10. NOISE AND VIBRATION

10.1 Introduction

This chapter assesses the likely noise and vibration impacts associated with the Proposed Development during the construction, operational and decommissioning phases. A detailed description of the Proposed Development is provided in Chapter 4 *Description of the Proposed Development*. The Proposed Development comprises several components that are considered as part of this noise and vibration assessment.

Each component of the Proposed Development is assessed in terms of the potential long term operational phase and short-term construction and decommissioning phase noise and vibration impacts.

There are no noise and vibration impacts associated with the omission of the 38kV Electrical Substation, 38kV underground cabling and Battery Storage Compound as these elements will not be constructed. Therefore, it is not required to considered this in the noise and vibration assessment.

10.1.1 Statement of Authority

This chapter has been prepared by Dermot Blunnie of AWN Consulting Ltd:

Dermot Blunnie (Senior Acoustic Consultant) 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, impact assessment of wind farms and related noise and vibration standards. He has commissioned noise surveys and completed noise impact assessments for numerous wind farm projects across Ireland.

The chapter has been reviewed by Mike Simms of AWN Consulting Ltd:

Mike Simms (Senior Acoustic Consultant) holds a BE and MEngSc in Mechanical Engineering and is a member of the Institute of Acoustics and of the Institution of Engineering and Technology. Mike has worked in the field of acoustics for over 19 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.

10.2 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 0 dB (for the threshold of hearing) to 120 dB (for the threshold of pain). In general, a subjective impression of doubling of loudness corresponds to a tenfold increase in sound energy which conveniently equates to a 10 dB increase in SPL. It should be noted that a doubling in sound energy (such as may be caused by a doubling of traffic flows) increases the SPL by 3 dB.

The frequency of sound is the rate at which a sound wave oscillates is expressed in Hertz (Hz). The sensitivity of the human ear to different frequencies in the audible range is not uniform. For example,

hearing sensitivity decreases markedly as frequency falls below 250 Hz. To rank the SPL of various noise sources, the measured level is 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 is 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 10-1.

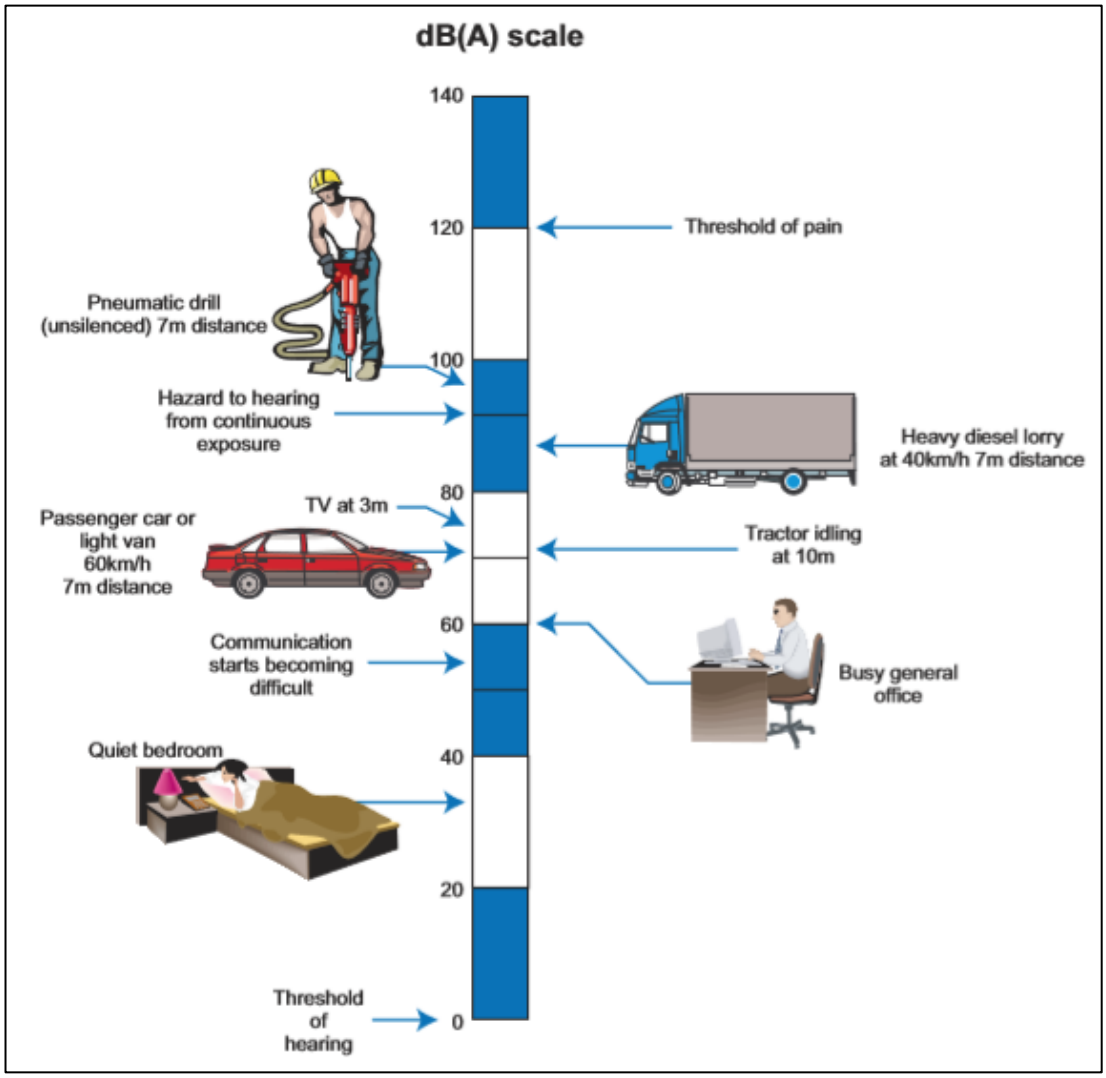


Figure 10-1 The level of typical common sounds on the dB(A) scale (NRA Guidelines for the Treatment of Noise and Vibration in National Road Schemes, 2004)

For a glossary of terms used in this chapter please refer to Appendix 10-1.

10.3 Methodology

The assessment of impacts for the Proposed Development has been undertaken with reference to the most appropriate guidance documents relating to environmental noise and vibration which are set out in section 10.3.1. In addition to these specific guidance documents, the EPA document *Guidelines on the information to be contained in Environmental Impact Assessment Reports (EIAR)* (EPA, May 2022) were considered when preparing this EIAR chapter.

The following outline methodology has been adopted for this assessment:

- Review of the relevant guidance to identify appropriate criteria for elements of the Proposed Development.
- Review noise monitoring survey data to identify the typical existing noise environment in the vicinity of the nearest noise sensitive locations (NSLs).
- Predict the typical levels of noise emissions at the nearest NSLs for both the construction and operational and decommissioning phases.
- Predict the relative change in noise levels in the environment due to the expected increase in road traffic flow associated with the Proposed Development.
- Assess the impact by comparing the calculated levels against the relevant criteria.
- Where necessary to achieve the relevant criteria, present ameliorative, remedial, or reductive measures to control noise and vibration impacts.
- Present the predicted impact of the Proposed Development considering any adopted ameliorative, remedial, or reductive measures.
- Describe the significance of the residual noise and vibration effects associated with the Proposed Development.
- Undertake a cumulative assessment to identify what likely significant effects the Proposed Development will have on the surrounding environment when considered in combination with relevant permitted, proposed, and constructed projects in the vicinity.

This outline methodology is described in further detail in the following sections.

10.3.1 Assessment Criteria

10.3.1.1 Construction Phase

There is no published statutory Irish guidance relating to the maximum permissible noise and vibration level that may be generated during the construction phase of a project. Account must be taken of the technical feasibility of the Proposed Development, the balance between the magnitude of noise and vibration and the duration of the exposure when setting criteria for construction noise. Local authorities normally control construction activities by imposing limits on the hours of operation and may consider noise and vibration limit values at their discretion.

The construction noise and vibration criteria outlined in the following sections shall also apply to any decommissioning works associated with the Proposed Development.

10.3.1.1.1 *Construction Phase – Noise*

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

The approach outlined in BS5228-1 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. Each category has a defined threshold value that, if exceeded (construction noise only), indicates a potential significant noise impact is associated with the construction activities.

Table 10-1 presents the threshold values which, if exceeded, potentially signify a significant effect as recommended by BS 5228 – 1. The threshold levels relate to construction noise only.

Table 10-1 Threshold of Significant effect at Dwellings

Assessment category and threshold Value Period (LAeq)	Threshold value in decibels (dB)		
	Category A	Category B	Category C
Night-time (23.00 – 07.00)	45	50	55
Evening and Weekends[1]	55	60	65
Daytime (07.00 – 19.00) and Saturdays (07.00-13.00)	65	70	75

Category A: Threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are less than these values.

Category B: Threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are the same as Category A values.

Category C: Threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are greater than Category A values.

This assessment method is valid for residential NSLs only. For the appropriate period (e.g., daytime) the ambient noise level is determined and rounded to the nearest 5 dB. In this instance the baseline noise survey has identified daytime ambient noise levels that typically range from 43 to 50 dB $L_{Aeq,T}$ and therefore, for this assessment all NSL's shall be afforded a Category A designation.

Section 10.5.2 presents the construction noise assessment of the Proposed Development.

10.3.1.1.2 Construction Traffic on Surrounding Roads- Noise

For the assessment of potential noise impacts from construction related traffic along public roads and haul routes it is proposed to adopt guidance from Design Manual for Roads and Bridges (DMRB), Highways England, Transport Scotland, The Welsh Government and The Department of Infrastructure 2019.

Table 10-2, taken from Section 13.7 of DMRB presents guidance as to the likely impact associated with any change in the background noise level ($L_{Aeq,T}$) at a noise sensitive receiver from construction traffic.

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

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

Table 10-2 Likely Impacts Associated with Change in Traffic Noise Level (Source DMRB, 2019)

Change in Sound Level	Magnitude of Impact
0	No Change
0.1 – 0.9	Negligible

[1] *19:00 – 23:00 weekdays, 13:00 – 23:00 Saturdays and 07:00 – 23:00 Sundays.*

Change in Sound Level	Magnitude of Impact
1.0 – 2.9	Minor
3.0 – 4.9	Moderate
>5	Major

The DMRB guidance will be used to assess the predicted increases in traffic noise levels on public roads associated with the Proposed Development and comment on the likely impacts and significance of effects during the construction phase.

10.3.1.1.3 Construction Phase – Vibration

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

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

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

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

BS 5228 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 Transport Infrastructure Ireland (TII) (formerly National Roads Authority (NRA)) document *Guidelines for the Treatment of Noise and Vibration in National Road Schemes* (NRA, 2004) also contains information on the permissible construction vibration levels during the construction phase as shown in Table 10-3.

Table 10-3 Recommended Transient Vibration Limits

Allowable vibration velocity (Peak Particle Velocity) at the closest part of any 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

The TII vibration limits are proposed for all construction activities associated with the Proposed Development; compliance with these limits should ensure that there is little to no risk of even cosmetic damage to buildings.

It is acknowledged that humans are particularly sensitive to vibration stimuli and that any perception of vibration may lead to concern. In the case of road traffic, vibration is perceptible at around 0.5 mm/s

and may be disturbing at higher magnitudes. However, higher levels of vibration are typically tolerated for single events or events of short duration when the source of vibration is known.

10.3.1.2 Operational Phase – Noise

10.3.1.2.1 *Guidance on Permissible Noise Levels from the Proposed Development*

BS 8233:2014 *Guidance on Sound Insulation and Noise Reduction for Buildings* provides guideline values for internal noise levels within residential dwellings. The BS8233 standard provides recommendation for indoor ambient noise levels as presented in Table 10-4.

Table 10-4 BS 8233 Recommended Indoor Noise Levels

Activity	Location	Day, dB $L_{Aeq, 16\text{-hour}}$	Night, dB $L_{Aeq, 8hour}$
Resting	Living room	35	-
Dining	Dining room/area	40	-
Sleeping (daytime resting)	Bedroom	35	30
Notes: Daytime assessment period – 07:00 to 23:00 hrs Night-time assessment period – 23:00 to 07:00 hrs			

The BS 8233:2014 guideline values are broadly in-line with the values as presented in the WHO *Guidelines for Community Noise* (1999), which are presented Table 10-5.

Table 10-5 WHO Recommended Indoor Noise Levels

Specific Environment	Critical Health Effect(s)	dB $L_{Aeq, T}$	Time Base (Hours)	dB L_{AFmax}
Dwelling indoors	Speech intelligibility and moderate annoyance, daytime and evening	35	16	-
Inside bedrooms	Sleep disturbance, night-time	30	8	45

It is appropriate to derive external noise limits based on the recommended internal noise criteria. This is done by factoring in the degree of noise reduction afforded by a partially open window. Annex G in BS 8233:2014 states that,

> "*If partially open windows were relied upon for background ventilation, the insulation would be reduced to approximately 15 dB*"

It is also acknowledged that the level difference through a window partially open for ventilation can vary depending on the window type and this is nominally deemed to fall in the range of 10 to 15 dB. Therefore, an inside-to-outside level difference in the range of between 10 to 15 dB is appropriate to define maximum external operational noise level that may be applicable to the Proposed Development as follows:

- Daytime (07:00 to 23:00 hours): between 45 - 50 dB $L_{Aeq, 16hr}$.
- Night-time (23:00 to 07:00 hours): between 40 - 45 dB $L_{Aeq, 8hr}$.

The expected operational noise levels from all elements of the Proposed Development at the nearest noise sensitive locations are expected to be well below these threshold values. The criteria for the Proposed Developed are discussed further in Section 10.3.1.2.3.

10.3.1.2.2 Noise Criteria for Permitted Development

The Knocknamork Renewable Energy Development (Permitted Development) has operational noise limits imposed through the planning conditions (planning ref 19/04972). Operational noise limits are defined in Condition no. 32, and this is presented below.

> *"Noise levels emanating from the proposed development following commissioning, when measured externally at a noise sensitive location, shall not exceed 43 dB(A), (LA90,10 mins),or a maximum increase of 5 dB(A) above background noise (LA90,10 mins) at nearby noise sensitive locations. If noise contains a discrete, continuous tone (whine, hiss, screech, hum etc.), or if there are distinctive impulses in the noise (bangs, clicks, clatters or thumps), or if the noise is irregular enough in character to attract attention, a penalty of + 5dBA will be applied to the measured noise level and this increased level shall be used in checking compliance with the specified levels. All sound measurements shall be carried out in accordance with ISO Recommendations R 1996, "Assessment of Noise with Respect to Community Response" as amended by ISO Recommendations R 1996/1, 2 and 3, "Description and Measurement of Environmental Noise", as appropriate. "*

The operational noise limit is specified in terms of the L_{A90} parameter and is fixed at 43 dB L_{A90} or 5 dB above background noise for all periods of day and night. A +5 dB penalty applies if noise is tonal or attracts attention.

It is generally that for wind turbine noise the equivalent L_{Aeq} level can be determine by adding a 2 dB correctio to the L_{A90} levels. Therefore, a lower threshold of 45 dB L_{Aeq} will be used for the lower threshold level of the Permitted Development when considering the potential cumulative impacts with the Proposed Development. The maximum external noise levels discussed in Section 10.3.1.2.1 are broadly in line with the conditioned noise limits for the Permitted Development when considering the night time thresholds.

10.3.1.2.3 Proposed Development Operational Noise Targets

Considering the nature of the Proposed Development, the receiving environment, and the distances from the source to the nearest noise sensitive receivers, a design target of 35 dB $L_{Aeq,T}$ is proposed for the Proposed Development. This threshold level is 10 dB below the lower threshold noise limit presented in Section 10.3.1.3.1 and will ensure no significant cumulative increases can occur due to the operation of the Proposed and Permitted Developments.

10.3.1.3 Operational Phase – Vibration

There will be no vibration emissions from the operation of the Proposed Development. Consequently, there is no requirement to consider operational vibration emissions further in this assessment. Notwithstanding this a description of potential effects will be presented as required.

10.3.2 EPA Description of Effects

The significance of effects of the Proposed Development shall be described in accordance with the EPA guidance document *Guidelines on the information to be contained in Environmental Impact Assessment Reports (EIAR), (EPA, 2022)*. Details of the methodology for describing the significance of the effects are provided in Table 1-2 of Chapter 1: Introduction.

10.3.3 Baseline Noise Survey

An environmental noise survey to quantify the existing baseline noise environment at NSLs was conducted by AWN consulting Ltd. as part of the planning assessment for the Permitted Development.

The survey was carried out in general accordance with ISO 1996: *Description, measurement, and assessment of environmental noise*. The details of the environmental baseline noise survey are presented in the following sections.

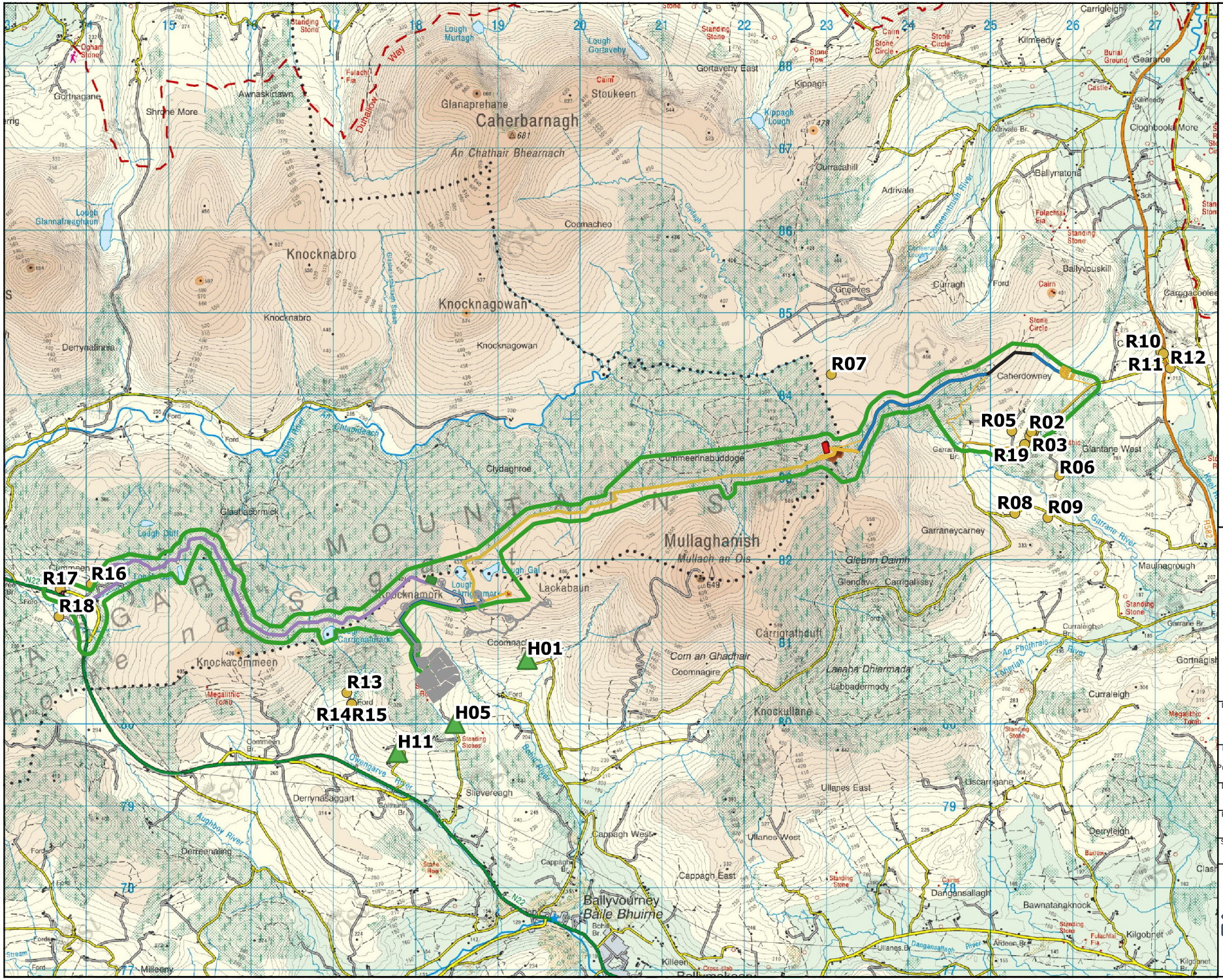
Given the rural nature and location of the NSL's considered in this assessment, the noise survey data is deemed sufficient for the assessment undertaken to determine the typical baseline noise environment at receptors in the vicinity of the Proposed Development. For receptors located along or close to the N22 road, the ambient noise levels are expected to be higher than those measured at the noise monitoring locations. Three measurement locations were selected to inform the assessment and to obtain a representative baseline of noise levels at typical noise sensitive locations. The noise monitoring locations were identified by preparing a preliminary noise contour at an early stage of the assessment. The selection of monitoring locations was supplemented by reviewing aerial images of the study area and other online sources of information (e.g., Google Earth) and verified on the ground. Figure 10-2 identifies the three measurement locations (H01, H05 and H11) and Table 10-6 confirms the coordinates of Noise Monitoring Locations. Table 10-7 confirms the NSL that were considered in the noise impact assessment of this EIAR chapter.

Table 10-6 Noise Monitoring Locations

Location Reference	Coordinates (ITM)	
	Easting	Northing
H01 (Noise Measurement Location)	519,332	580,844
H05 (Noise Measurement Location)	518,453	580,066
H11 (Noise Measurement Location)	517,756	579,711

Table 10-7 Noise Sensitive Location Considered in the Assessment

Location Reference	Coordinates (ITM)	
	Easting	Northing
R01	525,380	583,456
R02	525,487	583,596
R03	525,469	583,579
R05	525,440	583,558
R04	525,463	583,607
R05	525,224	583,619
R06	525,803	583,081
R07	523,029	584,308
R08	525,261	582,617
R09	525,661	582,565
R10	527,036	584,581
R11	527,068	584,559
R12	527,150	584,384
R13	517,138	580,436
R14	517,196	580,301
R15	517,197	580,297
R16	514,029	581,755
R17	513,654	581,698
R18	513,637	581,363
R19	525,380	583,456



Map Legend

- EIAR Study Boundary
- Access Road (Upgrade & New)
- Noise Monitoring Locations
- Noise Sensitive Locations
- Temp Road
- 33kV Underground Cabling and Access Roads
- 33kV Cabling in Permitted Development
- 110kV Underground Cabling
- 110kV Underground Cabling
- Ballyvouskill 220kV Substation
- Proposed 110kV Substation Location
- Proposed Borrow Pit
- Permitted Borrow Pit Extension
- Omitted 38kV Electrical Substation and Battery Compound

Drawing Title

Noise Monitoring Locations

Project Title

Proposed Substation, Underground Cabling & Access Roads to Knocknamork Renewble Energy Development

Drawn By	Checked By
NMcH	EOS
Project No.	Drawing No.
210732	10-2
Scale	Date
1:60000	07.07.22

MKO
Planning and Environmental Consultants
Tuam Road, Galway
Ireland, H91 VW84
+353 (0) 91 735611
email:info@mkoireland.ie
Website: ww.mkoireland.ie

10.3.3.1 Survey Periods

Unattended noise surveys were undertaken at locations H01, H05 and H11 to obtain typical baseline noise levels at noise sensitive locations The surveys were carried out over the following periods.

Table 10-8 Survey Periods

Location	Start Date	End Date
H01	12:50hrs 14 February 2018	10:20hrs 23 March 2018
H05	11:00hrs 14 February 2018	17:10hrs 13 March 2018
H11	10:00hrs 14 February 2018	10:40hrs 23 March 2018

10.3.3.2 Instrumentation

The measurements were undertaken using the following instrumentation which was calibrated with a Brüel & Kjaer Type 4231 calibrator prior to and after the measurement periods. The sound level meter was mounted on a tripod approximately 1.5 metres above ground level and at least 4m away from any reflective surfaces other than the ground.

The survey data was saved to the instrument memory for later analysis. Survey personnel noted the primary sources contributing to noise build-up during installation and removal.

10.3.3.3 Measurement Parameters

Several parameters were measured to interpret the noise levels. These included the following.

- $L_{Aeq:}$ This is the equivalent continuous A-weighted sound pressure level. It is an average of the total sound energy (noise) measured over a specified period.
- $L_{A90:}$ Noise level exceeded for 90% of measurement period (steady underlying noise level).

The "A" suffix denotes that the sound levels have been "A-weighted" to account for the non-linear nature of human hearing. The "F" suffix denotes that the parameter has been measured with 'Fast' time-weighting applied. All sound levels in this report are expressed in terms of decibels (dB) relative to $2x10^{-5}$ Pascal (Pa).

10.3.3.4 Meteorological Conditions

Rain fall was monitored and logged using a Texas Electronics Rainfall Sensor, Model TR 525. This allowed for the identification of periods of heavy rainfall and for the removal of sample periods affected by this from the noise monitoring data sets. The rainfall monitor was in the vicinity of Location H11 for the duration of the survey.

Wind speed data was recorded on meteorological mast with an anemometer at a height of 80 metres.

10.4 Existing Environment

10.4.1 Results of Unattended Noise Surveys

For this impact assessment consideration will be given to the measured baseline noise levels (dB L_{A90} and dB L_{Aeq}) when windspeeds are at the lower range, which is typically ≤3 m/s. Review of the measured noise data has identified typical baseline noise levels at each location for day and night time periods which are presented in Table 10-9.

Table 10-9 Measured Baseline Noise levels During the Survey

Location	Period	Average Baseline Noise Levels (dB)	
		L_{Aeq}	L_{A90}
H01	Day	43	39
	Night	40	37
H05	Day	46	40
	Night	39	36
H11	Day	50	43
	Night	41	33

10.4.2 Vibration

There is no significant source of vibration in the receiving environment therefore there it is not required to measure baseline vibration as part of this assessment.

10.5 Likely Significant Effects and Associated Mitigation Measures

10.5.1 Do-Nothing Scenario

If the Proposed Development were not to proceed the Permitted Development would not be able to supply the electricity generated to the national grid. The opportunity to generate renewable energy and electrical supply to the national grid would be lost. Commercial forestry operations and existing land-use practices would continue at the site. The existing noise environment in the vicinity of the Proposed Development will remain largely unchanged. In areas where traffic noise is a significant source, increases in traffic volumes on the road network would be expected to result in slight increases in overall ambient and background noise in the area over time.

10.5.2 Construction Phase Potential Impacts

The potential impacts of noise and vibration during the construction phase, in addition to the potential impacts from additional vehicular activity on public roads, will be assessed in accordance with best practice guidance as outlined in Section 10.3.1.

A variety of items of plant will be in use for the purposes of site preparation, roads, substation, underground electrical cabling, and other site works. There will be vehicular movements to and from the site that will make use of existing roads. Due to the nature of these activities, there is potential for generation of significant levels of noise, however, considering the distances between the construction activities and noise sensitive locations, the risk of significant impacts is considered low. An assessment of the potential construction noise and vibration impacts is presented in the following Sections.

Due to the nature of the construction activities, it is difficult to accurately calculate the magnitude of noise emissions to the local environment. However, it is possible to predict typical noise levels at the nearest sensitive receptors using guidance set out in *BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise*.

The predicted noise levels referred to in this section are indicative only and are intended to demonstrate that the contractor can comply with current best practice guidance to minimise any significant noise and vibration impacts. It should also be noted that the predicted "worst case" levels are expected to occur for only short periods of time at a very limited number of properties. Construction noise levels are expected to be lower than these levels for most of the time at most properties in the vicinity of the Proposed Development.

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

- Underground Electrical Cabling.
- Various Access Roads
- 110kV Substation.
- Borrow pits, and
- Forestry felling.

Detailed information is included in Chapter 4: Description of the Proposed Development.

The distances between the main construction activities associated with the Proposed Development and the nearest NSL's are such that there is no significant noise and vibration impacts at NSL's expected. The following sections present an assessment of the main stages of the construction phase that have the potential for associated noise and vibration impacts, all other stages and element are considered not to have significant noise and vibration impacts at NSL's.

10.5.2.1 Noise

There are several stages and elements associated with the construction phase of the Proposed Development as detailed in Chapter 4 of the EIAR. The indicative noise predictions are presented in outline form to highlight expected noise levels at the nearest noise sensitive receivers and, if necessary, to present mitigation measures that can be utilised to reduce impacts.

The anticipated construction hours are 07:00 to 19:00hrs, Monday to Saturday. However, to ensure that optimal use is made of good weather periods or at critical periods within the programme (i.e., concrete pours, component deliveries etc.) it will be necessary on occasion to work outside of these hours.

10.5.2.1.1 *Construction of 110kV Substation*

Several indicative sources that would be expected on a site of this nature have been identified and predictions made of the potential noise emissions calculated at the nearest NSL's. The nearest NSL to the proposed on-site 110kV substation is R08, which is situated approximately 820 m from the proposed 110kV substation. The assessment is considered worst-case, construction noise levels will be lower at properties located further from the works.

Construction noise levels at various set-back distances from areas of construction works have been calculated to assess the impact at NSL's situated at greater distances from the works.

Table 10-10 outlines the noise levels associated with the typical construction noise sources assessed in this instance along with typical sound pressure levels and spectra from BS 5228 – 1: 2009. Calculations have assumed an on-time of 66% for each item of plant i.e., 8-hours over a 12-hour assessment period.

Table 10-10 Typical Noise Emission Levels for Typical Construction Activities

Item (BS 5228 Ref.)	Activity/ Notes	Plant Noise Level at 10m Distance (dB $L_{Aeq,T}$) [2]	Predicted Noise Level at 820 m (dB $L_{Aeq,T}$)
HGV Movement (C.2.30)	Removing soil and transporting fill and other materials.	79	30
Excavator mounted rock breaker (C.1.9)	Rock breaking	90	41
Tracked Excavator (C.4.64)	Removing soil and rubble in preparation for foundation.	77	28
General Construction (Various)	All general activities plus deliveries of materials and plant.	84	39
Pumps (D.7.70)	If required.	80	32
JCB (D.8.13)	For services, drainage, and landscaping.	82	31
Vibrating Rollers (D.8.29)	Road surfacing.	77	28
Total Construction Noise (cumulative for all activities)			45

It is predicted that the likely worst-case potential noise levels due to construction activities associated with the substation will be in the order of 45 dB $L_{Aeq,T}$ at the nearest NSL. This level is well below the significance threshold of 65 dB $L_{Aeq,T}$. outlined in Section 10.3.1.1.

It is concluded that there will be no significant noise impacts from the construction of the 110kV substation, therefore no specific mitigation measures will be required.

With respect to the EPA's guidance for description of effects as referenced in Section 10.3.2, the potential worst-case associated effect associated with the construction the Substation at the nearest NSL is expected to be Negative, Not Significant and Temporary.

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

10.5.2.1.2 Temp Road

Details of the proposed Temp Road are described in Chapter 4, Section 4.3.4. Review of the proposed road layout has identified only one receptor within 200 m (R18) and this NSL is some 35 m from the proposed road at the nearest point.

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

Table 10-11 outlines the typical construction noise levels associated with the proposed works for this element of the construction. Calculations have assumed an on-time of 66% for each item of plant.

Table 10-11 Typical Construction Noise Emission Levels for Roads

Item	Plant Noise Level at 10m Distance (dB $L_{Aeq,T}$) [3]	Highest Predicted Noise Level at Stated Distance from Edge of Works (dB $L_{Aeq,T}$)
		35m
HGV Movement	79	62
Tracked Excavator (C.4.64)	77	60
Vibrating Rollers	77	60
Total Construction Noise (Cumulative for all activities)		65

At the nearest noise sensitive location, the predicted noise levels from construction activities associated with temporary site access road are of the order of 65 dB $L_{Aeq,T}$. This is at the threshold for significant impact for construction noise.

It is concluded that there is the potential for significant noise impacts over a period of days and mitigation measures will be adopted by the contractor to minimise potential noise impacts where possible. As noted in Section 10.3.3 the baseline Noise levels are likely to be higher at location R08 due to its proximity to the N22 which may trigger a Category B Threshold. Notwithstanding this, it should be noted that as the works progress away from the closest point to the NSL the worst-case predicted impacts will reduce as the distance from the works increases. The works at the closest position to the nearest NSL's will only exist for only a brief period.

With respect to the EPA's guidance for description of effects as referenced in Section 10.3.2, the potential worst-case associated effect associated with the construction of Temp Road at the nearest NSL is expected to be Negative, moderate to Significant and Temporary.

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

10.5.2.1.3 Access Roads

Details of the Access Roads area are described in Chapter 4, Section 4.3.4. The nearest NSL to the any point along the Access Road is R17, which is situated approximately 160 m from the nearest point. As a worst case, assuming the same typical construction activities as outlined in Table 10-11, it is predicted that the likely worst-case potential noise levels due to construction activities associated with the overrun area will be in the order of 49 dB $L_{Aeq,T}$ at the nearest NSL. This level is below the significance threshold of 65 dB $L_{Aeq,T}$ outlined in Section 10.3.1.1.

It is concluded that there will be no significant noise impacts from the construction of the Access Roads and therefore no specific mitigation measures will be required.

With respect to the EPA's guidance for description of effects as referenced in Section 10.3.2, the potential worst-case associated effect associated with the construction site roads at the nearest NSL is expected to be Negative, Moderate and Temporary.

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

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

10.5.2.1.4 Forestry Felling

The work will consist of cutting and/or removing trees and other obstacles to allow construction of elements of the proposed development. Details are described in Chapter 4, Section 4.3.7.

Most of the proposed forestry felling activities will occur at such distances from noise sensitive receptors that no significant noise impacts are likely to occur. The nearest NSL to the proposed felling activities is R17, which is situated approximately 150 m from the nearest point.

It should be noted that as the works progress the worst-case predicted impacts will reduce as the distance from the works increases. The works at the closest position to the nearest NSL's will only exist for only a short period.

Table 10-12 outlines the typical construction noise levels associated with the proposed works for this element of the construction. Calculations have assumed an on-time of 66% for each item of plant.

Table 10-12 Typical Construction Noise Emission Levels for Forestry felling

Item	Plant Noise Level at 10m Distance (dB $L_{Aeq,T}$) [4]	Highest Predicted Noise Level at Stated Distance from Edge of Works (dB $L_{Aeq,T}$)
		150m
HGV Movement	79	46
Tracked Excavator (C.4.64)	77	44
Chainsaw	83	50
Total Construction Noise (Cumulative for all activities)		52

At the nearest noise sensitive location, the predicted noise levels from construction activities associated with typical forestry felling activities are of the order of 52 dB $L_{Aeq,T}$. This is well below the threshold for significant impact for construction noise.

It is concluded that there will be no significant noise impacts from forestry felling and therefore no specific mitigation measures will be required.

With respect to the EPA's guidance for description of effects as referenced in Section 10.3.2, the potential worst-case associated effect associated with the construction site roads at the nearest NSL is expected to be Negative, Slight, and Temporary.

10.5.2.1.5 Underground Electrical Cabling and Access Roads

Details of the proposed underground electrical cabling and access roads are described in Chapter 4, Section 4.3.2.

The associated construction works will occur for short durations at varying distances from Noise Sensitive Locations (NSL's). Review of the layout has identified that the nearest NSL to the proposed

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

underground cabling and access roads is location R08, which is located at approximately 700 m at the nearest point.

presents outline noise calculations, considering the typical anticipated methods of construction. Calculations have been prepared taking account of the distances to the nearest NSL's and assume that plant items are operating for 66% of the time.

Table 10-13 Indicative noise calculations for construction – Underground Electrical Cabling Routes

Plant Item (BS 5228 Ref.)	Plant Noise Level at 10m Distance (dB $L_{Aeq,T}$) [5]	Calculated Construction Noise Levels dB $L_{Aeq,T}$ at reference distance from works
		700 m
Excavator mounted rock breaker (C.1.9)	90	40
Vibratory Plate (C.2.41)	80	30
Dump Truck (C.2.32)	74	24
Wheeled Loader (C.2.8)	68	18
HGV Movement	79	29
Vibrating Rollers	77	27
Combined L_{Aeq} from all works		41

The predicted Construction Phase noise levels, at distances of 700 m and greater from the works, are all well below the daytime construction noise criteria set out in Table 10-1 and are not significant.

It is concluded that there will be no significant noise impacts from construction of underground electrical cabling route and access roads, and therefore no specific mitigation measures will be required.

With respect to the EPA's guidance for description of effects as referenced in Section 10.3.2, the potential worst-case associated effect at the nearest NSL associated with the underground electrical cabling route construction phase is expected to be Negative, Not Significant and Temporary.

10.5.2.1.6 Borrow Pits

To inform this aspect of the proposal a comparative noise assessment has been prepared for the operation of the proposed borrow pit and the proposed extension to the permitted borrow pit as outlined in the following paragraphs. Two situations have been considered as follows:

- Scenario A Blasting operation
- Scenario B Rock breaking operation

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

In terms of these activities please note the following:

- A mobile crusher will operate on site for both options.
- In Scenario B two rock breakers will be in use on site during daytime periods.
- For the purposes of this assessment, we have assumed the plant is working in the vicinity of the borrow pit locations indicated in Table 10-14.
- Table 10-15 outlines the assumed noise levels for the plant items as extracted from BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise.
- If the blasting option is undertaken, it is estimated that some 10 to 15 blasts will be required over a 9 to 12-week period. It is expected that no more than 1 blast would occur in a single working day.

Table 10-14 Proposed Borrow Pit Location

Co-ordinates (ITM)		
Borrow Pit	Easting	Northing
Permitted Borrow Pit Extension	516,164	581,812
Proposed Borrow Pit	523,123	583,349

Table 10-15 Plant Noise Emission Levels

Item	BS 5228 Ref:	dB L_w Levels per Octave Band (Hz)								dB(A)
		63	125	250	500	1k	2k	4k	8k	
Crusher	Table C1.14	121	114	107	109	103	99	94	87	110
Rock Breaker	Table C9.11	119	117	113	117	115	115	112	108	121

A construction noise model has been prepared to consider the expected noise emissions from the proposed construction works for the two scenarios outlined above. The predicted noise levels at all NSL's in the study area are presented in Table 10-16.

Table 10-16 Prediction Noise Levels from Borrow Pit Activity at Nearest NSL's

Scenario A		Scenario B	
Location Ref	$L_{Aeq,T}$	Location Ref	$L_{Aeq,T}$
R01	24	R01	30
R02	23	R02	29
R03	24	R03	29
R04	24	R04	29
R05	24	R05	29
R06	25	R06	31
R07	22	R07	27
R08	33	R08	43

Scenario A		Scenario B	
Location Ref	$L_{Aeq,T}$	Location Ref	$L_{Aeq,T}$
R09	24	R09	30
R10	22	R10	27
R11	18	R11	22
R12	18	R12	22
R13	18	R13	22
R14	27	R14	34
R15	26	R15	33
R16	26	R16	33
R17	18	R17	22
R18	17	R18	21
R19	17	R19	21

Review of the results contained in Table 10-16 confirms the following:

- Predicted construction noise levels for both Scenario A and B at the borrow pit are well within the relevant construction noise criteria (65 dB $L_{Aeq,T}$). It is assumed that construction works at the borrow pit will only occur during daytime periods only (07:00 to 19:00hrs).
- The blasting proposal results in lower levels of construction noise as the rock breaking plant is not required to operate to the same extent in this scenario. Predicted noise levels are lower at all assessed locations for Scenario A.
- It is accepted that the individual blast events will be audible at certain locations. Blast events will be designed and controlled such that the best practice limits values outlined in the mitigation section of this chapter are not exceeded.

10.5.2.2 Construction Traffic

This section has been prepared to review potential noise impacts associated with construction traffic on the local road network. The information presented in Chapter 13 Material Assets has been used to inform the assessment here.

Changes in the traffic noise levels associated with the additional traffic for each of the construction stages listed above have been calculated for Route Option 1, Option 2 and for vehicles accessing the site from the east via the R582.

have been derived from the traffic data in Chapter 13 with corrections applied for the passenger car unit (PCU) factors.

Table 10-17 Construction Traffic Data for Assessment

Link	Stage	Vehicles	%HGV
N22 between the site and Killarney	Background traffic flow	9,421	2%

Link	Stage	Vehicles	%HGV
	Background traffic flow + Proposed Development traffic	9,494	2%
N22 through Macroom	Background traffic flow	16,858	2%
	Background traffic flow + Proposed Development traffic	16,930	2%
R582 north of Macroom	Background traffic flow	7,025	2%
	Background traffic flow + Proposed Development traffic	7,098	2%

Based on the traffic data presented in Table 10-17, the changes in noise level relative to the expected traffic noise from the baseline year have been calculated and are presented in Table 10-18.

Table 10-18 Calculated Changes in Traffic Noise Levels

Link	Change in Traffic Noise Level dB(A)	Estimated Number of Days
N22 between the site and Killarney	0.1	255
N22 through Macroom	0.1	255
R582 north of Macroom	0.1	255

With respect to the EPA's guidance for description of effects as referenced in Section 10.3.2 the potential noise effects are associated with construction traffic is expected to be Negative, not Significant and Temporary.

10.5.2.3 Vibration

There are no vibration impacts anticipated at sensitive locations during the Construction Phase. Notwithstanding the above, any construction activities undertaken on the site will be required to operate below the recommended vibration criteria set out in Table 10-3.

10.5.2.4 Decommissioning Phase

The expected decommissioning works will not be as significant as the works associated with the construction phase as most of the proposed works will remain in-situ, refer to Chapter 4 for full details. In relation to noise emissions from any decommissioning work associated with the Proposed Development, any works would generate at worst case comparable levels of noise as those calculated for the construction phase, as similar tools and equipment would be used.

In all instances the total decommissioning noise levels are expected to be below the recommended noise and vibration criteria set out in Section 10.3.1 and therefore a significant effect is not predicted in relation to the nearest noise sensitive locations during the decommissioning phase.

With respect to the EPA's guidance for description of effects as referenced in Section 10.3.2 the potential worst-case associated effect at the nearest NSL associated with the decommissioning phase is expected to be Negative, Not-significant and Temporary.

10.5.3 Operational Phase Potential Impacts

The following sections present an assessment of the expected noise and vibration impacts associated with the operational phases of the Proposed Development with respect to the assessment criteria that have been presented in Section 10.3.1.

10.5.3.1 Noise

10.5.3.1.1 *110kV Substation*

The location of the 110kV substation is shown in Figure 4-1 and further details are outlined in Chapter 4 Section 4.3.1.

As part of the Proposed Development, the substation will be operational on a continuous basis. The noise emission level associated with a typical substation that would support a development of this nature is the order of 93 dB(A) $L_{w.}$

Noise prediction calculations for the operation of the 110kV substation have been undertaken in accordance with *ISO 9613: Acoustics – Attenuation of sound outdoors, Part 2: General method of calculation* (1996), the predicted noise at the nearest noise sensitive location (R08) is 18 dB L_{Aeq}. This level is well below the design threshold and is likely to be inaudible at the nearest noise sensitive location and therefore no specific mitigation measures will be required.

The noise from the operation of the substation at the nearest NSL is predicted to be 18 dB $L_{Aeq,T}$. This level is well below the operation noise criteria outlined in Section 10.3.1.2.3. This level of noise is likely to be inaudible at the nearest NSL and it is concluded that there will be no significant noise emissions from the operation of the substation at any NSL.

With respect to the EPA's guidance for description of effects as referenced in Section 10.3.2, the potential effects at the nearest NSL associated with the operation of the substation is expected to be Negative, Not-Significant and Long Term.

10.5.3.1.2 *Underground Electrical Cabling Route*

The operation of the proposed underground electrical cable will not emit any noise that would be perceptible at nearby noise sensitive locations.

Once constructed and operational, there will be no noise from the underground electrical cable at any NSL and therefore no specific mitigation measures will be required.

With respect to the EPA's guidance for description of effects as referenced in Section 10.3.2; the underground electrical cable, once constructed, will not generate noise during the operational phase. The associated effects are Neutral, Imperceptible and Long Term.

10.6 Mitigation Measures

10.6.1 Construction Phase Mitigation

For most of the construction phase the recommended construction noise thresholds are not expected to be exceeded therefore no specific mitigation measures are proposed. Notwithstanding this, the contractor undertaking the construction works will be required to undertake noise abatement measures where necessary and comply with the recommendations of BS5228-1:2009+A1:2014.

It is proposed that various practices be adopted during construction as required, including the following:

- limiting the hours during which site activities likely to create high levels of noise or vibration are permitted;
- establishing channels of communication between the contractor/developer, Local Authority and residents;
- appointing a site representative responsible for matters relating to noise and vibration;
- monitoring typical levels of noise and vibration during critical periods and at sensitive locations; and
- keeping the surface of the site access roads even to mitigate the potential for vibration from lorries.

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

- selection of plant with low inherent potential for generation of noise and/ or vibration;
- placing of noisy / vibratory plant as far away from sensitive properties as permitted by site constraints; and,
- Switching off machinery/plant when not in use.

Air overpressure arising from blasting is difficult to control because of its variability, however, much can be done to reduce the effect. Further guidance will be obtained from the recommendations contained within BS 5228: Part 1 and the European Communities (Construction Plant and Equipment) (Permissible Noise Levels) Regulations 1988 in relation to blasting operations. The most appropriate method used to minimise effects shall be identified by the engineers responsible for the blasting and may consist of some or all the following:

- Restriction of hours within which blasting can be conducted.
- A publicity campaign undertaken before any work and blasting starts (e.g., 48 hours written notification) to all properties within 1km of the proposed blast location.
- The firing of blasts at similar times to reduce the 'startle' effect.
- On-going circulars informing people of the progress of the works.
- The implementation of an onsite documented complaints procedure.
- The use of independent monitoring by external bodies for verification of results.
- Trial blasts in less sensitive areas to assist in blast designs and identify potential zones of influence.

10.6.2 Decommissioning Phase Mitigation

The mitigation measures that will be considered in relation to any decommissioning of the site are the same as those proposed for the construction phase of the development outlined in Section 10.6.1.

10.6.3 Operational Phase Mitigation

Once operational, the Proposed Development will not have any significant impacts. The underground electrical cable will not emit noise. Any noise emissions associated with the 110kV substation at NSLs will not be significant and is expected to be well within the criteria set out in Section 10.3.1.2, therefore, no mitigation measures are required.

10.7 Description of Residual Effects

10.7.1 Construction and Decommissioning Phase

With respect to the EPA's criteria for description of effects, in terms of the construction and decommissioning activities, the overall associated residual effects at the nearest noise sensitive locations are described below.

The predicted residual noise and vibration effect associated with this element of the construction phase is described as follows:

Quality	*Significance*	*Duration*
Negative	Moderate	Temporary

10.7.2 Operational Phase

The residual impacts associated with the Proposed Development are not predicted to increase the existing noise levels at any NSL.

With respect to the EPA's criteria for description of effects, in terms of the operation of the Proposed Development, the potential worst-case associated residual effects at the nearest noise sensitive locations associated with the various elements of the Proposed Development are described below.

10.7.2.1.1 *110kV Substation*

The associated residual effect from the operation of the 110kV substation at the nearest NSL is summarised as follows:

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

10.7.2.1.2 *Underground Electrical Cabling*

The underground electrical cable, once constructed, will not generate noise during the operational phase. The associated residual effect is therefore summarised as follows:

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

10.8 Cumulative Impacts

This assessment has considered the potential cumulative impacts for both the construction and operational phases of the Proposed Development with other proposed and permitted developments in the surrounding area. Discussions on the potential cumulative impacts are presented in the following sections.

10.8.1.1 Construction Phase

With the exception of the Temp Road the associated noise levels at nearby NSLs from the proposed construction activities are at level that will not result in any cumulative noise and vibration impacts that would result in any significant effect. For construction of the Temp Road there is a slight potential for cumulative impacts if other construction activities were to occur in the vicinity, as the nearest NSLs are in proximity to the proposed works. The contractor will adopt the mitigation measures outlined in Section 10.6 as appropriate to minimise potential impacts. The risk of any significant cumulative effect is low.

The noise and vibration effects associated with cumulative impacts for the construction phase of the Proposed Development as a worst case, can be described as Negative, Moderate to Significant and Long Term.

These effects should be considered in terms that the effect is variable, and that this assessment considers the locations of the greatest potential impact. For most of the construction phase and proposed works the noise and vibration effects associated with cumulative impacts for the can be described as Neutral, not-significant and Long Term.

10.8.1.2 Operational Phase

Once the construction of Proposed Development is completed, the potential noise impacts to the surrounding environment are not significant.

The operational noise from the Proposed Development is limited to the 110kV substation. The predicted noise level from the 110kV substation at the nearest noise sensitive location is 18 dBA, this level of noise is very low and likely to be inaudible at the nearest NSL. It is concluded that there will be no cumulative impacts at any NSL associated with the operation of the Proposed Development in combination with the list of identified project in Tables 2-1 and 2-2 of Chapter 2 Section 2.3, as the predicted operational noise emissions are not of sufficient magnitude to have any significance.

The effects associated with cumulative impacts for the operational phase of the Proposed Development as a worst case, can be described as Neutral, Not Significant and Long Term.

10.9 Summary

A noise and vibration assessment of the Proposed Development has been undertaken for both the long-term operational and the temporary construction and decommissioning phases. The main elements of the Proposed Development that were considered in this assessment are components with a likely potential to generate noise and vibration impacts.

The predicted noise and vibration levels associated with the construction phase are predicted to be within the proposed criteria thresholds. The assessment for the Proposed Development has considered the cumulative construction noise and vibration impacts of other permitted and proposed developments. Notwithstanding the above, the contractor undertaking the construction works will be required to undertake noise abatement measures where necessary and comply with the recommendations of BS5228-1:2009+A1:2014.

The assessment has concluded that there is no significant noise and vibration effect associated with the operational phase of the Proposed Development. Due to the magnitude of the operational noise emissions at the nearest NSL, there is no potential for any cumulative impacts with the operation of the Permitted Development or any other permitted or proposed development in the environment.

The potential cumulative effects for both the construction/ decommissioning and operational phases of the Proposed Development with the Permitted Development and other developments listed in Chapter 2 have been considered in this assessment and are deemed to be not significant.