MANAGING DIRECTORS
MATTHEW PALAVIDIS
VICTOR FATTORETTO

DIRECTORS
MATTHEW SHIELDS
BEN WHITE

80-88 Regent Street, Redfern

DA Noise and Vibration Impact Assessment

SYDNEY
A: 9 Sarah St Mascot NSW 2020
T: (02) 8339 8000
F: (02) 8338 8399

SYDNEY MELBOURNE BRISBANE CANBERRA
LONDON DUBAI SINGAPORE GREECE

www.acousticlogic.com.au
ABN: 11 068 954 343

DOCUMENT CONTROL REGISTER

Project Number	20151747.1
Project Name	80-88 Regent Street, Redfern
Document Title	DA Noise and Vibration Impact Assessment
Document Reference	20151747.1/1901A/R1/BW
Issue Type	Email
Attention To	Sunny Thirdi Regent St Pty Ltd Jarrod White

Revision	Date	Document Reference	Prepared By	Checked By	Approved By
0	17/12/2015	20151747.1/1712A/R0/BW	GC		BW
1	19/1/2016	20151747.1/1712A/R0/BW	GC		BW

TABLE OF CONTENTS

1 INTRODUCTION

This report presents an acoustic assessment to accompany the development application for the residential development to be located at 80-88 Regent Street, Redfern.

The report:

- Identifies environmental noise sources which may impact on the site (primarily traffic) and recommend acoustic treatments to reduce these impacts to levels compliant with SEPP 2007 and typical City of Sydney Council acoustic criteria.

- Presents a train vibration assessment of the existing Illawarra rail tunnel to the west of the site to determine if vibration isolation treatment is required for the proposed development.

- Identifies potential noise sources on the site and determines noise emission goals for the development to meet NSW EPA and Council requirements to ensure that nearby properties are not adversely impacted.

This noise assessment is based on the architectural drawings provided by SJB to this office.

2 SITE DESCRIPTION

The proposed development is located at 80-88 Regent Street, Redfern.

The proposed works involve the construction of a 18 level building comprising of 2 levels of retail and 5 levels of basement carparking.

The eastern façade faces Regent Street, which is a four lane road that carries medium to high levels of traffic. The southern façade faces Marian Street. The north façade is bounded by existing mixed commercial/residential properties. The western façade faces William Lane which is a two lane road primarily used for residential/commercial access.

The noise sources which will potentially impact on the project site will be traffic noise along Regent Street to the east of the site.

The site is also potentially affected by vibration from the Illawarra and Bondi Junction railway line which is underground approximately 55 metres to the west of the site.

Noise potentially generated by the site will consist primarily of noise from the proposed mechanical plant serving the project site.

The nearest potentially affected noise receivers are:

- Commercial and residential properties on the eastern side of Regent Street;
- Commercial properties to the South of the site opposite on Marian Street;
- Commercial properties bounding the site to the North; which has been approved as student accommodation recently.
- Residential and commercial properties to the West of the site on Gibbons Street;

Refer to Figure 1 below, which is an aerial photo of the existing development.

Figure 1 - Aerial Picture Showing Site and Receivers

Please see the legend on the below for colour markings and descriptions.

Table 1 – Legend for Site Plan

Location	Marking
Subject Site	
Nearest Commercial/Residential Receivers	
Nearest Commercial Receiver	
Attended Vibration Measurements	
Attended Noise Measurements	
Unattended Noise Monitoring	

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_{10} 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 ASSESSMENT OF TRAFFIC NOISE

Significant traffic noise sources in the vicinity of the site are as follows:

- Regent Street, directly to the east of the subject site, which carries medium to high traffic flows.

Acoustic treatment of the proposed extensions will be designed in order to ensure compliance with the acoustic requirements of City of Sydney Council DCP, SEPP 2007 and Australian Standard 2107:2000.

4.1 TRAFFIC NOISE CRITERIA

4.1.1 City of Sydney Council DCP - Draft Sydney Development Control Plan 2010

The Draft Sydney DCP 2010 states the following with regards to the control of traffic noise intrusion:

> *"Dwellings are to be constructed so that in a naturally ventilated situation the repeatable maximum LAeq (1 hour) level does not exceed:*
>
> *i) for closed windows and doors::*
> *bedrooms (10pm-7am), 35dB; and*
> *main living area (24 hours) 45dB*
>
> *ii) for open windows and doors:*
> *bedrooms (10pm-7am), 45dB; and 45dB*
> *main living area (24 hours), 55dB. 55dB*
>
> *Where natural ventilation of a room cannot be achieved, the repeatable maximum LAeq (1hour) level when doors are windows are shut and mechanical ventilation/ air conditioning is operating in a dwelling is not to exceed, within:*
>
> *i) bedrooms (10pm-7am), 38dB; and*
>
> *ii) main living area (24 hours) 48dB*
>
> *These levels are to include the combined measured level of noise from both external sources and the ventilation system operating normally."*

4.1.2 Australian Standards AS2107:2000

The Australian Standard AS2107-2000 "Recommended Design Sound Levels and Reverberation Times for Building Interiors" recommends maximum design sound levels for different areas of occupancy in the residential development while AS 3671 -1989 "Road Traffic Noise Intrusion - Building Siting and Construction" recommends that an appropriate L_{eq} or L_{10} traffic noise descriptor be used for the occupancy being assessed. Traffic noise criteria for AS2107-2000 is presented in the table below, based on developments near major roadways.

Table 2 - AS2107:2000 Internal Traffic Noise Criteria

Space Activity Type	Noise Level dB(A) L_{eq}	
	Satisfactory	Maximum
Living Areas	35	45
Sleeping Areas	30	40
Retail	45	50
Common Lounge	40	45

4.2 STATE ENVIRONMENTAL PLANNING POLICY (SEPP INFRASTRUCTURE) 2007

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:
  - *"Clause 102: development for any of the following purposes that is on land in or adjacent to a road corridor for a freeway, a tollway or a transit way or any other road with an annual average daily traffic volume of more than 40,000 vehicles (based on the traffic volume data available on the website of the RTA) and that the consent authority considers is likely to be adversely affected by road noise or vibration:*
    - *building for residential use*
    - *a place of public worship*
    - *a hospital*
    - *an educational establishment or childcare."*

Clause 102 of the NSW SEPP for road traffic noise stipulates,

"This clause applies to development for any of the following purposes that is on land in or adjacent to the road corridor for a freeway, a tollway or a transit way or any other road with an annual average daily traffic volume of more than 40,000 vehicles (based on the traffic volume data published on the website of the RTA) and that the consent authority considers is likely to be adversely affected by road noise or vibration:

(a) a building for residential use,

If the development is for the purposes of a building for residential use, the consent authority must not grant consent to the development unless it is satisfied that appropriate measures will be taken to ensure that the following L_{Aeq} levels are not exceeded:

(a) in any bedroom in the building – 35 dB(A) at any time between 10 pm and 7am,

(b) anywhere else in the building (other than a garage, kitchen, bathroom or hallway) – 40 dB(A) at any time."

Internal requirements are for residential spaces and are measured internally with windows closed.

4.3 PROJECT CRITERIA

From the RTA annual average daily traffic count conducted in 2012, the AADT of Regent Street exceeds 40,000, therefore, the project criteria will be based on the more stringent requirements from the above documents. The governing project criteria are presented in Table 4, presenting the most stringent of the Council, SEPP and AS2107 requirements. This is, if these criteria are achieved then compliance with all the criteria is acheived.

Table 3 – Internal Noise Level Criteria

Location	Period	Criteria
Bedroom	Night (10pm – 7am)	35 dB(A) $L_{eq\ (1\ hr)}$
Living Areas	All Time (24 hour)	45dB(A) $L_{eq\ (worst\ 1hr)}$ 40 dB(A) $L_{eq\ (24hr)}$
Common Room (Lounge)	24 Hours	45 dB(A) $L_{eq\ (24hrs)}$
Retail	When In Use	50 dB(A) $L_{eq\ (1hr)}$

4.4 TRAFFIC NOISE MONITORING

As part of this investigation, traffic noise from the surrounding perimeter roadways has been measured. The results of this measurement will be used to determine the treatments required to reduce noise levels to within the project acoustic objectives.

Measurements included attended and unattended noise levels measurements conducted along the proposed northern façade as detailed in Figure 1 above.

4.4.1 Measurement Location

Traffic noise measurement locations are detailed above in Figure 1.

4.4.2 Attended Measurements

Measurements were taken using a Norsonic-118 precision sound level analyser, set to A-weighted fast response. The sound level meter was calibrated before and after the measurements using a RION NC73 precision sound calibrator and no significant drift was recorded. Measurements were taken on 15th December 2015 between 5:00pm and 6:30pm (afternoon peak hour). There were no periods of adverse weather during the measurement.

4.4.3 Unattended Measurements

Unattended noise measurements were obtained using an Acoustic Research Laboratories Pty Ltd noise logger. The logger was programmed to store 15-minute statistical noise levels throughout the monitoring period. The noises monitors were calibrated at the beginning and the end of the measurement using a Rion NC-73 calibrator. No significant drift was detected. All measurements were taken on A-weighted fast response mode. The logger was on site from the 7th to 14th December 2015. Refer to Appendix 1 for unmanned noise monitoring and weather data.

4.4.4 Resultant Noise Levels

The following table presents the resultant noise levels at the proposed façades of the development. The noise levels are based on both the attended and unattended noise measurement results conducted by this office. The noise levels are based on the manned background noise measurement results adjusted by the difference with the noise monitor results of similar time periods and distance attenuation.

Table 4 - Measured Traffic Noise Levels

Locations	Traffic Noise Levels*	
	Daytime (7am-10pm)	Night-time (10pm- 7am)
Eastern Façade (Facing Regent St)	72 dB(A) $L_{eq(1\ Hour)}$ – Sydney City 71 dB(A) $L_{eq(24hr)}$ - SEPP	70 dB(A) $L_{eq(1\ Hour)}$ – Sydney City 68 dB(A) $L_{eq(9\ Hour)}$ - SEPP
Western Façade (Facing William Lane)	66 dB(A) $L_{eq(1\ Hour)}$ – Sydney City 65 dB(A) $L_{eq(24hr)}$ - SEPP	64 dB(A) $L_{eq(1\ Hour)}$ – Sydney City 62 dB(A) $L_{eq(9\ Hour)}$ - SEPP

*The levels presented in the above table are façade corrected (that is, 2.5dB was subtracted from the measured noise levels).

4.5 RECOMMENDED CONSTRUCTIONS

Traffic noise intrusion into the proposed development was assessed using the measured external noise levels reported above as a basis.

Calculations were performed taking into account the orientation of windows, the total area of glazing, facade transmission loss and room sound absorption characteristics. In this way the likely interior noise levels can be predicted. Acoustic treatment required to ensure compliance with the assessment criteria are detailed in this section.

Internal noise levels will primarily be as a result of noise transfer through the windows, doors and varying cladded curtain wall façade constructions as these are relatively light building elements that offer less resistance to the transmission of sound.

The constructions necessary to achieve the noise levels are detailed below. The predicted noise levels have been based on the expected 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.

4.5.1 Glazed Windows and Doors

The following constructions are recommended to comply with the traffic noise objectives stated in Section 4.3. Aluminium framed/sliding glass doors and windows will be satisfactory provided they meet the following criteria. Thicker glazing may be required for structural, safety or other purposes. Where it is required to use thicker glazing than scheduled, this will also be acoustically acceptable.

The recommended constructions are listed in the table below.

Table 5 – Recommended Minimum Glazing Construction

Levels	Façade	Space	Recommended Glazing	Acoustic Seals
Ground and Level 1 Commercial/retail	East (Regent St)	Commercial/retail	6.38mm Laminated	Yes
	All other facades	Commercial/retail	6mm Float/Toughened	Yes
Residential Levels	East (Regent St) North and South facades	Living and sleeping areas	12.38mm Laminated	Yes
	West (William St) façade	Living and sleeping areas	10.38mm Laminated	Yes

In addition to meeting the minimum glazing thickness requirements given, the design of the window mullions, perimeter seals and the installation of the windows/doors in the building openings shall not reduce the STC rating of the glazing assembly below the values nominated in the table above. All external windows and doors are required to be fitted with Q – lon type acoustic seals. **Note that Mohair type seals will not be acceptable for the windows requiring acoustic seals.**

The window/door suppliers should provide evidence that the systems proposed have been tested in a registered laboratory with the recommended glass thicknesses and comply with the minimum listed STC requirements. Also, the glazing installer should certify that the window/doors have been constructed and installed in a manner equivalent to the tested samples.

Table 6 – Minimum STC of Glazing (with Acoustic Seals)

Glazing Assembly	Minimum STC of Installed Window
12.38mm laminated	37
10.38mm laminated	35
6.38mm laminated	30

4.5.2 Roof / Ceiling

The proposed concrete roof construction will have an R_w rating of over 50 and is acoustically acceptable and does not require additional treatment.

4.5.3 External Walls

External walls of masonry construction are acoustically acceptable and do not required additional acoustic treatments.

4.6 VENTILATION AND AIR CONDITIONING

The internal noise level criteria outlined in Table 4, cannot be achieved with windows open. Hence it is required that alternative outside mechanical ventilation or air conditioning is required to be provided to all units within the project.

5 RAIL INDUCED VIBRATION

Trains induce ground borne vibration that is transmitted through the subsoil. This vibration can be perceptible close to railways.

5.1 ASSESSMENT CRITERIA

This section presents the applicable assessment criteria for ground borne noise and tactile vibration.

5.1.1 Ground Borne Noise

Development located adjacent to railway lines must be assessed in accordance with Clause 87 of the SEPP (Infrastructure) 2007. It is noted that the requirements of this standard are achieved when assessed in accordance with the NSW Department of Planning *Development Near Rail Corridors and Busy Roads – Interim Guideline (2008).* The section relevant to ground borne noise is as follows:

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.

Table 7 - Internal Railway Noise Level Criteria for Ground Borne Noise

LOCATION	TIME OF DAY	Internal Ground Borne Noise Criteria $L_{Amax\ (SLOW)}$ dB(A)
Living and sleeping areas	Day (7am-10pm)	40
	Night (10pm-7am)	35

5.1.2 Project Vibration Objectives

5.1.2.1 Tactile Vibration

Human comfort is normally assessed with reference to the British Standard BS 7385 Part 2 1993 or Australian Standard AS 2670.2 1990.

The Interim Guideline references the DECCW *Assessing Vibration- A technical guideline* which recommends that habitable rooms should comply with the criteria therein which is in line with the requirements of British Standard BS 6472:1992 "Evaluation of Human Exposure to Vibration in Buildings (1Hz to 80Hz)".

British Standard BS 6472:1992 "Evaluation of Human Exposure to Vibration in Buildings (1Hz to 80Hz)" is recommended by the RIC's and SRA's Interim Guidelines for Councils "Consideration of rail noise and vibration in the planning process" as this standard includes guidance for the assessment of human response to building vibration including intermittent vibrations such as that caused by trains.

Human response to vibration has been shown to be biased at particular frequencies, which are related to the orientation of the person. This standard provides curves of equal annoyance for various orientations. These curves are applied as correction filters such that an overall weighted acceleration level is obtained. As the orientation of the resident is unknown or varying the weighting filter used is based on the combined base curve as given in ISO 2631 & Australian Standard 2670 "Evaluation of Human Exposure to Vibration and Shock in Buildings (1 to 80Hz)" which represent the worst case of the X, Y and Z axes. Filtered measurements are made in all three co-ordinate axes and the highest value axis used.

This standard 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" (6am-10pm) and "Night time" (10pm-6am). The overall value is then compared to the levels in Table 9. For this project the aim will be for a low probability of adverse comment.

Table 8 - Vibration Dose Values (m/s1.75) 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 16hr day (Daytime)	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential buildings 8hr night (Night time)	0.13	0.26	0.51

5.2 VIBRATION MEASUREMENTS

Rail vibration measurements were conducted internally on the ground floor of the existing building located at 80-88 Regent St. These locations are deemed to be potentially the worst affected from the railway tunnels below and along the centreline of the main building.

Attended train vibration measurements were conducted on 15th December 2015 from 2.30pm to 4.30pm. A Svan 958 AE Vibration Analyser was used for the vibration measurements. The analyser was fitted with a Dytran triaxial accelerometer.

5.2.1 Tactile Vibration

The measured vibration levels, duration of train passby and the number of rail movements per hour were used to determine the overall vibration dose (VDV) at the proposed development for both daytime and night time periods. The results are presented the table below.

Table 9- Vibration Dose Values

Time Period	Calculated VDV $m/s^{1.75}$	Criteria VDV $m/s^{1.75}$	Complies
Day (7am – 10pm)	0.1	0.2 to 0.4	Yes
Night (10pm -7am)	0.06	0.13	Yes

The Vibration Dose Values were found to be less than the "low probability of adverse comment" criteria (the most stringent criteria) for the subject site. No vibration attenuation treatment to the development is required.

5.3 STRUCTURE BORNE NOISE MEASUREMENTS

Internal noise levels within the most impacted residential units as a result of structure borne noise (due to the Eastern suburbs/Illawarra Train underground) have been calculated for a number of train passbys. Noise levels have been determined based on on-site measurements of rail induced vibration.

Table 10– Structure Borne Vibration Levels

LOCATION	TIME OF DAY	Predicted Internal Ground Borne Noise $L_{Amax\ (SLOW)}$ dB(A)	Internal Ground Borne Noise Criteria $L_{Amax\ (SLOW)}$ dB(A)	Complies
Living and sleeping areas	Day (7am-10pm)	<35	40	Yes
	Night (10pm-7am)	<35	35	Yes

The results above indicate full compliance with the project criteria without additional acoustic treatments.

6 NOISE EMISSION ASSESSMENT

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

Potential noise sources which should be assessed are:

- Noise generated by mechanical plant servicing the development.

The nearest potentially affected noise receivers are:

- Commercial properties on the eastern side of Regent Street;
- Commercial properties to the South of the site opposite on Marian Street;
- Commercial properties bounding the site to the North;
- Residential and commercial properties to the West of the site on Gibbons Street;

6.1 BACKGROUND NOISE MONITORING

Background noise levels at the site have been measured based on the unattended noise logging undertaken by this office as outlined in Section 4.4.

Measured background noise levels are presented below. Refer to Appendix 1 for unattended noise monitoring data.

The measured background noise levels have been analysed for meteorological conditions (excessive wind and/or rain), as required by Section 3.4 of the EPA Industrial Noise Policy. Exceedances of the 5m/s average wind speed limit of the EPA were noted and corrected for in determining the background noise levels. These areas are also highlighted in the logging data in Appendix 1.

The noise levels for William Lane are based on the manned background noise measurement results adjusted by the difference with the noise monitor results of similar time periods and distance attenuation.

Table 11- Measured Background Noise Levels

Location	Background noise level dB(A)L_{90}		
	Daytime (7am-6pm)	Evening (6pm-10pm)	Night (10pm-7 am)
Façade of 80-88 Regent Street, Redfern	56	55	44
Façade of William Lane	54	53	42

A background noise measurement was also conducted on site during the night time period (10pm) on 15th December 2015 to measure an ambient noise spectrum, which is presented below.

Table 12– Background Noise Spectrum

	31.5Hz	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	dB(A)
Regent St Façade	51	51	48	46	43	38	34	26	23	**44**
Other Commercial Receivers (William Lane)	49	49	46	44	40	37	32	25	19	**42**

6.2 METEOROLOGICAL CONDITIONS DURING MONITOR PERIOD

Section 3.4 of the NSW Environment Protection Authority (EPA) Industrial Noise Policy document outlines the following with regards to meteorological impacts on noise monitoring;

"Noise monitoring should not be conducted (or the data should be excluded) when average wind speeds (over 15-minute periods or shorter) at microphone height are greater than 5 m/s, or when rainfall occurs."

However, the same section of this policy also outlines that;

"Exceptions to this rule are allowed, provided the proponent is able to show that the wind-induced noise on the microphone, and sound levels due to rain, are at least 10 dB below the noise levels (that is, background and/or ambient) under investigation."

Weather conditions during the monitoring period have been assessed and the periods of inclement weather are highlighted in the logging data in Appendix 1.

On review of the monitoring data, the measured L_{90} noise levels during high wind speed days do not increase background noise levels significantly as periods with little to no wind. This demonstrates that even though wind speeds measured at Observatory Hill exceed EPA guidelines, either:

- The wind speed on site at this time was significantly lower than at Observatory Hills (which is likely given Observatory Hills is located in a very exposed area) and/or
- The wind on site was not sufficiently consistent to increase background noise levels compared to calm periods.

Never the less, periods of adverse weather have been eliminated when determining the rating background noise level at the site, which is presented in the section above.

6.3 ACOUSTIC CRITERIA

Acoustic criteria typically adopted by the City of Sydney Council require that:

- Noise emissions (plant noise and outdoor communal area), comply with the noise emission requirements of the EPA Industrial Noise Policy.

- Noise emissions (noise generally) not exceed background noise levels by more than 3dB when measured in octave bands between 31.5Hz and 8,000Hz.

These requirements are outlined below.

6.3.1 Mechanical Plant Noise (EPA Industrial Noise Policy)

Noise sources covered by this code will be mechanical services noise. Both the Intrusiveness and the Amenity criteria (as set out below) must be complied with.

6.3.1.1 INP - Intrusiveness Assessment

Intrusiveness criteria permit noise generation to be no more than 5dB(A) above existing background noise levels.

Table 13– Intrusiveness Assessment

Location	Time of Day	Background noise Level – dB(A)L_{90}	Intrusiveness Noise Objective dB(A)$L_{eq(15min)}$ (Background + 5dB)
Monitor Location – Regent Street Façade	Day Time (7am - 6pm)	56	61
	Evening (6pm - 10pm)	55	60
	Night (10pm - 7am)	44	49
Location – William Lane Façade	Day Time (7am - 6pm)	54	59
	Evening (6pm - 10pm)	53	58
	Night (10pm - 7am)	42	47

6.3.1.2 INP - Amenity Assessment

The Amenity criteria set additional criteria based on the land use of the noise sensitive receivers.

Amenity criteria are as follows:

Table 14– Amenity Criteria

Receiver Location	Land Type	Time of Day	Amenity Noise Objective dB(A) $L_{eq(Period)}$
All Potentially Affected Residential Properties	Suburban	Day Time (7am – 6pm)	55
		Evening (6pm – 10pm)	45
		Night (10pm-7am)	40
Commercial	All	When in use	65

6.3.2 City of Sydney Standard Conditions

The City of the Sydney Council standard conditions include the following;

(1) NOISE - GENERAL

(a) The emission of noise associated with the use of the premises including the cumulative operation of any mechanical plant and equipment, and air conditioning shall comply with the following:

(i) The $L_{Aeq,\ 15\ minute}$ noise level emitted from the use must not exceed the project specific noise level for that receiver as determined in accordance with the NSW EPA Industrial Noise Policy. Noise must be measured in accordance with the Industrial Noise Policy and relevant requirements of Australian Standard AS 1055-1997 Acoustics – Description and measurement of environmental noise.

(ii) Project specific noise levels shall be determined by establishing the existing environmental noise levels, in complete accordance with the assessment $L_{A90,\ 15\ minute}$ / rating $L_{A90,\ 15\ minute}$ process to be in accordance with the requirements for noise monitoring listed in the NSW EPA Industrial Noise Policy and relevant requirements of Australian Standard AS1055-1997 Standard AS 1055-1997 Acoustics – Description and measurement of environmental noise.

(iii) Modifying factors in Table 4.1 of the NSW EPA Industrial Noise Policy are applicable.

(b) An $L_{Aeq,15\ minute}$ noise level emitted from the use must not exceed the $L_{A90,\ 15\ minute}$ noise level by more than 3dB in any Octave Band Centre Frequency (31.5 Hz to 8 kHz inclusive) when assessed inside any habitable room of any affected residence or noise sensitive commercial premises provided that;

(i) Where the $L_{A90,\ 15\ minute}$ noise level is below the threshold of hearing, Tf at any Octave Band Centre Frequency as defined in Table 1 of International Standard ISO

226 : 2003- Normal Equal-Loudness-Level Contours then the value of Tf corresponding to that Octave Band Centre Frequency shall be used instead.

(ii) The $L_{Aeq,15\ minute}$ noise level and the $L_{A90,15\ minute}$ noise level shall both be measured with all external doors and windows of the affected residence closed;

(iii) The relevant background noise level ($L_{A90,\ 15\ minute}$) is taken to mean the day, evening or night rating background noise level determined in complete accordance with the methodology outlined in the NSW EPA Industrial Noise Policy and Australian Standard AS1055.1997 Acoustics – Description and measurement of environmental noise.

(iv) Background noise shall be established in the absence of all noise emitted from the use but with the ventilation equipment normally servicing the affected residence operating. Background noise measurements are to be representative of the environmental noise levels at the affected location.

(v) Modifying factors in Table 4.1 of the NSW EPA Industrial Noise Policy are applicable. Internal Noise measurements are not to be corrected for duration.

The resulting noise level criteria from the operation of the mechanical equipment on the site are detailed in the following sections based on the EPA, INP.

Based on the measured background noise levels and spectrums set out in section 6.1, the corresponding noise emission goals are as follows:

Table 15– Noise Emission Goals at Regent Street Facade

Time of Day	Criteria	31Hz	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	A-Wt.
Day (7am-6pm)	56BG+3	66	66	63	61	58	53	49	31	38	**59**
Evening (6pm-10pm)	55BG+3	65	65	62	60	57	52	48	30	37	**58**
Night (10pm-7am)	44BG+3	54	54	51	49	46	41	37	29	26	**47**

Table 16– Noise Emission Goals at other Receivers (William Lane)

Time of Day	Criteria	31Hz	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	A-Wt.
Day (7am-6pm)	54BG+3	64	64	61	59	56	51	47	29	37	**57**
Evening (6pm-10pm)	53BG+3	63	63	61	58	55	50	46	28	35	**56**
Night (10pm-7am)	42BG+3	52	52	49	47	44	39	35	27	24	**45**

6.4 RECOMMENDATIONS

A separate development application will be lodged for the fit out of ground floor and first floor retail tenancy. An acoustic report may be required as part of that application assessing noise impacts (if any).

6.4.1 Noise Emissions from External Mechanical Plant

Mechanical plant items are not typically selected at selected at DA stage.

Detailed review of these condensers and all other 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 this section of this report.

All plant can be satisfactorily attenuated to levels complying with noise emission criteria through appropriate location and (if necessary) standard acoustic treatments such as noise screens, enclosures, in-duct treatments (silencers/lined ducting) or similar.

7 CONSTRUCTION NOISE

This section presents a discussion of the processes which will be followed in order to manage noise and vibration from the construction of the residential development.

We note that a detailed construction program for the demolition, excavation and construction of the development is not available at present (this is not typically undertaken prior to project approval) and as such, a detailed construction noise assessment cannot be undertaken at this stage.

We recommend that a detailed assessment of noise emissions from construction activities be undertaken at Construction Certificate Stage, once a construction programme has been determined. As such, only an indicative analysis is possible, as outlined below.

7.1 CONSTRUCTION NOISE AND VIBRATION CRITERIA

Both noise and vibration criteria will be outlined below.

7.1.1 Construction Noise

Relevant guidelines are:

- The NSW EPA Interim Construction Noise Guidelines and
- Australian Standard 2436.

7.1.1.1 NSW EPA Interim Construction Noise Guideline

This guideline nominates acceptable levels of noise emissions above the background noise level. For projects within the recommended standard hours the guideline recommends a noise level of 10dB(A) above the background – this level is referred to as the "noise effected level". The noise emission goals for nearby development is as follows:

Table 19 – Noise Emission Goal – Residential Properties

TIME OF DAY	MEASURED BACKGROUND LEVELS – dB(A)L_{90}	NOISE EFFECTED LEVEL BACKGROUND + 10dB(A)$L_{eq(15min)}$
Day (7am-6pm)	56*	66

*This level has been determined based on long term on-site noise monitoring presented in Section 6.1 of this report.

Table 20 – Noise Emission Goal – Commercial Properties

TIME OF DAY	Noise Emission Goal dB(A)$L_{eq(15min)}$
Day (7am-6pm)	70 (external)

Where noise from the construction works is above the "noise affected level", the proponent should apply any feasible and reasonable work practices to minimise noise.

If noise emissions are likely to exceed 75dB(A)$L_{eq(15min)}$, the receiver is deemed to be "highly noise affected". Introduction of management controls such as scheduling of noisy periods, or respite periods is recommended.

7.1.1.2 Australian Standard 2436-1981 "Guide to Noise Control on Construction Maintenance and Demolition Site".

Where compliance with EPA cannot be achieved, noise emissions are to be managed in accordance with principles in AS2436:

- That reasonable suitable noise criterion is established (ie – adopt EPA/Council guidelines).
- That all practicable measures be taken on the building site to regulate noise emissions, including the siting of noisy static processes on parts of the site where they can be shielded, selecting less noisy processes, and if required regulating construction hours.
- The undertaking of noise monitoring where non-compliance occurs to assist in the management and control of noise emission from the building site.

7.1.2 Vibration

Vibration caused by construction should be limited to:

- For structural damage vibration, German Standard DIN 4150-3 *Structural Vibration: Effects of Vibration on Structures; and*
- For human exposure to vibration (amenity), the evaluation criteria presented in the British Standard BS 6472:1992 *Guide to Evaluate Human Exposure to Vibration in Buildings (1Hz to 80Hz)* for low probability of adverse comment

The criteria and the application of this standard are discussed in separate sections below.

7.1.2.1 Structure Borne Vibrations

German Standard DIN 4150-3 (1999-02) provides vibration velocity guideline levels for use in evaluating the effects of vibration on structures. The criteria presented in DIN 4150-3 (1999-02) are presented in Table 21.

It is noted that the peak velocity is the absolute value of the maximum of any of the three orthogonal component particle velocities as measured at the foundation, and the maximum levels measured in the x- and y-horizontal directions in the plane of the floor of the uppermost storey.

Table 21 – DIN 4150-3 (1999-02) Safe Limits for Building Vibration

	TYPE OF STRUCTURE	PEAK PARTICLE VELOCITY (mms^{-1})			
		At Foundation at a Frequency of			**Plane of Floor of Uppermost Storey**
		< 10Hz	**10Hz to 50Hz**	**50Hz to 100Hz**	**All Frequencies**
1	Buildings used in commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40
2	Dwellings and buildings of similar design and/or use	5	5 to 15	15 to 20	15
3	Structures that because of their particular sensitivity to vibration, do not correspond to those listed in Lines 1 or 2 and have intrinsic value (e.g. buildings that are under a preservation order)	3	3 to 8	8 to 10	8

7.1.1 Assessing Amenity

Department of Environment and Conservation NSW "Assessing Vibration: A Technical Guideline" (Feb 2006) is based on the guidelines contained in BS 6472:1992. This guideline provides procedures for assessing tactile vibration and regenerated noise within potentially affected buildings.

The recommendations of this guideline should be adopted to assess and regulate vibration within the construction site.

Table 22 - DECC Recommended Vibration Criteria

		RMS acceleration (m/s^2)		**RMS velocity (mm/s)**		**Peak velocity (mm/s)**	
Place	Time	Preferred	Maximum	Preferred	Maximum	Preferred	Maximum
Continuous Vibration							
Residences	Daytime	0.01	0.02	0.2	0.4	0.28	0.56
Impulsive Vibration							
Residences	Daytime	0.3	0.6	6.0	12.0	8.6	17.0

Note 1: Continuous vibration relates to vibration that continues uninterrupted for a defined period (usually throughout the daytime or night-time), e.g. continuous construction or maintenance activity. (EPA, 2006)

Note 2: impulsive vibration relate to vibration that builds up rapidly to a peak followed by a damped decay and that may or may not involve several cycles of vibration (depending on frequency and damping), with up to three occurrences in an assessment period, e.g. occasional loading and unloading, or dropping of heavy equipment. (EPA, 2006)

7.2 CONTROL OF CONSTRUCTION NOISE AND VIBRATION

The execution of this work will facilitate the formulation of noise control strategies for this project.

The flow chart presented in Figure 2 illustrates the process that will be followed in assessing construction activities.

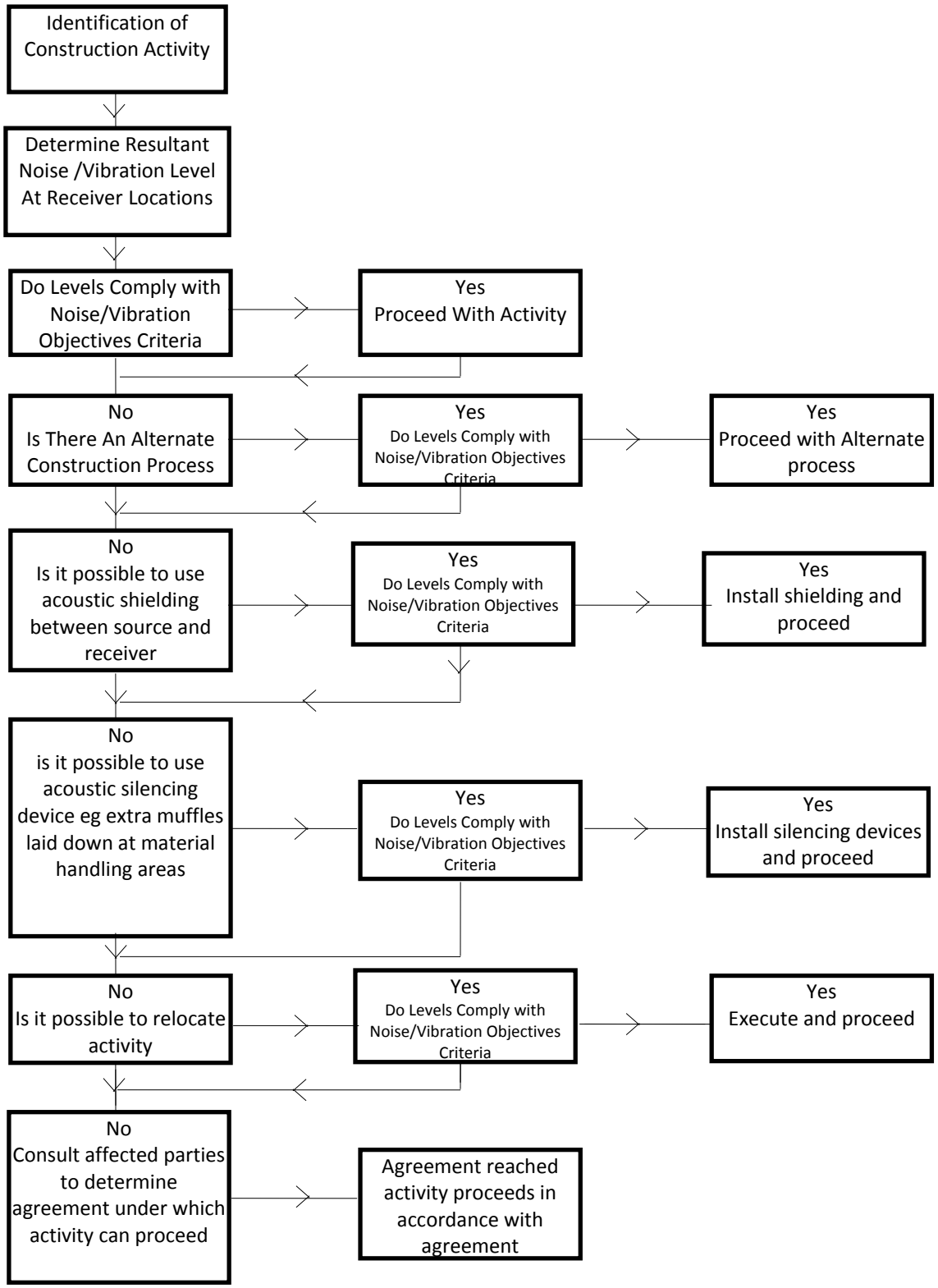


Figure 2 – Process Flowchart

7.3 NOISE AND VIBRATION CONTROL METHODS

The determination of appropriate noise control measures will be dependent on the particular activities and construction appliances. This section provides an outline of available methods.

7.3.1 Selection of Alternate Appliance or Process

Where a particular activity or construction appliance is found to generate excessive noise levels, it may be possible to select an alternative approach or appliance. For example; the use of a hydraulic hammer on certain areas of the site may potentially generate high levels of noise. By carrying this activity by use of pneumatic hammers, bulldozers ripping and/or milling machines lower levels of noise will result.

7.3.2 Acoustic Barrier

Barriers or screens can be an effective means of reducing noise. Barriers can be located either at the source or receiver.

The placement of barriers at the source is generally only effective for static plant (tower cranes). Equipment which is on the move or working in rough or undulating terrain cannot be effectively attenuated by placing barriers at the source.

Barriers can also be placed between the source and the receiver.

The degree of noise reduction provided by barriers is dependent on the amount by which line of sight can be blocked by the barrier. If the receiver is totally shielded from the noise source reductions of up to 15dB(A) can be effected. Where only partial obstruction of line of sight occurs, noise reductions of 5 to 8dB(A) may be achieved. Where no line of sight is obstructed by the barrier, generally no noise reduction will occur.

As barriers are used to provide shielding and do not act as an enclosure, the material they are constructed from should have a noise reduction performance that is approximately 10dB(A) greater than the maximum reduction provided by the barrier. In this case the use of a material such as 10mm or 15mm thick plywood (radiata plywood) would be acceptable for the barriers.

7.3.3 Silencing Devices

Where construction process or appliances are noisy, the use of silencing devices may be possible. These may take the form of engine shrouding, or special industrial silencers fitted to exhausts.

7.3.4 Material Handling

The installation of rubber matting over material handling areas can reduce the sound of impacts due to material being dropped by up to 20dB(A).

7.3.5 Treatment of Specific Equipment

In certain cases it may be possible to specially treat a piece of equipment to dramatically reduce the sound levels emitted.

7.3.6 Establishment of Site Practices

This involves the formulation of work practices to reduce noise generation. It is recommended that all available and reasonable treatments and mitigation strategies presented in this report be adopted to minimise noise emissions from the excavation and construction activities on site.

7.3.7 Noise Monitoring

Noise monitoring can be undertaken to determine the effectiveness of measures which are been implemented. The results of monitoring can be used to devise further control measures.

7.3.8 Combination of methods

In some cases it may be necessary that two or more control measures be implemented to minimise noise.

7.4 NOISE AND VIBRATION ASSESSMENT

An assessment of the principal sources of noise emission has been undertaken to identify the activities that may produce noise and/or vibration impacts so that appropriate ameliorative measures can be formulated.

7.4.1 Excavation Phase

Once the surface layer of soil and existing man made materials is removed, the remainder of the excavation will be in rock. The excavated materials will be loaded onto trucks.

The loudest activity would be the excavation of rock. These alternative rock excavation methods have been investigated:

- Hydraulic hammering - Hydraulic hammering generates the highest noise and vibration levels but is generally the quickest method of rock extraction.
- Rock sawing and ripping - Rock sawing would produce lower noise levels and much lower vibration levels than hammering.
- Line drilling and using rock splitting - Line drilling is an untried technology in general excavation and can therefore not be adopted.

Excavation will be undertaken primarily by ripping. Noise levels produced by the excavation equipment may exceed the noise goals at adjacent premises when works are undertaken near the boundary of the site, even when quieter excavation methods such as ripping are used.

The site measurements will establish noise/vibration levels at sensitive receivers. If noise levels exceed the criteria then the possibility of reducing noise emission should be investigated and all practical methods should be employed to reduce noise to the target levels in order to preserve the amenity of the nearby residences.

7.5 CONSTRUCTION TIMETABLING, TIME AND DURATION RESTRICTIONS, RESPITE PERIODS AND FREQUENCY

Work on site will be restricted to the hours detailed within the conditions of consent. Where no hours are specified, construction hours are to be in compliance with the EPA.

7.6 COMMUNITY INTERACTION AND COMPLAINTS HANDLING

7.6.1 Establishment of Direct Communication with Affected Parties

In order for any construction noise management programme to work effectively, continuous communication is required between all parties, which may be potentially impacted upon, the builder and the regulatory authority. This establishes a dynamic response process which allows for the adjustment of control methods and criteria for the benefit of all parties.

The objective in undertaking a consultation processes is to:

- Inform and educate the groups about the project and the noise controls being implemented;
- Increase understanding of all acoustic issues related to the project and options available;
- Identify group concerns generated by the project, so that they can be addressed; and
- Ensure that concerned individuals or groups are aware of and have access to a Constructions Complaints Register which will be used to address any construction noise related problems should they arise.

An additional step in this process is to produce a newsletter informing nearby residents of upcoming activities that are likely to generate higher noise/vibration levels.

7.6.2 Dealing with Complaints

Should ongoing complaints of excessive noise or vibration criteria occur immediate measures shall be undertaken to investigate the complaint, the cause of the exceedances and identify the required changes to work practices. In the case of exceedances of the vibration limits all work potentially producing vibration shall cease until the exceedance is investigated.

The effectiveness of any changes shall be verified before continuing. Documentation and training of site staff shall occur to ensure the practices that produced the exceedances are not repeated.

If a noise complaint is received the complaint should be recorded on a Noise Complaint Form. The complaint form should list:

- The name and address of the complainant (if provided);
- The time and date the complaint was received;
- The nature of the complaint and the time and date the noise was heard;
- The name of the employee who received the complaint;
- Actions taken to investigate the complaint, and a summary of the results of the investigation;
- Required remedial action, if required;
- Validation of the remedial action; and
- Summary of feedback to the complainant.

A permanent register of complaints should be held.

All complaints received should be fully investigated and reported to management. The complainant should also be notified of the results and actions arising from the investigation.

The investigation of a complaint shall involve where applicable;

- noise measurements at the affected receiver;
- an investigation of the activities occurring at the time of the incident;
- inspection of the activity to determine whether any undue noise is being emitted by equipment; and
- Whether work practices were being carried out either within established guidelines or outside these guidelines.

Where an item of plant is found to be emitting excessive noise, the cause is to be rectified as soon as possible. Where work practices within established guidelines are found to result in excessive noise being generated then the guidelines should be modified so as to reduce noise emissions to acceptable levels. Where guidelines are not being followed, the additional training and counselling of employees should be carried out.

Measurement or other methods shall validate the results of any corrective actions arising from a complaint where applicable.

7.7 CONTINGENCY PLANS

Where non-compliances or noise complaints are raised the following methodology will be implemented.

1. Determine the offending plant/equipment/process
2. Locate the plant/equipment/process further away from the affected receiver(s) if possible.
3. Implement additional acoustic treatment in the form of localised barriers, silencers etc where practical.
4. Selecting alternative equipment/processes where practical

8 CONCLUSION

This report presents the results from the acoustic assessment of noise impacts associated with the proposed mixed use commercial and student accommodation residential building located at 80-88 Regent St Redfern.

Noise intrusion from traffic associated with surrounding roadways will comply with the Sydney City Council, SEPP 2007 and AS2107:2000 noise criteria provided the acoustic treatments detailed in Section 4 are adopted.

Assessments of rail induced vibration will comply with SEPP 2007 criteria without treatment.

External noise emission criteria have been determined in Section 6 of this report based on the requirements of NSW EPA and Sydney City Council. A detailed noise emission assessment shall be conducted during CC stage based on the proposed plant to comply with the criteria. Noise emissions from the outdoor area has been assessed and discussed in section 6.4.2.

An assessment of construction noise and vibration has been presented in section 7.

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

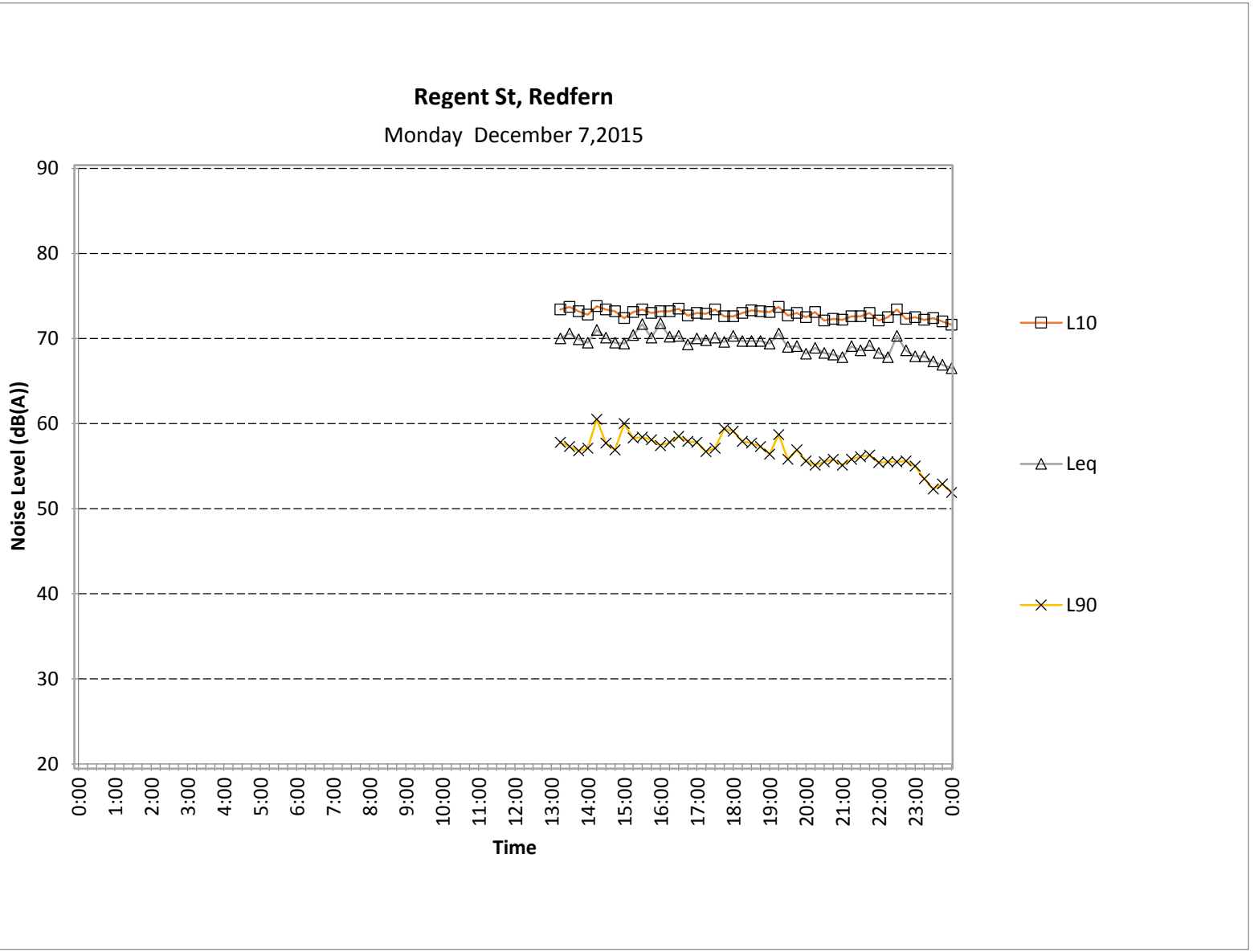
Yours faithfully,

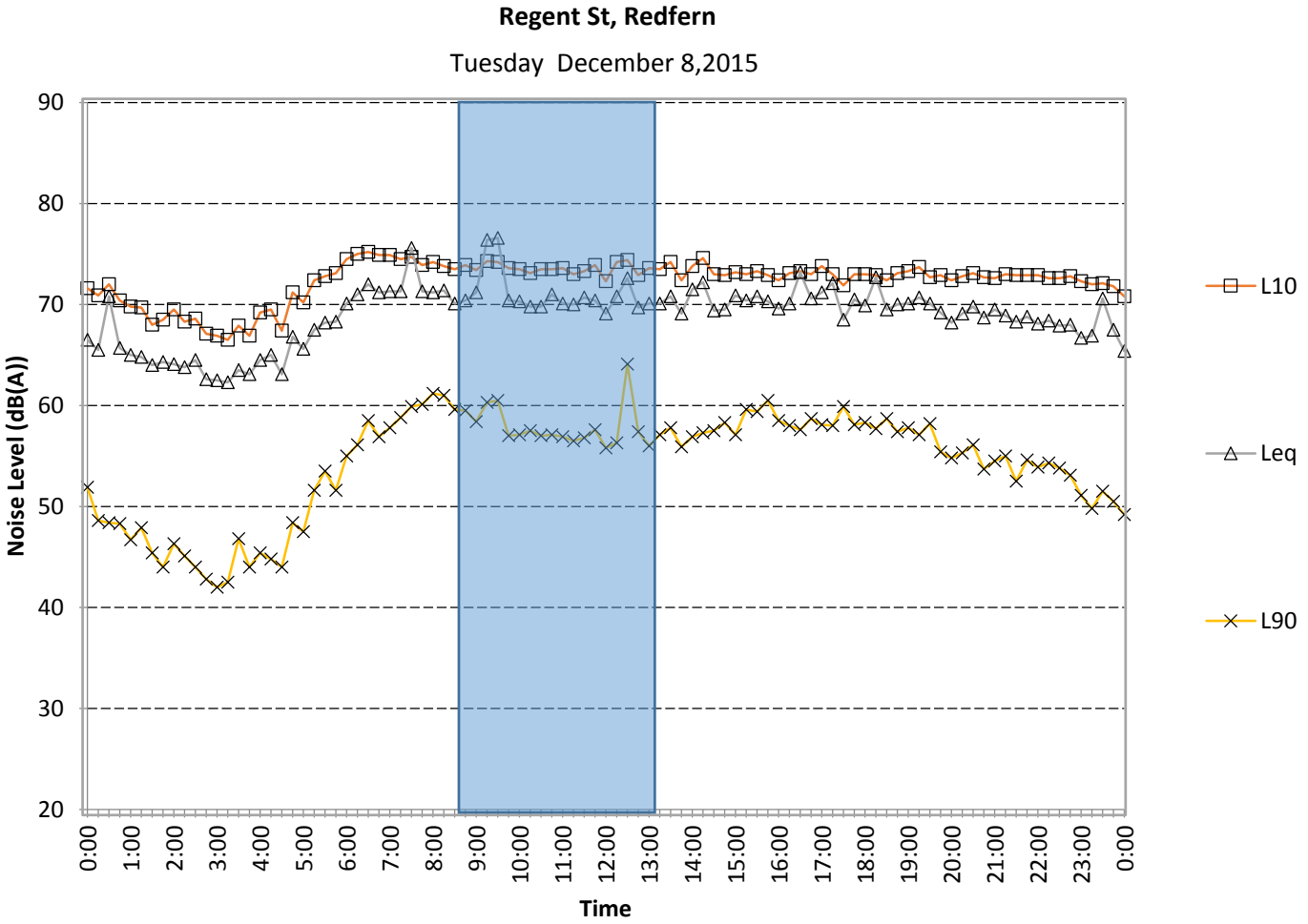
Acoustic Logic Consultancy Pty Ltd
Ben White

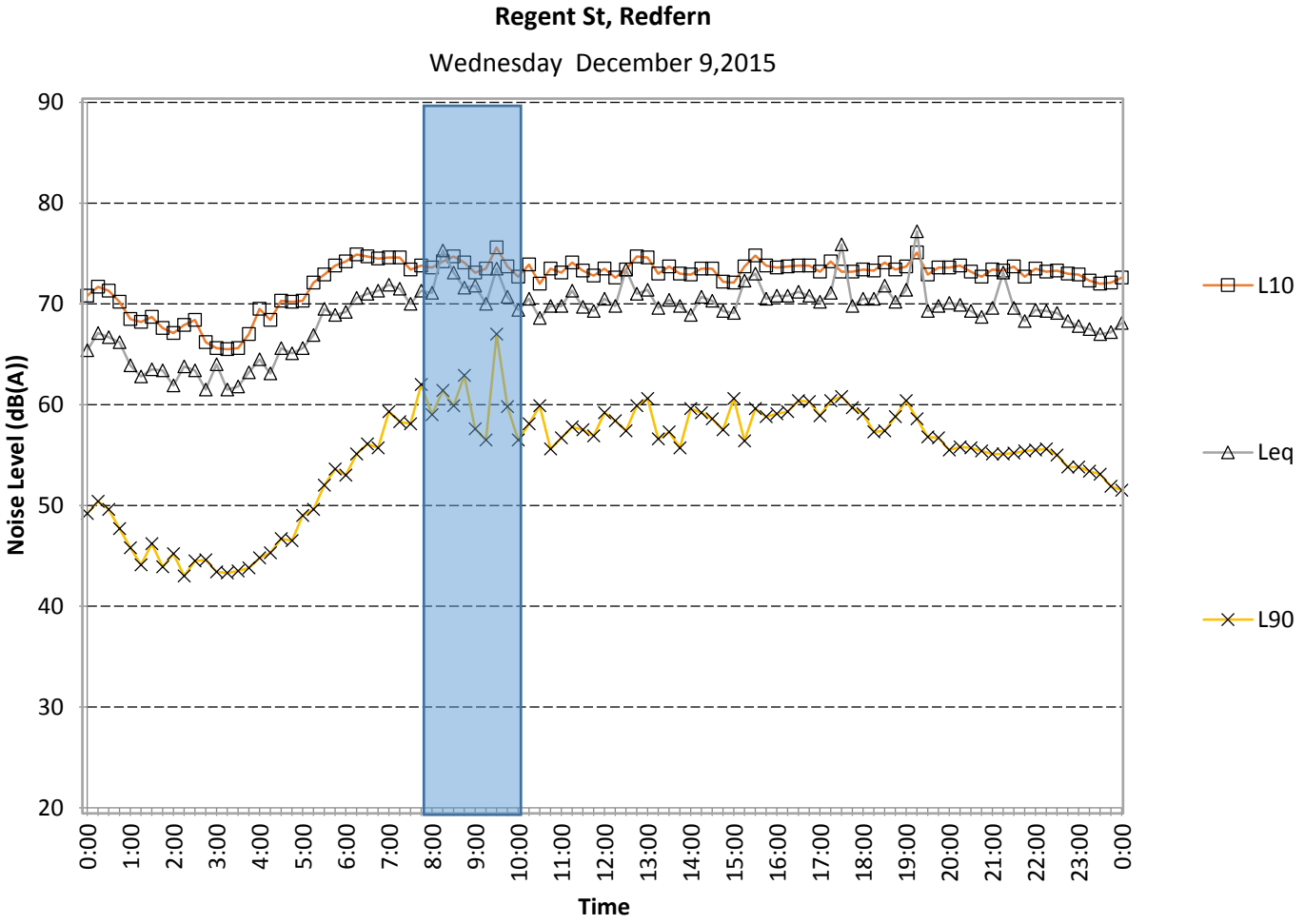
APPENDIX 1

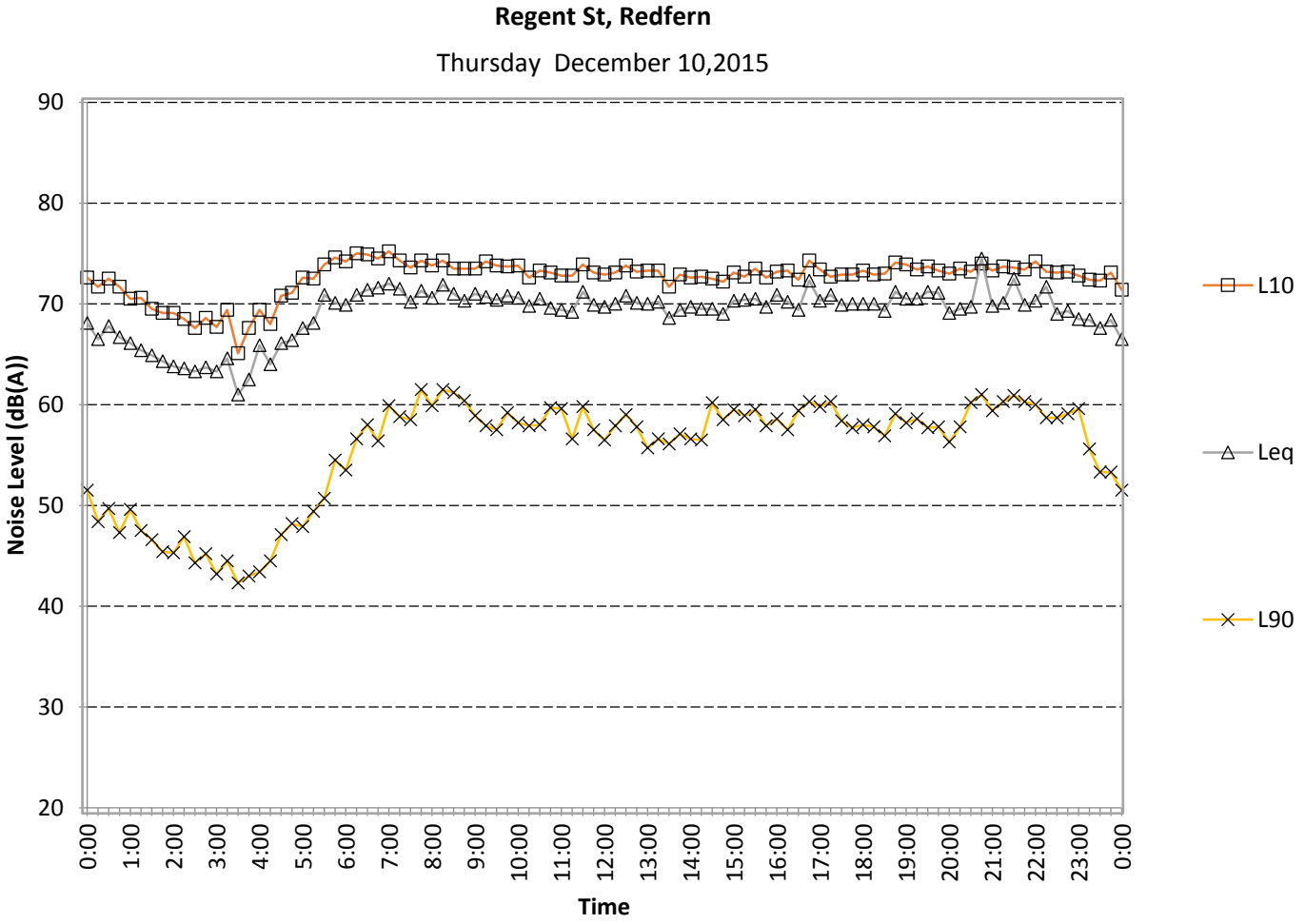
Unattended Noise Monitoring Data

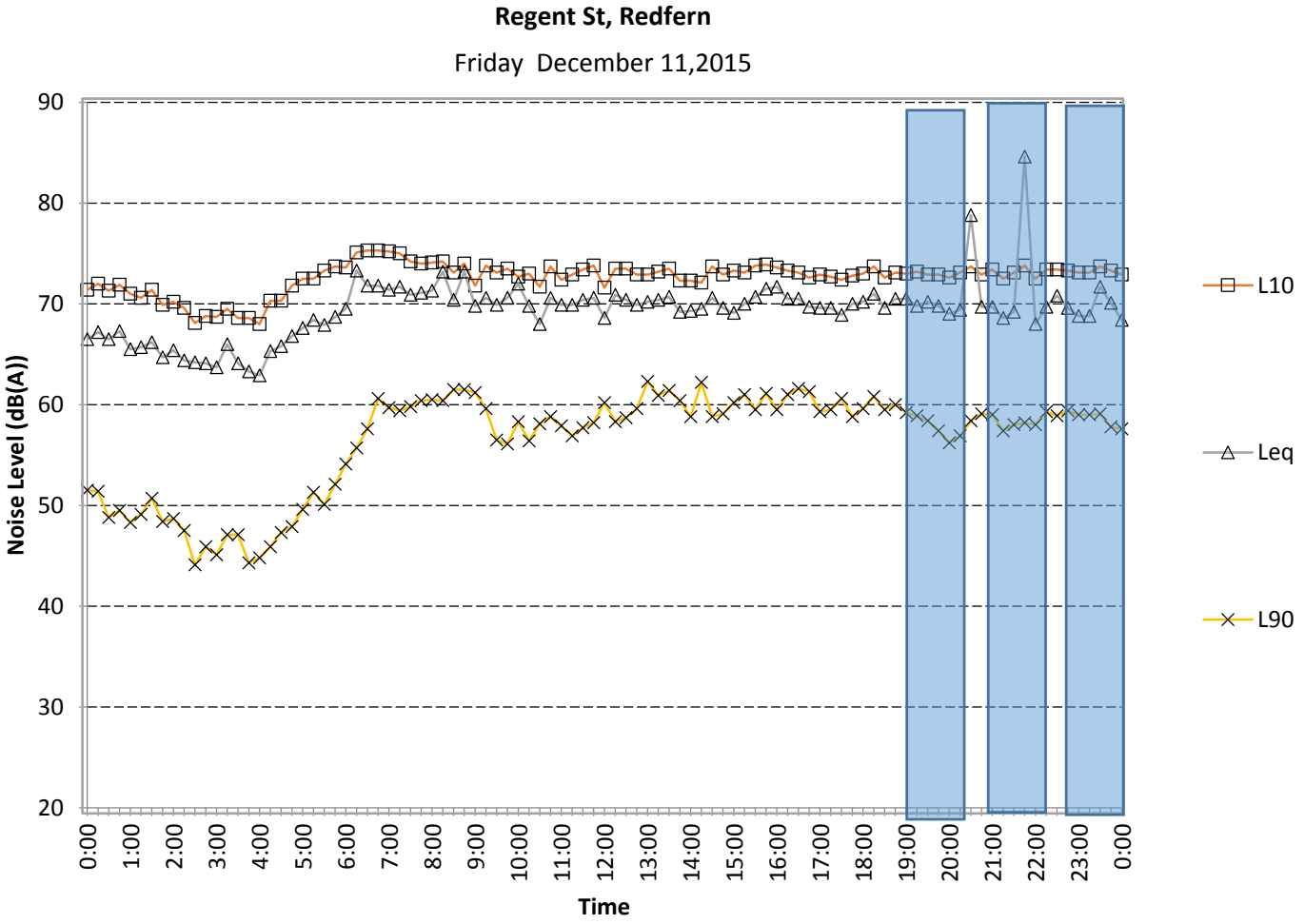
Periods of inclement weather conditions, note used in the report

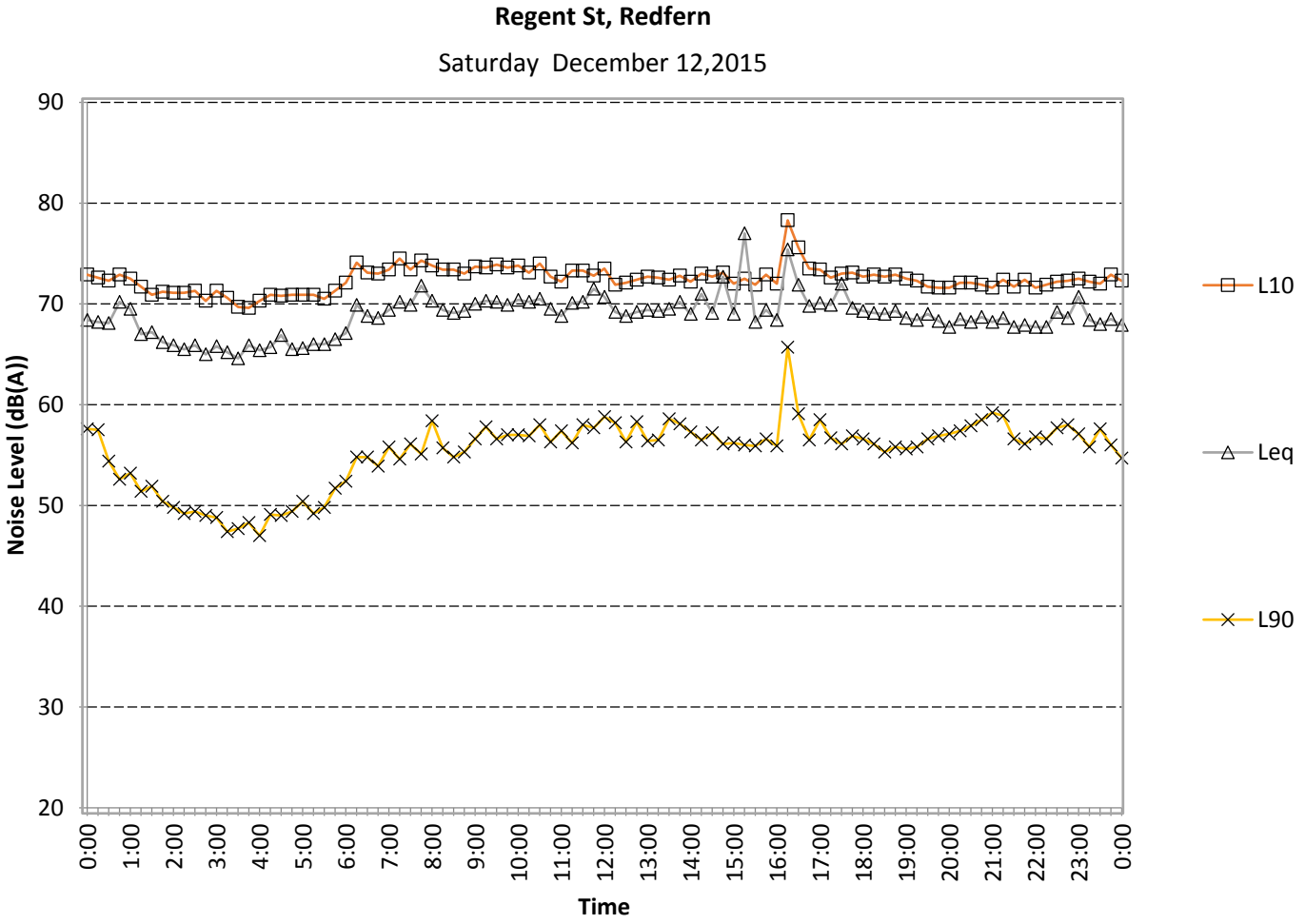

Regent St, Redfern
Monday December 7,2015
Noise Level (dB(A))
90
80
70
60
50
40
30
20
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
0:00
Time
L10
Leq
L90

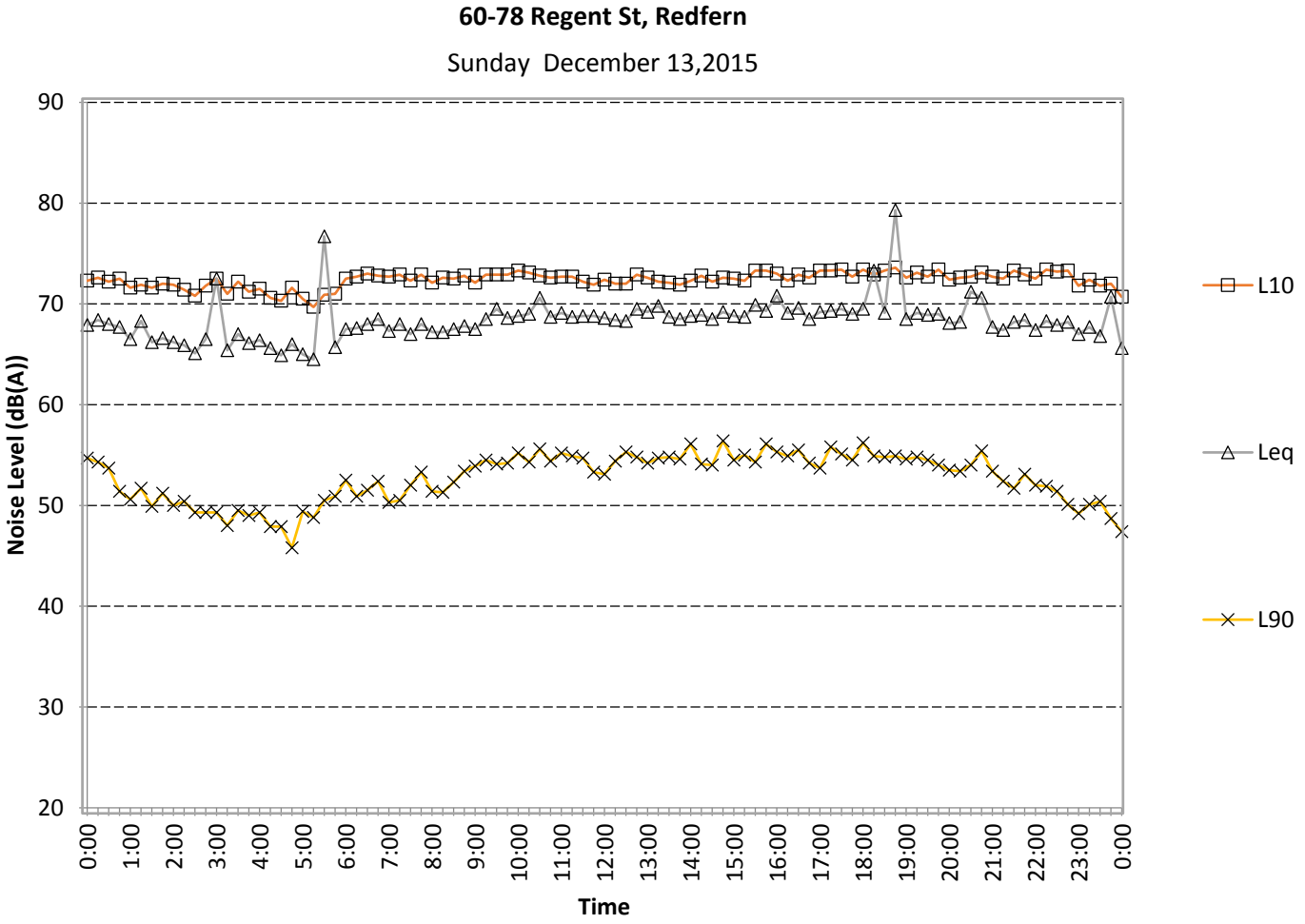

Regent St, Redfern
Tuesday December 8,2015
Noise Level (dB(A))
90
80
70
60
50
40
30
20
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
0:00
Time
L10
Leq
L90

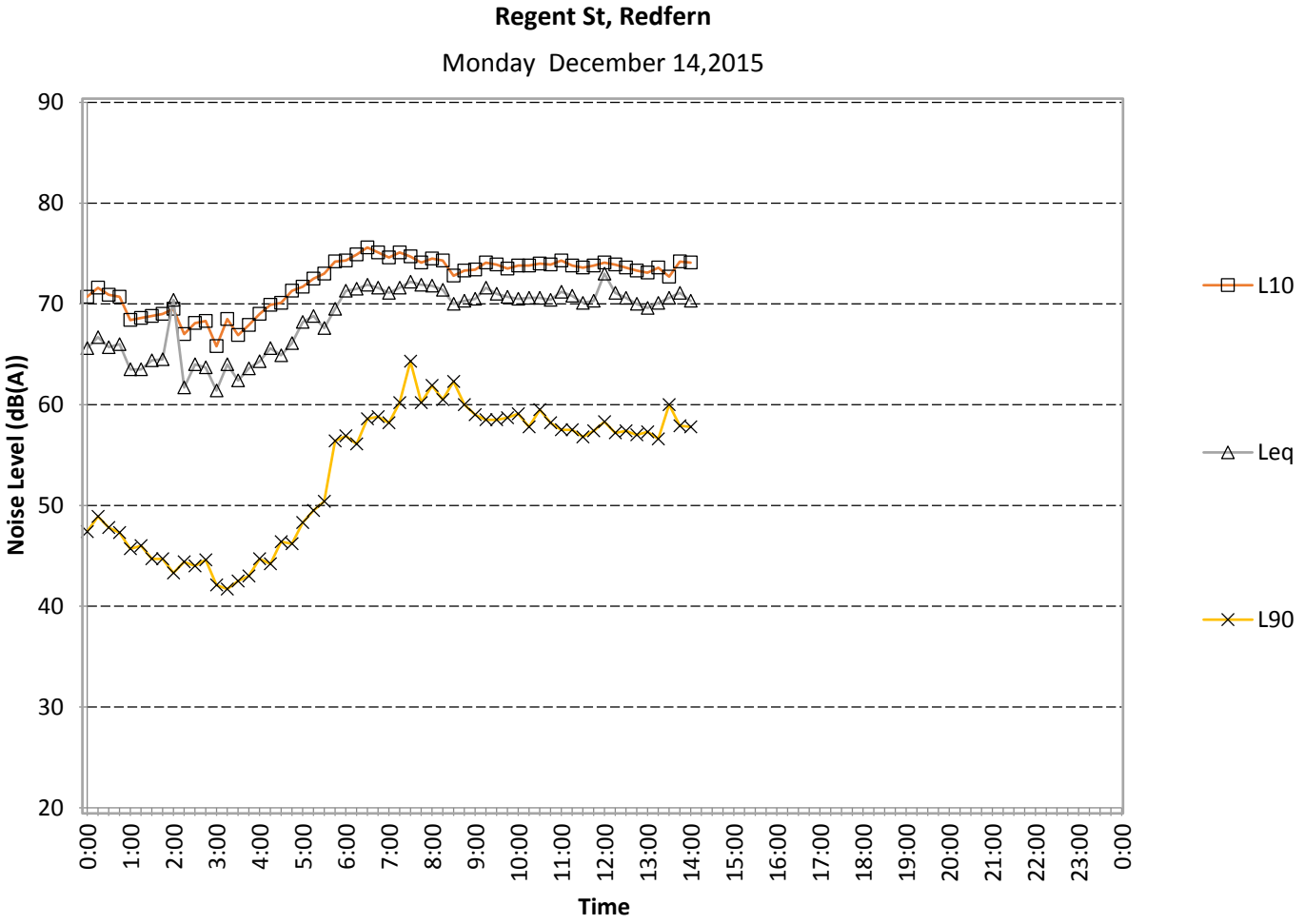

Regent St, Redfern
Wednesday December 9,2015
Noise Level (dB(A))
90
80
70
60
50
40
30
20
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
0:00
Time
L10
Leq
L90


Regent St, Redfern
Thursday December 10,2015
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
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
0:00
Time
L10
Leq
L90


Regent St, Redfern
Friday December 11,2015
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
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
0:00
Time
L10
Leq
L90


Regent St, Redfern
Saturday December 12,2015
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
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
0:00
Time
L10
Leq
L90


60-78 Regent St, Redfern
Sunday December 13,2015
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
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
0:00
Time
L10
Leq
L90


Regent St, Redfern
Monday December 14,2015
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
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
0:00
Time
L10
Leq
L90