



Report

WONGAWILLI COAL NOISE COMPLIANCE MONITORING SEPTEMBER 2016

WONGAWILLI COAL

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1 INTRODUCTION

Wollongong Coal Limited (Wollongong Coal) (formerly Gujarat NRE FCGL Pty Ltd) mining operations at NRE Wongawilli Colliery – Nebo Area Project (the Project) are subject to the conditions of the Project Approval, application number 09_0161 (The Project Approval). Tables 3 and 4 in Schedule 4 of the Project Approval set out the applicable noise limits.

Section 8 of the Project Approval requires a Noise Management Plan to be prepared. This management plan was prepared by Wollongong Coal in July 2016 (reference WWC EC PLN 007).

Section 5.1 of the Noise Management Plan (NMP) states that WCL proposes to undertake quarterly attended monitoring to determine compliance with the criteria. It is noted that two additional monitoring site are identified in the NMP than outlined in the Project Approval, these sites are related to rail noise.

Attended measurements are to be taken over a 15-minute period using Type-1 Sound Level Meters with consideration to the *NSW Industrial Noise Policy* (INP) (EPA 2000) and Australian Standard AS 1055 *Acoustics – Description and Measurement of Environmental Noise*.

This document describes the results of quarterly compliance noise measurements carried out on 20 and 21 September 2016.

Rail noise monitoring undertaken between 20th September and 27th September are also described in this document.

2 OBJECTIVES

The objective of the compliance noise monitoring was to assess compliance of Wongawilli Colliery (the Project) with the relevant noise limit conditions of the Project Approval.

3 REFERENCE DOCUMENTS

The following documents have been considered as part of the compliance noise monitoring:

- NRE Wongawilli Colliery Project Approval No. 09_0161
- NRE Wongawilli Colliery Environmental Protection Licences No. 1087 and 12442
- NRE Wongawilli Colliery Nebo Area Environmental Assessment (ERM Report 0097271s)
- NRE Wongawilli Colliery Noise Management Plan (WWC EC PLN 007, July 2016)
- NSW Environmental Protection Agency – Industrial Noise Policy (INP) (EPA 2000)
- NSW Environmental Protection Agency – Rail Infrastructure Noise Guideline (EPA 2013)
- Australian Standard AS 1055:1997 –Acoustics – Description and Measurement of Environmental Noise.
- Australian Standard AS 2377:2002 –Acoustics – Methods for the measurement of Railbound Vehicle Noise.

4 NOISE CRITERIA

4.1 Colliery Noise

The relevant noise criteria are contained within Tables 3 and 4 of the Project Approval. These tables are reproduced in Table 4.1 and Table 4.2 of this report. The locations of the nominated receiver locations are presented in Figure 5.1.

The Project Approval states both intrusive and amenity criteria, which are respectively assessed over a 15 minute period and relevant period (day, evening and night).

It is considered that the Intrusive criteria as both lower and assessed over a shorter time period represent the most stringent criteria and are therefore the limiting criteria to determine compliance for the Project.

Table 4.1: Noise Criteria dB(A) –Intrusive noise limits as defined in Table 3 of the Project Approval

Receiver Number	Day	Evening	Night	
	L _{Aeq} (15min)	L _{Aeq} (15min)	L _{Aeq} (15min)	L _{A1} (1min)
RA1	43	43	43	59
RA2	44	43	43	60
RA3	40	40	38	48
All other existing residential receivers	40	40	38	48

Note: Day is defined as 7.00am to 6.00pm, evening as 6.00pm to 10.00pm and night as 10.00pm to 7.00am.

Table 4.2: Noise Criteria dB(A) – Amenity Noise Limits as defined in Table 4 of the Project Approval

Receiver Area	Day	Evening	Night
	L _{Aeq} (11hr)	L _{Aeq} (4hr)	L _{Aeq} (9hr)
All privately-owned land	60	50	45

Notes to Tables 4.1 and 4.2:

- To interpret the locations, see Appendix 4 of the Project Approval.
- Noise generated by the project is to be measured in accordance with the relevant requirements, and exemptions (including certain meteorological conditions) of the INP.

Further to these conditions, the Project Approval outlines a range of noise goals to be considered with the objective of reducing future noise levels from the Project. These noise goals are presented in Table 4.3.

Table 4.3: Noise Criteria dB(A) –Intrusive noise goals as defined in Table 5 of the Project Approval

Receiver Number	Day	Evening	Night	
	L _{Aeq} (15min)	L _{Aeq} (15min)	L _{Aeq} (15min)	L _{A1} (1min)
RA1	40	40	38	51
RA2	40	40	38	51
RA3	40	40	38	48
All other existing residential receivers	40	40	38	48

Notes:

- To interpret the locations, see Appendix 4 of the Project Approval.
- Noise generated by the project is to be measured in accordance with the relevant requirements, and exemptions (including certain meteorological conditions), of the INP.
- The noise goals in Table 5 may be varied by way of direction to the Proponent by the Secretary, following consideration of the results of the noise audit required under condition 7 of the Project Approval.

4.2 Rail Spur Noise

The relevant noise criteria are contained within Table 6 of the Project Approval. This table is reproduced in Table 4.4 of this report.

Table 4.4: Noise Criteria dB(A) –Rail Noise Limits

Receiver Area	Day (7am – 10pm)	Night (10pm – 7am)
	L _{Aeq} (15hr)	L _{Aeq} (period)
All existing residential receivers	65	60

The Project Approval notes that these noise criteria do not apply if the Proponent has an agreement with the relevant owner/s of the residence or land to generate higher noise levels, and the Proponent has advised the Department in writing of the terms of this agreement.

Furthermore, by the end of July 2013, or other timing as may be agreed by the Secretary, the Proponent shall use its best endeavours to ensure that its rail spur is only accessed by:

- Locomotives that are approved to operate on the NSW rail network in accordance with noise limits L6.1 to L6.4 in RailCorp's EPL (No. 12208); and
- Trains comprising no less than 30 wagons.

In addition, the Proponent shall restrict train speeds on the Wongawilli rail spur to a maximum of 20 km/h.

5 NOISE MONITORING LOCATIONS

With consideration to the requirements of the Project Approval and the NMP, noise monitoring locations are summarised in Table 5.1 and Figure 5.1.

Table 5.1: Noise Monitoring Locations

Receiver Area Number	Description	Coordinates (MGA zone 56H)	
		Easting	Northing
RA1 a	30 Vista Parkway	293868	6183146
RA1 b	111 Smiths Lane	294095	6183327
RA2 a	18 Wongawilli Rd	294622	6182498
RA2 b	1 Wongawilli Rd	294225	6182572
RA3 a	80 Shone Ave	294884	6181794
RA3 b	Jersey Farm	294108	6181565
RA4 a	66 Ritchie Crescent	296299	6182088
RA4 b	61 Huxley Drive	296430	6182008

The rail noise monitoring location utilised during September 2016 monitoring is indicated in Figure 6.2. Monitoring was undertaken at a location representative of 441 West Dapto Road.

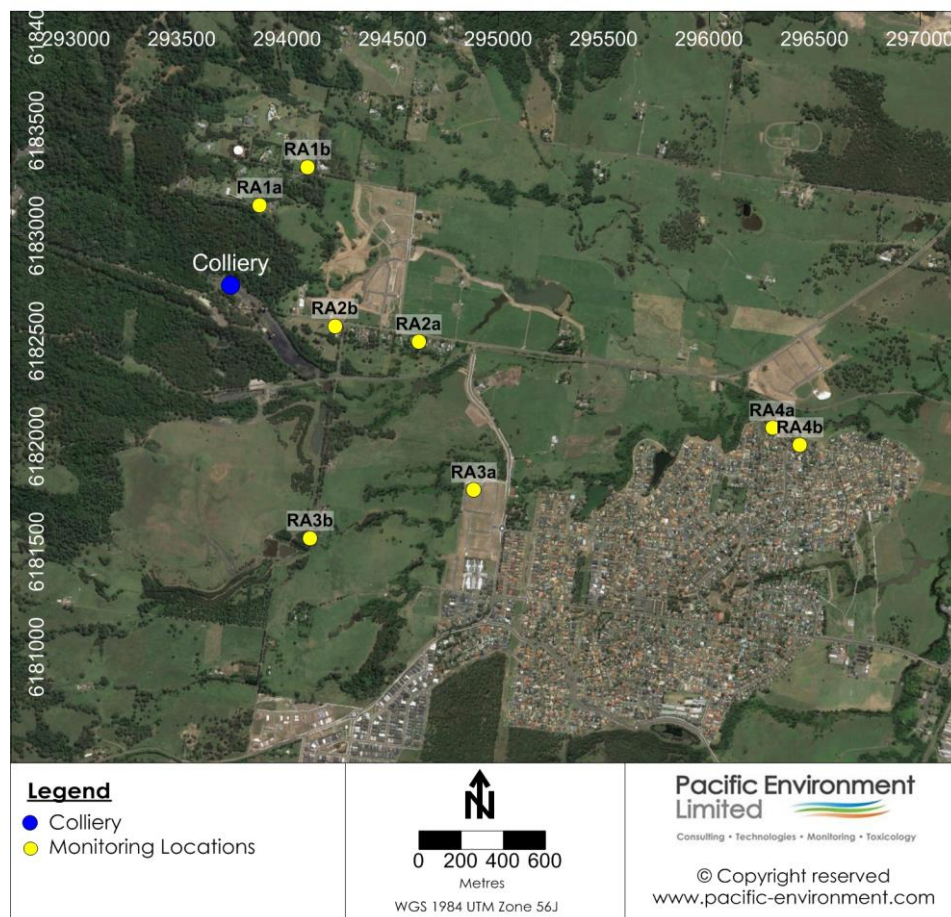


Figure 5.1: NMP monitoring Locations

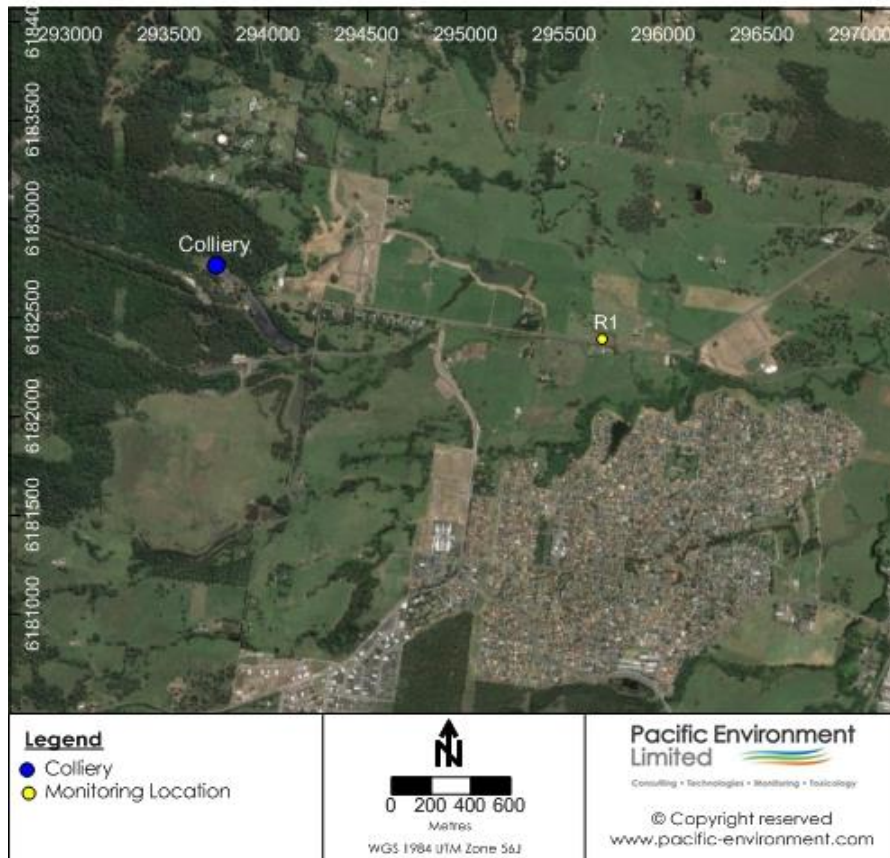


Figure 5.2: Rail Noise Monitoring Location

6 PROJECT OPERATIONS

Project operations were observed during the measurement period to include underground operations and product loadout. Fixed mechanical plant operating included continuous operation of:

- Syntron in the Transfer House at Pit Top,
- Screen and sizer building operation,
- Conveyor and conveyor drive head operation.

During the day time period loading of coal into trains also occurred. Mobile plant was also operating in the stockpile area.

7 MEASUREMENT METHODOLOGY

Attended noise compliance measurements were carried out with reference to the NSW INP (EPA, 2000) and Australian Standard AS 1055:1997. Rail noise measurements were completed with consideration to Australian Standard AS 2377:2002 and the NSW EPA, Rail infrastructure Guideline (2013).

7.1 Operational Noise

15-minute operator attended measurements were carried out at the 4 receiver locations nominated in the Project Approval and shown in Table 4.1, during the day, evening and night periods.

The meteorological conditions were observed during attended noise monitoring. Monitoring data collected at the project's automatic weather station (AWS) was also reviewed to confirm observations.

Wind conditions were estimated onsite using an anemometer and verified using data from the onsite weather station (AWS). The potential for temperature inversions to be present was estimated using the sigma-theta method (Appendix E4 of the INP) using data from the on-site AWS. Stability classes of F or G are considered to be indicative that strong temperature inversions are present.

Measurements were carried out on 20 and 21 September 2016 utilising two NTi Audio XL2 type 1 Sound Level Meters (serial numbers A2A-06985-E0 and A2A-06883-E0). Calibration was checked before and after measurements using a Svantek SV31 acoustic calibrator (serial number 38120). No significant drift (± 0.5 dB) was noted.

The weather conditions were observed to be generally suitable for noise monitoring and in accordance with those specified in the Project Approval. Observations from the onsite AWS indicated that inversion conditions were not present during the monitoring period.

Operator attended measurements quantified the contribution from the Project using a combination of measured levels, onsite observations and third octave frequency analysis, where appropriate.

For the determination of compliance, Section 11.1.3 of the NSW INP states the following:

A development will be deemed to be in non-compliance with 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 condition.

Therefore non-compliance will be reported where the noise level from the Project is determined to be at least 2 dB above the nominated criteria.

Where applicable, adjustments have been made for annoying characteristics such as tonality, impulsiveness and low frequency noise as defined in the INP.

The $L_{A1,15min}$ represents the level exceeded for 1% of the measurement time. In this case, 1% of the measurement time is 9 seconds. It is considered that the L_{A1} in addition to the L_{Amax} of the measurement are taken into account in addition to observed levels to provide an indication of short duration high noise level events that contribute to the potential for sleep disturbance.

7.2 Rail Noise

Unattended measurements were carried out between 20 and 27 September 2016, utilising Acoustic Research Laboratory's Ngara Real Time Sound Acquisition System (Serial Number: 8780f3). Continuous Audio and sound pressure level data was collected over the monitoring interval.

The logger was located in the free field at a similar set back distance from the rail spur as the façade of 441 West Dapto Road, approximately 20 m from the rail line.

Train passby events were identified in the collected data, then post processed to calculate passby sound exposure levels (SEL) for each event. Period noise levels were calculated from the event SEL's.

Where identified in the collected audio data, extraneous noise was removed from the passby event.

The meteorological conditions observed during the unattended noise monitoring were generally satisfactory for noise monitoring based on data collected at the onsite automatic weather station.

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8 MONITORING RESULTS

8.1 Colliery Operational Noise

The results of the operator attended measurements are presented in Table 7.1 for $L_{Aeq,15min}$ criteria and Table 7.2 for $L_{A1,1min}$ criteria. All values are in dB(A).

Table 8.1: Attended Measurement Results (L_{Aeq} Noise Levels)

Receiver	Time	Period	Criteria $L_{Aeq,15min}$ dB(A)	Weather	Measured Noise Level $L_{An,15min}$ dB(A)			Estimated Contribution from Project $L_{Aeq,15min}$ dB(A)	Complies	Notes
					L_{Aeq}	L_{A10}	L_{A90}			
RA1a	20/09/16 15:41	Day	43	0.5-1 m/s E	64	63	47	<35	Yes	Construction noise from nearby earthworks and birds constant @ 51. Occasional plane flyover @ 35-40. Truck manoeuvring nearby @ 50-65 for 5 minutes. Occasional car passbys @ 55. Site inaudible.
RA1b	20/09/16 16:05	Day	43	2 m/s E	50	53	38	<38	Yes	Construction noise from nearby earthworks and birds constant @ 45-48. Distant traffic on Wongawilli Road @ 40. Frequent car passbys @ 70. Site inaudible during lulls in construction traffic (background 38-40).
RA1a	20/09/16 17:30	Day	43	Overcast	51	43	44	<44	Yes	Dogs and distant traffic constant @ 42-44. Intermittent birds. Aircraft @ 45-50. Continuous traffic on road. Site inaudible.
RA2b	20/09/16 14:54	Day	44	0.5-1.3 m/s E	61	57	49	<39	Yes	Construction noise from nearby earthworks constant @ 55. Birds constant in background @42, distant traffic occasionally audible @ 39. Occasional dog barking. Site inaudible.
RA2a	20/09/16 15:16	Day	44	1.9-2 m/s E	61	65	41	<40	Yes	Frequent car passbys 60-75. Distant traffic and birds audible @ 42. Excavators from nearby construction intermittent @ 40. Site inaudible.
RA3b	20/09/16 16:55	Day	40	Nil winds, light cloud	46	46	39	33	Yes	Insects and distant traffic @ 42. Truck and car passbys @ 42-43. Distant dog barking occasionally. Birds and distant traffic @ 38-40. Slight hum audible from site audible @ 33 when background < 38. Crickets audible after 10 min @ 50-55. Construction noise @ 35-36.
RA1b	20/09/16 20:57	Eve	43	Overcast	48	36	37	<36	Yes	Distant traffic, frogs audible @ 36-37. Train audible in distance. Plane flyover. Site inaudible.
RA1a	20/09/16 21:20	Eve	43	Overcast	39	31	33	<35	Yes	Site just audible @ background. Frogs and distant traffic audible @ 35-37. Distant traffic peaks at 35-38.

Receiver	Time	Period	Criteria L _{Aeq,15min} dB(A)	Weather	Measured Noise Level L _{An,15min} dB(A)			Estimated Contribution from Project L _{Aeq,15min} dB(A)	Complies	Notes
					L _{Aeq}	L _{A10}	L _{A90}			
RA2a	20/09/16 20:57	Eve	43	Calm	51	58	34	35	Yes	Distant traffic and cicadas audible @ 35. Car passbys frequent @ 65-70. Dog barking and animal noises @ 42-45. Plane overhead @ 46. Hum just audible @ 32-35 during lulls.
RA2b	20/09/16 21:17	Eve	43	0.5 m/s SW	39	49	35	33-36	Yes	Insects and cicada noise constant, industrial noise including site to east @ 34-35. Intermittent dog barking @ 40. Dozer / excavator tracking just audible @ 36. Impact noise audible several times (product hitting bin / loadout) for 2 sec @ 38-40. Screen and Sizer noise audible @ 36. Constant processing noise audible @ 32-33. Car passbys audible @ 38.
RA3b	20/09/16 21:38	Eve	40	Calm, light cloud cover	41	39	35	33-34	Yes	Constant cicada noise and mine hum @ 35-38. Distant traffic audible @ 38. Cicadas dominant @ 38-40. During lulls site audible @ 33-34. Cicadas increased towards end of measurement to 38-41.
RA3a	20/09/16 21:43	Eve	40	Overcast	69	37	41	<35	Yes	Frogs audible @ 37-40. Intermittent car passbys, site just audible. Estimated site contribution of < 35.
RA1b	20/09/16 23:58	Night	43	Light W wind	43	32	34	32-34	Yes	Distant industrial noise, insect noise @ 33-36. Mechanical plant noise or similar from site @ 32-34. Car passbys 42-43. Distant cars @ 42-45.
RA1a	21/09/16 0:22	Night	43	Light W wind	42	30	34	30	Yes	Constant mechanical noise from site, insects and distant traffic @ 29-30. Plane flyover @ 45. Distant train @ 30-38 for 2-3 min.
RA2a	20/09/16 23:55	Night	43	Calm, light sprinkle of rain. 8/8 cloud	41	53	33	32	Yes	Cicadas and constant mine hum @ 32-33. Occasional dog bark, rural noise. Cicadas constant @ 32. Occasional car passby @ 60. Distant cars, constant site mechanical hum @ 32. Constant hum @ 31.
RA2b	21/09/16 0:14	Night	43	1.5 m/s E wind at start, calm at end. 8/8 cloud	35	35	33	33	Yes	Distant traffic, cicadas and constant mine mechanical hum @ 33-34. Hum and cicadas @ 32. Occasional car @ 33. Constant mechanical hum @ 32. Constant hum @ 31. Impact noise once for 2 sec @ 36.
RA3b	21/09/16 0:35	Night	38	0.8-1 m/s W wind. 8/8 cloud	42	41	34	34	Yes	Constant cicada noise and mine hum @ 37-38. Cicadas increasing to 32-33. During lulls site audible @ 33-34. Distant dog barking @ 38.

Receiver	Time	Period	Criteria L _{Aeq,15min} dB(A)	Weather	Measured Noise Level L _{An,15min} dB(A)			Estimated Contribution from Project L _{Aeq,15min} dB(A)	Complies	Notes
					L _{Aeq}	L _{A10}	L _{A90}			
RA3a	21/09/16 0:47	Night	38	Overcast	40	33	35	34	Yes	Constant insect noise, mine noise and traffic / rail noise @ 34-35. Mechanical noise audible @ 35-36.

Notes: All noise levels are rounded to the nearest whole decibel.

Table 8.2: Attended Measurement Results (Sleep Disturbance)

Receiver	Criteria L _{A1,1min} dB(A)	Measured Levels L _{A1,1min} dB(A) L _{A1}	Estimated Contribution from Project L _{A1,1min}	Complies	Notes
RA1a	59	35	<35	Yes	Site source generally steady state mechanical noise, no detectable peak events
RA1b	59	35	<35	Yes	Site source generally steady state mechanical noise, no detectable peak events
RA2a	60	63	<35	Yes	Site source generally steady state mechanical noise, no detectable peak events. Measured peaks not site related
RA2b	60	41	36	Yes	Site source generally steady state mechanical noise, no detectable peak events
RA3a	48	46	<35	Yes	Site source generally steady state mechanical noise, no detectable peak events
RA3b	48	36	<35	Yes	Site source generally steady state mechanical noise, no detectable peak events

Notes: All noise levels are rounded to the nearest whole decibel.

8.2 Rail Spur Noise

The results of the rail noise measurements at rail receiver location R1 are presented in Table 8.1 for $L_{Aeq,period}$ criteria. All values are in dB(A).

Table 8.3: Rail Noise events (L_{Aeq} Noise Levels)

Location	Date	Time (hh:mm)	Duration	LAE ¹	Rail Noise Level L_{Aeq} period	Criteria	Complies
R1	21-Sep	08:01	217	93	56 L_{Aeq} 15hr	65	Yes
R1	21-Sep	08:31	282	99			
R1	21-Sep	12:38	195	93			
R1	22-Sep	14:11	242	95	50 L_{Aeq} 15hr	65	Yes
R1	23-Sep	09:48	232	93	54 L_{Aeq} 15hr	65	Yes
R1	23-Sep	14:17	84	96			
R1	25-Sep	10:03	129	92	54 L_{Aeq} 15hr	65	Yes
R1	25-Sep	14:33	212	97			
R1	26-Sep	11:52	160	92	51 L_{Aeq} 15hr	65	Yes
R1	26-Sep	16:42	156	93			
R1	27-Sep	10:57	193	95	57 L_{Aeq} 15hr	65	Yes
R1	27-Sep	14:09	167	97			
R1	27-Sep	18:24	255	96			

Notes: Rail noise levels are corrected to a façade level (+2.5 dB) All results are rounded to 1 dB.

1: LAE is sound exposure level for each individual passby event is the measured free field noise level.

9 DISCUSSION

9.1 Operational Colliery Noise

The Project was generally inaudible during the daytime period, except one measurement at one location in RA3. During the day period, slight mechanical hum was audible and estimated at 33 dB(A) at location RA3b.

During the evening period, Wongawilli Colliery was generally inaudible at receivers within RA1, with one observation of site noise just above background at RA1a. Site contributions of up to 36 dB(A) were observed at receivers in RA2 and RA3. Mechanical hum was audible at locations RA2 and RA3, and noise from dozer /excavator tracking audible. Impact noise from product loadout or screening the conveyor was observed at one location in RA2.

During the night time period, site contributions were audible up to 34 dB(A) at receivers within RA1, RA2 and RA3. Site noise levels during the night time periods were found to be below the relevant sleep disturbance limits for all locations, where identified. Mechanical plant noise was again observed at locations RA1 and RA2.

During the night time period, no short duration high noise level events were identified. No annoying characteristics were observed during measures which would trigger the application of modifying factors as defined in Chapter 4 of the INP.

9.2 Rail Spur

Measured rail noise levels representative of 441 West Dapto Road were below the day time noise limit of 65 dB(A) for monitoring undertaken between 22nd and 27th September 2016. No night time train passbys occurred during the monitoring period.

10 STATEMENT OF COMPLIANCE

Pacific Environment has completed operational noise compliance monitoring for Wongawilli Colliery. Measurements were completed at four (4) locations representative of residential areas (RA1 to RA3), and demonstrated that measured noise levels are below relevant noise limits for all periods.

Project operations were inaudible at all locations during the day period, except one measurement at one location in RA3 where the site contribution was estimated at 33 dB(A).

During the evening period, Wongawilli Colliery was inaudible at receivers within RA1. Site contributions of up to 36 dB(A) were observed at receivers in RA2 and RA3.

During the night time period, site contributions were audible up to 34 dB(A) at receivers within RA1, RA2 and RA3. Maximum site noise levels during the night time periods were found to be below the relevant sleep disturbance limits for all locations, where identified.

No annoying impulsive, low frequency or tonal characteristics were observed from the Project at locations.

Rail noise levels at the selected monitoring location representative of a residence on West Dapto Road were within the day time rail noise limit of L_{Aeq} 65 dB(A) (7am to 10pm). No passby events occurred during the night time period.

11 CONCLUSION

Pacific Environment conducted operational compliance noise monitoring at Wongawilli Colliery on 20 and 21 September 2016 during typical operations. This involved the completion of attended noise measurements at four (4) locations during the day, evening and night periods as required by the Project Approval.

The assessment was conducted according to current guidelines, standards and assessment methods.

The compliance monitoring found that the Project is operating within its required noise limits. Project operations were inaudible at all locations during the day period, except one measurement at one location in RA3 where the site contribution was estimated at 33 dB(A). During the evening and night periods, where the project was audible, contributions were less than 36 dB(A) and 34 dB(A) during evening and night periods respectively at all monitoring locations.

No annoying impulsive, low frequency or tonal characteristics were observed from the Project at locations.

Maximum site noise levels during the night time periods were found to be below the relevant sleep disturbance limits for all locations, where identified.

Rail noise was measured at a residence located adjacent the rail spur on West Dapto Road between 22nd and 27th September. Measured rail noise levels were below the rail noise limit of 65 dB(A) day time on each day of monitoring. No night time rail passby events were observed in the collected noise data.

Therefore compliance has been demonstrated at all monitoring locations for all periods.

Appendix A

APPENDIX A – GLOSSARY OF TERMS

Term	Description
Adverse weather	Weather conditions that affect noise measurements (wind, rain and temperature inversions) that occur at a particular site for a significant period of time. The maximum wind speed allowed during acoustics measurements are in process is 5m/s. No rain is allowed.
Ambient noise	The all-encompassing noise environment at a given location, made up of many sources in the near and far field.
Assessment period	The period in a day over which assessments are made.
A-weighting	Adjustment made to a noise level based on international standards. Approximates a human's hearing response to frequency at lower sound levels.
Background noise	Background noise is the term used to describe the underlying level of noise present in an area, measured in the absence of any extraneous noise. Typically when measured with a sound level meter is measured statistically as the A-weighted noise level exceeded for ninety percent of a sample period ($L_{A90,T}$).
dB	Decibel, the logarithmic ratio of a given sound pressure to a reference pressure.
dB(A)	A-weighted decibels.
Free-field	A sound field where the effects of reflection are negligible throughout the region of interest.
Frequency	The number of cycles per unit of time. It is measured with cycles per second (cps) or the interchangeable Hertz (Hz). Frequency can be associated as a synonymous to pitch.
Intermittent noise	Level that drops to the background noise level several times during the period of observation.
Heavy vehicle	A truck or other vehicle with either two or three axles, two groups or three or more axles, more than two groups.
Light vehicle	Passenger vehicles (cars, vans, utilities, motorcycles etc.).
$L_{A1,T}$	The noise level exceeded for 1% of the time period, T.
$L_{A10,T}$	The noise level exceeded for 10% of the time period, T.
$L_{A90,T}$	The noise level exceeded for 90% of the time period, T. Commonly referred to as the background noise level.
$L_{Aeq,T}$	The equivalent average noise level of the time period, T. It represents in a single number, the energy of the actual fluctuating noise level over the period.
$L_{Amax,T}$	The maximum noise level measured during the period, T.
RBL	Rating Background Level. The background noise level as defined by the NSW Industrial Noise Policy (EPA, 2000). It is calculated by the taking the median value of the lowest 10th percentile L_{A90} measurements in any day, evening or night period.
Sound Pressure Level (SPL)	Is the difference between the pressure produced by a sound wave and the barometric (ambient) pressure at the same point in space. Typically expressed in decibels, as measured by a standard sound level meter with a microphone.
Sound Power Levels (L_w)	Ten times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power. Typically associated with noise sources.