIAR describes the assessment undertaken of the likely significant effects of noise and vibration impacts and effects associated with the proposed Cahermurphy West Wind Farm and Grid Connection (the ‘Proposed Project’). The Proposed Project includes the provision of 8 no. wind turbines with an overall ground to blade tip height of in the range 180 to 185 metres. A full description of the Proposed Project is provided in Chapter 4 (Description of the Proposed Project) of this EIAR.

This Noise and Vibration assessment considers the construction phase, operational phase and decommissioning phase of the Proposed Project on the nearby noise sensitive locations (NSLs).

This chapter is supported by material in the following appendices:

- Appendix 12-1: Glossary of Acoustic Terms
- Appendix 12-2: Noise Study Area
- Appendix 12-3: Background Noise Survey
- Appendix 12-4: Sound Power Levels
- Appendix 12-5: Noise Modelling Parameters
- Appendix 12-6: Baseline Noise Survey for Grid Connection Route
- Appendix 12-7: Predicted Noise Levels
- Appendix 12-8: Predicted Noise Contour
- Appendix 12-9: Draft Noise Complaint Management Protocol

12.1.2 Statement of Authority

This chapter of the EIAR has been prepared by Mike Simms and reviewed by Dermot Blunnie and 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.

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

12.2 Fundamentals of Acoustics

A sound wave travelling through the air is a regular disturbance of the atmospheric pressure. These pressure fluctuations are detected by the human ear, producing the sensation of hearing. To take account of the vast range of pressure levels that can be detected by the ear, it is convenient to measure sound in

terms of a logarithmic ratio of sound pressures. These values are expressed as Sound Pressure Levels (SPL) in decibels (dB).

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

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

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

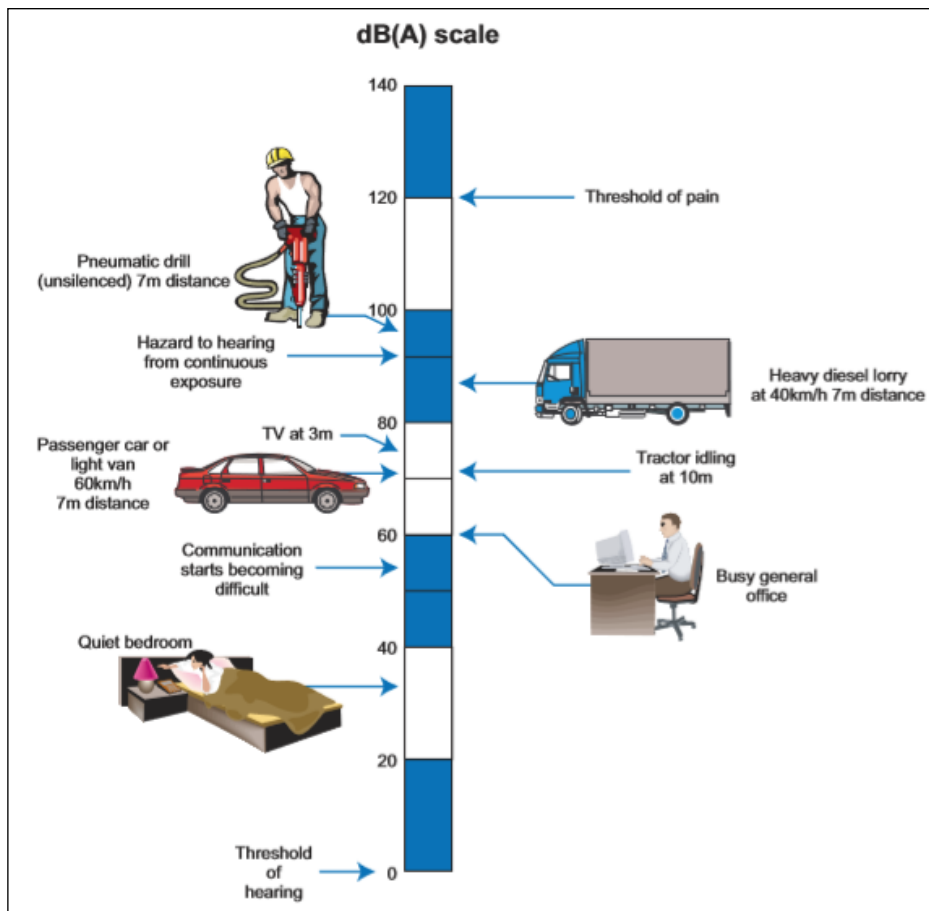


Figure 12-1 The level of typical common sounds on the dB(A) scale (National Roads Authority (NRA) Good Practice Guidance for the Treatment of Noise during the Planning of National Road Schemes (NRA, 2014)

12.3 Assessment Methodology

The assessment of impacts has been undertaken with reference to the best practice guidance documents relating to noise and vibration for each of the construction, operational and decommissioning phases 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 complied with 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:

- Determine the study area for the Proposed Project;
- Characterise the receiving environment through noise surveys at various locations in the receiving environment of the Proposed Project;
- Undertake predictive noise calculations to assess the potential impacts associated with the construction, operational and decommissioning phases of the Proposed Project at nearby NSLs;
- Evaluate the likely significant noise and vibration impacts and describe the effects;
- Assess the cumulative impacts;
- 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 Projects.

12.3.1 EPA Description of Effects

The significance of effects of the Proposed Project will be described in accordance with the EPA guidance document ‘*Guidelines on the information to be contained in Environmental Impact Assessment Reports (EIAR)*’ (EPA, 2022). Details of the methodology for describing the significance of the effects are provided in Chapter 1 (Introduction).

The effects associated with the Development are described in accordance with the criteria for assessment of effects as described in the guidance in EPA EIAR Guidelines in the relevant sections of this chapter (EPA, 2022).

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 Proposed Project. The relevant guidance documents are listed below and are discussed where relevant in the various sections of this chapter.

- *EPA Guidelines on the Information to be contained in Environmental Impact Statements*, (EPA, 2022).
- British Standard Institute (BSI) BS 5228-1:2009 +A1:2014 Code of Practice for noise and vibration control of construction and open sites - Part 1: Noise (hereafter referred to as BS 5228-1) (BSI, 2014)
- British Standard Institute (BSI) BS 5228-2:2009+A:2014 Code of Practice for noise and vibration control of construction and open sites - Part 2: Vibration (BSI, 2014)

- United Kingdom Highways England (now National Highways) (UKHE) Design Manual for Roads and Bridges (DMRB) Sustainability & Environment Appraisal LA 111 Noise and Vibration Revision 2 (hereafter referred to as DMRB) (UKHE, 2020)
- British Standard Institute (BSI) BS 7385: 1993 Evaluation and measurement for vibration in buildings Part 2: Guide to damage levels from ground borne vibration (BSI, 1993)
- Transport Infrastructure Ireland (formerly NRA) (TII) Good Practice Guidance for the Treatment of Noise during the Planning of National Road Schemes (TII, 2014)
- Department of Trade, and Industry (UK) Energy Technology Support Unit (ETSU) ETSU-R-97 The Assessment and Rating of Noise from Wind Farms (hereafter referred to as ETSU-R-97) (ETSU, 1996)
- Institute of Acoustics (IOA) A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise (hereafter referred to as IOAGPG) (IOA, 2013)
- Institute of Acoustics (IOA) Supplementary Guidance Note 1: Data Collection (IOA, 2014)
- Department of the Environment, Heritage, and Local Government (DoEHLG) Wind Energy Development Guidelines (DoEHLG, 2006)
- Department of Housing, Planning and Local Government (DoHPLG) Draft Wind Energy Development Guidelines (hereafter referred to as Draft Guidelines) (DoHPLG, 2006)
- WHO Regional Office for Europe (WHO) Environmental Noise Guidelines for the European Region (WHO, 2018)
- Environmental Protection Agency Office of Environmental Enforcement (OEE) Guidance Note on Noise Assessment of Wind Turbine Operations at EPA Licensed Sites (NG3) (OEE, 2011)
- IOA Noise Working Group (Wind Turbine Noise) Amplitude Modulation Working Group (IOA) A Method for Rating Amplitude Modulation in Wind Turbine Noise (IOA, 2016)
- International Electrotechnical Commission (IEC) Technical Specification 61400-11-2 (Edition 1.0, 2024) Wind Energy Generation Systems – Part 11-2: Acoustic noise measurement techniques – Measurement of wind turbine sound characteristics in receptor position (IEC, 2024)
- Environmental Protection Agency Office of Environmental Enforcement (OEE) Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4) (hereafter referred to as NG4) (OEE, 2016)
- International Organization for Standardization (ISO) ISO 9613-2:2024 Acoustics – Attenuation of sound during propagation outdoors - Part 2: Engineering method for the prediction of sound pressure levels outdoor (ISO, 2024)
- Acoustics Research Centre, University of Salford Procedure for the assessment of low frequency noise complaints, Revision 1, December 2011, Contract no. NANR45 (Salford, 2011) (hereafter referred to as NANR45)
- Department for Business, Energy & Industrial Strategy Wind Turbine AM Review: Phase 2 Report Project Number: 3514482A Issue: 3 Issued August 2016 (DBEIS, 2016)

12.3.2.1 Construction Phase

12.3.2.1.1 Construction Phase – Noise

General Construction

There is no published statutory Irish guidance relating to the maximum permissible noise level that may be generated during the construction phase of a project. Local authorities normally control

construction activities by imposing limits on the hours of construction works and may consider noise limits at their discretion.

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

An approach in BS5528-1 calls for the designation of receptors into a specific category (A, B or C) based on the existing ambient noise levels at the receptor in the absence of construction noise. This approach was chosen as it specifically applies to residential dwellings. A threshold noise value is applied to each category. An exceedance of the construction noise threshold (CNT) at the façade of a noise-sensitive location (NSL) during construction may indicate a potentially significant noise impact associated with the construction activities. The CNT values recommended by BS5228-1 are depicted in Table 12-1. The CNT values are applicable to both construction and decommissioning noise.

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.

The following steps have been followed to implement the A B C method from BS5228-1:

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

BS 5228-1 states that:

If the site noise level exceeds the appropriate category value [the CNT], then a potential significant effect is indicated. The assessor then needs to consider other project-specific factors, such as the number of receptors affected and the duration and character of the impact, to determine if there is a significant effect (BSI, 2014).

If the specific construction noise level exceeds the CNT, then a potential significant impact is identified. To determine the significance of effects, it is important to consider the duration and magnitude of the impacts as described in Section 12.3.2.1.3.

Linear Construction Works

It is proposed to construct a 110kV substation at the eastern end of the Wind Farm Site and to connect from here to the existing Moneypoint 110kV substation via underground 110kV electrical cabling,

measuring approximately 25 km in total, utilising public local road networks (24.008km) and private agricultural lands (0.88km), with an additional 0.16km located within the Proposed Wind Farm.

Due to the linear progressive nature of the construction works associated with the proposed grid connection cabling route, 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 progresses, 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.”

And:

“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”.*

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 weekdays for linear construction activities i.e. the underground cabling works and the temporary works associated with turbine component and abnormal load delivery. 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 CNTs, reference is made to DMRB (UKHE, 2020). Table 3.16 therein is adapted to include the relevant significance effects from EPA EIAR Guidelines (EPA, 2022); Table 12-2 includes guidance as to the likely magnitude of impact associated with construction activities.

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

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

Above CNT and below or equal to CNT + 5dB	Moderate	Moderate – Significant	
Above CNT + 5dB	Major	Significant – Very Significant	

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

12.3.2.1.2 **Additional Vehicular Activity on Public Roads - Noise**

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

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

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

Change in Sound Level (dB(A))	DMRB Magnitude of Impact (Short-term)	EPA Significance of Impact
Less than 1 dB	Negligible	Not Significant
1.0 – 2.9	Minor	
3.0 – 4.9	Moderate	Significant
≥5	Major	

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

12.3.2.1.3 **Consideration of Duration of Effects**

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

- 10 or more days or nights in any 15 consecutive days or nights; or
- A total number of days exceeding 40 in any 6 consecutive months (UKHE, 2020).

12.3.2.1.4 **Construction Phase - Vibration**

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

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

- > BS 7385
- > BS 5228-2

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

BS 5228-2 recommends that, for soundly constructed residential property and similar structures that are generally in good repair, a threshold for minor or cosmetic (i.e. non-structural) damage should be taken as a peak particle velocity of 15 mm/s for transient vibration at frequencies below 15 Hz and 20 mm/s at frequencies above than 15 Hz. Below these vibration magnitudes minor damage is unlikely, although where there is existing damage, these limits may be reduced by up to 50%. In addition, where continuous vibration is generated, the limits discussed above may need to be reduced by 50% (BSI, 2014).

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

Table 12-4 Allowable Transient Vibration at Properties

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

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

12.3.2.2 Operational Phase Noise

12.3.2.2.1 Wind Turbine Noise

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

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

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

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

ETSU-R-97 states on page 58, “*absolute noise limits and margins above background should relate to the cumulative effect of all wind turbines in the area which contribute to the noise received at the*

properties in question...”. The potential for other wind farms to contribute to the NSLs in the study area is assessed in Section 12.7.4 and Appendix 12-2.

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

Institute of Acoustics Good Practice Guide

The guidance contained within the Institute of Acoustics (IOA) *A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise* (hereafter referred to as IOAGPG) (IOA, 2013) and Supplementary Guidance Notes are widely recognised as best practice and have been adopted for this assessment. The IOA GPG states, that at a minimum continuous baseline noise monitoring should be carried out at the nearest noise sensitive locations for typically a two-week period and should capture a representative sample of wind speeds in the area (i.e. cut in speeds to wind speed of rated sound power of the proposed turbine). Background noise measurements (i.e. $L_{A90,10min}$) should be related to wind speed measurements that are collated at the site of the wind turbine development. Regression analysis is then conducted on the data sets to derive background noise levels at various wind speeds to establish the appropriate day and night-time noise criterion curves.

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

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

Cumulative Assessment Screening

Existing, permitted and proposed wind turbine developments must be considered cumulatively in the noise impact assessment. To determine where a particular wind farm development needs to be included in the assessment or whether it can be scoped out, a ‘10 dB rule’ is applied.

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

”5.1.4 During scoping of a new wind farm development consideration should be given to cumulative noise impacts from any other wind farms in the locality.

5.1.5 Equally, in such cases where noise from the Proposed Development is predicted to be 10 dB greater than that from the existing wind farm (but compliant with ETSU-R-97 in its own right), then a cumulative noise impact assessment would not be necessary.”

Study Area

In the first instance the study area must be defined. The IOA GPG states that the ‘study area’ for background noise surveys (and noise assessment) should, as a minimum, be the area within which noise levels from the proposed, consented and existing wind turbine(s) may exceed 35 dB LA90.

The initial study area can be refined by applying the 10 dB rule such that the following statement is true:

The initial study area is defined as the area within which noise levels from the proposed, consented, and existing wind turbine(s) may exceed 35 dB LA90, and where noise from the proposed project alone exceeds 25 dB LA90, i.e., is 10 dB below 35 dB LA90. As in this instance, where a fixed lower threshold of 40 dB applies, the maximum extent of the study area will correspond to the 30 dB LA90 noise contour of the proposed project in isolation.

An appraisal of the study area to determine whether a cumulative turbine noise impact assessment is required is presented 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. This following statement from WEDG06 represents the commonly adopted daytime noise criterion curve in relation to wind farm developments .

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

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

“However, in very quiet areas, the use of a margin of 5dB(A) above background noise at nearby noise sensitive 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 LA90, 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 LA90,10min 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 LA90 for quiet daytime environments with background noise levels of less than 30 dB LA90,10min;
- 45 dB LA90,10min 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 LA90,10min and;
- 43 dB LA90,10min for night time periods.

While the caveat of an increase of 5dB(A) above background for night-time operation is not explicit within the current guidance, this is commonly applied in noise assessments prepared and is detailed in numerous examples of planning conditions issued by An Coimisiún Pleanála (ACP). This set of criteria has been chosen as it is in line with the intent of the Guidelines (DoEHLG,2006). The proposed operational noise criteria for wind turbine noise at noise sensitive locations are presented in Section 12.4.2, Table 12-11.

Future Potential Guidance Changes for Wind Turbine Noise

In December 2019, the Draft Revised Wind Energy Development Guidelines (hereafter referred to as the Draft Guidelines (DoHPLG, 2019)) were published for consultation and at the time of writing, the final guidelines have yet to be published. It is important to note that during the public consultation on the Draft Guidelines (DoHPLG, 2019), several concerns relating to the proposed approach of the 2019 Draft have been expressed by various parties. Specific concerns expressed by a group of acoustic professionals working in the field are most relevant. The group was made up of acousticians who act for wind farm developers, Councils, Government bodies and residents' groups (all of whom are members of the Institute of Acoustics, IOA). The group contained several of the authors / contributors to ETSU-R-97 (ETSU, 1996), IOAGPG (IOA, 2013) and the IOA Amplitude Modulation Working Group (IOA, 2016), which are all referenced extensively in the Draft Guidelines (DoHPLG, 2019). A summary of the consultation response can be viewed at:

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

wherein it is stated that:

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

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

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

On 19 June 2025, during a Dail Eireann Debates, the Minister for Housing, Local Government and Heritage submitted a statement¹ confirming that while the draft guidelines are being reviewed, “*the current 2006 Wind Energy Development Guidelines remain in force, pending the finalisation of the review*”.

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

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

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

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

The objective of the WHO Environmental Noise Guidelines for the European Region (WHO, 2018) that was published in October 2018 is to provide recommendations for protecting human health from exposure to environmental noise from transportation, wind farm and leisure sources of noise. The guidelines present recommendations for each noise source type in terms of L_{den} and L_{night} levels above which there is potential for adverse health risks.

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

“For average noise exposure, the GDG conditionally recommends reducing noise levels produced by wind turbines below 45 dB L_{den} , as wind turbine noise above this level is associated with adverse health effects.

No recommendation is made for average night noise exposure L_{night} of wind turbines. The quality of evidence of night-time exposure to wind turbine noise is too low to allow a recommendation.

To reduce health effects, the GDG conditionally recommends that policymakers implement suitable measures to reduce noise exposure from wind turbines in the population exposed to levels above the guideline values for average noise exposure. No evidence is available, however, to facilitate the recommendation of one particular type of intervention over another.”

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

The WHO Environmental Noise Guidelines aim to support the legislation and policy-making process on local, national, and international level, thus shall be considered by Irish policy makers for any future revisions of the Guidelines (DoEHLG,2006).

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 L_{Aeq} -like indicators) and conversions between indicators do not normally influence the correlations between the noise indicator and a particular health effect, important assumptions remain when exposure to wind turbine noise in L_{den} is converted from original sound pressure level values. The conversion requires, as variable, the statistical distribution of annual wind speed at a particular height, which depends on the type of wind turbine and meteorological conditions at a particular geographical location. Such input variables may not be directly applicable for use in other sites. They are sometimes used without specific validation for a particular area, however, because of practical limitations or lack of data and resources. This can lead to increased uncertainty in the assessment of the relationship between wind turbine noise

exposure and health outcomes. Based on all these factors, it may be concluded that the acoustical description of wind turbine noise by means of L_{den} or L_{night} may be a poor characterization of wind turbine noise and may limit the ability to observe associations between wind turbine noise and health outcomes...

Further work is required to assess fully the benefits and harms of exposure to environmental noise from wind turbines and to clarify whether the potential benefits associated with reducing exposure to environmental noise for individuals living in the vicinity of wind turbines outweigh the impact on the development of renewable energy policies in the WHO European Region.”

Based upon the review outlined above, it is AWN’s professional judgement that the conditional WHO recommended average noise exposure level (i.e. 45dB L_{den}) should not currently be applied as target noise criteria for an existing or proposed wind turbine developments in Ireland.

12.3.2.2.2 **Infrasound/Low Frequency Noise**

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

“There is similarly no significant infrasound from wind turbines. Infrasound is high level sound at frequencies below 20 Hz. This was a prominent feature of passive yaw “downwind” turbines where the blades were positioned downwind of the tower which resulted in a characteristic “thump” as each blade passed through the wake caused by the turbine tower. With modern active yaw turbines (i.e. the blades are upwind of the tower and the turbine is turned to face into the wind by a wind direction sensor on the nacelle activating a yaw motor) this is no longer a significant feature.”

An IOA statement in Respect of Wind Farm Noise Assessment dated December 2024 and published² on the IOA website stated the following in relation to Infrasound and Low Frequency noise:

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

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

In conclusion, infrasound and low frequency noise associated with wind turbines is expected to be below perceptibility thresholds and are not likely to result in any significant effects at NSLs. There are no criteria proposed to assess low frequency noise or infrasound as part of the EIAR.

²

<https://www.ioa.org.uk/publications/wind-turbine-noise>

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 widely 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 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 UK Department of Environment Food and Rural Affairs (DEFRA), the Department of Business, Enterprise and Regulatory Reform (BERR) and the

Department of Communities and Local Government (CLG) investigated the issue of AM associated with wind turbine noise. The results were reviewed and published in the report *Research into Aerodynamic Modulation of Wind Turbine Noise* (2007). The broad conclusions of this report were that aerodynamic modulation was only considered to be an issue at 4, and a possible issue at a further eight, of 133 sites in the UK that were operational at the time of the study and considered within the review. At the four sites where AM was confirmed as an issue, it was considered that conditions associated with AM might occur between about 7% and 15% of the time. It also emerged that for three out of the four sites the complaints have subsided, in one case due to the introduction of a turbine control system.

It is not possible to predict an occurrence of AM at the planning stage. While OAM can occur, it is noted that the research has shown that it is a rare event associated with a limited number of wind farms.

RenewableUK Research Document states the following in relation to matter:

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

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

Page 61 Module F *“There is nothing at the planning stage that can presently be used to indicate a positive likelihood of OAM occurring at any given proposed wind farm site, based either on the site’s general characteristics or on the known characteristics of the wind turbines to be installed.”*

Concluding Comments on Amplitude Modulation

It is critical to this discussion to recognise that amplitude modulation (AM) is an inherent characteristic of wind turbine noise. A distinction must be made between ‘Normal’ AM, which is a regular fluctuation in noise levels, and ‘Other’ or ‘Excessive’ AM, which can be more pronounced and potentially disruptive. Normal AM is typically expected and accounted for in noise assessments, whereas Excessive AM should it occur, may require additional mitigation measures due to its potential impact on nearby residents. The term AM is commonly used without these descriptions; however, where AM is referenced in this chapter, it should be understood to refer to unacceptable or excessive AM with the potential to result in adverse impacts, unless otherwise stated.

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

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

A 2016 report commissioned by the UK government *Wind turbine AM review: Phase 2 report. 3514482A Issue 3. Department for Business, Energy & Industrial Strategy* completed by WSP Parsons

Brinckerhoff recommended the use of a penalty scheme as a potential planning condition for AM to cover periods of complaints due to unacceptable AM. The report included the following caveat “*Any condition developed using the elements proposed in this study should be subject to a period of testing and review. The period should cover a number of sites where the condition has been implemented and would be typically in the order of 2-5 years from planning approval being granted.*”

To date there is no clear industry consensus on how AM should be regulated or managed through the planning stage. In the absence of an accepted and robust planning conditions to control AM from wind turbines, the commitments outlined in the Section 12.6.2.1.3 below are considered to represent best practice to control AM and will be adopted in the event that an complaint relating to excessive AM is reported.

12.3.2.2.4 Fixed-Plant Items

There is no published statutory Irish guidance relating to the maximum permissible noise level from fixed mechanical and electrical plant that would be associated with 110 kV substation. In the absence of specific noise limits, appropriate criteria relating to fixed mechanical and electrical plant reference is made to best practice guidance contained in the following published guidelines and standards.

EPA NG4

In order to establish whether the NSLs in the vicinity of the proposed onsite 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 for areas of low background noise and all other areas.

Table 12-5 NG4 Approach for Determining Appropriate Noise Criteria

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

It is important to consider the likelihood of adverse noise impacts when assessing noise from fixed plant. The NG4 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.

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:

<i>“ambient sound level, $L_{Aeq,T}$</i>	<i>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.</i>
<i>residual sound level, $L_{Aeq,T}$</i>	<i>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.</i>
<i>specific sound level, $L_{Aeq, T}$</i>	<i>equivalent continuous A-weighted sound pressure level produced by the specific sound source at the assessment location over a given reference time interval, T.</i>
<i>Rating level, $L_{Ar,T}$</i>	<i>specific sound level plus any adjustment for the characteristic features of the sound.</i>
<i>background sound level, $L_{A90,T}$</i>	<i>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.”</i>

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

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

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

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

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

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

Where background sound levels and rating levels are low, absolute levels might be as, or more, relevant than the margin by which the rating level exceeds the background. This is especially true at night.”

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

12.3.2.3 **Factors to Consider when Assessing Operational Noise Effects**

12.3.2.3.1 **Wind Turbine Noise**

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

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

12.3.2.3.2 **Fixed-Plant Items**

The guidance discussed in Section 12.3.2.4 provides a framework in line with national guidelines for identifying appropriate noise limits at nearby NSLs.

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

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

12.3.2.4 **Operational Phase Vibration**

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

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

The shortest distance from any turbine in the Proposed Project to the nearest NSL is 743 m (distance from turbine T01 to NSL ref. H080). At that distance, the level of vibration will be significantly below any thresholds for perceptibility. Therefore, vibration criteria are not specified for the operational phase of the Proposed Project.

An IOA statement in Respect of Wind Farm Noise Assessment dated December 2024 and published³ on the IOA website stated the following in relation to Vibration:

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

There are no other sources likely to give rise to any perceptible vibration at NSLs during the operation of the proposed project. The assessment of operational phase vibration has therefore been scoped out of this assessment.

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, and decommissioning phases, and the potential for noise effects during the operational phase.

12.3.3.1 Operational Phase

For the operational phase, the initial study area covered the area where turbine noise levels are predicted to exceed 35 dB LA90 from all existing, permitted, and proposed wind turbines. Due to the potential for cumulative effects with other existing wind farm developments, the final study area for the operational phase of the proposed project is defined by the areas where predicted turbine noise levels from the proposed project in isolation are predicted to be above 30 dB LA90 at the maximum noise emission level for the proposed turbines. Refer to Appendix 12.2 which displays the relevant noise contours maps which identify this area.

The NSLs identified within this study area have been considered in the assessment of operational noise from the Proposed Wind Farm including the substation.

198 no. NSLs have been identified within the noise study area of the Proposed Wind Farm. The nearest NSL is located approximately at a distance of 743 m to the nearest Proposed Turbine location (i.e. Location H080 – a vacant property - from Proposed Turbine T1). The next closest NSL is H001 located at approximately 744 m from T5.

To confirm whether the set of NSLs covered the extent of the study area for wind turbine noise assessment, consideration was given to the potential cumulative impacts from other wind turbines in the wider area in line with guidance discussed in Section 12.3.2.2.1. An appraisal of the list of wind farm

³ <https://www.ioa.org.uk/sites/default/files/IOA%20Statement%20-%20Wind%20Farm%20Noise%20Assessment%20Dec%202024.pdf> accessed 8 January 2026

development presented in Ch. 2: Background to the Proposed Project identified that the nearest other wind turbine developments (existing, permitted or proposed) are the existing Cahermurphy Wind Farm located approximately 460 m from the T6 of the Proposed Wind Farm and Kiltumper Wind Farm located at 2.6km to the southeast of the Proposed Wind Farm.

In line with guidance discussed in Section 12.3.2.2.1, the existing Cahermurphy and Kiltumper wind farms have been included in the cumulative assessment presented in this Chapter..

12.3.3.2 Construction and Decommissioning Phase

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

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 Section 12.5.2 and are typically representative of the closest identified NSL or at defined set back distances from proposed activity.

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

12.3.4 Background Noise Assessment

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

A background noise survey was undertaken to establish typical background noise levels at representative NSLs surrounding the Proposed Wind Farm. The background noise survey was conducted through installing unattended sound level meters at 5 no. representative locations in the surrounding area. This noise survey was carried out by AWN in 2019 in support of a previous application and remains valid as an evaluation of the receiving environment and for determining noise criteria as required by IOA GPG. It is acknowledged that the survey was carried out in 2019; however this was prior to the construction and operation of the existing Cahermurphy wind farm. The IOA GPG states that the baseline noise survey should not contain any contribution from operational wind turbines in the noise environment, thus it is appropriate to use the 2019 survey as a baseline data for the current assessment.

Details of the background noise survey are in the following sections and in Appendix 12-3.

A separate baseline noise survey was carried out on 12 June 2024 by AWN at locations along the Proposed Grid Connection route; full details are presented in Appendix 12-6 and a summary of the findings it presented in Section 12.4.3.

12.3.4.1 Choice of Measurement Locations

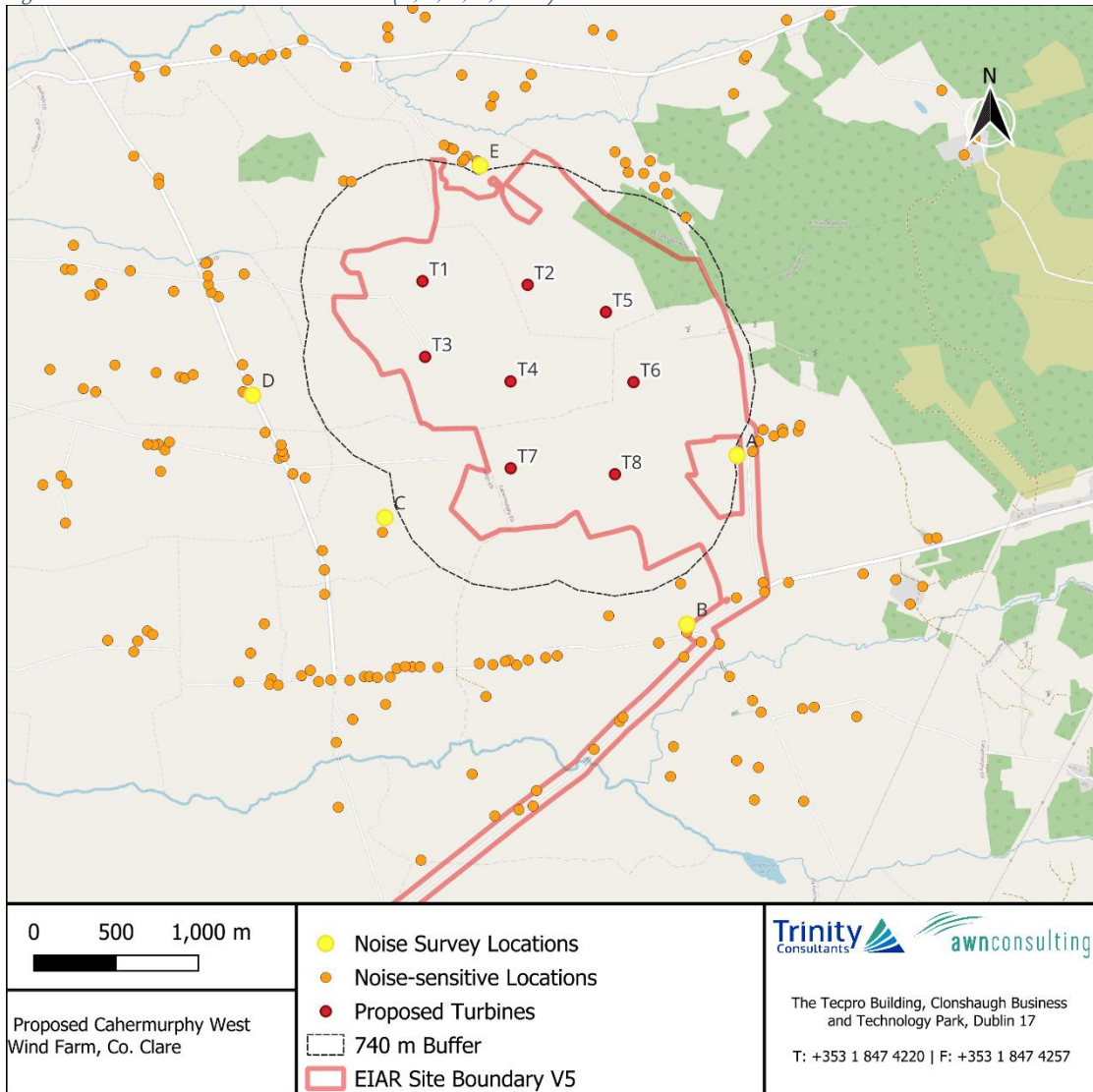
The noise monitoring locations were confirmed as suitable by preparing a preliminary noise model contour at an early stage of the assessment.

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

Table 12-6 Measurement Location Coordinates

Location	Coordinates – Irish Transverse Mercator (ITM)	
	Easting	Northing
A (H029)	509684	668702
B (H016)	509379	667675
C (H023)	507544	668324
D (H068)	506744	669064
E (H028)	508122	670462

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



Background Imagery © Opens Street Map

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. The survey was carried out prior to the construction of the

existing Cahermurphy Wind Farm; in line with the IOA GPG, the baseline noise survey should not include noise from other wind farms. Note that the assessment of cumulative noise effects from the proposed development along with other wind turbines in Section 12.3.2.2.1.

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

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

Section 12.4.1 of this chapter presents a summary of 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 data was measured at a meteorological mast located within the site of the Proposed Project and was supplied to AWN for data analysis. Details of the wind measurement system are included in Appendix 12-3.

12.3.4.3 Analysis of Background Noise Data

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

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

12.3.4.3.1 Consideration of Wind Shear

Wind shear is defined as the change of wind speed with height above ground. Any reference to wind speed in this chapter should be understood to be at standardised 10m height. The standardised equations used to determine the wind speed at standardised 10m above ground are presented in Appendix 12-3.

12.3.5 Construction Noise Calculations

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

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

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

12.3.6 Turbine Noise Calculations

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

12.3.6.1 Noise Modelling Software

Proprietary noise calculation software was used for the purposes of this impact assessment. The selected software, DGMR iNoise Enterprise, calculates noise levels in accordance with ISO 9613: *Acoustics – Attenuation of sound outdoors, Part 2: Engineering method for the prediction of sound pressure levels outdoor*, (ISO, 2024).

iNoise is a proprietary noise calculation package for computing noise levels and propagation of noise sources. iNoise calculates noise levels in different ways depending on the selected prediction standard. In general, however, the resultant noise level is calculated considering a range of factors affecting the propagation of sound, including:

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

12.3.6.2 Noise Prediction Model - Input Data and Assumptions

The calculation settings, input data and any assumptions made in the assessment are described in the following sections. Appendix 12-5 presents the modelling parameters applied, in accordance with IOAGPG.

12.3.6.2.1 Proposed Turbine Details

Table 4-1 in Chapter 4 ‘*Description of the Proposed Project*’ details the co-ordinates of the 8 No. Proposed Turbines that are being considered in this assessment.

In order to assess all scenarios within the range of possible turbine technologies and dimensions, the following list of turbines has been considered:

- Vestas V150 at 110 m hub height, and
- Vestas V162 at 104 m hub height;
- Nordex N149 at 110.5 m hub height;
- Nordex N163 at 103.5 m hub height;
- GE GE-158 at 106 m hub height;

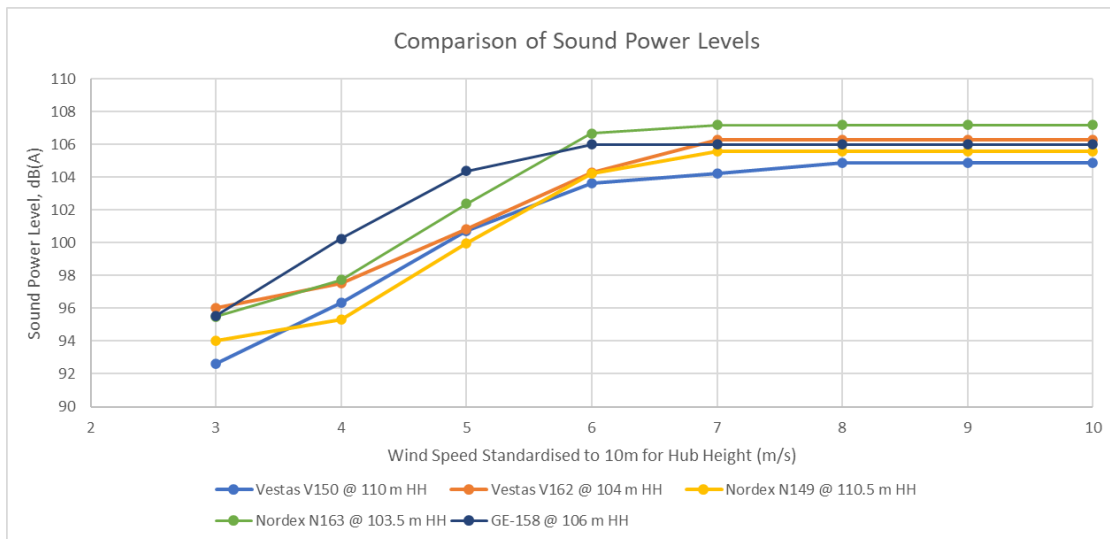
The dimensions of the above turbines all vary but are all within the proposed range of dimensions as described in Chapter 4 of this EIAR (Description of the Proposed Project).

In accordance with the IOA GPG, sound power levels for each of the turbines listed above, referred to wind speeds at standardised 10 m height are presented in Table 12-7 and Figure 12-3. In all cases, the turbine option with serrated trailing edges has been used.

Table 12-7 Sound Power Levels for various turbine options (highest SPL at each wind speed in **bold**)

Wind Speed (m/s at 10m Standardised Height)	Sound Power Level, dB(A)				
	V150 at 110m HH	V162 at 104 m HH	N149 at 110.5 m	N163 at 103.5 m	GE-158 106 m HH
3	92.6	96.0	94.0	95.5	95.5
4	96.4	97.5	95.3	97.7	100.3
5	100.7	100.8	100.0	102.4	104.4
6	103.6	104.3	104.3	106.7	106.0
7	104.2	106.3	105.6	107.2	106.0
8	104.9	106.3	105.6	107.2	106.0
9	104.9	106.3	105.6	107.2	106.0

Figure 12-3 Comparison of Sound Power Levels for each turbines under consideration



The turbine with the highest sound power levels varies depending on the wind speed; the higher end of the range of turbines is considered to be the following:

- > 3 m/s: Vestas V162 at 104 m hub height
- > 4 m/s: GE-158 at 106 m hub height
- > 5 m/s: GE-158 at 106 m hub height
- > 6 m/s: Nordex N163 at 103.5 m hub height
- > 7 m/s: Nordex N163 at 103.5 m hub height
- > 8 m/s: Nordex N163 at 103.5 m hub height

➤ 9 m/s: Nordex N163 at 103.5 m hub height

As the turbine option with the highest sound power level at the majority of windspeeds is the Nordex N163, the hub height used throughout this assessment is 103.5 m.

Taking account of the above, Table 12-8 details the turbine noise data used in the noise predictions models for the Proposed Wind Farm site. In accordance with the IOA GPG, sound power levels referred to wind speeds at standardised 10 m height.

Table 12-8 Sound Power Level used in assessment, at 103.5 m hub height

Wind Speed (m/s)	Sound Power Level dB L_{WA} at Octave-Band Centre Frequency, Hz								Overall Sound Power Level, dB(A)
	63	125	250	500	1000	2000	4000	8000	A
3	87.6	90.7	88.9	87.0	87.1	85.5	77.7	64.9	96.0
4	81.3	88.3	93.4	94.8	94.4	91.7	85.9	71.6	100.3
5	85.1	91.5	96.6	98.7	99.2	96.4	89.6	75.1	104.4
6	88.0	94.6	98.3	100.4	101.7	99.8	90.2	82.3	106.7
7	88.6	95.1	98.8	100.9	102.2	100.4	90.8	82.9	107.2
8	88.9	95.1	98.8	101.4	102.1	99.6	92.0	84.0	107.2
9	88.9	95.1	98.8	101.4	102.1	99.6	92.0	84.0	107.2

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.

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

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

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

12.3.6.2.2

Effects of Wind Direction on Noise Propagation

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

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

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

Table 12-9 presents the directivity attenuation factor that has been applied to turbines when considering noise propagation in downwind conditions (fully downwind is represented by 0° and fully upwind is 180°).

Table 12-9 Turbine Directivity Attenuation with Consideration of Wind Direction

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

12.3.6.2.3 Modelling Calculation Parameters

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

12.3.6.3 Assessment of Turbine Noise Levels

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

12.4 Receiving Environment

12.4.1 Background Noise Levels

Appendix 12-3 presents the details of the background noise surveys. Table 12-10 presents the various derived $L_{A90,10\min}$ 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 12-10 Derived Background Noise Levels of $L_{A90,10\min}$ for Various Wind Speeds

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	10
A (H029)	Day	21.5	23.2	25.2	27.5	30.0	32.9	36.0	39.4
	Night	18.8	19.8	21.3	23.3	26.0	29.1	32.9	37.2
B (H016)	Day	23.6	24.8	26.5	28.6	31.2	34.1	37.5	41.3
	Night	20.2	20.9	22.3	24.3	27.0	30.3	34.3	39.0
C (H023)	Day	22.9	24.8	27.0	29.3	31.9	34.6	37.5	40.6
	Night	17.6	18.9	20.9	23.5	26.8	30.7	35.2	40.3
D (H068)	Day	20.6	22.0	23.6	25.6	27.8	30.2	33.0	36.0
	Night	18.0	18.8	20.1	22.0	24.4	27.2	30.6	34.6
E (H028)	Day	20.3	21.8	23.6	25.6	27.8	30.3	33.0	35.9
	Night	17.5	18.4	19.7	21.6	23.9	26.8	30.1	34.0

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 turbines in the Proposed Wind Farm. The criteria curves have been derived following a detailed review of the background noise data conducted at the nearest noise sensitive locations.

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

- The EPA document ‘Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4)’ (OEE, 2016) proposes a daytime noise criterion of 45 dB L_{Aeq} in ‘areas of low background noise’. Turbine

noise limits are detailed in terms of the L_{A90} parameter while the NG4 daytime limit is detailed in terms of the L_{Aeq} . The accepted difference between the L_{Aeq} and L_{A90} for wind turbine noise assessments is 2 dB, i.e., 45 dB L_{Aeq} equates to 43 L_{A90} . This approach accounts for the 3 dB difference when comparing the NG4 limits and the 2006 limits (DoEHLG, 2006). The proposed lower threshold daytime criterion for wind turbine noise here is 3 dB more stringent than the equivalent daytime noise limit for areas of low background noise outlined in NG4 (OEE, 2016).

- A lower threshold of 40 dB is commonly adopted in planning conditions for similar wind energy developments that have been granted planning permission by ACP and local planning authorities in recent years for example Derrinlough Wind Farm (ABP Ref: 306706-20) Derryadd Wind Farm (ABP Ref: PL14.303592⁴), Coole Wind Farm (ABP Ref: PL25M.300686) Cloncreen Wind Farm (ABP Ref: PA0047), Meenbog Wind Farm (ABP Ref: PL05E.300460), Borrisbeg Wind Farm (ABP-318704-23) Ballivor Wind Farm (ABP-316212-23) and Carrig Renewables Wind Farm (Planning Ref: 318689-23).

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

Noise levels generated by the windfarm following commissioning by itself or in combination with other existing or permitted wind energy development in the vicinity when measured externally at noise sensitive locations, shall not exceed:

- 40 dB $L_{A90,10min}$ for quiet daytime environments of less than 30 dB $L_{A90,10min}$;
- 45 dB $L_{A90,10min}$ for daytime environments greater than 30 dB $L_{A90,10min}$ or a maximum increase of 5 dB above background noise (whichever is higher), and;
- 43 dB $L_{A90,10min}$ or a maximum increase of 5 dB above background noise (whichever is higher) for night-time periods.

Prior to the commissioning of the wind farm, the developer shall submit a Noise Compliance Monitoring Programme (NCMP) to the planning authority for written agreement. The NCMP shall include a detailed methodology for all noise measurements, the frequency of monitoring and procedures for recording results. The approved NCMP shall be fully implemented throughout the operational phase of the wind farm.

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 12-11 outlines the derived noise criteria curves which are based on the background noise levels derived and presented in Table 12-10.

⁴ Derryadd decision was subsequently quashed, for reasons not related to environmental noise or vibration.

Table 12-11 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	9
A (H029)	Day	40.0	40.0	40.0	40.0	45.0	45.0	45.0
	Night	43.0	43.0	43.0	43.0	43.0	43.0	43.0
B (H016)	Day	40.0	40.0	40.0	40.0	45.0	45.0	45.0
	Night	43.0	43.0	43.0	43.0	43.0	43.0	43.0
C (H023)	Day	40.0	40.0	40.0	40.0	45.0	45.0	45.0
	Night	43.0	43.0	43.0	43.0	43.0	43.0	43.0
D (H068)	Day	40.0	40.0	40.0	40.0	40.0	45.0	45.0
	Night	43.0	43.0	43.0	43.0	43.0	43.0	43.0
E (H028)	Day	40.0	40.0	40.0	40.0	40.0	45.0	45.0
	Night	43.0	43.0	43.0	43.0	43.0	43.0	43.0

12.4.3 Grid Connection Cabling Route

The main purpose of the baseline noise survey for the grid connection cabling route is to fulfil the EIA requirement to characterise the baseline noise environment.

An environmental noise survey was conducted by AWN in July 2024, in the environs of the Proposed Grid Connection cabling route, in order to quantify the existing noise environment. The survey was conducted in accordance with ISO 1996: 2017: Acoustics – Description, measurement and assessment of environmental noise. Full details of the baseline noise survey for the grid connection route are given in Appendix 12-6.

The locations selected for the noise monitoring locations are presented in Figure 12-4.

Figure 12-4 Baseline Noise Measurement Locations along grid connection route



A summary of the survey results for the daytime attended monitoring is given in Table 12-9. Further details are provided in Appendix 12-6.

Table 12-12 Baseline Noise Levels measured along grid connection cabling route

Location	Measured Noise Level, dB(A)	
	L _{Aeq}	L _{A90}
AT1	46 - 54	28 - 39
AT2	35 - 52	29 - 31
AT3	61 - 64	29 - 34
AT4	40 - 48	36 - 39
AT5	51 - 57	35 - 36

Location	Measured Noise Level, dB(A)	
	L _{Aeq}	L _{A90}
AT6	39 - 44	35 - 37

Audible noise sources at the survey locations were distant and local traffic, birdsong, occasional wind noise in foliage, and cattle.

12.5 Likely Significant Effects

12.5.1 Do-Nothing Effect

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

12.5.2 Construction Phase Potential Impacts

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

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

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

- Construction of turbines and hardstand areas;
- Construction of the Meteorological Mast;
- Construction of substation and control building;
- Construction of new roads within the site including the new site entrance;
- Upgrading of existing site roads within the site;
- Operation of borrow pits during the construction phase;
- Temporary works associated with turbine component and abnormal load delivery;
- Construction of the grid connection to Moneypoint.

The distances between the construction activities associated with the Proposed Project and the nearest NSLs are such that there will be no significant noise and vibration impacts at 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 Project elements, such as the peat and spoil management areas, temporary construction compounds, ancillary forestry felling, and the hen harrier enhancement plan are considered unlikely to have any significant noise and vibration impacts due to the nature of the works and distance from the nearest NSLs.

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

- Install safety signage, upgrade entrances, and prepare areas for site offices and compounds.

- Construct roads, crane pads, and drainage systems, and bunded oil storage areas.
- Build turbine foundations, including excavation, reinforcement, concrete works, and backfilling.
- Install electrical infrastructure: site cabling, ducting, internal networks, and substation connection.
- Erect turbines and met mast, commission systems, reinstate site, and remove temporary facilities.

Construction activities will be carried out during normal daytime working hours (i.e., 0700 – 1900 Mondays to Fridays and 08:00 - 13:00 in Saturdays). However, to ensure that optimal use is made of good weather periods or at critical periods within the programme (e.g., concrete pours, erection of turbines) or to accommodate delivery of large turbine components along public routes it could be necessary on occasion to work outside of these hours. Any such out of hours working will be notified in advance to the Local Authority.

12.5.2.1 Turbines, Hardstandings and Met Mast

12.5.2.1.1 Noise

The shortest distance from any turbine in the Proposed Project to the nearest NSL is 743 m (Distance from turbine T01 to NSL ref. H080).

One permanent meteorological mast is proposed as part of the Proposed Project. The meteorological mast will be equipped with wind monitoring equipment at various heights. The mast will be located at E508187, N668430 (ITM) as shown on the site layout drawing in Figure 4-1. The mast will be a slender structure 100m in height. The nearest NSL to the mast is H023 at a distance of approximately 625m.

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 NSLs. The assessment is representative of a worst-case and construction noise levels will be lower at properties located further from the works.

Table 12-13 outlines the noise levels associated with anticipated construction noise sources assessed in this instance along with sound pressure levels and spectra from BS 5228 – 1: 2009. Calculations have assumed an on-time of 66% for each item of plant i.e. 8 hours over a 12-hour assessment period.

Table 12-13 Typical Construction Noise Emission Levels – Turbines and Hardstanding, and Met Mast

Item (BS 5228 Ref.)	Activity/ Notes	Plant Noise Level at 10m Distance (dB $L_{Aeq,T}$) ⁵
HGV Movement (C.2.30)	Removing soil and transporting fill and other materials.	79
Tracked Excavator (C.4.64)	Removing soil and rubble in preparation for foundation.	75
Excavator Mounted Rock Breaker (C9.12)	Excavation in rocky areas	85
General Construction (Various)	All general activities plus deliveries of materials and plant.	84

⁵ 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}) ⁵
Concrete Mixer Truck and Concrete Pump (C.4.27)	Turbine Foundations	79
Dumper Truck (C.4.39)	Backfilling Turbine Foundations	76
Mobile Telescopic Crane (C.4.39)	Turbine Erection	77
Dewatering Pumps (D.7.70)	If required.	80
JCB (D.8.13)	For services, drainage and landscaping.	82
Vibrating Rollers (D.8.29)	Road surfacing.	77

Assuming as a worst-case that all turbines and hardstands were to be constructed simultaneously along with the met mast (in reality this will not occur as detailed in Section 8.5.1 Chapter 8 of this EIAR), the predicted noise levels for these NSL are presented in Table 12-14.

Table 12-14 Worst-case predicted noise levels for Turbines and Hardstanding, and Met Mast

NSL Ref	Predicted Noise Level (dB L _{Aeq,T})
H029	42
H023	42
H001	40

The predicted noise levels are well below the Construction Noise Threshold of 65 dB L_{Aeq,T} adopted in 12.3.2.1.1. It is concluded that there will be no significant noise impact associated with the construction of the turbines in the Proposed Wind Farm, hardstanding and meteorological mast therefore no specific mitigation measures are required.

12.5.2.1.2 Vibration

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

- Three tonne hydraulic breaker on small CAT tracked excavator

- Six tonne hydraulic breaker on large Liebherr tracked excavator.

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

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

12.5.2.2 Proposed Substation

12.5.2.2.1 Noise

The nearest NSL to the proposed substation is H029, which is approximately 179 m to the closest point of the substation. As a worst-case example assuming the same construction activities as outlined in Table 12-13, it is predicted that the likely worst-case potential noise levels from construction activities associated with the substation will be in the order of 56 dB $L_{Aeq,T}$ H029, at the nearest NSL. This level of noise is well below the significance threshold of 65 dB $L_{Aeq,T}$, therefore no specific mitigation measures are required.

12.5.2.2.2 Vibration

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

12.5.2.3 Proposed Access Roads and Existing Road Upgrades

It is proposed to upgrade existing internal roads and also to construct new internal roads as part of the Proposed Project. Review of the road layout has identified that the nearest NSL to any point along the proposed new roads is H029 at a distance of approximately 172 m. The nearest NSL to any point along the existing road upgrades is H029 at a distance of approximately 329 m. All other locations are at greater distances with the majority at significantly greater distances. The full description of the new roads is outlined in Chapter 4 (Description of the Proposed Project) of the EIAR.

12.5.2.3.1 Noise

Table 12-15 outlines the anticipated construction noise levels associated with the proposed works for this element of the construction. Calculations have assumed an on-time of 66% for each item of plant.

Table 12-15 Typical Construction Noise Emission Levels – Internal Roads

Item (BS 5228 Ref.)	Plant Noise Level at 10m Distance (dB $L_{Aeq,T}$) ⁶	Highest Predicted Noise Level at Stated Distance from Edge of Works (dB $L_{Aeq,T}$)
		314m
HGV Movement (C.2.30)	79	44
Tracked Excavator (C.4.64)	75	40
Dumper Truck (C.4.39)	77	42
Excavator Mounted Rock Breaker (C9.12)	85	50
Vibrating Rollers (D.8.29)	77	42
Total Construction Noise (cumulative for all activities)		52

The predicted noise levels are well below the Construction Noise Threshold of 65 dB $L_{Aeq,T}$ adopted in 12.3.2.1.1. It is concluded that there will be no significant noise impact associated with the construction of the proposed access roads or existing road upgrades, therefore no specific mitigation measures are required.

12.5.2.3.2 **Vibration**

Which reference to the discussion on vibration presented in Section 12.5.2.1.2 there will be no significant vibration impacts associated with the construction of the proposed access roads or existing road upgrades and therefore no specific mitigation measures will be required.

12.5.2.4 **Borrow Pits**

12.5.2.4.1 **Noise**

Two borrow pits are proposed, one to the west of turbine T5 and one to the north of turbine T8. The nearest NSLs to either borrow pits is H029 at approximately 520 m. To inform this aspect of the proposal a comparative noise assessment has been prepared and is outlined in the following paragraphs. Two situations have been considered as follows:

- Scenario A Blasting operation
- Scenario B Rock breaking operation

In terms of these activities please note the following:

- A mobile crusher will operate on site for both options.
- In Scenario B that two rock breakers will be in use on Site during daytime periods for a short period of time.

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

- Table 12-16 outlines the assumed noise levels for the plant items as extracted from BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise.

Table 12-16 Typical Borrow Pit Plant Noise Levels

Item	BS 5228 Ref:	dB L _w Levels per Octave Band (Hz)								dB(A)
		63	125	250	500	1k	2k	4k	8k	
Crusher	Table C1.14	121	114	107	109	103	99	94	87	110
Rock Breaker	Table C9.11	119	117	113	117	115	115	112	108	121
Dozer	Table C8.9	78	90	97	95	99	94	89	82	103
Excavator (3 no. per pit)	Table (C9.12)	114	114	111	106	108	106	104	99	112
Dewatering	Table D7.70	90	95	102	102	104	100	97	83	109
Generator	Table C6.39	81	86	93	89	83	80	74	67	96

A construction noise model has been prepared to consider the expected noise emissions from the proposed construction works for the two scenarios outlined above. A percentage on-time of 66% has been assumed for the noise calculations. The predicted levels are detailed in Table 12-17, at the 10 no. closest NSL's to the borrow pit acting together.

Table 12-17 Typical Plant Noise Levels Borrow Pits

Loc.	Predicted Construction Noise Level L _{Aeq,1hr}		Diff. dB(A)
	Scenario		
	A (Blasting)	B (Rock breaking)	
H085	45	50	-5
H029	44	53	-9
H031	44	51	-7
H030	43	51	-8
H032	43	48	-5
H001	42	46	-4
H002	42	45	-3

Loc.	Predicted Construction Noise Level $L_{Aeq,1hr}$		Diff. dB(A)
	Scenario		
	A (Blasting)	B (Rock breaking)	
H003	42	46	-4
H004	42	46	-4
H033	42	49	-7

Review of the data contained in Table 12-17 confirms the following:

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

12.5.2.4.2 **Vibration**

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

12.5.2.5 **Temporary works associated with turbine component and abnormal load delivery**

12.5.2.5.1 **Noise**

As described in Chapter 4 (Description of the Proposed Project), it is proposed that temporary roads are established through agricultural fields at 3 no. locations for the purposes of turbine components and abnormal load delivery:

- Reversing manoeuvre in the village of Kilmihil
- Field crossing in the townland of Castlepark
- Field crossing north of Scoil Mhichil

Accommodation works in the form of road widening are also proposed at

- R484 Junction at the Crossroads Bar
- Slight bend on Church street, Kilmihil:
- Bend before field crossing, Castlepark
- Straight on the L6254

Construction of these temporary and permanent works will require removal of existing boundaries, upgrade of existing track and temporary placement of hardcore, so the area can be used during the

delivery of large turbine components as indicated in Section 4.2.10.2 of Chapter 4 (Description of the Proposed Project).

There are three NSLs located within 10 m of the accommodation works; however, the majority of the NSLs are located at further distances from these works. Typical construction plant items and their associated noise levels at 10, 50 and 100 m distance are presented in Table 12-17.

Table 12-18 Typical Construction Noise Levels for the Turbine Delivery Route Accommodation Areas

Item (BS 5228 Ref.)	Plant Noise Level at 10m Distance (dB L _{Aeq,T}) ⁷	Highest Predicted Noise Level at Stated Distance from Edge of Works (dB L _{Aeq,T})			
		10m	25	50	100
Tracked Excavator (C.4.64)	75	73	61	54	46
HGV Movement (C.2.30)	79	77	65	58	50
Dumper Truck (C.4.4)	76	74	62	55	47
Vibrating Rollers (D.8.29)	77	75	63	56	48
Cumulative Predicted Construction Noise Level	–	81	69	62	54

Noise levels at distances of 10 m exceed the 70 dB L_{Aeq} noise threshold outlined in Section 12.3.2.1.1, however, considering the short duration of these works it is concluded that the effects are Not Significant in accordance with the guidance in Section 12.3.2.1.3. Noise levels at further distances are within the criteria.

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

12.5.2.5.2 Vibration

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

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

12.5.2.6 Proposed Grid Connection Underground Cabling

An underground cable connection to the national electricity grid is proposed, from the proposed onsite 110kV electrical substation at the eastern end of the Wind Farm Site to the existing Moneypoint 110kV substation via underground 110kV electrical cabling. Details of the proposed underground 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 underground electrical cable route is approximately 25km in length, it will take an estimated 12 months

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

to construct the full length of the route. Review of the Proposed Grid Connection has identified that the nearest NSLs to the proposed underground cable route, along local and regional roads, as well as private roads and through agricultural lands, 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 12-19 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 underground electrical cable route 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 within 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, with reference to the time periods in Section 12.3.2.1.3, it is concluded that there will not be any significant noise effect is associated with the construction of this element of the proposed works.

12.5.2.7 Construction Traffic – Proposed Wind Farm

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

- Stage 1a – Site Preparation – Concrete Pouring;

- Stage 1b – Site Preparation & Ground Works including the Proposed Grid Connection;
- Stage 2a – Turbine Construction Stage – Extended Artic Deliveries, and
- Stage 2b – Turbine Construction Stage – Other Conventional Deliveries

The proposed turbine delivery route is detailed in Section 4.2.10 of Chapter 4 (Description of the Proposed Project).

Table 12-20 Assumptions for Construction Traffic Noise Assessment (Background + Proposed Project)

Route	Stage	Car/LGV Flows (vehicles)	HGV Flows (vehicles)
1-N68	Existing	4,683	336
	Existing + 1a	4,753	696
	Existing + 1b	4,753	406
	Existing + 2a	4,728	396
	Existing + 2b	4,728	355
2-R484	Existing	2,378	313
	Existing + 1a	2,448	673
	Existing + 1b	2,448	383
	Existing + 2a	2,423	373
	Existing + 2b	2,423	332
3-L2082	Existing	1,410	216
	Existing + 1a	1,480	576
	Existing + 1b	1,480	286
	Existing + 2a	1,455	276
	Existing + 2b	1,455	235
4-L248	Existing	546	43
	Existing + 1a	616	403
	Existing + 1b	616	113
	Existing + 2a	591	103
	Existing + 2b	591	62

Based on the assumptions presented above changes in noise level based on the existing flows have been estimated and is presented in Table 12-21.

Table 12-21 Estimated Changes in Traffic Noise Levels

Route	Stage	Change in Traffic Noise Level dB(A)	Initial Significance of Effect	Estimated Number of Days
1-N68	1a	+2.3	Not Significant	8
	1b	+0.6	Imperceptible	8
	2a	+0.3	Imperceptible	8
	2b	+0.1	Imperceptible	8
2-R484	1a	+2.8	Not Significant	344
	1b	+0.7	Imperceptible	344
	2a	+0.4	Imperceptible	344
	2b	+0.1	Imperceptible	344
3-L2082	1a	+3.7	Slight/Moderate	22
	1b	+1.0	Not Significant	22
	2a	+0.6	Imperceptible	22
	2b	+0.4	Imperceptible	22
4-L2048	1a	+8.3	Significant	8
	1b	+3.3	Slight/Moderate	8
	2a	+1.8	Not Significant	8
	2b	+0.4	Imperceptible	8

The increase in noise levels due to additional construction traffic on each of the routes is predicted to be less than 3 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 3 dB:

- During Stage 1a, the predicted changes in noise levels at road links 3 and 4 are in the range +3.7 to +8.3 dB $L_{Aeq,1hr}$. However, the predicted noise levels of existing and construction traffic are in the range 61 to 63 dB, $L_{Aeq,1hr}$.
- During Stage 31b the predicted changes in noise levels at road link 4 is +3.3 dB $L_{Aeq,1hr}$. However, the predicted noise levels of existing and construction traffic are 56 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.

12.5.2.8 Construction Traffic – Proposed Grid Connection

In respect of noise from the construction traffic associated with the grid connection, it is confirmed in Section 15.1.12.2 of the Chapter 15 Material Assets, that the related traffic flows are low. In order to increase traffic noise levels by 1 dB, traffic volumes would need to increase by the order of 25%; in this context the noise effect of construction traffic for the grid connection is not significant.

12.5.2.9 Cumulative Construction Noise and Vibration Effects

The list of cumulative projects from Appendix 2-2 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.

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.

12.5.3.1.1 Turbine Noise Assessment

The noise levels due to the turbines in the Proposed Wind Farm have been calculated for all noise sensitive receivers identified within approximately 2 km of the Proposed Turbines.

A worst-case assessment has been completed assuming all noise locations are downwind of the Proposed Turbines at the same time. The predicted levels have been compared against the adopted noise criteria curves and noise levels are exceeded at 30 locations:

During daytime periods, at up to 30 locations, there are exceedances of between +0.1 and +2.8 dB, as follows:

- 12 locations with exceedances from +0.1 to +1.0 dB;
- 14 locations with exceedances from +1.1 to 2.0 dB;
- 6 locations with exceedances from +2.1 to +2.8 dB.

During night-time periods, nine locations have exceedances of up to 0.8 dB L_{A90} .

Table 12-22 presents the details of the exercise at these locations. Results for the full set of NSLs are presented in Appendix 12-7.

Table 12-22 Review of Cumulative Predicted Turbine Noise Levels against Relevant Criteria

NSL	Parameter	Predicted Noise Level dB L_{A90} at Standardised Wind Speed at 10m at ground level (A.G.L.)						
		3	4	5	6	7	8	9
H001	Predicted	34.5	36.3	39.9	42.1	42.8	43.2	43.5
	Daytime Criterion	40	40	40	40	40	45	45
	Daytime Excess	–	–	–	2.1	2.8	–	–
	Night-time Criterion	43	43	43	43	43	43	43
	Night-time Excess	–	–	–	–	–	0.2	0.5
H002	Predicted	33.4	35.5	39.1	41.3	41.9	42.3	42.5

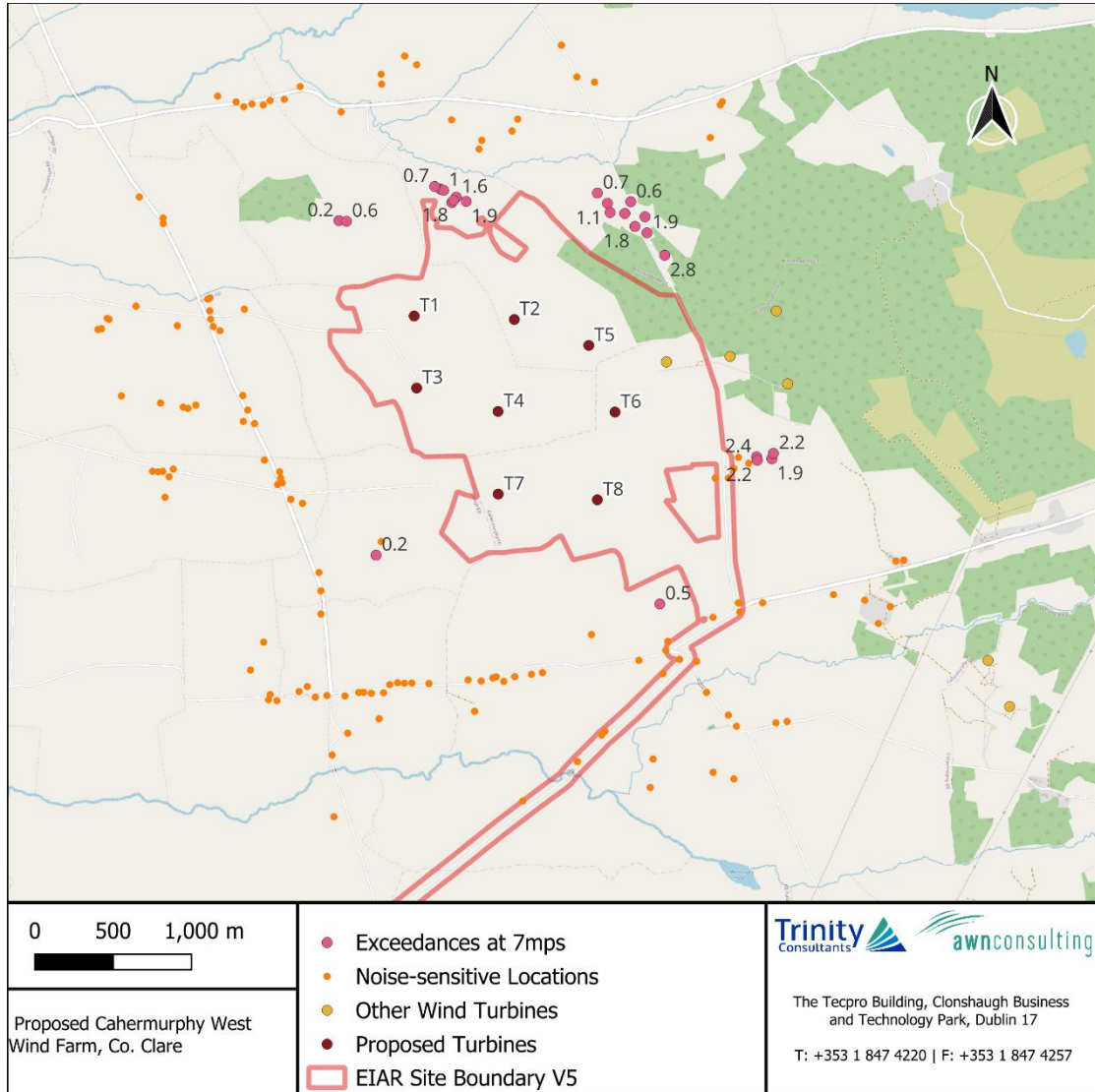
NSL	Parameter	Predicted Noise Level dB L _{A90} at Standardised Wind Speed at 10m at ground level (A.G.L.)						
		3	4	5	6	7	8	9
	Daytime Criterion	40	40	40	40	40	45	45
	Daytime Excess	–	–	–	1.3	1.9	–	–
	Night-time Criterion	43	43	43	43	43	43	43
	Night-time Excess	–	–	–	–	–	–	–
H003	Predicted	33.1	35.4	39	41.2	41.8	42.1	42.3
	Daytime Criterion	40	40	40	40	40	45	45
	Daytime Excess	–	–	–	1.2	1.8	–	–
	Night-time Criterion	43	43	43	43	43	43	43
	Night-time Excess	–	–	–	–	–	–	–
H004	Predicted	32.6	35	38.8	40.9	41.5	41.8	41.9
	Daytime Criterion	40	40	40	40	40	45	45
	Daytime Excess	–	–	–	0.9	1.5	–	–
	Night-time Criterion	43	43	43	43	43	43	43
	Night-time Excess	–	–	–	–	–	–	–
H005	Predicted	32.2	34.6	38.3	40.5	41.1	41.3	41.5
	Daytime Criterion	40	40	40	40	40	45	45
	Daytime Excess	–	–	–	0.5	1.1	–	–
	Night-time Criterion	43	43	43	43	43	43	43
	Night-time Excess	–	–	–	–	–	–	–
H006	Predicted	32	34.2	37.8	40	40.6	40.9	41.1
	Daytime Criterion	40	40	40	40	40	45	45
	Daytime Excess	–	–	–	–	0.6	–	–
	Night-time Criterion	43	43	43	43	43	43	43
	Night-time Excess	–	–	–	–	–	–	–
H007	Predicted	31.8	34.2	38	40.1	40.7	40.9	41.1
	Daytime Criterion	40	40	40	40	40	45	45
	Daytime Excess	–	–	–	0.1	0.7	–	–
	Night-time Criterion	43	43	43	43	43	43	43
	Night-time Excess	–	–	–	–	–	–	–
H023	Predicted	31.6	34.4	38.3	40.4	41	41.1	41.2
	Daytime Criterion	40	40	40	40	45	45	45
	Daytime Excess	–	–	–	0.4	–	–	–
	Night-time Criterion	43	43	43	43	43	43	43
	Night-time Excess	–	–	–	–	–	–	–
H024	Predicted	31.6	34.4	38.3	40.4	40.9	41.1	41.1
	Daytime Criterion	40	40	40	40	40	45	45
	Daytime Excess	–	–	–	0.4	0.9	–	–
	Night-time Criterion	43	43	43	43	43	43	43
	Night-time Excess	–	–	–	–	–	–	–
H025	Predicted	32.2	35	38.9	41	41.6	41.7	41.8
	Daytime Criterion	40	40	40	40	40	45	45
	Daytime Excess	–	–	–	1.0	1.6	–	–
	Night-time Criterion	43	43	43	43	43	43	43
	Night-time Excess	–	–	–	–	–	–	–
H026	Predicted	32.4	35.3	39.2	41.4	41.9	42	42.1
	Daytime Criterion	40	40	40	40	40	45	45
	Daytime Excess	–	–	–	1.4	1.9	–	–
	Night-time Criterion	43	43	43	43	43	43	43
	Night-time Excess	–	–	–	–	–	–	–

NSL	Parameter	Predicted Noise Level dB L _{A90} at Standardised Wind Speed at 10m at ground level (A.G.L.)						
		3	4	5	6	7	8	9
H027	Predicted	31.7	34.5	38.4	40.5	41	41.2	41.2
	Daytime Criterion	40	40	40	40	40	45	45
	Daytime Excess	–	–	–	0.5	1.0	–	–
	Night-time Criterion	43	43	43	43	43	43	43
	Night-time Excess	–	–	–	–	–	–	–
H028	Predicted	32.4	35.4	39.2	41.4	41.9	42	42.1
	Daytime Criterion	40	40	40	40	40	45	45
	Daytime Excess	–	–	–	1.4	1.9	–	–
	Night-time Criterion	43	43	43	43	43	43	43
	Night-time Excess	–	–	–	–	–	–	–
H029	Predicted	34.5	36.6	40.2	42.4	43.1	43.5	43.7
	Daytime Criterion	40	40	40	40	45	45	45
	Daytime Excess	–	–	0.2	2.4	–	–	–
	Night-time Criterion	43	43	43	43	43	43	43
	Night-time Excess	–	–	–	–	0.1	0.5	0.7
H030	Predicted	34.2	36	39.6	41.8	42.5	42.9	43.2
	Daytime Criterion	40	40	40	40	45	45	45
	Daytime Excess	–	–	–	1.8	–	–	–
	Night-time Criterion	43	43	43	43	43	43	43
	Night-time Excess	–	–	–	–	–	–	0.2
H031	Predicted	34.5	36.2	39.7	41.9	42.7	43.1	43.4
	Daytime Criterion	40	40	40	40	45	45	45
	Daytime Excess	–	–	–	1.9	–	–	–
	Night-time Criterion	43	43	43	43	43	43	43
	Night-time Excess	–	–	–	–	–	0.1	0.4
H032	Predicted	35.1	36.5	39.9	42.2	43	43.5	43.8
	Daytime Criterion	40	40	40	40	45	45	45
	Daytime Excess	–	–	–	2.2	–	–	–
	Night-time Criterion	43	43	43	43	43	43	43
	Night-time Excess	–	–	–	–	–	0.5	0.8
H033	Predicted	34.4	35.9	39.2	41.5	42.3	42.8	43.2
	Daytime Criterion	40	40	40	40	45	45	45
	Daytime Excess	–	–	–	1.5	–	–	–
	Night-time Criterion	43	43	43	43	43	43	43
	Night-time Excess	–	–	–	–	–	–	0.2
H034	Predicted	34.8	36	39.3	41.6	42.4	43	43.4
	Daytime Criterion	40	40	40	40	40	45	45
	Daytime Excess	–	–	–	1.6	2.4	–	–
	Night-time Criterion	43	43	43	43	43	43	43
	Night-time Excess	–	–	–	–	–	–	0.4
H035	Predicted	34.4	35.5	38.7	41	41.9	42.5	43
	Daytime Criterion	40	40	40	40	40	45	45
	Daytime Excess	–	–	–	1.0	1.9	–	–
	Night-time Criterion	43	43	43	43	43	43	43
	Night-time Excess	–	–	–	–	–	–	–
H055	Predicted	30.9	33.7	37.6	39.7	40.2	40.4	40.4
	Daytime Criterion	40	40	40	40	40	45	45
	Daytime Excess	–	–	–	–	0.2	–	–
	Night-time Criterion	43	43	43	43	43	43	43

NSL	Parameter	Predicted Noise Level dB L _{A90} at Standardised Wind Speed at 10m at ground level (A.G.L.)						
		3	4	5	6	7	8	9
	Night-time Excess	–	–	–	–	–	–	–
H077	Predicted	30.9	33.7	37.6	39.7	40.2	40.4	40.4
	Daytime Criterion	40	40	40	40	40	45	45
	Daytime Excess	–	–	–	–	0.2	–	–
	Night-time Criterion	43	43	43	43	43	43	43
	Night-time Excess	–	–	–	–	–	–	–
H080	Predicted	31.2	34.1	38	40.1	40.6	40.8	40.8
	Daytime Criterion	40	40	40	40	40	45	45
	Daytime Excess	–	–	–	0.1	0.6	–	–
	Night-time Criterion	43	43	43	43	43	43	43
	Night-time Excess	–	–	–	–	–	–	–
H081	Predicted	32.3	35.2	39.1	41.2	41.8	41.9	42
	Daytime Criterion	40	40	40	40	40	45	45
	Daytime Excess	–	–	–	1.2	1.8	–	–
	Night-time Criterion	43	43	43	43	43	43	43
	Night-time Excess	–	–	–	–	–	–	–
H082	Predicted	32.6	34.7	38.3	40.5	41.1	41.4	41.6
	Daytime Criterion	40	40	40	40	40	45	45
	Daytime Excess	–	–	–	0.5	1.1	–	–
	Night-time Criterion	43	43	43	43	43	43	43
	Night-time Excess	–	–	–	–	–	–	–
H083	Predicted	32.6	34.8	38.6	40.7	41.3	41.6	41.8
	Daytime Criterion	40	40	40	40	40	45	45
	Daytime Excess	–	–	–	0.7	1.3	–	–
	Night-time Criterion	43	43	43	43	43	43	43
	Night-time Excess	–	–	–	–	–	–	–
H085	Predicted	31.3	33.9	37.7	39.9	40.5	40.8	40.9
	Daytime Criterion	40	40	40	40	40	45	45
	Daytime Excess	–	–	–	–	0.5	–	–
	Night-time Criterion	43	43	43	43	43	43	43
	Night-time Excess	–	–	–	–	–	–	–
H125	Predicted	31.4	34.2	38.1	40.2	40.7	40.9	40.9
	Daytime Criterion	40	40	40	40	40	45	45
	Daytime Excess	–	–	–	0.2	0.7	–	–
	Night-time Criterion	43	43	43	43	43	43	43
	Night-time Excess	–	–	–	–	–	–	–
H135	Predicted	34.8	35.8	39	41.3	42.2	42.8	43.4
	Daytime Criterion	40	40	40	40	40	45	45
	Daytime Excess	–	–	–	1.3	2.2	–	–
	Night-time Criterion	43	43	43	43	43	43	43
	Night-time Excess	–	–	–	–	–	–	0.4
H144	Predicted	34.5	35.8	39.1	41.4	42.2	42.8	43.2
	Daytime Criterion	40	40	40	40	40	45	45
	Daytime Excess	–	–	–	1.4	2.2	–	–
	Night-time Criterion	43	43	43	43	43	43	43
	Night-time Excess	–	–	–	–	–	–	0.2

To understand the distribution of the NSLs with predicted exceedances of the noise criteria, Figure 12-5 shows NSLs with exceedances at 7 m/s displayed at each NSL.

Figure 12-5 Exceedances of noise criteria at 7 m/s



A noise contour for standard mode operation rated power wind speed (i.e. highest noise emission) has been presented in Appendix 12-8.

12.5.3.1.2 Consideration of Wind Direction

The next stage in the assessment is to consider the effects of wind direction adopting the methodology described in Section 12.3.6.2.2 to assess the exceedances identified. Directional noise prediction models have been developed to identify the number and magnitude of exceedances of the noise criteria. Table 12-23 and Table 12-24 present the number of NSLs with exceedances at various wind speeds, taking into account the wind direction, for day and night-time periods respectively.

Table 12-23 Number of NSLs with Exceedances - Daytime

Direction	Number of NSLs with exceedances at Standardised Wind Speed at 10m A.G.L.								Highest Exceedance, dB L _{A90}
	3	4	5	6	7	8	9	10	
North	0	0	0	10	6	0	0	0	+1.9
Northeast	0	0	0	3	5	0	0	0	+0.8
East	0	0	0	1	6	0	0	0	+0.6
Southeast	0	0	0	12	16	0	0	0	+1.9
South	0	0	0	16	18	0	0	0	+2.7
Southwest	0	0	0	14	17	0	0	0	+2.3
West	0	0	0	12	10	0	0	0	+1.8
Northwest	0	0	0	9	5	0	0	0	+2.3

Table 12-24 Number of NSLs with Exceedances - Night

Direction	Number of NSLs with exceedances at Standardised Wind Speed at 10m A.G.L.								Highest Exceedance, dB L _{A90}
	3	4	5	6	7	8	9	10	
North	0	0	0	0	0	0	2	2	+0.3
Northeast	0	0	0	0	0	0	0	0	-
East	0	0	0	0	0	0	0	0	-
Southeast	0	0	0	0	0	0	0	0	+1.9
South	0	0	0	0	0	1	1	1	+0.4
Southwest	0	0	0	0	0	0	0	0	-
West	0	0	0	0	0	0	1	1	+0.1
Northwest	0	0	0	0	0	2	7	7	+0.5

12.5.3.1.3

Consideration of Lower End of Design Range

The highest tip height for the proposed development is 185 m. As presented in in Section 12.4.2, the turbine option with the highest sound power level at the majority of windspeeds is the Nordex N163, therefore the hub height selected for the assessment is 103.5 m, corresponding to the tip height of 185 m.

However the Proposed Project includes a range of tip heights from 180 to 185 m. If the same turbine were constructed with a tip height of 180 m, the hub height would be 98.5 m. Thus there is the potential for predicted noise levels at NSLs to be slightly different to those for a hub height of 103.5m.

In order to understand the potential difference in noise levels at NSLs and whether there are any differences in the potential effects, the calculations were repeated for the NSLs in Table 12-22, i.e. the NSLs where exceedances are noted, before directionality is taken into account.

Table 12-25 presents the differences in predicted noise level between those for the two hub heights, 103.5m and 98.5 m, for the same set of NSLs presented in Table 12-22. The majority of predicted noise levels are the same as for both scenarios.

Table 12-25 Comparison of Predicted Noise Levels for upper and lower end of the design flexibility range

Name	Predicted Noise Level dB L _{A90} at Standardised 9 m/s Wind Speed at 10m at ground level (A.G.L.)		
	103.5 m HH	98.5 m HH	Difference
H001	43.5	43.5	0
H002	42.5	42.5	0
H003	42.3	42.3	0
H004	41.9	41.9	0
H005	41.5	41.5	0
H006	41.1	41.1	0
H007	41.1	41.1	0
H023	41.2	41.2	0
H024	41.1	41.2	0.1
H025	41.8	41.8	0
H026	42.1	42.1	0
H027	41.3	41.3	0
H028	42.1	42.1	0
H029	43.7	43.7	0
H030	43.2	43.2	0
H031	43.5	43.5	0
H032	43.9	43.9	0
H033	43.2	43.2	0

Name	Predicted Noise Level dB L _{A90} at Standardised 9 m/s Wind Speed at 10m at ground level (A.G.L.)		
	103.5 m HH	98.5 m HH	Difference
H034	43.4	43.4	0
H035	43.0	43.0	0
H055	40.4	40.4	0
H077	40.4	40.4	0
H080	40.8	40.8	0
H081	42.0	42.0	0
H082	41.7	41.7	0
H083	41.8	41.8	0
H085	40.9	40.9	0
H125	40.9	40.9	0
H135	43.4	43.4	0
H144	43.2	43.2	0

Given the similarity of the predicted noise levels, there is no change in the significance of the noise impact between the upper end and the lower end of the design flexibility range.

12.5.3.1.4 **Significance of effect**

At the majority of locations, the predicted noise levels are within the noise criteria and therefore at those NSLs, the effect on the noise environment is not considered significant.

Exceedances up to 2.3 dB L_{A90} are considered to have moderate effect. Mitigation measures to reduce noise levels to within criteria are proposed in Section 12.6.2.

12.5.3.2 **Substation Noise Assessment**

Details of the proposed 110kV substation are described in Chapter 4 (Description of the Proposed Project). The substation is likely to be operating continuously, and the noise impact at the nearest NSL has been assessed to identify the potential greatest impact associated with the operation of the substation at the nearest NSL.

Noise prediction model calculations for the operation of the substation have been undertaken in accordance with ISO 9613:2024. The predicted noise level from the operation of the substation at the nearest NSL (H029 at approximately 179 m to the nearest point of the substation compound) is 34 dB L_{Aeq,T}. This level of noise is low, and it is concluded that there will be no significant noise emissions from the operation of the substation at any NSL. Furthermore, the predicted noise level is well below the criterion for fixed mechanical plant outlined in Section 12.3.2.2.4 and will not result in any adverse impacts at nearby NSLs. During the future design progression, acoustic features such as tonality,

impulsivity and intermittency, will be considered in the context of the character assessment framework contained in BS-4142. Where these acoustic features are present, the Rating Level should be controlled to avoid adverse impacts at NSLs in accordance with BS-4142. Given the distances to the nearest NSLs, the occurrence of any acoustic features is unlikely.

12.5.3.3 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 impacts anticipated and no perceptible vibration from site roads during the operational phase.

12.5.4 Decommissioning Phase

No specific mitigation measures are required for decommissioning. To ameliorate any potential noise impacts that may present during the decommissioning phase, a schedule of general best-practice noise control measures has been formulated in accordance with best practice guidance. These are outlined in the Construction and Environmental Management Plan (CEMP) (Appendix 4-5) that has been prepared for the Proposed Project.

12.6 Mitigation Measures

12.6.1 Construction Phase

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

12.6.1.1 Construction and Decommissioning Phase Mitigation Measures – Noise

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

The contract documents will specify that the Contractor undertaking the works will be obliged to take specific noise abatement measures and comply with the recommendations of British Standard BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise. To ameliorate any potential noise impacts that may present during the construction phase, a schedule of noise control measures has been formulated in accordance with best practice guidance. These are outlined in the Construction and Environmental Management Plan (CEMP) that has been prepared for the Proposed Project. The following list of measures will be implemented, where necessary, to ensure compliance with the relevant construction noise criteria:

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

- The hours of construction activity will be limited to avoid unsociable hours where possible. Construction operations shall generally be restricted to between 07:00hrs 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. Any out of hours works will be communicated with local residents in advance of any works.

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

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

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

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

- Restriction of hours within which blasting can be conducted (e.g. 09:00 – 19:00hrs).
- The firing of blasts at similar times to reduce the ‘startle’ effect.
- On-going circulars informing people of the progress of the works.
- The implementation of an onsite documented complaints procedure.
- The use of independent monitoring for verification of results.
- Trial blasts in less sensitive areas to assist in blast designs and identify potential zones of influence.

12.6.1.2 Construction and Decommissioning Phase Mitigation Measures – Vibration

The assessment presented in Section 12.5.2 has demonstrated that there will be no significant vibration impacts associated with the construction of the Proposed 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%.

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

12.6.2 Operational Phase

12.6.2.1.1 Wind Turbine Noise Levels

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 have determined that mitigation measures are required to reduce noise levels from the turbines in the Proposed Wind Farm to within the criteria outlined in Section 12.3.2.

Modern wind turbines can be programmed to run in reduced modes of operation (or low noise modes) to achieve the required attenuation in specific wind conditions (i.e., wind speed and direction). Operating the turbines in reduced noise modes, referred to as curtailment, typically results in a corresponding reduction in energy generation capacity for the turbine(s).

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

A curtailment scheme has been developed for the Proposed Wind Farm to reduce noise levels at 6 and 7 m/s for daytime periods and for 8 and 9 m/s for night-time periods, presented in Table 12-26 and Table 12-27 respectively. Where no value is shown, the turbine operates in standard mode.

If permission for the Proposed Project is granted, the curtailment scheme identified here will be brought forward and proven as part of the noise management plan.

Table 12-26 Curtailment Matrix for Daytime Periods

Wind Speed (m/s)	Turbine	Reduction Required (dB(A)) for wind direction sector							
		N	NE	E	SE	S	SW	W	NW
6	T01	–	–	2	8	–	–	–	–
	T02	5	–	–	5	9	9	4	3
	T03	–	–	–	–	–	–	–	–
	T04	–	–	–	–	5	–	–	6
	T05	9	–	–	8	9	9	9	9
	T06	9	–	–	5	9	8	8	9
	T07	2	6	–	–	–	–	–	7
	T08	9	–	–	–	3	3	9	9
7	T01	3	–	3	7	4	–	–	3
	T02	9	–	3	5	9	9	6	9
	T03	–	–	–	–	5	–	–	5
	T04	7	–	–	–	9	4	–	9
	T05	9	9	–	9	9	9	9	9
	T06	9	9	–	9	9	9	9	9
	T07	9	–	–	–	5	–	–	9
	T08	9	9	–	–	7	–	9	9

Table 12-27 Curtailment Matrix for Night-time Periods

Wind Speed (m/s)	Turbine	Reduction Required (dB(A)) for wind direction sector							
		N	NE	E	SE	S	SW	W	NW
8	T01	–	–	–	–	–	–	–	–
	T02	–	–	–	–	–	–	–	–
	T03	–	–	–	–	–	–	–	–
	T04	–	–	–	–	–	–	–	–
	T05	–	–	–	–	2	–	–	–
	T06	–	–	–	–	–	–	–	–
	T07	–	–	–	–	–	–	–	–
	T08	–	–	–	–	–	–	–	3
9	T01	–	–	–	–	–	–	–	–
	T02	–	–	–	–	–	–	–	–
	T03	–	–	–	–	–	–	–	–
	T04	–	–	–	–	–	–	–	–
	T05	–	–	–	–	5	–	–	–
	T06	5	–	–	–	–	–	–	4
	T07	–	–	–	–	–	–	–	–
	T08	–	–	–	–	–	–	1	4

With the implementation of the above curtailment schemes, predicted noise levels are within the criteria outlined in Section 12.3.2.2 at all NSLs.

In practice, noise levels at NSLs would be controlled through a planning condition imposing noise limits on operational noise from the wind turbines at neighbouring residential properties, in line with the noise criteria outlined in Section 12.3.2.2 and/or the relevant operational criteria associated with the grant of planning for the proposed project.

12.6.2.2 Fixed Plant

The assessment of noise from the operation of fixed plant at the substation is predicted to comply with the proposed criteria in Section 12.3.2.2.4. Therefore, no specific mitigation measures are required.

12.6.2.3 Monitoring

12.6.2.3.1 Noise Compliance Monitoring Plan

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

Prior to the commissioning of the wind farm, the developer will submit a Noise Complaint Monitoring Programme (NCMP) to the planning authority for written agreement. The NCMP will include a detailed methodology for noise measurements and procedures for recording results and a protocol for managing complaints.

Compliance noise surveys will be undertaken to verify compliance with any noise conditions applied to the development. It is common practice to commence surveys within six months of a wind farm being commissioned. The guidance outlined in the IOA GPG and Supplementary Guidance Note 5: Post Completion Measurements (July 2014) will be taken into account.

In the unlikely event that an exceedance of the noise criteria is identified as part of the commissioning assessment, implementation of noise reduced operational modes resulting in curtailment of turbine operation will be implemented for specific turbines in specific wind conditions to ensure turbine noise levels are within the relevant noise criterion curves/planning conditions limits. Such curtailment can be

applied using the wind farm SCADA system without undue effect on the wind turbine performance. Following implementation of these measures, noise surveys will be repeated to confirm compliance with the noise criteria.

12.6.2.3.2 **Amplitude Modulation**

In the event that a complaint which indicates potential excessive amplitude modulation (AM) or tonality associated with the Proposed Project, the operator will fully investigate the complaint in collaboration with the turbine manufacturer, through review of the meteorological periods and conditions during which the reported AM or tonality occurs. A noise monitoring protocol will be established, in consultation with the local authority, which will set out the location and analysis methodology to be employed for the noise monitoring. This can be secured via a planning condition.

If an ongoing issue with excessive AM is identified, a mitigation strategy to reduce the level of AM will be agreed with Clare County Council and implemented through engineering methods and/or curtailment of specific turbines. The operator will appoint a qualified acoustic consultant to objectively assess the level of AM in accordance with the methods outlined in the Institute of Acoustics IOA Noise Working Group (Wind Turbine Noise) Amplitude Modulation Working Group Final Report: *A Method for Rating Amplitude Modulation in Wind Turbine Noise* (9 August 2016) or subsequent revisions.

The measurement method outlined in the IOA AMWG document, known as the ‘Reference Method’, will provide a robust and reliable indicator of AM and yield important objective information on the frequency and duration of occurrence, which can be used to evaluate different operational conditions including methods to mitigate any excessive AM. Examples of mitigation measures which could be considered include turbine blade modifications, the implementation of specific operational controls for the relevant turbine type or operating turbines in different operational modes or turbine curtailment under specific operational conditions. The aim of the mitigation would be to minimise adverse impacts from excessive AM associated with the proposed project as much as is reasonably practicable.

The commitments outlined to control amplitude modulation (AM) and tonality from wind turbines are considered best practice. The proposed approach provides a clear commitment that additional adverse impacts from excessive amplitude modulation (AM) or tonality associated with the operation of the proposed project will be effectively managed and minimised by the operator.

12.6.2.3.3 **Tonality**

Similarly, if the complaints suggest the potential occurrence of clearly audible tonality in the wind turbine noise, the audibility of the tones will be investigated from measured data with a robust, objective method such as that included in ISO 1996-2:2017.

In the unlikely event that a clearly audible tone or tones are identified at a noise-sensitive location, the operator would liaise with the turbine manufacturer to investigate and implement measures to mitigate or minimise the occurrence of tonality as much as is reasonably practicable. The appropriate mitigation measures will depend on the cause or source of the tonal noise and will typically be applied at source. This may involve engineering modifications to mechanical or electrical components, or the implementation of software-based operational controls via the turbine control system, such as adjustments to the turbine operating mode, rotor speed and/or blade pitch. These capabilities are embedded within the control systems of modern wind turbines.

12.6.2.3.4 **Noise Compliance Management Protocol**

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

In the event of a complaint associated with noise, for example, from tonality or amplitude modulation due to the proposed project, in line with the NCMP documents to be submitted and agreed with the local authority), the operator will fully investigate the complaint in collaboration with the turbine manufacturer, through review of the meteorological periods and conditions.

A Draft Noise Complaint Management Protocol for addressing AM or tonality presented in Appendix 12-9. A final version of this protocol will be contained within the NCMP to be agreed the relevant Local Authority and/or Authorities.

12.7 Description of Residual Effects

12.7.1 Construction Phase

During the construction phase of the Proposed Project there will be some effect on nearby noise sensitive properties due to noise emissions from site traffic and other construction activities. However, given the distances between the main construction works and nearby noise sensitive properties and the fact that the construction phase of the Proposed 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 worst-case associated effects at the nearest noise sensitive locations associated with the various elements of the construction phase are described below.

12.7.1.1 Proposed Turbines, Hardstanding, and Met Mast

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

Quality	Significance	Duration
Negative	Not Significant	Short-term

12.7.1.2 Proposed Substation

The predicted worst-case construction noise and vibration effects, at NSLs, associated with proposed substation to existing roads, at NSLs, are not significant and are summarised as follows:

Quality	Significance	Duration
Negative	Not Significant	Temporary

12.7.1.3 Proposed Access Roads and Existing Road Upgrades

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

Quality	Significance	Duration
Negative	Not Significant	Temporary

12.7.1.4 Borrow Pits

The predicted worst-case noise and vibration effects, at NSLs, associated with proposed use of borrow pits at NSLs is not significant and are summarised as follows:

Quality	Significance	Duration
Negative	Not Significant	Temporary

12.7.1.5 Turbine Delivery Route Accommodation Works

The predicted worst-case noise and vibration effects, at NSLs, associated with construction of the proposed temporary works at NSLs are not significant and are summarised as follows:

Quality	Significance	Duration
Negative	Not significant	Temporary

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

12.7.1.6 Grid Connection Cabling

The predicted worst-case noise and vibration effects, at NSLs, associated with construction of the proposed grid connection cabling works at NSLs are not significant and are summarised as follows:

Quality	Significance	Duration
Negative	Not significant	Temporary

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

12.7.1.7 Construction Traffic

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

Quality	Significance	Duration
Negative	Not significant	Short-term

12.7.2 Operational Phase

12.7.2.1 Noise

12.7.2.1.1 Wind Turbine Noise

The predicted noise levels associated with the Proposed Wind Farm will be within best practice noise criteria curves recommended in Irish guidance ‘*Wind Energy Development Guidelines for Planning Authorities*’ therefore, once the mitigation measures described in Section 12.6.2 are implemented, it is not considered that a significant effect is associated with the Proposed Wind Farm.

The predicted residual operational turbine noise effects are not significant and summarised as follows at the closest noise sensitive locations 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 Substation Noise

Similarly the predicted noise levels due to the proposed substation are within the proposed criteria in Section 12.3.2.2.4. The predicted residual substation noise effects are not significant and summarised as follows at the closest noise sensitive locations to the site:

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 vibration the associated effect is not significant and summarised as follows:

Quality	Significance	Duration
Negative	Imperceptible	Long-term

12.7.3 Decommissioning Phase

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

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	Not Significant	Short-term

12.7.4 Cumulative Effects

12.7.4.1 Other Wind Farms

The above operational noise assessment has considered the potential cumulative impacts of the Proposed Project in combination with other wind energy developments in the area as required by best practice guidance discussed in Section 12.3.2.2.1 and as detailed in Section 12.5.3.1.1.

As noted in Section 12.5.3.1.1, the predicted noise levels associated with the Proposed Project, which takes into account other wind energy developments in the area, will be within best practice noise criteria curves recommended in Irish guidance ‘*Wind Energy Development Guidelines for Planning Authorities*’

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

12.8 Conclusion

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

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

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

Noise from the operation of the proposed onsite 110kV substation has also been assessed and there is no potential for any significant effects.

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

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

EIA CLASSIFICATION SUMMARY

Please see the below table for a summary of all identified impacts for the Proposed Project relating to noise.

1.

PROPOSED PROJECT

Topic	Pre-Mitigation Effect	Mitigation Section Reference	Residual Effect	Significance
Construction Phase				
Turbines, Hardstand Areas, and Met Mast	Short-term, Not Significant, Negative	Section 12.6.1 – None Required	Short-term, Not Significant, Negative	Not Significant
Substation	Short-term, Not Significant, Negative	Section 12.6.1 – None Required	Temporary, Not Significant, Negative	Not Significant
Access Roads and Existing Road Upgrades	Short-term, Not Significant, Negative	Section 12.6.1 – None Required	Temporary, Not Significant, Negative	Not Significant
Borrow Pits	Short-term, Not Significant, Negative	Section 12.6.1 – None Required	Temporary, Not Significant, Negative	Not Significant
TDR Accommodation Works	Short-term, Not Significant, Negative	Section 12.6.1 – None Required	Temporary, Not Significant, Negative	Not Significant
Grid Connection Cabling	Short-term, Not Significant, Negative	Section 12.6.1 – None Required	Temporary, Not Significant, Negative	Not Significant
Construction Traffic	Short-term, Not Significant, Negative	Section 12.6.1 – None Required	Short-term, Not Significant, Negative	Not Significant
Vibration	Long-term, Negative, Imperceptible	Section 12.6.1 – None Required	Long-term, Negative, Imperceptible	Not Significant
Operational Phase				
Wind Turbine Noise	Long-term, Not Significant to Moderate, Negative	Section 12.6.2.1 Section 12.6.2.2	Long-Term, Not Significant, Negative	Not Significant
Substation Noise	Long-Term, Not Significant, Negative	Section 12.6.3	Long-Term, Not Significant, Negative	Not Significant

Use of Site Roads	No Impact	No Impact	No Impact	Not Significant
Decommissioning Phase				
Proposed Wind Farm	Short-Term, Not Significant, Negative	Section 12.6.1	Short-Term, Not Significant, Negative	Not Significant