

NARRABRI MINE NOISE MONITORING

**Quarter Ending December 2021
Summary Noise Report**

Prepared for:

Narrabri Coal Operations Pty Ltd
10 Kurrajong Creek Road
Baan Baa NSW 2390

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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 Narrabri Coal Operations Pty Ltd (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-R15-v0.1	24 January 2022	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 8 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 ¹	Measurement Periods	Standard Weather ³			Compliant		
			L _{Aeq} 15 min Day	L _{Aeq} 15 min Evening	L _{Aeq} 15 min Night	LA1 (1 min) Night			Day	Evening	Night			
N5	Oakleigh ²	14/12/2021	I/A	I/A	I/A	I/A	Day, Evening and Night – L _{Aeq} (15minute) 35 dBA Night LA1(1minute) – 45 dBA	Day - 1.5 hrs Evening - 0.5 hrs Night – 1hrs	Y	N	Y	Y		
		15/12/2021	I/A	I/A	I/A	I/A			Y	Y	Y	Y		
		16/12/2021	33	I/A	25	28			Y	Y	N	Y		
N6	Newhaven	14/12/2021	I/A	I/A	I/A	I/A		Day, Evening and Night – L _{Aeq} (15minute) 35 dBA Night LA1(1minute) – 45 dBA	Day - 1.5 hrs Evening - 0.5 hrs Night – 1hrs	Y	N	Y	Y	
		15/12/2021	I/A	I/A	I/A	I/A				Y	Y	N	Y	
		16/12/2021	I/A	I/A	I/A	I/A				Y	Y	N	Y	
N8	Haylin View ⁵	14/12/2021	I/A	I/A	I/A	I/A			Day, Evening and Night – L _{Aeq} (15minute) 35 dBA Night LA1(1minute) – 45 dBA	Day - 1.5 hrs Evening - 0.5 hrs Night – 1hrs	Y	N	N	Y
		15/12/2021	I/A	I/A	I/A	I/A					Y	Y	Y	Y
		16/12/2021	I/A	I/A	23	25					Y	N	N	Y
N9	High Range ²	14/12/2021	N/M	<25	I/A	I/A	Day, Evening and Night – L _{Aeq} (15minute) 35 dBA Night LA1(1minute) – 45 dBA			Day - 1.5 hrs Evening - 0.5 hrs Night – 1hrs	Y	N	N	Y
		15/12/2021	I/A	I/A	I/A	I/A					Y	Y	N	Y
		16/12/2021	I/A	I/A	I/A	I/A					Y	Y	N	Y
-	Bow Hills ¹	22/11/2021 ⁴	I/A	I/A	I/A	I/A		Day 15 min Evening 15 min Night 15 min		N	N	N	Y	
-	Ardmona	22/11/2021 ⁴	I/A	I/A	I/A	I/A				N	N	N	Y	
-	Merriman ²	22/11/2021 ⁴	I/A	I/A	I/A	I/A				N	N	N	Y	
-	Matilda ²	15/12/2021	I/A	I/A	I/A	I/A			Y	Y	N	Y		

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

Note 1: A private agreement between NCOPL and the residents of N1 Bow Hills of 50 dBA L_{Aeq}(15minute) is in place. This new level of 50 dBA L_{Aeq}(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 2: Property is owned by Narrabri Coal Operations

Note 3: Noise levels presented are the highest measured noise level under standard weather conditions over the monitoring period.

Note 4: Evening and Night monitoring conducted on this date, Day monitoring conducted during the following day period on 23/11/2021.

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 20** 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
- N8 Haylin View – 791 Mayfield Road, Baan Baa
- N9 High Range – 92 Davis Road Turrawan

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_(NMP) Matilda – 773 Mayfield Road Baan Baa

It is noted that the Narrabri Mine owns the properties Merriman (N7) and Matilda (N8_(NMP)) 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, 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.

NMP Monitoring Requirements

- At each one of the monitoring locations N1, N3, N7 and N8_(NMP)
- 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 ± 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 ^{1,2}	EPL	Residence	Oakleigh – 16293 Kamilaroi Highway Baan Baa	779526	6617751
N6 ^{1,2}	EPL	Residence	Newhaven – 184 Greylands Road Turrawan	776564	6624643
N8 ¹	EPL	Residence	Haylin View – 791 Mayfield Road Baan Baa	777428	6617316
N9 ¹	EPL	Residence	High Range – 92 Davis Road Turrawan	775879	6625895
N1	NMP	Residence	Bow Hills – 16652 Kamilaroi Highway Baan Baa	780114	6620641
N3 ²	NMP	Residence	Ardmona – 16462 Kamilaroi Highway Baan Baa	780233	6618836
N7 ²	NMP	Residence	Merriman – 16896 Kamilaroi Highway Baan Baa	779290	6623143
N8 _(NMP) ²	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 LA1(1minute) and the LAeq(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. L_{Amax}, LA1, LA10, LA90, and LAeq) over the 15 minute measurement interval.

Operator attended noise measurements were conducted using one-third octave integrating Brüel & Kjær Type 2250 sound level meters (s/n 3006994 and s/n 3011830 respectively). Attended noise measurements were undertaken by SLR staff Keiran Murphy and Adam Sirianni.

Figure 1 Attended Noise Monitoring Locations

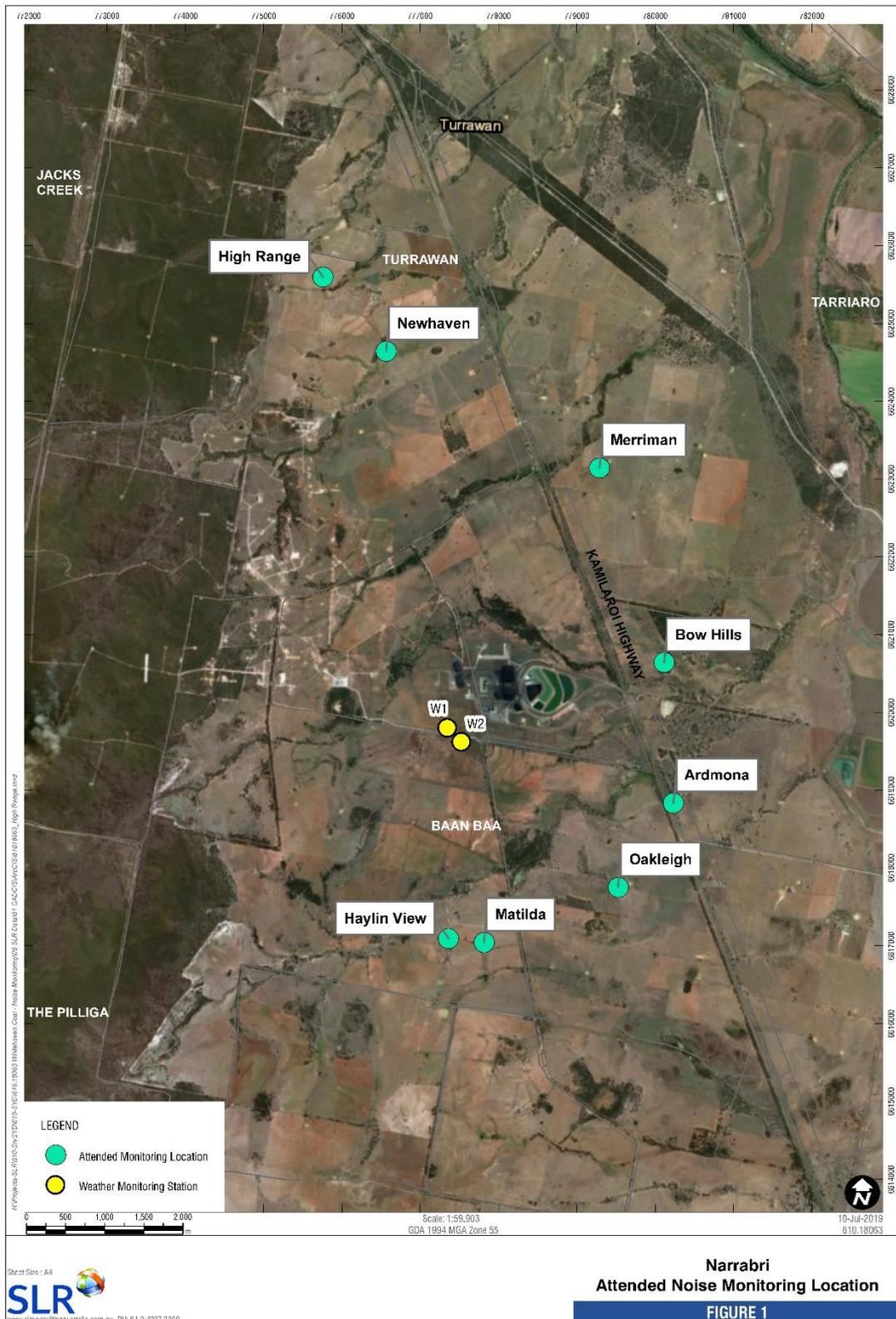


Table 4 presents a summary of which days of the week the quarterly monitoring was conducted, in accordance with condition M7.4 of EPL 12789 and Section 5 of the NMP.

Table 4 Days of the Week Quarterly EPL Monitoring was Conducted – Q4 2021

Period	Day of the Week (Excluding Weekends and Public Holidays)				
	Monday	Tuesday	Wednesday	Thursday	Friday
EPL Monitoring Locations					
Day		14 December 2021	15 December 2021	16 December 2021	
Evening		14 December 2021	15 December 2021	16 December 2021	
Night ¹		14 December 2021	15 December 2021	16 December 2021	
NMP Monitoring Locations					
Day	22 November 2021	23 November 2021	15 December 2021		
Evening	22 November 2021	23 November 2021	15 December 2021		
Night ¹	22 November 2021	23 November 2021	15 December 2021		

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_(NMP) are provided **Table 5** to **Table 20**.

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_{Amax}) and contributed L_{Aeq(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 _{Amax} (dB)	L _{A1} (dB)	L _{A10} (dB)	L _{A90} (dB)	L _{Aeq} (dB)	L _{Amin} (dB)		
Day 1 14/12/2021 11:05 2.2 - 3 m/s SE/SSE 27-29 °C 3006694	35 dBA L _{Aeq} (15minute)	1	D	60	49	36	27	36	25	I/A	Site Related Noise Events: Inaudible Other Noise Events: Traffic 30-37 Birds 45-60 Wind 30-41 Local Traffic 50-60
		2	D	59	48	34	27	36	25	I/A	
		3	D	56	45	37	28	35	26	I/A	
		4	D	60	55	41	28	41	26	I/A	
		5	A	51	43	35	27	33	25	I/A	
		6	C	49	42	39	29	35	26	I/A	
Evening 1 14/12/2021 19:59 2.6 - 3 m/s ESE 22-24 °C 3006694	35 dBA L _{Aeq} (15minute)	1	F	53	43	39	29	36	25	I/A	Site Related Noise Events: Inaudible Other Noise Events: Traffic 36-41 Birds 41-53 Insects 36-38 Aircraft 45-50
		2	F	50	47	43	34	41	31	I/A	
Night 1 14/12/2021 23:10 1.3 – 3.2 m/s SSE 18-19 °C 3006694	35 dBA L _{Aeq} (15minute) 45 dBA L _{A1} (1minute)	1	F	53	46	42	37	40	34	I/A	Site Related Noise Events: Inaudible Other Noise Events: Insects 41-43 Traffic 37-49 Birds 50-53 Train 50-56
		2	G	51	46	40	37	39	34	I/A	
		3	G	56	51	44	37	42	35	I/A	
		4	F	52	47	39	33	38	30	I/A	

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 _{Amax} (dB)	L _{A1} (dB)	L _{A10} (dB)	L _{A90} (dB)	L _{Aeq} (dB)	L _{Amin} (dB)		
Day 2 15/12/2021 09:14 0.6 – 1.8 m/s E/ENE 24-29 °C 3006694	35 dBA L _{Aeq} (15minute)	1	C	62	49	37	28	37	25	I/A	Site Related Noise Events: Inaudible Other Noise Events: Aircraft 43-54 Traffic 30-39 Birds 45-62 Train 40-46
		2	D	50	40	34	28	32	26	I/A	
		3	B	53	42	34	27	32	25	I/A	
		4	D	58	48	39	28	37	26	I/A	
		5	A	57	42	35	28	33	26	I/A	
		6	C	62	49	37	28	37	26	I/A	
Evening 2 15/12/2021 20:30 Calm 22-23 °C 3006694	35 dBA L _{Aeq} (15minute)	1	G	52	48	46	40	43	35	I/A	Site Related Noise Events: Inaudible Other Noise Events: Train 46-50 Insects 41-50 Traffic 40-53 Birds 49-55
		2	F	55	51	49	44	47	41	I/A	
Night 2 15/12/2021 22:01 0 – 2.1 m/s SW/WSW 21-22 °C 3006694	35 dBA L _{Aeq} (15minute)	1	G	55	53	51	47	49	45	I/A	Site Related Noise Events: Inaudible Other Noise Events: Traffic 48-55 Insects 48-51 Train 43-54
		2	G	55	52	50	47	49	44	I/A	
	3	G	55	52	50	47	48	44	I/A		
	4	F	52	50	49	45	47	42	I/A		
	45 dBA L _{A1} (1minute)										

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 _{Amax} (dB)	L _{A1} (dB)	L _{A10} (dB)	L _{A90} (dB)	L _{Aeq} (dB)	L _{Amin} (dB)		
Day 3 16/12/2021 07:01 0 – 1.8 m/s NW/ESE 21-27 °C 3006694	35 dBA L _{Aeq} (15minute)	1	F	73	49	43	33	44	29	28 L _{Aeq}	Site Related Noise Events: Dozer operations 30-39 General surface activity 27-33 Engine revs 28-36 Other Noise Events: Birds 53-73 Traffic 38-47 Aircraft 40-49
		2	F	54	44	40	34	38	31	32 L _{Aeq}	
		3	F	56	42	38	34	36	31	33 L _{Aeq}	
		4	E	43	37	34	29	32	27	30 L _{Aeq}	
		5	D	51	44	34	29	33	27	28 L _{Aeq}	
		6	D	59	46	37	29	35	27	28 L _{Aeq}	
Evening 3 16/12/2021 20:24 0.8 – 2.1 m/s SW/WSW 22-25 °C 3006694	35 dBA L _{Aeq} (15minute)	1	F	56	49	45	35	41	32	I/A	Site Related Noise Events: Inaudible Other Noise Events: Train 45-50 Birds 49-56 Traffic 35-45 Insects 37-40
		2	F	49	43	42	38	40	36	I/A	
Night 3 16/12/2021 22:01 0– 1.1 m/s W/WSW 19-20 °C 3006694	35 dBA L _{Aeq} (15minute) 45 dBA L _{A1} (1minute)	1	G	54	51	48	44	46	42	I/A	Site Related Noise Events: General surface activity 25-28 Engine revs 28 Other Noise Events: Train 43-48 Traffic 40-53 Aircraft 45-54 Insects 45-48
		2	G	52	49	47	43	46	40	I/A	
		3	G	54	52	50	45	48	42	I/A	
		4	G	52	51	49	43	46	40	25 L _{Aeq} 28 L _{A1}	

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 _{Amax} (dB)	L _{A1} (dB)	L _{A10} (dB)	L _{A90} (dB)	L _{Aeq} (dB)	L _{Amin} (dB)		
Day 1 14/12/2021 15:00 2.4 – 4.6 m/s SE/ESE 30-31 °C 3011830	35 dBA L _{Aeq} (15minute)	1	A	61	55	45	33	43	32	I/A	Site Related Noise Events: Inaudible Other Noise Events: Traffic 42-50 Wind 35-61 Birds 52-73 Aircraft 40-60
		2	A	64	47	42	35	40	32	I/A	
		3	A	60	52	44	35	42	33	I/A	
		4	A	53	43	40	34	37	32	I/A	
		5	B	60	49	43	35	40	33	I/A	
		6	D	73	62	51	37	50	34	I/A	
Evening 1 14/12/2021 19:08 4.3 – 4.9 m/s ESE 27-28 °C 3011830	35 dBA L _{Aeq} (15minute)	1	E	62	51	44	36	42	34	I/A	Site Related Noise Events: Inaudible Other Noise Events: Wind 37-45 Birds 45-62 Insects 38-45
		2	E	62	51	44	37	42	34	I/A	
Night 1 14/12/2021 23:48 1.3 – 2.6 m/s SE/SSE 17-19 °C 3011830	35 dBA L _{Aeq} (15minute) 45 dBA L _{A1} (1minute)	1	G	46	43	39	35	37	32	I/A	Site Related Noise Events: Inaudible Other Noise Events: Traffic 39-45 Birds 45-52 Insects 32-46 Train 45-61
		2	F	52	42	40	36	38	32	I/A	
		3	F	58	41	39	35	37	33	I/A	
		4	F	61	50	44	37	41	33	I/A	

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 _{Amax} (dB)	L _{A1} (dB)	L _{A10} (dB)	L _{A90} (dB)	L _{Aeq} (dB)	L _{Amin} (dB)		
Day 2 15/12/2021 09:55 0.6 – 1.4 m/s E/ENE 27-30 °C 3011830	35 dBA L _{Aeq} (15minute)	1	D	57	46	40	33	38	32	I/A	Site Related Noise Events: Inaudible Other Noise Events: Birds 35-75 Insects 32-42 Aircraft 38-42 Traffic 31-36 Train 35-42
		2	A	75	57	45	34	47	32	I/A	
		3	C	62	50	41	32	39	31	I/A	
		4	B	67	49	39	32	40	31	I/A	
		5	C	56	45	37	31	35	30	I/A	
		6	D	59	46	37	31	36	30	I/A	
Evening 2 15/12/2021 19:31 0.9 – 1.2 m/s NE/ENE 28-30 °C 3011830	35 dBA L _{Aeq} (15minute)	1	F	77	55	45	36	46	33	I/A	Site Related Noise Events: Inaudible Other Noise Events: Birds 35-77 Insects 38-44 Traffic 35-40
		2	F	60	49	43	36	41	33	I/A	
Night 2 15/12/2021 23:42 0 – 0.9 m/s E 19-21 °C 3011830	35 dBA L _{Aeq} (15minute)	1	G	51	46	42	39	41	37	I/A	Site Related Noise Events: Inaudible Other Noise Events: Traffic 38-51 Insects 37-45 Impact 56
		2	G	52	43	41	38	40	36	I/A	
	45 dBA L _{A1} (1minute)	3	G	56	45	40	37	39	35	I/A	
		4	G	50	46	42	37	40	35	I/A	

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 _{Amax} (dB)	L _{A1} (dB)	L _{A10} (dB)	L _{A90} (dB)	L _{Aeq} (dB)	L _{Amin} (dB)		
Day 3 16/12/2021 10:10 0.9 – 3.3 m/s SW/ESE 28-29 °C 3011830	35 dBA L _{Aeq} (15minute)	1	C	67	52	42	33	41	32	I/A	Site Related Noise Events: Inaudible Other Noise Events: Birds 35-67 Insects 31-36 Wind 35-40
		2	D	67	49	38	32	39	31	I/A	
		3	D	62	52	39	33	39	31	I/A	
		4	D	58	47	38	33	37	31	I/A	
		5	D	62	49	42	32	39	31	I/A	
		6	D	55	47	40	32	38	30	I/A	
Evening 3 16/12/2021 19:35 0.8 - 1 m/s W/WNW 26-29 °C 3011830	35 dBA L _{Aeq} (15minute)	1	E	66	49	41	35	40	32	I/A	Site Related Noise Events: Inaudible Other Noise Events: Insects 33-45 Birds 40-66
		2	E	63	53	42	35	42	33	I/A	
Night 3 16/12/2021 23:27 Calm 18-19 °C 3011830	35 dBA L _{Aeq} (15minute) 45 dBA L _{A1} (1minute)	1	G	48	45	42	38	40	36	I/A	Site Related Noise Events: Inaudible Other Noise Events: Insects 38-43 Traffic 38-51 Train 45-49
		2	G	51	49	47	37	43	35	I/A	
		3	G	49	47	43	36	40	33	I/A	
		4	G	51	45	42	35	39	33	I/A	

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

5.1.3 Operator Attended Noise Survey Results – EPL Monitoring Location N8

Results of the operator attended noise surveys at N8 are provided in **Table 11**, **Table 12** and **Table 13**. Monitoring location N8 represents residential receptors located to the southeast of the site in Haylin View.

Table 11 Operator Attended EPL Noise Survey Results – N8 – Haylin View (Day 1)

Period Date/Start Time Weather SLM Details	Criteria	Measurement Number	Stability Category	Primary Noise Descriptor						Narrabri Mine Contribution, (dB)	Description
				L _{Amax} (dB)	L _{A1} (dB)	L _{A10} (dB)	L _{A90} (dB)	L _{Aeq} (dB)	L _{Amin} (dB)		
Day 1 14/12/2021 12:40 2.5 – 3.4 m/s SE/ESE 28-30 °C 3011830	35 dBA L _{Aeq} (15minute)	1	C	62	42	36	30	34	27	I/A	Site Related Noise Events: Inaudible Other Noise Events: Aircraft 50-62 Wind 30-35 Birds 40-64 Insects 35-40
		2	C	59	42	36	28	34	26	I/A	
		3	A	56	44	37	28	34	26	I/A	
		4	D	60	47	38	28	36	26	I/A	
		5	A	52	41	37	30	34	28	I/A	
		6	A	64	43	37	28	34	26	I/A	
Evening 1 14/12/2021 20:14 2.6 - 3 m/s ESE 22-24 °C 3011830	35 dBA L _{Aeq} (15minute)	1	F	58	48	43	38	42	33	I/A	Site Related Noise Events: Inaudible Other Noise Events: Insects 38-42 Aircraft 45-50 Birds 38-58
		2	F	57	48	47	42	44	40	I/A	
Night 1 14/12/2021 22:04 2.6 – 3.2 m/s SSE 19-20 °C 3011830	35 dBA L _{Aeq} (15minute) 45 dBA L _{A1} (1minute)	1	G	51	49	47	41	44	39	I/A	Site Related Noise Events: Inaudible Other Noise Events: Insects 40-50 Aircraft 42-50 Traffic 41-51 Train 40-43
		2	F	50	48	45	41	43	39	I/A	
		3	G	49	48	44	41	42	39	I/A	
		4	G	51	48	42	40	42	39	I/A	

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

Table 12 Operator Attended EPL Noise Survey Results – N8 – Haylin View (Day 2)

Period Date/Start Time Weather SLM Details	Criteria	Measurement Number	Stability Category	Primary Noise Descriptor						Narrabri Mine Contribution, (dB)	Description
				L _{Amax} (dB)	L _{A1} (dB)	L _{A10} (dB)	L _{A90} (dB)	L _{Aeq} (dB)	L _{Amin} (dB)		
Day 2 15/12/2021 12:07 1.2 – 2.6 m/s NE/SE 30-31 °C 3011830	35 dBA L _{Aeq} (15minute)	1	C	50	36	33	30	32	28	I/A	Site Related Noise Events: Inaudible Other Noise Events: Insects 30-37 Roadworks 30-40 Birds 40-64
		2	B	56	40	33	29	32	27	I/A	
		3	B	56	40	32	29	32	27	I/A	
		4	B	55	40	32	28	32	27	I/A	
		5	A	64	38	32	28	33	25	I/A	
		6	C	42	37	32	27	30	26	I/A	
Evening 2 15/12/2021 20:25 Calm 22-23 °C 3011830	35 dBA L _{Aeq} (15minute)	1	G	60	55	52	37	47	34	I/A	Site Related Noise Events: Inaudible Other Noise Events: Insects 34-60
		2	F	57	56	55	44	52	39	I/A	
Night 2 15/12/2021 10:00 0 – 2.1 m/s SW/WSW 21-22 °C 3011830	35 dBA L _{Aeq} (15minute)	1	G	51	49	47	44	46	43	I/A	Site Related Noise Events: Inaudible Other Noise Events: Aeroplane 45-51 Insects 44-51 Traffic 42-48 Impact 57
		2	G	51	48	47	44	45	42	I/A	
	45 dBA L _{A1} (1minute)	3	G	50	47	46	45	46	43	I/A	
		4	F	57	48	46	44	45	42	I/A	

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

Table 13 Operator Attended EPL Noise Survey Results – N8 – Haylin View (Day 3)

Period Date/Start Time Weather SLM Details	Criteria	Measurement Number	Stability Category	Primary Noise Descriptor						Narrabri Mine Contribution, (dB)	Description
				L _{Amax} (dB)	L _{A1} (dB)	L _{A10} (dB)	L _{A90} (dB)	L _{Aeq} (dB)	L _{Amin} (dB)		
Day 3 16/12/2021 12:04 1.8 – 3.0 m/s SE/ESE 28-31 °C 3011830	35 dBA L _{Aeq} (15minute)	1	D	55	41	35	27	32	26	I/A	Site Related Noise Events: Inaudible Other Noise Events: Birds 30-60 Aircraft 40-55 Insects 30-40 Traffic 25-40
		2	B	60	47	35	27	35	25	I/A	
		3	E	57	41	34	27	32	25	I/A	
		4	D	59	42	34	26	32	25	I/A	
		5	D	53	36	30	26	29	24	I/A	
		6	B	54	45	34	26	33	24	I/A	
Evening 3 16/12/2021 20:46 0 – 2.1 m/s SW 22 °C 3011830	35 dBA L _{Aeq} (15minute)	1	G	55	48	40	35	39	32	I/A	Site Related Noise Events: Inaudible Other Noise Events: Insects 39-49 Birds 45-55
		2	G	49	48	47	42	45	39	I/A	
Night 3 16/12/2021 22:00 0– 1.1 m/s W/WSW 19-20 °C 3011830	35 dBA L _{Aeq} (15minute) 45 dBA L _{A1} (1minute)	1	G	55	47	46	44	45	42	I/A	Site Related Noise Events: General surface activity 20-25 Other Noise Events: Insects 44-48 Aircraft 45-50 Impact 55 Animals 49-51
		2	G	49	46	45	43	44	41	I/A	
		3	G	51	46	45	42	44	41	I/A	
		4	G	50	46	45	43	44	41	23 L _{Aeq} 25 L _{A1}	

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

5.1.4 Operator Attended Noise Survey Results – EPL Monitoring Location N9

Results of the operator attended noise surveys at N9 are provided in **Table 14**, **Table 15** and **Table 16**. Monitoring location N9 represents residential receptors located to the northwest of the site in High Range.

Table 14 Operator Attended EPL Noise Survey Results – N9 – High Range (Day 1)

Period Date/Start Time Weather SLM Details	Criteria	Measurement Number	Stability Category	Primary Noise Descriptor						Narrabri Mine Contribution, (dB)	Description
				L _{Amax} (dB)	L _{A1} (dB)	L _{A10} (dB)	L _{A90} (dB)	L _{Aeq} (dB)	L _{Amin} (dB)		
Day 1 14/12/2021 13:36 3.0 – 4.6 m/s SE/ESE 29-30 °C 3006694	35 dBA L _{Aeq} (15minute)	1	A	69	55	35	27	44	25	N/M	Site Related Noise Events: Main exhaust vent fan faintly audible Other Noise Events: Birds 53-60 Aircraft 41-45 Local traffic 60-69 Animals 53-56
		2	A	58	41	35	27	33	25	N/M	
		3	C	56	47	37	28	36	25	N/M	
		4	C	55	42	35	28	33	25	N/M	
		5	A	53	42	36	29	33	25	I/A	
		6	A	51	42	34	28	32	25	I/A	
Evening 1 14/12/2021 19:22 3.5- 4.7 m/s ESE 26-27 °C 3006694	35 dBA L _{Aeq} (15minute)	1	E	58	48	40	30	37	26	N/M	Site Related Noise Events: Main exhaust vent fan 20-25 Other Noise Events: Birds 42-58 Traffic 35-46 Animals 42-46
		2	E	58	46	38	32	36	28	<25 L _{Aeq}	
Night 1 15/12/2021 00:34 2.3 – 2.9 m/s SSE 17 °C 3006694	35 dBA L _{Aeq} (15minute) 45 dBA L _{A1} (1minute)	1	F	49	45	41	34	38	33	I/A	Site Related Noise Events: Inaudible Other Noise Events: Insects 35-38 Traffic 33-44 Train 40-49 Train Horn 64 Birds 44-57
		2	G	54	45	43	35	40	32	I/A	
		3	F	47	42	36	32	35	31	I/A	
		4	F	57	39	35	33	35	31	I/A	

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

Table 15 Operator Attended EPL Noise Survey Results – N9 – High Range (Day 2)

Period Date/Start Time Weather SLM Details	Criteria	Measurement Number	Stability Category	Primary Noise Descriptor						Narrabri Mine Contribution, (dB)	Description
				L _{Amax} (dB)	L _{A1} (dB)	L _{A10} (dB)	L _{A90} (dB)	L _{Aeq} (dB)	L _{Amin} (dB)		
Day 2 15/12/2021 07:12 2.7 – 3.6 m/s SE/ESE 19-24 °C 3006694	35 dBA L _{Aeq} (15minute)	1	D	61	53	43	32	41	27	I/A	Site Related Noise Events: Inaudible Other Noise Events: Traffic 36-46 Birds 47-63 Wind 35-41 Train 41-54
		2	D	63	56	43	29	43	26	I/A	
		3	D	58	52	44	29	41	26	I/A	
		4	D	54	43	37	28	34	25	I/A	
		5	D	60	49	36	27	36	25	I/A	
		6	D	62	44	33	26	36	24	I/A	
Evening 2 15/12/2021 19:37 0.9 – 1.2 m/s NE/ESE 28-30 °C 3006694	35 dBA L _{Aeq} (15minute)	1	F	55	39	34	29	33	27	I/A	Site Related Noise Events: Inaudible Other Noise Events: Traffic 35-41 Animals 38-55 Birds 52-57 Insects 34-36
		2	F	57	49	39	30	38	28	I/A	
Night 2 15/12/2021 23:32 0 – 0.9 m/s E 19-21 °C 3006694	35 dBA L _{Aeq} (15minute)	1	G	49	44	43	41	42	39	I/A	Site Related Noise Events: Inaudible Other Noise Events: Insects 41-44 Traffic 43-49 Impact 58
		2	G	49	44	42	40	41	38	I/A	
	45 dBA L _{A1} (1minute)	3	G	48	44	41	39	40	37	I/A	
		4	G	58	45	42	39	41	37	I/A	

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

Table 16 Operator Attended EPL Noise Survey Results – N9 – High Range (Day 3)

Period Date/Start Time Weather SLM Details	Criteria	Measurement Number	Stability Category	Primary Noise Descriptor						Narrabri Mine Contribution, (dB)	Description
				L _{Amax} (dB)	L _{A1} (dB)	L _{A10} (dB)	L _{A90} (dB)	L _{Aeq} (dB)	L _{Amin} (dB)		
Day 3 16/12/2021 13:06 1.8 – 2.9 m/s SE 29-31 °C 3006694	35 dBA L _{Aeq} (15minute)	1	B	59	50	37	28	37	26	I/A	Site Related Noise Events: Inaudible Other Noise Events: Residential Mech Plant 30-33 Birds 46-60 Aircraft 45-50
		2	D	59	50	41	28	38	25	I/A	
		3	D	55	44	33	27	33	25	I/A	
		4	D	51	40	32	27	31	26	I/A	
		5	D	57	46	34	27	35	26	I/A	
		6	D	59	46	36	28	36	26	I/A	
Evening 3 16/12/2021 19:30 0.8 - 1 m/s W/WNW 26-29 °C 3006694	35 dBA L _{Aeq} (15minute)	1	E	66	58	35	28	42	25	I/A	Site Related Noise Events: Inaudible Other Noise Events: Birds 42-66 Traffic 34-39 Residential Mech Plant 30-32
		2	E	53	45	33	29	33	27	I/A	
Night 3 16/12/2021 23:27 Calm 18-19 °C 3006694	35 dBA L _{Aeq} (15minute)	1	G	54	44	41	38	40	37	I/A	Site Related Noise Events: Inaudible Other Noise Events: Animals 41-53 Insects 37-42 Traffic 44-51 Train 43-47
		2	G	51	43	41	39	40	37	I/A	
	45 dBA L _{A1} (1minute)	3	G	46	43	40	38	39	36	I/A	
		4	G	47	43	40	36	38	35	I/A	

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

5.1.5 Operator Attended Noise Survey Results – NMP Monitoring Location N1

Results of the operator attended noise surveys at N1 are provided in **Table 17**. Monitoring location N1 represents residential receptors located to the east of the site in Bow Hills.

Table 17 Operator Attended NMP Noise Survey Results – N1 – Bow Hills

Period Date/Start Time Weather SLM Details	Criteria ¹	Measurement Number	Stability Category	Primary Noise Descriptor						Narrabri Mine Contribution, (dB)	Description
				L _{Amax} (dB)	L _{A1} (dB)	L _{A10} (dB)	L _{A90} (dB)	L _{Aeq} (dB)	L _{Amin} (dB)		
Day 23/11/2021 13:58 3.6 m/s ESE 26 °C 3006694	35 dBA L _{Aeq} (15minute)	1	C	59	51	45	35	42	31	N/M	Site Related Noise Events: Surface Activity faintly audible Other Noise Events: Traffic 50-55 Birds 41-59
Evening 22/11/2021 20:20 5.5 m/s SE 19 °C 3006694	35 dBA L _{Aeq} (15minute)	1	E	59	55	54	51	52	49	I/A	Site Related Noise Events: Inaudible Other Noise Events: Insects 50-56 Traffic 45-59
Night 22/11/2021 23:44 4.6 m/s SE 17 °C 3006694	35 dBA L _{Aeq} (15minute)	1	E	62	61	54	48	52	45	I/A	Site Related Noise Events: Inaudible Other Noise Events: Wind 44-58 Traffic 50-58 Insects 50-62

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_{Aeq}(15minute) is in place. This new level of 50 dBA L_{Aeq}(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

5.1.6 Operator Attended Noise Survey Results – NMP Monitoring Location N3

Results of the operator attended noise surveys at N3 are provided in **Table 18**. Monitoring location N3 represents residential receptors located to the southeast of the site in Ardmona.

Table 18 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 _{Amax} (dB)	L _{A1} (dB)	L _{A10} (dB)	L _{A90} (dB)	L _{Aeq} (dB)	L _{Amin} (dB)		
Day 23/11/2021 13:30 4.4 m/s E 27 °C 3006694	35 dBA L _{Aeq} (15minute)	1	A	91	85	72	40	71	91	I/A	Site Related Noise Events: Inaudible Other Noise Events: Traffic 80-91 Birds 55
Evening 22/11/2021 20:42 5.3 m/s SE 19 °C 3006694	35 dBA L _{Aeq} (15minute)	1	E	81	77	60	45	62	43	I/A	Site Related Noise Events: Inaudible Other Noise Events: Traffic 78-81 Insects 44-48 Wind 40-50
Night 22/11/2021 23:20 4.5 m/s ESE 17 °C 3006694	35 dBA L _{Aeq} (15minute)	1	E	90	79	56	43	66	41	I/A	Site Related Noise Events: Inaudible Other Noise Events: Traffic 80-90 Bat 44-55 Wind 40-53

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

5.1.7 Operator Attended Noise Survey Results – NMP Monitoring Location N7

Results of the operator attended noise surveys at N7 are provided in **Table 19**. Monitoring location N7 represents residential receptors located to the northeast of the site in Merriman.

Table 19 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 _{Amax} (dB)	L _{A1} (dB)	L _{A10} (dB)	L _{A90} (dB)	L _{Aeq} (dB)	L _{Amin} (dB)		
Day 23/11/2021 14:47 3.2 m/s ESE 27 °C 3011830	35 dBA L _{Aeq} (15minute)	1	D	78	73	62	38	60	33	I/A	Site Related Noise Events: Inaudible Other Noise Events: Traffic 69-78 Birds 35-60
Evening 22/11/2021 20:34 5.3 m/s SE 19 °C 3011830	35 dBA L _{Aeq} (15minute)	1	E	83	71	54	42	59	41	I/A	Site Related Noise Events: Inaudible Other Noise Events: Traffic 69-83 Insects 40-50
Night 22/11/2021 23:27 4.5 m/s ESE 17 °C 3011830	35 dBA L _{Aeq} (15minute)	1	E	60	46	43	40	41	37	I/A	Site Related Noise Events: Inaudible Other Noise Events: Traffic 58-60 Insects 45 Wind 40-45

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

Note: Due to roadworks restricting access to the property, monitoring was undertaken at the property boundary.

5.1.8 Operator Attended Noise Survey Results – NMP Monitoring Location N8_(NMP)

Results of the operator attended noise surveys at N8_(NMP) are provided in **Table 20**. Monitoring location N8_(NMP) represents residential receptors located to the south of the site in Matilda.

Table 20 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 _{Amax} (dB)	L _{A1} (dB)	L _{A10} (dB)	L _{A90} (dB)	L _{Aeq} (dB)	L _{Amin} (dB)		
Day 15/12/2021 13:44 1.2 m/s E 31 °C 3011830	35 dBA L _{Aeq} (15minute)	1	B	53	40	33	27	31	26	I/A	Site Related Noise Events: Inaudible Other Noise Events: Birds 28-53 Insects 30-38 Roadworks 30-38
Evening 15/12/2021 20:55 Calm 22 °C 3011830	35 dBA L _{Aeq} (15minute)	1	F	58	56	55	47	53	44	I/A	Site Related Noise Events: Inaudible Other Noise Events: Birds 50-58 Insects 30-48
Night 15/12/2021 23:00 Calm 21 °C 3011830	35 dBA L _{Aeq} (15minute)	1	G	50	48	46	44	45	42	I/A	Site Related Noise Events: Inaudible Other Noise Events: Insects 30-50

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

Note: Due to access restraints, monitoring for this location was done at the property boundary with N8 - Haylin View.

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 eight locations in order to determine the noise performance of the Narrabri Mine, with compliance achieved at all locations 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 2×10^{-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	
80	Kerbside of busy street	Loud
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

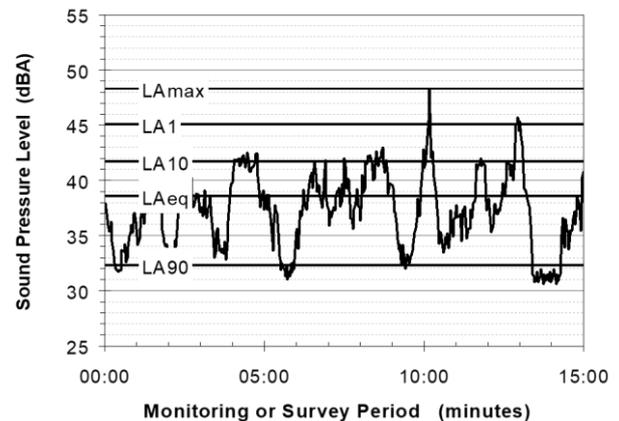
The Sound Power of a source is the rate at which it emits acoustic energy. As with Sound Pressure Levels, Sound Power Levels are expressed in decibel units (dB or dBA), but may be identified by the symbols SWL or LW, or by the reference unit 10^{-12} W.

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

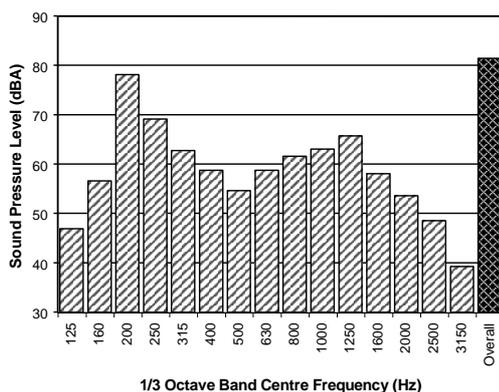
Frequency analysis is the process used to examine the tones (or frequency components) which make up the overall noise or vibration signal. This analysis was traditionally carried out using analogue electronic filters, but is now normally carried out using Fast Fourier Transform (FFT) analysers.

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

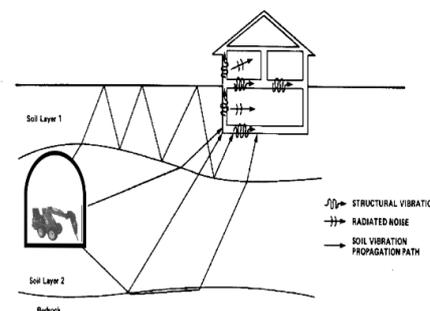
The term “over-pressure” is used to describe the air pressure pulse emitted during blasting or similar events. The peak level of an event is normally measured using a microphone in the same manner as linear noise (ie unweighted), at frequencies both in and below the audible range.

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: SLM30484

EQUIPMENT TESTED: Sound Level Meter

Manufacturer: B&K
Type No: 2250
Mic. Type: 4952
Pre-Amp. Type: N/A
Filter Type: 1/3 Octave
Serial No: 3011830
Serial No: 3122120
Serial No: N/A
Test No: FILT 6651

Owner: SLR Consulting Australia Pty Ltd
120 High Street
North Sydney, NSW 2060

Tests Performed: IEC 61672-3:2013, IEC 1260:1995, & AS/NZS 4476:1997
Comments: All Test passed for Class 1. (See overleaf for details)

CONDITIONS OF TEST:

Ambient Pressure	1010 hPa ±1 hPa	Date of Receipt :	02/09/2021
Temperature	23 °C ±1° C	Date of Calibration :	06/09/2021
Relative Humidity	37 % ±5%	Date of Issue :	06/09/2021

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

CHECKED BY:  **AUTHORISED SIGNATURE:** 

Hein Soc

Accredited for compliance with ISO/IEC 17025 - Calibration
Results of the tests, calibration and/or measurements included in this document are traceable to SI units through reference equipment that has been calibrated by the Australian National Measurement Institute or other NATA accredited laboratories demonstrating traceability.

This report applies only to the item identified in the report and may not be reproduced in part.
The uncertainties quoted are calculated in accordance with the methods of the ISO Guide to the Uncertainty of Measurement and quoted at a coverage factor of 2 with a confidence interval of approximately 95%.



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

Tests Performed:	<i>Clause</i>	<i>Result</i>
<i>Absolute Calibration</i>	10	Pass
<i>Acoustical Frequency Weighting</i>	12	Pass
<i>Self-Generated Noise</i>	11.1	Observed
<i>Electrical Noise</i>	11.2	Observed
<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	Not Applicable
<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 successfully completed the periodic tests of IEC 61672-3:-2013, for the environmental conditions under which the tests were performed. However, no general statement or conclusion can be made about conformance of the sound level meter to the full specifications of IEC 61672-1:-2013 because evidence was not publically available, from an independent testing organization responsible for pattern approvals, to demonstrate that the model of sound level meter fully conformed to the class 1 specifications in IEC 61672-1:-2013 and because the periodic tests of IEC 61672-3:-2013 cover only a limited subset of the specifications in IEC 61672-1:-2013.

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

A full technical report is available on request.

CERTIFICATE OF CALIBRATION

CERTIFICATE No.: **SLM 26583 & FILT 5697**

Equipment Description: Sound Level Meter

Manufacturer: B & K

Model No: 2250 **Serial No:** 3006994

Microphone Type: 4952 **Serial No:** 3017903

Preamplifier Type: - **Serial No:** -

Filter Type: 1/3 Octave **Serial No:** 3006994

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

Owner: SLR Consulting Australia Pty Ltd
120 High Street
North Sydney, NSW 2060

Ambient Pressure: 1009 hPa \pm 1.5 hPa

Temperature: 24 °C \pm 2° C **Relative Humidity:** 57% \pm 5%

Date of Calibration: 18/03/2020 **Issue Date:** 19/03/2020

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

CHECKED BY: *KB* **AUTHORISED SIGNATURE:** *Helu Soe*

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



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CERTIFICATE NO.: SLM 26583 & FILT 5697

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

Tests Performed:	<i>Clause</i>	<i>Result</i>
<i>Absolute Calibration</i>	10	Pass
<i>Acoustical Frequency Weighting</i>	12	Pass
<i>Self Generated Noise</i>	11.1	Observed
<i>Electrical Noise</i>	11.2	Observed
<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 IEC61672-1:2013. A full technical report is available if required.

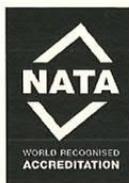
This Sound Level Meter included an Octave Filter Set. Tests were based on IEC 1260: 1995 and AS/NZS 4476 - 1997 and were conducted to test the following performance characteristics:

1. Relative attenuation clause 5.3

Date of Calibration: 18/03/2020 **Issue Date:** 19/03/2020

Checked by: *JRB*

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



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