

# NARRABRI MINE NOISE MONITORING

**Quarter Ending September 2020  
Summary Noise Report**

**Prepared for:**

Whitehaven Coal Mining Limited  
Whitehaven Coal Admin Office  
10409 Kamilaroi Hwy  
GUNNEDAH NSW 2380

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## PREPARED BY

SLR Consulting Australia Pty Ltd  
ABN 29 001 584 612  
Tenancy 202 Submarine School, Sub Base Platypus, 120 High Street  
North Sydney NSW 2060 Australia

T: +61 2 9427 8100  
E: sydney@slrconsulting.com www.slrconsulting.com

## BASIS OF REPORT

This report has been prepared by SLR Consulting Australia Pty Ltd (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Whitehaven Coal Mining Limited (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

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## DOCUMENT CONTROL

Reference	Date	Prepared	Checked	Authorised
610.18063-R10-v1.0	8 October 2020	Adam Sirianni	Martin Davenport	Martin Davenport

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## 1 Introduction

Narrabri Coal Operations Pty Ltd has commissioned SLR Consulting Australia Pty Ltd (SLR) to conduct operational noise monitoring for the Narrabri Mine located near Narrabri, New South Wales (NSW) in accordance with the approved Noise Management Plan (NMP) dated June 2018, the Narrabri Mine Project Approval (PA) 08\_0144 and the Environment Protection Licence 12789 (EPL 12789).

The objectives of the noise monitoring programme for this operating period were as follows:

- Conduct operator attended noise surveys at 7 locations (as listed in **Section 3.3**) surrounding the mine during the day, evening and night-time periods.
- Quantify all sources of noise within each of the attended noise surveys, including their measured and/or estimated contribution and maximum level of individual noise sources.
- Assess the noise emissions of Narrabri Mine and determine compliance with respect to the limits contained in Section 2 of the NMP and the relevant approvals.

The following report uses specialist acoustic terminology. An explanation of common terms is provided in **Appendix A**.

## 2 PERFORMANCE ASSESSMENT AND DISCUSSION

The following provides a summary of the attended noise measurements undertaken at each monitoring location. Further details are provided for each location in **Section 5** of this report.

**Table 1 Performance Assessment – Operations**

EPL ID	Location	Date	Narrabri Mine Contribution dBA				Noise Criteria <sup>2</sup>	Measurement Periods	Weather Compliant			Compliant <sup>1</sup>
			LAeq 15 min Day	LAeq 15 min Evening	LAeq 15 min Night	LA1 (1 min) Night			Day	Evening	Night	
N5	Oakleigh <sup>4</sup>	08/09/2020	I/A	<25	33	41	Day, Evening and Night – LAeq(15minute) 35 dBA  Night LA1(1minute) – 45 dBA	Day - 1.5 hrs Evening - 0.5 hrs Night – 1hrs	Y	Y	Y	Y
		09/09/2020	40	I/A	I/A	I/A			Y	Y	N	Y <sup>5</sup>
		10/09/2020	I/A	N/M	I/A	I/A			N	N	N	Y
N6	Newhaven	08/09/2020	<25	N/M	30	31			Y	Y	Y	Y
		09/09/2020	26	<30	N/M	N/M			Y	N	N	Y
		10/09/2020	<30	30	N/M	N/M			N	N	N	Y
N9	High Range <sup>3</sup>	08/09/2020	N/M	I/A	29	32			Y	Y	Y	Y
		09/09/2020	N/M	<30	N/M	N/M			Y	N	N	Y
		10/09/2020	N/M	N/M	N/M	N/M			N	N	N	Y
-	Bow Hills <sup>2</sup>	08/09/2020	I/A	I/A	40	45		Day 15 min Evening 15 min Night 15 min	Y	Y	N	Y
-	Ardmona	08/09/2020	N/M	I/A	39	44			Y	N	N	Y
-	Merriman <sup>4</sup>	08/09/2020	I/A	N/M	29	30			Y	Y	N	Y
-	Matilda <sup>4</sup>	08/09/2020	22	I/A	26	27			Y	Y	N	Y

I/A = Inaudible, N/M = Not Measurable

Note 1: Compliant during applicable meteorological conditions.

Note 2: A private agreement between NCOPL and the residents of N1 Bow Hills of 50 dBA LAeq(15minute) is in place. This new level of 50 dBA LAeq(15minute) replaces the levels identified in Conditions 1-3, Schedule 4 of PA 08\_0144 Mod 2 and the identical limits contained in condition L3 of Environment Protection Licence No 12789

Note 3: A private agreement between NCOPL and the residents of N9 High Range of 40 dBA LAeq(15minute) and 50 dBA LA1(1minute) is in place. These new levels of 40 dBA LAeq(15minute) and 50 dBA LA1(1minute) replace the levels identified in Conditions 1-3, Schedule 4 of PA 08\_0144 Mod 2 and the identical limits contained in condition L3 of Environment Protection Licence No 12789

Note 4: Property is owned by Narrabri Coal Operations.

Note 5: The Noise Criteria for EPL Monitoring Location N5 (Oakleigh) does not apply as the property is not a privately owned residence (owned by Narrabri Coal).

## 3 Noise Criteria

### 3.1 Project Approval, EPL and NMP

Noise monitoring at the Narrabri Mine was conducted in accordance with EPL 12789, the PA requirements and the NMP. The site specific EPL and PA noise limits are summarised in Section 2 of the NMP and are reproduced in **Table 2**. These criteria do not apply where the mine has an agreement with the relevant owner/s of the residence to generate higher noise levels.

**Table 2 Project Approval and EPL Noise Criteria**

Location	Day	Emergency Day	Night	
	LAeq(15minute)	LAeq(15minute)	LAeq(15minute)	LA1(1minute)
All Privately owned Residences	35	35	35	45

### 3.2 Non-compliances & Exemptions

In accordance with Section 11.1.3 of the NSW Industrial Noise Policy (INP) a development is deemed to be in non-compliance with a noise consent or licence condition if the monitored noise level is more than 2 dB above the statutory noise limit specified in the consent or licence. This may occur for two reasons:

- The noise from the Narrabri Mine is excessive, in which case Narrabri Mine will be not complying with its consent or licence condition.
- The noise was increased by extreme, non-standard weather effects—in which case the Narrabri Mine is not considered to be in noncompliance with its consent or licence condition.

In this latter case, further monitoring at a later date is required to determine compliance under “normal” meteorological conditions.

The INP states in Section 9.2 that *“it is not practicable to meet the noise limit under all inversion events; hence exceedances under extreme temperature inversions are not considered to be a non-compliance with consent or licence conditions.”*

Non-standard weather effects include:

- Wind speeds greater than 3 m/s at 10m above ground level; or
- Stability category F temperature inversion conditions and wind speeds greater than 2 m/s at 10 metres above ground level; or
- Stability category G temperature inversion conditions

As stated in EPL 12789 *“Data recorded by the meteorological station identified as EPA Identification Point(s) W1 must be used to determine meteorological conditions and temperature inversion conditions (stability category) are to be determined by direct measurement over a minimum 50m height interval as referred to in Part E2 of Appendix E of the “New South Wales Industrial Noise Policy” dated January 2000 ISBN 0 7313 2715 2.”*

Weather and Temperature inversion monitoring is undertaken continuously in accordance with EPL 12789 with monitoring locations displayed in **Figure 1**. Monitoring Location W1 records wind speed and direction at 10m above ground level. Temperature inversion monitoring is undertaken continuously by directly measuring temperature at two elevations 50m apart (10m & 60m from ground level) at monitoring location W2. All weather data reported in **Table 5** to **Table 17** have been recorded at these monitoring locations.

### 3.3 Attended Monitoring

Attended Noise monitoring is to be undertaken on a quarterly basis at residential areas. The attended monitoring will take place at the following locations:

#### EPL Monitoring Locations

- N5 Oakleigh – 16293 Kamilaroi Highway Baan Baa
- N6 Newhaven – 184 Greylands Road Turrawan
- N9 High Range – 92 Davis Road Turrawan

EPL also requires monitoring at N8 Haylin View to be conducted quarterly when surface activities approach the eastern end of the southern longwall panels. No works are currently being undertaken over the eastern end of the southern longwall panels, therefore monitoring has been ceased until required.

It is noted that the Narrabri Mine own the properties Oakleigh (N5) and Haylin View (N8) and has a private agreement with the landholders of High Range (N9) for increased noise limits.

#### NMP Monitoring Locations

- N1 Bow Hills – 16652 Kamilaroi Highway Baan Baa
- N3 Ardmona – 16462 Kamilaroi Highway Baan Baa
- N7 Merriman – 16896 Kamilaroi Highway Baan Baa
- N8 Matilda – 773 Mayfield Road Baan Baa

It is noted that the Narrabri Mine owns the properties Merriman (N7) and Matilda (N8) and has a private agreement with the landholder of Bow Hills (N1) for increased noise limits.

The following details the requirements of the monitoring:

#### EPL Monitoring Requirements

- At each one of the monitoring locations N5, N6, N8 and N9;
- Occur quarterly in a reporting period;
- Occur during each day, evening and night period as defined in the NSW Industrial Noise Policy for a minimum of:
  - i) 1.5 hours during the day;
  - ii) 30 minutes during the evening; and
  - iii) 1 hour during the night.
- Occur for three consecutive operating days.

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### NMP Monitoring Requirements

- At each one of the monitoring locations N1, N3, N7 and N8
- Occur quarterly in a reporting period; and
- Occur during a day, evening and night period as defined in the NSW Industrial Noise Policy for a minimum 15 minutes.

## 4 Operational Noise Monitoring Methodology

### 4.1 General Requirements

All acoustic instrumentation employed throughout the monitoring programme has been designed to comply with the requirements of AS IEC 61672.1 – 2004 *Electroacoustics—Sound level meters – Specifications*, AS IEC 61672.2-2004, AS IEC 61672.3-2004 and carried current NATA or manufacturer calibration certificates. Instrument calibration was checked before and after each measurement survey, with the variation in calibrated levels not exceeding  $\pm 0.5$  dBA. Calibration certificates for all instruments employed during the monitoring campaign are presented in **Appendix B**.

### 4.2 Methodology - Operator Attended Noise Monitoring

Operator attended noise measurements were conducted during the day, evening and night-time periods for a minimum of 1.5 hours during the day; 30 minutes during the evening and 1 hour during the night at the three EPL nominated noise monitoring locations and for 15 minutes during the day, evening and night at each of the NMP nominated noise monitoring location representing the most affected receiver locations, listed in **Table 3** and shown in **Figure 1**. During the operator attended noise measurements, the character and relative contribution of ambient noise sources and mine contributions were determined.

**Table 3 Noise Monitoring Locations**

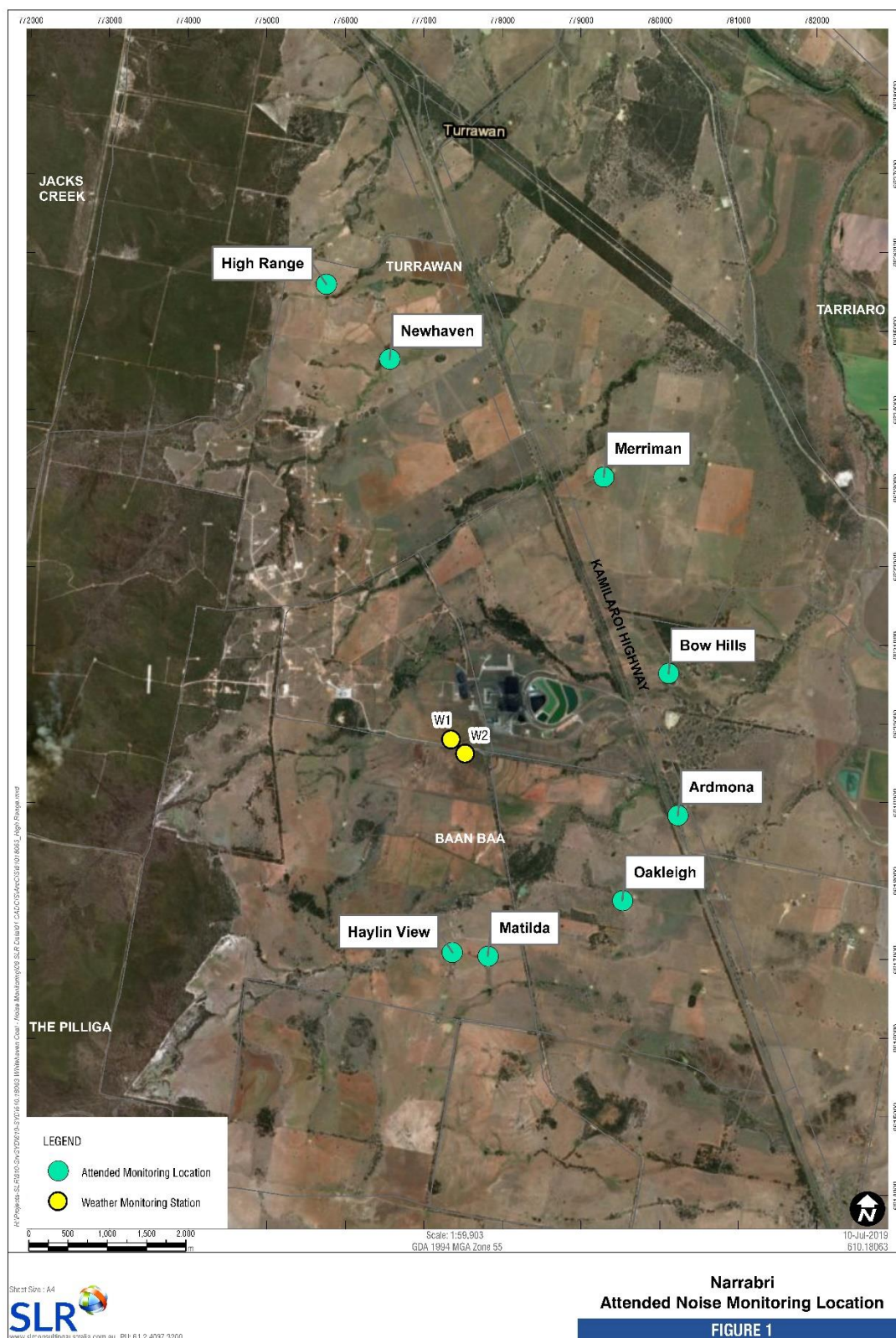
Monitoring Location	Monitoring Requirements	Receiver Type	Address	Monitoring Location - MGA Zone 55	
				Easting (m)	Northing (m)
N5 <sup>1,2</sup>	EPL	Residence	Oakleigh – 16293 Kamilaroi Highway Baan Baa	779526	6617751
N6 <sup>1,2</sup>	EPL	Residence	Newhaven – 184 Greylands Road Turrawan	776564	6624643
N9 <sup>1</sup>	EPL	Residence	High Range – 92 Davis Road Turrawan	775879	6625895
N1	NMP	Residence	Bow Hills – 16652 Kamilaroi Highway Baan Baa	780114	6620641
N3 <sup>2</sup>	NMP	Residence	Ardmona – 16462 Kamilaroi Highway Baan Baa	780233	6618836
N7 <sup>2</sup>	NMP	Residence	Merriman – 16896 Kamilaroi Highway Baan Baa	779290	6623143
N8 <sup>2</sup>	NMP	Residence	Matilda – 773 Mayfield Road Baan Baa	777815	6617045

Note: 1. EPL monitoring locations  
 2. NMP monitoring locations

The objective of the operator attended noise monitoring was to measure the (LA<sub>1</sub>(1minute)) and the LA<sub>eq</sub>(15minute) noise level contribution from the Narrabri Mine at the nearest potentially affected receptors in order to determine the noise contribution of operational activities associated with Narrabri Mine over each 15 minute measurement period. In addition, the operator quantifies and characterises the overall levels of ambient noise in the area (i.e. LA<sub>max</sub>, LA<sub>1</sub>, LA<sub>10</sub>, LA<sub>90</sub>, and LA<sub>eq</sub>) over the 15 minute measurement interval.

Operator attended noise measurements were conducted using one-third octave integrating Brüel & Kjær Type 2250 and 2270 sound level meters (s/n 3011919 and s/n 2679354 respectively). Attended noise measurements were undertaken by SLR staff Adam Sirianni and Jordan Murray.

**Figure 1 Attended Noise Monitoring Locations**



**Table 4** presents a summary of which days of the week the quarterly monitoring was conducted, in accordance with condition M7.4 of EPL 12789 and Section 5 of the NMP.

**Table 4 Days of the Week Quarterly EPL Monitoring was Conducted – Q3 2020**

Period	Day of the Week (Excluding Weekends and Public Holidays)				
	Monday	Tuesday	Wednesday	Thursday	Friday
Day		8 <sup>th</sup> September 2020	9 <sup>th</sup> September 2020	10 <sup>th</sup> September 2020	
Evening		8 <sup>th</sup> September 2020	9 <sup>th</sup> September 2020	10 <sup>th</sup> September 2020	
Night <sup>1</sup>		8 <sup>th</sup> September 2020	9 <sup>th</sup> September 2020	10 <sup>th</sup> September 2020	

Note 1: Taken to mean the night-time period from 10:00 pm on the stated day to 7:00 am the following day.

## 5 Results and Discussion

### 5.1 Results of Operator Attended Monitoring

Results of the operator attended noise surveys at N5, N6, N9, N1, N3, N7 and N8<sub>(NML)</sub> are provided **Table 5** to **Table 17**.

Ambient noise levels presented include all noise sources such as transport (roads, rail and aircraft), fauna (insects, frogs, birds and bats), the natural environment (wind in trees), domestic noises, other industrial operations as well as Narrabri Mine noise emissions.

Weather data during the monitoring period has been obtained from the weather station located on the Narrabri Mine site and observed conditions.

The tables also provide the following information:

- Date and start time, operator and equipment details.
- Monitoring location.
- Wind velocity (m/s) and temperature (°C) at weather station W1, as detailed in **Section 3.2**.
- Typical maximum (L<sub>Amax</sub>) and contributed L<sub>Aeq</sub>(15minute) noise levels.

### 5.1.1 Operator Attended Noise Survey Results – EPL Monitoring Location N5

Results of the operator attended noise surveys at N5 are provided in **Table 5**, **Table 6** and **Table 7**. Monitoring location N5 represents residential receptors located to the southeast of the site in Oakleigh.

**Table 5 Operator Attended EPL Noise Survey Results – N5 – Oakleigh (Day 1)**

Period Date/Start Time Weather SLM Details	Criteria	Measurement Number	Stability Category	Primary Noise Descriptor						Narrabri Mine Contribution, (dB)	Description
				L <sub>Amax</sub> (dB)	L <sub>A1</sub> (dB)	L <sub>A10</sub> (dB)	L <sub>A90</sub> (dB)	L <sub>Aeq</sub> (dB)	L <sub>Amin</sub> (dB)		
Day 1 08/09/2020 08:08 1.8 – 3.3 m/s SE 16-21 °C 3011919	35 dBA L <sub>Aeq</sub> (15minute)	1	D	68	49	38	31	39	28	I/A	<b>Site Related Noise Events:</b> Inaudible <b>Other Noise Events:</b> Birds 58-68 Animals 30-35 Traffic 35-38 Train horn 40
		2	C	66	53	41	29	41	26	I/A	
		3	B	58	46	37	29	35	27	I/A	
		4	B	62	53	43	30	41	27	I/A	
		5	A	56	47	39	27	36	25	I/A	
		6	A	57	46	37	26	35	23	I/A	
Evening 1 08/09/2020 20:56 1.8 – 2.1 m/s NE 11-13 °C 3011919	35 dBA L <sub>Aeq</sub> (15minute)	1	F	61	45	42	29	38	24	<25 L <sub>Aeq</sub>	<b>Site Related Noise Events:</b> Dozer operations 25-27 General mine activity 25 <b>Other Noise Events:</b> Traffic 35-51 Insects 39-44 Impact 47-61
		2	F	51	46	42	24	38	20	N/M	

Period Date/Start Time Weather SLM Details	Criteria	Measurement Number	Stability Category	Primary Noise Descriptor						Narrabri Mine Contribution, (dB)	Description
				LAmax (dB)	LA1 (dB)	LA10 (dB)	LA90 (dB)	LAeq (dB)	L Amin (dB)		
Night 1 08/09/2020 22:03 0 – 0.7 m/s WSW 12-13 °C 3011919	35 dBA LAeq(15minute) 45 dBA LA1(1minute)	1	G	56	53	50	34	44	28	N/M	<b>Site Related Noise Events:</b> Dozer operations 33-41 General mine activity 31-35 Onsite engine revs 29-33 <b>Other Noise Events:</b> Traffic 42-54 Train 44-56 Insects 35-40 Impact 41
		2	G	50	45	41	30	37	27	33 LAeq 41 LA1	
		3	F	54	49	44	29	39	27	32 LAeq 37 LA1	
		4	G	43	38	35	30	33	27	31 LAeq 37 LA1	

Note: N/M = Not Measurable, I/A = Inaudible

**Table 6 Operator Attended EPL Noise Survey Results – N5 – Oakleigh (Day 2)**

Period Date/Start Time Weather SLM Details	Criteria	Measurement Number	Stability Category	Primary Noise Descriptor						Narrabri Mine Contribution, (dB)	Description
				L <sub>Amax</sub> (dB)	L <sub>A1</sub> (dB)	L <sub>A10</sub> (dB)	L <sub>A90</sub> (dB)	L <sub>Aeq</sub> (dB)	L <sub>Amin</sub> (dB)		
Day 2 09/09/2020 08:08 1.1 – 2.3 m/s NW/NNW 19-21 °C 3011919	35 dBA L <sub>Aeq</sub> (15minute)	1	C	63	50	46	40	44	37	40 L <sub>Aeq</sub>	<b>Site Related Noise Events:</b> Dozer operations 36-48 General activity 32-36 <b>Other Noise Events:</b> Train 44-55 Birds 45-63 Traffic 38-46 Aircraft 37-45 Horn 39
		2	A	56	47	44	35	40	31	33 L <sub>Aeq</sub>	
		3	B	60	52	42	33	40	30	33 L <sub>Aeq</sub>	
		4	B	60	49	39	30	38	27	31 L <sub>Aeq</sub>	
		5	B	57	43	36	29	34	26	28 L <sub>Aeq</sub>	
		6	B	60	49	40	30	39	28	29 L <sub>Aeq</sub>	
Evening 2 09/09/2020 18:23 3.2 – 3.6 m/s SE 16-17°C 3011919	35 dBA L <sub>Aeq</sub> (15minute)	1	E	53	47	44	36	41	29	I/A	<b>Site Related Noise Events:</b> Inaudible <b>Other Noise Events:</b> Traffic 41-51 Insects 43-45
		2	E	51	46	43	35	40	32	I/A	
Night 2 09/09/2020 22:01 4.9 – 6.6 m/s SE 13-14 °C 3011919	35 dBA L <sub>Aeq</sub> (15minute) 45 dBA L <sub>A1</sub> (1minute)	1	E	60	51	45	39	43	36	I/A	<b>Site Related Noise Events:</b> Inaudible <b>Other Noise Events:</b> Traffic 38-43 Wind 41-55
		2	E	55	47	42	36	40	33	I/A	
		3	D	52	44	40	35	38	32	I/A	
		4	D	51	44	41	34	38	32	I/A	

Note: N/M = Not Measurable, I/A = Inaudible

**Table 7 Operator Attended EPL Noise Survey Results – N5 – Oakleigh (Day 3)**

Period Date/Start Time Weather SLM Details	Criteria	Measurement Number	Stability Category	Primary Noise Descriptor						Narrabri Mine Contribution, (dB)	Description
				L <sub>Amax</sub> (dB)	L <sub>A1</sub> (dB)	L <sub>A10</sub> (dB)	L <sub>A90</sub> (dB)	L <sub>Aeq</sub> (dB)	L <sub>Amin</sub> (dB)		
Day 3 10/09/2020 09:25 5.5 – 6.2 m/s SE 12 °C 3011919	35 dBA L <sub>Aeq</sub> (15minute)	1	D	63	50	46	42	44	39	I/A	<b>Site Related Noise Events:</b> Inaudible <b>Other Noise Events:</b> Wind 45-63 Horn 50 Traffic 40-47 Birds 49-73 Train 45-61
		2	D	54	47	44	38	42	35	I/A	
		3	D	57	49	46	40	44	37	I/A	
		4	D	60	50	46	39	44	36	I/A	
		5	D	68	57	51	40	47	37	I/A	
		6	D	73	61	47	40	50	35	I/A	
Evening 3 10/09/2020 20:34 5.2 – 6.3 m/s SE 12-13 °C 3011919	35 dBA L <sub>Aeq</sub> (15minute)	1	E	54	46	43	37	41	35	N/M	<b>Site Related Noise Events:</b> General activity barely audible <b>Other Noise Events:</b> Traffic 37-45 Wind 40-54
		2	E	54	47	44	37	41	34	N/M	
Night 3 10/09/2020 22:00 5.9 – 6.5 m/s SE 10-11 °C 3011919	35 dBA L <sub>Aeq</sub> (15minute) 45 dBA L <sub>A1</sub> (1minute)	1	E	52	45	43	38	41	34	I/A	<b>Site Related Noise Events:</b> Inaudible <b>Other Noise Events:</b> Wind 40-52 Traffic 38-53
		2	E	53	49	46	37	42	34	I/A	
		3	E	50	43	40	35	38	32	I/A	
		4	E	53	46	42	36	40	32	I/A	

Note: N/M = Not Measurable, I/A = Inaudible

### 5.1.2 Operator Attended Noise Survey Results – EPL Monitoring Location N6

Results of the operator attended noise surveys at N6 are provided in **Table 8**, **Table 9** and **Table 10**. Monitoring location N6 represents residential receptors located to the northwest of the site in Newhaven.

**Table 8 Operator Attended EPL Noise Survey Results – N6 – Newhaven (Day 1)**

Period Date/Start Time Weather SLM Details	Criteria	Measurement Number	Stability Category	Primary Noise Descriptor						Narrabri Mine Contribution, (dB)	Description
				L <sub>Amax</sub> (dB)	L <sub>A1</sub> (dB)	L <sub>A10</sub> (dB)	L <sub>A90</sub> (dB)	L <sub>Aeq</sub> (dB)	L <sub>Amin</sub> (dB)		
Day 1 08/09/2020 09:52 1.1 – 1.8 m/s NE/SE 21-24 °C 2679354	35 dBA L <sub>Aeq</sub> (15minute)	1	A	58	48	39	25	36	23	<25 L <sub>Aeq</sub>	<b>Site Related Noise Events:</b> Vent fan briefly audible <25 <b>Other Noise Events:</b> Birds 38-64 Road traffic 35-44 Roadworks 31-37
		2	A	64	45	35	25	34	24	I/A	
		3	A	58	46	35	28	35	23	I/A	
		4	A	63	50	37	25	38	23	N/M	
		5	A	59	53	41	25	40	24	I/A	
		6	A	58	48	37	24	35	22	I/A	
Evening 1 08/09/2020 21:22 0.9 – 2.1 m/s NE/ENE 17 °C 2679354	35 dBA L <sub>Aeq</sub> (15minute)	1	E	55	41	37	29	35	26	N/M	<b>Site Related Noise Events:</b> Vent fan barely audible <b>Other Noise Events:</b> Road traffic 36-55 Frogs/insects 27 Residential noise 39-43
		2	D	46	41	37	26	33	23	I/A	

Period Date/Start Time Weather SLM Details	Criteria	Measurement Number	Stability Category	Primary Noise Descriptor						Narrabri Mine Contribution, (dB)	Description
				L <sub>Amax</sub> (dB)	L <sub>A1</sub> (dB)	L <sub>A10</sub> (dB)	L <sub>A90</sub> (dB)	L <sub>Aeq</sub> (dB)	L <sub>Amin</sub> (dB)		
Night 1 08/09/2020 22:06 0 – 0.7 m/s WSW 11-12 °C 2679354	35 dBA L <sub>Aeq</sub> (15minute) 45 dBA L <sub>A1</sub> (1minute)	1	G	57	39	36	28	33	26	28 L <sub>Aeq</sub> 30 L <sub>A1</sub>	<b>Site Related Noise Events:</b> General operations 25-31  <b>Other Noise Events:</b> Road traffic 30-39 Frogs/insects
		2	G	64	42	38	27	35	24	29 L <sub>Aeq</sub> 30 L <sub>A1</sub>	
		3	F	51	48	44	26	38	23	30 L <sub>Aeq</sub> 31 L <sub>A1</sub>	
		4	G	55	36	32	24	29	21	26 L <sub>Aeq</sub> 28 L <sub>A1</sub>	

Note: N/M = Not Measurable, I/A = Inaudible

**Table 9 Operator Attended EPL Noise Survey Results – N6 – Newhaven (Day 2)**

Period Date/Start Time Weather SLM Details	Criteria	Measurement Number	Stability Category	Primary Noise Descriptor						Narrabri Mine Contribution, (dB)	Description
				L <sub>Amax</sub> (dB)	L <sub>A1</sub> (dB)	L <sub>A10</sub> (dB)	L <sub>A90</sub> (dB)	L <sub>Aeq</sub> (dB)	L <sub>Amin</sub> (dB)		
Day 2 09/08/2020 12:52 1.1 – 3.4 m/s E-SE 25 °C 2679354	35 dBA L <sub>Aeq</sub> (15minute)	1	B	62	51	41	28	39	24	26 L <sub>Aeq</sub>	<b>Site Related Noise Events:</b> Vent fan <25-28 <b>Other Noise Events:</b> Birds/insects 40-62 Road traffic 30-33 Roadworks 29-34 Wind 29-36
		2	A	57	47	40	26	36	24	<25 L <sub>Aeq</sub>	
		3	A	55	44	35	28	34	24	26 L <sub>Aeq</sub>	
		4	A	59	51	43	30	40	26	<25 L <sub>Aeq</sub>	
		5	A	57	49	36	28	36	25	<25 L <sub>Aeq</sub>	
		6	C	53	42	35	29	33	26	N/M	
Evening 2 09/09/2020 20:51 5.8 – 7.7 m/s SE 15 °C 2679354	35 dBA L <sub>Aeq</sub> (15minute)	1	D	50	45	43	38	41	36	<30 L <sub>Aeq</sub>	<b>Site Related Noise Events:</b> General operations <30 <b>Other Noise Events:</b> Wind 35-50 Insects 30
		2	D	50	48	46	40	43	37	<30 L <sub>Aeq</sub>	
Night 2 09/09/2020 22:07 4.9 – 6.6 m/s SE 13-14 °C 2679354	35 dBA L <sub>Aeq</sub> (15minute)	1	E	67	48	45	38	43	35	N/M	<b>Site Related Noise Events:</b> Not Measurable <b>Other Noise Events:</b> Road traffic 33-38 Wind related noise 39-67
		2	E	60	43	40	35	38	33	N/M	
	45 dBA L <sub>A1</sub> (1minute)	3	D	58	42	39	35	37	32	N/M	
		4	D	59	42	40	37	39	33	N/M	

Note: N/M = Not Measurable, I/A = Inaudible

**Table 10 Operator Attended EPL Noise Survey Results – N6 – Newhaven (Day 3)**

Period Date/Start Time Weather SLM Details	Criteria	Measurement Number	Stability Category	Primary Noise Descriptor						Narrabri Mine Contribution, (dB)	Description
				L <sub>Amax</sub> (dB)	L <sub>A1</sub> (dB)	L <sub>A10</sub> (dB)	L <sub>A90</sub> (dB)	L <sub>Aeq</sub> (dB)	L <sub>Amin</sub> (dB)		
Day 3 10/09/2020 09:32 5.5 – 6.2 m/s SE 12°C 2679354	35 dBA L <sub>Aeq</sub> (15minute)	1	D	58	49	47	41	44	39	N/M	<b>Site Related Noise Events:</b> General operations <30 <b>Other Noise Events:</b> Wind 37-43 Birds 43-62
		2	D	53	47	45	40	43	37	N/M	
		3	D	62	54	48	41	46	39	N/M	
		4	D	58	50	46	41	44	39	N/M	
		5	D	59	52	49	39	45	36	<30 L <sub>Aeq</sub>	
		6	D	62	50	47	40	45	37	N/M	
Evening 3 10/09/2020 20:11 5.7 – 6.3 m/s SE 12-13 °C 2679354	35 dBA L <sub>Aeq</sub> (15minute)	1	E	51	44	41	34	39	31	<30 L <sub>Aeq</sub>	<b>Site Related Noise Events:</b> Vent fans up to 30 <b>Other Noise Events:</b> Road traffic 35-45 Bat 49-53
		2	E	53	47	43	36	41	33	30	
Night 3 10/09/2020 23:26 5.1 – 5.7 m/s ESE 9-10 °C 2679354	35 dBA L <sub>Aeq</sub> (15minute) 45 dBA L <sub>A1</sub> (1minute)	1	E	54	48	45	41	43	39	N/M	<b>Site Related Noise Events:</b> Not Measurable <b>Other Noise Events:</b> Wind related noise 40-57
		2	E	57	49	45	40	43	38	N/M	
		3	E	54	46	43	40	42	38	N/M	
		4	E	57	46	44	40	43	39	N/M	

Note: N/M = Not Measurable, I/A = Inaudible

### 5.1.3 Operator Attended Noise Survey Results – EPL Monitoring Location N9

Results of the operator attended noise surveys at N9 are provided in **Table 11**, **Table 12** and **Table 13**. Monitoring location N9 represents residential receptors located to the northwest of the site in High Range.

**Table 11 Operator Attended EPL Noise Survey Results – N9 – High Range (Day 1)**

Period Date/Start Time Weather SLM Details	Criteria <sup>1</sup>	Measurement Number	Stability Category	Primary Noise Descriptor						Narrabri Mine Contribution, (dB)	Description
				L <sub>Amax</sub> (dB)	L <sub>A1</sub> (dB)	L <sub>A10</sub> (dB)	L <sub>A90</sub> (dB)	L <sub>Aeq</sub> (dB)	L <sub>Amin</sub> (dB)		
Day 1 08/09/2020 10:53 1 – 2.4 m/s N/WSW 24-25 °C 3011919	35 dBA L <sub>Aeq</sub> (15minute)	1	A	62	39	31	26	36	24	N/M	<b>Site Related Noise Events:</b> Main vent fan barely audible <b>Other Noise Events:</b> Birds 45-62 Wind 35-49 Roadworks 27-36 Reverse beeper 28-31 Traffic 30-33
		2	A	50	39	33	25	30	23	N/M	
		3	A	44	39	34	26	31	23	I/A	
		4	B	46	36	31	25	28	23	I/A	
		5	A	57	46	32	25	34	24	N/M	
		6	A	43	36	31	25	28	23	N/M	
Evening 1 08/09/2020 19:31 1.7 – 2 m/s S 15-16 °C 3011919	35 dBA L <sub>Aeq</sub> (15minute)	1	E	51	48	47	42	45	37	I/A	<b>Site Related Noise Events:</b> Inaudible <b>Other Noise Events:</b> Insects 44-51 Traffic 30-45 Dog 47
		2	E	49	48	47	41	45	34	I/A	

Period Date/Start Time Weather SLM Details	Criteria <sup>1</sup>	Measurement Number	Stability Category	Primary Noise Descriptor						Narrabri Mine Contribution, (dB)	Description
				L <sub>Amax</sub> (dB)	L <sub>A1</sub> (dB)	L <sub>A10</sub> (dB)	L <sub>A90</sub> (dB)	L <sub>Aeq</sub> (dB)	L <sub>Amin</sub> (dB)		
Night 1 08/09/2020 23:53 0.7 – 0.9 m/s SE 11-13 °C 3011919	35 dBA L <sub>Aeq</sub> (15minute) 45 dBA L <sub>A1</sub> (1minute)	1	G	51	46	37	26	35	23	29 L <sub>Aeq</sub> 32 L <sub>A1</sub>	<b>Site Related Noise Events:</b> Dozer operations 25-30 Main vent fan 24-32 <b>Other Noise Events:</b> Traffic 35-51 Impact 50 Animals 33-40 Birds 32-42
		2	G	48	37	34	27	31	25	27 L <sub>Aeq</sub> 28 L <sub>A1</sub>	
		3	G	44	36	33	24	30	22	25 L <sub>Aeq</sub> 30 L <sub>A1</sub>	
		4	G	42	32	28	24	27	21	<25 L <sub>Aeq</sub> 25 L <sub>A1</sub>	

Note: N/M = Not Measurable, I/A = Inaudible

Note 1: A private agreement between NCOPL and the residents of N9 High Range of 40 dBA L<sub>Aeq</sub>(15minute) and 50 dBA L<sub>A1</sub>(1minute) is in place. These new levels of 40 dBA L<sub>Aeq</sub>(15minute) and 50 dBA L<sub>A1</sub>(1minute) replace the levels identified in Conditions 1-3, Schedule 4 of PA 08\_0144 Mod 2 and the identical limits contained in condition L3 of Environment Protection Licence No 12789

**Table 12 Operator Attended EPL Noise Survey Results – N9 – High Range (Day 2)**

Period Date/Start Time Weather SLM Details	Criteria <sup>1</sup>	Measurement Number	Stability Category	Primary Noise Descriptor						Narrabri Mine Contribution, (dB)	Description
				L <sub>Amax</sub> (dB)	L <sub>A1</sub> (dB)	L <sub>A10</sub> (dB)	L <sub>A90</sub> (dB)	L <sub>Aeq</sub> (dB)	L <sub>Amin</sub> (dB)		
Day 2 09/09/2020 10:56 0.7 – 2.2 m/s NW/SE 24-25 °C 2679354	35 dBA L <sub>Aeq</sub> (15minute)	1	A	64	45	41	25	36	23	N/M	<b>Site Related Noise Events:</b> Vent fans very faintly audible  <b>Other Noise Events:</b> Dogs 34-36 Residential 33-44 Plane 42-46 Birds 35-64 Road traffic 32-36
		2	A	51	42	33	25	32	23	I/A	
		3	A	62	41	32	25	33	23	I/A	
		4	A	62	44	32	24	33	23	I/A	
		5	A	55	43	32	25	33	23	I/A	
		6	A	54	42	37	22	33	23	N/M	
Evening 2 09/09/2020 19:48 4.9-5.3 m/s SE 15-16 °C 2679354	35 dBA L <sub>Aeq</sub> (15minute)	1	D	56	51	48	42	47	35	<30 L <sub>Aeq</sub>	<b>Site Related Noise Events:</b> Vent fan faintly audible <30  <b>Other Noise Events:</b> Wind 29-42 Road traffic 31-35 Insects 41-45 Birds 56 Operator 73
		2	D	73	45	39	32	39	30	<30 L <sub>Aeq</sub>	
Night 2 09/09/2020 23:23 4.6 – 4.6 m/s SE/ESE 12-13 °C 3011919	35 dBA L <sub>Aeq</sub> (15minute) 45 dBA L <sub>A1</sub> (1minute)	1	D	58	49	42	37	40	35	N/M	<b>Site Related Noise Events:</b> Main vent fan and distant engine revs barely audible  <b>Other Noise Events:</b> Wind 44-58 Traffic 37-43
		2	D	52	42	39	34	37	32	N/M	
		3	E	49	41	38	35	37	33	N/M	
		4	D	55	42	40	36	38	34	N/M	

Note: N/M = Not Measurable, I/A = Inaudible

Note 1: A private agreement between NCOPL and the residents of N9 High Range of 40 dBA L<sub>Aeq</sub>(15minute) and 50 dBA L<sub>A1</sub>(1minute) is in place. These new levels of 40 dBA L<sub>Aeq</sub>(15minute) and 50 dBA L<sub>A1</sub>(1minute) replace the levels identified in Conditions 1-3, Schedule 4 of PA 08\_0144 Mod 2 and the identical limits contained in condition L3 of Environment Protection Licence No 12789

**Table 13 Operator Attended EPL Noise Survey Results – N9 – High Range (Day 3)**

Period Date/Start Time Weather SLM Details	Criteria <sup>1</sup>	Measurement Number	Stability Category	Primary Noise Descriptor						Narrabri Mine Contribution, (dB)	Description
				L <sub>Amax</sub> (dB)	L <sub>A1</sub> (dB)	L <sub>A10</sub> (dB)	L <sub>A90</sub> (dB)	L <sub>Aeq</sub> (dB)	L <sub>Amin</sub> (dB)		
Day 3 10/09/2020 11:18 5.3 – 5.9 m/s ESE 13 °C 3011919	35 dBA L <sub>Aeq</sub> (15minute)	1	D	86	63	46	38	55	35	N/M	<b>Site Related Noise Events:</b> Main vent fan barely audible <b>Other Noise Events:</b> Birds 63-86 Local vehicle 60-70 Wind 33-58 Traffic 40-43
		2	D	58	49	44	38	41	36	N/M	
		3	D	60	51	46	39	43	37	I/A	
		4	D	63	50	44	39	42	37	I/A	
		5	D	54	49	44	38	42	36	I/A	
		6	D	66	52	45	39	43	37	I/A	
Evening 3 10/09/2020 21:00 5.2 – 5.4 m/s SE 11-12 °C 2679354	35 dBA L <sub>Aeq</sub> (15minute)	1	E	52	48	44	38	41	35	N/M	<b>Site Related Noise Events:</b> Not Measurable <b>Other Noise Events:</b> Wind related noise 34-52
		2	E	50	44	39	33	37	30	N/M	
Night 3 10/09/2020 22:03 5.9 – 6.5 m/s SE 10-11 °C 2679354	35 dBA L <sub>Aeq</sub> (15minute) 45 dBA L <sub>A1</sub> (1minute)	1	E	55	47	42	38	40	35	N/M	<b>Site Related Noise Events:</b> Not Measurable <b>Other Noise Events:</b> Wind related noise 40-55 Residential 38-46
		2	E	52	47	44	39	42	37	N/M	
		3	E	54	48	45	40	43	38	N/M	
		4	E	55	48	44	38	41	36	N/M	

Note: N/M = Not Measurable, I/A = Inaudible

Note 1: A private agreement between NCOPL and the residents of N9 High Range of 40 dBA L<sub>Aeq</sub>(15minute) and 50 dBA L<sub>A1</sub>(1minute) is in place. These new levels of 40 dBA L<sub>Aeq</sub>(15minute) and 50 dBA L<sub>A1</sub>(1minute) replace the levels identified in Conditions 1-3, Schedule 4 of PA 08\_0144 Mod 2 and the identical limits contained in condition L3 of Environment Protection Licence No 12789

### 5.1.4 Operator Attended Noise Survey Results – NMP Monitoring Location N1

Results of the operator attended noise surveys at N1 are provided in **Table 14**. Monitoring location N1 represents residential receptors located to the east of the site in Bow Hills.

**Table 14 Operator Attended NMP Noise Survey Results – N1 – Bow Hills**

Period Date/Start Time Weather SLM Details	Criteria <sup>1</sup>	Measurement Number	Stability Category	Primary Noise Descriptor						Narrabri Mine Contribution, (dB)	Description
				L <sub>Amax</sub> (dB)	L <sub>A1</sub> (dB)	L <sub>A10</sub> (dB)	L <sub>A90</sub> (dB)	L <sub>Aeq</sub> (dB)	L <sub>Amin</sub> (dB)		
Day 08/09/2020 10:22 1.5 m/s SE 22 °C 3011919	35 dBA L <sub>Aeq</sub> (15minute)	1	A	54	46	40	32	38	28	I/A	<b>Site Related Noise Events:</b> Inaudible <b>Other Noise Events:</b> Birds 48-54 Traffic 40-45 Roadworks haulage truck 40-43
Evening 08/09/2020 20:24 1.2 m/s N 16 °C 3011919	35 dBA L <sub>Aeq</sub> (15minute)	1	F	54	50	44	37	42	31	I/A	<b>Site Related Noise Events:</b> Inaudible <b>Other Noise Events:</b> Traffic 35-54 Insects 37-48
Night 08/09/2020 23:21 1.4 m/s WSW 11 °C 3011919	35 dBA L <sub>Aeq</sub> (15minute) 45 dBA L <sub>A1</sub> (1minute)	1	G	56	53	47	41	45	38	40 L <sub>Aeq</sub> 45 L <sub>A1</sub>	<b>Site Related Noise Events:</b> Dozer operations 39-45 Train loading operations 38-40 Onsite alarm 45 <b>Other Noise Events:</b> Traffic 45-56 Animals 48-49

Note: N/M = Not Measurable, I/A = Inaudible

Note 1: A private agreement between NCOPL and the residents of N1 Bow Hills of 50 dBA L<sub>Aeq</sub>(15minute) is in place. This new level of 50 dBA L<sub>Aeq</sub>(15minute) replaces the levels identified in Conditions 1-3, Schedule 4 of PA 08\_0144 Mod 2 and the identical limits contained in condition L3 of Environment Protection Licence No 1278

### 5.1.5 Operator Attended Noise Survey Results – NMP Monitoring Location N3

Results of the operator attended noise surveys at N3 are provided in **Table 15**. Monitoring location N3 represents residential receptors located to the southeast of the site in Ardmona.

**Table 15 Operator Attended NMP Noise Survey Results – N3 – Ardmona**

Period Date/Start Time Weather SLM Details	Criteria	Measurement Number	Stability Category	Primary Noise Descriptor						Narrabri Mine Contribution, (dB)	Description
				L <sub>Amax</sub> (dB)	L <sub>A1</sub> (dB)	L <sub>A10</sub> (dB)	L <sub>A90</sub> (dB)	L <sub>Aeq</sub> (dB)	L <sub>Amin</sub> (dB)		
Day 08/09/2020 10:00 1.4 m/s ESE 22 °C 3011919	35 dBA L <sub>Aeq</sub> (15minute)	1	A	94	85	71	29	72	27	N/M	<b>Site Related Noise Events:</b> General mine activity barely audible <b>Other Noise Events:</b> Traffic 80-94 Birds 60-66 Farming machinery 43-48
Evening 08/09/2020 20:01 1.3 m/s S 15 °C 2679354	35 dBA L <sub>Aeq</sub> (15minute)	1	G	89	72	54	20	62	18	I/A	<b>Site Related Noise Events:</b> Inaudible <b>Other Noise Events:</b> Frogs/insects 27 Road traffic 33-89
Night 09/09/2020 00:02 0.8 m/s SE 12 °C 2679354	35 dBA L <sub>Aeq</sub> (15minute) 45 dBA L <sub>A1</sub> (1minute)	1	G	87	79	61	39	65	37	39 L <sub>Aeq</sub> 44 L <sub>A1</sub>	<b>Site Related Noise Events:</b> Train loading operations 38-42 Dozer operations 40-45 <b>Other Noise Events:</b> Road traffic 39-87 Insects 30

Note: N/M = Not Measurable, I/A = Inaudible

### 5.1.6 Operator Attended Noise Survey Results – NMP Monitoring Location N7

Results of the operator attended noise surveys at N7 are provided in **Table 16**. Monitoring location N7 represents residential receptors located to the northeast of the site in Merriman.

**Table 16 Operator Attended NMP Noise Survey Results – N7 – Merriman**

Period Date/Start Time Weather SLM Details	Criteria	Measurement Number	Stability Category	Primary Noise Descriptor						Narrabri Mine Contribution, (dB)	Description
				L <sub>Amax</sub> (dB)	L <sub>A1</sub> (dB)	L <sub>A10</sub> (dB)	L <sub>A90</sub> (dB)	L <sub>Aeq</sub> (dB)	L <sub>Amin</sub> (dB)		
Day 08/09/2020 12:45 1.3 m/s WNW 25 °C 2679354	35 dBA L <sub>Aeq</sub> (15minute)	1	A	69	41	36	26	35	24	I/A	<b>Site Related Noise Events:</b> Inaudible <b>Other Noise Events:</b> Road traffic 33-45 Wind 27-33
Evening 08/09/2020 20:54 1.8 m/s NE 17 °C 2679354	35 dBA L <sub>Aeq</sub> (15minute)	1	F	56	41	36	26	33	21	N/M	<b>Site Related Noise Events:</b> Not Measurable <b>Other Noise Events:</b> Road traffic 27-31 Frogs/insects 25-27 Animal 50-56
Night 09/09/2020 00:37 0.8 m/s SE 13 °C 2679354	35 dBA L <sub>Aeq</sub> (15minute) 45 dBA L <sub>A1</sub> (1minute)	1	G	48	43	34	27	23	25	29 L <sub>Aeq</sub> 30 L <sub>A1</sub>	<b>Site Related Noise Events:</b> General operations 26-30 <b>Other Noise Events:</b> Road traffic 32-37 Animal 48 Birds / insects 31-34

Note: N/M = Not Measurable, I/A = Inaudible

### 5.1.7 Operator Attended Noise Survey Results – NMP Monitoring Location N8

Results of the operator attended noise surveys at N8 are provided in **Table 17**. Monitoring location N8 represents residential receptors located to the south of the site in Matilda.

**Table 17 Operator Attended NMP Noise Survey Results – N8 – Matilda**

Period Date/Start Time Weather SLM Details	Criteria	Measurement Number	Stability Category	Primary Noise Descriptor						Narrabri Mine Contribution, (dB)	Description
				L <sub>Amax</sub> (dB)	L <sub>A1</sub> (dB)	L <sub>A10</sub> (dB)	L <sub>A90</sub> (dB)	L <sub>Aeq</sub> (dB)	L <sub>Amin</sub> (dB)		
Day 08/09/2020 12:10 1.9 m/s WNW 25 °C 2679354	35 dBA L <sub>Aeq</sub> (15minute)	1	A	57	48	33	23	35	21	22 L <sub>Aeq</sub>	<b>Site Related Noise Events:</b> Dozer faintly audible 20-24 <b>Other Noise Events:</b> Birds 28-57 Wind 27-33
Evening 08/09/2020 20:25 1.5 m/s N 16 °C 2679354	35 dBA L <sub>Aeq</sub> (15minute)	1	F	50	39	32	23	30	20	I/A	<b>Site Related Noise Events:</b> Inaudible <b>Other Noise Events:</b> Road traffic 27-41 Frogs/insects 23-26 Cow 46-50
Night 08/09/2020 23:35 1.1 m/s WSW 11 °C 2679354	35 dBA L <sub>Aeq</sub> (15minute) 45 dBA L <sub>A1</sub> (1minute)	1	G	57	35	31	25	30	23	26 L <sub>Aeq</sub> 27 L <sub>A1</sub>	<b>Site Related Noise Events:</b> General operations 25-27 <b>Other Noise Events:</b> Owl 51-57 Birds 27 Frogs/insects 25-27 Road traffic 33-39

Note: N/M = Not Measurable, I/A = Inaudible

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## 6 Conclusion

SLR was engaged by Narrabri Coal Operations Pty Ltd to conduct attended noise monitoring for the Narrabri Mine in accordance with the Narrabri Mines' Noise Management Plan, Environment Protection Licence and Project Approval.

Operator attended noise monitoring was conducted at seven locations in order to determine the noise performance of the Narrabri Mine, with compliance achieved at all locations under applicable meteorological conditions during all time periods.

# APPENDIX A

## Acoustic Terminology

## Sound Level or Noise Level

The terms “sound” and “noise” are almost interchangeable, except that in common usage “noise” is often used to refer to unwanted sound.

Sound (or noise) consists of minute fluctuations in atmospheric pressure capable of evoking the sense of hearing. The human ear responds to changes in sound pressure over a very wide range. The loudest sound pressure to which the human ear responds is ten million times greater than the softest. The decibel (abbreviated as dB) scale reduces this ratio to a more manageable size by the use of logarithms.

The symbols SPL, L or LP are commonly used to represent Sound Pressure Level. The symbol LA represents A-weighted Sound Pressure Level. The standard reference unit for Sound Pressure Levels expressed in decibels is  $2 \times 10^{-5}$  Pa.

## 2 “A” Weighted Sound Pressure Level

The overall level of a sound is usually expressed in terms of dBA, which is measured using a sound level meter with an “A-weighting” filter. This is an electronic filter having a frequency response corresponding approximately to that of human hearing.

People’s hearing is most sensitive to sounds at mid frequencies (500 Hz to 4000 Hz), and less sensitive at lower and higher frequencies. Thus, the level of a sound in dBA is a good measure of the loudness of that sound. Different sources having the same dBA level generally sound about equally loud.

A change of 1 dBA or 2 dBA in the level of a sound is difficult for most people to detect, whilst a 3 dBA to 5 dBA change corresponds to a small but noticeable change in loudness. A 10 dBA change corresponds to an approximate doubling or halving in loudness. The table below lists examples of typical noise levels.

Sound Pressure Level (dBA)	Typical Source	Subjective Evaluation
130	Threshold of pain	Intolerable
120	Heavy rock concert	Extremely noisy
110	Grinding on steel	
100	Loud car horn at 3 m	Very noisy
90	Construction site with pneumatic hammering	Loud
80	Kerbside of busy street	
70	Loud radio or television	
60	Department store	Moderate to quiet
50	General Office	
40	Inside private office	Quiet to very quiet
30	Inside bedroom	
20	Recording studio	Almost silent

Other weightings (eg B, C and D) are less commonly used than A-weighting. Sound Levels measured without any weighting are referred to as “linear”, and the units are expressed as dB(lin) or dB.

## 3 Sound Power Level

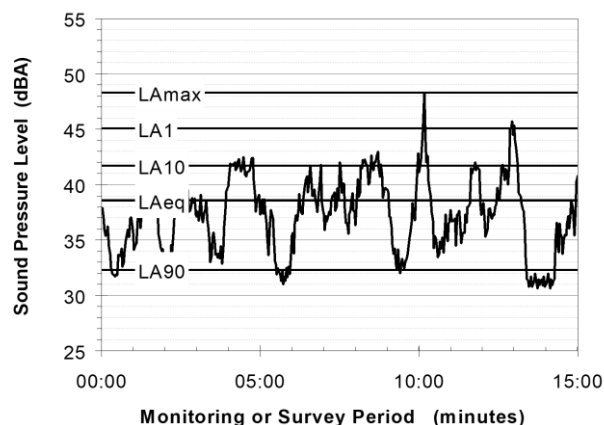
The Sound Power of a source is the rate at which it emits acoustic energy. As with Sound Pressure Levels, Sound Power Levels are expressed in decibel units (dB or dBA), but may be identified by the symbols SWL or LW, or by the reference unit  $10^{-12}$  W.

The relationship between Sound Power and Sound Pressure may be likened to an electric radiator, which is characterised by a power rating, but has an effect on the surrounding environment that can be measured in terms of a different parameter, temperature.

## 4 Statistical Noise Levels

Sounds that vary in level over time, such as road traffic noise and most community noise, are commonly described in terms of the statistical exceedance levels LAN, where LAN is the A-weighted sound pressure level exceeded for N% of a given measurement period. For example, the LA1 is the noise level exceeded for 1% of the time, LA10 the noise exceeded for 10% of the time, and so on.

The following figure presents a hypothetical 15 minute noise survey, illustrating various common statistical indices of interest.



Of particular relevance, are:

- LA1 The noise level exceeded for 1% of the 15 minute interval.
- LA10 The noise level exceeded for 10% of the 15 minute interval. This is commonly referred to as the average maximum noise level.
- LA90 The noise level exceeded for 90% of the sample period. This noise level is described as the average minimum background sound level (in the absence of the source under consideration), or simply the background level.
- LAeq The A-weighted equivalent noise level (basically the average noise level). It is defined as the steady sound level that contains the same amount of acoustical energy as the corresponding time-varying sound.

When dealing with numerous days of statistical noise data, it is sometimes necessary to define the typical noise levels at a given monitoring location for a particular time of day. A standardised method is available for determining these representative levels.

This method produces a level representing the “repeatable minimum” LA90 noise level over the daytime and night-time measurement periods, as required by the EPA. In addition the method produces mean or “average” levels representative of the other descriptors (LAeq, LA10, etc).

## 5 Tonality

Tonal noise contains one or more prominent tones (ie distinct frequency components), and is normally regarded as more offensive than “broad band” noise. 7. Impulsiveness

## 6 Impulsiveness

An impulsive noise is characterised by one or more short sharp peaks in the time domain, such as occurs during hammering.

## 7 Frequency Analysis

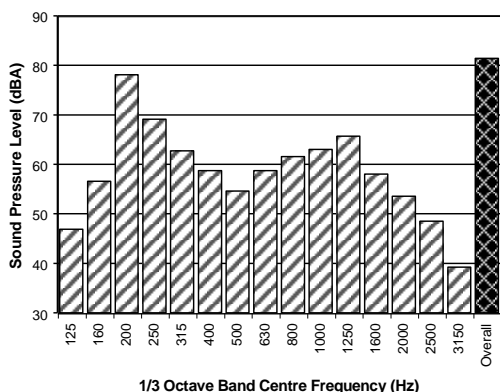
Frequency analysis is the process used to examine the tones (or frequency components) which make up the overall noise or vibration signal. This analysis was traditionally carried out using analogue electronic filters, but is now normally carried out using Fast Fourier Transform (FFT) analysers.

The units for frequency are Hertz (Hz), which represent the number of cycles per second.

Frequency analysis can be in:

- Octave bands (where the centre frequency and width of each band is double the previous band)
- 1/3 octave bands (3 bands in each octave band)
- Narrow band (where the spectrum is divided into 400 or more bands of equal width)

The following figure shows a 1/3 octave band frequency analysis where the noise is dominated by the 200 Hz band. Note that the indicated level of each individual band is less than the overall level, which is the logarithmic sum of the bands.



## 8 Vibration

Vibration may be defined as cyclic or transient motion. This motion can be measured in terms of its displacement, velocity or acceleration. Most assessments of human response to vibration or the risk of damage to buildings use measurements of vibration velocity. These may be expressed in terms of “peak” velocity or “rms” velocity.

The former is the maximum instantaneous velocity, without any averaging, and is sometimes referred to as “peak particle velocity”, or PPV. The latter incorporates “root mean squared” averaging over some defined time period.

Vibration measurements may be carried out in a single axis or alternatively as triaxial measurements. Where triaxial measurements are used, the axes are commonly designated vertical, longitudinal (aligned toward the source) and transverse.

The common units for velocity are millimetres per second (mm/s). As with noise, decibel units can also be used, in which case the reference level should always be stated. A vibration level  $V$ , expressed in mm/s can be converted to decibels by the formula  $20 \log (V/V_0)$ , where  $V_0$  is the reference level ( $10^{-9}$  m/s). Care is required in this regard, as other reference levels may be used by some organizations.

## 9 Human Perception of Vibration

People are able to “feel” vibration at levels lower than those required to cause even superficial damage to the most susceptible classes of building (even though they may not be disturbed by the motion). An individual’s perception of motion or response to vibration depends very strongly on previous experience and expectations, and on other connotations associated with the perceived source of the vibration. For example, the vibration that a person responds to as “normal” in a car, bus or train is considerably higher than what is perceived as “normal” in a shop, office or dwelling.

## 10 Over-pressure

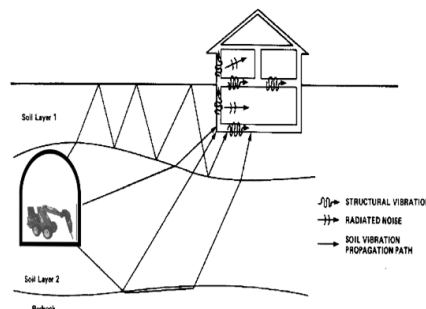
The term “over-pressure” is used to describe the air pressure pulse emitted during blasting or similar events. The peak level of an event is normally measured using a microphone in the same manner as linear noise (ie unweighted), at frequencies both in and below the audible range.

Ground-borne Noise, Structure-borne Noise and Regenerated Noise

Noise that propagates through a structure as vibration and is radiated by vibrating wall and floor surfaces is termed “structure-borne noise”, “ground-borne noise” or “regenerated noise”. This noise originates as vibration and propagates between the source and receiver through the ground and/or building structural elements, rather than through the air.

Typical sources of ground-borne or structure-borne noise include tunnelling works, underground railways, excavation plant (eg rockbreakers), and building services plant (eg fans, compressors and generators).

The following figure presents the various paths by which vibration and ground-borne noise may be transmitted between a source and receiver for construction activities occurring within a tunnel.



The term “regenerated noise” is also used in other instances where energy is converted to noise away from the primary source. One example would be a fan blowing air through a discharge grill. The fan is the energy source and primary noise source. Additional noise may be created by the aerodynamic effect of the discharge grill in the airstream. This secondary noise is referred to as regenerated noise

# APPENDIX B

## Calibration Certificates

# CERTIFICATE OF CALIBRATION

CERTIFICATE No.: **SLM 25561 & FILT 5417**

**Equipment Description:** Sound Level Meter

**Manufacturer:** B&K

**Model No:** 2250      **Serial No:** 3011919

**Microphone Type:** 4952      **Serial No:** 3094024

**Preamplifier Type:** N/A      **Serial No:** N/A

**Filter Type:** 1/3 Octave      **Serial No:** 3011919

**Comments:** All tests passed for class 1.  
(See over for details)

**Owner:** SLR Consulting Australia Pty Ltd  
Level 2, 2 Lincoln Street  
Lane Cove, NSW 2066

**Ambient Pressure:** 1001 hPa  $\pm 1.5$  hPa

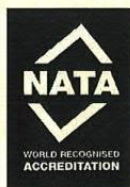
**Temperature:** 24 °C  $\pm 2^\circ$  C      **Relative Humidity:** 27%  $\pm 5\%$

**Date of Calibration:** 16/09/2019      **Issue Date:** 17/09/2019

**Acu-Vib Test Procedure:** AVP10 (SLM) & AVP06 (Filters)

**CHECKED BY:** *J.K.*      **AUTHORISED SIGNATURE:** *Hein Sod*

Accredited for compliance with ISO/IEC 17025 - Calibration  
The results of the tests, calibration and/or measurements included in this document are traceable to



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Accredited Lab. No. 9262  
Acoustic and Vibration  
Measurements

**HEAD OFFICE**  
Unit 14, 22 Hudson Ave. Castle Hill NSW 2154  
Tel: (02) 96808133 Fax: (02) 96808233  
Mobile: 0413 809806  
web site: [www.acu-vib.com.au](http://www.acu-vib.com.au)

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**CERTIFICATE No.: SLM 25561 & FILT 5417**

The performance characteristics listed below were tested. The tests are based on the relevant clauses of IEC 61672-3:2013

Tests Performed:	Clause	Result
<i>Absolute Calibration</i>	10	Pass
<i>Acoustical Frequency Weighting</i>	12	Pass
<i>Self Generated Noise</i>	11.1	Entered
<i>Electrical Noise</i>	11.2	Entered
<i>Long Term Stability</i>	15	Pass
<i>Electrical Frequency Weightings</i>	13	Pass
<i>Frequency and Time Weightings</i>	14	Pass
<i>Reference Level Linearity</i>	16	Pass
<i>Range Level Linearity</i>	17	NA
<i>Toneburst</i>	18	Pass
<i>Peak C Sound Level</i>	19	Pass
<i>Overload Indicator</i>	20	Pass
<i>High Level Stability</i>	21	Pass

**Statement of Compliance:** The sound level meter submitted for testing has successfully completed the class 1 periodic tests of IEC 61672-3:2013, for the environmental conditions under which the tests were performed. As public evidence was available, from an independent organization responsible for approving the results of pattern evaluation tests performed in accordance with IEC 61672-2:2013, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2013, the sound level meter submitted for testing conforms to the class 1 requirements of IEC 61672-1:2013.  
A full technical report is available if required.

**This Sound Level Meter included an Octave Filter Set. Tests were based on IEC 1260: 1995 and AS/NZS 4476 - 1997 and were conducted to test the following performance characteristics:**

1. Relative attenuation clause 5.3

**Date of Calibration:** 16/09/2019 **Issue Date:** 17/09/2019

**Checked by:** *[Signature]*

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**HEAD OFFICE**  
Unit 14, 22 Hudson Ave. Castle Hill NSW 2154  
Tel: (02) 96808133 Fax: (02) 96808233  
Mobile: 0413 809806  
web site: www.acu-vib.com.au

# CERTIFICATE OF CALIBRATION

CERTIFICATE No.: SLM 25532 & FILT 5408

**Equipment Description:** Sound Level Meter

**Manufacturer:** B & K

**Model No:** 2270      **Serial No:** 2679354

**Microphone Type:** 4189      **Serial No:** 2695417

**Preamplifier Type:** ZC0032      **Serial No:** 12254

**Filter Type:** 1/3 Octave      **Serial No:** 2679354

**Comments:** All tests passed for class 1.  
(See over for details)

**Owner:** SLR Consulting Australia Pty Ltd  
Level 2, 2 Lincoln Street  
Lane Cove, NSW 2066

**Ambient Pressure:** 998 hPa  $\pm 1.5$  hPa

**Temperature:** 23 °C  $\pm 2^\circ$  C      **Relative Humidity:** 26%  $\pm 5\%$

**Date of Calibration:** 09/09/2019      **Issue Date:** 09/09/2019

**Acu-Vib Test Procedure:** AVP10 (SLM) & AVP06 (Filters)

**CHECKED BY:** *MB*

**AUTHORISED SIGNATURE:** .....

*Jack Kieft*

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**ACU-VIB**  
ELECTRONICS

**HEAD OFFICE**  
Unit 14, 22 Hudson Ave. Castle Hill NSW 2154  
Tel: (02) 96808133 Fax: (02) 96808233  
Mobile: 0413 809806  
web site: www.acu-vib.com.au

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**CERTIFICATE No.: SLM 25532 & FILT 5408**

The performance characteristics listed below were tested. The tests are based on the relevant clauses of IEC 61672-3:2013

Tests Performed:	Clause	Result
<i>Absolute Calibration</i>	10	Pass
<i>Acoustical Frequency Weighting</i>	12	Pass
<i>Self Generated Noise</i>	11.1	Entered
<i>Electrical Noise</i>	11.2	Entered
<i>Long Term Stability</i>	15	Pass
<i>Electrical Frequency Weightings</i>	13	Pass
<i>Frequency and Time Weightings</i>	14	Pass
<i>Reference Level Linearity</i>	16	Pass
<i>Range Level Linearity</i>	17	NA
<i>Toneburst</i>	18	Pass
<i>Peak C Sound Level</i>	19	Pass
<i>Overload Indicator</i>	20	Pass
<i>High Level Stability</i>	21	Pass

**Statement of Compliance:** The sound level meter submitted for testing has successfully completed the class 1 periodic tests of IEC 61672-3:2013, for the environmental conditions under which the tests were performed. As public evidence was available, from an independent organization responsible for approving the results of pattern evaluation tests performed in accordance with IEC 61672-2:2013, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2013, the sound level meter submitted for testing conforms to the class 1 requirements of IEC 61672-1:2013.  
A full technical report is available if required.

This Sound Level Meter included an Octave Filter Set. Tests were based on IEC 1260: 1995 and AS/NZS 4476 - 1997 and were conducted to test the following performance characteristics:

1. Relative attenuation
- clause 5.3

**Date of Calibration:** 09/09/2019      **Issue Date:** 09/09/2019

Checked by: KB

Accredited for compliance with ISO/IEC 17025 - Calibration

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Acoustic and Vibration  
Measurements



**HEAD OFFICE**  
Unit 14, 22 Hudson Ave. Castle Hill NSW 2154  
Tel: (02) 96808133 Fax: (02) 96808233  
Mobile: 0413 809806  
web site: [www.acu-vib.com.au](http://www.acu-vib.com.au)

Page 2 of 2 End of Calibration Certificate  
AVCERT10

## ASIA PACIFIC OFFICES

### BRISBANE

Level 2, 15 Astor Terrace  
Spring Hill QLD 4000  
Australia  
T: +61 7 3858 4800  
F: +61 7 3858 4801

### CANBERRA

GPO 410  
Canberra ACT 2600  
Australia  
T: +61 2 6287 0800  
F: +61 2 9427 8200

### DARWIN

Unit 5, 21 Parap Road  
Parap NT 0820  
Australia  
T: +61 8 8998 0100  
F: +61 8 9370 0101

### GOLD COAST

Level 2, 194 Varsity Parade  
Varsity Lakes QLD 4227  
Australia  
M: +61 438 763 516

### MACKAY

21 River Street  
Mackay QLD 4740  
Australia  
T: +61 7 3181 3300

### MELBOURNE

Suite 2, 2 Domville Avenue  
Hawthorn VIC 3122  
Australia  
T: +61 3 9249 9400  
F: +61 3 9249 9499

### NEWCASTLE

10 Kings Road  
New Lambton NSW 2305  
Australia  
T: +61 2 4037 3200  
F: +61 2 4037 3201

### PERTH

Ground Floor, 503 Murray Street  
Perth WA 6000  
Australia  
T: +61 8 9422 5900  
F: +61 8 9422 5901

### SYDNEY

2 Lincoln Street  
Lane Cove NSW 2066  
Australia  
T: +61 2 9427 8100  
F: +61 2 9427 8200

### TOWNSVILLE

Level 1, 514 Sturt Street  
Townsville QLD 4810  
Australia  
T: +61 7 4722 8000  
F: +61 7 4722 8001

### TOWNSVILLE SOUTH

12 Cannan Street  
Townsville South QLD 4810  
Australia  
T: +61 7 4772 6500

### WOLLONGONG

Level 1, The Central Building  
UoW Innovation Campus  
North Wollongong NSW 2500  
Australia  
T: +61 404 939 922

### AUCKLAND

68 Beach Road  
Auckland 1010  
New Zealand  
T: +64 27 441 7849

### NELSON

6/A Cambridge Street  
Richmond, Nelson 7020  
New Zealand  
T: +64 274 898 628