12. NOISE & VIBRATION

12.1 Introduction

This chapter of the Remedial Environmental Impact Assessment Report (rEIAR) assesses the potential for any likely significant noise and vibration effects of arising from the Existing Development. For a detailed description of the Existing Development please refer to Chapter 4 of this rEIAR.

Noise impact assessments have been prepared for the construction phase at the nearest Noise Sensitive Locations (NSLs).

Noise-sensitive locations in this context are any occupied dwelling house, hostel, health building or place of worship and may include areas of particular scenic quality or special recreational amenity importance. In this instance all of the NSLs are dwellings. A total of 61 houses were identified as NSLs within the study area, four of which are described as derelict.

Baseline noise levels representative of the nearest NSLs in the vicinity of the Wind Farm Site were measured as part of the assessment of operational wind farm noise.

It is important to note that in the case of construction noise in general, once the noise generating activity has ceased, any environmental noise effects also stop, and there is no effect which persists after the noise has stopped.

As detailed in Section 1.1.1 in Chapter 1 of this rEIAR, the various development components are described and assessed using the following references: ‘Subject Development’, ‘Existing Development’, ‘Prospective Development’, 'Permitted Development', ‘Site’, 'Wind Farm Site', ‘Grid Connection Site’, 'BMEP Site', 'Grid Connection', ' November 2020 Peat Slide', '2017 EIAR' and 'proposed turbines' or 'proposed turbine locations'.

12.1.1 Statement of Authority

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

Alistair Maclaurin

This chapter has been prepared by Alistair Maclaurin (Senior Acoustic Consultant) of AWN Consulting Ltd. Alistair holds a BSc in Creative Music and Sound Technology and a Diploma in Acoustics and Noise Control. He is a member of the Institute of Acoustics. Alistair has worked in the field of acoustics since 2012. He has been the lead noise consultant across various sites on major infrastructure projects such as Crossrail and Thames Tideway Tunnel, specialising in construction noise assessment and control. He has undertaken several environmental noise assessments for infrastructure developments and planning reports across the UK and Ireland including wind and solar farm EIARs such as Knocknamork wind farm and Maughanaclea wind farm.

Mike Simms

Mike Simms (Principal Acoustic Consultant) holds a BE and MEngSc in Mechanical Engineering and is a member of the Institute of Acoustics (MIOA). Mike has worked in the field of acoustics for over 20 years. He has extensive experience in all aspects of environmental surveying, noise modelling and impact assessment for various sectors including, wind energy, industrial, commercial and residential.

Dermot Blunnie

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

12.2 Fundamentals of Acoustics

A sound wave travelling through the air is a regular disturbance of the atmospheric pressure. These pressure fluctuations are detected by the human ear, producing the sensation of hearing. To take account of the vast range of pressure levels that can be detected by the ear, it is convenient to measure sound in terms of a logarithmic ratio of sound pressures. These values are expressed as Sound Pressure Levels (SPL) in decibels (dB).

The audible range of sounds expressed in terms of Sound Pressure Levels (SPL) is 0dB (for the threshold of hearing) to 120dB (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 and 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. SPL's 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. For a glossary of terms used in this chapter please refer to Appendix 12-1.

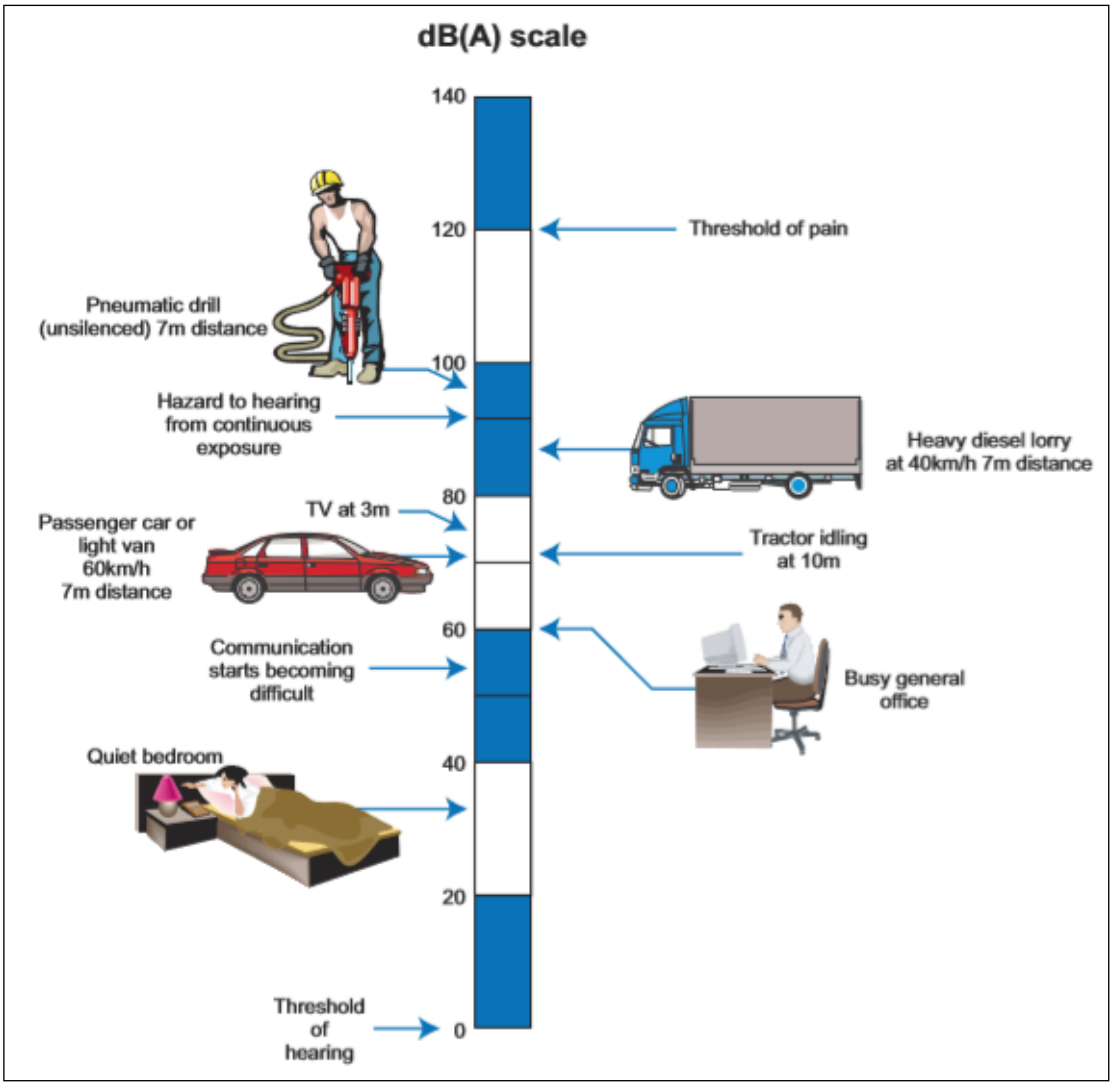

Figure 12-1 The level of typical common sounds on the dB(A) scale (NRA Guidelines for the Treatment of Noise and Vibration in National Road Schemes, 2004)

12.3 Assessment Methodology

The assessment of impacts has been undertaken with reference to guidance documents relating to noise and vibration for the Existing Development construction activities, which are set out within the relevant sections of this chapter.

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

The methodology adopted for this noise impact assessment is summarised as follows:

- Review of appropriate guidance to identify noise and vibration criteria for the Existing Development;
- Characterise the receiving environment through baseline noise surveys at a representative set of NSLs;
- Undertake predictive calculations to assess the potential impacts associated with the various activities at NSLs; evaluate the potential noise and vibration impacts and effects, and
- Describe the significance of the residual noise and vibration effects associated with the Existing Development.

12.3.1 Guidance

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

- *EPA Guidelines on the Information to be contained in Environmental Impact Statements*, (EPA, 2022).
- *The Assessment and Rating of Noise from Wind Farms*, Department of Trade, and Industry (UK) Energy Technology Support Unit (ETSU) (1996).
- *A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise* (IOA GPG) (2013).
- *Good Practice Guidance for the Treatment of Noise during the Planning of National Road Schemes, Transport Infrastructure Ireland* (TII) (formerly National Roads Authority (NRA) (2014).
- British Standard BS 5228-1:2009+A1:2014 *Code of practice for noise and vibration control on construction and open sites – Noise.*
- British Standard BS 5228-2:2009+A1:2014 *Code of practice for vibration control on construction and open sites – Vibration.*
- British Standard BS 7385 – *Evaluation and measurement for vibration in buildings – Part 2: Guide to damage levels from groundborne vibration* (BSI, 1993).
- *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.*

12.3.1.1 Construction Noise

12.3.1.1.1 General Construction

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

In the absence of specific noise limits, appropriate criteria relating to permissible construction noise levels for a development of this scale may be found in the British Standard British Standard BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise.

The approach adopted here calls for the designation of a noise sensitive location into a specific category (A, B or C) based on existing ambient noise levels in the absence of construction noise. This then sets a threshold noise value that, if exceeded, indicates a significant noise impact is associated with the construction activities.

Table 12-1 sets out the values which, when exceeded, potentially signify a significant effect at the facades of residential receptors as recommended by BS 5228 – 1. These levels relate to construction noise only.

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

Assessment category and threshold value period ($L_{Aeq,T}$)	Threshold value, in decibels (dB)		
	Category A Note A	Category B Note B	Category C Note C
Night-time (23:00 to 07:00hrs)	45	50	55
Evenings and weekends Note D	55	60	65
Daytime (07:00 – 19:00hrs) and Saturdays (07:00 – 13:00hrs)	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.

For the appropriate period (e.g. daytime) the ambient noise level is determined and rounded to the nearest 5dB. An extensive noise survey was undertaken for this rEIAR, reference to this survey shows that in this instance, with the rural nature of the Site and surrounding area, all properties in the vicinity of the Existing Development have ambient noise levels in the range of 40 to 50 dB L_{Aeq}. 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.*

12.3.1.1.2 *Linear Construction Works*

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

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

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

Paragraph E.2 goes on to state: -

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

This construction noise criterion is similar to that in the Transport Infrastructure Ireland (TII) (formerly National Roads Authority (NRA)) document *Guidelines for the Treatment of Noise and Vibration in National Road Schemes* (TII, 2014) construction noise limits of 70 dB $L_{Aeq,1hr.}$ for weekday periods (Monday to Friday 0700 – 1900 hrs) and 65 dB $L_{Aeq,1hr}$. on Saturdays (08:00 to 16:30hrs).

In this assessment, a construction noise limit of 70 dB $L_{Aeq,T}$ is adopted for the Grid Connection works.

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

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

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

BS 7385 states that there should typically be no cosmetic damage if transient vibration does not exceed 15 mm/s at low frequencies rising to 20 mm/s at 15 Hz and 50 mm/s at 40 Hz and above. These guidelines relate to relatively modern buildings and should be reduced to 50% or less for more critical buildings.

BS 5228 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 such that resonances are excited within structures the limits discussed above may need to be reduced by 50%.

The NRA document Guidelines for the Treatment of Noise and Vibration in National Road Schemes also contains information on the permissible construction vibration levels during the construction phase as shown in

Table 12-2.

Table 12-2 Assessment of impact by reference to existing noise levels

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

12.3.1.3 Consideration of Duration of Impacts

In accordance with the DMRB Noise and Vibration Guidance, construction noise and construction traffic noise effects shall constitute a significant effect where it is determined that a major or moderate magnitude of effect will occur for a duration exceeding:

- Ten or more days or nights in any 15 consecutive days or nights, or
- A total number of days exceeding 40 in any six consecutive months.

The duration and noise effects of linear works is discussed in Section 12.5.2.1.2.

See Section 12.5.2.1 for the detailed assessment in relation to the construction of the Existing Development. If the specific construction noise level exceeded the appropriate category value then a significant effect is deemed to have occurred.

12.3.1.4 Construction Traffic

There are no specific guidelines or limits relating to traffic related sources along the local or surrounding roads. Given that construction traffic from the Existing Development made use of existing roads already carrying traffic volumes, it is appropriate to assess the calculated increase in traffic noise levels that arose because of vehicular movements associated with the Existing Development.

For the assessment of 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) (hereafter referred to as DMRB).

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

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

Change in Sound Level (dB(A))	DMRB Magnitude of Impact (Short-term)
Less than 1 dB	No Change
1.0 – 2.9	Minor
3.0 – 4.9	Moderate
≥5	Major

Section 3.19 of LA 111, DMRB states that construction traffic noise shall constitute a significant effect where it is found that a major or moderate magnitude of impact will occur for a duration exceeding those in Section 12.3.1.3 above.

Where a major or moderate impact is identified due to the change in traffic noise level, reference will be made to the overall calculated noise level from construction traffic in the context of the construction noise criteria outlined in Section 12.3.1.1.

12.3.2 Difficulties Encountered During the Preparation of This Chapter

No limitations or difficulties were encountered in the preparation of this chapter of the rEIAR. The retrospective impact assessment has been carried out based on the availability of the information relating to the construction of the Existing Development.

12.4 Existing Environment

The Wind Farm Site is located within a rural, agricultural setting in County Donegal approximately 8 km southwest of the twin towns of Ballybofey and Stranorlar and approximately 12 km northeast of Donegal Town at its nearest point. The Grid Connection Site extends southwest from the Wind Farm Site for approximately 6 km along the N15 National Road towards Donegal Town before exiting the N15 to the southeast and following Local Roads, adjacent agricultural land and private access track to the Clogher 110kV substation.

This section presents full details of the baseline noise survey carried out in order to inform the assessment of operational noise from Meenbog Wind Farm. As such, it was carried out in accordance with guidance contained in the Institute of Acoustics (IOA) document *A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise* (IOA, 2013, hereafter referred to as the IOAGPG) and its associated *Supplementary Guidance Note 1: Data Collection* (IOA, 2014) and *Supplementary Guidance Note 2: Data Processing & Derivation* of ETSU-R-97 Background Curves' (IOA, 2014).

12.4.1 Choice of Measurement Locations

The IOAGPG recommends that the study area for the 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 may exceed 35 dB L_{A90}.

The selected locations for the noise monitoring locations (NMLs) are outlined in the following sections and are identified in Figure 12-2 to Figure 12-4. Coordinates for the noise monitoring locations and wind measurement location are detailed in Table 12.3.

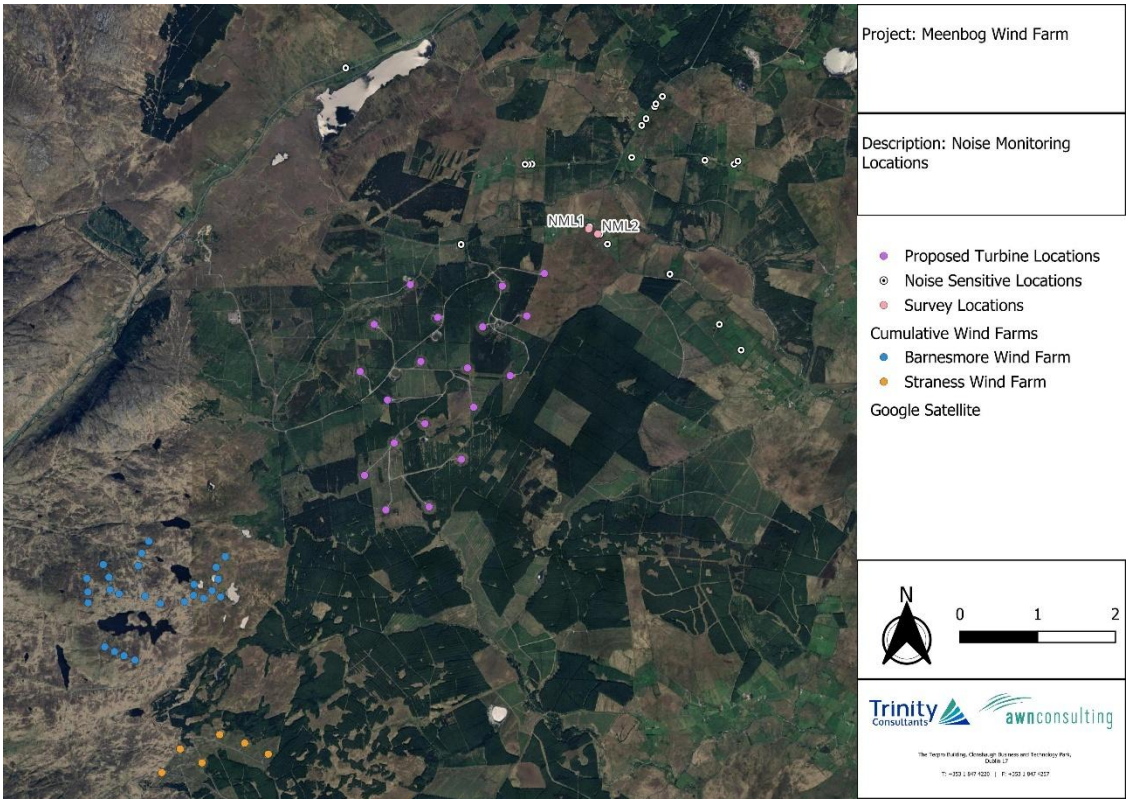

Figure 12-2 Noise Measurement Locations.

Table 12-4 ***Background Noise Measurement Coordinates***

Location	Coodinates – Irish Transverse Mercator (ITM)	
	Easting	Northing
NML1 (H002)	609,688	887,808
NML2 (H003)	609,847	887,714

Figure 12-3 Noise Monitoring Location 1(NML1) Installation

Figure 12-4 Noise Monitoring Location 2 (NML2)Installation

Noise sources were noted to be local road traffic distant farm machinery and activity, distant road traffic noise and noise in local foliage was not contributing much to the background noise. Wind turbine noise from existing developments was not audible at any of the locations during periods when engineers were on site. It is considered that the background noise monitoring locations give a robust picture of background noise levels experienced at typical residential noise sensitive locations in the vicinity of the Site.

12.4.2 Measurement Periods

Noise measurements were conducted at each of the monitoring locations over the following periods:

Table 12-5 Noise Monitoring Locations and Periods

Location	Start Date	End Date
NML1 (H002)	13:50hrs 15th October 2014	16:10hrs 31st October 2014
NML2 (H003)	16:50hrs 31st October 2014	13:50hrs 18th November 2014

While it is clear that the noise measurements were carried out some years ago in 2014, the guidance under which the background noise survey was carried out remains the same: i.e. the IOA GPG, which was published in 2013 with important updates on the previous guidance, in particular the treatment of wind shear and the general adaptation to larger wind turbines. The background noise survey therefore remains in full accordance with the latest best-practice methods.

A sufficient variety of wind speed and weather conditions were encountered over the survey periods in question. Figure 12-5 and Figure 12-6 illustrate the distributions of wind speed and wind direction over each of the monitoring locations and periods detailed in Table 12-5.

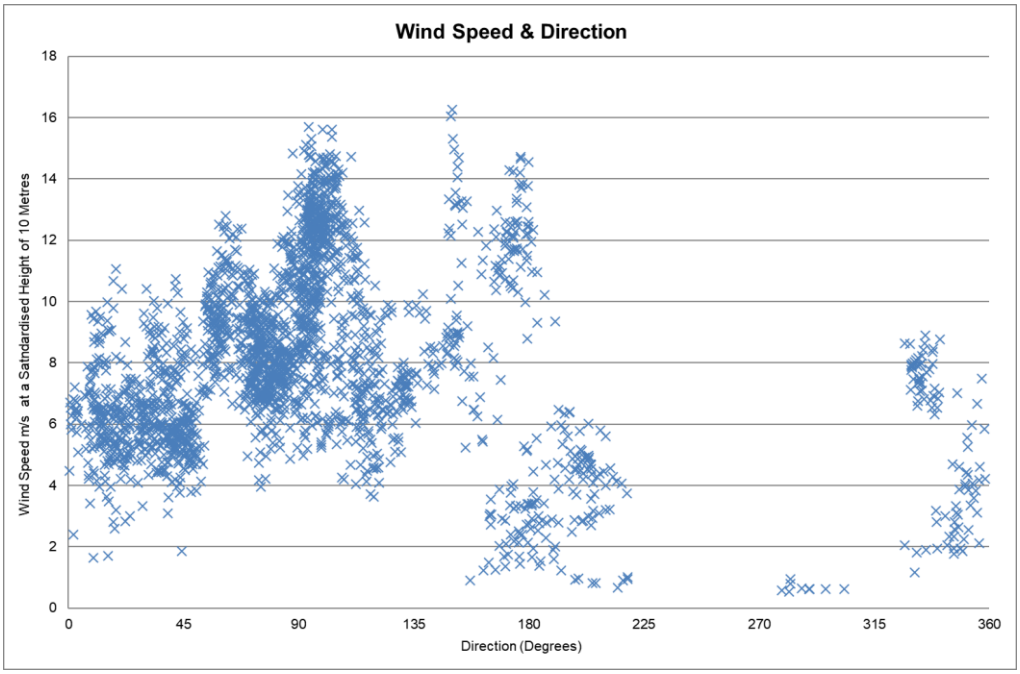

Figure 12-5 Distributions of Wind Speeds & Direction at Location A

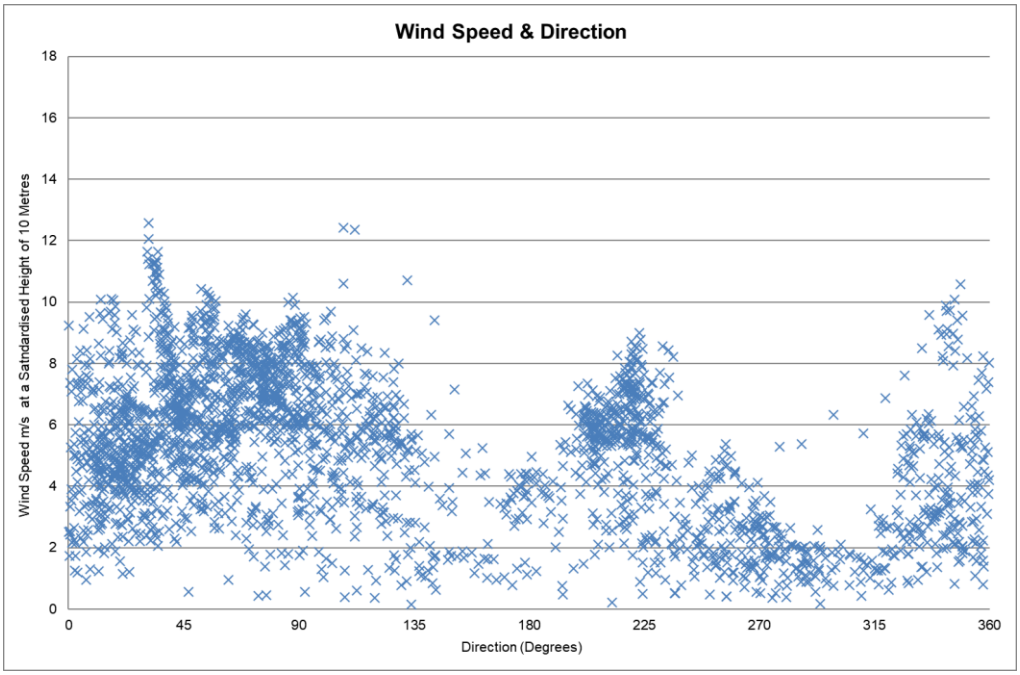

Figure 12-6 Distributions of Wind Speeds & Direction at Location B

12.4.3 Personnel and Instrumentation

AWN Consulting installed and removed the noise monitors at all locations. The following instrumentation was used at the various locations:

Table 12-6 Equipment Details

Location	Equipment	Serial Number
NML1 (H002)	Brüel & Kjær Type 2238	2246196
NML2 (H003)	Brüel & Kjær Type 2238	2246196

Before and after each phase of the monitoring survey noise measurement equipment was check calibrated using a Brüel & Kjær type 4231 Sound Level Calibrator. A copy of the relevant calibration certification for the instrument is presented in Appendix 12.2.

Rain fall was monitored and logged using a Texas Electronics Rainfall Sensor, Model TR 525. This allows for the identification of periods of rain fall to allow for the removal sample periods affect by rainfall from the noise monitoring data sets in line with best practice when calculating the prevailing background noise levels. The rain fall monitor was located in the vicinity of the site for the duration of the survey.

Wind speed and directional data was obtained from the existing met mast, located in the townland of Meenbog, for the survey periods (Met Mast ID 6071, E 606807, N885320). The Meenbog met mast consists of various anemometers at 80m, 65m 50m 35m and 10m heights.

12.4.4 Procedure

Measurements were conducted at the two locations over the survey periods. Sample periods for the noise measurements were 10-minutes during both the daytime and night-time periods. The results were saved to the instrument memory for later analysis. Survey personnel noted potential primary noise sources contributing to noise build-up during the installation and removal of the sound level meters from site (e.g. identified significant noise sources in the area such as local traffic or farm yard activities). $L_{Aeq,10min}$ and $L_{A90,10min}$ parameters were measured in this instance.

12.4.4.1 Analysis of Background Noise Data

12.4.4.1.1 *Atypical Noise Data*

The data sets have been filtered to remove issues such as the dawn chorus and the influence of other atypical noise sources. An example of atypical sources would be short, isolated periods of raised noise levels attributable to local sources, agricultural activity, boiler flues, operation of gardening equipment etc. In addition, sample periods affected by rainfall or when rainfall resulted in prolonged periods of atypical noise levels have also been screened form the data sets. The assessment methods outlined above are in line with the guidance contained in the IOA GPG.

12.4.4.1.2 Assessment Periods

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

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

12.4.4.1.3 Consideration of Wind Shear

Wind shear is defined as the increase of wind speed with height above ground. As part of a robust wind farm noise assessment due consideration should be given to the issue of wind shear. The issue of wind shear has been considered in this assessment and followed relevant guidance as outlined in the IOA GPG. It is standard procedure to reference noise data to standardised 10 metre height wind speed.

Wind speed measurements at 80 m and 65 m heights have been corrected to a height of 103.5 m (the hub height adopted for the noise assessment) in accordance with Method B of Section 2.6 of the IOA GPG. The calculated hub height wind speeds were then corrected to standardised 10 metre height wind speed.

The IOA GPG presents the following equations in relation to the derivation of a standardised wind speed at 10m above ground level:

Shear Exponent Profile: $U = U_{ref}\,[(H / H_{ref})]^{m}$

Where:

U	Calculated wind speed
U_{ref}	Measured HH wind speed.
H	Height at which the wind speed will be calculated.
H_{ref}	Height at which the wind speed was measured.
m	shear exponent = $\log(U/U_{ref})/\log(H/H_{ref})$

The Calculated hub height wind speeds have been standardised to 10 m height using the following equation:

Roughness Length Shear Profile: $U_1 = U_2 \times [(\ln(H_1/z))/(\ln(H_2/z))]$

Where:

H_1	The height of the wind speed to be calculated (10m)
H_2	The height of the measured or calculated HH wind speed.
U_1	The wind speed to be calculated.
U_2	The measured or calculated HH wind speed.
Z	The roughness length.

Note: A roughness length of 0.05m is used to standardise hub height wind speeds to 10 m height in the IEC 61400-11:2003 standard, regardless of what the actual roughness length seen on a site may have been. This 'normalisation' procedure was adopted for comparability between test results for different turbines.

Any subsequent reference to wind speed in this chapter should be understood to be the standardised 10 m height wind speed reference unless otherwise stated.

12.4.5 Background Noise Levels

Appendix 12-3 presents the results of the background noise surveys in graphical form, as analysed in accordance with the methodology discussed above.

Table 12-7 presents the various derived $L_{A90,10min}$ noise levels for each of the monitoring locations for daytime quiet periods and night-time periods. These levels have been derived using analysis carried out on the data sets in line with guidance contained the IOA GPG and its SGN No. 2 *Data Collection.*

Table 12-7 Derived Noise Levels of $L_{A90,10min}$ for Various Wind Speeds

Location	Period	Derived $L_{A90,\ 10\ min}$ Levels (dB) at various Standardised 10m Height Wind Speed (m/s)						
		4	5	6	7	8	9	10
NML1 (H002)	Day	27.2	27.5	28.5	30.1	32.2	34.5	37.1
	Night	20.0	22.6	25.3	28.1	31.0	33.9	36.7
NML2 (H003)	Day	29.1	29.9	31.1	32.7	34.3	35.6	36.4
	Night	29.3	29.6	30.2	31.2	32.9	35.3	38.8

For the purposes of this rEIAR, the background noise data serves to characterise the noise environment and also to confirm, according to the methodology in Section 12.3.1.1.1, the Construction Noise Threshold for daytime periods is 65 dB $L_{Aeq,T}$.

12.5 Likely Significant Effects

12.5.1 Do-Nothing Scenario

The 'Do Nothing' Scenario is an alternative scenario to retaining and regularising the Existing Development. In this scenario, should the Existing Development not secure substitute consent it will remain in-situ as an unauthorised and partially completed wind farm, which is, in effect, the "do nothing" option insofar as it represents the current situation as at the date of the application for Substitute Consent. There would be no additional noise or vibration effects associated with the "Do Nothing" scenario.

12.5.2 Existing Development

12.5.2.1 Existing Development Construction Noise Impacts

This section covers all works associated with the Existing Development.

A variety of items of plant were in use for the purposes of construction activities for the Existing Development. Plant items ranged from HGVs, excavators and also included impulsive noise from activities such as rock-breaking. BS-5228 provides empirical data for typical plant items found on construction sites. General construction works were limited to the working hours of 7am-7pm. Concrete pours may have commenced early at 5am, however, the noise impact from this item will have remained below the threshold criteria.

Note that rock breaking activity noise levels are significantly higher than the other construction activities that took place during the construction phase, hence, for the purposes of this assessment it is considered prudent to demonstrate the potential impacts associated with the noisiest scenario; this is where rock-breaking occurred at the closest location to the receptors. Considering the high noise level of the rock-breaking activity it will encompass plant items for all other activities that may have occurred concurrently. Hence, if construction activities including rock-breaking as a worst-case did not cause a significant impact at the closest receptors, it is concluded that there were no significant impacts associated with any of the construction activities.

The components of the Existing Development are plotted in Figure 12-7 alongside the receptor locations. The figure shows that the closest works in terms of turbine bases and borrow pits are at distances of the order of 500m to a receptor location which is identified as receptor H001. (The construction of the access track at 60m from H001 is considered separately.) Calculations have been performed to determine the noise level of potential rock breaking (along with other items of plant that may have been operational during the construction works) at this receptor location using formulae referenced in BS5228 and considering mixed ground conditions.

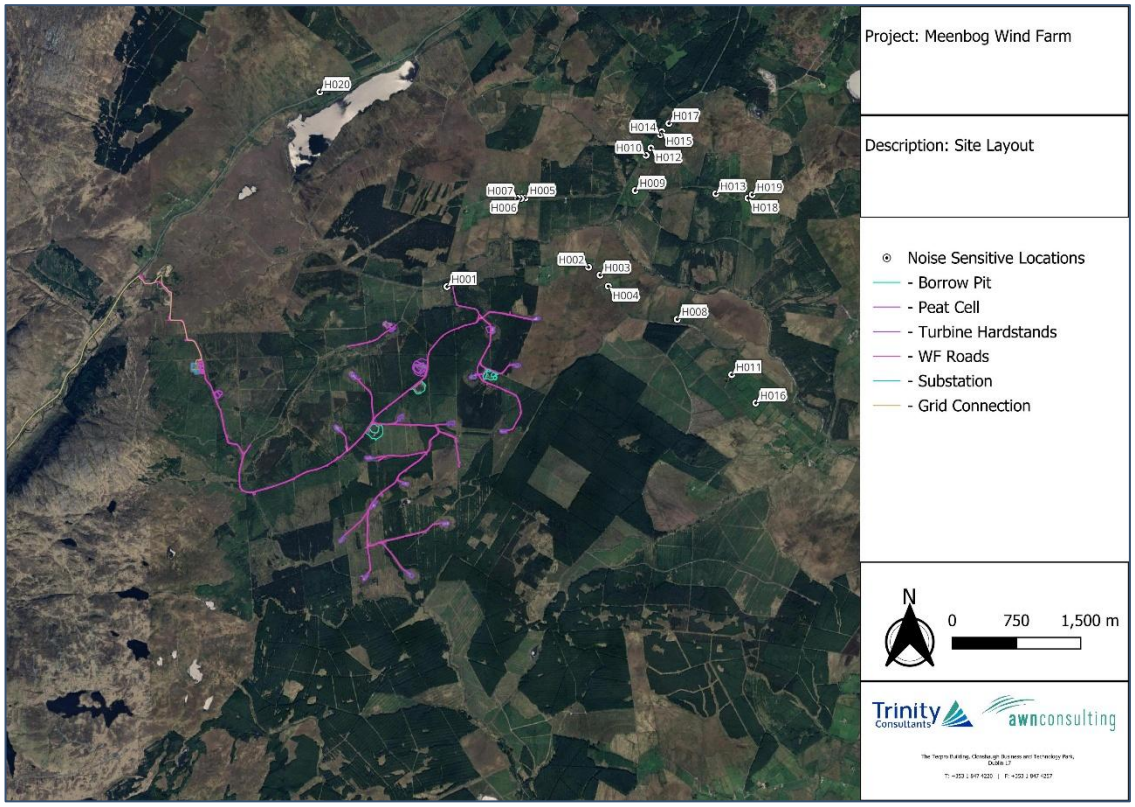

Figure 12-7 Closest wind farm works to noise-sensitive locations

12.5.2.1.1 Turbine foundations, hardstands, and met mast

Table 12-8 Typical Construction Noise Levels – Turbines and Hardstanding, and Met Mast

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 (500 m)
HGV Movement (C.2.30)	Removing spoil and transporting fill and other materials within the site	79	40
Tracked Excavator (C.4.64)	Removing soil and rubble in preparation for turbine foundations	75	36
Excavator Mounted Rock Breaker (C9.12)	Rock Breaking	85	46
General Construction (Various)	All general activities plus deliveries of materials and plant to the site	84	45
Concrete Mixer Truck and Concrete Pump (C.4.27)	Foundations	79	40
Steel cutting (C.4.93)	Grinding steel	80	41
Dumper Truck (C.4.4)	Removing peat and spoil and transporting fill and other materials.	76	37
Mobile Telescopic Crane (C.4.39)	Installation of nacelles	77	38
JCB (D.8.13)	Road surfacing.	82	43
Vibrating Rollers (D.8.29)	For services, drainage and landscaping.	77	38
Cumulative Construction Noise Level			52

The predicted construction noise level at the receptor location is 52 dB $L_{Aeq,T}$. Construction noise was likely audible during impulsive works, however, the worst case noise level is predicted as being significantly below the threshold, hence the impact can be described as **Negative, Temporary and Not Significant to Slight.** Overall, the impact is considered Not Significant.

Note that this is a worst-case scenario as it assumes that rock breaking activities occur for 100% of the working period without any mitigation applied. It's likely that percentage on times throughout the working period would have been lower and that rock breaking activities may not have occurred at all locations within the Existing Development, hence, it's likely that lower construction noise levels would have resulted.

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

Blasting works also occurred on site which is considered a momentary impact. At this stage there is no way to calculate the potential noise level that occurred due to this activity, however, the impact occurred at distances of greater than 1 km from the closest NSL and would have been momentary. Once the activity had occurred the noise environment would return to the existing state.

It's possible that simultaneous construction works at components of the Existing Development occurred during periods of the construction programme. Given that the worst-case predicted noise level for construction works is nearly 10 dB below the construction noise threshold, it can be concluded that a significant impact due to combined construction activities on site would be unlikely. The reasoning for this is that if a noise source is 10 dB or more below the assessment criterion, it does not materially affect the cumulative noise level and can reasonably be excluded from further consideration. Overall, the cumulative impact for these construction activities is considered not significant.

12.5.2.1.2 Access Track

This section applies the same construction noise calculation method as presented above; the access track passes by NSL H001 at a distance of 60 m. A reduced set of plant items was used for this section of the works, as presented in Table 12-9.

Table 12-9 Typical Construction Noise Emission Levels – Access Roads

Item (BS 5228 Ref.)	Plant Noise Level at 10m Distance (dB $L_{Aeq,12hr}$) [2]	Highest Predicted Noise Level at NSL H001 (60 m from works) (dB $L_{Aeq,12hr}$)
HGV (C.10.18)	83	62
Tracked Excavator (C.4.63)	77	56
Dumper Truck (C.4.4)	76	55
Vibrating Rollers (C.5.26)	77	56
Total Construction Noise (cumulative for all activities)		**64**

The predicted noise level at H001 is 64 dB $L_{Aeq,T}$ which is within the criterion of 65 dB $L_{Aeq,T}$ for construction works. It's noted that the dwelling was vacant during the time of the construction works, however, regardless, the resultant impact is not significant.

12.5.2.1.3 Grid Connection

A connection between the onsite 110kV electrical substation and the national electricity grid was constructed over a length of 9.6 km; details of the route are presented in Chapter 4.

Table 12-10 presents outline noise calculations, considering the anticipated plant required and methods of construction. Calculations have been prepared taking account of the distances to the nearest NSLs and assume that plant items are operating at 66% 'on-time'.

[2] *All plant noise levels are derived from BS 5228: Part 1do I o*

Table 12-10 Indicative noise calculations for construction – Underground Cabling Route

Plant Item (BS 5228 Ref.)	Plant Noise Level at 10m Distance (dB $L_{Aeq,12hr}$)	Calculated Construction Noise Levels dB $L_{Aeq,12hr}$ at reference distance from works			
		20 m	50 m	70 m	100 m
HGV (C.10.18)	83	75	64	61	57
Tracked Excavator (C.4.64)	75	67	56	53	49
Dumper Truck (C.4.4)	76	68	57	54	50
Vibrating Rollers (C.5.26)	77	69	58	55	51
Road Saw (C.4.70)	91	83	72	69	65
Total Construction Noise		**84**	**73**	**70**	**66**

It is important to note that the works for the construction of the Grid Connection varied over time and were not continuous in nature. The associated construction works occurred for short durations (rolling construction method, approx. 100 m per day over an estimated 130 working days for works on public roads) at varying distances from NSLs. Works were therefore in proximity to the closest NSLs for limited amount of time, i.e. less than one day.

The predicted noise levels at the closest NSLs, at distances of within 70m from works had the potential to exceed the construction noise criterion of 70 dB $L_{Aeq,1hr}$ set out in Section 12.3.1.1.2, at 13 NSLs located along the grid connection route. However, on the basis that the duration of the noise effect was brief, mitigation measures were not required.

12.5.2.1.4 *Description of Effects*

The calculated noise effects are below the limits and/or thresholds identified. With respect to the EPA, 2022 criteria for description of effects, the likely effects at the nearest NSL, under a theoretical precautionary scenario, associated with construction of windfarm infrastructure, including the grid connection are described as follows:

Quality	Significance	Duration
Negative	Not Significant	Temporary

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

12.5.2.2 Existing Development Vibration Impacts

During rock breaking, there is potential for vibration to be generated through the ground. Empirical data for this activity is not provided in the BS 5228-2:2009+A1:2014 (BSI 2014b) standard, however the likely level of vibration from this activity is expected to be significantly below the vibration criteria for building damage or perceptibility based on experience from other sites. AWN Consulting Ltd have previously conducted vibration measurements under controlled conditions, during trial construction works, where

breaking was carried out. The trial construction works consisted of the use of the following plant and equipment when measured at various distances:

- 3 tonne hydraulic breaker on small CAT tracked excavator; and
- 6 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 3 Tonne Breaker ranged from 0.48 PPV (mm/s) to 0.25 PPV (mm/s) at distances of 10m to 50m respectively from the breaking activities. Using a 6 Tonne Breaker, measured vibration levels ranged between 1.4 PPV (mm/s) to 0.24 PPV (mm/s) at distances of 10m to 50m respectively.

Whilst these measurements relate to a breaking of concrete, the range of values recorded provides some context in relation typical ranges of vibration generated by construction breaking activity. The nearest receptors are located at distances of approximately 500m from the construction works and, hence, no vibration will have been perceptible.

Hence, the impact is defined as **Negative, Not Significant and Temporary.**

12.5.2.2.1 *Description of Effects*

The vibration effects associated with the Existing Development were below the limits and/or thresholds identified. With respect to the EPA, 2022 criteria for description of effects, the likely effects are described below.

Quality	Significance	Duration
Negative	Not Significant	Temporary

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

12.5.2.3 Construction Traffic

This section reviews potential noise impacts associated with construction traffic on the local road network. Chapter 15 of this rEIAR presents an assessment of traffic and transportation and reference has been made to this chapter to inform the following discussion. The following situations are commented upon here:

- Concrete foundation delivery days; and,
- General construction

Changes in traffic noise levels along the N15 road have been estimated and are commented upon. The following assumptions have been made in relation to the calculation of changes in traffic noise levels on the local road network due to the additional construction traffic volumes:

Table 12-11 Assumptions for Construction Traffic Noise Assessment

Route	Stage	Traffic Units	%HGV
N15 between Ballybofey and Donegal	Existing	7,418	5.4
	Concrete Pouring	7,628	7.6
	General Construction	7,479	5.9

Based on the assumptions presented above changes in noise level based on the existing flows have been estimated as presented in Table 12-13:

Table 12-12 Estimated Changes in Traffic Noise Levels

Route	Stage	Change in Traffic Noise Level dB(A)	Estimated No. of Days
N15 between Ballybofey and Donegal	Existing	–	–
	Concrete Pouring	+1.1	14
	Site Preparation and Groundworks only	<1	325

The works programme for concrete pouring lasted approximately 14 days and therefore any effects were temporary. The increase in noise level along the delivery route due to additional construction traffic is calculated to be 1.1dB, which is considered to have a Not Significant effect and likely imperceptible. All other stages have an increase in the noise levels of less than 1 dB, which are considered a neutral effect.

In relation to the other stages the same conclusion is reached; the increase in noise level along the delivery route due to additional construction traffic is considered to have had a neutral effect as an increase of this order of magnitude would have been imperceptible.

12.5.2.3.1 Description of Effects

The calculated effects are below the limits and/or thresholds identified for a significant effect to occur. With respect to the EPA, 2022 criteria for description of effects, the effects at the nearest NSLs associated with additional traffic generated during the construction of the Existing Development are described below.

Quality	Significance	Duration
Negative	Not Significant	Temporary

12.5.2.4 Fixed Plant Noise

12.5.2.4.1 Onsite 110kV Substation

Details of the existing onsite 110kV substation are described in Chapter 4. The onsite substation is 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 the substation is the order of 93 dB(A) L_w.

Noise prediction model calculations for the operation of the existing onsite 110kV substation have been undertaken in accordance with ISO 9613: '*Acoustics – Attenuation of sound outdoors, Part 2: General method of calculation'* (2024). The predicted noise level from the operation of the existing onsite 110kV substation at the nearest NSL (H001) at approximately 3 km northeast is 11 dB $L_{Aeq,T}$. This level of noise is low and inaudible, and it is concluded that there are no significant noise emissions from the operation of the existing onsite 110kV substation at any NSL.

12.5.2.4.2 Description of Effects

With respect to the EPA, 2022 criteria for description of effects, the calculated effects, under a theoretical precautionary scenario, at the nearest NSLs associated with the operation of the fixed mechanical and electrical plant at the onsite 110kV substation is described below.

Quality	Significance	Duration
Negative	Imperceptible	Long Term

12.6 Mitigation Measures

The following mitigation measures in relation to Noise and Vibration were employed during the construction of the Existing Development.

- All vehicles and mechanical plant were fitted with effective exhaust silencers and maintained in good working order for the duration of the contract.
- Compressors were attenuated models fitted with properly lined and sealed acoustic covers which were kept closed whenever the machines are in use
- Machinery that was used intermittently was shut down or throttled back to a minimum during periods when not in use.
- Any plant, such as generators or pumps, which was required to operate before 07:00hrs or after 19:00hrs was surrounded by an acoustic enclosure or portable screen where appropriate.
- The hours of construction activity were limited to avoid unsociable hours where possible. Construction operations were generally restricted to between 7:00hrs and 19:00hrs weekdays and between 7:00hrs and 19:00hrs on Saturdays. However, to ensure that optimal use was made of good weather period or at critical periods within the programme (i.e. concrete pours) it was occasionally necessary to work out of these hours.

12.7 Residual Effects

This section summarises the residual noise and vibration effects associated with the Existing Development following the implementation of mitigation measures.

12.7.1 Construction Noise

In accordance with EPA criteria for description of effects, the effects at the nearest NSLs associated with the Existing Development were as follows:

Quality	*Significance*	*Duration*
Negative	Not Significant to Slight	Temporary

12.7.2 Construction Vibration

In accordance with EPA criteria for description of effects, the effects at the nearest NSLs associated with the Existing Development were as follows:

Quality	*Significance*	*Duration*
Negative	Not Significant	Temporary

12.7.3 Construction Traffic

The largest increase in noise level along the delivery route due to additional construction traffic is calculated to be 1.1dB, which is considered to have a Not Significant effect.

Quality	Significance	Duration
Negative	Not Significant	Temporary

12.7.4 Operation of onsite 110kV Substation and Ancillary Works Operation

The residual effects at the nearest NSLs of the onsite 110kV substation and all ancillary infrastructure are described as follows:

Quality	Significance	Duration
Negative	Imperceptible	Long Term

12.7.5 Significance of Effects

Overall, the effects from the Existing Development were not significant.

12.8 Cumulative Effects

12.8.1 Cumulative Effects – Existing Development

Noise and vibration effects associated with the Existing Development primarily arose during the construction phase. These construction noise effects, including construction traffic, were temporary and ceased once construction activities were completed. No ongoing or residual construction noise effects associated with the Existing Development remain in the receiving environment. No other identified construction projects were on-going at the same time as the Existing Development, hence, there was no potential for a cumulative impact.

Operational elements of the Existing Development comprise infrastructure such as the onsite 110kV substation, which operates continuously. Calculated noise levels from this infrastructure are extremely low at the nearest NSLs and are considered imperceptible. No significant operational noise effects associated with the Existing Development have been identified.

12.8.2 In-Cumulation Effects

This section considers the in-cumulation impact of the Existing Development and Prospective Development combined (the Subject Development). Table 12-13 below details the residual in-cumulation effects of the Subject Development.

Table 12-13 Assessment of potential In-Cumulation Effects of the Subject Development

Description	Existing Development	Prospective Development	Subject Development (In-Cumulation Conclusion)
Noise-Sensitive Locations (Construction Noise)	Noise effects associated with the Existing Development primarily arose during the construction phase. These construction noise effects were temporary and ceased once construction activities were completed. No ongoing or residual construction noise effects associated with the Existing Development remain in the receiving environment.	Construction activities associated with the Prospective Development will be temporary and short-term in nature. Predicted construction noise levels at the nearest Noise Sensitive Locations (NSLs) comply with the applicable construction noise criteria adopted in accordance with BS 5228-1. With standard best practice construction noise measures in place, no significant noise effects are predicted at NSLs during the construction phase of the Prospective Development when assessed in isolation.	As the construction noise effects of the Existing Development are no longer present and construction noise effects from the Prospective Development are temporary, there is no potential for in-cumulation construction noise effects at NSLs.

Noise-Sensitive Locations (Operational Noise)	Operational elements of the Existing Development comprise infrastructure such as the onsite 110kV substation and associated Grid Connection, which operates continuously. Calculated noise levels from this infrastructure are extremely low at the nearest NSLs and are imperceptible. No significant operational noise effects associated with the Existing Development have been identified.	Operational noise from the Prospective Development, including wind turbines and associated infrastructure, has been assessed in accordance with ETSU-R-97 and the IOA Good Practice Guide. Predicted cumulative operational noise levels are within the relevant noise limits at all NSLs, and no significant operational noise effects are anticipated.	The operational noise contribution from the Existing Development is negligible relative to the noise criteria and does not materially influence cumulative noise levels. Operational noise from the Prospective Development, are within the relevant noise limits at all NSLs, and no significant operational noise effects are anticipated Accordingly, no significant adverse in cumulation operational noise effects are predicted to occur.
Construction-Related Vibration	Construction-phase vibration effects associated with the Existing Development were limited, temporary and ceased upon completion of construction works. No residual vibration sources remain.	Construction-phase vibration associated with the Prospective Development has been assessed with reference to BS 5228-2 and BS 7385. Due to separation distances between works and receptors, vibration levels are not predicted to approach criteria for cosmetic or structural damage and are unlikely to be perceptible at NSLs.	As vibration effects associated with the Existing Development no longer occur and predicted vibration levels from the Prospective Development are low and temporary, there is no potential for in-cumulation vibration effects.
Construction Traffic Noise	Construction traffic associated with the Existing Development was temporary and has ceased. No ongoing traffic noise effects attributable to the Existing Development are present.	Construction traffic associated with the Prospective Development will make use of the existing road network. Predicted changes in traffic noise levels are low, temporary, and generally imperceptible in accordance with DMRB LA 111 guidance.	Given the temporary nature of construction traffic noise and the absence of overlapping or ongoing traffic effects, no significant in-cumulation effects associated with construction traffic noise are anticipated.

Human Receptors – Amenity and Health (Noise and Vibration)	No significant residual noise- or vibration-related effects on human health or amenity associated with the Existing Development have been identified.	With construction and operational noise and vibration levels predicted to remain within applicable guidance limits, no significant adverse effects on residential amenity or human health are anticipated as a result of the Prospective Development.	Therefore, there is no potential for significant adverse in-cumulation effects in respect of human amenity or health arising from noise or vibration.

12.8.3 Cumulative Effects – Subject Development

12.8.3.1 Wind Turbine Noise

Existing, permitted and proposed wind farm developments with the potential for cumulative impacts have been considered as part of the turbine noise impact assessment of the Subject Development.

As outlined in Section 12.4.4.4 of the EIAR for the Prospective Development, the cumulative turbine noise from the Barnesmore Repowering wind farm, Meenakeeran Wind Farm and the Straness Wind Farm have been included in the operational turbine noise assessment. The residual cumulative impacts are considered Not Significant.

12.8.3.2 Noise from Fixed Plant Operation

The predicted noise from the operation of the onsite 110kV substation at the nearest NSL is 11 dB which is significantly below the adopted criteria to the point that it cannot contribute to a cumulative impact. The reasoning for this is that if a noise source is 10 dB or more below the assessment criterion, it does not materially affect the cumulative noise level and can reasonably be excluded from further consideration. Given the predicted noise level, any fixed plant from other projects would likely dominate at the NSLs, and the substation would not be able to contribute sufficient energy to increase these noise levels over the criteria. The resultant impact is Not Significant.

12.8.3.3 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 Subject Development are not of a magnitude to cause an increase in the cumulative construction noise emissions exceeding the threshold for significant impacts at any NSL.

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 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 with construction activities from other developments is unlikely and not significant.

Construction activities that progressed over a defined route, such as the grid connection, are predicted to have exceeded the construction noise threshold at the closest receptor locations, however, given the duration of the activities outside each individual NSL, the temporal criteria was not exceeded and hence higher cumulative noise levels for those periods would not cause an additional effect.

12.9 Transboundary Effects

This section considers the potential transboundary impact of the Subject Development.

Potential transboundary effects have been considered with respect to Northern Ireland. The construction methodology, as described in Section 12.3.1.1, applies across the jurisdictional boundary. Construction noise was temporary and not significant, in both Ireland and Northern Ireland.

Operational noise modelling for the substation indicates that predicted noise levels within Northern Ireland are extremely low and remain below all relevant assessment thresholds applicable in either jurisdiction. These levels are considered imperceptible at all locations including receptors in Northern Ireland.

Accordingly, no significant transboundary effects occurred during the construction of the Existing Development, and no transboundary mitigation measures were required.

In terms of the Prospective Development, existing, permitted and proposed wind farm developments with the potential for cumulative impacts have been considered as part of the turbine noise impact assessment.

In relation to the Subject Development, the ETSU-R-97 Guidelines are pertinent as the Guidelines (DoEHLG, 2006) are not applicable in Northern Ireland.

The set of NSL within Northern Ireland all have predicted noise levels below 35 dB(A) (See Chapter 12 of the EIAR for details), therefore the lowest and most conservative ETSU noise criteria are met.

As outlined in Section 12.4.4.4 of the EIAR, the cumulative turbine noise from the Barnesmore Repowering wind farm, Meenakeeran Wind Farm and the Straness Wind Farm have been included in the operational turbine noise assessment. Additionally, a scenario has been assessed where the existing Barnesmore Wind Farm continues to operate. The residual cumulative impacts for both scenarios are considered Not Significant.

Furthermore, section 12.9.3.3 of the EIAR details in terms of construction and decommissioning noise, that 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.

It follows that as both the Existing Development and Prospective Development do not have the potential for a transboundary effect that the Subject Development does not have the potential for a significant transboundary effect.

12.10 Summary

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

Residual noise associated with the construction of the Existing Development has been calculated to be below the appropriate threshold values. The associated noise and vibration levels did not cause significant effect at any NSL.

Operational noise from the onsite 110kV substation has been assessed and found to be imperceptible. No significant vibration effects are associated with the operation of the substation. Therefore, it is concluded that no significant noise and vibration effects are associated with the Existing Development.