Environmental Impact Assessment Report (EIAR)

Cunlaghfadda Green Energy Project, Co. Mayo

Chapter 12 Noise and Vibration

12. NOISE AND VIBRATION

12.1 Introduction

This chapter of the EIAR describes the assessment undertaken of the likely significant noise and vibration effects from the Cunlaghfadda Green Energy Project, Co. Mayo (the Proposed Project). As detailed in Section 1.1.1 in Chapter 1, for the purposes of this EIAR, the various project components are described and assessed using the following references:

- Where the 'Proposed Wind Farm' is referred to, this refers to turbines and associated foundations and hardstanding areas, including access tracks, underground cabling, permanent meteorological mast, temporary construction compound, peat and spoil management, biodiversity enhancement, tree felling, site drainage, operational stage signage, turbine delivery route and junction accommodation works and all ancillary works and apparatus. The Proposed Wind Farm is described in detail in Chapter 4, Section 4.4.1 of this EIAR.
- Where the 'Proposed Grid Connection' is referred to, this refers to the proposed 110kV onsite substation, underground 110kV cabling and end masts connecting the proposed 110kV substation to the 110kV Castlebar to Cloon overhead line, access tracks and all ancillary works and apparatus. The Proposed Grid Connection Route is described in detail in Chapter 4, Section 4.4.2 of this EIAR.
- Where the 'Proposed Project' is referred to, this encompasses the entirety of the project (Proposed Wind Farm and Proposed Grid Connection) for the purposes of this EIA in accordance with the EIA Directive. The Proposed Project is described in detail in Chapter 4 of this EIAR.
- Where 'the Site' is referred to, this relates to the primary study area for the EIAR, as delineated by the EIAR Site Boundary in green as shown on Figure 1-2 of the EIAR and encompasses an area of approximately 165 hectares.

To facilitate the transportation of turbine components off the L-55512 and onto the L-1519, minor accommodating works are required along the L-55512 which involves temporary road widening and wall removal. A similar degree of works will be required on the junction along the L-5531, L-1505 and L1506 where temporary road widening, and vegetation clearance and extension of an existing culvert along a small stream will be required to provide the necessary clearance of the turbine delivery vehicle. All works are minor and have been assessed as part of this EIAR. Full details of the assessment are included as part of the traffic impact assessment set out in Section 15.1 of this EIAR. Once the turbines have been delivered, these areas will be reseeded/reinstated.

Noise and vibration impact assessments have been prepared for the construction, operational, and decommissioning phases of the Proposed Project at noise sensitive locations (NSLs). To inform this assessment baseline noise levels have been surveyed at five representative NSLs surrounding the Proposed Project site. Noise predictions for the nearest NSLs have been prepared for all key elements of the Proposed Project that have the potential for noise and vibration impacts and effects.

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

This chapter is supported by material in the following appendices:

- Appendix 12-1: Glossary of Acoustic Terms
- Appendix 12-2: Noise Modelling Assumptions and Parameters
- Appendix 12-3: Background Noise Summary
- Appendix 12-4: Predicted Noise Contours
- Appendix 12-5: Tabulated V136 Noise Results
- Appendix 12-6: Lidar Installation Report
- Appendix 12-7: Noise Study Area Selection

12.1.1 Statement of Authority

This chapter of the EIAR has been prepared by the following staff of AWN Consulting Ltd:

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

This chapter of the EIAR has been reviewed by the following staff of AWN Consulting Ltd:

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 including Oweninny Phase 3 Wind Farm, Garracummer Wind Farm, Meenbog Wind Farm, Lettergull Wind Farm, Ardderroo Wind Farm, Derryadd Wind Farm, Lisheen Wind Farm, Knockalough Wind Farm, Carrickaduff Wind Farm, Knockacummer Wind Farm, Kill Hill Wind Farm, Upperchurch Wind Farm.

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 0dB (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 10dB 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 250Hz. 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.

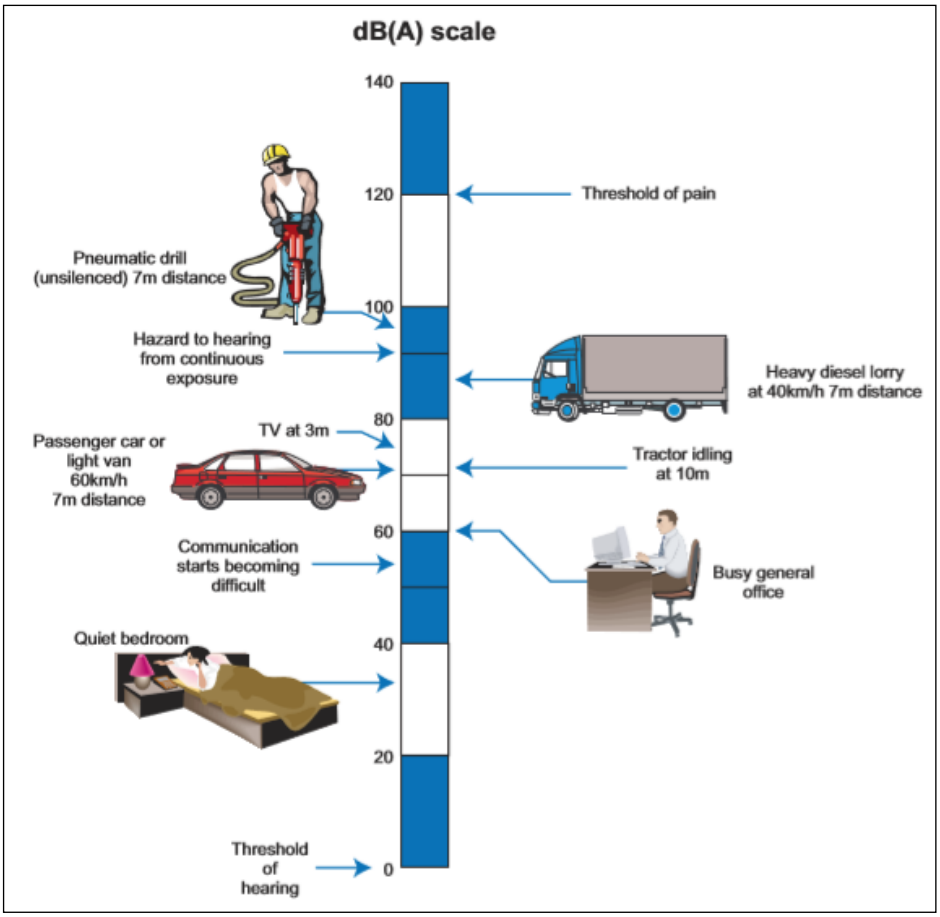


Figure 12-1 The level of typical common sounds on the dB(A) scale (National Roads Authority (NRA) Good Practice Guidance for the Treatment of Noise during the Planning of National Road Schemes (NRA, 2014)

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

12.3 Legislation, Policy and Guidance

The assessment of effects for the Proposed Project has been undertaken with reference to the most relevant guidance documents relating to environmental noise and vibration.

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

- Review of best practice guidance to identify appropriate noise and vibration criteria for the construction, operational and decommissioning phases;
- Characterise the receiving environment through baseline noise surveys at various NSLs surrounding the Proposed Project site;
- Undertake predictive calculations to assess the potential effects associated with the construction phase of the Proposed Project;
- Undertake predictive calculations to assess the potential effects associated with the operation of the Proposed Project at NSLs;
- Undertake predictive calculations to assess the potential effects associated with the decommissioning of the Proposed Project at NSLs;
- Specify mitigation measures to reduce, where necessary, the identified potential outward effects relating to noise and vibration from the Proposed Project; and,
- Describe the significance of the residual noise and vibration effects associated with the Proposed Project.

12.3.1 Environmental Protection Agency (EPA) Description of Effects

The significance of effects of the Proposed Project shall be described in accordance with the EPA guidance document *Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (EIAR)*, (EPA, 2022). Details of the methodology for describing the significance of the effects are provided in Section 1.6.2 of Chapter 1 Introduction.

The effects associated with the Proposed Project are described in the relevant sections of this chapter in accordance with the EPA guidance set out in Chapter 1 Introduction of the EIAR.

12.3.2 Guidance Documents and Assessment Criteria

The following sections review best practice guidance that is commonly adopted in relation to renewable energy developments such as the one under consideration here.

The following guidance documents have been consulted when preparing this chapter of the EIAR:

- EPA Guidelines on the Information to be contained in Environmental Impact Statements, (EPA, 2022);
- Mayo County Development Plan 2022-2028 (Mayo CDP)
- Mayo County Renewable Energy Strategy 2011-2022 (Mayo CRES)
- Regional Spatial and Economic Strategy 2020-2032 (RSES)
- Mayo Noise Action Plan 2024-2028 (Mayo NAP)
- Wind Energy Development Guidelines for Planning Authorities, Department of the Environment, Heritage, and Local Government (2006) (the Guidelines (DoEHLG 2006)) with cognisance of *Draft Revised Wind Energy Development Guidelines* 2019 Department of Housing, Local Government and Heritage (the Draft Guidelines (DoHPLG, 2019));
- The Assessment and Rating of Noise from Wind Farms, Department of Trade, and Industry (UK) Energy Technology Support Unit (ETSU) (1996)[1];
- A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise and its Supplementary Guidance Notes (IOA GPG) (2013);
- Guidelines for the Treatment of Noise and Vibration in National Road Schemes, Transport Infrastructure Ireland (TII) (formerly National Roads Authority (NRA) (2004).
- Good Practice Guidance for the Treatment of Noise during the Planning of National Road Schemes, Transport Infrastructure Ireland (TII) (formerly National Roads Authority (NRA) (2014);
- British Standard BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise;
- British Standard BS 5228-2:2009+A1:2014 Code of practice for vibration control on construction and open sites – Vibration;
- British Standard BS 7385 – Evaluation and measurement for vibration in buildings – Part 2: Guide to damage levels from groundborne vibration (BSI, 1993);

[1] *A draft update of the guidance 'Assessment and Rating of Wind Turbine Noise' (2025) was published for consultation on 4 July 2025. This draft update to ETSU-R-97 is a UK consultation document and is not applicable to wind energy assessments in Ireland. In line with its draft status, and the advice within the document that it should not be used by planning authorities, the consultation draft has not been considered in this assessment.*

- Design Manual for Roads and Bridges (DMRB) Sustainability & Environment Appraisal LA 111 Noise and Vibration Revision 2 (National England (now National Highways) 2020);
- ISO 1996: 2017: Acoustics – Description, measurement, and assessment of environmental noise;
- ISO 9613-2:1996 Acoustics – Attenuation of sound during propagation outdoors - Part 2: General method of calculation (ISO, 1996);
- ISO 9613-2:2024 Acoustics – Attenuation of sound during propagation outdoors - Part 2: Engineering method for the prediction of sound pressure levels outdoors (ISO, 2024);
- EPA document Guidance Note for Noise Assessment of Wind Turbine Operations at EPA Licensed Sites (NG3) (EPA, 2011);
- EPA document 'Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4) (EPA, 2016);
- World Health Organisation (WHO) Environmental Noise Guidelines for the European Region (2018);
- Department for Business, Energy & Industrial Strategy Wind Turbine AM Review: Phase 2 Report Project Number: 3514482A Issue: 3 Issued August 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.

12.3.2.1 Construction and Decommissioning Phase - Noise

There is no published statutory Irish guidance relating to the maximum permissible noise level that may be generated during the construction phase of a project. Local authorities normally control construction activities by imposing limits on the hours of operation and may consider noise limits at their discretion. Mayo Noise Action Plan (Mayo NAP) refers to BS 5228-1 in terms of recommended methodology and good practice.

Thus, the appropriate criteria relating to permissible construction noise levels for a renewable energy development of this scale may be found in the '*British Standard BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites'* – Noise (BS5528-1).

The approach adopted here calls for the designation of an NSL into a specific category (A, B or C) based on existing ambient noise levels in the absence of construction noise. A threshold noise value is applied to each category. Exceedances (construction noise only) of the threshold value, at the facade of a NSL during construction, indicates a potential significant noise impact associated with the construction activities. The threshold values are applicable to both construction and decommissioning noise.

The threshold values recommended by BS5228-1 are depicted in Table 12-1 which, if exceeded, potentially signify a significant effect as recommended by BS 5228 – 1.

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

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
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 method is applied:

For each period (e.g., daytime) the ambient noise level is determined and rounded to the nearest 5 dB. At some sensitive properties, especially those situated near busy roads, ambient noise levels are anticipated to be relatively high. However, given the rural nature of the Site in general, reference has been made to the quietest properties near the development which have daytime ambient noise levels typically in the range of 28 to 45 dB $L_{Aeq,1hr}$. Therefore, for the purposes of this assessment, as a precautionary approach, all properties will be afforded a 'Category A' designation for initial assessing of construction noise impacts.

BS 5228-1 states that:

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

Please see Section 12.6.2 for the detailed assessment in relation to the construction of the Proposed Project.

12.3.2.1.1 *Linear Construction Works*

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

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

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

Paragraph E.2 goes on to state:

> *"Noise levels, between say 07.00 and 19.00 hours, outside the nearest window of the occupied room closest to the site boundary should not exceed:*

- *70 decibels (dBA) in rural, suburban areas away from main road traffic and industrial noise;*
- *75 decibels (dBA) in urban areas near main roads in heavy industrial areas".*

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 all the above guidance, a construction noise threshold of 70 dB $L_{Aeq,1hr}$ is proposed for linear construction activities on weekdays (i.e. upgraded and new tracks) . Noise levels above 70 dB $L_{Aeq,1hr}$ would indicate a likely significant effect depending on the duration and frequency of occurrence (Section 12.3.2.1.2 below).

12.3.2.1.2 *Interpretation of the CNT*

In order to assist with interpretation of the construction noise thresholds (CNT), Table 12-2 includes guidance as to the likely magnitude of impact associated with construction activities, relative to the CNT. This guidance is derived from guidance in the document published by Highways England (now National Highways) *Design Manual for Roads and Bridges Sustainability & Environment Appraisal LA 111 Noise and Vibration* (Revision 2) (hereafter referred to as DMRB). The DMRB guidance is considered appropriate and best practice as it provides a well-established, internationally recognised framework with objective criteria for assessing construction noise and vibration impacts, which aligns closely with the relevant significance effects from EPA 2022. Table 3.16 therein has been and adapted to include these significance descriptions.

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

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

The adapted DMRB guidance outlined will be used to assess the predicted construction noise levels at NSLs and comment on the likely significant effects during the construction phase.

12.3.2.2 Construction and Decommissioning Phase - Additional Vehicular Activity on Public Roads

There are no specific guidelines or limits relating to traffic related sources along the local or surrounding roads. Given that traffic from the Proposed Project will make use of existing 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 it is proposed to adopt guidance from Highways England (now National Highways) '*Design Manual for Roads and Bridges Sustainability & Environment Appraisal LA 111 Noise and Vibration (Revision 2)*' (DMRB Guidance). This guidance is consistent with TII document (NRA, 2014), including magnitudes of impacts along with sound levels changes.

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

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

Change in Sound Level (dB(A))	DMRB Magnitude of Impact (Short-term)	Initial Significance Rating
Less than 1 dB	No Change	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 (this includes the Turbine Delivery Route (TDR)) and comment on the likely 'short-term' impacts during the construction phase. Where a major or moderate impact is identified due to the change in traffic noise level, reference will be made to the overall predicted noise level from construction/decommissioning traffic in the context of the construction noise threshold values outlined previously in this section.

12.3.2.3 Construction and Decommissioning Phase – Vibration

Vibration standards come in two varieties: those dealing with human comfort and those dealing with cosmetic or structural damage to buildings. With respect to the Proposed Project, the range of relevant criteria used for building protection is expressed in terms of Peak Particle Velocity (PPV) in mm/s.

Guidance relevant to acceptable vibration within buildings is contained in the following documents that, in the absence of Irish statutory vibration limits, represent the primary guidance consistently referenced and accepted in EIARs reviewed by ACP and Local Authorities:

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

BS7385 states that there should typically be no cosmetic damage if transient vibration does not exceed 15 mm/s at 4 Hz rising to 20 mm/s at 15 Hz and 50 mm/s at 40 Hz and above. These guidelines relate to relatively modern buildings and should be reduced to 50% or less for more critical buildings.

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

The Transport Infrastructure Ireland (TII) '*Good Practice Guidance for the Treatment of Noise during the Planning of National Road Schemes'* (TII, 2014) (NRA Guidelines) also contains information on the permissible construction vibration levels during the construction phase as shown in Table 12-4.

Table 12-4 Allowable Transient Vibration at Properties

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

In accordance with the suggested vibration criteria discussed above from BS7385, BS5228-2 and the NRA Guidelines, the values in Table 12-4 from the NRA Guidelines are considered appropriate for this assessment as they provide nationally recognised, conservative PPV thresholds specifically developed for Irish infrastructure and construction works, ensuring a robust assessment in the absence of statutory Irish vibration limits.

12.3.2.4 Consideration of Duration When Assessing Effects

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

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

12.3.2.5 Operational Phase Noise – Wind Turbines

The Mayo CDP and Mayo CRES identify the Guidelines (DoEHLG, 2006) as the applicable best-practice guidance for wind energy developments. The noise assessment documented in this chapter is based on guidance in relation to acceptable levels of noise from wind farms as contained in the Guidelines (DoEHLG, 2006). The Guidelines (DoEHLG, 2006) are based on detailed recommendations set out in ETSU-R-97[1]. The ETSU-R-97 document has been used to supplement the guidance contained within the Guidelines (DoEHLG, 2006), where appropriate and necessary.

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

The core of the noise guidance contained within the Guidelines (DoEHLG, 2006) is based on the ETSU publication '*The Assessment and Rating of Noise from Wind Farms*' (*ETSU-R-97*).

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

[1] *A draft update of the guidance 'Assessment and Rating of Wind Turbine Noise' (2025) was published for consultation on 4 July 2025. This draft update to ETSU-R-97 is a UK consultation document and is not applicable to wind energy assessments in Ireland. In line with its draft status, and the advice within the document that it should not be used by planning authorities, the consultation draft has not been considered in this assessment.*

Page 58 of ETSU-R-97 states: "*...absolute noise limits and margins above background should relate to the cumulative effect of all wind turbines in the area which contribute to the noise received at the properties in question...*". Therefore, the noise contribution from all wind turbine projects (existing, permitted and proposed) in the area should be included in the assessment.

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

12.3.2.5.2 Institute of Acoustics Good Practice Guide

The original ETSU-R-97 concepts underwent a thorough standardisation and modernisation in 2013 with the Institute of Acoustics publication of the A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise (IOA GPG) including 6 Supplementary Guidance Notes. These documents bring together the combined experience of acoustic consultants in the UK and Ireland in the application of the assessment methods. Numerous improvements in the accuracy and robustness are described including the treatment of wind shear and the general adaptation to larger wind turbines. The guidance contained within IOA GPG is considered to represent best practice because they provide a long-established, internationally recognised and consistently accepted framework methodology endorsed by Irish planning authorities, and therefore has been adopted for this assessment.

12.3.2.5.3 Background Noise Surveys

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

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

12.3.2.5.4 Noise Prediction Calculations

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

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

Additional details on the noise prediction calculation settings are provided in Appendix 12.2.

12.3.2.5.5 Cumulative Assessment Screening

Existing, permitted and proposed wind turbine developments must be considered cumulatively in the noise impact assessment. To determine whether a particular wind farm development can be scoped out of the final assessment a '10 dB rule' is applied. The '10 dB rule,' is grounded in scientific principles and supported by best-practice guidance. It states that if the contribution from another wind farm is 10 dB below the cumulative turbine noise limits applied at NSLs within the study area, its contribution is insignificant to the overall cumulative turbine noise level, and it can therefore be scoped out of the final assessment.

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

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

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

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

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

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

An appraisal of the study area to determine whether a cumulative turbine noise impact assessment is required is presented in Appendix 12-7.

12.3.2.5.6 Wind Energy Guidelines for Planning Authorities

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

This following statement from the Guidelines (DoEHLG, 2006) represents the widely accepted daytime noise criterion 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, he use of a margin of 5dB(A) above background noise at nearby noise sensitive properties is not necessary to offer a reasonable degree of protection and may unduly restrict wind energy developments which should be recognised as having wider national and global benefits. Instead, in low noise environments where background noise is less than 30dB(A), it is recommended that the daytime level of the 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 $L_{A90,10min}$ parameter. This represents the commonly adopted night time noise criterion curve in relation to wind farm developments.

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

- An appropriate absolute limit level in the range of 35 – 40 dB L_{A90} for quiet daytime environments with background noise levels of less than 30 dB $L_{A90,10min}$;
- 45 dB $L_{A90,10min}$ or a maximum increase of 5 dB above background noise (whichever is higher), for daytime environments with background noise levels equal to or greater than 30 dB LA90,10min and;
- 43 dB $L_{A90,10min}$ for night time periods or a maximum increase of 5 dB above background noise (whichever is higher).

While the caveat of an increase of 5dB(A) above background for night-time operation is not explicit within the Guidelines (DoEHLG, 2006), an allowance for same is commonly applied in noise assessments prepared and is accepted as detailed in numerous examples of planning conditions issued by An Coimisiún Pleanála. This is supported by the guidance in ETSU-R-97 and the IOA GPG and is based on the principle that when background noise levels are sufficiently elevated, the potential impact of wind turbine noise is less significant, provided it does not exceed 5 dB above the background level. This approach is also consistent with the daytime criteria in the Guidelines (DoEHLG 2006), which allow the limit to increase by up to 5 dB above background where this exceeds the fixed threshold level.

12.3.2.5.7 Future Potential Guidance Changes

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

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

Wherein it is stated that:

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

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

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

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

> *"My Department is currently undertaking a focused review of the 2006 Wind Energy Development Guidelines. The review is addressing a number of key aspects of the Guidelines including noise, setback distance, shadow flicker, community obligation, community dividend and grid connections.*
>
> *My Department, in conjunction with the Department of the Climate, Energy and Environment (DCEE) which has primary responsibility for environmental noise matters, has been working to advance guidance on the noise aspect of the Guidelines, which is highly technical in nature. The two Departments have been engaging on proposals regarding the measurement and assessment of noise from wind turbines to ensure they are robust and fit for purpose having regard to, inter alia, the revised 2030 target to generate up to 80% of our electricity from renewable sources.*
>
> *My Department, in conjunction with DCEE, will make any further changes to the draft Guidelines which are deemed necessary or appropriate in the wake of this work to ensure that the finalised Guidelines, once issued, are fit for purpose to provide guidance in line with renewable energy and climate targets, whilst having appropriate regard to the impacts of wind energy development, including in relation to noise annoyance.*
>
> *The evolving policy and technical context including the new Planning and Development Act 2024, which was signed by the President on 17 October 2024, and the revision of the National Planning Framework (NPF) reinforces the need to ensure that the finalised Guidelines, once issued, are fit for purpose.*
>
> *In addition to this work, and in line with EU Directive requirements, a strategic environmental assessment (SEA) is being carried out on the draft Guidelines as part of the review process. In this regard, my Department intends to undertake a public consultation on updated draft Guidelines as part of the SEA process whereby all interested parties will have an opportunity to submit observations on the draft Guidelines. Finalised Guidelines will be prepared following detailed analysis and consideration of the submissions received during the consultation phase.*
>
> *More generally, with regard to the planning process and ensuring that the views of communities concerning wind energy developments are heard and given appropriate consideration, I wish to highlight that public participation is a crucial element of all substantive decision-making processes under the Planning and Development Act 2000, and the recently enacted Planning and Development Act 2024. As part of the process to review city and county development plans, it is open to members of the public to make an observation or submission on the draft development plan. The development plan sets out land use zoning objectives and outlines the types of potential development, including ancillary developments, which might be suitable for a particular area, and may include objectives for wind energy development. In addition, it is open to any member of the public to make an observation or submission on a planning application, including in relation to a proposed wind energy development, and the*

[1] https://www.oireachtas.ie/en/debates/question/2025-06-19/308/ *Last accessed 10 April 2026*

planning authority is statutorily obliged to consider such observation or submission before making a decision on the application.

My Department notes the commitment in the recently published Programme for Government 2025 – Securing Ireland's Future to prioritise the publication of the Wind Energy Development Guidelines, having regard to international best practice and standards. In light of this commitment, my Department is working towards concluding the finalisation of review of the Guidelines as a matter of priority, having regard to the intended public consultation and the finalisation of associated reforms and reviews including the revision of the NPF. When finalised, the revised Guidelines will be issued under section 28 of the Planning and Development Act 2000, as amended or, subject to commencement of the Planning and Development Act 2024, as a National Planning Statement, as appropriate. The current 2006 Wind Energy Development Guidelines remain in force, pending the finalisation of the review."

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

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

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

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

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

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

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

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

To reduce health effects, the GDG conditionally recommends that policy-makers implement suitable measures to reduce noise exposure from wind turbines in the population exposed to levels above the guideline values for average noise

exposure. No evidence is available, however, to facilitate the recommendation of one particular type of intervention over another."

The document acknowledges that no evidence is available to justify implementing the L_{den} parameter as an appropriate noise criterion for wind turbines.

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

There is potential for increased uncertainty due to the parameter used by the WHO for assessment of exposure (i.e., L_{den}), which it is acknowledged may be a poor characterisation of wind turbine noise and may limit the ability to observe associations between wind turbine noise and health outcomes, as stated below, from within the WHO Environmental Noise Guidelines for the European Region[1]:

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

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

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

12.3.2.5.9 Low Frequency Noise and Infrasound

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

[1] *Environmental noise guidelines for the European Region content Page 85 – Last accessed 09 April 2026*

> *the wake caused by the turbine tower. With modern active yaw turbines (i.e. the blades are upwind of the tower and the turbine is turned to face into the wind by a wind direction sensor on the nacelle activating a yaw motor) this is no longer a significant feature."*

An IOA statement in Respect of Wind Farm Noise Assessment dated December 2024 and published on the IOA website[1] 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, low frequency noise and infrasound associated with wind turbines is expected to be below perceptibility thresholds and are not likely to result in any significant effects at NSLs. The are no criteria proposed to assess low frequency noise or infrasound as part of the EIAR; this approach is standard practice in Ireland when assessing wind turbine noise at planning stage.

12.3.2.5.10 Tonality

A tone is the concentration of acoustic energy into a very narrow frequency range, with a noticeable character (such as a "hum" or "whine" for example). The audibility of any tones can be assessed by comparing the narrow band level of such tones with the masking level contained in a band of frequencies around the tone. Several objective methodologies to assess tonal audibility are available, such as the one included in ETSU-R-97 or that of ISO 1996-2 (2017) .

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

Wind farm noise guidelines such as those of ETSU-R-97 assume that the wind turbine noise does not normally contain clearly audible tones. It is not possible to predict the occurrence of tonality on a project reliably at the planning stage. The unlikely occurrence of tonality in the wind turbines of the Proposed Project will be managed through the commitments provided by the Applicant in Section 12.7.2.

12.3.2.5.11 Amplitude Modulation

In the context of this assessment, amplitude modulation (AM) is defined in the IOA Noise Working Group (Wind Turbine Noise) Amplitude Modulation Working Group (AMWG) document '*A Method for Rating Amplitude Modulation in Wind Turbine'* (IOA, 2016)[2] as:

[1] IOA Statement Final 18.12.24 – *Last access 30 Jan 2026*
[2] AMWG Final Report-09-08-2016.docx – *Last access 30 Jan 2026*

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

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

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

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

'Normal' AM

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

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

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

'Other' AM

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

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

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

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

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

Frequency of Occurrence of AM

Research by Salford University commissioned by the Department of Environment Food and Rural Affairs (DEFRA), the Department of Business, Enterprise and Regulatory Reform (BERR) and the Department of Communities and Local Government (CLG) investigated the issue of AM associated with wind turbine noise. The results were reviewed and published in the report '*Research into Aerodynamic Modulation of Wind Turbine Noise*' (2007). The conclusions of this report were that aerodynamic modulation was only considered to be an issue at four, and a possible issue at a further eight, of 133 sites in the UK that were operational at the time of the study and considered within the review. At the four sites where AM was confirmed as an issue, it was considered that conditions

associated with AM might occur between about 7 and 15% of the time. It also emerged that for three out of the four sites the complaints have subsided, in one case due to the introduction of a turbine control system.

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

RenewableUK Research Document states the following in relation to matter:

Page 68 Module F	*"even on those limited sites where it has been reported, its frequency of occurrence appears to be at best infrequent and intermittent."*
Page 6 Module F	*"It has also been the experience of the project team that, even at those wind farm sites where AM has been reported or identified to be an issue, its occurrence may be relatively infrequent. Thus, the capture of time periods when subjectively significant AM occurs may involve elapsed periods of several weeks or even months."*
Page 61 Module F	*"There is nothing at the planning stage that can presently be used to indicate a positive likelihood of OAM occurring at any given proposed wind farm site, based either on the site's general characteristics or on the known characteristics of the wind turbines to be installed."*

Concluding Comments on AM

Current research and guidance relating to wind turbine noise AM are ongoing. Among the most recent notable contributions is the IOA AMWG's 2016 publication, which outlines an objective measurement and rating approach known as the Reference Method. The IOA AMWG does not propose thresholds for adverse community response or recommend specific limits for AM. The purpose of the group is to consolidate existing research and to establish a consistent methodology for the objective measurement and rating of AM. A 2016 IOA AMWG proposes an objective method for measuring and rating AM known as the Reference Method. The IOA AMWG does not propose what level of AM is likely to result in adverse community response or propose any limits for AM. The purpose of the group is simply to use existing research to develop a Reference Methodology for the measurement and rating of AM.

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

> *"Any condition developed using the elements proposed in this study should be subject to a period of testing and review. The period should cover a number of sites where the condition has been implemented and would be typically in the order of 2-5 years from planning approval being granted."*

It is noted that the WSP report recommended that AM be controlled specifically during period of complaints. The key point is that while excessive amplitude modulation (AM) may occur during the operation of the wind farm, it may not necessarily result in any adverse impacts because the frequency of occurrence, the level and/or duration of the AM may not be sufficient to trigger such impacts, or it may occur at locations where no sensitive receptors are present. The WSP report states "*at present it is not possible to predict whether AM will or will not be prevalent on a site*".

As per the discussion on the research presented previously in this Section, excessive/other AM is considered an atypical phenomenon, and the duration, meteorological conditions, topography and

specific location or locations at which it presents cannot be predicted in the planning stage. For these reasons, the assessment of AM is typically triggered in response to complaints where the contributing factors aligning to the period of the complaint such as meteorological conditions and turbine operations can be investigated.

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

To date there is no clear industry and Governmental consensus on how AM should be regulated or managed through the planning and operational stage. In the absence of clear policy in Ireland to control AM from wind turbines, the commitments outlined in the Section 12.7.2.1 are considered to represent best practice to control AM and will be adopted in the event that an complaint relating to excessive AM is reported. A suitable Noise Complaint Monitoring Programme (NCMP) will be implemented for the Proposed Project. Should a noise complaint or evidence of an exceedance of the noise limits occur, the operator shall comply with any requirements of the Planning Authority to undertake an investigation (including shutting down wind turbines for background noise monitoring if required) and the implementation of appropriate mitigation measures, such as a curtailment programme, on the wind turbine operations will be undertaken. The NCMP will include standard practice methodology for AM to be investigated, only in the event of complaint, and, where the investigation verifies its presence, mitigation measures will be put in place to address the identified turbine AM noise characteristics.

12.3.2.6 Operational Phase Noise – Fixed Plant Items

The Proposed Project will include a 110kV substation located at the northwest of the Site, in the townland of Cloonbaul.

There is no published statutory Irish guidance relating to the maximum permissible noise level from fixed mechanical and electrical plant that would be associated with the proposed Substation and associated equipment (fixed mechanical and electrical plant). 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.

12.3.2.6.1 *EPA NG4*

In order to establish whether the NSLs would be considered 'low background noise' areas as defined in the EPA publication, '*Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities 2016*' (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 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 $L_{Ar,T}$	Evening Noise Criterion, dB $L_{Ar,T}$ (19:00 to 23:00hrs)	Night Noise Criterion, dB $L_{Aeq,T}$ (23:00 to 07:00hrs)

	(07:00 to 19:00hrs)		
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 '*Methods for rating and assessing industrial and commercial sound'* BS 4142:2014 that can be used to assess the likelihood of complaints from specific plant noise sources.

12.3.2.6.2 BS4142

BS 4142:2014 is the industry standard method for analysing fixed plant sound emissions to residential receptors. BS 4142:2014 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 4142:2014 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 4142:2014 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 4142:2014 recommends the application of a 2 dB penalty for a tone which is just perceptible at the receptor, 4 dB where it is clearly perceptible, and 6 dB where it is highly perceptible. In relation to intermittency, BS 4142:2014 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 4142:2014 as summarised below:

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

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

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

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

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

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

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

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

BS4142:2014 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 NSL's 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 guidance discussed above 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.

In light of the above guidance from EPA's NG4 and BS4142:2014, the proposed criteria are set out in Section 12.5.3 below. These criteria is intended to apply consistently across every NSL included in the assessment.

12.3.2.7 Operational Phase - Vibration

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

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

The shortest distance from any turbine within the Proposed Wind Farm to the nearest NSL is in excess of 643 m (distance from turbine T01 to NSL ref. H001). This setback distance complies with the four-times tip height setback requirement as set out in the Draft Guidelines (DoHPLG, 2019). 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 Wind Farm.

An IOA statement in Respect of Wind Farm Noise Assessment dated December 2024[1] and published 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.

12.4 Assessment Methodology

12.4.1 Study Area

The study area for the noise and vibration impact assessment was defined by the area where there is potential for noise and vibration impacts at NSLs associated with the Proposed Project during the construction, operational, decommissioning phases, and the turbine delivery route (TDR).

12.4.1.1 Construction and Decommissioning Study Area

During the construction and decommissioning phases, noise could occur at any location where activities occur as part of the Proposed Wind Farm, TDR, Proposed Grid Connection and along public roads where there are increases in traffic associated with the Proposed Project. There is also a potential for noise impacts from HGVs along the proposed TDR.

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

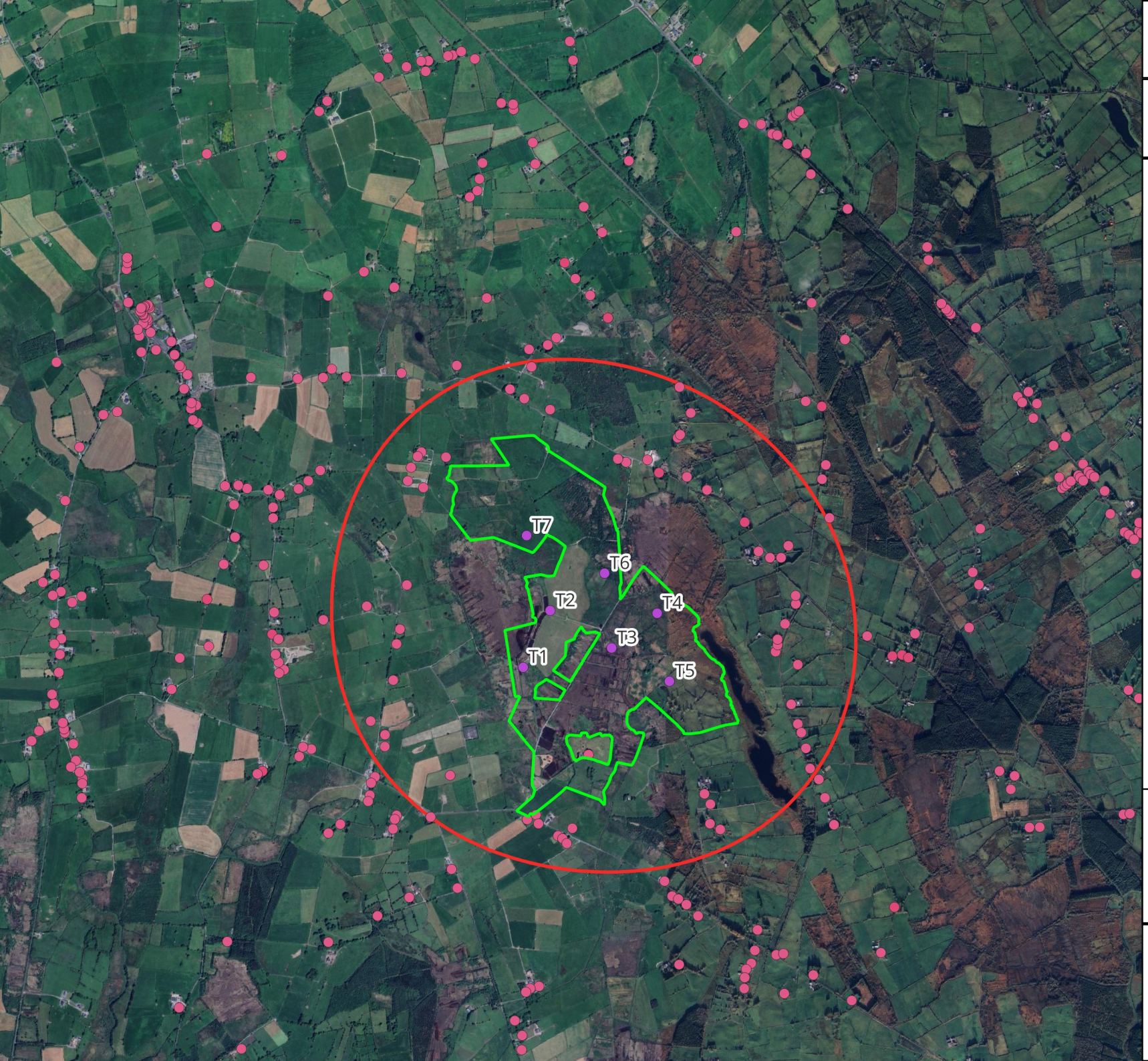
12.4.1.2 Operational Phase Study Area

As described in Section 12.3.2.5.5 the operational phase study area should cover, at a minimum, the area predicted to exceed 35 dB L_{A90} from all existing, permitted, and proposed wind turbines. Due to the distance at which cumulative wind farms are located to the Proposed Project, the contribution is

[1] Microsoft Word - IOA Statement Final 18.12.24

imperceptible and therefore, the operational phase study area is the 35 dB L_{A90} contour of the Site only. The nearest turbine to the 35 dB L_{A90} contour is T7 at approximately 984 m.

Refer to Appendix 12.7 – Noise Study Area Selection which displays the relevant noise contour maps which identify this area. 328 no. NSLs were found within the Study Area as indicated in Figure 12-2.



Project: Cunlaghfadda Green Energy Project

Description: Noise Sensitive Locations

EIAR Site Boundary

Proposed Turbines

Noise Sensitive Locations

35 dB Study Area

Google Satellite

N

0 0.5 1 km

Trinity Consultants

awnconsulting

The Tecpro Building, Clonshaugh Business and Technology Park, Dublin 17

T: +353 1 847 4220 | F: +353 1 847 4257

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

12.4.2 Background Noise Survey

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.

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

12.4.2.1 Choice of Monitoring Locations

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

The co-ordinates for selected locations for the NMLs are outlined in Table 12-6 and identified in Figure 12-3.

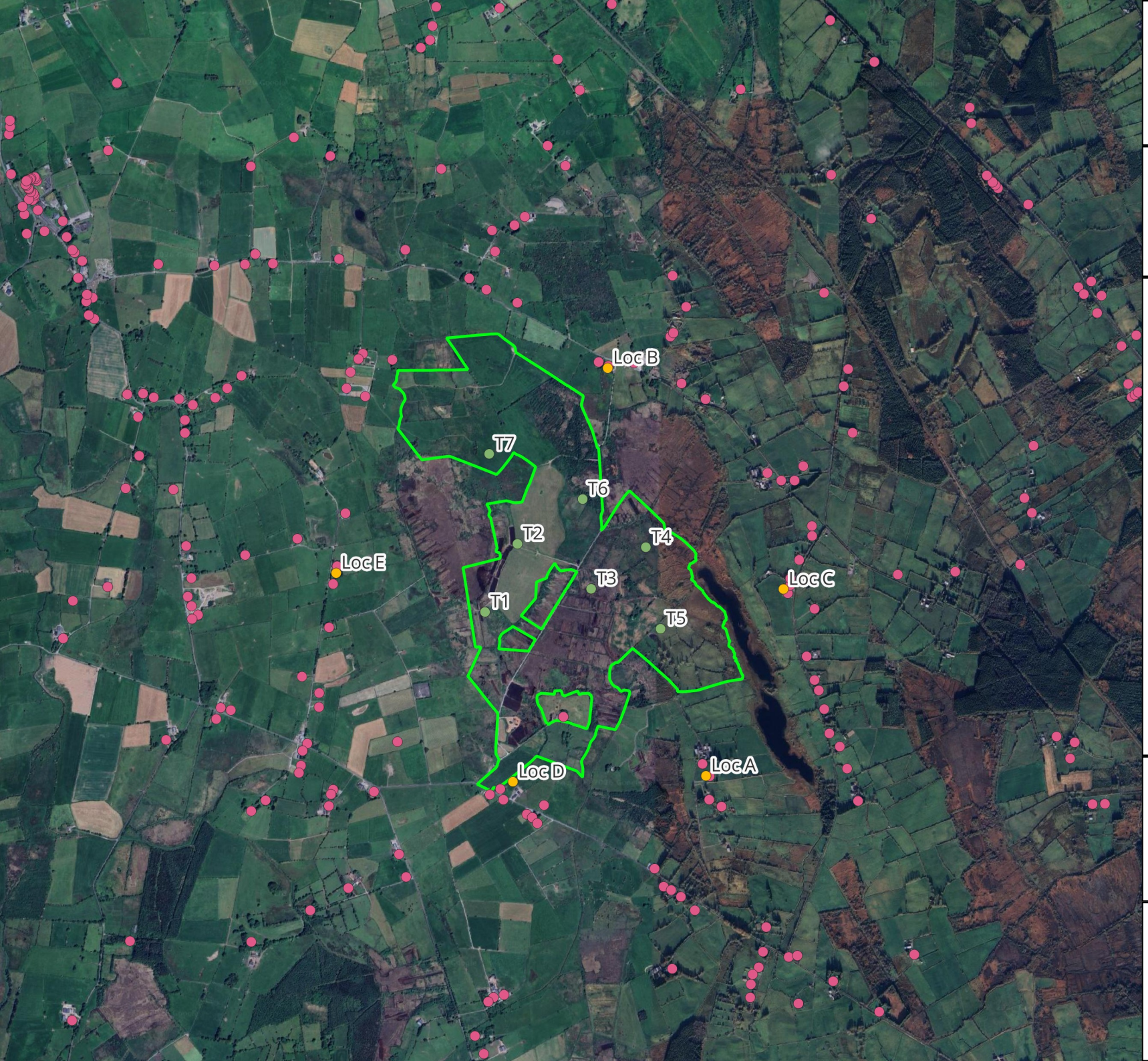
Table 12-6 Noise Measurement Location Coordinates

Location	Coordinates – Irish Transverse Mercator (ITM)	
	Easting	Northing
Loc A (H020)	529,399	777,050
Loc B (H004)	528,913	779,067
Loc C (H002)	529,782	777,974
Loc D (H037)	528,444	777,021
Loc E (H016)	527,570	778,053

Site visits by survey personnel were carried out during morning and afternoon periods; during these visits, primary noise sources contributing to noise environment were noted as being occasional local traffic noise and farming activity, birdsongs and distant agricultural activity. In respect of night-time periods, when noise due to traffic on local roads, agricultural activities and other sources tend to reduce, there was no indication of any significant local night-time sources of noise at any location.

No significant sources of vibration were noted at any of the survey locations.

Figure 12-3 shows a map of the NMLs in relation to the EIAR Site Boundary and the proposed turbines. Further details on noise monitoring are included in Appendix 12-3 – Summary of Background Noise Levels.



Project: Cunlaghfadda Green Energy Project

Description: Noise Monitoring Locations

- Proposed Turbines Locations
- Noise Monitoring Locations
- Noise Sensitive Locations
- EIAR Site Boundary

Google Satellite

N

0 0.5 1 km

Trinity Consultants

awnconsulting

The Tecpro Building, Clonshaugh Business and Technology Park, Dublin 17

T: +353 1 847 4220 | F: +353 1 847 4257

12.4.2.2 Wind Data

Wind speed measurements were obtained from an onsite Lidar which coordinates are outlined in Table 12-7. A copy of the Lidar installation report is included in Appendix 12-6.

Table 12-7 Coordinates of LIDAR

Item	Coordinates (ITM)	
	Easting	Northing
Lidar	528,651	777,338

12.4.2.3 Analysis of Survey Data

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

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

12.4.2.4 Consideration of Wind Shear

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

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

The Standardised Wind Speed is a wind speed measured at a height different than 10m (generally measured at the turbine hub height) which is expressed to a reference height of 10m in accordance with the IEC 61400-11 standard. The standardised equations used to determine the wind speed at standardised 10m above ground is presented in Appendix 12-2.

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

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

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

12.4.4 Operational 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 Project on the receiving environment. This section discusses the methodology behind the noise modelling process and presents the results of the modelling exercise.

12.4.4.1 Noise Prediction Software

The selected software, DGMR '*iNoise Enterprise (Version 2024.3)'* calculates noise levels in accordance with ISO 9613: '*Acoustics – Attenuation of sound during propagation outdoors, Part 2: General method of calculation*' (ISO, 1996).

iNoise is a proprietary noise calculation package for computing noise levels and propagation of noise sources. iNoise calculates noise levels in different ways depending on the selected prediction standard. In 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 impacts at distances greater than approximately 400 m).

12.4.4.2 Proposed Turbine Details

The turbine used in the noise assessment is the Vestas V136-4.5MW with serrated edges at 92 m hub height. This turbine is considered representative of the type of turbine that would be installed on the Site taking into consideration the proposed dimensions and the nominal generation capacity.

While the noise profile of the Vestas V136 wind turbine has been used for the purposes of this assessment, the exact make and model of the turbine installed on the Site will be dictated by a competitive procurement process but will adhere to the specifications and parameters set out above.

In terms of predicting noise levels at noise-sensitive locations the turbine noise emission levels can be defined by two parameters:

- The hub height (HH), and
- The sound power noise emissions at various wind speeds.

Sound power levels for the Vestas V136 referenced to wind speeds at standardised 10 m height (calculated in accordance with the IOAGPG), are presented in Table 12-8.

Table 12-8 Sound Power Level Spectra for Vestas V136 with a hub height of 92 m

Wind Speed (m/s)	Sound Power Level (dB(A)) at Octave Band Centre Frequency (Hz)								dB L_{WA}
	63	125	250	500	1000	2000	4000	8000	
3	70.9	79.0	84.3	86.6	86.0	82.5	76.1	66.7	91.6
4	74.5	82.7	87.9	90.2	89.3	85.4	78.6	68.5	95.0
5	79.3	87.5	92.8	95.0	94.3	90.5	83.7	73.9	99.9
6	82.8	91.1	96.3	98.6	97.7	93.8	87.0	76.9	103.4
7	83.2	91.5	96.7	99.0	98.3	94.6	87.9	78.2	103.9
8	82.6	90.8	96.2	98.7	98.5	95.4	89.6	80.9	103.9
9	82.0	90.1	95.6	98.4	98.6	96.1	91.0	83.3	103.9

Table 4-1 in Chapter 4 Description of the Proposed Project details the co-ordinates and elevations of the 7 no. turbines of the Proposed Wind Farm.

The manufacturer's 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 Table 12-8.

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

Current good practice recommends that tonal issues at wind farms are best addressed through appropriate planning conditions. A tonal penalty has not been included in the predicted noise levels for this assessment. A warranty will be provided by the manufacturer of the selected turbine to ensure that the noise output, including tonality, is controlled. In addition, as part of the Noise Compliance Monitoring Programme detailed in Section 12.7.4, tonal assessment will be conducted during the commissioning of the wind farm, as well as in the event of a complaint.

12.4.4.3 Cumulative Turbine Details

At the time of writing there are no known cumulative wind farms in the Proposed Project surroundings that would influence the noise results in the study area. The nearest wind farm development to the Site is the Mace Upper Wind Farm, located approximately 7.2 km east of the Site.

A detailed noise study area assessment is presented in Appendix 12-7.

A discussion on cumulative effects is presented in Section 12.9.

12.4.4.4 Modelling Calculation Parameters

Prediction calculations for turbine noise have been conducted in accordance with ISO 9613: '*Acoustics – Attenuation of sound propagation outdoors, Part 2: General method of calculation*' (1996).

Appendix 12-2 provides details of noise prediction calculation settings, as well as the turbine and receptor locations.

12.4.4.5 Effects of Propagation from Wind Directions

As discussed in Section 12.3.2.5.4, 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 address this issue, a review of expected noise levels downwind of the turbines has been prepared for various wind directions in accordance with the IOA GPG.

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

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

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

Table 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

12.5 Existing Environment

This section of the chapter documents the typical background noise levels measured in the vicinity of the NSLs in closest proximity to the Site. The NMLs locations are presented in Table 12-6. Appendix

12-3 presents the results of the background noise surveys as analysed in accordance with the methodology in Section 12.4.2.

12.5.1 Summary of Derived Background Noise Levels

Table 12-10 and Table 12-11 presents the various derived $L_{A90,10min}$ noise levels for each of the monitoring locations for daytime quiet periods and night-time periods. These levels have been derived using regression analysis carried out on the data sets measured in line with best practice guidance contained in the IOA GPG and its SGN No. 2 Data Collection.

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

Locations	Period	Background Noise Levels dB L_{A90} at standardised 10m height wind speed m/s for 92 m Hub Height						
		3	4	5	6	7	8	9
Loc A	Daytime	25.7	27.7	30.5	33.6	36.6	39.2	41.0
Loc B	Daytime	24.7	27.1	29.9	32.9	35.8	38.3	40.1
Loc C	Daytime	22.9	25.0	27.7	30.6	33.4	35.7	37.4
Loc D	Daytime	25.0	26.9	28.9	31.0	33.0	35.0	37.0
Loc E	Daytime	24.2	26.5	29.3	32.4	35.4	38.2	40.4

Table 12-11 Derived Background Noise Levels of $L_{A90,10min}$ for Various Wind Speeds – Night-time

Locations	Period	Background Noise Levels dB L_{A90} at standardised 10m height wind speed m/s for 92 m Hub Height						
		3	4	5	6	7	8	9
Loc A	Night-time	16.0	18.0	21.2	25.4	30.2	35.2	40.0
Loc B	Night-time	16.8	18.5	21.3	25.0	29.3	34.0	38.8
Loc C	Night-time	16.2	17.5	19.8	23.0	26.8	31.1	35.6
Loc D	Night-time	16.7	17.9	20.1	23.2	26.9	30.9	35.0
Loc E	Night-time	15.8	17.6	20.6	24.7	29.5	34.7	39.9

12.5.2 Wind Turbine Noise Limits

With respect to the relevant guidance documents outlined in Section 12.3.2, noise criteria curves have been established for the Proposed Project. The criteria curves have been derived following a detailed review of the background noise data conducted at representative NSLs described in Section 12.5.1.

The turbine noise limits proposed are in line with the applicable Guidelines (DoEHLG, 2006) and noise conditions applied to similar sites previously granted planning permission by An Bord Pleanála (now An Coimisiún Pleanála).

For the Proposed Project, it is considered that a lower daytime threshold of 40 dB LA90 is appropriate for low noise environments where the background noise is less than 30 dB(A), based on the following considerations:

- The EPA NG4 Guidance proposes a daytime noise criterion of 45 dB(A) in 'areas of low background noise'. Turbine noise limits are stated in terms of the L_{A90} parameter while the NG4 daytime limit an L_{Aeq}. The accepted difference between L_{Aeq} and L_{A90} in wind turbine noise assessments is 2 dB; for example, 45 dB L_{Aeq} corresponds to 43 dB L_{A90}. This approach implies a 3 dB difference when comparing the parameter definitions used in NG4 and DOEHLG 2006. Accordingly, the proposed lower daytime threshold of 40 dB L_{A90} is 3 dB more stringent than the equivalent daytime noise limit for low background noise areas as outlined in NG4.
- A lower threshold of 40 dB is commonly adopted in planning conditions for similar developments that have been granted planning permission by ACP in recent years for example, Derrinlough Wind Farm (ACP Ref: 306706-20), Coole Wind Farm (ACP Ref: PL25M.300686) Cloncreen (ACP Ref: PA0047), Meenbog (ACP Ref: PL05E.300460), Borrisbeg (ACP ref: 318704-23), Castlebanny Wind Farm (Planning Ref: 309306-21), Ballivor (ACP-316212-23), Carrig Renewables Wind Farm (ACP Ref: 318689-23), and Cushaling Wind Farm (ACP Ref: PL.19.306924).

Best practice for setting wind turbine noise limits at NSLs is that the limits should relate to the cumulative turbine noise levels from all turbines. Therefore, the proposed noise limits shall be cumulative, accounting for all operational wind turbines. When setting appropriate turbine noise limits in accordance with the criteria from the Guidelines (DoEHLG, 2006) and best practice guidance, it is important to bear in mind that where an existing wind turbine development is the dominant source of turbine noise at a given NSL, this must be considered in the context of the planning condition for noise under which other developments operate.

The proposed turbine noise criteria should apply to the nearest NSLs where it can be reasonably determined that the noise contribution from the operation of Proposed Project is the dominant wind turbine source or has a significant contribution to the cumulative turbine noise level at a given NSL. The operational noise limits for the Proposed Project are as:

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

In line with ETSU-R-97 guidance (see Section 12.3.2.5.1), a fixed lower threshold of 45 dB L_{A90} or a maximum increase of 5 dB above background noise (whichever is the higher) is proposed for NSLs identified as being involved in the project.

12.5.2.1 Assigning Turbine Noise Limits

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

For the purpose of this assessment, a conservative 'envelope review' will be applied to all non-surveyed locations. The envelope review is a conservative approach that adopts the lowest noise criteria derived from the measured background noise levels and applies it to all non-surveyed locations. This is not to say that this is the actual background noise at these locations.

Table 12-12 outlines the operational noise criteria for each measurement location.

Table 12-12 Proposed Noise Criteria Curves

Location	Period	Turbine Noise Limits LA90, 10min Levels (dB) at Various Standardised 10m Height Wind Speeds)							
		3	4	5	6	7	8	9	10
Loc A (H020)	Day	40	40	45	45	45	45	46	46.6
	Night	43	43	43	43	43	43	43	43
Loc B (H004)	Day	40	40	45	45	45	45	45.2	46.1
	Night	43	43	43	43	43	43	43	43
Loc C (H002)	Day	40	40	40	45	45	45	45	45
	Night	43	43	43	43	43	43	43	43
Loc D (H037)	Day	40	40	40	45	45	45	45	45
	Night	43	43	43	43	43	43	43	43
Loc E (H016)	Day	40	40	40	45	45	45	45.4	46.9
	Night	43	43	43	43	43	43	43	43

12.5.3 Noise Limits for Fixed Plant

Based on a review of the measured noise from the background noise survey (Section 12.4.2), the NSLs in the vicinity of the Site are defined as areas of low background noise as per the NG4 guidance. As the proposed substation will operate on a 24-hour basis, the potential impact during night-time periods is the primary consideration in this assessment.

A nighttime criterion of 35 dB $L_{Aeq,T}$ is considered appropriate for the operation of the substation. Where background noise levels are elevated at specific NSLs, i.e. greater than 30 dB L_{A90}, a higher absolute threshold, of up to 5 dB above the background level, may be acceptable in accordance with BS4142.

In accordance with the guidance from the BS4142 standard, discussed in Section 12.3.2.6.2, it is considered that the proposed absolute criterion of 35 dB $L_{Aeq,T}$ for noise from the substation is robust and should prevent adverse impacts at NSLs.

12.6 Likely Significant Effects

12.6.1 Do-nothing Scenario

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

If the Proposed Project were not to proceed, the opportunity to capture part of Mayo's valuable renewable energy resource would be lost, as would the opportunity to contribute to meeting Government and EU targets for the production and consumption of electricity from renewable resources and the reduction of greenhouse gas emissions.

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

12.6.2 Construction Phase

Construction noise prediction calculations have been conducted using the assessment methodology outlined and discussed in Sections 12.3.2.1 to Section 12.3.2.3. The source noise levels referred to in this section are indicative of the type of plant items and activities associated with the construction of the Proposed Project.

The highest predicted noise levels are expected to occur for 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 most properties in the vicinity of the Proposed Project.

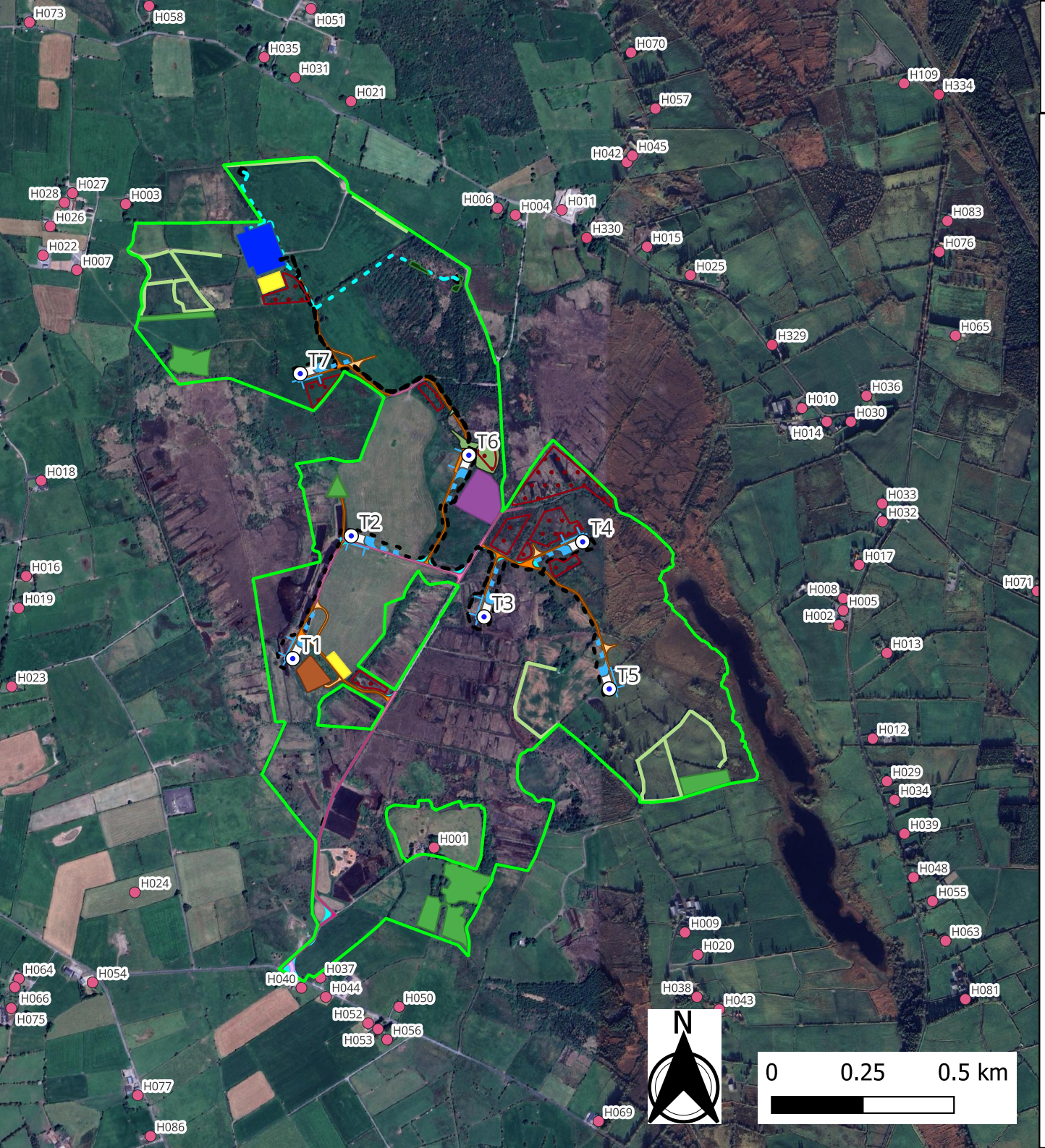
There are several stages and elements associated with the construction phase of the Proposed Project which will include the following:

- Construction of new entrance(s) and hardcore existing entrance, construction of internal site access tracks;
- Excavation and operation of a borrow pit;
- Construction of turbines and hardstand areas;
- Construction of a 110kV substation;
- Grid Connection and Underground Cabling.
- Construction of Meteorological Mast
- Construction of 2 no. temporary construction compounds and 2 no. security cabins.
- Tree felling, vegetation removal and biodiversity enhancement.
- Turbine Delivery Route accommodation works

Chapter 4 Description of the Proposed Project has detailed information on each of these elements.

In general, the distances between the construction activities associated with the Proposed Project and the nearest NSLs are such that there will be no significant noise or vibration impacts at the NSLs. Figure 12-4 shows the Proposed Project layout in relation to the NSLs. The following sections present an assessment of the main stages of the construction phase that have the potential for associated noise and vibration effects, all other stages and elements are considered unlikely to have any significant noise and vibration effects namely, temporary construction compounds, meteorological mast, parking, security fencing, onsite cabling and site drainage works, due to the distances to NSLs.

Construction activities will be carried out during normal daytime working hours (i.e., weekdays 08:00hrs – 20:00hrs and Saturdays 08:00hrs – 13:00hrs). However, to ensure that optimal use is made of good weather periods or at critical periods within the programme (e.g., concrete pours) or to accommodate delivery of large turbine components along public routes it could be necessary on occasion to work outside of these hours, and therefore lower limits outlined in Table 12-1 will be applied. Any such out of hours working will be agreed in advance with the Local Authority.



Project: Cunlaghfadda Green Energy Project

- EIAR Site Boundary
- Proposed Turbines
- Noise Sensitive Locations
- Turbine Hardstands
- Temp Hardstand Areas
- Borrow Pit
- Peat and Spoil Management Areas
- Met Mast
- Internal Cables
- Proposed Felling
- 110kV Substation
- Construction Compound
- 110kV Grid Connection Cable Route
- End Masts
- Upgrade to Existing Access Tracks
- New Access Tracks
- Upgrade to Public Road
- Temp Construction Tracks
- Temporary Site Entrance
- Temp Widening Areas
- Passing Bay
- Marsh Fritillary Enhancement Areas
- Woodland Planting
- Linear Planting and Enhancement

Google Satellite

Trinity Consultants

awnconsulting

12.6.2.1 General Construction of Turbines, Hardstand Areas and Met Mast

12.6.2.1.1 *Noise*

Foundation and hardstanding construction is required at all turbine locations. Several noise sources that would be expected on a construction site of this nature have been identified and predictions of the potential noise emissions have been calculated at the nearest NSL. In this instance the closest noise sensitive receptors are Location H001 at approximately 643 m from the proposed works. The distance from the met mast is approximately 812 m from the nearest NSL (H018).

Table 12-13 outlines the methods of construction, the noise levels associated with typical construction noise sources along with typical sound pressure levels and spectra from *BS 5228 - 1: 2009+A1 2014.* Calculations have assumed an on-time of 66% for each item of plant i.e., that the item is operational for 8 hours over a 12-hour assessment period and that there is no acoustic screening (i.e. barriers) in place between the site works and the NSL.

Table 12-13 Typical Wind Farm Turbine Construction Noise Emission Levels

Item (BS 5228 Ref.)	Activity/Notes	Plant Noise level at 10m Distance (dB $L_{Aeq,T}$)[1]	Predicted Noise Level (dB $L_{Aeq,T}$) at distance (643m)
HGV Movement (C.2.30)	Removing spoil and transporting fill and other materials within the site	79	30
Tracked Excavator (C.4.64)	Removing soil and rubble in preparation for turbine foundations	75	26
Excavator Mounted Rock Breaker (C9.12)	Rock Breaking	85	36
General Construction (Various)	All general activities plus deliveries of materials and plant to the site	84	35
Concrete Mixer Truck and Concrete Pump (C.4.27)	Foundations	79	30
Dumper Truck (C.4.4)	Removing peat and spoil and transporting fill and other materials.	76	27
Mobile Telescopic Crane (C.4.39)	Installation of nacelles	77	28
JCB (D.8.13)	Road surfacing.	82	28

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

Item (BS 5228 Ref.)	Activity/Notes	Plant Noise level at 10m Distance (dB $L_{Aeq,T}$)[1]	Predicted Noise Level (dB $L_{Aeq,T}$) at distance (643m)
Vibrating Rollers (D.8.29)	For services, drainage and landscaping.	77	33
Cumulative Construction Noise Level			41

Blasting will be required at the borrow pit. On this basis, the cumulative construction noise level is predicted to be 40 dB $L_{Aeq,T}$. While individual blast events are likely to be audible at some locations, all blasting will be designed and controlled as per Section 12.7.1 to ensure that the noise and vibration best-practice limit values outlined in Section 12.3.2.1 of this chapter are not exceeded.

At 643 m from the works the predicted noise levels from construction activities are in the range of 26 to 36 dB $L_{Aeq,T}$ with a total theoretical precautionary cumulative construction level of the order of 41 dB $L_{Aeq,T}$. In all instances the predicted noise levels at the nearest NSLs are below the adopted significance threshold outlined in Table 12-1

Table 12-1 (Category A – 65 dB $L_{Aeq,T}$ during daytime periods). This assessment is considered representative of worst-case construction noise levels at NSLs.

There is no item of plant that would be expected to give rise to noise levels that would be considered out of the ordinary or in exceedance of the thresholds outlined in Table 12-1

Table 12-1 and this finding is valid should all items of plant operate simultaneously. No specific mitigation measures are required.

12.6.2.1.2 *Vibration*

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

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

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

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

12.6.2.1.3 *Description of Effects*

The likely predicted noise and vibration effects are below the limits and/or thresholds identified. With respect to the EPA's criteria for description of effects, the likely potential effects at the nearest NSL, under a theoretical precautionary scenario, associated with construction of proposed turbines and hardstanding areas are described as follows:

Quality	Pre-Mitigation Impact	Duration
Negative	Not Significant to Slight	Short Term

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

The effect on noise and vibration due to general construction of turbines, hardstand areas and the met mast during the construction of the Proposed Project is considered Not Significant.

12.6.2.2 Construction of Internal Access Track

It is proposed to construct new permanent and temporary access tracks, upgrade existing internal access tracks and upgrade the existing public road (L15053) as a means to access the various parts of the Site from public roads. Review of the access track layout has identified that the nearest NSL to any element of the internal access network is the upgrade to public road in the south of the Site which is located approximately 74 m from the closest NSL, this being H040. The full description of the upgrade works to the existing public road (L15053) are outlined in Chapter 4 Description of the Proposed Project.

Table 12-14 Indicative Noise Levels from Construction Plant at Various Distances from Site Roads/ Tracks

Item (BS 5228 Ref.)	Plant Noise level at 10m Distance (dB $L_{Aeq,T}$)[1]	Predicted Noise Level at Stated Distance from Edge of Works (dB $L_{Aeq,T}$) at 74 m
Tracked Excavator (C.4.64)	75	56
HGV Movement (C.2.30)	79	60
Vibrating Rollers (D.8.29)	76	57
Dumper Truck (C.4.4)	77	58
Cumulative Total	–	64

Table 12-15 shows that the predicted noise level from individual items of plant range from 56 to 60 dB with a total worst-case construction level of the order of 64 dB.

The assessment is considered worst-case with construction noise decreasing commensurately with distance from the works.

The predicted noise levels at the nearest NSL do not exceed the construction adopted significance threshold outlined in

[1] *All plant noise levels are taken from BS5228: Part 1*

Table 12-1 (Category A – 65 dB $L_{Aeq,T}$ during daytime periods).

12.6.2.2.1 Vibration

Due to the distance of the proposed works from sensitive locations vibration effects are not likely to occur at any NSL. With reference to the discussion on vibration presented in Section 12.6.2.1.2 there will be no significant vibration impacts associated with the construction of internal site access tracks and therefore no specific mitigation measures are required.

12.6.2.2.2 Description of Effects

The likely predicted noise and vibration effects are below the limits and/or thresholds identified. With respect to the EPA's criteria for description of effects, the likely potential effects, under a theoretical precautionary scenario, at the nearest NSL associated with construction of internal roads are described below.

Quality	Pre-Mitigation Impact	Duration
Negative	Not Significant to Slight	Temporary

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

The effect on noise and vibration due to construction of the internal access track network during the construction of the Proposed Project is considered Not Significant.

12.6.2.3 Borrow Pit Excavation and Reinstatement

12.6.2.3.1 Noise

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:

- 1 mobile crusher and 1 rock breaker will be used at the borrow pit location;
- The plant will operate simultaneously in the vicinity of the proposed borrow pit location; and
- Table 12-15 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 12-15 Plant Noise Emissions

Location	Plant Noise level at 10m Distance (dB $L_{Aeq,T}$)[1]								dB(A)
	63	125	250	500	1k	2k	4k	8k	
Crusher	95	98	98	106	103	100	95	86	110
Rock Breaker	93	101	104	114	115	116	113	106	121
HGV Movement	77	88	95	93	93	92	86	76	98
Dump Truck	87	92	99	97	102	99	94	85	105
Semi-mobile screen/stockpiler	69	82	96	99	103	101	99	88	107
Tracked Excavator	77	88	95	93	93	92	86	76	99

A noise model prediction model has been prepared to consider the expected noise emissions from the proposed construction works at borrow pit as outlined above. A percentage on-time of 66% has been used for the noise calculations. The predicted levels at the ten NSLs with the highest predicted noise levels are presented in Table 12-16.

Table 12-16 Prediction Noise Levels from Borrow Pit Activity at Nearest NSLs

Loc.	Predicted Construction Noise Level $L_{Aeq,1hr}$		Diff. dB(A)
	Scenario		
	A (Blasting)	B (Rock breaking)	
H001	44	52	-8
H024	42	49	-7
H019	41	48	-7
H023	41	48	-7
H016	41	48	-7
H037	41	48	-7
H040	40	48	-8
H044	40	47	-7
H018	40	47	-7
H041	40	47	-7

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

The nearest NSL to the proposed borrow pit location is NSL H001, which lies approximately 520 m to the south of the proposed works. Review of the results contained in Table 12-16 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. Construction works at the borrow pit will only occur during daytime periods only (07:00 to 19:00hrs).
- The blasting proposal results in lower levels of construction noise since the use of the rock breaking plant is not required in this instance. Predicted noise levels are lower at all assessed locations for Scenario A.
- It is accepted that the individual blast events will be audible at some locations. Blast events will be designed and controlled such that the best practice noise and vibration limit values outlined in section 12.3.2.1 of this chapter are not exceeded.

12.6.2.3.2 *Vibration*

Due to the distance of the proposed works from sensitive locations vibration effects are not likely to occur at any NSL. With reference to the discussion on vibration presented in Section 12.6.2.1.2 there will be no significant vibration impacts associated with the construction and operation of the borrow pit and therefore no specific mitigation measures are required.

12.6.2.3.3 *Description of Effects*

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

Quality	Pre-Mitigation Impact	Duration
Negative	Not Significant to Slight	Short Term

The effect on noise and vibration due to borrow pit excavation and reinstatement during the construction of the Proposed Project is considered Not Significant.

12.6.2.4 Tree felling, native broadleaved woodland and treeline/ hedgerow planting

Areas of coniferous tree felling, native broadleaved woodland planting and treeline/ hedgerow planting and enhancement are also proposed as part of the Proposed Project. The nearest NSL to any of the proposed areas is H001 at a distance of approximately 55m. The construction machinery to be used in these areas presented in Table 12-17.

Table 12-17 Typical Construction Noise Emission Levels – Tree felling Areas

Item (BS 5228 Ref.)	Plant Noise Level at 10m Distance (dB $L_{Aeq,T}$) [1]	Predicted Noise Level at 55 m
Hand-held saw (C.4.70)	91	68

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

Item (BS 5228 Ref.)	Plant Noise Level at 10m Distance (dB $L_{Aeq,T}$) [1]	Predicted Noise Level at 55 m
Harvester (Tracked Excavator C.4.64)	75	52
Cumulative Total	**91**	**68**

As indicated above, these levels are slightly above the construction noise criterion outlined in Table 12-1(Category A – 65 dB $L_{Aeq,T}$ during daytime periods). However, as the tree felling is due to take place only for a short duration within this distance, based on methodology set out in Section 12.3.2.4 it is concluded that that there will be no significant noise impact associated with the tree felling areas, therefore no specific mitigation measures are required.

No vibration is expected due to the equipment used and distance from nearest receivers.

12.6.2.4.1 *Description of Effects*

The likely predicted noise and vibration impacts are slightly above the limits and/or thresholds identified. However, as indicated above, based on the short duration of the works, it is concluded that there is no significant impact. With respect to the EPA's criteria for description of effects, the likely potential associated effects at the nearest NSLs associated with the coniferous tree felling, native broadleaved woodland planting and treeline/hedgerow planting are described below:

Quality	Pre-Mitigation Impact	Duration
Negative	Not Significant to Slight	Temporary

The effect on noise and vibration due to felling, native broadleaved woodland planting and treeline/ hedgerow planning and enhancement during the construction of the Proposed Project is considered Not Significant.

12.6.2.5 Construction of Temporary Construction Compound

A temporary compound will be constructed to provide office space, welfare facilities, car parking and hardstands for storing materials. Full description of the temporary compounds is included in Chapter 4 Section 4.9.3.3.

The nearest NSL to the compound is H001, at a distance of 525 m. Based on the same construction activities as outlined in Table 12-14 for new site tracks, it is predicted that the likely noise levels from construction activities associated with the compounds will be in the order of 47 dB $L_{Aeq,T}$ at H001, at the nearest NSL. This level of noise is well below the significance threshold of 65 dB $L_{Aeq,T}$, therefore no specific mitigation measures are required.

12.6.2.5.1 *Vibration*

Due to the distance of the proposed works from sensitive locations, vibration effects are not likely to occur at any NSL. With reference to the discussion on vibration presented in Section 12.6.2.1.2 there will be no significant vibration impacts associated with the construction of the construction compound and therefore no specific mitigation measures are required.

12.6.2.5.2 *Description of Effects*

The likely predicted noise and vibration effects are below the limits and/or thresholds identified. With respect to the EPA's criteria for description of effects, the likely potential effects, under a theoretical precautionary scenario, at the nearest NSL associated with construction of internal roads are described below.

Quality	Pre-Mitigation Effect	Duration
Negative	Not Significant to Slight	Temporary

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

The effect on noise and vibration due to construction of the temporary compound during the construction phase of the Proposed Project is considered Not Significant.

12.6.2.6 Peat and Spoil Management Areas

Areas of peat and spoil management are also proposed as part of the Proposed Project. The nearest NSL to any of the proposed peat and spoil management areas is H001 at a distance of approximately 445m from the nearest peat and spoil management area. The construction machinery to be used in these areas presented in Table 12-18.

Table 12-18 Typical Construction Noise Emission Levels – Peat and Spoil Management Areas

Item (BS 5228 Ref.)	Plant Noise Level at 10m Distance (dB $L_{Aeq,T}$) [1]	Predicted Noise Level at 445 m
Tracked Excavator (C.4.64)	75	40
Dumper Truck (C.4.39)	77	42
Total Construction Noise		**44**

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

No vibration is expected due to the equipment used and distance from nearest receivers.

12.6.2.6.1 *Description of Effects*

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

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

Quality	Pre-Mitigation Impact	Duration
Negative	Not Significant	Short Term

The effect on noise and vibration due to peat and spoil management during the construction of the Proposed Project is considered Not Significant.

12.6.2.7 Construction Traffic

This section has been prepared to review potential noise impacts associated with construction traffic on the local road network. The information presented in Table 15-16 to Table 15-19 in Chapter 15 Material Assets has been used to inform the assessment presented in this chapter.

Table 12-19 presents the change in noise level during the different construction phases at the junctions assessed.

Table 12-19 Change of noise level at different junctions during the phases of the construction

Link	Change in Traffic Noise Level (dB) during different phases of construction			
	Concrete foundation Delivery	General Construction Delivery	Turbine Construction (Abnormal HGVs)	Turbine Construction (Standard HGVs)
1 – N17 – South of Claremorris	+0.8	+0.5	+0.2	+0.1
2 – N17 – Northeast of Claremorris	+1.0	+0.6	N/A	N/A
3 – N60 – Northwest of Claremorris	+1.7	+1.1	N/A	N/A
4 – R331 – Claremorris	+1.0	+0.6	+0.2	+0.1
5 – L1506 – East	+3.4	+2.3	+0.8	+0.3
6 – L1506 – West	+4.7	+3.4	+1.3	+0.5
7 – L1505	10.2	8.2	+4.4	+2.0
Estimate no. days	7	222	38	7

Table 12-19 shows that for the large majority of the junction assessed, the change in noise level is below 3 dB which is considered as No Change to Minor, as described in Table 12-2 (DMRB, 2020), therefore the effect is considered Not Significant.

However, at link location 5, location 6 and location 7, during the concrete foundation, general construction and abnormal HGVs deliveries, the change of noise level indicates a Moderate to Major impact and therefore the effect is considered Significant.

As outlined in Section 12.3.2.2, 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/decommissioning traffic in the context of the construction noise threshold values outlined previously in Section 12.3.2.1.

Table 12-20 shows the predicted traffic noise levels for the different phases at a reference distance of 20 m from the road for the links where Moderate to Major impact were found. It is shown that all links and phases noise levels are below the threshold of 65 dB $L_{Aeq,T}$, therefore the significance of effect is considered not significant and no specific mitigation measures are required.

Table 12-20 Predicted Traffic Noise Levels during different phases of construction

Link	Predicted Noise Level during different phases of construction			
	Concrete foundation deliveries	Turbine Construction (Large components)	Turbine Construction (Small components)	General Construction
5 – L1506 – East	59	–	–	–
6 – L1506 – West	58	56	–	–
7 – L1505	56	54	50	–

12.6.2.7.1 Description of Effects

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

Quality	Pre-Mitigation Impact	Duration
Negative	Not Significant to Slight	Short-Term

12.6.2.8 Turbine Delivery Route

The turbine delivery route is described in full in Section 4.6.2 of Chapter 4. Vehicles delivering large turbine components and other abnormal loads to the Site will depart from Galway Port and travel northwest via the N6, M17, N17 travelling through Claremorris town and thereafter on local roads towards the proposed Site entrance.

The transport route for the Proposed Project, as shown on Figure 4-33, Chapter 4 has been the subject of a route assessment to determine if any works are required along its length. Full details of the assessment are included as part of the traffic impact assessment set out in Section 15.1 of Chapter 15 of this EIAR.

To facilitate the transportation of turbine components off the L-55512 and onto the L-1519, minor accommodating works are required which involves temporary road widening and wall removal. A similar degree of works will be required on the L-1505 and L-5531 where temporary road widening and vegetation clearance will be required to provide the necessary clearance of the turbine delivery vehicle. Once the turbines have been delivered, these areas will be reseeded/reinstated. The locations of the accommodation areas are shown in Appendix 15-2, Chapter 15. The construction machinery to be used in these areas presented in Table 12-21. Review of the proposed route has identified that the nearest NSL to any point of this element of the works is at approximately 30 m.

Table 12-21 Indicative Noise Levels from Construction Plant at Various Distances from TDR Accommodation Works

Item (BS 5228 Ref.)	Plant Noise level at 10m Distance (dB $L_{Aeq,T}$)[1]	Predicted Noise Level at 30m Distance from Edge of Works (dB $L_{Aeq,T}$)

[1] *All plant noise levels are taken from BS5228: Part 1*

Tracked Excavator (C.4.64)	75	63
Vibrating Rollers (D.8.29)	76	64
Dumper Truck (C.4.4)	77	65
Cumulative Total	–	69

Table 12-19 shows that at 30m, noise levels exceed the construction noise thresholds outlined in Table 12-1(threshold values recommended by BS5228). However, works will be in proximity to the closest NSLs for a limited period and giving consideration to the temporal criteria detailed in Section 12.3.2.4 it is unlikely to be a significant effect at the closest NSL. At a 50 m distance or more, the noise levels due to turbine delivery accommodation works are well below the significance threshold outlined in Table 12-1 (Category A – 65 dB $L_{Aeq,T}$ during daytime periods).

12.6.2.8.1 *Description of Effects*

The likely predicted noise and vibration impacts are below the limits and/or thresholds identified in Table 12-1. With respect to the EPA's criteria for description of effects, the likely significant effects at the nearest NSLs associated with the proposed turbine delivery route works are described below:

Quality	Pre-Mitigation Impact	Duration
Negative	Not Significant to Slight	Temporary

The effect on noise and vibration due to works associated with turbine delivery during the construction of the Proposed Project is considered Not Significant.

12.6.2.9 Proposed Grid Connection

As discussed in Section 4.1.1 in Chapter 4, the Proposed Grid Connection will be subject to a separate planning application to ACP. The Proposed Grid Connection consists of a 110kV loop-in substation, c.982m of 110kV underground cabling from the proposed substation to 2 no. new end masts and the removal of 3 no. wooden pole sets to facilitate the new loop-in connection. New access tracks and a construction compound will also need to be constructed to facilitate the Proposed Grid Connection, with this being assessed in Section 12.6.2.2 and Section 12.6.2.5 above.

The full description of the loop in / loop out connection is outlined in Chapter 4 (Description of the Proposed Project) of this EIAR.

12.6.2.9.1 *Noise*

The nearest NSL to the proposed 110kV substation is H003, which is approximately 314m to the closest point of the substation. As a worst-case example assuming the same construction activities as outlined in Table 12-13, the predicted noise levels from construction activities associated with the substation will be in the order of 53 dB $L_{Aeq,T}$ at the nearest NSL. This level of noise is well below the significance threshold of 65 dB $L_{Aeq,T}$, therefore no specific mitigation measures are required.

The associated underground grid connection construction works will occur for short durations (rolling construction method, approximately 100 m per day) at varying distances from NSLs. As the Proposed Grid Connection underground electrical cable route is approximately 982m in length, the expected time required to complete the works will not give rise to a Significant effect as per Section 12.3.2.4 .

Review of the proposed 110kV underground grid cabling has identified that the nearest NSLs to the proposed underground cabling route, are at distances of the order of 223 to 330m.

Table 12-22 outlines the typical construction noise levels associated with the proposed 110kV underground grid cabling. Calculations have assumed an on-time of 66% for each item of plant i.e., that the item is operational for 8 hours over a 12-hour assessment period. Note the plant items and activities are indicative and based on assumption to be representative of a reasonable conservative assessment.

The nearest NSL to the proposed 110kV underground grid cabling is H006 and is located at approximately 223m.

Table 12-22 Indicative Noise Levels for Typical Construction Plant at nearest distance from the Grid Connection Works

Plant Item (BS 5228 Ref.)	Plant Noise Level at 10m Distance (dB L_{Aeq})	Predicted Noise Level at Stated Distance from Edge of Works (dB $L_{Aeq,T}$) at 223 m
Tracked Excavator (C.2.7)	70	37
Vibrating Rollers (C.2.40)	73	40
Wheeled Loader (C.2.8)	68	35
Cumulative Predicted Construction Noise Level (No Rock Breaking)		43
Excavator Mounted Rock Breaker (C9.12)[a]	85	47
Cumulative Predicted Construction Noise Level (with Rock Breaking)[b]		48

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

For standard grid connection works, any NSL set back at 15 m or more from the proposed works is predicted to experience noise levels within the linear construction noise limit of 70 dB $L_{Aeq,1hr}$ as set out in Section 12.3.2.1. The Grid Connection is an on-site loop in/loop out connection with the nearest NSL to the connection being 223 m (H006) from the works area.

Based on the guidance in Section 12.3.2.4, the likely noise impacts are considered not significant, and no specific mitigation measures are required.

In line with the guidance in Section 12.3.2.4 the likely noise impacts are considered Not Significant to Slight, and no specific mitigation measures are required.

12.6.2.9.2 Vibration

Due to the distance of the proposed works from sensitive locations vibration effects are not likely at any NSL. Due to the distance of the proposed works from sensitive locations vibration effects are not likely to occur at any NSL. With reference to the discussion on vibration presented in Section 12.6.2.1.2 there will be no significant vibration impacts associated with the construction of the substation and therefore no specific mitigation measures are required.

12.6.2.9.3 Description of Effects

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

nearest noise sensitive locations associated with construction of the grid connection and associated underground cabling are described below.

Quality	Pre-Mitigation Impact	Duration
Negative	Not Significant to Slight	Temporary

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

The effect on noise and vibration due to construction of the Proposed Grid Connection infrastructure is considered Not Significant.

12.6.3 Operational Phase

12.6.3.1 Assessment of Wind Turbine Noise

Using the assessment methodology described in Section 12.4.4 the predicted turbine noise levels have been calculated at all NSLs within the study area of the Proposed Project. A conservative omni-directional turbine noise prediction assessment has been carried out using the ISO 9613-2 calculation standard and best practice guidance for turbine noise prediction contained in the IOA GPG. These calculations are based on conservative theoretical conditions favourable to noise propagation, i.e., downwind propagation from source to receiver and downward refraction under temperature inversions. On that basis the omnidirectional turbine noise predictions can be considered worst case.

The results of the noise prediction models have been compared against the lowest turbine noise limits that have been presented in Section 12.5.2, which have been derived in accordance with the criteria set out in Section 12.3.2.4.

At all NSLs the worst omni-directional cumulative turbine noise levels are below the noise criteria Appendix 12-5 presents the predicted omni-directional turbine results at all NSLs in tabulated form. Table 12-23 presents the result of the turbine noise predictions and assessment review at the 15 no. locations with the highest levels of wind turbine noise predicted; at all other locations the maximum turbine noise levels are predicted to be less than 40 dB L_{A90}.

Noise contours for the omni-directional rated power wind speed (i.e., highest noise emission) are presented in Appendix 12-4.

Table 12-23 Predicted Noise Levels

NSL Ref	Parameter	Predicted Noise Level dB L_{A90} at Standardised Wind Speed at 10m						
		3	4	5	6	7	8	9
H001	Predicted	30.0	33.4	38.3	41.8	42.3	42.1	42.1
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0	45.0	45.0
	Daytime Excess	–	–	–	–	–	–	–
	Night-time Criterion	43.0	43.0	43.0	43.0	43.0	43.0	43.0
	Night-time Excess	–	–	–	–	–	–	–
H002	Predicted	28.0	31.4	36.3	39.8	40.3	40.1	40.1

NSL Ref	Parameter	Predicted Noise Level dB L_{A90} at Standardised Wind Speed at 10m						
		3	4	5	6	7	8	9
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0	45.0	45.0
	Daytime Excess	–	–	–	–	–	–	–
	Night-time Criterion	43.0	43.0	43.0	43.0	43.0	43.0	43.0
	Night-time Excess	–	–	–	–	–	–	–
H004	Predicted	28.4	31.9	36.8	40.3	40.8	40.6	40.6
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0	45.0	45.0
	Daytime Excess	–	–	–	–	–	–	–
	Night-time Criterion	43.0	43.0	43.0	43.0	43.0	43.0	43.0
	Night-time Excess	–	–	–	–	–	–	–
H005	Predicted	27.8	31.3	36.2	39.7	40.1	40.0	40.0
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0	45.0	45.0
	Daytime Excess	–	–	–	–	–	–	–
	Night-time Criterion	43.0	43.0	43.0	43.0	43.0	43.0	43.0
	Night-time Excess	–	–	–	–	–	–	–
H006	Predicted	28.4	31.9	36.8	40.3	40.8	40.6	40.6
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0	45.0	45.0
	Daytime Excess	–	–	–	–	–	–	–
	Night-time Criterion	43.0	43.0	43.0	43.0	43.0	43.0	43.0
	Night-time Excess	–	–	–	–	–	–	–
H008	Predicted	27.8	31.3	36.2	39.7	40.1	39.9	39.9
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0	45.0	45.0
	Daytime Excess	–	–	–	–	–	–	–
	Night-time Criterion	43.0	43.0	43.0	43.0	43.0	43.0	43.0
	Night-time Excess	–	–	–	–	–	–	–
H010	Predicted	27.4	30.9	35.8	39.3	39.8	39.6	39.6
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0	45.0	45.0

NSL Ref	Parameter	Predicted Noise Level dB L_{A90} at Standardised Wind Speed at 10m						
		3	4	5	6	7	8	9
	Daytime Excess	–	–	–	–	–	–	–
	Night-time Criterion	43.0	43.0	43.0	43.0	43.0	43.0	43.0
	Night-time Excess	–	–	–	–	–	–	–
H011	Predicted	27.8	31.2	36.1	39.6	40.1	39.9	39.9
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0	45.0	45.0
	Daytime Excess	–	–	–	–	–	–	–
	Night-time Criterion	43.0	43.0	43.0	43.0	43.0	43.0	43.0
	Night-time Excess	–	–	–	–	–	–	–
H014	Predicted	27.0	30.5	35.3	38.9	39.3	39.1	39.1
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0	45.0	45.0
	Daytime Excess	–	–	–	–	–	–	–
	Night-time Criterion	43.0	43.0	43.0	43.0	43.0	43.0	43.0
	Night-time Excess	–	–	–	–	–	–	–
H015	Predicted	27.5	31.0	35.8	39.4	39.8	39.6	39.6
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0	45.0	45.0
	Daytime Excess	–	–	–	–	–	–	–
	Night-time Criterion	43.0	43.0	43.0	43.0	43.0	43.0	43.0
	Night-time Excess	–	–	–	–	–	–	–
H016	Predicted	26.9	30.4	35.3	38.8	39.2	39.0	39.0
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0	45.0	45.0
	Daytime Excess	–	–	–	–	–	–	–
	Night-time Criterion	43.0	43.0	43.0	43.0	43.0	43.0	43.0
	Night-time Excess	–	–	–	–	–	–	–
H017	Predicted	27.2	30.7	35.6	39.1	39.5	39.3	39.3
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0	45.0	45.0
	Daytime Excess	–	–	–	–	–	–	–

NSL Ref	Parameter	Predicted Noise Level dB L_{A90} at Standardised Wind Speed at 10m						
		3	4	5	6	7	8	9
	Night-time Criterion	43.0	43.0	43.0	43.0	43.0	43.0	43.0
	Night-time Excess	–	–	–	–	–	–	–
H018	Predicted	27.3	30.8	35.6	39.2	39.6	39.4	39.4
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0	45.0	45.0
	Daytime Excess	–	–	–	–	–	–	–
	Night-time Criterion	43.0	43.0	43.0	43.0	43.0	43.0	43.0
	Night-time Excess	–	–	–	–	–	–	–
H019	Predicted	26.6	30.1	35.0	38.5	39.0	38.8	38.8
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0	45.0	45.0
	Daytime Excess	–	–	–	–	–	–	–
	Night-time Criterion	43.0	43.0	43.0	43.0	43.0	43.0	43.0
	Night-time Excess	–	–	–	–	–	–	–
H025	Predicted	27.4	30.9	35.8	39.3	39.7	39.5	39.5
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0	45.0	45.0
	Daytime Excess	–	–	–	–	–	–	–
	Night-time Criterion	43.0	43.0	43.0	43.0	43.0	43.0	43.0
	Night-time Excess	–	–	–	–	–	–	–

12.6.3.1.1 *Description of Effects*

The predicted turbine noise levels associated with the Proposed Project are within the applicable noise criteria described in Section 12.5.2 therefore it is not considered that a significant effect is associated with turbine noise from the Proposed Wind Farm.

With respect to the EPA's criteria for description of effects, the potential effects at the most impacted NSLs associated with noise from the operation of the wind turbines of the Proposed Wind Farm are described as follows:

Quality	Pre-Mitigation Impact	Duration
Negative	Not Significant	Long Term

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

The effect on noise and vibration due to wind turbine noise during the operational phase of the Proposed Project is considered Not Significant.

12.6.3.2 Onsite 110kV Substation

Details of the proposed onsite 110kV substation are described in Chapter 4. The onsite substation will be operational 24/7 and the noise impact at the nearest NSL has been assessed to identify the potential greatest impact associated with the operation at the nearest NSL including night-time hours when background noise is lower.

The noise emission level associated with a substation that would support a renewable energy development of this nature is the order of 92 dB(A) L_w.

Noise prediction model calculations for the operation of the proposed onsite 110kV substation have been undertaken in accordance with ISO 9613: '*Acoustics – Attenuation of sound during propagation outdoors, Part 2: Engineering method for the prediction of sound pressure levels outdoors'* (2024). The predicted noise level from the operation of the proposed onsite 110kV substation at the nearest NSL (H003) at approximately 366 m northwest is 30 dB $L_{Aeq,T}$. This level of noise is below the criterion for fixed mechanical plant outlined in Section 12.3.2.6 and will not result in an adverse impact at nearby NSLs. During the detailed design stage of the Proposed Project, careful consideration will be given to the selection of mechanical and electrical plant to ensure that noise emissions comply with the proposed criteria and that any character corrections are appropriately addressed in accordance with the requirements outlined in Section 12.3.2.6.

12.6.3.2.1 *Description of Effects*

With respect to the EPA's criteria for description of effects, the potential effects, at the nearest NSLs associated with noise from the operation of the fixed mechanical and electrical plant at the proposed onsite 110kV substation is described below.

Quality	Pre-Mitigation Impact	Duration
Negative	Not Significant	Long Term

The effect on noise and vibration due to operation of the 110kV Substation during the operational phase of the Proposed Project is considered Not Significant.

12.6.4 Decommissioning Phase

In relation to the decommissioning phase, 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 Proposed Wind Farm can be considered comparable to those outlined in relation to the construction phase (as per Section 12.6.2) albeit less works will be required as only above ground structures will be removed. Turbine and mast foundations will remain underground, and cable ducting will remain in situ. Refer to Section 4.12 of Chapter 4 and Appendix 4-6 for full details on decommissioning. The predicted noise levels are expected to be below the appropriate Category A value (i.e. 65 dB $L_{Aeq,T}$) at all NSLs for the decommissioning phase, the effect is not significant.

12.6.4.1.1 *Description of Effects*

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

noise sensitive locations associated with construction of turbines and hardstanding areas are described below.

Quality	Pre-Mitigation Impact	Duration
Negative	Not Significant to Slight	Short Term

The effect on noise and vibration due to decommissioning of Proposed Project is considered Not Significant.

12.7 Mitigation Measures

The assessment of potential effects has demonstrated that the Proposed Project is expected to comply with the identified criteria for the construction, operational and decommissioning phases of the Proposed Project and therefore no specific mitigation measures are required.

12.7.1 Construction Phase

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

The assessment of potential impacts presented in Section 12.6.2 has demonstrated that the Proposed Project is expected to comply with the noise and vibration criteria during the construction phase and therefore no specific mitigation measures are required.

However, as a matter of best practice, the contract documents will specify the following mitigation measures that the Contractor when undertaking the construction works will be obliged to adopt best practice noise abatement measures contained in *British Standard BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise and BS 5228-2:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Vibration.* To ameliorate any potential noise impacts that may present during the construction phase, a schedule of noise control measures has been formulated in accordance with best practice guidance, and the contract documents will require the Contractor to implement these measures. These are also outlined in the Appendix 4-5 the CEMP that has been prepared for the Proposed Project.

The following list of measures will be considered, where necessary, to ensure compliance with the relevant construction noise criteria:

- Limiting the hours during which Site activities likely to create high levels of noise or vibration are permitted;
- Establishing channels of communication between the contractor/developer, Local Authority and residents;
- Monitoring typical levels of noise and vibration during critical periods and at sensitive locations;
- Selection of plant with low inherent potential for generation of noise and/ or vibration where practical;
- Placing of noise generating / vibratory plant as far away from sensitive properties as practical within the Site constraints, and;
- The hours of construction activity will be limited to avoid unsociable hours where possible. Construction operations shall generally be restricted to between 7:00hrs and

19:00hrs Monday to Saturday. However, to ensure that optimal use is made of good weather periods or at critical periods within the programme (i.e. concrete pours, turbine component deliveries) it could occasionally be necessary to work out of these hours.

Where potential temporary exceedances are predicted associated with tree felling at the nearest receivers, the following mitigation measures are proposed to reduce noise impacts during the activities:

- Orientating plant to minimise the noise impact on nearby receptors where practicable,
- Erection of temporary localised mobile noise screens where practicable around activities,
- Phasing of work and reduce percentage on time to lower the noise impact.

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

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

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

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

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

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

12.7.2 Operational Phase

12.7.2.1 Wind Turbine Noise

An assessment of the operational wind turbine noise levels has been undertaken in accordance with best practice guidelines and procedures recommended in line with the Guidelines (DoEHLG 2006) as outlined in Section 12.3.2.4. The findings of the assessment, presented in Section 12.6.3.1 has confirmed that the predicted operational noise levels associated with the Proposed Wind Farm will be within best

practice applicable turbine noise criteria at all locations with no significant cumulative impacts or effects.

Therefore, no specific mitigation measures are required.

If alternative turbine models are considered for the Proposed Wind Farm, an updated noise assessment will be prepared to confirm that the noise emissions will comply with the noise criteria outlined in Section 12.5.2 and/or the relevant operational criteria associated with the grant of planning for the Proposed Project.

In the unlikely event that an issue with low frequency noise is associated with the Proposed Project, an appropriate detailed investigation, by an independent acoustic consultant, shall be undertaken. Due consideration shall be given to guidance on conducting such an investigation which is outlined in Appendix VI of the EPA document NG4 (EPA, 2016). In the unlikely event that a complaint is received which indicates potential amplitude modulation (AM) associated with turbine operation, an independent acoustic consultant shall be employed to assess the level of AM in accordance with the methods outlined in ISO 1996-2:2017 with modifications in IEC 61400-11-2 and the IOA Wind Turbine Noise Amplitude Modulation Working Group (AMWG) document - A Method for Rating Amplitude Modulation in Wind Turbine Noise (IOA, 2016) or subsequent revisions.

As indicated in Section 12.3.2.7, there will be no vibration effects due to the operation of the wind turbines.

12.7.2.2 Onsite 110kV Substation

The assessment of noise from the operation of fixed plant at the proposed onsite 110kV substation is predicted to comply with the proposed criteria in Section 12.3.2.6. Therefore, no specific mitigation measures are required. However, at the detailed design stage consideration will be given to controlling and minimising any potential noise impacts at NSLs associated with the operation of the selected plant.

12.7.3 Decommissioning Phase

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

No specific mitigation measures are required for decommissioning. To ameliorate any potential noise impacts that may present during the decommissioning phase, a schedule of noise control measures has been formulated in accordance with best practice guidance. A similar list of recommended methods to the ones in Section 12.7.1 apply. These are outlined in the Decommissioning Plan (Appendix 4-6) that has been prepared for the Proposed Project.

12.7.4 Monitoring

12.7.4.1 Construction Phase

As indicated in Section 12.7.1, construction management includes monitoring of the construction operations to confirm the noise generated due to the works do not exceed the construction limits outlined in Section 12.3.2.1. Any monitoring conducted will be targeted at those activities with the greatest potential to generate noise, such as blasting or rock breaking, and will be undertaken in accordance with the principles of BS 5228. The purpose of such monitoring will be to verify compliance with the adopted limits and to inform construction management practices, where necessary.

12.7.4.2 Operational Phase

Post-commissioning operational noise monitoring will be undertaken to demonstrate compliance with the relevant noise criteria. It is common practice to commence surveys within six months of a wind farm being commissioned.

In the unlikely event that an exceedance of the noise criteria is identified as part of the compliance assessment, the guidance outlined in the IOA GPG and Supplementary Guidance Note 5: Post Completion Measurements (July 2014) will be followed, and relevant corrective actions taken to ensure residual compliance with the turbine noise criteria. For example, implementation of noise reduced operational modes which are embedded within the control system of the wind turbine can be implemented for specific turbines in specific wind conditions to ensure turbine noise levels are within the relevant noise criterion curves/planning conditions limits.

12.8 Residual Effects

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

12.8.1 Construction Phase

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

With respect to the EPA Guideline criteria for description of effects, in terms of these construction activities, the potential effects at the nearest NSLs associated with the various elements of the construction phase are described in Table 12-24 below.

Table 12-24 Construction Phase description of effects

Construction Phase	Quality (Noise and Vibration)	Residual Effect	Duration
General Construction of Turbines, Hardstand and Met Mast	Negative	Not Significant to Slight	Short Term
Construction of Internal Tracks	Negative	Not Significant to Slight	Temporary
Borrow Pit excavation and reinstatement	Negative	Not Significant to Slight	Short Term
Tree Felling and Woodland/ treeline Planting and enhancement proposals	Negative	Not Significant to Slight	Short Term

Construction Phase	Quality (Noise and Vibration)	Residual Effect	Duration
Temporary Compound	Negative	Not Significant to Slight	Temporary
Peat and Spoil Management Areas	Negative	Not Significant	Short Term
Construction Traffic	Negative	Not Significant to Slight	Short-Term
Turbine Delivery Route Works	Negative	Not Significant to Slight	Temporary
Proposed Grid Connection Works	Negative	Not Significant to Slight	Temporary

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

Based on the above, the effect on noise and vibration due to the construction of the Proposed Project is considered Not Significant.

12.8.2 Operational Phase

12.8.2.1 Wind Turbine Noise

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

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

The predicted residual operational turbine noise effects with respect to EPA (2022) description of effects are summarised as follows at the nearest NSLs.

Quality	Residual Effect	Duration
Negative	Not Significant	Long Term

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

Based on the above, the effect from wind turbine noise during the operational phase is considered Not Significant.

12.8.2.2 110kV Onsite Substation

The residual effects at the nearest NSLs of the proposed onsite 110kV substation are described as follows with respect to EPA criteria (2022):

Quality	Residual Effect	Duration
Negative	Not Significant	Long Term

Based on the above, the effect from the 110kV onsite substation during the operational phase is considered Not Significant.

12.8.3 Decommissioning Phase

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

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

Quality	Residual Effect	Duration
Negative	Not Significant	Short-term

Based on the above, the effect from noise emissions during the decommissioning phase is considered Not Significant.

12.9 Cumulative Effects

12.9.1 Wind Turbine Noise

This 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 12.3.2.5.5. , As outlined in Section 12.4.4.3, there is no other wind farm development, existing or proposed within 7km of the Proposed Project. It is therefore considered that a significant effect is not associated with the Proposed Project in combination with other wind farm developments.

The likely effect due to the cumulative wind turbine noise is Not Significant, Long Term.

12.9.2 Noise from Fixed Plant Operation

A review of the planning applications submitted in the area in proximity to the Site (as detailed in Chapter 2) has been undertaken.

The operation of the proposed 110kV substation is 30 dB $L_{Aeq,T}$ at the nearest NSL. Aerial imagery has shown that there is a substation, Knockroe Above Ground Installation (Knockroe AGI), to the

southwest of the Proposed Project, approximately 910 m north of H018, that has been considered as part of the cumulative assessment.

The nearest NSL to both substations is H018, which is 820 m southwest of the proposed substation. At such distances, the predicted cumulative impact is in the order of 28 dBA L_{Aeq}. The background noise survey (refer to Section 12.4.2) that was undertaken in the vicinity of the Site showed that levels were in the order of 24 dB L_{A90} for daytime and 16 dB L_{A90} for night time periods and did not identify any steady industrial plant noise sources in the receiving environment. Therefore, the potential for any cumulative noise effects is not significant. In conclusion, the predicted noise from the operation of the proposed onsite 110kV substation at the nearest NSL is below the adopted criteria.

There is no other known electrical plant in the area that would contribute cumulatively to the proposed 110kV substation. Therefore, the predicted cumulative noise levels are within the criterion for fixed machinal plant outlined in Section 12.3.2.6 and unlikely to result in any adverse impacts at nearby NSLs. Plant will be selected such that no tonal components are evident at any NSLs. At NSLs further from the proposed onsite 110kV substation the noise levels will be lower.

Therefore, the likely effects due to the cumulative noise from fixed plant operation is Not Significant to Slight, and Long Term.

12.9.3 Construction and Decommissioning

It is not anticipated that there will be any other activities that would give rise to significant cumulative noise effects during the construction or decommissioning phases. The predicted noise emissions for the Proposed Project are not of enough magnitude to cause an increase in the cumulative construction noise emissions exceeding the threshold for significant impacts at any NSL.

In order for cumulative noise levels to increase, the contribution of noise from the Proposed Project must be within 10 dB of the other source of noise. The predicted noise levels from construction activity would need to be well in excess of 55 dB $L_{Aeq,T}$ at an NSL in order for a potential cumulative construction noise increase to exceed the noise thresholds. The assessment in Section 12.6.2 and Section 12.9 confirms that the predicted noise levels from activities at static construction sites at any NSL are $\leq$55 dB $L_{Aeq,T}$, therefore the potential for any cumulative noise effect from all of the proposed activities occurring simultaneously or with construction activities from other developments is unlikely and not significant.

Construction activities that will progress over a defined route are predicted to exceed the construction noise threshold at the closest receptor locations, however, given the duration of the activities outside each individual NSL, the temporal criteria is not likely to be exceeded and hence higher cumulative noise levels for those periods would not cause an additional effect.

12.10 Difficulties Encountered During the Preparation of this Chapter

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

12.11 Interactions

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

on the impact assessment and related noise levels are also summarised specifically with respect to potential human health impacts in Chapter 5 and Chapter 6. The traffic flow projections associated with the Proposed Project provided in Chapter 15 has been utilised in the calculations in Section 12.6.2.7 of this Chapter.

12.12 Summary

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

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

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

Based on detailed information on the Site layout, turbine noise emission levels and turbine hub height, turbine noise levels have been predicted at 328 NSLs for a range of operational wind speeds. The predicted noise levels associated with the Proposed Project are within the best practice noise limits recommended in the Guidelines (DoEHLG, 2006). Therefore, it is not considered that a significant effect is associated with the Proposed Project.

Operational noise from the proposed onsite 110kV substation has been assessed and found to be within the adopted criteria.

No significant vibration effects are associated with the operation of the site.

Therefore, it is not considered that a significant effect is associated with the Proposed Project.

12.12.1 EIA Classification Summary

Please see Table 12-25 below for a summary of all identified impacts for the Proposed Project relating to Noise and Vibration.

Table 12-25 EIA Impact Assessment Summary

Topic	Pre-Mitigation Effect	Mitigation Section Reference	Residual Effect	Significance
Construction Phase				
General Construction of Turbines, Hardstand Areas and Met Mast	Negative, Not Significant to Slight, Short Term	Section 12.7.1	Negative, Not Significant to Slight, Short Term	Not Significant

Construction of Internal Access Tracks	Negative, Not Significant to Slight, Temporary	Section 12.7.1	Negative, Not Significant to Slight, Temporary	Not Significant
Borrow Pit Excavation and Reinstatement	Negative, Not Significant to Slight, Short Term	Section 12.7.1	Negative, Not Significant to Slight, Short Term	Not Significant
Tree felling and planting enhancement proposals	Negative, Not Significant to Slight, Temporary	Section 12.7.1	Negative, Not Significant to Slight, Short Term	Not Significant
Temporary Construction Compound	Negative, Not Significant to Slight, Temporary	Section 12.7.1	Negative, Not Significant to Slight, Temporary	Not Significant
Peat and Spoil Management Areas	Negative, Not Significant, Short Term	Section 12.7.1	Negative, Not Significant, Short Term	Not Significant
Construction Traffic	Negative, Not Significant to Slight, Short Term	Section 12.7.1	Negative, Not Significant to Slight, Short Term	Not Significant
Turbine Delivery Route Works	Negative, Not Significant to Slight, Short Term	Section 12.7.1	Negative, Not Significant to Slight, Short Term	Not Significant
Proposed Grid Connection works	Negative, Not Significant to Slight, Temporary	Section 12.7.1	Negative, Not Significant to Slight, Temporary	Not Significant
Operational Phase				
Wind Turbine Noise	Negative, Not Significant, Long Term	Section 12.7.2.1	Negative, Not Significant, Long Term	Not Significant
110kV Substation	Negative, Not Significant, Long Term	Section 12.7.2.2	Negative, Not Significant, Long Term	Not Significant
Decommissioning Phase				
Decommissioning	Negative, Not Significant to Slight, Short Term	Section 12.7.1	Negative, Not Significant to Slight, Short Term	Not Significant