AMENDMENT MAY 2013

ENVIRONMENTAL IMPACT ASSESSMENT
MARY'S MOUNT BLUE METAL QUARRY

SECTION 4.6
NOISE AND BLASTING IMPACT ASSESSMENT

PREPARED BY:

Spectrum Acoustics

Project No: 13779

Noise and Blasting Impact Assessment
Gunnedah Gravel Products Quarry Expansion
Mary's Mount, NSW

Prepared for:

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1.0 INTRODUCTION

1.1 The Proposal

Gunnedah Quarry products Pty Ltd (the "Applicant"), proposes to extend the area available for the extraction of a gravel resource from its existing gravel quarry on the property "Burleith" off Barker Road at Mary's Mount located approximately 33 km west of Gunnedah and 10 km east of Mullaley, NSW (see **Figure 1**). The Existing project site is shown in **Figure 2**.

This noise impact assessment has been carried out in accordance with the *NSW Industrial Noise Policy* (INP, 2000) to accompany a *Statement of Environmental Effects* (SoEE) for the proposal.

1.2 Receiver Locations

Land owners around the Project Site are identified in **Figure 3**. Representative private residences considered in this assessment are shown in **Table 1**.

TABLE 1
ASSESSED RESIDENTIAL RECEIVERS

Receiver	Property Name	Distance from project footprint
R1	"Broad Acre"	2870 m
R2	"Beulah"	2140 m
R3	"Longlea" 1	1650 m
R4	"Longlea" 2	3130 m
R5	"Kandoo" 1	3760 m
R6	"Kandoo" 2	3550 m
R7	"Keewong"	1780 m
R8	"Burleith" 2	1490 m
R9	"Verona"	3330 m
R10	"Burleith" 1	<100m

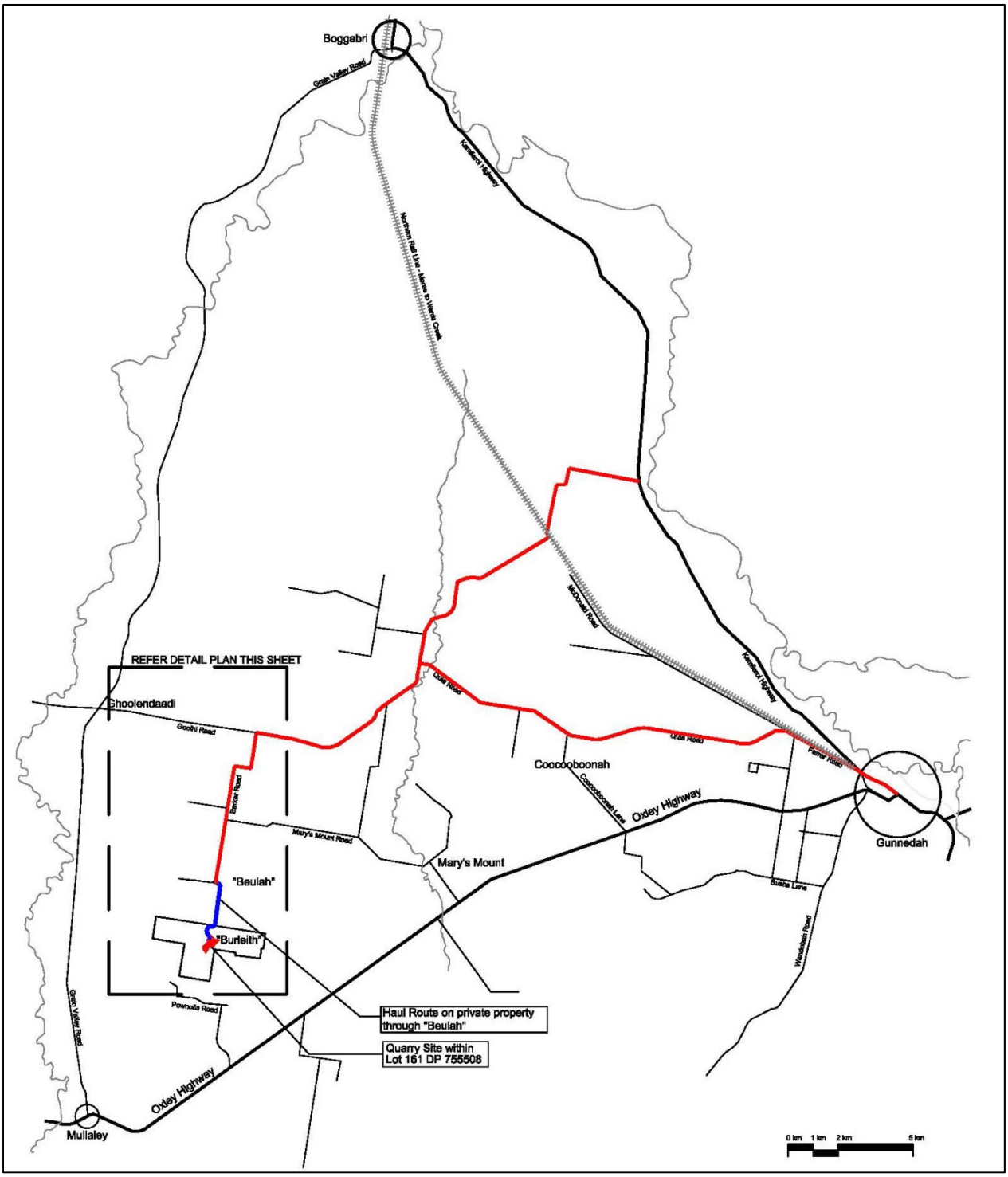


Figure 2. Existing Project Site Layout.

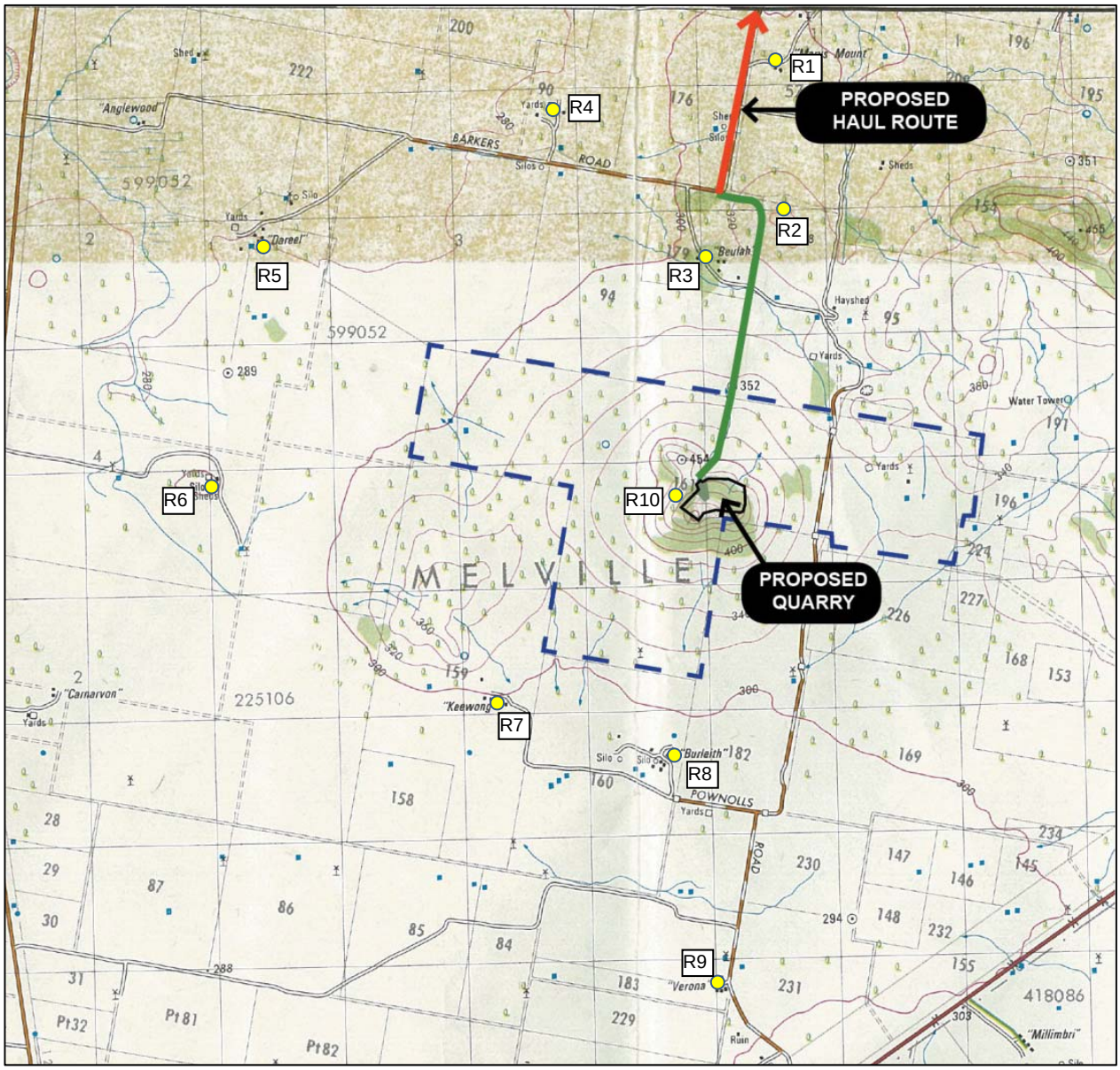


Figure 3. Project Site and Residential Receivers

2.0 THE PROPOSAL

2.1 Quarry Extension

The proposed Mary's Mount Blue Metal Quarry has a pit area of 14 hectares, and a project boundary area of 17.64 hectares surrounding the pit and 1.17 hectares of existing stockpile area north of the pit.

The proposed extraction rate at the quarry is 120,000bcm a year or 360,000 tonnes. The sequence of quarrying has been divided into three stages. Each stage has a span of approximately 12 years. The boundaries of these stages are shown on the proposed quarry site plan.

Stage 1: Extends from the currently operating pit footprint, in a westerly direction. Excavation in this stage is to 440m AHD and the pit meets the existing levels along the northern and western boundaries. The quarrying method proposed for this stage is mechanical.

Stage 2 has a similar footprint to Stage 1, excavating deeper to the final pit levels as shown in the proposed quarry site plan. At approximately year 19 of operation a new haul route will need to be built at the north eastern extent of the project site. This stage may require some drill and blast operations dependant on basalt density at lower levels.

Stage 3 is located east of the existing quarry footprint meeting with existing levels to the north and eastern boundary of the project.

All highwalls within the pit will be benched to a width of 5 metres at 10 metre vertical intervals. The pit will drain along the northern base of the highwall out letting in the north eastern section of the site where it will be collected by contour banks and diverted into a farm dam which is being expanded as part of the proposed development. Rehabilitation will be progressive and completed as each area of the quarry reaches it full life.

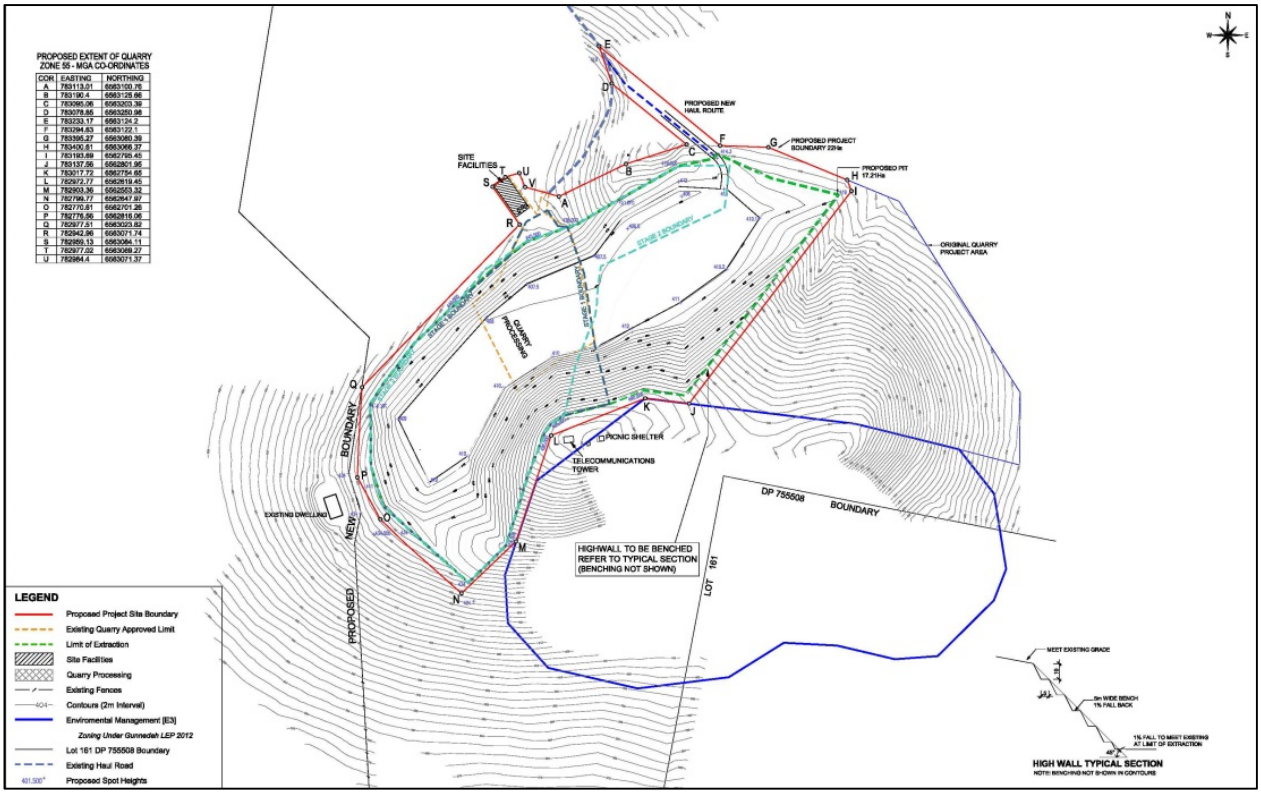


Figure 4. Proposed extraction sequence

2.2 Haul route works

The current haul route from the quarry entry along Barker Road to Goolhi Road will be retained. The applicant has committed to bitumen seal the haul route up to the Goolhi Road intersection over a two year period.

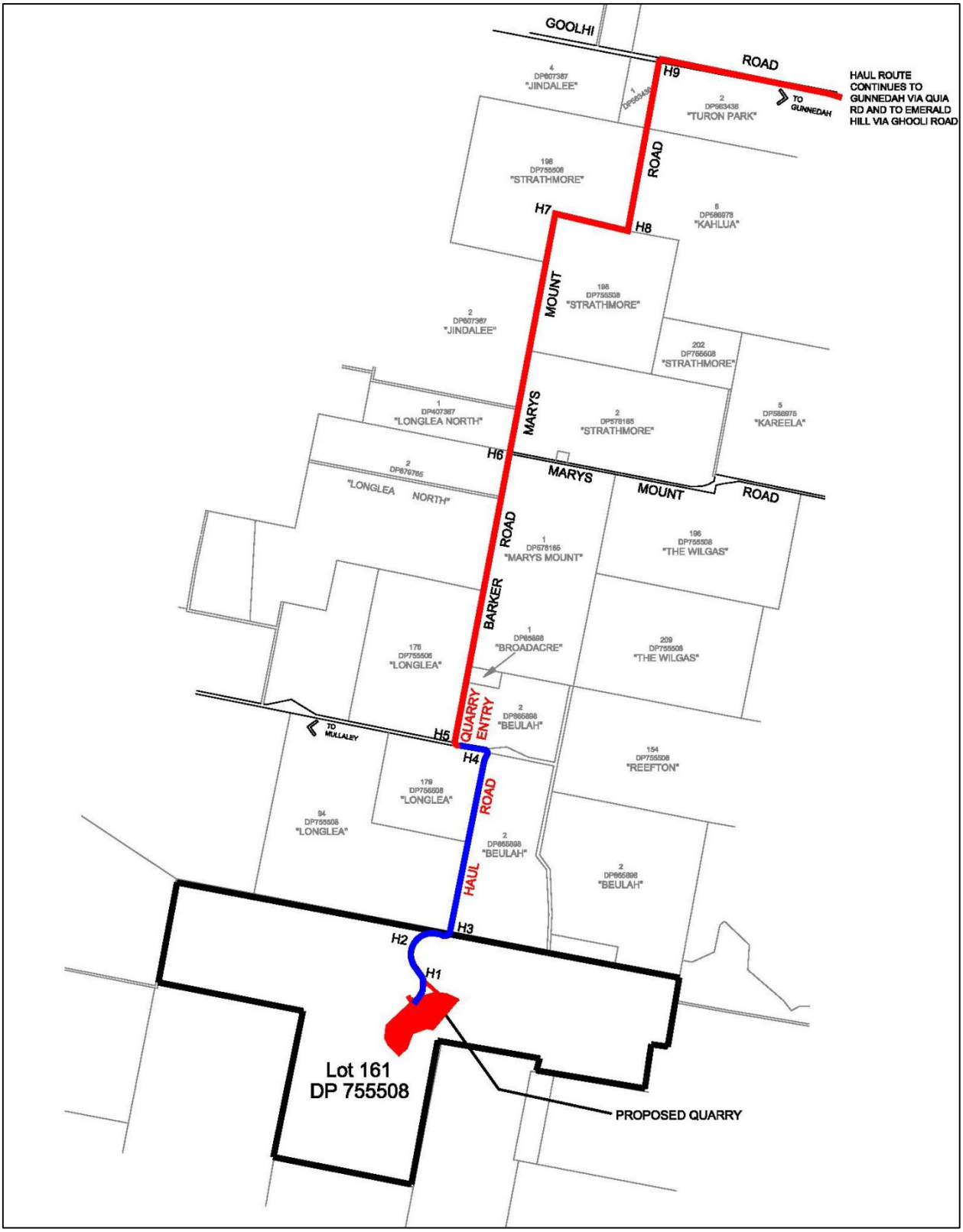


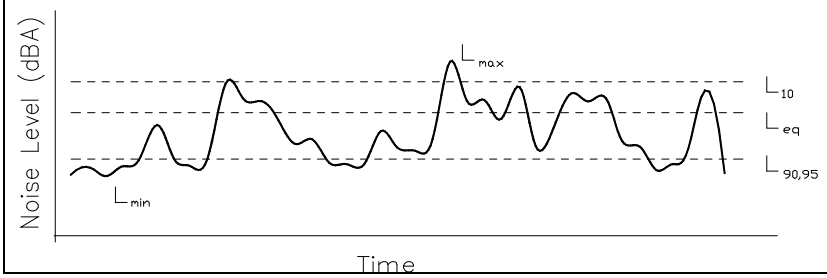
Figure 5. Existing haul route

3.0 DESCRIPTION OF TERMS

Table 2 contains the definitions of commonly used acoustical terms and is presented as an aid to understanding this report.

TABLE 2
DEFINITION OF ACOUSTICAL TERMS

Term	Description
dB(A)	The quantitative measure of sound heard by the human ear, measured by the A-Scale Weighting Network of a sound level meter expressed in decibels (dB).
SPL	Sound Pressure Level. The incremental variation of sound pressure above and below atmospheric pressure and expressed in decibels. The human ear responds to pressure fluctuations, resulting in sound being heard.
STL	Sound Transmission Loss. The ability of a partition to attenuate sound, in dB.
Lw	Sound Power Level radiated by a noise source per unit time re 1pW.
Leq	Equivalent Continuous Noise Level - taking into account the fluctuations of noise over time. The time-varying level is computed to give an equivalent dB(A) level that is equal to the energy content and time period.
L1	Average Peak Noise Level - the level exceeded for 1% of the monitoring period.
L10	Average Maximum Noise Level - the level exceeded for 10% of the monitoring period.
L90	Average Minimum Noise Level - the level exceeded for 90% of the monitoring period and recognised as the Background Noise Level. In this instance, the L90 percentile level is representative of the noise level generated by the surrounds of the residential area.



4.0 EXISTING ENVIRONMENT AND NOISE CRITERIA

The existing meteorological and acoustical environments of the site have been studied to determine prevailing conditions and to allow noise goals to be set.

4.1 Meteorology

The atmospheric conditions most relevant to noise assessments are temperature inversions, gentle winds (indicative of possible wind shear) and relative humidity. The INP states that wind effects need to be assessed where source to receiver winds (at 10m height) of 3m/s or below occur for 30% or more of the time in any season in any assessment period.

Meteorological data from Gunnedah airport for 2005 were analysed by Spectrum Acoustics for the acoustic assessment of the Sunnyside coal mine (Spectrum Acoustics, may 2007) which is approximately 33km east of the project site. The analysis found that winds were strongly aligned along a northwest – southeast axis as shown in **Figure 6**. Both of these wind directions have been adopted in the noise modelling

The INP also requires assessment of temperature inversions if the project is to operate at night time during winter months. As a daytime-only operation, inversions are not required to be considered.

In addition to the two prevailing wind directions, noise modelling for the proposal also considers neutral daytime conditions of 20^0C air temperature and 70% relative humidity with no vertical temperature gradient.

4.2 Existing Acoustic Environment

The area around the Project Site is rural in nature with some potential noise from agricultural activities, but contains no significant industrial noise sources. Taking a conservative approach, the INP default minimum background noise level of 30 dB(A),L_{90} will be adopted at all receivers.

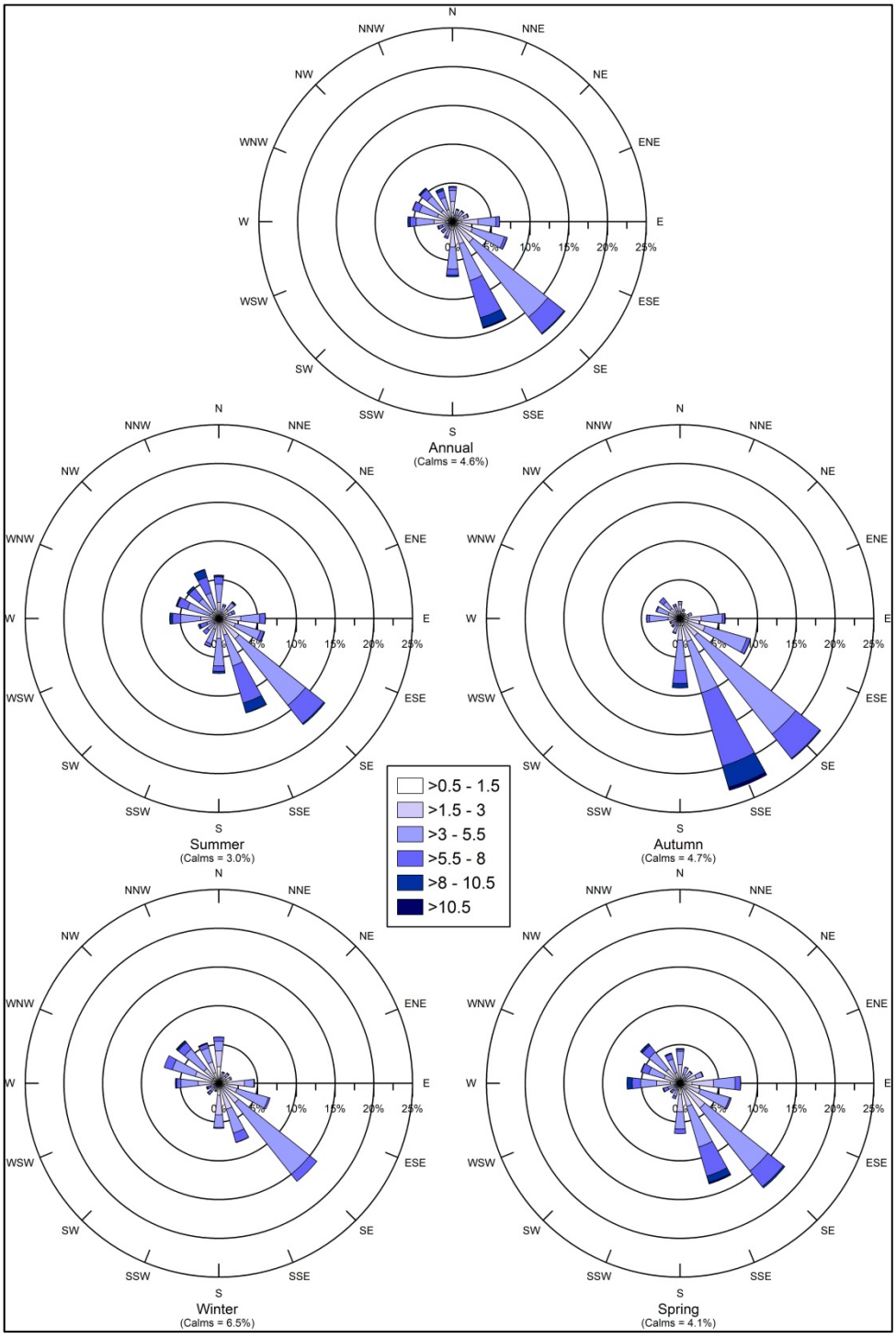


Figure 6. Wind roses, Gunnedah airport 2005

4.3 Construction Noise Goals

Construction of the new section(s) of haul route would occur during the first two years of the project but would only potentially impact any given receiver for a short duration in the order of weeks.

For daytime construction activities the EPA's *Interim Construction Noise Guidelines* (ICNG) effectively recommends a construction noise level of "background + 10 dB" which is **40 dB(A),$L_{eq(15minute)}$** based on the adopted background noise level of 30 dB(A).

4.4 Project Specific Noise Goals

Industrial noise is assessed against the requirements of the INP. In relation to residential receivers, the INP specifies two noise criteria: *intrusiveness and amenity criteria*.

The *Intrusiveness Criterion* limits Leq noise levels from the industrial source to a value of 'background plus 5dB'. That is, the Rating Background Level (RBL) for the time period, plus 5 dB(A). The RBL (L90) is defined as the overall single figure background level representing each assessment period (in this case day only).

The *Amenity Criterion* aims to protect against excessive noise levels where an area is becoming increasingly developed. Amenity criteria are dependent upon the nature of the receiver area and the existing level of industrial noise. There is very little existing industrial noise in the area and the residential area that is potentially affected by noise emissions from the current proposal is best described acoustically as rural.

The project specific noise level for all receivers will therefore be the intrusiveness criterion of **35 dB(A) $L_{eq(15\ min)}$.**

This criterion applies to all emissions from the site including heavy vehicles on private sections of the haul (shown as a blue dotted line in Figure 5).

4.5 Sleep Disturbance

As the extraction process and product transport will only operate after 7 am (i.e. during the day) the sleep disturbance criterion does not apply.

4.6 Vehicle Noise

In NSW, noise from vehicle movements associated with an industrial source is assessed in terms of the INP if the vehicles are not on a public road. If the vehicles are on a public road, the NSW *Road Noise Policy* (RNP) applies. Noise from the proposal must, therefore, be assessed against the project specific noise goals of the INP and also the criteria in the RNP.

The RNP recommends various criteria based on the functional categories of roads applied by the Roads and Traffic Authority (RTA). The RTA differentiates

roads based on a number of factors including traffic volume, heavy vehicle use, through or local traffic, vehicle speeds and applicable traffic management options.

Vehicles accessing the site will do so via Barker Road which is considered a local road as per definitions in the RNP, and then either Ghooli Road or Grain valley Road, which are sub-arterial roads.

Table 3 below shows the noise criteria relevant to traffic on various road types extracted from Table 1 of the RNP. For the assessment of traffic noise, the day time period is from 7am to 10pm, whilst night is from 10pm to 7am.

TABLE 3
ROAD TRAFFIC NOISE CRITERIA

Situation	Recommended Criteria	
	Day (7am to 10pm)	Night* (10pm to 7am)
3. Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments	Leq (1hr) 60 (external)	Leq (1hr) 55 (external)
6. Existing residences affected by additional traffic on existing local roads generated by land use developments	Leq (1hr) 55 (external)	Leq (1hr) 50 (external)

* It is not proposed to haul product at night, so only the daytime criteria are applicable.

The local road criteria will be applied to residences along the entire haulage route, including Barker Road and Goolhi Road.

4.7 Blasting

Overpressure and vibration levels from blasting are assessable against criteria proposed by the Australian and New Zealand Environment and Conservation Council (ANZECC) in their publication *"Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration – September 1990"*. These criteria are summarised as follows.

- The recommended maximum overpressure level for blasting is 115dB.
- The level of 115dB may be exceeded for up to 5% of the total number of blasts over a 12-month period, but should not exceed 120dB at any time.
- The recommended maximum vibration velocity for blasting is 5mm/s Peak Vector Sum (PVS).
- The PVS level of 5mm/s may be exceeded for up to 5% of the total number of blasts over a 12-month period, but should not exceed 10mm/s at any time.
- Blasting should generally only be permitted during the hours of 9am to 5pm Monday to Saturday, and should not take place on Sundays and Public Holidays.
- Blasting should generally take place no more than once per day.

5.0 ASSESSMENT METHODOLOGY

5.1 Road construction

Road construction/sealing noise modelling was conducted using the Environmental Noise Model (ENM, v 3.05) software from RTA Technology. This modelling software is accepted by all Australian regulatory authorities.

A single point source of noise accounting for all construction noise sources was placed in the model at the nearest point of the road alignment to a receiver, this being R3 "Longlea" 1, at 400m from the eastern end of the proposed new Barker Road section of haul road.

5.1 Site Operations

The proponent is planning to campaign mine the site, meaning the product will be excavated and stockpiled. When a sufficient volume of material is stockpiled, excavation will cease and processing will begin. This type of operation makes efficient use of machinery and minimises noise and duct impacts during different processes.

5.2 Modelled Scenarios

Based on the above description of quarrying operations the following scenarios were modelled using the ENM point-calculation mode to represent the potential worst case typical noise emissions to the north, west and south/east during the life of the quarry.

Scenario 1: Existing quarrying activities near the eastern boundary of Stage 2 extraction area and processing plant in current location, noting that extraction and processing activities will not coincide.

Scenario 2: Quarrying activities near the western extent of Stage 1 extraction area and processing plant at current location.

5.3 Noise Sources

Quarrying equipment for use for extraction and processing is listed in **Table 4**.

TABLE 4 NOISE SOURCES AND SOUND POWER LEVELS, Lw dB(A)			
Equipment	Indicative Number	Use	Lw dB(A)
Excavator (similar to Komatsu – PC300)	1	Road construction and processing	111
Front End Loader (similar to WA 500)	1	Truck loading, processing and moving stockpiles	113
Articulated dump Truck (Cat)	1	Road construction and processing	112
D10 dozer	1	Road construction, stripping overburden and rehabilitation	114
Roller	1	Road construction	113
McCloskey jaw crusher	1	Processing	98[1]
Triple deck screen	1	Processing	104
Cone crusher	1	Processing	109

[1] Noise measurements provided by the Client.

The modelling was undertaken for the atmospheric conditions described in Section 4.1.

5.2 Road Traffic Noise

Additional traffic noise generated by the proposal will be of a discrete rather than constant nature. There are many methods available for calculating the cumulative noise impact arising from discrete signals of various shapes. The methodology employed in this Section was sourced from the US Environmental Protection Agency document No. 550/9-74-004 *Information on Levels of Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety, March 1974*.

The document refers to *triangular* and *trapezoidal* time signals, which are illustrated in **Figure 5**. A triangular time signal rises from the background level to a peak noise level and then immediately begins to subside. A triangular time signal is a good approximation of the Sound Pressure Level (SPL) signal of a truck as it passes an observation point. A trapezoidal time signal rises from the background level to a maximum level and sustains that level for a period of time before subsiding. The trapezoidal time signal is a good approximation of the SPL signal of a train as it passes an observation point.

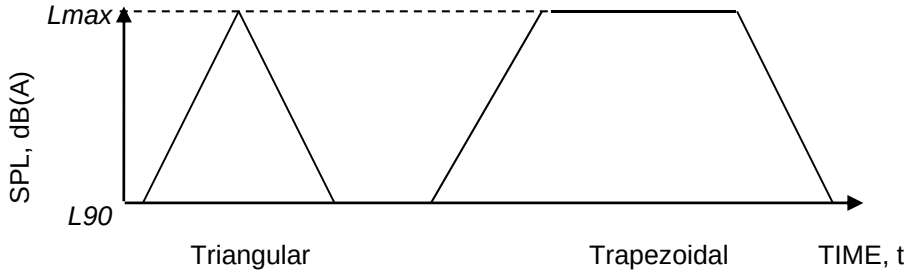


Figure 5. Triangular and Trapezoidal Time Signals

The value of $L_{eq,T}$ for a series of identical triangular time patterns having a maximum level of L_{max} is given by **Equation 1**.

$$L_{eq},T = L_b + 10\log\left[1+\frac{ND}{T}\left(\frac{10^{(L\max - Lb)/10}-1}{2.3}-\frac{\left(L_{\max}-L_b\right)}{10}\right)\right] \quad (1)$$

Where

- L_b is background noise level, dB(A)
- L_{MAX} is vehicle noise, dB(A)
- T is the time for each group of vehicles (min)
- N is number of vehicle trips
- D is duration of noise of each vehicle (min)

For calculation purposes, L_{max} is the maximum vehicle noise at the assessment point(s), and has been based on numerous measurements of quarry truck pass-by noise taken by Spectrum Acoustics at receivers near other quarries in recent years. The background noise level is the level that existed prior to the introduction of the new noise, the L90 level. The assessment period *T* corresponds to the stated criterion period, that is, 60 minutes.

5.3 Blasting

The following sections provide standard equations for predicting blast overpressure and ground vibration levels, sourced from the United States Bureau of Mines.

5.2.1 Blast Overpressure

Unweighted airblast overpressure levels (OP) are predicted from **Equation 2** below.

$$OP = 165 - 24(\log_{10}(D) - 0.3\log_{10}(Q)), \quad dB \quad (2)$$

where *D* is distance from the blast to the assessment point (m) and
Q is the weight of explosive per delay (kg).

Equation 1 has been found through previous analysis of large quantities of blast data to underestimate overpressure levels by up to 3 dB for small blasts (MIC 100-400kg) and overestimate by 1 dB for larger blasts (MIC > 400kg). A +3d correction will be applied for the relatively small blasts proposed for the project.

5.2.2 Blast Vibration

The basic equations for calculation of peak particle vibration (PPV) levels from blasting are as follows:

$$PPV = 1140\left(\frac{D}{Q^{0.5}}\right)^{-1.6} \text{, mm/s (for average ground type)} \quad (3)$$

$$PPV = 500\left(\frac{D}{Q^{0.5}}\right)^{-1.6} \text{, mm/s (for hard rock)} \quad (4)$$

where *D* and *Q* are defined as in Equation 2. The difference between Equations 3 and 4 is the value of the coefficient 1140 or 500 and, for conservatism, the larger value of 1140 will be adopted.

6.0 RESULTS AND DISCUSSION

6.1 Predicted Construction Noise Levels

A construction noise level of 37 dB(A) has been predicted at receiver R3 "Longlea" 1 under worst case conditions (NW wind, all plant operating simultaneously). Since this is below the recommended construction noise level of 40 dB(A) from the ICNG, no further discussion of road construction noise is required.

6.2 Predicted Operational Noise Levels

Noise levels were modelled using ENM for each of the atmospheric scenarios described in Section 4.1. Point calculations were performed for all receivers in **Table 1**.

Predicted noise levels for the modelled scenarios are summarised in **Tables 5-6**.

TABLE 5
CALCULATED NOISE LEVELS dB(A), $L_{eq\ (15\ min)}$
Scenario 1: Extraction and processing in Stage 2

	Extraction			Processing			
Receiver	Neutral	NW wind	SE wind	Neutral	NW wind	SE wind	Criterion
R1	24	21	26	23	20	25	35
R2	28	26	32	26	23	31	35
R3	31	28	33	30	26	33	35
R4	22	<20	26	21	<20	25	35
R5	<20	<20	25	<20	<20	23	35
R6	<20	<20	22	<20	<20	20	35
R7	<20	<20	<20	<20	<20	<20	35
R8	<20	<20	<20	<20	<20	<20	35
R9	<20	<20	<20	<20	<20	<20	35
R10	38	36	38	40	39	40	35

TABLE 6 CALCULATED NOISE LEVELS dB(A),$L_{eq\ (15\ min)}$ Scenario 2: Extraction at western and of Stage 1							
	Extraction			Processing			
Receiver	Neutral	NW wind	SE wind	Neutral	NW wind	SE wind	Criterion
R1	<20	<20	20	<20	<20	<20	35
R2	<20	<20	20	<20	<20	<20	35
R3	<20	<20	23	<20	<20	21	35
R4	23	21	26	21	<20	24	35
R5	21	<20	24	20	<20	25	35
R6	22	<20	24	20	<20	23	35
R7	31	31	31	28	29	29	35
R8	27	30	25	25	28	23	35
R9	<20	24	<20	<20	22	<20	35
R10	>45	>45	>45	40	39	40	35

The above results show that there are no predicted exceedances of the noise criterion at any receiver when the extraction and processing activities do not occur simultaneously, except at R10 which is within 100m of the extraction footprint and the criterion would be exceeded by 5-10 dB under all scenarios. The criterion of 35 dB(A) would be exceeded by a minor 1 dB at R3 if the extraction and processing activities occurred simultaneously under SE winds.

Although the proponent has advised that extraction and processing activities would not occur at the same time, they could do so under conditions other than those summarised above and still remain at or below the noise criterion.

6.3 Road Traffic Noise

The closest residence to the Barker Road section of the haul route is "Longlea North" which is 270m west of Barker Road, opposite the Mary's Mount Road intersection. The speed limit is 40 km/h in this location. There is also a residence approximately 140m from Ghooli Road, 900m south of the intersection with Quia Road, where the speed limit is 100 km/h. This traffic noise assessment considers potential noise impacts at both receivers.

Spectrum Acoustics has previously measured maximum noise level up to 63 dB(A) at 100m from empty B-doubles arriving at a gravel quarry with a speed of approximately 40 km/h. This implies a maximum level of 54 dB(A) at a distance of 270m at "Longlea North". Using the appropriate inputs, Equation 1 gives a value of 36.2 dB(A),$L_{eq(1\ hour)}$ for a single truck pass-by.

The total noise contribution (SPL_N) from a number, N, of events of equal sound pressure level (SPL_1) is given by

$$SPL_N = SPL_1 + 10\log_{10}(N) \qquad (2)$$

Taking the daytime traffic noise criterion of 55 dB(A),$L_{eq(1\ hour)}$ as SPL_N and solving equation (2) for *N* gives a maximum of more than 50 trucks per hour to equal the noise criterion at this receiver.

The proponent has advised that approximately 31 trucks per day (62 movements including arrival and departure) would be generated. An average there would be fewer than six truck movements per hour resulting in a traffic noise level of 43 dB(A),$L_{eq(1\ hour)}$ which is well below the RNP noise criterion.

For a heavy vehicle (B-double) travelling at 100 km/h on a tar-sealed road, Spectrum Acoustics has previously measured maximum noise levels up to 68 dB(A), based on hundreds of measurements. At a distance of 140m this would reduce to 65 dB(A). Using equation 1 and assuming six tuck movements per hour gives a predicted level of 51 dB(A),$L_{eq(1\ hour)}$ at the nearest residence to Ghooli Road. This is below the 55 dB(A) criterion.

6.4 Blasting

The client has advised that blasting within the quarry would only be required a maximum of 7 times per year. Typical quarrying operations previously assessed by Spectrum Acoustics have required up to 20 kg charge/hole for small blasts and no more than three holes/delay, implying a a maximum instantaneous charge weight (MIC) of 60 kg.

Calculated blast overpressure and ground vibration levels at the two nearest receivers based on this worst case MIC are summarised in Table 7.

TABLE 7
CALCULATED BLAST OVERPRESSURE AND VIBRATION LEVELS

Location	Distance, m	Overpressure, dB	Criterion	Vibration, mm/s	Criterion
R10 "Burleath" 1	100	134	115	16.7	5.0
R3 "Longlea" 1	1650	105	115	0.2	5.0

The above results show worst case blast impact levels well below the overpressure and ground vibration criteria for all receivers beyond 1650m from the quarry footprint.

The residence at R10 is predicted to receive vibration levels well in excess of the human comfort criteria.

7.0 SUMMARY

A noise impact assessment of the proposed expansion of the existing gravel quarry at Mary's Mount has been conducted. The study has found the following:

- With one exception, no noise criterion exceedances at residential receivers;
- With one exception, no blasting criterion exceedances at residential receivers; and
- No exceedance of off-site traffic noise criteria at any receiver.

The exception to the above findings is residence R10 "Berleith" 1 which is within 100m of the western extent of the quarry footprint. Noise and blasting impacts at this residence are predicted to exceed the relevant criteria at all times.