CHAPTER 11

NOISE AND VIBRATION

JUNE 2025

QUARRY CONSULTING

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Introduction

Scope of Assessment

Chapter 2 of this EIAR contains a detailed description of the Proposed Development. However, in summary, the planning application will consist of:

- Continued use of the existing quarry (granted under Planning Ref. File No.: 06/2275 and ABP Ref.: PL07.222783), including drilling, blasting, crushing, processing, and stockpiling of materials within a total site area of 15.09 hectares to the permitted depth of 33m OD.
- Continued use of existing permitted structures and facilities, including:
  - Weighbridge and wheelwash with side and overhead spray bars.
  - Office and staff facilities building and carpark provision (Ref. 17512).
  - Asphalt plant (Ref. 15104), concrete batching plant (Ref. 20419), maintenance shed (Ref. 141295), aggregate shed, ESB substation (Ref. 191964), crushing and screening plant, and stock bays (Ref. 062275 & 21442).
  - Associated site infrastructure.
- Construction of a new quarry storage yard (c. 1.09 Ha.) to the east of the existing quarry.
- Relocation of the existing permitted sheds (Plan Ref File No. 21442) to an area beside the proposed storage yard area.
- Importation of soil and stone (both waste and non-waste) for site restoration purposes and selected construction and demolition waste for recycling to preserve natural aggregate resources, subject to the necessary authorisations.
- The proposed development will facilitate the continued operation and restoration of the site, with the operational life of the quarry ceasing upon resource exhaustion, followed by restoration to agricultural and natural uses using imported material.

The proposed development is within an overall application area of c. 16.3 hectares and is for a total period of 35 years (comprising an operational period of 33 years followed by 2 years for completion of restoration).

11.1 This chapter considers whether any potential significant noise or vibration effects are likely to arise at the closest noise sensitive receptors to the Application Site in relation to:

- Continued operation of heavy plant and equipment, together with the asphalt and the concrete manufacturing facilities at the quarry,
- Continued blasting at the quarry,
- Vehicle movements along the unnamed access road to the quarry from the L2212.
- Restoration of the quarry.

11.2 Activities using heavy plant and equipment within the quarry void will include drilling, crushing, screening, grading and stockpiling of materials.

11.3 The asphalt plant and concrete manufacturing facilities would continue operation in their current locations.

11.4 The operation of heavy plant and equipment, the asphalt manufacturing facility and the concrete manufacturing facility are considered together as ‘operational noise’. This is distinct from blasting noise (more correctly ‘air overpressure’) which has quite different characteristics and which is considered separately.

11.5 Vibration from the operation of heavy plant, equipment, asphalt and concrete manufacturing facilities dissipates rapidly with distance, and is unlikely to be perceptible at distances in excess of 100m. Vibration from the operation of plant and equipment has therefore been scoped out of this assessment as it is unlikely to cause any significant effects, although vibration from blasting is considered.

11.6 Noise and vibration arising from the use of the weighbridge, wheel wash, welfare facilities, car parking, offices, storage facilities, waste management and ancillary activities are likely to be negligible and are also scoped out of this assessment.

11.7 The Traffic and Transport Assessment (Chapter 13) indicates that the continued operation of the Proposed Development will result in only a modest change in traffic volumes on the L2112 local road. It is widely accepted that an increase in traffic volume of approximately 25% is typically required to produce a perceptible change of 1 dB(A) in road traffic noise levels, assuming no significant changes in traffic composition or speed. As the projected increase falls well below this threshold, any associated change in road traffic noise levels is expected to be negligible (imperceptible). Accordingly, a detailed assessment of road traffic noise has been scoped out of this assessment.

Information presented

11.8 This chapter sets out:

- Relevant legislation, standards and guidance;
- The methods used to assess the effects from operational noise, blasting vibration, blasting air overpressure and vehicle movements;
- The baseline conditions currently existing at the Site and surrounding area;
- The current control measures implemented to prevent, reduce or offset any significant negative effects;
- The assessment of likely impacts and effects, due to the quarry operation alone and cumulatively with other nearby developments;
- Consideration of whether any additional mitigation is required; and,
- The likely residual effects after any recommended additional mitigation have been implemented.

Competence

11.9 This chapter has been prepared by Sam Williams B.Eng MIOA of Sine Environmental Limited. Sam is a corporate Member of the UK Institute of Acoustics (IoA) and sits on the IoA membership committee. Sam is active within the IoA, having presented at two IoA branch events in 2024 and also presented at the Association of Noise Consultants Annual Conference. Sam is a guest lecturer at the University of Derby, and this year he gave the IoA Diploma and MSc Applied Acoustics students their lectures about noise and vibration from minerals extraction, construction and wind turbines.

11.10 Over the past 27 years Sam has been responsible for the acoustic assessment of over 150 schemes. He is experienced in environmental impact assessments, planning submissions and has been appointed as an expert witness for a range of planning appeals, public inquiries and at the high court (UK). Sam is an experienced practitioner with respect to the assessment of noise and vibration impacts of minerals extraction and processing, construction sites, power developments major transport schemes and industrial schemes.

Legislation, Policy and Guidance

11.11 Table 11-1 below presents the legislation, policy and guidance relevant to the assessment and details how their requirements have been met in the assessment.

Table 11-1
Relevant Legislation, Policy and Guidance

Legislation / Policy / Guidance	Consideration within the EIAR
The Environmental Protection Agency Act 1992 (as amended) [2] requires the EPA to 'prepare guidelines on information to be contained in environmental impact assessment reports' and requires that regard be given to such guidelines in the preparation of an Environmental Impact Assessment Report (EIAR). This applies to all EIARs and not simply those for which the EPA is a competent authority.	This chapter of the EIAR is written with due regard for the guidelines prepared by the EPA in response to the duty imposed by The Environmental Protection Agency Act 1992 as amended. Further detail on the guidelines and how this chapter considers them are set out below.
The Planning & Development Act, 2000 [3], **Section 261 – Control of Quarries** provides for further regulation of the sector. This section of the Act commenced on the 28th April 2004 and sets out planning controls relating to quarries. It also requires the owner or operator to report information about a quarry, including the levels of noise generated by the operations.	The baseline section of this EIAR presents recent noise measurements of the existing quarry operations.
National Planning Framework First Revision National Policy Objective 66: The planning system will be responsive to our national environmental challenges and ensure that development occurs within environmental limits, having regard to the medium and longer-term requirements of all relevant environmental and climate legislation and the sustainable management of our natural capital.	This EIAR demonstrates that the Application Site can operate within the relevant EPA Environmental Limit Values.
The '**Quarries and Ancillary Activities: Guidelines for Planning Authorities**' [4] was published by the Department of the Environment, Heritage & Local Government in April 2004. These Guidelines seek to identify land use and environmental issues that can arise from the operation of quarries and suggest best practice in dealing with them. The guidelines are intended for statutory planning bodies but are of interest to operators since they set out the range of environmental impacts that the planning authority will consider and provide	This EIAR chapter considers whether any issues relating to operational noise, blasting air overpressure or blasting vibration are likely to arise due to the continued operation or restoration of the quarry. This chapter also recommends appropriate and proportional best practice control measures for mitigating operational noise, blasting air overpressure and blasting vibration, and sets out mechanisms for these to be implemented (if they are not already).

Legislation / Policy / Guidance	Consideration within the EIAR
examples of best practice control measures that authority may expect to see in quarry applications. The guidelines note that quarries vary greatly in size and potential impacts, and that the planning response to proposed developments should be tailored accordingly. These planning guidelines apply to non-scheduled minerals and do not apply to mineral workings as defined in the Minerals Development Acts.	
Environmental Management in the Extractive Industry - Non-Scheduled Minerals [5]. While not the regulator for the extraction of non-scheduled minerals, the EPA has conducted a review of environmental management practices within the sector. This project report makes recommendations on noise and vibration control measures that can be implemented at quarries, and proposes Emission Limit Values (ELVs) for noise, vibration and air overpressure. The report also makes recommendations regarding monitoring and reporting, blasting times and notifications.	This EIAR chapter assesses operational noise, blasting air overpressure and blasting vibration against the ELVs set out in this guidance, and adopts the recommendations regarding monitoring and reporting, blasting times and notifications.
Guidance Note for Noise in Relation to Scheduled Activities [6]. This EPA guidance is now superseded by the 2016 guidance note detailed below. However, this guidance includes useful clarification on interpretation on ELVs that is not included in [5] above.	This EIAR chapter interprets the ELVs presented in Environmental Management in the Extractive Industry - Non-Scheduled Minerals [5] as being free field values.
Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4) [7].	Although the Proposed Development does not require an EPA licence, the baseline section of this EIAR chapter includes the information set out in the checklist for noise measurement reports that this guidance note contains.
Guidelines on the Information to be Contained in Environmental Impact Assessment Reports [8] is published by the EPA with the primary objective of improving the quality of EIARs with a view to facilitating compliance with Directive 2014/52/EU.	The description of the baseline, assessment methods, quality of effects, significance of effects, and the extent and context of effects presented in this EIAR chapter are based on these guidelines.
Guidelines for Environmental Noise Impact Assessment [1] published by the Institute of	This EIAR has been conducted in accordance

Legislation / Policy / Guidance	Consideration within the EIAR
Environmental Management & Assessment sets out advice on the various factors that should be considered. The guidance covers: • how to scope a noise assessment; • issues to be considered when defining the baseline noise environment; • prediction of changes in noise levels as a result of implementing development proposals; and • the definition and evaluation of the significance of the effect of changes in noise levels where the assessment is undertaken within an EIA.	with the principles set out in these guidelines.
Guidelines for Community Noise [9] is the outcome of the World Health Organization expert task force meeting held in London, United Kingdom, in April 1999 which consolidated the scientific knowledge of the time on the health effects of community noise. The WHO guidelines identify that, in dwellings, the critical effects of noise are on sleep, annoyance and speech interference, and recommend that: *'To protect the majority of people from being seriously annoyed during the daytime, the sound pressure level on balconies, terraces and outdoor living areas should not exceed 55 dB* L_{Aeq} *for a steady, continuous noise.'* Since the Guidelines for Community Noise were drafted there has been significant research into the health effects of noise. However, the majority of these studies are focussed on identifying dose-effect curves for various health effects from specific sources of noise. It is well established that the human response to noise differs depending on the source (e.g. aircraft, road traffic, trains or wind farms), and the Guidelines for Community Noise remain relevant to noise from a wide range of activities such as quarrying for which dose-effect curves have not been commonly adopted.	This assessment assesses the potential health effects of operational noise from the quarry against the *55 dB* L_{Aeq} threshold from the WHO Guidelines for Community Noise [9].
British Standard BS 5228-1:2009+A1:2014 Code of Practice for Noise and Vibration Control on Construction and Open Sites [10] provides	The calculation methodologies set out in BS5228-1 been adopted for the prediction of noise from:

Legislation / Policy / Guidance	Consideration within the EIAR
methods of estimating noise from construction and minerals activities, a database of heavy plant noise emissions, and advice for noise control on construction sites. The Standard also includes several example methods for determining the thresholds at which 'significant effects' may occur at residential dwellings.	• the winning and processing of minerals on site, • the operation of the asphalt and concrete batching plants, and • the proposed remediation activities. BS5228-1 also suggests that for large scale and long term earth moving activities similar to surface mineral extraction that a daytime limit of 55 dB $L_{Aeq,\ 1hr}$ be adopted. This coincides with the Emission Limit Values recommended by the EPA and referenced by DoEHLG.
Australian Standard AS 2187.2-2006 Explosives—Storage and use Part 2: Use of Explosives [11]	Levels of groundborne vibration at the closest sensitive receptors have been predicted in accordance with AS 2187.2-2006 [11].

Introduction to Noise and Vibration

Noise

11.12 Noise is commonly defined as 'unwanted sound' and is therefore subjective.

11.13 The human perception of noise is influenced by physical, physiological and psychological factors. Physical factors include the sound pressure level at the position of the listener, physiological factors include the acuity of hearing, and psychological factors include acclimatization to steady noise and the activity that an individual is undertaking while the noise is present.

11.14 Sound consists of vibrations transmitted to the ear as rapid variations in air pressure which can be measured accurately. The more rapid the variations in air pressure the higher the frequency of the sound. Frequency is defined as the number of pressure fluctuations per second and is expressed in Hertz (Hz).

11.15 The ear can detect both loudness and frequency of sound. However, the sensitivity of the human ear varies with frequency, and therefore sound is commonly measured using the A-weighted filter network which mimics the frequency response characteristics of the human ear. The 'A' notation is used to indicate when sound levels have been filtered using the A-weighting network.

11.16 Sound levels range from the threshold of hearing at 0 dB(A) to levels of over 130 dB(A) at which point the noise becomes painful. Sound levels over 80 dB(A) are considered potentially damaging to hearing. **Table 11-2** below, published in the EPA guidance '*Environmental Management in the Extractive Industry - Non-Scheduled Minerals*' [5] presents a guide to the A-weighted sound pressure levels due to common objects and activities.

Table 11-2
Relevant Legislation, Policy and Guidance

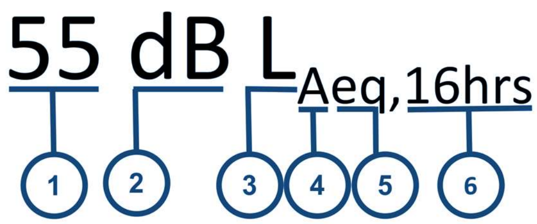
Description of Activity	Sound Level (dB(A))
Absolute silence	0
Very quiet room	25
Rural night-time setting (No wind)	35
Day time, busy road 0.5 km away	55
Busy restaurant	70
Very busy pub, voice has to be raised to be heard	85
Disco or rock concert	100
Uncomfortably loud, conversation impossible	120
Noise causes pain in ears	140

11.17 Generally, a change of 3 dB(A) in fluctuating environmental noise is the minimum change perceptible to a human. A change of around 5 dB is easily perceptible and most people perceive a 10 dB change as halving or doubling the noise level.

Acoustic descriptors

11.18 Outdoor sound levels fluctuate rapidly over time, and therefore to describe the acoustic environment it is necessary to collect statistical data on the distribution of noise levels during the period of interest.

11.19 The nomenclature used to represent statistical acoustic quantities can appear complicated, however once understood it becomes a logical and efficient way of qualifying measures. Take for instance the upper limit recommended by BS 8233 for noise levels in gardens and balconies of $L_{Aeq,T}$ 55dB:



11.20 The above descriptor is comprised as follows:

1. The first part of the statistical descriptor identifies its numeric value. This value is usually given as a whole number or to one decimal place.
2. The second part identifies that the quantity is expressed in decibels (one tenth of a Bel).
3. The third part ('L') indicates that the quantity is a sound pressure level. Other common quantities are sound intensity level ('LI') and sound power level ('LW').
4. The fourth part ('A') denotes that the sound pressure level is evaluated using the A-weighted filter network, which approximates the response of the human ear to different frequency sounds.
5. The fifth part identifies the statistical index. In this example, the letters indicate that the quantity is in terms of the equivalent continuous noise level (eq), which has some similarities with the concept of an average noise level. Numerical values are also used, and these indicate the level exceeded for *n* per cent of the measurement (e.g. a value of 45 dB $L_{A90,T}$ indicates that the A-weighted sound pressure level exceeds 45 dB for 90% of the period being considered).
6. The duration (T) is shown after the statistical descriptor is the duration over which the quantity is evaluated. This is typically represented in minutes or hours, e.g. 15min, 16hrs.

11.21 It should be noted that there are competing conventions regarding acoustic nomenclature. Whilst appearing different, all the following are equivalent and may be used interchangeably:

- 55 dB $L_{Aeq,16hrs}$
- $L_{Aeq,16hrs}$ 55 dB
- $L_{eq,16hr}$s 55 dB(A)

11.22 Which convention is used is a matter of preference; however, it is considered good practice to remain consistent within a document for the convenience of the reader, although this is difficult in practice if a document contains quotations from sources using different conventions.

11.23 A wide variety of statistical indices are used to quantify sound in different situations. However, the two most commonly used to describe the acoustic environment are the *ambient sound level* and the *background sound level*.

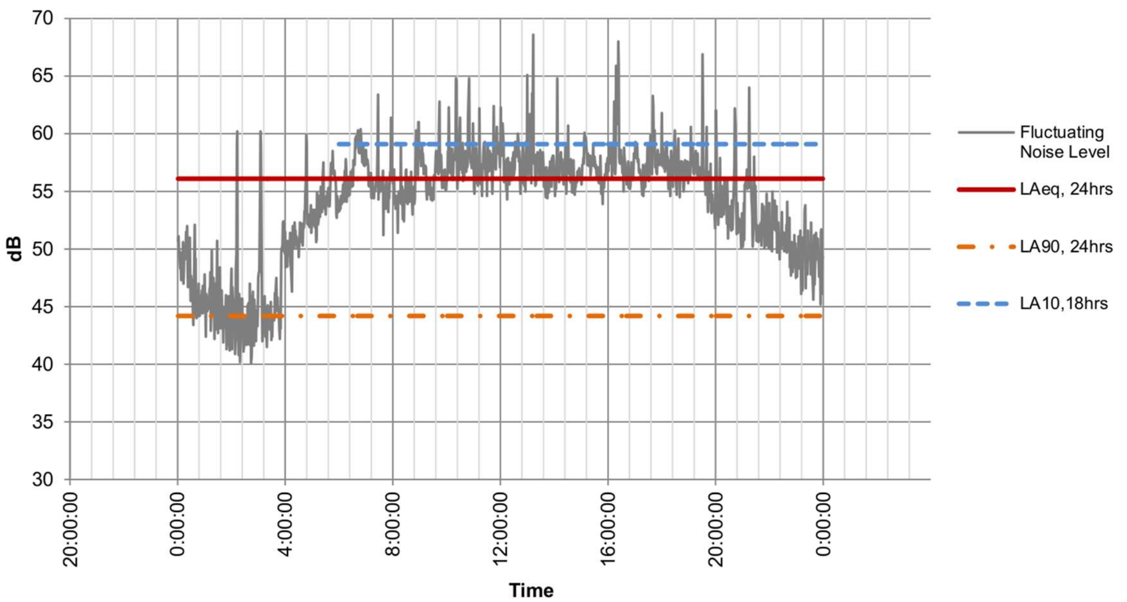
Ambient sound level

11.24 General environmental noise from commercial, industrial or unidentified sources is often expressed in terms of the equivalent continuous sound pressure level over the time period of interest ($L_{Aeq,T}$). This is the notional continuous constant sound that contains the same sound energy over the period of interest as the actual fluctuating sound. This is not an 'average' sound level over a period, but the concept has some similarities and provides a single figure quantity that can be used to compare noise levels which fluctuate with time.

Background sound level

11.25 The $L_{A90,T}$ index identifies the sound level exceeded for 90% of the period of interest, and provides a good indication of the background sound level that remains in a location in the absence of any easily identifiable sources.

11.26 The figure below demonstrates the difference between the fluctuating instantaneous sound level, the *ambient sound Level* ($L_{Aeq,24hrs}$) and the *background sound level* ($L_{A90,24hrs}$) over the example 24-hour period.



Vibration

11.27 Blasting at quarries and opencast coal sites can have adverse impacts that extend beyond the site boundary. Potential environmental impacts of blasting at surface mineral workings include ground vibration.

11.28 Detonation of an explosive charge within a blasthole will fracture the surrounding rock in the region where the strain from the explosive exceeds the ultimate strength of the rock. At greater distances, the rock will exhibit elastic deformation in response to the stress waves radiating away from the blast, rather than fracturing. In this region, rock particles will be moved momentarily by the stress waves but will return to their original position after the wave has passed. The resulting cyclic movement of the particles is referred to as ground vibration (or 'ground-borne vibration' in some texts).

11.29 All blasts will result in some ground vibration. However, good blast design and controls can minimise the levels of ground vibration caused. Key factors that affect the level of vibration arising from a blast are the Maximum Instantaneous Charge (MIC) weight (kg) of explosive that is detonated in each delay, site and rock properties and the distance between the blast site and the receptor.

Air Overpressure

11.30 In addition to the energy transmitted into the rock, a proportion of the blast energy will enter the atmosphere and form a pressure wave known as '*air overpressure*'. This consists of energy manifested as audible (noise) and largely inaudible ('infrasound', which is also known as 'concussion'). Air overpressure differs from noise from other construction activities, which do not normally contain the low-frequency pressure-wave components associated with explosive sources [12].

11.31 Infrasound is often described as sound that is lower in frequency than 20Hz. The frequency of 20 Hz used to be regarded as the lower threshold of hearing, however, more recent research has demonstrated that the threshold of hearing may be as low as 4Hz in special listening conditions if the level is sufficient [13]. Infrasound is primarily sensed by the ear, the sensitivity of which decreases with frequency. To be perceived, the sound pressure level of the infrasound must exceed the threshold of hearing. At higher intensities, infrasound may also be felt as vibrations in other parts of the body.

11.32 There are four component parts to air overpressure, as detailed below.

- Air Pressure Pulse (APP): Direct rock displacement at the face or mounding at the blasthole collar creates a low-frequency air pressure wave. The effects of the individual blastholes can be seen on the time histories from measurements made close-in or in front of the face, but at distance or behind the face the individual pulses become less distinct and a single, low-frequency pulse is observed. For a well-designed and well-confined blast, the APP is of greater magnitude than the other air overpressure components.
- Rock Pressure Pulse (RPP): ground vibrations caused by the detonation travel through the ground to the receptor, where the movement of the ground surface causes an air wave. As ground vibration travels faster than the speed of sound in air, the RPP is the first component of air overpressure to arrive at the receptor, though it is usually quite small in magnitude compared to the airborne pressure wave caused by the other components. The dominant frequency of the RPP is the same as the frequency of the vertical ground vibration, which is normally higher than for the APP.
- Gas Release Pulse (GRP): Gases arising from the detonation escape from the blasthole to the surface of the face through cracks and fissures in the rock, where they cause higher frequency air pressure waves than the APP.
- Stemming Release Pulse (SRP): Gases arising from the detonation also escape along the blasthole through the stemming material to the surface. The SRP also causes higher frequency air pressure waves than the APP.

11.33 Air overpressure is transmitted through the atmosphere, and so the prevailing meteorological conditions at the time of the blast are important. Wind speed, wind direction, the amount of cloud cover and humidity levels will all affect the intensity and phase of the pressure wave at the receptor. Some of these factors can vary rapidly with time, with height above ground and with horizontal distance from the blast site. Unlike predicting equivalent continuous sound levels, it is not possible to determine 'average' atmospheric propagation conditions for a given moment in time.

11.34 The relative energies of the GRP and the SRP depend on factors such as the type of blast, the location, number and geometry of fissures in the rock and how the blasthole has been stemmed; these variables are complex and difficult to account for in a model.

11.35 The propagation of the air overpressure through the atmosphere to the receptor is highly influenced by the weather conditions at the time of propagation; wind direction/speed gradients, atmospheric turbulence, air temperature and relative humidity all affect the propagation of sound. The shape of the terrain (e.g. focussing in valleys), ground roughness and the acoustic impedance of the ground surface are also factors.

11.36 Both the weather conditions and the terrain/ground conditions vary continuously from source to receptor. While it is possible to describe the terrain/ground conditions accurately, as these are generally static, is difficult to accurately describe the variable weather conditions within the volume of atmosphere represented in the model.

Assessment Methodology

Operational Noise from Plant and Equipment

Operational Noise Assessment Thresholds

11.37 In relation to quarry developments and ancillary activities the EPA guidance *Environmental Management in the Extractive Industry - Non-Scheduled Minerals* [5] recommends that noise from the activities on site should not exceed the following noise emission limit values (ELV) at the nearest noise sensitive receptor:

Table 11-3
Recommended Emission Limit Values

Period	Emission Limit Value
Daytime:	55 dB $L_{Aeq,1hr}$
Nighttime:	45 dB $L_{Aeq,1hr}$

11.38 Quarry operations vary considerably over time, as do the noise emissions and the propagation conditions between the source and receptor also change. It is therefore not appropriate to expect quarry noise to be below the ELVs at all times. On this, the EPA [5] guidance recommends that:

- 95% of all noise levels shall comply with the specified limit value(s). No noise level shall exceed the limit value(s) by more than 2 dB(A).
- It is also appropriate to permit higher noise emission limit values for short-term temporary activities such as construction of screening bunds etc., where these activities will result in a considerable environmental benefit.

11.39 With respect to night-time noise, and very quiet environments, the guidance states:

- On site activities should be permitted during night-time hours where they comply with the noise emission limit values (e.g. heating up of asphalt plants, loading of materials).
- Where existing background noise levels are very low, lower noise emission limit values may be appropriate. Audible tones or impulsive noise should be avoided at night.

11.40 The guidance for non-scheduled minerals [5] does not state whether the emission limit values above should be interpreted apply in free-field or facade incident conditions. However, the now superseded EIA guidance note on noise in relation to scheduled activities from 2006 [6] presents the same numeric values as '*Free Field Rating Levels*'. This assessment has therefore been conducted assuming the emission limit values apply in free field conditions for consistency with previous guidance.

11.41 In relation to population and human health, it is considered that a 55 dB $L_{Aeq,1hr}$ limit based on WHO guidance provides a sufficient degree of protection to human health.

11.42 Consideration is also given to the change in noise environment, as recommended by IEMA [1] and the EPA [8]. A scale for assessing the impacts of a noise generating development by reference to the change (increase) over existing sound levels that has been adopted for other quarry noise assessments is set out in Table 11-4 below.

Table 11-4
Assessment of impacts by reference to increase over existing sound levels.

Change	Impact	Effect
<2 dB	Imperceptible	Capable of measurement, but without significant consequences.
2-4 dB	Not significant	Causes noticeable changes to soundscape, but without significant consequences
4-6 dB	Slight	Causes noticeable changes to soundscape without affecting its sensitivities
6-10 dB	Moderate	Alters soundscape in manner consistent with existing and emerging baseline trends
10-15 dB	Significant	Alters soundscape due to source character, magnitude, duration or intensity
15-20 dB	Very significant	Significantly alters soundscape due to source character, magnitude, duration or intensity
>20 dB	Profound	Obliterates soundscape

11.43 Therefore, predicted noise levels that are both below the ELV and which represent less than a 10 dB increase over existing sound levels are considered '*not significant*' in respect of the Environmental Impact Assessment (EIA) Directive as amended (2014/52/EU). Noise levels exceeding either of these criteria are considered to represent '*significant effects*'.

Operational Noise Predictions

11.44 Operational noise predictions have been undertaken in CadnaA 2020 noise modelling software.

11.45 Three-dimensional models of the existing and proposed quarry (existing plus future development) have been developed:

- The calculation parameters have been set to implement the sound power calculation method set out in BS 5228-1:2009+A1:2014 [10].
- The sound emissions for plant and equipment are in the form of sound power levels for the 1/1 octave bands between 63Hz and 8kHz which are generally taken from Annex C '*Current sound level data on site equipment and site activities*' to BS 5228-1:2009+A1:2014 [10].
- No sound emission data was available for the asphalt or concrete manufacturing facilities. Therefore, measured data from the following sources have been used for these facilities:
- Allied Asphalt Replacement Plant Assessment of Noise Effects, Marshall Day Acoustics (30 November 2022, Report: Rp 001 20210691).

- The sound power levels for a concrete plant producing 360m^3 of concrete per day was obtained from applications made by the HS2 high speed rail project in the UK to local authorities.
- The sound power levels, on-times and height above ground of the emission point associated with each source are provided in Appendix 11-1 to this EIAR.
- The intervening ground between the quarry and dwellings is rural farmland, which has been set to '*soft*' ground in the model. BS 5228-1 states that: *'Soft ground is taken to refer to surfaces which are absorbent to sound, e.g. grassland, cultivated fields or plantations'*.
- The positions of the closest noise sensitive receptors, which are dwellings, have been determined from aerial imagery. Calculations have been made at positions situated a minimum of 3.5m from the facades of buildings under free field conditions.

11.46 The noise models consider all plant and equipment operating to give a conservative assessment. The results of the noise model for the 'existing' scenario correlate well with the sound levels measured during the noise survey while the asphalt plant was in operation. The deviation between the noise model and measured levels is less than 1 dB at both measurement positions.

Groundborne Vibration from Blasting

Groundborne Vibration Assessment Threshold

11.47 The EPA guidance 'Environmental Management in the Extractive Industry - Non-Scheduled Minerals' [5] notes that *'people, property and animals are regularly exposed to vibration, both groundborne and airborne'* and sets out a range of vibration levels generated by everyday activities that are reproduced in Table 11-5 below:

Table 11-5
Recommended Emission Limit Values

Vibration Level[*]	Description of Activity
1.0 – 2.0 mm/s	Walking measured on a wooden floor
2.0 – 5.0 mm/s	Door slam, measured on a wooden floor
12 – 35 mm/s	Door slam, measured over doorway
5 – 50 mm/s	Foot-stamp, measured on a wooden floor
30 – 70 mm/s	Daily changes in temperature and humidity

* Parameter not explicitly given in the guidance but is likely to be Peak Particle Velocity (PPV) which is the most common parameter used for quantifying vibration and has units mm/s.

11.48 There is currently insufficient research to understand the impacts caused by changes in vibration levels compared to those experienced currently. Therefore, the significance of effect in relation to groundborne vibration from blasting is determined by comparison to the ELV given in *Environmental Management in the Extractive Industry - Non-Scheduled Minerals* [5]:

- Peak particle velocity = 12 mm per second (mm/s), measured in any of the three mutually orthogonal directions at the receiving location (for vibration with a frequency of less than 40 hertz).

11.49 Groundborne vibration levels below the ELV are considered to result in effects that are *'not significant',* while vibration levels above this threshold are considered likely to result in *'significant effects'.*

Groundborne Vibration Predictions

11.50 Indicative predictions of groundborne vibration at the closest properties due to blasting in the closest borrow pit have been made using the AS 2187.2-2006 [11] method.

11.51 For the purposes of this initial blast vibration assessment, the data for 'average' rock and site conditions (a site constant of Kg = 1140 and a site exponent of B = 1.6) have been used as inputs to the indicative blast vibration predictions. A distance of 490 m to the nearest dwelling has been used in the prediction.

11.52 The quarry operator reports that 200 kg is a typical Maximum Instantaneous Charge (MIC) weight for blasts. To provide a conservative assessment a MIC of 250 kg has been used as the input for this prediction.

Air Overpressure from Blasting

11.53 The EPA guidance 'Environmental Management in the Extractive Industry - Non-Scheduled Minerals' [5] notes that *'people, property and animals are regularly exposed to vibration, both groundborne and airborne'* and sets out a range of air overpressure levels generated by everyday activities that are reproduced in Table 11-6 below:

Table 11-6
Recommended Emission Limit Values

Vibration Level[*]	Description of Activity
120 dB	Constant wind of 5 m/s: Beaufort Scale 3, Gentle Breeze
130 dB	Constant wind of 8 m/s: Beaufort Scale 4, Moderate Breeze

[*] Parameter not explicitly given in the guidance but is likely to be dB (Lin) which has units dB and is the most common parameter used for quantifying air overpressure.

11.54 On potential damage to buildings due to air overpressure, BS 5228-2:2009+A1:2014 [14] states:

11.55 "*Windows are generally the weakest parts of a structure and research by the United States Bureau of Mines [65] has shown that a poorly mounted window that is prestressed might crack at 150 dB (lin), with most windows cracking at around 170 dB (lin), whereas structural damage would not be expected at levels below 180 dB (lin).*"

11.56 There is currently insufficient research to understand the impacts caused by changes in air overpressure levels compared to those experienced currently. Therefore, the significance of effect in relation to air overpressure from blasting is determined by comparison to the ELV given in *'Environmental Management in the Extractive Industry - Non-Scheduled Minerals'* [5]:

- 125 dB (Linear maximum peak value), with a 95% confidence limit.

Air Overpressure Predictions

11.57 Air overpressure associated with blasting events have been undertaken in accordance with the method set out in AS 2187.2-2006 [11] using the formula below:

$$P = K_a \left(\frac{R}{Q^{1/3}} \right)^a$$

where

P = pressure, in kilopascals

Q = explosives charge mass, in kilograms

R = distance from charge, in metres

K_a = site constant

a = site exponent

11.58 AS 2187.2-2006 [11] states that for confined blasthole charges, when using a site exponent of -1.45, the site constant (K_a) is commonly in the range 10 to 100. A review of other texts on this subject such as the ISEE Blasters Handbook [15] and the ICI Handbook of Blasting Tables [16] indicates that a site constant at the lower end of this range is appropriate for well confined blasts.

11.59 The propagation of air overpressure is greatly affected by the meteorological conditions at the time of the blast. On this AS 2187.2-2006 [11] notes:

11.60 "*In unfavourable meteorological conditions, it is common for airblast levels to be increased by up to 20 dBL due to the combined effects of an increase with altitude of temperature (an inversion) and/or wind velocity (windshear).*"

11.61 It should be noted that, for this reason and because of factors affecting the different aspects of air overpressure discussed in the introduction to this chapter, predictions of air overpressure should be considered indicative only.

Baseline Conditions

Site and Surroundings

11.62 The Proposed Development is located in County Galway, approximately 1.5m south-west of Belclare and 7km southwest of Tuam. The area around is predominantly rural in nature, and the closest dwellings are at Ballaghbaun to the south-east and at Knockcarigeen to the east. The nearest dwelling is approximately 590m from the Proposed Development in Ballaghbaun. There are two agricultural buildings adjacent to the quarry access road. Neither are dwellings.

11.63 The location of the Proposed Development and the nearest noise sensitive receptors are shown in Figure 11-1. The communities around the Proposed Development have been represented by eight receptor points in the noise model, at which operational noise levels are calculated. The locations of these receptor points, and the communities that they represent are set out in Table 11-7 below. All receptor points are set to 4m above ground level in the noise model.

Table 11-7
Receptor Points and Communities

Receptor Point / Community	Height Above Ground (m)	Irish Grid Coordinates	
		Easting (m)	Northing (m)
R01 - Ballaghbaun	4	537329	747877
R02 - Knockacarrigeen	4	537954	748269
R03 - Caherhugh	4	538500	747973
R04 - Belclare	4	538231	749249
R05 - Carrowbeg South	4	536724	749020
R06 - Knockma	4	535445	749390
R07 - Caltragh	4	535392	747892
R08 - Carheens	4	536164	747185

11.64 Currently, the floor of the quarry is 5 to 10 m below the surrounding land. Much of the plant and equipment is located on the quarry floor. The edge of the quarry screens the view of these items from the nearest sensitive receptors and therefore acts as a noise barrier.

11.65 In addition to residential and commercial receptors, relevant infrastructure assets are also considered. A Uisce Éireann water main, constructed in 1995, runs beneath the access road to the quarry. While it lies outside the extraction area, it has been considered in the assessment of potential vibration impacts associated with blasting activities.

EIA Noise Survey

11.66 An ambient sound survey was undertaken during the afternoon of 30 May 2024 to confirm the operational noise levels from the existing quarry.

11.67 The measurements were conducted by S Williams MIOA. The weather during the survey was dry with a moderate wind blowing from a northerly direction (i.e. from the quarry to the residential properties in Ballaghbaun.

11.68 The noise monitoring and the interpretation of acquired data conformed to the following standards:

- International Standard (ISO 1996-1: 2003E) Acoustics – Description, measurement and assessment of Environmental Noise. Part 1. Basic quantities and assessment procedures.
- International Standard (ISO 1996-2: 2007E) Acoustics – Description, measurement and assessment of Environmental Noise. Part 2. Determination of environmental noise levels.
- British Standard: BS 7445 Part 3: 1991 (ISO 1996-3: 1987) Description and measurement of Environmental Noise. Part 3. Guide to application to noise limits.

Equipment

11.69 A sound level meter compliant with IEC Class 1 was used to conduct the sound level measurements. The details of the equipment, and the date of the last periodic verification undertaken in an accredited laboratory are set out in Table 11-8:

Table 11-8
Noise Monitoring Equipment and Periodic Verification Dates

Equipment	Make	Model	Serial Number	Date of Last Periodic Verification
Sound level meter	RION	NL-52	520928	2022-08-01
Preamplifier	RION	NH-25	11775	2022-08-01
Microphone	RION	UC-59	21325	2022-08-01
Wind shield	RION	WS-10	N/A	
Field calibrator	RION	NC-75	35270130	2023-07-14

11.70 For all of the survey equipment the most recent periodic verification was conducted within the preceding 24 months of the survey.

11.71 The equipment was checked with a field calibrator before and after the measurements. The field calibration record is presented in Table 11-9 below.

Table 11-9
Field Calibration Record

Date and time	Calibrator reference level (dB)	Free-field correction for microphone (dB)	SLM reading before adjustment (dB)	Adjustment (dB)	SLM reading after adjustment (dB)
30/05/2024 12:06	94.0	0.0	93.9	0.1	94.0
30/05/2024 14:51	94.0	0.0	94.0	0.0	94.0

11.72 Very little variation was observed between the initial and final field calibration, and these results do not raise any concerns about the functioning of the equipment.

Measurement Locations

11.73 Two sound level measurement locations were selected as shown in Figure 11-1. Table 11-10 below provides descriptions of the measurement locations.

Table 11-10
Noise Monitoring Locations

Location identifier:	NMP01	NMP02
GPS coordinates:	53.479047 -8.94754	53.477156 -8.941542
GPS coordinates precision (m):	8.84	4.57
Height above ground (m):	1.50	1.30
Description of location:	Farmland adjacent to quarry entrance. Not directly representative of a noise sensitive receptor.	Property on south side of unnamed road L2112, close to the site access road junction.
Briefly describe the location around the measurement (e.g. rural, urban):	Rural sheep farm. Low stone walls. Open grassland.	Measurement on driveway. Rural surroundings but main road in front.
What type of ground is the measurement on?	Grass (soft ground)	Asphalt (hard ground)
Purpose of measurements:	Ambient sound level	Ambient sound level
Is the location free-field or facade incident?	Free-field: 3.5m or more from reflecting surface	Free-field: 3.5m or more from reflecting surface
Distance from the nearest vertical reflecting surface:	4 m	>4 m

Brief description of measurement location:	Measurement on open grassland approximately 4m from stone walls/gate in corner of field.	Corner of driveway over 4m from any vertical reflecting walls.
Brief description of dominant sounds at location during measurements:	Tarmac plant. Crusher. Vehicle movements and tipping. Fairly constant and well above baseline. Some noise from wind but not affecting measured levels much. Tend towards about 55 dB(A) in lulls.	Road traffic and quarry noise. Tarmac and crusher both audible. Wind from quarry towards measurement point but less exposed than NMP01.
Acoustic Character (Impulsive/Tonal/Intermittent)	Broadband noise from fixed plant with occasional bangs.	Quarry noise audible but not intrusive. Noise broadband in character without any distinctive acoustic characteristics.

Photo of Position NMP01:

Photo of Position NMP02

Measured Noise Levels

11.74 The measured sound level at NMP01 are shown in Table 11-11 below. The overall value was around 59 dB $L_{Aeq,30\text{-}min}$, although this reduced during the lulls, which indicates that wind noise at the microphone was increasing the measured level. The sound levels during the lulls, which is considered representative of the quarry at this location, which is much closer to the quarry boundary than the closest residential property trended towards 57 dB L_{Aeq}. The time history and summary data for this measurement are presented below:

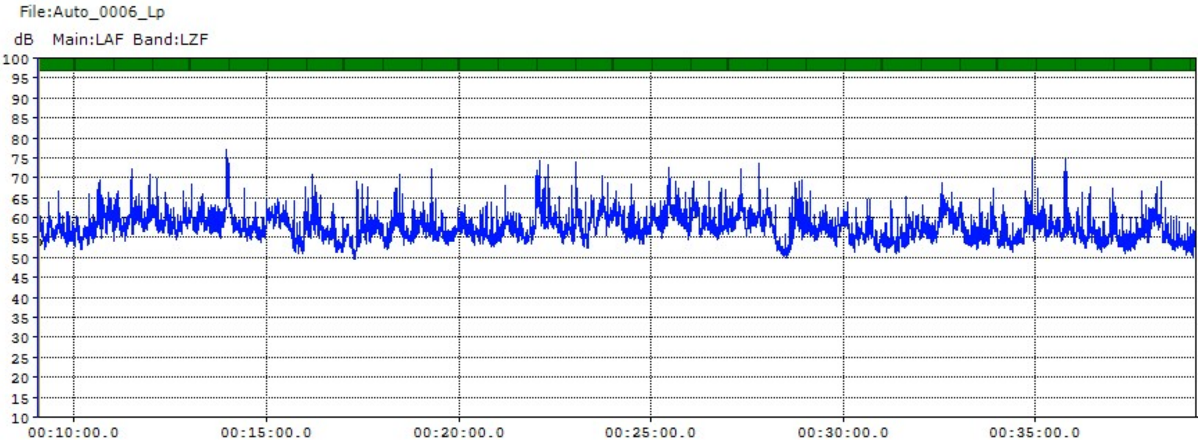


Table 11-11
Summary of Measured Noise Levels at NMP01

Start Time	Duration (T)	$LA_{eq,T}$ (dB)	$L_{AFmax,T}$ (dB)	$L_{A10,T}$ (dB)	$L_{A90,T}$ (dB)	Over	Under
30/05/2024 12:10	05:00	59.9	75.0	62.2	55.8	-	-
30/05/2024 12:15	05:00	58.0	70.0	60.7	53.4	-	-
30/05/2024 12:20	05:00	59.4	72.9	61.9	54.6	-	-
30/05/2024 12:25	05:00	59.8	73.8	62.2	55.3	-	-
30/05/2024 12:30	05:00	57.9	74.1	60.7	53.5	-	-
30/05/2024 12:35	04:13	57.3	72.9	59.8	53.0	-	-
Overall	29:13	58.9	75.0	61.5	53.8	-	-

11.75 The ambient sound environment at NMP02 was dominated by local traffic on the L2112 local road and the measured levels are shown in Table 11-12 below. Each of the peaks on the time history graph below represent a vehicle on the local road. However, between the vehicle pass-bys, noise from the quarry operations were audible. As this was present at all times, and remained reasonably constant, then it is well represented by the L_{A90} parameter which is not affected by short duration sound events. A rule of thumb often used in such situations to provide a conservative (over) estimate of the likely operational noise is to add 2 dB to the measured L_{A90} value to estimate the L_{Aeq} value, which results in a contribution from the quarry of approximately 51 dB L_{Aeq}.

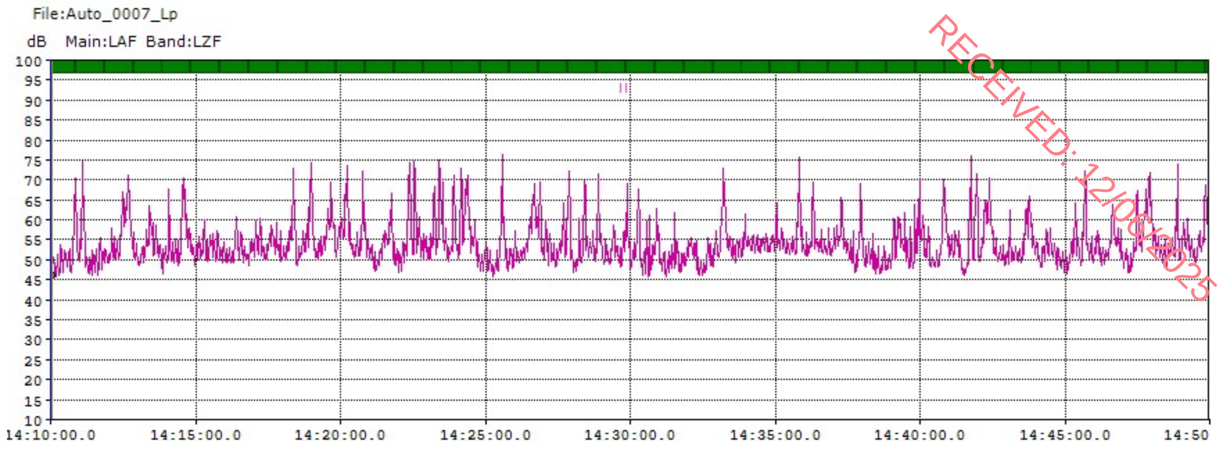


Table 11-12
Summary of Measured Noise Levels at NMP02

Start Time	Duration (T)	$L_{Aeq,T}$ (dB)	$L_{AFmax,T}$ (dB)	$L_{A10,T}$ (dB)	$L_{A90,T}$ (dB)	Over	Under
30/05/2024 14:10	05:00.0	57.3	74.7	60.0	48.1	-	-
30/05/2024 14:15	05:00.0	56.9	74.6	58.1	50.4	-	-
30/05/2024 14:20	05:00.0	61.0	75.7	64.6	49.4	-	-
30/05/2024 14:25	05:00.0	58.6	76.5	60.2	48.7	-	-
30/05/2024 14:30	05:00.0	55.3	73.2	55.4	47.7	-	-
30/05/2024 14:35	05:00.0	57.4	75.9	58.1	48.9	-	-
30/05/2024 14:40	05:00.0	58.0	76.0	60.3	49.1	-	-
30/05/2024 14:45	05:00.0	58.5	74.2	61.5	49.4	-	-
Overall	40:00.0	58.2	76.5	59.8	**48.9**	-	-

Historic Operational Noise Levels

11.76 The results of historic sound measurements are presented in Table 11-13 below. Position N2 is the same as position NMP02 detailed above, but position N1 differs slightly being closer to the access road (beside the agricultural building) where the access road splits (Irish Grid

Coordinates 537236, 748207). This position was occupied by a vocal herd of sheep during the EIA noise survey, which made it unsuitable for measurements.

Table 11-13
Summary of Historic Noise Measurements

Location	Date	Time	L_{Aeq} dB	L_{A10} dB	L_{A90} dB	Impulsive/ Tonal	Notes
N1	12/09/2022	13:56-14:56	48	49	37	No	Crusher and mobile plant with reversing sirens operating on site audible at 35-45 with some rockfall/loading sounds at up to 50 dBA, 18 trucks entered or exited the quarry at up to 75 dBA. Traffic noise from the L2112 at 35-45 dBA.
N2	12/09/2022	15:01-16:01	46	48	37	No	Quarry crusher, mobile plant and reversing sirens audible at 35-45 dBA with occasional rockfall sounds at up to 55 dBA. Trucks on quarry road at 50-60 dBA. 14 trucks entered or exited the access road. Passing traffic on the L2112 at 60-70 dBA paused out where possible, distant traffic at 40-50 dBA. Quarry crusher, mobile plant and reversing sirens audible at 35-45 dBA with occasional rockfall sounds at up to 55 dBA. Trucks on quarry road at 50-60 dBA. 14 trucks entered or exited the access road. Passing traffic on the L2112 at 60-70 dBA paused out where possible, distant traffic at 40-50 dBA.
N1	08/05/2024	12:06-13:06	52	53	43	No	Activity from the quarry including crusher and mobile plant with reversing sirens operating on site audible at 45-50 approx with some rockfall/loading sounds at up to 55 dBA approx. Trucks on the quarry road at up to 72 dBA. Some traffic noise from the L2112 at 35-45 dBA. Sheep in nearby field at 40-50 dBA occasionally.

Location	Date	Time	L_{Aeq} dB	L_{A10} dB	L_{A90} dB	Impulsive/ Tonal	Notes
N2	08/05/ 2024	12:11-13:11	47	50	38	No	Quarry crusher, mobile plant and reversing sirens audible at 40-45 dBA approx. with occasional rockfall/loading sounds at up to 50 dBA. Trucks entering and exiting quarry road at 50-60 dBA. approx . Passing traffic on the L2112 at 55-65 dBA.

Blasting Vibration and Air Overpressure Records

11.77 Table 11-14 below sets out historic measurements of blasting air overpressure and vibration. The measurement position was close to NMP02, but at the property on the opposite (north) side of the L2112.

Table 11-14
Summary of Historic Blasting Measurements

Date	Air Overpressure dB(L)	PPV Horizontal (mm/s)	PPV Traverse (mm/s)	PPV Vertical (mm/s)
30/03/2018	123	0.80	0.60	0.50
22/06/2018	114	0.64	0.64	0.51
29/08/2018	118	1.01	0.63	0.63
05/10/2018	122	1.00	0.80	1.00
14/12/2018	115	1.40	0.70	0.80
01/02/2019	110	0.63	0.95	0.63
10/04/2019	115	0.82	0.82	0.57
17/06/2019	116	1.84	0.76	0.57
20/11/2019	107	0.76	0.69	0.82
2020 Q1	110	0.63	0.95	0.63
2020 Q2	115	0.82	0.82	0.57
2020 Q3	116	1.84	0.76	0.57
2020 Q4	107	0.76	0.69	0.82
2021 Q1	110	0.63	0.95	0.63
2021 Q2	115	0.82	0.82	0.57

Date	Air Overpressure dB(L)	PPV Horizontal (mm/s)	PPV Traverse (mm/s)	PPV Vertical (mm/s)
2021 Q3	116	1.84	0.76	0.57
2021 Q4	107	0.76	0.69	0.82
23/02/2022	<125	<.5	<.5	<.5
27/05/2022	110	1.72	0.89	0.70
23/08/2022	125	1.59	1.21	0.76
24/11/2022	112	0.83	0.70	0.64
03/02/2023	120	1.40	0.76	1.14
18/07/2023	<100	<0.5	<0.5	<0.5
22/09/2023	121	0.76	0.69	0.82

Quarry Design and Operation

Planning conditions

11.78 The extant quarry planning conditions require monitoring of noise and vibration:

- Condition 5 of ABP Ref: PL07.222783 requires periodic noise monitoring.
- Condition 10 of ABP Ref: PL07.222783 requires groundborne vibration and air overpressure monitoring of blasts carried out at the quarry site.

Environmental Management System

11.79 The quarry site has an established Environmental Management System in operation. Noise and blast monitoring is carried out on a regular basis, to demonstrate that the development is not having an adverse impact on the surrounding environment.

Operational Noise Control Measures

11.80 EPA guidance sets out specific control measures that may be considered BAT for the quarrying and mining sector. The quarry currently implements the following recommended control measures, wherever practical:

- Sequencing of site workings/activities to maximise screening by natural topography;
- Locating haul roads, wherever possible, so they are screened by natural topography or stockpiles;
- Minimising road gradients to avoid low gear/high revving of vehicles;
- Using low profile plant which minimises overall height to maximise the screening effects of topography or stockpiles;
- Minimising drop heights;
- Using rubber (or other resilient materials) linings in chutes, dumpers, trucks and at other transfer points to reduce the noise caused by rock impacting upon metal surfaces;
- Limiting the use of certain noisy items of plant;
- Limiting the number of plant operating simultaneously;
- Maintaining equipment well to ensure noise emissions are not elevated;
- Using broadband (also known as 'white noise') reversing alarms, those which adjust to the ambient noise level, or directional modulated alarms where safety permits;
- Effective traffic management which might include:
  - Minimising the number of vehicles that area active on site at any one time;
  - Ensuring regular maintenance of vehicles and periodically assessing their noise emissions;
  - Ensuring that vehicles are parked as far as possible from noise sensitive areas;
  - Maintaining road surfaces;
  - Switching off idling engines where possible and preventing excess revving;
  - Educating drivers on noise disturbance and positive behaviours; and,
  - Minimising early morning and late evening operational hours.
- Developing good relations and communications with neighbouring residents;

- Using buildings to contain noise from fixed plant and/or noisy activities;
- Fitting silencing equipment (e.g. baffles or muffles) to plant and equipment;
- Using acoustic screens or enclosures around plant;
- Ensuring doors, windows and hatches to noisy process areas are properly sealed and closed; and,
- Effectively recording and investigating all noise complaints.

11.81 The quarry operator will continue to implement these control measures, where practicable, in respect of the future operation of the quarry.

Blasting Vibration and Air Overpressure Control Measures

11.82 Existing blasting mitigation measures currently implemented out at the quarry site include:

- Blasting occurs approximately once every three months.
- Blasting only during the hours of 09:00 to 18:00 during Monday to Friday. No blasting takes place at the weekend or during public holidays (as recommended in EPA guidance [5]);
- Geological characteristics are included in the blast design,
- The blast design is optimised along the rock-face and features adequately spaces charges;
- Air overpressure is minimised through proper blast design, spacing and timing of multiple charges;
- Blast monitoring is undertaken at a position representative of the nearest occupied dwelling for each blast carried out on site;
- Nearby residents are informed prior to planned blasting schedule through house-calls.

11.83 The quarry operator will continue to implement these control measures, where practicable, in respect of the future operation of the quarry.

Assessment of Likely Impacts and Effects

Operational Noise

11.84 A comparison of the predicted operational noise levels for the existing quarry and Proposed Development against the EPA recommended Emission Limit Value are set out in Table 11-15 below.

11.85 The predicted levels at the two noise monitoring locations used during the EIA noise survey are also included, to provide a sense check of the model against measured levels.

Table 11-15
Predicted Operational Noise Levels vs EPA Emission Limit Value, dB $L_{Aeq-1hr}$

Receptor	EPA ELV	Predicted Level		Excess over ELV*	
		Existing Situation	Proposed Development	Existing Situation	Proposed Development
R01 - Ballaghbaun	55	53.6	49.2	-1.4	-5.8
R02 - Knockacarrigeen	55	48.1	43.7	-6.9	-11.3
R03 - Caherhugh	55	43.5	39.5	-11.5	-15.5
R04 - Belclare	55	39.7	35.2	-15.3	-19.8
R05 - Carrowbeg South	55	43.8	39.8	-11.2	-15.2
R06 - Knockma	55	30.2	27.4	-24.8	-27.6
R07 - Caltragh	55	32.7	29.9	-22.3	-25.1
R08 - Carheens	55	43.3	42.5	-11.7	-12.5
NMP01 (EIA Survey Position)	N/A	57.4	55.4	N/A	N/A
NMP02 (EIA Survey Position)	N/A	50.7	46.9	N/A	N/A

* Negative numbers indicate predicted operational noise levels are less than the ELV

11.86 The predicted operational noise levels for the existing situation are very similar to those measured during the EIA noise survey. It can also be seen that the noise levels predicted at all communities are below the EPA recommended ELV of 55 dB $L_{Aeq,1\text{-}hour}$ for both the existing and future operations.

11.87 The operational noise modelling reveals that as the quarry floor is lowered, the barrier effect of the quarry edge improves which will lead to reduced noise levels at surrounding receptors in the future. Therefore continued operation of the quarry will result in lower quarry noise levels than are currently observed at Ballaghbaun and the other nearby settlements.

Blasting Vibration

11.88 A prediction of blast vibration using the methodology set out in Australian Standard Explosives—Storage and use Part 2: Use of explosives [11] based on a MIC of 250 kg and typical site and rock constants results in a PPV of 4.7 mm/s. This is well below the EPA's recommended ELV of 12 mm/s PPV which applies in any single axis (for vibration with a frequency of less than 40 Hertz).

11.89 Blasting has been undertaken at the quarry for many years, and the quarry operator has confirmed that a MIC of 200 kg is more typical for blasts. The prediction above is therefore likely to be an over-estimate of the vibration caused by most blasts.

11.90 This is confirmed by the vibration level measured during a blast at the closest property to the quarry in Ballaghbaun (near receptor position R01 on Figure 11-1). The vibration meter recorded a peak particle velocity of 1.59 mm/s PPV (vector sum), with a dominant frequency of 28.4Hz. This is also well below the EPA's recommended ELV of 12 mm/s PPV.

11.91 The quarry operator does not propose any significant changes to the MIC or any other aspects of their blasting regime as a result of continuing the use of the quarry. The location of blasts will not get closer to any of the receptors around the quarry. It is therefore unlikely that any significant adverse effects due to blasting vibration will occur as a result of the Application Site.

11.92 It is noted that a Uisce Éireann water main runs beneath the access road to the quarry, outside the extraction area. In relation to underground services, BS 5228-2 [14] provides the following advice:

11.93 "Some statutory undertakers have introduced criteria governing the maximum level of vibrations to which their services should be subjected. These criteria are usually conservative and it is recommended that the following limits be used in the absence of specific criteria from the undertakers:

a) maximum PPV for intermittent or transient vibrations 30 mm·s−1;

b) maximum PPV for continuous vibrations 15 mm·s−1.

11.94 Criteria should be applied at the nearest point to the source or activity.

11.95 Even a PPV of 30 mm·s−1 gives rise to a dynamic stress which is equivalent to approximately 5% only of the allowable working stress in typical concrete and even less in iron or steel.

11.96 In the event of encountering elderly and dilapidated brickwork sewers, the base data should be reduced by 20% to 50%. For most metal and reinforced concrete service pipes, however, the values in a) and b) are expected to be quite tolerable."

11.97 Blast vibration monitoring has been undertaken at the site as part of the original grant of permission (PL07.222783, 2007), and no vibration-related impacts on the water main have been recorded during the quarry's operation to date. This infrastructure has only been in place since 1995 and therefore is unlikely to be in an 'elderly and dilapidated' condition. Therefore the continuation of current blasting practices and the adoption of the 30 mm/s criteria for intermittent vibration at the water main in the site's blast design and vibration management protocols, will ensure that the integrity of the water main and nearby Uisce Éireann assets is maintained.

Blasting Air Overpressure

11.98 A prediction of air overpressure due to blasting has been undertaken in accordance with the method set out in AS 2187.2-2006 [11]. The calculations assume a distance of 490 m between the blast and the receptor position, and a +20dB correction has been applied for worst case meteorological conditions. The predicted air overpressure level is 124.1 dB(Lin) which is just below the 125 dB (Lin) ELV set out in '*Environmental Management in the Extractive Industry - Non-Scheduled Minerals*' [5].

11.99 The measurement of air overpressure during a blast on 23/08/2022 in Ballaghbaun (near receptor R01 on Figure 11-1) recorded a level of 125.5 dB(Lin). This is marginally above the ELV, but the ELV is stated in terms of a 95% confidence level, and so 5% of blasts may exceed this value. An air overpressure of around 125 dB(Lin) would be experienced as a gust between Beaufort scales 3 and 4, lasting a few seconds. It is far below the level at which damage may occur to windows [14].

Restoration Noise

11.100 Noise levels from restoration activities at the quarry are likely to be lower than those expected from the operation of the quarry, due to the absence of the rock drill, minerals processing equipment (crushers and screens), the concrete plant and the tarmac plant. The heavy plant utilised for the restoration activities is likely to be similar to the heavy plant currently used for material extraction (primarily excavators, dumper trucks and bulldozers).

11.101 It is therefore unlikely that any significant adverse effects would occur as a result of the restoration activities.

Assessment of Cumulative Effects

11.102 A second quarry, formerly operated by another company (McTigue Quarries Limited), is located immediately to the north of the Proposed Development. This quarry is smaller in scale and situated further from Ballaghbaun. At the time of the EIA noise survey, the McTigue quarry was not operational and no noise from this location was audible at monitoring positions NMP01 or NMP02.

11.103 As there is no indication that the McTigue quarry will resume operations in the short term, no change in operational noise levels from that site is anticipated. Given that this quarry is not currently a contributing noise source at Ballaghbaun, and that the Proposed Development is implementing improved noise management measures, the overall cumulative quarry noise at Ballaghbaun and other nearby receptors is expected to decrease.

Additional Mitigation

Enquiries and Complaints Procedure

11.104 The operator shall record complaints of noise, air overpressure or vibration from any party, and these shall be reported direct to the Environment Section of the Local Authority. The operator shall complete its own Complaint Form, which shall set out the actions and response time, including findings of an investigation.

11.105 Upon receipt of a complaint, the operator shall initiate an investigation into the cause of the complaint within an adequate time-frame and, where appropriate, provide details of corrective action taken. Copies of all complaints are maintained at the quarry and shall be provided to the Environment Section of the local Authority as part of on-going quarterly reports.

Blasting Vibration Control Measures

11.106 To limit ground vibration from blasting the operator shall undertake the following actions.

- Maximise the use of free faces and apply caution to less common situations such as at corners of benches where blasts may be more constrained.
- Ensure the burden is appropriate to avoid over-confinement of charges;
- Undertake detailed rock face surveys, checking the setting out of holes and record any deviations; on the basis of these observations revise the blast design if necessary.
- Reduce to a practical minimum the Maximum Instantaneous Charge (MIC) through the use of decked or sequenced charge configurations, minimising bench height and hole depth, and reducing borehole diameters.
- Ensure that blast design incorporates appropriate safety margins.
- Continue monitoring blast induced vibration at the closest properties.

Air Overpressure Control Measures

11.107 The operator will reduce the impacts due to air overpressure from blasting to a practicable minimum by undertaking the following steps. These are primarily related to reducing the Gas Release Pulse (GRP) and Stemming Release Pulse (SRP) which are the most controllable factors in air overpressure:

- Continue to monitor air overpressure at the closest properties to inform future blast designs.
- Record the depths and thicknesses of any geologic anomalies encountered while drilling and ensure that this information is provided to the blaster.
- Take face burden measurements and view the face before hole loading begins.
- Optimise the placement of explosives within boreholes to reduce air overpressure, accounting for areas of localised weaknesses in the rock strata, including joints, fissures and overbreak from a previous blast.
- Ensure that suitable stemming material (e.g. angular chippings) of sufficient thickness and a good burden-to-hole depth ratio are employed. Drilling fines shall not be used as a stemming material.
- Select the detonation technique which will result in the least air overpressure for each blast; this will normally be an in-hole initiation method. The use of surface detonating cord shall be avoided apart from in the unusual situation that it is required for safety or

technical reasons. If the use of surface detonating cord is unavoidable then exposed lengths shall be covered with as much material as possible.

- Secondary blasting shall be avoided wherever possible; where it is absolutely necessary, the pop-shooting method shall be used in preference to the mudcap method.

Training

11.108 The operator shall ensure that all site personnel with responsibility for operating plant and machinery shall be made aware of the noise, vibration and air overpressure hazards, and the mitigation measures relevant to the contracted works during the site induction. In particular, the working methods required by this Operator's Blasting Management Plan, and the relevant planning conditions shall be understood by all relevant personnel.

11.109 Induction training shall as a minimum include noise and vibration information on:

- Construction hours;
- Emergency works resulting in out of normal working hours;
- Sensitive receivers; and,
- Control measures required by the relevant planning conditions, and the operators Blasting Management Plan.
- These working methods shall be integrated into all relevant working method statements and risk assessments.

11.110 Toolbox talks shall be delivered to remind all site personnel of the requirements on a regular basis.

Record Retention

11.111 Records of blasting vibration and air overpressure monitoring should be maintained for an appropriate period (often 7 years). The records should include: the time and date of the measurement, details of the monitoring location, a description of the monitoring equipment, calibration certificates and a summary of the measured levels.

Assessment of Residual Effects

11.112 Residual noise impacts are assessed in Table 11-16 below. Blasting vibration and air overpressure are expected to remain similar in frequency and level as they are currently. However, as the quarry is excavated deeper, the operational sound sources on the floor will be better screened by the quarry pit faces. The increased screening will reduce sound from quarry activities levels at the closest dwellings, resulting in a positive impact compared to the current situation.

Table 11-16
Recommended Emission Limit Values

Aspect	Category	Description	Assessment
Frequency	Continuous	Present for extended periods	←
	Intermittent	Present at intervals	
	Occasional	Extended absences	
Duration	Temporary	<1 year	
	Short term	1-7 years	
	Medium term	7-15 years	
	Long term	15-60 years	←
	Permanent	>60 years	
Magnitude	Micro	<10 m	
	Near zone	<100 m	
	Localised	<200 m	
	Local	<500 m	
	Community	<1000 m	←
	Distant	>1000 m	
Quantification	Imperceptible	Capable of measurement but without noticeable consequences, <3 dB	
	Slight	Causing noticeable changes in character of environment without affecting its sensitivities, 3-5 dB	←
	Noticable	Altering character of environment in manner consistent with existing & emerging trends, 6-10 dB	

	Substantial	Altering sensitive aspect(s) of environment due to character, magnitude, duration or intensity, 11-15 dB	
	Profound	Obliterates sensitive characteristics of environment, >15 dB	
Impact	Negative	Reduces quality of noise environment	
	Neutral	Noise environment remains unchanged	
	Positive	Improves noise environment	←

11.113 No significant adverse residual effects are expected due to the continued operation of the quarry and proposed storage yard considered in this assessment.

Glossary of Terms

Term	Description
1/1 Octave Band	See: Octave Bands
1/3 Octave Band	The subdivision of an octave band into three narrower frequency bands for improved frequency resolution. The upper band-edge frequency is the lower band frequency times the cube root of two.
AADT	Annual Average Daily Traffic is the average (mean) number of daily traffic movements over the course of a year on a particular section of road. A related quantity is the proportion of heavy vehicles, often expressed as a percentage of the overall AADT.
A-Weighting	The human ear demonstrates increased sensitivity at some frequencies compared to others. The A-weighting network applies filters to the signal processing of a sound level meter to mimic the response of the human ear at each frequency. The logarithmic sum of the sound levels in each frequency band after the A-weighting network has been applied is referred to as the A-weighted level.
Absorption	Whenever sound waves encounter an obstacle, such as when a sound source is placed within the boundaries of a room, part of the acoustic energy is reflected, part is absorbed, and part is transmitted. Different surfaces reflect, absorb and transmitting an incident sound wave in different proportions. Absorption relates to how much of the incident sound energy is absorbed by a material. A hard, compact, smooth surface will reflect much more, and absorb much less, sound energy than a porous, soft surface.
Acceleration	The rate at which an object changes velocity.
Accelerometer	An accelerometer is an electromechanical device that will measure acceleration forces. It is typically used to measure vibration levels.
Air Overpressure	A pressure wave in the atmosphere produced by a detonation of explosives. Air overpressure consists of both audible and inaudible energy, is measured in pascals and is normally reported in dB(lin).
Air Pressure Pulse	A component of air overpressure caused by the direct displacement of rock at the face.
Airblast	Alternate term for Air Overpressure
Ambient Sound	Defined in BS4142: 2014 as '*the totally encompassing sound associated with a given situation at a given time, usually composed of sound from many sources near or far*'.

Term	Description
Annoyance	The WHO defines health as "*a state of complete physical, mental and social wellbeing and not merely the absence of disease or infirmity*". Therefore, a high level of annoyance caused by environmental noise is often considered an environmental health burden.
APP	See Air Pressure Pulse.
AOD	Above Ordnance Datum. Height relative to the average sea level.
Attenuation	Reduction in sound pressure level.
Background Sound Level	*Defined in BS4142: 2014 as 'A-weighted sound pressure level that is exceeded by the residual sound at the assessment location for 90% of a given time interval, T, measured using time weighting F and quoted to the nearest whole number of decibels'*.
Bench	Most commonly encountered in surface mining, a bench is a horizontal ledge in or at the top of a highwall into which holes are drilled vertically (or at an incline) down into the material to be blasted. Also referred to as a '*bluff*' or '*ledge*'.
Bench height	The vertical distance between the top level of a bench and the floor of the bench.
Blast	The action of breaking and displacing rock by means of explosives, also known as a '*shot*'.
Blaster	A qualified person in charge of and responsible for a blast (including the design, loading and detonation). Also known as a '*shotfirer*'.
Blasthole	A hole drilled into rock and/or other materials within which explosives are placed. The explosives may be '*decked*' at different levels within the blast hole, and the blasthole is backfilled with stemming material after the placement of the explosives.
Blasting cap	A form of detonator incorporating a small primary explosive device initiated by a safety fuse, which is used to detonate a larger, more powerful and less sensitive secondary explosive.
Broadband	Sound energy distributed over a wide frequency range.
BSI	The British Standards Institution
Burden	In relation to blasting, 'burden' can have several meanings: (1) The distance from an explosive charge to the nearest free or open face. (2) The distance between rows of boreholes as measured perpendicular to the spacing. (3) The quantity of material to be blasted by a given hole.
Cardiovascular	Hypertension and ischaemic heart disease, including myocardial infarction

Term	Description
disease	(commonly referred to as a 'heart attack').
Centre Frequency	See: Octave Bands
Cap Shot	A secondary blasting method used to break-up boulders which are too large to manage using an explosive detonated on the surface of a rock, without the use of a borehole. The explosive placed on the boulder is usually covered with wet mud or wet earth, although it can be unconfined. Also known as an '*adobe*','*dobie*', '*bulldoze*', '*sandblast*' or '*plaster shot*'.
Class 1	The International Electrotechnical Commission (IEC) publishes IEC 61672 in three parts: • Part 1 'Specifications' published in 2013; • Part 2 'Pattern evaluation tests' published 2013; and • Part 3 'Periodic tests' published 2013. Part 1 sets out standards for two classes of sound level meter, with Class 1 having more stringent acceptance limits over a wider temperature range than Class 2.
Confinement	Constraining effect of the environment on the explosive charge. The confinement of a charge depends on the characteristics of the surrounding rock and free faces, the distance from the blasthole to the free face, the amount of rock being broken and other factors. No general system has been devised for quantifying confinement.
Corner	Where the faces of two benches orientated in different directions meet. Blasts at corners can be more constrained than blasts some way along a free face.
CRTN	Calculation of Road Traffic Noise, published by the Department of Transport Welsh Office in 1988. The procedures set out in this memorandum form the authoritative method for predicting road traffic noise levels in the UK.
dB	A scale for comparing the ratios of two quantities, including sound pressure and sound power. The difference in level between two sounds s1 and s2 is given by 20•log10(s1/s2). The decibel can also be used to measure absolute quantities by specifying a reference value that fixes one point on the scale. For sound pressure, the reference value is 20 µPa.
dB(A)	A-weighted decibel. See: A-weighting and dB.
dB(Lin)	Sound pressure level expressed in dB with the application of a flat, linear frequency weighting network. In recent years this has largely been replaced by the '*Zero*' [dB(Z)] weighting network which implies no frequency weighting, although it is still common in older texts and guidance.

Term	Description
dB(Z)	'*Zero*' weighted decibel, which was introduced in IEC 61672:2003 as a replacement for the older '*Flat*' and '*Linear*' weighting networks.
Deck (or Decking)	Vertically positioning an explosive charge within a blasthole to separate it from other explosive charges in the same borehole, using stemming material or an air cushion.
Delay	The predetermined interval of time between the sequential detonation of explosive charges.
DMRB	Design Manual for Roads and Bridges, published by Highway England (formerly the Highways Agency).
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
END	Environmental Noise Directive (END) 2002/49/EC of the European Parliament and of the Council of 25 June 2002.
Effect	IEMA [1] states that effect is the consequence of the impact and provides the following examples: *'This may be in the form of a change in the annoyance caused, a change in the degree of intrusion or disturbance caused by the acoustic environment, or the potential for the change to alter the character of an area such that there is a perceived change in quality of life. This will be dependent on the receptor and its sensitivity'*.
Equivalent continuous sound pressure level (Leq)	The notional steady sound level which, over a stated period of time, would contain the same amount of acoustical energy as the fluctuating sound measured over that period. The period of time over which this quantity is evaluated is normally added to the sub-script notation, as shown in the following examples which relate to five minutes, one hour, and eight hours respectively: $L_{eq,5min}$, $L_{eq,1\text{-}hour}$, $L_{eq,8\text{-}hours}$.
Façade (or Facade)	A side of a building.
Façade Level	Sound levels (measured or predicted) at a point one metre from a building façade, and which include the effect of noise reflected from the building. A façade level is typically 2.5-3 dB higher than would be measured at the same point in free-field conditions if no reflecting surface was present.
Face	A rock surface in open cast blasting which usually near vertical and which is exposed to air, which allows movement of the burden during a blast. Also referred to as a 'free face' or 'open face'.
FFT	See: Fast Fourier Transform
Free face	See: Face.

Term	Description
Free Field	The free field is a region in space where sound may propagate free from any form of obstruction (except for the ground).
Frequency	Sound consists of vibrations transmitted to the ear as rapid variations in air pressure. The more rapid the variations in air pressure the higher the frequency of the sound. Frequency (f) is defined as the number of pressure fluctuations per second and is expressed in Hertz (Hz). Noise is usually composed of many frequencies combined together.
Gas Release Pulse	The gas release pulse is the component of air overpressure which results from gas escaping from the detonation through rock fractures.
Geophone	Vibrographs usually detect ground vibration by means of transducers known as geophones. Historically geophones have converted ground movement into voltage fluctuations detected by the vibrograph by means of a spring mounted permanent magnet situated within a coil of fine copper wire. Some recent designs use a different principle involving microelectromechanical systems (MEMS) technology, however these can only be used in strong motion or active seismic applications.
Ground Effect	Attenuation due to the ground surface interfering with the sound propagating from the source to receptor. For downwind propagation, the characteristics of the ground surfaces near the source and receptor are of greatest importance.
GRP	See: Gas Release Pulse.
Hertz	Hertz (Hz) are the units of frequency (f), expressed as the number of pressure variation cycles per second.
Highwall	A near vertical face at the edge of a bench, bluff or ledge on a surface excavation.
Hz	See: Hertz
Impact	IEMA [1] states that impact relates to the 'd*ifference in the acoustic environment before and after the implementation of the proposals (also known as the magnitude of change). This includes any change in noise level and in other characteristics/features, and the relationship of the resulting noise level to any standard benchmarks*.'
IEC	International Electrotechnical Commission
IoA	Institute of Acoustics in the United Kingdom. See http://www.ioa.org.uk
ISO	International Organization for Standardization. See http://www.iso.org/iso/home.htm
L_{10} or L_{A10}	A noise level index representing the sound pressure level which is

Term	Description
	exceeded for one-tenth of a measurement period. When the subscript begins with the letter 'A' it denotes that the quantity is an A-weighted decibel.
L_{90} or L_{A90}	A noise level index representing the noise level exceeded for 90% of the time over the period T. The L_{90} can be considered to be the "typical minimum" noise level and is often used to describe the background noise. When the subscript begins with the letter 'A' it denotes that the quantity is an A-weighted decibel.
L_{Aeq}	A-weighted equivalent continuous sound level.
$L_{AF,Max}$	See: Maximum Sound Level
$L_{Ar,T}$	See: Rating Level
L_{eq} or L_{Aeq}	Equivalent Continuous Sound Level. When the subscript begins with the letter 'A' it denotes that the quantity is A-weighted.
LiDAR	A surveying system which uses light from a laser to map the position and height of surfaces, from which a 3D model can be created.
L_p	Sound pressure level, normally expressed relative to a reference level of 20 micro Pascals ($2x10^{-12}$ Pa).
$L_{p, peak}$	See: Peak Sound Pressure Level.
L_w	Acoustic nomenclature denoting a Sound Power Level.
Maximum Instantaneous Charge weight	The maximum weight of explosive detonated in any delay, measured in kg.
Maximum Sound Level	The maximum sound level (LAmax) is the highest time-weighted sound level measured during a short period. The time constant of the measure may either be Fast (125 ms), Slow (1 s) or Impulsive (35 ms), and it is usual to identify the time constant in the notation – e.g. L_{AFmax} indicates that the maximum sound level was measured with the fast time-weighting. The letter 'A' it denotes that the quantity is an A-weighted decibel.
MIC	See Maximum Instantaneous Charge weight.
Mudcap shot	A secondary blasting method used to break-up boulders which are too large to manage using an explosive detonated on the surface of a rock, without the use of a borehole. The explosive placed on the boulder is usually covered with wet mud or wet earth, although can be unconfined. Also known as an '*adobe*','*dobie*', '*bulldoze*', '*sandblast*' or '*plaster shot*'.

Term	Description
Octave Bands	An octave band is a frequency band where the highest frequency is twice the lowest frequency. The band is identified by the centre frequency in the range that it encompasses (e.g. the 1000 Hz band contains the sound energy of all frequencies between 707 and 1414 Hz). The ISO standard centre frequencies of the octave bands spanning the typical human hearing range are: 31.5 Hz, 63 Hz, 125 Hz, 250 Hz, 500 Hz, 1000 Hz, 2000 Hz, 4000 Hz, 8000 Hz and 16000 Hz. These values are not exact but are rounded to the nearest Preferred Number.
Overbreak	Excessive breakage of rock beyond the desired excavation limit.
Overburden	Unwanted material lying on top of a deposit to be extracted. Overburden is often earth or gravel, but can be less useful types of rock, which have to be removed to access the deposit.
Particle Velocity	The particle velocity is the velocity of a particle undergoing temporary displacement caused by a wave travelling through a medium.
Parting Blast	A blast where the explosive charge is decked within a parting (a rock mass) located between two seams of coal. A parting is usually relatively thin and this type of blast often creates a high gas release pulse caused by blast gases escaping to the face through the softer coal strata.
Peak particle velocity	The greatest instantaneous particle velocity during a given time interval.
Peak sound pressure level	Ten times the logarithm to the base 10 of the ratio of the square of the peak sound pressure, to the square of a reference value p_0 expressed in decibels. The reference value p_0 is 20 µPa.
Pop-shooting	A secondary blasting method used to break-up boulders which are too large to manage. A hole is drilled to just beyond the middle of the boulder so that the charge is central. The method is relatively quiet and economical.
PPV	See: Peak Particle Velocity
Production blast	A blast undertaken for the purpose of winning a useful quantity of the desired minerals.
Rating Level	The specific sound level from an activity plus any adjustment for the characteristic features of the noise ($L_{Ar,Tr}$).
Rock Pressure Pulse	A component of air overpressure caused by vibrating ground close to the receptor.
RPP	See: Rock Pressure Pulse
Setting out	Setting out is the accurate measurement and marking of a design on the ground using surveying instruments and setting out techniques.

Term	Description
Sound Power	Sound Power is the total sound energy radiated in all directions by an object, expressed in Watts. This quantity is rarely used as the very large range of human hearing (from 0.000000000001 watts to 100 watts or more) means Sound Power values are not practical for everyday use. Instead, the related Sound Power Level is used, as this provides the same information but in a more manageable range of values.
Sound Power Level	Sound Power Level (L_W) is a Logarithmic measure of the sound power as a relation to the threshold of hearing which is intended to make the range of sound powers encountered in environmental acoustics into a more manageable range of values (i.e. 0 to 160 dB). The sound power level expresses the Sound Power relative to a reference value (W_0) of 1 Pico Watt (10^{-12} Watts) according to the following formula: $Lw = 10 \bullet lg (W/W_0)$ dB
Sound Pressure Level	Sound pressure level uses a logarithmic scale to represent the sound pressure of a sound relative to a reference pressure, and is expressed in decibels (dB). The use of a logarithmic scale is intended to make the wide range of sound pressures encountered in environmental acoustics into a more manageable range of values (typically in the range 0 to 140 dB). The sound pressure level at the threshold of human hearing is commonly taken to be 0 dB, which corresponds to the SI reference pressure (p_0) of $2x10^{-5}$ Pa (20 µPa). The sound pressure level (L_p) is calculated according to the following formula: $Lp = 20 \bullet log10 (p/p_0)$ dB
Source height	The distance of a sound source above the local ground surface in metres, usually denoted 'h_s'.
Stemming material	An inert fill material such as angular chippings which is packed above the explosives in a blasthole to confine the gaseous products arising from the detonation.
Stemming Release Pulse (SRP)	The stemming release pulse is the component of air overpressure which results from gas escaping up the blasthole through the stemming material.
Wavelength	The distance in metres travelled by a sound pressure wave during one cycle.
Initial sound	Total sound present in an initial situation before any change to the situation occurs.
Fluctuating sound	Continuous sound whose sound pressure level varies significantly, but not in an impulsive manner, during the observation period.
Intermittent sound	Sound that is only present for some time periods (which may be regular or irregular), and the duration of each occurrence must last at least 5 seconds.

Term	Description
Impulsive sound	Sound with a sudden onset. The definition includes only the onset of the sound, and sudden is based on an auditive judgement translated to a physical measurement criterion of a rise in sound pressure level where the time history gradient exceeds 10 dB per second. Irregularities (on the onset) shorter than 50 ms are disregarded.

References

[1] Graham Parry and Martin Broderick, *Guidelines for Environmental Noise Impact Assessment*, Version 1.2. Lincoln, UK: Institute of Environmental Management & Assessment, 2014. [Online]. Available: https://www.iema.net/event-reports/2016/01/07/Launch-Webinar-IEMA-Guidelines-for-Environmental-Noise-Impact-Assesment-2014/

[2] *Environmental Protection Agency Act, 1992*. 1992. [Online]. Available: https://www.irishstatutebook.ie/eli/1992/act/7/enacted/en/html

[3] *Planning and Development Act, 2000*. 2000. [Online]. Available: https://www.irishstatutebook.ie/eli/2000/act/30/enacted/en/html

[4] *Quarries and Ancillary Activities Guidelines for Planning Authorities*. Ireland: Department of the Environment, Heritage and Local Government, 2004. [Online]. Available: https://www.opr.ie/wp-content/uploads/2019/08/2004-Quarries-and-Ancillary-Activities.pdf

[5] Tim Paul, John Sheils, Bernadette O'Regan, and Richard Moles, 'Environmental Management in the Extractive Industry - Non-Scheduled Minerals', Environmental Protection Agency, Final Report JBA 2733-JBA/UL/GSI/CTP, Apr. 2006. [Online]. Available: https://www.epa.ie/publications/research/waste/MS11-FinalProjectReport.pdf

[6] Environmental Protection Agency, *Guidance Note For Noise In Relation To Scheduled Activities*, 2nd Edition. Ireland: Environmental Protection Agency, 2006. [Online]. Available: https://www.epa.ie/publications/licensing--permitting/industrial/ied/EPA_guidance_note_noise.pdf

[7] Office of Environmental Enforcement (OEE), *Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4)*. Ireland: Environmental Protection Agency, 2016. [Online]. Available: https://www.epa.ie/publications/monitoring--assessment/noise/NG4-Guidance-Note-(January-2016-Update).pdf

[8] CAAS Ltd, *Guidelines on the information to be contained in Environmental Impact Assessment Reports*. Ireland: Environmental Protection Agency, 2022. [Online]. Available: https://www.epa.ie/publications/monitoring--assessment/assessment/EIAR_Guidelines_2022_Web.pdf

[9] Birgitta Berglund, Thomas Lindvall, and Dietrich H Schwela, Eds., *Guidelines for Community Noise*. Geneva, Switzerland: World Health Organization, 1999. Accessed: Apr. 23, 2017. [Online]. Available: http://www.who.int/docstore/peh/noise/guidelines2.html

[10] British Standards Institution, *BS 5228-1:2009+A1:2014 - Code of practice for noise and vibration control on construction and open sites. Noise*. London, UK: British Standards Institution, 2014. Accessed: Dec. 12, 2016. [Online]. Available: http://shop.bsigroup.com/ProductDetail/?pid=000000000030258086

[11] Standards Australia Committee CE-005, *AS 2187.2-2006 Explosives - Storage and use - Use of explosives*. Australia: Standards Australia, 2006.

[12] Dowding, Charles H, *Construction Vibrations*, 2nd ed. Ohio, United States of America: International Society of Explosives Engineers, 2000.

[13] Watanabe, Toshio and Møller, Henrik, 'Low Frequency Hearing Thresholds in Pressure Field and in Free Field', *J. Low Freq. Noise Vib. Act. Control*, vol. 9, no. 3, pp. 106--115, 1990, Accessed: Jul. 16, 2017. [Online]. Available: http://journals.sagepub.com/doi/abs/10.1177/026309239000900303

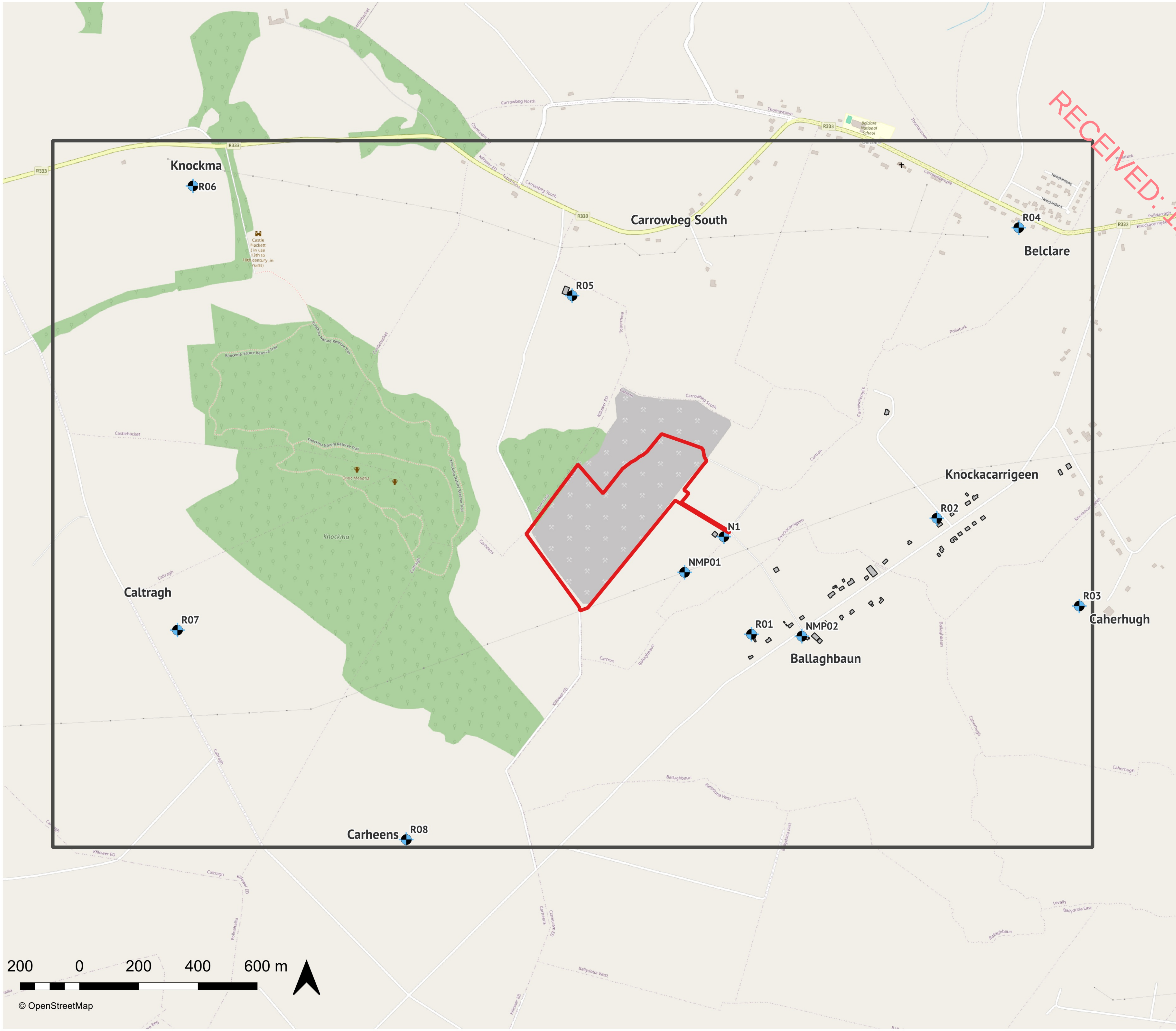
[14] British Standards Institution, *BS 5228-2:2009+A1:2014 - Code of practice for noise and vibration control on construction and open sites. Vibration*. London, UK: British Standards Institution, 2008. Accessed: Dec. 13, 2016. [Online]. Available: http://shop.bsigroup.com/ProductDetail?pid=000000000030258089

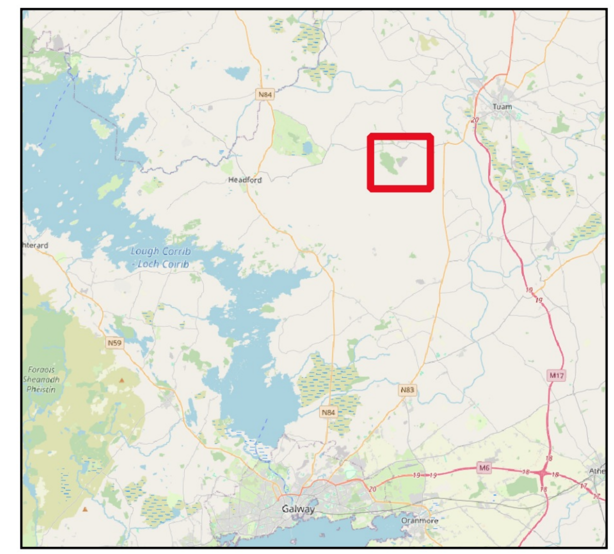
[15] International Society of Explosives Engineers, *ISEE Blaster's Handbook, 18th Edition*, 18th ed. Ohio, United States of America: International Society of Explosives Engineers, 2011. Accessed: Oct. 25, 2016. [Online]. Available: https://www.isee.org/publications/blasters-handbook

[16] ICI Australia Operations. ICI Explosives., *Handbook of Blasting Tables*. Victoria, Australia: Deer Park, 1990.

FIGURE 11-1

Legend
- Application Boundary
- Operational Noise Study Area
- Noise Assessment Locations





Rev.	Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd
1	1/5/2025	First Issue	SW	LW	XXX	XXX

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Client	Quarry Consulting Limited
Project	Mortimer's Quarry, Tuam
Drawing Title	Noise Study Area and Noise Sensitive Receptors
Drawing Status	Issued
Scale @ A3	1:12,500 DO NOT SCALE
Project No.	A030.01
Client No.	
Drawing No.	Figure 11-1

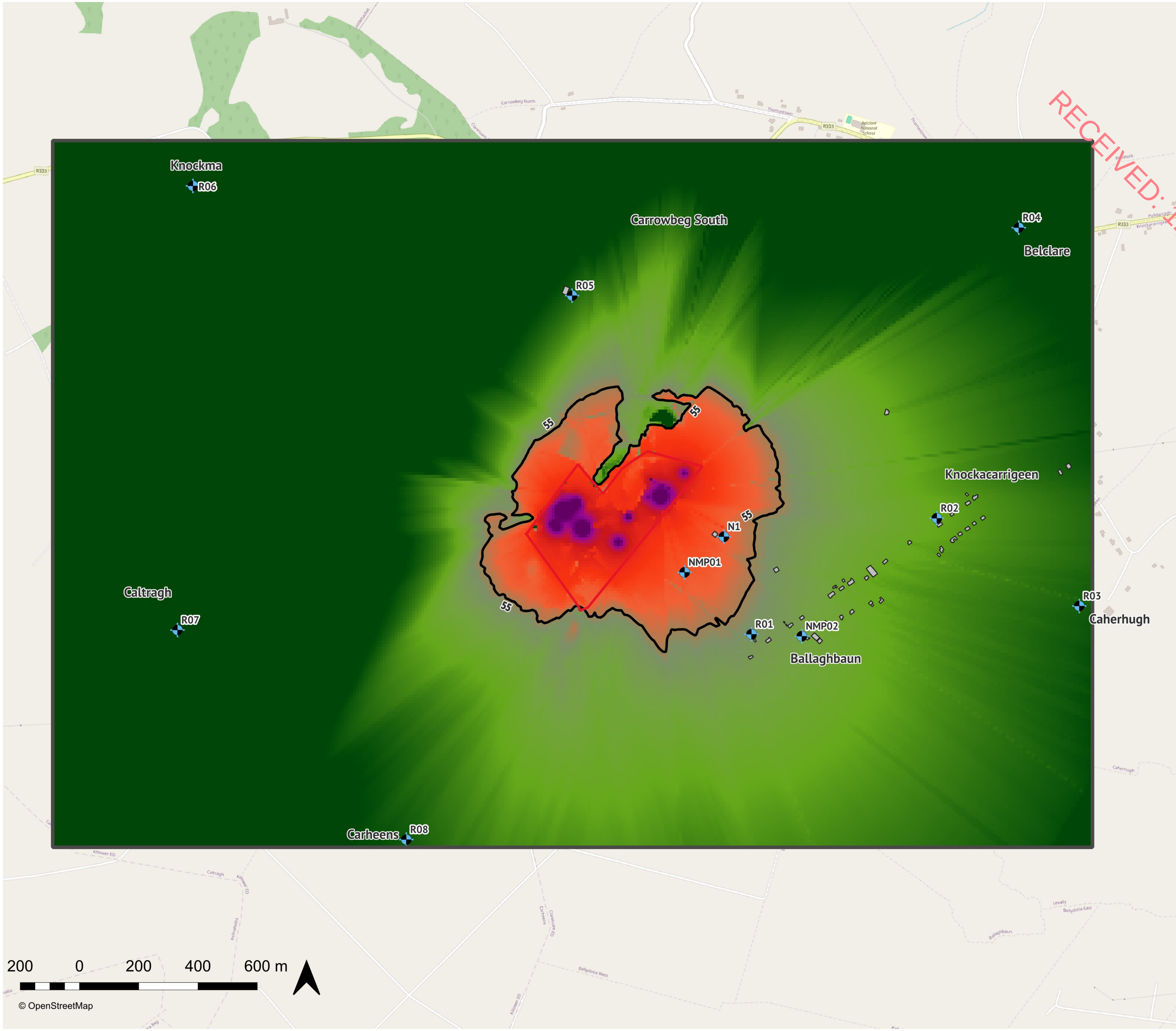
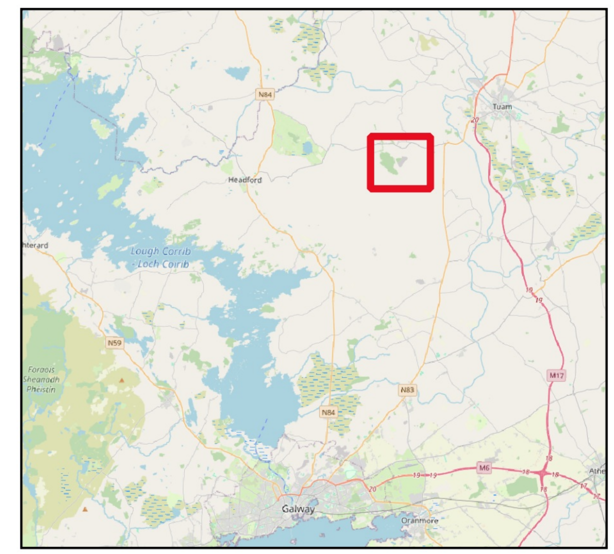


FIGURE 11-2

Legend

- Application Boundary
- Operational Noise Study Area
- Existing Operational Noise Levels
  - dB LAeq,1-hour
  - 81
  - 42
- ELV 55 dB LAeq,1-hour Contour



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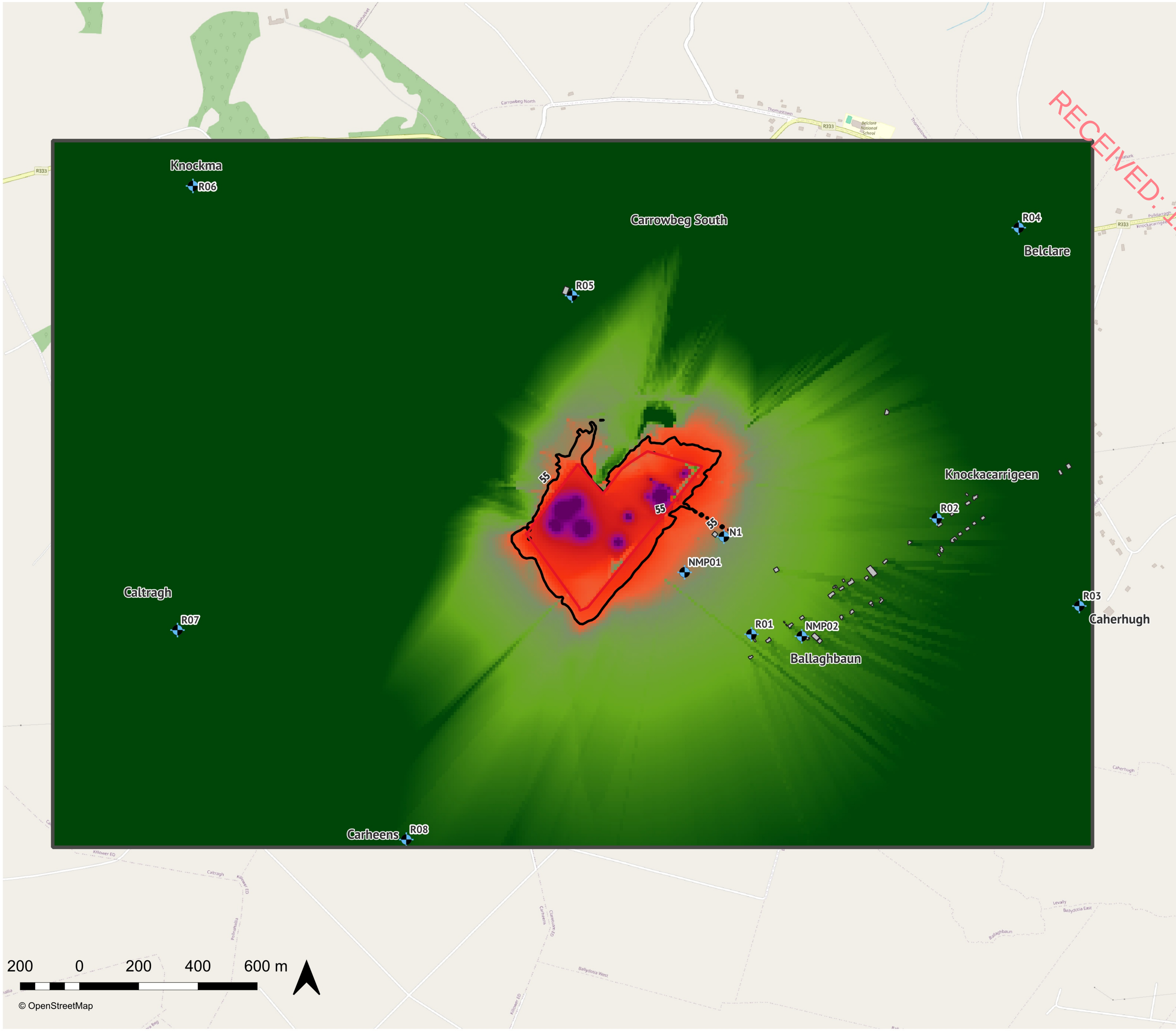
Project	Mortimer's Quarry, Tuam
Drawing Title	Operational Noise Model Existing Scenario
Drawing Status	Issued
Scale @ A3	1:12,500 — DO NOT SCALE
Project No.	A030.01
Client No.	
Drawing No.	Figure 11-2

FIGURE 11-3



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Project

Mortimer's Quarry, Tuam

Drawing Title

Operational Noise Model
Proposed Scenario

Drawing Status

Issued

Scale @ A3	1:12,500	DO NOT SCALE
Project No.	A030.01	
Client No.		
Drawing No.	Figure 11-3	