9

NOISE AND VIBRATION

PUBLIC

9 NOISE AND VIBRATION

9.1 INTRODUCTION

This Environmental Impact Assessment Report (EIAR) has been prepared to accompany a planning application to be made under S.37L of the Planning and Development Act, 2000 as amended for the continuation of extraction at an existing quarry at Philipstown and Red Bog, Co. Kildare. The Proposed Development is located within the administrative boundary of Kildare County Council, (KCC).

This chapter of the EIAR has been prepared by WSP Ireland Consulting Ltd (WSP) and assesses the potential noise and vibration impacts associated with the Proposed Development during extraction (and restoration) at the Application Site.

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 SCOPE OF ASSESSMENT

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, including noise and vibration.

The scope of this assessment has included the following:

- Identification of the study area and sensitive receptors;
- Analysis of noise and vibration survey data;
- Derivation of applicable noise criteria;
- Prediction of operational phase noise and vibration impacts;
- Evaluation of noise and vibration impacts against criteria; and
- Specification of appropriate mitigation, if required.

9.1.2 EFFECTS SCOPED OUT – HGV CONTRIBUTION TO ROAD TRAFFIC NOISE

DMRB LA111 (see Section 9.2.3) provides scoping criteria for the evaluation of operational noise from a road. With reference to the LA111 scoping criteria provided in Section 3.4.1, the following questions need to be considered:

1) Is the project likely to cause a change in the basic noise level (BNL) of 1 dB $L_{A10,18hr}$ in the 'do minimum' opening year compared to the 'do something' opening year?

2) Is the project likely to cause a change in the BNL of 3 dB $L_{A10,18hr}$ in the 'do something' future year compared to the 'do minimum' opening year?

3) Does the project involve the construction of new road links within 600 m of noise sensitive receptors?

4) Would there be a reasonable stakeholder expectation that an assessment would be undertaken?

In consideration of the first two questions, with all other factors remaining the same, i.e. vehicle speed, road gradient and surface type, an increase in traffic flow of 25% would be required in the short term to facilitate a 1dB increase in traffic noise. To facilitate a 3dB increase in traffic noise in the longer term would require a double in road traffic flow.

The current application does not propose an increase in traffic generated by the facility. Operations at the Application Site will remain relatively consistent with previous production rates. There is likely to be small increase in extraction tonnage (1,016,000 tonnes per annum compared with circa 1,000,000 tonnes per annum at present) but this is primarily due to a small increase in the average HGV size used to export the extracted aggregate from the Site.

For the final two scoping questions, the proposals do not include any new road construction and it is unlikely that there would be reasonable expectation from stakeholders that an assessment of noise from operational road traffic would be required seeing as HGV movements will not change.

Changes in operational phase traffic noise levels have therefore been scoped out of this assessment.

9.1.3 SITE LOCATION AND SETTING

The Site is located in the east of Co. Kildare, immediately west of the border with Co. Wicklow, and ca. 1.8 km northwest of Blessington and ca. 7.5 km northeast of Naas. The lands surrounding the Site to the north and west can be characterised as rural in nature, with land uses in the area being agricultural and single house residential. Glen Ding Wood is located in the lands further to the south-west defined as forestry and a semi-natural area. Quarrying and aggregate extraction are widely practiced in the adjacent lands to the east and south. The quarries in the Blessington area are a major source of aggregate used in the production of construction material in the Greater Dublin region.

The Site is located within an area of historical quarrying. The existing operational quarry has been in use since the early 1950s and has been registered with Section 261, Planning & Development Act 2000 (Quarry Ref. No. QR42) and subsequent planning permission for continuation of quarrying operations was granted under Planning Reg. Ref. 07/267.

9.1.4 GEOGRAPHICAL, TEMPORAL SCOPE AND NOISE SENSITIVE RECEPTORS

The geographical study area for the assessment covers the EIA site boundary (Site) (identified on Figure 9-1) and a buffer zone of around 500 m from the EIA boundary (i.e. the study area), because most potential effects due to noise and vibration emissions from the Proposed 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 35 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.

Note that each of these receptors may also be considered for the purposes of this assessment to be vibration sensitive.

In the context of the EIAR, the Site boundary contains lands which form the existing quarry site and some areas which extend beyond the working areas.

The temporal scope of the assessment covers current 'baseline conditions' of the Site and draws on available historical information. The assessment aims to establish the baseline conditions at the

Site and then assess what impacts the proposed extension of quarrying activities will have on the Site and surrounding environment.

Under the current programme of the Proposed Development, the extraction phase will last for 13 - 15 years, which will provide for fluctuations in market demands for the aggregate extracted from the Site. The duration of the extraction phase is therefore classified as 'medium-term' by the Environmental Protection Agency's (EPA) 2022 'Guidelines on the information to be contained in environmental impact assessment reports'. The Proposed Development totals a remaining volume of ca. 8,708,900 m^3 (13,218,200 tonnes) of combined sands and gravels and rock. This is made up of ca. 5,544,900 m^3 (8,317,350 tonnes) of sands and gravels and ca. 1,960,345 m^3 (4,900,860tonnes) of rock.

The restoration phase of the Proposed Development will follow the extraction phase and will be 2 - 3 years in duration, which is 'short-term' - those lasting from one to seven years (EPA, 2022). From a noise perspective restoration works will be substantially less intensive than the operational phasing of the Proposed Development and as such the assessment of the operational phases in this chapter represents a worst-case assessment compared with the restoration phase. No blasting will occur in the restoration phase of the Proposed Development.

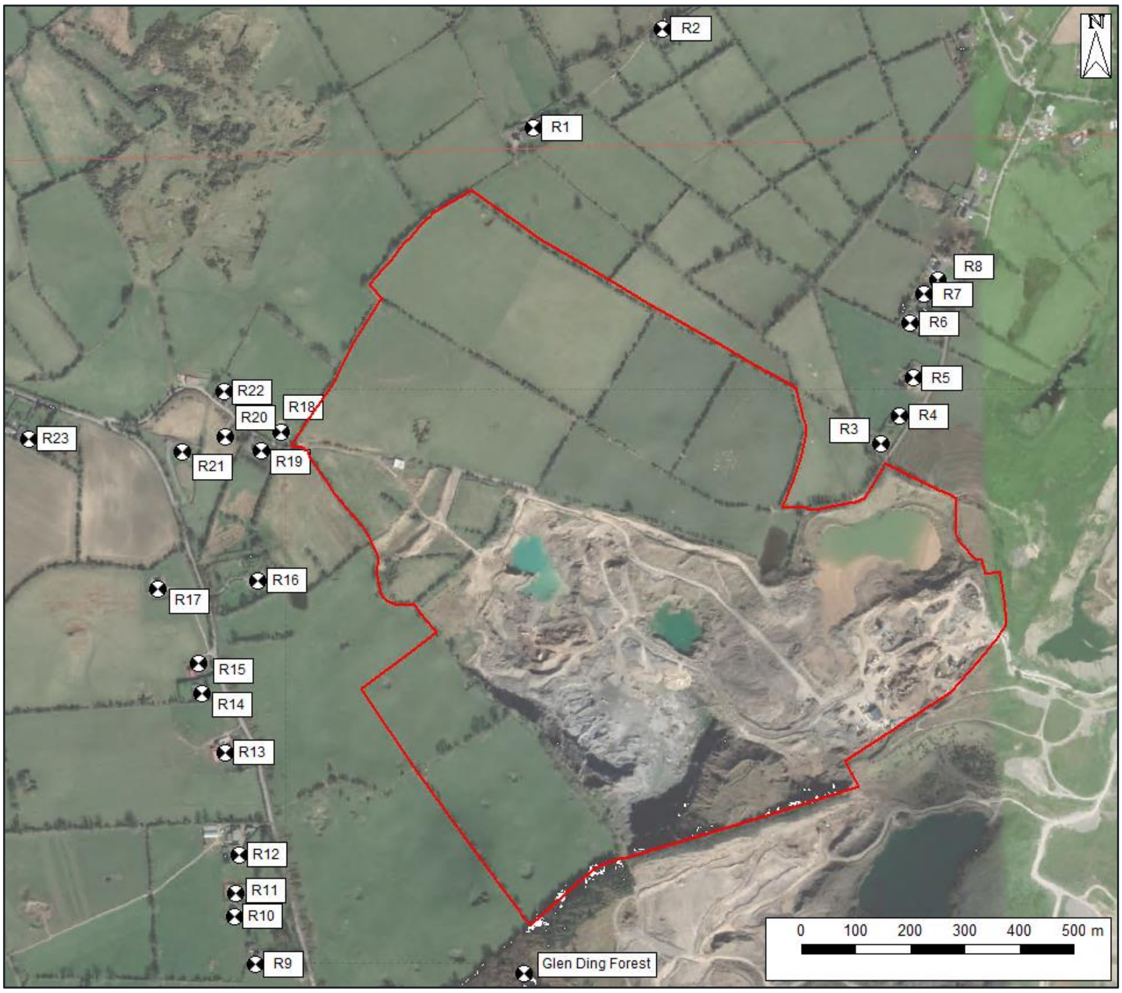

Figure 9-1: Location of the Site (EIA site boundary) with NSRs identified

Note that each of these receptors may also be considered for the purposes of this assessment to be vibration sensitive.

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, particularly built-up areas, public parks or quiet areas in an agglomeration, 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 the importance of protecting surrounding residential and natural amenities. The KCDP also identifies that gravel resources are important to the 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 from adverse environmental impact from extractive industry, which includes nuisance noise and excessive vibrations from these projects. The Council acknowledges that nuisance noise and vibrations can have negative effects on the 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 2020). 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

The most recent Irish guidance document in relation to noise was published in 2016 by the 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 but 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 the table 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 the table 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 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 the table above and figure below be reduced by 50%.

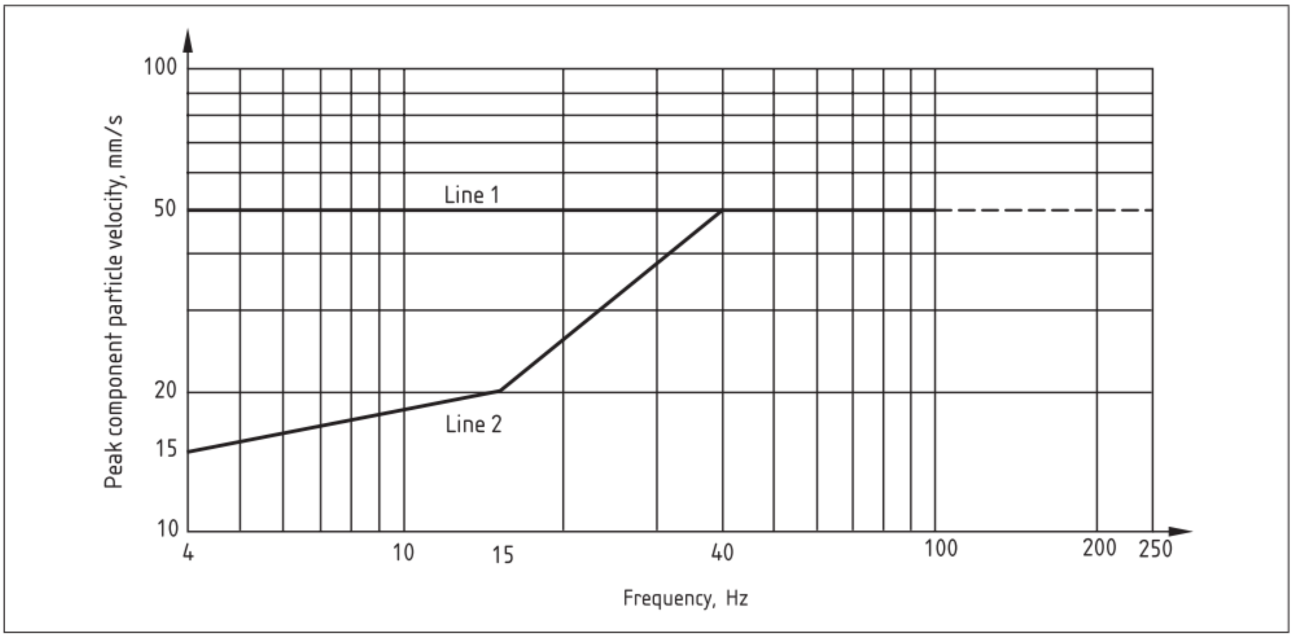

Figure 9-2: BS 5228-2 Guidance on transient vibration guide values for cosmetic damage

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	6.0 to 10.0
	Night – 23:00 to 07:00	2.0
	Other times	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.

British Standard BS 8233:2014 Guidance on sound insulation and noise reduction for buildings (BS 8233), 2014

The scope of BS 8233 is the provision of guidance for the control of noise in and around buildings. It suggests appropriate criteria for different situations, which primarily are intended to guide the design of new buildings, or refurbished buildings undergoing a change of use. The noise level criteria recommended in BS 8233 for residential spaces are based on the World Health Organisation Guidelines for Community Noise and are summarised in Table 9-6 below.

Table 9-6: Indoor ambient noise levels for dwellings (BS 8233 Table 4)

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

Note 7 to the above table states:

"Where development is considered necessary or desirable, despite external noise levels above WHO (World Health Organisation) guidelines, the internal target levels may be relaxed by up to 5 dB and reasonable internal conditions still achieved."

On design criteria for external noise, BS 8233 states that:

"For traditional external areas that are used for amenity space, such as gardens and patios, it is desirable that the external level does not exceed 50 dB $L_{Aeq,T}$, with an upper guideline value of 55 dB $L_{Aeq,T}$ which would be acceptable in noisier environments".

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 on assessment and mitigation. Recommended noise limit values are 55dB $L_{Aeq,1hr}$ and 45dB $L_{Aeq,15min}$ for daytime and night-time respectively.

World Health Organisation (WHO) Guidelines for Community Noise, 1999

The WHO guidelines consolidate scientific knowledge on the health effects of community noise and provide guidance to environmental health authorities and professionals trying to protect people from the harmful effects of noise in non-industrial environments. The main sources of community noise are identified as road, rail and air traffic, industries, construction and public work and neighbours.

A wide range of specific effects and environments are considered in the guidelines but a few that relate to this study are described below.

With regard to community noise, the guidelines state (in section 4.2.7) that annoyance "*varies with the type of activity producing the noise…..During the daytime, few people are seriously annoyed by activities with L_{Aeq} levels below 55 dB; or moderately annoyed with L_{Aeq} levels below 50 dB.*" The time base for these values, which relate to the daytime period, is 16 hours.

In dwellings, the critical effects of noise are on sleep, annoyance and speech interference. To avoid sleep disturbance "*indoor guideline values for bedrooms are 30 dB L_{Aeq} for continuous noise and 45 dB L_{Amax} for single sound events*".

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 below.

Table 9-7: 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 9-8.

Table 9-8: 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 9-7. 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 9-9: 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 or minor 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 9.3.1.3).

9.3 ASSESSMENT METHODOLOGY

9.3.1 NOISE IMPACT ASSESSMENT

9.3.1.1 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 hours and limits stated in Condition 33 are maintained for the proposed continuation of extraction and processing at the Site.

9.3.1.2 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 9-10.

Table 9-10: 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

9.3.1.3 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 9-11 details the resulting impact magnitude that have been applied.

Table 9-11: 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 9-11 have been used to determine the significance of noise effects for receptors of different sensitivities, as shown in Table 9-12.

Table 9-12: Level of significance, relative to sensitivity of receptors

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

9.3.1.4 Significance of Effect

A significant effect occurs where a medium or high impact 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, noise impacts that are determined to be large or profound are considered to be **significant** with impacts that are slight or moderate considered to be **not significant**.

9.3.1.5 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 9.5.1.

9.3.1.6 Prediction of Noise Levels from Proposed 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 proposed 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 proposed future extent of the quarry, including new quarry walls, was also incorporated into the model. 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).

Working Scenarios for Noise Prediction

Both the current operational condition and future potential operational scenarios have been modelled. Modelling the current condition (based on topographical surveys undertaken in 2023) allows for direct comparison between predicted and measured noise levels.

Further details on the activities included within the model are provided below:

Current Operational Condition

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.

Future Operational Scenarios

Future scenarios will include the same activities as currently experienced but at new locations within the proposed pit extensions as follows:

Southern pit extension

- 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.

Northern pit extension (to occur during the latter phases of the project, see Chapter 2, Project Description):

- The extraction of sand and gravel by mechanical means, using excavators and haul trucks.

Surface activities (screening and loading vehicles) will be unchanged.

Based on these operations and the project phasing, the current operational condition and three future noise prediction scenarios have been developed and assessed as follows:

- Existing operational condition: processing of blasted rock towards centre of main pit; extraction of sand/gravel in southern and western areas of main pit; surface activities at eastern boundary of site.

- Future Scenario 1: processing of blasted rock in most southerly extent of southern pit extension; extraction of sand/gravel in most southerly extent of southern pit extension only; surface activities as existing at eastern boundary of site.
- Future Scenario 2: processing of blasted rock in most southerly extent of southern pit extension; extraction of sand/gravel shared between most southerly extent of southern pit extension and westerly extent of southern pit extension; surface activities as existing at eastern boundary of site.
- Future Scenario 3: processing of blasted rock in most southerly extent of southern pit extension; extraction of sand/gravel shared between most southerly extent of southern pit extension and most northerly extent of northern pit extension; surface activities as existing at eastern boundary of site.

Topsoil and Overburden

Topsoil and overburden will be stripped from the Application area in phases. The stripping will occur infrequently at the Site and for short durations. Therefore, soil stripping has not been included within the assessment.

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 9-13, 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 9-13: 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

Predicted Operational Scenarios

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).

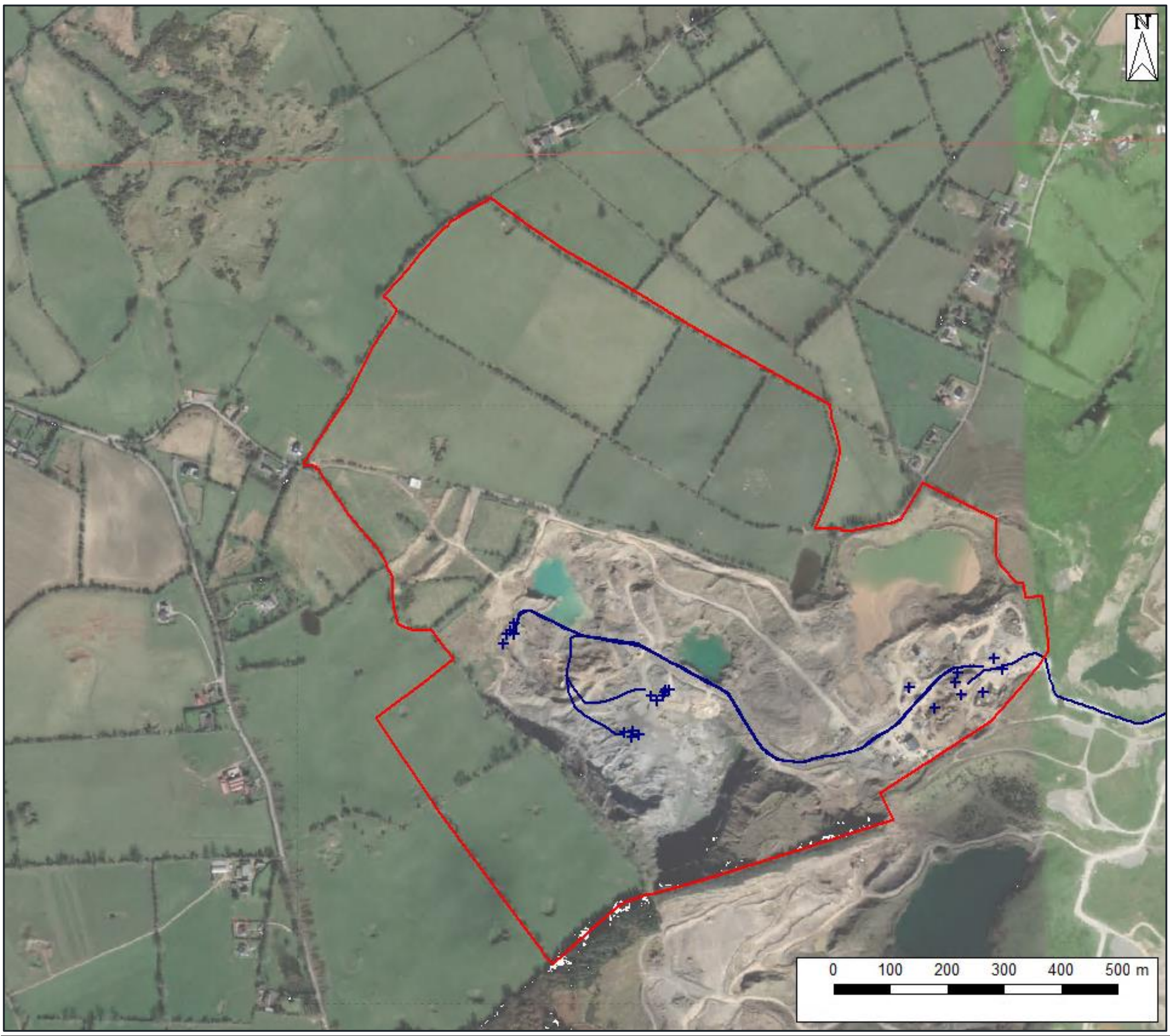

Figure 9-3: Existing operational condition inputs and plant locations

Scenario 1 – all extraction works in southwest pit

In Scenario 1, all plant associated with extraction is located within the proposed southwest pit extension. Plant associated with screening activities is located at the site's eastern boundary. Plant have been located at the extremity of the pit void so that they are at the closest working location to the closest receptors.

The predicted inputs for this scenario include the activities of the fixed and mobile equipment detailed below with locations relative to the current site extents identified in **Figure 9-4**.

Proposed southwest pit extension

- 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 in the southern corner of the pit closest to NSR refs. R13, R14 and R15;
- 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.

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).

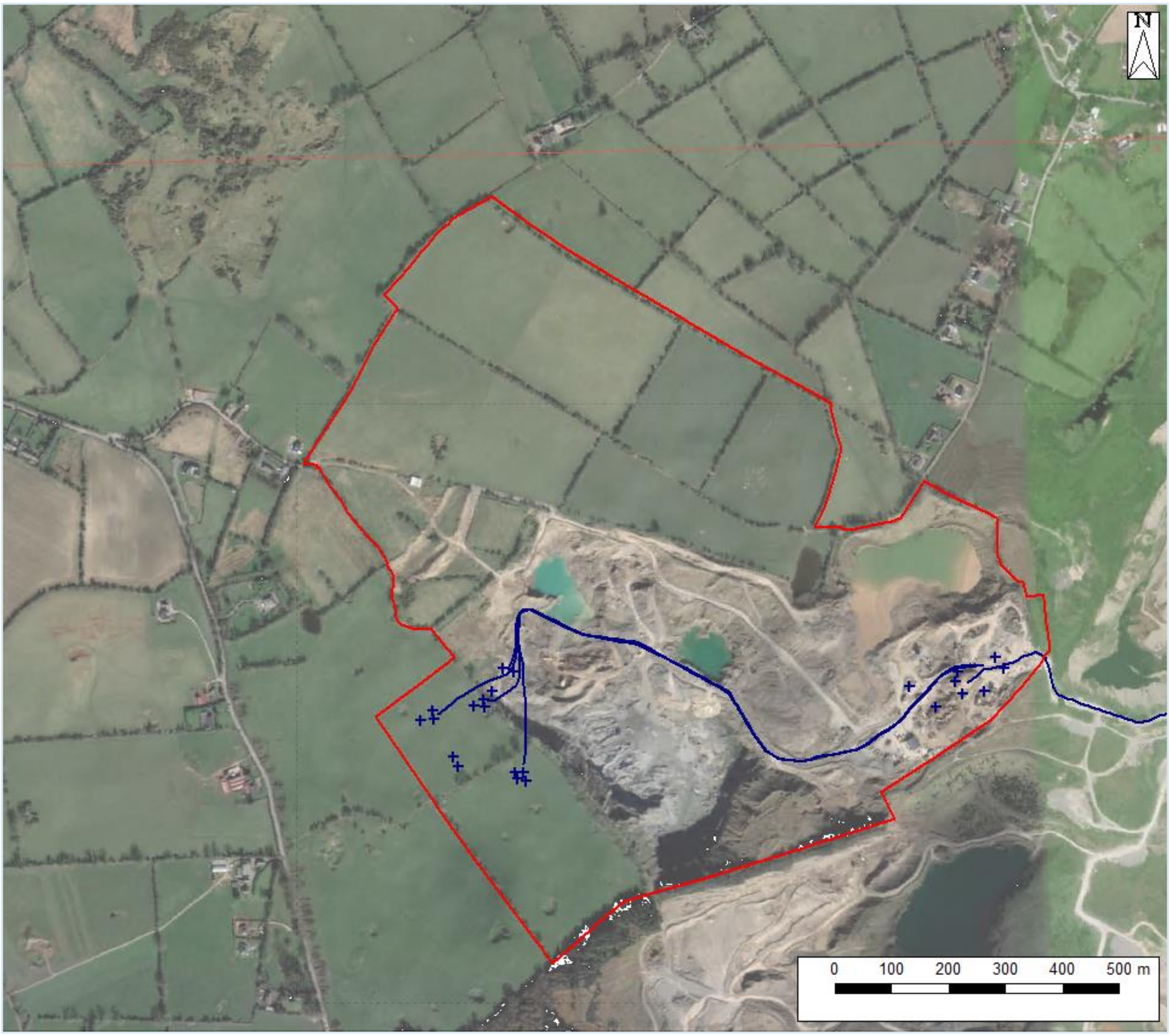

Figure 9-4: Scenario 1 inputs and plant locations

Scenario 2 – extraction works in southwest pit: sand and gravel extraction in northern section of southern pit

This scenario is similar to Scenario 1 described above, but the workings of sand and gravel in the extension area have progressed into the northern section of the southern pit. Plant have been located at the extremity of the pit void so that they are at the closest working location to the closest receptors.

The predicted inputs for this scenario include the activities of the fixed and mobile equipment detailed below with locations relative to the current site extents identified in **Error! Reference source not found.**. All plant has an on-time of 100 % unless otherwise stated.

Proposed southwest pit extension

- 1 no. excavator and 1 no. rock breaker at a recently blasted face in the southern corner of the pit closest to NSR refs. R13, R14 and R15;
- 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.

Northern extent of proposed southwest pit extension

- 1 no. face shovel and 1 no. excavator excavating sand and gravel in the pit and loading haul trucks.

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.

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).

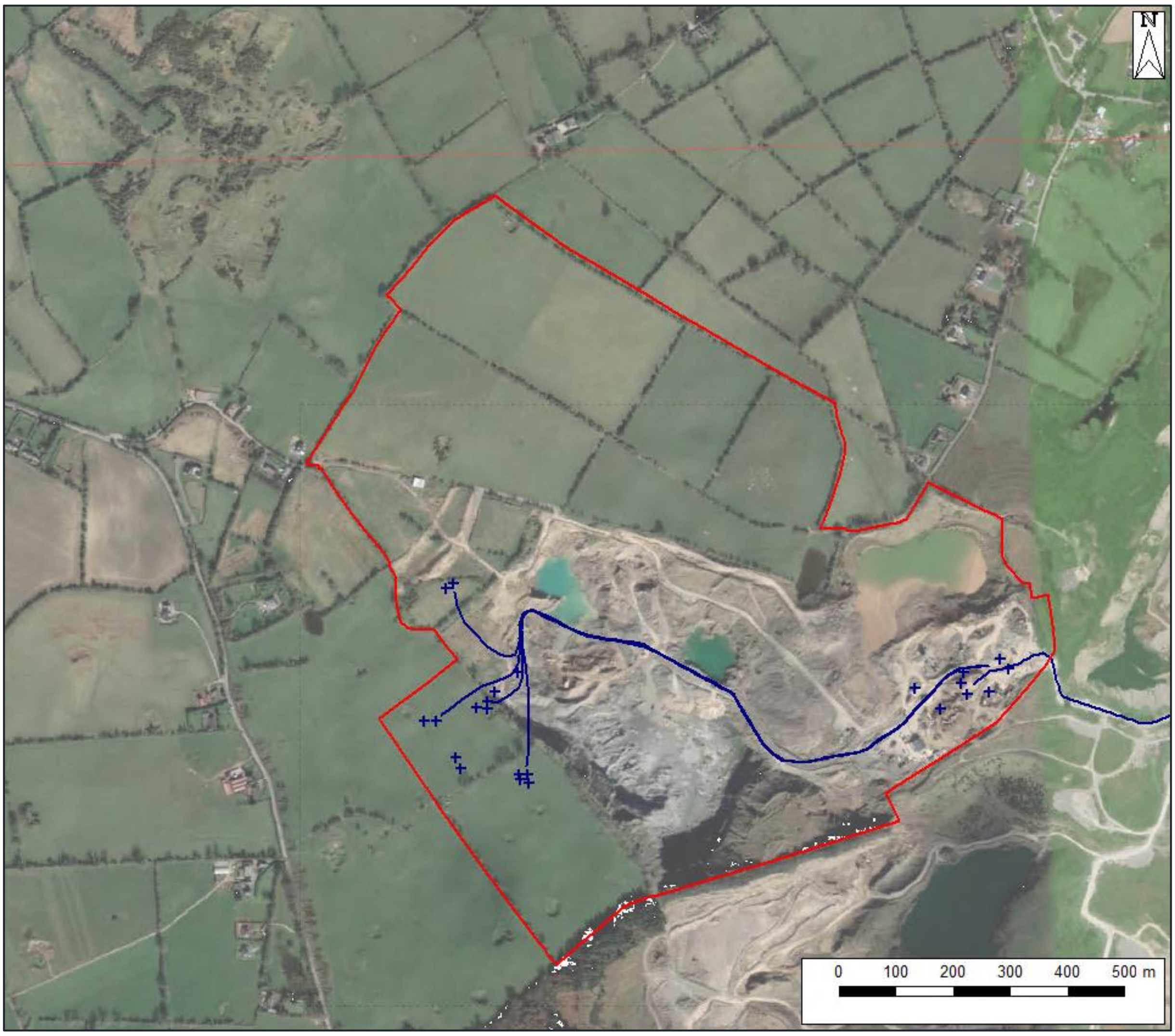

Figure 9-5: Scenario 2 inputs and plant locations

Scenario 3 – extraction works in southwest pit; sand and gravel extraction in northern pit extension

This predicted scenario is similar to Scenario 2 described above, but the workings of sand and gravel have progressed to the northern pit, which represents the latter phases of the proposed development. Plant have been located at the extremity of the pit void so that they are at the closest working location from the sensitive receptors.

The predicted inputs for this scenario include the activities of the fixed and mobile equipment detailed below with locations relative to the current site extents identified in **Figure 9-6**. All plant has an on-time of 100 % unless otherwise stated.

Proposed southwest pit extension

- 1 no. excavator and 1 no. rock breaker at a recently blasted face in the southern corner of the pit closest to NSR refs. R13, R14 and R15;
- 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.

Proposed northern pit extension

- 1 no. face shovel and 1 no. excavator excavating sand and gravel in the pit and loading haul trucks.

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.

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).

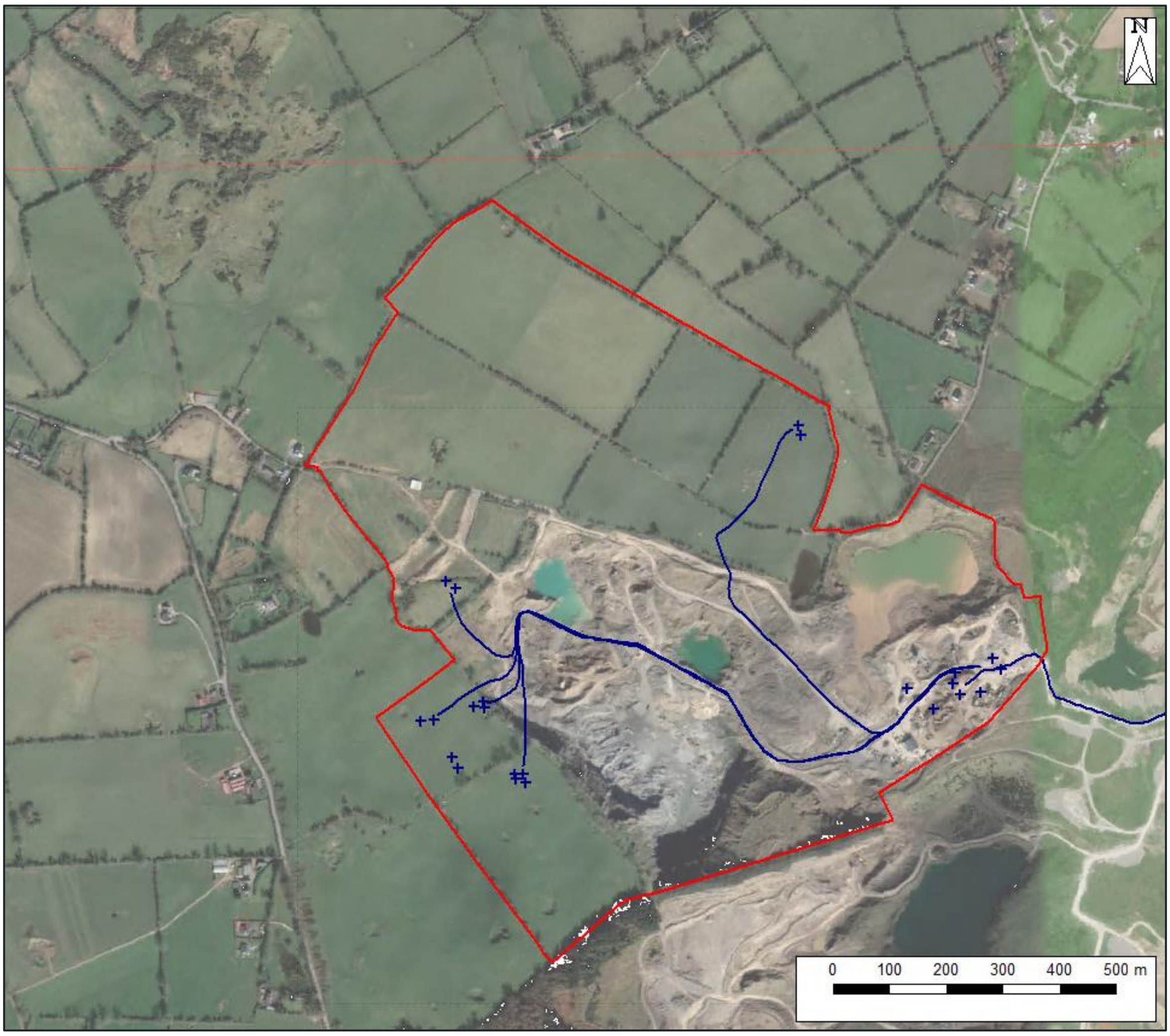

Figure 9-6: Scenario 3 inputs and plant locations

9.3.2 VIBRATION IMPACT ASSESSMENT

9.3.2.1 Introduction

The most significant potential source of ground borne vibration that could be generated by the proposed operations at the quarry is the extraction of rock from the active face. Rock extraction requires the use of a pneumatic rock breaker and blasting.

In addition to ground borne vibration, energy is transmitted from the blast site in the form of airborne pressure waves. These pressure waves occur over a wide range of frequencies, some of which are audible, some of which are not. The audible component is generally perceived as a loud bang; the inaudible component can be sensed as a change in pressure, or concussion. The combination of sound and concussion is referred to as air overpressure (AOP).

In order to characterise potential vibration impacts at the closest receptors, monitoring has been undertaken by a blasting contractor during blasting activities at the closest vibration sensitive receptors to the northeast and southwest boundaries of the quarry.

Measured vibration levels have been assessed according to British Standard BS 7385:1990 Parts 1 and 2.

9.3.2.2 Blast Measurement Parameters

The following terminology is specific to vibration and overpressure:

- Ground borne vibration at sensitive receptors is measured as Peak Particle Velocity (PPV) in mm/s. The PPV is the maximum instantaneous velocity of a particle at a point during a given time interval.
- AOP has a strong low frequency component and for this reason it is measured in linear decibels, dB(lin), rather than with an A-weighting, dB(A).

9.3.2.3 Evaluation Criteria

Vibration limits from blasting are recommended in DEHLG (now DCCAE)s, EPA and ICF Environmental Guidelines. The vibration limit from blasting should not exceed a peak particle velocity of 12 mm/s when measured in any three mutually orthogonal planes at a receiver location when blasting occurs at a frequency of once per week or less.

The acceptable vibration and air overpressure limits at sensitive receptors in Ireland are 12 mm/s (PPV) and 125 dB(lin) AOP as defined in the EPA management guidelines.

9.3.2.4 Impact Magnitude Criteria

Based on the evaluation criteria provided in Table 9-5 and the permitted vibration limits described above, the following magnitude of impact criteria and significance of effect at the nearest sensitive receptors identified in Table 9-14 have been adopted for blasting during the day.

Table 9-14: Quarry blasting vibration impact magnitude criteria

Quarry Blasting Vibration (x) in PPV, mm/s	Magnitude of Impact
x < 6.0	Negligible to low
6.0 < x < 12.0	Low to medium
x > 12.0	Medium to high

9.3.2.5 Significance of Effect

9.3.3 A significant effect occurs where a medium or high magnitude of impact is identified, but also subject to consideration of the following contextual factors:

- Absolute vibration level;
- Proximity of sensitive receptors to the blasting site;
- Number of blasts in a day; and
- Likelihood of damage to a property as a result of vibration or air overpressure.

9.3.4 CONSTRUCTION PHASE

Future construction phase quarry works will consist of stripping the top and subsoils to expose the rock reserve and will be of relatively short-term duration. The construction of the screening banks around the quarry will, upon completion, provide effective attenuation to noise generated by site activities. Noise levels associated with any future construction phase activities will be controlled via the application of best practicable means (BPM) in accordance with methods provided in BS 5228.

Appropriate construction phase noise limits, which are presented in Table 9-15 (NRA Guidelines, 2004) represent a reasonable compromise between the practical limitations in a construction project, and the need to ensure an acceptable noise level for the nearby residents. In addition to the standard workday criterion of 70 dB(A), the guidelines specify a reduced limit of 65 dB(A) for work on Saturdays, and 60 dB(A) for evening periods, and Sundays and bank holidays.

Table 9-15: Construction phase noise limit values

Period	Times	Ambient Level, dB $L_{Aeq,1hr}$	Maximum Level, dB L_{Amax}
Monday to Friday	07:00 to 19:00	70	80
Monday to Friday	19:00 to 22:00	60	65
Saturday	08:00 to 16:30	65	75
Sundays and Bank Holidays	08:00 to 16:30	60	65

9.4 BASELINE CONDITIONS

This Section presents a summary of the baseline conditions and detailed information about conditions on and surrounding the Site.

9.4.1 SITE SETTING

The Site is on lands at Athgarrett, Philipstown and Redbog, Red Lane, Co. Kildare, along the Kildare/Wicklow border. Access to the Site is via the N81 National Road, and through the Hudson Brothers Limited Wicklow site, to the southeast. Regionally, the nearest town is Blessington, which is located approximately 2 km to the south of the Site. Beyond this there are several other small towns and the suburbs of Dublin.

The Red Bog SAC is located approximately 257 m northeast of the Site and is a similar elevation (approximately 260 mAOD), to the highest point within the Site.

Three main land uses have been identified within the Site and the study area (500 m from the Site boundary). These are the agricultural and single-house residential lands, the R410 road and other quarry operations. The lands to the north and west can be characterised as rural in nature, with land uses in the area being agricultural and single-house residential. Sheep rearing and grazing of cattle are the main activities in the area. The R410 road passes through the 500 m buffer to the southwest of the Site and the lands immediately to the east and south of the Site are largely taken up by quarrying activities operated by unrelated parties.

9.4.2 SITE LAYOUT

A detailed description of the Site layout and infrastructure is presented in Chapter 2.0 (Project Description). Only key information relevant to the water environment is detailed below.

The Site comprises lands which are currently used for quarrying activities. The Site is comprised of different areas which include: a northeastern area with buildings, parking and storage areas; an eastern plant area with the processing plant used for the screening and washing of excavated sand and gravel material and a water treatment plant; a southern area where sediment laden water from processing is pumped to settle in a silt pond; a central area where and gravel, and rock material is subject to extraction.

9.4.3 SITE TOPOGRAPHY

The Site sits within a valley that slopes to the northwest and is shouldered by a high peak (at ca. 346 m AOD) to the north of the Site and Red Bog SAC, and a smaller peak to the south of the Site, in the area of Glen Ding Wood and Deer Park Plantation (at ca. 286 mAOD).

The Site is on the northwestern side of a saddle between the two peaks. On the southeastern side of the saddle are the adjacent quarries and the topography slopes down towards Blessington town and the Poulaphouca Reservoir.

The topography at the Site boundary peaks at ca. 271 mAOD and ca. 264 mAOD in the northeastern and southeastern corners respectively and drops to a low of ca. 205 mAOD on the western boundary.

9.4.4 OVERVIEW OF CURRENT OPERATIONS

Sands and gravels are extracted at the operational face by mechanical means and are transported by haul truck to a fixed processing plant in the plant area located in the eastern part of the Site. Processed sand and gravel are stockpiled adjacent to the aggregate plant prior to being transferred to road going trucks via a mobile loader and are then transported to market.

Rock material is currently extracted from active rock faces by an excavator with a rock braker attachment. Prior to September 2020 rock was extracted via blasting with some use of the rock braker on oversize materials. Rock is then processed on the quarry floor by mobile crushing, screening, and associated plant before being stockpiled into specific graded aggregate stockpiles. Crushed rock aggregate is then loaded into road going trucks for transport to market.

9.5 NOISE AND VIBRATION MONITORING

9.5.1 NOISE MONITORING

9.5.1.1 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).

9.5.1.2 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 9-16 displayed in Figure 9-7.

Table 9-16: 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

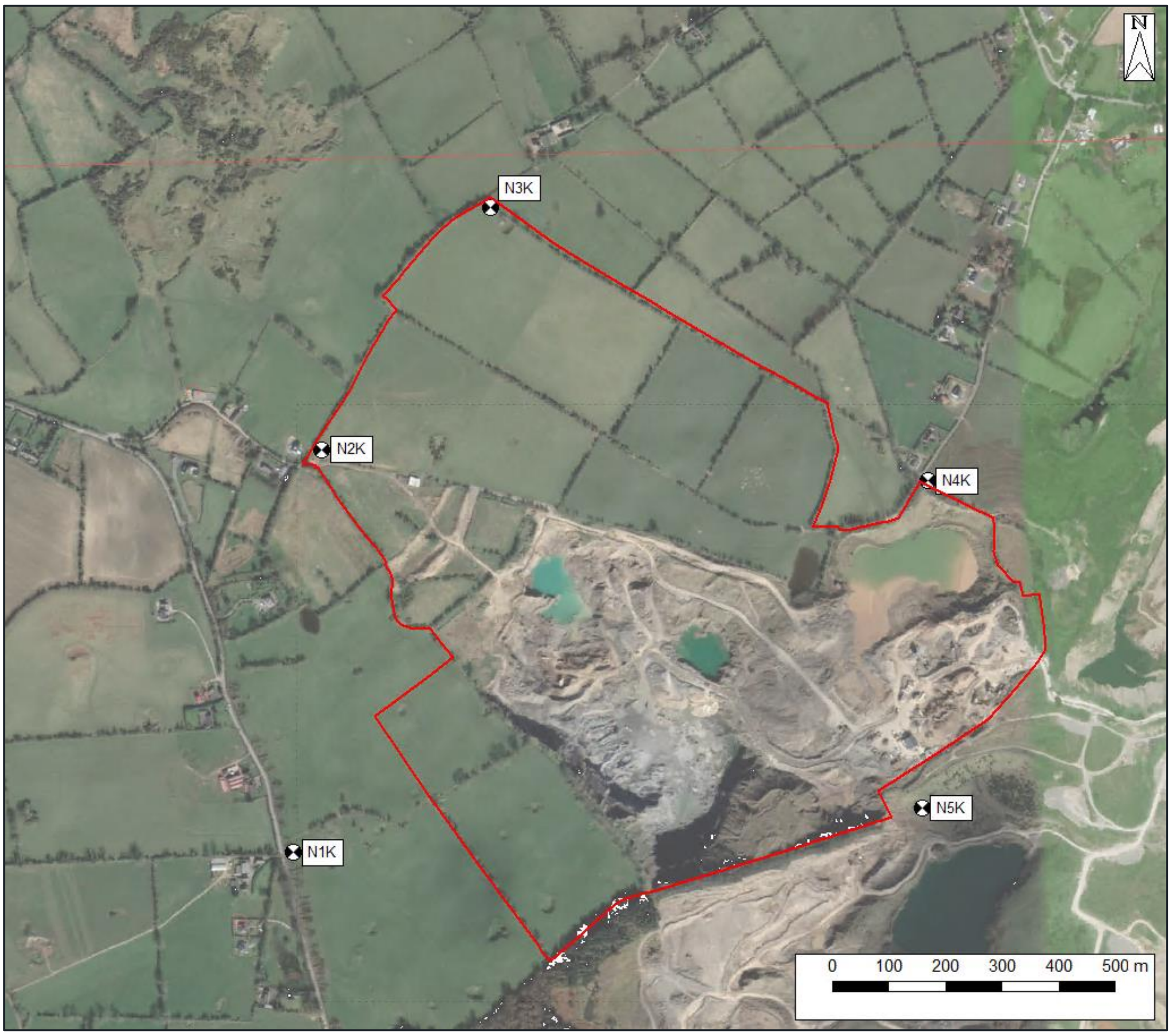

Figure 9-7: Noise monitoring locations

9.5.1.3 Noise Monitoring Equipment

The sound measuring equipment utilised for noise monitoring is detailed in Table 9-17 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 9-17: 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.

9.5.1.4 Noise Monitoring Results

A summary of the noise monitoring results obtained between from April 2019 and January 2024 are presented in Table 9-18 below, with detailed results in Appendix 9B.

Table 9-18: 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	16	55.0	61.3	6.3	50.5 - 66.4	54.3 - 71.8	32.7 - 49.8
N2K	16	55.0	50.1	-4.9	39.1 - 59.1	41.2 - 51.8	30.9 - 42.7
N3K	16	55.0	46.3	-8.7	34 - 51.4	35.4 - 54.2	27.4 - 45.1
N4K	17	55.0	47.1	-7.9	39.1 - 50.4	39.6 - 52.2	34.1 - 47.4
N5K	17	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.

9.5.1.5 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 surface 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.

9.5.1.6 Exceedances During the Noise Monitoring Surveys

It can be seen in both the monitoring data in Appendix 9B and the summary in Table 9-18 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.

9.5.2 VIBRATION MONITORING

9.5.2.1 Introduction

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

9.5.2.2 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 9-19 and displayed in Figure 9-8.

Table 9-19: 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

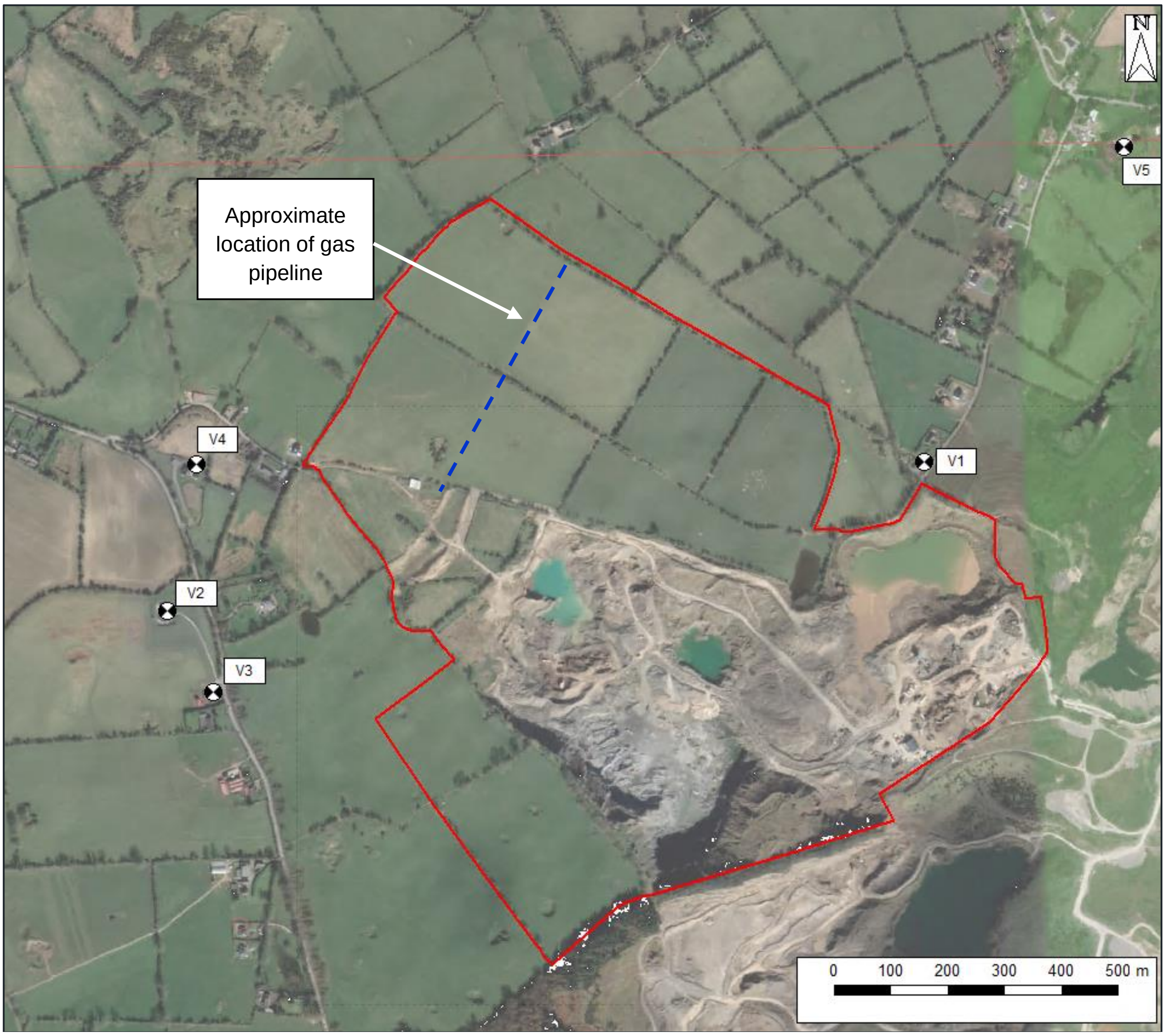

Figure 9-8: Blast monitoring locations

9.5.2.3 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 9-8.

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. As the proposed quarry extension progresses westwards, the blasting activities will occur nearer to the transmission line. However, the closest blasted face will be located ca. 315 m away from the line at its closest point. 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.

In order to mitigate and reduce the potential of damage to the gas transmission line, numerous mitigation measures are employed during blasts, as identified in Section 9.7.2. These measures include a number of operational controls and also the requirement for blasting contractors to be trained and competent.

HBL deploy a vibration monitor at the gas transmission line during all blasting events. From these monitoring records the blasting contractor can determine whether the MIC or methods need to be altered for future blasting events. .

9.5.2.4 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 9-20 below, with full results in Appendix 9C.

Table 9-20: 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

9.5.2.5 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.

9.6 PREDICTED OPERATIONAL NOISE AND VIBRATION IMPACTS

9.6.1 PREDICTED OPERATIONAL NOISE LEVELS

This section provides the results of noise modelling from each of the assessed operational scenarios and current operational condition described in 9.3.1.6.

9.6.1.1 Current Operational Condition

The predicted noise levels from the current operational condition for each NSR are provided in Table 9-21 with noise contours at a height of 4.0 m above ground level provided in Figure 9-9.

Table 9-21: Predicted noise levels for Current Operational Condition

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

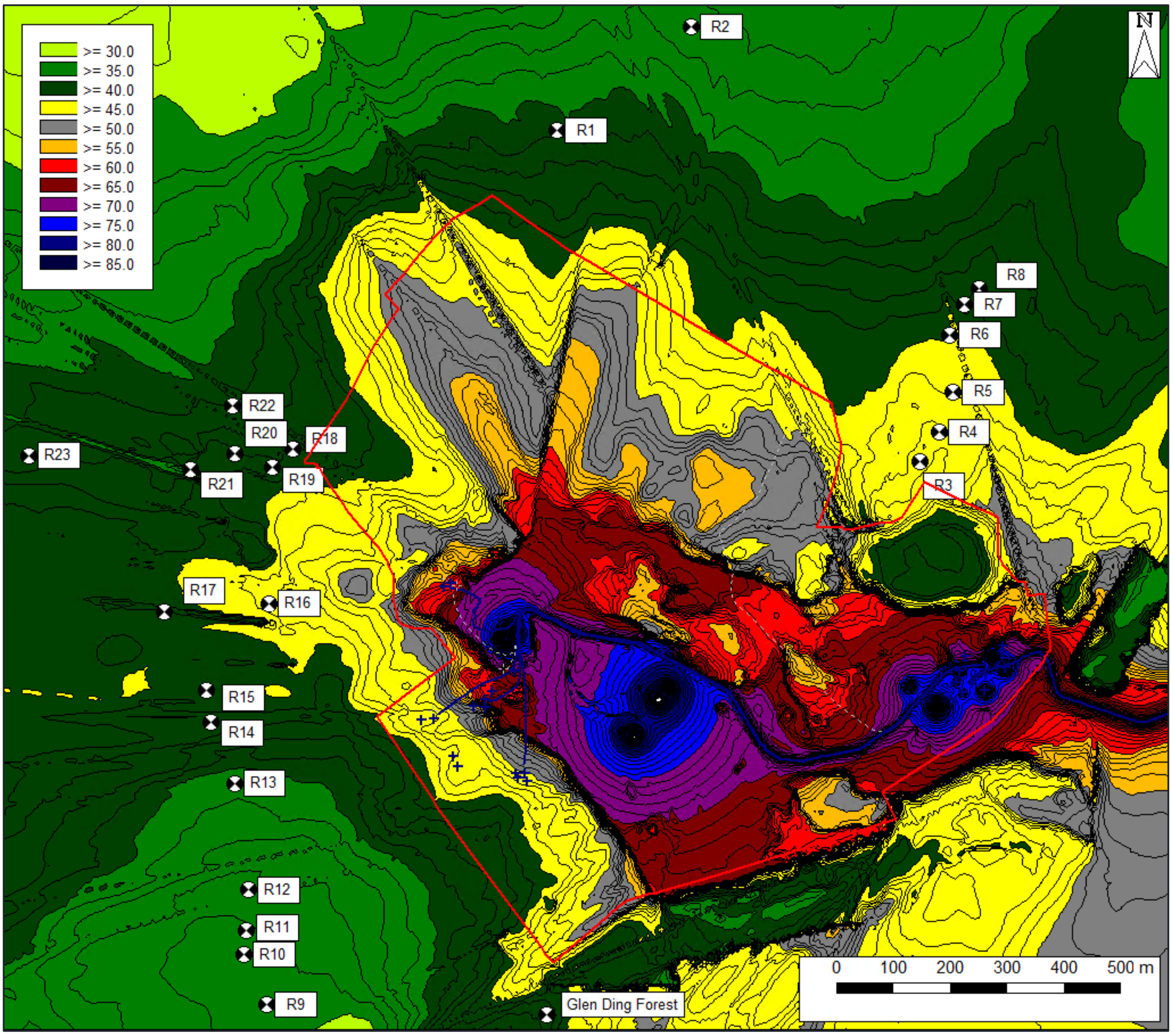

Figure 9-9: Current Operational Condition

9.6.1.2 Proposed Operational Scenario 1

The predicted noise levels from Scenario 1 for each NSR are provided in Table 9-22 with noise contours at a height of 4.0 m above ground level provided in Figure 9-10.

Table 9-22: Predicted noise levels for Operational Scenario 1

Noise Sensitive Receptor	Predicted Noise Level, dB $L_{Aeq,1hr}$	Noise Limit, dB $L_{Aeq,T}$	Exceedance of Noise Limit, dB $L_{Aeq,T}$
R1	40.3	55.0	-14.7
R2	38.0	55.0	-17.0
R3	49.2	55.0	-5.8
R4	50.3	55.0	-4.7
R5	46.9	55.0	-8.1
R6	47.3	55.0	-7.7
R7	46.3	55.0	-8.7
R8	45.9	55.0	-9.1
R9	38.2	55.0	-16.8
R10	39.4	55.0	-15.6
R11	40.0	55.0	-15.0
R12	41.0	55.0	-14.0
R13	44.1	55.0	-10.9
R14	46.8	55.0	-8.2
R15	46.5	55.0	-8.5
R16	46.4	55.0	-8.6
R17	44.9	55.0	-10.1
R18	42.7	55.0	-12.3
R19	43.1	55.0	-11.9
R20	43.2	55.0	-11.8
R21	41.0	55.0	-14.0
R22	40.1	55.0	-14.9
R23	41.2	55.0	-13.8

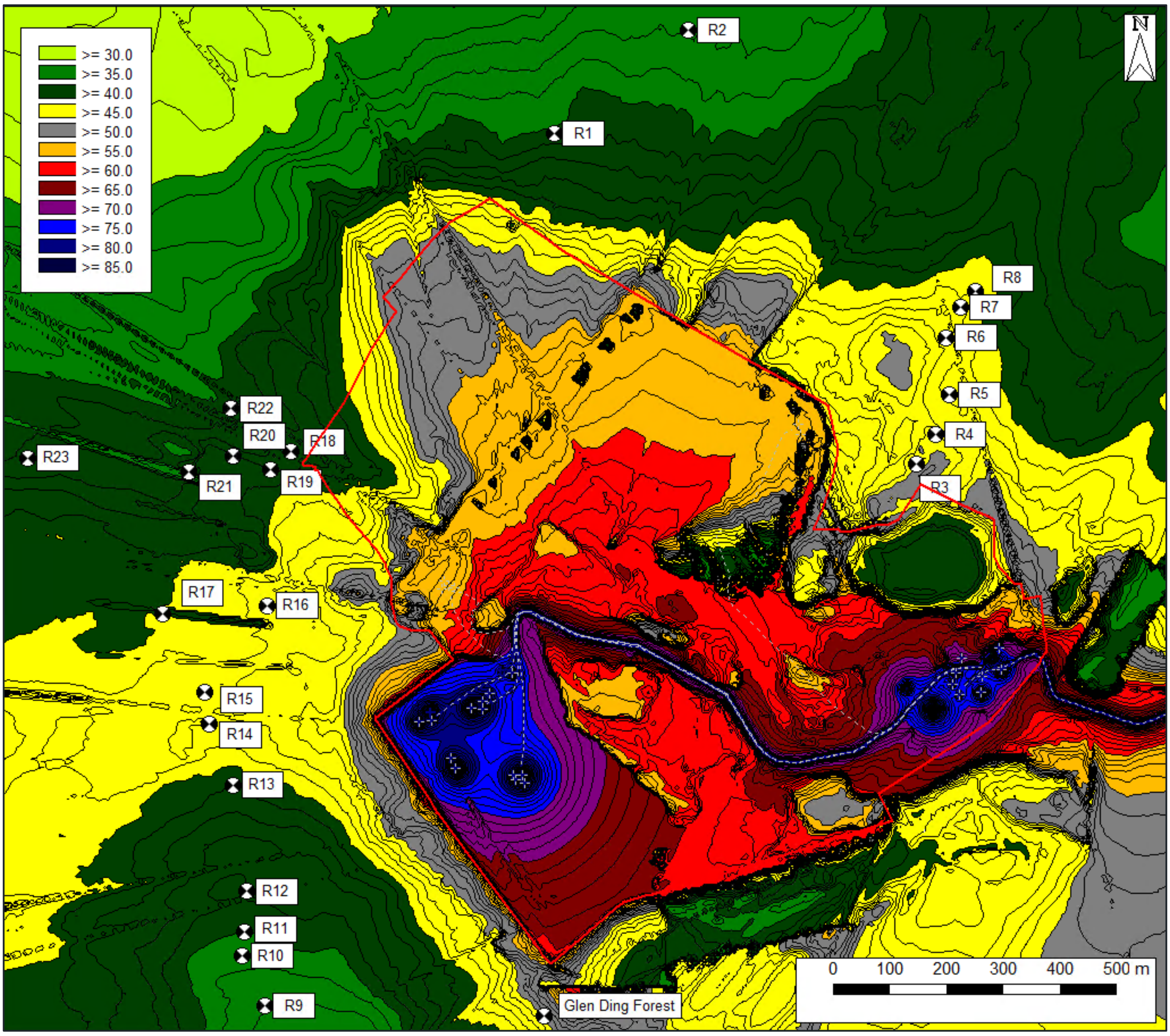

Figure 9-10: Scenario 1 – Noise contours at 4.0 m height, dB $L_{Aeq,1hr}$

9.6.1.3 Proposed Operational Scenario 2

The predicted noise levels from Scenario 2 for each NSR are provided in Table 9-23 with noise contours at a height of 4.0m above ground level provided in Figure 9-11**.**

Table 9-23: Predicted noise levels for Operational Scenario 2

Noise Sensitive Receptor	Predicted Noise Level, dB $L_{Aeq,1hr}$	Noise Limit, dB $L_{Aeq,T}$	Exceedance of Noise Limit, dB $L_{Aeq,T}$
R1	40.9	55.0	-14.1
R2	38.5	55.0	-16.5
R3	49.1	55.0	-5.9
R4	50.2	55.0	-4.8
R5	47.0	55.0	-8.0
R6	47.2	55.0	-7.8
R7	46.1	55.0	-8.9
R8	45.8	55.0	-9.2
R9	38.6	55.0	-16.4
R10	39.8	55.0	-15.2
R11	40.4	55.0	-14.6
R12	41.3	55.0	-13.7
R13	44.5	55.0	-10.5
R14	47.2	55.0	-7.8
R15	47.1	55.0	-7.9
R16	48.1	55.0	-6.9
R17	45.8	55.0	-9.2
R18	44.0	55.0	-11.0
R19	44.1	55.0	-10.9
R20	44.0	55.0	-11.0
R21	41.8	55.0	-13.2
R22	41.3	55.0	-13.7
R23	41.7	55.0	-13.3

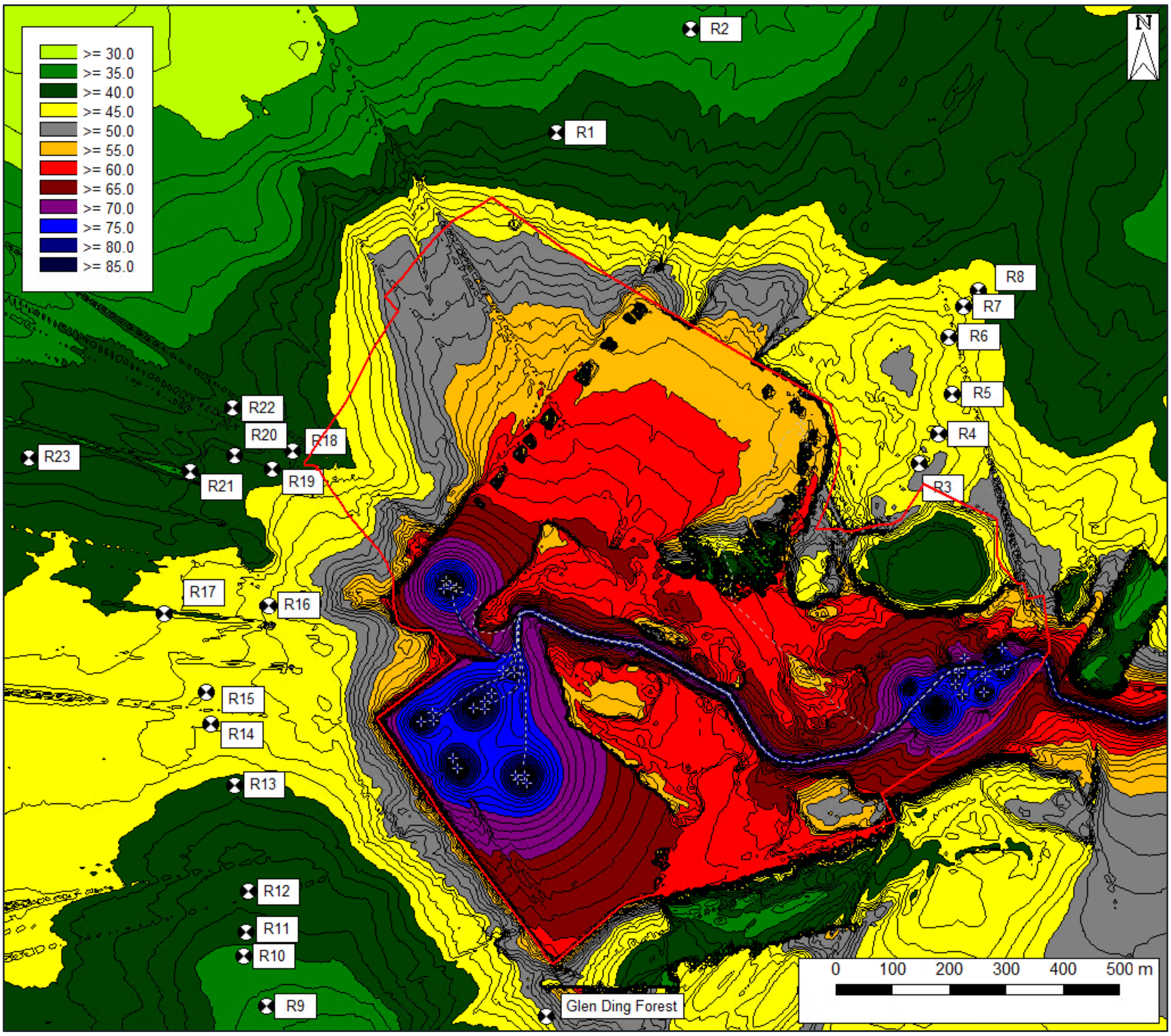

Figure 9-11: Scenario 2 – Noise contours at 4.0m height, dB $L_{Aeq,1hr}$

9.6.1.4 Proposed Operational Scenario 3

The predicted noise levels from Scenario 3 for each NSR are provided in Table 9-24 with noise contours at a height of 4.0m above ground level provided in Figure 9-12..

Table 9-24: Predicted noise levels for Operational Scenario 3

Noise Sensitive Receptor	Predicted Noise Level, dB $L_{Aeq,1hr}$	Noise Limit, dB $L_{Aeq,T}$	Exceedance of Noise Limit, dB $L_{Aeq,T}$
R1	41.5	55.0	-13.5
R2	38.6	55.0	-16.4
R3	49.2	55.0	-5.8
R4	50.3	55.0	-4.7
R5	47.1	55.0	-7.9
R6	47.3	55.0	-7.7
R7	46.2	55.0	-8.8
R8	45.8	55.0	-9.2
R9	38.9	55.0	-16.1
R10	40.0	55.0	-15.0
R11	40.7	55.0	-14.3
R12	41.8	55.0	-13.2
R13	44.8	55.0	-10.2
R14	47.4	55.0	-7.6
R15	47.4	55.0	-7.6
R16	48.1	55.0	-6.9
R17	46.0	55.0	-9.0
R18	44.5	55.0	-10.5
R19	44.5	55.0	-10.5
R20	44.4	55.0	-10.6
R21	42.3	55.0	-12.7
R22	41.6	55.0	-13.4
R23	42.2	55.0	-12.8

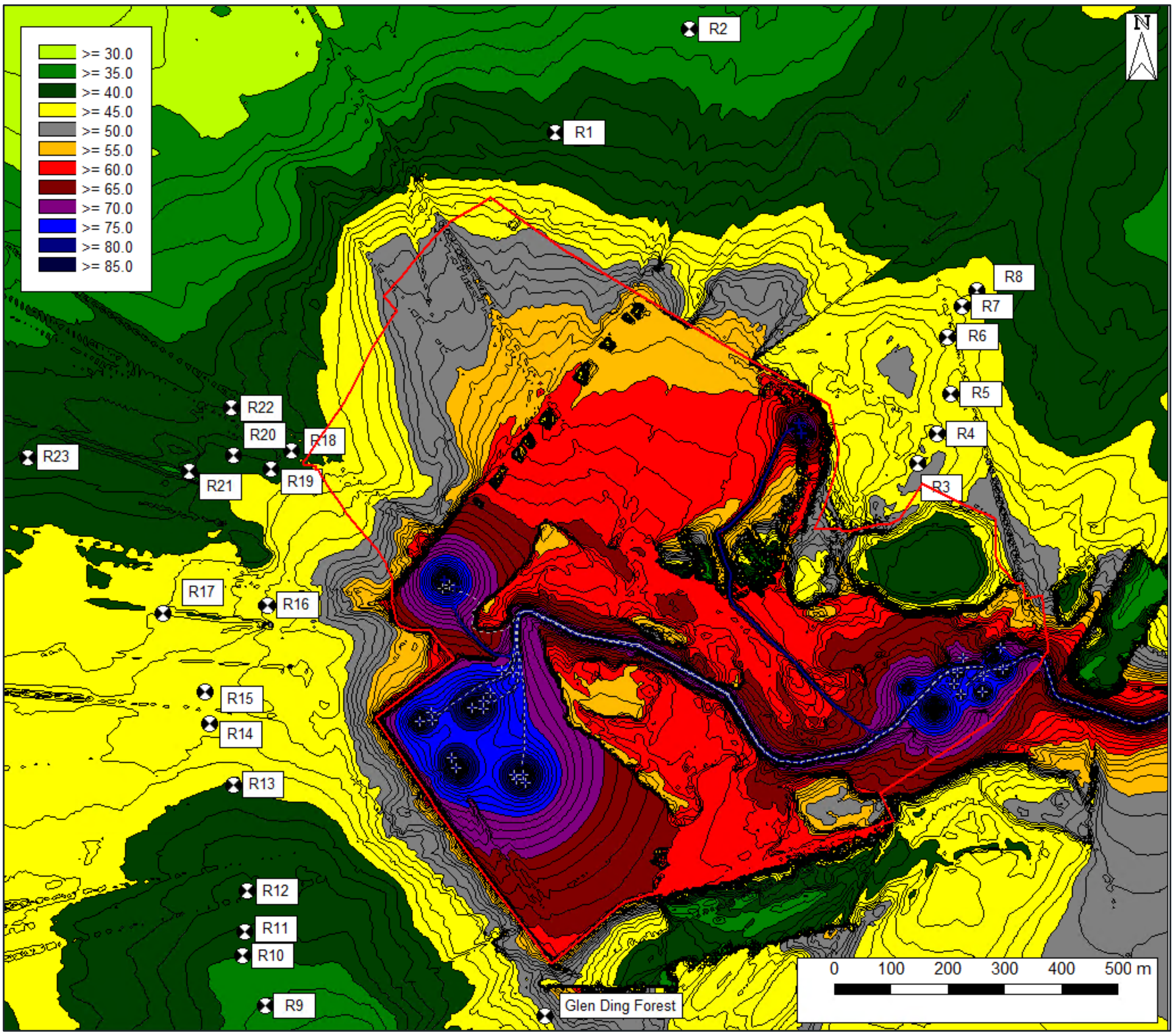

Figure 9-12: Scenario 3 – Noise contours at 4.0m height, dB $L_{Aeq,1hr}$

9.6.1.5 Comments on Predicted Operational Noise Levels

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 during each of the three proposed operational scenario and the current operational condition. It is acknowledged that the predicted levels for the future proposed scenarios include the attenuating effect of the proposed 6 m high earthworks bund along the northern site boundary of the northern extension area. This will be included within the embedded mitigation proposed for the Proposed Development.

9.6.1.6 Predicted Operational Noise at Glen Ding Wood

The wood is considered a lower value NSR compared to the residential NSRs identified in

Figure 9-1 and Table 9-1 and assessed in 9.3.1. This is due to the amenity classification of the woodland and the transient nature of users as receptors of the noise.

Nevertheless, the wood was included in the three predicted scenarios and the current operational condition as used for the residential NSRs. The resultant predicted noise levels are provided in Table 9-25.

Table 9-25: Predicted operational noise levels at Glen Ding Wood

Operational Scenario	Noise Level, dB $L_{Aeq,1hr}$
Current Operational Condition	41.4
Scenario 1	48.8
Scenario 2	48.5
Scenario 3	48.5

It is evident that predicted noise levels for current and proposed future operational scenarios are below the 55 dB $L_{Aeq,T}$ limiting value for the Application Site and below the level which would normally be considered acceptable within an outdoor amenity area (in accordance with guidance within BS 8233). It is therefore considered that noise from activities within the Application Site will have a 'not significant' impact on the amenity of the Glen Ding woodland.

9.6.1.7 Comparison of Predicted Noise Levels with Noise Levels Measured at Receptors

A comparison has been made of the predicted operational noise levels against the noise levels measured at representative locations during the noise surveys conducted between 2019 and 2023. The existing daytime value is derived as the logarithmic average of all sample periods measured during the daytime at each location. Table 9-26 below shows the comparison for the three quarrying scenarios. Cells in orange signify an exceedance of the daytime baseline noise level (rather than the permitted limit, which is not exceeded for any operational scenario). The predicted levels at each of the five noise monitoring locations are also provided for reference.

Table 9-26: Comparison of predicted operational noise levels for Current Operational Condition plus future Scenarios 1 to 3 against existing baseline noise levels measured at nearest monitoring positions

Receptor	Nearest Monitoring Position	Existing Noise Level, dB $L_{Aeq,T}$*	Predicted Operational Noise Level, dB$L_{Aeq,1hr}$				Predicted Operational Noise Level minus Existing Noise Level, dB			
			Curr.	Sc.1	Sc.2	Sc.3	Curr.	Sc.1	Sc.2	Sc.3
R1	N3K	46.3	40.7	40.3	40.9	41.5	-5.6	-6.0	-5.4	-4.8
R2	N3K	46.3	37.6	38.0	38.5	38.6	-8.7	-8.3	-7.8	-7.7
R3	N4K	47.1	47.5	49.2	49.1	49.2	0.4	2.1	2.0	2.1
R4	N4K	47.1	48.1	50.3	50.2	50.3	1.0	3.2	3.1	3.2
R5	N4K	47.1	45.9	46.9	47.0	47.1	-1.2	-0.2	-0.1	0.0
R6	N4K	47.1	44.9	47.3	47.2	47.3	-2.2	0.2	0.1	0.2

Receptor	Nearest Monitoring Position	Existing Noise Level, dB $L_{Aeq,T}$*	Predicted Operational Noise Level, dB$L_{Aeq,1hr}$				Predicted Operational Noise Level minus Existing Noise Level, dB			
			Curr.	Sc.1	Sc.2	Sc.3	Curr.	Sc.1	Sc.2	Sc.3
R7	N4K	47.1	43.9	46.3	46.1	46.2	-3.2	-0.8	-1.0	-0.9
R8	N4K	47.1	43.9	45.9	45.8	45.8	-3.2	-1.2	-1.3	-1.3
R9	N1K	61.3	35.3	38.2	38.6	38.9	-26.0	-23.1	-22.7	-22.4
R10	N1K	61.3	35.6	39.4	39.8	40.0	-25.7	-21.9	-21.5	-21.3
R11	N1K	61.3	35.9	40.0	40.4	40.7	-25.4	-21.3	-20.9	-20.6
R12	N1K	61.3	36.7	41.0	41.3	41.8	-24.6	-20.3	-20.0	-19.5
R13	N1K	61.3	39.3	44.1	44.5	44.8	-22.0	-17.2	-16.8	-16.5
R14	N1K	61.3	43.8	46.8	47.2	47.4	-17.5	-14.5	-14.1	-13.9
R15	N1K	61.3	44.6	46.5	47.1	47.4	-16.7	-14.8	-14.2	-13.9
R16	N1K	61.3	46.2	46.4	48.1	48.1	-15.1	-14.9	-13.2	-13.2
R17	N1K	61.3	44.6	44.9	45.8	46.0	-16.7	-16.4	-15.5	-15.3
R18	N2K	50.1	43.1	42.7	44.0	44.5	-7.0	-7.4	-6.1	-5.6
R19	N2K	50.1	43.2	43.1	44.1	44.5	-6.9	-7.0	-6.0	-5.6
R20	N2K	50.1	43.3	43.2	44.0	44.4	-6.8	-6.9	-6.1	-5.7
R21	N1K	61.3	41.0	41.0	41.8	42.3	-20.3	-20.3	-19.5	-19.0
R22	N2K	50.1	40.8	40.1	41.3	41.6	-9.3	-10.0	-8.8	-8.5
R23	N1K	61.3	41.5	41.2	41.7	42.2	-19.8	-20.1	-19.6	-19.1
Glen Ding Wood	N5K	51.8	41.4	48.8	48.5	48.5	-10.4	-3.0	-3.3	-3.3
N1K	N1K	61.3	37.4	41.6	41.8	42.1	-23.9	-19.7	-19.5	-19.2
N2K	N2K	50.1	42.9	42.1	43.6	44.1	-7.2	-8.0	-6.5	-6.0
N3K	N3K	46.3	43.1	44.3	45.4	45.9	-3.2	-2.0	-0.9	-0.4
N4K	N4K	47.1	47.6	49.2	48.8	48.9	0.5	2.1	1.7	1.8
N5K	N5K	51.8	44.1	43.9	43.9	43.9	-7.7	-7.9	-7.9	-7.9

*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; orange denotes an increase in noise level above existing >3.0 dB.

It can be seen that, with the exception of locations R3, R4 and R6, the predicted noise level due to quarrying activities under each scenario is below the measured baseline noise level at each receptor. At R3 and R6, the predicted noise levels for Scenarios 1, 2 and 3 are above the measured $L_{Aeq,T}$ by up to 2.1 dB. At R4, the predicted noise levels for Scenarios 1, 2 and 3 are above the measured $L_{Aeq,T}$ by up to 3.2 dB.

The predicted levels at the noise monitoring positions are below existing measured levels with the exception of N4K, where there is a maximum 2.1 dB uplift (compared with the measured level) for all three scenarios.

To give context to these increases, a 3 dB difference in noise level is usually considered to be the minimum change normally perceptible by the human ear under 'real world' situations (as opposed to a controlled laboratory environment).

It is noted that the predicted current operational scenario is also below the measured 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.

It should be noted that predicted noise levels are within the acceptable limits of the existing planning permission and those prescribed in Environmental Management in the Extractive Industry (Non-Scheduled Minerals) (EPA 2006).

9.6.2 PREDICTED VIBRATION RESULTS

9.6.2.1 Ground Borne Vibration

Results from vibration monitoring during blasting at the quarry have been analysed using scaled distance graphs and regression analysis techniques following the guidance presented within BS 6472-2:2008. The use of a scaled distance graph allows the prediction of the likely vibration level at a given distance for a given MIC. The scaled distance approach follows the following equation:

$$s=d\sqrt{C} ;$$

where *s* is the scaled distance, *d* is the slant distance and *C* is the MIC.

The scaled distance graph using the provided vibration monitoring data is presented in Figure 9-13 below.

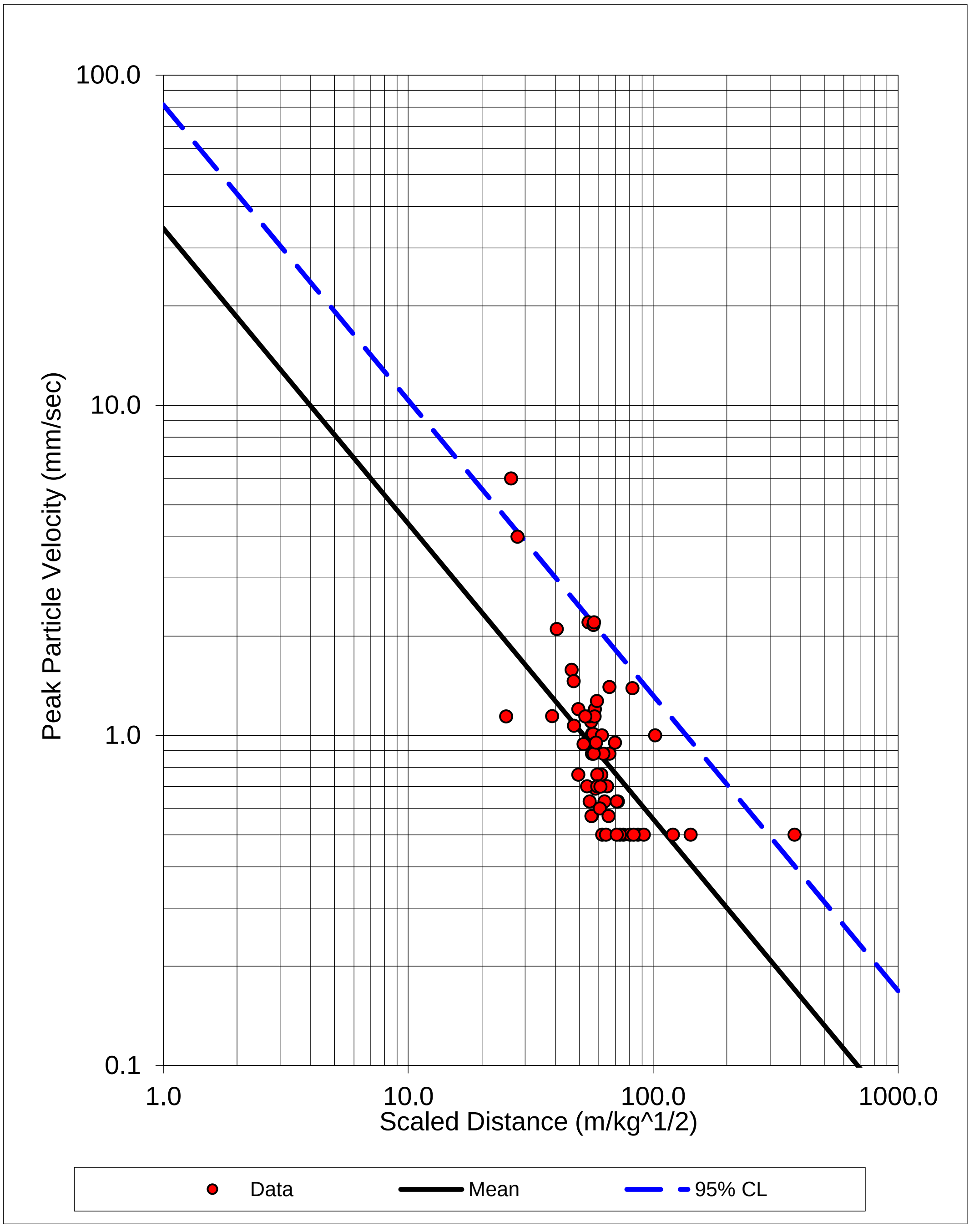

Figure 9-13: Scaled distance against maximum peak particle velocity

The distance of the nearest vibration sensitive receptor to the proposed blasting locations is approximately 300 m and the maximum MIC used to date in blasting at the site is 285 kg. Under these conditions, the predicted maximum PPV at the nearest receptor, calculated with a 95% confidence level (CL), would be 6.2 mm/s and the permitted limit of 12 mm/s is unlikely to be exceeded with even a substantial increase in MIC.

9.6.2.2 Air Overpressure

As advised in BS 6472-2, the accurate prediction of air overpressure is almost impossible due to the variable effects of the prevailing weather conditions in the vicinity of the blast site. Meteorological conditions such as air temperature, lapse rate (the rate at which temperature changes with height), cloud cover, humidity, wind speed and direction can all affect the magnitude of air overpressure at any particular location. This makes any quantitative prediction of air overpressure highly unreliable.

The control of air overpressure should always be via its minimisation at source through appropriate blast design, as directed by the blasting contractor. Ongoing monitoring of vibration and air overpressure at nearby vibration sensitive receptors will be undertaken during each blast to assist this process.

9.6.3 VIBRATION AND AIR OVERPRESSURE CONTROL MEASURES

9.6.3.1 Groundborne Vibration Control

Groundborne vibration from blasting at any receptor is influenced mainly by:

- The characteristics of the rock mass;
- The MIC of explosives;
- The medium between blast source and receptor point; and
- The distance between the blast source and receptor point.

Groundborne vibration control is based on reducing the weight of explosives detonated per delay (reducing the maximum instantaneous charge). In any given situation, large amounts of explosives can be detonated using time delay intervals between each specific charge within the overall blast. The peak level of ground vibration is related to the maximum charge weight per delay.

In terms of predicting ground vibration, each location is 'site specific'. However, ground vibration is recorded simultaneously for each blast at a minimum of one sensitive location.

9.6.3.2 Air Overpressure Control

The principal factors governing AOP are as follows:

a) The type and quantity of explosives;
b) The degree of confinement (plaster shooting, overcharging and poor stemming);
c) The method of initiation (exposed detonating fuse etc.);
d) Local geology and topography;
e) Atmospheric conditions; and
f) Distance and condition of structures.

Factors a), b) and c) are variables within the control of the quarry operator whereas d), e) and f) are essentially uncontrollable at any particular site. However, by varying the timing of a blast (avoid early morning or late evening), the quantities of explosives, the degree of confinement and the method of initiation, the quarry operator, in effect, achieves partial control over the influence of atmospheric conditions and hence over the blast emissions.

9.6.4 MAGNITUDE OF NOISE AND VIBRATION IMPACTS

The following table provides a summary of the potential noise effects and magnitude of noise impact resulting from the three assessed operational scenarios:

Table 9-27: Summary of Potential Effects and Magnitude of Noise and Vibration Impacts

Operational Scenario	Sensitive Receptor(s)	Summary of Potential Effects	Likely Magnitude of Impacts and Level of Significance			
			Absolute Noise Level	Change in Noise Level	Vibration	Overall Noise and Vibration Impact
Sc. 1	R1, R2, R5, R9 to R23 inclusive, Glen Ding Wood	Noise limit not exceeded. No change in current noise level predicted. Existing acoustic climate likely to be unchanged. PPV likely to be <6 mm/s.	Negligible, imperceptible, not significant.	Negligible, imperceptible, not significant.	Negligible to low adverse, depending on proximity to blast site, imperceptible to slight, not significant.	Negligible, imperceptible. ***Not significant.***
	R3, R6	Noise limit not exceeded. <3.0 dB change in current noise level predicted. Possible that a perceptible change to existing acoustic climate occurs. PPV likely to be <6 mm/s.	Negligible, imperceptible, not significant.	Low adverse, imperceptible, not significant.	Negligible to low adverse, depending on proximity to blast site, imperceptible to slight, not significant.	Negligible to low adverse, imperceptible to slight. ***Not significant***.
	R4	Noise limit not exceeded. >3.0 dB change in current noise level predicted. May result in a perceptible change to existing acoustic climate. PPV likely to be <6 mm/s.	Negligible, imperceptible, not significant.	Low to medium adverse, slight to moderate, not significant.	Negligible to low adverse, depending on proximity to blast site, imperceptible to slight, not significant.	Low adverse, imperceptible to slight. ***Not significant.***
	Gas pipeline	Unlikely to be any change in vibration level as a result of blasting with PPV levels up to 6 mm/s.	-	-	Low adverse, slight, not significant.	Low adverse, slight. ***Not significant.***

Operational Scenario	Sensitive Receptor(s)	Summary of Potential Effects	Likely Magnitude of Impacts and Level of Significance			
			Absolute Noise Level	Change in Noise Level	Vibration	Overall Noise and Vibration Impact
Sc. 2	R1, R2, R5, R6, R9 to R23 inclusive, Glen Ding Wood	Noise limit not exceeded. No change in current noise level predicted. Existing acoustic climate likely to be unchanged. PPV likely to be <6 mm/s.	Negligible, imperceptible, not significant.	Negligible, imperceptible, not significant.	Negligible to low adverse, depending on proximity to blast site, imperceptible to slight, not significant.	Negligible, imperceptible ***Not significant.***
	R3	Noise limit not exceeded. <3.0 dB change in current noise level predicted. Possible that a perceptible change to existing acoustic climate occurs. PPV likely to be <6 mm/s.	Negligible, imperceptible, not significant.	Low adverse, slight, not significant.	Negligible to low adverse, depending on proximity to blast site, imperceptible to slight, not significant.	Negligible to low adverse, imperceptible to slight. ***Not significant***.
	R4	Noise limit not exceeded. >3.0 dB change in current noise level predicted. May result in a perceptible change to existing acoustic climate. PPV likely to be <6 mm/s.	Negligible, imperceptible, not significant.	Low to medium adverse, not significant.	Negligible to low adverse, depending on proximity to blast site, imperceptible to slight, not significant.	Low adverse, imperceptible to slight. ***Not significant.***
	Gas pipeline	Unlikely to be any change in vibration level as a result of blasting with PPV levels up to 6 mm/s.	-	-	Low adverse, slight, not significant.	Low adverse, slight. ***Not significant.***

Operational Scenario	Sensitive Receptor(s)	Summary of Potential Effects	Likely Magnitude of Impacts and Level of Significance			
			Absolute Noise Level	Change in Noise Level	Vibration	Overall Noise and Vibration Impact
Sc. 3	R1, R2, R5, R9 to R23 inclusive, Glen Ding Wood	Noise limit not exceeded. No change in current noise level predicted. Existing acoustic climate likely to be unchanged. PPV likely to be <6 mm/s.	Negligible, imperceptible, not significant.	Negligible, imperceptible, not significant.	Negligible to low adverse, depending on proximity to blast site, not significant.	Negligible, imperceptible. ***Not significant.***
	R3, R6	Noise limit not exceeded. <3.0 dB change in current noise level predicted. Possible that a perceptible change to existing acoustic climate occurs. PPV likely to be <6 mm/s.	Negligible, imperceptible, not significant.	Low adverse, slight, not significant.	Negligible to low adverse, depending on proximity to blast site, not significant.	Negligible to low adverse, imperceptible to slight. ***Not significant***.
	R4	Noise limit not exceeded. >3.0 dB change in current noise level predicted. May result in a perceptible change to existing acoustic climate. PPV likely to be <6 mm/s.	Negligible, imperceptible, not significant.	Low to medium adverse, not significant.	Negligible to low adverse, depending on proximity to blast site, not significant.	Low adverse, slight. ***Not significant.***
	Gas pipeline	Unlikely to be any change in vibration level as a result of blasting with PPV levels up to 6 mm/s.	-	-	Low adverse, slight, not significant.	Low adverse, slight. ***Not significant.***

At the majority of receptors, the likely magnitude of noise and vibration impact is predicted to be negligible or low adverse for each operational scenario, which is ***not significant***.

At receptor R4 the likely magnitude of noise impact is predicted to be low to medium adverse for each operational scenario as a result of the predicted increase in noise level of up to 3.1 dB compared with the baseline condition. However, as the predicted operational noise level is below the threshold level, the overall impact is considered to be low adverse, which is ***not significant***.

The magnitude of vibration impact at each of the blast monitoring locations was either negligible or low adverse, depending on the proximity to the blast, and is predicted to remain so under future proposed blasting conditions. The predicted vibration impact at each assessment location is, therefore, ***not significant***.

Nevertheless, mitigation to control noise and vibration impacts will be required and is discussed in the following section.

9.7 MITIGATION

9.7.1 NOISE CONTROL

Noise control measures for the proposed operations will be incorporated into the design and operation from the existing quarry operation's management and work practices. A noise monitoring programme at the five existing noise monitoring locations will be maintained at bi-annual intervals - this will determine compliance with the permitted noise limits and the effectiveness of mitigation. Measures to manage potential noise impacts include:

- Any measured exceedances of the threshold levels at locations representative of the nearest noise sensitive receptors as a result of quarrying operations will be communicated to the Quarry Manager on the day of the monitoring surveys so that the cause of the exceedance can be identified and measures put in place to reduce noise below the threshold level.
- Site activities will only take place during the permitted hours of operation and will be monitored to determine compliance with the conditioned noise limits. There will be no activities on site on Sundays or public holidays.
- Perimeter screening berms will be constructed as appropriate along the boundaries of the proposed extended operational area to reduce noise propagation beyond the quarry boundary. This includes a 6 m high berm along the boundary of the proposed northern extension to the Site.
- All haul roads will be kept clear and maintained in a good state of repair to minimise noise from rattling and bouncing of mobile plant.
- Heavy goods vehicles entering and leaving the quarry will have tailgates securely fastened. All mobile plant used at the proposed development will have noise emission levels that comply with relevant guidance.
- Plant will be operated in a proper manner with respect to minimising noise emissions, e.g. minimisation of drop heights, no unnecessary revving of engines, plant used intermittently not left idling.
- Plant will be subject to regular maintenance, i.e., all moving parts kept well lubricated, the integrity of silencers and acoustic hoods maintained.
- Haul routes within the northern pits should be demarked around the perimeter of the pit to maximise topographical screening to reduce any potential noise impacts on nearby residential dwellings.

- Haul routes will be designed so as to have as low a gradient as possible so as to minimise excessive revving of vehicle engines on-site.
- 30 kmph speed limit will be applied to access road.
- Plant will be fitted with effective exhaust silencers and maintained in good working order to meet manufacturers' noise rating levels. Defective silencers will be replaced.
- Quarry operations such as blasting, excavation or crushing will not occur outside normal operating hours.
- All site plant, machinery and vehicles will shut down when not in use.

9.7.2 VIBRATION CONTROL

The following blast mitigation procedures will continue to be employed during each blast event at the quarry:

- Blast events will be conducted by an approved blasting contractor in accordance with best practice in this field, and potential impacts associated with the activity will therefore be minimised.
- All operatives involved in the blasting procedure will be adequately trained and suitably competent.
- The use of delayed blasting techniques whereby each blast event takes place in a series of timed small blasts rather than a single large blast will be employed to minimise vibrations in the rock body.
- All shot holes will be drilled to exact specifications by specialist contractors. Any features encountered during drilling such as cavities or soft material will be recorded by the drilling contractor and this information will be subsequently passed on to the shot-firer so that the correct charge will be used. This will ensure safe and efficient blasting of the rock face.
- In addition to implementing the necessary blast specifications, the quarry operator will provide appropriate advance warning of blasts to neighbouring residents, undertake required environmental monitoring and record any complaints arising, as detailed below.
- The following blast warnings will be provided by the quarry:
  - A warning sign will be posted at the quarry entrance on the day of each blast and will be removed following each blast;
  - Residents will be notified of blasting times by means of a phone call or text message prior to the blast taking place;
  - The blast operator signals 30 seconds prior to each blast;
  - The blast operator signals after each blast.
- Drilling contractors complete a log for every borehole drilled, and the drilled holes are probed for an as-built survey of each to confirm the holes' specifications.
- Ensuring that the optimum blast ratio is maintained and ensuring that the maximum amount of explosive on any one delay, the maximum instantaneous charge is optimised so that the ground vibration levels are kept below those specified.
- Blasting shall be confined to between 10:00 to 18:00 Monday to Friday. Blasting shall not take place on Saturdays (or Sundays and public holidays).
- Vibration levels from blasting shall not exceed a peak particle velocity of 12 millimetres per second, measured in any three mutually orthogonal directions at any sensitive location. The peak particle velocity relates to low frequency vibration of less than 40 hertz where blasting occurs no more than once in seven continuous days. Where blasting operations are more

frequent, the peak particle velocity limit is reduced to eight millimetres per second. Blasting shall not give rise to air overpressure values at sensitive locations which are in excess of 125 dB (Linear) maximum peak with a 95% confidence limit. No individual air overpressure value shall exceed the limit value by more than 5 dB (Linear).

- The quarry operator will engage with GNI to agree appropriate vibration limits for its infrastructure and a method and programme of monitoring such that compliance with limits will be established as required.
- All blasts measured (ground vibration and air overpressure) in the area of at least one sensitive residence to determine compliance with the aforementioned limits and, so that information can be employed in any necessary modification of future blast designs.

9.7.3 PROPOSED ADDITIONAL MITIGATION MEASURES FOR FUTURE OPERATION

The following additional measures are proposed:

- Vibration monitoring records will continue to be maintained by the Quarry Manager (or appointed Environmental Manager) and will be available for display to local residents that may have been affected by site operations; and
- The Quarry Manager (or appointed Environmental Manager) will maintain a written complaints log in which all complaints made by local residents are detailed. This will ensure that the concerns of local residents who may be affected by site activities are considered during the management of activities at the quarry site.
- Monitoring of vibration levels at local residences will be conducted in agreement and with the consent of local residents. The Quarry Manager (or appointed Environmental Manager) will give at least 24-hours' notice to the residents at whose homes vibration monitoring will occur. GNI will also be contacted in advance of any blasting activities in close proximity to their pipeline to the north of the quarry.

9.8 CUMULATIVE EFFECTS

9.8.1 NOISE

Quarrying activities currently take place in the adjacent sites to the south and east of the Application Site. Cumulative impacts of the activities within the Application Site and these surrounding developments on the local noise environment are considered *'imperceptible'*. Quarrying activities were operational at both local sites during the noise surveys and cumulative noise was assessed. As demonstrated in these surveys the ambient noise in the locality was dominated by the regional road network. Noise from typical site work practices, the quarry facility to the south of the Site, the quarry facility to the east and the regional road network are not considered to cumulatively impact the local sound environment.

There is no discernible effect in cumulative noise anticipated as a result of proposed activities at the Application Site.

9.8.2 VIBRATION

Other quarrying activities taking place to the east and south of the site consist of sand and gravel extraction by mechanical means. Therefore, cumulative vibration impacts of the Application Site and adjacent quarry operations are considered *'negligible'* as there is no requirement to conduct blasting for rock extraction at these other operations.

The closest quarries to the Application Site which conduct blasting activities for rock are located ca. 2.2 km to the north-west. Given the distance of these operations from each other and the strict blasting controls employed at these sites, any cumulative impacts are deemed to be *'imperceptible'*.

Phased restoration activities at the existing quarry and the Application Site do not use blasting techniques. Restoration will be carried out using mobile plant. Therefore, there will be no cumulative impacts from extractive phases at the Application Site and restoration activities at the existing quarry and proposed development.

9.9 RESIDUAL EFFECTS

9.9.1 NOISE

At present the noise environment at the Application Site is typical of a rural setting with influences of the national road to the southeast of the Site and slight influences of the extractive industry and road traffic noted. Any impacts resulting from the continuation of the quarry void in this Application are considered consistent with the existing permitted development and, with the implementation of the noise mitigation techniques detailed in Section 9.7, would be ***not significant.***

It is considered that there will be no significant residual effect from noise at the Application Site on the local environs if the mitigation measures practiced on site and outlined in Section 9.7 are adhered to.

9.9.2 VIBRATION

Once all mitigation measures, as highlighted in Section 9.7 are adopted there should be no significant residual vibration effects in the area after blasting is completed. However, there may be some concerns from local residences about damage to their properties. Recent research shows that blasting can have the potential to upset people but well-established quarries which have developed good relationships with local residents are less likely to attract complaints.

In general, complaints concerning blast-induced vibration are not the result of actual structural damage, but rather due to adverse human responses and fears of structural damage[1].

9.10 DIFFICULTIES AND CHALLENGES ENCOUNTERED

Some of the survey work undertaken for this assessment coincided with the Covid-19 global pandemic, and as such it is possible that road traffic and commercial activities at the height of the pandemic between March 2020 and around Spring 2021 were at lower levels than before Covid-19 restrictions came into force. As a result, measured baseline noise levels during this period where road traffic was a dominant source may have been lower than would have been expected in the pre-Covid situation.

The above comments notwithstanding, it is not immediately obvious that baseline measurements were adversely affected by Covid related changes in road traffic. For example, at N1K (the receptor closest to the R410), one of the lowest measured noise levels was recorded on 5th March 2020,

[1] Farnfield, R.A. (1998) Environmental Effects of Blasting - Recent Experiences. International Mining and Minerals. 1, 4, 94-99.

although this was taken several weeks prior to Ireland's first Covid related national 'stay-at-home' order and therefore before significant restrictions on travel came into play.

Nevertheless, any reduction in road traffic flows that may affect baseline noise levels would result in a greater prominence of quarrying noise, thereby resulting in a more representative assessment.

9.11 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 9-28 below provides a general summary of submissions relevant to this section and details where or how this item has been considered.

Table 9-28 - 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	The measured air overpressure levels were substantially lower than the levels which would see structural damage to windows. The predicted vibration impact due to blasting is predicted to be negligible to low adverse, depending on the proximity to the blast site, which is not significant.
Potential damage from blasting to the high-pressure gas pipeline that runs to the north of the subject site	Potential adverse effects to the GNI gas transmission pipeline have been assessed in this chapter. Please refer to Sections 9.6.2, 9.6.3, and 9.6.4. Potential impacts to the gas transmission pipeline are not significant.
Noise, dust and air pollution	The potential adverse impacts from noise as a result of the proposed 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. 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 9.5.1.2. Vibration monitoring is to be undertaken the nearest sensitive receptors surrounding the site and at the gas transmission pipeline. The closest receptors are monitored during each blast.

9.12 SUMMARY AND CONCLUSIONS

This assessment has considered potential noise and vibration impacts associated with the proposed future operations of the quarry on the amenity of residents at existing nearby properties. It has also assessed noise impacts on Glen Ding Wood and vibration impacts on the GNI gas transmission pipeline.

The assessment has comprised a desk-top study to determine an appropriate study area and identify potentially sensitive receptors, prediction of worst-case operational phase noise and vibration levels, and evaluation against appropriate criteria. In addition to this desk-top assessment, baseline noise monitoring during existing quarrying operations has been undertaken at least biannually at five monitoring locations around the Site between April 2019 and January 2024 and this has been used to inform the noise impact assessment. Vibration and air overpressure monitoring has also been undertaken between February 2018 and August 2020 during periods of quarry blasting by the blasting contractor at five further vibration monitoring locations.

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.

Operational noise from the quarry has been predicted for three future operational scenarios within the proposed extensions to the quarry. These scenarios occur during daytime periods only; night-time operations are not proposed (and do not currently take place). All modelled scenarios have followed a conservative approach to determine the likely 'worst-case' noise levels at NSRs. Predicted noise levels for each operational scenario are within the permitted daytime limits and the levels recommended by the EPA Environmental Management Guidelines – Environmental Management in Extractive Industry.

The specific noise levels from quarry operations for each modelled scenario are predicted to not exceed the permitted threshold level, resulting in a negligible adverse impact at all NSRs which is ***not significant***.

At NSRs R3 and R6, noise levels are predicted to increase the ambient noise level above the measured noise level (relative to the nearest measurement location) by <3dB for Scenarios 1 and 3 and no increase for Scenario 2, which may result in a negligible or low adverse impact at these NSRs which is ***not significant***.

At NSR R4, the noise level is predicted to increase the ambient noise level above the measured noise level (relative to the nearest measurement location) by >3dB but <5dB for all future operational scenarios, which may result in a low to medium adverse impact at this NSR which is ***not significant***.

At all other NSRs and at Glen Ding Wood, there is predicted to be no or negligible change in ambient noise level (relative to the nearest measurement location) due to proposed future quarrying activities which is ***not significant***.

Vibration monitoring undertaken between 2018 and 2020 at the nearest vibration sensitive receptors to the quarry, including the GNI gas pipeline, determined there were no exceedances in the specified vibration or air overpressure limits. Regression analysis indicates that at the NSR closest to the proposed new quarry face (approximately 300m from the nearest proposed blasting site), the PPV at the typical maximum MIC of 285 kg would be around 6 mm/s (at 95% CL), below the permitted threshold of 12 mm/s. The measured air overpressure levels were substantially lower than the levels which would see structural damage to windows. The predicted vibration impact due to blasting is predicted to be negligible to low adverse, depending on the proximity to the blast site, which is ***not significant***.

When taking into account the predicted absolute noise level, the change in ambient noise level and the likely vibration level due to blasting, the overall magnitude of impact at each receptor is ***not significant***.

Noise from operational activities associated with other quarries in the vicinity of the Site were ascertained to be imperceptible at all measurement locations. As such, the cumulative impact is **not significant**.

Potential noise and vibration impacts will be controlled by the continued implementation of mitigation measures at the quarry. Supplementary measures have been proposed to ensure that blasting is monitored appropriately, and potential impacts associated with the GNI pipeline are considered. With these mitigation measures in place, residual noise and vibration impacts due to proposed quarry operations have been determined to be ***not significant***.

9.13 REFERENCES

Environmental Impact Assessments of Projects Guidance on the Preparation of the Environmental Impact Assessment Report (Directive 2011/92/EU as amended by 2014/52/EU). European Commission 2018.

EU Environmental Impact Assessment Directive (Council Directive 2014/52/EU).

Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment, Department of Environment, Community and Local Government, 2018.

Department of the Environment, Quarries and Ancillary Activities, Guidelines for Planning Authorities 2004.

Kildare County Development Plan 2017 – 2023.

Environmental Code (Irish Concrete Federation, 2005).

Draft Guidelines on the information to be contained in Environmental Impact Assessment Reports (EIAR). Environmental Protection Agency, Johnstown Castle Estate, Co. Wexford, Ireland. EPA. 2017.

Draft Advice Notes for preparing Environmental Impact Statements. Environmental Protection Agency, Johnstown Castle Estate, Co. Wexford, Ireland. EPA. 2015.

Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4), Environmental Protection Agency (EPA), Office of Environmental Enforcement (OEE), 2016.

Environmental Effects of Blasting - Recent Experiences. International Mining and Minerals. 1, 4, 94-99, Farnfield, R.A., 1998.

BS 4142:2014 Method for Rating and Assessing Industrial and Commercial Sound.

BS 8233:2014 Guidance on sound insulation and noise reduction for buildings.

Guidelines for Environmental Noise Impact Assessment, Institute of Environmental Management and Assessment, 2014.

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

BS 5228-1:2009+A1:2014 Code of Practice for Noise and Vibration Control on Construction and Open Sites, Part 2: Vibration

BS 64722:2008 Guide to evaluation of human exposure to vibration in buildings, Part 2: Blast-induced vibration

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.

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

Design Manual for Roads and Bridges (DMRB) LA 111 Noise and vibration (revision 2), 2020

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

Public

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
N3K	04/08/2023	15:32	01:00	55	46.2	45.6	36.9

Monitoring Location	Date	Time (start of measurement)	Duration	Day-time Limit $L_{Aeq,T}$	$L_{Aeq,T}$	$L_{A10,T}$	$L_{A90,T}$
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

Public

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