



DM McMahon Pty Ltd
ENVIRONMENTAL CONSULTANTS

Environmental Noise Monitoring

**Hanson Quarry
Wagga Wagga, NSW**

October 2012

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1. Introduction

DM McMahon Pty Ltd has been engaged by Hanson to undertake a noise monitoring on neighbouring properties of a quarry located at Wagga Wagga NSW. Noise monitoring and subsequent assessment was undertaken by reference to the New South Wales Environment Protection Authority, Industrial Noise Policy (INP).

The assessment entailed a monitoring program to evaluate ambient and background noise over a 7 day period and monitoring on an attended basis as per the supplied specifications, table 1. The ambient noise levels have been compared to the INP Amenity Criteria for residences in rural areas. The background levels have been assessed to be used as a benchmark level if any future noise monitoring is to be carried out.

Table 1: Noise monitoring specifications

Type	Timing	Location	Duration	Person
Unattended Noise Monitoring	At commencement of each stage of the development	Nominated sensitive receivers	7 days (site must be operating normally during the monitoring period).	Person suitably experienced and qualified to conduct noise monitoring
Operator Attended Monitoring	At commencement of each stage of the development	Nominated sensitive receivers	Minimum of two 15 minute periods during hours of operation (site must be operating normally during the monitoring period).	Person suitably experienced and qualified to conduct noise monitoring

2. Unattended Noise Monitoring

Noise levels were recorded from Tuesday 16 October 2012 to 23 October 2012. The noise loggers were set up on the residences 'Kullaroo', 'Sweetwater', 'Riverglen' and on the farming block 'Riverbend'. All locations are located to the North and East of existing and planned quarry operations across the Murrumbidgee River. The monitoring was carried out to assess the ambient noise conditions. The locations of the noise loggers in relation to the quarry operations can be seen in figure 1 on the following page.

During the monitoring period quarry operations were normal. On weekdays work times are 6:30am to 5:30pm with quarrying activities usually taking place from 7am to 5:30pm due to a morning toolbox talk and prestart checks. Maintenance was carried out at the quarry from 6am to 1:30pm on Saturday, with minimal truck and machinery movements during this time as has been typical of Saturday work during recent months. There were no quarrying or maintenance activities on Sunday.

The noise loggers used were the Acoustic Research Laboratories (ARL) Environmental Noise Logger NL-42 EX. All Levels are A-weighted. An A-weighting is a sound level meter fitted with an electronic filter that has a frequency response similar to that of human hearing. The A-weighting is sensitive to sounds at 500 Hz to 4000 Hz and is expressed as dBA. A change in sound level of under 3dBA is minor whilst a 10dBA change corresponds to a doubling or halving in loudness. The meters were set to have sample periods at 15 minute intervals. All meters were calibrated at ARL prior to use. The equipment calibration was checked before and after the survey and no significant drift occurred.

Meteorological data for the relevant periods was obtained from the nearest weather station at Wagga Wagga AMO (station 072150). Periods in which extended rainfall was noted was excluded from analysis, in accordance with principles of the INP.



Figure 1: Map of noise loggers and quarry operations

Sound levels sample periods are set at the rate of 10 per second and the instrument stores the L_{Aeq} , L_{Amax} , L_{A1} , L_{A5} , L_{A10} , L_{A50} , L_{A90} , L_{A95} and the L_{Amin} levels. L_{A90} is the most important level for background assessment as it records the noise level exceeded for 90% of the sample period and this has been taken to be the assessment background level which represents the background noise. During a 15 minute period this would represent the quietest 90 seconds. By reference to the INP the background noise was determined. The following table is based on table 3.1 from the INP, Methods for determining background noise.

Table 2: Methods for determining background noise

Features	Method
	Long-term
When to use	During planning and approval stage where there is significant potential for noise impact
Type of monitoring	Continuous sampling accompanied by periods of operator-attended monitoring
Length of monitoring	Equivalent to one week's worth of valid data covering the days and times of operation of the development
Conditions for monitoring	Average wind speed < 5 m/s, no rain, no extraneous noise
Monitoring location	Most or potentially most affected noise-sensitive location/s
Assessment time periods	Day (0700–1800) Evening (1800–2200) Night (2200–0700)
Base measure	LA90,15 minute
Analysis method	Determine the assessment background level for each day, evening and night by using the tenth percentile method. The rating background level is the median assessment background level over all days for each period.

3. Existing Background Noise Levels

By reference to the INP, the Assessment Background Level (ABL) has been established. The ABL by definition from the INP is: The single-figure background level representing each assessment period – day, evening and night (that is three assessment background levels are determined for each 24-hour period of the monitoring period). The ABL is determined by calculating the lower 10 percentile level of all $L_{A90, 15\text{minute}}$ samples for each assessment period. The following tables present the calculated ABLs.

Table 3: Summary of the L_{A90} Assessment Background Levels – Kullaroo

	Date	Day	Evening	Night
Tuesday	16/10/12	30*	32	28
Wednesday	17/10/12	32	31	29
Thursday	18/10/12	30	34	28
Friday	19/10/12	29	32	27
Saturday	20/10/12	33	31	22
Sunday	21/10/12	31	31	25
Monday	22/10/12	33	29	22
Tuesday	23/10/12	35*	-	-

*Denotes incomplete monitoring period.

Table 4: Summary of the L_{A90} Assessment Background Levels – Sweetwater

	Date	Day	Evening	Night
Tuesday	16/10/12	30*	33	27
Wednesday	17/10/12	33	33	28
Thursday	18/10/12	30	29	26
Friday	19/10/12	30	33	28
Saturday	20/10/12	34	32	25
Sunday	21/10/12	34	30	25
Monday	22/10/12	35	32	24
Tuesday	23/10/12	37*	-	-

Table 5: Summary of the L_{A90} Assessment Background Levels – Riverglen

	Date	Day	Evening	Night
Tuesday	16/10/12	31*	32	29
Wednesday	17/10/12	36	39	29
Thursday	18/10/12	29	29	27
Friday	19/10/12	28	32	26
Saturday	20/10/12	34	32	23
Sunday	21/10/12	34	32	27
Monday	22/10/12	32	31	23
Tuesday	23/10/12	32*	-	-

*Denotes incomplete monitoring period.

Table 6: Summary of the L_{A90} Assessment Background Levels – Riverbend

	Date	Day	Evening	Night
Tuesday	16/10/12	31*	40	30
Wednesday	17/10/12	37	39	29
Thursday	18/10/12	29	29	28
Friday	19/10/12	29	28	26
Saturday	20/10/12	35	33	23
Sunday	21/10/12	35	34	27
Monday	22/10/12	33	33	23
Tuesday	23/10/12	32*	-	-

*Denotes incomplete monitoring period.

The INP introduces an additional measurement metric called the Rating Background Level (RBL), which by definition to the INP is: The overall single-figure background level representing each assessment period (day/evening/night) over the whole monitoring period (as opposed to over each 24-hour period used for the assessment background level). The RBL is the level used for assessment purposes. Where the rating background level is found to be less than 30 dBA then is set at 30 dBA. The RBLs for the site can be seen in the following table 7.

For the short term method the RBL is simply the measured L_{A90 15 minute} level. For the long-term method, the rating background level is defined as the median value of:

- all the day assessment background levels over the monitoring period for the day;
- all the evening assessment background levels over the monitoring period for the evening; and
- all the night assessment background levels over the monitoring period for the night.

“Median’ is the middle value in a number of values. For an odd number of values, the value of the median is simply the middle value in a number of values ranked in ascending or

descending order. For an even number of values, the median is the arithmetic average of the two middle values.

Table 7: Summary of the L_{A90} Rating Background Levels

Logger	Day	Evening	Night
Kullaroo	31	31	27
Sweetwater	33	32	26
Riverglen	32	32	27
Riverbend	32	33	27

The RBLs are a baseline assessment of noise on the site with extraneous interference removed. They can be used as a benchmark level if any future noise monitoring is to be carried out.

4. Existing Ambient Noise Levels

Existing ambient noise levels (L_{Aeq}) have been determined for the assessment period. In determining the existing L_{Aeq} noise level, a representative level has been obtained. Hence the L_{Aeq} noise level calculation as defined by the INP has been adhered to. The levels provided are the logarithmic average of the individual L_{Aeq} 15 minute levels for each day/evening/night assessment period as per the INP. The L_{Aeq} by reference to the INP is: The equivalent continuous noise level – the level of noise equivalent to the energy-average of noise levels occurring over a measurement period. The equivalent continuous noise level is: The level of noise equivalent to the energy average of noise levels occurring over a measurement period. The L_{Aeq} is defined as the steady sound level that contains the same amount of acoustical energy as a given time-varying sound. This is basically the average ambient noise level. The following tables outline the logarithmic average of the L_{Aeq} levels recorded on site and the following figures shows the 15 minute data presented graphically.

Table 8: Summary of the L_{Aeq} Ambient Noise Levels – Kullaroo

	Date	Day	Evening	Night
Tuesday	16/10/12	39*	44	35
Wednesday	17/10/12	44	39	35
Thursday	18/10/12	42	44	35
Friday	19/10/12	41	41	37
Saturday	20/10/12	43	40	34
Sunday	21/10/12	43	38	32
Monday	22/10/12	45	38	30
Tuesday	23/10/12	46*	-	-
Median		43	40	35

Table 9: Summary of the L_{Aeq} Ambient Noise Levels – Sweetwater

	Date	Day	Evening	Night
Tuesday	16/10/12	46*	43	38
Wednesday	17/10/12	47	44	38
Thursday	18/10/12	48	43	36
Friday	19/10/12	44	45	38
Saturday	20/10/12	49	43	37
Sunday	21/10/12	48	41	35
Monday	22/10/12	50	42	38
Tuesday	23/10/12	51*	-	-
Median		48	43	38

Table 10: Summary of the L_{Aeq} Ambient Noise Levels – Riverglen

	Date	Day	Evening	Night
Tuesday	16/10/12	48*	48	41
Wednesday	17/10/12	48	53	38
Thursday	18/10/12	44	42	36
Friday	19/10/12	45	48	38
Saturday	20/10/12	49	42	35
Sunday	21/10/12	49	43	37
Monday	22/10/12	46	40	34
Tuesday	23/10/12	49*	-	-
Median		48	43	37

*Denotes incomplete monitoring period.

Table 11: Summary of the L_{Aeq} Ambient Noise Levels – Riverbend

	Date	Day	Evening	Night
Tuesday	16/10/12	46*	49	44
Wednesday	17/10/12	49	54	39
Thursday	18/10/12	46	43	36
Friday	19/10/12	45	47	37
Saturday	20/10/12	51	43	34
Sunday	21/10/12	50	44	36
Monday	22/10/12	46	42	34
Tuesday	23/10/12	49*	-	-
Median		49	44	36

*Denotes incomplete monitoring period.

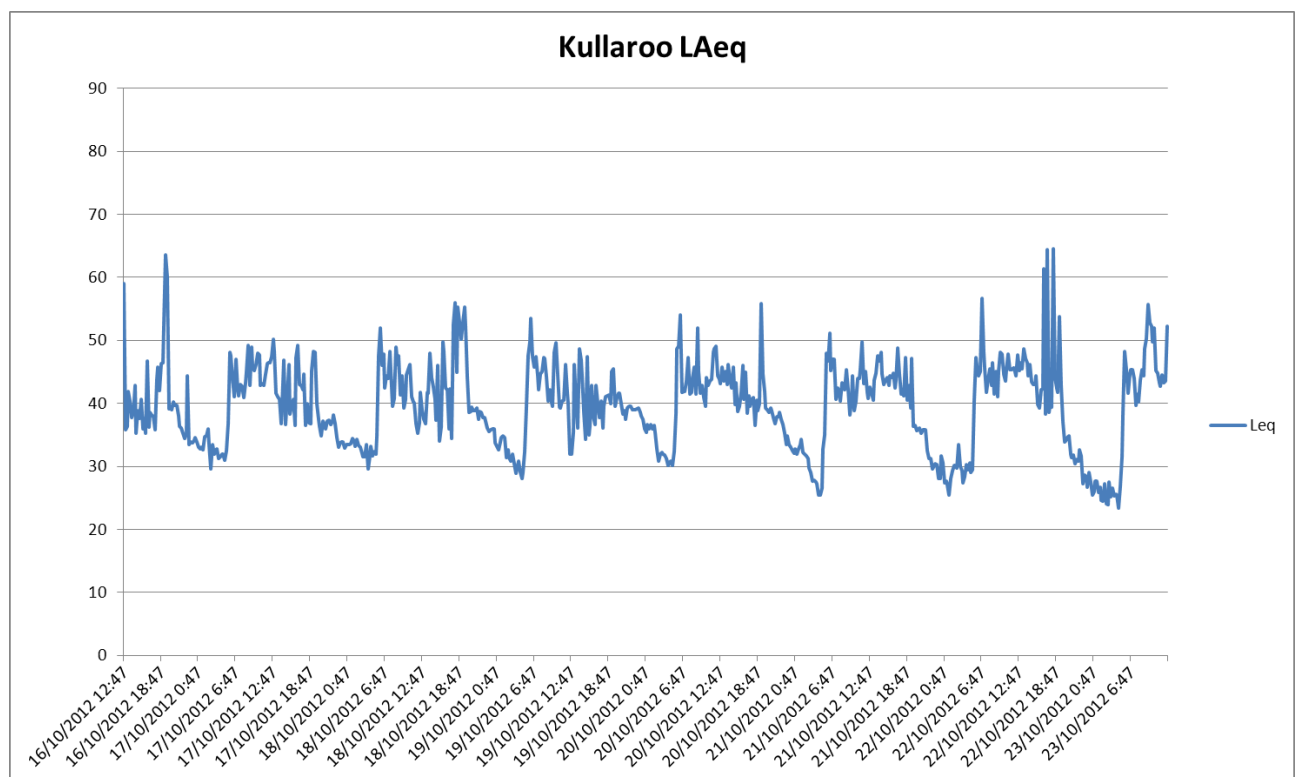


Figure 2: Kullaroo L_{Aeq} Ambient Noise Graph

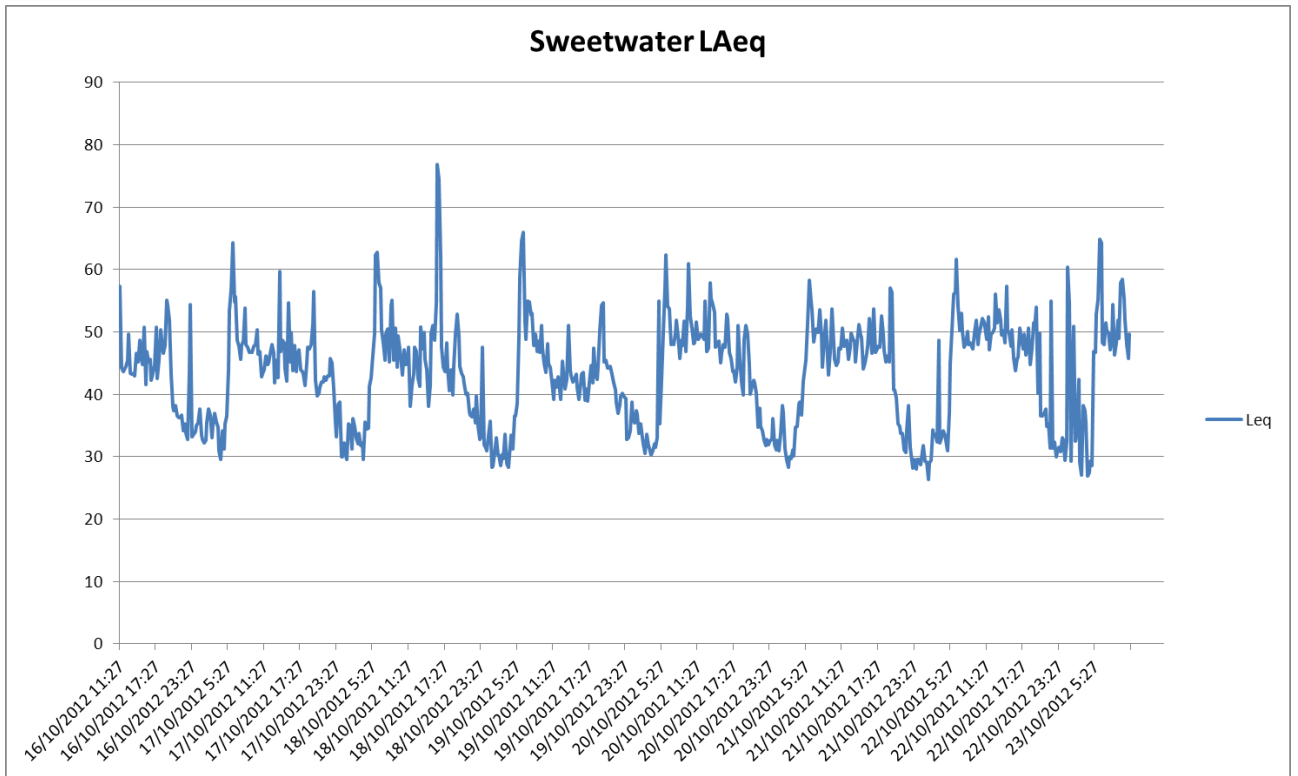


Figure 3: Sweetwater L_{Aeq} Ambient Noise Graph

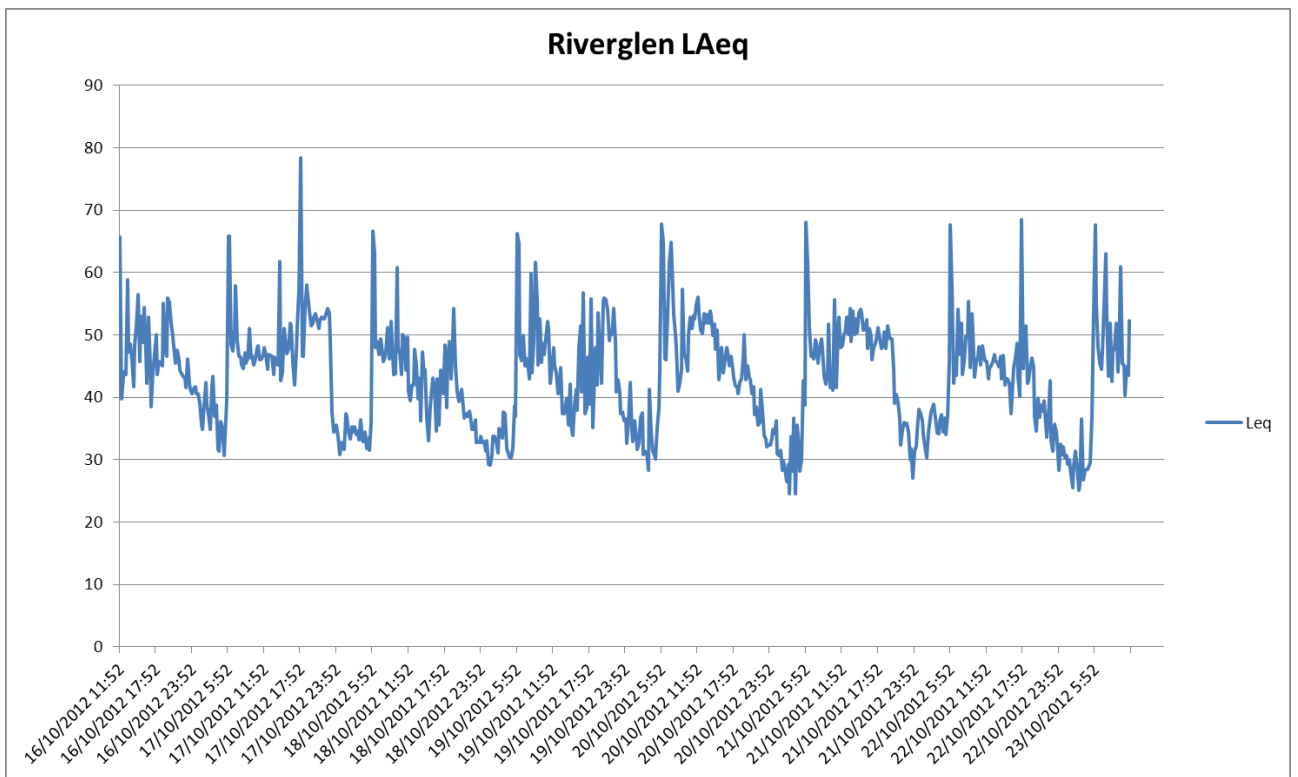


Figure 4: Riverglen L_{Aeq} Ambient Noise Graph

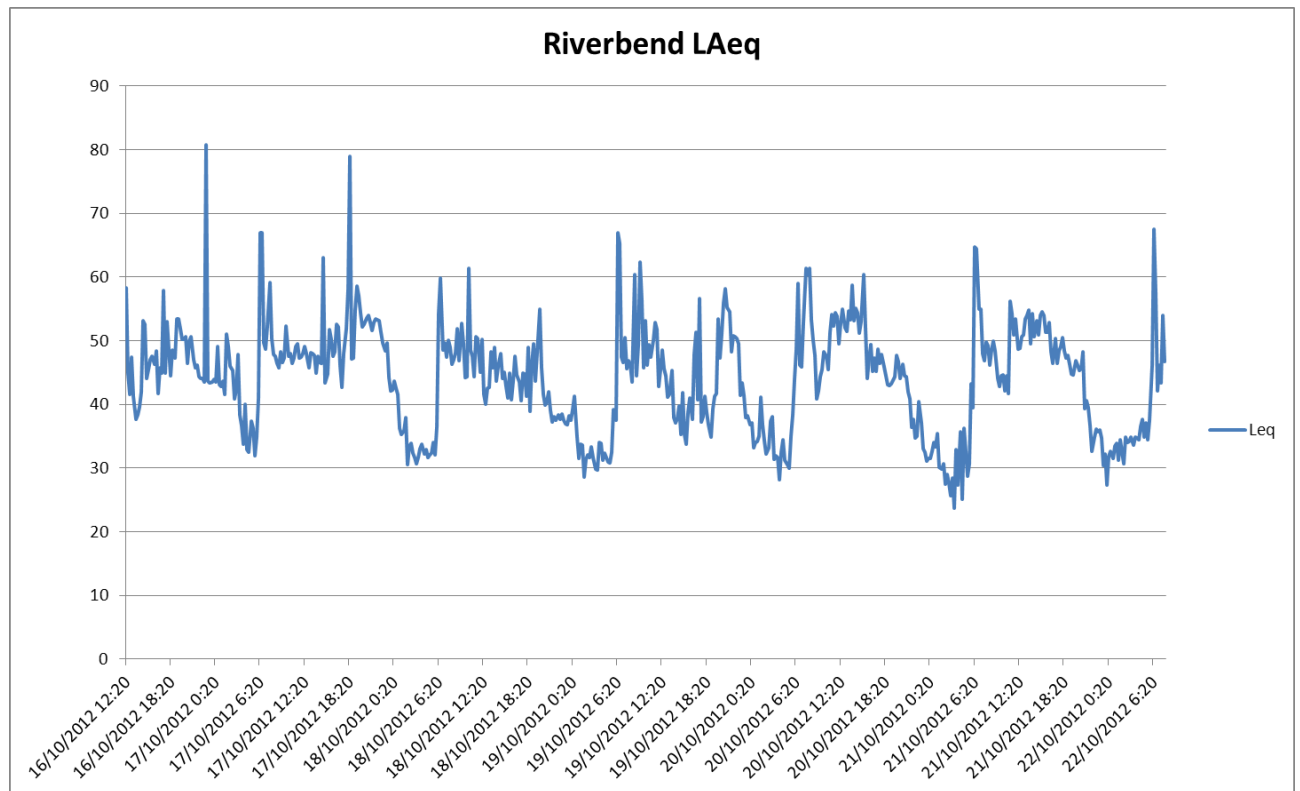


Figure 5: Riverbend L_{Aeq} Ambient Noise Graph

5. Intrusive Noise Impacts

The recommended acceptable and maximum L_{Aeq} noise levels are designed to protect the noise amenity of an area. The recommended L_{Aeq} noise level refers to the acceptable and maximum ambient noise levels for particular areas, in this case rural areas.

Ambient noise by definition from the INP is: The all-encompassing noise associated within a given environment. It is the composite of sounds from many sources, both near and far.

For the purpose of assessment the subject site has been classified as rural due to the fact that the acoustic environment is dominated by natural sounds, having little or no road traffic. Rural area noise amenity has been included in the following table for comparison.

Intrusive noise thresholds for rural residential settings (suburban, urban, rural) from the INP are outlined in table 12 as follows.

Table 12: INP Amenity Criteria

Type of receiver	Indicative Noise Amenity Area	Time of Day	Recommended L_{Aeq} Noise Level dB(A)	
			Acceptable	Recommended Maximum
Residence	Rural	Day	50	55
		Evening	45	50
		Night	40	45
	Suburban	Day	55	60
		Evening	45	50
		Night	40	45
	Urban	Day	60	65
		Evening	50	55
		Night	45	50

The INP defines Rural which satisfies the subject sites, as follows:

An area with an acoustical environment dominated by natural sounds, having little or no road traffic. Such areas may include:

- an agricultural area, except those used for intensive agricultural activities;
- a rural recreational area such as resort areas;
- a wilderness area or national park; and
- an area generally characterised by low background noise levels (except in the immediate vicinity of industrial noise sources).

The following table shows the measured ambient noise levels in comparison to the INP recommended acceptable rural amenity criteria.

Table 13: Assessment of acceptable L_{Aeq} site noise

Time of Day	Recommended L_{Aeq} Noise Level dB(A) RURAL	Kullaroo L_{Aeq}	Sweetwater L_{Aeq}	Riverglen L_{Aeq}	Riverbend L_{Aeq}
	Acceptable	Measured	Measured	Measured	Measured
Day	50	43	48	48	49
Evening	45	40	43	43	44
Night	40	35	38	37	36

The current measured ambient noise levels at all sites, in comparison to the INP Amenity Criteria, are acceptable for rural indicative noise amenity areas.

Work undertaken by Heggies Pty Ltd in 2009 (Report 10-3393-R2, 18 August 2009) which formed part of the Environmental Assessment (EA) also found similar to higher levels of ambient noise as follows, table 14:

Location	Period	Sound Pressure Level (dBA)			
		LAeq	LA1	LA10	LA90
BG-A (Kullaroo 1)	Daytime	50	55	44	29
	Night-time	45	41	37	30
BG-B (Sweetwater)	Daytime	65	64	55	38
	Night-time	58	44	41	34
BG-C	Daytime	50	49	40	27
	Night-time	41	42	34	28
BG-D	Daytime	51	57	48	33
	Night-time	43	41	38	29

Note 1: Noise levels less than 29 dBA may have a signal to noise ratio less than 5 dBA for a logger Type 1.

7. Project Specific Noise Impact Assessment Criteria

The Noise Impact Assessment Criteria (NIAC) as presented by PAE Holmes in the Wagga Wagga Quarry Noise Management Plan (Job Number 6563, 14 May 2012) is as follows:

Table 14: Noise Impact Assessment Criteria dB(A) L_{Aeq} (15 min)

Location	^a Day
Kullaroo 2	39
Riverglen	40
All other privately owned land	35

Notes:

- Receiver locations are as identified in the noise assessments presented in the EA and Addendum EA.
- Noise limits are to be measured in accordance with the relevant requirements, and exemptions (including certain metrological conditions), of the NSW Industrial Noise Policy.
- The noise limits do not apply if the Proponent has an agreement with the relevant owner/s of these residences/land to generate higher noise levels, and the Proponent has advised the Department in writing of the terms of this agreement.
- ^a Day is defined as 6:00am to 6:00pm Monday to Fridays, and 8:00am to 1:00pm on Saturdays, but does not include public holidays.

The NIAC has been developed from work undertaken by Heggies Pty Ltd in 2009 (Report 10-3393-R2, 18 August 2009) which formed part of the Environmental Assessment (EA). It is important to note that as part of the EA Heggies determined the Project Specific Assessment Criteria based on the day time being 7am to 6pm which is in line with the INP. This monitoring assessment was also undertaken by reference to the INP with day time being 7am to 6pm while the EA criterion is 6am to 6pm. The PAE Holmes Noise Management Plan recommends that monitoring be carried out at the residences of Kullaroo, Riverglen and Sweetwater and the unoccupied farming block Riverbend while the NIAC only specifically relates to Riverglen and Kullaroo, Sweetwater and Riverbend being classed as 'all other privately owned land'. Kullaroo 2 is a point in the paddock approximately 400 metres south of the Kullaroo residence where this monitoring was undertaken as recommended by PAE Holmes.

As follows is a summary of the ambient (L_{Aeq}) and background (L_{A90}) noise levels with day being defined as 6:00am to 6:00pm Monday to Fridays, and 8:00am to 1:00pm on Saturdays which is designed to reflect operation hours of the quarry, table 15.

Table 15: Assessment of Daytime Ambient Noise Levels

Location	L _{Aeq} (15 min)
Kullaroo	44
Riverglen	48
Riverbend	47
Sweetwater	49

Because the purpose of the noise monitoring is for the expansion of the quarry, the existing measured noise levels at the subject sites could be affected by the existing quarry operations and the subsequent noise it generates. During attended monitoring noise from the quarry was generally inaudible to faintly audible at the subject sites and no discernable difference in ambient noise was noted. By reference to Table 2.2 of the INP modification of the acceptable noise levels has been undertaken to account for existing level of industrial noise.

Table 16: Assessment of Daytime Ambient Noise Levels

Location	NIAC	Modified L _{Aeq} (15min)
Kullaroo	35*	≤ 44 – 10 = 34
Riverglen	40	≤ 48 – 10 = 38
Riverbend	35*	≤ 47 – 10 = 37
Sweetwater	35*	≤ 49 – 10 = 39

*All other privately owned land as per the NIAC

Therefore it can be seen that for Riverglen the modified ambient noise level is below the NIAC. Kullaroo meets the criteria for 'All other privately owned land' whilst Sweetwater and Riverbend are slightly over the NIAC.

8. Attended monitoring results

Attended monitoring was undertaken on 16 and 23 October 2013. L_{Aeq} readings were taken at 3 minute intervals over a 15 minute period and are provided below.

Table 17: Summary of the L_{Aeq} attended monitoring results

	Date	Kullaroo	Sweetwater	Riverglen	Riverbend
Tuesday	16/10/12	36.7	40.8	42.5	42.4
		38.3	38.8	39.1	39.5
		35.5	40.4	44.7	36.1
		34.9	41.4	40.2	38.7
		35.5	39.8	41.8	40.0
Mean		36.2	40.2	41.7	39.3
Tuesday	23/10/12	45.0	44.6	41.6	40.6
		39.1	45.7	39.5	44.6
		36.4	46.8	37.5	50.4
		42.5	49.2	37.9	47.8
		38.5	46.2	38.5	40.9
Mean		40.3	46.5	39.0	44.9

During the attended monitoring most noise observed was environmental noise such as the wind in the trees and birds such as kookaburras, cockatoos and galahs. At Kullaroo on 23 October 2012 some tractor noise from the surrounding farm was observed. On 16 and 23 October 2012 some faint quarry noise was observed during attended monitoring at Sweetwater, Riverglen and Riverbend with no discernable difference in ambient noise noted.

10. Weather

As follows is a representation of the weather experienced during the monitoring period at the nearest operational Bureau of Meteorology station.

Table 18: Weather conditions during the monitoring period

Daily Weather Observations for Wagga Wagga, New South Wales for October 2012

Prepared at 23:37 UTC on Thursday 25 October 2012 IDCJDW2139.201210

Copyright 2003 Commonwealth Bureau of Meteorology

Observations were drawn from Wagga Wagga AMO {station 072150}

Date	Minimum temperature (°C)	Maximum temperature (°C)	Rainfall (mm)	Evaporation (mm)	Sunshine (hours)
16/10/2012	10.9	24.8	0	4.8	2
17/10/2012	5	20.3	0	2.8	12.5
18/10/2012	3.5	25.2	0.2	6.2	11
19/10/2012	8.9	30.4	0	5	12.2
20/10/2012	8.4	26.6	0	5.2	11.9
21/10/2012	6.9	23.6	0	8	11.2
22/10/2012	5.4	20.6	0	7	12.6
23/10/2012	1.6	23.2	0	7	12.3

Date	Direction of maximum wind	Speed of maximum wind gust (km/h)	Time of maximum wind gust	9am Temperature (°C)	9am relative humidity (%)
16/10/2012	NNW	30	14:46	19.3	37
17/10/2012	WSW	31	11:39	11.5	60
18/10/2012	ENE	26	8:52	12.7	67
19/10/2012	ENE	28	17:05	16.5	64
20/10/2012	SSW	43	13:40	17.4	65
21/10/2012	W	54	14:18	14.1	69
22/10/2012	SE	46	12:55	12	55
23/10/2012	NE	37	8:38	13	41

Date	9am cloud amount (oktas)	9am wind direction	9am wind speed (km/h)	9am MSL pressure (hPa)	3pm Temperature (°C)
16/10/2012	7	N	6	1017	22.7
17/10/2012	2	WSW	17	1019.4	19.1
18/10/2012	2	ENE	15	1020.6	24.4
19/10/2012	2	ESE	13	1015.5	29
20/10/2012	1	WNW	15	1011.9	26.1
21/10/2012	7	NNW	7	1015.7	23.3
22/10/2012	0	S	19	1019.6	19.3
23/10/2012	2	ENE	24	1026.6	21.6

Date	3pm relative humidity (%)	3pm cloud amount (oktas)	3pm wind direction	3pm wind speed (km/h)	3pm MSL pressure (hPa)
16/10/2012	39	7	NE	13	1014.8
17/10/2012	31	1	SSW	19	1018.6
18/10/2012	29	7	ENE	13	1016.8
19/10/2012	22	5	NNE	6	1010.3
20/10/2012	20	3	SW	26	1011.9
21/10/2012	18	3	WSW	26	1013.7
22/10/2012	20	2	SSE	24	1020.5
23/10/2012	28	6	NNE	9	1023.6

<http://www.bom.gov.au/climate/dwo/IDCJDW2139.latest.shtml> Accessed 26 October 2012

As follows is the average wind speed recorded at the Hanson quarry weather station over 30 minute intervals. As per the INP no wind speed was over 5 m/s therefore no data was deducted.

Table 19: Wind speed during the monitoring period

