9

NOISE

9 NOISE

9.1 INTRODUCTION

This remedial Environmental Impact Assessment Report (rEIAR) has been prepared to accompany a substitute consent application for an existing quarry over approximately 71.9 hectares (ha.) located in the townlands of Philipstown and Redbog, Co. Kildare (the Development). The Development is located within the administrative boundary of Kildare County Council, (KCC).

This chapter of the rEIAR has been prepared by WSP Ireland Consulting Ltd (WSP) and assesses the potential noise impacts associated with the Development during the assessment period, (September 2020 to present).

The following assessment was prepared by Kevin McGillycuddy (BA (Mod), MSc), and Simon Faircloth (PGDip MIOA). Kevin is a Practitioner Member of the Institute of Environmental Management and Assessment and has more than 11 years' experience in environmental consultancy. Simon is a Corporate Member of the Institute of Acoustics and has over 17 years' experience in acoustic consultancy.

9.1.1 TECHNICAL SCOPE

The EIA Directive (Directive 2011/92/EU, as amended by Directive 2014/52/EU), requires that a description of the likely significant effects of the project on the environment resulting from the emission of pollutants noise and vibration. Given the retrospective nature of this rEIAR the scope of this section is a review of monitoring records of operations that occurred at the Development.

9.1.2 EFFECTS SCOPED OUT

Following the expiration of the KCC Reg. Ref.: 07/267 permission in September 2020, a decision was made by the Applicant to abstain from blasting activities in order to avoid potential environmental and social impacts associated with the process. Given the absence of blasting operations during the assessment period, (September 2020 to present), the assessment of vibration from blasting has been scoped out of this rEIAR.

For reference purposes the vibration monitoring records (monitored during every blast on Site) from February 2018 to August 2020 have been provided in Section 9.4.2 of this assessment.

9.1.3 GEOGRAPHICAL AND TEMPORAL SCOPE

The geographical study area for the assessment covers the EIA site boundary (Site) (identified on Figure 9-1) and a buffer zone of 500 m from the EIA boundary (i.e. the study area), because most potential effects noise emissions from the Development are anticipated to occur within this area. This area includes the receptors anticipated to be impacted by quarry operations. The closest receptors are located approximately 230 metres northeast of the EIA boundary. Representative Noise Sensitive Receptors (NSRs) considered within this assessment are shown in Figure 9-1 and are listed in Table 9-1.

In the context of the rEIAR, the Site boundary contains lands which form the existing quarry site and some areas which extend beyond the working areas. The substitute consent (the Planning Application) boundary is shown on the drawing set which accompanies the planning application.

The baseline for this rEIAR has been set to September 2020, and the rEIAR process has assessed environmental impacts from that date to the present. This assessment period equates to approximately three and a half years and is identified as 'short-term' duration (those lasting one to seven years), (EPA, 2022).

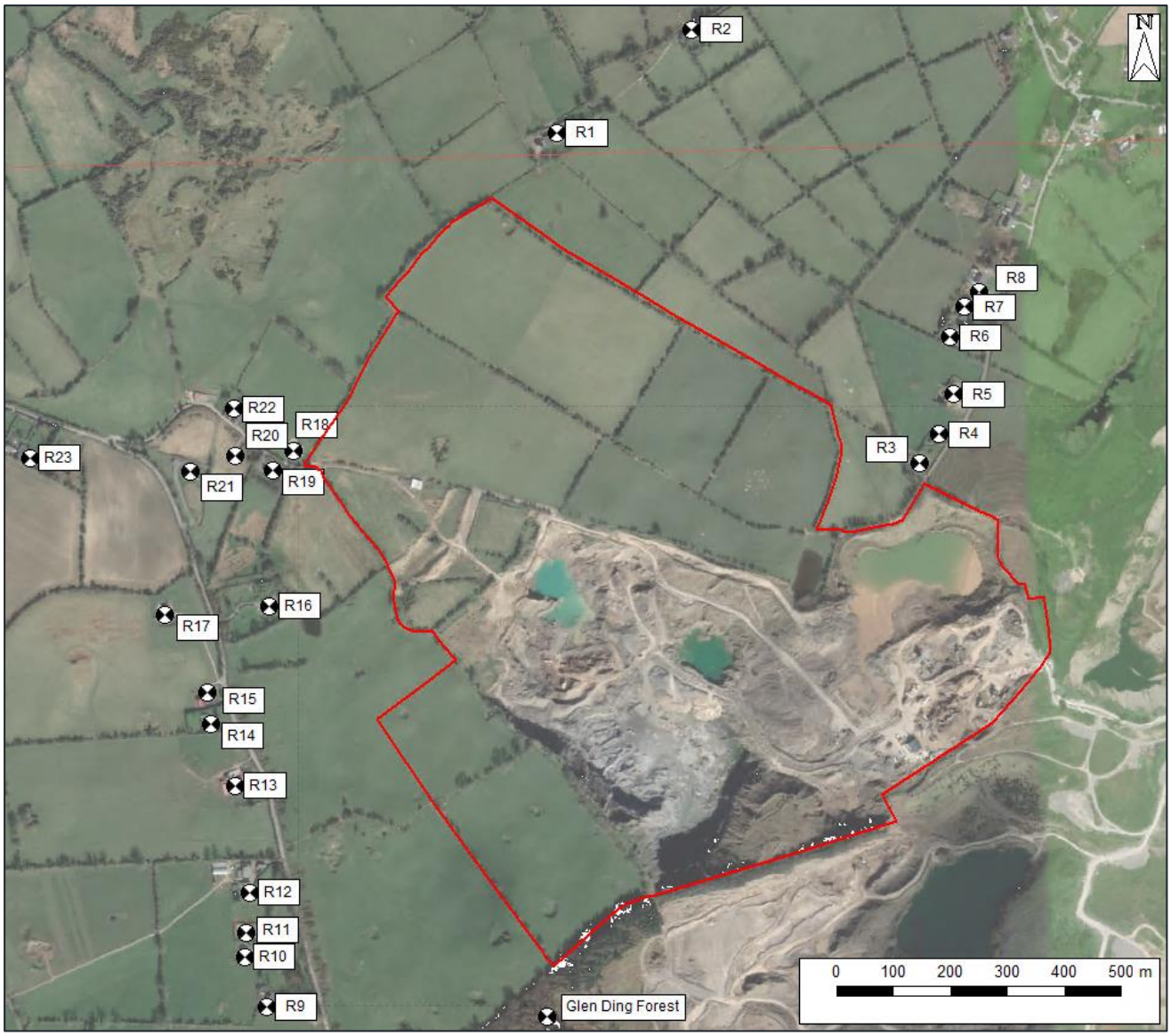

Figure 9-1: Location of the Site (EIA site boundary) with NSRs identified

Table 9-1: Coordinates of relevant NSR prediction locations. All receptors are residential properties unless stated otherwise.

Receptor	Coordinates (m) – Irish National Grid		
	Easting (X)	Northing (Y)	Height (Z)
R1	296860	217527	236
R2	297095	217708	230
R3	297493	216951	271
R4	297527	217002	280
R5	297552	217072	270
R6	297546	217171	264
R7	297571	217224	260
R8	297596	217251	259
R9	296353	216003	228
R10	296315	216091	220
R11	296318	216132	219
R12	296323	216203	219
R13	296299	216389	216
R14	296256	216497	210
R15	296249	216551	206
R16	296359	216703	215
R17	296176	216687	207
R18	296400	216973	209
R19	296364	216940	206
R20	296299	216965	207
R21	296220	216937	207
R22	296296	217047	202
R23	295940	216961	205
Glen Ding Wood (non-residential)	296842	215985	275

9.2 LEGISLATIVE AND POLICY CONTEXT

9.2.1 LEGISLATION

Legislative references considered specifically for the assessment of noise from quarrying activities and relevant statutory instruments in a planning context include:

- Directive 2014/52/EU of the European Parliament and of the Council, (amending Directive 2011/92/EU);
- European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018, S.I. 296 of 2018; and
- Planning and Development Regulations 2001 (as amended).

In addition to the above, Directive 2002/49/EC provides a basis for developing and completing the Community measures concerning noise emitted by the major sources, in particular; road and rail vehicles and infrastructure, aircraft, outdoor and industrial equipment and mobile machinery. The Directive applies to environmental noise in which humans are exposed, in particular built-up areas, in public parks or quiet areas in an agglomeration, in quiet areas in open country, near schools, hospitals and other noise-sensitive buildings and areas.

“Environmental noise” is defined within the Directive as “unwanted or harmful outdoor sound created by human activities, including noise emitted by means of road traffic, and from site of industrial activity…”.

9.2.2 RELEVANT POLICIES AND PLANS

The Kildare County Development Plan 2023-2029 (KCDP) is the key strategy document which structures the proper planning and sustainable development of land-use across County Kildare over the six-year statutory time period of the plan. The KCDP seeks to ensure that proposals in the county take account of the need to prevent major accidents involving hazardous substances and safeguard the public, property and the environment.

The KCDP acknowledges the potential environmental effects of the aggregate industry and importance of protecting surrounding residential and natural amenities. The KCDP also identifies that gravel resources are important to the general economy and provide a valuable source of employment in some areas of the county. There is an increasing demand for aggregates and that areas for extraction of aggregates and minerals are needed in the county. To address this the KCDP identifies that planning policies should be carefully constructed to avoid adverse effects on aggregate resources and related extractive industries. The KCDP notes that it is necessary to ensure that aggregates can be sourced without significantly damaging the landscape, environment, groundwater and aquifer sources, road network, heritage and / or residential amenities of the area. KCC has adopted policies and objectives within the development plan in relation to the protection of environs from adverse environmental impact from extractive industry, which includes nuisance noise and excessive vibrations from these projects. KCC acknowledges that nuisance noise and vibrations can have negative effects on these environs.

KCC policies relevant to the assessment of noise and vibration in respect to the extraction industry include:

RD P8 – *(*It is the policy of KCC to*) Support and manage the appropriate future development of Kildare's natural aggregate resources in appropriate locations to ensure adequate supplies are available to meet the future needs of the county and the region in line with the principles of sustainable development and environmental management and to require operators to appropriately manage extraction sites when extraction has ceased.*

KCC objectives relevant to the assessment of noise and vibration from extractive industries includes:

RD O42 – *(*It is the policy of KCC to*) Ensure that development for aggregate extraction, processing and associated concrete production does not significantly impact the following:*

- *Special Areas of Conservation (SACs)*
- *Special Protection Areas (SPAs)*
- *Natural Heritage Areas (NHAs)*
- *Other areas of importance for the conservation of flora and fauna.*
- *Zones of Archaeological Potential.*
- *The vicinity of a recorded monument.*
- *Sensitive landscape areas as identified in Chapter 13 of this Plan.*
- *Scenic views and prospects.*
- *Protected Structures.*
- *Established rights of way and walking routes.*
- *Potential World Heritage Sites in Kildare on the UNESCO Tentative List, Ireland..*

RD O44 – *(*It is the policy of KCC to*) Require applications for mineral or other extraction to include (but not limited to):*

- *An Appropriate Assessment Screening where there is any potential for effects on a Natura 2000 site.*
- *An Environmental Impact Assessment Report (EIAR).*
- *An Ecological Impact Assessment may also be required for subthreshold developments to evaluate the existence of any protected species / habitats on site.*

RD O44 – *(*It is the policy of KCC to*) Have regard to the following guidance documents (as may be amended, replaced, or supplemented) in the assessment of planning applications for quarries, ancillary services, restoration and after-use:*

- *Quarries and Ancillary Activities: Guidelines for Planning Authorities, DEHLG (2004). - Environmental Management Guidelines*
- *Environmental Management in the Extractive Industry (Non-Scheduled Minerals), EPA (2006). - Archaeological Code of Practice between the DEHLG an ICF (2009).*
- *Geological Heritage Guidelines for the Extractive Industry (2008).*
- *Wildlife, Habitats, and the Extractive Industry – Guidelines for the protection of biodiversity within the extractive industry, NPWS (2009).*

9.2.3 RELEVANT GUIDANCE

This assessment has been made with guidance from the Environmental Protection Agency (EPA) Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (May 2022). A glossary of acoustic terminology has been provided in Appendix 9A. Other guidance related specifically to noise and vibration has been identified below.

NG4: Guidance Note for Noise: Licence Applications, Surveys and Assessment in Relation to Scheduled Activities

With regards to noise, the most recent Irish guidance document in relation to noise was published in 2016 by the Environmental Protection Agency (EPA), Office of Environmental Enforcement (OEE), entitled 'Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4)'.

NG4 sets methods for addressing noise from operations that fall under IPPC and Waste Licensing functions of the EPA's Office of Environmental Enforcement (OEE). The activities at the Development are not Scheduled Activities however the NG4 guidance provides detailed consideration of a range of noise related issues including basic background to noise issues, various noise assessment criteria and procedures, noise reduction measures, Best Available Techniques (BAT) and the detailed requirements for noise surveys. NG4 identifies typical limit values for noise from licensed sites as: Daytime (07:00 to 19:00hrs) – 55dB $L_{Ar,\,T}$; Evening (19:00 to 23:00hrs) – 50dB $L_{Ar,T}$; and, Night-time (23:00 to 07:00hrs) – 45dB $L_{Aeq,\,T}$.

NG4 identifies the following guidance as potentially appropriate for assessing noise, subject to the use of the methodology being considered and justified by a competent person:

- BS 4142: 2014: Methods for rating and assessing industrial and commercial sound – evaluation of industrial and commercial noise sources at residential properties;
- BS 8233: 2014 Guidance on sound insulation and noise reduction for buildings – outline guidance on noise matters and deals specifically with noise within buildings; and
- BS 5228-1: 2009 + A1: 2014 Code of practice for noise and vibration control on construction and open sites – Part 1: Noise – outline guidance on prediction and control of noise from construction and open sites.

British Standard BS 5228-1:2009+A1:2014 Code of Practice for Noise and Vibration Control on Construction and Open Sites, Part 1: Noise

BS 5228 provides a procedure for the estimation of construction noise and vibration levels and for the assessment of the significance of the predicted effects at the nearest sensitive receptors. Annex D of the Standard includes measured typical noise levels for a range of construction plant and activities.

The Standard provides several methods for the evaluation of the significance of construction noise effects. The ABC method considers significance by comparison to the measured baseline $L_{Aeq,T}$ noise level, rounded to the nearest 5 dB. Three categories of threshold values are provided; A, B and C, in increasing 5 dB bands, for the periods "daytime and Saturdays", "evenings and weekends" and "night-time". If the construction site noise level exceeds the relevant threshold value this is deemed a 'significant effect'. Furthermore, where the measured baseline exceeds the highest

category C, a 3 dB increase over baseline is considered significant. The evaluation periods and thresholds of potential significant effect are set out in **Table 9-2**below:

Table 9-2: Example threshold of potential significant effect at dwellings

Assessment Category and Threshold Value Period	Threshold Value (dB $L_{Aeq,T}$)		
	Category A (A)	Category B (B)	Category(C)
Night-time (23:00 − 07:00)	45	50	55
Evenings and weekends (D)	55	60	65
Daytime (07:00 − 19:00) and Saturdays (07:00 − 13:00)	65	70	75

Notes:
[1] A potential significant effect is indicated if the $L_{Aeq,T}$ noise level arising from the site exceeds the threshold level for the category appropriate to the ambient noise level.
[2] If the ambient noise level exceeds the Category C threshold values given in the table (i.e. the ambient noise level is higher than the above values), then a potential significant effect is indicated if the total $L_{Aeq,T}$ noise level for the period increases by more than 3 dB due to site noise.
[3] Applied to residential receptors only.

(A) Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are less than these values.
(B) Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are the same as category A value (C) Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are higher than category A values.
(D) 19:00 – 23:00 weekdays, 13:00 – 23:00 Saturdays and 07:00 – 23:00 Sundays.

The second method states that "*Noise levels generated by site activities are deemed to be potentially significant if the total noise (pre-construction ambient plus site noise) exceeds the pre-construction ambient noise by 5 dB or more, subject to lower cut off values of 65 dB, 55 dB and 45 dB $L_{Aeq,T}$ from site noise alone, for the daytime, evening and night-time periods, respectively; and a duration of one month or more, unless works of a shorter duration are likely to result in significant impact*."

These criteria may be applied not just to residential buildings, but also to hotels and hostels and buildings in religious, educational and health/community use.

The +5 dB criterion for a period of one month or more, might also be deemed to cause significant effects in public open space. However, the extent of the area impacted relative to the total available area also needs to be taken into account.

Annex F of the Standard provides guidance on estimating noise from construction sites. The estimation procedures described in this Annex take into account the following more significant factors:

- sound power outputs of processes and plant;
- periods of operation of processes and plant;
- distances from source to receiver;
- the presence of screening by barriers;

- reflections of sound; and
- attenuation from absorbent ground.

Four discrete prediction methods are described, two for stationary plant – the activity $L_{Aeq,T}$ method and the plant sound power method – and two for mobile plant – the method for mobile plant in a defined area and the method for haul roads.

British Standard BS 5228-2:2009+A1:2014 Code of Practice for Noise and Vibration Control on Construction and Open Sites, Part 2: Vibration

The Standard provides the latest recommendations for basic methods of vibration control where there is a need for the protection of persons living and working in the vicinity of, and those working on, construction and open sites.

With respect to human exposure to building vibration, Table B1 of Annex B to BS 5228-2 provides guidance on the effects of vibration levels on human beings, and it is these (as reproduced in Table 9-3 below) that the construction vibration effects have been based upon.

Table 9-3: Guidance on effects of vibration levels

Vibration Level (mm/s)	Effect
0.14	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration.
0.3	Vibration might be just perceptible in residential environments.
1.0	It is likely that vibration of this level in residential environments will cause complaint, but can be tolerated if prior warning and explanation has been given to residents.
10	Vibration is likely to be intolerable for any more than a very brief exposure to this level.
Notes: [1] The magnitudes of the values presented apply to a measurement position that is representative of the point of entry into the recipient. [2] A transfer function (which relates an external level to an internal level) needs to be applied if only external measurements are available. [3] Single or infrequent occurrences of these levels do not necessarily correspond to the stated effect in every case. The values are provided to give an initial indication of potential effects, and where these values are routinely measured or expected then an assessment in accordance with BS 6472-1 or -2, and/or other available guidance, might be appropriate to determine whether the time varying exposure is likely to give rise to any degree of adverse comment.	

Guide values for cosmetic damage to buildings are given in Table B.2 of the Standard, and this is reproduced below, together with Figure B.1 (also reproduced in Table 9-4 below) to which it refers.

Table 9-4: BS 5228-2 Guidance on transient vibration guide values for cosmetic damage

Line (see Figure below)	Type of Building	Peak Component Particle Velocity in Frequency Range of Predominant Pulse (mm/s)	
		4 Hz to 15 Hz	15 Hz and above
1	Reinforced or framed structures and industrial and heavy commercial buildings	50 (at 4 Hz and above)	50 (at 4 Hz and above)
2	Unreinforced or light framed structures and residential or light commercial buildings	15 (at 4 Hz) increasing to 20 (at 15 Hz)	20 (at 15 Hz) increasing to 50 (at 40 Hz and above)
Notes: [1] Values referred to are at the base of the building. [2] For line 2, at frequencies below 4 Hz, a maximum displacement of 0.6 mm (zero to peak) is not to be exceeded.			

It should be noted that the above guidance is for transient vibration. For continuous vibration, such as may occur during the use of vibratory equipment, the guidance in the Standard is that the levels in **Table 9-4**above and in **Figure 9-2**below be reduced by 50%.

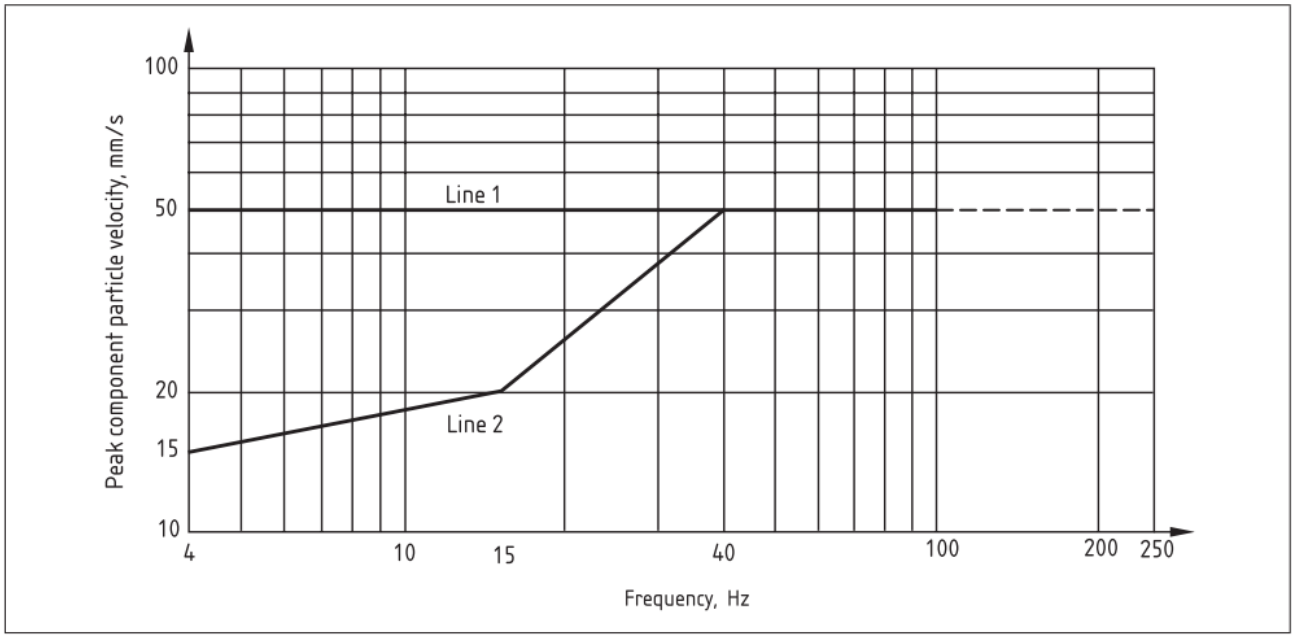

Figure 9-2: BS 5228-2 Guidance on transient vibration guide values for cosmetic damage

BS 6472:2008 Guide to evaluation of human exposure to vibration in buildings. Part 2: Blast induced vibration (BS 6472-2)

The Standard provides guidance on human exposure to blast-induced vibration within buildings. It describes the characteristics of both blast-induced vibration and air overpressure and provides guidance on methods of measurement and prediction of both phenomena. BS 6472-2 also

acknowledges the difficulties experienced in the accurate prediction of air overpressure generated by explosive blasts.

Table 1 in BS 6472-2 (reproduced here in Table 9-5) provides maximum magnitudes of vibration that are acceptable with respect to human response for up to three blast vibration events per day.

Table 9-5: Maximum satisfactory magnitude of vibration with respect to human response for up to three blast vibration events per day

Place	Time	Satisfactory Magnitude, PPV (mm/s)
Residential	Day – 08:00 to 18:00 Mon-Fri, 08:00 to 13:00 Saturdays Night – 23:00 to 07:00 Other times	6.0 to 10.0 2.0 4.5
Offices	Any time	14.0
Workshops	Any time	14.0

With respect to satisfactory magnitudes of air overpressure, the Standard advises that: "Windows are generally the weakest parts of a structure exposed to air overpressure. Research by the United States Bureau of Mines has shown that a poorly mounted window that is pre-stressed can crack at around 150 dB(lin), with most windows cracking at around 170 dB(lin). Structural damage would not be expected at air overpressure levels below 180 dB(lin)."

BS 7385: Evaluation and measurement for vibration in buildings, Part 1 1990: Guide for measurement of vibrations and evaluation of their effects on buildings and Part 2 1993: Guide to damage levels arising from ground borne vibration

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

BS 7385 also provides the same comments regarding air overpressure as that provided in BS 6472-2.

BS 7445-1:2003 Description and Measurement of Environmental Noise. Guide to Quantities and Procedures.

BS 7445 provides guidance on appropriate environmental noise monitoring, including specification of equipment and appropriate calibration intervals, suitable weather conditions and observations to note regarding the nature of the noise environment.

Environmental Management in the Extractive Industry (Non-Scheduled Minerals) (2006).

The EPA's 2006 guidance on Environmental Management in the Extractive Industry (Non-Scheduled Minerals) outlines primary sources of noise associated with quarrying and offers guidance in relation to the correct approach to be followed in respect of assessment and mitigation. Recommended noise limit values are 55dB L_{Aeq},1hr and 45dB L_{Aeq},15min for daytime and night-time respectively.

Design Manual for Roads and Bridges (DMRB) LA 111 Noise and vibration (revision 2), 2020
DMRB LA 111 was first published in November 2019, superseding DMRB HD213/11 which was

withdrawn at that time. The document sets out the requirements for noise and vibration assessments from road projects, including operational and construction noise, applying a proportionate and consistent approach using best practice and ensuring compliance with relevant legislation.

For operational road traffic noise, the magnitude of change shall be defined in accordance with LA 111 Table 3.54a (short-term) and Table 3.54b (long term). These tables are combined in **Table 9-6** below.

Table 9-6: Magnitude of change – short and long-term

Magnitude of Impact	Noise Change (dB $L_{A10,18h}$) or L_{night}	
	Short-term	Long-term
Major	Greater than or equal to 5.0	Greater than or equal to 10.0
Moderate	3.0 – 4.9	5.0 – 9.9
Minor	1.0 – 2.9	3.0 – 4.9
No change or negligible	Less than 1.0	Less than 3.0

For the assessment of magnitude of impact due to construction noise, LA111 recommends adopting the criteria provided in Table 9-7.

Table 9-7: Magnitude of impact due to construction noise

Magnitude of Impact	Construction Noise Level
Major	Above or equal to threshold level +5 dB
Moderate	Above or equal to threshold level and below +5 dB
Minor	Above or equal to threshold level
Negligible	Below existing baseline level

Where the threshold level is determined using the 'ABC Method' as described in BS 5228-1:2009+A1:2014 Section 3.2 and Table E.1 (see Table 9-2). Note that LA111 states that the impact of noise from construction traffic on public roads may be evaluated against the short-term noise change criteria provided in Table 9-6.

LA 111 further states that the initial assessment of likely significant effect on noise sensitive buildings shall be determined using Table 3.58, reproduced below.

Table 9-8: Initial assessment of operational noise significance

Significance	Short-term Magnitude of Change
Significant	Major
Significant	Moderate
Not significant	Minor
Not significant	Negligible

Where the magnitude of change in the short term is negligible at noise sensitive buildings, it shall be concluded that the noise change will not cause changes to behaviour or response to noise and as such, will not give rise to a likely significant effect.

Note that the 'major', 'moderate' and 'minor' magnitudes of impact referenced in LA11 correlate to 'high', 'medium' and 'low' magnitudes of impact referenced within this EIAR (see Section 9.3.2.3).

9.3 ASSESSMENT METHODOLOGY AND SIGNIFICANCE CRITERIA

9.3.1 ASSESSMENT AIMS

The objectives of this section are to assess the potential noise impacts from the Development on the local environment during the assessment period of September 2020 to present, and to identify remedial mitigation or control measures which may have been needed, or that need to be implemented, to mitigate the likely significant adverse effects from noise on the environment.

9.3.2 NOISE IMPACT ASSESSMENT

9.3.2.1 Proposed Noise Limits

The Site's existing planning permission (KCC Reg. Ref.: 07/267, Condition 33), states the following with respect to noise and vibration:

(a) *'The noise level attributable to all on-site operations associated with the proposed development shall not exceed 55 dB(A) (L_{eq}) over a continuous one-hour period between 0800 hours and 1800 hours Monday to Friday inclusive (excluding bank holidays), and between 0800 hours and 1300 hours on Saturdays, when measured outside any noise sensitive location house in the vicinity of the site. Sound levels shall not exceed 45 dB(A) (L_{eq}) at any other time.'*

(b) *A Noise Assessment shall be carried out on the site by a competent Noise Consultant within 1 month of commencement of on-site operations and at 6 monthly intervals thereafter or at any other time specified by the Planning Authority and shall give advance notice as specified by the Planning Authority. The locations of the noise monitoring stations shall be agreed with the Planning Authority. The Noise Assessment shall be submitted to the Planning Authority.*

(c) *Vibration due to blasting activities shall not exceed a peak particle velocity of 12 mm/s when measured in any of the three mutually orthogonal directions (for vibration with a frequency at less than 40 Hz) at any vibration sensitive location in the vicinity of the site. Air overpressure shall not exceed 125 dB (linear maximum peak value) at any overpressure sensitive location in the vicinity of the site.*

The Site's existing permitted hours of operation (KCC Reg. Ref.: 07/267, Condition 14) are:

'Excavation and processing of material shall be carried out between 0800 hours and 1800 hours, Monday to Friday and between 0800 hours and 1300 hours on Saturdays. However, loading and transporting of processed material may be carried out between 0700 hours and 1800 hours: Monday to Friday and between 0700 hours and 1300 hours on Saturdays. No activities shall be permitted on Sundays or public holidays.'

The noise limits stated in Condition 33 correlate to those recommended by NG4 (see Section 9.2.3), which identifies typical limit values for noise from EPA licensed facilities as: Daytime (07:00 to 19:00) – 55 dB $L_{Ar,T}$; Evening (19:00 to 23:00) – 50 dB $L_{Ar,T}$; and Night-time (23:00 to 07:00) – 45 dB $L_{Aeq,T}$.

It is therefore proposed that the noise limits stated in Condition 33 are adopted as the threshold noise levels for extraction and processing at the Site with the permitted hours of operation also as per those stated in Condition 33.

9.3.2.2 Receptor Sensitivity

This assessment considers that human receptors, including residential properties, have a high sensitivity to noise and vibration. Glen Ding Wood to the southwest of the site has also been considered in the assessment and as woodland/amenity space, a medium sensitivity is assumed. Commercial and industrial receptors, comprising buildings and businesses, are considered to have a low sensitivity to noise and vibration and have been scoped out of further assessment.

The assumed sensitivity of identified representative existing NSRs are provided in Table 9-9.

Table 9-9: Sensitivity of Receptors

Receptor	Type of receptor	Sensitivity	Scoped In/Out
All existing dwellings (NSRs)	Human / residential	High	Scoped in
Glen Ding Wood	Woodland / amenity space	Medium	Scoped in
Business, agricultural	Commercial / industrial	Low	Scoped out

9.3.2.3 Evaluation Criteria

Appropriate criteria have been adopted for the derivation of noise impact magnitude resulting from the operation of the scheme. The criteria have been adapted from those provided within DMRB for construction phases of road schemes and which are considered to be appropriate for this evaluation. Table 9-10 details the resulting impact magnitudes that have been applied.

Table 9-10: Quarry operational noise impact magnitude criteria

Exceedance of Threshold Value OR Change in Noise Level, dB $L_{Aeq,T}$	Subjective Response	Magnitude of Impact
≥5	Clearly perceptible	High adverse
≥3, <5	Perceptible	Medium adverse
>0, <3	Barely perceptible	Low adverse
≤0	Imperceptible	Negligible/no change

The criteria in Table 9-10 have been used to determine the significance of noise effects for receptors of different sensitivities, as shown in Table 9-11.

Table 9-11: Assumed sensitivity of representative NSRs

Magnitude of Impact	Level of Significance, Relative to Sensitivity of Receptor			
	Negligible	Low	Medium	High
High	Slight	Slight or moderate	Moderate or large	Profound
Medium	Imperceptible or slight	Slight or moderate	Moderate	Large or profound
Low	Imperceptible	Slight	Slight	Slight or moderate
Negligible	Imperceptible	Imperceptible or slight	Imperceptible or slight	Slight

9.3.2.4 Significance of Effect

A significant effect is deemed to occur where a moderate or large significance is identified, but also subject to consideration of the following contextual factors:

- Absolute noise level;
- Proximity of sensitive receptors to the noise source
- Whether or not the impact changes the acoustic character; and
- Likely perception of change by residents.

For the purposes of this assessment (and in line with guidance within LA111), noise impacts of medium or high magnitude are considered to be **significant** with impacts of low or negligible magnitude considered to be **not significant**.

9.3.2.5 Method of Baseline Noise Collation

Noise monitoring has been undertaken on Site at five noise monitoring locations over a period between April 2019 and January 2024. The surveys were conducted during daytime hours as night-time works are not conducted on the Site. The monitoring periods chosen are considered to be representative of typical daytime noise at each of the NSRs.

The following noise indices were recorded during each survey period:

- $L_{Aeq,T}$ – the equivalent continuous level is the constant noise level that would result in the same sound energy over a given period and is used to represent varying noise levels over a time, T, as a single number. Typically referred to as the 'ambient' noise level.
- $L_{A90,T}$ – the 'background' or 90th percentile noise level, i.e. the noise level that is exceeded for 90% of a time period, T. Representative of the quieter moments experienced at a location, this index is unaffected by short-duration noisy events.
- $L_{A10,T}$ – the 10th percentile noise level, i.e. the noise level that is exceeded for 10% of a time period, T. Typically used to characterise road traffic noise.
- $L_{Amax,T}$ – the maximum noise level recorded over a time, T.

Weather conditions during each survey were in accordance with the requirements of BS 7445, with no rain, and wind speeds below 5 m/s throughout.

Further information relating to noise monitoring is provided in Section 9.4.1.

9.3.2.6 Prediction of Noise Levels from Quarry Operations

Method of Prediction

A 3D model of the quarry was constructed within noise prediction software CadnaA and noise levels were predicted at the representative NSRs. The software enables prediction of noise levels under atmospheric conditions using the method in BS 5228-1.

BS 5228-1 provides a procedure for the estimation of construction noise levels, and for the assessment of the significance of the predicted effects at the receptors. Annex D of the Standard includes measured typical noise levels for a range of construction plant and activities.

Noise levels associated with the operation of the facility have been predicted using CadnaA. The software supports the ISO 9613 and BS 5228 prediction methods. The model utilised the BS 5228 prediction method, which provides a more conservative prediction of noise propagation based on distance attenuation and ground absorption only.

A topographic survey of the study area was included within the model as a digital terrain map (DTM) to consider screening from topographic features, including the quarry void and walls, between the proposed working area and the closest sensitive receptors. The model considers the effect of ground conditions based on mixed ground conditions beyond the Site (G = 0.5) and no ground absorption of noise within the Site (G = 0), where G is the Ground Coefficient, which varies from 0 for hard ground, to 1 for ground covered by vegetation).

Current Operational Condition

The current operational condition was modelled in CadnaA to allow for direct comparison between predicted and measured noise levels.

The main activities currently experienced within the quarry, which would typically operate simultaneously on any given day, are as follows:

Main pit area:

- The processing of blasted rock; by rock-breaking, crushing and screening (using mobile equipment) and associated vehicle movements (excavators, loaders, road trucks etc.); and
- The extraction of sand and gravel by mechanical means, using excavators and haul trucks.

Surface activities at the eastern boundary of the site will include:

- The screening of sand and gravel by a fixed aggregate screening plant; and
- Associated vehicle movements including loaders, haul trucks, road trucks etc.

Conservatism in Predicted Scenarios

A conservative approach has been taken in carrying out the predicted scenarios. The void is considered at its maximum extent, therefore modelling has been carried out using scenarios where all mobile plant were placed at the closest area of the Site to the relevant receptors. It should be noted that these work practices would be very unlikely to occur in close proximity at such a location.

The predicted noise levels assume a receptor height of 4 m above local ground level, (representative of a first-floor bedroom window). This is a robust approach, which minimises the attenuation due to ground absorption and potential screening from the quarry face. Predicted noise

levels at the height of a person standing at ground level, (e.g. effective receptor height of 1.5 – 1.8 m) will be lower.

The modelling has assumed that the majority of fixed plant operates with a 90 % equipment 'on-time' (based on a 10 hr working day with 1 hr lunch break), with the exception of a rock breaker which is used, on average, for 50 % of the day and a telehandler in the surface plant area which is used for around 40 % of the day.

Embedded Mitigation Assumed within Model

The following mitigation embedded into the design of the proposed scheme has been incorporated within the noise model:

- A stand-off distance of approximately 150 m from the northern boundary of the proposed site extension to the nearest NSR; and
- An earth bund 6 m above ground level along the northern boundary of the proposed site extension.

Operational Plant for Prediction

A list of operational plant has been provided by the operator and is summarised in Table 9-12, below. The stated sound power levels of the surface fixed screen and generator were derived from on-site measurements; mobile plant sound power levels are as stated by the manufacturer, where available; all other plant sound power levels were based data provided in BS 5228 for equivalent plant. In each case, the octave band spectral shape was based on data within BS 5228.

Table 9-12: Operational plant and noise modelling assumptions applied

Item	Sound Power Level, dB L_{WA}	Spectral Shape, from BS5228-1:2009+A1:2014	Relative Height Above Ground, m
Point sources: Plant associated with extraction works			
Excavator with rock breaker	121.0(1)	BS_5228_2009_C9_11	4
Mobile crusher 1	118.1(1)	BS_5228_2009_C9_14	3
Mobile crusher 2	118.1(1)	BS_5228_2009_C9_14	3
Mobile screen 1	109.1(1)	BS_5228_2009_C10_15	3
Mobile screen 2	109.1(1)	BS_5228_2009_C10_15	3
Excavator 1 (working with crusher)	114.5(1)	BS_5228_2009_C6_5	1.5
Excavator 2 (working with crusher)	107.0(2)	BS_5228_2009_C6_6	1.5
Loader 1 (working in pits)	109.0(2)	BS_5228_2009_C9_27	1.5
Loader 2 (working in pits)	108.0(2)	BS_5228_2009_C9_27	1.5
Face shovel (loading sand and gravel)	116.5(1)	BS_5228_2009_C6_2	6
Excavator (loading sand and gravel)	107.0(2)	BS_5228_2009_C6_6	1.5
Point sources: Plant associated with aggregate plant			
Surface fixed screen	116.3(3)	BS_5228_2009_C10_15	6
Generator	107.0(3)	BS_5228_2009_C4_87	1.5
Loader 1	109.0(2)	BS_5228_2009_C9_27	1.5
Loader 2	109.0(2)	BS_5228_2009_C9_27	1.5
Loader 3	109.0(2)	BS_5228_2009_C9_27	1.5
Truck loading activities (site wide, pit and surface)	112.9(1)	BS_5228_2009_C10_11	4
Excavator	100.0(2)	BS_5228_2009_C6_9	1.5
Telehandler	109.9(2)	BS_5228_2009_C4_55	3
Line sources: Material movement around site			
Dumpers (3 x Volvo A40Fs)	104.8(2)	BS_5228_2009_C6_26	1
Dumpers (Komatsu HD785s)	112.6(1)	BS_5228_2009_C9_16	1
Road trucks	111.1(1)	BS_5228_2009_C11_4	1

(1) Derived from BS5228 equivalent
(2) Stated by manufacturer
(3) Derived by measurement at site

Current Operational Condition

Extraction works in the pit

- 1 no. face shovel and 1 no. excavator excavating sand and gravel in the pit and loading haul trucks;
- 1 no. excavator and 1 no. rock breaker at a recently blasted face near the centre of the pit
- 2 no. excavators feeding one mobile crusher at each of two locations within the pit;
- 2 no. mobile screening units being fed by each mobile crusher at the two locations identified above;
- 2 no. loaders working in quarry base, loading road trucks and conducting general stockpiling duties from the screens;

Aggregate plant operating on surface

- Generator adjacent to the aggregate plant;
- 1 no. fixed surface screen;
- 3 no. Volvo L220G loaders working at the aggregate plant loading road trucks and conducting general stockpiling duties from the fixed screen;
- 1 no. loading truck;
- 1 no. Komatsu PC210 excavator working at the aggregate plant loading materials;
- 1 no. Caterpillar H83 telehandler carrying out various duties around the surface plant area ('on-time' of 240 minutes per day)

Haul routes

- 3 no. Volvo A40F haul trucks and 1 no. Komatsu HD785 moving sand and gravel to the aggregate plant on the surface;
- Road trucks exporting materials from site at a frequency of 26 movements per hour (13 road trucks in and 13 road trucks out).

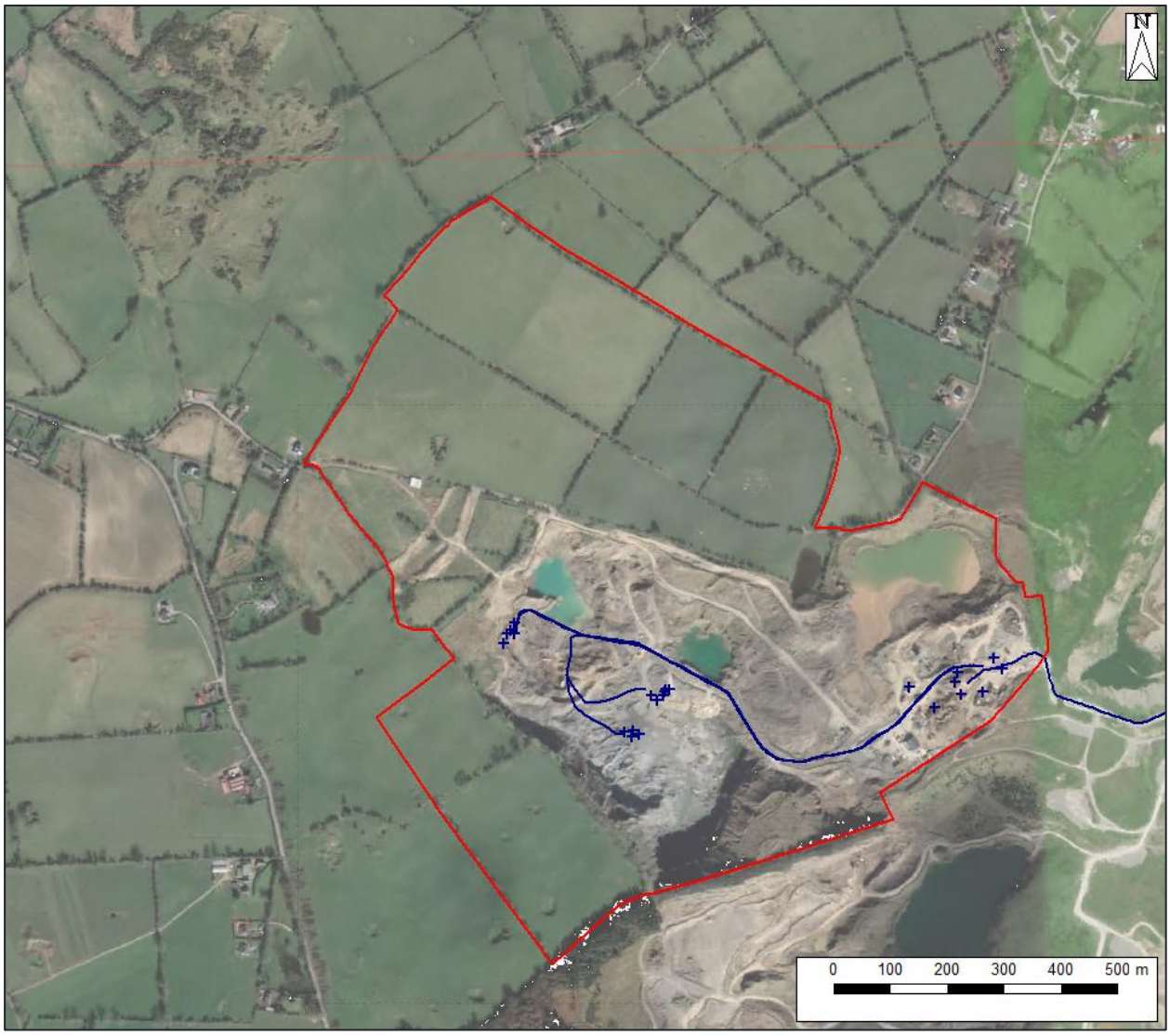

Figure 9-3: Existing operational condition inputs and plant locations, and EIA Boundary.

9.4 BASELINE AND SUBSEQUENT CONDITIONS (SEPTEMBER 2020 TO PRESENT)

9.4.1 BASELINE NOISE MONITORING

9.4.1.1 Measurement Methodology

Noise monitoring was undertaken by suitably competent personnel using sound measuring equipment rated Class 1 to IEC 61672-1:2013 and with a current UKAS Certificate of Calibration. Each noise monitoring survey occurred during a typical weekday period when the quarry was operational and consisted of a 30-minute (and most recently, 60-minute) measurement of the ambient noise level at each measurement location. Surveys took place during periods when the weather was suitable and appropriate (i.e. dry with wind speeds <5m/s).

9.4.1.2 Noise Monitoring Locations

The noise monitoring locations adopted in the site's routine surveys have been located at the closest NSRs or at a location closer to the development to be representative of a number of NSRs in that

area. The coordinates of these noise monitoring locations are presented in Table 9-13 displayed in Figure 9-4.

Table 9-13: Coordinates of noise monitoring locations

Name	Coordinates (m) – Irish National Grid		
	Easting (X)	Northing (Y)	Height (Z)
N1K	296403	216266	221
N2K	296454	216972	206
N3K	296748	217396	238
N4K	297514	216917	269
N5K (not an NSR)	297504	216344	229

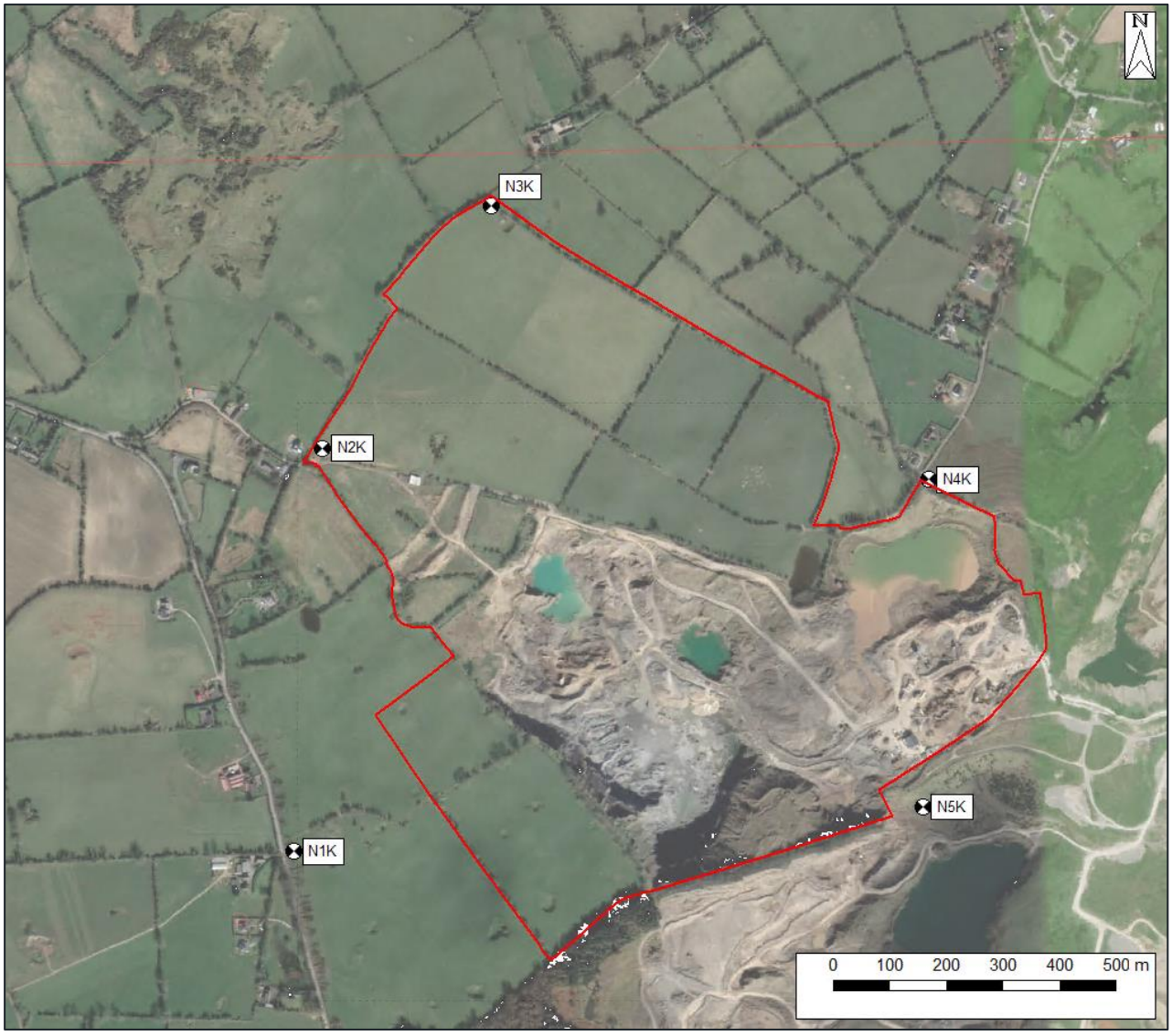

Figure 9-4: Noise monitoring locations, and EIA Boundary

9.4.1.3 Noise Monitoring Equipment

The sound measuring equipment utilised for noise monitoring is detailed in Table 9-14 below. The sound level meter was mounted on a tripod at a height of 1.2 – 1.5 m above ground level for each measurement. Calibration checks were carried out on the sound level meter prior to and on completion of the survey with no significant calibration drift (i.e., drift in excess of 0.1dB) noted.

Table 9-14: Equipment used during noise monitoring

Equipment	Make and Model	Serial Number
Sound level meter	Norsonic 140	1402742
Pre-amplifier	Norsonic 1209	12131
Microphone	Norsonic 1225	72926
Calibrator	Norsonic 1251	33002
Calibrator	Norsonic 1251	31525
All sound measurement equipment is certified Class 1 to IEC 61672-1:2013 and holds a current UKAS Certificate of Calibration with sound level meters having undergone UKAS calibration within the previous two years and calibrators within the previous 12 months.		

Noise levels attributable to the quarry operations were monitored and compared with the existing permitted limits.

9.4.1.4 Noise Monitoring Results

A summary of the noise monitoring results obtained between from April 2019 and January 2024 are presented in Table 9-15 below, with detailed results in Appendix 9B.

Table 9-15: Summary of noise monitoring results, April 2019 – January 2024

Monitoring Location	No. of Measurements	Daytime Limit, dB L_{Aeq}	Log-average dB $L_{Aeq,T}$	Exceedance of Daytime Limit, dB	Range dB $L_{Aeq,T}$	Range dB L_{A10}	Range dB L_{A90}
N1K	15	55.0	61.3	6.3	50.5 - 66.4	54.3 - 71.8	32.7 - 49.8
N2K	15	55.0	50.1	-4.9	39.1 - 59.1	41.2 - 51.8	30.9 - 42.7
N3K	15	55.0	46.3	-8.7	34 - 51.4	35.4 - 54.2	27.4 - 45.1
N4K	16	55.0	47.1	-7.9	39.1 - 50.4	39.6 - 52.2	34.1 - 47.4
N5K	16	55.0(1)	51.8	-3.2	41.0 – 60.0	42.4 - 62.6	35.1 - 54.8

(1) Whilst N5K is not a noise sensitive receptor, the measured noise levels have been evaluated against the same criteria for comparative purposes

The quarry was in full operation during each noise monitoring period. Crushing and screening operations were underway on the pit floor, mobile plant (such as loaders, excavators and dump trucks) were active around the site outside the pit and road trucks were being loaded for exportation

of aggregate. Rock breaking was being undertaken intermittently during the surveys. The surface aggregate screen was also fully operational during each survey.

9.4.1.5 Comments on Existing Noise Conditions

The results of the noise survey are typical of the levels expected for a rural environment which is not significantly influenced by a continuous or dominant noise source. In general, the main noise sources noted are intermittent passing traffic on adjacent roadways the R410 and the N81 to the west and east of the Site. Activities within the quarry site were audible at low levels, in addition to activities in the adjacent quarries which were also audible intermittently during the surveys.

N1K – This location is directly adjacent to the regional R410 road, which was the dominant noise source during the noise surveys. During lulls in road traffic, the quarry was faintly audible in the distance. No impulsive noise sources from the Site were observed during the survey. During some surveys the quarry operations were not noted at all during lulls in road traffic. Other audible noise sources included: birdsong, nearby treeline blowing in gusts of wind. This treeline along the R410 was felled prior to the March 2020 monitoring event. No tonal noises were audible on site during the surveys or identified in the resultant data.

N2K - The dominant noise sources at this receptor were identified to be birdsong (intermittently audible but dominant) and quarrying activities to the south-east. Intermittent noise sources included: construction machinery to the north-west, planes overhead, rock breaking equipment to the south-east (within the quarry at a low level), activities in adjacent properties, noise within an adjacent treeline and dogs barking adjacent to the monitoring location. No tonal noises were audible on site during the surveys or identified in the resultant data.

N3K – The dominant noise sources at this receptor were quarrying activities within the Site, consisting of engines and aggregate screening activities in the pit (noted to be at a low level and below the threshold but were the dominant noise source on occasions). Other audible noise sources included: construction activities on an adjacent house, sheep in the adjacent field, rustling in the treeline and birdsong. Other intermittent noise sources included aircraft overhead and reversing alarms on site. No distinctive tonal noises were identified in the resultant data.

N4K – The dominant noise sources at this receptor were quarrying activities within the Site, mainly aggregate screening. Birdsong was also noticeably audible. Other intermittently audible noise sources included: activities in a dwelling north of the monitoring location, dogs barking, construction activities on a nearby house, cars on an adjacent public road, voices in an adjacent house and airplanes overhead. No tonal noises were audible on site during the surveys or identified in the resultant data.

N5K – This location is not representative of a noise sensitive receptor but has been historically monitored at the site to provide a geographic spread of monitoring locations around the site's perimeter. The dominant noise sources at this receptor were quarrying activities in the adjacent quarry to the south (excavators, dump-trucks, screeners and crushers). Due to the topography and screening berm the HBL screen to the north was faintly audible on occasion. Other intermittent noise sources included: aircraft and helicopters, sound from screening plant in the neighbouring quarry, birdsong. No tonal noises were audible on site during the surveys or identified in the resultant data.

9.4.1.6 Exceedances During the Noise Monitoring Surveys

It can be seen in both the monitoring data in Appendix 9B and the summary in Table 9-15 that the individual L_{Aeq} noise levels at location N1K frequently exceeded the 55 dB $L_{Aeq,T}$ noise limit, with the overall logarithmically averaged level being 61 dB $L_{Aeq,T}$. Location N1K is situated off-site and adjacent to a public road, (R410, Blessington/Naas road). Due to the proximity of traffic passing the location it may be appropriate to consider the L_{A90} sound levels when assessing the magnitude of noise in the absence of road traffic. The L_{A90} is the sound level exceeded for 90% of the measurement period, is less affected by intermittent sounds (such as passing traffic) and is often used to quantify the background sound level. It can be seen that at this location the L_{A90} values were in the range of 33-50 dB $L_{A90,T}$ during the monitoring periods. This would suggest that in the absence of contributions from passing traffic, the permitted daytime limit of 55 dB $L_{Aeq,T}$ would be achieved.

One exceedance was also noted at N2K during the March 2020 survey. During this monitoring period, it was noted that the exceedance was due to off-site noise sources, namely a bough of a tree in an adjacent hedge row which was loose and squeaking loudly. The Site was audible at this location, but at a low level. The L_{A90} sound level for this monitoring event measured 34 dB $L_{A90,30min}$ and it is therefore considered that noise levels associated with the Site would also be compliant with the permitted noise limit.

Exceedances above the daytime noise limit noted at N5K have been attributed to noise from the processing plant and other quarry related activities. As noted previously, this location is not representative of a noise sensitive receptor and as the logarithmically averaged sound level from all survey periods at this location was determined to be 52 dB $L_{Aeq,T}$, the Site was still in compliance with the permitted noise limits.

9.4.2 VIBRATION MONITORING

9.4.2.1 Introduction

Vibration and air overpressure (AOP) monitoring of quarry blasting has been undertaken on Site at five vibration monitoring locations over a period between February 2018 and August 2020. No blasting has taken place at the Site since August 2020 so no data is available after this time and during the assessment period of this rEIAR. Although the effects of blasting have been scoped out of this rEIAR (see Section 9.1.2), an overview of monitoring undertaken prior to the assessment period has been provided in the following sections.

The surveys were conducted by the blasting contractor using monitoring equipment provided by the contractor during daytime periods only when blasting was taking place.

9.4.2.2 Blast Monitoring Locations

During each blasting event at the existing quarry both ground vibration and air overpressure are monitored at the closest sensitive locations (i.e. the locations nearest to the blast). The blast monitoring locations vary for each blast. The coordinates of these monitoring locations are presented in Table 9-16 and displayed in Figure 9-5.

Table 9-16: Coordinates of blast monitoring locations

Name	Coordinates (m) – Irish National Grid		
	Easting (X)	Northing (Y)	Height (Z)
V1	297505	216953	269
V2	296182	216693	211
V3	296262	216552	216
V4	296233	216950	202
V5	297855	217504	278

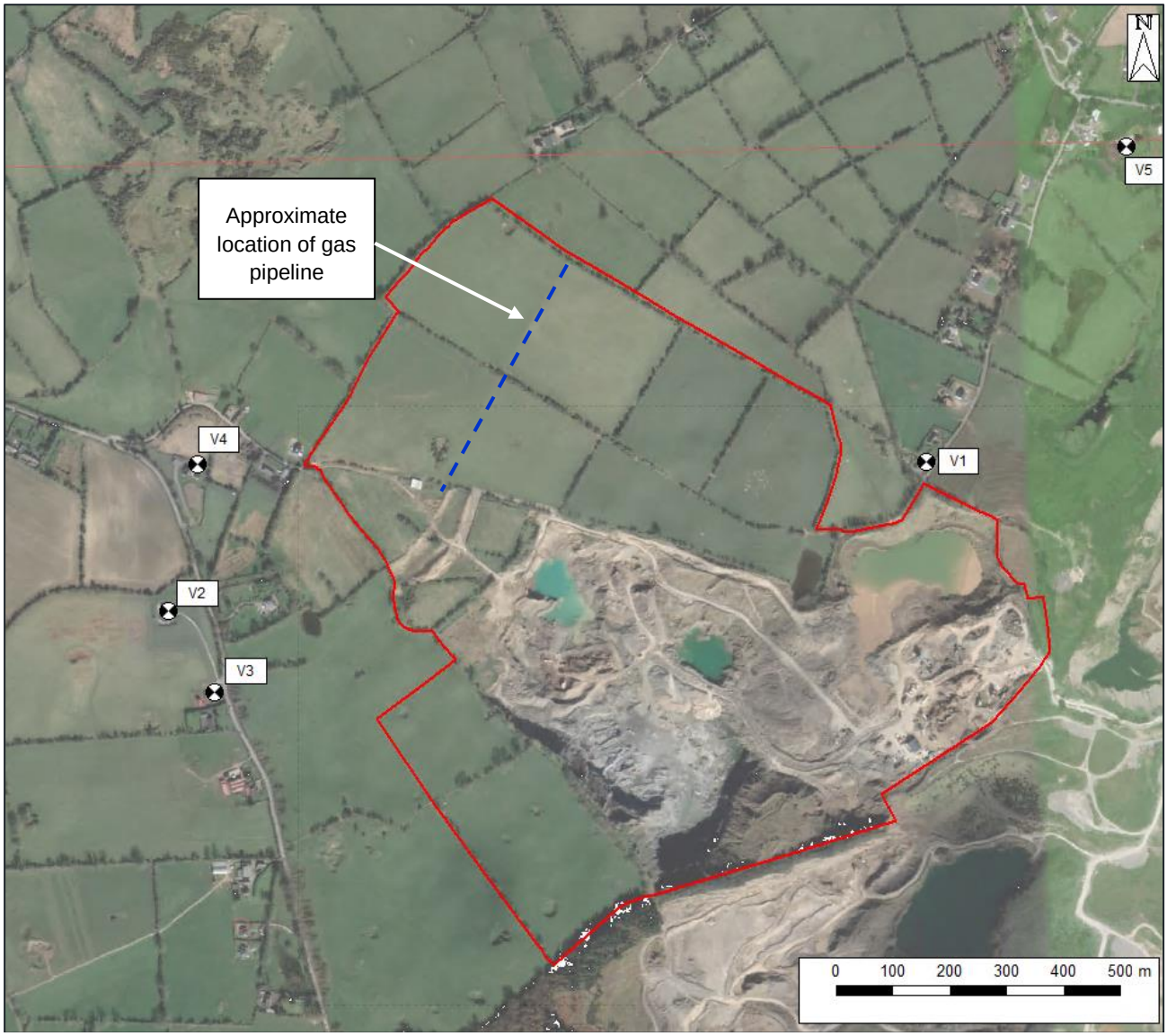

Figure 9-5: Blast monitoring locations, and EIA Boundary.

9.4.2.3 Gas Networks Ireland (GNI) Pipeline

A GNI transmission line lies to the northwest of the existing quarry, running in an approximate northeast to southwest direction, as identified in Figure 9-5.

There is the potential for an improperly managed blast to damage the gas transmission line. Fractures in the line could result in gas leaks and an explosion. The loss of gas transmission would result in further indirect effects elsewhere on the line.

The blasted rock face of the quarry is ca. 370 m from the gas transmission line. The GNI 2015 'Code of Practice for Working in the Vicinity of the Transmission Network' dictates that: 'blasting shall not be permitted within 400 metres of a transmission network without consulting GNI and making an assessment of the vibration levels at the pipeline'. HBL have liaised with GNI on this matter and a site visit has been conducted by GNI.

HBL deploy a vibration monitor at the gas transmission line during all blasting events, the results from which are included in the summary below.

9.4.2.4 Blast Monitoring Results

A summary of the vibration and AOP monitoring, indicating the highest measured PPV and AOP at each blast monitoring location, is provided in Table 9-17 below, with full results in Appendix 9C.

Table 9-17: Summary of highest measured vibration PPV and AOP during blasting

Location of Seismograph	No. of Measurements at Location	Distance from Blast (m)	Relative Position to Blast (degrees)	Highest Measured AOP, dB(lin) Limit: 125 dB(lin)	Highest Measured PPV, mm/s Limit: 12 mm/s		
					Transverse	Vertical	Horizontal
Gas pipeline	7	317	95	120.1	6.00	2.50	4.06
V1	30	656	250	124.8	2.20	1.80	1.80
V2	26	820	118	114.4	1.20	0.89	1.40
V3	16	690	73	113.1	2.20	1.80	2.00
V4	3	710	106	114.0	1.08	1.27	1.27
V5	3	1170	227	93.0	0.40	1.00	0.80

9.4.2.5 Comments on Vibration Monitoring Results

It can be seen from the summary above that none of the measurements exceeded the PPV limit of 12 mm/s in any direction, nor the 125 dB(lin) AOP limit although one AOP measurement (at location V1) was at the limit.

9.5 EMBEDDED NOISE MITIGATION CONSIDERED

The quarry did not operate in the night-time period or on Sundays or public holidays. Potential impacts of quarrying activities on the noise climate in the vicinity of the site were therefore limited to the weekday daytime period, which limited potential impacts on local residential amenity during the more sensitive evening, weekend and night-time hours.

A historical programme of minimum bi-annual (i.e. twice per year) noise monitoring surveys undertaken by the quarry operator established routine compliance with noise limits at the closest receptors. Monitoring was undertaken at two-monthly intervals during Q2, Q3 and Q4 of 2023.

The following noise control and mitigation techniques have historically been implemented at the quarry:

- Internal haul roads were designed so as to have as low a gradient as possible so as to minimise excessive revving of vehicle engines on-site;
- The use of vehicle horns was discouraged during the daytime period and was banned during the early morning periods before 10:00;
- Restriction of excavation and processing working hours to 08:00 - 18:00, Monday to Friday and to 08:00 - 13:00 on Saturdays with no works on Sundays and on public holidays;
- Quarry operations such as blasting, excavation or crushing did not occur outside normal permitted operating hours – with the exception of rock braking which had been incorrectly undertaken prior to 08:00 on occasions during weekdays in 2023. This practice was immediately rectified once the issue was raised with Site management;
- Presence of screening bunds surrounding the site boundaries in proximity to residential noise sensitive receptors;
- 10 kmph speed limit on access road;
- All site plant, machinery and vehicles were shut down when not in use;
- All pneumatic rock breakers were fitted with dampeners;
- Pumps and mechanical static plant were housed in acoustic enclosures;
- Noise levels were routinely monitored;
- Drop heights for materials were minimised; and
- Low noise level reverse warning alarms consistent with site safety were utilised.

9.6 EVALUATION OF NOISE IMPACTS

Measured baseline noise levels (see section 9.4.1) include noise from all sources, including road traffic from the R410 and N81 plus operational noise from both the applicant quarry and other nearby quarrying activities. Noise modelling has predicted noise from the applicant quarry activities only to determine the likely worst-case contribution of the applicant quarry operations to the noise environment.

The predicted noise levels are presented in Table 9-18 with noise contours at a height of 4.0 m above ground level provided in Figure 9-6. The magnitude of impact and significance of effect have been determined with reference to criteria provided in Table 9-10 and Table 9-11 respectively. A comparison has also been made of the predicted operational noise levels against the measured existing noise levels and is presented in Table 9-19. The predicted levels at each of the five noise monitoring locations are also provided for reference.

Table 9-18: Evaluation of Predicted noise levels for Current Operational Condition against noise limit

Noise Sensitive Receptor	Predicted Noise Level, dB $L_{Aeq,1hr}$	Noise Limit, dB $L_{Aeq,T}$	Exceedance of Noise Limit, dB $L_{Aeq,T}$	Magnitude of Impact	Significance of Effect
R1	40.7	55.0	-14.3	Negligible	Imperceptible
R2	37.6	55.0	-17.4	Negligible	Imperceptible
R3	47.5	55.0	-7.5	Negligible	Imperceptible
R4	48.1	55.0	-6.9	Negligible	Imperceptible
R5	45.9	55.0	-9.1	Negligible	Imperceptible
R6	44.9	55.0	-10.1	Negligible	Imperceptible
R7	43.9	55.0	-11.1	Negligible	Imperceptible
R8	43.9	55.0	-11.1	Negligible	Imperceptible
R9	35.3	55.0	-19.7	Negligible	Imperceptible
R10	35.6	55.0	-19.4	Negligible	Imperceptible
R11	35.9	55.0	-19.1	Negligible	Imperceptible
R12	36.7	55.0	-18.3	Negligible	Imperceptible
R13	39.3	55.0	-15.7	Negligible	Imperceptible
R14	43.8	55.0	-11.2	Negligible	Imperceptible
R15	44.6	55.0	-10.4	Negligible	Imperceptible
R16	46.2	55.0	-8.8	Negligible	Imperceptible
R17	44.6	55.0	-10.4	Negligible	Imperceptible
R18	43.1	55.0	-11.9	Negligible	Imperceptible
R19	43.2	55.0	-11.8	Negligible	Imperceptible
R20	43.3	55.0	-11.7	Negligible	Imperceptible
R21	41.0	55.0	-14.0	Negligible	Imperceptible
R22	40.8	55.0	-14.2	Negligible	Imperceptible
R23	41.5	55.0	-13.5	Negligible	Imperceptible
Glen Ding Wood	41.4	55.0	-13.6	Negligible	Imperceptible

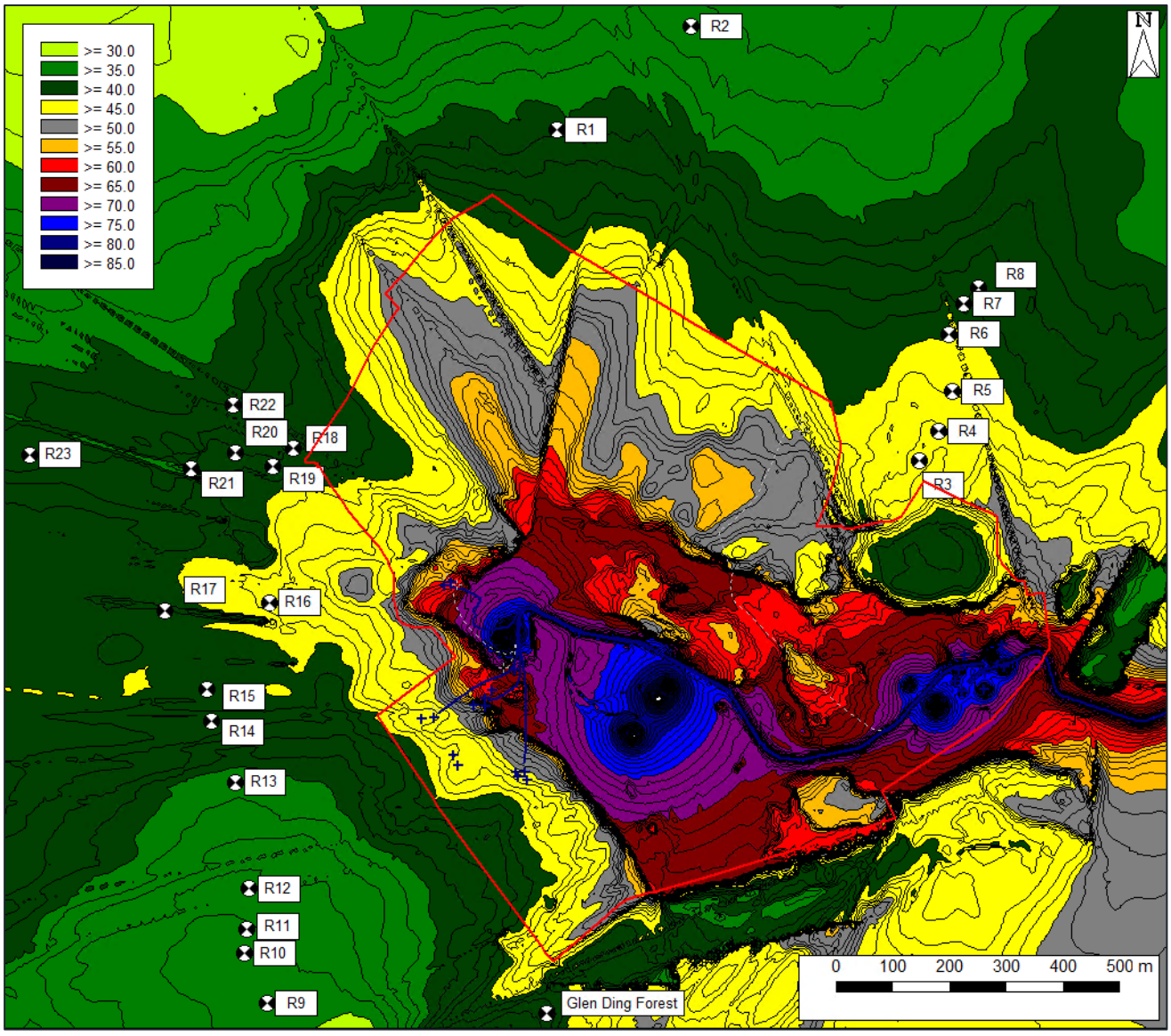

Figure 9-6: Current Operational Condition - Noise contours at 4.0m height, dB $L_{Aeq,1hr.}$ (EIA Boundary displayed)

Table 9-19: Comparison of predicted operational noise levels against measured noise levels at nearest monitoring positions

Noise Sensitive Receptor	Nearest Monitoring Position	Predicted Operational Noise Level, dB $L_{Aeq,1hr}$	Measured Existing Noise Level, dB $L_{Aeq,T}$*	Predicted Operational Noise Level minus Existing Noise Level, dB
R1	N3K	40.7	46.3	-5.6
R2	N3K	37.6	46.3	-8.7
R3	N4K	47.5	47.1	0.4
R4	N4K	48.1	47.1	1.0
R5	N4K	45.9	47.1	-1.2
R6	N4K	44.9	47.1	-2.2
R7	N4K	43.9	47.1	-3.2
R8	N4K	43.9	47.1	-3.2
R9	N1K	35.3	61.3	-26.0
R10	N1K	35.6	61.3	-25.7
R11	N1K	35.9	61.3	-25.4
R12	N1K	36.7	61.3	-24.6
R13	N1K	39.3	61.3	-22.0
R14	N1K	43.8	61.3	-17.5
R15	N1K	44.6	61.3	-16.7
R16	N1K	46.2	61.3	-15.1
R17	N1K	44.6	61.3	-16.7
R18	N2K	43.1	50.1	-7.0
R19	N2K	43.2	50.1	-6.9
R20	N2K	43.3	50.1	-6.8
R21	N1K	41.0	61.3	-20.3
R22	N2K	40.8	50.1	-9.3
R23	N1K	41.5	61.3	-19.8
Glen Ding Wood	N5K	41.4	51.8	-10.4
N1K	N1K	37.4	61.3	-23.9
N2K	N2K	42.9	50.1	-7.2
N3K	N3K	43.1	46.3	-3.2
N4K	N4K	47.6	47.1	0.5
N5K	N5K	44.1	51.8	-7.7

***Derived as the logarithmic average of all sample periods measured during the daytime at each location. Note that green shading denotes an increase in noise level above existing but <3.0 dB**

Comments on Predicted Operational Noise Levels and Significance of Impacts

It can be seen from the summary tables above that the daytime operational noise limit of 55 dB $L_{Aeq,T}$ is predicted to be achieved at all receptors for the current operational condition.

The predicted noise level from quarrying activities is below the measured existing level in almost every case, the exceptions being R3 and R4, where the predicted level is 0.4 dB and 1.0 dB respectively above measured. When considering the predicted levels at each measurement location, all are below measured with the exception of N4K (the closest measurement location to R3 and R4) where it is just 0.5 dB above measured. This exercise does indicate that noise sources other than the quarry influence the acoustic climate at most receptors, although the good correlation between predicted and measured at N4K (and nearby NSRs) suggest other noise source are less of an influence at this location.

When considering the predicted noise level against the permitted noise limit at all receptors, the magnitude of impact is ***negligible*** and the level of significance is ***imperceptible***. The impact is, therefore, ***not significant***.

9.7 CONSIDERATION OF THIRD-PARTY SUBMISSIONS MADE DURING THE HBL 2020 PLANNING APPLICATION (KCC REG. REF.: 20/532)

Following the submission of the 2020 planning application (KCC Reg. Ref.: 20/532) a number of third-party submissions were received by KCC. These third-party submissions were considered as part of the Further Information response submitted to KCC prior to the invalidation of the application in September 2020. In the compilation of this section these submissions, concerns and points of note have been addressed in this assessment. Table 9-20 below provides a general summary of submissions relevant to this section and details where or how this item has been considered.

Table 9-20 - KCC Reg. Ref.: 20/532 Third-Party Submissions Items Relevant to the Noise and Vibration Assessment

Submission Item Summary	Comment
Residential amenity	Residential amenity of the surrounding receptors has been considered in the predictive assessment – See Section 9.6
Structural damage to nearby homes from blasting	Blasting did not occur on Site during the assessment period of September 2020 to present.
Potential damage from blasting to the high-pressure gas pipeline that runs to the north of the subject site	Blasting did not occur on Site during the assessment period of September 2020 to present. Potential adverse effects to the GNI gas transmission pipeline have been assessed in the Noise and Vibration chapter of the EIAR which has been prepared for the concurrent Section 37L application for continued development of the Site. The potential impacts to the gas transmission pipeline are deemed not significant.
Noise, dust and air pollution	The potential adverse impacts from noise as a result of the development have been discussed and

	assessed throughout this chapter, with the overall impact categorised as 'not significant'.
Noise monitoring to be undertaken at the nearest occupied dwelling and at other noise sensitive locations in the vicinity of the quarry and the haul route	The noise monitoring locations adopted in the site's routine surveys have been located at the closest NSRs or at a location closer to the development to be representative of a number of NSRs in that area. See Section 9.5.1.2.
Corrective noise action to be incorporated into the Environmental Management Plan if exceedances of permitted limits are recorded	Environmental compliance is managed on site under the HBL Environmental Management System. Monitoring during the assessment period identified that levels were within the permitted noise limits or due to off site sources (i.e., the R410 regional road located to the west). Any exceedances reported to the Site are directed to the Quarry Manager for immediate investigation.
HSE submission - Include steps to be undertaken where noise, air water quality exceedances occur	Environmental compliance is managed on site under the HBL Environmental Management System. Any exceedances reported to the Site are directed to the Quarry Manager for immediate investigation.
HSE submission - Noise and vibration monitoring to be undertaken at nearest sensitive locations along the western boundary where blasting will occur,	The noise monitoring locations adopted in the site's routine surveys have been located at the closest NSRs or at a location closer to the development to be representative of a number of NSRs in that area. See Section 9.4. Vibration monitoring undertaken prior to the assessment period was monitored at the nearest sensitive receptors surrounding the site and at the gas transmission pipeline. The closest receptors were monitored during each blast.

9.8 CONCLUSIONS

This assessment considers historical noise from the quarry between September 2020 and present. No blasting was undertaken during this period and so ground borne vibration and air overpressure resulting from quarry blasting was scoped out of the assessment.

Baseline noise monitoring at five locations (four being representative of nearby dwellings and one being at the quarry boundary) has been undertaken at least bi-annually (i.e. twice a year) between April 2019 and January 2024. The baseline noise environment included contributions from road traffic noise, quarrying activities, other traffic sources, e.g., occasional overhead aircraft, and other sources typical of a rural environment, e.g., birdsong and rustling trees. With the exception of N1K, the average measured noise level at each location did not exceed the permitted level. At N1K, the exceedance was due to road traffic noise from the R410 rather than from quarrying activities.

Using a 3D environmental noise model, operational noise from the quarry has been predicted for the current operational activities undertaken at the quarry. These activities occurred during daytime periods only; night-time operations did not take place. The modelled operational scenario has followed a conservative approach to determine the likely 'worst-case' noise levels at NSRs. The predicted noise levels at each NSR are within the permitted daytime limits and the levels

recommended by the EPA Environmental Management Guidelines – Environmental Management in Extractive Industry. As such, the specific noise levels from quarry operations resulted in a negligible adverse impact at all NSRs which is ***not significant***.

In conclusion, no significant noise or vibration impacts have been identified throughout the operation of the quarry between September 2020 and present.

9.9 REFERENCES

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BS 7385-1:1990 - Evaluation and measurement for vibrations in buildings, Part 1: Guide for measurement of vibrations and evaluation of their effects on buildings.

BS 7385-2:1993 - Evaluation and measurement for vibrations in buildings, Part 2: Guide to damage levels from groundborne vibration.

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Appendix 9A

GLOSSARY OF ACOUSTICS TERMINOLOGY

GLOSSARY OF ACOUSTICS TERMINOLOGY

Ambient sound	The totally encompassing sound in a given situation, at a given time, including sound from any source in any direction.
Area source	A real or theoretical source that radiates as a planar surface. Sound from an area source at close range is radiated as plane waves rather than spherical waves, close range being considered as where the source is large relative to the wavelength of the sound produced. In the far field, the sound waves from an area source become spherical.
A-Weighting	The human ear can detect a wide range of frequencies, from 20Hz to 20kHz, but it is more sensitive to some frequencies than others. Generally, the ear is most sensitive to frequencies in the range 1 to 4 kHz. The A-weighting is a filter that can be applied to measured results at varying frequencies, to mimic the frequency response of the human ear, and therefore better represent the likely perceived loudness of the sound. SPL readings with the A-weighting applied are represented in dB(A).
Background sound	A component of the ambient and residual sound, comprising the steady sounds underlying sources that fluctuate in level within a period of consideration. This can be evaluated using the L_{A90} metric.
Band-Pass Filter	A band-pass filter allows defined sound frequencies with a certain range (or band) to pass with little or no impediment, while removing or impeding any other frequencies in the signal.
Decibel (dB)	The decibel scale is used in relation to sound because it is a logarithmic rather than a linear scale. The decibel scale compares the level of a sound relative to another. The human ear can detect a wide range of sound pressures, typically between $2x10^{-5}$ and 200 Pa, so the logarithmic scale is used to quantify these levels using a more manageable range of values.
Equivalent Continuous Level ($L_{eq,T}$)	The Equivalent Continuous Level represents a theoretical continuous sound, over a stated time period, T, which contains the same amount of energy as a number of sound events occurring within that time, or a source that fluctuates in level. For example, a noise source with an SPL of 80 dB(A) operating for two hours during an eight-hour working day, has an equivalent A-weighted continuous level over eight hours of 74 dB, or $L_{Aeq,8hrs}$ = 74 dB. The time period over which the L_{eq} is calculated should always be stated.

Level Envelope	The envelope of a signal describes its variation in amplitude over time, and 'encloses' the short-term variation in instantaneous signal levels.
Line Source	A theoretical source of sound, with length only, often used to model long, thin sound sources, such as roads.
Loudness	The loudness of a sound is subjective, and differs from person to person. The human ear perceives loudness in a logarithmic fashion, hence the suitability of the decibel scale. Generally, a perceived doubling or halving of loudness will correspond to an increase or decrease in SPL of 10dB. Note that a doubling of sound energy corresponds to an increase in SPL of only 3dB.
L_{10}, L_{90} and other L_n percentile-based measures	Percentile measures express statistical measures of noise: L_{10} represents the SPL exceeded for 10% of the time period considered; L10 is often used to describe typical noise levels of road traffic. L_{90} represents the SPL which is exceeded for 90% of the time, expressed in dB or dB(A); L_{A90} is used to quantify underlying 'background sound' levels. Other percentile-based measures are sometimes used for various types of noise assessment. These include L_{01}, L_{50}, L_{99}.
L_{den}	The day-evening-night noise level, also known as the day-evening-night noise indicator, is the A-weighted L_{eq} (equivalent continuous level) over a whole day, but with a penalty of 10 dB(A) for night-time noise (23.00-07.00) and 5 dB(A) for evening noise (19.00-23.00).
L_{night}	The night noise level, also known as the night noise indicator, is the A-weighted, L_{eq} (equivalent noise level) over the 8-hour night period of 23.00 to 07.00 hours.
Masking Noise	The human perception of a sound is affected by the presence of other audible sounds. Noise can provide masking for sounds that would otherwise be more clearly perceived. A masked sound may appear less distinct or may even not be detectable at all by a listener when a masking noise is present. In some situations, such as wind farms with residential neighbours, some masking noise (such as wind blowing through local vegetation) may be desirable.
Maximum Sound Level (L_{max})	The maximum sound level, L_{max} (or L_{Amax} if A-weighted) is the highest SPL that occurs during a given event or time period.
Minimum Sound Level (L_{min})	Similarly, the minimum sound level, L_{min} (or L_{Amin} if A-weighted) is the lowest SPL that occurs during a given event or time period.
Noise	A noise can be described as an unwanted sound. Noise can cause nuisance.

Noise Sensitive Receptors (NSRs)	Any identified receptor likely to be affected by noise. These are generally human receptors and may include residential dwellings, work places, schools, hospitals, community facilities, places of worship and recreational spaces.
Octave	In reference to the frequency of a sound, an octave describes the difference between a given frequency and that which is double that frequency, e.g. 125Hz to 500Hz, or 4kHz to 8kHz.
Octave Band / Third Octave Bands	A sound made up of more than one frequency can be described using a frequency spectrum, which shows the relative magnitude of the different frequencies within it. The possible range of frequencies is continuous, but can be split up into discrete bands, often an octave or third-octave in width. Each octave band is referred to by its centre frequency, generally 63Hz, 125Hz, 250Hz, 500Hz, 1kHz etc.
Point Source	A theoretical source of sound, with zero size and mass, often used as an approximation to model small sources. Sound from a point source radiates spherically in all directions.
Residual Sound	Another component of the ambient sound, associated with any sources other than the specific source(s) under consideration.
RMS	Root-mean-square. Instantaneous sound pressure can take positive or negative values around the mean (atmospheric pressure). To describe the energy in pressure waves the instantaneous pressure is squared, and averaged over a finite time interval. The square root reduces the mean-square value to linear, rather than squared, units.
Sound Power Level (SWL)	The Sound Power Level defines the rate at which sound energy is emitted by a source, and is also expressed in dB. It is defined as follows: SWL (dB) = 10 $Log_{10}(W/W_{ref})$ Where W = Sound Power (in Watts) W_{ref} = Reference Power 1 picoWatt

Sound Pressure Level (SPL)	The Sound Pressure Level has units of decibels, and compares the level of a sound to the smallest sound pressure generally perceptible by the human ear, or the reference pressure. It is defined as follows: SPL (dB) = 10 $Log_{10}(P/P_{ref})^2$ Where P = RMS Sound Pressure (in Pa) P_{ref} = Reference Pressure $2x10^{-5}$ Pa An SPL of 0dB suggests the Sound Pressure is equal to the reference pressure. This is known as the *threshold of hearing*. An SPL of 140dB represents the *threshold of pain*.
Specific Sound	A component of the ambient sound, associated with a specific source/s under consideration.
Spectral content	Sounds are typically made up of acoustic energy present in many frequencies of the audible spectrum. The frequency spectrum describes this signal 'content'.
Time Weighting	The sound pressure level is calculated from the root-mean-square (RMS) value of the instantaneous acoustic pressure. Calculation of the RMS value requires a finite time interval over which to calculate the mean. Sound level meters use a time-weighted average, which multiplies the squared pressure sample by an exponential function of the constant time interval over which the average is calculated. Standard time constants in current use include 'Fast', 'Slow', and 'Impulse' which have values of 0.125s, 1s, and 0.035s respectively. The weighting used is designated by subscripts attached to a level descriptor, e.g. $L_{p,F}$; L_{Smax} etc. The L_{eq} is not a time-weighted level descriptor.

Vibration	Vibration is defined as a repetitive oscillatory motion. Vibration can be transmitted to the human body through the supporting surfaces; the feet of a standing person, the buttocks, back and feet of a seated person or the supporting area of a recumbent person. In most situations, entry into the human body will be through the supporting ground or through the supporting floors of a building. Vibration is often complex, containing many frequencies, occurring in many directions and changing over time. There are many factors that influence human response to vibration. Physical factors include vibration magnitude, vibration frequency, vibration axis, duration, point of entry into the human body and posture of the human body. Other factors include the exposed persons experience, expectation, arousal and activity. Experience shows that disturbance or annoyance from vibration in residential situations is likely to arise when the magnitude of vibration is only slightly in excess of the threshold of perception.
Vibration and Blasting Terminology	
Air Overpressure	The energy transmitted within the atmosphere from a blast site in the form of pressure waves, comprising both audible (noise) and inaudible (concussion) energy. Measured in linear decibels, dB(lin).
Maximum Instantaneous Charge (MIC)	Maximum amount of explosive detonated on any one delay interval. Measured in kg.
Peak Particle Velocity (PPV)	The maximum instantaneous velocity of a particle at a point during a given time interval, usually stated in mm/s.
Vibration Sensitive Receptors (VSRs)	Any identified receptor likely to be affected by vibration. As with noise, these are generally human receptors and may include residential dwellings, work places, schools, hospitals, community facilities, places of worship and recreational spaces.

Appendix 9B

NOISE MONITORING DATA, APRIL 2019 – JANUARY 2024

Monitoring Location	Date	Time (start of measurement)	Duration	Day-time Limit $L_{Aeq,T}$	$L_{Aeq,T}$	$L_{A10,T}$	$L_{A90,T}$
N1K	05/04/2019	15:25	00:30	55	66.4	71.8	38.8
N1K	23/08/2019	12:58	00:30	55	64.6	69.8	45.1
N1K	17/09/2019	11:17	00:30	55	62.3	68.0	35.8
N1K	29/10/2019	12:28	00:30	55	60.7	66.0	45.5
N1K	05/03/2020	10:27	00:30	55	56.4	61.7	36.3
N1K	23/08/2020	12:59	00:30	55	64.6	69.8	45.1
N1K	30/04/2021	12:45	00:30	55	59.4	63.9	41.5
N1K	16/11/2021	11:28	00:30	55	60.2	65.1	42.4
N1K	28/07/2022	10:19	00:30	55	53.3	58.1	32.7
N1K	28/10/2022	15:16	00:30	55	50.5	54.3	42.4
N1K	04/04/2023	15:53	01:00	55	66.3	70.7	49.8
N1K	01/06/2023	12:14	01:00	55	57.2	74.4	42.6
N1K	04/08/2023	16:55	01:00	55	53.8	57.9	38.6
N1K	10/10/2023	10:00	01:00	55	53.2	57.9	37.1
N1K	29/11/2023	12:18	01:00	55	53.1	57.7	40.7
N1K	08/01/2024	15:58	01:00	55	54.9	59.0	45.3
N2K	05/04/2019	11:56	00:30	55	43.3	46.1	38.5
N2K	23/08/2019	16:26	00:30	55	47.3	49.5	42.1
N2K	17/09/2019	12:57	00:30	55	39.1	41.2	30.9
N2K	29/10/2019	15:27	00:30	55	46.5	48.9	42.7
N2K	05/03/2020	12:26	00:30	55	59.1	43.8	34.3
N2K	23/08/2020	16:26	00:30	55	47.3	49.5	42.1
N2K	30/04/2021	09:56	00:30	55	41.5	45.5	31.9
N2K	16/11/2021	13:57	00:30	55	53.8	50.0	41.4
N2K	28/07/2022	12:15	00:30	55	42.5	46.3	34.1
N2K	28/10/2022	14:07	00:30	55	46.9	49.8	40.6
N2K	04/04/2023	12:44	01:00	55	49.7	51.8	42.4
N2K	31/05/2023	16:28	01:00	55	49.4	68.7	38.5
N2K	04/08/2023	14:26	01:00	55	45.8	45.1	37.6
N2K	10/10/2023	14:59	01:00	55	46.1	48.3	41.0
N2K	29/11/2023	15:11	01:00	55	46.1	48.1	40.1
N2K	08/01/2024	17:41	01:00	55	43.9	46.7	36.9
N3K	05/04/2019	12:33	00:30	55	39.6	39.7	33.3
N3K	23/08/2019	15:51	00:30	55	48.2	50.7	44.1
N3K	17/09/2019	13:32	00:30	55	34.0	35.4	27.4
N3K	29/10/2019	13:43	00:30	55	46.0	48.5	41.6
N3K	05/03/2020	11:32	00:30	55	36.3	37.4	30.4
N3K	23/08/2020	15:52	00:30	55	48.2	50.7	44.1
N3K	30/04/2021	11:16	00:30	55	42.6	45.8	34.5
N3K	16/11/2021	14:37	00:30	55	46.7	49.2	42.8
N3K	28/07/2022	11:26	00:30	55	36.2	38.6	29.7
N3K	28/10/2022	14:42	00:30	55	51.4	50.8	42.6
N3K	04/04/2023	14:07	01:00	55	51.1	54.2	45.1
N3K	31/05/2023	14:56	01:00	55	43.9	66.4	38.5

Monitoring Location	Date	Time (start of measurement)	Duration	Day-time Limit $L_{Aeq,T}$	$L_{Aeq,T}$	$L_{A10,T}$	$L_{A90,T}$
N3K	04/08/2023	15:32	01:00	55	46.2	45.6	36.9
N3K	10/10/2023	16:19	01:00	55	46.7	48.5	42.2
N3K	29/11/2023	13:51	01:00	55	37.2	39.7	31.3
N3K	08/01/2024	14:30	01:00	55	45.4	44.3	37.7
N4K	05/04/2019	13:36	00:30	55	43.6	45.7	40.8
N4K	23/08/2019	13:50	00:30	55	50.4	52.2	47.4
N4K	17/09/2019	12:18	00:30	55	46.8	48.9	40.9
N4K	29/10/2019	16:39	00:30	55	46.9	48.4	44.0
N4K	05/03/2020	16:07	00:30	55	46.5	47.3	43.2
N4K	23/08/2020	13:50	00:30	55	50.4	52.2	47.4
N4K	30/04/2021	14:01	00:30	55	40.0	41.5	35.8
N4K	16/11/2021	13:13	00:30	55	47.8	49.0	44.7
N4K	28/07/2022	13:37	00:30	55	44.3	48.4	37.0
N4K	28/10/2022	12:14	00:15	55	47.6	47.3	37.3
N4K	28/10/2022	12:29	00:15	55	46.5	46.5	36.4
N4K	04/04/2023	11:13	01:00	55	49.0	51.7	44.3
N4K	31/05/2023	12:49	01:00	55	47.7	78.6	36.5
N4K	04/08/2023	13:09	01:00	55	40.8	41.7	35.1
N4K	10/10/2023	11:50	01:00	55	49.8	50.6	44.0
N4K	29/11/2023	10:44	01:00	55	39.1	39.6	34.1
N4K	08/01/2024	12:44	01:00	55	45.0	42.6	36.8
N5K	05/04/2019	14:28	00:30	55	49.9	53.0	42.5
N5K	23/08/2019	14:40	00:30	55	50.1	53.2	43.6
N5K	17/09/2019	14:21	00:30	55	45.4	48.3	37.6
N5K	29/10/2019	15:45	00:30	55	47.7	50.5	42.1
N5K	05/03/2020	16:00	00:30	55	47.2	60.9	38.9
N5K	23/08/2020	14:40	00:30	55	50.1	53.2	43.6
N5K	30/04/2021	15:21	00:30	55	41.0	42.4	35.1
N5K	16/11/2021	12:34	00:30	55	47.8	49.9	43.5
N5K	28/07/2022	12:55	00:30	55	41.7	43.8	38.8
N5K	28/10/2022	11:39	00:15	55	44.8	46.9	40.2
N5K	28/10/2022	11:54	00:15	55	45.5	47.6	39.8
N5K	04/04/2023	09:40	01:00	55	60.0	62.6	54.8
N5K	01/06/2023	10:19	01:00	55	52.0	71.3	44.6
N5K	04/08/2023	10:18	01:00	55	54.9	56.9	51.0
N5K	10/10/2023	13:26	01:00	55	47.3	49.6	41.7
N5K	29/11/2023	09:08	01:00	55	50.7	52.8	46.8
N5K	08/01/2024	10:43	01:00	55	55.5	56.6	49.3

Appendix 9C

VIBRATION MONITORING DATA, FEBRUARY 2018 – AUGUST 2020

Location of Seismograph	Date	Relative Position to Blast (degrees)	Distance (m)	AOP, dB(lin)	PPV, mm/s Transverse	PPV, mm/s Vertical	PPV, mm/s Horizontal	Company	No. of Holes	Diam. mm	Inclination, °	Depth, m	Burden, m	Spacing, m	Total Charge, kg	No. of Delays	Max. Inst. Charge, kg
Gas pipeline	10/06/2020	131	428	111	1.400	1.000	1.000										
Gas pipeline	09/07/2020	138	396	111	0.762	0.635	1.143	IIE Ltd	80	110	0-5	13.2	7.7	3.3	3750	74	105
Gas pipeline	20/07/2020	98	320	117.9	3.110	2.480	4.060	IIE Ltd	44	108	0	12.5	3.5	4230	44	115	
Gas pipeline	20/07/2020	NA	NA	117.9	3.112	2.477	4.064										
Gas pipeline	07/08/2020	95	317	120	6.000	2.500	3.100	IIE Ltd	49	106	0-6	15.3	6.5	3.5	6207	49	145
Gas pipeline	07/08/2020	NA	317	120	6.000	2.500	3.100										
Gas pipeline	31/08/2020	94	321	120.1	4.000	2.100	3.810	IIE Ltd	37	108	0-14	14.5	7	4	4294	37	132
V1	13/02/2018	n/a	n/a	Non-Trigger Event	-	-	-	Rock Solutions									
V1	13/03/2018	n/a	n/a	Non-Trigger Event	-	-	-	Rock Solutions									
V1	30/05/2018	n/a	n/a	Non-Trigger Event	-	-	-	Rock Solutions									
V1	13/09/2018	212	770	121.2	1.58	1.27	1.01	IIE Ltd	27	110/127	5-20°	22	9.5	5.3	6,184	26	275
V1	19/10/2018	222	744	113.3	0.95	0.69	1.01	IIE Ltd	46	110	0°	16	6.8	4.2	7,210	46	175
V1	20/11/2018	223	764	109.9	1.01	0.82	0.57	IIE Ltd	40	110	0-10°	18	7.5	5	6,370	40	180
V1	12/12/2018	227	781	98	0.69	0.63	0.38	IIE Ltd	22	110	0°	18.5	6.7	4	3,654	23	180
V1	07/01/2019	228	770	117	0.80	0.80	1.00	IIE Ltd	45	108	0 - 43°	17.4	8.5	3.8	5,320	41	155
V1	21/01/2019	230	794	115	0.57	0.57	0.50	IIE Ltd	29	110	0 °	20	7	4	5,407	29	200
V1	26/04/2019	222	828	117	1.08	0.82	1.14	IIE Ltd									
V1	05/07/2019	230	759	108	0.50	0.63	0.63	IIE Ltd	34	110	0°	20	7.2	4	3,430	32	190
V1	17/07/2019	215	800	114	1.10	0.80	0.80	IIE Ltd	56	110	0°	19.5	7	4.3	8,820	56	205
V1	19/08/2019	221	796	101.9	0.88	0.76	0.82	IIE Ltd	32	110	0-10°	20	7.6	3.9	5,190	28	200
V1	19/09/2019	224	880	91	0.50	0.51	0.63	IIE Ltd	30	110	0-10°	16.6	9.38	4	4,270	30	150
V1	08/10/2019	224	810	<120	<0.51	<0.51	<0.51	IIE Ltd	22	105	0°	12.5	12	3.7	2,405	22	115
V1	18/10/2019	220	825	106.5	0.44	0.88	0.69	IIE Ltd	54	110	0-15°	16.2	6.9	4.3	7,670	53	155
V1	31/10/2019	230	800	124.8	1.46	1.21	0.83	IIE Ltd	36+13	105	5-23°	28	10	4	8,476	38+8	285
V1	21/11/2019	220	780	120.8	0.63	0.88	0.63	IIE Ltd	54	110	0-20°	16.8	7	4.3	7,304	55	155
V1	02/12/2019	224	792	88	0.50	0.57	0.31	IIE Ltd	21	110	10-20°	20	8.9	3.7	3,300	20	200
V1	17/01/2020	130	805	118.7	0.57	0.45	0.70	IIE Ltd	35	108	8-12°	21.5	10.4	4.2	6,182	35	225
V1	11/02/2020	218	757	121	0.064	0.064	0.064	IIE Ltd	17	110	0-13°	11.5	8.6	4	1,108	15	96
V1	17/02/2020	230	759	103	0.25	0.38	1.39	IIE Ltd	32	110	0-15°	11.2	7.35	4	1,181	32	85
V1	09/03/2020	230	780	116	0.630	1.140	0.570	IIE Ltd	48	110	0-25°	21	3.3	3.8	6,190	40	205
V1	20/03/2020	NA	889	108.8	0.696	0.826	1.143										
V1	08/04/2020	232	4141	<116	<0.5	<0.5	<0.5	IIE Ltd	80	110	0	13.8	6.2	4	6237	78	120
V1	10/06/2020	236	703	105	0.889	0.572	0.445										
V1	20/07/2020	251	653	111	1.000	1.400	1.400	IIE Ltd	44	108	0	12.5	3.5	4230	44	115	
V1	20/07/2020	NA	NA	111	1.000	1.400	1.400										
V1	07/08/2020	250	656	110	2.200	1.800	1.800	IIE Ltd	49	106	0-6	15.3	6.5	3.5	6207	49	145
V1	31/08/2020	252	656	104.9	2.160	1.650	1.590	IIE Ltd	37	108	0-14	14.5	7	4	4294	37	132

Location of Seismograph	Date	Relative Position to Blast (degrees)	Distance (m)	AOP, dB(lin)	PPV, mm/s Transverse	PPV, mm/s Vertical	PPV, mm/s Horizontal	Company	No. of Holes	Diam. mm	Inclination, °	Depth, m	Burden, m	Spacing, m	Total Charge, kg	No. of Delays	Max. Inst. Charge, kg
V2	13/03/2018	n/a	n/a	Non-Trigger Event	-	-	-	Rock Solutions									
V2	19/04/2018	n/a	n/a	Non-Trigger Event	-	-	-	Rock Solutions									
V2	03/05/2018	n/a	n/a	Non-Trigger Event	-	-	-	Rock Solutions									
V2	18/06/2018	n/a	n/a	Non-Trigger Event	-	-	-	Rock Solutions									
V2	13/09/2018	118	820	114.4	1.20	0.85	1.14	IIE Ltd	27	110/127	5-20°	22	9.5	5.3	6,184	26	275
V2	19/10/2018	100	765	104.2	1.20	0.76	0.82	IIE Ltd	46	110	0°	16	6.8	4.2	7,210	46	175
V2	20/11/2018	115	849	110.2	0.63	0.57	0.57	IIE Ltd	40	110	0-10°	18	7.5	5	6,370	40	180
V2	12/12/2018	108	813	<90	0.40	0.60	0.60	IIE Ltd	22	110	0°	18.5	6.7	4	3,654	23	180
V2	07/01/2019	107	820	102.8	0.57	0.44	0.57	IIE Ltd	45	108	0 - 43°	17.4	8.5	3.8	5,320	41	155
V2	21/01/2019	106	809	94	0.88	0.57	0.38	IIE Ltd	29	110	0 °	20	7	4	5,407	29	200
V2	06/02/2019	108.41	926	<120	<0.5	<0.5	<0.5	IIE Ltd	39	105	0 °	15	8	3.6	4,019	37	132
V2	26/04/2019	103	776	99	0.50	0.50	0.72	IIE Ltd									
V2	07/06/2019	111	868	96	0.38	0.63	0.76	IIE Ltd	35	110	0 - 5°	20.4	7	3.3	6,867	35	200
V2	05/07/2019	106	816	88	0.63	0.50	0.76	IIE Ltd	34	110	0°	20	7.2	4	3,430	32	190
V2	17/07/2019	129	846	112	0.69	0.40	0.70	IIE Ltd	56	110	0°	19.5	7	4.3	8,820	56	205
V2	19/08/2019	331	907	<120	<0.5	<0.5	<0.5	IIE Ltd	32	110	0-10°	20	7.6	3.9	5,190	28	200
V2	19/09/2019	110	870	94	0.57	0.38	0.63	IIE Ltd	30	110	0-10°	16.6	9.38	4	4,270	30	150
V2	18/10/2019	110	870	104.2	0.95	0.69	0.82	IIE Ltd	54	110	0-15°	16.2	6.9	4.3	7,670	53	155
V2	21/11/2019	115	910	<120	<0.5	<0.5	<0.5	IIE Ltd	54	110	0-20°	16.8	7	4.3	7,304	55	155
V2	17/01/2020	106	780	112.3	0.94	0.45	0.79	IIE Ltd	35	108	8-12°	21.5	10.4	4.2	6,182	35	225
V2	17/02/2020	106	800	No reading	<0.5	<0.5	<0.5	IIE Ltd	32	110	0-15°	11.2	7.35	4	1,181	32	85
V2	20/03/2020	Na	755	106.5	0.826	0.889	1.080										
V2	10/06/2020	99	767	<115	<0.51	<0.51	<0.51	IIE Ltd	59	110	0	9	8.3	3	2992	59	70
V2	20/07/2020	85	765	107	1.000	0.800	0.800	IIE Ltd	44	108	0	12.5	3.5	4230	44	115	
V2	20/07/2020	NA	NA	107	1.000	0.800	0.800										
V2	31/08/2020	88	763	107	1.200	0.800	1.400	IIE Ltd	37	108	0-14	14.5	7	4	4294	37	132

Location of Seismograph	Date	Relative Position to Blast (degrees)	Distance (m)	AOP, dB(lin)	PPV, mm/s Transverse	PPV, mm/s Vertical	PPV, mm/s Horizontal	Company	No. of Holes	Diam. mm	Inclination, °	Depth, m	Burden, m	Spacing, m	Total Charge, kg	No. of Delays	
V3	13/02/2018	n/a	n/a	Non-Trigger Event	-	-	-	Rock Solutions									
V3	14/05/2018	n/a	n/a	Non-Trigger Event	-	-	-	Rock Solutions									
V3	30/05/2018	n/a	n/a	Non-Trigger Event	-	-	-	Rock Solutions									
V3	20/11/2018	160	337	108	1.01	1.14	0.88	IIE Ltd	40	110	0-10°	18	7.5	5	6,370	40	180
V3	07/01/2019	99	719	104.2	0.89	1.08	1.14	IIE Ltd	45	108	0 - 43°	17.4	8.5	3.8	5,320	41	155
V3	26/04/2019	95	665	109	0.88	0.88	1.01	IIE Ltd									
V3	07/06/2019	105	747	108	1.14	0.88	1.01	IIE Ltd	35	110	0 - 5°	20.4	7	3.3	6,867	35	200
V3	08/10/2019	106	696	97.5	0.38	0.44	0.70	IIE Ltd	22	105	0°	12.5	12	3.7	2,405	22	115
V3	31/10/2019	106	683	113.1	2.10	1.46	1.65	IIE Ltd	36+13	105	5-23°	28	10	4	8,476	38+8	285
V3	02/12/2019	101	699	106	0.76	0.50	0.31	IIE Ltd	21	110	10-20°	20	8.9	3.7	3,300	20	200
V3	11/02/2020	101	815	<120	<0.5	<0.5	<0.5	IIE Ltd	17	110	0-13°	11.5	8.6	4	1,108	15	96
V3	09/03/2020	100	680	104	1.07	0.63	0.63	IIE Ltd	48	110	0-25°	21	3.3	3.8	6,190	40	205
V3	08/04/2020	97	640	108	0.820	0.950	0.950	IIE Ltd	80	110	0	13.8	6.2	4	6237	78	120
V3	08/04/2020	NA	NA	108	0.826	0.953	0.953										
V3	09/07/2020	95	625	106.5	0.699	0.381	0.381	IIE Ltd	80	110	0-5	13.2	7.7	3.3	3750	74	105
V3	07/08/2020	73	690	113	2.200	1.800	2.000	IIE Ltd	49	106	0-6	15.3	6.5	3.5	6207	49	145
V4	06/02/2019	111.32	817	<120	<0.5	<0.5	<0.5	IIE Ltd	39	105	0 °	15	8	3.6	4,019	37	132
V4	07/08/2020	106	710	114	1.080	1.270	1.270	IIE Ltd	49	106	0-6	15.3	6.5	3.5	6207	49	145
V4	07/08/2020	NA	NA	114	1.080	1.270	1.270										
V5	19/04/2018	n/a	n/a	Non-Trigger Event	-	-	-	Rock Solutions									
V5	08/04/2020	220	1320	<117	<0.5	<0.5	<0.5	IIE Ltd	80	110	0	13.8	6.2	4	6237	78	120
V5	31/08/2020	227	1170	93	0.400	1.000	0.800	IIE Ltd	37	108	0-14	14.5	7	4	4294	37	132