MT BUNDARBO PIT QUARRY

Noise and Blasting Assessment

Prepared for:

NGH Pty Ltd
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BASIS OF REPORT

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DOCUMENT CONTROL

Reference	Date	Prepared	Checked	Authorised
610.30189.00100-R01-v2.0	9 November 2021	Matthew Bryce, Steven Luzuriaga	Aaron McKenzie	Matthew Bryce
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1 Introduction

SLR Consulting Australia Pty Ltd (SLR) has considered noise and vibration emissions associated with the proposed extension of the existing Bald Hill Quarry, Mt Bundarbo, NSW (Mt Bundarbo Pit; "the Project"), near Jugiong in New South Wales (NSW).

Noise and vibration emissions associated the proposed and existing quarry operations have been considered with regard to the following documents in place in NSW:

- Construction Noise – *Interim Construction Noise Guideline*
- Quarry noise – *Noise Policy for Industry*
- Delivery and construction vehicles – *Road Noise Policy*
- Blasting Emissions – Australia and New Zealand Environment and Council (ANZEC) *Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration*.

2 Project Description

2.1 Project Background

Bald Hill Quarry Pty Ltd (BHQ), is a regional landfill and basalt quarry operating adjacent to the Hume Highway, approximately 7 km east of Jugiong in southern NSW. The quarry has been operating in the area for more than 30 years with the operations including open pits, crushing, screening and transporting material offsite providing the local area with aggregates and road base material.

Development consent for the operation was originally granted in 1984. In 1989, following significant investment and restructuring, BHQ commenced a strategic market development plan targeting a quality product to a market specifically seeking high quality crushed rock products.

A DA for the existing north ridge operation was granted in April 1999 (DA T.98.027) for the extension of hard rock quarrying activities, a new extraction site, ongoing use of existing processing plant, new raw feed haul route and product transportation. BHQ currently extracts and despatches 100,000 to 150,000 tonnes per annum (tpa) with equivalent peak demands of up to 450,000 tpa.

BHQ operates under Environmental Protection Licence (EPL) number 2552, last updated in May 2016.

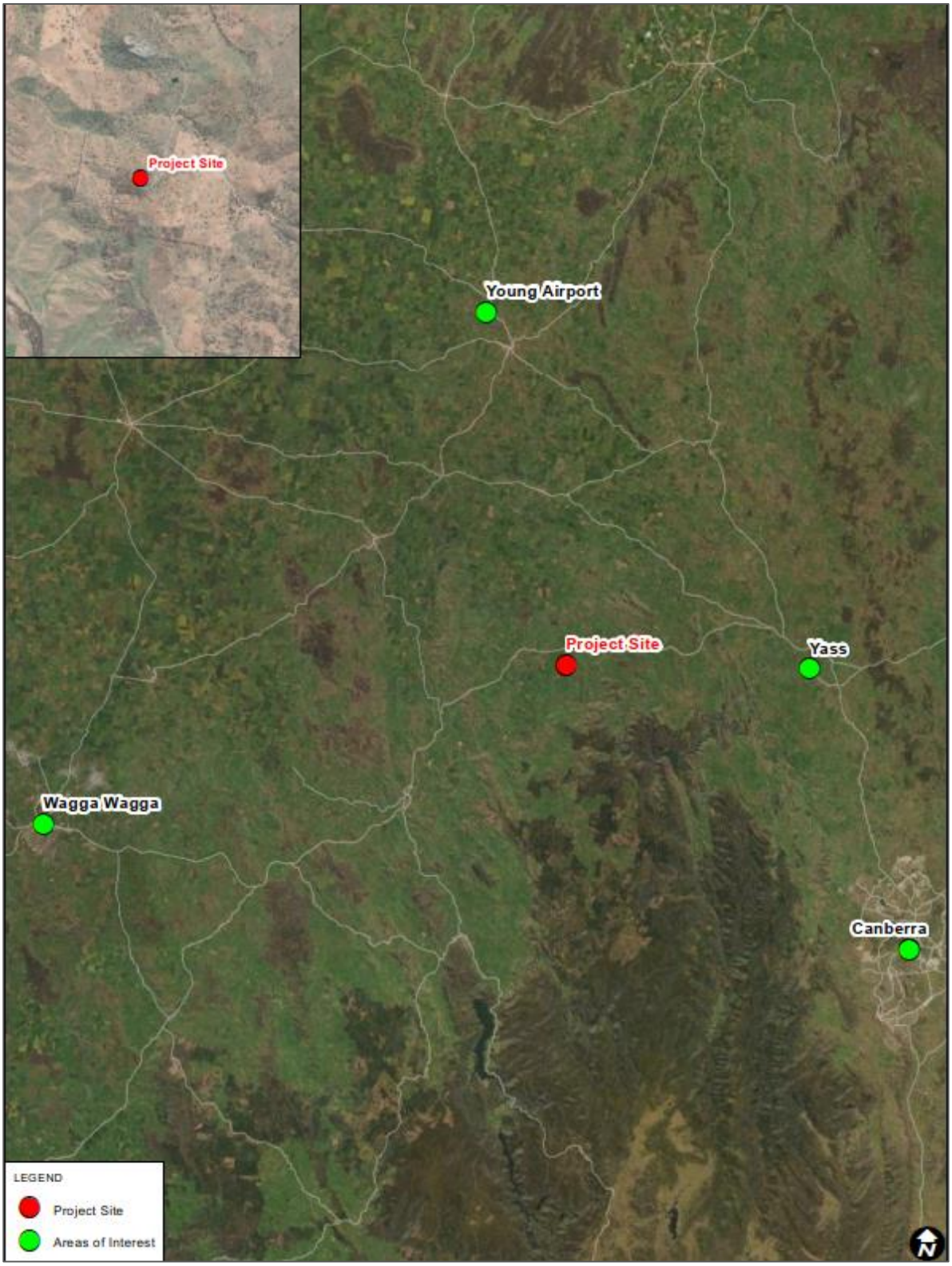
The original pit is now a landfill (known as "Ecofill") and the North Ridge pit is still in operation.

Ecofill has a contractual arrangement with a consortium of Local Government Councils known as South West Regional Waste Management Group (SWRWMG) to take waste from their waste transfer stations and furthermore to restrict all other sources of waste to the Local Government Areas the Councils represent. Ecofill is open five days a week with most waste being delivered by truck.

2.2 Project Location

The Project location is presented in **Figure 1**.

Figure 1 Location of Project



2.3 Project Expansion

The Project is to consist of a new open cut pit (Mt Bundarbo Pit) serviced by an 890 m extension to the current haul road servicing the North Ridge pit. The total Project area is approximately 10 hectares (ha).

Initial construction of the site will be through clearing and earthworks using excavator and dozer. Winning of material would be through drill and blast, with extraction by excavator, loader and dump truck to move the material for processing.

Processing of material is proposed to be either by campaign mobile crushing at Mt Bundarbo Pit or taken back to the existing processing plant near the landfill site for processing (crushing).

The existing and proposed Project layouts are presented in **Figure 2**.

The existing and Project operations will operate together, however, as the Mt Bundarbo Pit becomes more accessible and throughput increases, so the throughput of North Ridge pit will correspondingly reduce.

The existing and additional Project operations are summarised in **Table 1**.

Table 1 Existing and Proposed Quarry Operations

	Existing – North Ridge	Project – Mt Bundarbo
Throughput and progression timelines		
Normal	100,000 – 150,000 tpa	150,000 tpa
Peak	450,000 tpa	450,000 tpa
Construction phase	NA	Approx. 3 months
	NA	Haul road extension Sediment and erosion controls Strip topsoil and store Bulk earthworks (cut and fill) Topsoil restoration
Equipment inventory (fixed and mobile)		
Processing	Fixed three stage crushing and screening plant	Diesel mobile crushing and screening on campaign basis located at existing processing area or Bundarbo Pit.
	Up to maximum 2000 hours per annum (40 h/wk)	Up to maximum 2000 hours per annum (40 h/wk)
Excavators	Up to 3 shared across both pits	
Loaders	Up to 5 front end loaders (FEL) shared across both pits	
Haulage	Up to 3 dump trucks shared across both pits: • 1x Komatsu 325-6 31t empty 67t laden • 2x Komatsu 465-5 42t empty 96t laden	
Grading	1 grader shared across both pits	
Water cart	1 water cart shared across both pits – assume watering rate of 2L/m^2/h	
Tool truck	1 tool truck shared across both pits	
Light vehicles	3 utes shared across both pits	

	Existing – North Ridge	Project – Mt Bundarbo
Drilling and blasting		
Drilling for blasts	15 holes/day to 15 m shared across both pits	
Blasts	5 – 10 blasts per year, up to 650 m^2	
Hours of operation		
Construction	7:00 am to 6:00 pm Monday – Friday 7:00 am to 1:00 pm Saturday	
Pit activity	7:00 am to 6:00 pm Monday – Saturday	
Raw haulage	7:00 am to 6:00 pm Monday – Saturday	
Processing	7:00 am to 4:00 pm Monday – Friday	
Product dispatch	7:00 am to 10:00 pm Monday – Sunday	
Blasting	10:00 am to 3:00 pm Monday – Friday	

2.4 Sensitive Receptors

The Project is situated in a rural environment surrounded by farming properties with a small number of residential dwellings at least 1 km from the site.

A list of sensitive receptor points identified in the immediate vicinity of the site is shown in **Table 2**, along with the respective distances of each of these receptor points to the nearest site boundary. **Figure 2** shows the location of the surrounding receptors in relation to the Project.

Table 2 Details of Identified Sensitive Receptors

Receptor	Location (m, UTM)		Approximate Distance and Direction from Nearest Site Activity [a] (m)	Elevation (m, AHD)
	Easting	Northing		
R01	631,314	6,144,955	965 E	475
R02	631,628	6,144,971	1,270 E	475
R03	631,176	6,143,494	1,150 E	430
R04	630,557	6,140,984	1,510 SE	405
R05	628,385	6,140,872	1,720 SW	310
R06	627,921	6,145,007	1,510 W	370

Figure 2 Proposed Project Layout and Sensitive Receptors

3 Assessment Criteria

3.1 Construction Noise and Vibration

3.1.1 Construction Noise

The NSW *Interim Construction Noise Guideline* (ICNG) is used to assess and manage construction noise emitted during construction works and activities in NSW.

The ICNG contains procedures for determining project specific Noise Management Levels (NMLs) for sensitive receivers based on the existing background noise in the area. The 'worst-case' noise levels from construction of a project are predicted and then compared to the NMLs in a 15-minute assessment period to determine potential for adverse effects associated with construction of the project.

The NMLs are not mandatory limits, however, where construction noise levels are predicted or measured to be above the NMLs, feasible and reasonable work practices to minimise noise emissions are to be investigated.

The ICNG approach for determining NMLs at residential receivers is shown in **Table 3**.

Table 3 ICNG NML Criteria for Residential Receivers

Time of Day	NML $L_{Aeq(15minute)}$	How to Apply
Standard Construction Hours Monday to Friday 7:00 am to 6:00 pm Saturday 8:00 am to 1:00 pm No work on Sundays or public holidays	RBL[1] + 10 dB	• The noise affected level represents the point above which there may be some community reaction to noise • Where the predicted or measured LAeq(15minute) is greater than the noise affected level, the proponent should apply all feasible and reasonable work practises to meet the noise affected level • The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.

	Highly Noise Affected
	75 dBA
		• The Highly Noise Affected (HNA) level represents the point above which there may be strong community reaction to noise
		• Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restructuring the hours that the very noisy activities can occur, taking into account:
		  • Times identified by the community when they are less sensitive to noise (such as before and after school for works near schools or mid-morning or mid-afternoon for works near residences
		  • If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.

Outside Standard Construction Hours	RBL + 5 dB	• A strong justification would typically be required for works outside the recommended standard hours • The proponent should apply all feasible and reasonable work practices to meet the noise affected level • Where all feasible and reasonable practises have been applied and noise is more than 5 dB above the noise affected level, the proponent should negotiate with the community.

1. The RBL is the Rating Background Level and the ICNG refers to the calculation procedures in the NSW EPA *Noise Policy for Industry* (NPfI).

It is understood that construction works would be completed during the Standard Construction Hours. More stringent requirements are placed on work that is required to be completed outside Standard Construction Hours (ie during the evening or night-time or Sundays, Public Holidays etc), which reflects the greater sensitivity of communities to noise impacts during these periods.

Where Out of Hours Works (OoHW) are to be required, an assessment of the proposed activities must be undertaken during the preparation of the CNVMP in accordance with the ICNG.

The NMLs applicable at the surrounding receptors for the proposed construction hours, based on the NPfI minimum ambient background noise levels (RBLs), are shown in **Table 4**.

Table 4 Construction Noise Management Levels – All Receptors

Day of Week	Time	Assumed RBL, dBA	NML, dBA $L_{Aeq(30min)}$
Weekday (Monday – Friday)	7:00 am – 6:00 pm	35	45
Saturday	8:00 am – 1:00 pm	35	45

3.1.2 Construction Vibration

In terms of vibration emissions, the nearest sensitive receptor will be located approximately 1000 m from the Project. As blasting during construction is not proposed, the expected construction plant/activities would also not be considered significant sources of ground-borne vibration. Consequently, further consideration of construction vibration emissions has not been required.

3.2 Operational Noise

Noise limits for current operations are contained within EPL 2552. Following expansion into the Mt Bundarbo Pit, the EPL would require updating to be representative of this assessment and reflect the overall site activities.

The noise limits would be determined in accordance with the NSW *Noise Policy for Industry 2017* (NPfI), which sets out the requirements for the assessment and management of operational noise from industry in NSW.

3.2.1 Industrial Noise Trigger Levels

The NPfI defines how to determine 'trigger levels' for noise emissions from industrial developments. Where a development is likely to exceed the trigger levels at existing noise sensitive receivers, feasible and reasonable noise management measures are required to be considered to reduce the impacts.

There are two types of trigger levels – one to account for 'intrusive' noise impacts and one to protect the 'amenity' of particular land uses:

- The **intrusiveness** of an industrial noise source is generally considered acceptable at residential receptors if the L_{Aeq} noise level of the source, measured over a period of 15-minutes, does not exceed the representative background noise level by more than 5 dB.
- To limit continual increases in noise levels from the use of the intrusiveness level alone, the ambient noise level within an area from all industrial sources should remain below the recommended **amenity** levels specified in the NPfI for that particular land use.

For this assessment, the area surrounding the Project is considered to be 'rural' as per the NPfI definitions.

3.2.2 Project Noise Trigger Levels

This assessment has adopted the minimum Rating Background Level (RBL) values described in the NPfI, based on the high likelihood that the ambient background noise levels would be 'low' in the context of the NPfI, as is common in rural environments with few sources of noise-generating infrastructure.

The trigger levels for industrial noise from the Project are summarised in **Table 5**. The Project Noise Trigger Levels (PNTL) are the most stringent of the intrusiveness and amenity trigger level for each operational period and are highlighted below.

Table 5 Project Noise Trigger Levels – All Receptors

Period	Recommended "Rural" Amenity Noise Level, dBA L_{Aeq}	Minimum Noise Level, dBA		Project Noise Trigger Levels, dBA $L_{Aeq(15minute)}$	
		RBL[1]	$L_{Aeq(period)}$	Intrusiveness	Amenity[2, 3]
Daytime[4]	50	35	40	**40**	48
Evening[5]	45	30	35	**35**	43

1. RBL = Rating Background Level.
2. No other sources of industrial noise are present in the area and are not likely to be in the future. As such, the recommended amenity noise levels have been taken as the project amenity noise levels, as outlined in the NPfI.
3. The project amenity noise levels have been converted to a 15-minute level by adding 3 dB, as outlined in the NPfI.
4. Day – the period from 7:00 am to 6:00 pm Monday to Saturday or 8:00 am to 6:00 pm on Sundays and public holidays.
5. Evening – the period from 6:00 pm to 10:00 pm.

3.2.3 Modifying Factors

Sources of industrial noise can cause greater annoyance where they contain certain characteristics, such as tonality, intermittency or significant low-frequency content. The NPfI specifies the following modifying factors, shown in **Table 6**, applicable to the Project and which are to be applied to the received noise level where annoying characteristics are present.

Table 6 NPfI Modifying Factors

Factor	Assessment/Measurement	When to Apply	Correction[1]
Tonal noise	One-third octave or narrow band analysis	Level of one-third octave band exceeds the level of the adjacent bands on both sides by the levels defined in the NPfI.	5 dB[2]
Low-frequency noise	Measurement of source contribution C-weighted and A-weighted level and one-third octave measurements	Measure/assess source contribution C and A weighted $L_{eq,t}$ levels over same time period. Correction to be applied where the C minus A level is 15 dB or more and the level to which the thresholds defined in the NPfI are exceeded.	2 or 5 dB[2]
Maximum adjustment	Refer to individual modifying factors	Where two or more modifying factors are indicated.	Maximum correction 10 dB[2] (excluding duration correction)

1. Corrections to be added to the predicted levels.
2. Where a source emits tonal and low-frequency noise, only one 5 dB correction should be applied if the tone is in the low-frequency range, that is, at or below 160 Hz.

3.3 Project Traffic on Surrounding Roads

When trucks and other vehicles are operating within the boundaries of the Project site, noise contributions are included in the predicted noise emissions.

When Project-related (construction and operations) traffic moves onto the public road network a different noise assessment methodology is common and appropriate, as vehicle movements are regarded as 'additional road traffic' rather than as part of the works and are assessed in accordance with the NSW *Road Noise Policy*.

An initial assessment is first applied to evaluate if existing road traffic noise levels are expected to increase by more than 2 dB (ie equates to an increase in traffic volumes of approximately 60%) due to construction traffic.

Where noise levels increase by more than 2 dB (ie 2.1 dB or greater) further assessment is required using the criteria presented in the RNP, as shown in **Table 7**.

Table 7 RNP Criteria for Assessing Project-Related Traffic on Public Roads

Road Category	Type of Project/Land Use	Assessment Criteria, dBA	
		Daytime (7:00 am – 10:00 pm)	Night-time (10:00 pm – 7:00 am)
Freeway/ arterial/ sub-arterial roads	Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments	$L_{Aeq(15hour)}$ 60 (external)	$L_{Aeq(9hour)}$ 55 (external)
Local roads	Existing residences affected by additional traffic on existing local roads generated by land use developments	$L_{Aeq(1hour)}$ 55 (external)	$L_{Aeq(1hour)}$ 50 (external)

3.4 Blasting Emissions

The blast noise and vibration emission criteria are also contained within EPL 2552. The criteria have been adapted from the ANZEC *Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration* ("the ANZEC Guidelines") and are as follows:

3.4.1 Airblast Overpressure

The recommended maximum level for airblast overpressure is 115 dB Linear Peak.

That may be exceeded for up to 5% of the total number of blasts over a period of 12 months. However, the level should not exceed 120 dB Linear Peak at any time.

3.4.2 Ground Vibration

The recommended maximum level for ground vibration is 5 mm/s (peak particle velocity, ppv). It is recommended that a level of 2 mm/s be considered as a long term regulatory goal.

The ppv level of 5 mm/s may be exceeded for up to 5% of the total number of blasts over a period of 12 months. The level should not exceed 10 mm/s at any time.

3.4.3 Times and Frequency of Blasting

Blasting should only occur during the hours of 9:00 am to 5:00 pm Monday to Saturday and should generally take place no more than once per day.

The proposed blasting times between 10:00 am and 3:00 pm would therefore occur within those times.

4 Noise Modelling

In order to predict noise levels associated with the Proposal at nearby receptors, a SoundPLAN computer model was developed. SoundPLAN is a software package which enables compilation of a computer model comprising a digitised ground map (containing ground contours and significant structures, where appropriate), the location and acoustic power levels of significant noise sources, and the location of sensitive receptors.

4.1 Noise Prediction Standard

The Conservation of Clean Air and Water Europe (CONCAWE) prediction methodology was utilised within SoundPLAN. This prediction method was specially designed for industrial facilities and incorporates the influence of wind and the stability of the atmosphere on the propagation of noise.

4.2 Modelling Inputs

The computer model generates noise emission levels taking into account such factors as the source sound power levels, distance attenuation, ground absorption, air absorption and shielding attenuation, as well as meteorological conditions.

The topography of the site land and surrounds was provided to SLR. The ground within the quarry was modelled as hard compact earth that mostly reflects noise, while all ground between the quarry boundary and the receptors was modelled as “soft ground” that mostly absorbs noise.

4.2.1 Construction Activities and Equipment

The most significant activity in terms of noise emission will be the formation of the 890 m haul road extension between the North Ridge pit and the Mt Bundarbo Pit.

The plant items and their associated sound power levels that would be used are described in **Table 8**.

It is likely that most of the plant would operate continuously for lengthy periods but not always concurrently. The Sound Power Level (SWL) information has been sourced from the NSW Transport for NSW *Construction Noise and Vibration Strategy* (CNVS).

Table 8 Haul Road Construction Equipment

Equipment	Number	Source Height, m	SWL (per item), dBA Lw
Dozer	1	2.5	116
Excavator	1	2.5	110
Loader	1	2.5	115
Dump truck	2	2.5	110

4.2.2 Project Operations and Plant Equipment

The quarry will utilise conventional extraction and processing methods which includes the following:

- Blasting is used to loosen rock material
- The loosened material is loaded into a dump truck using an excavator
- The material is then fed into an impact crusher and secondary crusher
- The material then feeds into a screen to sort the various products.
- The screened and sorted material is stockpiled on site using a front-end loader, which is also used to load the delivery trucks (eg "dog and trailer").

4.2.3 Haulage and Dispatch Roads

The length of the roads between the various site areas are described in **Table 9**.

Table 9 Haulage and Dispatch Roads

Road	Length, m
Access road from Hume Freeway – Processing Area	1,270
Processing Area – North Ridge Pit	3,220
North Ridge Pit – Mt Bundarbo Pit	875
Landfill – Processing/Transfer area	320

4.2.4 Noise Sources

The acoustically significant plant/equipment associated with the quarrying operations has been shown in **Table 10** for each activity.

The SWL information for most plant items has also been sourced from comparable equipment described in the CNVS. The SWL for the crusher and screen has been sourced from SLR's in-house database of measurements of comparable noise sources.

The duration of each of the activities, the emission height and the base sound power level (SWL) have been shown in **Table 10**.

The sources were modelled relative to the existing local ground height at the new pit and haul road locations at commencement in order to represent a "worst case" situation. The noise sources will gradually lower into the pit as the quarry progresses.

In addition to the quarrying activities, the existing Ecofill landfill operations will continue in the original quarry pit at the north part of the site.

It is understood that approximately eight (8) trucks per day would deliver waste to the laydown/sorting area. The waste is then manoeuvred into the landfill using an excavator and i-track bobcat, and then compacted using a compactor.

Table 10 Quarrying Activities

Activity	Plant	Number and Description	Source Height, m	Speed, km/h		SWL (per item), dBA Lw	
				Steady	Accelerating[1]	Steady	Accelerating[1]
Processing materials	Crusher	1 (at North Ridge Pit)	2.5	--	--	118	--
	Screen	1 (3 stage, at North Ridge Pit)	3.0	--	--	111	--
	50 kW Loader (tracked)	1 (at North Ridge Pit)	2.5	--	--	115	--
	Truck idling	1 (loaded at North Ridge Pit)	2.5	--	--	105	--
	Mobile crusher	1 (at Mt Bundarbo Pit)	2.5	--	--	118	--
	50 kW Loader (tracked)	1 (at Mt Bundarbo Pit)	2.5	--	--	115	--
Landfill	30t Excavator	1 (In landfill pit)	2.5	--	--	110	--
	Compactor	1 (In landfill pit)	2.5	--	--	106	--
	Dump Truck	1 (to/from landfill)	2.5	40	10	110	115
	Dump Truck	1 (arrive with material)	2.5	40	10	110	115
	Bobcat	1 (sorting material)	1.5	--	--	95	--

Activity	Plant	Number and Description	Source Height, m	Speed, km/h		SWL (per item), dBA Lw	
				Steady	Accelerating[1]	Steady	Accelerating[1]
Product Dispatch (from Landfill/Processing area)	50 kW Loader (tracked)	1	2.5	--	--	115	--
	Truck idling (being loaded)	1	2.5	--	--	105	--
	Truck & dog	1	2.5	40	10	110	115
Haulage (between pit and North Pit processing area)	Dump truck	3 (shared across both pits)	2.5	20	10	110	115
Quarrying (in new Mt Bundarbo and North Pits)	30t Excavator	3 (1 in North Ridge Pit, 2 in Mt Bundarbo Pit)	2.5	--	--	110	--
	50 kW Loader (tracked)	5 (3 in North Ridge Pit, 2 in Mt Bundarbo Pit)	2.5	--	--	115	--
	Dump truck	1 (being loaded at Mt Bundarbo Pit)	2.5	--	--	110	--
	Truck & dog	1 On site access road	2.5	40	10	110	115
Maintenance	Tool truck	1 (shared across both pits)	2.5	20	5	100	105
	Water truck	1 (shared across both pits)	2.5	25	10	110	115
	Grader	1 (shared across both pits)	2.5	15	5	113	118

1. Trucks are assumed to accelerate 20% of the time.

5 Noise Assessment

5.1 Construction Noise Assessment

5.1.1 Methodology

The ICNG requires an assessment of the 'realistic worst case' noise emissions for construction scenarios based on proposed works within a 15-minute period. This is generally associated with works located nearest to a particular receptor, and also when the receptors are most exposed to the works.

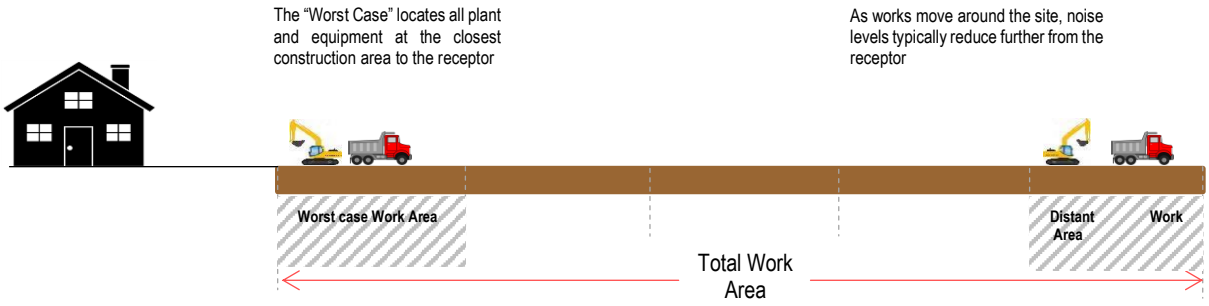
The noise emissions generated during construction activities would be expected to be highest when the construction activities commence as the works will occur at the existing ground surface level.

In reality at any particular location, the potential construction noise impacts can vary greatly depending on factors including the following:

- The position of the works within the site and distance to the nearest sensitive receptor;
- The overall duration of the works;
- The intensity of the works;
- The time at which the works are undertaken; and
- The character of the noise emissions.

Noise levels at sensitive receptors can be substantially lower than the worst-case scenario when the construction works move to a more distant location in a works area. This concept is shown in **Figure 3**.

Figure 3 Conceptual Illustration of Work Areas



5.1.2 Construction Scenarios

The noise associated with the construction of Cell 10 has been considered with regard to the following scenarios:

- Scenario 1 – All plant and equipment operating towards the northern end of the haul road; and
- Scenario 2 – All plant and equipment operating towards the southern end of the haul road.

5.1.3 Predicted Construction Noise Levels

Predicted construction noise levels for the equipment used to construct the new haul road extension (refer to **Table 8**) are shown in **Table 11**. The predictions assume that all plant/equipment operates close together, simultaneously and continuously for at least 15 minutes, to provide a 'worst-case' situation, which for some items will be a conservative assumption.

Table 11 Predicted Construction Noise Levels

Receptor	NML Standard Construction Hours, dBA $L_{Aeq,30min}$	Predicted Noise Level, dBA L_{Aeq}		Exceedance over NML, dBA	
		Scenario 1	Scenario 2	Scenario 1	Scenario 2
R01	45	31	28	--	--
R02	45	28	27	--	--
R03	45	37	35	--	--
R04	45	<15	36	--	--
R05	45	<15	18	--	--
R06	45	<15	<15	--	--

In **Table 11**, it can be seen that the predicted construction noise levels at any receptor would not be expected to exceed the NML at all receptors regardless of where the construction works are occurring.

Nonetheless, where feasible and reasonable, the proponent (or construction contractor) should undertake mitigation measures to minimise noise from the site as far as practicable, especially if undertaken as OoHW. These measures relate to plant selection and operation, and include:

- Operate plant and equipment in the quietest and most efficient way, including not idling or revving vehicles unnecessarily.
- Use the smallest plant practicable and fit quality/effective mufflers and non-tonal reversing beepers (broadband bland "quackers").
- Limit the speed of vehicles and avoid the use of engine compression brakes.

5.2 Operational Noise Assessment

Similar to construction activities, noise levels at the receptors would be highest when quarrying and landfill plant/equipment operates in the nearest part of the site to a receptor.

5.2.1 Weather Conditions

Noise assessments must include consideration of the weather conditions for the project area and their effect on noise propagation from the site activities.

Certain weather conditions can increase noise levels by enhancing the propagation of noise towards receivers. Noise-enhancing weather conditions occur where light wind (0.5 m/s – 3 m/s) blows from the source to the receiver, or where temperature inversions occur. Such conditions are considered prevalent to the area where the frequency of occurrence exceeds 30% of the time.

To determine the prevalence of noise-enhancing weather conditions, an analysis of site representative meteorological data prepared for the project air quality assessment[1] was undertaken.

Weather data generated for the year 2017 prepared for that assessment was analysed utilising the NSW EPA Noise Enhancing Wind Analysis program (NEWA). Results of the analysis for the daytime period relevant to extraction and processing operations are presented in **Table 12**.

Table 12 Occurrence of Noise Enhancing Winds for Daytime Period

Season	Percentage of Occurrence of Noise-Enhancing Winds (0.5 m/s – 3 m/s), (Winds Blowing From)							
	North	Northeast	East	Southeast	South	Southwest	West	Northwest
Summer	7.6	8.2	5.2	6.8	7.6	8.0	9.7	6.8
Autumn	12.1	17.4	13.3	9.2	12.1	12.0	13.0	9.2
Winter	18.3	18.2	8.7	17.4	18.3	19.6	25.7	17.4
Spring	9.1	10.0	7.0	6.8	9.1	7.7	9.2	6.8

The weather analysis shows that noise-enhancing winds (0.5 m/s – 3 m/s) are not a significant feature (>30% occurrence) of the Project area during the daytime period when extraction and processing operations occur.

The weather analysis also showed that during the evening period of winter, noise enhancing winds from the northeast would occur more than 30% of time.

The NPfI provides parameters for 'standard' and 'noise-enhancing' weather conditions to be used for modelling depending on the prevalence, or otherwise, of noise-enhancing weather conditions. The meteorological conditions used for this assessment have been described in **Table 13**.

Table 13 Modelled Weather Conditions

Period	Weather Condition	Meteorological Parameters used in Assessment
Daytime	Standard	Stability categories A–D with light winds up to 0.5 m/s
Evening[1]	Noise-enhancing	Stability categories A–D with light winds up to 3 m/s

1. Only the product dispatch activities would be in operation at this time.

[1] SLR Report "*Mt Bundarbo Pit Quarry – Air Quality Impact Assessment*", Ref: 610.30189-R01-v2.0, dated 29 January 2021

5.2.2 Modelling Results

The results of the noise modelling are shown in **Table 14**, together with the applicable Project PNTLs.

Table 14 Predicted Noise Levels – All Operations (Daytime)

Receptor	NPfI PNTL dBA $L_{Aeq(15min)}$	Predicted Noise Level, dBA $L_{Aeq(15minute)}$						
		Quarrying	Processing[1]	Haulage	Maintenance	Product Dispatch	Landfill	Total
R01	40	29	37	25	23	31	22	39
R02	40	27	34	21	21	28	17	36
R03	40	35	36	28	30	27	14	40
R04	40	34	35	19	30	<15	<15	38
R05	40	33	33	<15	<15	<15	<15	36
R06	40	28	36	21	18	31	19	38

1. Activity does not occur during the 6am – 7am period.

It can be seen in **Table 14** that noise levels from the day-to-day quarry operations are predicted to comply with the NPfI PNTLs at all receptors for the daytime activities.

Noise from the Project is not expected to contain any 'annoying' characteristics (described in **Table 6**) when observed at the surrounding receptors, and therefore no modifying factor is required for the predicted noise levels.

The predicted noise level from the product dispatch operations that may also occur during the evening period (6:00 pm – 10:00 pm) are shown in **Table 15**.

Table 15 Predicted Noise Levels – Product Dispatch Operations (Evening Period)

Receptor	NPfI PNTL, dBA $L_{Aeq(15minute)}$	Predicted Noise Level, dBA $L_{Aeq(15minute)}$
R01	35	35
R02	35	31
R03	35	23
R04	35	<15
R05	35	<15
R06	35	23

It can be seen in **Table 15** that noise levels from the product dispatching operations would comply with the evening PNTL at all receptors.

Therefore noise associated with the proposed expansion of the quarry to the Mt Bundarbo Pit, in conjunction with the existing quarrying and landfill activities, would be expected to comply with the NPfI PNTLs.

5.2.3 Ongoing Mitigation for Minimising Noise Emissions from the Project

Even though the predictions of Project noise would comply with the NPfI requirements, it is common and appropriate to undertake mitigation and management controls to ensure that site noise is minimised where practicable to reduce the likelihood of noise-related complaints.

The following controls are recommended:

- Update the EPL to include the new site operations and reflect the current NPfI requirements described in this assessment, ie
  - Noise at any receptor must not exceed the PNTLs described in **Table 5**.
  - The PNTLs apply under the weather conditions described in **Table 13**.
  - Maintain a noise complaint register including any complaints received, investigation and follow up.
- Update the quarry noise management plan to reflect this assessment and the updated EPL, including:
  - Undertake routine noise monitoring (eg annual or bi-annual) to confirm compliance with the EPL.
  - Maintain equipment in accordance with manufacturers requirements to avoid excess noise emissions.

5.3 Project-Related Road Traffic Noise Assessment

It is understood that the rate of material processed the quarry would not increase following the expansion of the quarry to include the Mt Bundarbo Pit. Therefore, additional trucks to dispatch product would not be required and the number of operations-related trucks using the surrounding road network would not change.

With regard to construction-related trucks, the number of trucks will be very low relative to the total number of existing vehicles on the Hume Freeway which carries over 9,000 vehicles per day.

Therefore, the Project would not noticeably increase the traffic volume on the Hume Freeway, so the RNP +2 dB criterion would not be exceeded.

5.4 Blasting Assessment

Airblast overpressure and ground vibration levels for the project have been considered based on the methodology contained within Australian Standard (AS) 2187.2-2006 "*Explosives - Storage and use, Part 2: Use of explosives*" (AS 2187.2).

Site constants representative of site-specific conditions of the Project were developed from monitoring data collected from previous blasts undertaken at the North Ridge Pit, around 700 m north of the proposed Mt Bundarbo Pit. The monitoring data included 14 measurements collected over one year (ie 2020). The monitoring location was located approximately 850 m north of the North Ridge Pit along the haul road.

5.4.1 Airblast Overpressure

To assess potential airblast overpressure levels at nearby receptors, the following site law formula was adopted from AS 2187.2:

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

Where:

P = Pressure (kilopascals)

Q = Maximum Instantaneous Charge (effective charge mass per delay), in kg. Explosive loading/detonation sequence/effective charge mass per delay. The maximum charge, in kilograms, initiated at any instant of time

R = Distance from charge (m)

Ka = Site constant

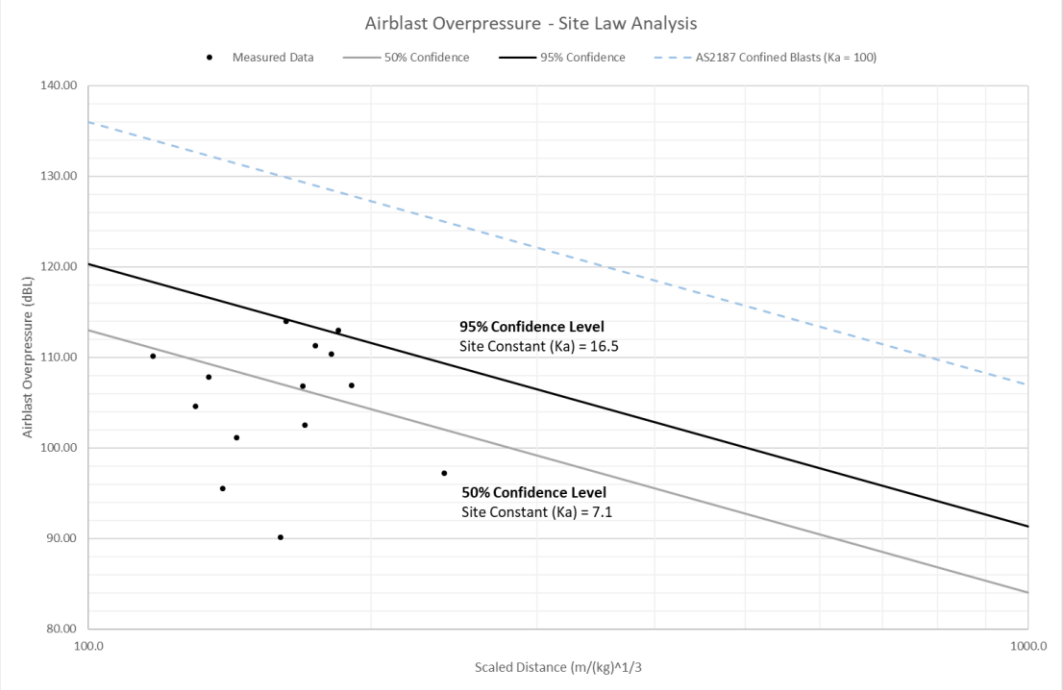
a = Site exponent, a value of -1.45 was adopted as per AS 2187.2

The conversion of the 'P' pressure unit to linear decibels (dBZ) is completed using the following formula:

$$\mathrm{SPL} = 10\, x \log \left(\frac{P}{P_0} \right)^2$$

The airblast overpressure site constant (Ka) derived for Mt Bundarbo conditions was based on the site law analysis corresponding to a 95% confidence level are presented below (refer **Figure 4**). The 95% confidence level allows for the inherent variation in emission levels with a 5% exceedance of the general blast criterion in accordance with the ANZEC Guidelines.

Figure 4 Air-blast Overpressure Site Law Analysis



5.4.2 Ground Vibration

To assess potential blasting vibration levels at nearby sensitive receptors, the following site law formula was adopted from AS 2187.2:

$$V = K_g \left(\frac{R}{(Q^{1/2})} \right)^{-B}$$

Where:

V = ground vibration as vector peak particle velocity (mm/s)

R = distance between charge and point of measurement (metres)

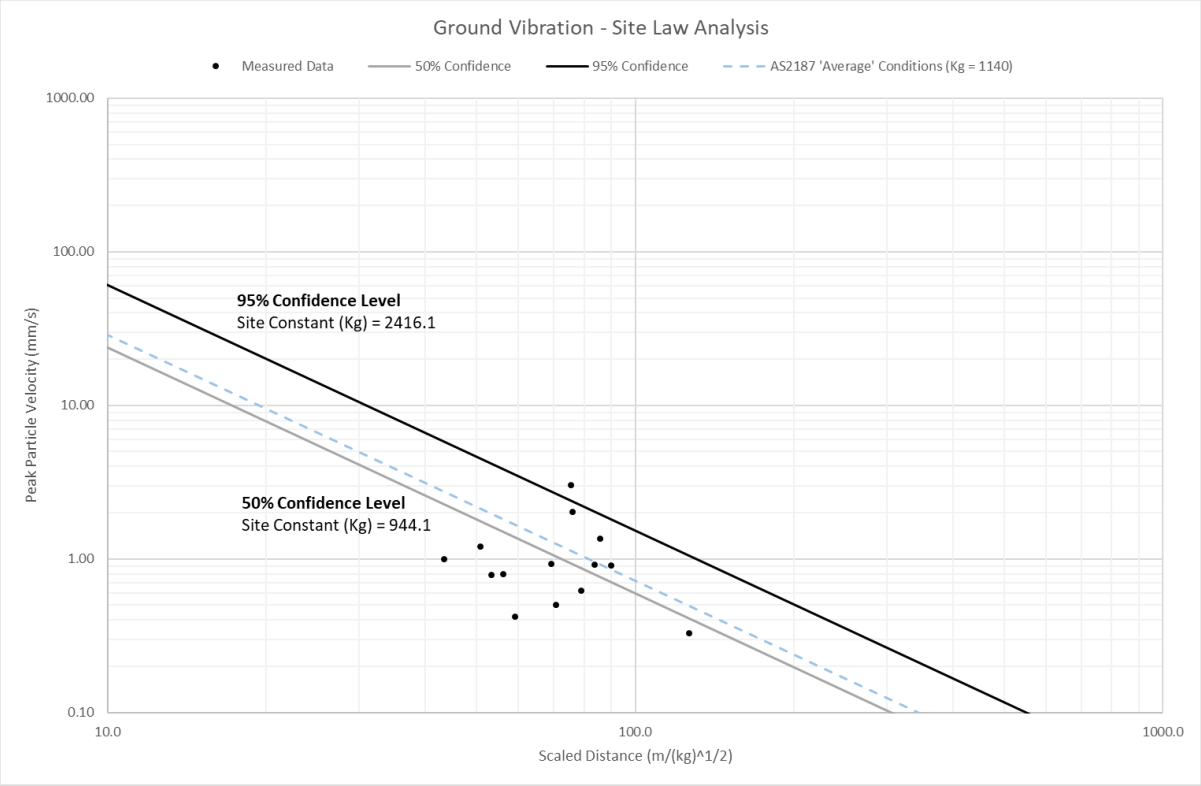
Q = Maximum Instantaneous Charge (effective charge mass per delay), in kg. Explosive loading/detonation sequence/effective charge mass per delay. The maximum charge, in kilograms, initiated at any instant of time.

Kg = a constant related to site and rock properties for estimation purposes

B = a constant related to site and rock properties for estimation purposes, a value of 1.6 was adopted.

The ground vibration site constant (Kg) derived for Mt Bundarbo conditions based on the site law analysis corresponding to a 95% confidence level are presented below (refer **Figure 5**). The 95% confidence level allows for the inherent variation in emission levels with a 5% exceedance of the general blast criterion in accordance with the ANZEC Guidelines.

Figure 5 Ground Vibration Site Law Analysis



5.4.3 Blasting Predictions

Based on the formulas and derived site constants presented above, predictions were made for airblast overpressure and ground vibration at the nearest receptor to the proposed Mt Bundarbo Pit.

At the closest receptor (approximately 1500 m from potential blasting locations), airblast overpressure is predicted to comply with the 115 dB Linear 5% threshold for blasts with a MIC (maximum instantaneous charge) value up to 940 kg.

Ground vibration is predicted to comply with the 5 mm/s PPV 5% threshold for blasts with a MIC value up to 980 kg.

Based on the 2020 monitoring data, blasts of this size are not expected to be required.

Notwithstanding the above assessment, it is recommended that blasting noise and vibration monitoring be carried out at the Mt Bundarbo Pit, in keeping with the current approved blast monitoring regime for the Bald Hills Quarry, to further develop the 'Site Law' for the new quarry pit. The purpose of the Site Law is to refine the efficiency of each blast whilst maintaining compliance with the applicable limits.

It should be noted that the maximum MIC calculations above are provided as a guide only and individual blast designs should be based on meeting the criteria rather than restrictions on MIC, noting that the blast design includes a number of variables including location, aspect if near an open face, etc.

The blasting variables are readily managed through good blasting practices and the implementation of a Blast Management Plan (BMP) which ensures the potential for impacts can be minimised such that adverse effects are fully avoided.

5.4.4 Blasting Recommendations

Based on the results and findings discussed above, blasting recommendations are provided below:

- All blasts, including initial blasts at the Mt Bundarbo Pit, should be monitored to obtain data which can be used to confirm site constants and compliance with blasting criteria.
- Blast monitoring must continue to take place in accordance with EPL requirements.
- A Blast Management Plan should be updated to incorporate proposed operations of the Mt Bundarbo Pit and detail the mitigation and management procedures for minimising potential impacts.

6 Conclusions

SLR has undertaken an assessment of construction and operations noise and vibration associated with the proposed expansion of the existing Bald Hill Quarry at Jugiong, NSW.

Project specific noise trigger and management levels have been established in accordance with guidelines and policies applicable to the assessment of construction and industrial operations noise in NSW.

Noise modelling based on the topography and layout of the Project site and surrounds, together with construction and operational scenarios and likely plant/equipment, has been undertaken. Local weather conditions have been incorporated into the noise modelling.

The proposed activities at the Mt Bundarbo Pit have been modelled, together with the existing North Ridge Pit and Ecofill landfill operations, to provide a cumulative noise level assessment.

Compliance with the daytime PNTL was predicted at all receptors. Compliance with the PNTL was also predicted for the product dispatch activities when occurring during the evening period.

Consequently, noise associated with the proposed expansion of the quarry to the Mt Bundarbo Pit, in conjunction with the existing quarrying and landfill activities, would be expected to comply with the NPfI PNTLs.

The EPL for the Bald Hills Quarry must be updated to include the overall site operations including the Mt Bundarbo Pit expansion. The noise and blasting limits in the EPL would be updated to reflect the current NPfI requirements as described in this assessment.

Predictions indicate that noise levels from construction activities would comply with the Project NMLs at all times during the standard construction hours. While not specifically required, the proponent should implement basic mitigation measures where feasible and reasonable, to minimise noise from the site as far as practicable.

The number of trucks and other vehicles associated with the construction and operations at the Project will be low relative to the existing traffic volumes on the Hume Freeway. Road traffic noise associated with the project construction and operations is not considered to be of acoustical significance.

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