Gibbons Place, 44-78 Rosehill Street, Redfern

Noise Impact Assessment

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1 INTRODUCTION

This report presents an analysis of the acoustic impacts associated with the proposed mixed use development at Gibbons Street, Redfern.

In this report we will:

- Conduct an external noise intrusion assessment and propose indicative acoustic treatments that will ensure a reasonable level of amenity is achieved for future tenants.
- Assess train vibration impacts from the existing T4 (Eastern Suburbs & Illawarra Line) railway tunnel to residential elements of the site to determine if vibration isolation treatment is required for the proposed development.
- Identify potential noise sources generated by the site, and determine noise emission goals for the development to meet Council acoustic requirements, ensuring that nearby developments are not adversely impacted by the subject development.

2 SITE DESCRIPTION

The proposed development consists of one 30 storey building and one 18 storey building. Both buildings are proposed to be mixed use with the following layouts:

- Four basement levels for car parking to service residential and retail / commercial uses
- Ground level communal open areas to be used for public thoroughfare and access
- Ground and first floor consisting of retail and commercial tenancies
- Remaining floors to consist of residential apartments. There are proposed to be a total of 312 apartments, with a mixture of 1, 2 & 3 bedroom layouts.

Refer to Figure 1 for site location. The site is bounded as follows;

- To the east by Rosehill Street, which is a single lane one way road with access from Gibbons Street. Further Rosehill Street is Gibbons Street, which is listed as a classified road (traffic volume greater than 40 000 vehicles / day) by NSW Planning.
- To the north by Margaret Street. Further this is a residential flat building located at 32 Rosehill Street, Redfern.
- To the west by Cornwallis Lane. Further this is a residential flat building located at 31-41 Cornwallis Street, and commercial premises located at 15A Cornwallis Street.
- Approximately 100m to the west of the site is a Sydney Trains on grade railway and Redfern Station. This rail corridor services the Central Coast and Newcastle Line, South Coast Line, T1 line (North Shore, Northern & Western Line), T2 line (Inner West and Leppington Line), T3 line (Bankstown Line), T7 line (Olympic Park Line) & T8 line (Airport & South Line).
- Below the site is the T4 (Eastern Suburbs & Illawarra Line) railway tunnel, which produces ground borne vibration impacts along Rosehill and Gibbon Streets. Detailed survey drawings may be needed to determine relative location of tunnel to project site.

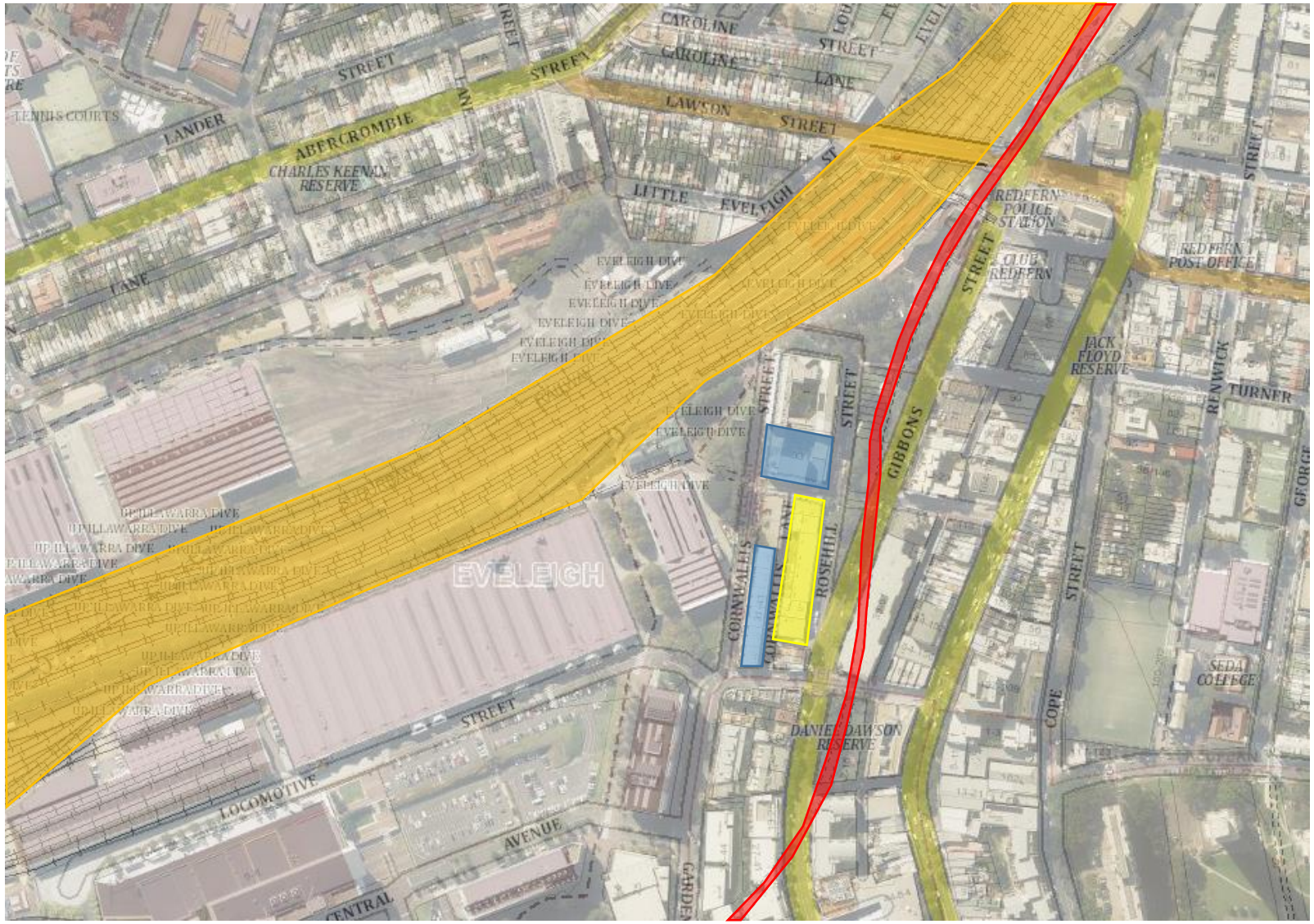


Figure 1 - Site Location & Context
Source: NSW Six Maps

Project Site

Adjacent Residential Receivers

Adjacent On Grade Rail Corridor

Adjacent Below Ground Rail Tunnel

Attended Vibration Measurements

Attended Noise Measurements

Unattended Noise Measurements

Figure 2 - Site Location & Measurement Positions
Source: NSW Six Maps

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 interval.

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 by 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.

Current practice favours the L_{eq} parameter as a means of measuring traffic noise, whereas the L_{10} parameter has been used in the past and is still incorporated in some codes. For the reasons outlined above, the L_{90} parameter is not used to assess traffic noise intrusion.

Structure borne noise is the sound generated from a vibrating source or impact event. The noise is transmitted when sound arises from the actual impact of an object on a building element such as wall, floor or foundation. Structure borne noise occurs because the impact causes the building element to vibrate, generating sound waves. Structure borne noise is transmitted through solid structures such as concrete columns & load bearing walls.

Noise descriptors used to categorise structure borne noise are as follows;

$L_{Amax,\ slow}$- A weighted maximum noise level during noise measurement period, with sound level meter set on slow response.

4 EXISTING ACOUSTIC ENVIRONMENT

4.1 BACKGROUND NOISE MONITORING

Noise emission objectives from the development will be determined with reference to existing background noise levels. Existing rating background noise levels have been determined based on long term noise monitoring conducted at a position representative of the nearest sensitive receivers, namely adjacent existing apartment buildings located at 32 Rosehill Street and 31 Cornwallis Street.

4.1.1 Measurement Position

The noise monitor was installed on the rooftop at the north-west boundary of the site. Monitor was located approximately 8m from ground level, and has a full view of nearby railway corridor. See Figures 1 and 2 for location.

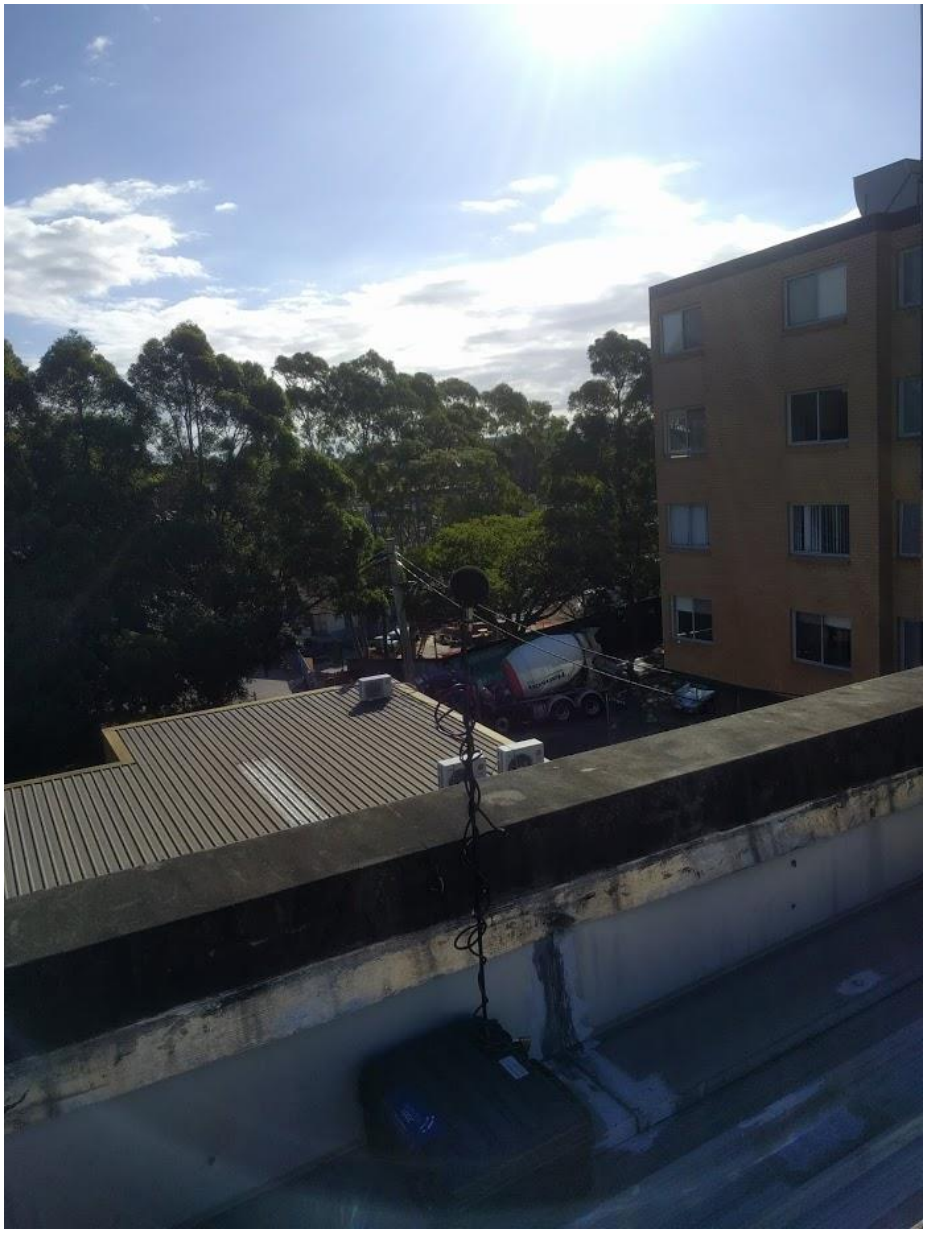


Figure 3 - Placement of Noise Logger on Rooftop of 44-78 Rosehill Street, Redfern

4.1.2 Time of Measurement

Monitoring has been conducted between 27th of April 2018 & 4th of May 2018.

4.1.3 Measurement Equipment

Equipment used consisted of an Acoustic Research Laboratories Pty Ltd noise logger. The logger was set to A-weighted fast response and was programmed to store 15-minute statistical noise levels throughout the monitoring period. The monitor was calibrated at the start and end of the monitoring period using a Rion NC-73 calibrator. No significant drift was noted. Noise logger data is provided in Appendix 1.

The measurement results are presented in Table 1 below.

Table 1 – Measured Rating Background Noise Levels

Location	Period	Rating Background Noise Level dB(A)L_{90}
Rooftop of Existing Building at 44-78 Rosehill Street, Redfern	Day (7am – 6pm)	53
	Evening (6pm – 10pm)	49
	Night (12am – 7am)	45

4.2 TRAFFIC/RAIL NOISE MEASUREMENTS

As part of this investigation, traffic and rail noise from the surrounding noise sources was measured. Measurement locations are further detailed in Figure 2, and are as follows;

- On eastern façade of project site, on Rosehill Street. Measurement was taken approximately 3m from kerb of Rosehill Street, and 12m from kerb of Gibbons Street. Measurements were taken of traffic noise impacting the site from adjacent roadways during peak hour traffic (7:30am – 9:30am)

- Marian Street, adjacent to Redfern railway station. Measurement of noise from adjacent railway corridor taken at boundary of rail corridor. Attended measurement taken at this location to determine noise levels from railway impacting on development.

- Cornwallis Street, at boundary of 4 Cornwallis Street, Redfern. Measurement of existing commercial / industrial noise emitted from site. Mechanical noise was noted as noise source from premises.

4.2.1 Attended Measurements

Measurements were taken using a Norsonic-140 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.

4.2.1.1 Attended Measurement Noise Levels

Table 2 - Measured Noise Levels

Location	Measurement Time	Noise Level
Eastern Façade (Rosehill Street at site boundary)	1st of May 2018 7:30am – 8:30am	69 dB(A) $L_{eq(1hr)}$
Marian Street (Boundary of Rail Corridor / Redfern Station)	27th of April 2018 2:00pm – 2:15pm	65 dB(A) $L_{eq(15mins)}$
4 Cornwallis Street (Existing Mechanical Noise)	27th of April 2018 2:30pm – 2:45pm	62 dB(A) $L_{eq\ (15mins)}$

4.2.2 Resultant Noise Levels

The following table presents the resultant noise levels at the development. The noise levels are based on both the attended and unattended noise measurement results.

Table 3 – Assessment Noise Levels

Locations	Traffic Noise Levels	
	Daytime (7am-10pm)	Night-time (10pm- 7am)
Eastern Façade (Rosehill Street at site boundary)	69 dB(A) $L_{eq(1\ Hour)}$ – Sydney City 68 dB(A) $L_{eq(24hr)}$ - SEPP	67 dB(A) $L_{eq(1\ Hour)}$ – Sydney City 65 dB(A) $L_{eq(9\ Hour)}$ – SEPP
Western Façade (Cornwallis Lane at site boundary (with full view of rail / adjacent traffic)	61 dB(A) $L_{eq(1\ Hour)}$ – Sydney City 59 dB(A) $L_{eq(24hr)}$ - SEPP	59 dB(A) $L_{eq(1\ Hour)}$ – Sydney City 52 dB(A) $L_{eq(9\ Hour)}$ – SEPP

4.2.3 Attended Measurement

Unattended noise monitor was enabled to measure noise spectrums. Average background noise spectrum for night time period (10pm – 7am) for the period of monitoring is as below. Measured spectrum is representative of nearest sensitive receiver, i.e. adjacent residential buildings.

Table 4 – Measured Background Spectrum

Time	31.5Hz	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	A-Weighted Level
Night	52	52	49	47	43	40	35	28	22	**45**

5 EXTERNAL NOISE INTRUSION ASSESSMENT

The predominant airborne noise source affecting the site is road traffic noise from Gibbons Street and to a lesser extent noise from railway corridor approximately 100m to the north-west.

5.1 NOISE INTRUSION CRITERIA

External noise impact into the proposed development will be assessed in with reference to the City of Sydney council DCP and the NSW Department of Planning document *Development Near Rail Corridors and Busy Roads – Interim Guideline (2008),* and AS2107 (for non-residential spaces).

5.1.1 Sydney Development Control Plan

Section 4.2 of the Sydney DCP 2012 relates to objectives and provisions for residential flat developments. Part 4.2.3.11 of this section of DCP 2012 outlines the following acoustic controls for new developments affected by traffic noise:

(7) The repeatable maximum $L_{Aeq(1hour)}$ for residential buildings and serviced apartments must not exceed the following levels:

(a) for closed windows and doors:

i) 35dB for bedrooms (10pm-7am); and

ii) 45dB for main living areas (24 hours).

(b) for open windows and doors:

i) 45dB for bedrooms (10pm-7am); and

ii) 55dB for main living areas (24 hours).

(8) Where natural ventilation of a room cannot be achieved, the repeatable maximum $L_{Aeq(1hour)}$ level in a dwelling when doors and windows are shut and air conditioning is operating must not exceed:

(a) 38dB for bedrooms (10pm-7am); and

(b) *48dB for main living areas (24 hours).*

5.1.2 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.

Map 16 of the traffic volume maps for the Infrastructure SEPP on the RTA website, classifies Gibbons Street, Redfern as a road with > 40,000 AADT. Although Rosehill Street is not a classified road, given the proximity of the site to Gibbons Street, and that many apartments will have direct line of sight to the classified roadway, an assessment of the development will be undertaken as per clause 102 of the State Environmental Planning Policy (SEPP Infrastructure) 2007.

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."

Additionally, the on-grade rain corridor located adjacent to the site is approximately 100m to the north-east of the closest point on the site. This falls outside of the recommended distance required to be assessed within the NSW Department of Planning document *Development Near Rail Corridors and Busy Roads – Interim Guideline*. Additionally, rail noise at the façade was not noted to be the primary contribution to the noise levels at this location. However, as many apartments on the western and northern facades will have direct line of sight to the train line, the criteria established by SEPP (Infrastructure) 2007 (detailed above) will be applied.

5.1.3 Australian Standard AS2107:2016

Project internal noise goals for the commercial/retail been set in accordance with Australian Standard AS2107:2016.

Table 5 – Internal Noise Objectives for Receivers on the site – AS2107:2016

Noise Receiver	Internal Noise Goals dB(A) $L_{eq\ (period)}$*	
	Day (7am – 10pm)	Night (10pm – 7am)
Commercial / Retail Spaces (When in Use)	50 dB(A) $L_{eq\ (15hour)}$	-
Residential Apartment	Living Room 35-45 dB(A) $L_{eq\ (15hour)}$	Sleeping Areas 35-40 dB(A) $L_{eq\ (9hour)}$

5.1.4 Summarised Internal Noise Criteria for Proposed Site

The summarised criteria for all spaces of the development is summarised below. Internal requirements are for are measured internally.

Table 6 – Summarised Criteria for Internal Noise Levels of Development

Space / Location	Time of Day	Criteria		
		City of Sydney Council DCP 2012	SEPP (Infrastructure) 2007	AS2107:2016
Residential (Living Areas)	Day (7am – 10pm)	Doors/ Windows Closed - 45 dB(A) $L_{eq(1hr)}$ Doors/ Windows Open 55 dB(A) $L_{eq(1hr)}$	Doors/ Windows Closed -40 dB(A) $L_{eq(15hr)}$	-
Residential (Bedrooms)	Night (10pm – 7am)	Doors/ Windows Closed - 35 dB(A) $L_{eq(1hr)}$ Doors/ Windows Open 45 dB(A) $L_{eq(1hr)}$	Doors/ Windows Closed -35 dB(A) $L_{eq(9\ hr)}$	-
Commercial / Retail	When in Use	-	-	50 dB(A) L_{eq}

5.2 INDICATIVE RECOMMENDED CONSTRUCTIONS

At this stage only preliminary layouts and dimensioning has been completed for the proposed development. Approximate dimensions of setbacks from roadways, window openings and floor areas have been used. As such, the recommendations contained within this section are indicative, and should only be used a basis for future design decisions of the building.

A full assessment of all treatments recommended within this report should be conducted after building designs have been finalised to ensure that the criteria determined in Section 5.1 is met.

5.2.1 Glazed Windows and Doors

The following constructions are recommended to comply with the project noise objectives. Aluminium framed/sliding glass doors and windows will be satisfactory provided they meet the following criteria. All external windows and doors listed are required to be fitted with Q-lon type acoustic seals. (**Mohair Seals are unacceptable**).

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 detailed in Table 8 overpage.

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 listed are required to be fitted with Q-lon type acoustic seals. **Note that mohair of fin 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 7 - Minimum STC or R_w of Glazing (with Acoustic Seals)

Glazing Assembly	Minimum R_W of Installed Window (with acoustic seals)
10.38mm Laminated / 90mm air gap / 5mm Float	45
12.5mm VLam Hush	40
10.38mm Laminated	35
6.38mm Laminated	31

Table 8 – Recommended Glazing Constructions

Façade	Area	Room Type	Recommended Construction
Eastern	Residential All Levels	Living Area	10.38 mm Laminated
	Residential Levels 2 – 20	Master Bedrooms (2 Glazed Walls)	10.38mm Laminated / 90mm air gap / 5mm Float
		Other Bedrooms (Single Glazed Wall)	12.5mm VLam Hush
	Residential Levels 20 and Above	Master Bedrooms (2 Glazed Walls)	12.5mm VLam Hush
		Other Bedrooms (Single Glazed Wall)	10.38mm Laminated
Southern	Residential All Levels	Living Area	10.38mm Laminated
		Master Bedrooms (2 Glazed Walls)	12.5mm VLam Hush
		Other Bedrooms (Single Glazed Wall)	10.38mm Laminated
Northern	Residential All Levels	Living Area	6.38mm Laminated
		Master Bedrooms (2 Glazed Walls)	10.38mm Laminated
		Other Bedrooms (Single Glazed Wall)	6.38mm Laminated
Western	Residential All Levels	Living Area	6.38mm Laminated
		Master Bedrooms (2 Glazed Walls)	10.38mm Laminated
		Other Bedrooms (Single Glazed Wall)	6.38mm Laminated
All	Commercial & Retail (Ground and First)	Retail / Commercial	6.38mm Laminated

5.2.2 Roof / Ceiling

The proposed concrete roof structure with ceiling below will be acoustically acceptable without additional acoustic treatments.

5.2.3 External Walls

The proposed masonry external wall constructions will be acoustically acceptable without additional acoustic treatments. If masonry walls are not used, then external wall systems with equivalent acoustic ratings will be required.

5.2.4 Ventilation and Air Conditioning

With respect to natural ventilation of a dwelling, City of Sydney Council allows noise levels to be up to 10 dB(A) Leq(1hr) higher with windows and doors to a dwelling open. The noise levels inside habitable rooms of a residential dwelling with doors or windows to the façade open are;

- Allowable level in bedrooms becomes 45dB(A) $L_{eq(1hr);}$
- Allowable noise level in living areas becomes 55dB(A) $L_{eq(1hr)}$

Based on the above, the following table details requirements for open windows / doors to dwellings.

Table 9 – Areas Where Internal Noise Levels May be Achieved With Windows or Doors Open

Façade	Room Type	Windows / Door Open
Eastern	Living	No
	Bedroom	No
Southern	Living	No
	Bedroom	No
Northern	Living	Yes
	Bedroom	No
Western	Living	Yes
	Bedroom	No

Where the recommended internal noise levels cannot be achieved with windows open within the development, consultation on the requirements of alternative outside air supply or air conditioning will be required.

Any supplementary ventilation system proposed to be installed should be acoustically designed to ensure that the acoustic performance of the acoustic treatments outlined above is not reduced and does not exceed Council criteria for noise emission to nearby properties.

6 RAIL INDUCED VIBRATION

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

6.1 ASSESSMENT CRITERIA

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

6.1.1 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 10 - Internal Railway Noise Level Criteria for Ground Borne Noise

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

6.1.2 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 11 - 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

6.2 VIBRATION MEASUREMENTS

Rail vibration measurements were conducted externally on the ground floor of the site and on the first floor of existing offices. Measurements were taken at what appeared to be the closest location of the site to the existing train tunnel, and also further set back along the existing building.

Attended train vibration measurements were conducted on 1st of May 2018 from 7.00am to 9.30am. A Svan 958 AE Vibration Analyser was used for the vibration measurements. The analyser was fitted with a Dytran triaxial accelerometer.

6.2.1 Tactile Vibration

The measured vibration levels, duration of train pass-by 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 12 - Vibration Dose Values

Time Period	Calculated VDV $m/s^{1.75}$	Criteria VDV $m/s^{1.75}$	Complies
Day (7am – 10pm)	0.05	0.2 to 0.4	Yes
Night (10pm -7am)	0.04	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.

6.2.2 Structure Borne Noise measurements

Internal noise levels within residential units as a result of structure borne noise have been calculated for a number of train pass-bys. Noise levels have been determined based on on-site measurements of rail induced vibration. Refer to Figure 4 for measurement locations.

Table 13 – Predicted Structure Borne Vibration Levels

Location	Time of Day	Predicted Internal Ground Borne Noise dB(A)$L_{max(Slow)}$	Criteria dB(A)$L_{max(Slow)}$	Complies
Level 2 Apartments South-Eastern Corner (Location One)	Day (7am-10pm)	42	40	No
	Night (10pm-7am)	42	35	No
Level 2 Apartments South-Western Corner (Location Two)	Day (7am-10pm)	36	40	Yes
	Night (10pm-7am)	36	35	No
Level 2 Apartments Eastern Façade, Centre of Site (Location Three)	Day (7am-10pm)	33	40	Yes
	Night (10pm-7am)	33	35	Yes

The results above indicate that vibration isolation treatment is required in order to reduce structure borne noise impacts on all residential areas of the building.

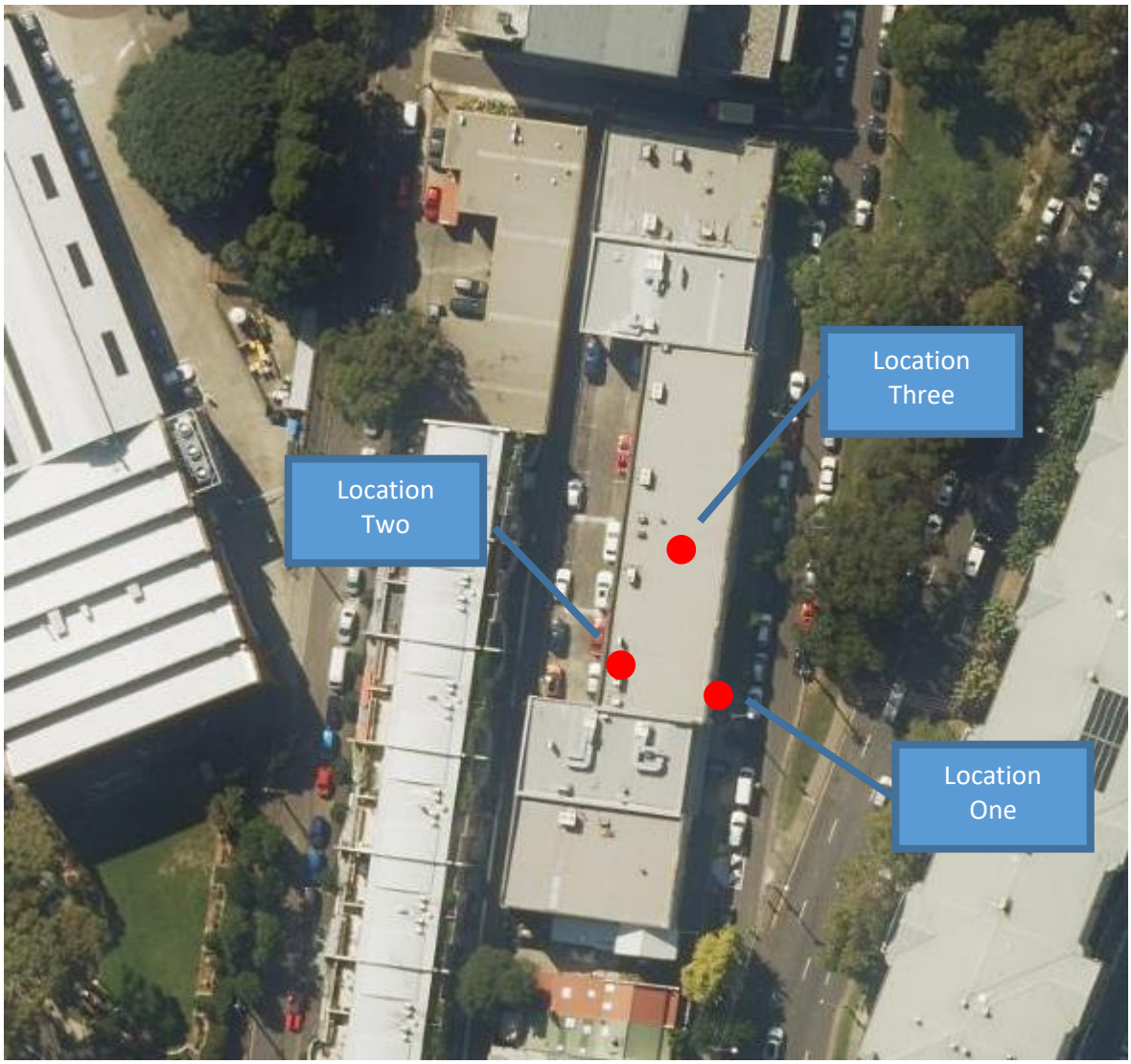


Figure 4 - Structure Borne Noise Measurement Locations

6.3 RECOMMENDATIONS TO MITIGATE NOISE FROM RAIL TUNNEL VIBRATION

Although tactile vibration is compliant with acoustic criteria, the structure borne noise from train pass-bys in the tunnel below is expected to exceed 35dB(A)L_{max} when measured within residential apartments of the development.

It is recommended that a detailed survey of the location of the rail tunnel relative to the proposed site is conducted to accurately site the tunnel at CC stage. Building will need vibration isolation to reduce structure borne noise impacts to acceptable levels.

Indicative vibration isolation treatment is to consist of:

- Vibration isolation of structural columns / supports for all below ground works. Isolation details typically consist of Embelton elastomeric building bearings. Detailed isolation structure will be determined at CC stage.

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.

The primary potential noise sources from the site will be noise generated by mechanical plant and from use of activity/lounge areas.

The nearest potentially affected noise receivers are to the north, south and east of the site (either directly adjacent to the site or on the opposite side of Marian Street/William Lane).

Noise emissions noise will be assessed to the following criteria:

- City of Sydney Standard Conditions (for typical operational noise).
- The NSW EPA Noise Policy for Industry (for mechanical plant).

7.1 EXTERNAL BACKGROUND NOISE MEASUREMENTS

Background noise levels at the site have been measured based on the unattended noise logging undertaken by this office. Measured background noise levels are presented below. Refer to Appendix 1 for unattended noise monitoring data.

Table 14 - Measured Background Noise Levels

Location	Background noise level dB(A)L_{90}		
	Daytime (7am-6pm)	**Evening (6pm-10pm)**	**Night (10pm-7 am)**
Rooftop of 44-78 Rosehill Street, Redfern (representative of adjacent apartment buildings)	53	49	45

Unattended noise monitor was enabled to measure noise spectrums. Average background noise spectrum for night time period (10pm – 7am) for the period of monitoring is as below. Measured spectrum is representative of nearest sensitive receiver, i.e. adjacent residential buildings.

Table 15 – Measured Background Spectrum

Time	31.5Hz	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	A-Weighted Level
Night	52	52	49	47	43	40	35	28	22	**45**

7.2 NOISE EMISSION OBJECTIVES

7.2.1 Mechanical Plant Noise (EPA Noise Policy for Industry)

The EPA NPfI has two criteria which both are required to be satisfied, namely Intrusiveness and amenity. The NPfI sets out acceptable noise levels for various localities. The policy indicates four categories to assess the appropriate noise level at a site. They are rural, suburban, urban and urban/industrial interface. Under the policy the nearest residential receivers would be assessed against the urban/industrial criteria.

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

7.2.1.1 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.

Background noise levels adopted are presented in Section 7.1. Noise emissions from the site should comply with the noise levels presented below when measured at nearby property boundary.

7.2.1.2 Project 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 NPfI sets out acceptable noise levels for various localities. The recommended noise amenity area is based upon the measured background noise levels at the sensitive receiver. Based on the measured background noise levels detailed in Section 7.1, the Noise Policy for Industry suggests the adoption of the 'urban' categorisation.

The NPI requires project amenity noise levels to be calculated in the following manner;

$$L_{Aeq,15min} = \textit{Recommended Amenity Noise Level} - 5\ dB(A) + 3\ dB(A)$$

The amenity levels appropriate for the receivers surrounding the project site are presented in Table 16

Table 16 – EPA NPfI Specific Amenity Noise Levels

Type of Receiver	Time of day	Recommended Noise Level dB(A)$L_{eq(period)}$	Project Amenity Noise Level dB(A)$L_{eq(15min)}$
Residential – Urban	Day	60	58
	Evening	50	48
	Night	45	43
Commercial premises	When in use	65	63
Industrial premises	When in use	70	68

The NSW EPA Noise Policy for Industry (2017) defines;

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

7.2.1.3 Sleep Arousal Criteria

The Noise Policy for Industry recommends the following noise limits to mitigate sleeping disturbance:

> *Where the subject development / premises night -time noise levels at a residential location exceed:*
>
> - *$L_{Aeq,15min}$ 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 even assessment should be undertaken.*

Table 17 - Sleep Arousal Criteria for Residential Receivers

Receiver	Rating Background Noise Level (Night) dB(A)L_{90}	Emergence Level
Adjacent Residential Receivers Night (10pm – 7am)	45	50 dB(A)$L_{eq,\ 15min}$; 60 dB(A)L_{AFmax}

In addition, NSW EPA Road Noise Policy states:

- *maximum internal noise levels below 50–55 dB(A) are unlikely to awaken people from sleep*
- *One to two noise events per night with maximum internal noise levels of 65-70dB(A) are not likely to affect health and wellbeing significantly*

7.2.1.4 Summarised Noise Policy for Industry Criteria

Table 18 – EPA NPI Noise Emission Criteria (Residential)

Time Period	Assessment Background Noise Level dB(A)L_{90}	Project Amenity Criteria dB(A) L_{eq}	Intrusiveness Criteria $L_{eq(15min)}$	NPI Criteria for Sleep Disturbance
Day	53	58	57	N/A
Evening	49	48	54	N/A
Night	45	43	50	50 dB(A)$L_{eq,\ 15min}$; 60 dB(A)L_{AFmax}

Table 19 – EPA NPI Noise Emission Criteria (Non-Residential)

Receiver	Time of Day	Amenity Criteria dB(A) $L_{eq,\ 15min}$
Commercial	When in use	63
Industrial	When in use	68

7.2.2 Noise Generally (City of Sydney "Background + 3dB" requirement) to Habitable Space of the Nearest Noise Receiver

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

- Noise emissions (plant noise), comply with the noise emission requirements of the EPA Industrial Noise Policy.
- Noise emissions (noise generally other than plant noise) not exceed background noise levels by more than 3dB when measured within habitable space of the nearest noise receiver in octave bands between 31.5Hz and 8,000Hz.

Based on the measured background noise levels and spectrums set out in Section 7.1, the corresponding noise emission goals are as follows:

Table 20 – Noise Emission Goals to Habitable Space of the Nearest Noise Receivers

Time of Day	Criteria	31Hz	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	A-Wt.
Day (7am-6pm)	53BG+3	63	63	60	58	54	51	46	39	33	**56**
Evening (6pm-10pm)	49BG+3	59	59	56	54	50	47	42	35	29	**52**
Night (10pm-7am)	45BG+3	55	55	52	50	46	43	38	31	25	**48**

7.3 NOISE EMISSION ASSESSMENT

7.3.1 Noise Emissions from External Mechanical Plant

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

Detailed review of all external mechanical plant (such as condenser units, fans, chillers etc) 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.

7.3.2 Noise from Commercial / Retail Spaces

Noise generated by future retail and commercial uses of the site must be in compliance with the criteria detailed in Section 7.2.2. Future tenancies and uses of these spaces is not currently known, however it is expected that each commercial / retail tenancy would be subject to an individual assessment at DA stage.

8 CONCLUSION

This report presents the results from the acoustic assessment of noise impacts associated with the proposed mixed use development at Gibbons Street, Redfern.

Noise intrusion of traffic & rail from adjacent roadways and rail corridors will be able to comply with the Sydney City Council, SEPP 2007 and AS2107:2016 noise criteria. Required façade treatments should be reviewed during construction certification phase (once apartment layouts and glazing sizes have been finalised) to ensure that internal noise levels are compliant.

Assessment of rail induced vibration indicates that vibration isolation treatment of the building is required, as detailed in Section 6.

External noise emission criteria have been determined in Section 7 of this report based on the requirements of NSW EPA and Sydney City Council. Detailed plant noise control will be determined at CC stage

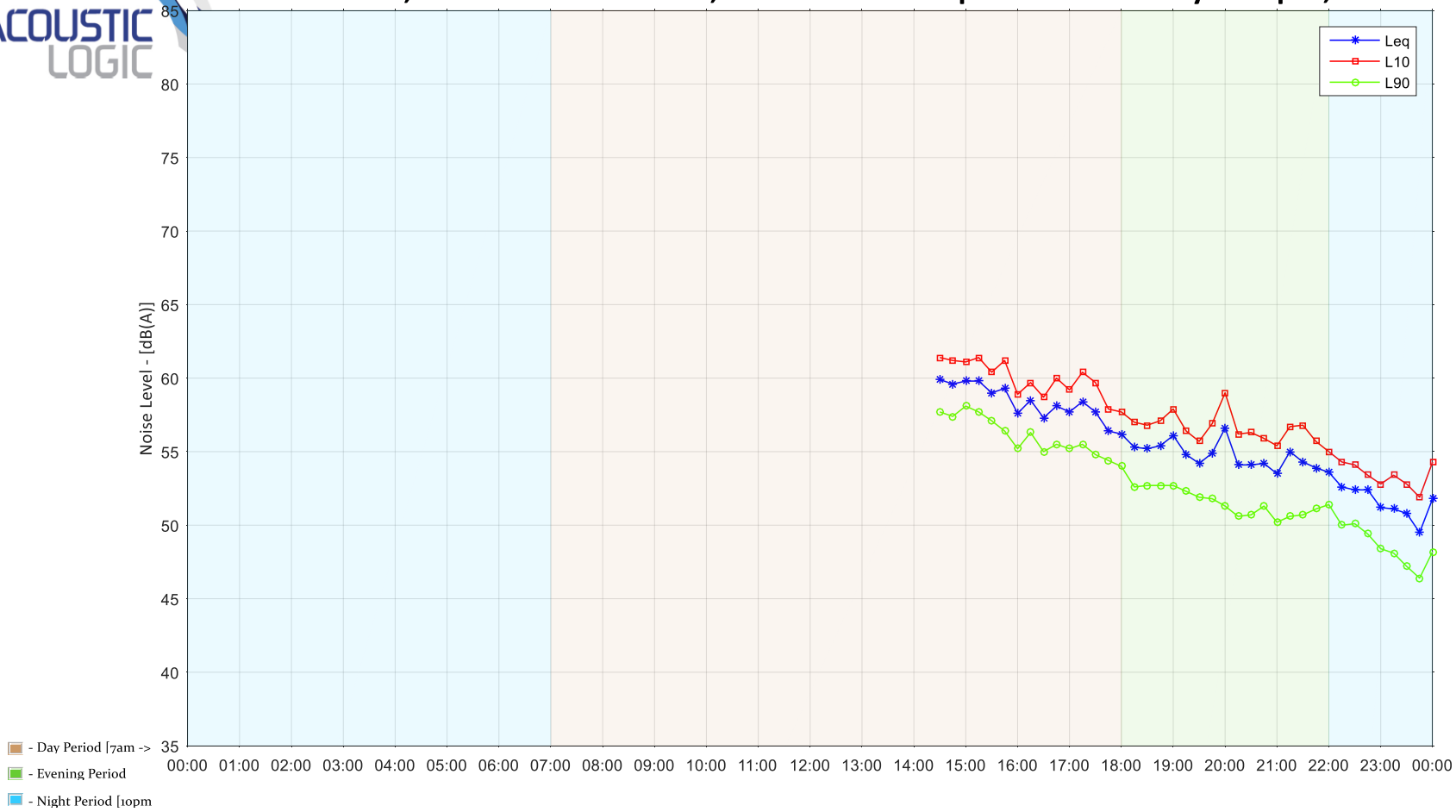
Please contact us should you have any further queries.

Yours faithfully,

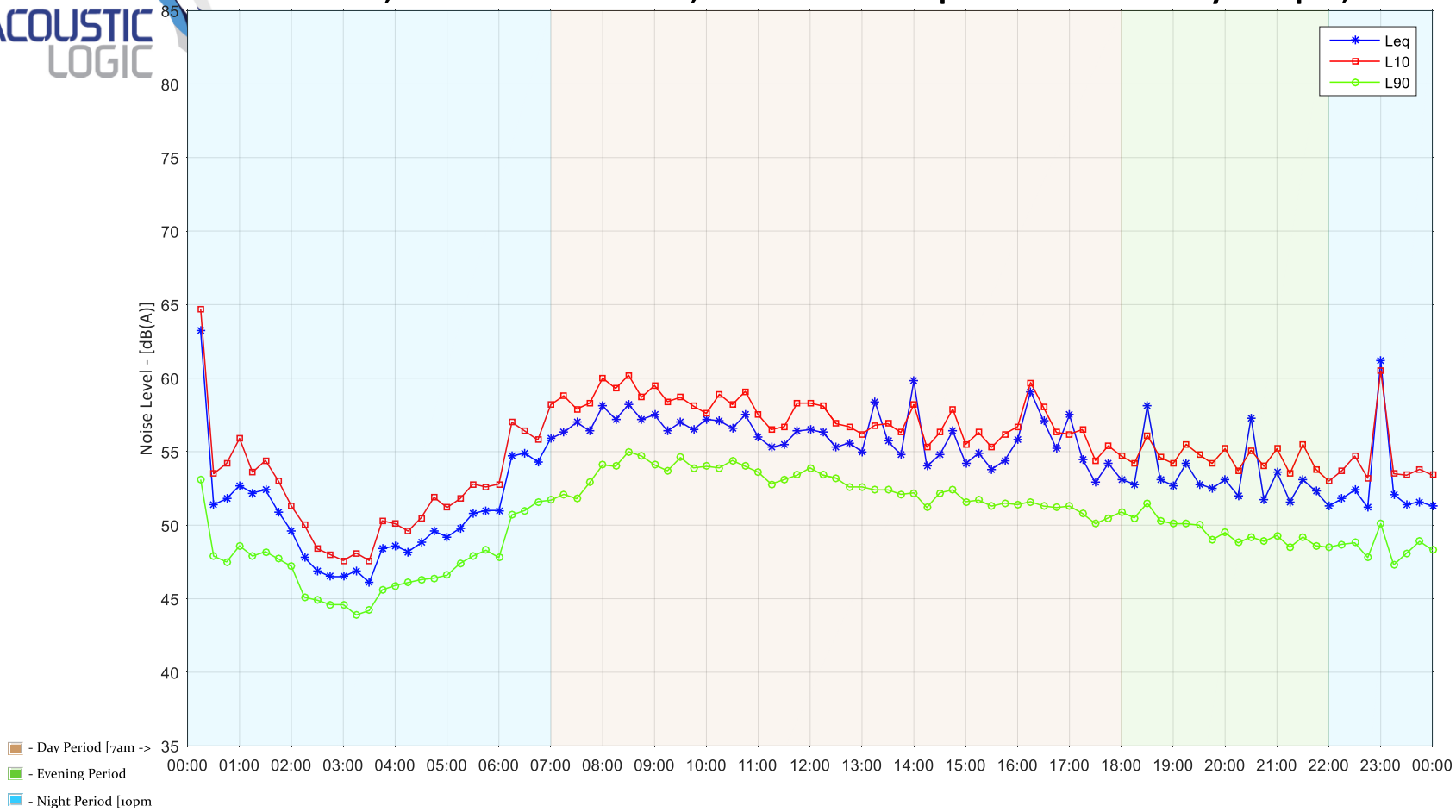
Alex Washer

APPENDIX ONE – UNATTENDED NOISE MONITOR DATA

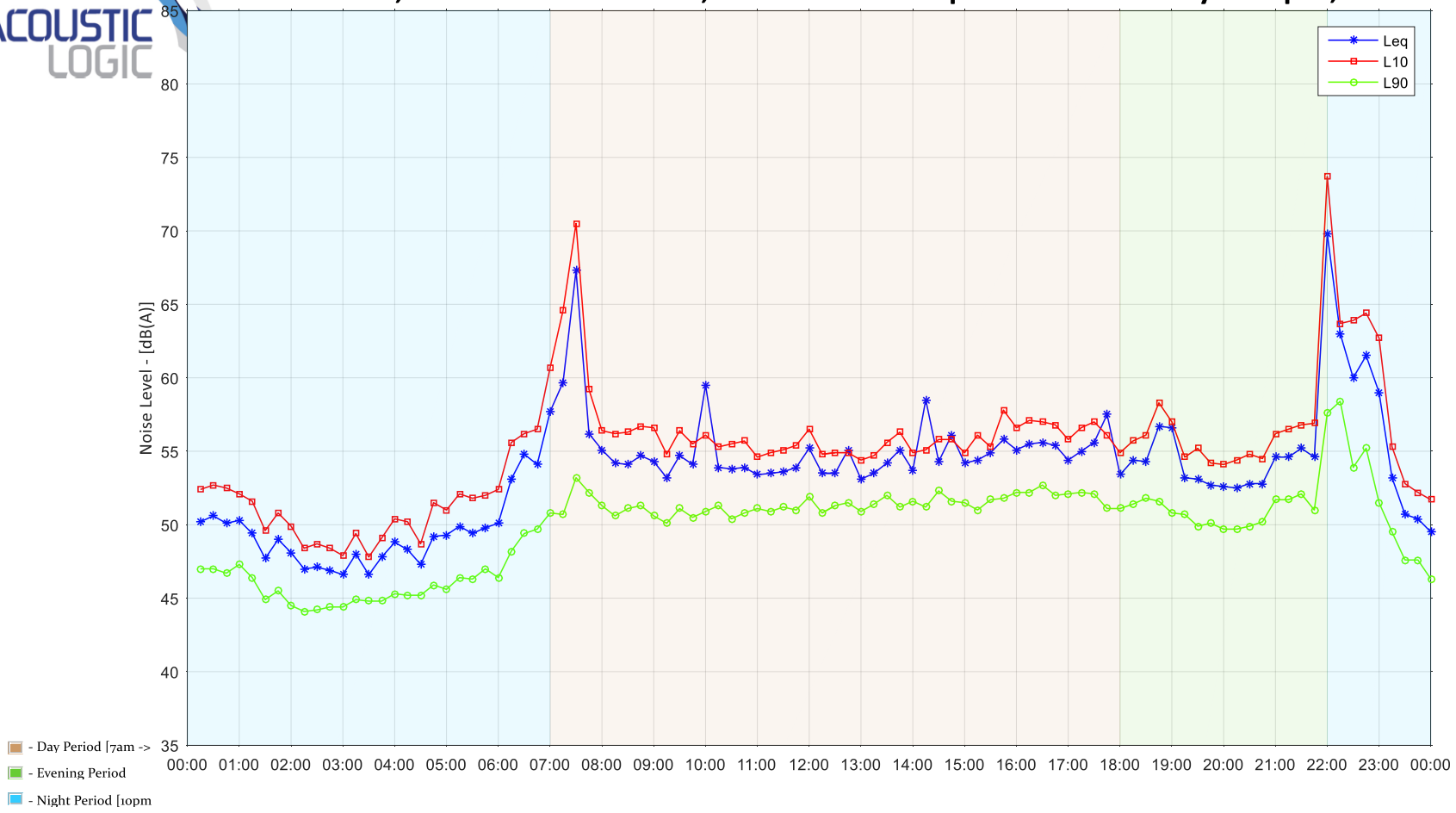
Gibbons Place, 44-78 Rosehill Street, Redfern - Rooftop Location: Friday 27 April, 2018



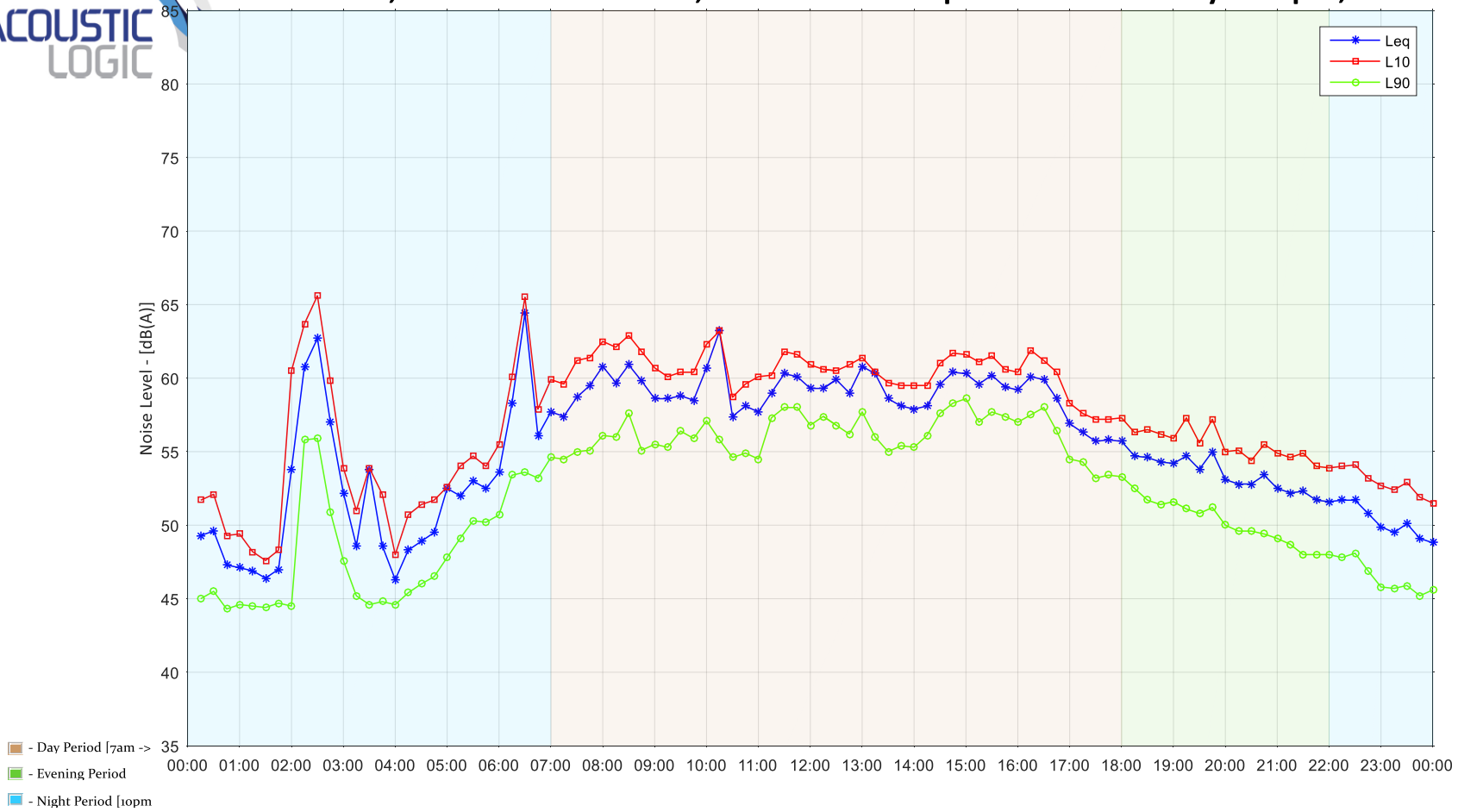
Gibbons Place, 44-78 Rosehill Street, Redfern - Rooftop Location: Saturday 28 April, 2018



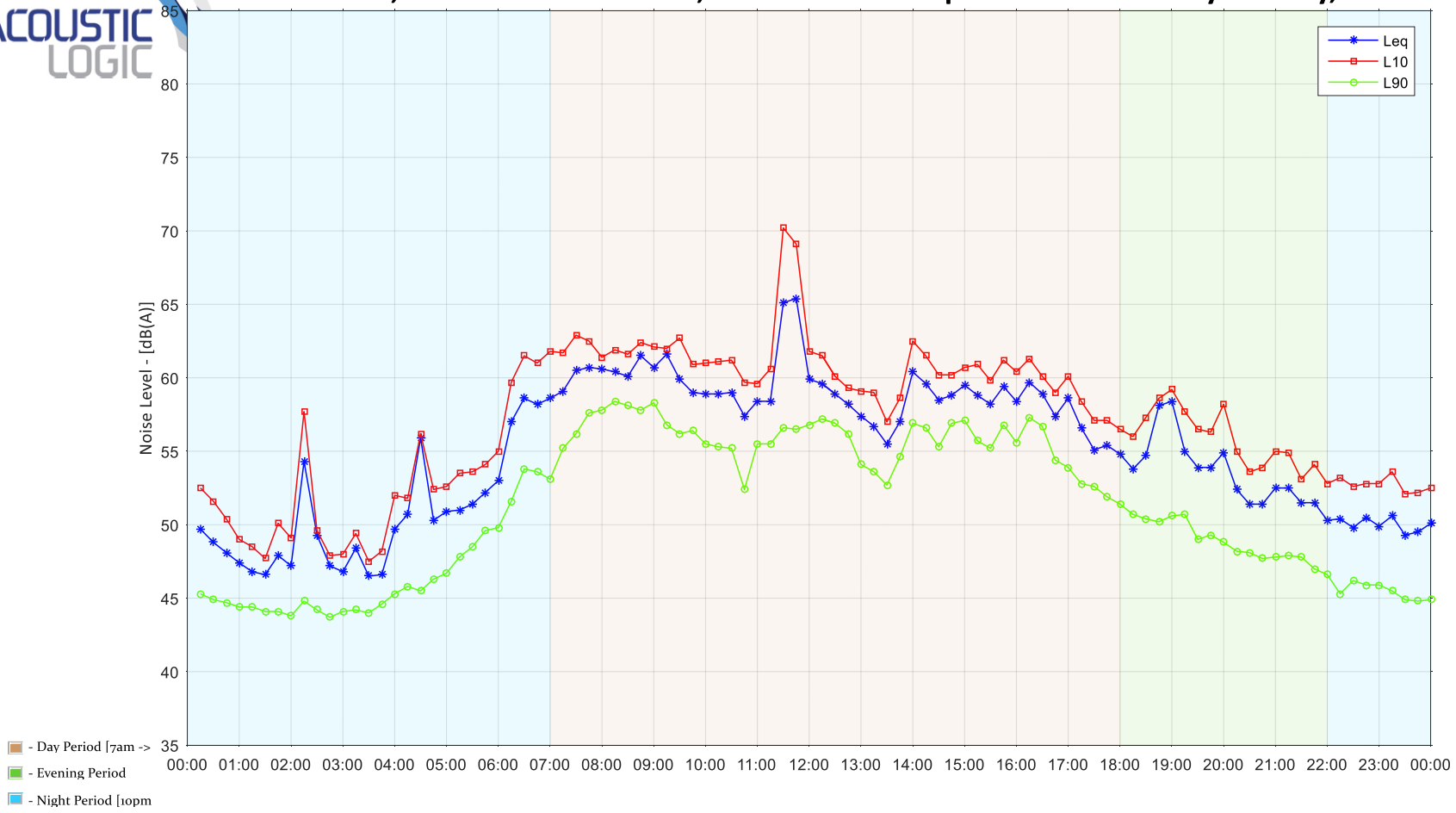
Gibbons Place, 44-78 Rosehill Street, Redfern - Rooftop Location: Sunday 29 April, 2018



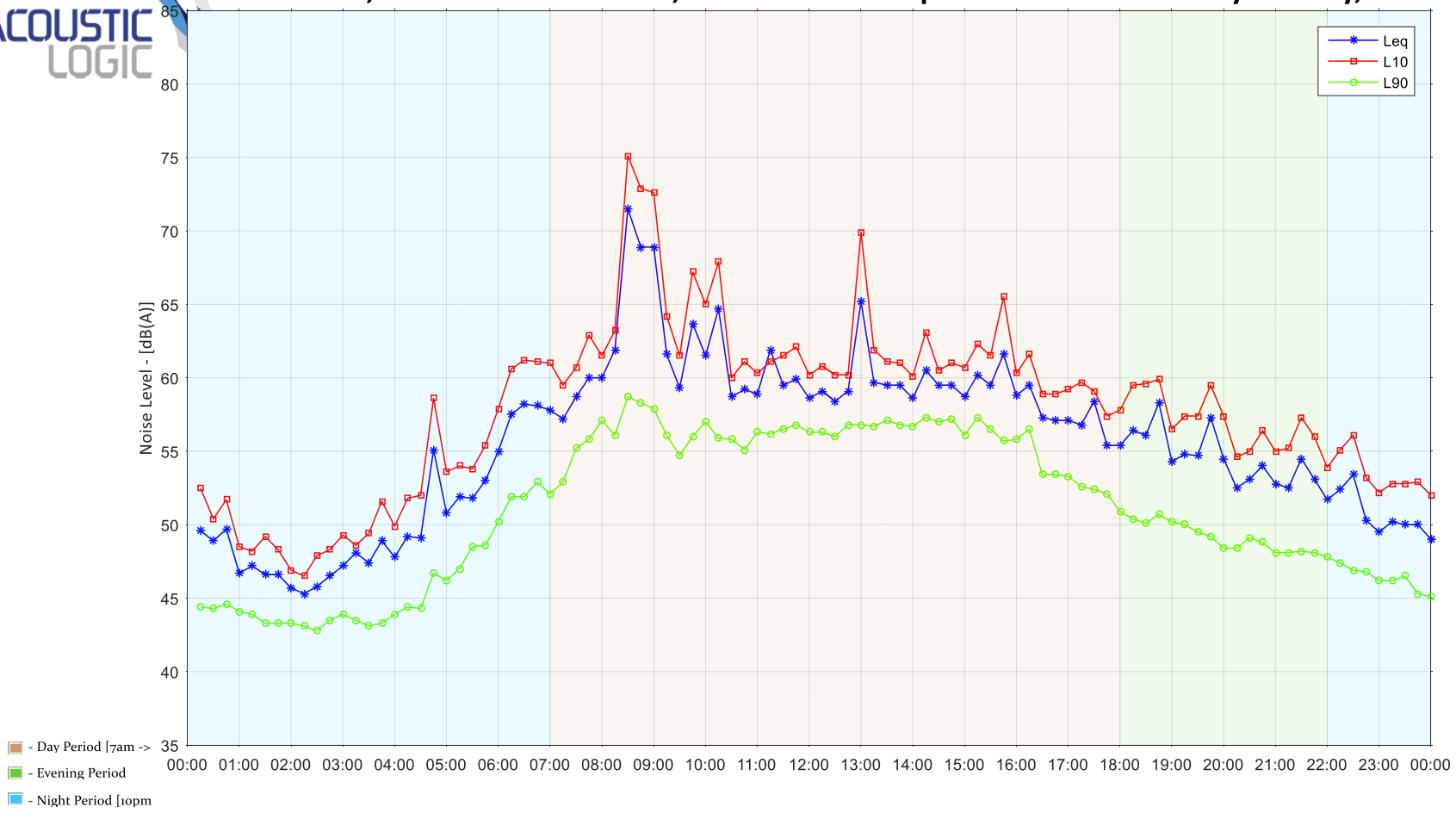
Gibbons Place, 44-78 Rosehill Street, Redfern - Rooftop Location: Monday 30 April, 2018



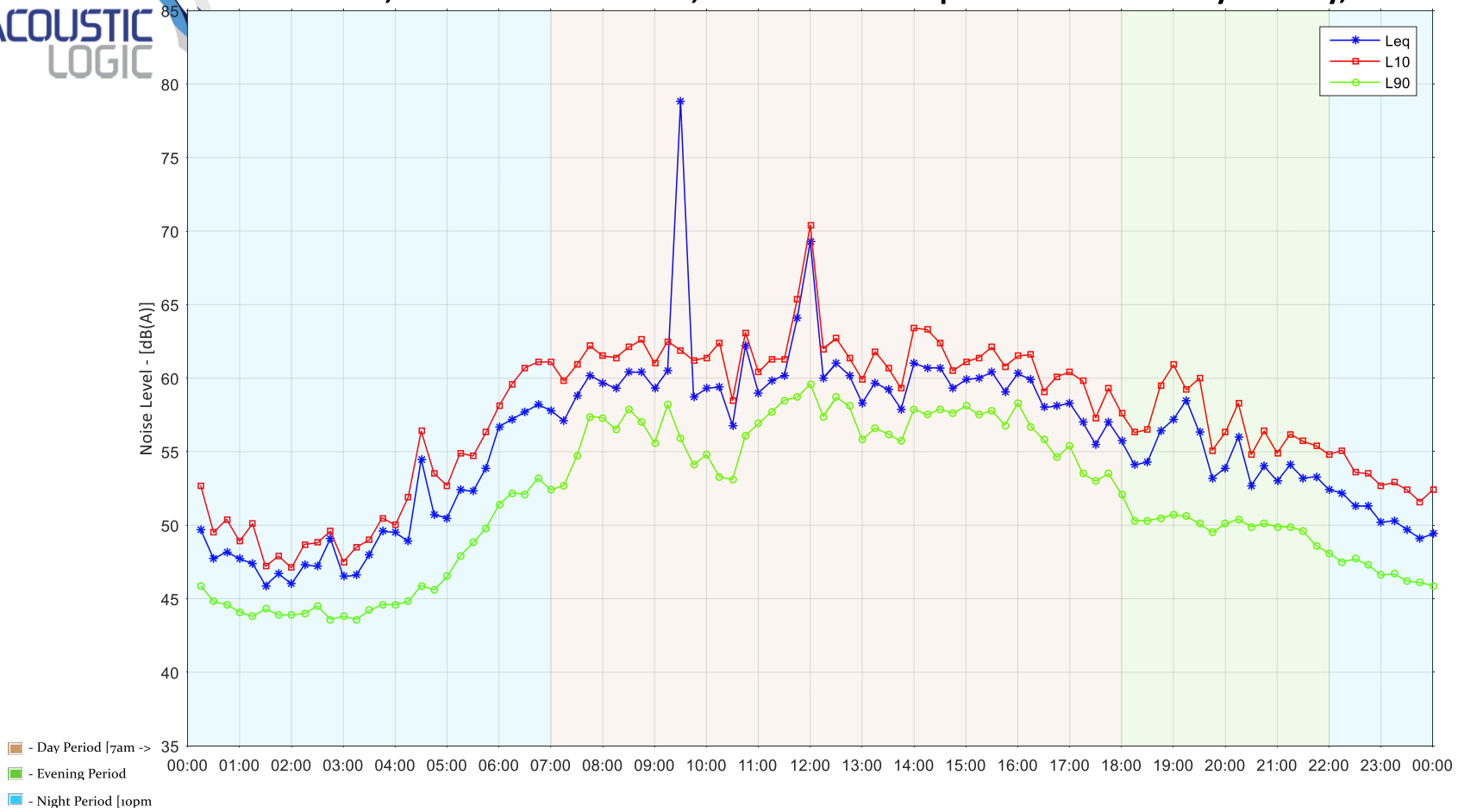
Gibbons Place, 44-78 Rosehill Street, Redfern - Rooftop Location: Tuesday 01 May, 2018

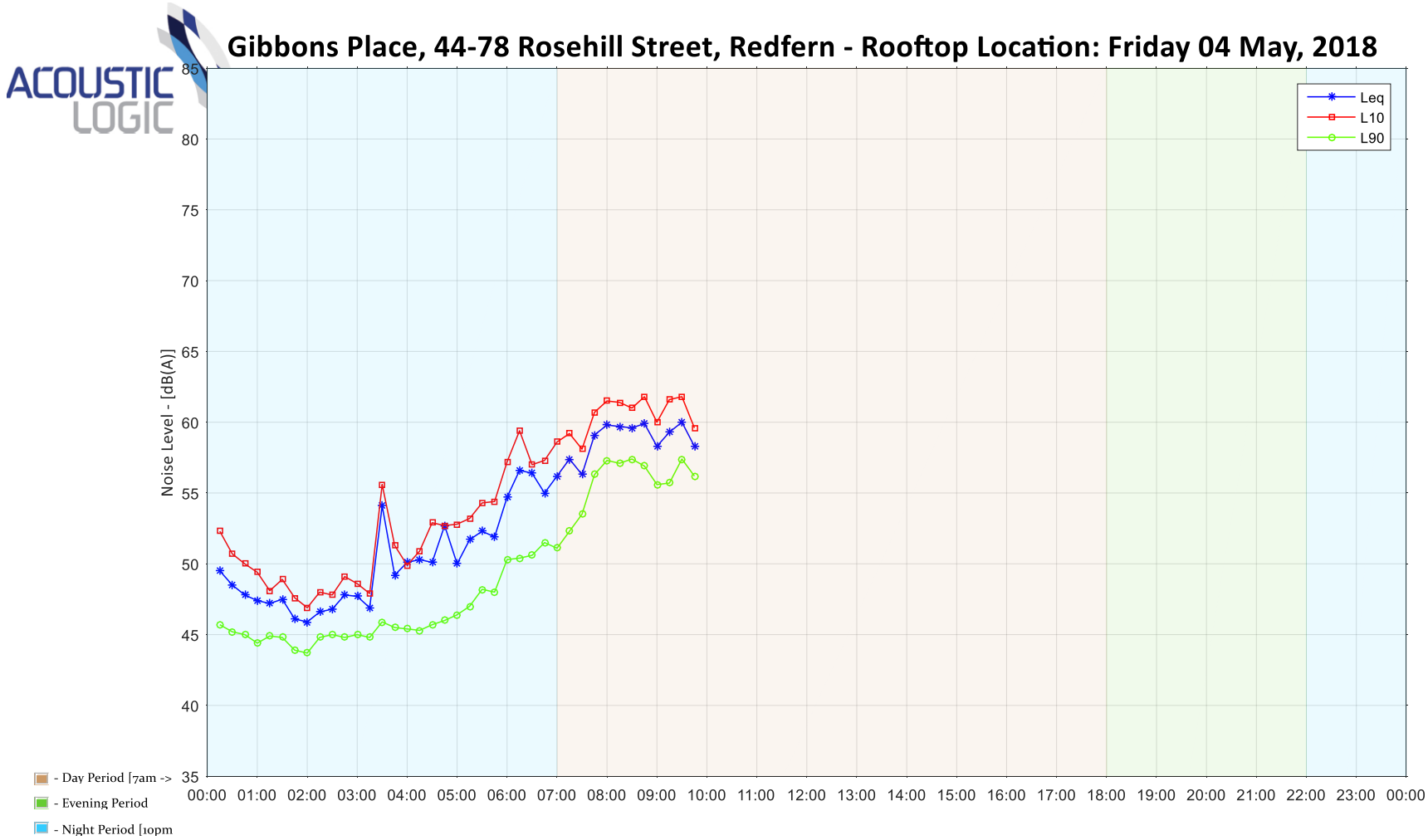


Gibbons Place, 44-78 Rosehill Street, Redfern - Rooftop Location: Wednesday 02 May, 2018



Gibbons Place, 44-78 Rosehill Street, Redfern - Rooftop Location: Thursday 03 May, 2018




Gibbons Place, 44-78 Rosehill Street, Redfern - Rooftop Location: Friday 04 May, 2018
Leq
L10
L90
Noise Level - [dB(A)]
85
80
75
70
65
60
55
50
45
40
35
00:00 01:00 02:00 03:00 04:00 05:00 06:00 07:00 08:00 09:00 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 00:00
- Day Period [7am ->
- Evening Period
- Night Period [10pm