Environmental Impact Assessment Report

Proposed Clonberne Wind Farm Development, Co. Galway

Chapter 12 – Noise and Vibration

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12. NOISE & VIBRATION

12.1 Introduction

Wind farms have the potential to create noise during their construction, operational and decommissioning phases. This chapter assesses the potential noise & vibration impacts at the nearest Noise Sensitive Receptors (NSRs), within c. 2 km of the Proposed Project, during each of the project phases. The full description of the Proposed Project is detailed in Chapter 4.

This chapter considers the likely significant effects with respect to the noise associated with the decommissioning of the existing turbines and relevant ancillary infrastructure and the construction, operation and decommissioning of the Proposed Project. The specific objectives of the chapter are to:

- describe the existing noise baseline;
- describe the assessment methodology and significance criteria used in completing the impact assessment;
- describe the potential effects;
- describe the mitigation measures proposed to address any likely significant effects; and
- assess the residual effects remaining, following the implementation of mitigation.

12.1.1 Statement of Authority

The noise assessments were carried out by TNEI Services Ltd (TNEI). TNEI is a specialist energy consultancy with an Acoustics team that has undertaken noise assessments for over 5 GW of onshore wind farm developments. The decommissioning and construction noise assessment was undertaken by Will Conway (BSc), who is a Technician Member of the Institute of Acoustics. The operational noise assessment was undertaken by Mark Tideswell (BSc, Dip) who is an Associate Members of the Institute of Acoustics. The decommissioning and construction noise assessment was reviewed and approved by Jim Singleton (BSc, Dip). The operational noise assessment and this EIAR Chapter were reviewed by James Mackay (BSc, Dip). Jim and James are full members of the Institute of Acoustics and hold the Diploma in Acoustics and Noise Control.

This chapter is supported by the following figures and appendices:

- Figures
  - Figure 12-1: Construction Noise Assessment;
  - Figure 12-2: Operational Noise Monitoring and Assessment Locations; and
- Appendices
  - Appendix 12-1: Construction Noise Report; and
  - Appendix 12-2: Operational Noise Report.

Figures and technical appendices are referenced in the text where relevant.

12.2 Legislation, Policy and Guidelines

As well as the guidance listed in Section 1.2.1 of Chapter 1 of this EIAR, this assessment considered the following combination of guidance and assessment methodologies:

- *British Standard BS 5228-1: 2009+A1:2014 'Code of practice for noise and vibration control on construction and open developments – Noise*[1]*;*
- *British Standard BS5228-2: 2009+A1:2014 'Code of practice for noise and vibration control on construction and open sites' – Part 2: Vibration*[2]
- *Department of Environment Heritage and Local Government (DoEHLG) 'Wind Energy Development Guidelines,' 2006*[3]*;*
- *The Working Group on Noise from Wind Turbines (NWG) (1996). ETSU-R-97 'The Assessment and Rating of Noise from Wind Farms*[4]*;*
- *Institute of Acoustics 'A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise' (2013) (IOA GPG)*[5]*;*
- *ISO 9613-2: 1996 'Acoustics – Attenuation of sound during propagation outdoors Part 2: General method of calculation*[6]*;*
- *British Standard BS7385-2: 1993 'The Evaluation and measurement for vibration in buildings. Guide to damage levels from groundborne vibration*[7]*; and*
- *British Standard BS6472: 2008 'Guide to evaluation of human exposure to vibration in buildings. Blast-induced vibration.*[8]

The above documents are discussed in detail within Section 2 of Appendix 12-1 and Appendix 12-2, where relevant.

It is noted that the Wind Energy Development Guidelines for Planning Authorities (2006) WEDG are currently under review and a set of draft updated guidelines were issued for consultation in December 2019 ('draft 2019 WEDG'). The draft 2019 WEDG included reference to, and reliance upon, some elements of ETSU-R-97 and the IOA GPG, however, significant concerns were raised during the consultation process regarding the noise section of the draft 2019 WEDGs and at the time of writing this report, no further updates have been issued. Given the limitations of the draft 2019 WEDGs and the likelihood that significant changes would need to be made to them before they could be adopted, an assessment using those draft guidelines has not been undertaken. On the 22 February 2023, a request for tender (RFT) was published for the review and redraft of the WEDGs by the Department of Environment. The timescales of the review indicated completion of the works by Q4 2023, in line with the Climate Action Plan 2023.

The guidance in the WEDG 2006 has been used to assess operational noise from the Proposed Project. In the absence of detailed guidance being included in WEDG 2006, the assessment methodology has been supplemented by the guidance in ETSU-R-97 and the IOA GPG where appropriate.

In 2018, the World Health Organisation issued noise guidelines *'Environmental Noise Guidelines for the European Region'*[9] that provide recommendations for protecting human health for exposure to environmental noise. The guidelines consider noise originating from various sources including from transportation noise (road traffic, railway and aircraft), leisure noise and wind turbine noise. The guidelines make a series of 'strong' and 'conditional' recommendations. Strong recommendations are made in relation to road, rail and aircraft noise whilst two conditional recommendations were made in relation to wind turbine noise. In relation to conditional recommendations the guidance notes that:

[1] *British Standards Institute, 2014. Code of practice for noise and vibration control on construction and open sites. Noise. UK : BSI, 2014. BS 5228-1:2009+A1:2014*
[2] *British Standard BS5228-2: 2009+A1:2014 'Code of practice for noise and vibration control on construction and open sites' – Part 2: Vibration*
[3] *Department of Environment Heritage and Local Government (DoEHLG) 'Wind Energy Development Guidelines,' 2006.*
[4] *ETSU for the DTI (Department of Trade and Industry), 1996 . The Working Group on Noise from Wind Turbines ETSU-R-97 The Assessment and Rating of Noise from Wind Farms'.*
[5] *Institute of Acoustics, 2013. Good Practice Guidance on the application of ETSU-R-97 for wind turbine noise assessment.*
[6] *(ISO), International Organisation for Standardisation. 1996. Acoustics – Attenuation of Sound During Propagation Outdoors: Part 2 – General Method of Calculation. Geneva: ISO, 1996. ISO 9613-2:1996*
[7] *British Standard BS7385-2: 1993 'The Evaluation and measurement for vibration in buildings. Guide to damage levels from groundborne vibration'*
[8] *British Standard BS6472: 2008 'Guide to evaluation of human exposure to vibration in buildings. Blast-induced vibration'*
[9] *World Health organisation, 2018. Environmental Noise Guidelines for the European Region'*

'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 guidance makes recommendations based on noise exposure levels characterised using the L_{den} parameter. L_{den} is a weighted annual average sound pressure level over all days, evenings and nights in a year which is commonly used for transportation noise but rarely used for wind turbine noise.

In relation to wind turbine noise the guidelines state:

'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.'

Notwithstanding the limitations associated with the derivation of the L_{den} threshold levels, serious concerns have also been raised about the practicality of using a threshold which is based on a weighed annual average which cannot actually be measured. Given the strength of recommendation and limitations associated with the use of L_{den} it is not considered appropriate to undertake an assessment against L_{den} levels.

12.3 Consultation

The scoping and consultation exercise carried out as part of the Proposed Project is described in Section 2.6 in Chapter 2 of this EIAR. The National Environmental Health Service issued a scoping response in February 2024, which included the following in relation to noise:

"Noise & Vibration

The potential impacts for noise and vibration from the proposed development on all noise sensitive locations must be clearly identified in the EIAR. The EIAR must also consider the appropriateness and effectiveness of all proposed mitigation measures to minimise noise and vibration.

A baseline noise monitoring survey should be undertaken to establish the existing background noise levels. Noise from any existing turbines in the area should not be included as part of the background levels.

In addition, an assessment of the predicted noise impacts during the construction phase and the operational phase of the proposed wind farm development must be undertaken which details the change in the noise environment resulting from the proposed development.

The Draft Revised Wind Energy Development Guidelines were published in December 2019. Whilst these have yet to be adopted, any proposed wind farm development should have consideration of the draft Guidelines.

https://www.housing.gov.ie/sites/default/files/public-consultation/files/draft_revised_wind_energy_development_guidelines_december_2019.pdf ."

This Chapter addresses the requirements of the Scoping Responses. A summary of the noise and vibration impact assessment, including the baseline survey and suitable mitigation measures, is detailed below with further information being included within Appendix 12-1 and 12-2.

Predicted noise levels and average background noise levels are presented in detail in Sections 5 and 6 of Appendix 12-2. Both background noise levels and wind turbine noise levels vary with wind speed and direction making the calculation of a change in noise level difficult to define, significance criteria are discussed in Section 12.4.6.

The Draft Revised Wind Energy Development Guidelines published in December 2019 are discussed in Appendix 12-2.

12.4 Assessment Methodology and Significance Criteria

12.4.1 Construction and Decommissioning Noise Methodology

There is no published statutory Irish guidance that contains suggested noise limits for construction or decommissioning activities, other than for road construction works, however, the Association of Acoustic Consultants of Ireland (AACI) have published 'Environmental Noise Guidance for Local Authority Planning & Enforcement Departments'[10], which states;

'The chief guidance document applied in the assessment of construction phase noise impacts is British Standard BS 5228:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites Part 1: Noise (2014)'.

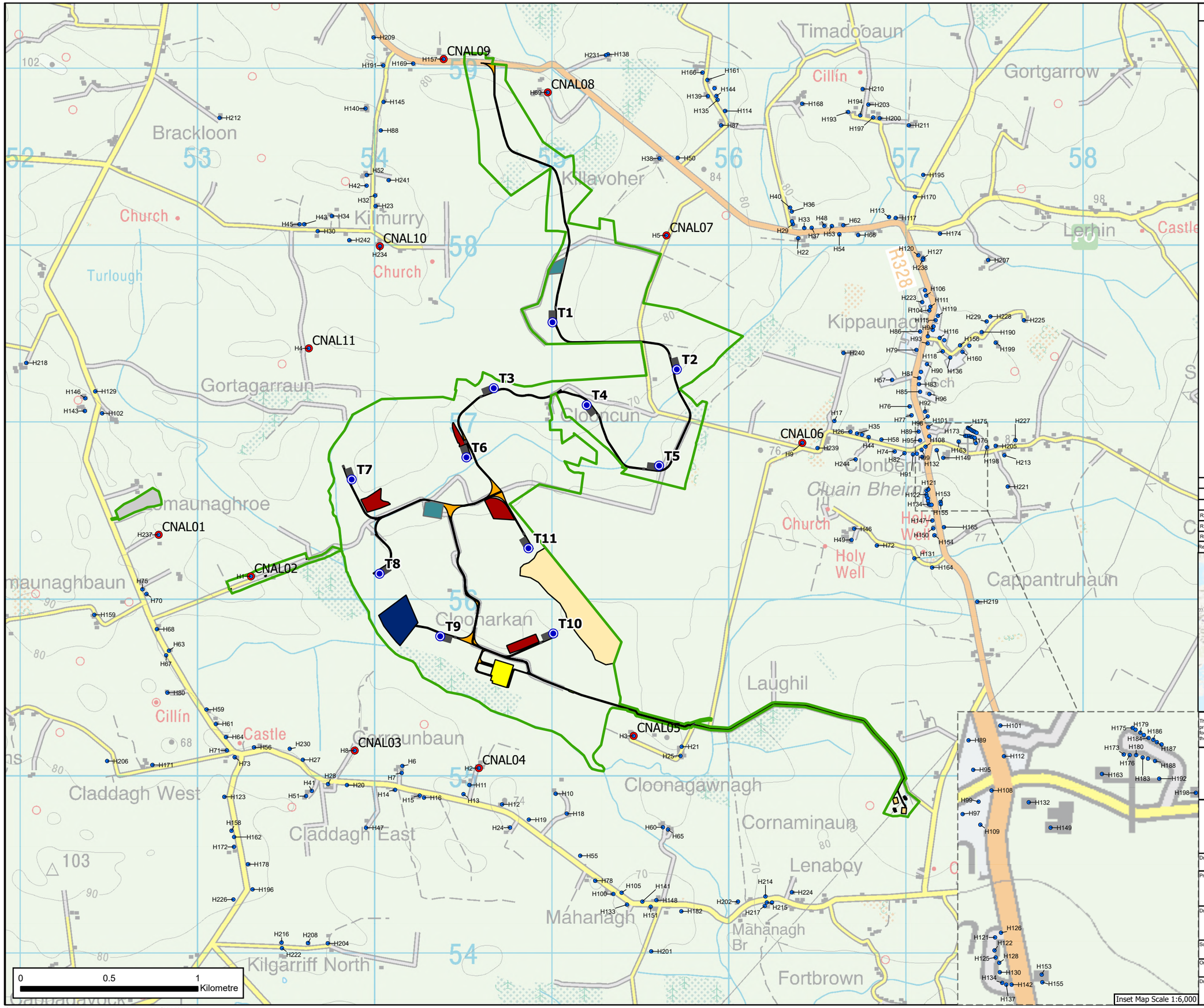
The construction and decommissioning noise assessment has therefore been undertaken using the BS 5228 guidance. The prediction of construction and decommissioning noise levels were undertaken using the calculation methodology presented in ISO 9613:1996, together with published noise data for appropriate construction and decommissioning plant.

To undertake an assessment of the construction and decommissioning noise impacts in accordance with the BS 5228 criteria, the following steps have been undertaken:

- identify noise sensitive receptors and select representative Construction Noise Assessment Locations (CNALs);
- identify applicable threshold of significant effects;
- predict noise levels for various construction and decommissioning noise activities;
- compare predicted noise levels against the applicable thresholds;
- where necessary, develop suitable mitigation measures to minimise any significant adverse effects during the construction/decommissioning phases; and, if required
- assess any residual adverse effects taking into account any identified mitigation measures.

Construction of the Proposed Project will be undertaken in several successive phases. During each phase the plant and equipment, and the associated traffic, would influence the noise generated. The selection of plant and equipment to be used will be determined by the main contractor when they are commissioned, therefore the assessment has been based upon a typical selection of plant for a wind farm project of this size and an indicative timetable which is provided in Section 4.5.10 in Chapter 4 of this EIAR. In view of this, the plant has been modelled operating at the closest points to each receptor

[10] *Association of Acoustic Consultants of Ireland, 2021. Environmental Noise Guidance for Local Authority Planning & Enforcement Departments*



Legend

- Noise Sensitive Receptors (NSRs)
- Construction Noise Assessment Locations (CNALs)
- EIAR Site Boundary
- Proposed Turbine Layout
- Proposed Crane Platform Hardstanding
- Proposed Turbine Foundations
- Proposed Construction Compounds
- Proposed Substation
- Proposed Cable Route and Cable Access Track
- Proposed Cable in the Public Road
- Proposed Borrow Pit
- Proposed New Roads
- Proposed Upgrades to Existing Roads
- Proposed Spoil Repository Access Road
- Proposed Operational Access Road
- Proposed TDR Accommodation Areas
- Proposed Passing Bays
- Proposed Grid Connection Compounds
- Proposed Grid Connection Masts
- Proposed Peat Repository Areas
- Proposed Proposed Spoil Storage Area
- Proposed Peatland Restoration Area

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R1	11/12/23	Second Issue	MT	JM	JM
R0	06/07/23	First Issue	MT	JM	JM

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Project Title: Clonberne Wind Farm

Drawing Title: Figure 12-1 - Construction Noise Assessment Locations

Scale	Designed	Drawn	Checked	Approved
1:20,000	MT	MT	MC	MC
Original Size	**Date**	**Date**	**Date**	**Date**
A3	27/02/2024	27/02/2024	27/02/2024	27/02/2024

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for a given activity in each phase, whereas in reality only certain plant will be working at the closest point for short periods of time.

The core hours for construction activities will be 07:00 to 19:00 Monday to Friday, and 07:00 to 13:00 on Saturday . There will be no working on Sundays and Public Holidays, however, it should be noted that out of necessity some activity outside of the core hours could arise, from delivery and unloading of abnormal loads or health and safety requirements, or to ensure optimal use is made of fair weather windows for concrete deliveries, the dismantling and erection of turbine blades and the erection and dismantling of cranes.

Chapter 4: Description outlines the tasks that will be undertaken during the construction period, which is estimated to last 18-24 months. For the purposes of this assessment, noise modelling has been undertaken for a number of scenarios, which simulate the likely overlap of several tasks within the phases that could occur during the decommissioning and construction period:

- Scenario 01 (Q1): Construction of the Grid Connection underground electrical cabling route has begun along with the construction and upgrading of roads and track leading into the Wind Farm Site from the site entrance (off the R328), through the site towards the temporary construction compounds and borrow pit.
- Scenario 02 (Q3): Track upgrade and installation is on-going across the site. Both construction compounds are now in operation. Construction of the turbine hard standings is underway. Construction of the Grid Connection underground electrical cabling route is on-going and construction of the onsite 220kV substation has begun.
- Scenario 03 (Q5): Track upgrade and installation has begun on the remaining Wind Farm Site roads. Both construction compounds are in operation. Construction of the turbine hardstandings and foundations are underway. Construction of the Grid Connection underground electrical cabling route and substation is on-going. Delivery of turbines has begun, including turbine delivery route upgrades, and landscaping and backfilling is occurring at all the proposed spoil management locations.
- Scenario 04 (Q6): Both construction compounds are in operation. Construction of the turbine hardstandings and foundations are completed in this quarter. Construction of the Grid Connection underground electrical cabling route and substation is on-going. Erection of some turbines are underway and landscaping and backfilling is occurring at all the proposed spoil management locations. Delivery of turbines is still on-going.
- Scenario 05 (Q7): Both construction compounds are in operation. Construction of the Grid Connection underground electrical cabling route and substation is on-going. Delivery and erection of the last turbines is underway and landscaping and backfilling is occurring at all the proposed spoil locations.
- Night-time: Diesel generators for the cabin and lighting at both construction compounds are operational.

In addition to the above, for Scenario 1, forestry activities have been modelled including felling of trees in the vicinity of T3, T4, T5, T6, T8 and T9 and forwarding for transportation off site.

It is understood that piling will be required at T7, and may be required at other turbines, depending on ground conditions. Piling activities will be limited to the proposed turbine foundations, which in all cases are located a considerable distance (greater than 720 m, or four times the turbine tip height) from the nearest receptors; at such distances, noise levels resulting from piling activities will be low of temporary duration, and as a result no significant impact will be experienced. Where piling is required, best practice mitigation measures will be used to limit noise output, as detailed in BS5228. The exact nature of the mitigation measures will vary depending on the pile type, strata to be penetrated and duration of the works required.

More detailed information on each of the construction Scenarios can be found within Appendix 12-1 of this EIAR. The noise-generating equipment assessed for each phase is detailed in Appendix 12-1, which shows actual noise data measured at 10 m from the noise source as detailed in BS5228. The noise levels

for all Scenarios have been calculated using the data contained in these tables. It is worth noting that for much of the working day the noise associated with construction activities will be less than predicted, as the assessment has assumed all equipment is constantly operating at full power and is located at the closest point to each receptor, whereas in practice equipment load and precise location will vary.

Construction activities outside the wind turbines area, along the cable route or distant road junctions that may need reinforcement have been assessed qualitatively. These activities will be of short duration and best practice during constructions would minimise any potential impact.

12.4.2 Construction Vibration

If it is deemed pertinent to set limits for vibration then two sets of vibration limits should be considered, one in regard to potential for damage to buildings and one in regard to the vibration effects on people within buildings.

Threshold values to determine the potential for damage to buildings are detailed in BS 7385-2:1993 (which is also referred to in BS 5228). The unit of measurement used for this assessment method is the Peak Particle Velocity (PPV), which is measured in mm/s or $mm.s^{-1}$. For dwellings, the standard provides the guideline threshold levels, as set out in Table 12-1 below.

Table 12-1: Transient vibration guide values for building damage

Peak Component Particle Velocity (mm/s)	Damage Levels for residential buildings
15 mm/s PPV for a frequency of 4 Hz, rising to 50 mm/s PPV for a frequency of 40Hz and above.	Cosmetic
30 mm/s PPV for a frequency of 4 Hz, rising to 100 mm/s PPV for a frequency of 40Hz and above.	Minor Damage
60 mm/s PPV for a frequency of 4 Hz, rising to 200 mm/s PPV for a frequency of 40Hz and above.	Major Damage

Table B.1 of BS 5228-2, reproduced here as Table 12-2 provides guideline PPV levels that can be used in a construction setting. It is important to note that the levels refer to internal vibration within a building, and not external levels.

Table 12-2: BS5228-2 Guidance on Effects of Vibration Levels

Vibration Level (A) (B) (C)	Effect
0.14 $mm.s^{-1}$	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration.
0.3 $mm.s^{-1}$	Vibration might be just perceptible in residential environments.
1.0 $mm.s^{-1}$	It is likely that vibration of this level in residential environments will cause complaint but can be tolerated if prior warning and explanation has been given to residents.
10 $mm.s^{-1}$	Vibration is likely to be intolerable for any more than a very brief exposure to this level in most building environments.
(A) The magnitudes of the values presented apply to a measurement position that is representative of the point of entry into the recipient. (B) A transfer function (which relates an external level to an internal level) needs to be applied if only external measurements are available. (C) Single or infrequent occurrences of these levels do not necessarily correspond to the stated effect in every case. The values are provided to give an initial indication of potential effects, and where these values are routinely measured or expected then an assessment in accordance with BS 6472-1 or -2, and/or other available guidance, might be appropriate to determine whether the time varying exposure is likely to give rise to any degree of adverse comment.	

With due regard to the above, external vibration level limits could be set at 15 mm/s PPV for frequencies between 4 Hz and 40 Hz and 50mm/s for frequencies above 40Hz.

Internal PPV limits could be set at somewhere between 1 mm/s^{-1} and 10.0 mm/s^{-1}, however, it should be noted that the measurement of vibration levels indoors is invasive and can be problematic. It should also be noted that the limits in Table 12-2 are generally considered guideline levels that should not be exceeded regularly or for long periods of time (see note c of Table 12-2).

12.4.3 Operational Noise Methodology

The assessment has been undertaken in accordance with the Wind Energy Development Guidelines (WEDG) 2006.

The AACI Environmental Noise Guidance states the following in relation to the WEDG 2006:

'The document includes daytime and night-time noise criteria. As criteria included in the document are evidently derived from ETSU-R-97, it is considered more robust to base noise assessments on the ETSU and IOA documents, particularly as the DOEHLG document is somewhat vague. The document has been undergoing a protracted review process for several years.'

In 2013 the ETSU-R-97 guidance was supplemented by a document produced by the Institute of Acoustics titled 'A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise' (IOA GPG). Given the lack of detail in parts of the WEDG, information contained in ETSU-R-97 and the IOA GPG has been used to supplement the WEDG.

The WEDG include limits for daytime and night time periods. Consequently, the test applied to operational noise is whether or not the calculated wind farm noise levels at nearby noise sensitive properties will be below the noise limits derived in accordance with WEDG 2006.

The daytime and night time periods are not defined within the WEDG 2006, therefore the assessment has considered these periods as detailed within IOA GPG. The daytime criteria are based upon background noise levels measured during 'quiet periods of the day' comprising:

- All weekday evenings from 18:00 to 23:00;
- Saturday afternoons and evenings from 13:00 to 23:00; and
- All day Sunday 07:00 to 23:00.

For the avoidance of doubt it should be noted that although the daytime limits are set based upon background data collected only during the quiet daytime period, they apply to the entire daytime period (07:00 – 23:00).

Night time periods are defined as 23:00 to 07:00, with no differentiation made between weekdays and weekends.

The WEDG 2006 include guidance on how to derive limits for daytime and night time periods.

The daytime limits take account of existing background noise levels and include a fixed limit of 45 dB or background + 5 dB, whichever is the greater, except in low background noise environments where a fixed minimum limit in the range 35-40 dB should be considered. TNEIs interpretation of these limits is that turbine noise should not exceed:

- 45 dB $L_{A90,\ 10\ min}$ or background noise + 5 dB, whichever is the greater, for daytime hours (applicable where background noise levels are greater than 30 dB L_{A90}); or
- 35 - 40 dB $L_{A90,\ 10\ min}$ where background noise is less than 30 dB L_{A90}.

The 40 dB $L_{A90,\ 10\ min}$ fixed minimum limit has been chosen for the daytime period based on the noise limits included within some recent planning decisions issued by An Bord Pleanála.

The WEDG 2006 states that a *"fixed limit of 43dB(A) will protect sleep inside properties during the night"*, however, whilst it is not explicit within the WEDG 2006 guidance, the addition of a night time 'background noise +5 dB' parameter is commonly applied in wind turbine noise assessments. This is detailed in numerous examples of planning conditions issued by local authorities. On that basis, the night time noise limits used in this assessment have been based on 43 dB or background noise + 5 dB, whichever is the greater.

The operational noise assessment is therefore undertaken in two stages:

- Stage 1 – Determine existing Total WEDG Noise Limits, which are already set for other wind farms within the vicinity of the Proposed Project at each NAL or establish the Total WEDG Noise Limits for each NAL (where noise limits are not already set) based on the measured background noise levels;
- Stage 2 – compare the noise predictions from the Proposed Project against the Total WEDG Noise Limits.

The aim of the operational noise assessment is to establish the Total WEDG Noise Limits and to establish whether the Proposed Project can meet those limits.

The exact model of turbine to be installed on the Proposed Project will be the result of a future tendering process should planning permission be granted. Achievement of the WEDG Noise Limits determined by this assessment will be a key determining factor in the final choice of turbine for the Proposed Project. Predictions of wind turbine noise for the Proposed Project were made based upon the sound power level data for a candidate wind turbine, the Vestas V162. This candidate turbine has a 162m rotor diameter, a maximum rated output capacity of 7.2MW, serrated trailing edge blades and a hub height of 99m. The candidate turbine modelled is considered to be representative of the type of turbine that will be installed at the Wind Farm Site based on the proposed turbine dimensions. Coordinates of the turbines modelled are summarised in Annex 6 of Appendix 12-2. Uncertainty in sound power data for the Proposed Project has been accounted for using the guidance contained within Section 4.2 of the IOA GPG (2013). The location of the wind turbines for the Proposed Project are shown on Figure 12-2.

Calculations of operational noise have been undertaken in accordance with International Standard ISO 9613-2, 'Acoustics – Attenuation of sound during propagation outdoors' (ISO 1996). The model calculates, on an octave band basis, attenuation due to geometric spreading, atmospheric absorption and ground effects. The noise model was set up to provide realistic noise predictions, including mixed ground attenuation (G=0.5) and atmospheric attenuation relating to 70 % relative humidity and 10 °C (Section 4.3 of the IOA GPG). The receiver height modelled was 4 m.

Typically wind farm noise assessments assume all properties are downwind of all turbines at all times (as this would result in the highest wind turbine noise levels). However, where properties are located in proximity to a number of turbines, they cannot be downwind of all turbines simultaneously, so it is appropriate to consider the effect of wind direction on predicted noise levels and the impact of directivity has been considered in the assessment (see Section 6 of Appendix 12-2).

In line with the IOA GPG, an assessment has been undertaken to determine whether a concave ground profile correction or barrier correction, is required due to the topography between the turbines and the noise sensitive receptors. Propagation across a valley (concave ground) increases the number of reflection paths, and in turn, has the potential to increase sound levels at a given receptor. Terrain screening effects (barrier corrections) act as blocking points, subsequently reductions in sound levels at a given receptor can potentially be observed. Concave ground and barrier corrections were found to be required for a number of turbines at a number of receptors as detailed in Annex 6 of Appendix 12-2.

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Legend

- Proposed Wind Turbines
- Noise Monitoring Locations (NMLs)
- Noise Assessment Locations (NALs)

Noise Sensitive Receptors (NSRs)

- NSRs represented by data from NML1
- NSRs represented by data from NML2
- NSRs represented by data from NML3
- NSRs represented by data from NML4
- NSRs represented by data from NML5

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R2	27/02/24	Third Issue	MT	MC	MC
R0	11/12/23	Second Issue	MT	JM	JM
R0	06/07/23	First Issue	MT	JM	JM

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MKO

Drawing Status	FOR PLANNING
Project Title	Clonberne Wind Farm
Drawing Title	Figure 12-2 Operational Noise Monitoring and Assessment Locations

Scale	Designed	Drawn	Checked	Approved
1:20,000	MT	MT	MC	MC
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A3	27/02/2024	27/02/2024	27/02/2024	27/02/2024

Drawing Number	Revision
13772-008	2

0 0.5 1 Kilometre

12.4.3.1 Amplitude Modulation

In the context of wind turbine noise, Amplitude Modulation (AM) describes a variation in noise level over time; for example, observers may describe a 'whoosh whoosh' sound, which can be heard close to a wind turbine as the blades sweep past. The AM of aerodynamic noise is an inherent characteristic of wind turbine noise and was noted in ETSU-R-97, on page 68, which states:

'The modulation or rhythmic swish emitted by wind turbines has been considered by some to have a characteristic that is irregular enough to attract attention. The level and depth of modulation of the blade noise is, to a degree, turbine-dependent and is dependent upon the position of the observer. Some wind turbines emit a greater level of modulation of the blade noise than others. Therefore, although some wind turbines might be considered to have a character that may attract one's attention, others have noise characteristics which are considerably less intrusive and unlikely to attract one's attention and be subject to any penalty.

This modulation of blade noise may result in a variation of the overall A-weighted noise level by as much as 3dBA (peak to trough) when measured close to a wind turbine. As distance from the wind turbine [or] wind farm increases, this depth of modulation would be expected to decrease as atmospheric absorption attenuates the high frequency energy radiated by the blade.'

The Acoustics community has sought to make a distinction between the AM discussed within ETSU-R-97, which is expected at most wind farms and as such may be considered as 'Normal Amplitude Modulation' (NAM), compared to the unusual AM that has sometimes been heard at some wind farms, hereinafter referred to as 'Other Amplitude Modulation' (OAM). The term OAM is used to describe an unusual feature of aerodynamic noise from wind turbines, where a greater than normal degree of regular fluctuation in sound level occurs at the blade passing frequency, typically once per second. In some literature it may also be referred to as 'Excess Amplitude Modulation' (EAM). It should be noted that the noise assessment and rating procedure detailed in ETSU-R-97 fully takes into account the presence of the intrinsic level of NAM when setting acceptable noise limits for wind farms.

Persistent OAM can be a source of nuisance to wind farm neighbours. Indeed, in a recent decision of the Irish High Court on the 8th of March 2024, the court found that frequent and sustained periods of OAM arising from the operational Ballyduff Wind Farm was an unreasonable interference with a neighbour's use and enjoyment of their property which was located approximately 359 m from the nearest turbine. The issue of damages and/or an injunction were held over for later determination by the court but in the meantime, the court directed all parties to engage in mediation with a view to devising ***'appropriate mitigation measures and if possible, to resolve all outstanding issues between them'***. In summary, therefore, where persistent and sustained OAM arises mitigation is possible and is the appropriate response.

A significant amount of research has been undertaken in relation to OAM and a summary of the most relevant research is included in Section 3.3 of Technical Appendix 12-2. Key outcomes of the research are that:

- It is clear that OAM, if it occurs frequently and for sustained periods, it has the potential to result in adverse impacts for wind farm neighbours.
- It is not currently possible to predict if and when OAM will occur at a proposed wind farm site. On sites where OAM has been identified it occurs intermittently and varies in terms of severity.
- There are methodologies available that can be used to measure and quantify OAM, in particular the method produced by the Amplitude Modulation Working Group (AMWG), which was formed by the Institute of Acoustics. The methodology was presented in a report '*Methods for Rating Amplitude Modulation in Wind Turbine Noise'* which was published in April 2015.
- Whilst it is possible to measure and quantify OAM using the AMWG methodology (which provides an AM rating for each 10 minute period), further study is still

required to help quantify what level of OAM, if any, is acceptable. This is complicated by the fact that it is unclear whether a small amount of OAM that occurs regularly is likely to be more (or less) annoying than a large amount of OAM that occurs very infrequently.

- Notwithstanding a lack of a defined threshold detailing what level of OAM is acceptable, there are measures available which have been shown to mitigate OAM should it occur. Measures can include:
  - Changes to the operation of the relevant wind turbine(s) by changing parameters such as blade pitch;
  - Addition of blade furniture (such has vortex generators) to alter the flow of air over the wind turbine blades; and, in extreme cases,
  - Targeted wind turbine shutdowns in specific conditions where OAM is found to occur.

Where mitigation is required, it needs to be designed on a site-specific basis.

To ensure that any future complaints relating to noise and OAM can be responded to appropriately, the Applicant proposes to appoint a community liaison officer who would be the first point of contact in the event that noise complaints were to occur and the mitigation strategy set out in Section 12.7.2 below will be employed.

12.4.3.2 Cumulative Operational Noise Methodology

Where cumulative wind turbine developments are identified in proximity to the Proposed Project, cumulative noise predictions will be compared against the Total WEDG Noise Limits. Where no cumulative wind turbine developments are identified within close proximity to the Proposed Project, such that cumulative noise levels will have a negligible contribution to overall operational noise levels, cumulative operational noise effects will be considered to be not significant.

12.4.4 Potential Effects Scoped Out

12.4.4.1 Decommissioning

Activities that occur during the decommissioning of the Proposed Project are unlikely to produce higher noise levels than those produced during construction and many of the activities will be similar in nature. As such it is considered that if construction noise levels are predicted to be below the threshold levels, then decommissioning noise will also be within the threshold levels.

12.4.4.2 Blasting

The extent of any blasting requirement cannot be determined until intrusive site investigation tests are completed. Nevertheless, should blasting be required, a series of tests would be undertaken by the appointed contractor in accordance with guidance outlined in BS5228-2:2009+A1:2014[11]. Following on from these tests, blasts would be designed through appropriate specification of Maximum Instantaneous Charge (MIC) to ensure that vibration levels at the nearest NSR's would not exceed the guideline limits presented in BS 5228 and related standards such as BS 7385-2: 1993 'The Evaluation and measurement for vibration in buildings. Guide to damage levels from groundborne vibration'[12][13]. A condition could be attached to the consent to require compliance with these limits.

[11] *British Standard BS5228-2: 2009+A1:2014 'Code of practice for noise and vibration control on construction and open sites' – Part 2: Vibration*
[12] *British Standard BS7385-2: 1993 'The Evaluation and measurement for vibration in buildings. Guide to damage levels from groundborne vibration'*
[13] *British Standard BS6472: 2008 'Guide to evaluation of human exposure to vibration in buildings. Blast-induced vibration'*

Given the relative distances between the potential locations of blasting and the closest sensitive receptors, the blast engineer should be able to calculate appropriate Maximum Instantaneous Charge (MIC) values that will ensure that the guideline limits within BS7385-2: 1993 and BS 6472-2: 2008 would be met, and therefore this issue can be scoped out of further detailed consideration.

12.4.5 Method of Baseline Characterisation

12.4.5.1 Extent of the Study Area

The Study Area is defined as the area within 2 km of the proposed wind turbines. Prior to the commencement of the operational noise assessment, an initial desktop review was undertaken in order to identify all NSRs and potential Noise Monitoring Locations (NMLs); 239 NSRs were identified in total, all residential properties. Five NMLs were selected to represent all of the NSRs, located at the closest NSRs around the Proposed Project. The NMLs and NSRs are shown on Figure 12-2. More information on the NMLs can be found in Section 5 of Appendix 12-2: Operational Noise Report.

Construction works related to grid route and road and junction improvements may occur outwith the Study Area in close proximity to residential receptors. It is therefore possible that noise from these activities may at times exceed the guideline levels, however it should be noted that this will be a short-term, temporary impact. Good practice during construction is recommended and will reduce noise levels from these short-term works to minimum levels.

12.4.5.2 Field Survey

The noise survey to determine the existing background noise environment at noise sensitive receptors neighbouring the Proposed Project was undertaken in accordance with the guidance contained within ETSU-R-97 and current good practice (IOA GPG).

Background noise monitoring was undertaken at five noise sensitive receptors. The NMLs were chosen by TNEI to be representative of all other receptors located around the Proposed Project and were selected with the aim of minimising the potential influence from existing operational wind turbines in the area. The selection of the NMLs considered local noise sources such as boiler flues, watercourses and vegetation.

Background noise monitoring was undertaken over the period of 19th February to 21st April 2020 at the NMLs detailed in Table 12-3 and Figure 12-2. Further details of the NMLs can be found within Appendix 12-2.

Table 12-3 Summary of Noise Monitoring Locations

Receptor	X (ITM)	Y (ITM)
NML 01	557115	756420
NML 02	555521	754284
NML 03	552801	755730
NML 04	553965	758300
NML 05	556608	758134

Simultaneous wind speed/direction data were recorded within the site at various heights using a LIDAR Unit (located at Irish Transverse Mercator reference 554932, 756999). The wind speed data collected directly at hub height (99 m) were standardised to 10 m height in accordance with good practice.

Wind speed/direction and rainfall data were collected over the same time scale and averaged over the same ten-minute periods as the noise data to allow analysis of the measured background noise as a function of wind speed and wind direction. All data analysis was undertaken in accordance with the IOA GPG. For the assessment locations where no background noise measurements were undertaken, noise data collected at proxy locations deemed representative of the background noise environment was used to derive noise limits at those receptors. Information on which background noise dataset was used at each NAL is provided on Figure 12-2 and within Appendix 12-2.

12.4.6 Criteria for the Assessment of Effects

The Environmental Protection Agency document *'Guidelines on the information to be contained in Environmental Impact Assessment Reports'* [14] has informed the criteria for the assessment of potential effects as summarised below. The descriptors used in this environmental impact assessment are those set out in the EPA (2022) Glossary of effects as shown in Chapter 1, Section 1.7.1 of this EIAR.

12.4.6.1 Criteria for Assessing Significance – Construction and Decommissioning Noise

The significance criteria adopted for this assessment are based on Appendix E part E.3.2 of BS5228-1:2009+A1:2014, as detailed in Section 4.3 of the Construction Noise Report (Appendix 12-1).

The criteria for indicating a potential significance use a noise metric of $L_{Aeq,T}$,, as detailed in Table 12-4. The L_{Aeq} is the A-weighted, equivalent continuous sound level in decibels measured over a stated period of time, ($L_{Aeq,T}$) where T is the length of the assessment period (Time).

Table 12-4 Construction Noise Significance Criteria

Significance of Effect	Significance Level	
	Not Significant	Significant
Category A[15] Daytime (07:00 – 19:00) and Saturdays (07:00 to 13:00)	≤65dB $L_{Aeq, T}$	>65dB $L_{Aeq, T}$
Category A Evenings and Weekends (19:00 – 23:00), Saturdays 13:00-23:00 and Sundays 07:00-23:00.	<55dB $L_{Aeq, T}$	>55dB $L_{Aeq, T}$
Category A Night time (23:00 – 07:00)	<45dB $L_{Aeq, T}$	>45dB $L_{Aeq, T}$

It should be noted that exceedance of the limit does not in itself indicate a significant effect, rather, the standard states *'If the site noise level exceeds the appropriate category value, then a potential significant effect is indicated. The assessor then needs to consider other project-specific factors, such as the number*

[14] *The Environmental Protection Agency, 2022. Guidelines on the information to be contained in Environmental Impact Assessment Reports*
[15] *Category A, B and C thresholds are provided within BS558. Category A thresholds have been used in this assessment as they are the most stringent. Further information on all Category Thresholds can be found in Appendix 12-1.*

of receptors affected and the duration and character of the impact, to determine if there is a significant effect'.

12.4.6.2 Criteria for Assessing Significance – Operational Noise

The WEDG do not define significance criteria but describe a framework for the measurement of wind farm noise and give indicative noise levels considered to offer a reasonable degree of protection to wind farm neighbours, without placing unreasonable restrictions on wind farm development. Achievement of the WEDG derived noise limits ensures that wind turbine noise will comply with current Government guidance.

In terms of the EIA Regulations, in this Chapter of the EIAR the use of the term 'significance' in this EIAR refers to compliance or non-compliance with the WEDG derived noise limits. For situations where predicted wind turbine noise meets or is less than the noise limits defined in WEDG, then the noise effects are deemed not significant. Any exceedance of the WEDG derived noise limits due to the Proposed Project has the potential to result in a significant effect.

12.4.6.3 Limitations and Assumptions

It has been assumed that the noise data collected during the background noise survey are representative of the typical baseline noise levels at the nearest noise sensitive receptors; the guidance in the WEDG supplemented by the IOA GPG has been followed by suitably experienced Acoustic Consultants to ensure that the data collected is as representative as possible.

A candidate wind turbine has been used for predictions of operational noise from the Proposed Project, whilst the final model of wind turbine to be used may differ from that presented in this assessment, operational noise levels will comply with the noise limits imposed by any An Bord Pleanála decision to grant permission.

No other assumptions or data gaps have been identified.

12.5 Baseline Conditions

12.5.1 Current Baseline

The Proposed Project is located within a rural location where existing background noise levels at the NSRs are generally considered to be low (<30 dB at low windspeeds as defined in the WEDG 2006[16]). The predominant noise sources in the area are wind induced noise (wind passing through vegetation and around buildings) and birdsong.

Table 12-5 and Table 12-6 provide a summary of the background noise levels measured during the monitoring period during the quiet daytime and night time periods. Background noise data recorded during periods of rainfall (including the preceding 10 minute period in line with IOA GPG) have been excluded from the dataset, as well as data following periods of heavy rainfall. Further information of the data recorded during the noise survey can be found in Section 5 of Appendix 12-2). The prevailing background noise levels are also shown on Figures A1.2a-A1.2e included in Annex 1 of Appendix 12-2.

[16] *Section 5.4 of WEDG 2006 refers to ' low noise environments where background noise is less than 30 dB(A)'*

Table 12-5 Summary of Prevailing Background Noise Levels during Quiet Daytime Periods (dB(A))

Noise Monitoring Location	Wind Speed (ms^{-1}) as standardised to 10m height											
	1	2	3	4	5	6	7	8	9	10	11	12
NML1	29.6*	29.6*	29.6	29.7	30.3	31.3	32.8	34.6	36.8	39.2	41.9	44.8
NML2	28.7*	28.7*	28.7*	28.7	29.4	30.8	32.7	35.0	37.7	40.7	43.8	47.0
NML3	24.0*	24.0*	24.0	24.4	25.8	28.0	30.8	34.0	37.2	40.4	43.1	45.3
NML4	23.4*	23.4*	23.4	23.8	25.7	28.7	32.5	36.9	41.3	45.6	49.4	52.4
NML5	23.8*	23.8*	23.8	23.8	24.8	26.6	29.0	31.9	35.2	38.6	42.1	42.1*

**flat-lined where derived minimum occurs at lower wind speeds and derived maximum occurs at higher wind speeds, see Section 5.7.5 of the Operational Noise Report (Appendix 12-2).*

Table 12-6 Summary of Prevailing Background Noise Levels during Night time Periods (dB(A))

Noise Monitoring Location	Wind Speed (ms^{-1}) as standardised to 10m height											
	1	2	3	4	5	6	7	8	9	10	11	12
NML1	22.5*	22.5*	22.5*	22.5	23.1	24.5	26.7	29.5	32.9	36.7	40.9	45.4
NML2	18.4*	18.4*	18.4*	18.4	19.5	22.0	25.6	29.8	34.5	39.1	43.4	46.9
NML3	16.2*	16.2*	16.2*	16.2	17.8	20.9	25.1	29.8	34.6	38.9	42.2	44.1
NML4	16.4*	16.4*	16.4*	16.4	18.3	22.5	28.2	34.6	40.9	46.5	50.5	52.2
NML5	15.7*	15.7*	15.7*	15.7	16.5	18.9	22.6	27.1	32.1	37.3	42.1	42.1*

**flat-lined where derived minimum occurs at lower wind speeds and derived maximum occurs at higher wind speeds, see Section 5.7.5 of the Operational Noise Report (Appendix 12-2).*

12.5.2 Summary of Sensitive Receptors

Of the 239 identified NSRs, a total of eight were chosen as Noise Assessment Locations (NALs) for the operational noise assessment and 12 Construction Noise Assessment Locations (CNALs) were selected for the Proposed Project construction noise assessment. The CNALs/ NALs were chosen to represent the noise sensitive receptors located closest to the Proposed Project and also some additional receptors were included to consider larger groups of NSRs. The modelling results for the CNALs/ NALs has been presented within the main body of this chapter and Appendices 12-1 and 12-2, whilst an assessment for all NSRs has been included within Annex C of Appendix 12-1 and Annex 5 of Appendix 12-2.

For the assessment locations where no background noise measurements were undertaken, noise data collected at proxy locations deemed representative of the background noise environment was used to assess the noise impacts at those receptors. For clarity, all NSRs are labelled with the letter 'H' and numbered to ensure consistency with the labelling within the rest of the EIAR.
The receptors considered as NALs within the noise assessment are summarised in Table 12-7 and Table 12-8 below. A list of all NSRs is included within Annex C of Appendix 12-1 and Annex 5 of Appendix 12-2. All CNALs and NSRs are shown on Figure 12-1 and NALs and NSRs on Figure 12-2.

12.6 Assessment of Likely Effects

The assessment examines the Proposed Wind Farm Site and the Proposed Grid Connection for each potential effect assessed. A Residual Effect is then provided for the Proposed Project (the Proposed Wind Farm Site and the Proposed Grid Connection) for each potential effect assessed.

12.6.1 Do-nothing Effect

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

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

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

12.6.2 Construction Noise Assessment Locations

The Construction Noise Assessment Locations (CNAL) are summarised in Table 12-7: Summary of Construction Noise Assessment Locations below and are shown on Figure 12-1.

Table 12-7 Summary of Construction Noise Assessment Locations

Receptor	X (ITM)	Y (ITM)
CNAL01 (H237)	552743	756385
CNAL02 (H01)	553264	756150
CNAL03 (H08)	553850	755166
CNAL04 (H02)	554551	755067
CNAL05 (H03)	555425	755249
CNAL06 (H09)	556377	756904
CNAL07 (H05)	555610	758076
CNAL08 (H69)	554940	758884
CNAL09 (H157)	554352	759072
CNAL10 (H234)	553992	758015
CNAL11 (H04)	553591	757438

12.6.3 Operational Noise Assessment Locations

Predictions of wind turbine noise have been made at each of the NALs as detailed in Table 12-8 and shown on Figure 12-2. Table 12-8 also details which NML has been used to set noise limits for each NAL. Predictions for all other NSRs are included within Annex 5 of Appendix 12-2.

Table 12-8 Summary of Operational Noise Assessment Locations

Receptor	X (ITM)	Y (ITM)	Elevation (m AOD)	Background Noise Data Used
NAL1 (H1)	553330	756117	81	NML3
NAL2 (H2)	554608	755045	72	NML2
NAL3 (H3)	555462	755228	66	NML2
NAL4 (H4)	553667	757425	79	NML4
NAL5 (H5)	555597	758045	87	NML5
NAL6 (H8)	553916	755170	73	NML3
NAL7 (H9)	556399	756886	78	NML1
NAL8 (H234)	553992	758015	86	NML4

12.6.4 Potential Noise Effects (Proposed Project)

12.6.4.1 Construction Noise

Table 12-9 presents the calculated noise immission levels at each CNAL for all modelled scenarios. The construction noise assessment results show that the predicted noise levels are below the Category A Threshold Levels for all threshold value periods, except Evenings and Weekends at CNAL02. As noted in Section 12.4, construction activities are only likely to take place out of hours on rare occasions, and where this is the case, it is likely that these activities will take place in close proximity to the wind turbine locations, a considerable distance from CNAL02. It is therefore likely that, in practice, the Evenings and Weekends Category A Threshold level will not be exceeded.

Accordingly, the impact is deemed **not significant** for construction activities associated with the proposed wind farm and supporting infrastructure. Full details of the modelling and assessment can be found in Appendix 12-1 along with the results for all other NSRs.

For the Grid Connection underground electrical cabling route, the amount of required plant is relatively small, typically being based around an excavator for trenching and backfill activities. As such, construction activities in any one location will be limited in duration and adverse noise effects are anticipated to be negligible. Where construction activities occur directly besides a dwelling the noise levels at that location are likely to be in the region of 75 – 80 dBA for a short period of time. It should be noted, however, that this would only occur where construction activities are directly opposite a dwelling within approximately 20 m, and this is a maximum noise level (i.e. not considering a full construction day). To put this into context, trenching and backfill activities are anticipated to move along the underground electrical cabling route at approximately 150 m to 300 m a day, therefore, the length of time when construction activities will be occurring adjacent to any given receptor is only likely to be for a few hours. For the majority of the time, plant and equipment will be located at greater distances and noise levels will be lower. It is possible that noise levels from trenching and backfill operations may occasionally exceed the BS 5228 threshold if very close to a NSR, however this would only occur for a short period of time at any one location.

At some watercourse, culvert and drain crossings there may be a requirement for Directional Drilling (DD). Specifically, this could be required for some small bridge or water crossings. DD for large crossing would require the use of multiple items of plant including pumps, mud recyclers, drilling rigs and generators, however, the proposed plant for these small crossings is a small Vermeer D36 x 50 Directional Drill (or similar). Calculations of the Vermeer DD rig, assuming a source noise level of 94 dBA at 1 m, indicates that noise levels would be below the 65dBA threshold from a distance of approximately 30 m. For small crossings, the work would likely be completed within 1 and 2 weeks so

it will be very short term only. Where activities involving the small HDD drilling rig are within 30 m of a dwelling then noise mitigation measures should be considered. This could include the erection of temporary boarding alongside the drilling rig or use of 'acoustic blanket panels' to hang from Heras fencing (or similar). This should be installed as close to the drilling rig as is practicable and fitted so as to interrupt any direct line of site between the drilling rig and the closest residential receptors. Examples of appropriate products include Echo Noise Defender and Soundex DeciBloc.

Construction works related to distant road junction improvements may also occur outwith the CNALs considered above, in close proximity to some residential receptors. It is possible that noise from these activities may at times exceed the guideline levels, however it should be noted that this will be a short-term, temporary impact. Good practice during construction is recommended and will reduce noise levels from these short-term works to minimum levels.

Accordingly, the impact is deemed **not significant** for construction activities associated with cable trenching, bridge crossings and distant road junctions.

Table 12-9 Predicted Decommissioning and Construction Noise Immission Levels

CNAL	Category A Threshold dB $L_{Aeq, t}$			Immission Level, dB $L_{Aeq, t}$ for each Scenario					
	Daytime (07:00 – 19:00) and Saturdays (07:00 - 13:00)	Evenings and Weekends (19:00 – 23:00), Saturdays 13:00-23:00 and Sundays 07:00-23:00.	Night-Time (23:00 – 07:00)	1	2	3	4	5	Night
CNAL01	65	55	45	50	49	50	49	50	19
CNAL02	65	55	45	61	54	54	55	54	33
CNAL03	65	55	45	41	41	45	45	43	20
CNAL04	65	55	45	42	38	40	41	40	20
CNAL05	65	55	45	42	39	42	39	37	25
CNAL06	65	55	45	40	32	41	40	30	21
CNAL07	65	55	45	43	34	45	44	34	24
CNAL08	65	55	45	48	48	48	48	41	19
CNAL09	65	55	45	42	40	43	38	32	29
CNAL10	65	55	45	43	39	42	40	37	19
CNAL11	65	55	45	41	39	41	41	36	24

12.6.4.2 Cumulative Construction Noise

In December 2023, a planning application was submitted for Lomaunaghbaun Quarry, a proposed sand quarry to located west of the borrow pit, on the western edge of the Proposed Project. The Lomaunaghbaun Quarry EIAR describes a total site area of 6.2 hectares and states a proposed average excavation depth of 3 m with a total lifespan of 10 years. In addition to excavation works, the extracted material will be processed on-site via crushing and washing facilities. The EIAR states that there is no

intention to extract bedrock, and that there is no expected requirement for blasting. No other potential cumulative construction noise developments have been identified near to the Proposed Project

The closest noise-sensitive receptor to Lomaunaghbaun Quarry is CNAL01 (see Table 12-7), located to the south of the Proposed Project borrow pit. Predicted noise levels at CNAL01 resulting from the construction of the Proposed Project are identified in Table 12-9; the highest predicted noise level at CNAL01 is 50 dB, 15 dB below the Category A threshold level of 65 dBA.

In order for the Category A threshold level to be exceeded at CNAL01, noise levels attributable to the Quarry would need to be at 65dB or above and at that point the temporary construction activities predicted for the Proposed Project would not contribute to any noise (i.e. would be at least 10dB below). In addition construction activities relating to the Proposed Project in proximity to CNAL01 will be short term.

In March 2024, a planning application (ref: 2460230) was submitted for the construction of a new 38 kV overhead line (OHL), which crosses the Proposed Project area north to south from the Cloon 110 kV substation to the Glenmaddy 37 kV substation. Works involved in the construction of the OHL are anticipated to be primarily related to the erection of 179 wooden poles along a distance of approximately 26.8 km. The Planning & Environmental Considerations Report for the application states that construction of the poles will be undertaken via the use of a single mechanical excavator to both dig the holes and erect the poles.

The closest noise-sensitive receptors to the route of the OHL are CNAL04 & CNAL05, located to the south of the Proposed Project, and CNAL07, located to the north of the Proposed Project. The predicted noise levels at these three noise-sensitive receptors resulting from the construction of the Proposed Project are identified in Table 5.1; the highest predicted noise level at any of these three receptors is 45 dB (at CNAL07), 20 dB below the Category A threshold level of 65 dBA.

In order for the Category A threshold level to be exceeded at CNAL04, CNAL05 or CNAL07, noise levels attributable to the OHL would need to be at 65dB or above and that point the temporary construction activities predicted for the Proposed Project would not contribute to any noise (i.e. would be at least 10dB below). In addition construction activities relating to the OHL will be short term.

It is therefore concluded that no significant effects will occur as a result of cumulative construction noise.

12.6.4.3 Construction Vibration

Due to the large separation distances between the construction activity areas on the Proposed Project and the nearest receptors, no significant effects are anticipated. Where construction activities on the underground electrical cabling route are close to residential receptors, some local vibration effects may be present, however, levels are expected to be low, of limited duration and therefore not significant.

12.6.5 Operational Noise Effects (Proposed Grid Connection)

The Grid Connection onsite 220 kV substation will be installed in the southern half of the Wind Farm Site. The closest receptor to a substation location is NAL2 (H2), which is at a distance of approximately 500 m from the 220 kV grid connection substation.

'*EirGrid Evidence Based Environmental Studies Study 8: Noise'* presents measured noise levels for a similar 220 kV substation (Gorman Substation). Sound pressure level measurements are provided at eight different locations around the substation at distances of 5 m and 10 m, which vary between 37 dB $L_{Aeq(t)}$ and 43 dB $L_{Aeq(t)}$. The document provides commentary on the measurements, stating, *"The measured data from the Gorman substation survey illustrates that noise levels from a 220kV substation are well within the daytime WHO threshold limits for serious annoyance (55dB L_{Aeq}) and moderate*

annoyance (50dB L_{Aeq}) for outdoor living areas and the night-time free-field threshold limit of 42dB (L_{Aeq}) for preventing negative effects on sleep."

With a separation distance of 500 m to the closest receptor, the level of distance attenuation will be approximately 40 dB. Accordingly, at distances of 500 m and greater, noise from the substation at the nearest receptor is likely to be inaudible over existing background noise. Furthermore, there will be no operational noise from the Grid Connection underground electrical cabling route. Therefore, there would be **no significant operational noise effects**.

12.6.6 Operational Noise Effects (Proposed Wind Farm)

12.6.6.1 Setting the Total WEDG Noise Limits (Stage 1)

Based on the prevailing background noise levels, the Total WEDG Noise Limits have been established for each of the NALs detailed in Table 12-8 above. The Total WEDG Noise Limits for the other NSRs are detailed in Annex 5 of Appendix 12-2.

The Total WEDG Noise Limits are as detailed in Table 12-10 and Table 12-11 below.

Table 12-10 Total WEDG Noise Limit - Daytime

Noise Assessment Location	Wind Speed (ms^{-1}) as standardised to 10m height											
	1	2	3	4	5	6	7	8	9	10	11	12
NAL1 (H1)	40	40	40	40	40	40	45	45	45	45.4	48.2	50.3
NAL2 (H2)	40	40	40	40	40	45	45	45	45	45.8	48.9	52.1
NAL3 (H3)	40	40	40	40	40	45	45	45	45	45.8	48.9	52.1
NAL4 (H4)	40	40	40	40	40	40	45	45	46.4	50.7	54.5	57.4
NAL5 (H5)	40	40	40	40	40	40	40	45	45	45	47	47
NAL6 (H8)	40	40	40	40	40	45	45	45	45	45.8	48.9	52.1
NAL7 (H9)	40	40	40	40	45	45	45	45	45	45	47	49.8
NAL8 (H234)	40	40	40	40	40	40	45	45	46.4	50.7	54.5	57.4

Table 12-11 Total WEDG Noise Limit – Night time

Noise Assessment Location	Wind Speed (ms^{-1}) as standardised to 10m height											
	1	2	3	4	5	6	7	8	9	10	11	12
NAL1 (H1)	43	43	43	43	43	43	43	43	43	44	47.3	49.1
NAL2 (H2)	43	43	43	43	43	43	43	43	43	44.3	48.5	52
NAL3 (H3)	43	43	43	43	43	43	43	43	43	44.3	48.5	52
NAL4 (H4)	43	43	43	43	43	43	43	43	46.1	51.7	55.6	57.1
NAL5 (H5)	43	43	43	43	43	43	43	43	43	43	47.2	47.2
NAL6 (H8)	43	43	43	43	43	43	43	43	43	44.3	48.5	52
NAL7 (H9)	43	43	43	43	43	43	43	43	43	43	46	50.5
NAL8 (H234)	43	43	43	43	43	43	43	43	46.1	51.7	55.6	57.1

12.6.6.2 Predicting the Likely Effects and assessment against Total WEDG Noise Limits (Stage 2)

The Stage 2 noise assessment has been undertaken to compare predicted noise immission levels from the Proposed Project to the Total WEDG Noise Limits.
A noise assessment has therefore been undertaken to compare predicted noise immission levels from the Proposed Project to the Total WEDG Noise Limits at the NALs listed in Table 12-8 and the results are summarised in tabular form in Table 12-12 and Table 12-13. The results show that the predicted wind turbine noise immission levels meet the 'Total WEDG Noise limits' under all conditions at all NALs. The only exception is at NAL5, where a marginal exceedance of 0.6 dB is observed only in daytime at 7 m/s. Such a minor exceedance would be removed by using low noise modes for the candidate turbine in that specific wind speed and in specific directions only, or alternatively by using an alternative candidate turbine. Therefore, there are **no significant effects** anticipated.

Table 12-12 Compliance Table – Comparison of predicted likely cumulative noise levels (all schemes) against the Total WEDG Noise Limit at each receptor - Daytime

NAL		Wind Speed (ms^{-1}) as standardised to 10m height											
		1	2	3	4	5	6	7	8	9	10	11	12
NAL1 (H1)	Total WEDG Noise Limit	40	40	40	40	40	40	45	45	45	45.4	48.2	50.3
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	30	30.7	34.8	39	40.6	40.7	41	41.4	41.5	41.5
	Exceedance Level	-	-	-10	-9.3	-5.2	-1	-4.4	-4.3	-4	-4	-6.7	-8.8
NAL2 (H2)	Total WEDG Noise Limit	40	40	40	40	40	45	45	45	45	45.8	48.9	52.1
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	29.4	30.1	34.2	38.4	40	40.1	40.3	40.7	40.9	40.9
	Exceedance Level	-	-	-10.6	-9.9	-5.8	-6.6	-5	-4.9	-4.7	-5.1	-8	-11.2
NAL3 (H3)	Total WEDG Noise Limit	40	40	40	40	40	45	45	45	45	45.8	48.9	52.1
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	28.8	29.6	33.7	37.9	39.4	39.6	39.8	40.2	40.3	40.3
	Exceedance Level	-	-	-11.2	-10.4	-6.3	-7.1	-5.6	-5.4	-5.2	-5.6	-8.6	-11.8
NAL4 (H4)	Total WEDG Noise Limit	40	40	40	40	40	40	45	45	46.4	50.7	54.5	57.4
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	29.5	30.2	34.3	38.6	40.1	40.3	40.5	40.9	41	41
	Exceedance Level	-	-	-10.5	-9.8	-5.7	-1.4	-4.9	-4.7	-5.9	-9.8	-13.5	-16.4
NAL5 (H5)	Total WEDG Noise Limit	40	40	40	40	40	40	40	45	45	45	47	47
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	30	30.7	34.8	39	40.6	40.7	41	41.4	41.5	41.5
	Exceedance Level	-	-	-10	-9.3	-5.2	-1	**0.6**	-4.3	-4	-3.6	-5.5	-5.5
NAL6 (H8)	Total WEDG Noise Limit	40	40	40	40	40	45	45	45	45	45.8	48.9	52.1
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	28.6	29.3	33.4	37.7	39.2	39.4	39.6	40	40.1	40.1
	Exceedance Level	-	-	-11.4	-10.7	-6.6	-7.3	-5.8	-5.6	-5.4	-5.8	-8.8	-12
NAL7 (H9)	Total WEDG Noise Limit	40	40	40	40	45	45	45	45	45	45	47	49.8
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	29.3	30	34.1	38.3	39.9	40	40.2	40.6	40.8	40.8
	Exceedance Level	-	-	-10.7	-10	-10.9	-6.7	-5.1	-5	-4.8	-4.4	-6.2	-9
	Total WEDG Noise Limit	40	40	40	40	40	40	45	45	46.4	50.7	54.5	57.4

NAL		Wind Speed (ms^{-1}) as standardised to 10m height											
		1	2	3	4	5	6	7	8	9	10	11	12
NAL8 (H234)	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	28.3	29	33.1	37.3	38.9	39	39.2	39.6	39.8	39.8
	Exceedance Level	-	-	-11.7	-11	-6.9	-2.7	-6.1	-6	-7.2	-11.1	-14.7	-17.6
Note: For the noise predictions the noise model considers the range of noise data available for each turbine type modelled. For some turbines noise data was not available for wind speeds less than 3 ms-1 therefore no predictions are included for wind speeds less than 3 ms-1.													

Table 12-13 Compliance Table – Comparison of predicted likely cumulative noise levels (all schemes) against the Total WEDG Noise Limit at each receptor – Night time

NAL		Wind Speed (ms^{-1}) as standardised to 10m height											
		1	2	3	4	5	6	7	8	9	10	11	12
NAL1 (H1)	Total WEDG Noise Limit	43	43	43	43	43	43	43	43	43	44	47.3	49.1
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	30	30.7	34.8	39	40.6	40.7	41	41.4	41.5	41.5
	Exceedance Level	-	-	-13	-12.3	-8.2	-4	-2.4	-2.3	-2	-2.6	-5.8	-7.6
NAL2 (H2)	Total WEDG Noise Limit	43	43	43	43	43	43	43	43	43	44.3	48.5	52
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	29.4	30.1	34.2	38.4	40	40.1	40.3	40.7	40.9	40.9
	Exceedance Level	-	-	-13.6	-12.9	-8.8	-4.6	-3	-2.9	-2.7	-3.6	-7.6	-11.1
NAL3 (H3)	Total WEDG Noise Limit	43	43	43	43	43	43	43	43	43	44.3	48.5	52
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	28.8	29.6	33.7	37.9	39.4	39.6	39.8	40.2	40.3	40.3
	Exceedance Level	-	-	-14.2	-13.4	-9.3	-5.1	-3.6	-3.4	-3.2	-4.1	-8.2	-11.7
NAL4 (H4)	Total WEDG Noise Limit	43	43	43	43	43	43	43	43	46.1	51.7	55.6	57.1
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	29.5	30.2	34.3	38.6	40.1	40.3	40.5	40.9	41	41
	Exceedance Level	-	-	-13.5	-12.8	-8.7	-4.4	-2.9	-2.7	-5.6	-10.8	-14.6	-16.1
NAL5 (H5)	Total WEDG Noise Limit	43	43	43	43	43	43	43	43	43	43	47.2	47.2
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	30	30.7	34.8	39	40.6	40.7	41	41.4	41.5	41.5
	Exceedance Level	-	-	-13	-12.3	-8.2	-4	-2.4	-2.3	-2	-1.6	-5.7	-5.7
NAL6 (H8)	Total WEDG Noise Limit	43	43	43	43	43	43	43	43	43	44.3	48.5	52
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	28.6	29.3	33.4	37.7	39.2	39.4	39.6	40	40.1	40.1
	Exceedance Level	-	-	-14.4	-13.7	-9.6	-5.3	-3.8	-3.6	-3.4	-4.3	-8.4	-11.9
NAL7 (H9)	Total WEDG Noise Limit	43	43	43	43	43	43	43	43	43	43	46	50.5
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	29.3	30	34.1	38.3	39.9	40	40.2	40.6	40.8	40.8
	Exceedance Level	-	-	-13.7	-13	-8.9	-4.7	-3.1	-3	-2.8	-2.4	-5.2	-9.7
	Total WEDG Noise Limit	43	43	43	43	43	43	43	43	46.1	51.7	55.6	57.1

NAL		Wind Speed (ms^{-1}) as standardised to 10m height											
		1	2	3	4	5	6	7	8	9	10	11	12
NAL8 (H234)	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	28.3	29	33.1	37.3	38.9	39	39.2	39.6	39.8	39.8
	Exceedance Level	-	-	-14.7	-14	-9.9	-5.7	-4.1	-4	-6.9	-12.1	-15.8	-17.3
Note: For the noise predictions the noise model considers the range of noise data available for each turbine type modelled. For some turbines noise data was not available for wind speeds less than 3 ms-1 therefore no predictions are included for wind speeds less than 3 ms-1.													

12.6.7 Potential Cumulative Effects

There are no other anticipated nearby large scale construction projects in close proximity to the Proposed Project that would occur at the same time as the construction of the Proposed Project, therefore there would be **no significant cumulative construction noise effects.**

There nearest cumulative wind turbine development to the Proposed Project is Cooloo Wind Farm, (proposed, pre-planning), located approximately 5.3km away. Several other proposed (in planning), permitted or operational wind developments are located at greater distances (>11 km) away. It has therefore been determined that due to the large distances between the Proposed Project and other nearby wind turbine developments, potential cumulative operational noise effects will be negligible at all NSRs within 2km of the Proposed Project, and as such a cumulative noise assessment is not required. Therefore, there would be **no significant cumulative operational noise effects**.

12.7 Mitigation

12.7.1 Mitigation during Decommissioning and Construction

No significant effects resulting from decommissioning or construction noise and vibration are predicted. Nevertheless, a range of good practice measures are presented in the Construction Environmental Management Plan (CEMP), included as Appendix 4-4 of this EIAR, and these will be employed to minimise noise impacts.

Good practices, both for construction of the wind turbines and along the grid connection underground electrical cabling route and road junctions will be implemented to minimise the likely effects. Particular care will be taken at watercourse, culvert and drain crossings along the underground electrical cabling route. Section 8 of BS5228-1:2009+A1:2014 recommends a number of simple control measures as summarised below that can be employed onsite:

- Keep local residents informed of the proposed working schedule, where appropriate, including the times and duration of any abnormally noisy activity that may cause concern;
- All vehicles and mechanical plant will be fitted with effective exhaust silencers and be subject to programmed maintenance;
- Select inherently quiet plant where appropriate - all major compressors will be 'sound reduced' models fitted with properly lined and sealed acoustic covers, which will be kept closed whenever the machines are in use;
- All ancillary pneumatic percussive tools will be fitted with mufflers or silencers of the type recommended by the manufacturers;
- Machines will be shut down between work periods (or when not in use) or throttled down to a minimum;
- Regularly maintain all equipment used on site, including maintenance related to noise emissions;
- Vehicles will be loaded carefully to ensure minimal drop heights so as to minimise noise during this operation; and
- All ancillary plant such as generators and pumps will be positioned so as to cause minimum noise disturbance and if necessary, temporary acoustic screens or enclosures will be provided.
- At any location within 30 m of a residential receptor, where trenching work or directional drilling activities are required for the underground grid connection cabling route, the installation of temporary boarding alongside the drilling rig or 'acoustic blanket panels' hanging from heras fencing (or similar) may be used to mitigate noise emissions.

12.7.2 Mitigation during Operation

Predicted operational noise levels from the Proposed Project, based on the candidate wind turbine described in Section 12.4.3, result in an exceedance of the Total WEDG Noise Limits at wind speeds of 7 m/s during Daytime periods. In the event that the candidate turbine considered here is chosen as the final choice of turbine, minor exceedance would be removed by using low noise modes during the Daytime period in that specific wind speed and in specific directions only.

The exact model of wind turbine to be used for the Proposed Project will be the result of a future tendering process. The final choice of turbine will, however, have to meet the derived WEDG 2006 noise limits and/or noise limits determined and contained within any planning permission condition imposed. In the event that mitigation is required, modern turbine control systems allow for turbines to operate in a reduced noise mode for a range of wind speeds and wind directions as required.

Achievement of the noise limits determined by this assessment would be a key determining factor in the final choice of wind turbines for the site. In order to meet the Total WEDG Noise Limits at NAL5, certain turbines will need to be operated in a lower noise mode for a limited range of wind speeds and wind directions when considering the candidate wind turbines modelled in the noise assessment. Other wind turbine models would be available which may not require the use of low noise modes.

Whilst it is not possible to predict if OAM will occur, in the event that complaints are received regarding OAM, mitigation measures are available. The design of such mitigation measures can only be determined once the wind farm is operational if OAM is found to occur frequently and at sustained levels. For this Proposed Project, the developer is committed to investigating noise complaints, inclusive of any complaint which may relate to OAM (i.e. beyond overall noise levels found in planning conditions). To deal with the eventuality of a complaint, the developer proposes the following:

- A community liaison officer will be appointed prior to first generation of electricity and contact details made publicly available;
- Any complaint relating to noise can be reported to the community liaison officer, who will undertake an initial screening of the complaint (review of logs submitted, review of wind conditions and turbine data etc.) and speak to the complainant in person, with an eventual visit to the complainant location if possible;
- Following initial screening, the community liaison officer will be responsible for commissioning a detailed noise complaint investigation. This will include appointing a qualified acoustic consultant to undertake noise measurements at the complaint location and quantify the occurrence and depth (in dB) of OAM for every 10 minute of the measurement campaign. The measured 10 minute noise levels and OAM depth would also be correlated with 10 minute wind conditions and operational data to find patterns; and,
- If frequent and sustained OAM is found, then appropriate mitigation would be designed and implemented, and the complainant informed by the community liaison officer. Mitigation measures considered would include: changes to the operation of the relevant wind turbine(s) by changing software parameters such as blade pitch for specific wind conditions and time periods, addition of blade furniture (such as vortex generators) to alter the flow of air over the wind turbine blades; and, in extreme cases, targeted wind turbine shutdowns in specific conditions.

12.8 Assessment of Residual Effects for Proposed Project

12.8.1 Residual Construction and Decommissioning Effects

Predicted decommissioning and construction noise levels relating to the Proposed Project are below the assessment criteria at all receptors, for all phases. Good practice mitigation measures are outlined above, however, with or without the good practice mitigation measures there will be **no significant residual effects**.

12.8.2 Residual Operational Effects

Predicted wind turbine operational noise levels relating to the Proposed Project at all the NALs and NSRs lie below the Total WEDG Noise Limits and it has also been demonstrated that Total WEDG Noise Limits can be met following minor mitigation or following selection of an alternative candidate wind turbine model. At some locations, under some wind conditions and for a certain proportion of the time operational wind farm noise would be audible; however, it would be at an acceptable level in relation to the WEDG guidelines and there would be **no significant residual effects**.

12.8.3 Residual Cumulative Effects

It was found that without mitigation there would be no significant cumulative construction noise effects. As such there would be **no residual cumulative effects during the construction phase**.

It was found that without mitigation there would be no significant cumulative operational noise effects. As such there would be **no residual cumulative effects during the operational phase**.

12.9 Summary

Predicted construction and decommissioning noise levels compared with the Category A criteria outlined in Section E.3 of BS5228: Part 1 2009+A1:2014 indicate that construction noise levels for the Proposed Project are below the guidelines considered acceptable at all receptors for all phases of the Proposed Project and therefore **no significant effects** are anticipated.

The guidance contained within the WEDG 2006 was used to assess the likely operational noise impact of the Proposed Project. Predicted operational noise levels and measured background noise levels indicate that for neighbouring dwellings, wind turbine noise from a candidate turbine would meet the Total WEDG Noise Limits, albeit with minor requirements for mode management for certain turbines, for certain wind speeds and wind directions (7m/s and westerlies) in daytime only. In addition, other wind turbine models would be available which may not require the use of low noise modes. Therefore the operational noise impact is **not significant.**

There are a range of wind turbine models that may be appropriate for the Proposed Project. If the Proposed Project receives planning permission, further data will be obtained from the supplier for the final choice of wind turbine model to demonstrate compliance with the derived WEDG 2006 noise limits and/or noise limits determined and contained within any planning permission condition imposed. In the event that mitigation is required, turbine control systems allow for turbines to operate in a reduced noise mode.