100 Bennelong Parkway, Sydney Olympic Park

Development Application Acoustic Report

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1 INTRODUCTION

This report presents our assessment of potential noise and vibration impact associated with the proposed residential development located at 100 Bennelong Road, Sydney Olympic Park.

The following have been addressed to determine the potential for adverse noise and vibration impacts:

- Potential impact associated with noise generated on Bennelong Road;
- Potential impact associated with noise and vibration generated on the railway corridor to the South; and
- Potential noise emitted by the proposed development on surrounding receivers;

The assessment has been based on noise and vibration levels generated by train movements on the Olympic Park Railway Line which runs adjacent to the west of the site, and traffic noise from Bennelong Road to the east.

Noise and vibration results have been used to predict internal noise levels within the development. If necessary, appropriate indicative noise/vibration attenuation treatments will be recommended to prevent excessive impacts on residents.

This report is based on architectural plans Turner and Associates dated April 2014.

2 SITE DESCRIPTION & PROPOSED DEVELOPMENT

The subject site is located between Bennelong Road and the Sydney Olympic Park Railway line. Bennelong Road carries moderate volumes of traffic. The south of the site is currently vacant land and the north of the site is currently occupies by an existing Scout Hall and University Admissions Centre. It is proposed that the north of the site will be residential development in the future.

The proposed development consists of the construction of three residential buildings ranging between 8 and 10 stories in height.

The western façade of Building A and B faces the railway line and the eastern façade of Building C faces Bennelong Road.

Figure1 details the site and surrounding noise sources. Figure 2 details the proposed development.

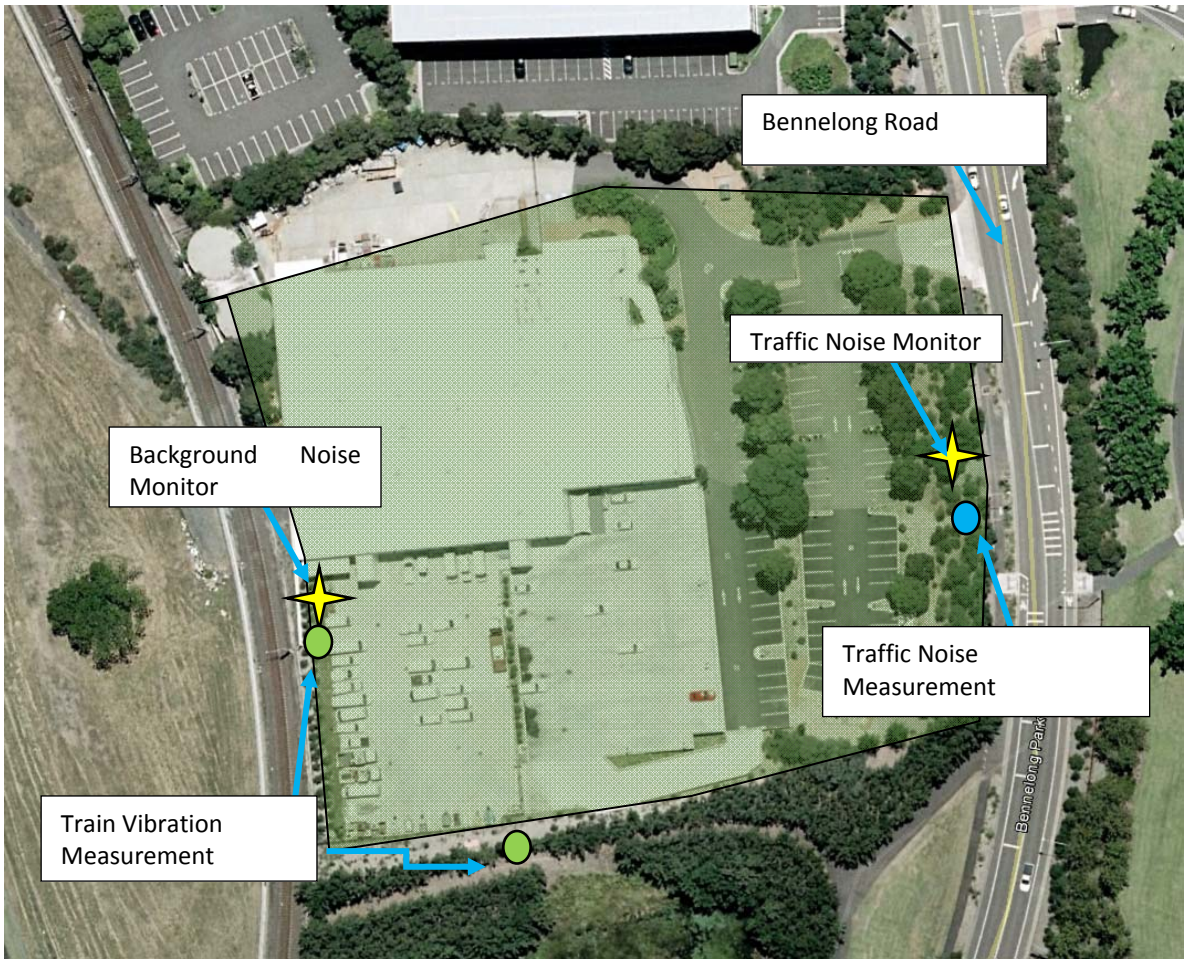


Figure 1 – Site Map

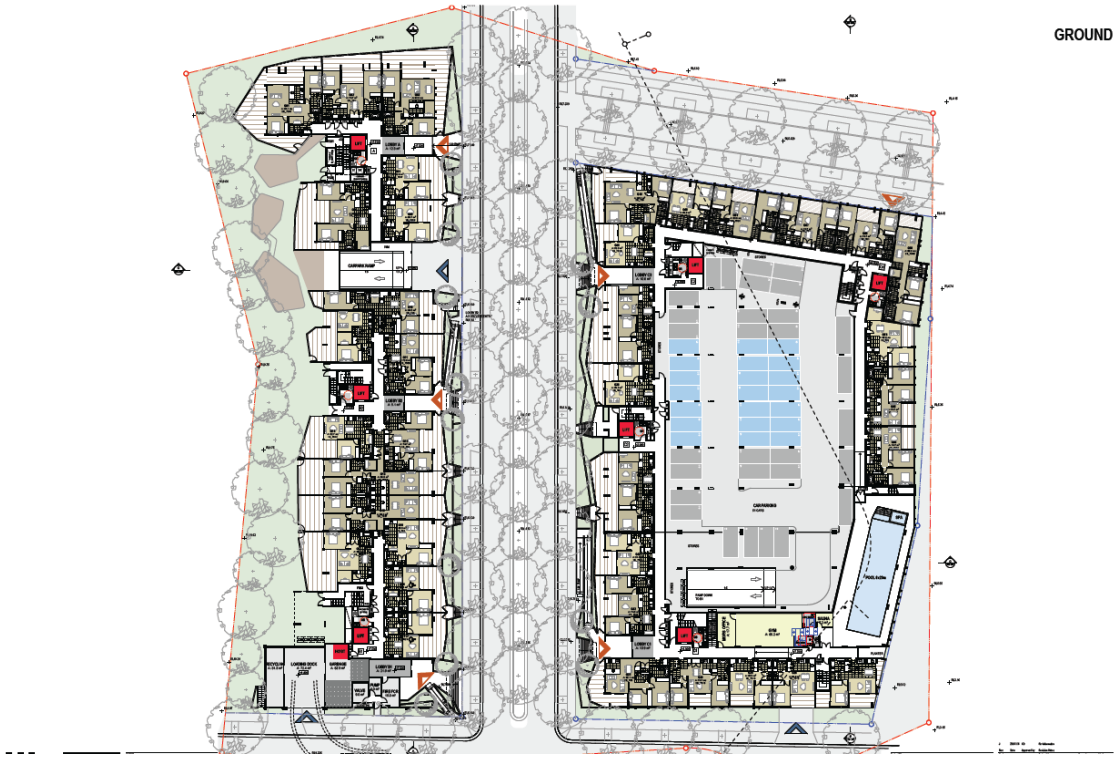


Figure 2 – Proposed Development

3 NOISE DESCRIPTORS

Traffic noise constantly varies in level, due to fluctuations in traffic speed, vehicle types, road conditions and traffic densities. Accordingly, it is not possible to accurately determine prevailing traffic noise conditions by measuring a single, instantaneous noise level. To accurately determine the effects of traffic noise a 15-20 minute measurement interval is utilised. Over this period, noise levels are monitored on a continuous basis and statistical and integrating techniques are used to determine noise description parameters. These parameters are used to measure how much annoyance would be caused by a particular noise source.

In the case of environmental noise three principle measurement parameters are used, namely L_{10}, L_{90} and L_{eq}.

The L_{10} and L_{90} measurement parameters are statistical levels that represent the average maximum and average minimum noise levels respectively, over the measurement intervals.

The L_{10} parameter is commonly used to measure noise produced by a particular intrusive noise source since it represents the average of the loudest noise levels produced at the source.

Conversely, the L_{90} level (which is commonly referred to as the background noise level) represents the noise level heard in the quieter periods during a measurement interval. The L_{90} parameter is used to set the allowable noise level for new, potentially intrusive noise sources since the disturbance caused by the new source will depend on how audible it is above the pre-existing noise environment, particularly during quiet periods, as represented by the L_{90} level.

The L_{eq} parameter represents the average noise energy during a measurement period. This parameter is derived by integrating the noise levels measured over the measurement period. L_{eq} is important in the assessment of traffic noise impact as it closely corresponds with human perception of a changing noise environment; such is the character of traffic noise.

4 TRAFFIC & TRAIN NOISE ASSESSMENT

4.1 ACOUSTIC CRITERIA

The NSW Department of Planning's policy, Development Near Rail Corridors And Busy Roads – Interim Guideline, sets out internal noise level criteria adapted from the State Environmental Planning Policy (Infrastructure) 2007 (the 'Infrastructure SEPP') for developments with the potential to be impacted by traffic or rail noise and vibration.

The Infrastructure SEPP defines busy roads that are subject to an acoustic assessment as:

> *"Roads specified in Clause 102 of the Infrastructure SEPP: a freeway, tollway or a transitway or any other road with an average annual traffic (AADT) volume of more than 40,000 vehicles (based on the traffic volume data provided on the website of the RTA).*
>
> *Any other road – with an average annual daily traffic (AADT) volume of more than 20,000 vehicles (based on the traffic volume data published on the website of the RTA).*
>
> *Any other road – with a high level of truck movements or bus traffic."*

As the site is located within 60m of a passenger rail line it would be deemed as a Zone B site (refer to table 3.1 of the guidelines), and an acoustic assessment is recommended in accordance with SEPP Infrastructure criteria.

The Infrastructure SEPP sets out the following criteria for internal noise levels from airborne rail and traffic noise:

> *"For Clauses 87 (Rail) and 102 (Road):*
>
> *"If the development is for the purpose of a building for residential use, the consent authority must be satisfied that appropriate measures will be taken to ensure that the following LAeq levels are not exceeded:*
>
> *in any bedroom in the building : 35dB(A) at any time 10pm–7am*
>
> *anywhere else in the building (other than a garage, kitchen, bathroom or hallway): 40dB(A) at any time."*

Pursuant to this, the following assessment criteria would apply to the proposed development for traffic and train noise intrusion.

Table 1 - Traffic & Train Noise Criteria for All Spaces

Space/Activity Type	Noise Level dB(A) L_{eq}
Bedrooms	35 (9 hour)
Living Areas	40 (15 hour)

4.2 TRAFFIC NOISE MEASUREMENTS

Traffic noise measurements were obtained along Bennelong Road using a combination of attended and unattended monitoring (See Figure 1). Attended noise monitoring was conducted during the afternoon peak of 21 January 2014. A Norsonic 140 Sound Level Analyser was used for the noise measurements. The analyser was set to fast response and calibrated before and after the measurements using a Norsonic 1251 calibrator. No significant drift was noted.

Unattended noise monitoring was conducted on Bennelong Road between 21 and 28 January 2014 using an Acoustic Research Laboratories Pty Ltd noise monitor. The monitor was programmed to store 15-minute statistical noise levels throughout the monitoring period. The noise monitors were calibrated at the beginning and the end of the measurement using a Rion NC-73 calibrator; no significant drift was detected. Measurements were taken on A-frequency weighting and fast time weighting.

The results of the noise monitoring are presented in Appendix One.

4.2.1 Measured Noise Levels

The results of traffic noise monitoring at are detailed in the table below.

Table 2 - Measured Traffic Noise Levels

Location	Time of Day	Noise Level - L_{Aeq}
Bennelong Road – 10m from Curb	7:00am – 10:00pm	65dB(A) $L_{Aeq\ (15Hr)}$
	10:00pm – 7:00am	58dB(A) $L_{Aeq\ (9Hr)}$

4.3 TRAIN MEASUREMENTS

Measurements were performed generally in accordance with the Australian Standard AS 1055 - "Description and measurement of environmental noise - General Procedures". Rail noise measurements were conducted in line with the future proposed eastern façade which is the potentially worst affected façade nearest to the railway lines.

Unattended noise monitoring was conducted during the period of 21 and 28 January 2014. Train noise levels were monitored using an Acoustic Research Laboratories noise logger. The monitor continuously measures noise levels and every 15 minutes stores statistical data within memory. The stored data was downloaded at the end of the measurement period. The monitor was calibrated before and after the measurement using a Rion NC-73 calibrator. No significant drift was recorded.

The results of the noise monitoring are presented in Appendix One.

4.3.1 Measured Noise Levels

The external noise levels from measurements conducted on site are detailed in Table 3 below.

Table 3 - External Noise Levels

Location	Day dB(A) $L_{eq,15hr}$	Night dB(A) $L_{eq,9hr}$
Western Facade	66	59

5 EVALUATION OF NOISE INTRUSION

Internal noise levels will primarily be as a result of noise transfer through the windows and doors and roof, as these are relatively light building elements that offer less resistance to the transmission of sound. **All external walls are proposed to be heavy masonry elements that will not require upgrading.**

The predicted noise levels through the windows, doors and roof are discussed below. The predicted noise levels have been based on the measured level and spectral characteristics of the external noise, the area of building elements exposed to traffic noise, the absorption characteristics of the rooms and the noise reduction performance of the building elements.

Calculations were performed taking into account the orientation of windows, barrier effects (where applicable), the total area of glazing, facade transmission loss and the likely room sound absorption characteristics. In this way the likely interior noise levels can be predicted.

Table 4 - Residential Glazing Building A/B

Façade	Room	Glazing Thickness	Acoustic Seals
West	Bedroom	10.38mm laminated	Yes
	Living	6.38mm laminated	Yes
North/ South	Bedroom	6.38mm laminated	Yes
	Living	6.38mm laminated	Yes
East	Bedroom	6mm	Yes
	Living	6mm	Yes

Table 5 - Residential Glazing Building C

Façade	Room	Glazing Thickness	Acoustic Seals
East	Bedroom	6.38mm laminated	Yes
	Living	6.38mm laminated	Yes
North/ South	Bedroom	6.38mm laminated	Yes
	Living	6.38mm laminated	Yes
West	Bedroom	6mm	Yes
	Living	6mm	Yes

The glazing thicknesses recommended are those needed to satisfy acoustic requirements and do not take into account other requirements such as structural, safety or other considerations. These additional considerations may require the glazing thickness to be increased beyond the acoustic requirement.

Noise intrusion through the masonry walls will be negligible and will not contribute to internal noise levels. Similarly, noise intrusion through the concrete slab roof construction will not be significant.

5.1 MECHANICAL VENTILATION

As internal levels cannot be achieved with windows open it is required that an alternative outside air supply system or air conditioning be installed to meet AS 1668.2 requirements. Any mechanical ventilation system that is installed should be acoustically designed such that the acoustic performance of the recommended constructions are not reduced by any duct or pipe penetrating the wall/ceiling/roof. Noise emitted to the property boundaries by any ventilation system shall comply with EPA Guidelines.

6 RAILWAY VIBRATION

Trains induce ground born vibration that is transmitted through the subsoil. This vibration can be perceptible close to railways, both a tactile vibration and as structure borne noise.

6.1 VIBRATION CRITERIA

As the site is located within 60m of a passenger rail line is deemed to require an acoustic assessment in accordance with *the* Department of Planning's *"Interim Guidelines for Development near Rail Corridors and Busy Roads"* (refer to table 3.2 of the guidelines).

Section 3.6.3 of the Interim Guidelines for Development near Rail Corridors and Busy Roads states that:

> *"Vibration levels such as the intermittent vibration emitted by trains should comply with the criteria in Assessing Vibration: A Technical Guideline (DECC 2006)".*

Assessing Vibration: A Technical Guide 2006 assesses the annoyance of intermittent vibration by using the Vibration Dose Value (VDV). Alternatively the VDV may be estimated by the eVDV which is derived by a simpler calculation using an empirical factor. The VDV or eVDV is calculated for the two periods of the day being the "Daytime" (7am-10pm) and "Night time" (10pm-7am). The overall value is then compared to the levels presented in Table 6. For this project the aim will be for a low probability of adverse comment.

Table 6 - Vibration Dose Values ($m/s^{1.75}$) above which various degrees of adverse comment may be expected in residential buildings.

Place	Low Probability of adverse comment	Adverse comment possible	Adverse comment probable
Residential buildings 15hr day	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential buildings 9hr night	0.13	0.26	0.51
Commercial buildings 15hr day	0.4	0.8	1.6
Commercial buildings 9hr night	0.4	0.8	1.6

Section 3.6.2 of the Interim Guidelines for Development near Rail Corridors and Busy Roads states that:

> *"Where buildings are constructed over or adjacent to land over tunnels, ground-borne noise may be present without the normal masking effect of airborne noise. In such cases, residential buildings should be designed so that the 95th percentile of train pass-bys complies with a ground-borne LAmax noise limit of 40dBA (daytime) or 35dBA (night-time) measured using the "slow" response time setting on a sound level meter.*
>
> *The Interim Guidelines for the Assessment of Noise from Rail Infrastructure Projects (DECC 2007) provides further guidance on this issue."*

6.2 STRUCTURE BORNE NOISE

Vibration generated by a train pass-by below the proposed development will potentially generate structure born vibration which will be radiated through internal building elements such as walls, floors and ceiling as audible noise. Internal noise levels associated with structure born noise generated from a train pass-by is required to comply with Department of Planning's *"Development near Rail Corridors and Busy Roads – Interim Guideline"* noise level objectives which are detailed below.

Table 7 - Internal Railway Noise Level Criteria

LOCATION	L_{MAX} dB(A)
Sleeping areas	35
Living area	40

Train vibration measurements conducted as part this assessment will be used to calculate internal noise levels generated from structure born vibration.

6.3 RAIL TRAFFIC VIBRATION MEASUREMENTS

Train vibration measurements were conducted on the in the car park of the existing site at the locations of the proposed future buildings. Vibration measurements were carried out between on 21 January 2014.

A Svan-958 Vibration Analyser was used for the vibration measurements. The analyser was connected to a SV08 four channel input module fitted with a Dytran triaxial accelerometer.

6.4 MEASUREMENT RESULTS: VIBRATION DOSE VALUES

The maximum train pass by ground vibration acceleration, the typical pass by period (gained from both the noise and vibration measurements) and the estimated number of train pass bys were used to calculate the overall eVDV values for each period of the day. The results are presented in table 9.

Table 8 - Measured Internal Rail Vibrations

Time Period	Calculated eVDV $m/s^{1.75}$	Criteria eVDV $m/s^{1.75}$	Complies
Day (7am – 10pm)	0.086	0.2	Yes
Night (10pm -7am)	0.056	0.13	Yes

eVDV values were determined based on the daily train timetable information from the CityRail website.

The calculated eVDV from measured vibrations, comply with the relevant daytime and night-time criteria for the residential development.

In the event the future train use increases, say by 10%, calculated eVDV will not increase significantly (no more than approximately 0.02 more than the levels predicted in the table above) and hence will not exceed the criteria.

6.5 STRUCTURE BORN NOISE MEASUREMENTS

Internal noise levels as a result of structure born noise have been calculated for a number of train pass by's. Noise levels have been determined based on on-site measurements of rail induced vibration.

Table 9 - Structure Born Vibration Levels

Location	Average Calculated/Measured Noise Level dB(A)L_{Max}	Noise Level Criteria L_{Max} dB(A)	Complies
Building A/B	44dB(A)	**40** Day (7am – 10pm) **35** Night (10pm -7am)	No
Building C	<30dB(A)	**40** Day (7am – 10pm) **35** Night (10pm -7am)	Yes

As detailed above, the building will not require vibration isolation.

6.6 RECOMMENDATIONS

Based on the predicted structure borne noise levels in Table 9, **vibration isolation will be required** for the Building A and B. Vibration isolation of the building structure will be required to comply with vibration goals set out in Section 6.2. Detailed design of any structural vibration isolation systems should be conducted at the Construction Certificate (CC) stage of this development.

7 NOISE EMISSION ASSESSMENT

Noise emissions from the site should be assessed to ensure that the amenity of nearby land users is not adversely affected.

Noise generated by mechanical plant servicing the development has been identified as the only potential source of noise emissions from the site.

The nearest potentially effected residential receivers are the residential receivers to the east on Victoria Street.

7.1 NOISE EMISSION OBJECTIVES

Noise emissions from the site should comply with the requirements of the EPA Industrial Noise Policy.

7.1.1 NSW EPA Industrial Noise Policy

The EPA Industrial Noise Policy, has two criteria which need to be satisfied namely Intrusiveness and Amenity.

The EPA Industrial Noise Policy sets out acceptable noise levels for various localities. Table 2.1 on page 16 of the policy indicates 4 categories to distinguish different residential areas. They are rural, suburban, urban and urban/industrial interface. Under the policy the nearest residence would be assessed against the urban criteria.

Noise levels are to be assessed at the property boundary or nearby dwelling, or at the balcony or façade of an apartment.

7.1.1.1 Intrusiveness Criterion

The guideline is intended to limit the audibility of noise emissions at residential receivers and requires that noise emissions measured using the L_{eq} descriptor not exceed the background noise level by more than 5dB(A). Where applicable, the intrusive noise level should be penalised (increased) to account for any annoying characteristics such as tonality.

Noise emissions from the site should comply with the noise levels presented below when measured at nearby property boundary.

7.1.1.2 Amenity Criterion

The guideline is intended to limit the absolute noise level from all noise sources to a level that is consistent with the general environment.

The EPA's Industrial noise policy sets out acceptable noise levels for various localities. Table 2.1 on page 16 of the policy indicates 4 categories to distinguish different residential areas. They are rural, suburban, urban and urban/industrial interface. This site is categorised by the residential receivers as suburban.

For the purposes of this condition:

- Day is defined as the period from 7am to 6pm Monday to Saturday and 8am to 6pm Sundays and Public Holidays;
- Evening is defined as the period from 6pm to 10pm.
- Night is defined as the period from 10pm to 7am Monday to Saturday and 10pm to 8am Sunday and public holidays.

Table 10 – EPA Amenity Noise Levels

Type of Receiver	Time of day	Recommended Noise Level dB(A)$L_{eq(period)}$	
		Recommended	Maximum
Residential - Suburban	Day	55	60
	Evening	45	50
	Night	40	45

7.1.2 Summary of Noise Emission Objectives

Based on the requirements stated in the sections above, Table 11 provides a summary of the assessment criteria applicable to the future residential development at the project site. The assessment criteria are also based on the ambient noise monitoring conducted at the site.

Table 11 - Environmental Noise Emission Criteria

Time Period	**Assessment Background Noise Level dB(A)L_{90}**	**Amenity Criteria dB(A) L_{eq}**	**Intrusiveness Criteria Background + 5 dB(A) $L_{eq(15min)}$**
Day	47	55	52
Evening	47	45	52
Night	39	40	44

7.2 MECHANICAL NOISE EMISSION ASSESSMENT

A detailed review of all external mechanical plant should be undertaken at construction certificate stage (once plant selections and locations are finalised). Acoustic treatments should be determined in order to control plant noise emissions to the levels set out in section 5.1 of this report. Compliance with these noise emission requirements will be achievable with standard acoustic treatments (plant enclosures, in-duct acoustic treatments and similar).

8 CONCLUSION

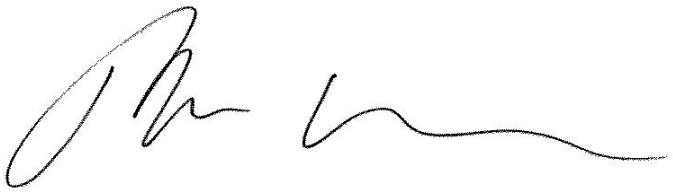
This report provides the results of an assessment of train and traffic noise and vibration impacts on the amenity of future tenants within the proposed residential development at 100 Bennelong Parkway, Sydney Olympic Park.

Provided that the treatments set out in this report are employed, internal noise levels shall comply with the requirements of the Department of Planning.

Trains induced ground born vibration measurements have been carried out and vibration isolation of Building A and B is required to mitigate structure borne noise into habitable space within the project. Detailed vibration isolation solutions shall be determined at CC stage.

We trust this information is satisfactory. Please contact us should you have any further queries.

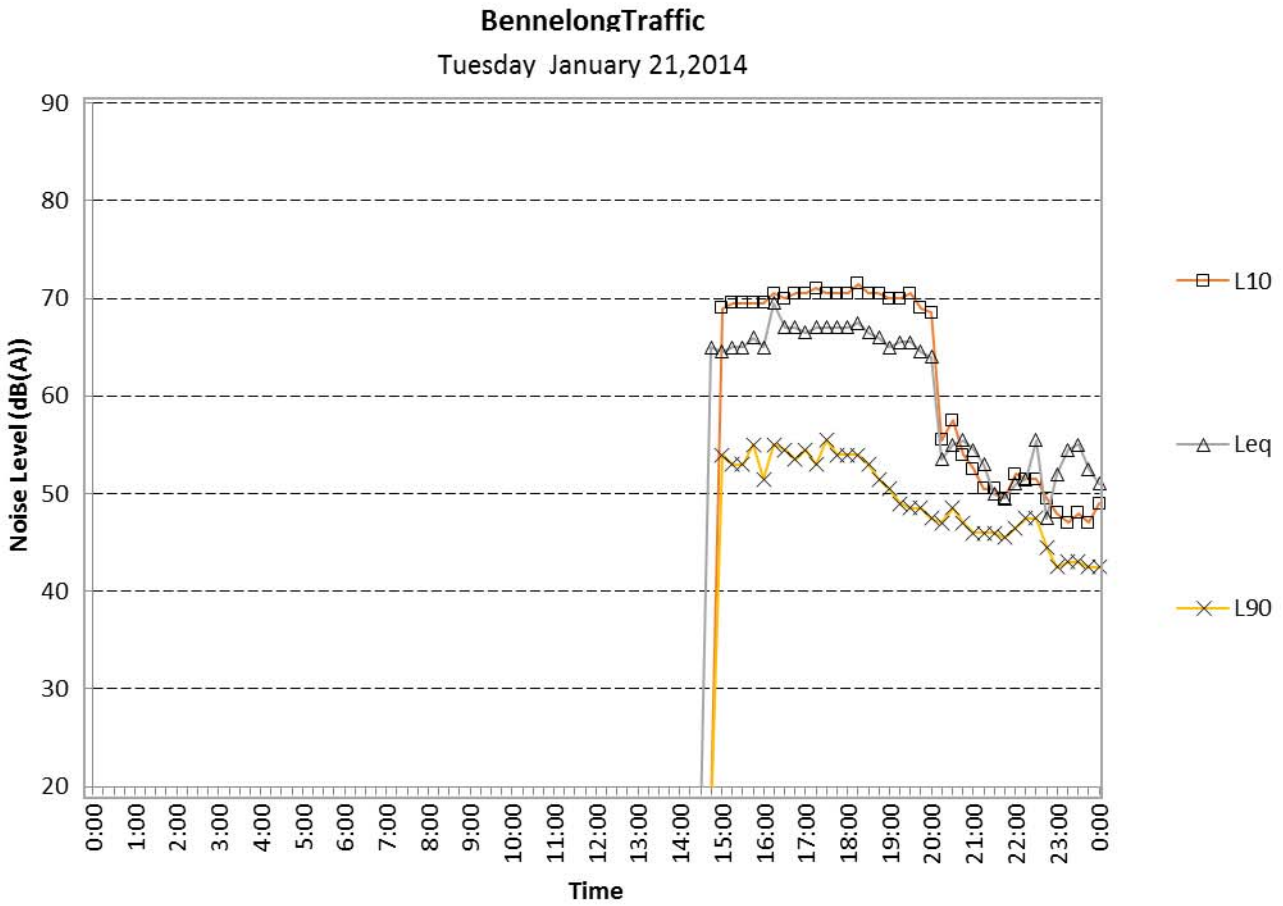
Yours faithfully,



Acoustic Logic Consultancy Pty Ltd
Tom Aubusson

APPENDIX ONE –

UNATTENDED NOISE MONITORING RESULTS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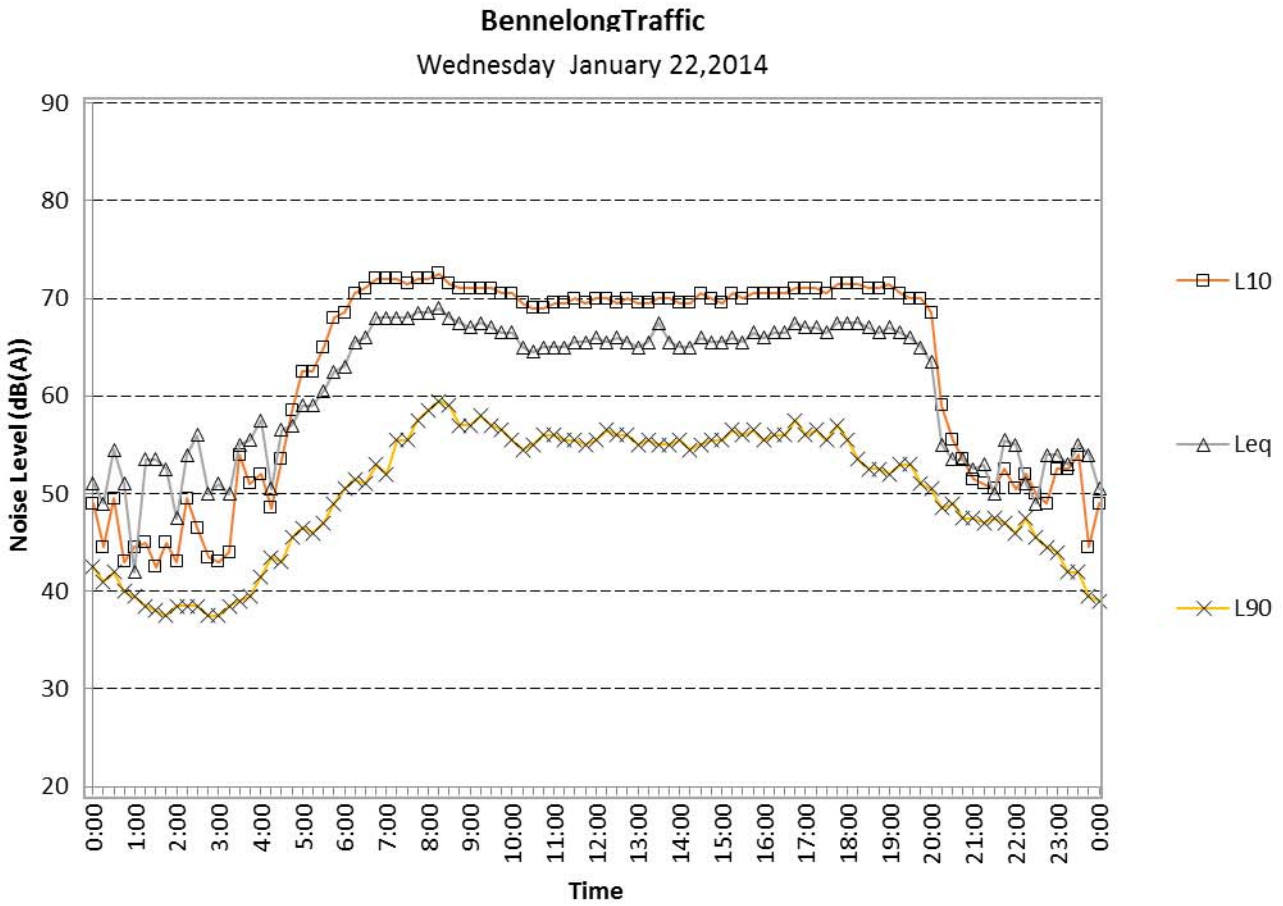
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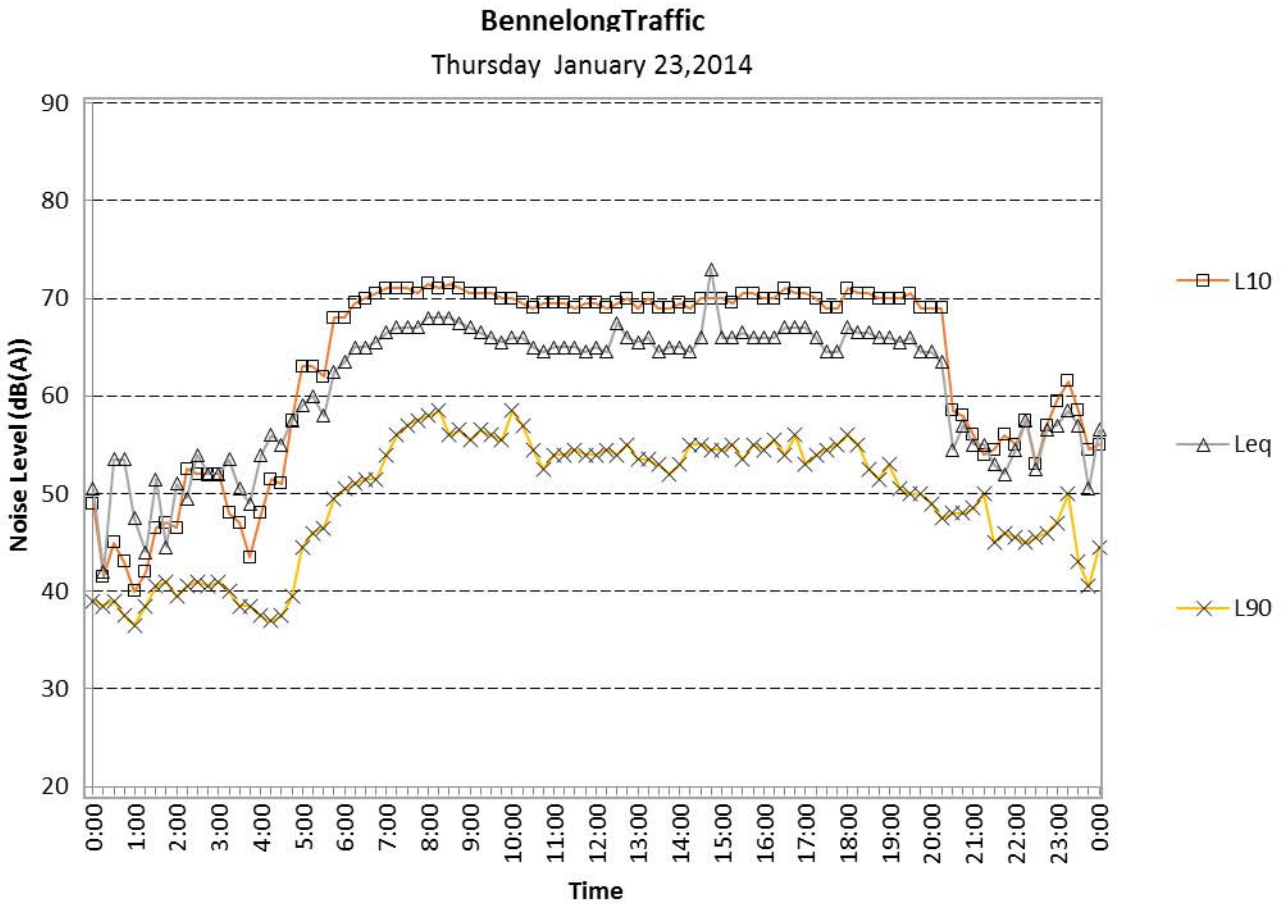
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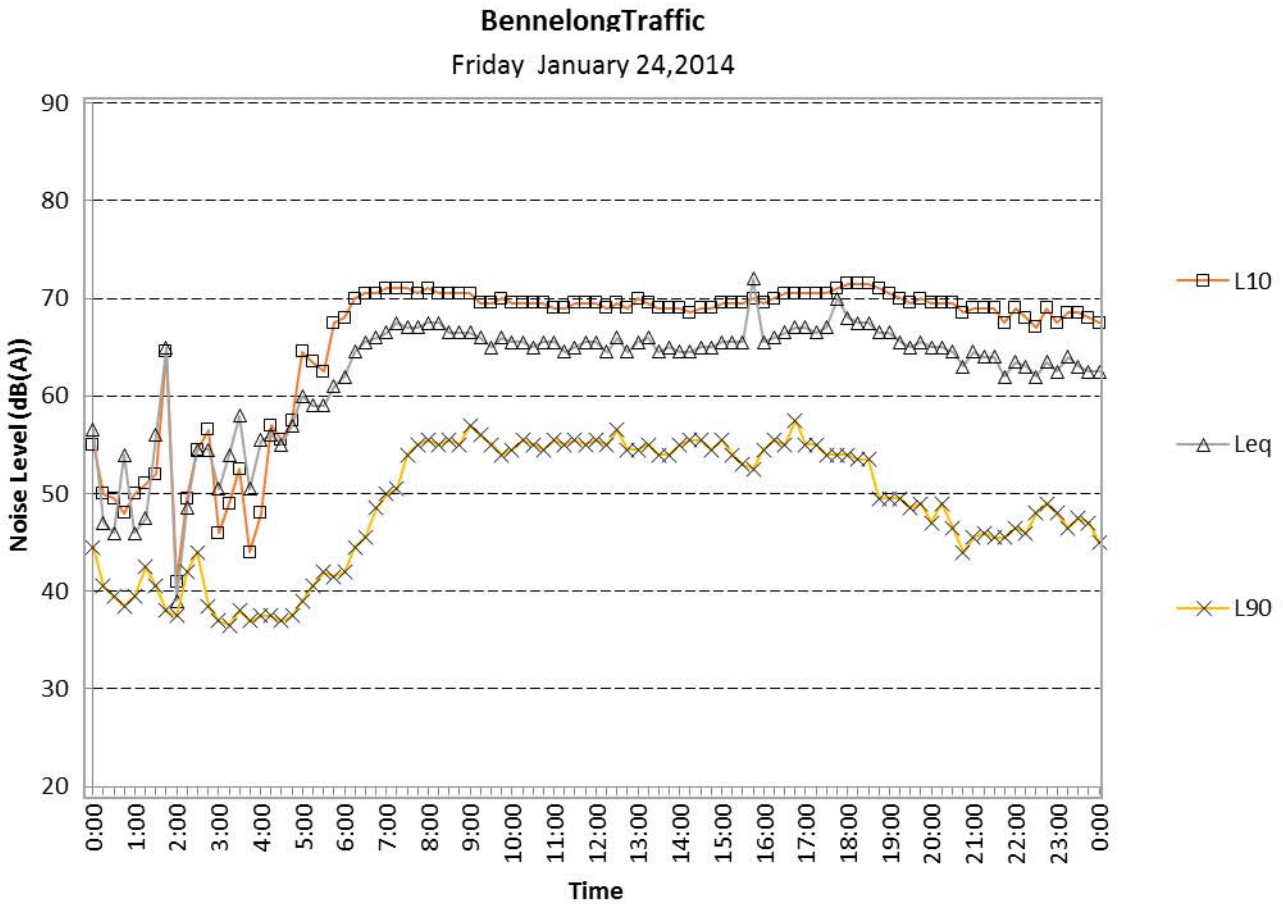
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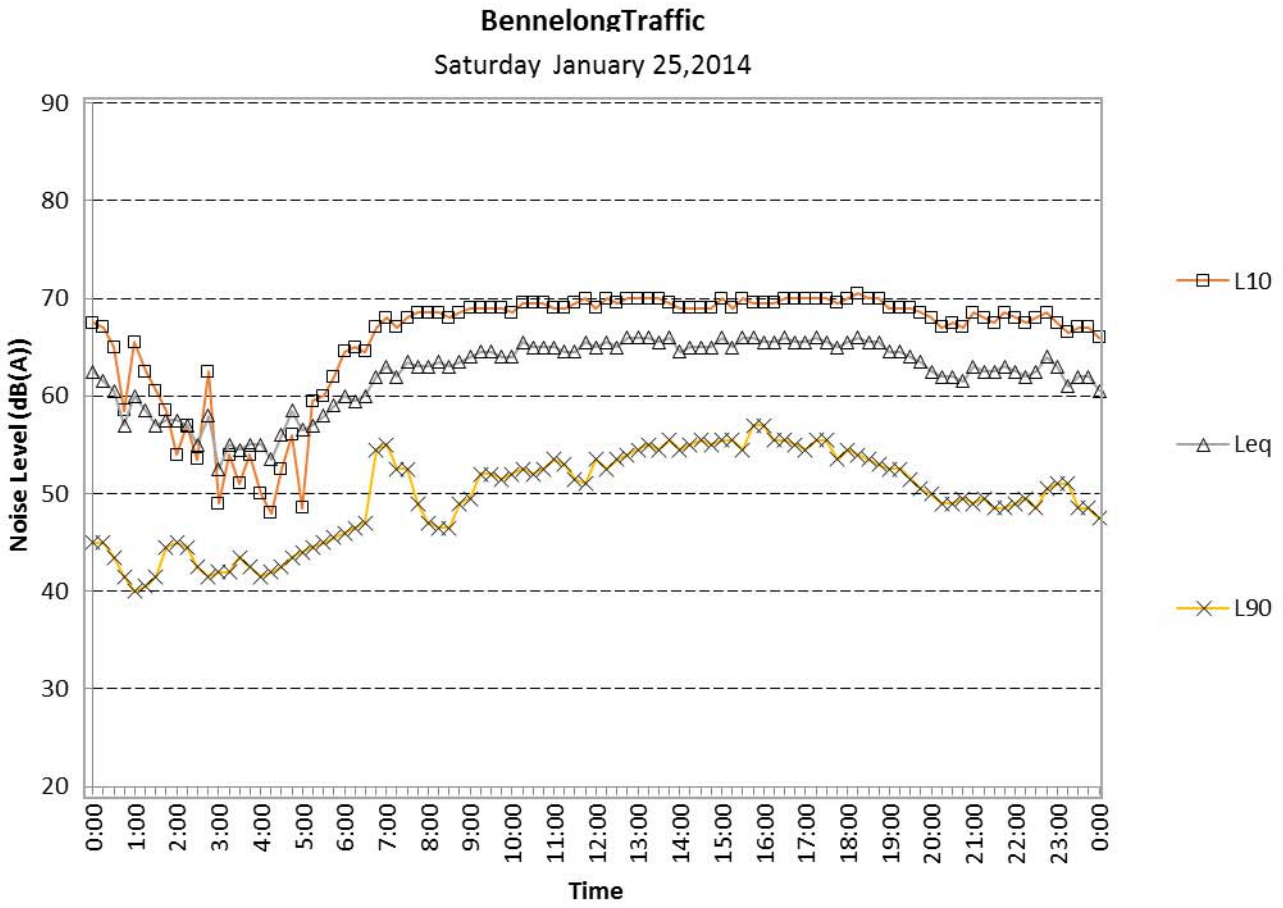
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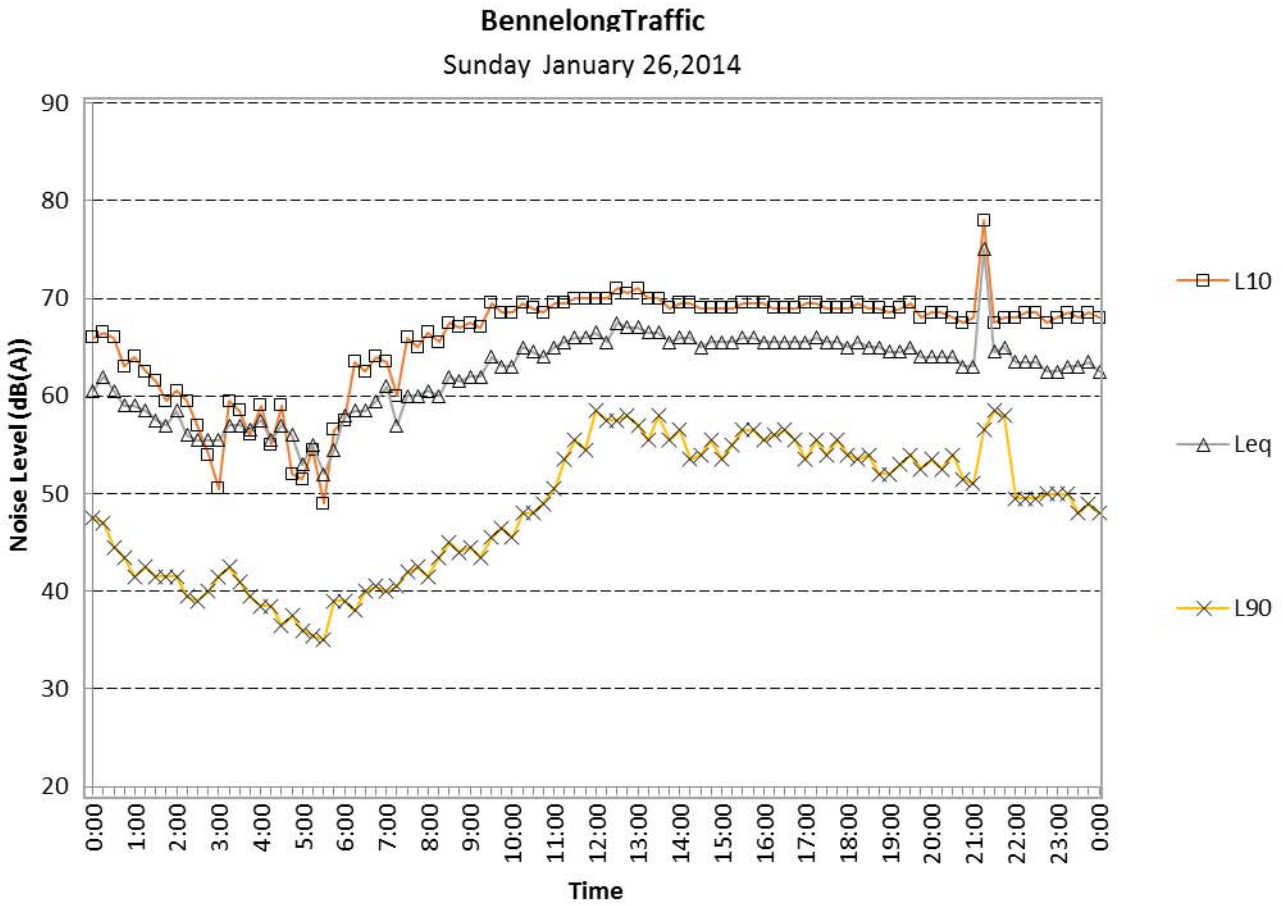
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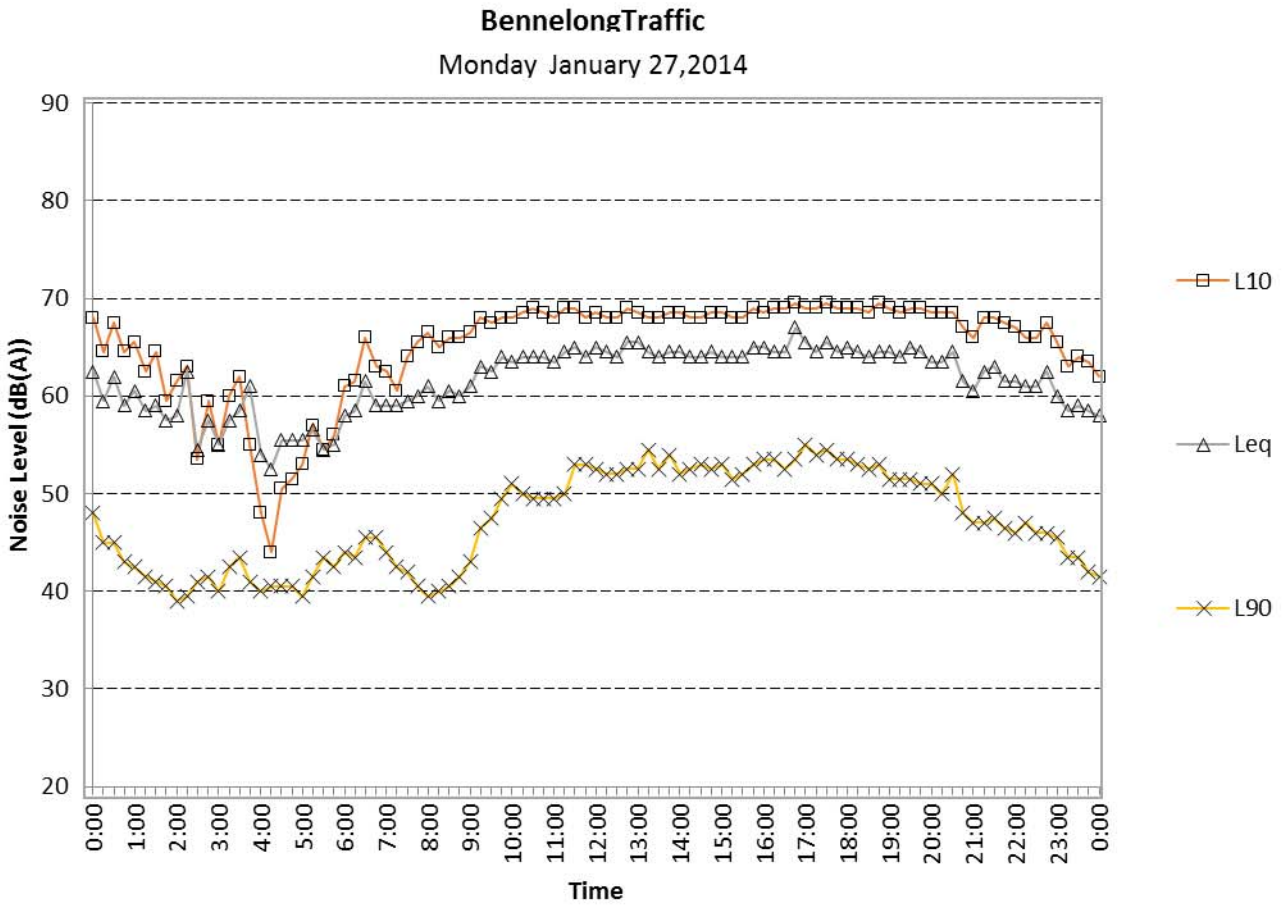
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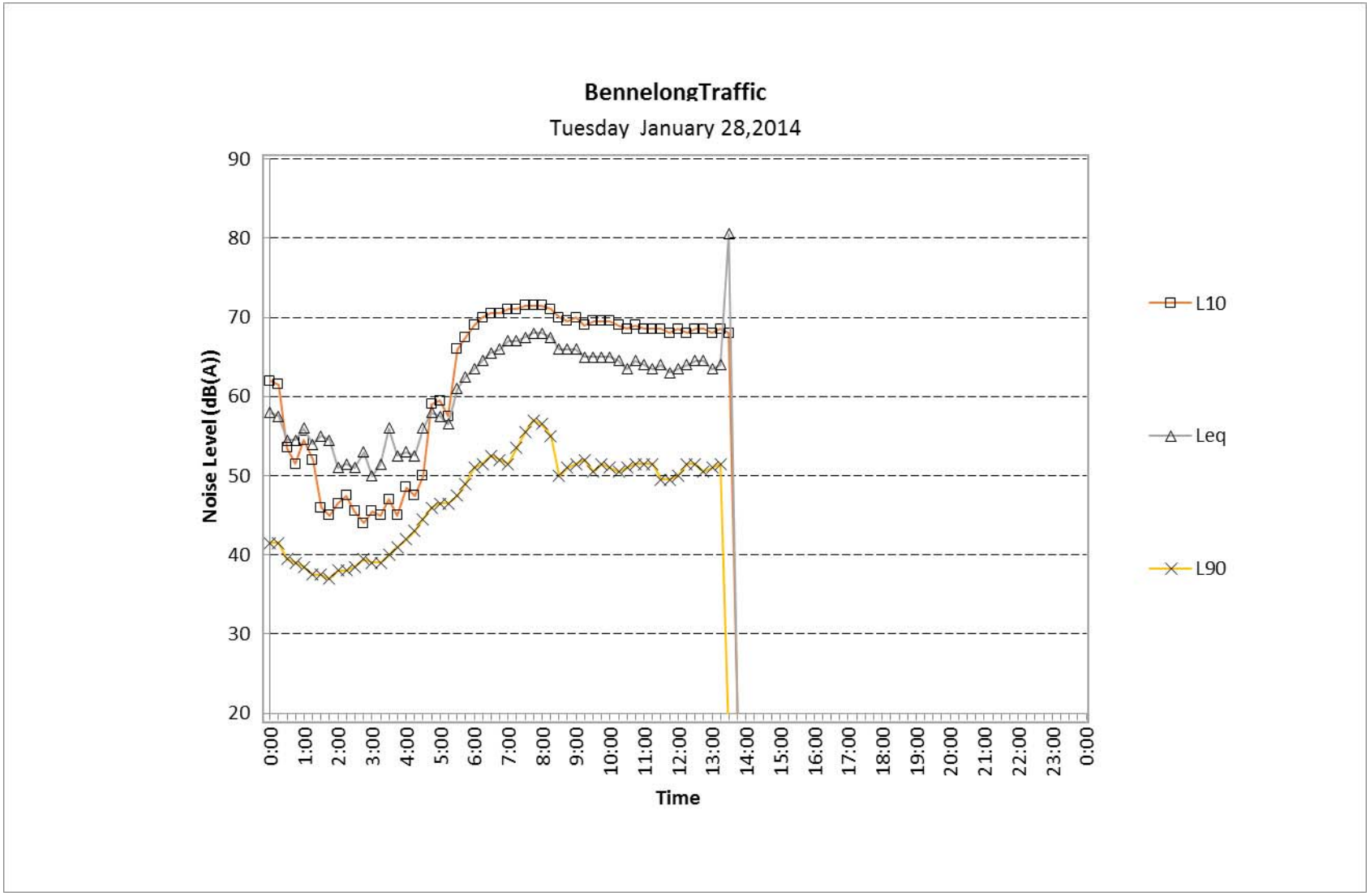
Leq
L90


BennelongTraffic
Tuesday January 28,2014
Noise Level (dB(A))
90
80
70
60
50
40
30
20
0:00
1:00
2:00
3:00
4:00
5:00
6:00
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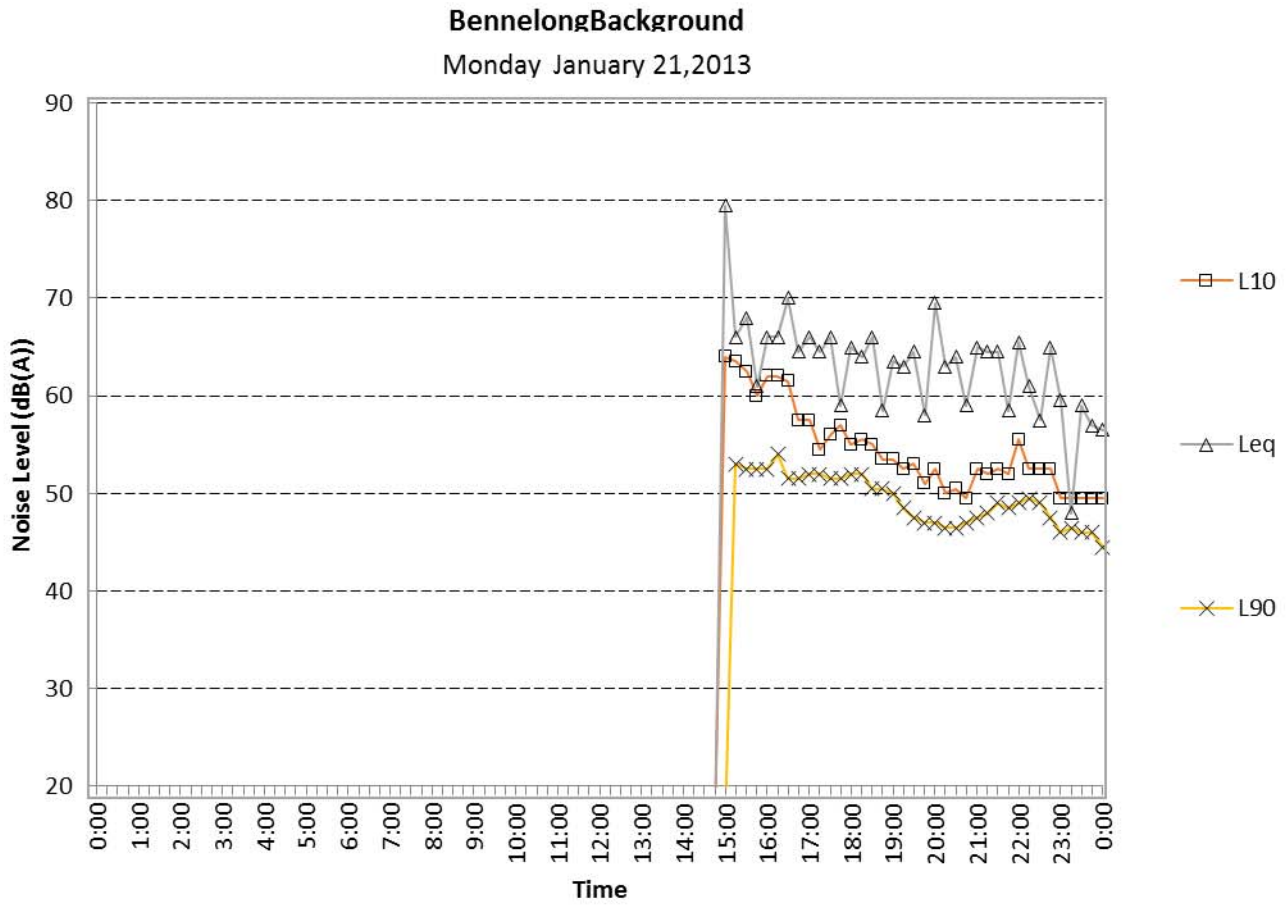
18:00
19:00
20:00
21:00
22:00
23:00
0:00
Time
L10
Leq
L90


BennelongBackground
Monday January 21,2013
Noise Level (dB(A))
90
80
70
60
50
40
30
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0:00
1:00
2:00
3:00
4:00
5:00
6:00
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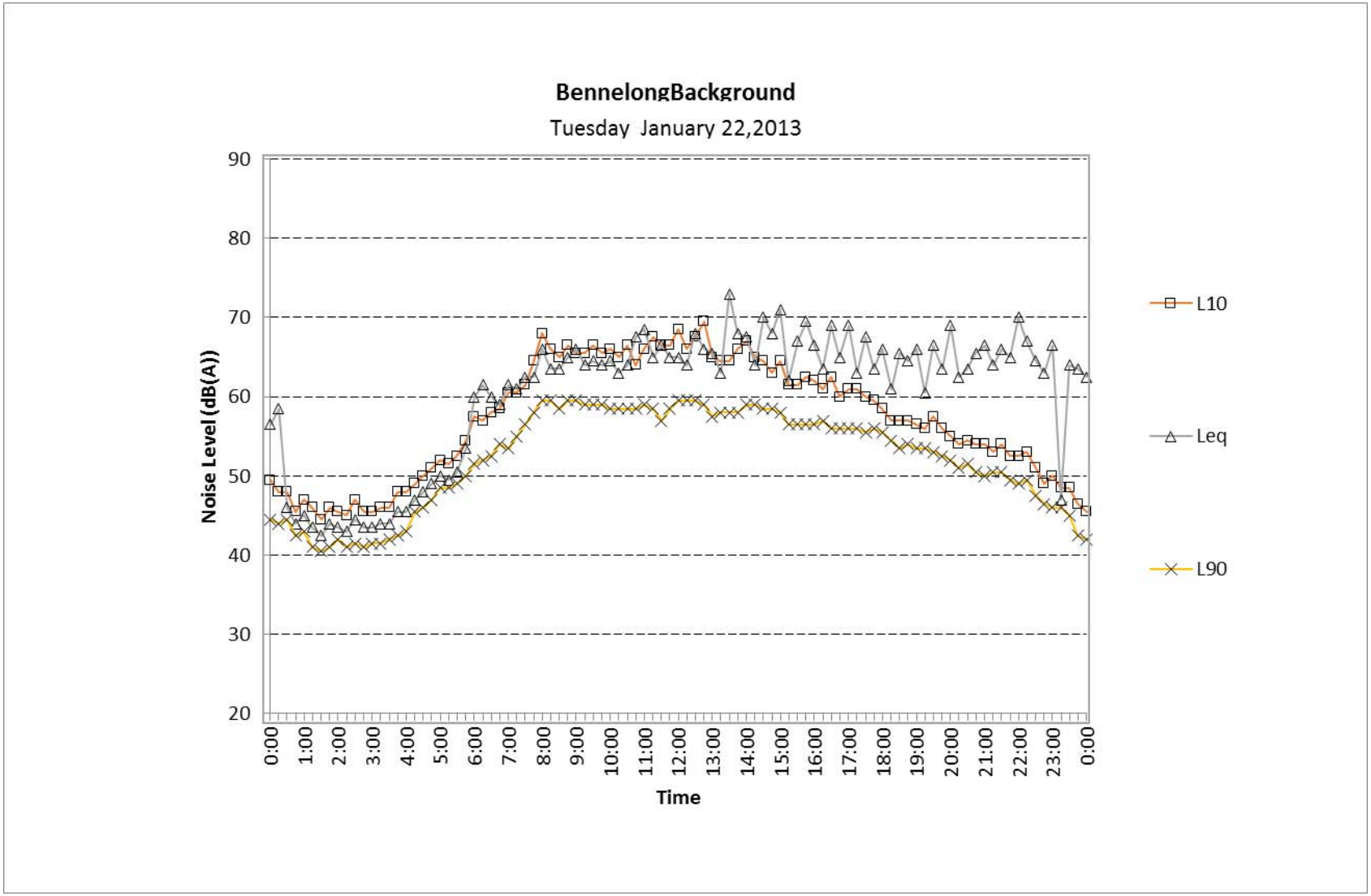
18:00
19:00
20:00
21:00
22:00
23:00
0:00
Time
L10
Leq
L90


BennelongBackground
Tuesday January 22,2013
Noise Level (dB(A))
90
80
70
60
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40
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0:00
1:00
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3:00
4:00
5:00
6:00
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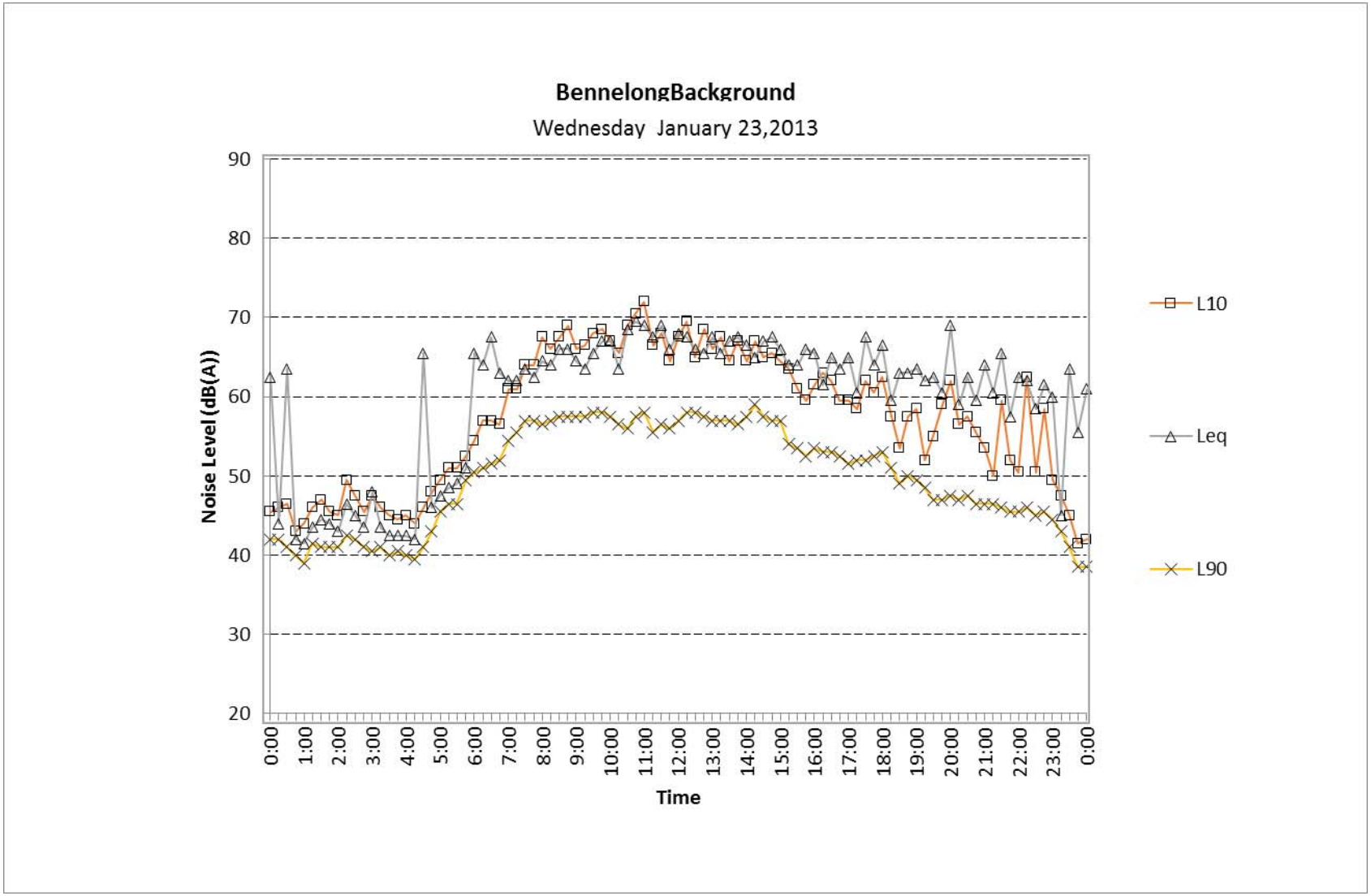
18:00
19:00
20:00
21:00
22:00
23:00
0:00
Time
L10
Leq
L90


BennelongBackground
Wednesday January 23,2013
Noise Level (dB(A))
90
80
70
60
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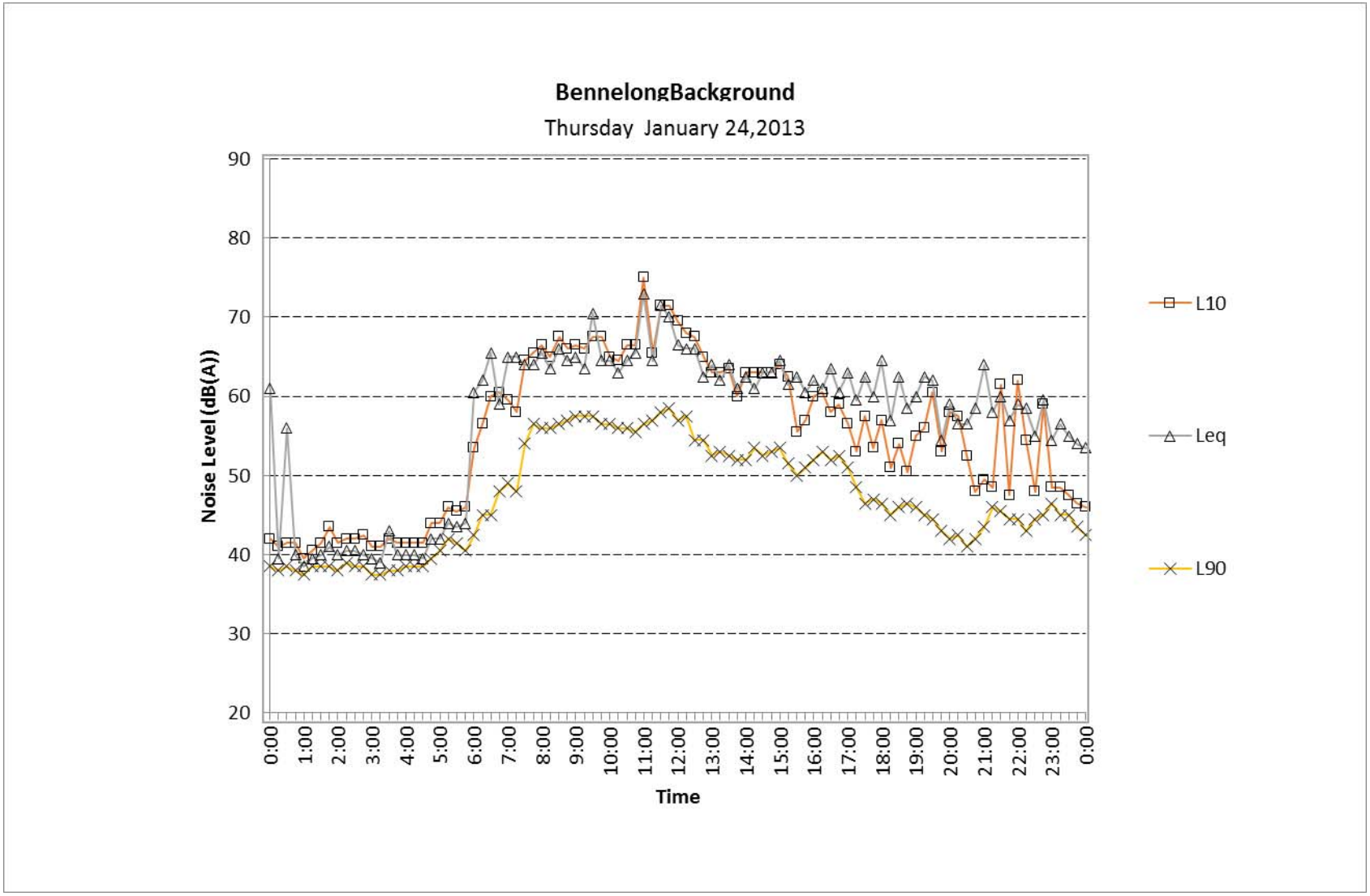
20:00
21:00
22:00
23:00
0:00
Time
L10
Leq
L90


BennelongBackground
Thursday January 24,2013
Noise Level (dB(A))
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80
70
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0:00
1:00
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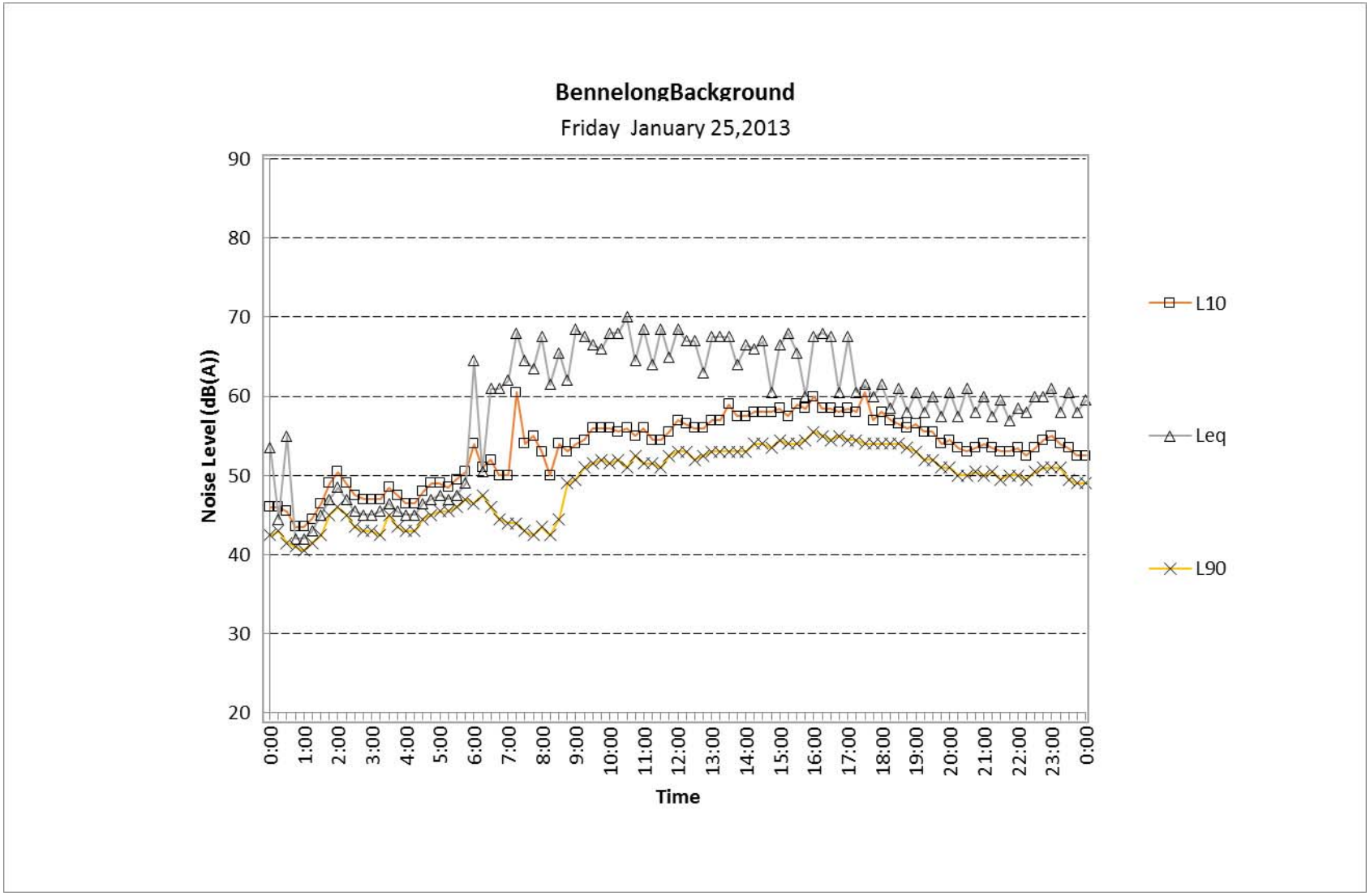
22:00
23:00
0:00
Time
L10
Leq
L90


BennelongBackground
Friday January 25,2013
Noise Level (dB(A))
90
80
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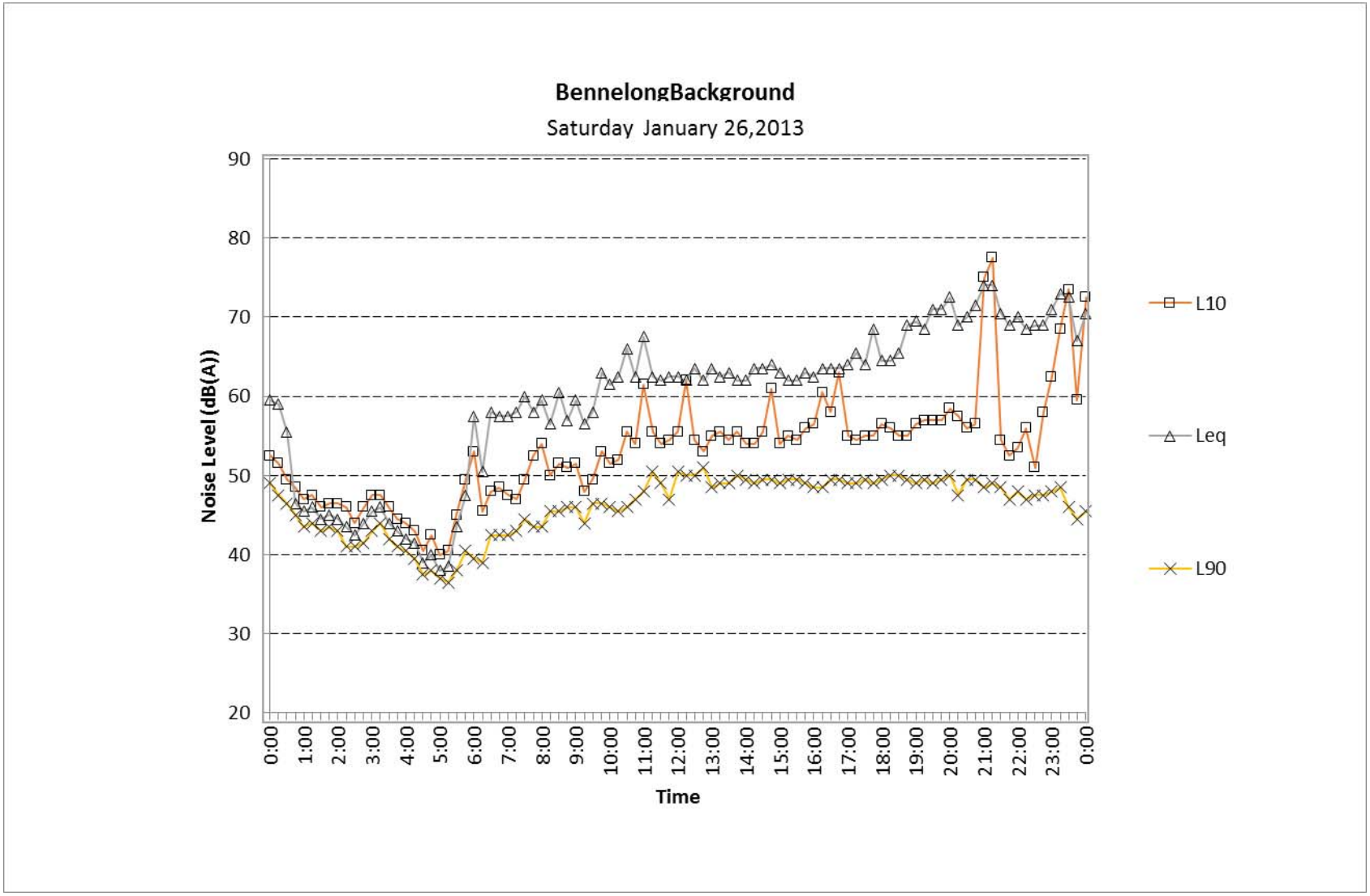
0:00
Time
L10
Leq
L90


BennelongBackground
Saturday January 26,2013
Noise Level (dB(A))
90
80
70
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0:00
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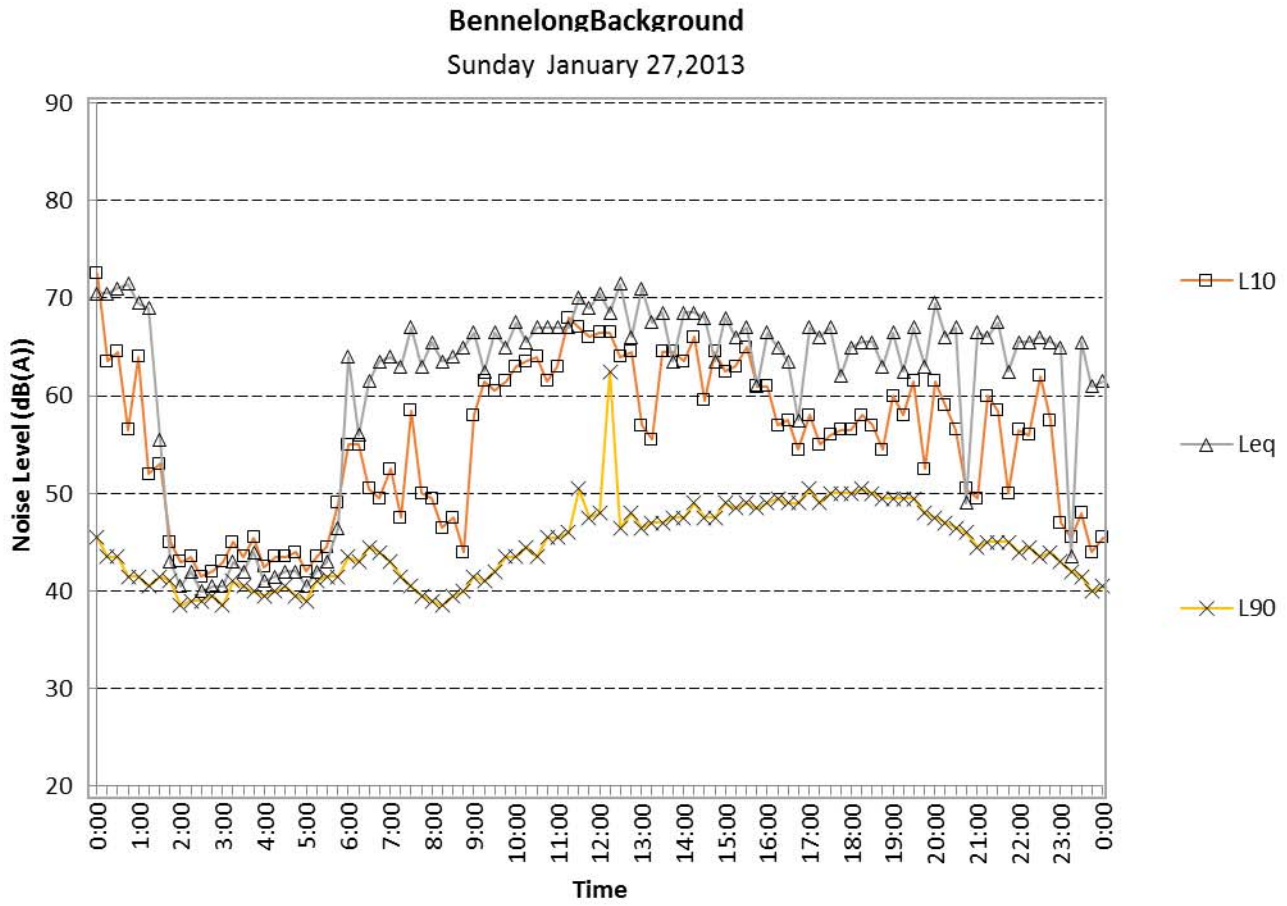
Time
L10
Leq
L90


BennelongBackground
Sunday January 27,2013
Noise Level (dB(A))
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80
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21:00
22:00
23:00
0:00
Time
L10
Leq
L90