NOISE IMPACT ASSESSMENT
FOR
AUSTRAL BRICKS PTY LTD
780 WALLGROVE ROAD, HORSLEY PARK

Prepared for: Megan Kublins, Executive General Manager Property & Development
Austral Bricks Pty Ltd

Prepared by: Emma Hansma, Senior Engineer
R T Benbow, Principal Consultant

Report No: 201189_NIA_Rev5
October 2021
(Released: 1 October 2021)

Benbow
ENVIRONMENTAL

Engineering a Sustainable Future for Our Environment

Head Office: 25-27 Sherwood Street Northmead NSW 2152 AUSTRALIA
Tel: 61 2 9896 0399 Fax: 61 2 9896 0544
Email: admin@benbowenviro.com.au

Visit our website: www.benbowenviro.com.au

DOCUMENT CONTROL

Prepared by:	Position:	Signature:	Date:
Emma Hansma	Senior Engineer		01 October 2021

Reviewed by:	Position:	Signature:	Date:
Victoria Hale	Environmental Scientist		01 October 2021

Approved by:	Position:	Signature:	Date:
R T Benbow	Principal Consultant		01 October 2021

DOCUMENT REVISION RECORD

Revision	Date	Description	Checked	Approved
1	25-3-2021	Draft / Rev 1	V Hale	R T Benbow
2	12-4-2021	Rev 2	V Hale	R T Benbow
3	26-4-2021	Rev 3	V Hale	R T Benbow
4	27-4-2021	Rev 4	V Hale	R T Benbow
5	1-10-2021	Rev 5	V Hale	R T Benbow

DOCUMENT DISTRIBUTION

Revision	Issue Date	Issued To	Issued By
1	25-3-2021	Austral Bricks Pty Ltd	Benbow Environmental
2	12-4-2021	Austral Bricks Pty Ltd	Benbow Environmental
3	26-4-2021	Austral Bricks Pty Ltd	Benbow Environmental
4	27-4-2021	Austral Bricks Pty Ltd	Benbow Environmental
5	1-10-2021	Austral Bricks Pty Ltd	Benbow Environmental

Benbow ENVIRONMENTAL
A.B.N. 17 160 013 641

Head Office:
25-27 Sherwood Street Northmead NSW 2152 Australia
P.O. Box 687 Parramatta NSW 2124 Australia
Telephone: +61 2 9896 0399 Facsimile: +61 2 9896 0544
E-mail: admin@benbowenviro.com.au
Visit our Website at www.benbowenviro.com.au

Contents **Page**

Tables Page

Figures Page

Attachments

1. INTRODUCTION

Benbow Environmental (BE) has been engaged by Austral Bricks Pty Ltd to undertake a noise impact assessment for the proposed modification to the existing Austral Bricks facility located at 780 Wallgrove Road, Horsley Park.

The proposed modifications include:

- Increase of capacity from 80 to 130 million tonnes per annum;
- Upgrade the scrubber;
- Expand the hardstand and install a new gatehouse;

Changes to the noise impacts include:

- Forklifts – forklift placing product in the yard between 10pm and 6am
- Vehicles – Impact of increased vehicle movement by 20 road trucks per day, during the day time period

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

The site is located in Horsley Park within 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.

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) and NSW Environment Protection Authority Draft Construction Guideline* (EPA 2020)
- *NSW Environment Protection Authority, Noise Policy for Industry (EPA 2017);* and
- *Department of Environment, Climate Change and Water NSW, Road Noise Policy (DECCW 2011).*

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) Identification of project specific noise levels;
d) Determination of all potential noise sources associated with the operations at the subject site;
e) Collection of required noise data;
f) Prediction of potential noise impacts at the nearby noise sensitive receptors;
g) Assessment of potential noise impacts against relevant legislation and guidelines;
h) Investigate ameliorative measures/control solutions (where required); and
i) 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 on 82 ha within the Local Government area of Fairfield City Council. The land is zoned Western Sydney Parklands under Fairfield Local Environment Plan 2013. 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 Motorsport Park to the north, Prospect Reservoir and Prospect nature reserve to the east, residential properties along Chandos Road to the south and Austral Brick Plant #1 is located to the west.

2.2 Proposal Description

The proposed modifications include:

- Increase of capacity from 80 million tonnes per annum to 130 million tonnes per annum;
- Upgrade the scrubber to twin tower scrubber;
- Expand the hardstand and install a new gatehouse.

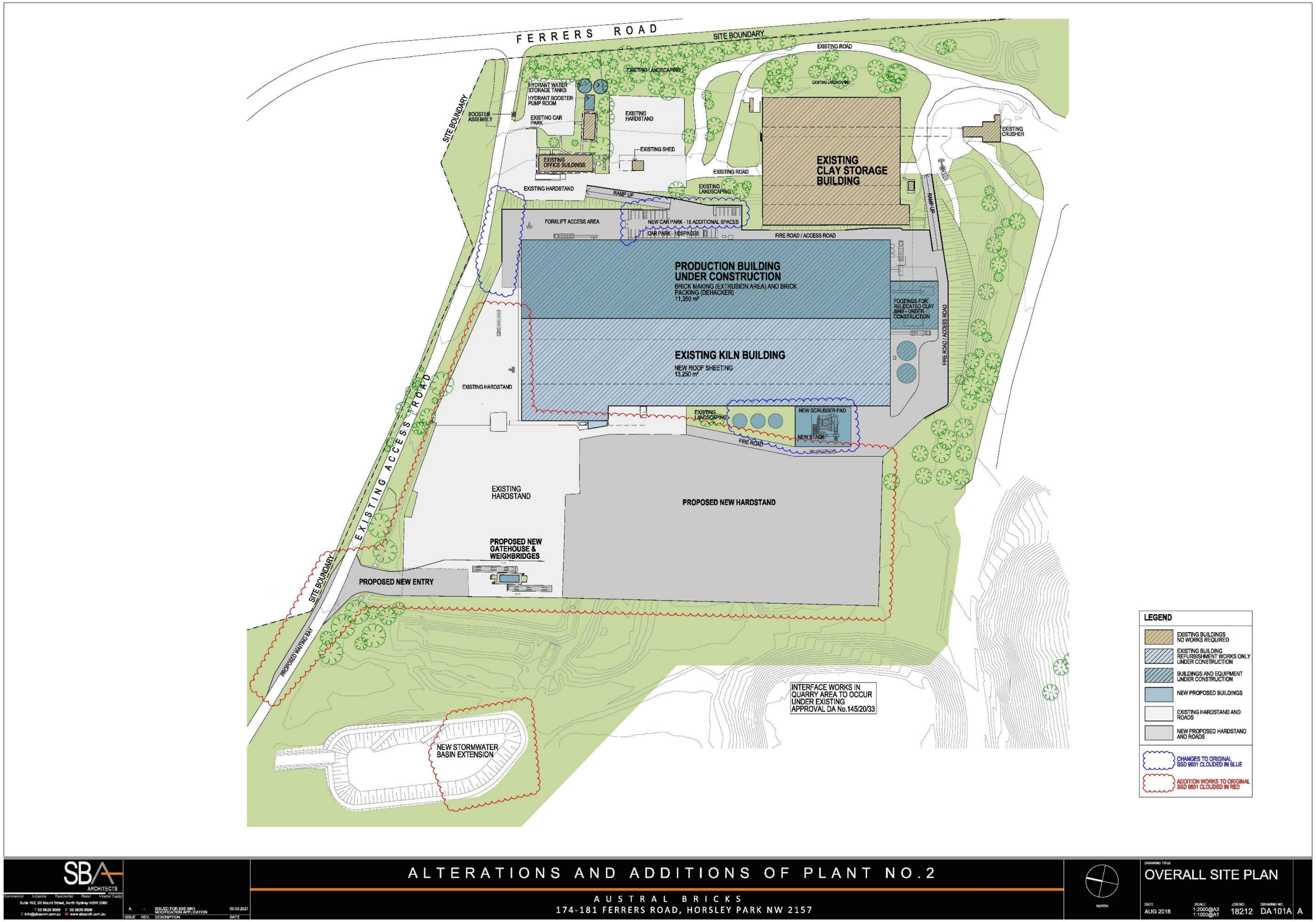
Changes to the noise impacts include:

- Forklifts – forklift placing product in the yard between 10pm and 6am; and
- Vehicles – Impact of increased vehicle movement by 20 road trucks per day, during the day time period.

The noise has been assessed for 24/7 operations.

The proposed site layout is shown in Figure 2-2.

Figure 2-2: Overall Site Plan



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 main production building.

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 an existing stockpile. Plant #2 is partially shielded by an 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 302846	Northing 6255133	Lot and DP	Type of Receiver
R1	785-811 Wallgrove Road, Horsley Park	W	1370 m	301476	6254973	Lot 4 DP 24094	Residential
R2	763-783 Wallgrove Road, Horsley Park	WSW	1330 m	301539	6254786	Lot 31 DP 1062703	Residential
R3	259-273 Chandos Road, Horsley Park	SW	1200 m	301851	6254325	Lot 120 DP 13905	Residential
R4	203-209 Chandos Road, Horsley Park	SSW	920 m	302342	6254232	Lot 58A DP 17288	Residential
R5	168-174 Chandos Road, Horsley Park	SSW	730 m	302575	6254276	Lot 93 DP 752041	Residential
R6	150-154 Chandos Road, Horsley Park	S	730 m	302693	6254257	Lot 3 DP 30290	Residential
R7	126-130 Chandos Road, Horsley Park	S	740 m	302883	6254223	Lot 7 DP 30290	Residential
R8	127-131 Ferrers Road, Horsley Park	SSE	1030 m	303190	6254049	Lot 50C DP 348693	Residential
R9	Prospect Water Filtration Plant, Chandos Road, Wetherill Park	ENE	230 m	303064	6255208	Lot 304 DP 1122291	Industrial
R10	Ferrers Road, Eastern Creek	N	570 m	302838	6255576	Lot 1 DP 1077822	Industrial
R11	Wallgrove Road, Eastern Creek	NW	1380 m	301724	6255706	Lot 10 DP 1048435	Industrial
R12	Prospect Nature Reserve, Reservoir Road, Prospect	ENE	490 m	303193	6255414	Lot 2 DP 1062094	Passive Recreation

Figure 3-1: Nearest Sensitive Receptors

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 Noise Policy for Industry requires that the level of background and ambient noise be assessed separately for the daytime, evening and night time periods. The Noise Policy for Industry 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 Benbow Environmental from 8th March 2017 to 9th March 2017 and 6th March 2018 to the 19th March 2018 at two (2) residential locations surrounding the subject site. The following Table 4-1 shows the logger location addresses.

Table 4-1: Long Term Monitoring Locations

Location ID	Address
Logger A	2C Burley Road, Horsley Park
Logger B	105-119 Chandos Road, Horsley Park

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 Noise Policy for Industry. 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 – 2C Burley 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
8/03/2017	65	58	50	56	52	49	48	47	46	54	52	47
9/03/2017	64	60	54	56	53	50	49	46	44	55	53	52
10/03/2017	64	57	54	56	52	50	47	48	43	55	51	50
11/03/2017	63	58	53	54	52	49	43	48	43	53	52	48
12/03/2017	61	62	53	54	57	49	45	48	44	52	62	49
13/03/2017	-	60	55	-	56	53	-	50	46	-	55	52
14/03/2017	-	59	-	-	53	-	-	47	-	-	52	-
15/03/2017	-	61	-	-	57	-	-	51	-	-	55	-
16/03/2017	-	60	-	-	52	-	-	48	-	-	52	-
17/03/2017	66	-	-	59	-	-	52	-	-	58	-	-
18/03/2017	-	54	-	-	51	-	-	34	-	-	51	-
19/03/2017	-	49	-	-	42	-	-	32	-	-	42	-
Average	64	58	53	56	53	50	*	*	*	*	*	*
Median (RBL)	*	*	*	*	*	*	**47**	**48**	**44**	*	*	*
Logarithmic Average	*	*	*	*	*	*	*	*	*	**55**	**55**	**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 – 105-119 Chandos 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
6/09/2018	62	55	53	53	49	48	43	41	42	52	47	46
7/09/2018	-	-	-	-	-	-	-	-	-	-	-	-
8/09/2018	58	52	52	51	48	48	39	40	38	53	46	46
9/09/2018	62	57	52	53	50	48	41	43	40	63	49	46
10/09/2018	63	53	53	53	48	49	40	41	39	56	45	50
11/09/2018	60	54	53	53	49	49	43	43	38	51	47	48
12/09/2018	59	55	-	53	51	-	43	44	-	51	48	-
13/09/2018	-	53	53	-	47	49	-	38	37	-	45	49
14/09/2018	58	67	53	52	55	48	42	45	38	50	56	48
15/09/2018	-	-	54	-	-	49	-	-	40	-	-	47
16/09/2018	-	53	-	-	47	-	-	39	-	-	45	-
17/09/2018	60	55	55	53	49	51	42	41	40	51	47	50
18/09/2018	60	55	54	53	49	50	41	43	40	51	47	50
19/09/2018	-	-	55	-	-	50	-	-	40	-	-	51
Average	60	55	53	53	49	49	*	*	*	*	*	*
Median (RBL)	*	*	*	*	*	*	**42**	**41**	**40**	*	*	*
Logarithmic Average	*	*	*	*	*	*	*	*	*	**55**	**49**	**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 the logger locations during the day period. The results of the short-term attended noise monitoring are displayed in Table 4-4.

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

Location / Time Period	Noise Descriptor				Comments
	L_1	L_{10}	L_{90}	L_{eq}	
Location A Monday 13/03/2017 17:09 Daytime Period	66	62	57	60	M7 traffic <64 dB(A) M7 trucks <69 dB(A) Ambient birds chirping consistently <63 dB(A) Insects <48 dB(A) Aeroplane <56 dB(A) Wind rustling through trees <45 dB(A) Car leaving property <72 dB(A) Austral Plant inaudible Industrial air release <62 dB(A) Forklift reverse alarm (0:10 total) <60 dB(A) Hand Tools (0:05 total) <56 dB(A)
Location B Monday 6/09/2018 17:12 Daytime Period	65	61	53	59	Aeroplane <55 dB(A) Birds <60 dB(A) Wind rustling through trees <35 dB(A) Car on Chandos Road <66 dB(A) Truck on Chandos Road <81 dB(A) Austral Plant inaudible

5. METEOROLOGICAL CONDITIONS

Wind and temperature inversions may affect the noise emissions from the site and are to be incorporated in the assessment when considered to be a feature of the area. In this section, an analysis of the 2017 weather data has been conducted to establish whether significant winds are characteristic of the area.

5.1.1 Wind Effects

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

5.1.2 Wind Rose Plots

Wind rose plots show the direction that the wind is coming from, with triangles known as “petals”. The petals of the plots in the figures summarise wind direction data into 8 compass directions i.e. north, north-east, east, south-east, etc. The length of the triangles, or “petals”, indicates the frequency that the wind blows from that direction. Longer petals for a given direction indicate a higher frequency of wind from that direction. Each petal is divided into segments, with each segment representing one of the six wind speed classes.

Thus, the segments of a petal show what proportion of wind for a given direction falls into each class. The proportion of time for which wind speed is less than 0.5 m/s, when speed is negligible, is referred to as calm hours or “calms”. Calms are not shown on a wind rose as they have no direction, but the proportion of time consisting of the period under consideration is noted under each wind rose.

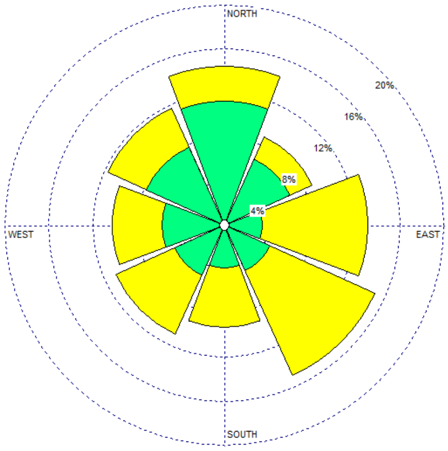
The concentric circles in each wind rose are the axis, which denote frequencies. In comparing the plots it should be noted that the axis varies between wind roses, although all wind roses are similar in size. The frequencies denoted on the axes are indicated beneath each wind rose.

5.2 WIND EFFECTS

Seasonal wind rose plots for this site utilising Horsley Park Equestrian Centre AWS data have been included in Figure 5-1, Figure 5-2 and Figure 5-3 for day, evening and night periods respectively.

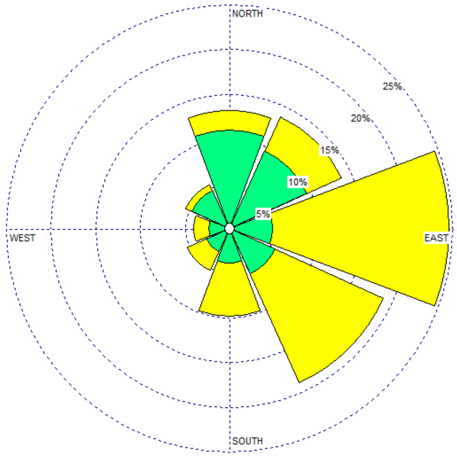
Figure 5-1: Wind Rose Plots– Bureau of Meteorology Horsley Park 2018 Daytime (7:00-18:00)

All Seasons



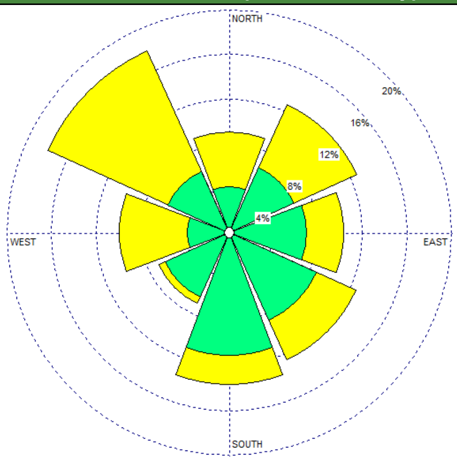
Average Wind Speed: 2.89 m/s
Axis Frequencies: 4%, 8%, 12%, 16%, 20%

Summer Season (December – February)



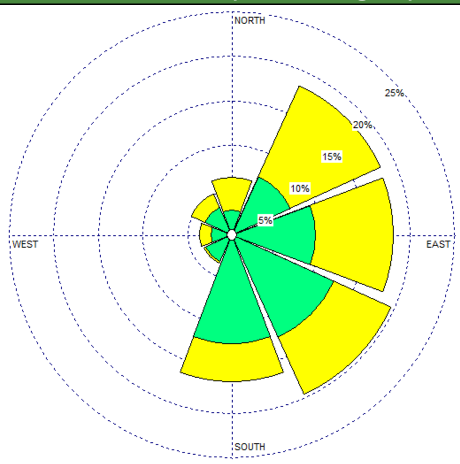
Average Wind Speed: 3.19 m/s
Axis Frequencies: 5%, 10%, 15%, 20%, 25%

Autumn Season (March – May)



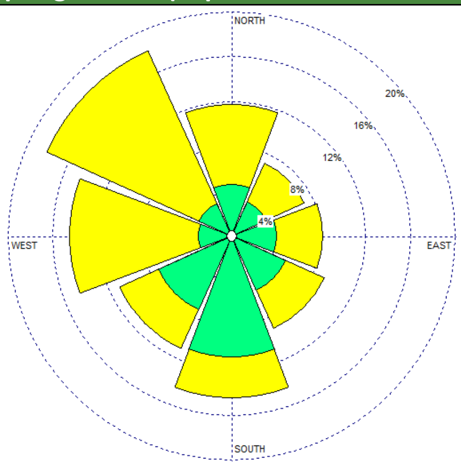
Average Wind Speed: 2.63 m/s
Axis Frequencies: 4%, 8%, 12%, 16%, 20%

Winter Season (June – August)



Average Wind Speed: 2.64 m/s
Axis Frequencies: 5%, 10%, 15%, 20%, 25%

Spring Season (September – November)



Average Wind Speed: 3.12 m/s
Axis Frequencies: 4%, 8%, 12%, 16%, 20%

Legend

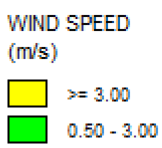
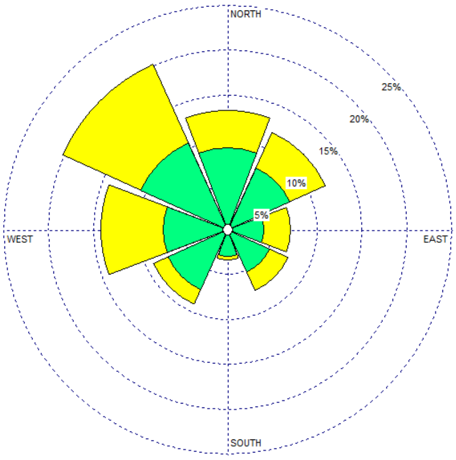


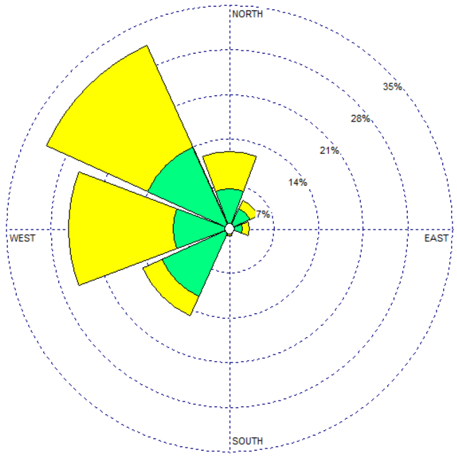
Figure 5-2: Wind Rose Plots– Bureau of Meteorology Horsley Park 2018 Evening (18:00-22:00)

All Seasons



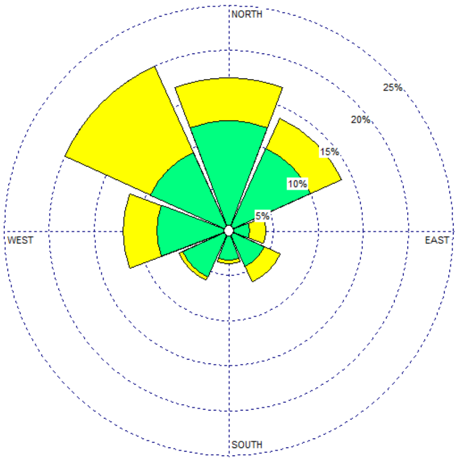
Average Wind Speed: 2.25 m/s
Axis Frequencies: 5%, 10%, 15%, 20%, 25%

Summer Season (December – February)



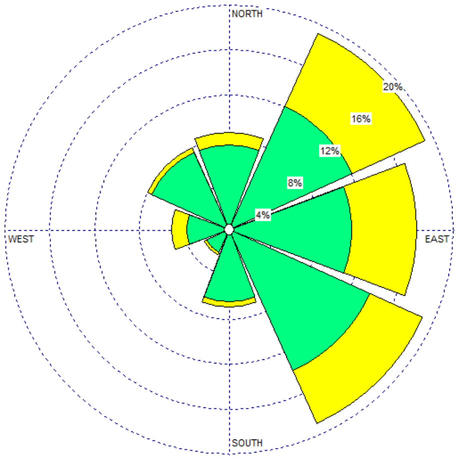
Average Wind Speed: 2.81 m/s
Axis Frequencies: 7%, 14%, 21%, 28%, 35%

Autumn Season (March – May)



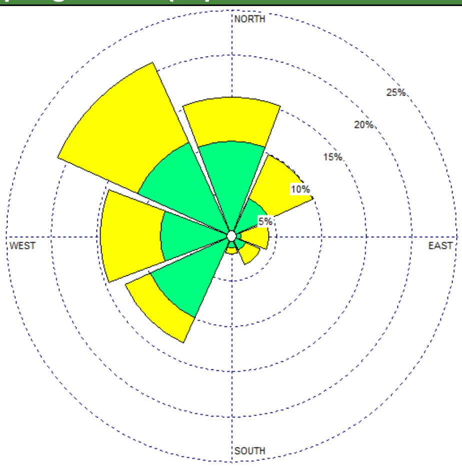
Average Wind Speed: 2.00 m/s
Axis Frequencies: 5%, 10%, 15%, 20%, 25%

Winter Season (June – August)



Average Wind Speed: 1.91 m/s
Axis Frequencies: 4%, 8%, 12%, 16%, 20%

Spring Season (September – November)



Average Wind Speed: 2.28 m/s
Axis Frequencies: 5%, 10%, 15%, 20%, 25%

Legend

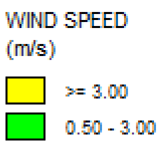
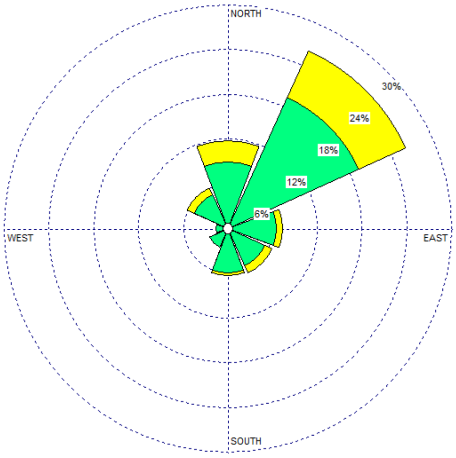


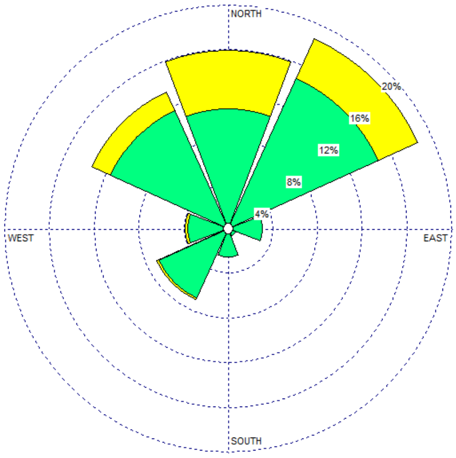
Figure 5-3: Wind Rose Plots– Bureau of Meteorology Horsley Park 2018 Night (22:00-7:00)

All Seasons



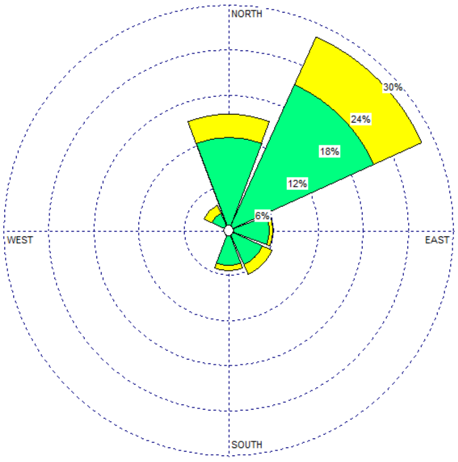
Average Wind Speed: 1.35 m/s
Axis Frequencies: 6%, 12%, 18%, 24%, 30%

Summer Season (December – February)



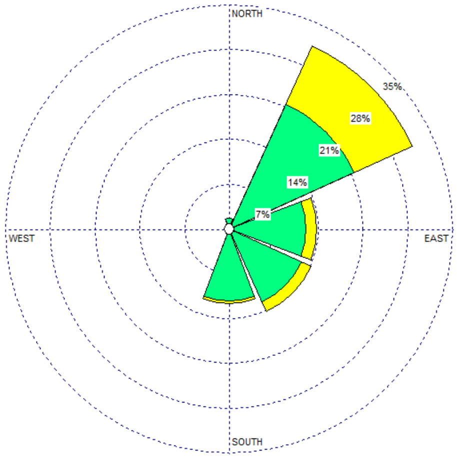
Average Wind Speed: 1.21 m/s
Axis Frequencies: 4%, 8%, 12%, 16%, 20%

Autumn Season (March – May)



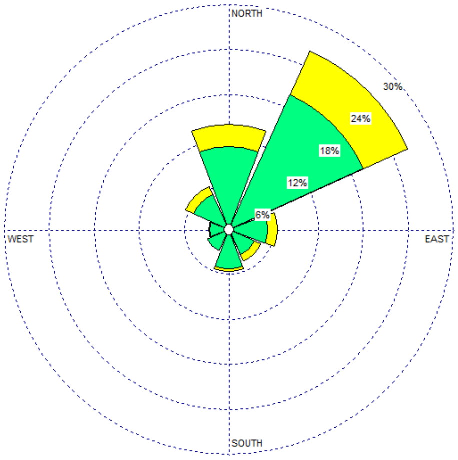
Average Wind Speed: 1.34 m/s
Axis Frequencies: 6%, 12%, 18%, 24%, 30%

Winter Season (June – August)



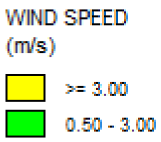
Average Wind Speed: 1.48 m/s
Axis Frequencies: 7%, 14%, 21%, 28%, 35%

Spring Season (September – November)



Average Wind Speed: 1.38 m/s
Axis Frequencies: 6%, 12%, 18%, 24%, 30%

Legend



Appendix D2 of the Noise Policy for Industry (EPA, 2017), refers to utilising the Noise Enhancing Wind Analysis (NEWA) program on the NSW EPA website to determine the significance of source-to-receiver winds.

Table 5-1 below contains the noise wind component analysis from the NEWA software. Wind speeds are taken up to 3 m/s and wind direction is taken from source-to-receiver, plus and minus 45 degrees, as per appendix D2 of the Noise Policy for Industry.

It can be seen from Table 5-1 that there are several instances during the evening and night periods, where more than 30% of wind speeds are less than 3 m/s in the plus and minus 45 degree arc from source to receiver. Therefore worst case 3 m/s source-to-receiver winds have been included in the assessment. As a worst case scenario, the 3 m/s source-to-receiver winds are modelled in all time periods.

Table 5-1: Noise Wind Component Analysis 2018 Horsley Park

Receiver	Day				Evening				Night			
	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter	Spring
R1	16.7	14.9	6.4	12.1	36.4	7.9	5.7	23.4	8.8	0.2	0.4	4.8
R2	17.7	15.7	6.6	11.8	30.3	7.6	5.2	20.6	7.9	0.0	0.4	4.6
R3	21.7	18.3	8.2	16.6	23.1	5.4	4.1	20.9	7.2	0.2	1.3	4.6
R4	21.9	20.1	13.9	21.5	20.3	7.6	8.7	16.8	8.6	4.1	9.4	6.6
R5	22.6	20.7	16.9	22.1	14.2	8.2	11.1	13.7	8.8	4.7	13.2	7.4
R6	21.8	20.4	19.0	20.4	11.1	8.7	14.7	9.6	7.2	5.9	15.7	7.4
R7	18.8	20.0	21.8	18.9	5.3	10.3	18.5	8.0	6.5	7.5	19.6	8.2
R8	15.6	20.9	24.4	18.2	2.5	10.6	23.1	5.2	5.6	8.6	21.6	8.7
R9	3.7	10.1	18.4	7.0	8.6	18.8	32.1	7.7	19.4	30.7	35.1	26.3
R10	5.4	8.6	4.1	5.0	15.3	15.2	4.6	16.8	12.0	7.7	0.6	7.6
R11	14.3	16.9	8.0	9.7	34.7	11.7	7.9	24.5	13.0	4.5	0.4	7.1
R12	4.0	8.7	15.9	6.1	12.2	24.2	29.9	12.4	22.1	32.1	30.0	28.8

(shaded) Noise enhancing meteorological conditions occur for 30% or more of the period and season

5.3 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 2017 weather data highlighted that during winter 18.5% of the nights presented temperature inversion conditions, therefore these effects have not been included in the noise impact assessment.

5.4 Weather Conditions Considered in the Assessment

The following condition was considered:

- Condition A: neutral weather conditions
- Condition B: 3 m/s source-to-receiver wind conditions

The meteorological condition considered in the noise model has been displayed in detail in Table 5-2.

Table 5-2: 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	Gradient Flow	10 °C	70%	3 m/s	Source-to-receiver	No	R1,R2,R9,R11,R12	All periods

6. CURRENT LEGISLATION AND GUIDELINES

The following criteria are relevant to the proposed development:

(1) Operational Noise Criteria: The existing Environment Protection Licence applies noise limits to the site and the NSW EPA Noise Policy for Industry are also applied in deriving the project specific noise limits.
(2) Road Noise Criteria: Public roadway generated noise limits from the NSW Road Noise Policy.
(3) Construction Noise and Vibration Criteria: Construction noise limits derived from the Interim Construction Noise Guideline/Draft Construction Noise Guideline.

Each of these aspects are discussed in the following sections of this report.

6.1 OPERATIONAL NOISE CRITERIA

Operational noise criteria is derived from the noise limits in the current Environment Protection Licence (section 6.1.1) and noise limits derived from the NSW Noise Policy for Industry (section 6.1.2).

6.1.1 NSW EPA Environment Protection Licence

Current operations at the Austral Bricks 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."

6.1.2 NSW EPA Noise Policy for Industry

The L_{A10} noise criteria presented under the Environment protection Licence utilises the L_{A10} descriptor. Under the current Noise Policy for Industry criteria, the $L_{Aeq\ (15\ minutes)}$ descriptor is utilised. Noise limits that would apply to the site as per the current NSW Noise Policy for Industry are therefore presented in this section.

6.1.2.1 Introduction

The NSW Noise Policy for Industry was developed by the NSW EPA primarily for the assessment of noise emissions from industrial sites regulated by the NSW EPA.

The policy sets out two components that are used to assess potential site-related noise impacts. The intrusiveness noise level aims at controlling intrusive noise impacts in the short-term for residences. The amenity noise level aims at maintaining a suitable amenity for particular land uses including residences in the long-term. The more stringent of the intrusiveness or amenity level becomes the project noise trigger levels for the project.

6.1.2.2 Project Intrusiveness Noise Level

The project intrusiveness noise level is determined as follows:

$L_{Aeq,\ 15\ minute}$ = rating background noise level + 5 dB

Where 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 residential dwelling.

6.1.2.3 Amenity Noise Level

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 2.2 of the NSW Noise Policy for Industry 2017. The relevant recommended noise levels applicable are reproduced in Table 6-1. The suburban category has been selected for the residential noise amenity criteria. As per Table 2.3 of the Noise Policy for Industry, considering the RBLs of the noise loggers, and that the area features intermittent traffic flows with limited commercial and industry, the suburban category appears to be most applicable.

Table 6-1: NSW EPA Amenity Criteria - Recommended L_{Aeq} noise levels from industrial noise sources

Receiver	Noise Amenity Area	Time of Day	L_{Aeq} dB(A) Recommended amenity noise level
Residence	Suburban	Day	55
		Evening	45
		Night	40
Area reserved for passive recreation	All	When in use	50
Industrial premises	All	When in use	70

The project amenity noise level for industrial developments = recommended amenity noise level minus 5 dB(A)

The following exceptions to the above method to derive the project amenity noise levels apply:

1. *In areas with high traffic noise levels*
2. *In proposed developments in major industrial clusters*
3. *Where the resultant project amenity noise level is 10 dB or more lower than the existing industrial noise level. In this case the project amenity noise levels can be set at 10 dB below existing industrial noise levels if it can be demonstrated that existing industrial noise levels are unlikely to reduce over time.*
4. *Where cumulative industrial noise is not a necessary consideration because no other industries are present in the area, or likely to be introduced into the area in the future. In such cases the relevant amenity noise level is assigned as the project amenity noise level for development.*

This development is not considered to be captured by the above exceptions.

6.1.2.4 Sleep Disturbance

In accordance with the NSW EPA Noise Policy for Industry, the potential for sleep disturbance from maximum noise level events from premises during the night-time period needs to be considered. Sleep disturbance is considered to be both awakenings and disturbance to sleep stages.

Where the subject development/premises night-time noise levels at a residential location exceed:

- **$L_{Aeq,\ 15\ minute}$ 40 dB(A) or the prevailing RBL plus 5 dB, whichever is the greater, and/or**
- **L_{AFmax} 52 dB(A) or the prevailing RBL plus 15 dB, whichever is the greater,**

a detailed maximum noise level assessment should be undertaken.

6.1.2.5 Project Noise Trigger Levels

The project noise trigger levels for the site have been established in accordance with the principles and methodologies of the NSW Noise Policy for Industry (EPA, 2017).

The table below presents the rating background level, project intrusive noise level, recommended amenity noise level, and project amenity noise level. The project noise trigger level is the lowest value of intrusiveness or project amenity noise level after conversion to $L_{Aeq\ 15\ minute}$, dB(A) equivalent level. Sleep disturbance trigger levels associated with operational activities are presented in Table 6-2.

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 period. In order to ensure compliance under all circumstances, a 15 minute period assessment has been considered for all receptors.

Table 6-2: Project Noise Trigger Levels (PNTL) for Operational Activities, dB(A)

Receiver	Type of Receptor	Time of day	Rating background noise level	Project intrusiveness noise level $L_{eq\ 15\ minute}$	Recommended amenity noise level $L_{Aeq\ period}$	Project amenity noise level $L_{Aeq\ 15\ minute}$[2]	PNTL $L_{Aeq\ 15\ minute}$	Sleep Disturbance L_{Amax}
R1-R3	Residential – Urban	Day	47	**52**	60	58	**52**	**-**
		Evening	47[1]	52	50	**48**	**48**	**-**
		Night	44	49	45	**43**	**43**	**59**
R4-R8	Residential – Urban	Day	42	**47**	60	58	**47**	**-**
		Evening	41	**46**	50	48	**46**	**-**
		Night	40	45	45	**43**	**43**	**55**
R9-R11	Industrial Premises	When in use	-	-	70	68	**68**	**-**
R12	Passive Recreation	When in use	-	-	50	48	**48**	**-**

Notes:
1) It is recommended that the project intrusiveness noise level for the evening be set no greater than the project intrusiveness noise level for the day (NSW Noise Policy for Industry Section 2.3).
2) These levels have been converted to $L_{Aeq\ 15\ minute}$ using the following: $L_{Aeq\ 15\ minute} = L_{Aeq\ period}$ **+ 3 dB** (NSW Noise Policy for Industry Section 2.2).

6.2 NSW EPA ROAD NOISE POLICY

6.2.1 Introduction

The NSW Road Noise Policy (RNP) has been adopted to establish the noise criteria for the potential noise impact associated with additional traffic generated by the proposed development. 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.

6.2.2 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".*

Trucks arrive to site and leave site using Wallgrove Road. Wallgrove Road has been classified as a 'sub-arterial road' 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.

6.2.3 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 6-3.

Table 6-3: 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}.

6.2.4 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 6-4.

Table 6-4: Relative Increase Criteria For Residential Land Uses, dB(A)

Road Category	Type of Project/Land Use	Total Traffic Noise Level Increase, dB(A)	
		Day (7am-10pm)	Night (10pm-7am)
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 6-3 and the relative increase criteria provided in Table 6-4 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.

6.2.5 Exceedance of Criteria

If the criteria shown in both Table 6-3 and Table 6-4 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'.

6.2.6 Assessment Locations for Existing Land Uses

Table 6-5: 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.

6.2.7 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 proposed development.

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

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

Receptor along	Period	Assessment Criteria $L_{eq,15 \text{ or } 9 \text{ hour}}$
763-783 Wallgrove Road (R2)	Day	60
	Night	55

6.3 Construction Noise and Vibration Criteria

Criteria for construction and demolition noise has been obtained from the NSW Interim Construction Noise Guideline (DECC, 2009).

At time of writing a Draft Construction Noise Guideline is has been prepared by the NSW EPA dated November 2020 which in public consultation stage and is not yet in effect. There are no changes in the draft from the adopted Interim Construction Noise Guideline that are likely to change the outcomes of this assessment. The Noise Management Levels and standard construction hours are the same as the Interim Construction Noise Guideline.

Guidance for construction vibration has been taken from British Standard BS7385-Part 2: 1993 'Evaluation and measurement for vibration in buildings' and other standards.

6.3.1 NSW Interim Construction Noise Guideline

Residential Criteria

Table 2 of the Interim Construction Noise Guideline (DECC, 2009), sets out construction noise management levels for noise at residences and how they are to be applied. The management noise levels are reproduced in Table 6-7 below. Restrictions to the hours of construction may apply to activities that generate noise at residences above the 'highly noise affected' noise management level.

Table 6-7: 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 Land Uses

Table 6-8 sets out management levels for construction noise at other land uses applicable to the surrounding area.

Table 6-8: Management Levels at Other Land Uses

Land use	Management Level $L_{Aeq(15\ minute)}$ (applies when properties are being used)
Industrial Premises	External Noise Level 75 dB(A)
Passive Recreation	External Noise Level 65 dB(A)

There are no other sensitive land uses in the area surrounding the site. The noise criterion for construction noise is presented in Table 6-9.

Table 6-9: Construction Noise Criterion dB(A)

Receiver	Land Use	Period	RBL L_{A90}	Management Level $L_{Aeq(15\ minute)}$
R1-R3	Residential	Standard Hours	47	57
R4-R8	Residential	Standard Hours	42	52
R9-R11	Industrial	Standard Hours	-	75
R12	Passive Recreation	Standard Hours	-	65

6.3.2 Vibration Criteria

Vibration criteria from construction works are outlined in this section, including guidelines to avoid cosmetic damage, structural damage or human discomfort. There is no specific vibration standard in NSW to assess cosmetic or structural damage to buildings. Usually the British Standard BS 7385–Part 2: 1993 '*Evaluation and measurement for vibration in buildings*' or the German standard DIN4150–Part 3: 1999 '*Structural Vibration Part 3 – effects of vibration on structures*' is referenced. The *Assessing Vibration – A Technical Guideline* (DEC, 2006) provides guidance on preferred levels for human exposure.

6.3.3 BS 7385-2:1993

The British Standard BS 7385–Part 2:1993 '*Evaluation and measurement for vibration in buildings*' provides vibration limits to avoid cosmetic damage on surrounding structures. Limits are set at the lowest limits where cosmetic damage has previously been shown.

Table 6-10: Vibration criteria for cosmetic damage (BS 7385:2 1993)

Type of building	Peak component particle velocity in frequency range of predominant pulse		
	4 Hz to 15 Hz	15 Hz to 40 Hz	40 Hz and above
Reinforced or framed structures. Industrial and heavy commercial buildings	50 mm/s at 4 Hz and above		
Unreinforced or light framed structures. Residential or light commercial type buildings	15 to 20 mm/s	20 to 50 mm/s	50 mm/s

6.3.4 DIN4150-3:1999

The German standard DIN4150-Part 3:1999 'Structural Vibration Part 3 – effects of vibration on structures' has also been considered. The German standard is considered more onerous than the British standard, and specifically includes more stringent limits to avoid structural damage to surrounding heritage buildings.

Table 6-11: Structural damage criteria heritage structures (DIN4150-3 1999)

Type of building	Peak component particle velocity (PPV) mm/s			
	Vibration at the foundation at a frequency of:			Vibration of horizontal plane of highest floor at all frequencies
	1 to 10 Hz	10 to 50 Hz	50 to 100 Hz	
Buildings used for commercial purposes, industrial buildings or buildings of similar design	20	20 to 40	40 to 50	40
Residential dwellings and similar	5	5 to 15	15 to 20	15
Structures that, because of their particular sensitivity to vibration, cannot be classified as the two categories above, and are of intrinsic value (for example heritage listed buildings).	3	3 to 8	8 to 10	8

6.3.5 Human Exposure

The guideline *Assessing Vibration – A Technical Guideline* (DEC, 2006) describes preferred criteria for human exposure. The limits describe values where occupants of buildings would be impacted by construction work.

Table 6-12: Preferred and maximum weighted rms z-axis values, 1-80 Hz

Location	Daytime		Night time	
	Preferred	Maximum	Preferred	Maximum
Continuous Vibration (weighted root mean square (rms) vibration levels for continuous acceleration (m/s^2) in the vertical direction)				
Residences	0.01	0.02	0.007	0.014
Offices, schools, educational institutions and places of worship	0.02	0.04	0.02	0.04
Workshops	0.04	0.08	0.04	0.08
Impulsive Vibration (weighted root mean square (rms) vibration levels for impulsive acceleration (m/s^2) in the vertical direction)				
Residences	0.3	0.6	0.1	0.2
Offices, schools, educational institutions and places of worship	0.64	1.28	0.64	1.28
Workshops	0.64	1.28	0.64	1.28
Intermittent Vibration (m/s)				
Residences	0.2	0.4	0.13	0.26
Offices, schools, educational institutions and places of worship	0.4	0.8	0.4	0.8
Workshops	0.8	1.6	0.8	1.6

7. NOISE IMPACT ASSESSMENT

An outline of the predictive noise modelling methodology and operational noise modelling scenarios has been provided in this section of the report.

7.1 Modelling Methodology

Predictive Noise Modelling was carried out using the Concawe algorithm within SoundPLAN. This model has been extensively utilised by Benbow Environmental for assessing noise emissions for numerous sites, and is recognised by regulatory authorities throughout Australia.

Inputs into the noise model include topographical features of the area, ground absorption, on site structures, surrounding buildings, residential fences and predicted noise sources. Receivers were included to predict the noise emissions of the proposed development at the nearest potentially affected residences.

The modelling scenario has been carried out using the L_{Aeq}, L_{A10} and L_{AMax} descriptors. Using the model, noise levels were predicted at the potentially most affected receivers to determine the noise impact against the project specific noise levels and other relevant noise criteria in accordance with the NSW Noise Policy for Industry (EPA, 2017).

7.2 Noise Sources

The sound power levels for the identified noise sources associated with the operational activities have been taken from on-site measurements of Plant #2, other Austral Bricks plants as well as from Benbow Environmental's database.

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

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

Noise Source	Height	Max	Overall	Third Octave Band Centre Frequency (Hz)									
				25	31	40	50	63	80	100	125	160	200
				250	315	400	500	630	800	1000	1250	1600	2000
				2500	3150	4000	5000	6300	8000	10000	12500	16000	20000
Jaw Crusher	2 m	-	108	50	63	68	75	82	86	91	94	97	97
				91	90	94	99	101	98	96	97	96	94
				92	89	86	84	81	78	75	71	67	62
Kiln	2 m	-	100	39	44	50	58	64	70	71	73	78	84
				83	85	86	92	96	89	87	89	86	86
				85	85	84	80	77	73	68	64	60	54
Extruder	2 m	-	98	34	40	41	48	66	59	63	68	72	79
				76	76	77	77	79	81	95	86	82	81
				82	84	88	91	85	84	81	78	74	68
Concrete Mixer	1 m	-	105	35	36	38	42	49	53	65	71	69	74
				73	76	84	82	87	89	90	95	95	96
				97	97	95	92	90	88	85	85	80	70
Dehacker	2 m	-	94	35	39	41	48	49	54	59	62	66	70
				68	73	74	75	77	78	81	82	82	83
				83	84	85	85	85	83	79	78	74	69
Vibrating Screen	2 m	-	100	46	42	48	59	59	64	69	67	72	80
				82	86	86	87	91	92	93	88	88	88
				88	89	86	85	83	81	77	73	67	60
Conveyor	8 m	82	78	27	33	47	47	45	50	53	53	57	60
				60	60	62	64	65	66	68	70	70	68
				68	65	66	65	63	62	56	52	47	39
Truck Filling	1.5 m	105	102	61	64	66	72	74	78	78	79	88	92
				91	87	88	91	93	92	92	92	92	90
				85	83	82	79	77	72	66	61	57	54
Forklift	1.5 m	104	99	40	45	51	58	66	62	65	71	72	81
				83	87	85	87	89	88	88	89	88	88
				88	86	88	84	80	78	72	69	64	59
Tanker Delivery	1.5 m	105	102	41	49	49	53	63	60	65	69	75	74
				76	81	83	86	89	93	97	93	93	92
				90	88	85	80	76	71	66	61	55	46
Feed Conveyor	2 m	82	88	37	43	57	57	55	60	63	63	67	70
				70	70	72	74	75	76	78	80	80	78
				78	75	76	75	73	72	66	62	57	49
Front End Loader	2 m	109	104	46	50	53	64	74	89	83	79	86	84
				88	84	91	97	93	95	95	93	92	89
				88	85	81	80	76	78	69	62	58	50
Scrubber	2 m	98	96	51	52	61	65	66	71	72	78	85	78
				79	82	84	85	89	83	89	84	84	82
				79	78	77	74	69	68	66	62	58	57
Scrubber Stack	35m	97	96	-	-	-	-	64	-	-	79	-	-
				84	-	-	91	-	-	92	-	-	85
				-	-	80	-	-	78	-	-	-	-

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

Noise Source	Height	Max	Overall	Third Octave Band Centre Frequency (Hz)									
				25	31	40	50	63	80	100	125	160	200
				250	315	400	500	630	800	1000	1250	1600	2000
				2500	3150	4000	5000	6300	8000	10000	12500	16000	20000
Truck Engine	1 m	106	103	44	48	57	65	70	73	78	78	80	82
				83	85	94	98	94	96	89	88	82	87
				85	84	82	83	83	82	78	-	-	-
Truck Exhaust	3.6 m	104	101	42	46	55	63	68	71	76	76	78	80
				81	83	92	96	92	94	87	86	80	85
				83	82	80	81	81	80	76	-	-	-

7.2.1 Modelling Scenario and Equipment

One scenario was modelled for operational noise emissions. The scenario considered the operation of all equipment within the clay preparation area, Plant #2 building, the crusher and outdoor mobile equipment simultaneously, during all time periods as a worst case scenario.

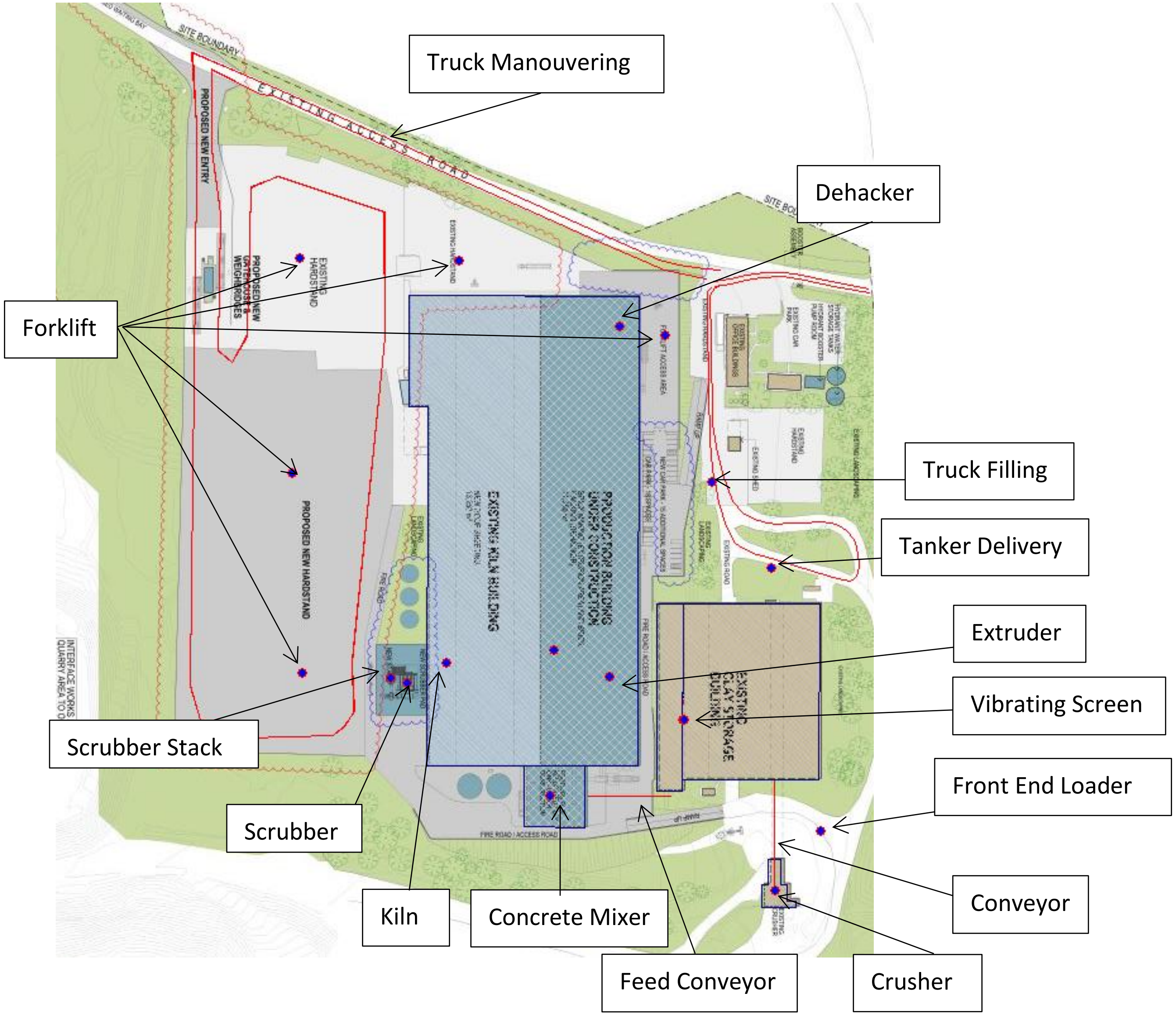
The noise generating scenario broadly corresponds to the existing noise generating activities on site with additional trucks and forklifts in the new yard areas.

As the proposed noise generating scenario is very similar to the existing noise generating scenario, noise impacts are therefore predicted to be similar to the existing activities on site. The details regarding the modelled scenario are presented in Table 7-2. The locations of the noise sources for the operational scenario are shown in Figure 7-1.

Table 7-2: Modelled Noise Sources

Scenario	Description and Equipment
Scenario 1: Operations Day, evening and night	The scenario includes the following indoor equipment: • Kiln; • Extruder; • Concrete mixer; • Dehacker; • Vibrating screen; • Crusher; and • Feed Conveyor. The following equipment are generally located outdoors: • Conveyor; • Front end loader; • Truck filling; • Tanker delivery; • Scrubber; • Forklift x 6; and • Truck engine and exhaust manouvering x 2.

Figure 7-1: Scenario 1 – Operational Scenario



7.2.2 Modelling Assumptions

The relevant assessment period for operational noise emissions is 15 minutes when assessing noise levels against the Intrusive Criterion; therefore noise source durations detailed throughout the following assumptions section 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 has been obtained from Google Earth and implemented in SoundPLAN. On site topographical information has been entered from the site survey.
- All ground areas surrounding the subject site and the nearest nominated occupancies have been modelled considering different ground factors ranging from 0 to 1. The site and surrounding grassland areas have been modelled with a ground absorption factor of 0.6.
- Heavy vehicles enter and exit the site twice per 15 minute period in the worst case scenario. Trucks travel on the site at 10 km/h.
- Trucks have been modelled as line sources in SoundPLAN using moving point source definition. Truck engines are modelled at a height of 1.5 m, and truck exhausts are modelled at a height of 3.6 m.
- The crusher, front end loader, tanker delivery, truck filling, vibrating screens, forklifts, dehacker, concrete mixer, extruder and the kiln are all modelled as point sources and are assumed to operate for 100% of the 15 minute period.
- The conveyors have been modelled as a line source and will be operational for 100% of the assessment period.
- The walls and roofs of on-site buildings are modelled with 0.48 mm trimdek material of R_w = 22 dB. Doors are modelled in the open position R_w = 0 dB.
- The SoundPLAN function “Hallout (In>Out)” was utilised to calculate the noise breakout through all Existing and Proposed buildings.
- All residential receivers were modelled at 1.5 m above ground level at the most noise-affected point within the property boundary.

7.3 PREDICTED NOISE LEVELS – OPERATIONAL

Noise levels at the nearest receptors have been calculated and results of the predictive noise modelling considering operational activities are shown in Table 7-3 and Table 7-4. Noise predictions are presented against both the noise limits in the EPL and a contemporary noise criteria as derived from the Noise Policy for Industry. Modelled operational results are predicted against the $L_{Aeq(15\ minute)}$ criteria under the Noise Policy for Industry in Table 7-3. Modelled operational results are predicted against the L_{A10} criteria under the Environment Protection Licence in Table 7-4.

Table 7-3: Predicted $L_{eq,15\ minutes}$ Noise Levels – Operational Activities dB(A)

Receptor	Noise Policy for Industry Project Criteria				Scenario 1 Neutral Weather – Day, Evening and Night		Scenario 1 Source-To-Receiver Winds, Evening and Night	
	$L_{eq(15\ minute)}$			L_{AMax}				
	Day	Evening	Night	Max	$L_{eq(15\ minute)}$	Max	$L_{eq(15\ minute)}$	Max
R1	52	48	43	59	30 ✓	33 ✓	36 ✓	40 ✓
R2	52	48	43	59	30 ✓	33 ✓	36 ✓	40 ✓
R3	52	48	43	59	24 ✓	31 ✓	N/A	N/A
R4	47	46	43	55	27 ✓	20 ✓	N/A	N/A
R5	47	46	43	55	32 ✓	32 ✓	N/A	N/A
R6	47	46	43	55	33 ✓	35 ✓	N/A	N/A
R7	47	46	43	55	33 ✓	37 ✓	N/A	N/A
R8	47	46	43	55	32 ✓	34 ✓	N/A	N/A
R9	68			N/A	55 ✓	N/A	55 ✓	N/A
R10	68			N/A	45 ✓	N/A	N/A	N/A
R11	68			N/A	32 ✓	N/A	31 ✓	N/A
R12	48			N/A	47 ✓	N/A	47 ✓	N/A

✓Complies ✗ Non-compliance

Table 7-4: Predicted L_{A10} Noise Levels – Operational Activities during the Day, Evening and Night dB(A)

Receptor	EPL Project Criteria $L_{A10(15\ minute)}$		Scenario 1 Neutral Weather – Day, Evening and Night	Scenario 1 Source-To-Receiver Winds, Evening and Night
	Day & Evening	Night	$L_{A10(15\ minute)}$	$L_{A10(15\ minute)}$
R1	50	40	33 ✓	39 ✓
R2	50	40	33 ✓	39 ✓
R3	50	40	27 ✓	N/A
R4	50	40	30 ✓	N/A
R5	50	40	35 ✓	N/A
R6	50	40	36 ✓	N/A
R7	50	40	36 ✓	N/A
R8	50	40	35 ✓	N/A
R9	N/A	N/A	N/A	N/A
R10	N/A	N/A	N/A	N/A
R11	N/A	N/A	N/A	N/A
R12	N/A	N/A	N/A	N/A

✓Complies ✗ Non-compliance

It is shown that the operational activities are predicted to comply with the criteria under the Noise Policy for Industry and the Environment Protection Licence in Table 7-3 and Table 7-4 respectively. Noise compliance is predicted at all receivers during all activities and considered weather conditions.

All equipment has been modelled as operating during the day, evening and night time periods, all of which is predicted to comply. The equipment proposed to be operating is largely similar to that of current operations with the addition of trucks and forklifts in the new hardstand area, this has been modelled and is demonstrated in the predicted results.

Source to receiver winds that occur during the evening and night time have been modelled and are shown in the predicted results for wind affected receptors R1, R2, R9, R11 and R12 against the PNTL and for R1 and R2 against the EPL criteria.

As mentioned in section 7.2.1, it is additionally noted that the predicted noise levels in Table 7-3 and Table 7-4 broadly correspond with the existing noise levels generated by the site.

7.3.1 Noise Contours

The following figures show the noise contours from the predicted results for Scenario 1 during neutral and adverse wind conditions.

Figure 7-2: Scenario 1 Noise Contour Map – Neutral Weather Conditions

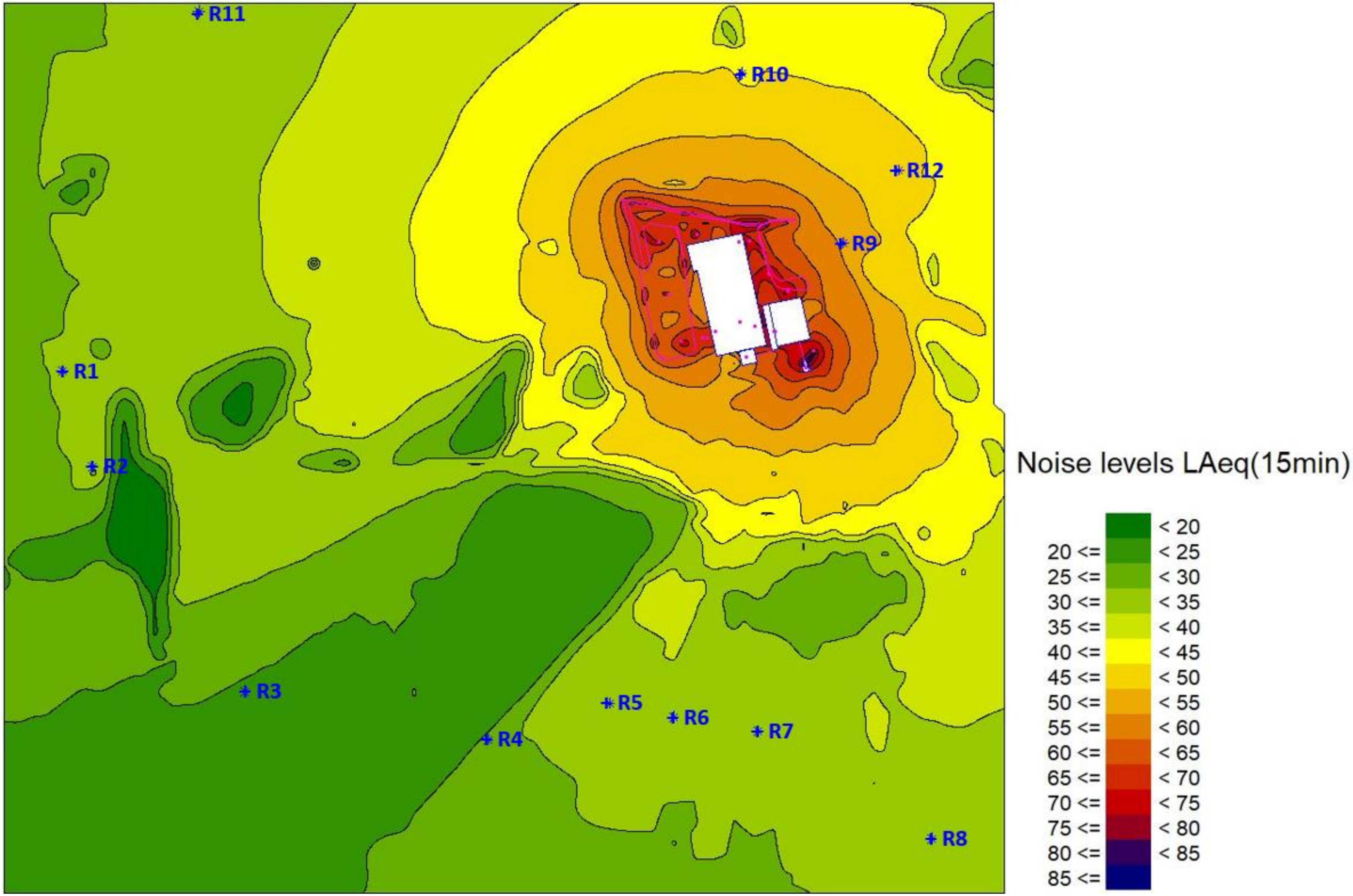


Figure 7-3: Scenario 1 Noise Contour Map – Neutral Weather Conditions with Aerial Overlay

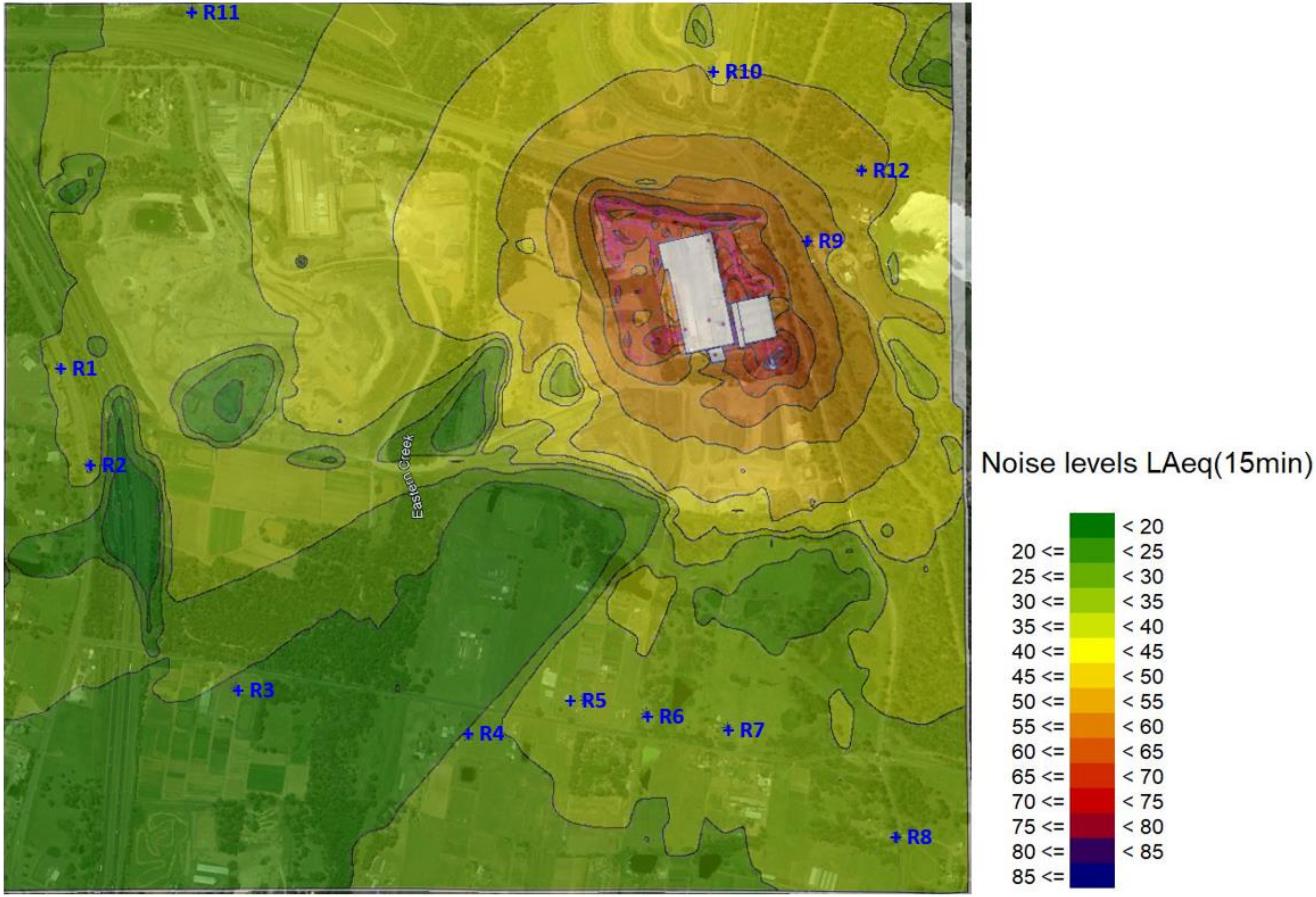


Figure 7-4: Scenario 1 Noise Contour Map – Adverse Wind Conditions

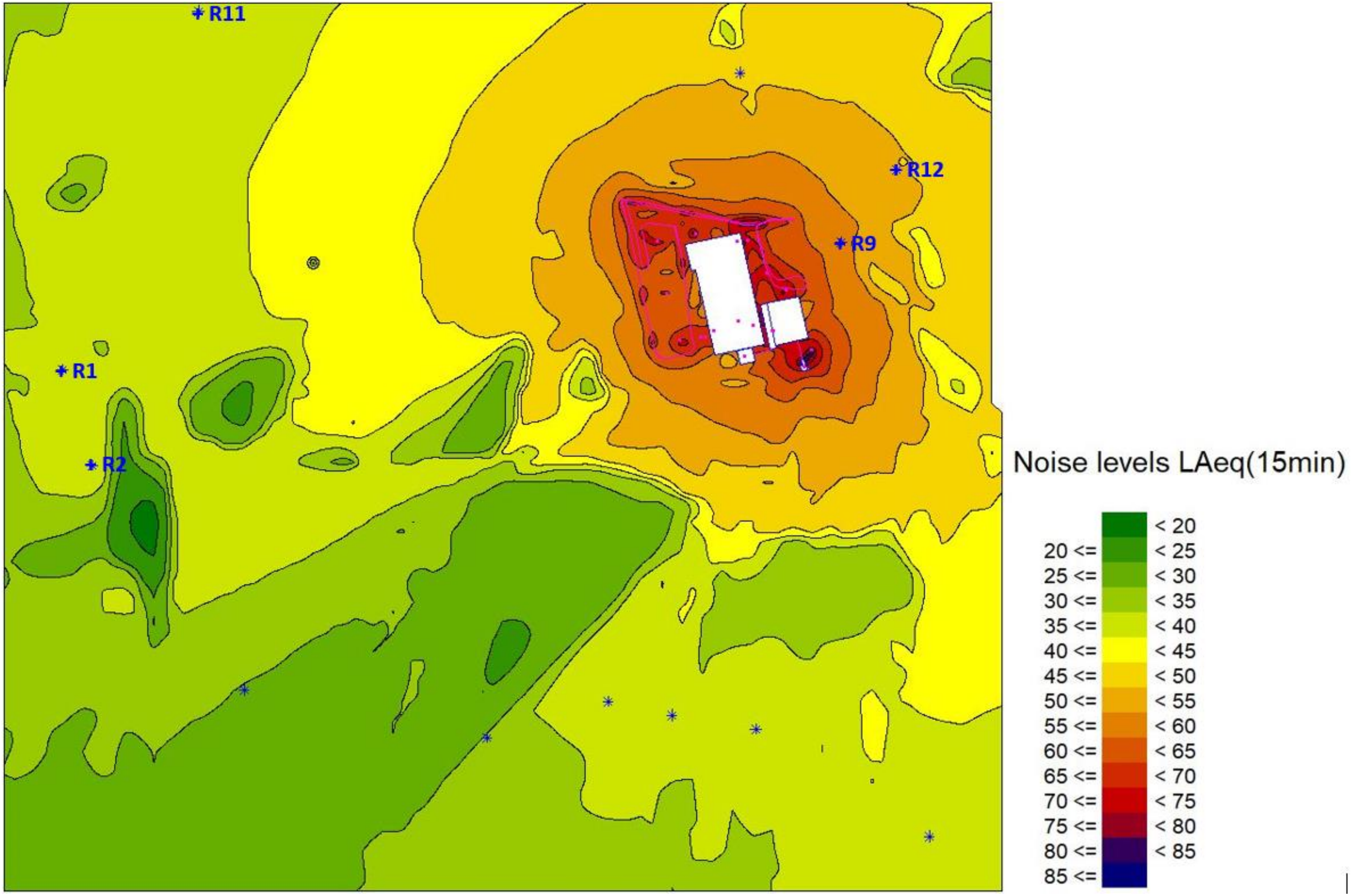
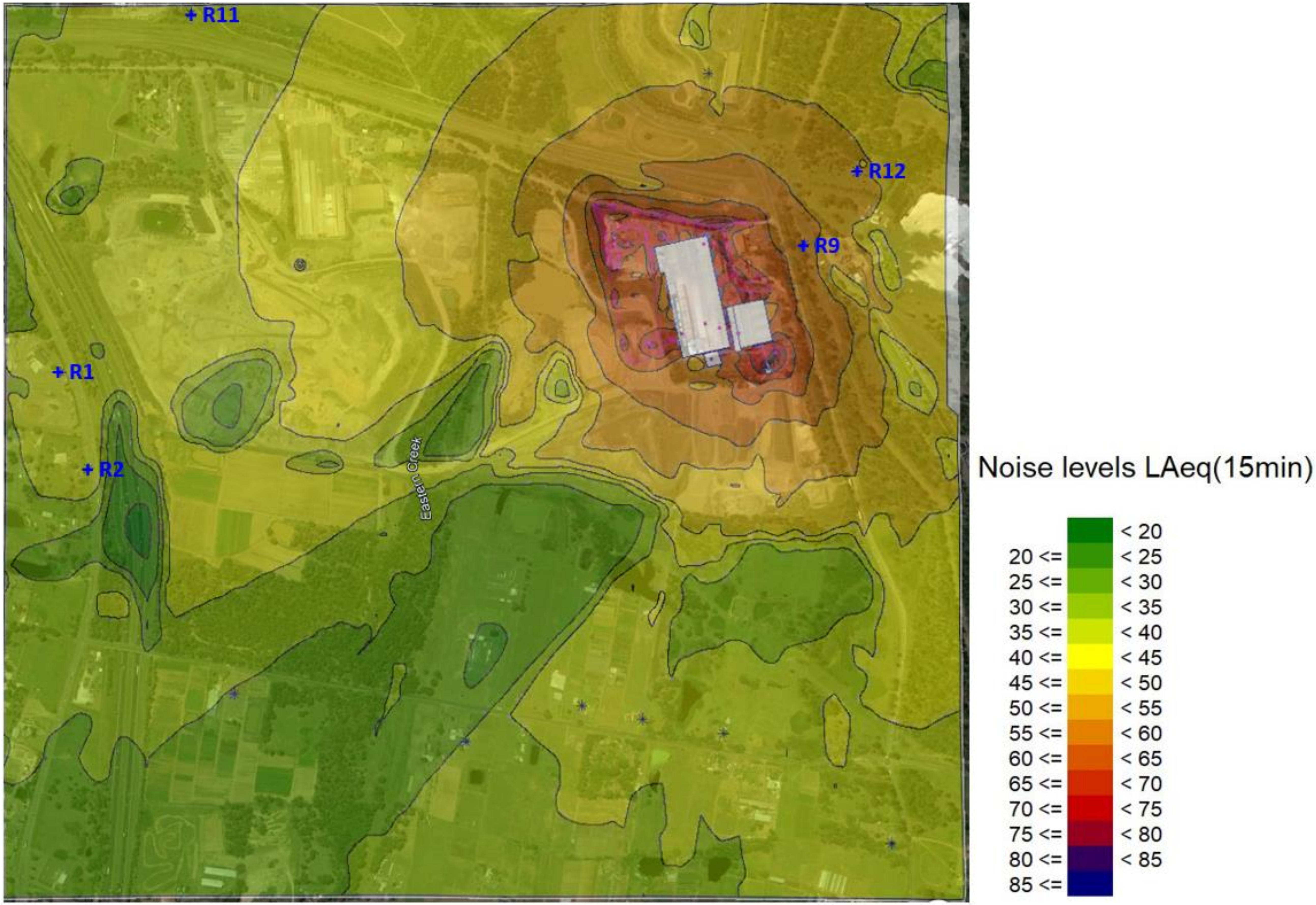


Figure 7-5: Noise Contour Map Wind – Adverse Wind Conditions with Aerial Overlay



8. ROAD TRAFFIC NOISE ASSESSMENT

A description of the calculation methodology and the noise predictions associated with road traffic has been provided below.

As mentioned in section 6.2, the closest residential receptors along the proposed truck routes to and from site are along Wallgrove Road. Road traffic noise impacts have been analysed at the potentially most impacted road traffic receiver at 763-783 Wallgrove Road (R2).

Calculation of the road traffic noise contribution has been undertaken using line source modelling with moving point spectrum in SoundPLAN. Road traffic noise associated with staff cars would be negligible compared to truck movements. Vehicles are assumed to travel at the posted speeds of 70 km/h .

Existing truck numbers:
An average of 60 truck movements per 24 hour period has been considered to be the existing truck numbers. 30 movements are considered to utilise Wallgrove Road to/from the north, 30 movements are considered to utilise Wallgrove Road to/from the South. The distribution of trucks will vary, with 12 movements during the night period (10pm to 7am) and 48 movements during the day period (7am to 10pm).

Proposed truck numbers:
The proposed development will result in 20 additional road trucks (40 movements) per day, during the day. The resulting distribution is 12 movements during the night period (10pm to 7am) and 88 movements during the day period (7am to 10pm).

The $L_{Aeq,\ 15\ hour}$ and $L_{Aeq,\ 9\ hour}$ noise descriptors have been calculated at the most affected residential receptors along Wallgrove Road. The predicted noise levels are displayed in Table 8-1.

Table 8-1: Predicted Noise Levels Associated with Road Traffic, dB(A)

Receptor	Period	PSNL $L_{eq,15\ or\ 9\ hour}$	Existing Site Specific Road Traffic Noise	Proposed Site Specific Road Traffic Noise
763-783 Wallgrove Road (R2)	Day	60	39 ✓	41 ✓
	Night	55	35 ✓	35 ✓

For residential dwellings that front onto Wallgrove Road, the predicted noise levels associated with the vehicle movements from the site would be below the daytime criteria of $L_{Aeq\ (15\ hour)}$ 60 dBA and $L_{Aeq\ (9\ hour)}$ 55 dBA for arterial roads. Furthermore, given the current volumes along Wallgrove Road, the proposal will not increase the cumulative road traffic noise levels during the day or night periods.

Step 3 of Section 3.4.1 of the RNP identifies possible reasonable and feasible control measures when exceedances of either of the outlined criteria. As no exceedances are predicted, the proposed vehicle movements comply with the RNP, and no additional mitigation strategies are recommended.

9. CONSTRUCTION NOISE ASSESSMENT

The construction steps predicted to generate the most noise are as follows:

- Demolition works (Scenario 1);
- Civil works (Scenario 2);
- Concreting works (Scenario 3); and
- Structure works (Scenario 4).

The noise generating scenarios consider situations in which equipment may be simultaneously running over the 15 minute assessment period. The equipment list for the scenario is detailed in Table 9-1, including the predicted worst case percentages of equipment running per 15 minute period. Equipment location diagrams are presented in Figure 9-1 to Figure 9-4.

All works are proposed to be undertaken during standard construction hours, that is:

- Monday to Friday, 7am to 6pm;
- Saturday 8am to 1pm; and
- No work on Sundays or public holidays.

Table 9-1: Modelled Noise Scenarios for Proposed Construction Works

Scenario	Time of the day	Noise Sources for Worst 15-minute Period
1. Demolition works	Standard hours	• Jackhammer[1] • Hand tools • Truck
2. Civil works	Standard hours	• 20T excavator • Backhoe • Roller • Dozer • Hand tools • Truck
3. Concreting construction works	Standard hours	• Concrete mixer truck • Concrete pump • Hand tools
4. Structure construction works	Standard hours	• Truck • Crane • Hand Tools

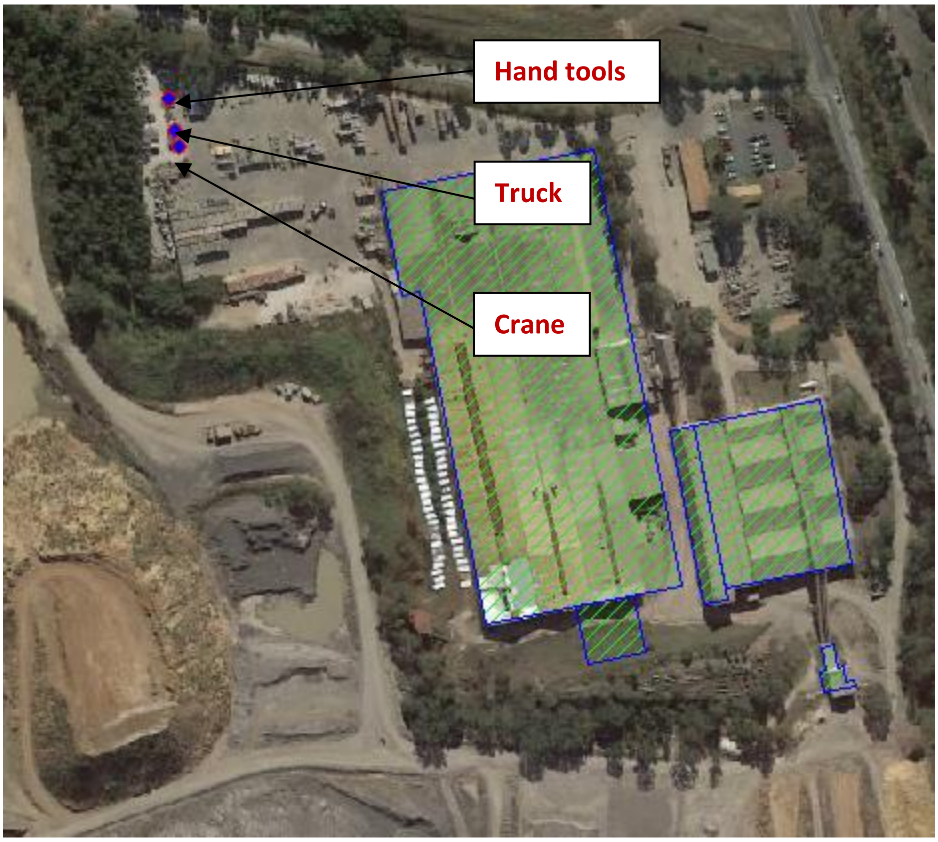
Note 1: As per section 4.5 of the Interim Construction Noise Guideline (DECC, 2009), a number of activities have proven to be particularly annoying to residents and have therefore had 5 dB added to their predicted levels.

Figure 9-1: Construction Scenario 1 – Demolition Works

Figure 9-2: Construction Scenario 2 – Civil Works

Figure 9-3: Construction Scenario 3 – Concreting Construction Works

Figure 9-4: Construction Scenario 4 – Structure Construction Works



9.1 MODELLING METHODOLOGY

9.1.1 Noise Model

Noise propagation modelling for the construction activities was carried out using the Concawe algorithm within SoundPLAN. The construction scenarios were modelled using the $L_{Aeq,\ 15\ minutes}$ descriptor.

Assumptions made in the noise modelling of the construction noise scenarios are as follows:

- The relevant assessment period for operational noise emissions has been considered to be 15 minutes. Construction scenarios assume equipment is running for 100% of the 15 minute assessment period;
- Off-site topographical information has been obtained from Google Earth and implemented in SoundPLAN. On site topographical information has been entered from the site survey.
- All receptors were modelled at 1.5 m above ground level;
- All ground areas surrounding the subject site and the nearest nominated occupancies have been modelled considering different ground factors ranging from 0 to 1. The site and surrounding grassland areas have been modelled with a ground absorption factor of 0.6.
- All noise sources associated with the construction works have been modelled as point sources.

9.1.2 Noise Sources

A-weighted octave band centre frequency sound power levels are presented shown in Table 9-2 below. The sound power levels for the relevant noise sources have been calculated from measurements of sound pressure levels undertaken by an acoustic engineer from Benbow Environmental at similar sites and sourced from Benbow Environmental's noise source database, as well as taken from AS 2436: 2010 and the UK Department for Environmental Food and Rural Affairs (DEFRA) database, *Update of noise database for prediction of noise on construction and open sites*.

Table 9-2: A-weighted Sound Power Levels Associated with Construction Activities, dB(A)

Noise Source	Overall	Octave Band Centre Frequency (Hz)							
		63	125	250	500	1k	2k	4k	8k
Jackhammer	**117**	84	94	101	114	111	107	104	97
Excavator 20T	**102**	82	85	91	97	96	95	92	85
Backhoe	**96**	76	78	83	89	91	89	88	77
Roller	**101**	81	86	96	96	94	91	82	72
Dozer	**108**	91	102	100	98	102	99	97	91
Hand tools	**100**	71	81	91	96	94	90	87	81
Truck	**105**	76	84	89	104	95	93	88	88
Concrete mixer truck	**104**	70	84	92	96	97	98	92	85
Concrete pump	**105**	77	92	97	99	100	95	95	89
Crane	**103**	84	84	87	94	98	97	95	85

9.2 Construction Predicted Noise Levels

Results of the predictive noise modelling of the construction activities are shown in Table 9-3. It can be seen that the predicted noise levels comply with the construction noise criteria at all receivers during standard construction hours for all scenarios.

Table 9-3: Noise Modelling Results Associated with Construction Activities for L_{eq}, dB(A)

Receiver	PSNL ($L_{eq,15\ minute}$ dB(A))	Scenario (Standard Hours) (L_{eq}, dB(A))			
	Standard Hours	1[1]	2	3	4
R1	57	41 ✓	32 ✓	29 ✓	29 ✓
R2	57	40 ✓	31 ✓	29 ✓	28 ✓
R3	57	41 ✓	22 ✓	15 ✓	16 ✓
R4	52	26 ✓	18 ✓	16 ✓	16 ✓
R5	52	32 ✓	20 ✓	14 ✓	13 ✓
R6	52	46 ✓	19 ✓	14 ✓	12 ✓
R7	52	34 ✓	32 ✓	27 ✓	18 ✓
R8	52	34 ✓	32 ✓	28 ✓	27 ✓
R9	75	67 ✓	43 ✓	44 ✓	40 ✓
R10	75	57 ✓	42 ✓	39 ✓	36 ✓
R11	75	43 ✓	33 ✓	32 ✓	31 ✓
R12	65	58 ✓	38 ✓	40 ✓	37 ✓

Note 1: As per section 4.5 of the Interim Construction Noise Guideline (DECC, 2009), a number of activities have proven to be particularly annoying to residents and have therefore had 5 dB added to their predicted levels.

✓Complies ✗ Non-compliance

9.3 CONSTRUCTION NOISE CONTROLS

It is proposed that construction works take place during standard hours only. The proposed hours of operations for all **construction** works are as follows:

Monday to Friday:	7am to 6pm
Saturday:	8am to 1pm
Sunday and Public Holidays:	No works permitted

10. VIBRATION IMPACT ASSESSMENT

The potential vibration impacts of construction and operational equipment is analysed in this section.

10.1 CONSTRUCTION EQUIPMENT

The construction activities will not utilise equipment that generates significant vibration apart from the jackhammer.

From Table 3-1, no surrounding receivers are located within the immediate vicinity of any surrounding residential or non-residential receivers. Therefore, given the distances to surrounding receivers, it is considered unlikely that cosmetic damage or human response to vibration will occur as part of the proposed construction works.

10.2 OPERATIONAL EQUIPMENT

The operational activities do not include equipment that generates vibration apart from the vibrating screen. The equipment is well isolated and is not predicted to cause vibration that will be perceptible at any neighbouring structures or receivers.

11. STATEMENT OF POTENTIAL NOISE IMPACT

Benbow Environmental has been engaged by Austral Bricks Pty Ltd to prepare a noise impact assessment for the proposed alterations and additions to the existing Austral Bricks facility located at 780 Wallgrove Road, Horsley Park. The proposal seeks to introduce a new production building and introduce new footings for the relocated clay bins and conveyor system.

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

- *Department of Environment and Climate Change NSW, Interim Construction Noise Guideline (DECC 2009) and NSW Environment Protection Authority Draft Construction Guideline* (EPA 2020)
- *NSW Environment Protection Authority, Noise Policy for Industry (EPA 2017);* and
- *Department of Environment, Climate Change and Water NSW, Road Noise Policy (DECCW 2011).*

The noise impact assessment also assessed the proposed operational noise against the existing environmental protection licence noise limits (Licence no. 546, Anniversary Date: 31st October).

Assessment criteria for noise emissions from the subject site were used to determine whether the potential noise impacts from the site were within the derived limits or in exceedance of the guidelines.

The site operations, construction scenarios and road traffic impacts were modelled using the predictive noise software, Sound Plan. Operational noise modelling utilised a worst case scenario in which all activities were conducted simultaneously in all time periods. The noise generating scenarios are predicted to comply with the project specific noise levels at all receivers during all time periods and considered weather conditions. The operational noise levels also complied with the existing environmental protection licence noise limits.

Compliance with the criteria set out in the Interim Construction Noise Guideline was predicted at all considered receivers. Construction works are recommended to take place during standard construction hours.

Road traffic noise levels associated with the development have been considered against the NSW Road Noise Policy, with compliance predicted at all considered receptors.

This concludes the report.

Prepared by:

Emma Hansma
<u>Senior Engineer</u>

R T Benbow
<u>Principal Consultant</u>

12. 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 Austral Bricks Pty Ltd, as per our agreement for providing environmental services. Only Austral Bricks Pty 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 Austral Bricks Pty 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

Acoustic Research Labs Pty Ltd
Level 7 Building 2 423 Pennant Hills Rd
Pennant Hills NSW AUSTRALIA 2120
Ph: +61 2 9484 0800 A.B.N. 65 160 399 119
www.acousticresearch.com.au

Sound Level Meter

AS 1259.1:1990 - AS 1259.2:1990

Calibration Certificate

Calibration Number C15348

Client Details Benbow Environmental
13 Daking Street
North Parramatta NSW 2151

Equipment Tested/ Model Number : ARL EL-215
Instrument Serial Number : 194593
Microphone Serial Number : N/A
Pre-amplifier Serial Number : N/A

Atmospheric Conditions
Ambient Temperature : 20.8°C
Relative Humidity : 50.9%
Barometric Pressure : 99.8kPa

Calibration Technician : Calvin Simpfendorfer
Secondary Check: Kate Alchin
Calibration Date : 24/07/2015
Report Issue Date : 27/07/2015

Approved Signatory : Ken Williams

Clause and Characteristic Tested	Result	Clause and Characteristic Tested	Result
10.2.2: Absolute sensitivity	*Pass*	10.3.4: Inherent system noise level	*Pass*
10.2.3: Frequency weighting	*Pass*	10.4.2: Time weighting characteristic F and S	*Pass*
10.3.2: Overload indications	*Pass*	10.4.3: Time weighting characteristic I	*Pass*
10.3.3: Accuracy of level range control	*Pass*	10.4.5: R.M.S performance	*Pass*
8.9: Detector-indicator linearity	*Pass*	9.3.2: Time averaging	*Pass*
8.10: Differential level linearity	*Pass*	9.3.5: Overload indication	*Pass*

Least Uncertainties of Measurement -

Acoustic Tests		Environmental Conditions	
31.5 Hz to 8kHz	*±0.120dB*	*Temperature*	*±0.3°C*
12.5kHz	*±0.165dB*	*Relative Humidity*	*±4.1%*
16kHz	*±0.245dB*	*Barometric Pressure*	*±0.1kPa*
Electrical Tests			
31.5 Hz to 20 kHz	*±0.098dB*		

All uncertainties are derived at the 95% confidence level with a coverage factor of 2.

This calibration certificate is to be read in conjunction with the calibration test report.

Acoustic Research Labs Pty Ltd is NATA Accredited Laboratory Number 14172.
Accredited for compliance with ISO/IEC 17025.

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

CERTIFICATE OF CALIBRATION

CERTIFICATE NO: 18874

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	93.82	991.2	1.58
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: 990 hPa ±1.5 hPa **Relative Humidity:** 42% ±5%
Temperature: 20 °C ±2° C
Date of Calibration: 26/05/2016 **Issue Date:** 26/05/2016
Acu-Vib Test Procedure: AVP02 (Calibrators)
Test Method: AS IEC 60942 - 2004

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

.Accredited for compliance with ISO/IEC 17025
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. 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.: SLM 41048 & FILT 0932

Equipment Description:	Sound & Vibration Analyser		
Manufacturer:	Svantek		
Model No:	Svan-957	**Serial No:**	15336
Microphone Type:	7052E	**Serial No:**	47869
Filter Type:	1/3 Octave	**Serial No:**	15336
Comments:	All tests passed for type 1. (See over for details)		
Owner:	Benbow Environmental 13 Daking Street North Parramatta 2151		
Ambient Pressure:	1018 hPa ±1.5 hPa		
Temperature:	24 °C ±2° C	**Relative Humidity:**	42% ±5%
Date of Calibration:	21/07/2015	**Issue Date:**	23/07/2015

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

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

Accredited for compliance with ISO/IEC 17025
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

Acoustic Research Labs Pty Ltd
Level 7 Building 2 423 Pennant Hills Rd
Pennant Hills NSW AUSTRALIA 2120
Ph: +61 2 9484 0800 A.B.N. 65 160 399 119
www.acousticresearch.com.au

Sound Level Meter

AS 1259.1:1990 - AS 1259.2:1990

Calibration Certificate

Calibration Number C18127_Reissued

Client Details Benbow Environmental
13 Daking Street
North Paramattta NSW 2151

Equipment Tested/ Model Number : ARL EL-215
Instrument Serial Number : 194702
Microphone Serial Number : N/A
Pre-amplifier Serial Number : N/A

Atmospheric Conditions
Ambient Temperature : 22.3°C
Relative Humidity : 53.1%
Barometric Pressure : 100.61kPa

Calibration Technician : Lucky Jaiswal
Calibration Date : 9 Mar 2018
Secondary Check: Sandra Minto
Report Issue Date : 3 Oct 2018
Approved Signatory : Ken Williams

Clause and Characteristic Tested	Result	Clause and Characteristic Tested	Result
10.2.2: Absolute sensitivity	*Pass*	10.3.4: Inherent system noise level	*Pass*
10.2.3: Frequency weighting	*Pass*	10.4.2: Time weighting characteristic F and S	*Pass*
10.3.2: Overload indications	*Pass*	10.4.3: Time weighting characteristic I	*Pass*
10.3.3: Accuracy of level range control	*Pass*	10.4.5: R.M.S performance	*Pass*
8.9: Detector-indicator linearity	*Pass*	9.3.2: Time averaging	*Pass*
8.10: Differential level linearity	*Pass*	9.3.5: Overload indication	*Pass*

Least Uncertainties of Measurement -

Acoustic Tests		Environmental Conditions	
31.5 Hz to 8kHz	*±0.15dB*	*Temperature*	*±0.2°C*
12.5kHz	*±0.21dB*	*Relative Humidity*	*±2.4%*
16kHz	*±0.29dB*	*Barometric Pressure*	*±0.015Pa*
Electrical Tests			
31.5 Hz to 20 kHz	*±0.12dB*		

All uncertainties are derived at the 95% confidence level with a coverage factor of 2.

The sound level meter under test has been shown to conform to the type 2 requirements for periodic testing as described in AS 1259.1:1990 and AS 1259.2:1990 for the tests stated above.

NATA WORLD RECOGNISED ACCREDITATION

This calibration certificate is to be read in conjunction with the calibration test report.

Acoustic Research Labs Pty Ltd is NATA Accredited Laboratory Number 14172.
Accredited for compliance with ISO/IEC 17025 - calibration.

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

NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration and inspection reports.

CERTIFICATE OF CALIBRATION

CERTIFICATE NO: 23100

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	94.16	990.12	3.98
Level 2:	NA	N	NA	NA	NA
Uncertainty:			±0.11 dB	±0.05%	±0.20 %
Uncertainty (at 95% c.l.) k=2					

CONDITION OF TEST:
Ambient Pressure: 1010 hPa ±1.5 hPa **Relative Humidity:** 31% ±5%
Temperature: 24 °C ±2° C
Date of Calibration: 11/07/2018 **Issue Date:** 11/07/2018
Acu-Vib Test Procedure: AVP02 (Calibrators)
Test Method: AS IEC 60942 - 2004

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

.Accredited for compliance with ISO/IEC 17025 - Calibration
The results of the tests, calibration and/or measurements included in this document are traceable to Australian/national standards.
The uncertainties quoted are calculated in accordance with the methods of the ISO Guide to the Uncertainty of Measurement and quoted at a coverage factor of 2 with a confidence interval of approximately 95%.

NATA
WORLD RECOGNISED ACCREDITATION
Accredited Lab. 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.: **SLM 20815 & FILT 4015**

Equipment Description: Sound & Vibration Analyser

Manufacturer: Svantek

Model No: Svan-957 **Serial No:** 15335

Microphone Type: 7052E **Serial No:** 40814

Filter Type: 1/3 Octave **Serial No:** 15335

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

Owner: Benbow Environmental
13 Daking Street
North Parramatta NSW 2151

Ambient Pressure: 1014 hPa ±1.5 hPa

Temperature: 23 °C ±2° C **Relative Humidity:** 53% ±5%

Date of Calibration: 14/06/2017 **Issue Date:** 16/06/2017

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

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

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

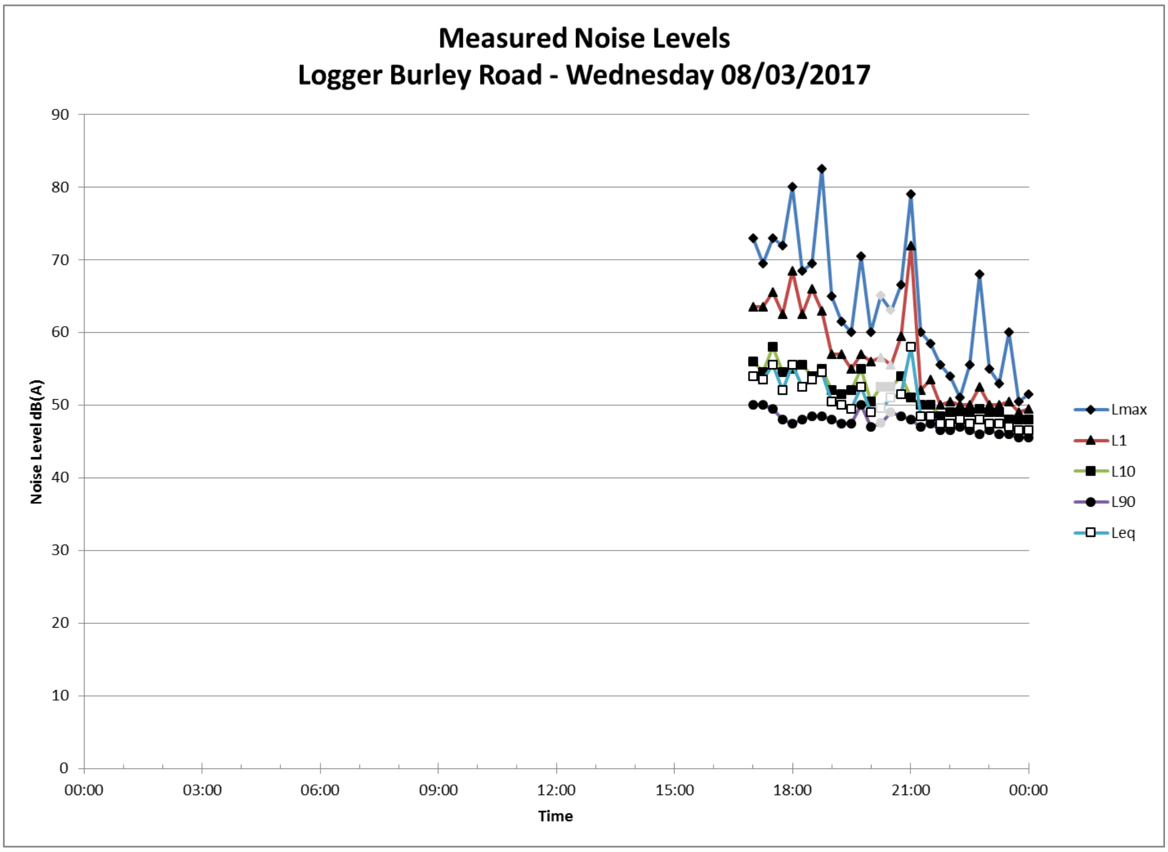
NATA
WORLD RECOGNISED ACCREDITATION

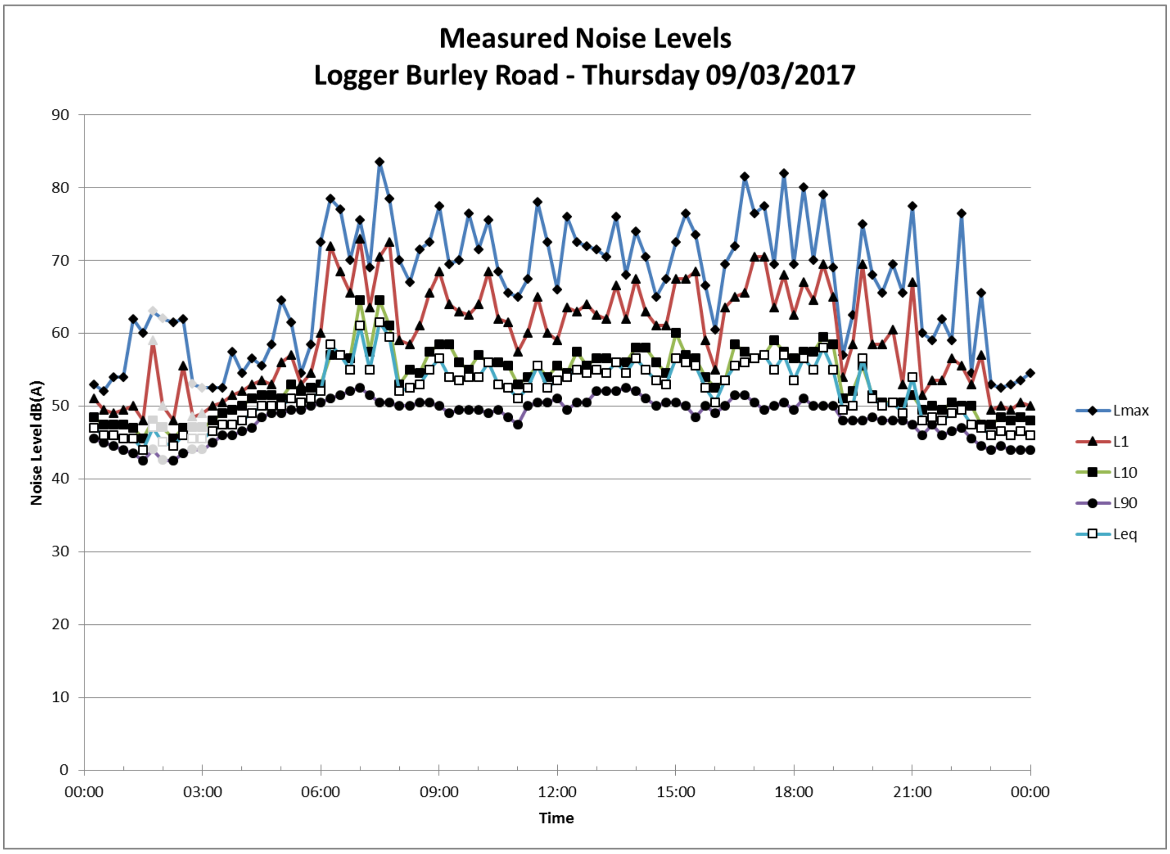
Accredited Lab. No. 9262
Acoustic and Vibration Measurements

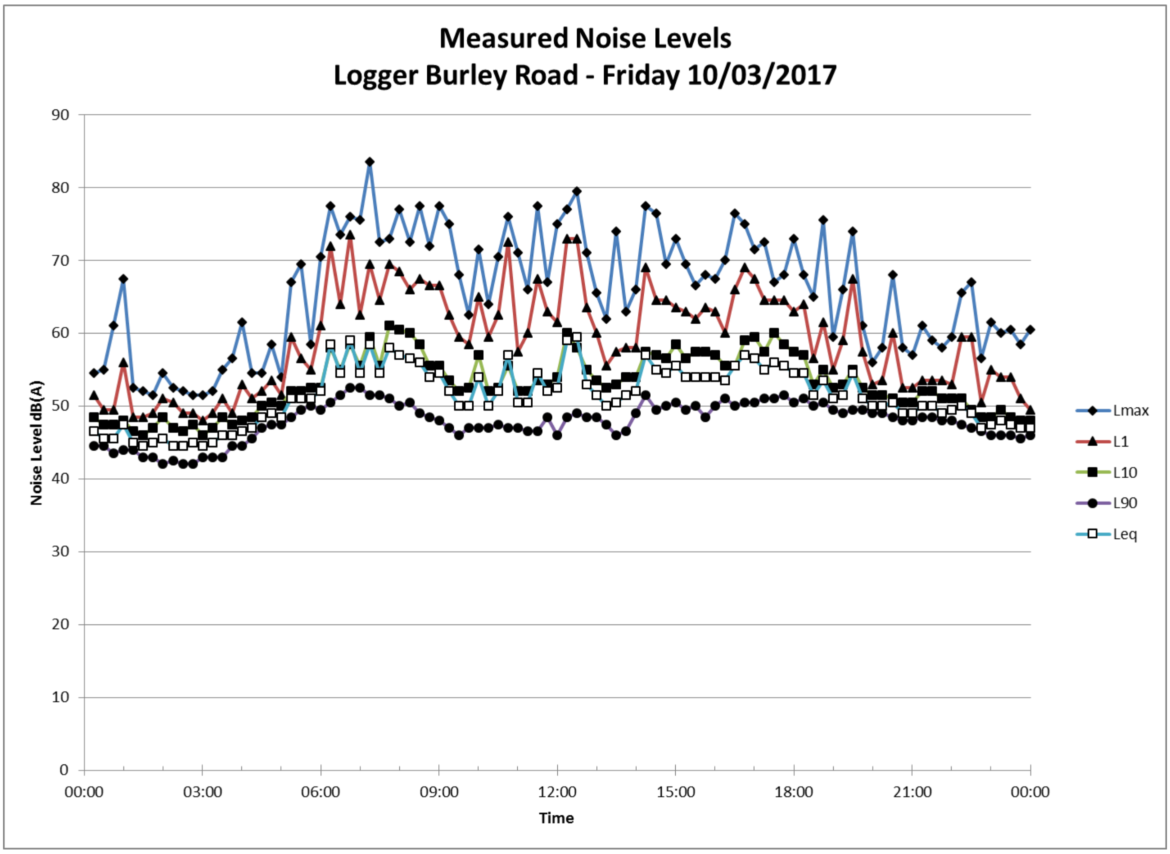
ACU-VIB
ELECTRONICS

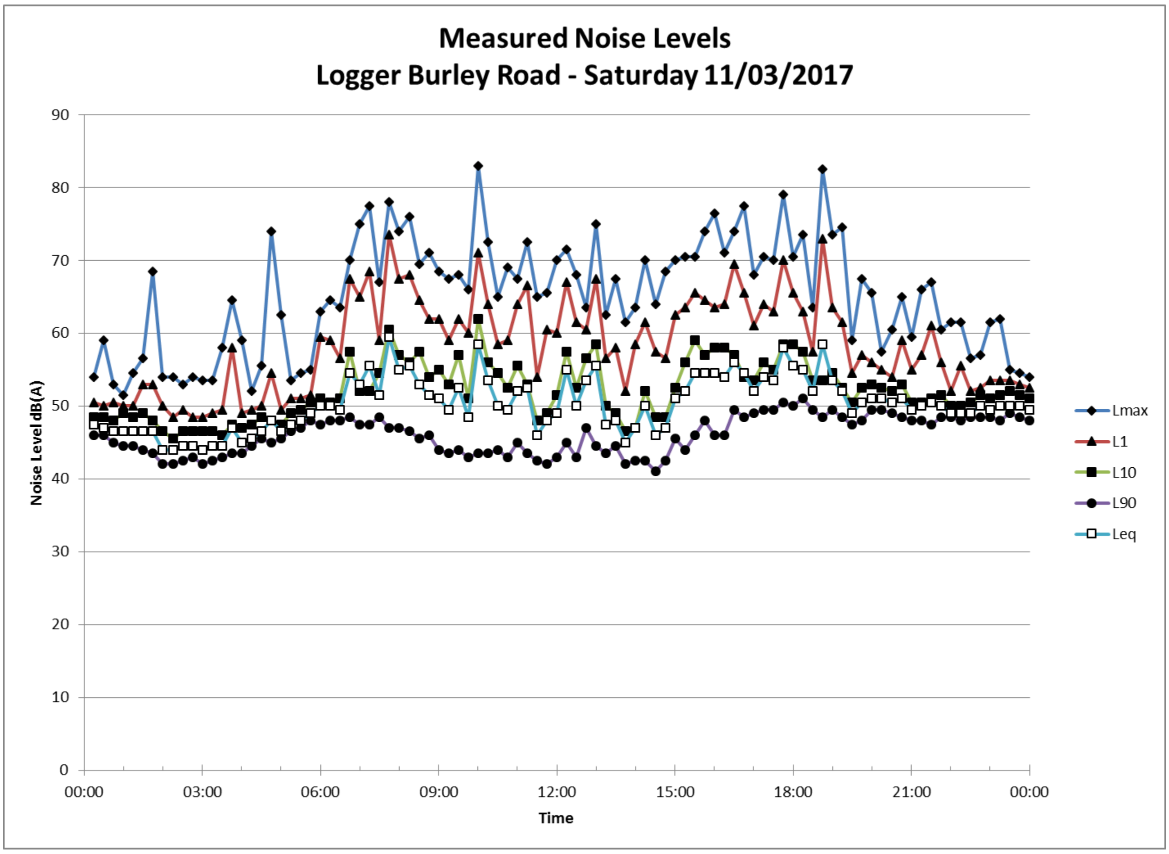
HEAD OFFICE
Unit 14, 22 Hudson Ave Castle Hill NSW 2154
Tel: (02) 96808133 Fax: (02)96808233
Mobile: 0413 809806
web site: www.acu-vib.com.au

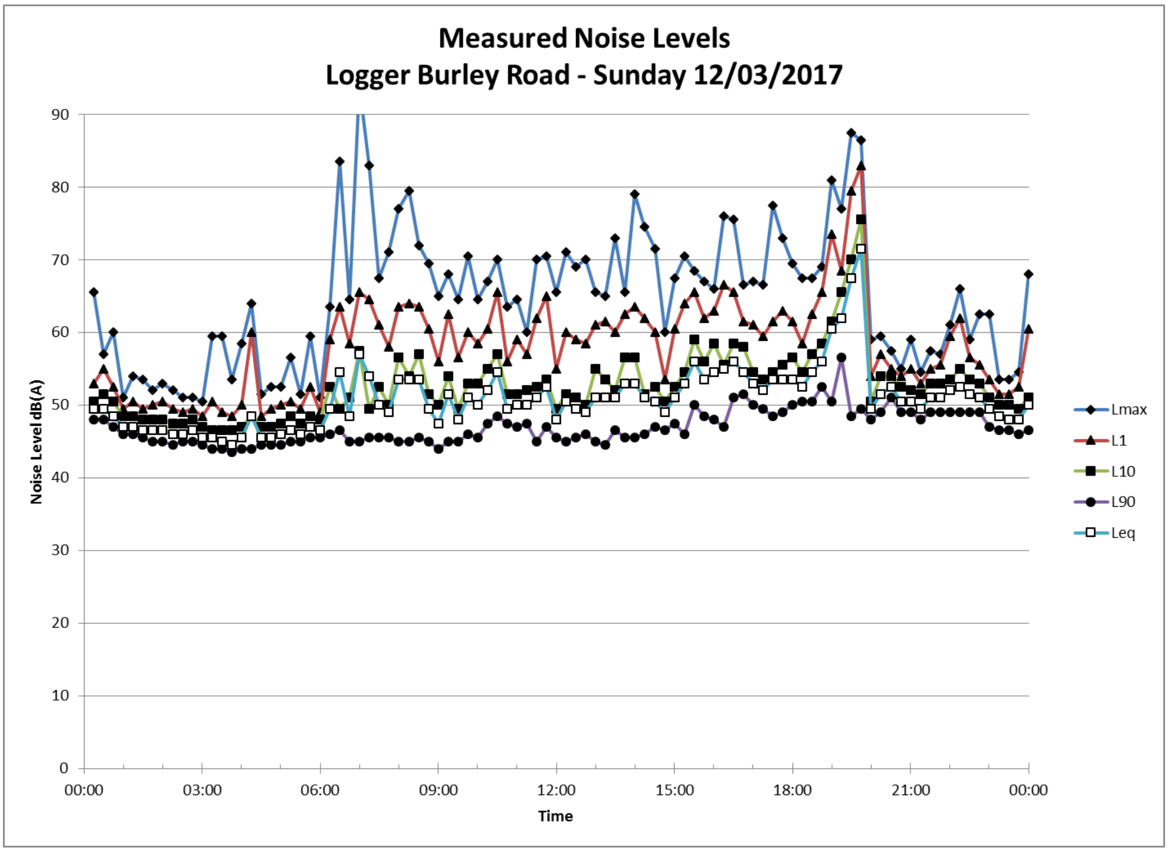
Attachment 4: Noise Logger Graphs

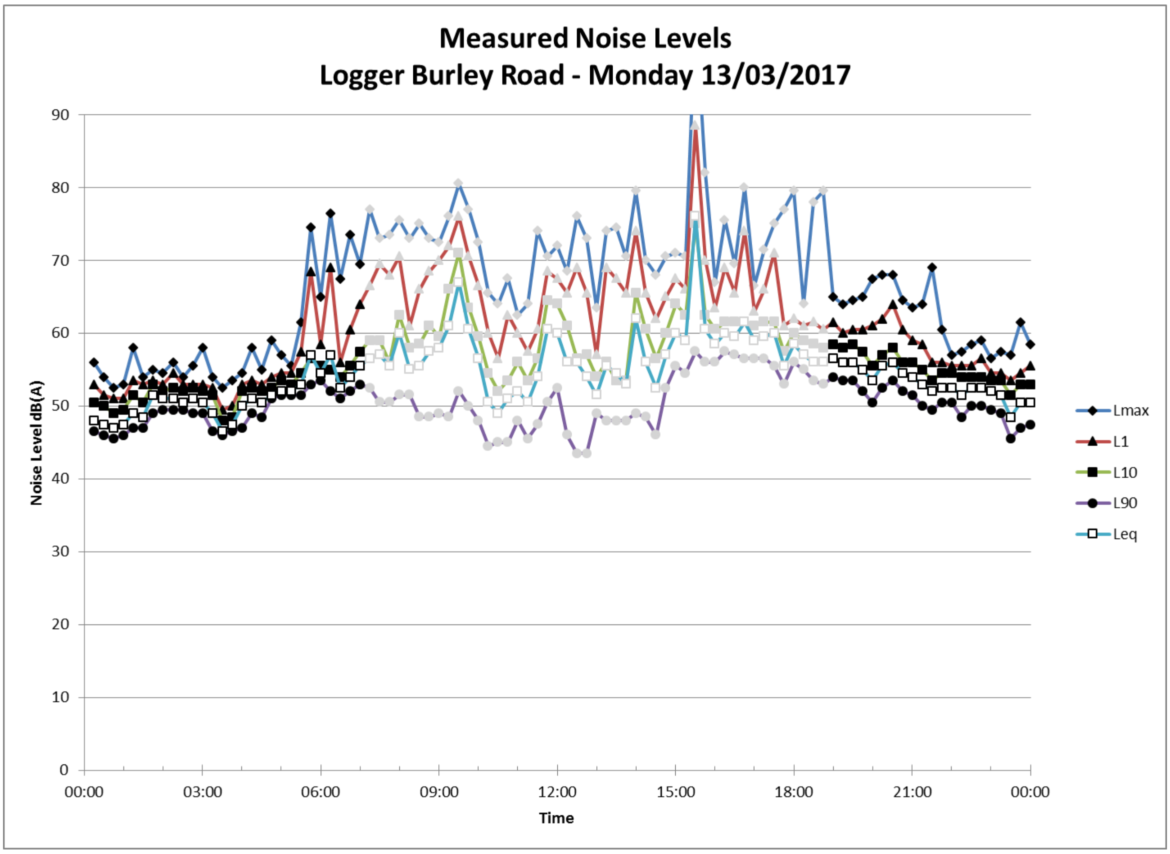

Measured Noise Levels
Logger Burley Road - Wednesday 08/03/2017
Noise Level dB(A)
Time
Lmax
L1
L10
L90
Leq

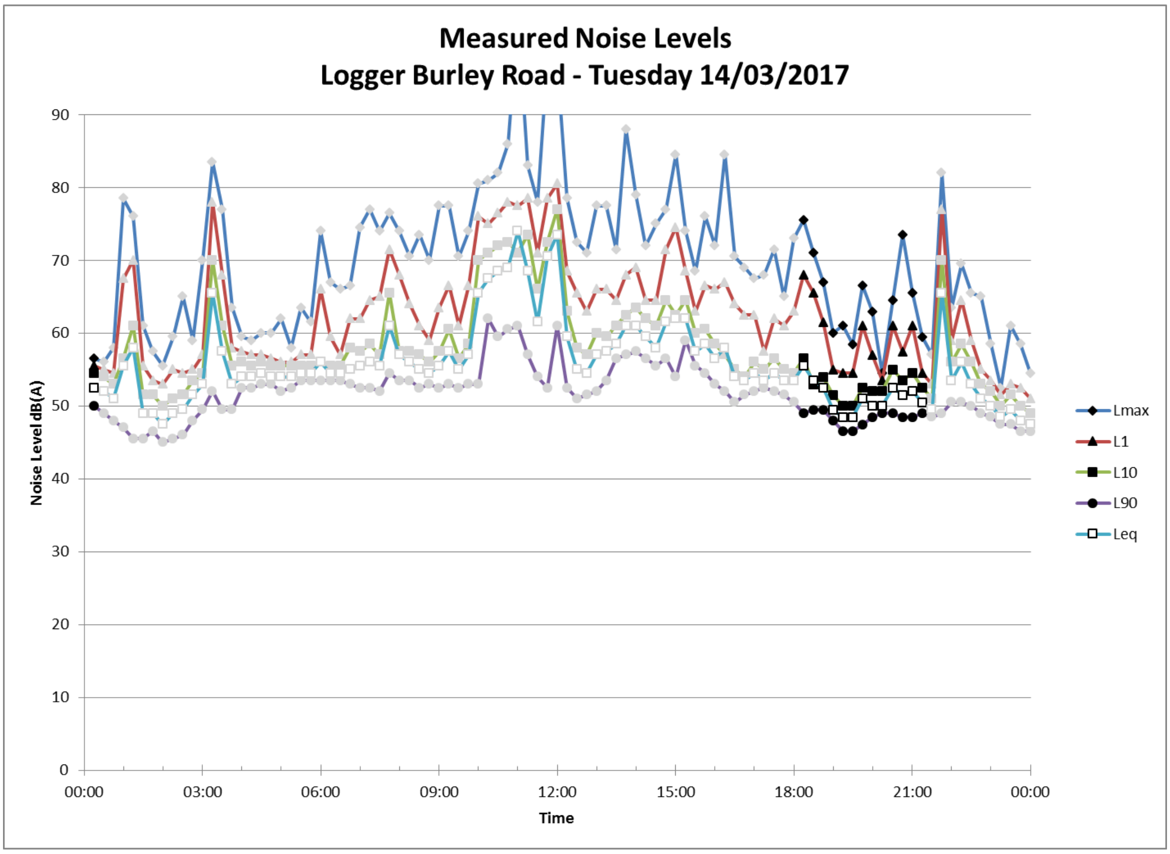

Measured Noise Levels
Logger Burley Road - Thursday 09/03/2017
Noise Level dB(A)
Time
Lmax
L1
L10
L90
Leq

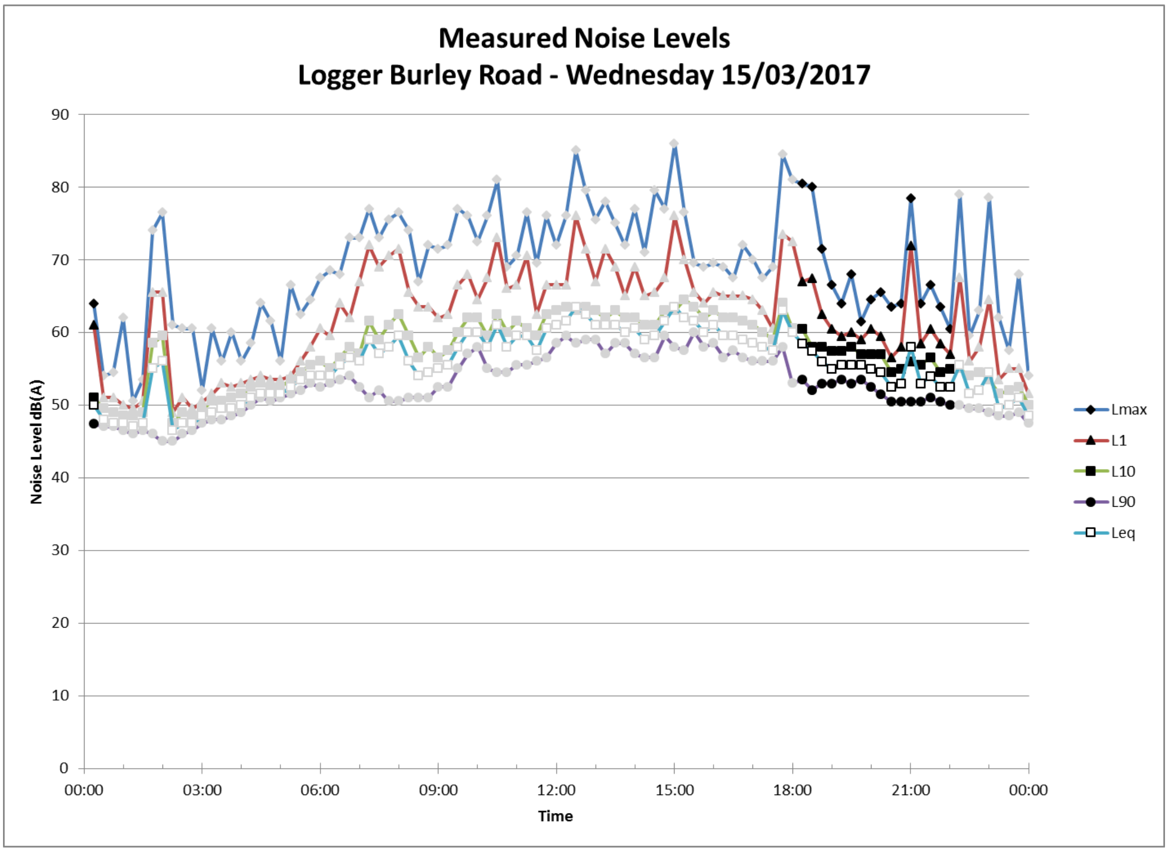

Measured Noise Levels
Logger Burley Road - Friday 10/03/2017
Noise Level dB(A)
0
10
20
30
40
50
60
70
80
90
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Time
Lmax
L1
L10
L90
Leq

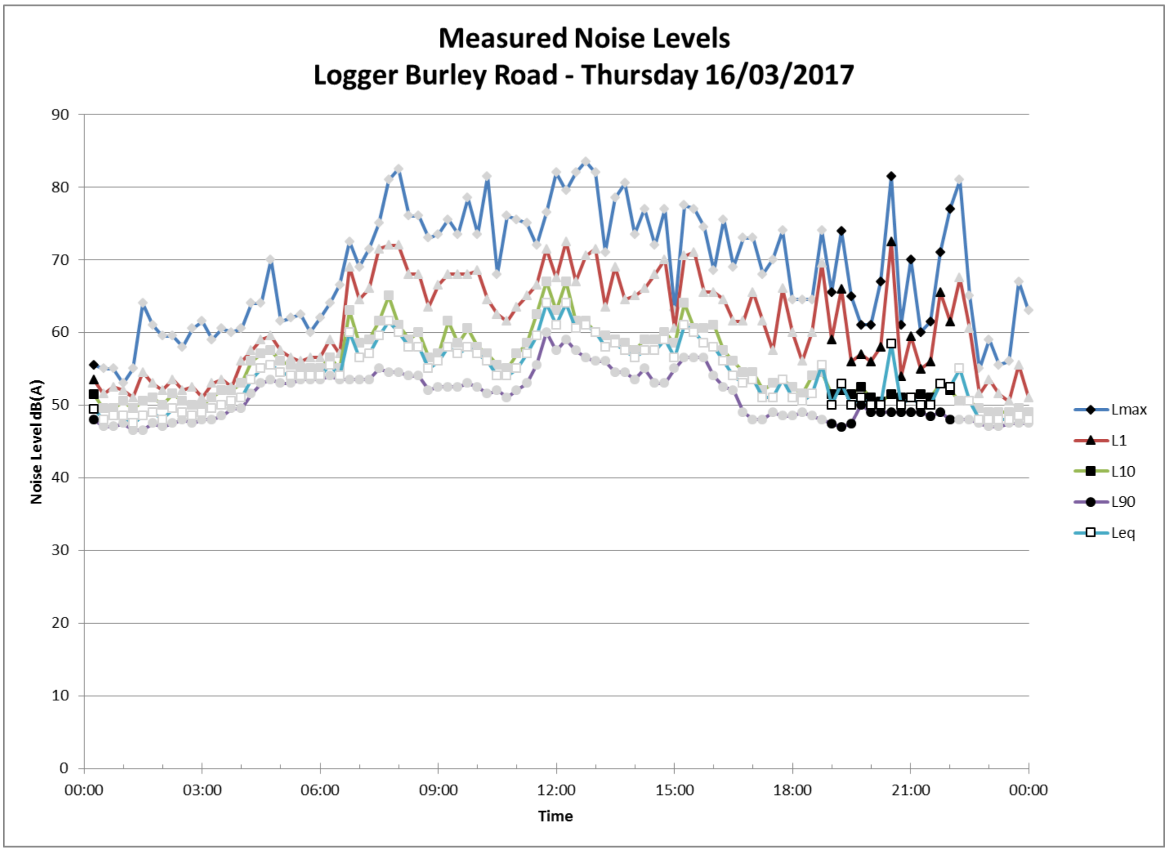

Measured Noise Levels
Logger Burley Road - Saturday 11/03/2017
Noise Level dB(A)
0
10
20
30
40
50
60
70
80
90
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Time
Lmax
L1
L10
L90
Leq

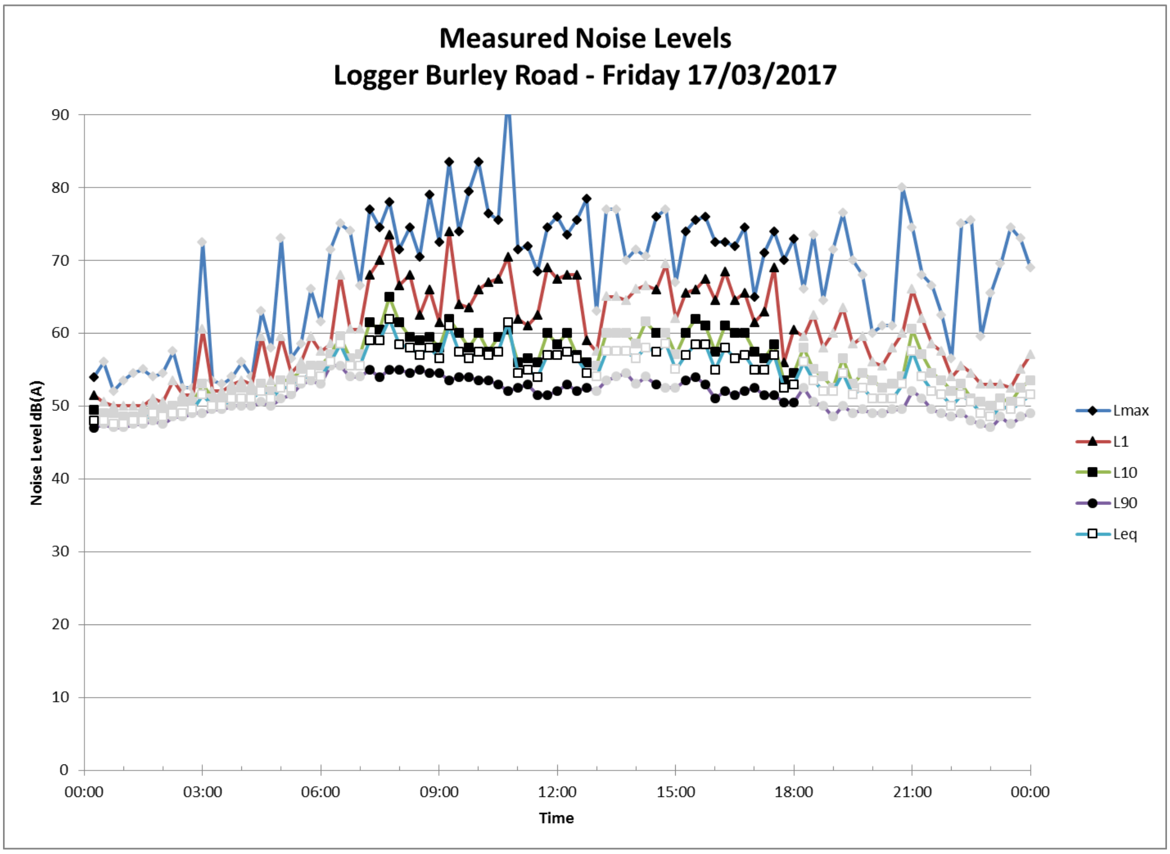

Measured Noise Levels
Logger Burley Road - Sunday 12/03/2017
Noise Level dB(A)
90
80
70
60
50
40
30
20
10
0
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Time
Lmax
L1
L10
L90
Leq

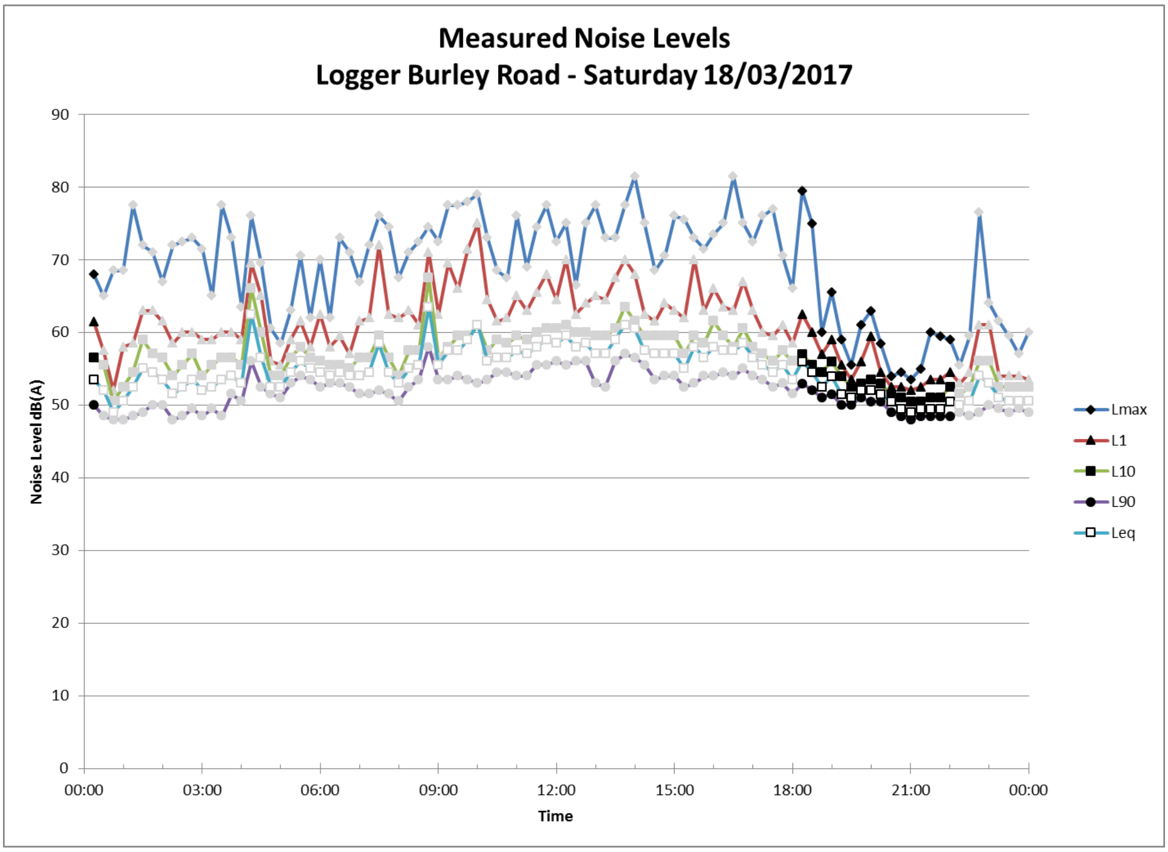

Measured Noise Levels
Logger Burley Road - Monday 13/03/2017
Noise Level dB(A)
90
80
70
60
50
40
30
20
10
0
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Time
Lmax
L1
L10
L90
Leq

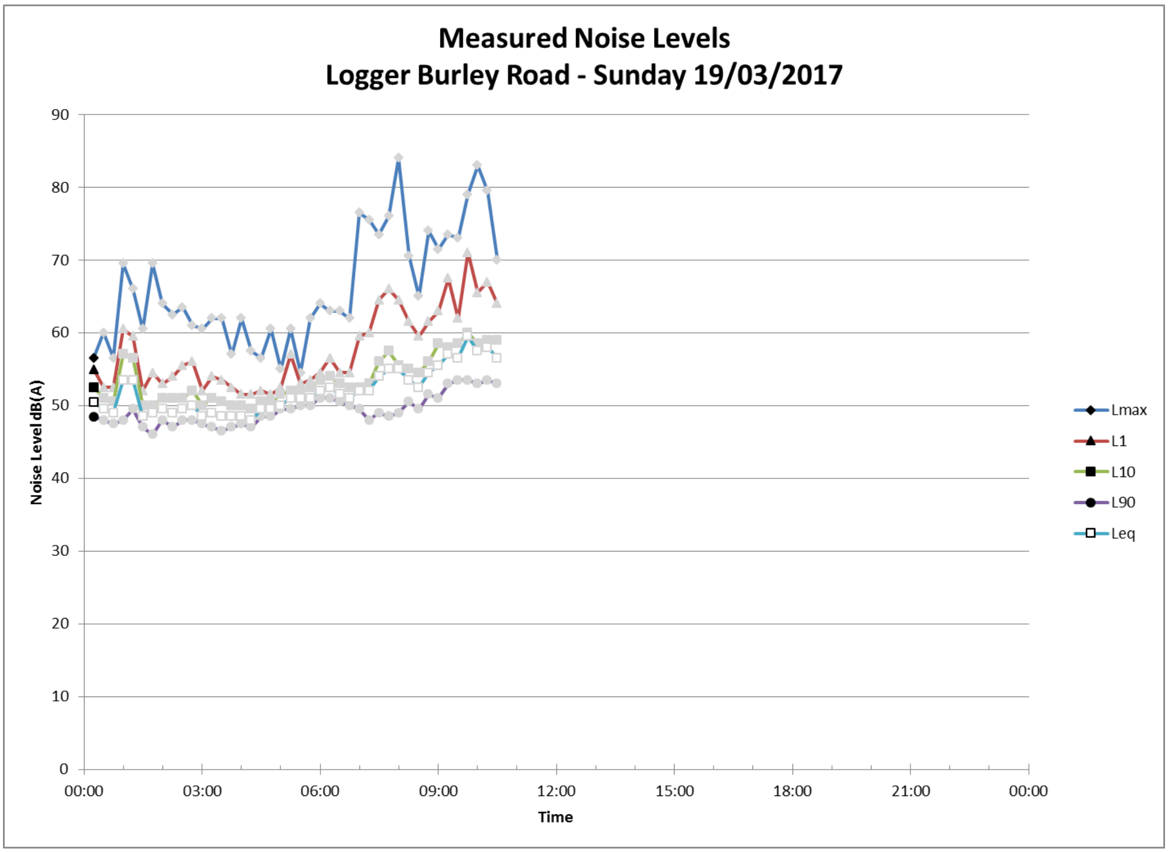

Measured Noise Levels
Logger Burley Road - Tuesday 14/03/2017
Noise Level dB(A)
0
10
20
30
40
50
60
70
80
90
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Time
Lmax
L1
L10
L90
Leq

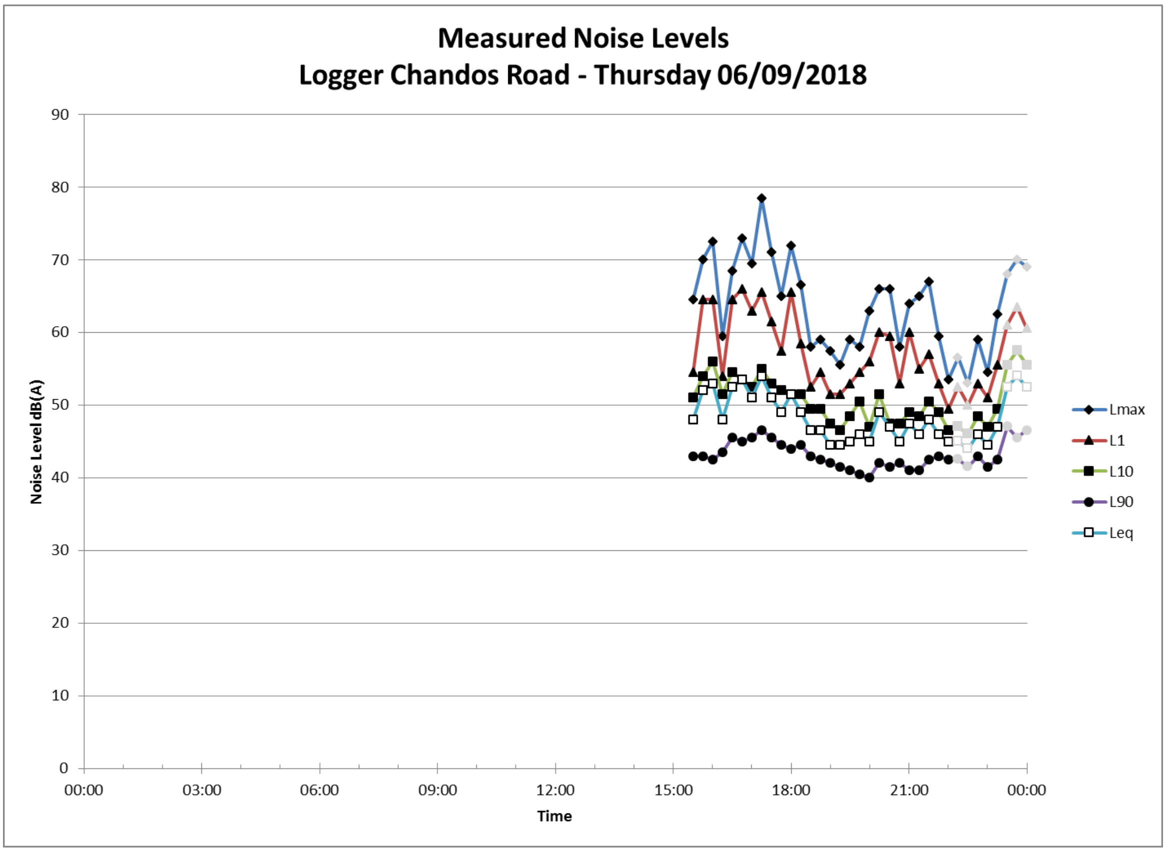

Measured Noise Levels
Logger Burley Road - Wednesday 15/03/2017
Noise Level dB(A)
0
10
20
30
40
50
60
70
80
90
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Time
Lmax
L1
L10
L90
Leq


Measured Noise Levels
Logger Burley Road - Thursday 16/03/2017
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

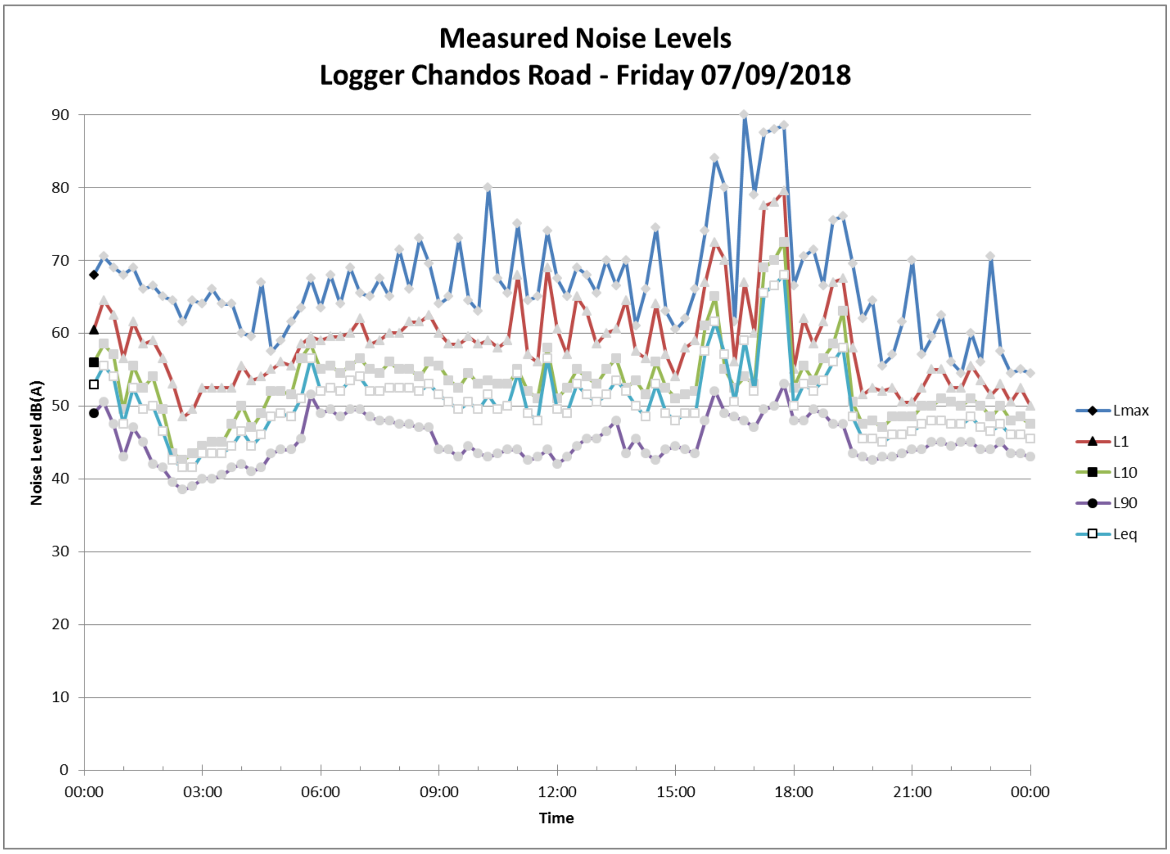

Measured Noise Levels
Logger Burley Road - Friday 17/03/2017
Noise Level dB(A)
Time
0
10
20
30
40
50
60
70
80
90
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq


Measured Noise Levels
Logger Burley Road - Saturday 18/03/2017
90
80
70
60
50
40
30
20
10
0
Noise Level dB(A)
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Time
Lmax
L1
L10
L90
Leq

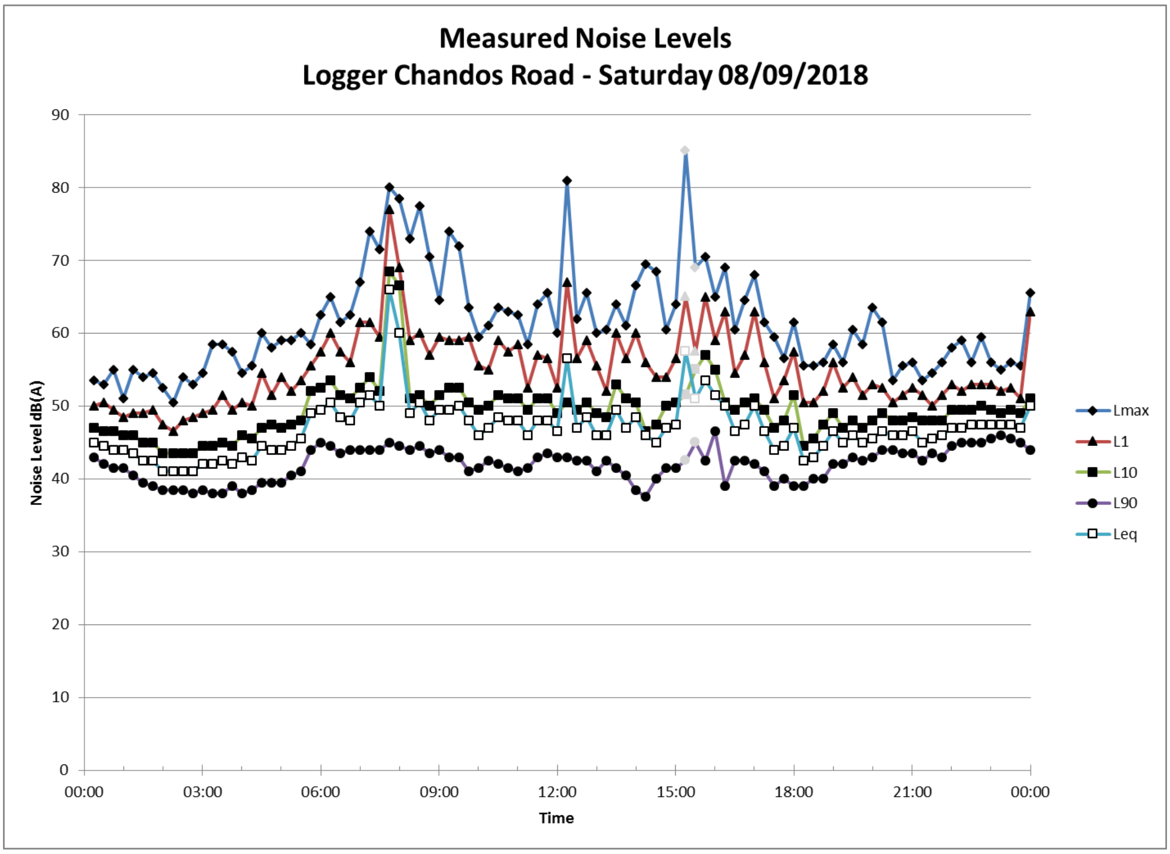

Measured Noise Levels
Logger Burley Road - Sunday 19/03/2017
90
80
70
60
50
40
30
20
10
0
Noise Level dB(A)
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Time
Lmax
L1
L10
L90
Leq

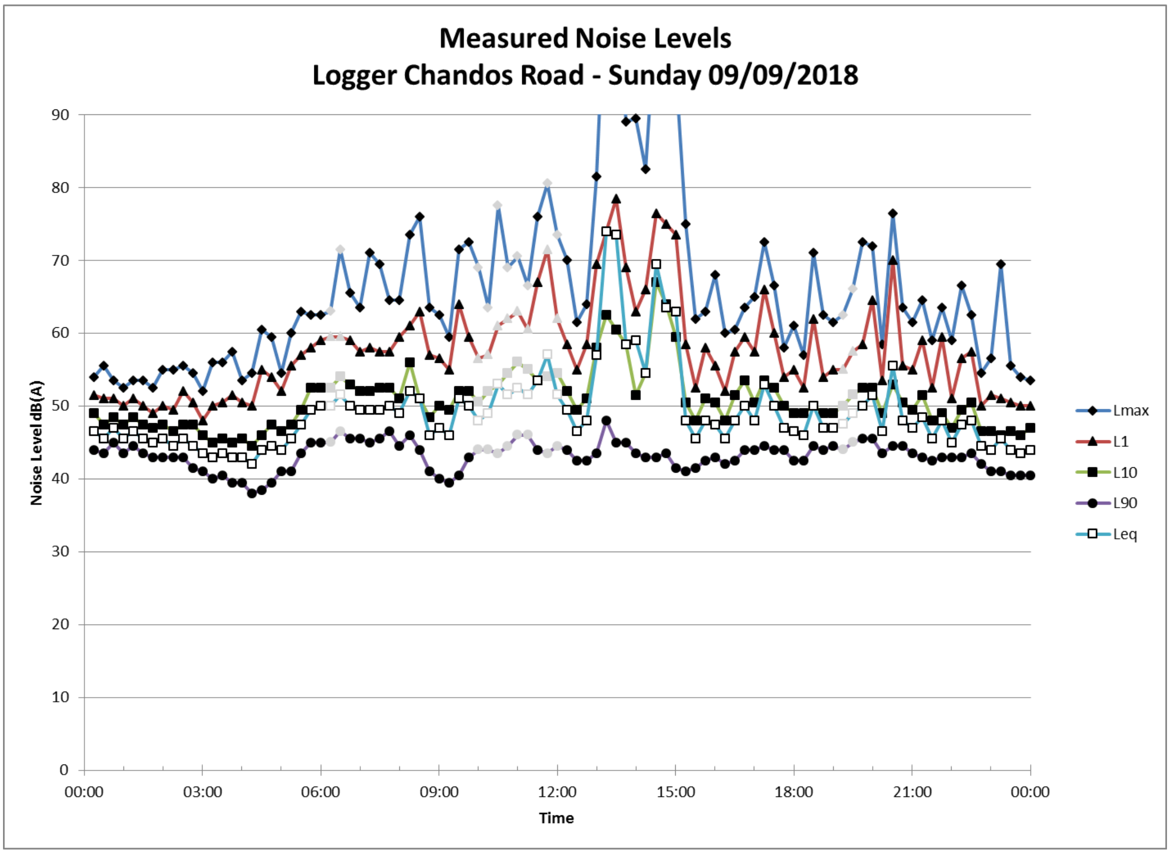


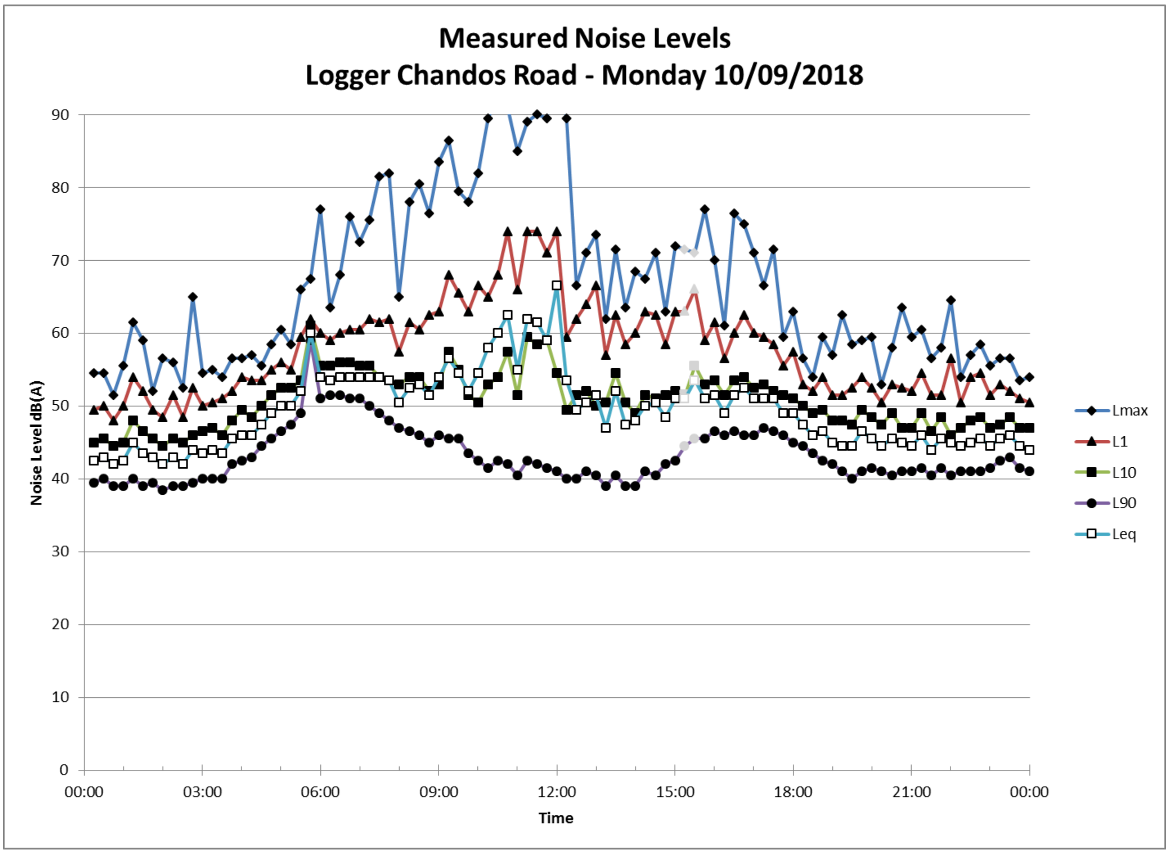
Measured Noise Levels
Logger Chandos Road - Thursday 06/09/2018
Noise Level dB(A)
90
80
70
60
50
40
30
20
10
0
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Time
Lmax
L1
L10
L90
Leq

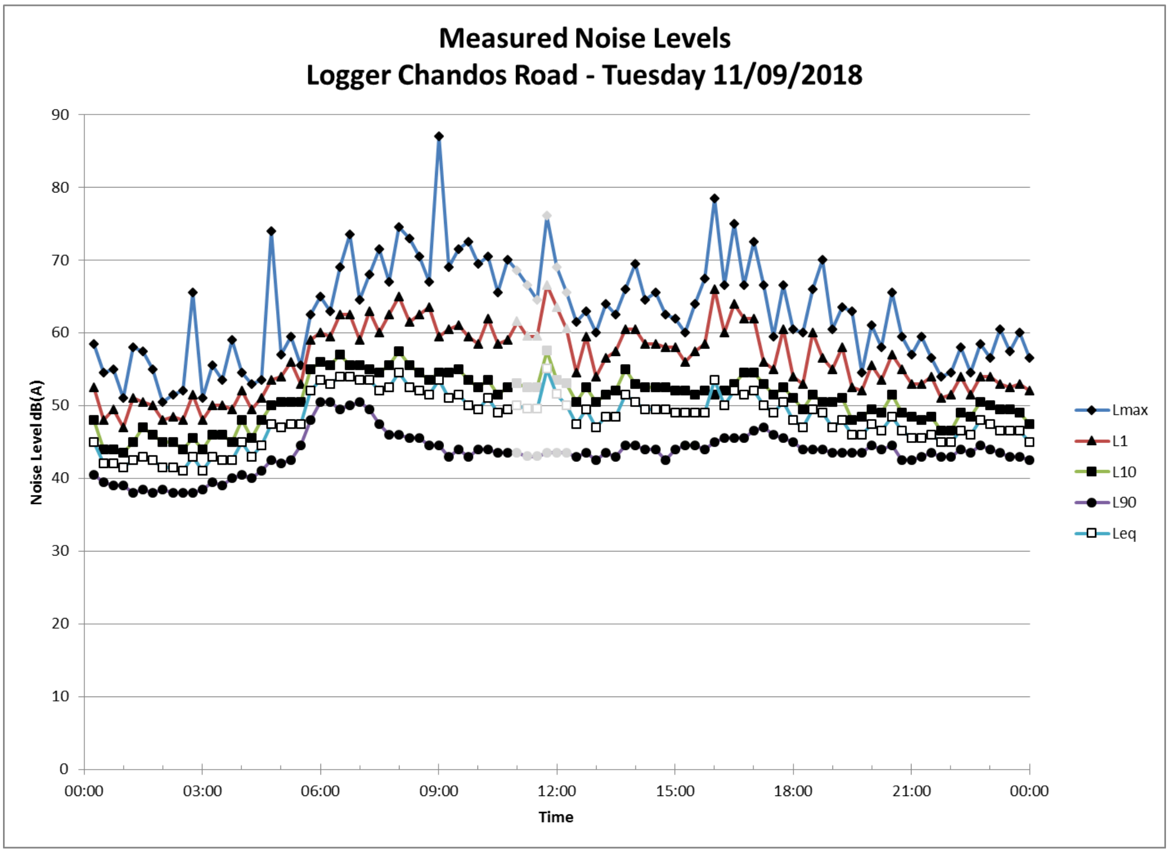


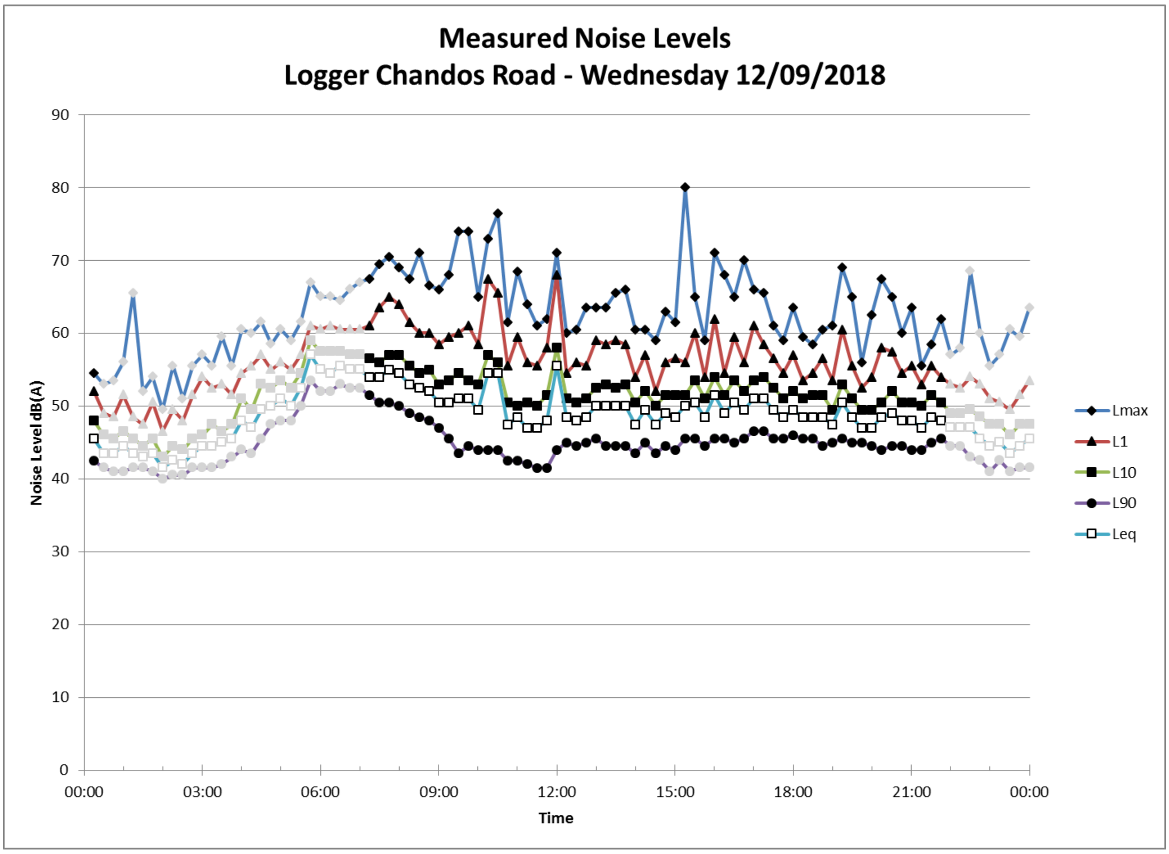
Measured Noise Levels
Logger Chandos Road - Friday 07/09/2018
Noise Level dB(A)
90
80
70
60
50
40
30
20
10
0
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Time
Lmax
L1
L10
L90
Leq

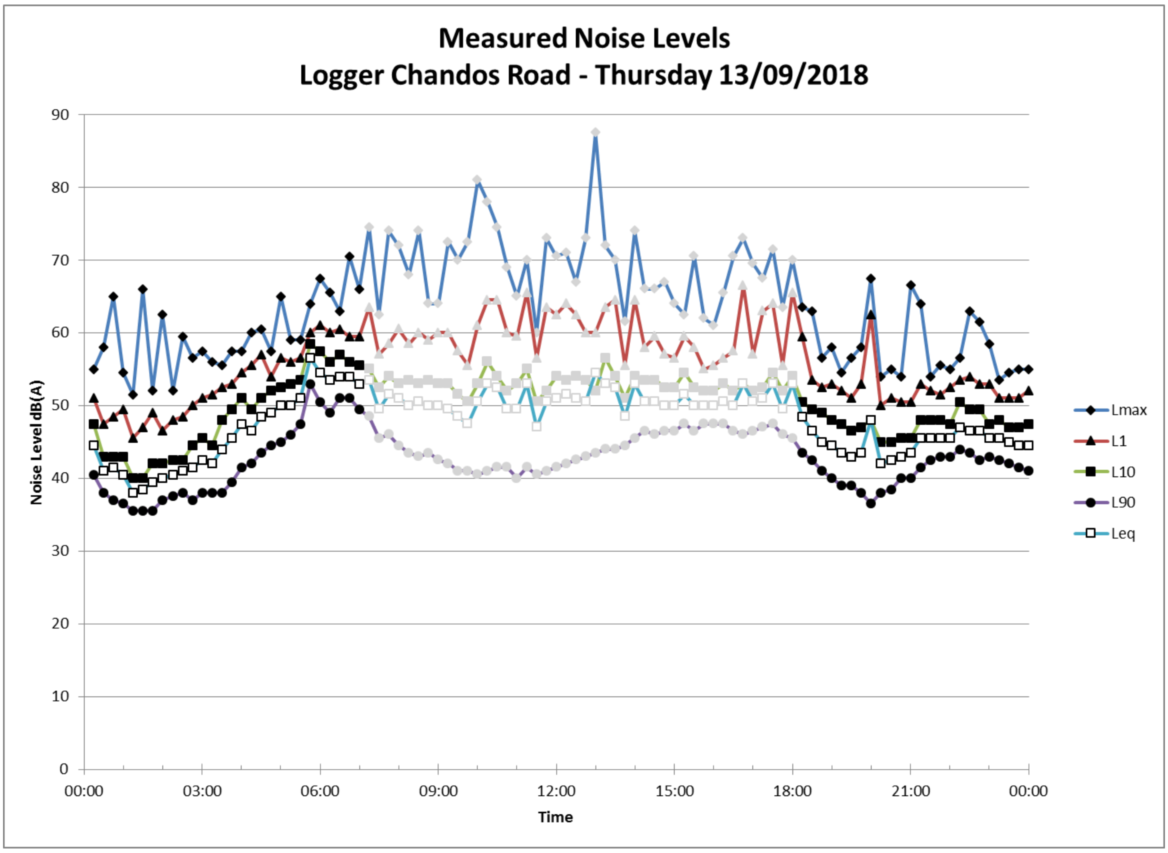

Measured Noise Levels
Logger Chandos Road - Saturday 08/09/2018
Noise Level dB(A)
Time
Lmax
L1
L10
L90
Leq

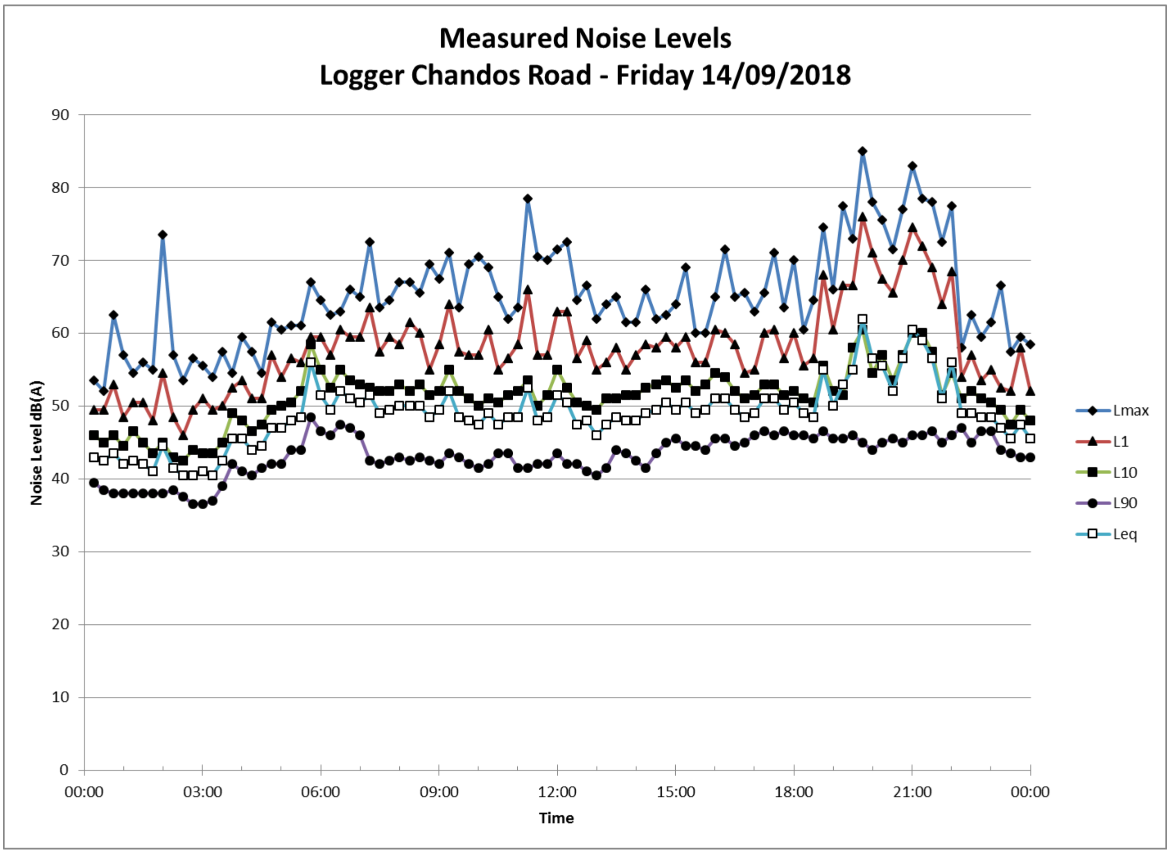

Measured Noise Levels
Logger Chandos Road - Sunday 09/09/2018
Noise Level dB(A)
Time
Lmax
L1
L10
L90
Leq

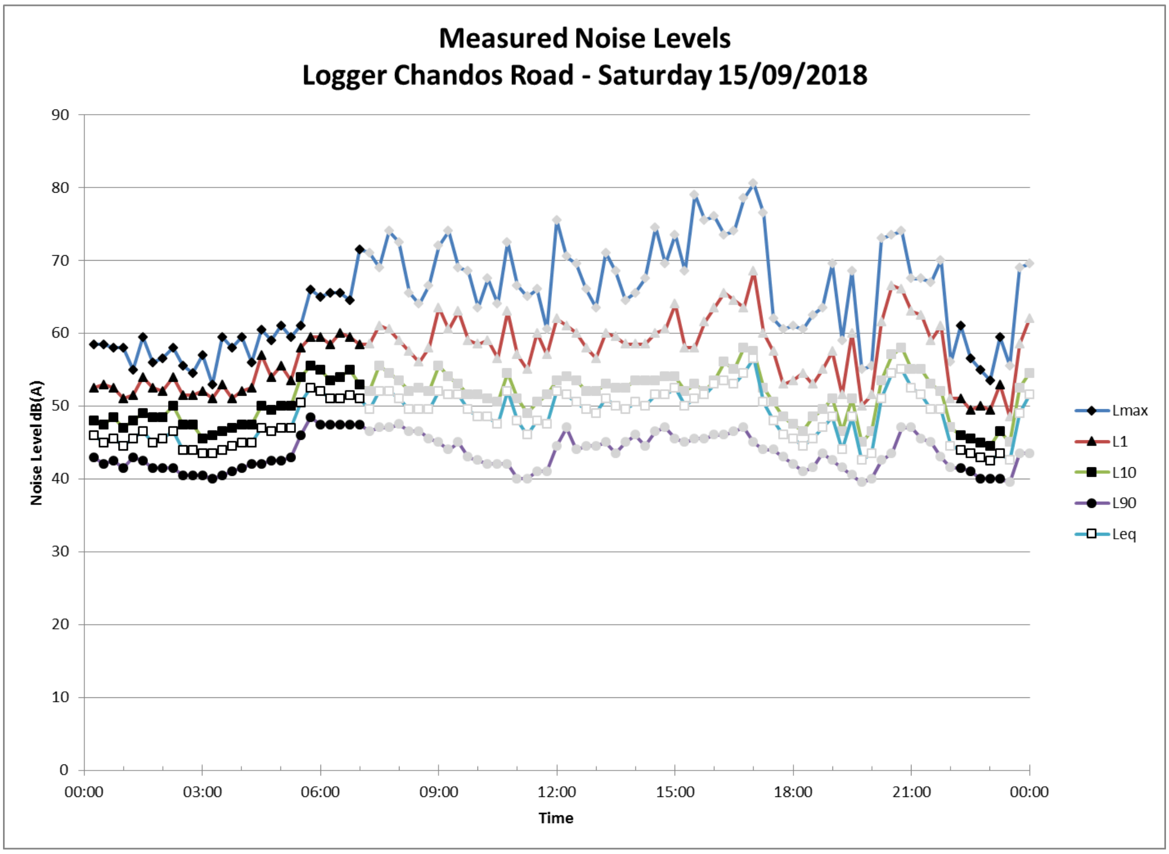

Measured Noise Levels
Logger Chandos Road - Monday 10/09/2018
Noise Level dB(A)
0
10
20
30
40
50
60
70
80
90
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Time
Lmax
L1
L10
L90
Leq

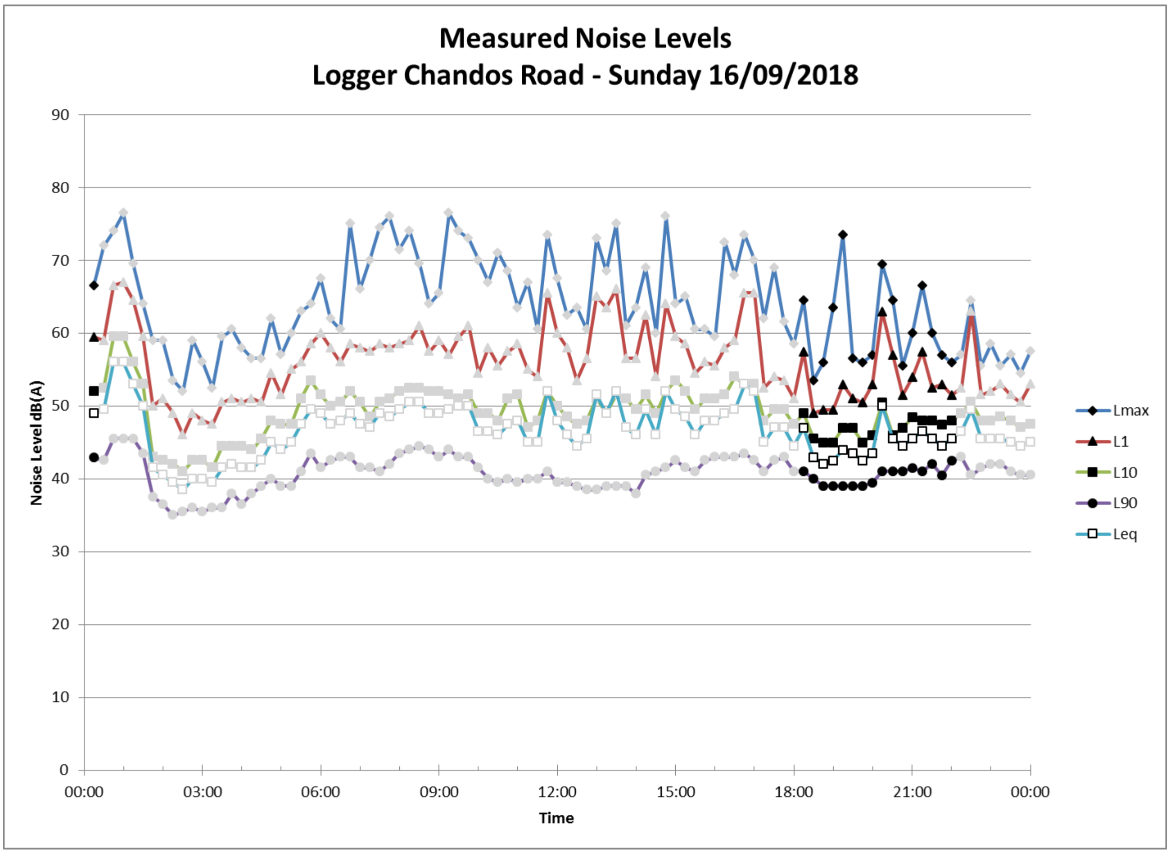

Measured Noise Levels
Logger Chandos Road - Tuesday 11/09/2018
Noise Level dB(A)
0
10
20
30
40
50
60
70
80
90
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Time
Lmax
L1
L10
L90
Leq

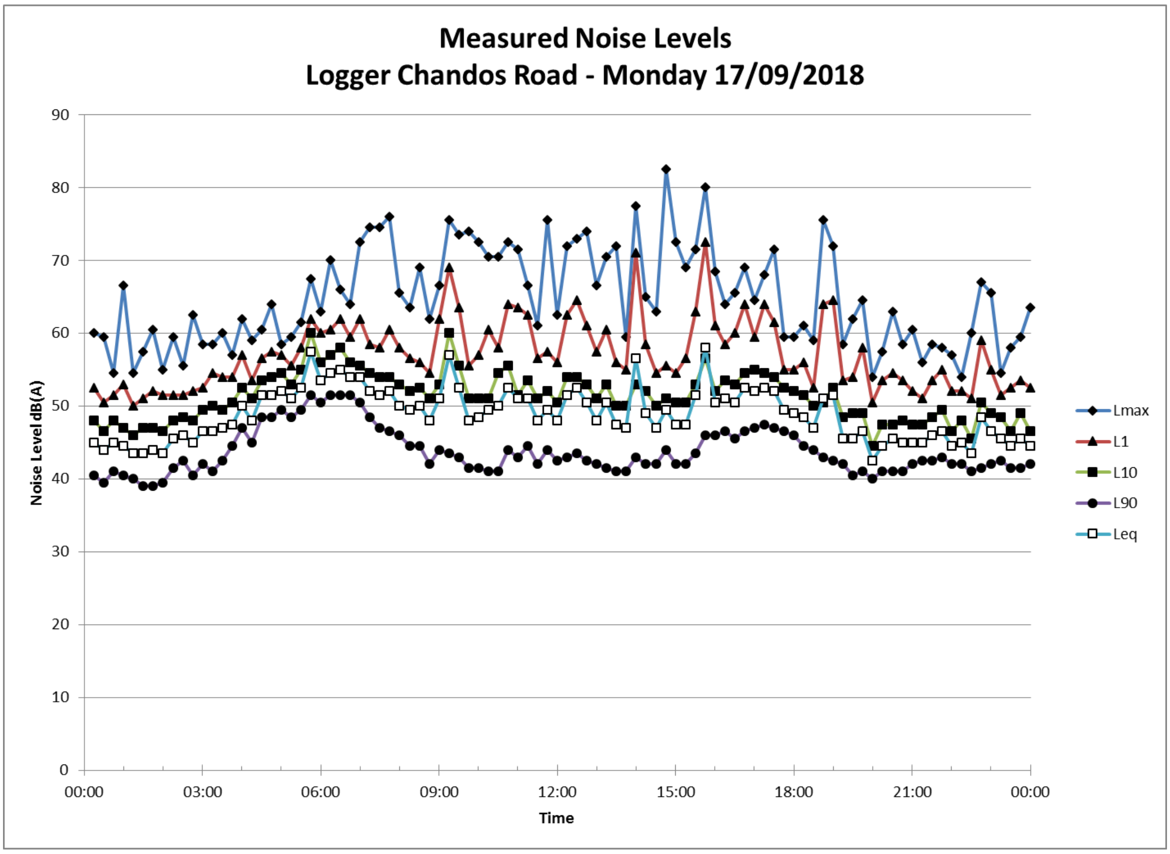

Measured Noise Levels
Logger Chandos Road - Wednesday 12/09/2018
Noise Level dB(A)
Time
Lmax
L1
L10
L90
Leq

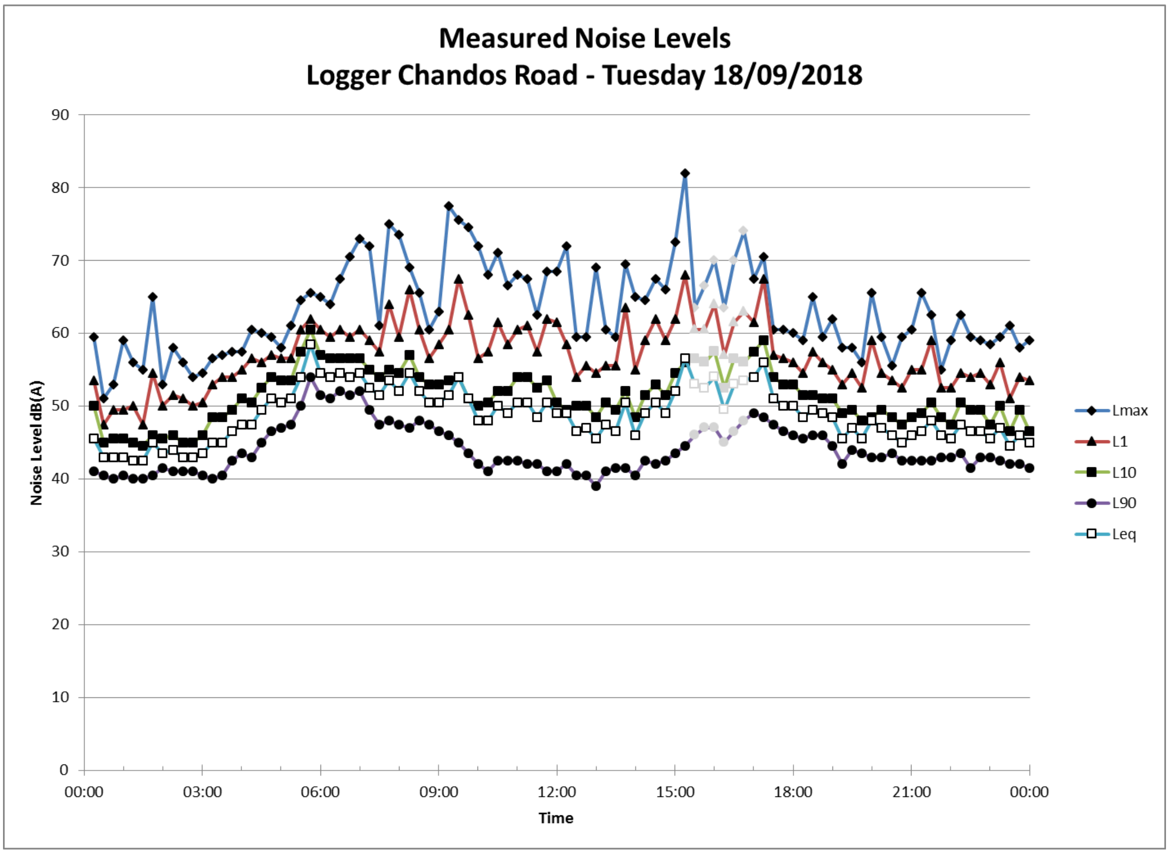

Measured Noise Levels
Logger Chandos Road - Thursday 13/09/2018
Noise Level dB(A)
Time
Lmax
L1
L10
L90
Leq


Measured Noise Levels
Logger Chandos Road - Friday 14/09/2018
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

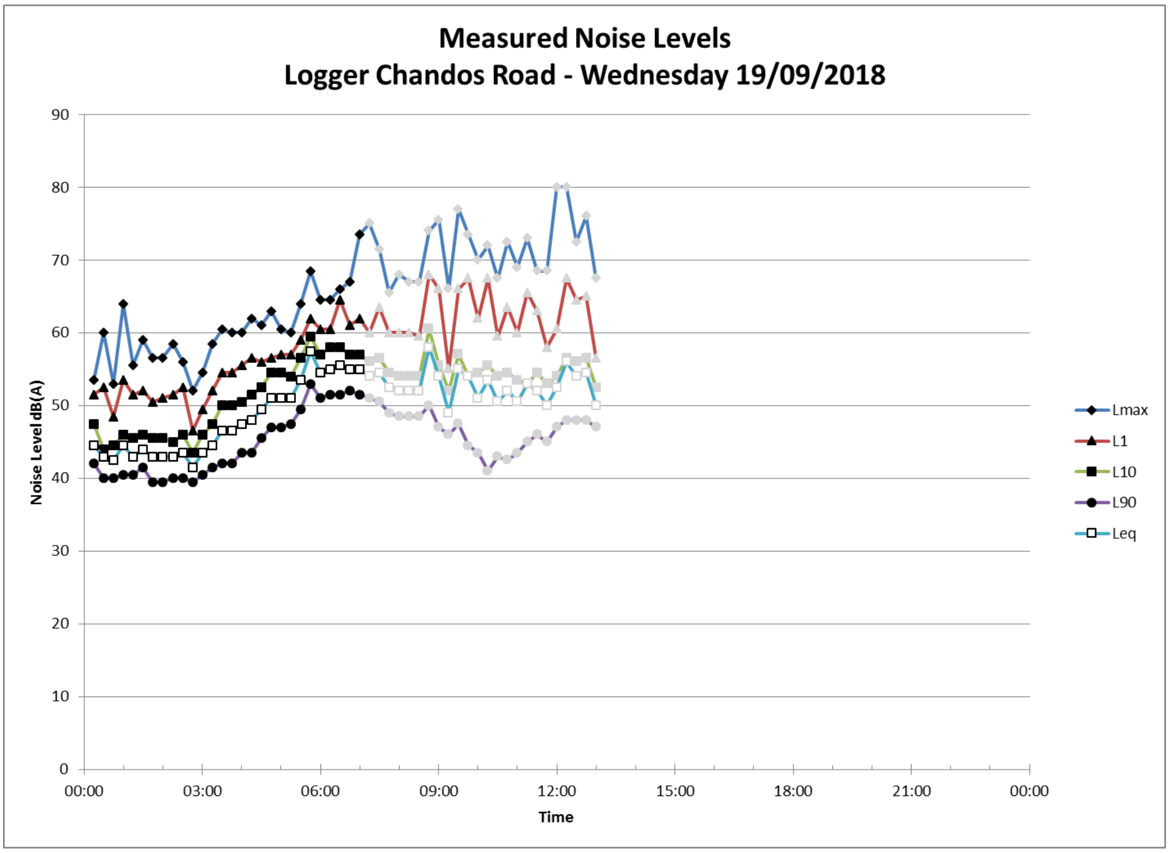

Measured Noise Levels
Logger Chandos Road - Saturday 15/09/2018
Noise Level dB(A)
0
10
20
30
40
50
60
70
80
90
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Time
Lmax
L1
L10
L90
Leq


Measured Noise Levels
Logger Chandos Road - Sunday 16/09/2018
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 Chandos Road - Monday 17/09/2018
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 Chandos Road - Tuesday 18/09/2018
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 Chandos Road - Wednesday 19/09/2018
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