NOISE IMPACT ASSESSEMENT
FOR
BRICKWORKS LTD
780 WALLGROVE ROAD, HORSLEY PARK

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Report No: 151005_Noise_Rep_Rev5
October 2015
(Released: 6 October 2015)

Benbow
ENVIRONMENTAL

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DOCUMENT REVISION RECORD

Revision	Date	Description	Checked	Approved
1	21-05-2015	Draft / Rev 1	R T Benbow	R T Benbow
2	16-6-2015	Draft / Rev 2	R T Benbow	R T Benbow
3	17-6-2015	Draft / Rev 3	R T Benbow	R T Benbow
4	7-7-2015	Final / Rev 4	R T Benbow	R T Benbow
5	6-10-2015	Final / Rev 5	R T Benbow	R T Benbow

DOCUMENT DISTRIBUTION

Revision	Issue Date	Issued To	Issued By
1	21-05-2015	Brickworks Ltd	Benbow Environmental
2	16-6-2015	Brickworks Ltd	Benbow Environmental
3	17-6-2015	Brickworks Ltd	Benbow Environmental
4	7-7-2015	Brickworks Ltd	Benbow Environmental
5	6-10-2015	Brickworks Ltd	Benbow Environmental

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Contents Page

Tables Page

Figures Page

Attachments

1. INTRODUCTION

Benbow Environmental (BE) has been engaged by Brickworks Ltd to undertake a noise impact assessment for the proposed alterations and additions to the existing Brickworks facility located at 780 Wallgrove Road, Horsley Park.

In particular, this report details the findings of construction, operational and road traffic noise impacts from the proposed development.

The site is located in the north-eastern area of Horsley Park in the Fairfield Local Government Area. Nearest sensitive receptors (residential) were noted as being approximately 730 metres south of the proposed development's location.

Noise predictions were undertaken utilising the predictive noise modelling software, Sound Plan (v7.3).

This noise survey has been prepared in accordance with the following guidelines:

- *Department of Environment and Climate Change NSW, Interim Construction Noise Guideline (DECC 2009);*
- *NSW Environment Protection Authority, Industrial Noise Policy (EPA 2000) (INP); and*
- *Department of Environment, Climate Change and Water NSW, Road Noise Policy (DECCW 2011)(RNP).*

Based on the location of the proposed operations and our experience working with numerous industrial plants across Australia, a detailed vibration assessment is not required as the vibration impact at the nearest sensitive receptors is expected to be negligible.

A detailed description of the proposed development is provided in the Environmental Impact Statement prepared by McKenzie Group.

1.1 SCOPE OF WORKS

This noise impact assessment has been limited to the following scope of works:

a) Site inspection and review of existing and proposed site operations;
b) Undertaking of long term and short term background and ambient noise monitoring;
c) Undertaking of long term and short term road traffic noise measurements;
d) Establishment of project specific noise levels;
e) Determination of all potential noise sources associated with the operations at the subject site;
f) Collection of required noise data;
g) Prediction of potential noise impacts at the nearby noise sensitive receptors;
h) Assessment of potential noise impacts against relevant legislation and guidelines;
i) Investigate ameliorative measures/control solutions (where required); and
j) The compilation of this report containing concise statements of potential noise impact.

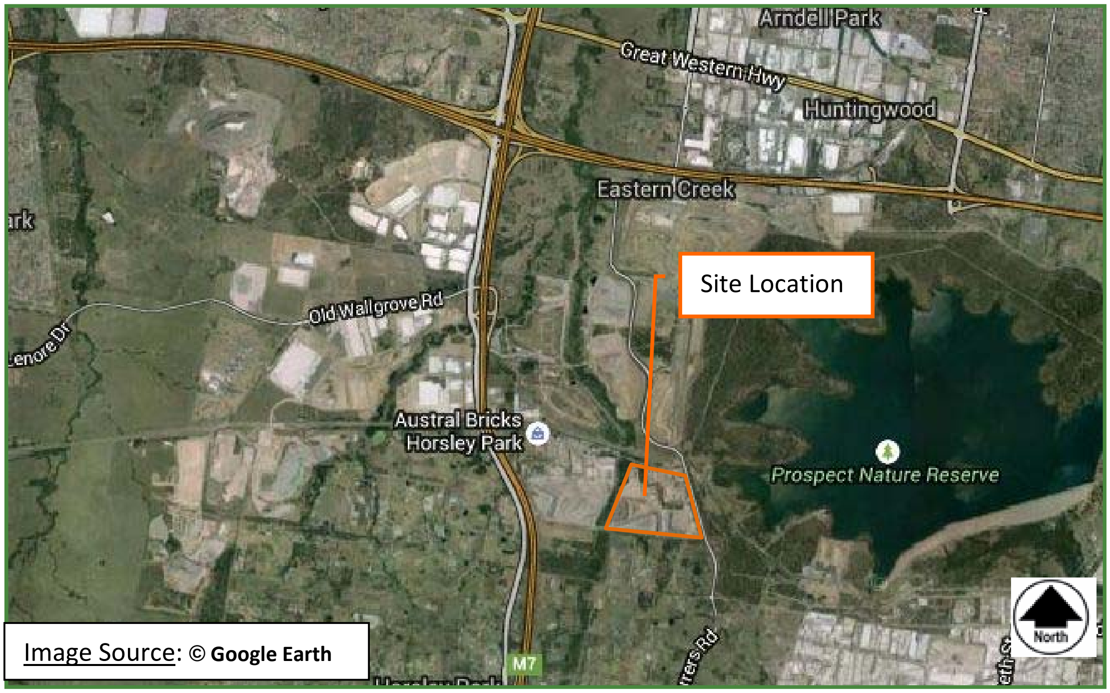
To aid in the review of this report, supporting documentation has been included within the Attachments.

2. SITE IDENTIFICATION

2.1 Site Description

The subject site is located at 780 Wallgrove Road, Horsley Park. The land is situated within the Local Government area of Fairfield City Council. The site location is shown in Figure 2-1.

Figure 2-1: Site Location



The subject site is the main brick manufacturing premises for the Austral Brick Company.

Existing clay stockpiles are present and two facilities are located at the site used for the purpose of brick manufacturing.

The site is predominately clear of vegetation due to the historical land use being quarrying and brick manufacturing.

The subject site is surrounded by the Sydney Dragway, located to the north; to the east the prospect water filtration plant and prospect nature reserve (reservoir) are present.

To the south along Chandos Road there are a number of residences, while to the west the Austral Brick Plant #1 is located.

Details of the surroundings are presented in the Environmental Impact Statement.

2.2 Proposal Description

The proposed development seeks to utilise a stockpile area on the property for the installation of 2 new kilns, a screening and crushing plant, and removal of the existing stockpiles of material and ancillary site works.

The existing Plant #2 currently operates a crusher, the existing mill and the brick factory. Two brick machines are operating within the brick factory. A conveyor is used to transport material from the crusher to the existing mill.

The proposed development includes the following:

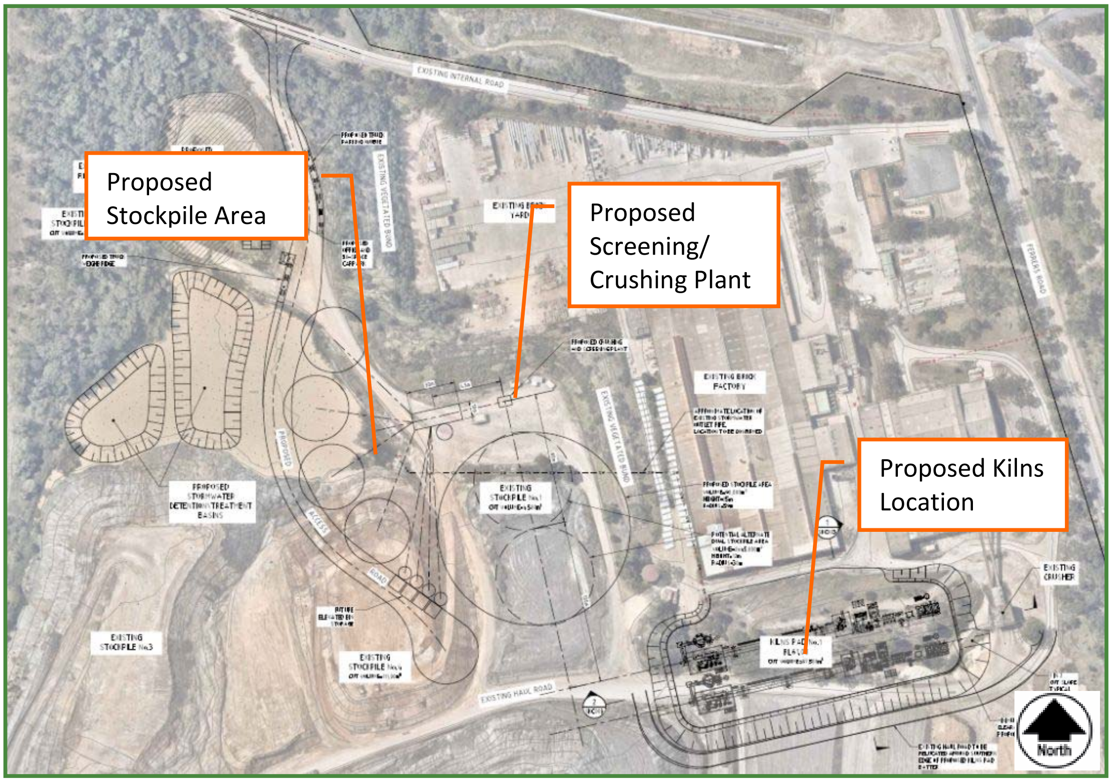
- Construction of 2 Rotary Kilns to the west of the subject site;
- Installation of a Multi Fuel Burner for the purpose of providing energy supply to the kilns;
- Solid fuel storage and preparation;
- Installation of a Crushing and Screening Plant;
- Construction of a Storage and Stockpiling area;
- Construction of internal roadways; and
- Construction of offices and amenities.

The main noise generators are associated with the crushing and screening operations and a number of fans and stacks associated with the proposed kilns operation.

Figure 2-2 shows the location of the proposed development. The proposed site layout is shown in Figure 2-3.

Figure 2-2: Proposed Development Location

Figure 2-3: Proposed Development Layout



3. NEAREST SENSITIVE RECEPTORS

Table 3-1 provides details of the nearest identified sensitive receptors that could be potentially affected by the noise impacts from the site's activities. These receptors were selected based on their proximity and directional bearing from the subject site.

The nearest residential receptor is located approximately 730 m away from the location of the proposed kilns.

The nearest sensitive receptors located to the south from the subject site are situated on large landholdings and the residences are located along Chandos Road, away from the subject site's boundary. Plant #1 is shielded by the existing stockpile. Plant #2 is partially shielded by the existing stockpile.

The location of each receptor is shown in an aerial photograph provided in Figure 3-1.

Table 3-1: Nearest Identified Sensitive Receptors

Receptor ID	Address	Direction from Site	Approximate Distance to Proposed Development	Easting (m)	Northing (m)
Residential Receptors					
R1	785-811 Wallgrove Road, Horsley Park	W	1375 m	301473	6254991
R2	763-783 Wallgrove Road, Horsley Park	WSW	1331 m	301548	6254784
R3	259-273 Chandos Road, Horsley Park	SW	1200 m	301847	6254341
R4	203-209 Chandos Road, Horsley Park	SSW	920 m	302329	6254246
R5	168-174 Chandos Road, Horsley Park	SSW	734 m	302577	6254329
R6	150-154 Chandos Road, Horsley Park	S	730 m	302695	6254293
R7	126-130 Chandos Road, Horsley Park	S	740 m	302884	6254266
R8	108-112 Chandos Road, Horsley Park	S	760 m	302960	6254250
R9	127-131 Ferrers Road, Horsley Park	SSE	1035 m	303234	6254057
Passive Recreational Areas					
PR1	Prospect Nature Reserve	ENE	490 m	303251	6255371
Industrial Receptors					
I1	21 Shale Place, Eastern Creek	NW	1880 m	301150	6255708
I2	Wallgrove Road Eastern Creek	NW	1380 m	301723	6255687
I3	Ferrers Road, Eastern Creek	N	570 m	302835	6255503
I4	Prospect Water Filtration Plant	ENE	230 m	303066	6255203
I5	33-41 Cowpasture Road, Wetherill Park	NE	1520 m	304066	6254065

Figure 3-1: Noise Monitoring Location and Nearest Sensitive Receptors

Note: R: Residential; PR: Public Recreation; I: Industry

4. EXISTING ACOUSTIC ENVIRONMENT

The level of background noise varies over the course of any 24 hour period, typically from a minimum at 3.00am to a maximum during morning and afternoon traffic peak hours. Therefore the INP requires that the level of background and ambient noise be assessed separately for the daytime, evening and night time periods. The INP defines these periods as follows:

- **Day** is defined as 7.00am to 6.00pm, Monday to Saturday and 8.00am to 6.00pm Sundays and Public Holidays;
- **Evening** is defined as 6.00pm to 10.00pm, Monday to Sunday and Public Holidays; and
- **Night** is defined as 10.00pm to 7.00am, Monday to Saturday and 10.00pm to 8.00am Sundays and Public Holidays.

4.1 MEASUREMENT LOCATION

Unattended long-term noise monitoring was undertaken by BE from 5th May 2015 to 12th May 2015 at three (3) residential locations surrounding the subject site.

The following Table 4-1 shows the logger location addresses and approximate distance from the proposed development.

Table 4-1: Long Term Monitoring Locations

Location ID	Address	Approximate Distance from Proposed Development
Residential Receptors		
Logger A	144-150 Redmayne Road, Horsley Park	1375 m
Logger B	727 Wallgrove Road, Horsley Park	1550 m
Logger C	134-154 Walworth Road, Horsley Park	1930 m

The measured noise levels have been considered as being representative of the existing background noise environment of the area in the absence of site emissions. This methodology has been adopted in accordance with the requirements included in Appendix B of the Industrial Noise Policy Application Notes.

4.2 MEASURED NOISE LEVELS

4.2.1 Long-Term Unattended Noise Monitoring Results

The data obtained was analysed to determine a single assessment background level (ABL) for each day, evening and night time period, in accordance with the INP. That is, the ABL is best established by determining the lowest tenth-percentile level of the L_{A90} noise data over each period of interest. The background noise level or rating background level (RBL) representing the day, evening and night assessment periods is based on the median of individual ABL's determined over the entire monitoring period.

The results of the long-term unattended noise monitoring are displayed in Table 4-2.

Daily noise logger graphs have been included in the Attachments.

Table 4-2: Unattended Noise Monitoring Results, dB(A) – Logger A - 144-150 Redmayne Road, Horsley Park

Date	Average L_1			Average L_{10}			ABL (L_{90})			L_{eq}		
	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night
5/05/2015	61	56	51	57	52	48	50	46	41	55	51	46
6/05/2015	61	56	56	55	52	51	49	46	41	55	50	50
7/05/2015	62	58	55	56	53	51	46	47	42	58	51	50
8/05/2015	60	58	57	54	54	53	44	48	42	53	52	54
9/05/2015	62	55	54	55	51	51	45	45	41	58	49	49
10/05/2015	-	-	52	-	-	47	-	-	38	-	-	46
11/05/2015	60	56	54	55	53	50	49	47	39	54	51	50
12/05/2015	60	-	56	54	-	52	45	-	42	54	-	52
Average	61	56	54	55	52	50	*	*	*	*	*	*
Median (RBL)	*	*	*	*	*	*	**46**	**46**	**41**	*	*	*
Logarithmic Average	*	*	*	*	*	*	*	*	*	**56**	**51**	**50**

Note: - indicates value that has not been considered due to adverse weather conditions
* Indicates value that is not relevant to that noise descriptor
Value in bold indicates most relevant noise descriptor

Table 4-3: Unattended Noise Monitoring Results, dB(A) – Logger B - 727 Wallgrove Road, Horsley Park

Date	Average L_1			Average L_{10}			ABL (L_{90})			L_{eq}		
	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night
5/05/2015	78	77	75	75	73	71	61	53	49	72	70	66
6/05/2015	79	77	76	75	74	71	53	53	46	72	70	69
7/05/2015	79	77	77	75	74	72	54	53	47	72	70	69
8/05/2015	79	77	77	75	74	72	54	53	46	72	70	69
9/05/2015	78	76	76	74	73	71	54	53	45	71	69	67
10/05/2015	-	-	75	-	-	69	-	-	43	-	-	65
11/05/2015	79	77	76	75	73	70	54	51	42	72	70	68
12/05/2015	80	-	77	75	-	72	55	-	48	72	-	70
Average	79	77	76	75	73	71	*	*	*	*	*	*
Median (RBL)	*	*	*	*	*	*	**54**	**53**	**46**	*	*	*
Logarithmic Average	*	*	*	*	*	*	*	*	*	**72**	**70**	**68**

Note: - indicates value that has not been considered due to adverse weather conditions
* Indicates value that is not relevant to that noise descriptor
Value in bold indicates most relevant noise descriptor

Table 4-4: Unattended Noise Monitoring Results, dB(A) – Logger C - 134-154 Walworth Road, Horsley Park

Date	Average L_1			Average L_{10}			ABL (L_{90})			L_{eq}		
	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night
5/05/2015	64	58	51	55	49	45	46	38	37	56	49	44
6/05/2015	63	56	52	52	46	45	39	39	35	53	47	50
7/05/2015	64	57	55	53	46	49	39	37	37	54	46	51
8/05/2015	63	58	53	53	46	45	40	37	36	54	47	49
9/05/2015	62	56	50	53	49	44	40	39	34	54	47	45
10/05/2015	-	-	50	-	-	44	-	-	35	-	-	44
11/05/2015	61	56	52	52	46	46	38	38	35	51	45	49
12/05/2015	66	-	53	56	-	49	41	-	40	63	-	50
Average	63	57	52	53	47	46	*	*	*	*	*	*
Median (RBL)	*	*	*	*	*	*	**40**	**38**	**35**	*	*	*
Logarithmic Average	*	*	*	*	*	*	*	*	*	**57**	**47**	**49**

Note: - indicates value that has not been considered due to adverse weather conditions
* Indicates value that is not relevant to that noise descriptor
Value in bold indicates most relevant noise descriptor

4.2.2 Short-Term Attended Noise Monitoring Results

Given that the results of the unattended noise monitoring are affected by all ambient noise sources such as local fauna, road traffic, and industrial sources, it is not possible to determine with precision the exact existing industrial noise contribution based on unattended monitoring alone. Therefore, the attended noise monitoring allows for a more detailed understanding of the existing ambient noise characteristics and a more meaningful final analysis to be undertaken.

Short term operator attended noise monitoring was undertaken at several receptors during day, evening and night time period.

The results of the short-term attended noise monitoring are displayed in Table 4-5.

Table 4-5: Attended Noise Monitoring Results, dB(A) – Daytime

Location / Time Period	Noise Descriptor				Comments
	L_1	L_{10}	L_{90}	L_{eq}	
Location R7 Daytime 12/05/2015 (1:42pm)	83	74	51	71	• Industrial noise inaudible (<<43 dB(A)) • Wind Through Leaves ≈ 46 dB(A) • Birds ≈ 52 dB(A) • Distant Traffic Hum < 47 dB(A) • Site Noise Contribution inaudible < 43 dB(A) • Plant #1 inaudible
Location R4 Daytime 12/05/2015 (1:58pm)	85	75	55	72	• Industrial noise inaudible (<42 dB(A)) • Jemena Horsley Park Meter Station ≈ 49 dB(A) • Trucks ≈ 84 dB(A) • Cars < 83 dB(A) • Traffic Hum from M7 and Wallgrove Rd < 52 dB(A) • Site Noise inaudible < 45 dB(A) • Plant #1 inaudible
Location R3 Daytime 12/05/2015 (1:17pm)	78	72	60	68	• Industrial noise inaudible (<<50 dB(A)) • Trucks ≈ 82dB(A) • Cars < 80 dB(A) • Traffic Hum from M7 and Wallgrove Rd < 60 dB(A) • Site Noise inaudible << 50 dB(A)
Location Logger A Daytime 12/05/2015 (2:12pm)	63	57	53	56	• Traffic Hum from M7 and Wallgrove Rd ≈ 56 dB(A) • Birds < 51 dB(A) • Wind through leaves < 52 dB(A) • Cars on Redmayne Road < 67 dB(A) • Industrial Noise Inaudible < 43 dB(A) • Site Noise Contribution inaudible
Location Logger C Daytime 12/05/2015 (2:28pm)	70	62	48	59	• Traffic Hum from M7 and Wallgrove Rd ≈ 45 dB(A) • Birds < 52 dB(A) • Wind through leaves < 47 dB(A) • Aeroplane < 69 dB(A) • Truck on Walworth Road < 77 dB(A) • Truck Horn on Walworth Road < 88 dB(A) • Industrial Noise Inaudible < 35 dB(A) • Site Noise Contribution inaudible • Plant #1 inaudible

Table 4-5: Attended Noise Monitoring Results, dB(A) – Daytime

Location / Time Period	Noise Descriptor				Comments
	L_1	L_{10}	L_{90}	L_{eq}	
Location Logger B Daytime 12/05/2015 (2:50pm)	80	76	64	73	• Cars on Wallgrove Rd < 76 dB(A) • Trucks on Wallgrove Road < 80 dB(A) • Road Traffic Noise Dominant • Industrial Noise Inaudible < 46 dB(A) • Plant #1 inaudible • Site Noise Contribution inaudible< 46 dB(A)

Table 4-6: Attended Noise Monitoring Results, dB(A) – Evening time

Location / Time Period	Noise Descriptor				Comments
	L_1	L_{10}	L_{90}	L_{eq}	
Location R7 Evening 12/05/2015 (8:16pm)	81	60	46	67	• Industrial noise inaudible (<40 dB(A)) • Cars < 60 dB(A) • Birds ≈ 52 dB(A) • Distant Traffic Hum < 47 dB(A) • Site Noise Contribution inaudible (estimated) < 43 dB(A) • Other Industrial Noise inaudible < 40 dB(A)
Location R4 Evening 12/05/2015 (8:34pm)	80	60	51	64	• Traffic Hum from M7 and Wallgrove Rd ≈ 51 dB(A) • Jemena Horsley Park Meter Station ≈ 49 dB(A) • Trucks on M7 ≈ 53 dB(A) • Bike on M7 < 55 dB(A) • Noisy Car on Chandos Rd ≈ 88 dB(A) • Site Noise inaudible << 45 dB(A)
Location R3 Evening 12/05/2015 (8:52pm)	76	60	51	62	• Site Noise Inaudible (estimated) < 40 dB(A) • Cars on Chandos Road < 80 dB(A) • Traffic Hum on M7 and Wallgrove Road = 54 dB(A) calculated $L_{eq(15minute)}$ • Traffic noise is dominant • Plant #1 inaudible • Industrial noise inaudible < 40 dB(A)
Location R3 Evening 12/05/2015 (9:07pm)	77	59	51	66	• Site Noise Inaudible (estimated) < 40 dB(A) • Bikes on Chandos Road < 88 dB(A) • Cars on Chandos Road < 77 dB(A) • Traffic Hum on M7 and Wallgrove Road = 54 dB(A) calculated $L_{eq(15minute)}$ • Traffic noise is dominant • Industrial noise inaudible < 40 dB(A)

Table 4-7: Attended Noise Monitoring Results, dB(A) – Night time

Location / Time Period	Noise Descriptor				Comments
	L_1	L_{10}	L_{90}	L_{eq}	
Location I4 Brickworks Eastern Boundary Night 12/05/2015 (10:00pm)	80	67	49	66	• Cars < 79 dB(A) • Distant Traffic Hum < 44 dB(A) • Site Noise Contribution < 46 dB(A) • Estimated $L_{10(15\ minute)}$ at boundary < 48 dB(A) • Other Industrial Noise inaudible < 39 dB(A)
Location R3 Night 12/05/2015 (10:29pm)	77	61	49	63	• Cars < 87 dB(A) • Traffic Hum from M7 and Wallgrove Rd ≈ 45 dB(A) • Plant #1 inaudible • Site Noise Contribution < 40 dB(A) • Estimated $L_{10(15\ minute)}$ at boundary < 40 dB(A) • Other Industrial Noise inaudible < 38 dB(A)
Location R6 Night 12/05/2015 (10:50pm)	74	54	44	60	• Industrial noise ≈ 43 dB(A) (Jemena Horsley Park Meter Station) • Traffic Noise Dominant • Traffic hum from M7 and Wallgrove Road < 42 dB(A) • Distant Dogs Barking < 46 dB(A) • Site Noise Contribution (estimated) L10 <40

The measured noise levels are used to derive the Project Specific Noise Limits. These are derived after discussion of the acoustic criteria in Section 6 of this report.

5. METEOROLOGICAL CONDITIONS

Wind and temperature inversions may affect the noise emission from the site and these need to be assessed when they are considered to be a feature of the area.

The purpose of this is to determine if noise enhancing conditions may be present due to wind or temperature inversions.

This section of the report presents the analysis undertaken on the 2011 to 2014 weather data in order to establish whether wind and temperature inversions are features of the area.

5.1 WIND EFFECTS

Wind is considered to be a feature where source-to-receptor wind speeds (at 10 m above ground) of 3 m/s or below occur for 30% or more of the time in any assessment period in any season.

The meteorological data was obtained from the TAPM weather data provided by Airlabs Environment and utilised in their Air Quality Impact Assessment for this project.

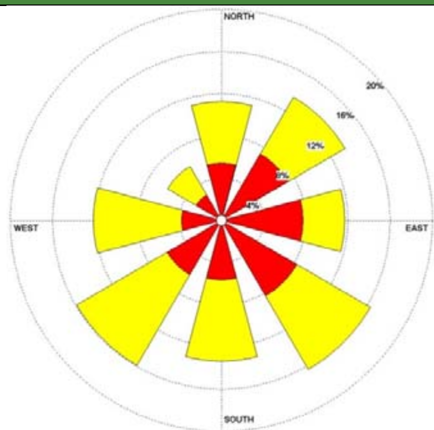
Seasonal wind rose plots for the site-representative meteorological file have been included in Figure 5-1, Figure 5-2 and Figure 5-3, based on the TAPM data received.

Based on the wind rose analysis source-to receptor wind speeds of 3 m/s or below, winds are present for less than 30% of the time.

Figure 5-1, Figure 5-2 and Figure 5-3 show the wind rose plot for the years 2011-2014 for daytime, evening time and night time respectively.

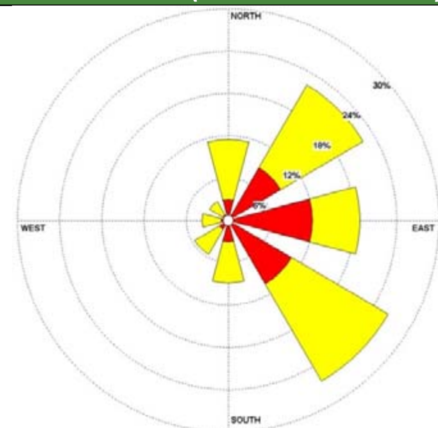
Figure 5-1: Wind Rose Plots – TAPM 2011-2014 – Day time

All Seasons



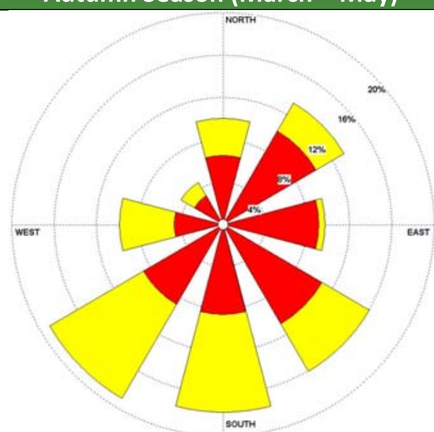
Average Wind Speed: 3.31 m/s

Summer Season (December – February)



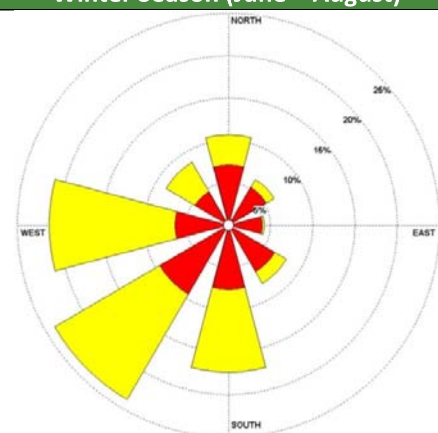
Average Wind Speed: 3.38 m/s

Autumn Season (March – May)



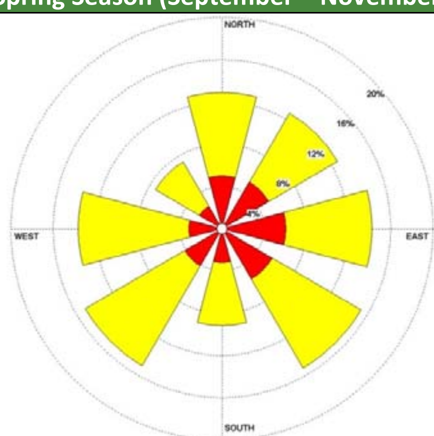
Average Wind Speed: 2.75m/s

Winter Season (June – August)



Average Wind Speed: 3.30m/s

Spring Season (September – November)

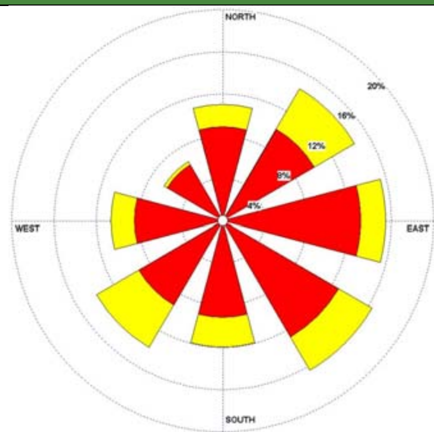


Average Wind Speed: 3.81 m/s

Legend

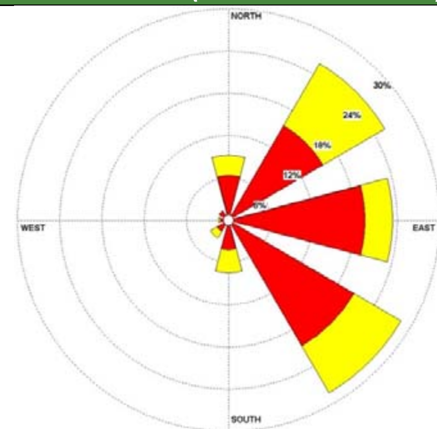
Figure 5-2: Wind Rose Plots – TAPM 2011-2014 – Evening Time

All Seasons



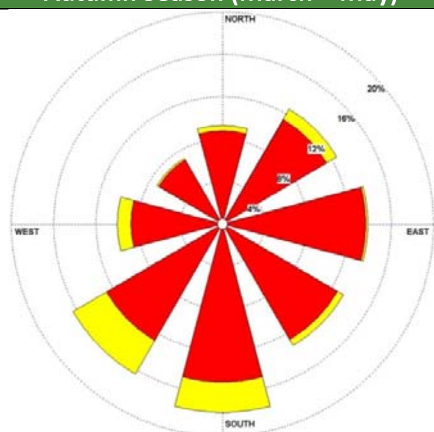
Average Wind Speed: 2.32 m/s

Summer Season (December – February)



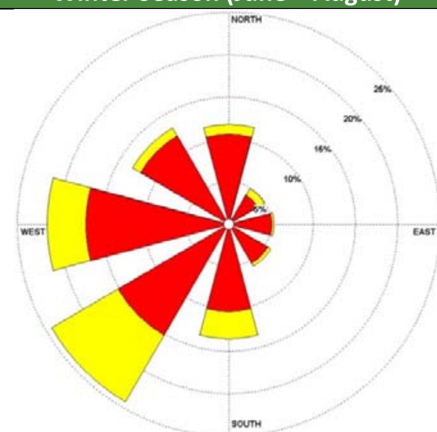
Average Wind Speed: 2.49 m/s

Autumn Season (March – May)



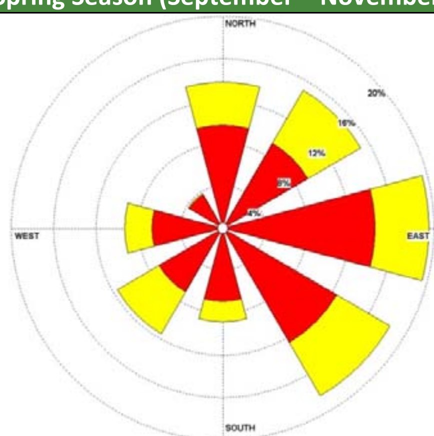
Average Wind Speed: 1.99 m/s

Winter Season (June – August)



Average Wind Speed: 2.31m/s

Spring Season (September – November)

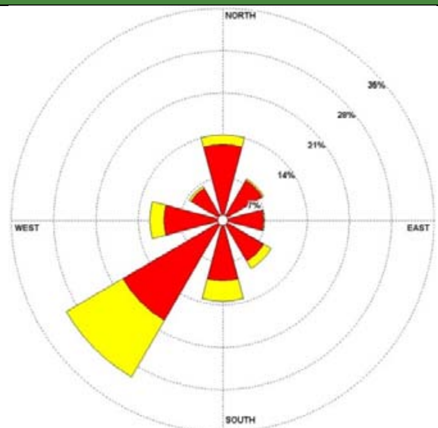


Average Wind Speed: 2.50 m/s

Legend

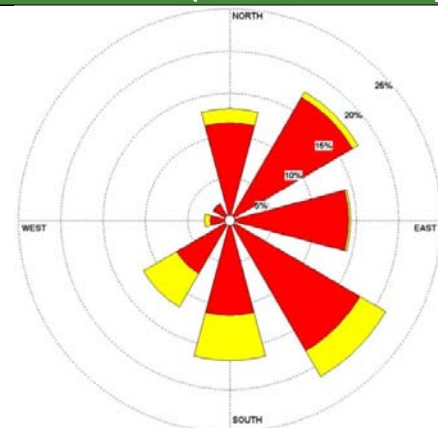
Figure 5-3: Wind Rose Plots – TAPM 2011-2014 – Night Time

All Seasons



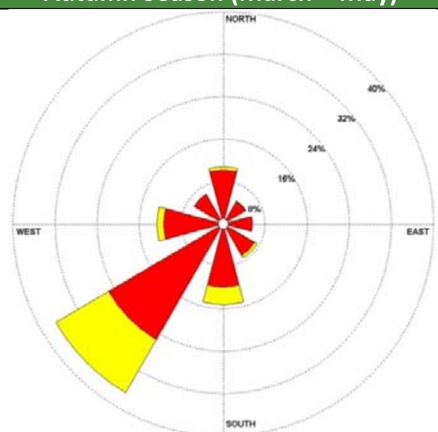
Average Wind Speed: 2.17 m/s

Summer Season (December – February)



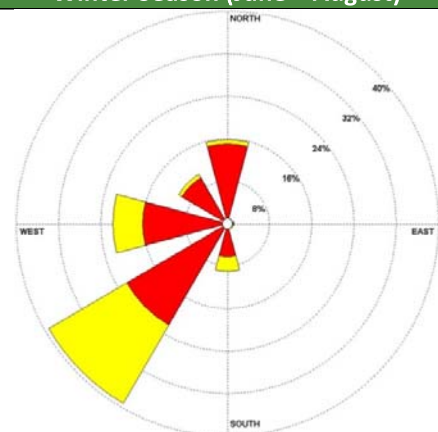
Average Wind Speed: 2.42 m/s

Autumn Season (March – May)



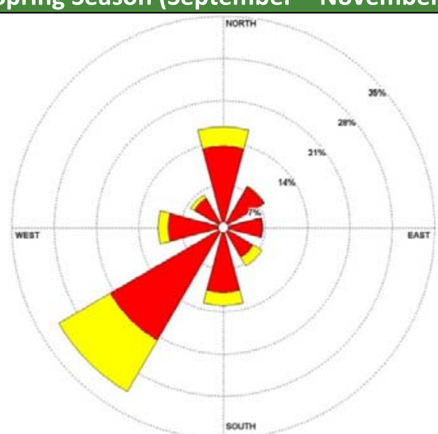
Average Wind Speed: 2.08m/s

Winter Season (June – August)



Average Wind Speed: 2.02m/s

Spring Season (September – November)



Average Wind Speed: 2.15 m/s

Legend

Based on the information presented from the TAPM weather data, source-to receiver wind speeds of 3 m/s or below are present for less than 30% of the time during any season and each assessment period, therefore wind effects have not been included in the assessment.

5.2 Temperature Inversions

Temperature inversions are considered a feature where they occur more than 30% of the total night time during winter (June, July and August) between 6:00pm and 7:00am. This is different from the night noise assessment period over which inversions are to be assessed, which is from 10:00pm to 7:00am.

This involves determining the percentage occurrence of moderate (Class F) and strong (Class G) inversions. Weak inversions (Class E) should not be included in the analysis.

The analysis conducted on the 2014 weather data highlighted that during winter, approximately 53% of the total night periods presented temperature inversion conditions. Therefore, temperature inversion effects have been considered in the noise impact assessment as per NSW EPA INP.

5.3 Weather Conditions Considered in the Assessment

The following condition was considered:

- Condition A: neutral weather conditions;
- Condition B: 2 m/s wind speed and temperature inversion.

The meteorological condition considered in the noise model has been displayed in detail in Table 5-1.

Table 5-1: Meteorological Conditions Assessed in Noise Propagation Modelling

Condition	Classification	Ambient Temp.	Ambient Humidity	Wind Speed	Wind Direction (blowing from)	Temperature Inversion	Affected Receptors	Applicability
A	Neutral	10°C	70%	–	–	No	All	All periods
B	Temperature Inversion	10°C	70%	2 m/s	Source to receiver	Yes 3°C/100m	All	Night time

6. CURRENT LEGISLATION AND GUIDELINES

There are five sets of noise criteria relevant to the proposed development:

(1) The construction noise guidelines. These are applied to determine noise levels that need to be satisfied during the construction of the proposed development.
(2) Different noise levels apply to residences and commercial/industrial premises.
(3) The existing Environment Protection Licence applies noise limits to the site.
(4) Even though this EPL has noise limits, the NSW EPA Industrial Noise Policy is applied in deriving the project specific noise limits for the expansion of the site.
(5) Roadway generated noise limits.

Each of these aspects are discussed in this Section of the report.

6.1 NSW EPA Interim Construction Noise Guideline

6.1.1 Airborne Noise

Residential Criteria

Table 6-1 sets out management levels for noise at residences and how they are to be applied. Restrictions to the hours of construction may apply to activities that generate noise at residences above the 'highly noise affected' noise management level.

Table 6-1: Management Levels at Residences Using Quantitative Assessment

Time of Day	Management Level $L_{Aeq(15\ minute)}$	How to Apply
Recommended standard hours: Monday to Friday 7am – 6pm Saturday 8am – 1pm No work on Sundays or Public Holidays	Noise Affected RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. • Where the predicted or measured $L_{Aeq(15\ minute)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practises to meet the noise affected level. • The proponent should also inform all potentially affected residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly Noise Affected 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: 1. times identified by the community when they are less sensitive to noise (such as before and after school, or mid-morning or mid-afternoon for works near residents). 2. if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise Affected RBL + 5 dB	• A strong justification would typically be required for works outside the recommended standard hours. • The proponent should apply all feasible and reasonable work practices to meet the noise affected level. • Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community. • For guidance on negotiating agreements see section 7.2.2 (RNP).

Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5 m above ground level. If the property boundary is more than 30 m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30 m from the residence.

Other Sensitive Land Uses

Other sensitive land uses, such as schools typically consider noise from construction to be disruptive when the properties are being used. Table 6-2 presents management levels for noise at other sensitive land uses based on the principal that the characteristic activities for each of these land uses should not be unduly disturbed.

Table 6-2: Noise at Sensitive Land Uses (other than residences) using qualitative assessment

Land Use	Management Level $L_{Aeq(15\ minute)}$
Classrooms at school and other educational institutions	Internal noise level 45 dB(A)
Hospital wards and operating theatres	Internal noise level 45 dB(A)
Places of worship	Internal noise level 45 dB(A)
Active recreational areas	External noise level 65 dB(A)
Passive recreational areas	External noise level 60 dB(A)
Community centres	Depends on the intended use of the centre. Refer to the recommended 'maximum' internal levels in AS 2107 for specific uses.

As a guide, the difference between internal noise level and the external noise level is typically 10 dB with windows open for adequate ventilation.

Commercial and Industrial Premises

Due to the broad range of sensitivities that commercial or industrial land can have to noise from construction, the process of defining management levels is separated into three categories. Table 6-3 presents the management levels for noise at commercial or industrial land uses.

Table 6-3: Commercial and Industrial Premises using qualitative assessment

Industrial Category	Management Level $L_{Aeq(15\ minute)}$
Industrial Premises	External noise level 75 dB(A)
Offices, Retail Outlets	External noise level 70 dB(A)
Other businesses that may be sensitive to noise	Refer to AS 2107 to assist in determining relevant noise levels

6.1.2 Construction Project Specific Noise Levels

The applicable noise criteria associated with construction noise for all receptors considered throughout this survey are displayed in Table 6-4.

Table 6-4: Project Specific Noise Levels Associated with Construction Works, dB(A)

Receptors	Measured RBL L90	PSNL $L_{eq,15\ minute}$
R1, R2	54	**64***
R3, R4, R5, R6, R7, R8, R9	46	**56***
I1, I2, I3, I4, I5	–	**75**
PR1	–	**60**

Note: Bold values indicate the applicable project specific noise levels
* indicates noise level during recommended standard hours

6.2 NSW EPA Environment Protection Licence

Current operations at the Brickworks Ltd Site are required to satisfy specific NSW EPA requirements, as outlined in the site's Environment Protection Licence (Licence no. 546, Anniversary Date: 31st October).

Condition L6 of the licence states the following:

"L6 Noise Limits

L6.1 Noise from the premises must not exceed:
a) an LA10 (15 minute) noise emission criterion of 50 dB(A) (7am to 10pm) Monday to Saturday and 8am to 10pm on Sundays and Public Holidays; and
b) at all other times, an LA10 (15 minutes) noise emission criterion of 40 dB(A), except as expressly provided by this licence.
"
L6.2 Noise from the premises is to be measured or computed at any point within 30 metres of the boundary of the most affected residence to determine compliance with condition L6.1. 5dB(A) must be added if the noise is tonal or impulsive in character."

6.3 NSW EPA Industrial Noise Policy

6.3.1 Introduction

The NSW INP was developed by the NSW EPA primarily for the assessment of noise emissions from industrial sites regulated by the NSW EPA. However, the policy can also be used by NSW Planning and Infrastructure and local government to assist in their assessment of potential noise issues.

An important point to note in the policy is presented in Section 1.4.1. This section states:

> *"The industrial noise source criteria set down in Section 2 are best regarded as planning tools. They are not mandatory, and an application for a noise-producing development is not determined purely on the basis of compliance or otherwise with the noise criteria. Numerous other factors need to be taken into account in the determination. These factors include economic consequences, other environmental effects and the social worth of the development."*

The policy sets out two criteria that are used to assess potential site-related noise impacts. The first criterion aims at controlling intrusive noise impacts in the short-term for residences. This criterion is therefore called the intrusiveness criterion.

The second criterion aims at maintaining a suitable amenity for particular land uses including residences in the long-term. This criterion is called the amenity criterion.

6.3.2 Intrusiveness Criterion

The intrusiveness criterion can be summarised as:

$$L_{Aeq,(15minute)} \leq \text{rating background level} + 5 \text{ dB(A)}$$

The $L_{Aeq,(15minute)}$ is the predicted or measured L_{Aeq} from noise generated within the project site over a fifteen minute interval at the receptor.

This is to be assessed at the most affected point on or within the residential property boundary or if that is more than 30 m from the residence, at the most affected point within 30 m of the residence.

6.3.3 Amenity Criterion

To limit continuing increases in noise levels, the maximum ambient noise level within an area from industrial noise sources should not normally exceed the acceptable noise levels specified in Table 2.1 of the INP, the applicable parts of which are reproduced in Table 6-5.

Table 6-5: NSW EPA Amenity Criteria - Recommended L_{Aeq} noise levels from industrial noise sources

Type of Receptor	Indicative Noise Amenity Area	Period	Recommended L_{Aeq} noise level (dB(A))	
			Acceptable	Recommended Maximum
Residence	Urban	Day	60	65
		Evening	50	55
		Night	45	50
Area reserved for passive recreation	All	When in use	50	55
Commercial premises	All	When in use	65	70
Industrial premises	All	When in use	70	75

The existing industrial noise levels are compared to the acceptable level and Table 6-6 is then used to derive the applicable amenity criteria.

Table 6-6: Modification to Acceptable Noise Level (ANL[1]) to Account for Existing Levels of Stationary Noise

Total Existing L_{Aeq} Noise Level From Industrial Sources	Maximum L_{Aeq} Noise Level for Noise from New Sources Alone
≥ ANL + 2	If existing noise level is likely to decrease in future: ANL – 10 If existing noise level is unlikely to decrease in the future: Existing level – 10
ANL + 1	ANL – 8
ANL	ANL – 8
ANL –1	ANL – 6
ANL – 2	ANL – 4
ANL – 3	ANL – 3
ANL – 4	ANL – 2
ANL – 5	ANL –2
ANL – 6	ANL – 1
< ANL - 6	ANL

Source: Table 2.2 NSW EPA INP
Note: [1]ANL is the recommended acceptable L_{Aeq} noise level for the specific receptor, area and time of day.

Section 2.2.3 of the Industrial Noise Policy states the follow:

> *"The level of transportation noise—road traffic noise in particular—may be high enough to make noise from an industrial source effectively inaudible, even though the LAeq noise level from that industrial noise source may exceed the recommended acceptable noise levels.*
>
> *In such cases, the amenity criterion for noise from the industrial noise becomes the LAeq, period (traffic) minus 10 dB. This criterion replaces the amenity criterion in Tables 2.1 and 2.2 above, and is used in the same way the amenity criterion is used, that is, in conjunction with the intrusiveness criterion, to determine the limiting criterion. General and more specific case studies showing how the high traffic criterion works are included in Appendix A. (See Section A1 and case study (c) in Section A2.)*
>
> *This criterion may be applied only if all the following apply:*
>
> 1. *Traffic noise is identified as the dominant noise source at the site. NSW industrial noise policy*
> 2. *The existing traffic noise level (determined using the procedure outlined in Section 3.2) is 10 dB or more above the Acceptable noise level for the area.*
> 3. *It is highly unlikely the road traffic noise levels would decrease in the future."*

The road traffic noise was found to be the dominant source at location R1 and R2 where all three abovementioned rules are valid. The principles here outlined have been applied to derive the amenity criteria at location R1 and R2.

6.3.4 Sleep Disturbance

The occurrence of instantaneous maximum noise levels or maximum noise levels over a very short time period have potential to cause sleep disturbance to nearby residents. The World Health Organisation recommends individual noise events to be contained under 45 dB(A) Lmax indoors (fast response) in order to minimise sleep disturbance. Generally, the number of such events should be less than 10–15 events per night for a 'good night's sleep'.

The NSW Industrial Noise Policy Application Notes refers to the NSW Road Noise Policy to assist in deriving criteria for assessing sleep disturbance.

Section 5.4 of the NSW Road Noise Policy details the effects of disruption of a person's normal sleep patterns due to road traffic noise, outlines research regarding the causes of sleep disturbance, and states conclusions regarding the noise levels from road traffic noise correlating to sleep disturbance.

From the research on sleep disturbance to date it can be concluded that:

- Maximum internal noise levels below 50–55 dB(A) are unlikely to awaken people from sleep; and

- One or two noise events per night, with maximum internal noise levels of 65–70 dB(A), are not likely to affect health and well being significantly.

An appropriate sleep disturbance criteria of 45 dB(A) Lmax (internal) was considered for all residential premises surrounding the subject site with respect to onsite noise generating activities. This approach of setting an internal limit, as opposed to an external limit, has been applied to similar noise assessments that consider night time (10pm–7am) site operations and vehicle movements and has been accepted as a suitable noise management approach that is fair and reasonable.

A conservative 10 dB reduction in sound pressure levels resulting from the façade and ceiling of the house has been considered in order to derive an acceptable noise limit that is to be achieved outside the house. This is based on windows being partially open, equivalent to a summer period.

Therefore if the recommended internal noise level is to be below 45 dB(A) Lmax, and the house offers a 10 dB reduction in sound pressure level with the windows partially open, the exterior sound pressure level can be 55 dB(A) Lmax.

6.3.5 Operational Project Specific Noise Levels

Noise limits for the subject site can be established in accordance with the principles and methodologies of the INP, the measured background noise levels and the existing industrial operational noise levels of the area.

According to the INP, it is recommended that the more stringent noise limits be applied to protect the existing acoustic amenity from deteriorating.

The selected project specific noise levels and the sleep disturbance criteria associated with operational noise are presented in Table 6-7.

It should be noted that different time periods apply for the noise criteria as the intrusive criterion considers a 15 minute assessment period while the amenity criterion requires assessment over the total length of time that a site is operational within each day, evening or night. In order to ensure compliance under all circumstances, a 15 minute assessment period has been considered for all receptors.

Existing road traffic noise levels were obtained from the data collected at the Logger location B. Calculations were made to estimate the road traffic noise levels at the façade of the residences R1 and R2.

Table 6-7: Project Specific Noise Levels Associated with Operational Activities, dB(A)

Receptor	Time Period	Measured RBL L90	Estimated Industrial Noise L_{eq}	Existing Road Traffic Noise L_{eq}	Acceptable Noise Level L_{eq}	Intrusive Criterion $L_{eq,15minute}$	Amenity Criterion $L_{eq,\ period}$	PSNL $L_{eq,period}$		Sleep Disturbance L_{max}
								Descriptor	Limit	
Residential Receptors										
R1, R2	Day	54	<39	67	60	59	60	$L_{eq,15minute}$	**59**	-
	Evening	53	<39	65	50	58	55*	$L_{eq,evening}$	**55**	-
	Night	46	<39	64	45	51	54*	$L_{eq,15minute}$	**51**	**55**
R4	Day	46	49	-	60	51	60	$L_{eq,15minute}$	**51**	**-**
	Evening	46	49	-	50	51	50	$L_{eq,15minute}$	**51**	**-**
	Night	41	49	-	45	46	39	$L_{eq,night}$	**39**	**55**
R5	Day	46	43	-	60	51	60	$L_{eq,15minute}$	**51**	**-**
	Evening	46	43	-	50	51	50	$L_{eq,evening}$	**50**	**-**
	Night	41	43	-	45	46	41	$L_{eq,night}$	**41**	**55**
R3, R6, R7, R8, R9	Day	46	<39	-	60	51	60	$L_{eq,15minute}$	**51**	**-**
	Evening	46	<39	-	50	51	50	$L_{eq,15minute}$	**51**	**-**
	Night	41	<39	-	45	46	45	$L_{eq,night}$	**45**	**55**
Public Recreational Areas										
PR1	When in use	-	-		50	-	50	$L_{eq,\ period\ when\ in\ use}$	**50**	-
Industrial Receptors										
I1, I2, I3, I4, I5	When in use	-	-		70	-	70	$L_{eq,\ period\ when\ in\ use}$	**70**	**-**

Note: - indicates not applicable
* indicates that road traffic noise is dominant and existing Leq-10dB was applied.
Bold values indicate the applicable project specific noise levels

6.4 NSW EPA Road Noise Policy

6.4.1 Introduction

The RNP has been adopted by the EPA to establish the off-site road traffic noise criteria for the potential noise impact associated with the facility. The RNP was developed by the NSW EPA primarily to identify the strategies that address the issue of road traffic noise from:

- Existing roads;
- New road projects;
- Road redevelopment projects; and
- New traffic-generating developments.

The RNP also defines criteria to be used in assessing the impacts of such noise.

6.4.2 Road Category

The RNP states the following:

> *"Roads are functionally classified by a range of factors, including their role in facilitating traffic movement; their relationship to other road categories; and whether they support through or local traffic, access to adjacent land uses and applicable traffic management options".*

Wallgrove Road has been considered as the road most affected by site road traffic noise. This road is classified as 'Sub-arterial roads' as defined in the RNP.

The functional role of a 'Sub-arterial road' is explained as follows:

- Provide connection between arterial roads and local roads;
- May support arterial roads during peak periods; and
- May have been designed as local streets but can serve major traffic-generating developments or support non-local traffic.

6.4.3 Noise Assessment Criteria

Section 2.3 of the RNP outlines the criteria for assessing road traffic noise. The relevant sections of Table 3 of the RNP are shown in Table 6-8.

Table 6-8: Road Traffic Noise Assessment Criteria For Residential Land Uses, dB(A)

Road Category	Type of Project/Land Use	Assessment Criteria, dB(A)	
		Day (7am-10pm)	Night (10pm-7am)
Sub-arterial roads	3. Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments	$L_{Aeq\ (15\ hour)}$ 60 dB (external)	$L_{Aeq\ (9\ hour)}$ 55 dB (external)

The noise level descriptor that has been adopted by the RNP for use with the above criteria is the $L_{Aeq.}$

6.4.4 Relative Increase Criteria

In addition to the assessment criteria outlined above, any increase in the total traffic noise level at a location due to a proposed project or traffic-generating development, must be considered. Residences experiencing increases in total traffic noise levels above the relative criteria should also be considered for mitigation as described in Section 3.4 of the RNP. For road projects where the main subject road is a local road, the relative increase criterion does not apply.

Table 6 of the RNP outlines the relative increase criteria for residential land uses and is shown in Table 6-9.

Table 6-9: Relative Increase Criteria For Residential Land Uses, dB(A)

Road Category	Type of Project/Land Use	Total Traffic Noise Level Increase, dB(A)	
		Day (7 am-10 pm)	Night (10 pm-7 am)
Freeway/arterial/sub-arterial roads and transit ways	New road corridor/redevelopment of existing road/land use development with potential to generate additional traffic on existing road	Existing traffic $L_{Aeq\ (15\ hour)}$ + 12 dB (external)	Existing traffic $L_{Aeq\ (9\ hour)}$ + 12 dB (external)

The assessment criteria provided in Table 6-8 and the relative increase criteria provided in Table 6-9 should both be considered when designing project specific noise levels, and the lower of the two should be adopted. For example, if the assessment criteria is 60 dB(A) and the relative increase criteria is 42 dB(A), then a project specific noise level of 42 dB(A) should be adopted. Similarly, if the assessment criteria is 60 dB(A) and the relative increase criteria is 65 dB(A), a project specific noise level of 60 dB(A) should be adopted.

6.4.5 Exceedance of Criteria

If the criteria shown in both Table 6-8 and Table 6-9 cannot be achieved, justification should be provided that all feasible and reasonable mitigation measures have been applied.

For existing residences and other sensitive land uses affected by additional traffic on existing roads generated by land use developments, any increase in the total traffic noise level should be limited to 2 dB above that of the corresponding 'no build option'.

6.4.6 Assessment Locations for Existing Land Uses

Table 6-10: Assessment Locations for Existing Land Uses

Assessment Type	Assessment Location
External noise levels at residences	The noise level should be assessed at 1 metre from the façade and at a height of 1.5 metres from the floor. Separate noise criteria should be set and assessment carried out for each façade of a residence, except in straightforward situations where the residential façade most affected by road traffic noise can be readily identified. The residential noise level criterion includes an allowance for noise reflected from the façade ('façade correction'). Therefore, when taking a measurement in the free field where reflection during measurement is unlikely (as, for instance, when measuring open land before a residence is built), an appropriate correction – generally 2.5 dB – should be added to the measured value. The 'façade correction' should not be added to measurements taken 1 metre from the façade of an existing building. Free measurements should be taken at least 15 metres from any wall, building or other reflecting pavement surface on the opposite side of the roadway, and at least 3.5 metres from any wall, building or other pavement surface, behind or at the sides of the measurement point which would reflect the sound.
Noise levels at multi-level residential buildings	The external points of reference for measurement are the two floors of the building that are most exposed to traffic noise. On other floors, the internal noise level should be at least 10 dB less than the relevant external noise level on the basis of openable windows being opened sufficiently to provide adequate ventilation. (Refer to the Building Code of Australia (Australian Building Codes Board 2010) for additional information.)
Internal noise levels	Internal noise levels refer to the noise level at the centre of the habitable room that is most exposed to the traffic noise with openable windows being opened sufficiently to provide adequate ventilation. (Refer to the Building Code of Australia (Australian Building Codes Board 2010) for additional information.)
Open space – passive or active use	The noise level is to be assessed at the time(s) and location(s) regularly attended by people using the space. In this regard, 'regular' attendance at a location means at least once a week.

6.4.7 Road Traffic Project Specific Noise Levels

A traffic report was obtained from Ason Group and utilised for the purpose of assessing road traffic noise associated with the propose development.

Based on the traffic volume data obtained and the long term road traffic noise measurement results, the current existing road traffic noise levels readily exceed the assessment criteria. As a conservative approach, the assessment criteria has been considered to assess the additional road traffic noise associated with the proposed operations.

The selected project specific noise levels associated with road traffic noise are presented in Table 6-11.

Where existing traffic noise levels are above the noise assessment criteria, any increase in the total traffic noise level should be limited to 2 dB above that of the corresponding 'no build option'.

Table 6-11: Project Specific Noise Levels Associated with Road Traffic, dB(A)

Receptor along	Period	Existing Road Traffic Noise L_{eq}	Assessment Criteria $L_{eq,15 \text{ or } 9 \text{ hour}}$	Relative Increase Criteria $L_{eq,15 \text{ or } 9 \text{ hour}}$	PSNL $L_{eq,15 \text{ or } 9 \text{ hour}}$
Logger B, Calculated at R1 and R2	Day	67	60	69	**69**
	Night	62	55	64	**64**

7. NOISE IMPACT ASSESSMENT

An outline of the predictive noise modelling methodology and scenarios has been provided below.

7.1 NOISE SOURCES

The sound power levels associated with the proposed construction works have been sourced from BE's extensive noise source database. The sound power levels for the identified noise sources associated with the operational activities have either been calculated from measurements of sound pressure levels undertaken by an acoustic engineer from BE during current operations at the subject site or calculated at a similar facility.

Approximate A-weighted octave and third octave band centre frequency sound power levels have been used and are presented in Table 7-1 and Table 7-2. The noise sources utilised as part of this assessment are comprised of the primary noise generating activities associated with the proposed operations.

Sound power levels for all the proposed fans associated with the kilns have been calculated based on the air volume data and static pressure data provided by the client. Approximation has been carried out in accordance with the Formulae indicated in the Woods Practical Guide to Noise Control, published by Woods Acoustics 1972.

Table 7-1: A-weighted Sound Power Levels Associated with Construction Works, dB(A)

Noise Source	Octave Band Centre Frequency (Hz)									
	Overall	31.5	63	125	250	500	1k	2k	4k	8k
Concrete cutter	**123**	-	92	91	94	103	106	112	120	119
Excavator	**103**	94	93	95	97	95	94	92	87	80
Concrete truck	**99**	-	58	76	87	92	95	92	90	79
Articulated truck	**103**	-	84	84	87	94	98	97	95	85
Grinding	**111**	-	57	71	88	97	99	107	106	100
Welding	**97**	-	58	65	74	84	88	89	94	90
Crane	**103**	64	84	84	87	94	98	97	95	85
Backhoe	**96**	-	76	78	83	89	91	89	88	77
Dump Truck	**107**	-	87	86	97	98	101	103	96	90
Roller	**101**	-	81	86	96	96	94	91	82	72
Dozer	**108**	-	91	102	100	98	102	99	97	91
Scraper	**112**	-	85	87	101	104	110	103	94	86
Grader	**111**	-	86	95	99	100	109	104	99	88
Trencher	**111**	-	87	91	94	108	104	104	99	93
Diesel Pumps	**87**	12	36	46	59	78	79	72	67	60

Table 7-2: A-weighted Sound Power Levels Associated with Operational Activities, dB(A)

Area	Height	Overall	Third Octave Band Centre Frequency (Hz)									
			25	31	40	50	63	80	100	125	160	200
			250	315	400	500	630	800	1k	1.25k	1.6k	2k
			2.5k	3.15k	4k	5k	6.3k	8k	10k	12.5k	16k	20k
Kiln and Screening/Crushing Plant												
1 – Vent Stack	28 m	**118**					77			92		
			101			113			112			112
					110			105				
2 – Vent Fan	2 m	**118**					96			104		
			108			112			113			1
					108			103				
3 – Vent Filter	11 m	**93**	8	8	52	58	62	74	73	76	84	78
			86	82	80	83	80	80	82	79	79	77
			77	78	77	76	76	75	73	70		
4 – Grate Cooler Fan 1 – with lagging	1 m	**93**					74			82		
			83			88			88			84
					81							
5 – Grate Cooler Fan 2	1 m	**93**					74			82		
			83			88			88			84
					81							
6 – Grate Cooler Fan 3	1 m	**93**					74			82		
			83			88			88			84
					81							
7 – Grate Cooler Fan 4	1 m	**93**					74			82		
			83			88			88			84
					81							
8 – Primary Air Fan	8 m	**98**					79			87		
			88			93			93			89
					86			81				
9 – Burner	8 m	**103**					81			92		
			100			98			93			80
					69			55				

Table 7-2: A-weighted Sound Power Levels Associated with Operational Activities, dB(A)

Area	Height	Overall	Third Octave Band Centre Frequency (Hz)									
			25	31	40	50	63	80	100	125	160	200
			250	315	400	500	630	800	1k	1.25k	1.6k	2k
			2.5k	3.15k	4k	5k	6.3k	8k	10k	12.5k	16k	20k
10 – H.W Pump	8 m	**93**	30	34	38	40	64	44	45	52	52	59
			66	72	81	84	82	87	85	83	84	79
			76	75	74	71	68	66	63	60	57	52
11 – Rotary Kiln	8 to 13 m	**94**	80	80	79	80	82	82	78	78	76	77
			76	77	76	79	78	78	79	80	81	82
			83	84	85	84	83	86	79	75	73	63
12 – H.W. Pump	13 m	**93**	30	34	38	40	64	44	45	52	52	59
			66	72	81	84	82	87	85	83	84	79
			76	75	74	71	68	66	63	60	57	52
13 – System Water Pump	20 m	**93**	30	34	38	40	64	44	45	52	52	59
			66	72	81	84	82	87	85	83	84	79
			76	75	74	71	68	66	63	60	57	52
14 – Feed Conveyor	23 m	**93**				61	69	73	71	75	75	77
			78	83	81	82	81	81	82	83	82	82
			82	81	80	78	75	72				
15 – Cyclone	24	**104**				65	76	79	78	80	82	82
			84	87	86	89	92	93	92	90	91	93
			94	94	95	94	94	92				
16 – Air-Gas Heat Exchanger	11 to 17m	**92**					73			81		
			82			87			87			83
					80			75				
17 – Throttle Valve	6.7m	**108**									74	77
			79	83	87	87	94	94	94	93	97	97
			99	100	100	98	96	91				

Table 7-2: A-weighted Sound Power Levels Associated with Operational Activities, dB(A)

Area	Height	Overall	Third Octave Band Centre Frequency (Hz)									
			25	31	40	50	63	80	100	125	160	200
			250	315	400	500	630	800	1k	1.25k	1.6k	2k
			2.5k	3.15k	4k	5k	6.3k	8k	10k	12.5k	16k	20k
						65	76	79	78	80	82	82
18 – Gas Suspension Absorber Outlet	24 m	**104**	84	87	86	89	92	93	92	90	91	93
			94	94	95	94	94	92	94	94	95	94
			61	65	68	72	72	74	74	74	77	77
19 – Bucket Elevator	24 m	**90**	78	76	76	79	78	77	77	78	76	77
			77	76	76	75	72	70	66	62		
						56	67	70	69	71	73	73
20 – Bag Filter	6 to 20 m	**95**	75	78	77	80	83	84	83	81	82	84
			85	85	86	85	85	83				
							74			82		
21 – ID Fan – with lagging	2 m	**93**	83			88			88			84
					81							
							74			82		
22 – ID Fan – with lagging	2 m	**93**	83			88			88			84
					81							
							82			90		
23 – 24 – Heat Exchanger – RSCR	2 m	**101**	91			96			96			92
					89			84				
							99			107		
25 – Stack	47 m	**118**	108			113			113			109
					106			101				
			33	42	40	62	75	63	72	81	80	75
26 - Feeder	2 m	**93**	72	79	77	81	79	81	81	80	80	83
			81	82	83	78	75	75	77	70	68	52
						62	71	74	72	76	76	77
27 – Conveyor Belt	Various	**94**	78	84	82	83	81	82	83	83	82	82
			82	81	79	78	74	72				

Table 7-2: A-weighted Sound Power Levels Associated with Operational Activities, dB(A)

Area	Height	Overall	Third Octave Band Centre Frequency (Hz)									
			25	31	40	50	63	80	100	125	160	200
			250	315	400	500	630	800	1k	1.25k	1.6k	2k
			2.5k	3.15k	4k	5k	6.3k	8k	10k	12.5k	16k	20k
28 – Proposed Jaw Crusher	2 m	**112**	112	47	51	61	63	65	67	72	80	86
			88	92	102	102	105	104	103	103	101	99
			96	91	86	82	78	75	69	64	59	96
29 – Vibrating Screen	2 m	**106**	84	82	91	92	99	96	91	94	92	92
			89	88	92	94	90	91	91	92	92	91
			90	89	88	86	84	81	78	75	71	66
29 – Alternative Mobile Screen (QA450)	2 m	**113**	91	89	98	99	106	103	98	101	99	99
			96	95	99	101	97	98	98	99	99	98
			97	96	95	93	91	88	85	82	78	73
30– Stacker	Various	**100**										
				77	85	88	88	89	89	91	92	92
			91	90	86	84	77					
On Site Vehicles												
Water Cart	2 m	**103**	46	51	62	79	79	78	79	83	81	82
			82	85	92	90	94	95	93	93	94	92
			90	89	87	84	80	76	71	68	63	57
Excavator	2 m	**111**	49	65	62	68	79	81	86	87	90	89
			87	88	95	100	98	101	101	102	101	101
			101	100	97	95	92	89	83	78	71	61
Trucks (laden)	1.5 and 3m	**98**	41	44	60	67	81	71	73	76	72	78
			75	78	81	87	88	89	91	89	88	87
			84	81	80	76	71	68	63	59	54	46
Front End Loader	2 m	**112**	60	63	69	81	72	77	86	91	92	95
			96	95	100	100	96	95	101	110	92	93
			92	93	87	82	83	76	70	67	63	56

Table 7-2: A-weighted Sound Power Levels Associated with Operational Activities, dB(A)

Area	Height	Overall	Third Octave Band Centre Frequency (Hz)									
			25	**31**	**40**	**50**	**63**	**80**	**100**	**125**	**160**	**200**
			250	**315**	**400**	**500**	**630**	**800**	**1k**	**1.25k**	**1.6k**	**2k**
			2.5k	**3.15k**	**4k**	**5k**	**6.3k**	**8k**	**10k**	**12.5k**	**16k**	**20k**
Existing Operations At Plant 2												
Existing Crusher	Underground -1m	**112**	112	47	51	61	63	65	67	72	80	86
			88	92	102	102	105	104	103	103	101	99
			96	91	86	82	78	75	69	64	59	96
Existing Mill (indoor)	1 m	**110**	64	58	62	68	72	77	79	84	89	89
			91	90	97	101	97	102	99	100	100	99
			101	96	93	90	85	85	80	73	66	60
Existing Brick Machine	3 m	**111**	53	56	61	65	76	76	81	84	87	94
			92	98	97	98	100	99	102	100	100	100
			100	99	99	98	96	94	89	85	79	72
Brick Factory Fans	4 m	**92**	54	56	61	65	67	70	70	71	77	80
			80	84	81	83	78	80	82	81	78	74
			73	69	67	66	63	61	59	55	53	56

Figure 7-1: Operational Noise Source Locations – Kiln

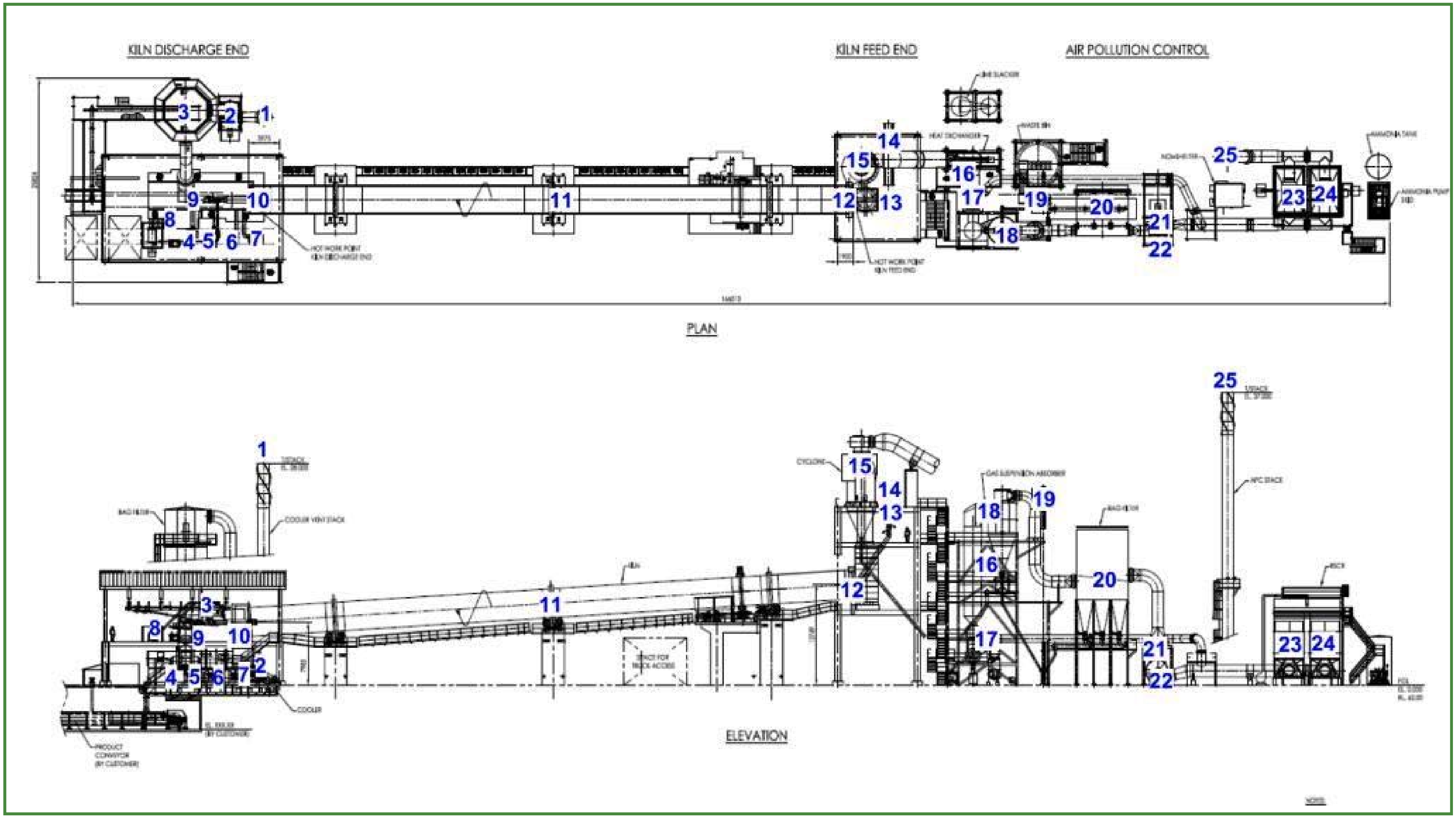


Figure 7-2: Operational Noise Source Locations – Crushing and Screening Plant

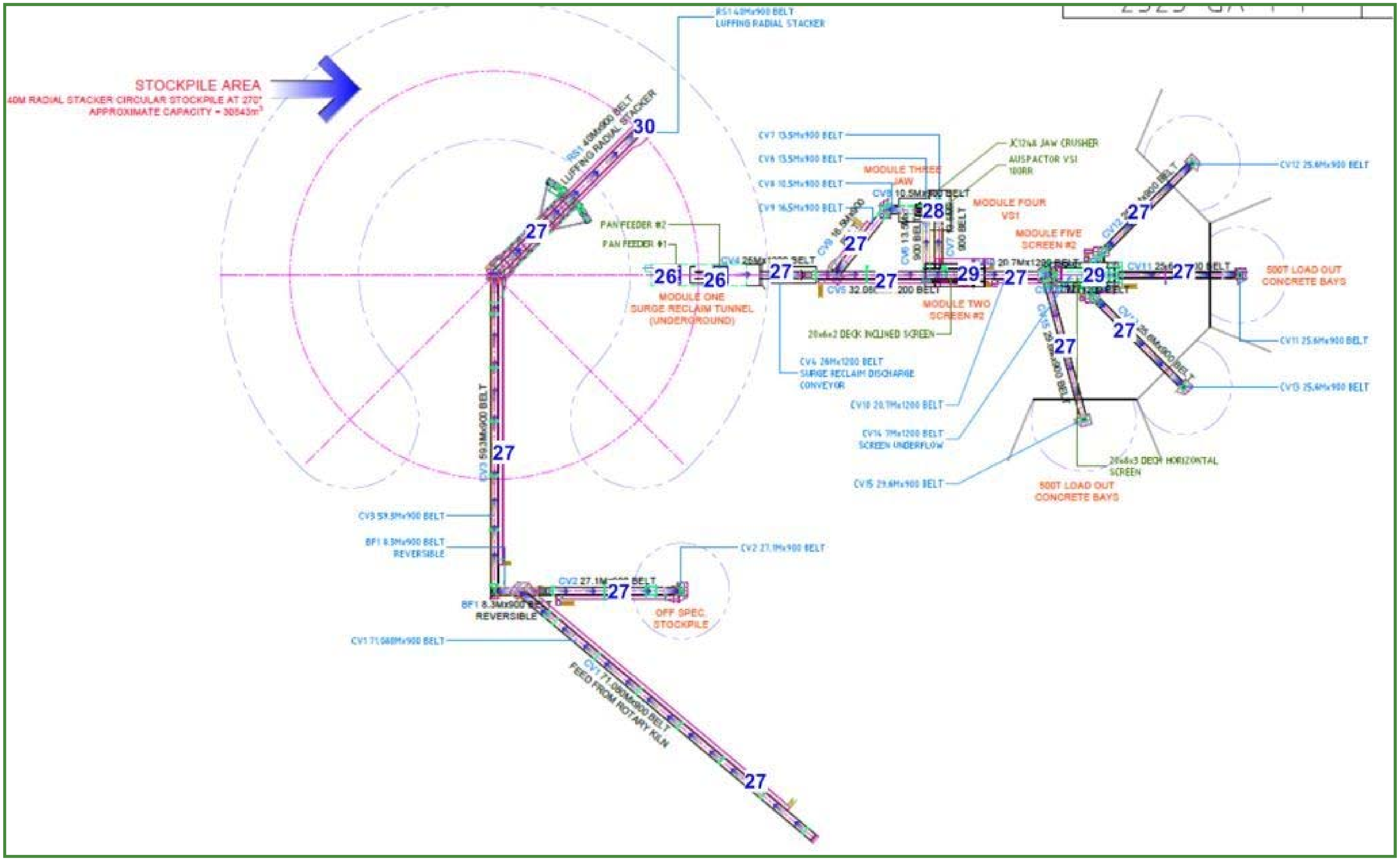
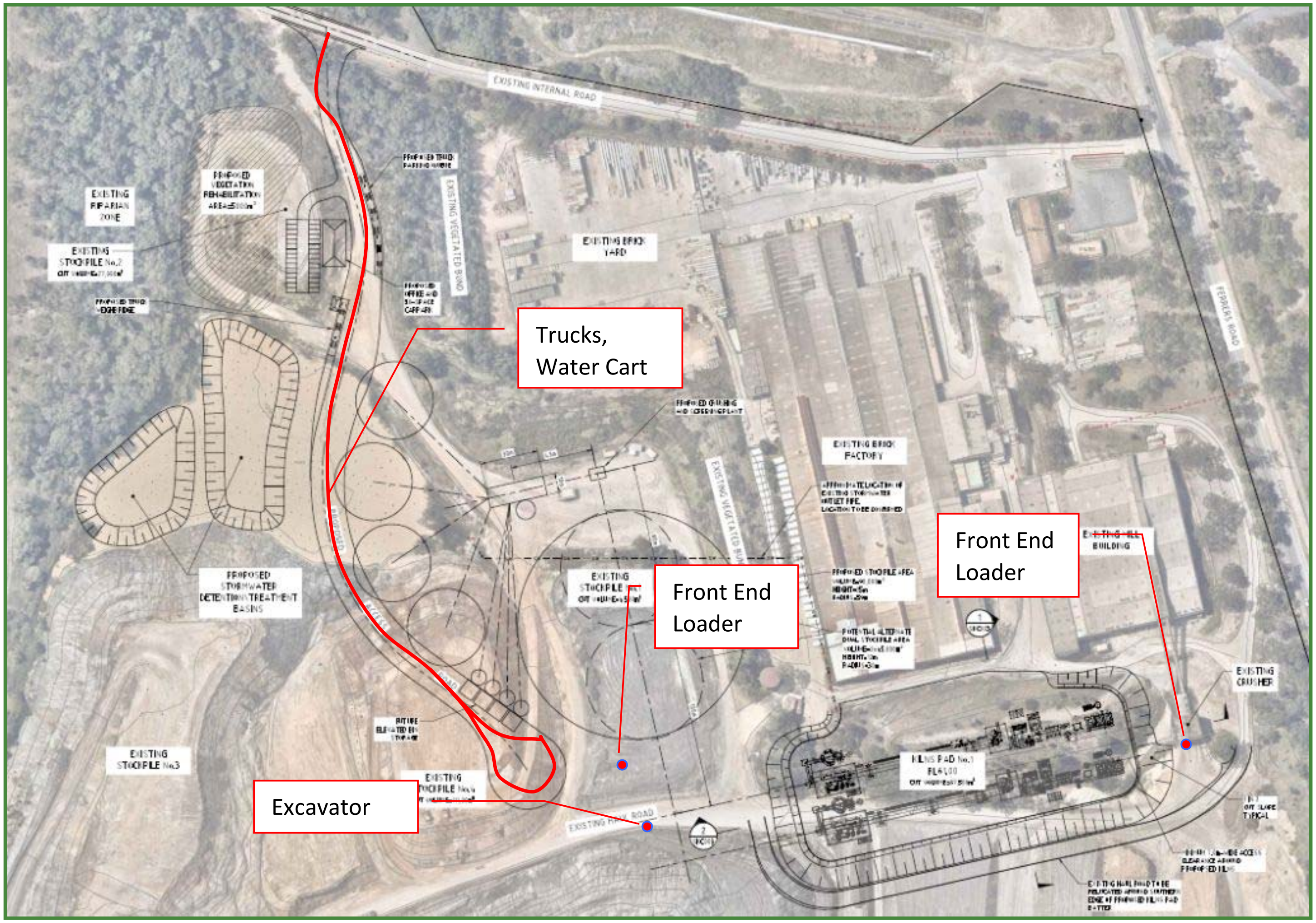


Figure 7-3: Operational Noise Source Locations – On Site Vehicles



7.2 MODELLING METHODOLOGY

7.2.1 Noise Model

Predictive Noise Modelling was carried out in SoundPLAN v7.3 using the Concawe and CoRTN algorithms when assessing construction/operational and road traffic noise respectively. This model has been extensively utilised by BE for assessing noise emissions for existing and proposed developments, and is recognised by regulatory authorities throughout Australia. The model allows for the prediction of noise from a site, at the specified receptor, by calculating the contribution of each noise source.

The noise sources as well as the topographical features of the subject area, surrounding buildings and receiver locations, were all input into the noise model to determine the noise emissions of the proposed development at the nearest potentially affected residences.

The modelling scenario has been carried out using both $L_{Aeq,\ 15\ minutes}$ and L_{Amax} descriptors when assessing operational noise whilst $L_{Aeq,\ 15\ hours}$ and $L_{Aeq,\ 9\ hours}$ when assessing road traffic noise. Using these descriptors, noise emission levels were predicted at the nearest potentially affected sensitive receptors to determine the noise impact against the relevant noise criteria in accordance with the INP and RNP.

7.2.2 General Assumptions Made for Noise Modelling

It should be noted that the relevant assessment period for construction and operational noise emissions has been considered to be 15 minutes. Therefore noise source durations detailed in the following assumptions should be considered per 15 minute period in view of potential noise impacts under worst-case scenarios. Each assessment-specific assumption has been detailed below:

- Off-site topographical information was obtained from the Department of Lands, Six Maps, with contour maps having intervals of 10 m. However, this area was observed to be relatively flat.
- All Receptors were modelled at 1.5 m above ground level.
- On site ground areas have been modelled considering ground factor of 0 (hard surface).
- Off site ground areas have been modelled considering a conservative ground factor of 0.5.

7.2.2.1 Assumptions Made for Noise Modelling – Construction Works

- Construction activities would typically be undertaken between 7.00am and 6.00pm Monday to Saturday, public holidays excluded, with some specialised activities and maintenance undertaken outside these core hours. Construction of the proposed concrete batching plant is expected to take approximately 6 months;
- All noise sources have been modelled as point sources at several heights within the area of the proposed activities. The operation of all noise sources were considered to be operating during 100% of the time. This would provide a worst case scenario; and

- Construction works have been considered to take place within the proposed kilns area.

7.2.2.2 Assumptions Made for Noise Modelling – Operational Activities

- Trucks have been modelled considering two moving point sources at heights of 1.5 m and 3 m above ground level in order to account for the engine (1.5 m) and the exhaust outlet (3 m). An on-site speed of 10 km/hr has been considered.

- All noise sources associated with the proposed kilns have been modelled as point sources and will be operational for 100% of the assessment period.

- The conveyor belts have been modelled as a line source and will be operational for 100% of the assessment period.

- The front-end has been modelled as a point source at 1.5 m above ground level and will be operational for 100% of the assessment period.

- The proposed crusher is located within a building made of 0.42BMT colorbond and 20% of this is open.

- All noise sources have been considered to operate simultaneously for 100% of the time over any 15 minute period.

- The site is operational 24/7.

- Noise generating activities were assessed over a 15 minute assessment period.

- The SoundPLAN function "Hallout (In>Out)" was utilised to calculate the noise breakout through all Existing and Proposed buildings.

- The proposed burner is located within a building made of 0.42BMT colorbond.

- The noise breakout through the stack walls has been assumed to be negligible as the expected thickness of the stack walls would be sufficient in order to minimize the breakout effect. This would need to be adequately selected at a later stage of the development.

7.2.2.3 Assumptions Made for Noise Modelling – Road Traffic

The relevant assessment period for road traffic noise emissions is 15 hours for the day and 9 hours for the night. Each assessment-specific assumption has been detailed below:

- Several factors such as gradient, road surface and mean speed have been considered.

- A total of 60 additional truck movements per day have been considered. 60 trucks per day over the 15-hour day time period have been conservatively considered.

- 30 trucks over 9-hour night time periods on Wallgrove Road have been considered in order to assess the road traffic noise impact at receptor R1 and R2.

- This information was based on the Traffic Impact Assessment prepared for the project.

7.2.3 Noise Modelling Scenarios

7.2.3.1 Construction Scenarios

Two (2) model scenarios were configured to provide a realistic assessment of potential construction noise emissions under the worst case scenarios. Details of the modelled scenarios are provided in Table 7-3 below.

Table 7-3: Modelled Noise Scenarios for Proposed Operations

Scenario/ Time Period	Construction Noise Sources
Construction Scenario 1 Cut, Fill and Drainage Works 7.00am and 6.00pm Monday to Saturday	• 1 x Excavator • 1 x Back Hoe • 1 x Dump truck • 1 x Roller • 1 x Dozer • 1 x Scraper • 1 x Grader • 1 x trencher • 3 x Diesel Pumps
Construction Scenario 2 Construction of Kiln and Crushing/ Screening Plant 7.00am and 6.00pm Monday to Saturday	• 1 x Concrete cutter • 1 x Concrete truck • 1 x Articulated truck • 1 x Grinding • 1 x Welding • 1 x Crane • 1 x Dump truck • 3 x Diesel Pumps

7.2.3.2 Operational Scenario

Table 7-4: Modelled Noise Scenarios for Proposed Operations

Scenario/ Time Period	Noise Sources for Worst 15-minute Period
Operational Scenario 1 Day and Evening and Night	• 1 x Brick Factory • 1 x Existing Crusher • 1 x Truck movement over 15 minute period • 2 x Kiln • 1 x Proposed Crusher • 2 x Vibrating Screens • 13 x Conveyor Belt

7.3 PREDICTED NOISE LEVELS

7.3.1 Construction Works Predicted Noise Levels

Results of the predictive noise modelling considering construction activities are shown in Table 7-5.

Table 7-5: Noise Modelling Results, dB(A)

Receptor	Predicted Noise Levels		PSNL
	Day $L_{eq,\ 15min}$		Recommended Standard hours
	Construction		
	Scenario 1	Scenario 2	
Residential Receptors			
R1	36 ✓	25 ✓	64
R2	35 ✓	24 ✓	64
R3	33 ✓	<20 ✓	56
R4	38 ✓	34 ✓	56
R5	48 ✓	45 ✓	56
R6	48 ✓	45 ✓	56
R7	48 ✓	45 ✓	56
R8	48 ✓	44 ✓	56
R9	43 ✓	38 ✓	56
Public Recreational Areas			
PR1	41 ✓	49 ✓	60
Industrial Receptors			
I1	38 ✓	32 ✓	75
I2	42 ✓	37 ✓	75
I3	51 ✓	50 ✓	75
I4	46 ✓	58 ✓	75
I5	36 ✓	24 ✓	75

<u>Comments</u>:

The noise impact associated with construction activities was predicted to comply with the project specific noise levels at all receptors.

7.3.2 Operational Predicted Noise Levels

Results of the predictive noise modelling without considering any control measures are shown in Table 7-6.

Table 7-6: Noise Modelling Results, dB(A) – Neutral Weather Conditions

Receptor	Operational Scenario 1							
	Predicted Noise Levels				PSNL			
	Day $L_{eq,\ 15min}$	Evening $L_{eq,\ 15min}$	Night $L_{eq,\ 15min}$	Night L_{max}	Day $L_{eq,\ 15min}$	Evening $L_{eq,\ 15min}$	Night $L_{eq,\ 15min}$	Night L_{max}
Residential Receptors								
R1	48 ✓	48 ✓	48 ✓	48 ✓	59	55	51	55
R2	45 ✓	45 ✓	45 ✓	45 ✓	59	55	51	55
R3	41 ✓	41 ✓	41 ✓	41 ✓	51	51	45	55
R4	46 ✓	46 ✓	46 ✗	46 ✓	51	51	39	55
R5	50 ✓	50 ✓	50 ✗	50 ✓	51	50	41	55
R6	51 ✓	51 ✓	51 ✗	51 ✓	51	51	45	55
R7	50 ✓	50 ✓	50 ✗	50 ✓	51	51	45	55
R8	50 ✓	50 ✓	50 ✗	50 ✓	51	51	45	55
R9	48 ✓	48 ✓	48 ✗	48 ✓	51	51	45	55
Public Recreational Areas								
PR1	54 ✗	-	-	-	50	-	-	-
Industrial Receptors								
I1	45 ✓	45 ✓	45 ✓	-	70	-	-	-
I2	50 ✓	50 ✓	50 ✓	-	70	-	-	-
I3	57 ✓	57 ✓	57 ✓	-	70	-	-	-
I4	61 ✓	61 ✓	61 ✓	-	70	-	-	-
I5	43 ✓	43 ✓	43 ✓	-	70	-	-	-

Table 7-7: Noise Modelling Results, dB(A) – Adverse Weather Conditions

Receptor	Operational Scenario 1							
	Predicted Noise Levels				PSNL			
	Day $L_{eq, 15min}$	Evening $L_{eq, 15min}$	Night $L_{eq, 15min}$	Night L_{max}	Day $L_{eq, 15min}$	Evening $L_{eq, 15min}$	Night $L_{eq, 15min}$	Night L_{max}
Residential Receptors								
R1	53 ✓	53 ✓	53 ✗	53 ✓	59	55	51	55
R2	50 ✓	50 ✓	50 ✓	50 ✓	59	55	51	55
R3	44 ✓	44 ✓	44 ✓	44 ✓	51	51	45	55
R4	50 ✓	50 ✓	50 ✗	50 ✓	51	51	39	55
R5	53 ✗	53 ✗	53 ✗	53 ✓	51	50	41	55
R6	54 ✗	54 ✗	54 ✗	54 ✓	51	51	45	55
R7	54 ✗	54 ✗	54 ✗	54 ✓	51	51	45	55
R8	53 ✗	53 ✗	53 ✗	53 ✓	51	51	45	55
R9	52 ✗	52 ✗	52 ✗	52 ✓	51	51	45	55
Public Recreational Areas								
PR1	-	-	-	-	-	-	-	-
Industrial Receptors								
I1	50 ✓	50 ✓	50 ✓	-	70	-	-	-
I2	55 ✓	55 ✓	55 ✓	-	70	-	-	-
I3	61 ✓	61 ✓	61 ✓	-	70	-	-	-
I4	64 ✓	64 ✓	64 ✓	-	70	-	-	-
I5	48 ✓	48 ✓	48 ✓	-	70	-	-	-

Note: - indicates Not Applicable.
Public Recreational Areas not expected to be utilised when temperature inversion occur (night time/ early morning).

Comments:

The noise impact associated with operational activities was predicted to comply with the project specific noise levels at all industrial receptors when assessing L_{Aeq} descriptors under both neutral and adverse weather conditions.

Under neutral weather conditions the noise levels associated with the site's operations were predicted to comply with the PSNL during day and evening times.

During night-time the noise levels exceed the PSNL at receptors R4, R5, R6, R7, R8 and R9 by up to 9 dB.

Noise levels were predicted to comply with the noise criteria at location R2 and R3 under both neutral and temperature inversion conditions. A marginal exceedance would occur at location R1 under noise enhancing weather conditions.

The noise levels associated with the existing and proposed operations have been predicted to exceed the PSNL at location R5 to R9 during day, evening and night time under adverse weather conditions. At location R4 exceedance would occur during night time only.

At the public recreation area identified, the noise levels were predicted to exceed the PNSL. However, no sensitive use of the area was observed at this location.

7.4 NOISE MITIGATION MEASURES

In order to significantly reduce the noise emissions associated with the existing and proposed operations a number of noise mitigation measures shall be put in place.

A 10-metre high earth berm is required to the south of the existing crusher. The berm shall be located as close as practicable to the existing crusher building. The relative height of the berm should be maintained at 79 m Ahd. The location of the berm based on the current proposed site layout is shown in Figure 7-4. Alternative noise control measures can be investigated in order to reduce the noise contribution from the existing crusher. Relocation of the berm may also be considered.

A noise reduction of at least 15 dB(A) is required for source no. 1 and no. 2 (Vent Stack and Vent Fan). This can be achieved through the installation of a silencer at the air fan outlet. The source n.2 Vent Fan would need to achieve a maximum sound pressure level of 93 dB(A) at 1 metre. The in-duct sound power level generated shall not exceed 103 dB(A).

A noise reduction of at least 10 dB is to be achieved by the two cyclones (source no.15). Similarly, this can be achieved by utilising an acoustic enclosure or acoustic wall around the pumps or by selecting a cyclone that would generate less than 86 dB(A) at 1 metre.

A 15 dB(A) noise reduction would be required also for the two proposed Throttle Valves. The sound power level for this noise source was assumed to be equal to 108 dB(A). The proposed throttle valve shall achieve a sound power level of 93 dB(A) or less. This would result in a sound pressure level of 83 dB(A) at 1 metre.

The opening present to the western side of the existing crusher building would need to be sealed by using a 0.42BMT colorbond steel or alternative.

The proposed crusher building would need to be constructed of a double cladding system of 0.48 BMT steel having a 200 mm air gap filled with insulating material.

The buildings located around the burner would need to be constructed using a double cladding system of 0.48 BMT steel having a 200 mm air gap filled with insulating material.

Alternative construction materials can be selected in order to achieve an Rw of 30 dB. Lightweight systems are not recommended due to their poor sound reduction index provided for the low frequency range.

Table 7-8 summarises the requirements for several noise sources identified as primarily contributing to the predicted noise levels and requiring noise control measures.

Figure 7-4: Earth Berm Location

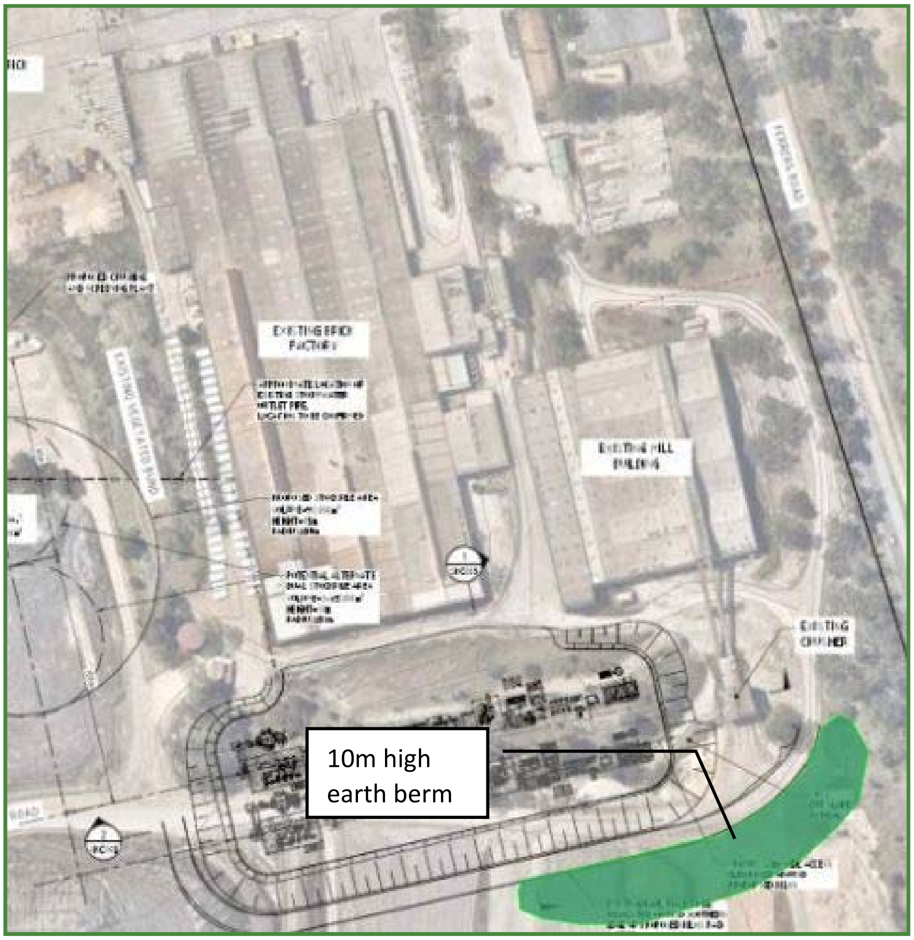


Table 7-8: Noise Sources Requirements and noise controls

Source ID	Noise Source	Assumed SPL at 1 metre	Recommended SPL at 1 metre	Noise Control Measures*
1	Vent Stack	108	93	Silencer
2	Vent Fan	108	93	Acoustic enclosure achieving 15 dB reduction or selection of adequate equipment or alternative noise control measure
15	Cyclone	94	86	Acoustic enclosure achieving 15 dB reduction or selection of adequate equipment or alternative noise control measure
17	Throttle Valve	98	83	Acoustic enclosure achieving 15 dB reduction or selection of adequate equipment or alternative noise control measure
25	Stack	108	93	Silencer

7.4.1 Predicted Noise Levels – With Noise Controls

The predicted noise levels at the considered residential locations after the implementation of the noise control measures listed in Table 7-8 above are shown in Table 7-9 and Table 7-10. In this scenario all the noise sources are considered to comply with the requirements specified in Table 7-8.

Table 7-9: Noise Modelling Results, dB(A) – Neutral Weather Conditions

Receptor	Predicted Noise Levels				PSNL			
	Day $L_{eq, 15min}$	Evening $L_{eq, 15min}$	Night $L_{eq, 15min}$	Night L_{max}	Day $L_{eq, 15min}$	Evening $L_{eq, 15min}$	Night $L_{eq, 15min}$	Night L_{max}
Residential Receptors								
R1	46 ✓	46 ✓	46 ✓	46 ✓	59	55	51	55
R2	42 ✓	42 ✓	42 ✓	42 ✓	59	55	51	55
R3	36 ✓	36 ✓	36 ✓	36 ✓	51	51	45	55
R4	39 ✓	39 ✓	39 ✓	39 ✓	51	51	39	55
R5	41 ✓	41 ✓	41 ✓	41 ✓	51	50	41	55
R6	42 ✓	42 ✓	42 ✓	42 ✓	51	51	45	55
R7	41 ✓	41 ✓	41 ✓	41 ✓	51	51	45	55
R8	42 ✓	42 ✓	42 ✓	42 ✓	51	51	45	55
R9	39 ✓	39 ✓	39 ✓	39 ✓	51	51	45	55
Public Recreational Areas								
PR1	50 ✓	-	-	-	50	-	-	-
Industrial Receptors								
I1	41 ✓	41 ✓	41 ✓	-	70	-	-	-
I2	45 ✓	45 ✓	45 ✓	-	70	-	-	-
I3	55 ✓	55 ✓	55 ✓	-	70	-	-	-
I4	58 ✓	58 ✓	58 ✓	-	70	-	-	-
I5	36 ✓	36 ✓	36 ✓	-	70	-	-	-

Table 7-10: Noise Modelling Results, dB(A) – Adverse Weather Conditions

Receptor	Predicted Noise Levels				PSNL			
	Day $L_{eq, 15min}$	Evening $L_{eq, 15min}$	Night $L_{eq, 15min}$	Night L_{max}	Day $L_{eq, 15min}$	Evening $L_{eq, 15min}$	Night $L_{eq, 15min}$	Night L_{max}
Residential Receptors								
R1	51 ✓	51 ✓	51 ✓	51 ✓	59	55	51	55
R2	46 ✓	46 ✓	46 ✓	46 ✓	59	55	51	55
R3	40 ✓	40 ✓	40 ✓	40 ✓	51	51	45	55
R4	43 ✓	43 ✓	43 ✗	43 ✓	51	51	39	55
R5	45 ✓	45 ✓	45 ✗	45 ✓	51	50	41	55
R6	45 ✓	45 ✓	45 ✓	45 ✓	51	51	45	55
R7	45 ✓	45 ✓	45 ✓	45 ✓	51	51	45	55
R8	45 ✓	45 ✓	45 ✓	45 ✓	51	51	45	55
R9	43 ✓	43 ✓	43 ✓	43 ✓	51	51	45	55
Public Recreational Areas								
PR1	-	-	-	-	-	-	-	-
Industrial Receptors								
I1	45 ✓	45 ✓	45 ✓	-	70	-	-	-
I2	50 ✓	50 ✓	50 ✓	-	70	-	-	-
I3	59 ✓	59 ✓	59 ✓	-	70	-	-	-
I4	61 ✓	61 ✓	61 ✓	-	70	-	-	-
I5	41 ✓	41 ✓	41 ✓	-	70	-	-	-

Note: - indicates Not Applicable
Public Recreational Areas not expected to be utilised when temperature inversion occur (night time/early morning)

Comments:

The noise impact associated with operational activities was predicted to comply with the project specific noise levels at all industrial receptors when assessing L_{Aeq} descriptors under both neutral and adverse weather conditions.

The noise impact associated with operational activities was predicted to comply with the project specific noise levels at all residential receptors when assessing L_{Aeq} descriptors under neutral weather conditions.

Under noise enhancing weather conditions the predicted noise levels would exceed the PSNL at location R4 and R5.

At location R4 the night-time amenity acceptable noise level of 45 dB(A) is currently exceeded. This is due to the presence of a meter station which generates a noise level of 49 dB(A) at the boundary of location R4.

The Cumulative Noise Impact at receptor R4 would result in 50 dB(A). This corresponds to the recommended maximum noise level for urban areas stipulated by the NSW EPA Industrial Noise Policy. However, no significant increase in the current ambient noise levels at location R4 is expected.

Similarly for location R5, the current existing noise level associated with the meter station is 43 dB(A). This would result in a cumulative noise level of 47 dB(A). This would exceed the amenity acceptable noise level by 2 dB. This is considered to be a marginal exceedance and unlikely to result in a disruptive noise emission from the site.

7.4.2 Alternative Mobile Triple Deck Double Screen

An additional scenario has been implemented by considering the use of a mobile triple deck double screen (Sandvik QA450). The noise data was obtained from the manufacturer.

A sound power level of 113 dB(A) was considered.

The resultant cumulative noise levels at the nearest considered receptors was predicted to increase by up to 1dB under noise enhancing weather conditions. This is not considered a significant increase in noise levels.

In addition to the exceedances predicted at location R4 and R5, marginal exceedances (1 dB) during night time were predicted at location R6 and R8. The predicted $L_{eq(15\ minute)}$ noise levels at location R6 and R8 is equal to 46 dB(A) under noise enhancing weather conditions.

Compliance would be achieved at all receptors under neutral weather conditions.

7.4.3 Alternative Mobile Crushers

The use of mobile crushers (Jaw Crusher and Cone Crusher) was also investigated. Sound Power Levels up to 119 dB(A) were considered based on manufacturer data.

Exceedances up to 5 dB above criteria were predicted at the residential receptors when considering the use of a mobile crusher outdoor. Implementation of noise control measures, such as noise barriers, would be necessary in order to reduce the noise emissions associated with the mobile crusher.

In addition, as the noise emissions associated with the crushers is dependant on their orientation, investigation on best equipment orientation and noise directivity would be necessary.

7.4.4 Road Traffic Predicted Noise Levels

The main road traffic noise impact would occur on receptors located along Wallgrove Road. For the purpose of assessing the Road Traffic Noise impact, receptors R1 and R2 have been considered in the assessment.

An average of 60 truck movements per day has been considered in this assessment. The distribution of trucks during the day would vary. Generally the majority of traffic movements would occur between 6am and 6pm. Road traffic noise associated with staff cars would be negligible.

Although this is considered to generate negligible noise increases on the existing road traffic noise, this scenario has been implemented in the noise model in order to predict the noise impacts.

Results of the predictive noise modelling are shown in Table 7-11.

Table 7-11: Predicted Noise Levels Associated with Road Traffic, dB(A)

Receptor along Wallgrove Rd	Period	Existing Road Traffic Noise L_{eq}	Predicted Additional Road Traffic Noise	Cumulative Road Traffic Noise $L_{eq,15 \text{ or } 9 \text{ hour}}$	PSNL $L_{eq,15 \text{ or } 9 \text{ hour}}$
R1	Day	67	48	67 ✓	69
	Night	62	47	62 ✓	64
R2	Day	67	49	67 ✓	69
	Night	62	47	62 ✓	64

<u>Comments</u>:

The noise impact associated with site road traffic was predicted to readily comply with the project specific noise levels when assessing L_{Aeq} descriptor. The additional noise impact on Wallgrove Road due to truck movements associated with the proposed development was predicted to readily comply with the assessment criteria and therefore the increase on the existing road traffic noise levels would be negligible.

8. STATEMENT OF POTENTIAL NOISE IMPACT

A noise impact assessment was undertaken to assess the noise emissions associated with the proposed alterations and additions to the existing Brickworks facility located at 780 Wallgrove Road, Horsley Park.

In particular, this report details the findings of construction, operational and road traffic noise impacts from the proposed operations.

The noise survey and assessment was undertaken in accordance with the following guidelines:

- *Department of Environment and Climate Change NSW, Interim Construction Noise Guideline (DECC 2009);*
- *NSW Environment Protection Authority, Industrial Noise Policy (EPA 2000) (INP); and*
- *Department of Environment, Climate Change and Water NSW, Road Noise Policy (DECCW 2011)(RNP).*

The noise impact associated with construction and operational activities is predicted to comply with the project specific noise levels at all considered receptors when assessing L_{Aeq} and L_{Amax} descriptors.

The additional traffic associated with the proposed operations is minimal compared to existing traffic volumes and would not significantly increase the existing road traffic noise.

The noise emissions associated with the operations of the proposed kilns and crushing and screening plant was predicted to exceed the project specific noise levels at the majority of the residential receptors when no noise control measures were implemented.

A series of noise mitigation measures and/or noise emission requirements have been listed in this report in order to significantly reduce the noise levels associated with the proposed operations.

Compliance with the noise limits has been predicted for all receptors under neutral weather conditions. However, under noise enhancing weather conditions a marginal exceedance was predicted at location R4 and R5. This is due to the existing crusher located within Plant 2. The marginal exceedances of the amenity criteria are considered not to be of significant impact and the predicted cumulative noise levels are below the recommended maximum amenity noise levels.

In order to verify all assumptions made, and strengthen all conclusions drawn, the undertaking of post-commissioning validation measurements is recommended during construction and operational stages. This investigation would allow the operators to determine if further noise control measures are required to be implemented on-site.

This concludes the report.

Prepared by:

Daniele Albanese	R T Benbow
Senior Acoustic Consultant	Principal Consultant

9. LIMITATIONS

Our services for this project are carried out in accordance with our current professional standards for site assessment investigations. No guarantees are either expressed or implied.

This report has been prepared solely for the use of Brickworks Ltd, as per our agreement for providing environmental services. Only Brickworks Ltd is entitled to rely upon the findings in the report within the scope of work described in this report. Otherwise, no responsibility is accepted for the use of any part of the report by another in any other context or for any other purpose.

Although all due care has been taken in the preparation of this study, no warranty is given, nor liability accepted (except that otherwise required by law) in relation to any of the information contained within this document. We accept no responsibility for the accuracy of any data or information provided to us by Brickworks Ltd for the purposes of preparing this report.

Any opinions and judgements expressed herein, which are based on our understanding and interpretation of current regulatory standards, should not be construed as legal advice.

ATTACHMENTS

Attachment 1: Noise Terminology

‘A’ FREQUENCY WEIGHTING

The ‘A’ frequency weighting roughly approximates to the Fletcher-Munson 40 phon equal loudness contour. The human loudness perception at various frequencies and sound pressure levels is equated to the level of 40 dB at 1 kHz. The human ear is less sensitive to low frequency sound and very high frequency sound than midrange frequency sound (i.e. 500 Hz to 6 kHz). Humans are most sensitive to midrange frequency sounds, such as a child’s scream. Sound level meters have inbuilt frequency weighting networks that very roughly approximates the human loudness response at low sound levels. It should be noted that the human loudness response is not the same as the human annoyance response to sound. Here low frequency sounds can be more annoying than midrange frequency sounds even at very low loudness levels. The ‘A’ weighting is the most commonly used frequency weighting for occupational and environmental noise assessments. However, for environmental noise assessments, adjustments for the character of the sound will often be required.

AMBIENT NOISE

The ambient noise level at a particular location is the overall environmental noise level caused by all noise sources in the area, both near and far, including all forms of traffic, industry, lawnmowers, wind in foliage, insects, animals, etc. Usually assessed as an energy average over a set time period ‘T’ (L_{Aeq},T).

AUDIBLE

Audible refers to a sound that can be heard. There are a range of audibility grades, varying from “barely audible”, “just audible” to “clearly audible” and “prominent”.

BACKGROUND NOISE LEVEL

Total silence does not exist in the natural or built-environments, only varying degrees of noise. The Background Noise Level is the minimum repeatable level of noise measured in the absence of the noise under investigation and any other short-term noises such as those caused by all forms of traffic, industry, lawnmowers, wind in foliage, insects, animals, etc.. It is quantified by the noise level that is exceeded for 90 % of the measurement period ‘T’ (L_{A90}, T). Background Noise Levels are often determined for the day, evening and night time periods where relevant. This is done by statistically analysing the range of time period (typically 15 minute) measurements over multiple days (often 7 days). For a 15 minute measurement period the Background Noise Level is set at the quietest level that occurs at 1.5 minutes.

‘C’ FREQUENCY WEIGHTING

The ‘C’ frequency weighting approximates the 100 phon equal loudness contour. The human ear frequency response is more linear at high sound levels and the 100 phon equal loudness contour attempts to represent this at various frequencies at sound levels of approximately 100 dB.

DECIBEL

The decibel (dB) is a logarithmic scale that allows a wide range of values to be compressed into a more comprehensible range, typically 0 dB to 120 dB. The decibel is ten times the logarithm of the ratio of any two quantities that relate to the flow of energy (i.e. power). When used in acoustics it is the ratio of square of the sound pressure level to a reference sound pressure level, the ratio of the sound power level to a reference sound power level, or the ratio of the sound intensity level to a reference sound intensity level. See also Sound Pressure Level and Sound Power Level. Noise levels in decibels cannot be added arithmetically since they are logarithmic numbers. If one machine is generating a noise level of 50 dB, and another similar machine is placed beside it, the level will increase to 53 dB (from $10 \log_{10} (10^{(50/10)} + 10^{(50/10)})$ and not 100 dB. In theory, ten similar machines placed side by side will increase the sound level by 10 dB, and one hundred machines increase the sound level by 20 dB. The human ear has a vast sound-sensitivity range of over a thousand billion to one so the logarithmic decibel scale is useful for acoustical assessments.

dBA – See 'A' frequency weighting

dBC – See 'C' frequency weighting

EQUIVALENT CONTINUOUS SOUND LEVEL, LAeq

Many sounds, such as road traffic noise or construction noise, vary repeatedly in level over a period of time. More sophisticated sound level meters have an integrating/averaging electronic device inbuilt, which will display the energy time-average (equivalent continuous sound level - L_{Aeq}) of the 'A' frequency weighted sound pressure level. Because the decibel scale is a logarithmic ratio, the higher noise levels have far more sound energy, and therefore the LAeq level tends to indicate an average which is strongly influenced by short term, high level noise events. Many studies show that human reaction to level-varying sounds tends to relate closer to the L_{Aeq} noise level than any other descriptor.

'F'(FAST) TIME WEIGHTING

Sound level meter design-goal time constant which is 0.125 seconds.

FLETCHER–MUNSON EQUAL LOUDNESS CONTOUR CURVES

The Fletcher–Munson curves are one of many sets of equal loudness contours for the human ear, determined experimentally by Harvey Fletcher and Wilden A. Munson, and reported in a 1933 paper entitled "Loudness, its definition, measurement and calculation" in the Journal of the Acoustic Society of America.

FREE FIELD

In acoustics a free field is a measurement area not subject to significant reflection of acoustical energy. A free field measurement is typically not closer than 3.5 metres to any large flat object (other than the ground) such as a fence or wall or inside an anechoic chamber.

FREQUENCY

The number of oscillations or cycles of a wave motion per unit time, the SI unit is the hertz (Hz). 1 Hz is equivalent to one cycle per second. 1000 Hz is 1 kHz.

IMPACT ISOLATION CLASS (IIC)

The American Society for Testing and Materials (ASTM) has specified that the IIC of a floor/ceiling system shall be determined by operating an ISO 140 Standard Tapping Machine on the floor and measuring the noise generated in the room below. The IIC is a number found by fitting a reference curve to the measured octave band levels and then deducting the sound pressure level at 500 Hz from 110 decibels. Thus the higher the IIC, the better the impact sound isolation. Not commonly used in Australia.

'I' (IMPULSE) TIME WEIGHTING

Sound level meter time constant now not in general use. The 'I' (impulse) time weighting is not suitable for rating impulsive sounds with respect to their loudness. It is also not suitable for assessing the risk of hearing impairment or for determining the 'impulsiveness' of a sound.

IMPACT SOUND INSULATION ($L_{nT,w}$)

Australian Standard AS ISO 717.2 – 2004 has specified that the Impact Sound Insulation of a floor/ceiling system be quantified by operating an ISO 140 Standard Tapping Machine on the floor and measuring the noise generated in the room below. The Weighted Standardised Impact Sound Pressure Level ($L_{nT,w}$) is the sound pressure level at 500 Hz for a reference curve fitted to the measured 1/3 octave band levels. Thus the lower $L_{nT,w}$ the better the impact sound insulation.

IMPULSE NOISE

An impulse noise is typified by a sudden rise time and a rapid sound decay, such as a hammer blow, rifle shot or balloon burst.

LOUDNESS

The volume to which a sound is audible to a listener is a subjective term referred to as loudness. Humans generally perceive an approximate doubling of loudness when the sound level increases by about 10 dB and an approximate halving of loudness when the sound level decreases by about 10 dB.

MAXIMUM NOISE LEVEL, LAFmax

The root-mean-square (rms) maximum sound pressure level measured with sound level meter using the 'A' frequency weighting and the 'F' (Fast) time weighting. Often used for noise assessments other than aircraft.

MAXIMUM NOISE LEVEL, LASmax

The root-mean-square (rms) maximum sound pressure level measured with sound level meter using the 'A' frequency weighting and the 'S' (Slow) time weighting. Often used for aircraft noise assessments.

NOISE RATING NUMBERS

A set of empirically developed equal loudness curves has been adopted as Australian Standard AS1469-1983. These curves allow the loudness of a noise to be described with a single NR number. The Noise Rating number is that curve which touches the highest level on the measured spectrum of the subject noise. For broadband noise such as fans and engines, the NR number often equals the 'A' frequency weighted dB level minus five.

NOISE

Noise is unwanted, harmful or inharmonious (discordant) sound. Sound is wave motion within matter, be it gaseous, liquid or solid. Noise usually includes vibration as well as sound.

NOISE REDUCTION COEFFICIENT – See: "Sound Absorption Coefficient"

OFFENSIVE NOISE

Reference: Dictionary of the NSW Protection of the Environment Operations Act 1997). "Offensive Noise means noise:
(a) that, by reason of its level, nature, character or quality, or the time at which it is made, or any other circumstances:
(i) is harmful to (or likely to be harmful to) a person who is outside the premise from which it is emitted, or
(ii) interferes unreasonably with (or is likely to interfere unreasonably with) the comfort or repose of a person who is outside the premises from which it is emitted, or
(b) that is of a level, nature, character or quality prescribed by the regulations or that is made at a time, or in other circumstances prescribed by the regulations."

PINK NOISE

Pink noise is a broadband noise with an equal amount of energy in each octave or third octave band width. Because of this, Pink Noise has more energy at the lower frequencies than White Noise and is used widely for Sound Transmission Loss testing.

REVERBERATION TIME, T60

The time in seconds, after a sound signal has ceased, for the sound level inside a room to decay by 60 dB. The first 5 dB decay is often ignored, because of fluctuations that occur while reverberant sound conditions are being established in the room. The decay time for the next 30 dB is measured and the result doubled to determine the T_{60}. The Early Decay Time (EDT) is the slope of the decay curve in the first 10 dB normalised to 60 dB.

SOUND ABSORPTION COEFFICIENT, α

Sound is absorbed in porous materials by the viscous conversion of sound energy to a small amount of heat energy as the sound waves pass through it. Sound is similarly absorbed by the flexural bending of internally damped panels. The fraction of incident energy that is absorbed is termed the Sound Absorption Coefficient, α. An absorption coefficient of 0.9 indicates that 90% of the incident sound energy is absorbed. The average α from 250 to 2 kHz is termed the Noise Reduction Coefficient (NRC).

'S' (SLOW) TIME WEIGHTING

Sound level meter design-goal time constant which is 1 second.

SOUND ATTENUATION

A reduction of sound due to distance, enclosure or some other devise. If an enclosure is placed around a machine, or an attenuator (muffler or silencer) is fitted to a duct, the noise emission is reduced or attenuated. An enclosure that attenuates the noise level by 20 dB reduces the sound energy by one hundred times.

SOUND EXPOSURE LEVEL (LAE)

Integration (summation) rather than an average of the sound energy over a set time period. Use to assess single noise events such as truck or train pass by or aircraft flyovers. The sound exposure level is related to the energy average (L_{Aeq}, T) by the formula L_{Aeq}, T = L_{AE} – 10 $\log_{10}$ T. The abbreviation (SEL) is sometimes inconsistently used in place of the symbol (L_{AE}).

SOUND PRESSURE

The rms sound pressure measured in pascals (Pa). A pascal is a unit equivalent to a newton per square metre (N/m^2).

SOUND PRESSURE LEVEL, Lp

The level of sound measured on a sound level meter and expressed in decibels (dB). Where L_P = 10 $\log_{10}$ $(Pa/Po)^2$ dB (or 20 log10 (Pa/ Po) dB) where Pa is the rms sound pressure in Pascal and Po is a reference sound pressure conventionally chosen is 20 µPa (20 x 10^{-6} Pa) for airborne sound. L_p varies with distance from a noise source.

SOUND POWER

The rms sound power measured in watts (W). The watt is a unit defined as one joule per second. A measures the rate of energy flow, conversion or transfer.

SOUND POWER LEVEL, Lw

The sound power level of a noise source is the inherent noise of the device. Therefore sound power level does not vary with distance from the noise source or with a different acoustic environment. Lw = Lp + 10 $\log_{10}$ 'a' dB, re: 1pW, (10^{-12} watts) where 'a' is the measurement noise-emission area (m^2) in a free field.

SOUND TRANSMISSION CLASS (STC)

An internationally standardised method of rating the sound transmission loss of partition walls to indicate the sound reduction from one side of a partition to the other in the frequency range of 125 Hz to 4000 kHz. (Refer: Australian Standard AS 1276 – 1979). Now not in general use in Australia see: weighted sound reduction index.

SOUND TRANSMISSION LOSS

The amount in decibels by which a random sound is reduced as it passes through a sound barrier. A method for the measurement of airborne Sound Transmission Loss of a building partition is given in Australian Standard AS 1191 - 2002.

STATISTICAL NOISE LEVELS, Ln.

Noise which varies in level over a specific period of time 'T' (standard measurement times are 15 minute periods) may be quantified in terms of various statistical descriptors for example:-

- The noise level, in decibels, exceeded for 1 % of the measurement time period, when 'A' frequency weighted and 'F' time weighted is reference to as L_{AF1}, T. This may be used for describing short-term noise levels such as could cause sleep arousal during the night.
- The noise level, in decibels, exceeded for 10 % of the measurement time period, when 'A' frequency weighted and 'F' time weighted is reference to as L_{AF10}, T. In most countries the LAF10, T is measured over periods of 15 minutes, and is used to describe the average maximum noise level.
- The noise level, in decibels, exceeded for 90 % of the measurement time period, when 'A' frequency weighted and 'F' time weighted is reference to as L_{AF90}, T. In most countries the LAF90, T is measured over periods of 15 minutes, and is used to describe the average minim um or background noise level.

STEADY NOISE

Noise, which varies in level by 6 dB or less, over the period of interest with the time-weighting set to "Fast", is considered to be "steady" (refer AS 1055.1–1997).

WEIGHTED SOUND REDUCTION INDEX, Rw

This is a single number rating of the airborne sound insulation of a wall, partition or ceiling. The sound reduction is normally measured over a frequency range of 100 Hz to 3.150 kHz and averaged in accordance with ISO standard weighting curves (Refer AS/NZS 1276.1:1999). Internal partition wall Rw + C ratings are frequency weighted to simulate insulation from human voice noise. The R_w + C is similar in value to the STC rating value. External walls, doors and windows may be $R_w + C_{tr}$ rated to simulate insulation from road traffic noise. The spectrum adaptation term Ctr adjustment factor takes account of low frequency noise. The weighted sound reduction index is normally similar or slightly lower number than the STC rating value.

WHITE NOISE

White noise is broadband random noise whose spectral density is constant across its entire frequency range. The sound power is the same for equal bandwidths from low to high frequencies. Because the higher frequency octave bands cover a wider spectrum, white noise has more energy at the higher frequencies and sounds like a hiss.

'Z' FREQUENCY WEIGHTING

The 'Z' (Zero) frequency weighting is 0 dB within the nominal 1/3 octave band frequency range centred on 10 Hz to 20 kHz. This is within the tolerance limits given in AS IEC 61672.1–2004: 'Electroacoustics - Sound level meters – Specifications'.

Attachment 2: QA/QC Procedures

Calibration of Sound Level Meters

A sound level meter requires regular calibration to ensure its measurement performance remains within specification. Benbow Environmental sound level meters are calibrated by a National Association of Testing Authority (NATA) registered laboratory or a laboratory approved by the NSW Environment Protection Authority (EPA) every two years and after each major repair, in accordance with AS 1259-1990.

The calibration of the sound level meter was checked immediately before and after each series of measurements using an acoustic calibrator. The acoustic calibrator provides a known sound pressure level, which the meter indicates when the calibrator is activated while positioned on the meter microphone.

The sound level meters also incorporate an internal calibrator for use in setting up. This provides a check of the electrical calibration of the meter, but does not check the performance of the microphone. Acoustical calibration checks the entire instrument including the microphone. Calibration certificates for the instrument sets used have been included as Attachment 3.

Care and Maintenance of Sound Level Meters

Noise measuring equipment contains delicate components and therefore must be handled accordingly. The equipment is manufactured to comply with international and national standards and is checked periodically for compliance. The technical specifications for sound level meters used in Australia are defined in Australian Standard AS 1259 – 1990 "*Sound Level Meters*".

The sound level meters and associated accessories are protected during storage, measurement and transportation against dirt, corrosion, rapid changes of temperature, humidity, rain, wind, vibration, electric and magnetic fields. Microphone cables and adaptors are always connected and disconnected with the power turned off. Batteries are removed (with the instrument turned off) if the instrument is not to be used for some time.

Investigation Procedures

All investigative procedures were conducted in accordance with AS 1055.1–1997 *Acoustics – "Description and Measurement of Environmental Noise (Part 1: General Procedures)"*.

The following information was recorded and kept for reference purposes:

- type of instrumentation used and measurement procedure conducted;
- description of the time aspect of the measurements, ie. measurement time intervals; and
- positions of measurements and the time and date were noted.

As per AS 1055.1–1997, all measurements were carried out at least 3.5 m from any reflecting structure other than the ground. The preferred measurement height of 1.2 m above the ground was utilised. A sketch of the area was made identifying positions of measurement and the approximate location of the noise source and distances in meters (approx.).

Unattended Noise Monitoring

NOISE MONITORING EQUIPMENT

ARL noise loggers type Ngara and EL-215 were used to conduct the long-term unattended noise monitoring. This equipment complies with Australian Standard 1259.2–1990 "Acoustics – Sound Level Meters" and is designated as a Type 1 and Type 2 instrument suitable for field use.

The measured data is processed statistically and stored in memory every 15 minutes. The equipment was calibrated prior and subsequent to the measurement period using a Rion NC-73 sound level calibrator. There were no significant variances observed in the reference signal between the pre-measurement and post-measurement calibrations. Instrument calibration certificates have also been included in Attachment 3.

METEOROLOGICAL CONSIDERATION DURING MONITORING

For the long-term attended monitoring, meteorological data for the relevant period were provided by the Bureau of Meteorology, which was considered representative of the site for throughout the monitoring period.

DESCRIPTORS & FILTERS USED FOR MONITORING

Noise levels are commonly measured using A-weighted filters and are usually described as dB(A). The "A-weighting" refers to standardised amplitude versus frequency curve used to "weight" sound measurements to represent the response of the human ear. The human ear is less sensitive to low frequency sound than it is to high frequency sound. Overall A-weighted measurements quantify sound with a single number to represent how people subjectively hear different frequencies at different levels.

Noise environments can be described using various descriptors depending on characteristics of noise or purpose of assessments. For this survey the L_{A90} was used to analyse the monitoring results. The statistical descriptors L_{A90} measures the noise level exceeded for 90% of the sample measurement time, and is used to describe the “Background noise”. Background noise is the underlying level of noise present in the ambient noise, excluding extraneous noise or the noise source under investigation.

Measurement sample periods were fifteen minutes. The Noise -vs- Time graphs representing measured noise levels at the noise monitoring location are presented in Attachment 4.

ATTENDED NOISE MONITORING

NOISE MONITORING EQUIPMENT

The attended short-term noise monitoring was carried out using a SVANTEK SVAN957 Class 1 Precision Sound Level Meter. The instrument was calibrated by a NATA accredited laboratory within two years of the measurement period. The instrument sets comply with AS 1259 and was set on A-weighted, fast response.

The microphone was positioned at 1.5 metres above ground level and was fitted with a windsock. The instrument was calibrated using a Rion NC-73 sound level calibrator prior and subsequent to the measurement period to ensure the reliability and accuracy of the instrument sets. There were no significant variances observed in the reference signal between the pre-measurement and post-measurement calibrations. Instrument calibration certificates have also been included in Attachment 3.

WEATHER CONDITIONS
It was clear, find without significant breeze.

METHODOLOGY
The attended noise measurements were carried out generally in accordance with Australian Standard AS 1055-1997 - "Acoustics – Description and Measurement of Environmental Noise".

Attachment 3: Calibration Certificates

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Pennant Hills NSW AUSTRALIA 2120
Ph: +61 2 9484 0800 A.B.N. 65 160 399 119
www.acousticresearch.com.au

Calibration Certificate

Number : C13669

Client Details : Benbow Environmental
13 Daking Street
North Parramatta NSW 2151

Equipment Tested/ Model Number : **ARL Ngara**
Instrument Serial Number : 8780AC
Microphone Serial Number : 317859
Preamplifier Serial Number : 27984

Ambient Temperature : 23°C
Relative Humidity : 50%
Barometric Pressure : 100.4 kPa

Calibration Technician : Jeff Yu
Calibration Date : 04-December-2013
Secondary Check by : Sandra Minto
Report Issue Date : 09-December-2013
Approved Signatory :

Tested To : AS1259.1:1990
AS1259.2:1990

Comments : All tests passed for type 1

Clause and Characteristic Tested	Result	Clause and Characteristic Tested	Result
10.2.2: Absolute sensitivity	Pass	10.4.5: R.M.S performance	Pass
10.2.3: Frequency weighting	Pass	9.3.2: Time averaging	Pass
10.3.2: Overload indications	Pass	9.3.5: Overload indication	Pass
8.9: Detector-indicator linearity	Pass		
8.10: Differential level linearity	Pass		
10.3.4: Inherent weighted system noise level	Pass		
10.4.2: Time weighting characteristics F and S	Pass		

NATA
WORLD RECOGNISED ACCREDITATION

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Calibration Certificate

Number : C13670

Client Details :	Benbow Environmental 13 Daking Street North Parramatta NSW 2151
Equipment Tested/ Model Number :	**ARL Ngara**
Instrument Serial Number :	8780AD
Microphone Serial Number :	317856
Preamplifier Serial Number :	27983
Ambient Temperature :	23°C
Relative Humidity :	47%
Barometric Pressure :	100 kPa
Calibration Technician :	Adrian Walker
Calibration Date :	04-December-2013
Secondary Check by :	Sandra Minto
Report Issue Date :	09-December-2013
Approved Signatory :	
Tested To :	AS1259.1:1990 AS1259.2:1990
Comments :	All tests passed for type 1

Clause and Characteristic Tested	Result	Clause and Characteristic Tested	Result
10.2.2: Absolute sensitivity	Pass	10.4.5: R.M.S performance	Pass
10.2.3: Frequency weighting	Pass	9.3.2: Time averaging	Pass
10.3.2: Overload indications	Pass	9.3.5: Overload indication	Pass
8.9: Detector-indicator linearity	Pass		
8.10: Differential level linearity	Pass		
10.3.4: Inherent weighted system noise level	Pass		
10.4.2: Time weighting characteristics F and S	Pass		

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Calibration Certificate

Number : C13392

Client Details : Benbow Environmental
13 Darking Street
North Parramatta NSW 2151

Equipment Tested/ Model Number : ARL EL-215

Instrument Serial Number : 194552

Microphone Serial Number : N/A

Preamplifier Serial Number : N/A

Ambient Temperature : 22°C

Relative Humidity : 48%

Barometric Pressure : 102.2 kPa

Calibration Technician : Adrian Walker

Calibration Date : 16-July-2013

Secondary Check by : Tim Williams

Report Issue Date : 16-July-2013

Approved Signatory :

Tested To : AS1259.1:1990

Comments : All tests passed for type 2

Clause and Characteristic Tested	Result	Clause and Characteristic Tested	Result
10.2.2: Absolute sensitivity	Pass		
10.2.3: Frequency weighting	Pass		
8.9: Detector-indicator linearity	Pass		
8.10: Differential level linearity	Pass		
10.3.4: Inherent weighted system noise level	Pass		
10.4.2: Time weighting characteristics F and S	Pass		
10.4.5: R.M.S performance	Pass		

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CERTIFICATE OF CALIBRATION

CERTIFICATE NO.: **SLM 39750 & FILT 0166**

Equipment Description:	Sound & Vibration Analyser		
Manufacturer:	Svantek		
Model No:	Svan-957	**Serial No:**	15335
Microphone Type:	7052E	**Serial No:**	47869
Filter Type:	1/3 Octave	**Serial No:**	15335
Comments:	All tests passed for type 1. (See over for details)		
Owner:	Benbow Environmental 13 Daking Street North Parramatta NSW 2151		
Ambient Pressure:	1013 hPa ±1.5 hPa		
Temperature:	23 °C ±2° C	**Relative Humidity:**	48% ±5%
Date of Calibration:	16/07/2013	**Issue Date:**	16/07/2013

Acu-Vib Test Procedure: AVP05 (SLM) & AVP06 (Filters)

CHECKED BY: ..AK.. **AUTHORISED SIGNATURE:** ....

Jack Kielt

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The results of the tests, calibration and/or measurements included in this document are traceable to Australian/national standards.

NATA
WORLD RECOGNISED ACCREDITATION

Accredited Lab. No. 9262
Acoustic and Vibration
Measurements

ACU-VIB
ELECTRONICS

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

CERTIFICATE OF CALIBRATION

CERTIFICATE NO: 16962

EQUIPMENT TESTED: Sound Level Calibrator

Manufacturer: Rion
Type No: NC-73 **Serial No:** 10186522
Owner: Benbow Environmental
13 Daking Street
North Parramatta NSW 2151

Tests Performed: Measured output pressure level was found to be:

Parameter	Pre-Adj	Adj Y/N	Output: (db re 20 μPa)	Frequency: (Hz)	THD&N (%)
Level 1:	NA	N	94.03	993.70	0.40
Level 2:	NA	N	NA	NA	NA
Uncertainty:			±0.11 dB	±0.05 Hz	±0.2 %
Uncertainty (at 95% c.l.) k=2					

CONDITION OF TEST:
Ambient Pressure: 1001 hPa ±1.5 hPa **Relative Humidity:** 57% ±5%
Temperature: 23 °C ±2° C
Date of Calibration: 23/02/2015 **Issue Date:** 23/02/2015
Acu-Vib Test Procedure: AVP02 (Calibrators)
Test Method: AS IEC 60942 - 2004

CHECKED BY: ..... **AUTHORISED SIGNATURE:** ....
Jack Kielt

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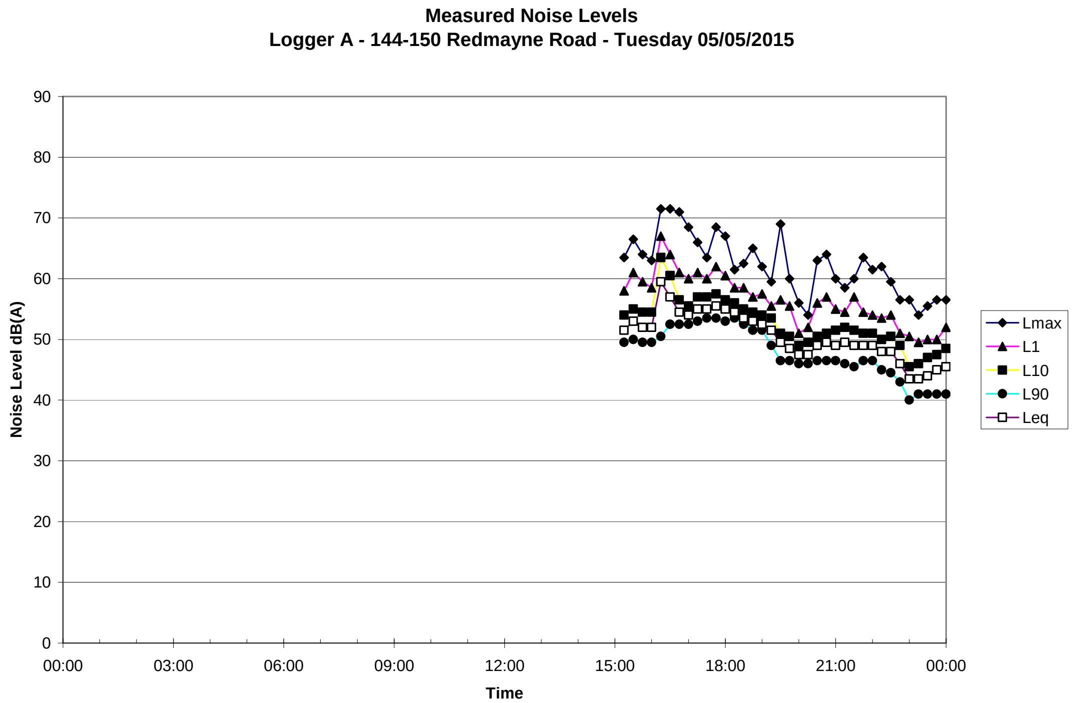
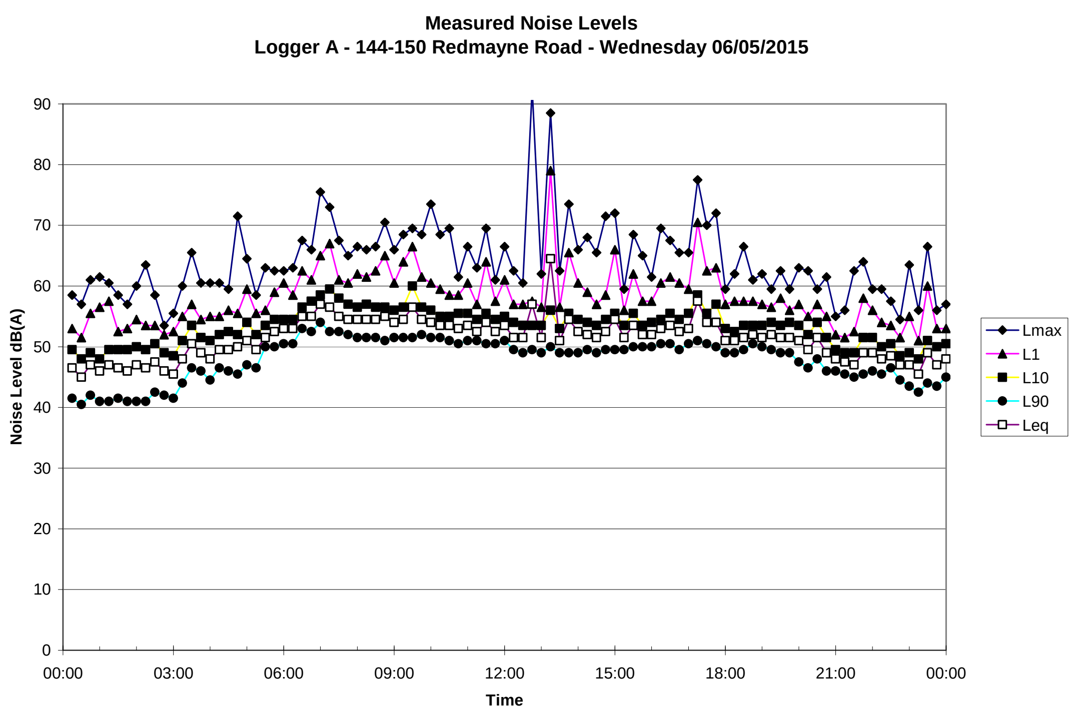
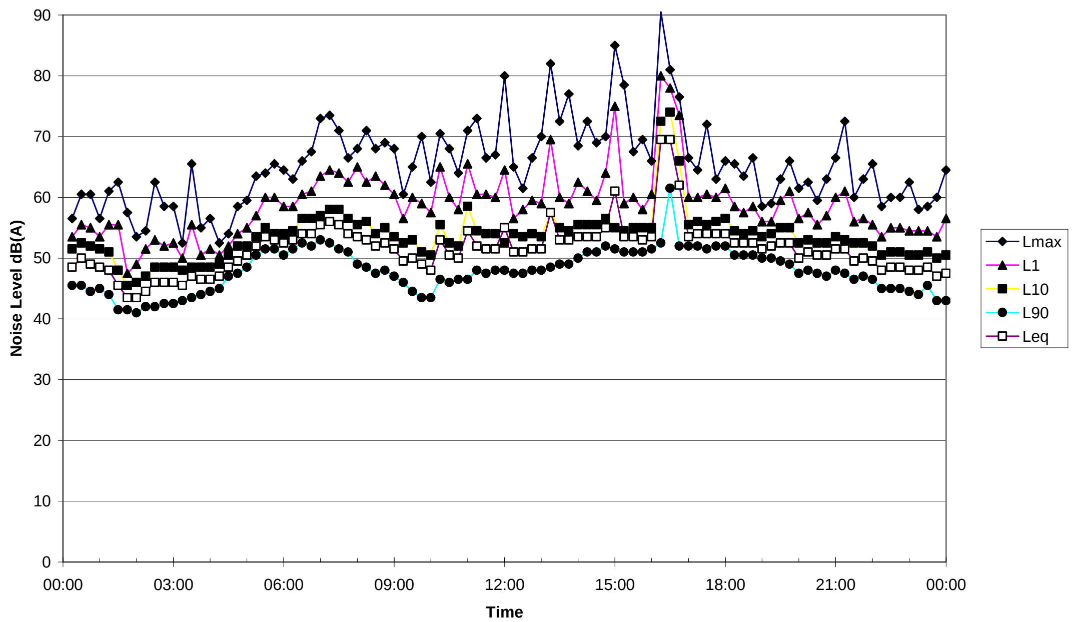
Attachment 4: Noise Logger Graphs

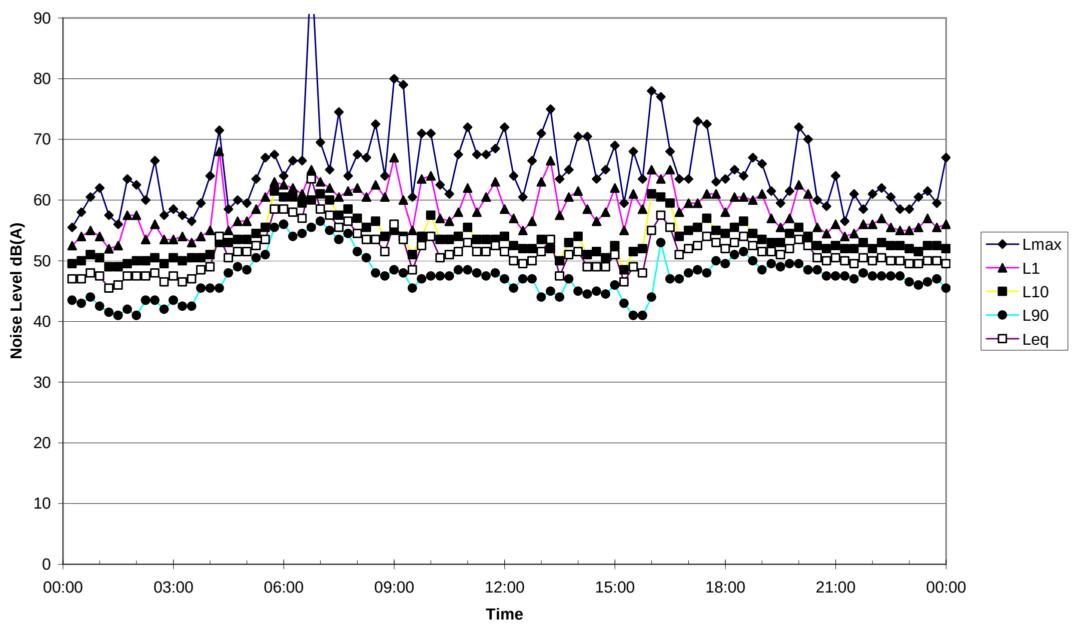

Measured Noise Levels
Logger A - 144-150 Redmayne Road - Tuesday 05/05/2015
Noise Level dB(A)
0
10
20
30
40
50
60
70
80
90
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Time
Lmax
L1
L10
L90
Leq


Measured Noise Levels
Logger A - 144-150 Redmayne Road - Wednesday 06/05/2015
Noise Level dB(A)
0
10
20
30
40
50
60
70
80
90
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Time
Lmax
L1
L10
L90
Leq

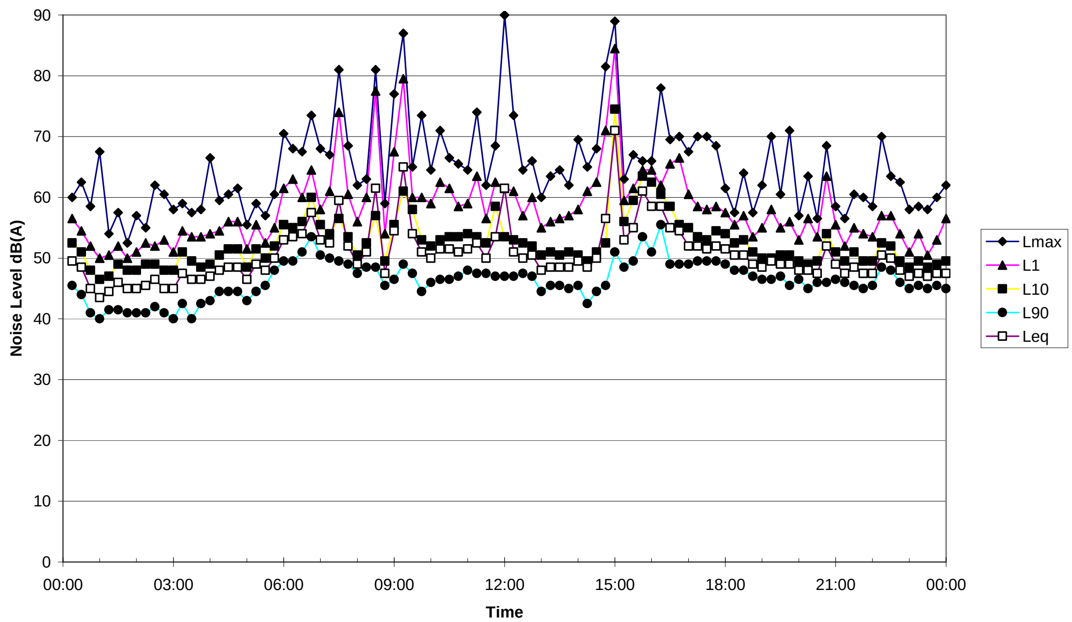
Measured Noise Levels
Logger A - 144-150 Redmayne Road - Thursday 07/05/2015



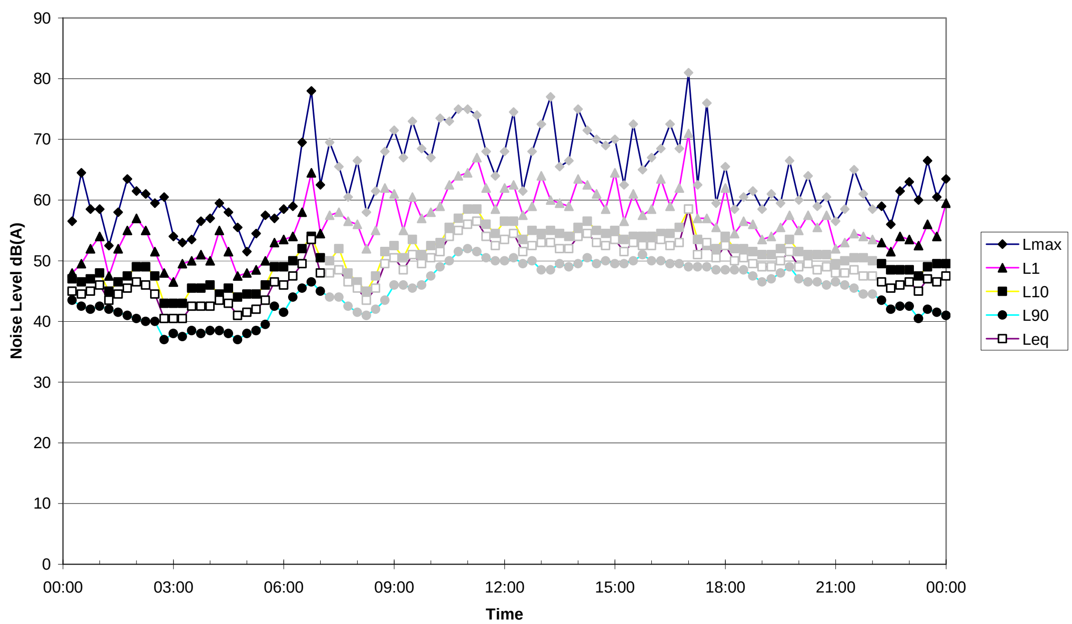
Measured Noise Levels
Logger A - 144-150 Redmayne Road - Friday 08/05/2015



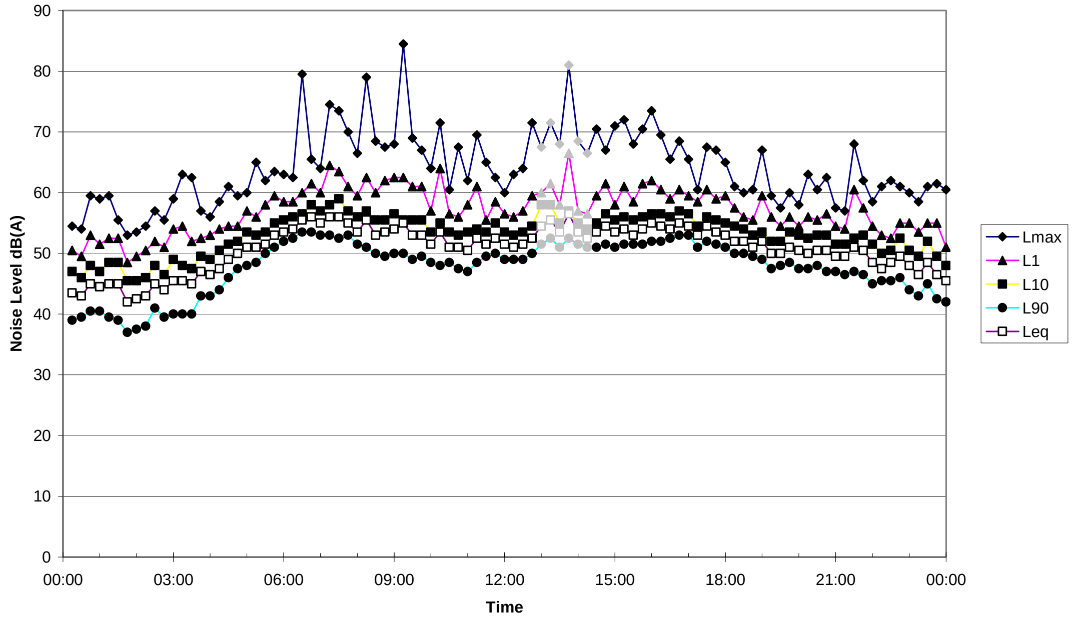
Measured Noise Levels
Logger A - 144-150 Redmayne Road - Saturday 09/05/2015



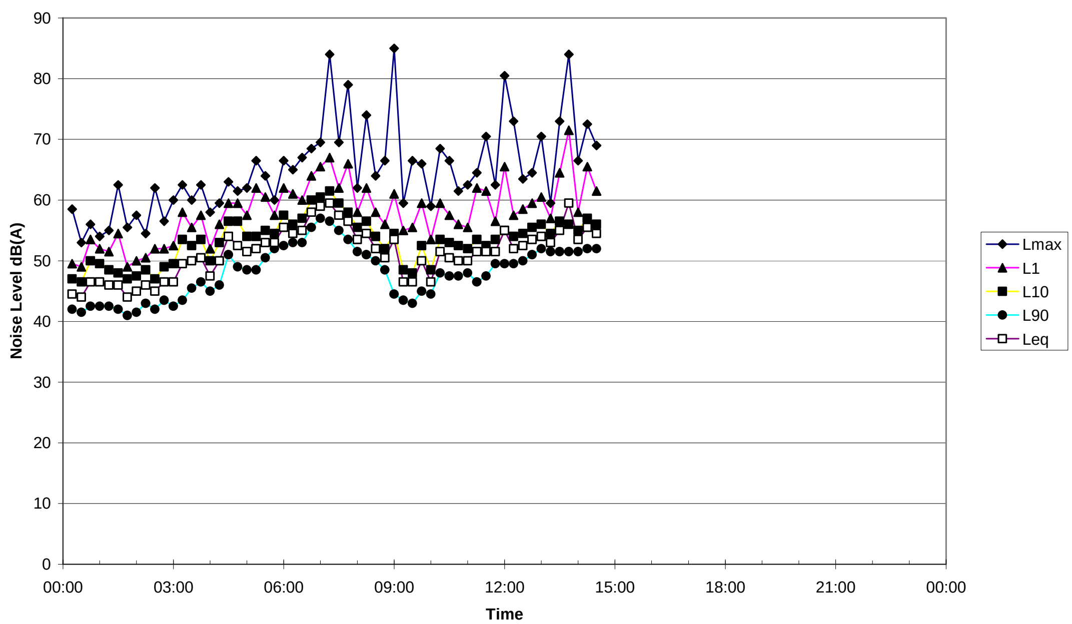
Measured Noise Levels
Logger A - 144-150 Redmayne Road - Sunday 10/05/2015



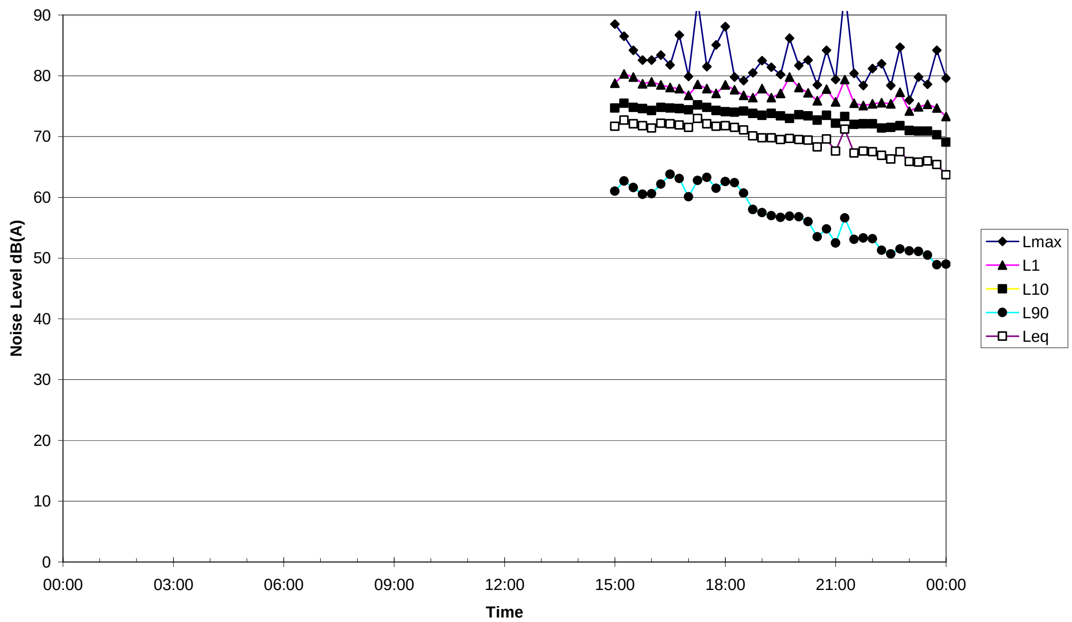
Measured Noise Levels
Logger A - 144-150 Redmayne Road - Monday 11/05/2015



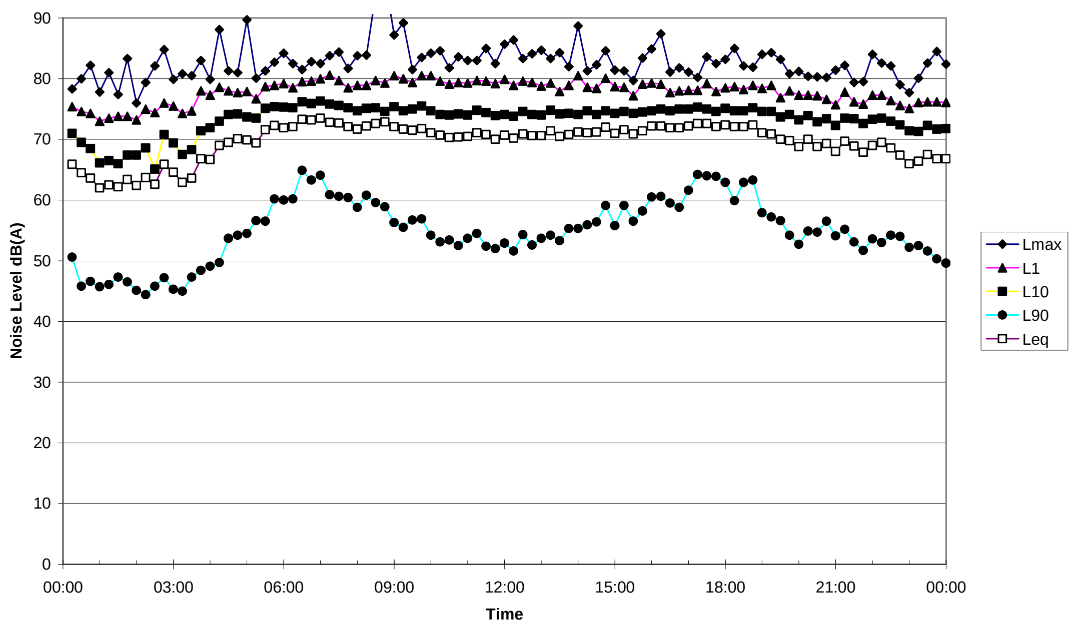
Measured Noise Levels
Logger A - 144-150 Redmayne Road - Tuesday 12/05/2015



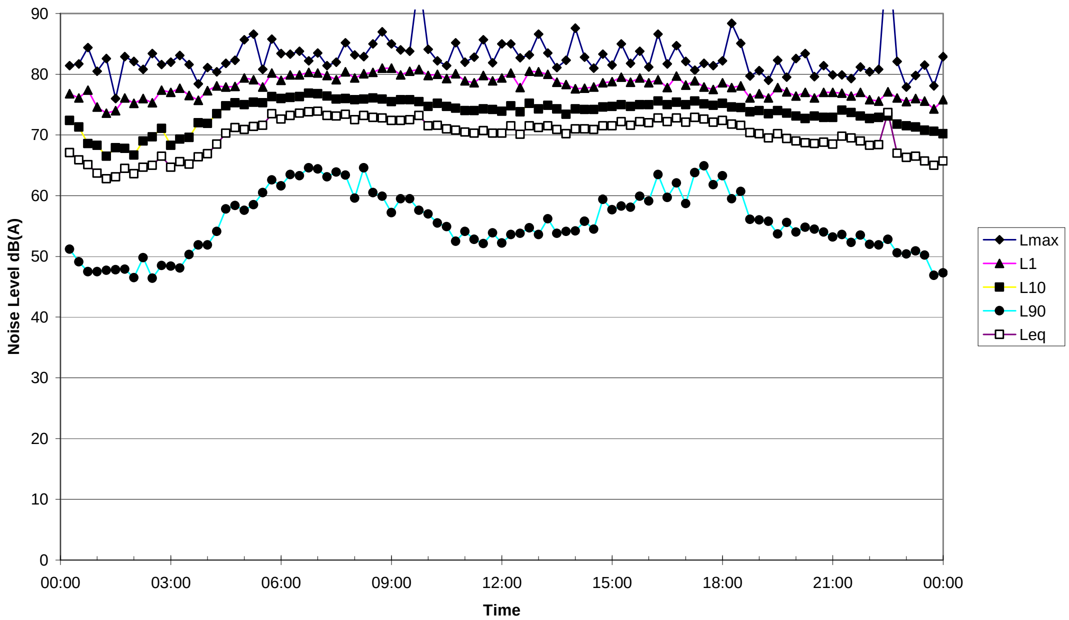
Measured Noise Levels
Logger B - 727 Wallgrove Road - Tuesday 05/05/2015



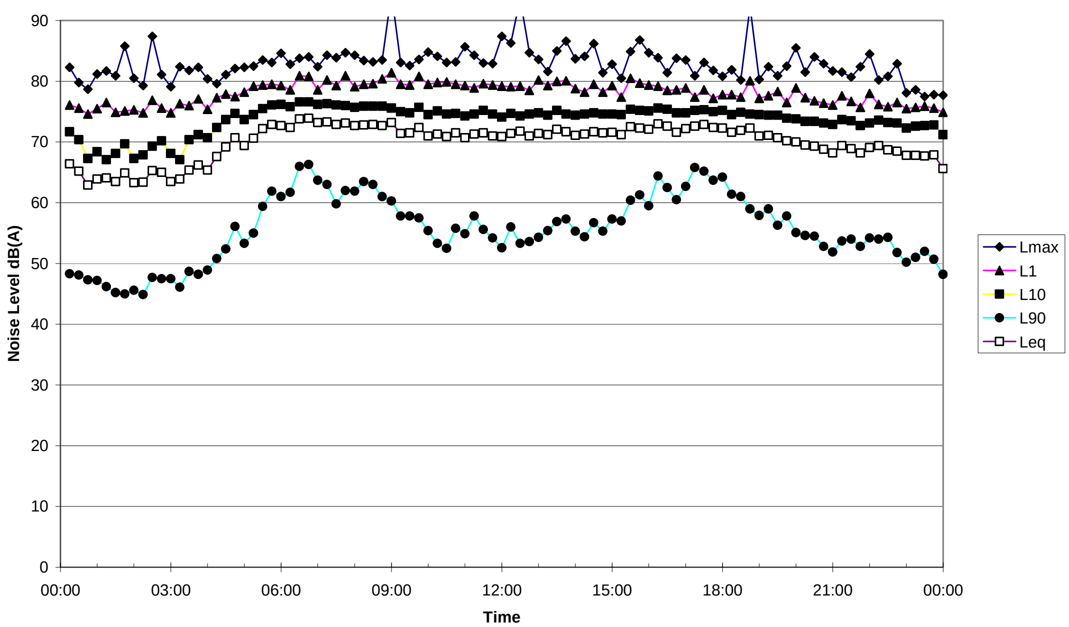
Measured Noise Levels
Logger B - 727 Wallgrove Road - Wednesday 06/05/2015

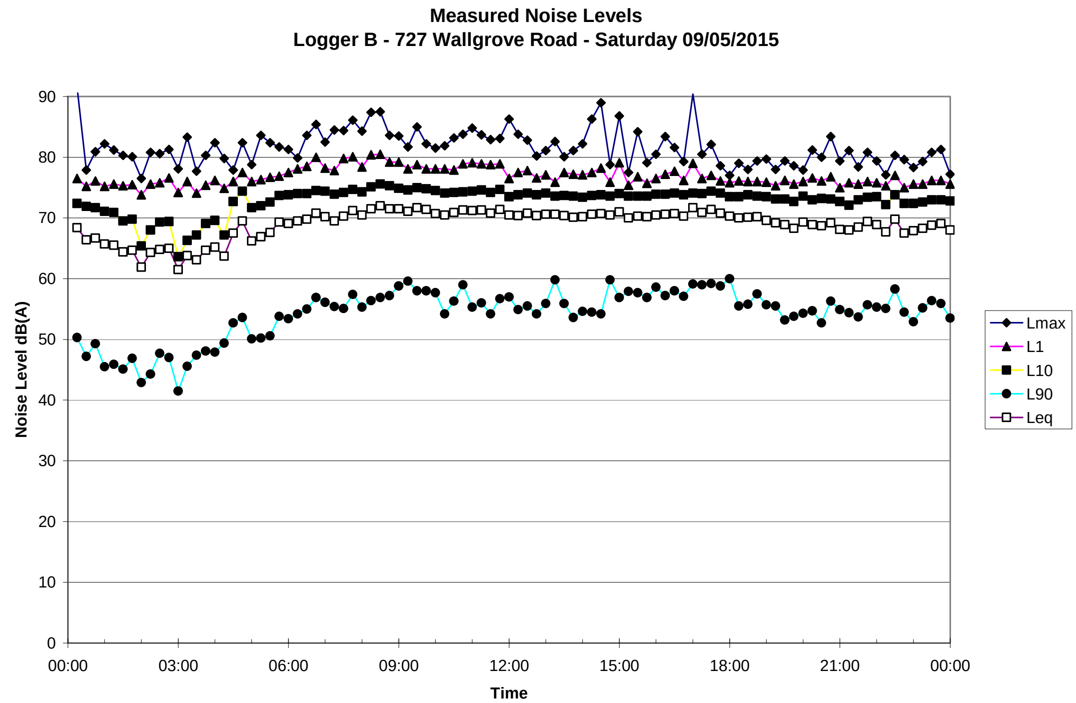


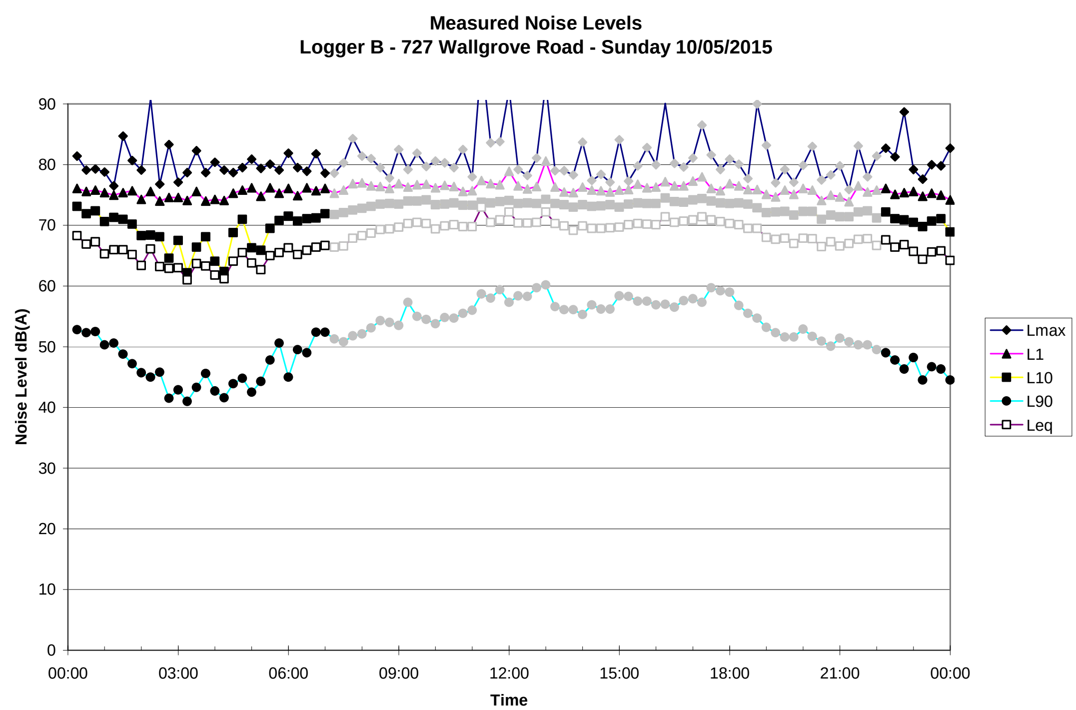
Measured Noise Levels
Logger B - 727 Wallgrove Road - Thursday 07/05/2015



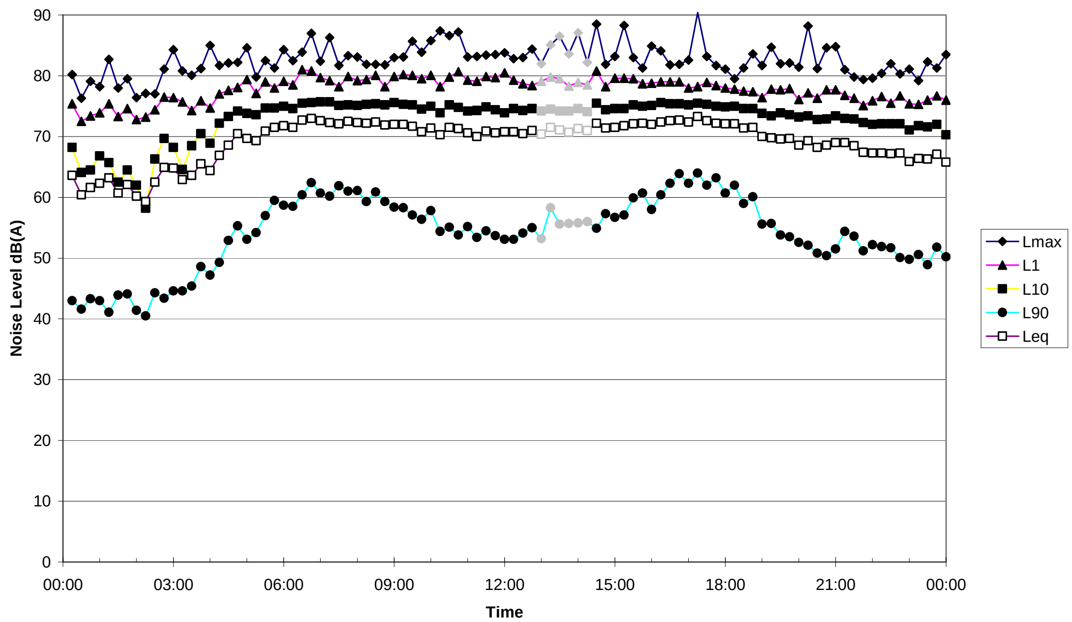
Measured Noise Levels
Logger B - 727 Wallgrove Road - Friday 08/05/2015



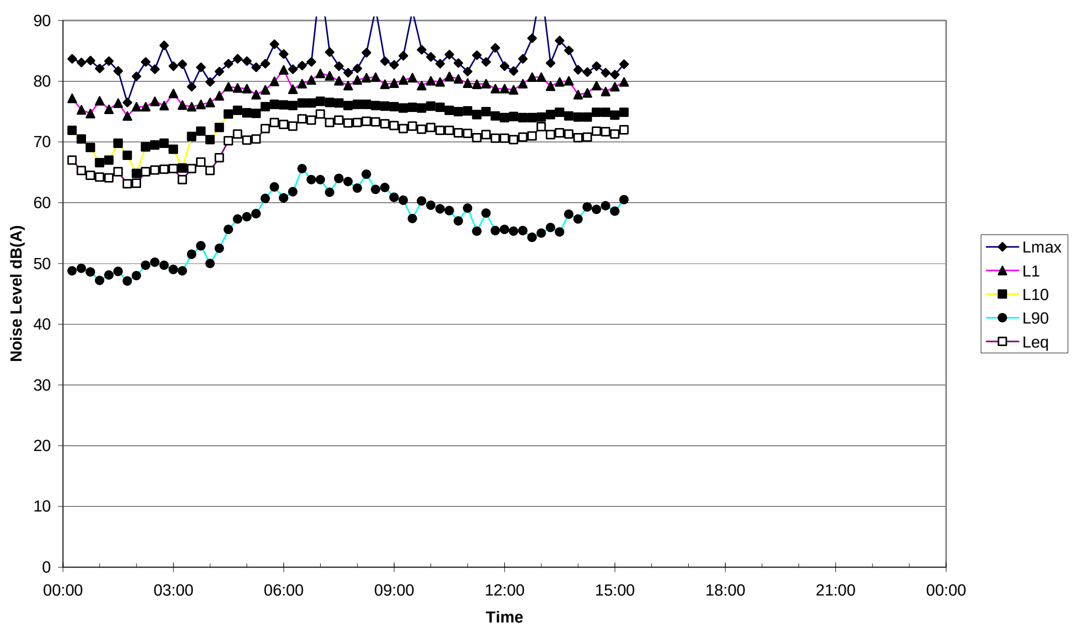

Measured Noise Levels
Logger B - 727 Wallgrove Road - Saturday 09/05/2015
Noise Level dB(A)
90
80
70
60
50
40
30
20
10
0
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Time
Lmax
L1
L10
L90
Leq


Measured Noise Levels
Logger B - 727 Wallgrove Road - Sunday 10/05/2015
Noise Level dB(A)
90
80
70
60
50
40
30
20
10
0
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Time
Lmax
L1
L10
L90
Leq

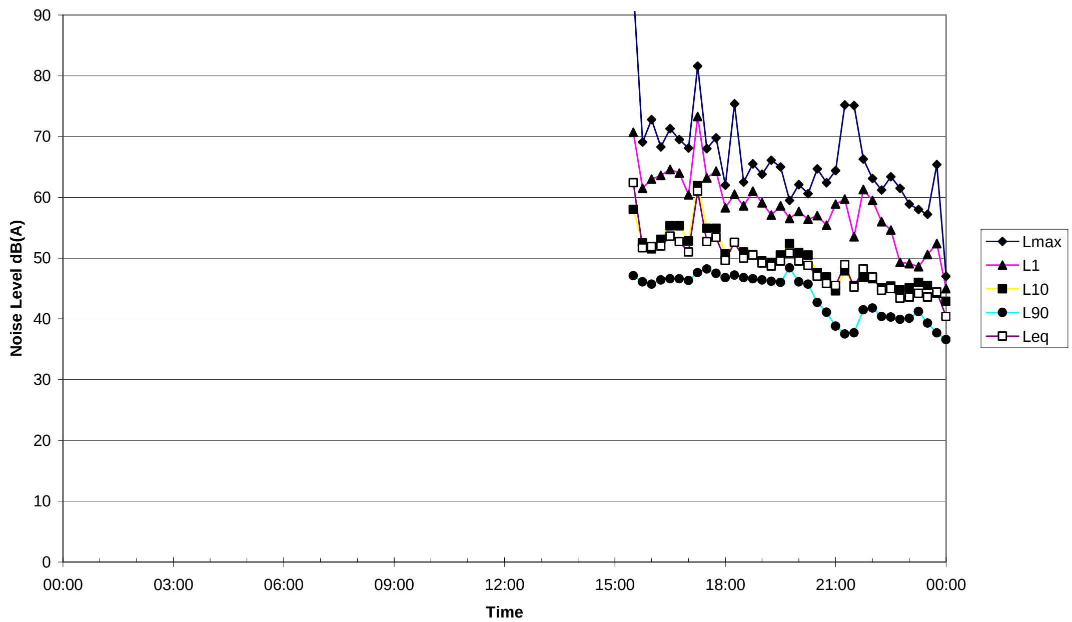
Measured Noise Levels
Logger B - 727 Wallgrove Road - Monday 11/05/2015



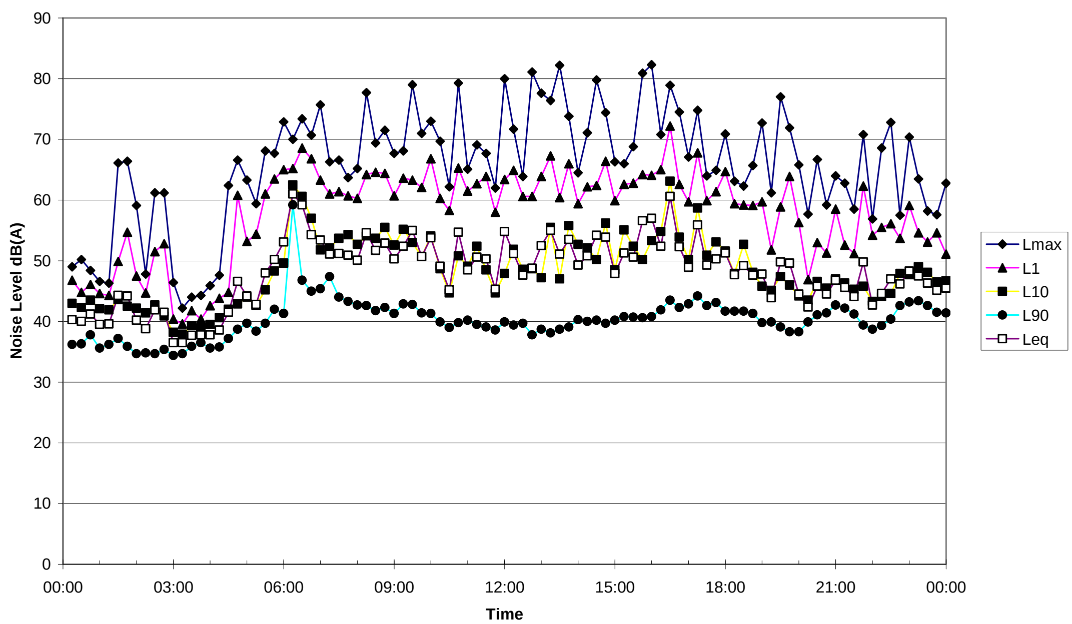
Measured Noise Levels
Logger B - 727 Wallgrove Road - Tuesday 12/05/2015

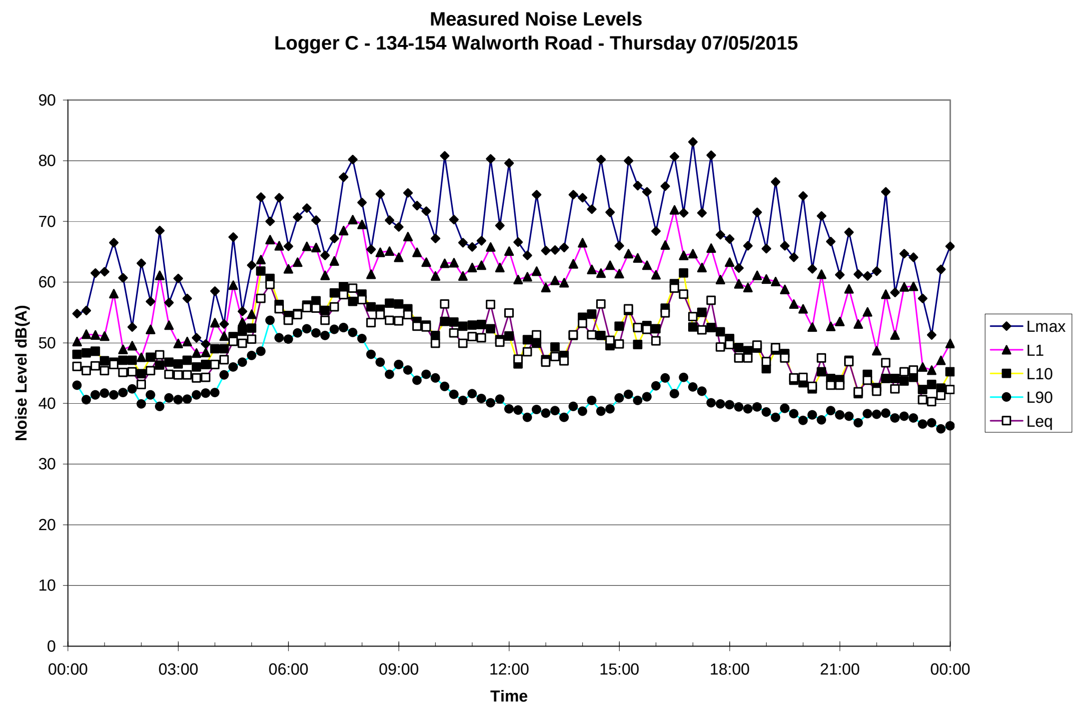


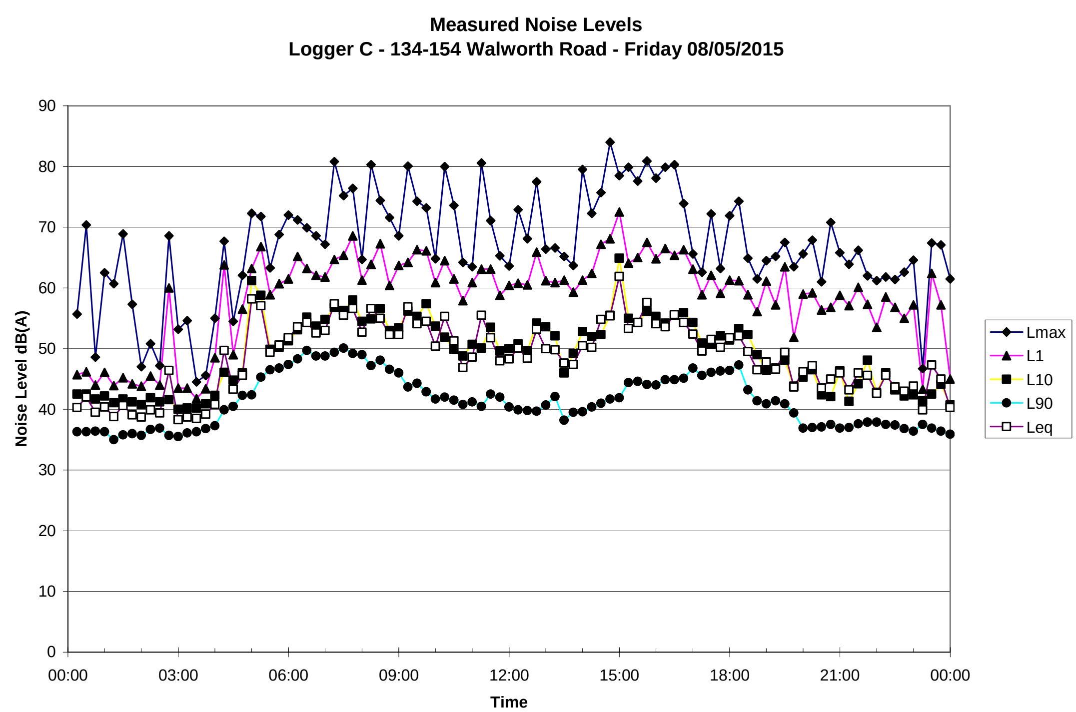
Measured Noise Levels
Logger C - 134-154 Walworth Road - Tuesday 05/05/2015



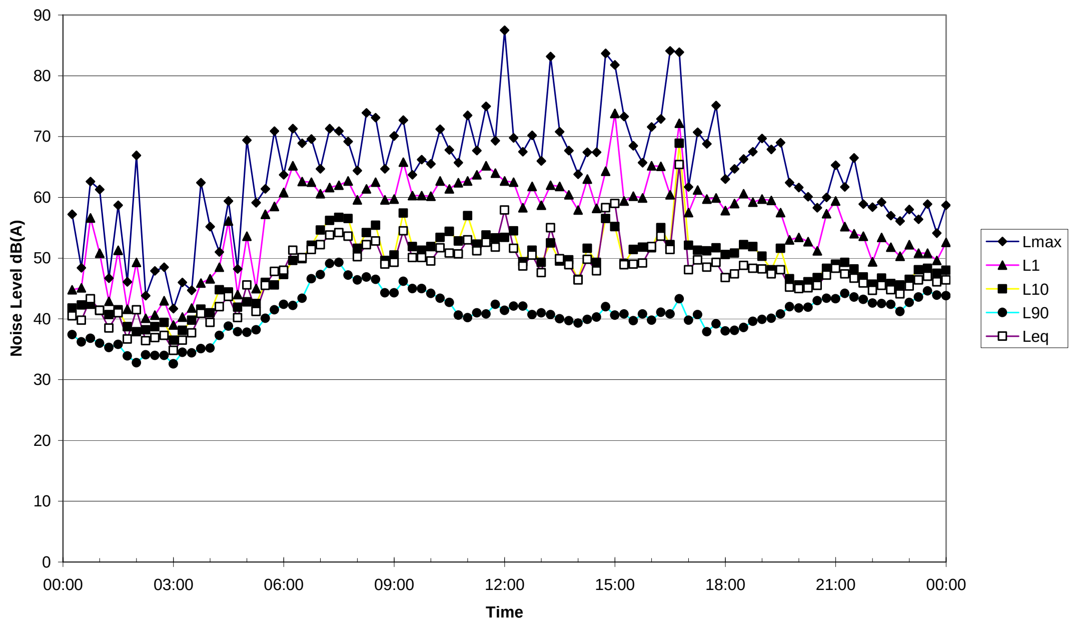
Measured Noise Levels
Logger C - 134-154 Walworth Road - Wednesday 06/05/2015



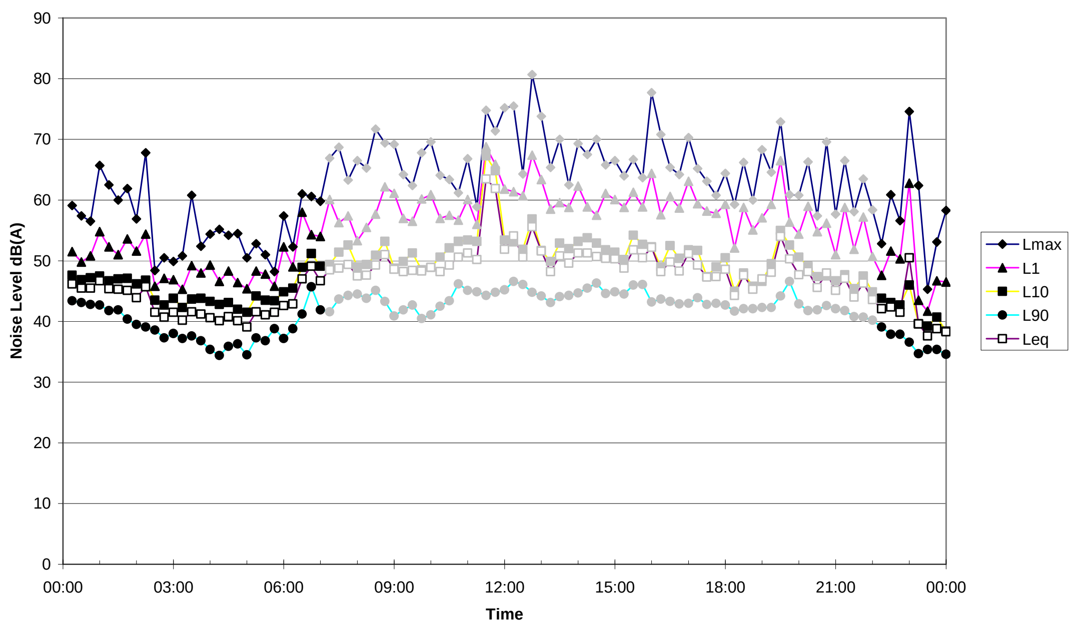

Measured Noise Levels
Logger C - 134-154 Walworth Road - Thursday 07/05/2015
Noise Level dB(A)
Time
0
10
20
30
40
50
60
70
80
90
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq


Measured Noise Levels
Logger C - 134-154 Walworth Road - Friday 08/05/2015
Noise Level dB(A)
Time
0
10
20
30
40
50
60
70
80
90
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq

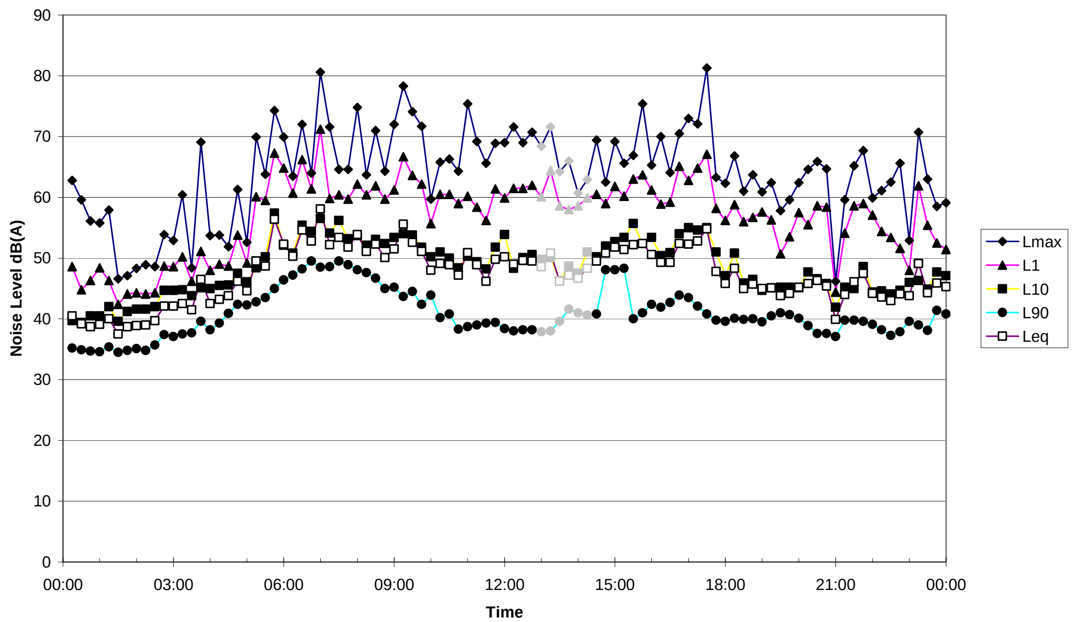
Measured Noise Levels
Logger C - 134-154 Walworth Road - Saturday 09/05/2015



Measured Noise Levels
Logger C - 134-154 Walworth Road - Sunday 10/05/2015



Measured Noise Levels
Logger C - 134-154 Walworth Road - Monday 11/05/2015



Measured Noise Levels
Logger C - 134-154 Walworth Road - Tuesday 12/05/2015