

Annual Noise Monitoring Assessment 2023

Dunmore Quarry
Dunmore, NSW
July 2023

Document Information

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1 Introduction

Muller Acoustic Consulting Pty Ltd (MAC) has completed a Noise Monitoring Assessment (NMA) on behalf of Boral Resources (NSW) Pty Ltd for Dunmore Quarry (the quarry), Tabbita Road, Dunmore, NSW.

The monitoring has been conducted in accordance with the Dunmore Quarry Noise Management Plan (NMP V4, December 2017) during July 2023 and forms the annual noise monitoring program to address conditions outlined in the Development Consent (Ref: 470-11-2003).

This report summarises the operator-attended noise monitoring results measured at five receivers in comparison to the relevant noise limits contained in the Development Consent and NMP.

The assessment has been conducted in general accordance with the following documents:

- NSW Environment Protection Authority (EPA), Noise Policy for Industry (NPI), 2017;
- Dunmore Quarry Noise Management Plan V4 (NMP), 2017 (EMM Consulting);
- Discussion Paper - Validation of Inversion Strength Estimation Method (EPA) 2014;
- NSW Environment Protection Authority (EPA's), Approved Methods for the measurement and analysis of environmental noise in NSW, 2022; and
- Standards Australia AS 1055:2018 - Acoustics - Description and measurement of environmental noise.

A glossary of terms, definitions and abbreviations used in this report is provided in **Appendix A**.

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2 Noise Criteria

The Dunmore Quarry Noise Management Plan (NMP) outlines the applicable noise criteria for residential receivers surrounding the quarry and are presented in **Table 1**.

Table 1 Noise Limits						
Description	Day	Evening	Night		Morning Shoulder	
	(7am - 6pm)	(6pm - 10pm)	(10pm - 7am)		(6am - 7am)	
	dB	dB	dB	dB	dB	dB
	LAeq(15min)	LAeq(15min)	LAeq(15min)	LA1(1min)	LAeq(15min)	LA1(1min)
Location K Stocker	49	44	38	48	47	55
Location O Dunmore Lakes	49	44	38	48	47	55
Location J Creagan	Negotiated Agreement in place					
Location AA	38	38	38	45	38	45
Location AB and T	36	36	36	45	36	45
Locations D, F, G and Z	40	40	40	45	40	45
Location S	37	37	37	45	37	45

Source: Table 2 of Dunmore Quarry NMP.

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3 Methodology

3.1 Locality

The quarry is located at Dunmore near Shellharbour, NSW. Receivers in the locality surrounding the quarry are primarily rural and residential. The quarry is surrounded by rural properties to the west, with the Princes Highway situated to the east of the site. Highway traffic is a dominant noise source for those receivers east of the quarry along with rural noise. The representative noise monitoring locations identified in Table 4.1 of the NMP with respect to the quarry are presented in the locality plan in **Figure 1**.

Table 2 presents the noise limits for each receiver as per the EPL.

Table 2 Attended Monitoring Locations and EPL Noise Limits							
ID	Description	Day ¹	Evening ¹	Night ¹	Morning Shoulder ¹		
		dB, LAeq(15min)	dB, LAeq(15min)	dB, LAeq(15min)	dB, LA1(1min)	dB, LAeq(15min)	dB, LA1(1min)
Location K Stocker							
NM1	40 Swamp Road Dunmore	49	44	38	48	47	55
Location S							
NM2	86 Croome Vale Road Croom	37	37	37	45	37	45
Location T							
NM3	1338 Jamberoo Road Croom	36	36	36	45	36	45
Location G ²							
NM4	318 Croome Road Croom	40	40	40	45	40	45
Location F ³							
NM5	316 Croome Road Croom	40	40	40	45	40	45

Note 1: Day - the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays; Evening - the period from 6pm to 10pm; Night - the remaining periods and the morning shoulder period is from 6am to 7am.

Note 2: Representative location for western residences G, D, Z.

Note 3: Representative location for northwestern residences F, AA, AB.

3.2 Assessment Methodology

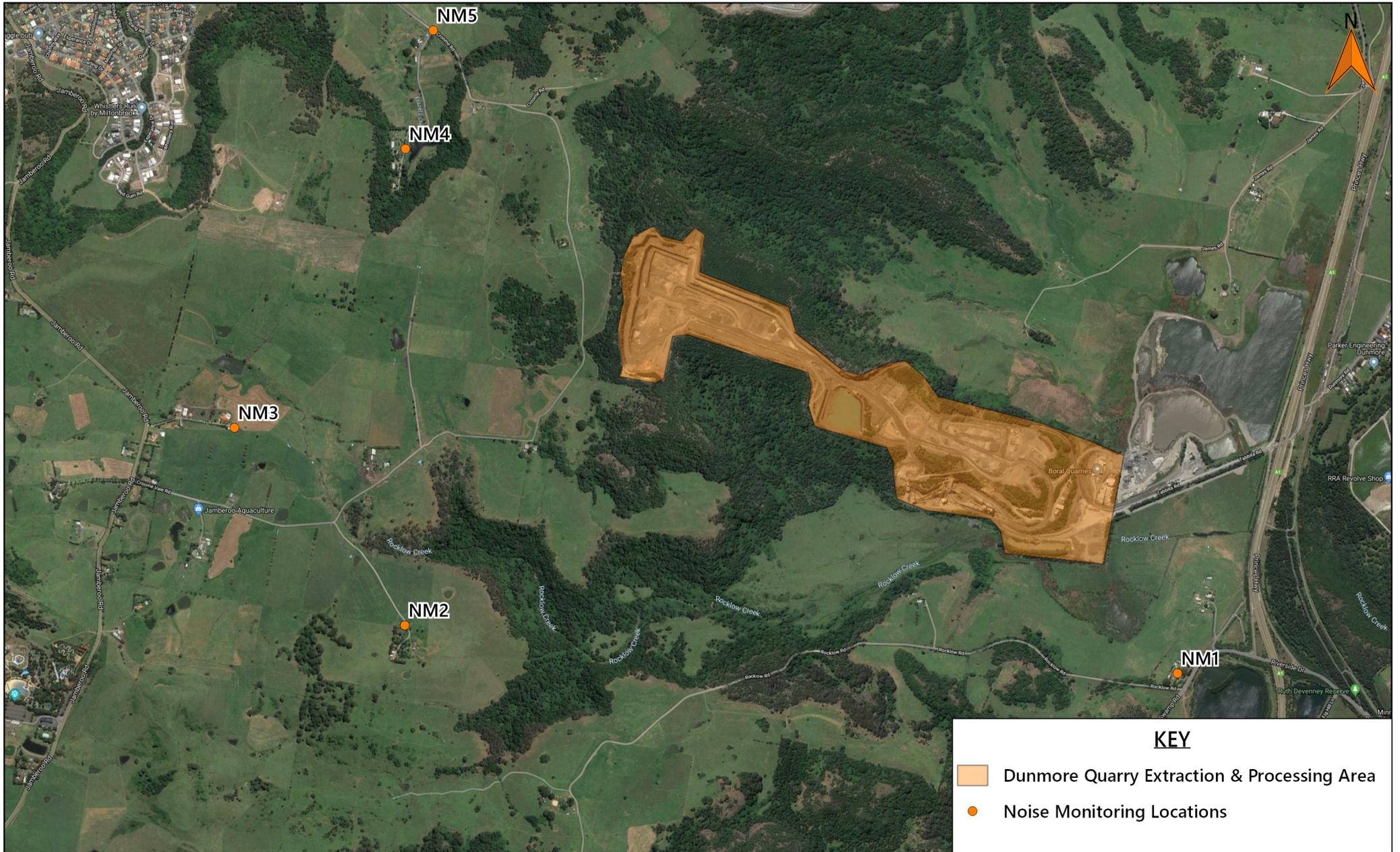
The attended noise measurements were conducted in general accordance with the procedures described in Standards Australia AS 1055:2018, "Acoustics - Description and Measurement of Environmental Noise" and the Dunmore Quarry NMP. Noise measurements of 15-minutes in duration were conducted at five locations (NM1-NM5) using a Svantek Type 1, 971 noise analyser between Tuesday 11 July 2023 and Friday 14 July 2023 to satisfy the requirements of the NMP. All acoustic instrumentation used carries appropriate and current NATA (or manufacturer) calibration certificates with records of all calibrations maintained by MAC as per Approved Methods for the measurement and analysis of environmental noise in NSW (EPA, 2022) and complies with AS/NZS IEC 61672.1-2019- Electroacoustics - Sound level meters - Specifications. Calibration of all instrumentation was checked prior to and following measurements. Drift in calibration did not exceed ± 0.5 dBA.

To understand meteorological conditions during the evening period, direct measurement of temperature profile was undertaken at Trevethan Reserve, Minnamurra on Tuesday 11 July 2023 and Wednesday 12 July 2023 and at Croom Road, Croom (near NM4) on Friday 14 July 2023, at 2m above ground level and at 50m above ground level using a weather balloon.

The results of the temperature measurements were used to determine the temperature lapse rate in general accordance with the Validation of Inversion Strength Estimation Method (2014). These measurements, in combination with the onsite weather station provide a reference to validate the relevant meteorological conditions under which compliance is assessed.

Extraneous noise sources were excluded from the analysis to determine the dB LA_{eq(15min)} quarry noise contribution for comparison against the relevant criteria. In the event of quarry attributed noise being above criteria, prevailing meteorological conditions for the monitoring period are sourced from the onsite meteorological station and analysed in accordance with Fact Sheet A4 of the NPI to determine the stability category present at the time of each attended measurement.

Where the quarry is inaudible, the contribution is estimated to be at least 10dBA below the ambient noise level.



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4 Results

A summary of the operator attended measurements at location NM1 to NM5 are presented **Table 3** to **Table 7** and provide the following information;

- Monitoring location.
- Date, time and assessment period.
- Observed Wind Speed (WS, m/s), Wind Direction (WD) and Temperature (Temp) in °C at 1.5m above the ground measured at the monitoring location.
- Measured Temperature (Temp) in °C at 2m and 50m above ground level at a representative location.
- Average Wind Speed (WS, m/s), Wind Direction (WD) and Temperature (Temp) in °C at 10m above ground level at the on-site weather station.
- Atmospheric stability class derived from the on-site weather station.
- Calculated temperature inversion strength.
- Ambient measured noise levels LAeq(15min) and LA90(15min) in dB re 20µPa.
- Quarry LAeq(15min) and LA1(1min) noise level contribution.
- Noise Limit LAeq(15min) and LA1(1min).

Results of the attended noise survey identified that the quarry was generally inaudible during the measurement periods, however extraneous sources such as traffic, insects, aircraft, birds, livestock, dogs barking, and local residential noise were audible during the survey period and dominated the results. Temperature data, from on-site measurements, indicated that inversion strengths during the morning shoulder and evening periods between Tuesday 11 July 2023 to Friday 14 July 2023 were generally outside the development consent conditions (ie higher than 6°C/100m).

Table 3 NM1 - Attended Noise Monitoring Summary

Date & Period	Time (hrs)	1.5m WS WD Temp ³	Descriptor		EPL Limits		Observed Meteorology					Description and SPL, dBA	
			LAeq	LA90	LAeq (15min)/ LA1 (1min)	WS (m/s) ¹	WD ¹	2m Temp°C	50m Temp°C	Delta Temp°C	Lapse Rate °C/100m ²		Stability Class ¹
13/07/2023 (Morning Shoulder)	06:30	0.1m/s N 11°	62	56	47/55	1.7	W	3°	12°	9°	21°	G	Traffic 54-79 Birds <50-69 Industrial Noise (DLSP) <50 Quarry Inaudible
Quarry Contribution												<45dB LAeq(15min) <55dB LA1(1min)	
11/07/2023 (Day)	16:35	0.2m/s N 18°	65	52	49	0.7	NNW	n/a	n/a	n/a	n/a	n/a	Traffic 49-82 Birds 49-56 Quarry Inaudible
Quarry Contribution												<45dB LAeq(15min)	
11/07/2023 (Evening)	20:56	0.1m/s N 12°	60	50	44	1.5	W	8°	13°	5°	12°	G	Traffic 47-85 Quarry Inaudible
Quarry Contribution												<40dB LAeq(15min)	

Note 1: Data from on-site weather station.

Note 2: Calculated from 2m and 50m temperature.

Note 3: At operator position as per AS1055.

Table 4 NM2 - Attended Noise Monitoring Summary

Date & Period	Time (hrs)	1.5m WS WD Temp ³	Descriptor		EPL Limits		Observed Meteorology					Description and SPL, dBA	
			LAeq	LA90	LAeq (15min)/ LA1 (1min)	WS (m/s) ¹	WD ¹	2m Temp°C	50m Temp°C	Delta Temp°C	Lapse Rate °C/100m ²		Stability Class ¹
14/07/2023 (Morning Shoulder)	06:30	<0.5m/s NW 11°	37	33	37/45	1.6	WNW	12°	15°	3°	6°	G	Insects 30-38 Agricultural Noise 31-45 Birds 30-54 Traffic 28-43 Livestock 30-43 Quarry Inaudible
Quarry Contribution												<30dB LAeq(15min) <45dB LA1(1min)	
11/07/2023 (Day)	17:38	0.1m/s W 18°	42	38	37	2.2	W	n/a	n/a	n/a	n/a	n/a	Insects 36-41 Traffic 33-38 Dogs Barking 35-46 Aircraft 35-56 Quarry Inaudible
Quarry Contribution												<35dB LAeq(15min)	
11/07/2023 (Evening)	20:37	<0.5m/s NW 10°	38	34	37	1.5	W	8°	13°	5°	11°	G	Insects 31-42 Traffic 30-35 Dogs Barking 35-48 Quarry Inaudible
Quarry Contribution												<30dB LAeq(15min)	

Note 1: Data from on-site weather station.

Note 2: Calculated from 2m and 50m temperature.

Note 3: At operator position as per AS1055.

Table 5 NM3 - Attended Noise Monitoring Summary

Date & Period	Time (hrs)	1.5m WS WD Temp ³	Descriptor		EPL Limits		Observed Meteorology						Description and SPL, dBA
			LAeq	LA90	LAeq (15min)/ LA1 (1min)	WS (m/s) ¹	WD ¹	2m Temp°C	50m Temp°C	Delta Temp°C	Lapse Rate °C/100m ²	Stability Class ¹	
14/07/2023 (Morning Shoulder)	06:05	0.1m/s NW 13°	57	28	36/45	1.7	WNW	12°	15°	3°	7°	G	Traffic 25-75 Livestock 30-38 Insects <25-28 Birds 25-32 Quarry Inaudible
Quarry Contribution												<30dB LAeq(15min) <45dB LA1(1min)	
12/07/2023 (Day)	07:30	0.1m/s NW 13°	62	39	36	0.9	W	n/a	n/a	n/a	n/a	n/a	Birds 30-58 Traffic 29-82 Livestock 30-41 Quarry – Impacts <30 (<1min total duration)
Quarry Contribution												<35dB LAeq(15min)	
11/07/2023 (Evening)	20:17	0.1m/s W 12°	55	27	36	1.5	W	8°	13°	5°	10°	G	Insects 23-32 Traffic 25-755 Aircraft 30-41 Livestock 25-48 Quarry Inaudible
Quarry Contribution												<30dB LAeq(15min)	

Note 1: Data from on-site weather station.

Note 2: Calculated from 2m and 50m temperature.

Note 3: At operator position as per AS1055.

Table 6 NM4 - Attended Noise Monitoring Summary

Date & Period	Time (hrs)	1.5m WS WD Temp ³	Descriptor		EPL Limits		Observed Meteorology					Description and SPL, dBA	
			LAeq	LA90	LAeq (15min)/ LA1 (1min)	WS (m/s) ¹	WD ¹	2m Temp°C	50m Temp°C	Delta Temp°C	Lapse Rate °C/100m ²		Stability Class ¹
14/07/2023 (Morning Shoulder)	06:04	0.1m/s N 8°	54	36	40/45	1.7	WNW	12°	15°	3°	7°	G	Dogs Barking 34-61 Insects 32-34 Traffic 34-77 Birds 35-53 Quarry Inaudible
Quarry Contribution												<30dB LAeq(15min) <45dB LA1(1min)	
11/07/2023 (Day)	16:47	0.1m/s W 18°	52	40	40	0.7	NW	n/a	n/a	n/a	n/a	n/a	Dogs Barking 40-58 Birds 30-64 Aircraft 40-48 Residential Noise 30-69 Quarry Inaudible
Quarry Contribution												<35dB LAeq(15min)	
11/07/2023 (Evening)	19:26	0.1m/s W 13°	52	35	40	0.5	N	8°	13°	5°	10°	G	Insects 30-35 Aircraft 35-53 Residential Noise 35-70 Dogs Barking 45-70 Quarry Inaudible
Quarry Contribution												<30dB LAeq(15min)	

Note 1: Data from on-site weather station.

Note 2: Calculated from 2m and 50m temperature.

Note 3: At operator position as per AS1055.

Table 7 NM5 - Attended Noise Monitoring Summary

Date & Period	Time (hrs)	1.5m WS WD Temp ³	Descriptor		EPL Limits		Observed Meteorology					Description and SPL, dBA	
			LAeq	LA90	LAeq (15min)/ LA1 (1min)	WS (m/s) ¹	WD ¹	2m Temp°C	50m Temp°C	Delta Temp°C	Lapse Rate °C/100m ²		Stability Class ¹
14/07/2022 (Morning Shoulder)	06:23	1.5m/s W 8°	50	38	40/45	1.4	W	12°	15°	3°	6°	G	Birds 37-44 Traffic 36-77 Wind Gusts 34-42 Quarry Inaudible
Quarry Contribution												<35dB LAeq(15min) <45dB LA1(1min)	
11/07/2023 (Day)	17:06	0.1m/s W 19°	50	34	40	1.9	W	n/a	n/a	n/a	n/a	n/a	Traffic 31-38 Birds 30-48 Residential Noise 30-72 Dogs Barking 35-41 Aircraft 35-51 Quarry Inaudible
Quarry Contribution												<30dB LAeq(15min)	
11/07/2023 (Evening)	19:47	0.1m/s W 12°	38	33	40	1.4	W	8°	13°	5°	10°	G	Traffic 30-43 Aircraft 35-48 Insects 25-33 Wildlife 40-48 Quarry Inaudible
Quarry Contribution												<30dB LAeq(15min)	

Note 1: Data from on-site weather station.

Note 2: Calculated from 2m and 50m temperature.

Note 3: At operator position as per AS1055.

5 Discussion and Compliance Assessment

The compliance assessment summary for each monitoring location is presented in **Table 8** for all assessment periods.

5.1 Discussion of Results - Location NM1

The noise monitoring survey identified that the acoustic environment at this location is dominated by road traffic noise from the Princes Highway, approximately 350m to the east. During the survey, quarry emissions were inaudible during all monitoring periods and quarry noise contributions were calculated (during short breaks in traffic) to be at or below the relevant noise criteria for all periods. Extraneous sources audible during the survey included traffic, birds, aircraft, and other industrial noise.

5.2 Discussion of Results - Location NM2

The noise monitoring survey identified that the acoustic environment at this location is dominated by natural sounds such as insects and bird noise, and agricultural noise such as livestock. Occasional local traffic on Jamberoo Road, approximately 350m to the west was audible for short periods. During the survey, quarry noise emissions were inaudible and quarry contributions were calculated to be below the relevant noise criteria for all periods.

5.3 Discussion of Results - Location NM3

Due to access restrictions at the NM3 location, measurements were conducted at the front fence line of the location approximately 300m to the west of the receiver. The noise monitoring survey identified that the acoustic environment at this location is dominated by natural sounds such as insects, and bird noise, and agricultural noise such as livestock. Traffic on Jamberoo Road, to the west was audible for short periods. During the survey, quarry noise emissions were barely audible for very short periods during daytime measurement period and inaudible during morning shoulder and evening measurement periods. Quarry contributions were calculated to be below the relevant noise criteria for all periods.

5.4 Discussion of Results - Location NM4

The noise monitoring survey identified that the acoustic environment at these locations is dominated by natural sounds such as insects, and bird noise and agricultural noise such as livestock. Occasional distant traffic on the East-West Link Road, approximately 2km to the north was audible for short periods. During the survey, quarry noise emissions were inaudible and quarry contributions were calculated to be below the relevant noise criteria for all periods.

5.5 Discussion of Results - Location NM5

The noise monitoring survey identified that the acoustic environment at these locations is dominated by natural sounds such as insects and bird noise and agricultural noise such as livestock. Occasional distant traffic on the East-West Link Road, approximately 2km to the north was audible for short periods. During the survey, quarry noise emissions were inaudible and quarry contributions were calculated to be below the relevant noise criteria for all periods.

Table 8 Noise Compliance Assessment Summary

Location	Estimated Quarry Noise Contribution ¹				Noise Limit ¹				Demonstrated Compliance			
	Day	Evening	Morning Shoulder		Day	Evening	Morning Shoulder		Day	Evening	Morning Shoulder	
			LAeq(15min)	LA1(1min)			LAeq(15min)	LA1(1min)			LAeq(15min)	LA1(1min)
NM1	<45	<40	<45	<55	49	44	47	55	Yes	Yes	Yes	Yes
NM2	<35	<30	<30	<45	37	37	37	45	Yes	Yes	Yes	Yes
NM3	<35	<30	<30	<45	36	36	36	45	Yes	Yes	Yes	Yes
NM4	<35	<30	<30	<45	40	40	40	45	Yes	Yes	Yes	Yes
NM5	<30	<30	<35	<45	40	40	40	45	Yes	Yes	Yes	Yes

Note 1: All levels are dBA.

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7 Conclusion

Muller Acoustic Consulting Pty Ltd (MAC) has completed a Noise Monitoring Assessment (NMA) on behalf of Boral Resources (NSW) Pty Ltd for Dunmore Quarry (the quarry), Tabbita Road, Dunmore, NSW.

Attended noise monitoring was undertaken between Tuesday 11 July 2023 and Friday 14 July 2023 at five representative monitoring locations. The assessment has identified that noise emissions generated by Dunmore Quarry were barely audible for very short periods on one occasion during the day period at NM3. The quarry was inaudible during the remaining periods. Quarry contributed noise emissions were below the relevant noise criteria at all locations during all measurement periods, thus satisfying the relevant noise limits.

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Appendix A - Glossary of Terms

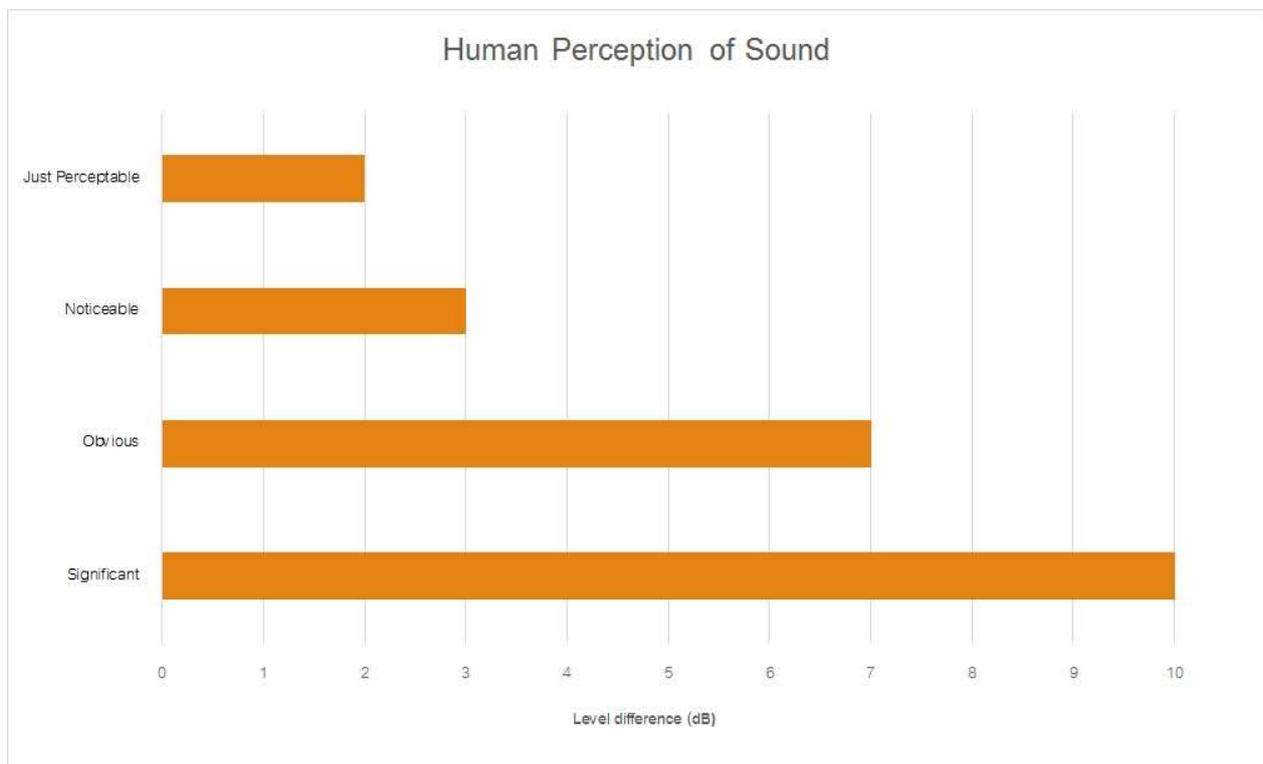
Table A1 provides a number of technical terms have been used in this report.

Table A1 Glossary of Terms	
Term	Description
1/3 Octave	Single octave bands divided into three parts
Octave	A division of the frequency range into bands, the upper frequency limit of each band being twice the lower frequency limit.
ABL	Assessment Background Level (ABL) is defined in the NPI as a single figure background level for each assessment period (day, evening and night). It is the tenth percentile of the measured LA90 statistical noise levels.
Adverse Weather	Weather effects that enhance noise (that is, wind and temperature inversions) that occur at a site for a significant period of time (that is, wind occurring more than 30% of the time in any assessment period in any season and/or temperature inversions occurring more than 30% of the nights in winter).
Ambient Noise	The noise associated with a given environment. Typically a composite of sounds from many sources located both near and far where no particular sound is dominant.
A Weighting	A standard weighting of the audible frequencies designed to reflect the response of the human ear to noise.
dBA	Noise is measured in units called decibels (dB). There are several scales for describing noise, the most common being the 'A-weighted' scale. This attempts to closely approximate the frequency response of the human ear.
dB(Z), dB(L)	Decibels Linear or decibels Z-weighted.
Hertz (Hz)	The measure of frequency of sound wave oscillations per second - 1 oscillation per second equals 1 hertz.
LA10	A noise level which is exceeded 10 % of the time. It is approximately equivalent to the average of maximum noise levels.
LA90	Commonly referred to as the background noise, this is the level exceeded 90 % of the time.
LAeq	The summation of noise over a selected period of time. It is the energy average noise from a source, and is the equivalent continuous sound pressure level over a given period.
LAm _{ax}	The maximum root mean squared (rms) sound pressure level received at the microphone during a measuring interval.
RBL	The Rating Background Level (RBL) is an overall single figure background level representing each assessment period over the whole monitoring period. The RBL is used to determine the intrusiveness criteria for noise assessment purposes and is the median of the ABL's.
Sound power level (LW)	This is a measure of the total power radiated by a source. The sound power of a source is a fundamental location of the source and is independent of the surrounding environment. Or a measure of the energy emitted from a source as sound and is given by : $= 10 \cdot \log_{10} (W/W_0)$ Where : W is the sound power in watts and W ₀ is the sound reference power at 10-12 watts.

Table A2 provides a list of common noise sources and their typical sound level.

Table A2 Common Noise Sources and Their Typical Sound Pressure Levels (SPL), dBA	
Source	Typical Sound Level
Threshold of pain	140
Jet engine	130
Hydraulic hammer	120
Chainsaw	110
Industrial workshop	100
Lawn-mower (operator position)	90
Heavy traffic (footpath)	80
Elevated speech	70
Typical conversation	60
Ambient suburban environment	40
Ambient rural environment	30
Bedroom (night with windows closed)	20
Threshold of hearing	0

Figure A1 – Human Perception of Sound



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