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DOCUMENT CONTROL REGISTER

Project Number	20180922.1
Project Name	Iglu II, 80-88 Regent Street, Redfern
Document Title	DA Acoustic Assessment
Document Reference	20180922.1/2108A/R0/YK
Issue Type	Email
Attention To	Iglu No. 209 Pty Ltd

Revision	Date	Document Reference	Prepared By	Checked By	Approved By
0	21/08/2018	20180922.1/2108A/R0/YK	YK		YK

TABLE OF CONTENTS

1 INTRODUCTION

Acoustic Logic Consultancy (ALC) have been engaged by Iglu Pty Limited to conduct an acoustic assessment of the potential noise impacts associated with the proposed 'Iglu II' student accommodation development at 80-88 Regent Street, Redfern.

In this report we will:

- Conduct an external noise (traffic) and vibration (rail – below ground) impact assessment and recommend acoustic treatments to ensure that a reasonable level of amenity is achieved for future tenants.

- Identify potential noise generating sources associated with the subject proposal and determine relevant noise emission goals, ensuring that nearby developments are not adversely impacted by the subject proposal.

Noise impacts will be addressed in accordance with the following standards and guidelines;

- Sydney DCP 2012.

- NSW Department of Planning State Environmental Planning Policy (Infrastructure SEPP) 2007.

- Australian and New Zealand Standard AS/NZS 2107:2016 *'Acoustics - Recommended design sound levels and reverberation times for building interiors'*.

- Australian Standard AS 3671:1989 '*Acoustics—Road traffic noise intrusion—Building siting and construction*'.

- NSW Department of Planning (DoP) *'Development Near Rail Corridors and Busy Roads – Interim Guideline'*.

- NSW Environmental Protection Authority (EPA) Noise Policy for Industry (NPfI).

- NSW EPA Protection of Environmental Operations Regulation 2008.

ALC confirms that the proposed development can comply with all of the aforementioned authorities and standards, on the proviso that the acoustic treatments nominated in this report are adopted.

This assessment is based on the following architectural drawings provided by Bates Smart Architects.

Table 1 – Architectural Drawings

Drawing Number	Revision	Date
A01.001	A	10/08/2018
A03.101 – 108		
A03.119		
A09.001 – 004		
A10.001 – 002		

2 SITE DESCRIPTION

The subject site is located at the corner of Regent Street and Marian Street in Redfern. It is bounded by Regent Street to the east, Marian Street to the south, William Lane to the west and Iglu I to the north. Regent Street is a major sub-arterial road, with high volumes of traffic. Marian Street and William Lane are local roads with low volumes of traffic.

It is proposed to demolish all existing properties on site and construct a new 18-storey student accommodation development, with ground level retail and 17 levels of accommodation facilities. The proposal will operate as an integrated campus with the adjoining Iglu facility at 66 Regent St, Redfern, which commenced operation in early 2018.

Surrounding properties are as follows;

- Double storey mixed-use properties to the south, across Marian Street, at 90-92 Regent Street, Redfern. We have assumed ground level commercial tenancy and level 1 residential tenancy.

- Multi-storey mixed-use properties to the west, across William Lane, at 9 Gibbons Street and 161 Redfern Street, Redfern.

- Iglu I development, adjoining the site to the north.

Figure 1 below illustrates the locations of the subject site, attended noise measurements and surrounding receivers.

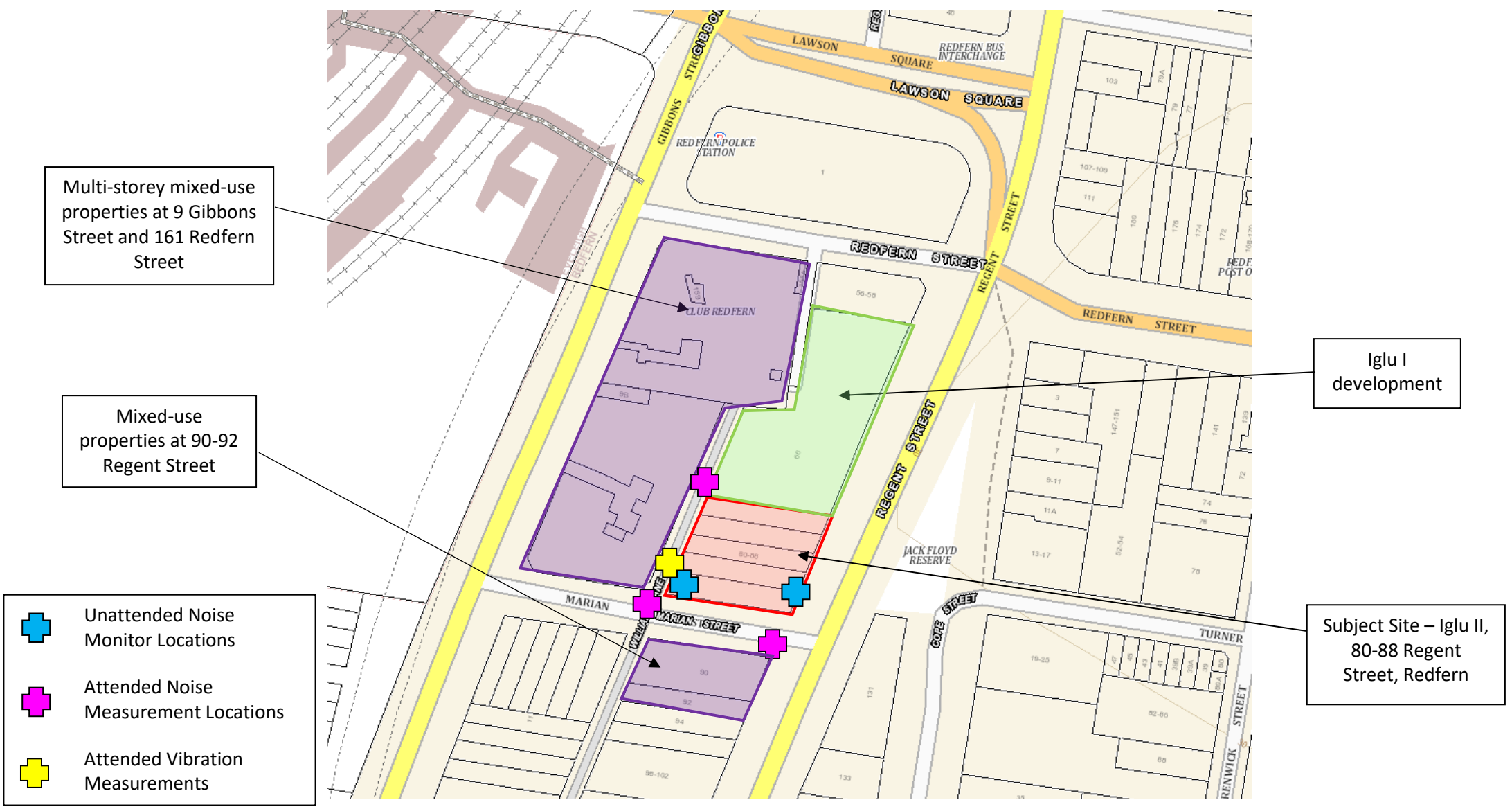


Figure 1 – Site Description (source: SixMaps)

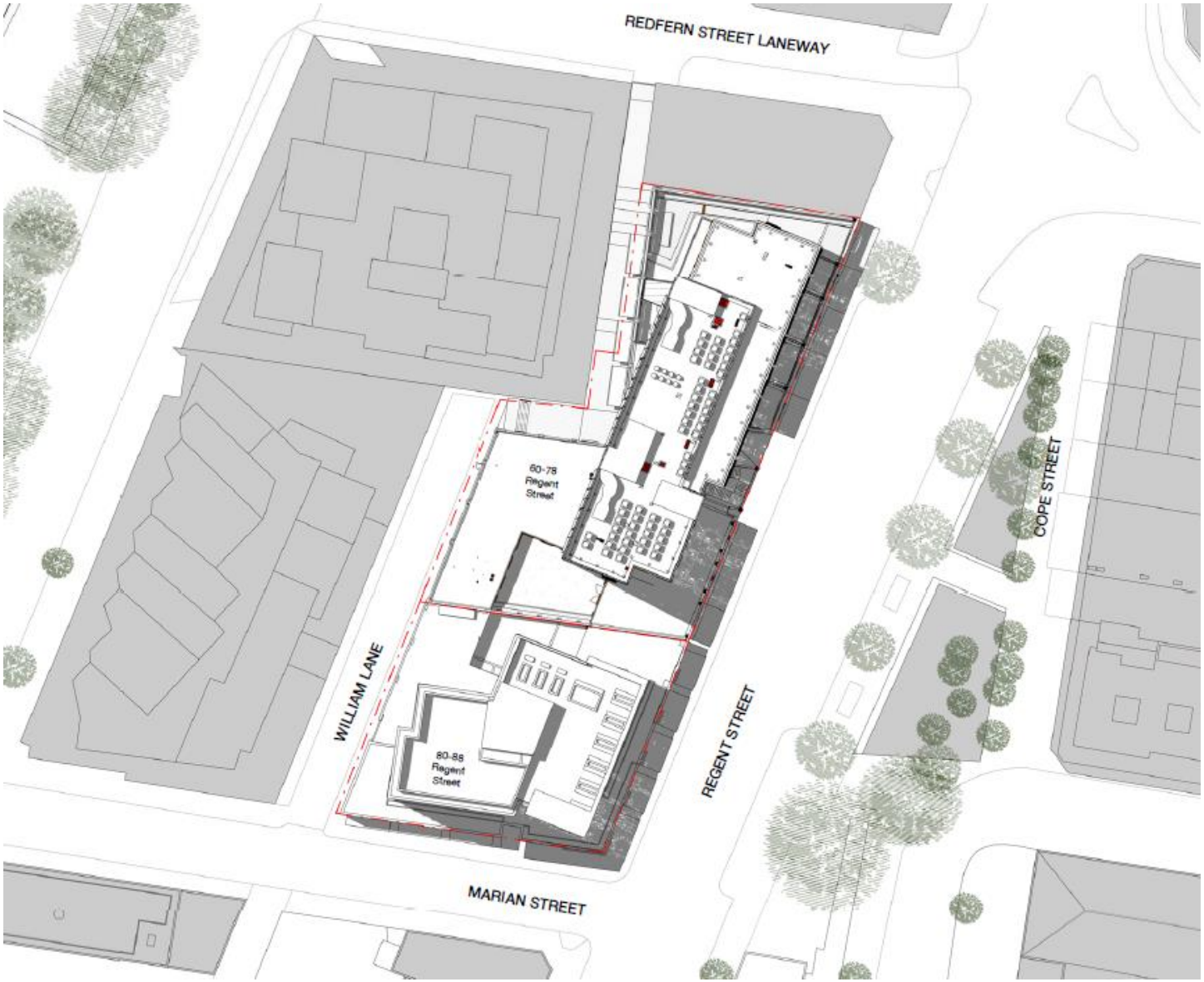


Figure 2 – Proposed Site Plan

3 NOISE DESCRIPTORS

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.

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.

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.

4 EXTERNAL NOISE IMPACT ASSESSMENT

Traffic noise from vehicle movements along Regent Street, will be the primary external noise source impacting the subject development. During a site visit high levels of mechanical noise was also noted towards the western boundary of the site, from louvres located along the eastern façade of the property at 9 Gibbons Street, Redfern.

4.1 ASSESSMENT CRITERIA

4.1.1 Sydney Development Control Plan 2012

It should be noted that the DCP does not outline any specific provisions for student accommodation. For the purpose of this assessment the subject development will be assessed as a multi-storey residential/mixed-use development and hence reference section 4.2 of the council DCP. Subsection 4.2.3.11 of the council DCP outlines the following requirements with regards to acoustic privacy;

(7) The repeatable maximum LAeq (1 hour) 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 LAeq (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).

(9) These levels are to include the combined measured level of noise from both external sources and the ventilation system operating normally.

4.1.2 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,
(b) a place of public worship,
(c) a hospital,
(d) an education establishment or child care centre.

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."

Map 16 of the traffic volume maps for Infrastructure SEPP (from the road and maritime services website) classifies Regent Street (adjacent to site) as a carriageway carrying >40,000 AADT, and hence mandatory under clause 102 of the Infrastructure SEPP.

4.1.3 Australian Standard AS/NZS 3671:1989 'Acoustics—Road traffic noise intrusion—Building siting and construction'

Australian Standard AS 3671-1989 notes the following in relation to traffic noise:

- Internal noise levels should be determined in accordance with AS/NZS 2107:2016 '*Acoustics – Recommended design sound levels and reverberation times for building interiors*'.
- A suitable descriptor should be adopted, relevant to the use of the proposed development. As AS2107:2016 adopts the L_{Aeq} descriptor, ALC will also use this descriptor.
- AS3671 does not specifically recommend a time interval. On this basis, ALC have adopted the worst 1-hour noise level descriptor for the two-time periods of the day, being:
    - Daytime – 7am to 10pm ($L_{eq(worst\ 1\ hr)}$), and
    - Night-time – 10pm to 7am ($L_{eq(worst\ 1\ hr)}$).

4.1.4 Australian and New Zealand AS/NZS 2107:2016 'Recommended Design Sound Levels and Reverberation Times for Building Interiors'

AS2107-2016 *"Acoustics – Recommended design sound levels and reverberation times for building interiors"* recommends internal design criteria for occupiable spaces of difference types of development. The design noise levels are determined based on the occupancy type, function/activity of the space within the occupancy and proximity to environmental noise sources.

Internal design noise level criteria applicable for non-residential areas of the proposed development are detailed below;

Table 2 – AS2107:2016 Recommended Internal Design Noise Levels

Space	Time	Internal Traffic Noise Criteria dB(A)$L_{eq(1\ hour)}$
Open Plan Office/General Office Areas	When in use	40 – 45
Retail Stores	When in use	<50 dB(A)
Common Rooms	When in use	40 – 45
Games Rooms	When in use	45 – 50

4.2 EXISTING ENVIRONMENT NOISE LEVELS

Measurements of existing ambient noise levels on site was conducted using both long term unattended monitoring and short term attended measurements.

Long term noise monitoring was conducted using 2 unattended noise monitors installed on site;

- Monitor 1 – Installed on level 1 of the commercial property at 88 Regent Street, Redfern. The monitor was installed with the microphone positioned outside a window along the eastern façade of the property, with a clear and unrestricted view of Regent Street.

- Monitor 2 – backyard of commercial property at 88 Regent Street.

Acoustic Research Laboratories noise monitors were used for the long-term monitoring, set to record continuously on an A-weighted fast response mode. The monitors were calibrated at the start and end of the monitoring period using a Rion NC-73 calibrator. No significant drift was noted. Noise logging was conducted from the 18th to 25th July 2018.

Unattended noise logging data is attached in Appendix 1 below.

Measurements of existing peak hour traffic noise levels were also conducted at various locations around the site, as illustrated in Figure 1. These measurements were conducted using a Norsonic type 140 Precision Sound Analyser between 7:30am and 9:00am, on the 25th July 2018. The analyser was set to record at 15-minute intervals in an A-weighted fast response mode. The analyser was calibrated before and after the measurements using a Norsonic Sound Calibrator type 1251. No significant drift was noted. Highest recorded 15-minute noise levels during the measurement interval have been used for this assessment.

Measured noise levels are presented below. In determination of acoustic treatments, the measured levels are adjusted for distance and orientation.

Table 3 – Measured Existing Traffic Nosie Levels

Location	Measured Traffic Noise Level	
	Daytime (7am-10pm)	**Night time (10pm-7am)**
Along Regent Street (approx. 3m from curb)	69 dB(A)$L_{eq(1hour)}$ 68 dB(A)$L_{eq(15\ hour)}$	68 dB(A)$L_{eq(1hour)}$ 66 dB(A)$L_{eq(9\ hour)}$
Along William Lane (site boundary)	66 dB(A)$L_{eq(1hour)}$ 65 dB(A)$L_{eq(15\ hour)}$	64 dB(A)$L_{eq(1hour)}$ 62 dB(A)$L_{eq(9\ hour)}$

4.3 METHODOLOGY OF EXTERNAL NOISE INTRUSION ASSESSMENT

External noise intrusions will primarily be as a result of noise transfer through the roof, windows and doors, as these are relatively light building elements, which offer less resistance to the transmission of sound. Noise transfer through masonry external walls will not be significant and need not be considered further.

The constructions necessary to attenuate external noise impacts to levels complying with those detailed in section 4 above, are set out below.

4.3.1 Recommended Treatments

Internal noise levels were calculated based on the expected level and spectral characteristics of the external noise, the area of building elements exposed to the noise source, the absorption characteristics of the rooms and the noise reduction performance of the building elements.

4.3.1.1 Recommended Glazing

Minimum constructions to ensure compliance with the internal noise goals detailed in section 4 above, are outlined below. 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.

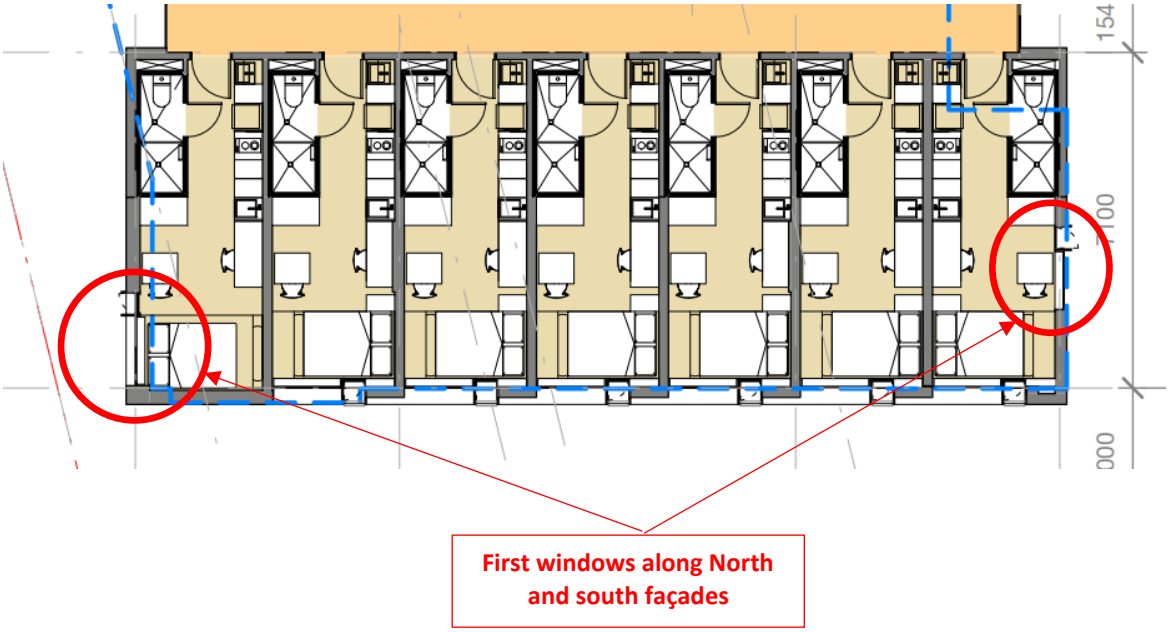
Table 4 – Recommended Minimum Glazing Construction

Levels	Space	Façade	Glazing Thickness	Acoustic Seals
Ground & Leve 00 (Mezzanine)	Retail	East (Regent Street)	10.38mm laminate	Yes
		South (Marian Street)		
	Office*	South or West (William Lane)	6.38mm laminate	Yes
Level 1	Community Space	East	10.38mm laminate	Yes
		South	6.38mm laminate	
		West or Courtyard	6mm float/toughened	
	Rooms	South or West	10.38mm laminate	

Levels	Space	Façade	Glazing Thickness	Acoustic Seals
Levels 2 to 10	Rooms	East and North	12.38mm laminate for the fixed glass element + 6mm toughened Breezway louvre for ventilation box. The box must be of a minimum 9mm FC sheet construct. 6mm float/toughened for internal casement window of the box.	Yes
		North or South (first apartments – see figure below)	12.38mm laminate for the fixed glass element + 6mm toughened Breezway louvre for ventilation box. The box must be of a minimum 9mm FC sheet construct. 6mm float/toughened for internal casement window of the box.	
		North, South & West	10.38mm laminate for the fixed glass element + 6mm toughened Breezway louvre for ventilation box. The box must be of a minimum 9mm FC sheet construct. 6mm float/toughened for internal casement window of the box.	
	Living/Kitchen (Common)	North and South	6.38mm laminate for the fixed glass element + 6mm toughened Breezway louvre for ventilation box. The box must be of a minimum 9mm FC sheet construct. 6mm float/toughened for internal casement window of the box.	
	Corridor	North or South	6mm float/toughened	
Levels 11 to 17	Rooms	East and North	10.38mm laminate for the fixed glass element + 6mm toughened Breezway louvre for ventilation box. The box must be of a minimum 9mm FC sheet construct. 6mm float/toughened for internal casement window of the box.	Yes

Levels	Space	Façade	Glazing Thickness	Acoustic Seals
Levels 11 to 17		North or South (first apartments – see figure below)	10.38mm laminate for the fixed glass element + 6mm toughened Breezway louvre for ventilation box. The box must be of a minimum 9mm FC sheet construct. 6mm float/toughened for internal casement window of the box.	Yes
		North, South & West	6.38mm laminate for the fixed glass element + 6mm toughened Breezway louvre for ventilation box. The box must be of a minimum 9mm FC sheet construct. 6mm float/toughened for internal casement window of the box.	
	Living/Kitchen (Common)	North and South	6.38mm laminate for the fixed glass element + 6mm toughened Breezway louvre for ventilation box. The box must be of a minimum 9mm FC sheet construct. 6mm float/toughened for internal casement window of the box.	
	Corridor	North or South	6mm float/toughened	

***Assumed as general/open plan office space. If this space is proposed to be part of future fit-out, any sensitive areas such as meeting rooms, private office etc. located along the façade will need to be reviewed, as these spaces will require an upgraded façade construction.**



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 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 5 – Minimum STC/R_w of Glazing Assembly (with Acoustic Seals)

Glazing Assembly	Minimum STC/R_w of Glazing Assembly* (with acoustic seals)
6mm toughened Breezway louvres	24
6mm float/toughened	29
6.38mm laminate	31
10.38mm laminate	35
12.38mm laminate	37

***Glazing assembly is a combination of glass, frame and seals.**

4.3.1.2 External Doors

Any glass door or glazed panels set into solid doors should be constructed using glazing thickness outlined in the above section. Full perimeter acoustic seals around the doors are required.

Any timber external doors (this includes apartment entry doors along external corridor areas) shall be a minimum 40mm solid core timber with Raven RP10 to the top and sides and Raven RP38 to the underside of the door.

Entry doors to rooms within internal corridor areas shall be of a minimum 35mm solid core timber construct with gaps minimised (maximum undercut of 5mm).

4.3.1.3 External Walls

Proposed masonry external wall construction is acoustically acceptable and does not require any additional treatments. There should not be vents on the internal skin of external walls. All penetrations in the internal skin of external walls should be acoustically sealed.

4.3.1.4 Roof / Ceiling

Proposed concrete slab roof is acoustically acceptable and does not require any additional treatments. All opening or penetrations in ceilings must be acoustically sealed.

4.3.2 Ventilation and Air Conditioning

The following areas of the development can comply with this internal noise goal (refer section 4.1.1), with windows/doors;

- Living/Kitchen (Common) from levels 11 – 17. Operable façade elements on only 1 side can be open (glazing proposed along north and south façades).

All other areas of the development can only comply with the internal noise level criteria, with windows/doors closed. Any alternate source/mechanical ventilation system that is installed should be acoustically designed such that the acoustic performance of the recommended constructions is not reduced by any duct or pipe penetrating the wall/ceiling/roof. Noise emitted to the property boundaries by any ventilation system shall also comply with the noise emission goals detailed in the following section.

5 RAIN INDUCED VIBRATION

Below ground rail infrastructure induce ground borne vibration that is transmitted through the subsoil. These vibrations can be perceptible within developments on or adjacent to rail infrastructure, both as tactile vibration and structure borne (ground-borne) noise. Given the location of below ground rail line to the site (approximately 10m from the eastern boundary) the proposed new residential development will be assessed for both these impacts.

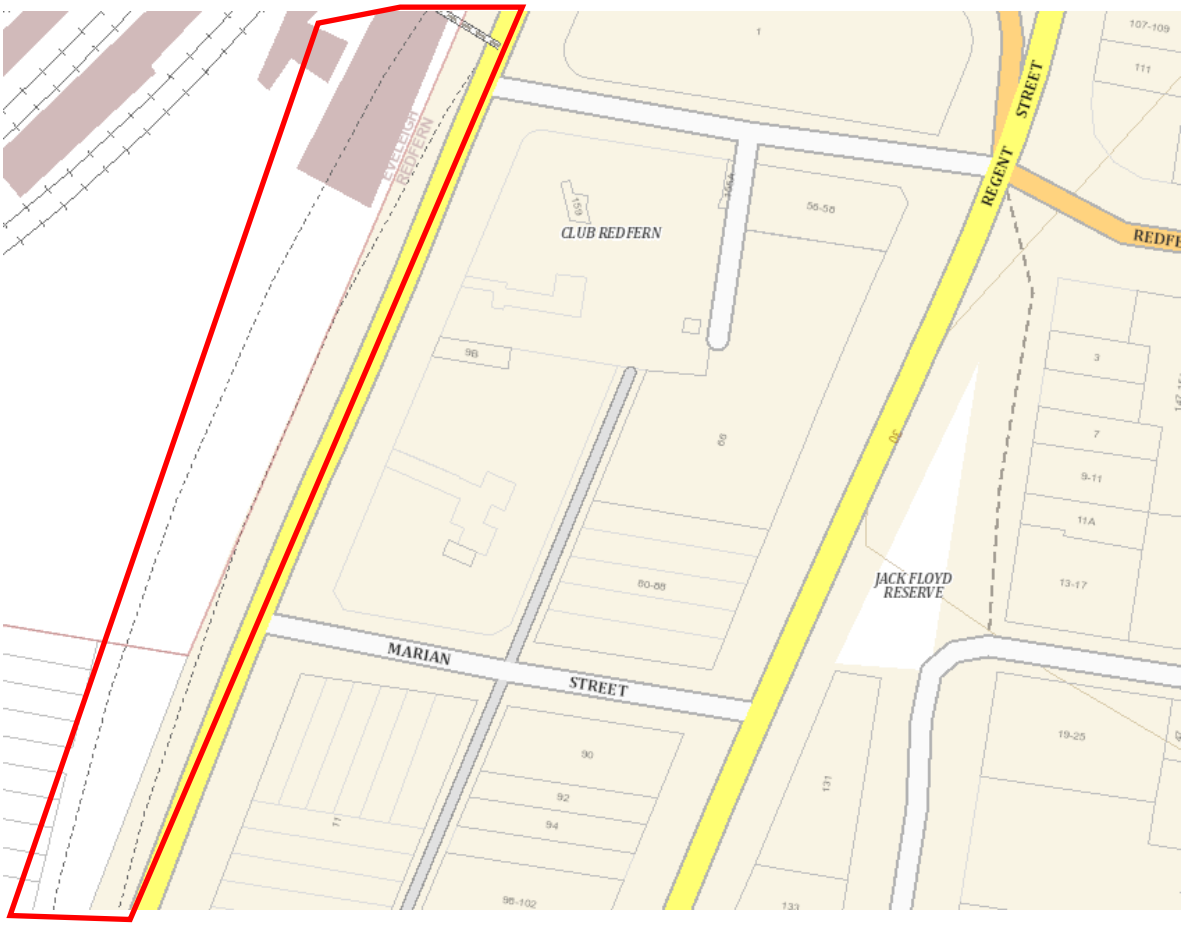


Figure 3 – Location of Underground Rail Infrastructure (source: SixMaps)

5.1 ASSESSMENT CRITERIA

5.1.1 NSW DoP '*Development Near Rail Corridors and Busy Roads – Interim Guideline*'

Section 3.5.1 of this guideline provides a guide for vibration assessment zones for developments adjacent to rail corridors or above rail tunnels. Figure 3.2 in this section recommends for a vibration assessment to be conducted for sensitive building located within 60m from the nearest operational track.

Section 3.6.2 and 3.6.3 of this guideline outlines criteria for ground borne or structure borne noise impacts.

- ***Ground Borne or Structure Borne Noise Criteria***

The guideline outlines that generally, ground-borne noise may be present when developments are constructed over or adjacent to land over tunnels.

This guideline outlines that residential buildings should be designed such that 95th percentile of train pass-bys complies with a ground borne L_{max} noise limit of 40 dB(A) (daytime) and 35 dB(A) (night-time), measured using a "slow" response time setting in the centre of the space.

Table 6 – Ground Borne Noise Criteria

LOCATION	TIME OF DAY	Internal Ground Borne Noise Criteria dB(A) $L_{Max\ (slow)}$
Residential buildings – living and sleeping areas	Day (7am-10pm)	40
	Night (10pm-7am)	35

- ***Tactile Vibration Criteria***

Section 3.6.3 of the DoP guideline outlines that intermittent vibration emitted by trains must be against the criteria detailed in the NSW EPA *Assessing Vibration: a technical guideline* document.

This guideline in turn recommends that habitable rooms within a new development comply with the criteria in British Standard BS 6472:1992 "*Evaluation of Human Exposure to Vibration in Buildings (1Hz to 80Hz)"*, 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 represents 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.

The 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” (7am-10pm) and “Night time” (10pm-7am). The overall value is then compared to the levels presented in the table below.

Table 7 – Vibration Dose Values (m/s^1.75) above which various degrees of adverse comment may be expected in residential buildings

Place	Low Probability of adverse comment	Adverse comment possible	Adverse comment probable
Building for Residential Use Daytime (7am – 10pm) 15-hour period	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Building for Residential Use Night-time (10pm – 7am) 9-hour period	0.13	0.26	0.51

5.2 MEASURED VIBRATION LEVELS

Attended vibration measurements were conducted by this office along the western boundary of the site (refer Figure 1).

These measurements were conducted on the 25th July 2017 between 9:00am and 11:00am, using a SVANTEK 958a sound and vibration analyser. The analyser was connected to a SVANTEK SV48 triaxial accelerometer (tri-axial measurements).

5.2.1 Ground Borne Noise Impacts

Vibration measurements were conducted in a 3-dimensional plan, along the x, y and z axis’s. The z-axis typically records the highest magnitude of impacts and is the case for the measurements conducted on site. The worst case predicted noise levels on ground level, based on these measurements are presented in the table below.

Table 8 – Average Ground Borne Noise Impacts

Location	Maximum Noise Limit dB(A)L_{Max}	Calculated Maximum Internal Noise Level dB(A)L_{Max}	Complies
Western boundary of the site	35 (Night-time, 10pm to 7am)	<30	Yes

5.2.2 Tactile Vibration Impacts

The maximum train passby ground vibration acceleration, the typical passby period and the estimated number of train passbys for each time period (obtained from the NSW Rail website) were used calculate the overall eVDV values for the daytime and nigh-time periods. Results are presented in the table below.

Table 9 – Calculated Vibration Dose Values (m/s^1.75)

Location	Time Period	Calculated eVDV $m/s^{1.75}$	Criteria VDV $m/s^{1.75}$	Complies
Western boundary of the site	Daytime (7am – 10pm)	<0.02	0.2 to 0.4	Yes
	Night-time (10pm – 7am)	<0.05	0.13	Yes

5.3 RESULTS AND DISCUSSION

All measured vibration levels comply with the tactile vibration and structure borne noise level requirements of the NSW Department of Planning's *'Development Near Rail Corridors and Busy Road – Interim Guideline'*.

Hence no adverse vibration impacts are expected from the underground rail infrastructure on the proposed development, and no additional ameliorative treatments required.

6 NOISE EMISSION ASSESSMENT

Noise emissions from the subject development 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 impacts from then use of rooftop terrace.
- Noise generated by any future mechanical plant and equipment associated with the proposed development.

The potentially nearest affected sensitive receivers are illustrated in Figure 1 above.

6.1 EXISTING AMBIENT ENVIRONMENT

A survey of the existing background noise levels on site was also conducted using the noise monitors detailed in section 4.2 above.

It should be noted that the background noise levels recorded by monitor 2, which was installed in the backyard of 88 Regent Street, to shield the monitor from traffic noise along Regent Street was severely impacted by mechanical noise from the adjoining mixed-use development at 9 Gibbons Street and 161 Redfern Street. The rating background noise levels measured by this logger are presented below.

Table 10 – Measured Rating Background Noise Levels (Monitor 2)

Location	Rating Background Noise Level dB(A)$L_{90(period)}$		
	Daytime (7am – 6pm)	Evening (6pm – 10pm)	Night (10pm – 12am)
Backyard of 88 Regent Street, Redfern (refer figure 1)	58	58	57

The noise levels measured at this location will be representative of the ambient noise levels at the boundary of the residential properties along William Lane and Marian Street. However, given the elevated noise levels recorded project rating background noise levels will be based on the levels measured by monitor 1.

The measured noise levels have been corrected for meteorological conditions (excessive wind and/or rain), as required by section A4 of the EPA Noise Policy for Industry. Weatherzone data for observations recorded at Observatory Hill, indicate no rain during the monitoring period. Periods where the average wind speed limit exceeded 5m/s was noted and excluded in determining the rating background noise levels. Detailed unattended noise monitoring data is attached in Appendix 1.

Table 11 – Measured Rating Background Noise Levels (Monitor 1)

Location	Rating Background Noise Level dB(A)$L_{90(period)}$		
	Daytime (7am – 6pm)	Evening (6pm – 10pm)	Night (10pm – 12am)
Level 1 of the commercial property at 88 Regent Street, Redfern (refer Figure 1)	56	52	45

A background noise measurement was also conducted on site during the night-time period (after 10pm) on 26th July 2018 to determine an ambient spectrum. This is presented below.

Table 13– Background Noise Spectrum

	31.5Hz	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	dB(A)
Along William Lane	53	53	50	48	44	41	36	29	23	**46**

6.2 ASSESSMENT OBJECTIVES

Noise emissions from the development will have to achieve the following requirements.

- City of Sydney Council Standard Conditions of Development Consent (previously issued by council email received from Meredith Anderson, City of Sydney Senior Environmental Health Officer, dated 13 January 2017 and used on other restaurant/café & pub fitout projects).

6.2.1 City of Sydney Standard Conditions of Development Consent

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.

6.2.2 NSW Environmental Protection Authority (EPA) document – *'Noise Policy for Industry (NPfI)'*

The NPfI provides guidelines for assessing noise impacts from developments. The recommended assessment objectives vary depending on the potentially affected receivers, the time of day, and the type of noise source. The NPfI has two requirements which both have to be complied with, namely an amenity criterion and an intrusiveness criterion.

6.2.2.1 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 5 dB(A).

Table 12 – NPfI Intrusiveness Criteria

Receiver	Time of day	Intrusiveness Criteria dB(A)$L_{Aeq(15mins)}$
Residential	Daytime (7am-6pm)	61
	Evening (6pm-10pm)	57
	Night-time (10pm-7am)	50

6.2.2.2 Amenity Criterion

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

The Industrial Noise Policy sets out acceptable noise levels for various land uses. Table 2.2 of the policy has four categories to distinguish different residential areas. They are rural, suburban, urban and urban/industrial interface.

For the purposes of a conservative assessment, ALC will assess noise emissions in accordance with the 'Urban' category.

Table 13 – NPfI Project Amenity Criteria

Type of Receiver	Time of day	Recommended Amenity Noise Level dB(A)$L_{eq(15mins)}$
Residential (Urban)	Daytime (7am-6pm)	58*
	Evening (6pm-10pm)	48*
	Night-time (10pm-7am)	43*
Commercial	When in Use	65

***Correction of -5dB(A) & +3dB(A) has been applied in accordance with the *NPfI* procedures.**

6.2.3 Summary of Project Criteria

6.2.3.1 Activity Noise

External Nosie Emission Criteria

Table 14 – Activity Noise External Noise Emission Criteria

Type of Receiver	Time of day	Recommended Amenity Noise Level dB(A)$L_{eq(15mins)}$
Any surrounding affected residential receiver	Daytime (7am-6pm)	58
	Evening (6pm-10pm)	48
	Night-time (10pm-7am)	43
Commercial	When in Use	65

Internal Nosie Emission Criteria

ALC have previously conducted ambient internal noise measurements within a residential apartment in 161 Redfern Street. This measurement was conducted with all façade elements closed and air conditioning switched off. The internal ambient noise level measured in this apartment will be representative of the internal noise levels within apartments located along the eastern façade of 9 Gibbons Street, facing the rooftop terrace.

Table 15 – Internal Criteria for Residential Receivers – Acoustic Objectives dB(A)$L_{eq(15minutes)}$ (Background + 5dB)

Location	31.5Hz	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	A-wt
Apartment 161 Redfern Street	37	37	36	32	30	28	20	11	5	**32**
Criteria	40	40	39	35	33	31	23	14	8	**35**

Internal Nosie Emission Criteria for Commercial Receivers

The rooftop terrace is unlikely to impact on the commercial tenancies of surrounding properties, as they are located either on ground level or levels 1,2 and the terrace is proposed on level 18.

6.2.3.2 Noise from any External Mechanical Plant and Equipment

The following table outlines the noise emission goals for any future external mechanical plant and equipment servicing the proposed development.

Table 16 – External Noise Emission Goals

Type of Receiver	Time of day	Measured Rating Background Noise Level dB(A) $L_{90(15minutes)}$	NSW EPA Amenity Criteria dB(A) $L_{eq(15mis)}$	NSW EPA Intrusiveness Criteria (Background + 5dB) dB(A) $L_{eq(15minutes)}$
Residential	Day (7am-6pm)	56	58	61
	Evening (6pm-10pm)	52	48	57
	Night (10pm-7am)	45	43	50
Commercial	When in use	-	65	-

6.3 PREDICTED NOISE EMISSIONS

6.3.1 Activity Noise

The rooftop terrace will generally be used as a relaxation space, with seating and BBQ facilities. The terrace will only be accessible to tenants and will not be permitted to be used for parties and amplified events.

Noise emission predictions to the identified adjoining and surrounding sensitive receivers are based on the following assumptions;

- A total of 100 patrons occupying this space at any given time.
- Sound power level of vocal noise from a patron is 75 dB(A) L_{eq}, with one on two speaking at any one time. This is based on measurements of elevated speech patron noise in other outdoor terrace spaces (with no amplified music). Sound spectrum used in this analysis is as follows:

Table 17 – L_{eq} Sound Power Level Spectrum of Single Patron

Noise Level dB – Frequency (Hz)									
31.5	63	125	250	500	1k	2k	4k	8k	**A-wt**
60	60	68	68	74	71	66	57	45	**75**

- The internal noise criteria of council (section 6.2.1) requires all external doors and windows of the affected residence closed. We will assume standard glazing to all façade glazed elements, which represents a conservative approach (these glazing systems are more likely to be thick single glazing i.e. 6.38mm, 10mm or 10.38mm laminate). STC of standard full height sliding door with acoustic seals is as follows;

Table 18 – Transmission Loss of Standard Glazed Sliding Door with Seals

31.5	63	125	250	500	1k	2k	4k	8k
15	19	22	24	27	33	28	34	40

- Acoustic treatments and management controls recommended in section 6.4 below.

Noise levels are predicted below, assuming most of the patrons (approx. 25 patrons) are located towards the northern end of the terrace, at the façade of the residential apartments to the north. This façade is approx. 12m from the current DA outline, as shown in figure below.

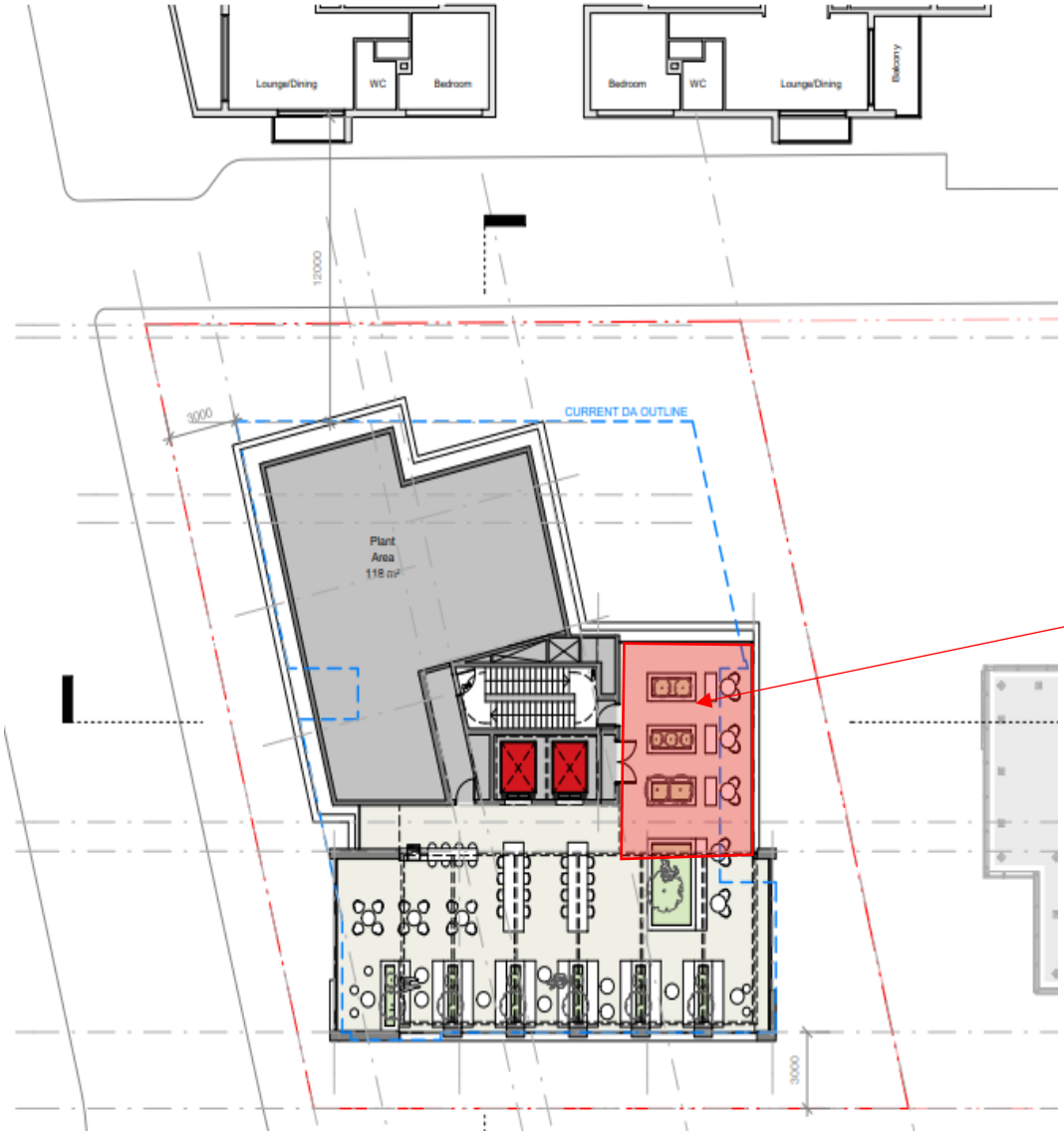


Figure 4 – Proposed Rooftop Terrace

Table 19 – Noise Emissions from the Rooftop Terrace (External)

Type of Receiver	Predicted Noise Level dB(A)$L_{eq(15mins)}$	Recommended External Noise Level Criteria dB(A)$L_{eq(15mins)}$
Residential apartments in the properties at 9 Gibbons Street and 161 Redfern Street	45	48*

***Evening period requirement is more stringent than daytime.**

Table 20 – Noise Emissions from Rooftop Terrace (Internal)

Descriptor	31.5Hz	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	A-wt
Predicted Noise Level dB(A)$L_{eq(15mins)}$	<20	<20	<25	<23	<26	<17	<17	<2	0	**<25**
Criteria dB(A)$L_{eq(15mins)}$	40	40	39	35	33	31	23	14	8	**35**
Complies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	**Yes**

6.4 RECOMMENDATIONS AND MANAGEMENT CONTROLS

6.4.1 Activity Noise

The following building and management controls are recommended;

- The terrace must be restricted to a maximum of 100 patrons at any given time.
- The terrace cannot be used during the night-time period (10pm-7am).
- No amplified music is permitted in this space.
- Construct a solid screen (FC, timber, glass, Perspex etc.) on top of the parapet wall as illustrated below. Total height (including) parapet must be 2m.

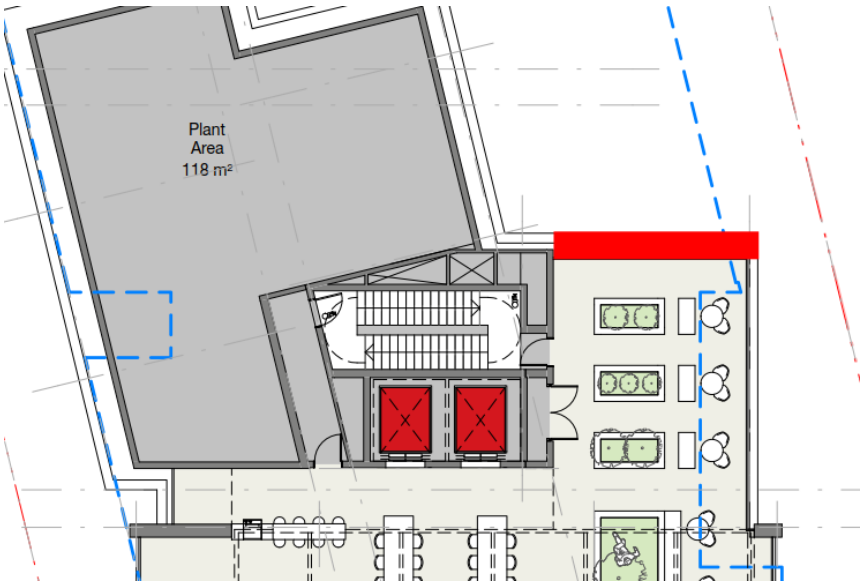


Figure 5 – Recommended Acoustic Screen to Terrace

6.4.2 Noise from any External Mechanical Plant and Equipment

Mechanical plant design has not been undertaken at this stage, as plant selections and layout have not been determined. This is typically only done after DA approval. We recommend that a detailed review of all external mechanical plant and equipment be undertaken at CC stage (once plant selections and locations are finalised), to determine minimum acoustic treatments required to ensure compliance with NSW EPA requirements.

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

7 CONCLUSION

This report presents the results of an acoustic assessment of potential noise impacts associated with the 'Iglu II' student accommodation development, located at 80-88 Regent Street, Redfern.

- Noise impacts from existing environmental noise sources on future occupants of the development, have been assessed in accordance with the requirements of the Sydney DCP 2012, NSW DoP Infrastructure SEPP 2007 and Australian Standard 2107-2016. The acoustic treatments necessary to achieve compliance with the requirements contained within these guidelines have been set out in section 4.3.1.

- Potential vibration impacts from the Sydney Trains below ground rail infrastructure, located approximately 55m from the western boundary of the site, was also assessed. Based on vibration level measurements conducted on site (section 5.2, no adverse vibration impacts are on the proposed

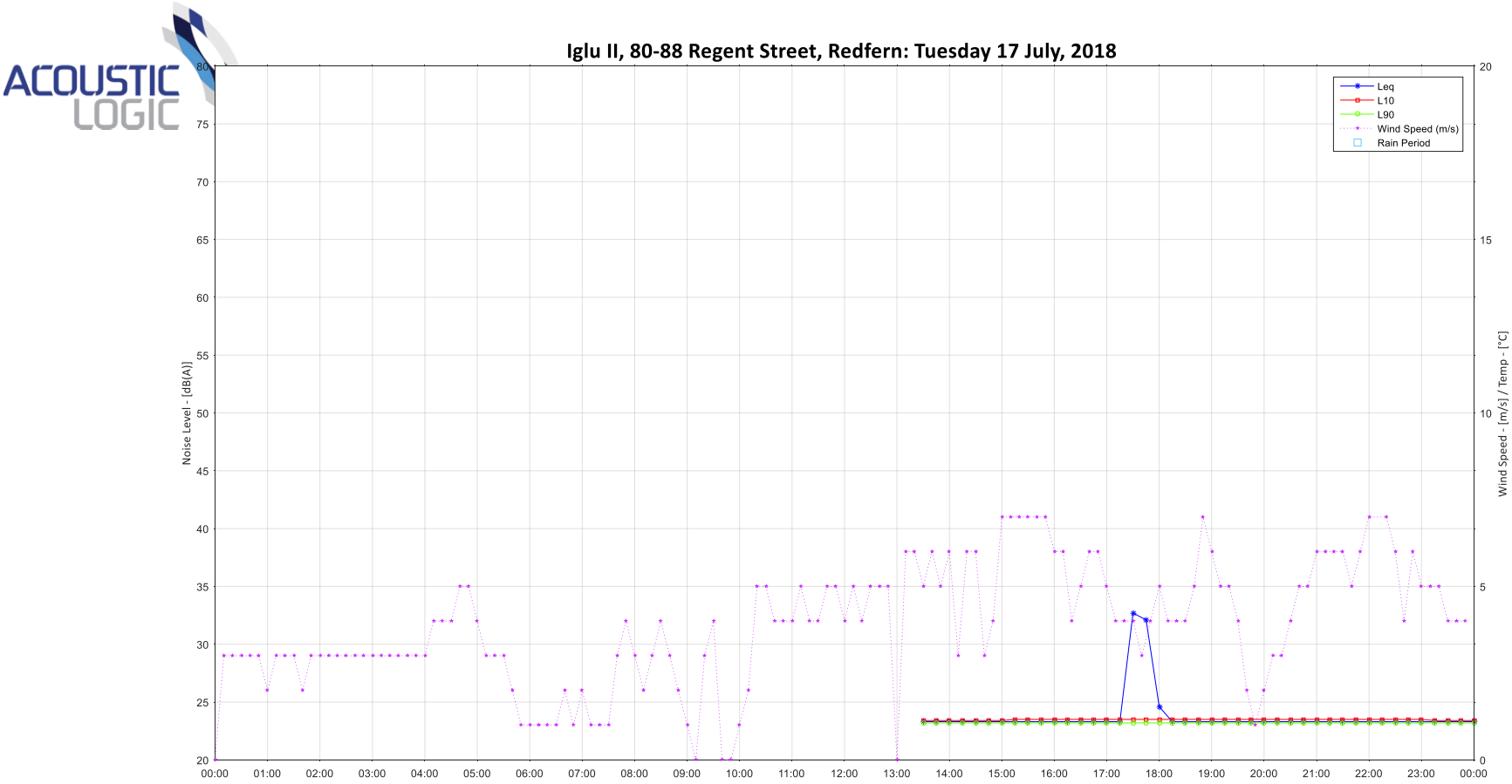
- Noise emissions objectives for the site have also been determined, based on the noise emission guidelines typically adopted by council and the requirements of NSW EPA. This is outlined in section 6.2.3 above. Potential noise emissions from the use of the rooftop terrace was also predicted. Provided the recommendations and management controls detailed in section 6.4.1 of this report are implemented in full, noise impacts from the use of this space will comply with the criteria detailed in section 6.2.3.1.

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

Yours faithfully,

Yogendra Kalkunte

APPENDIX 1 – NOISE LOGGING DATA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Rain Period
Noise Level - [dB(A)]
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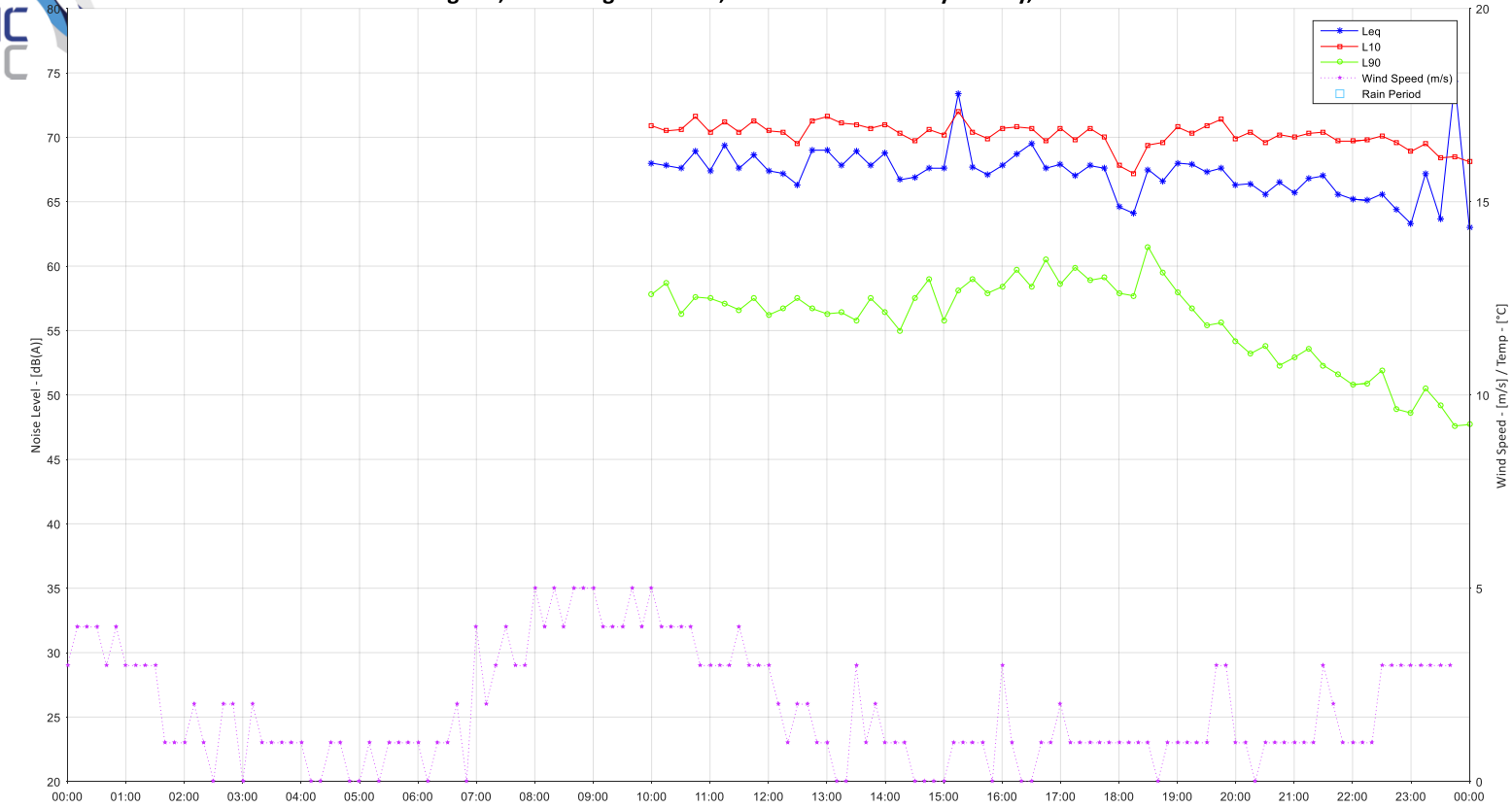
Iglu II, 80-88 Regent Street, Redfern: Wednesday 18 July, 2018
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Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
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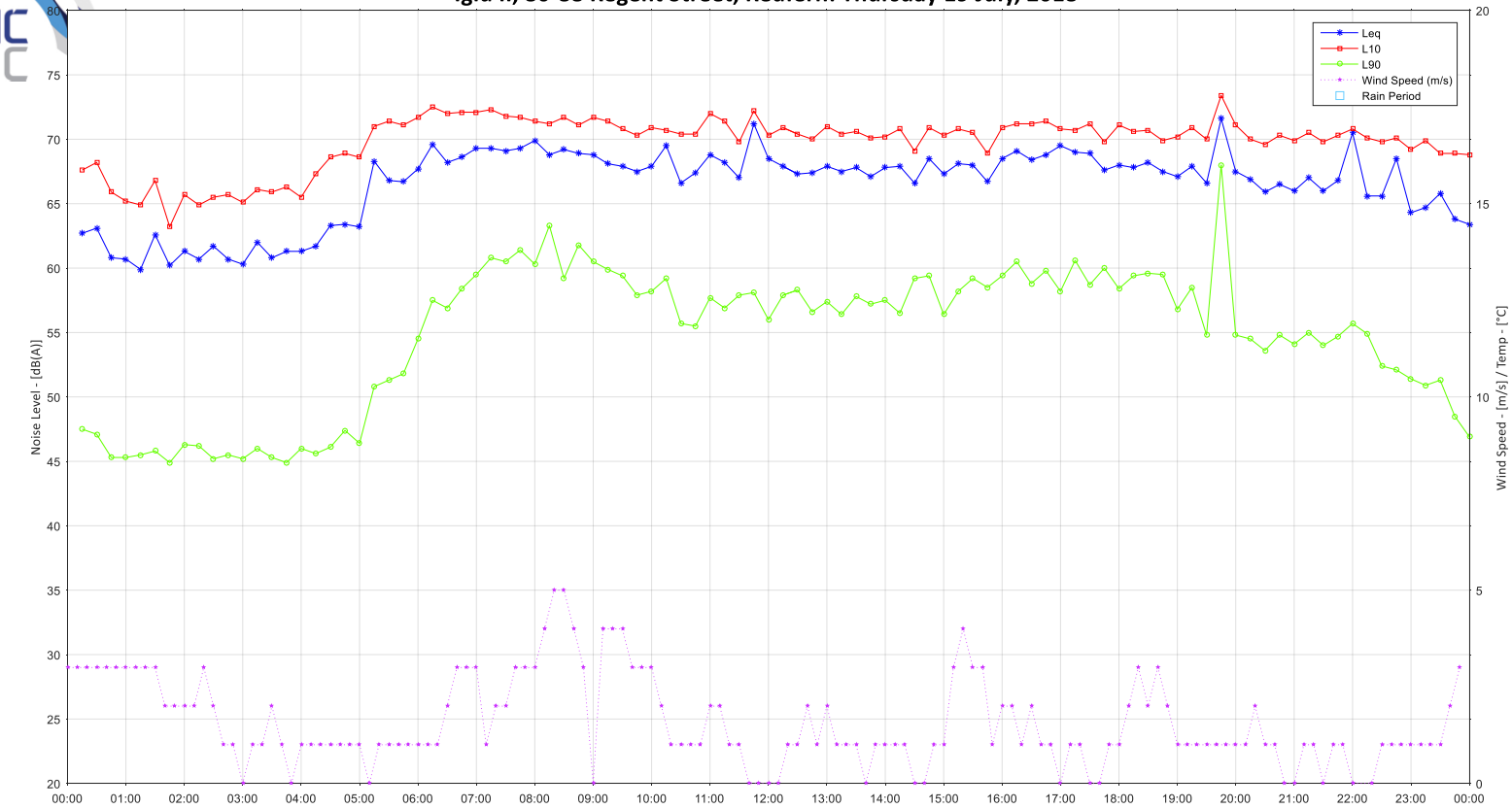
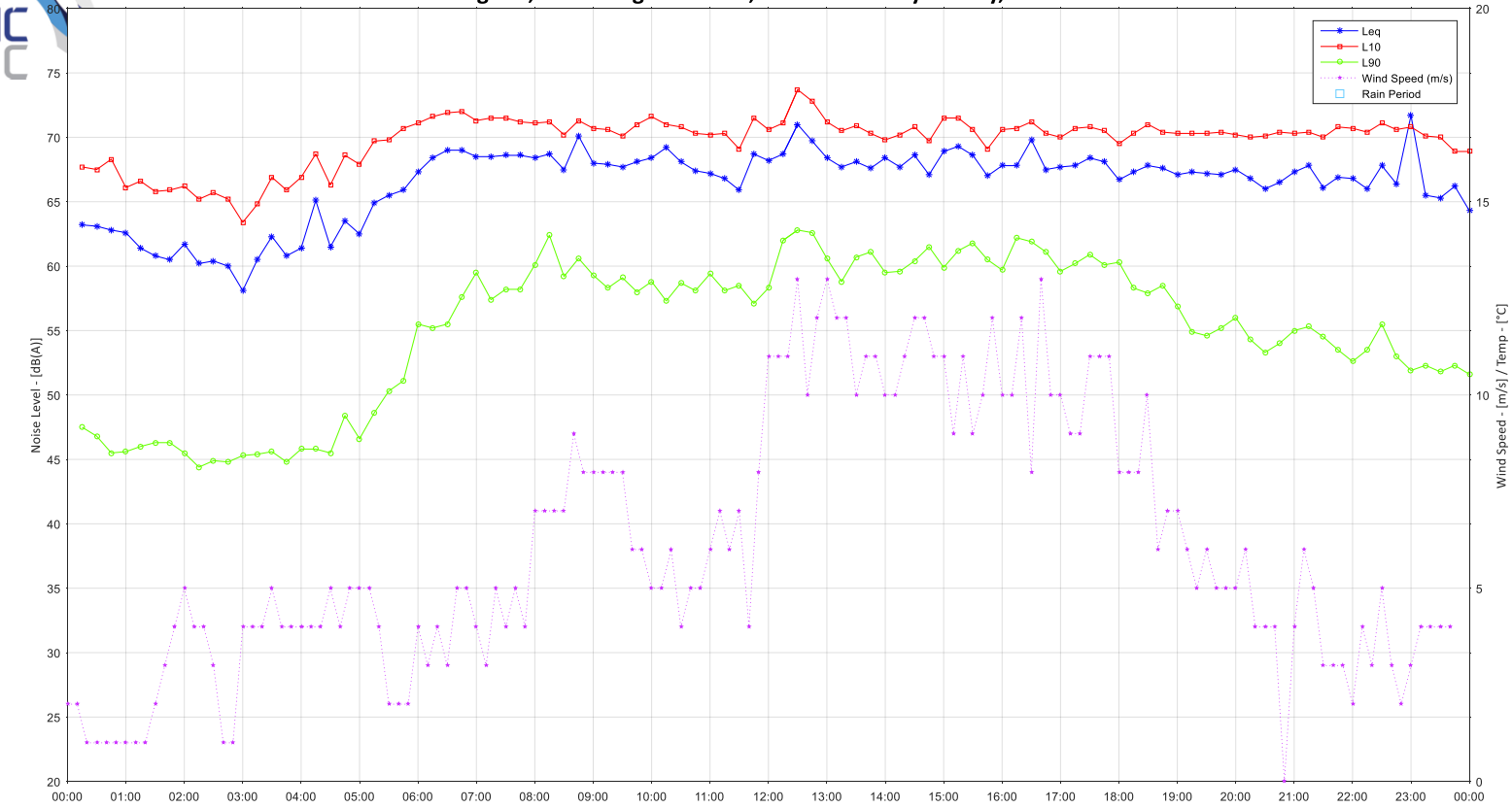
ACOUSTIC LOGIC

Iglu II, 80-88 Regent Street, Redfern: Thursday 19 July, 2018

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Rain Period
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
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ACOUSTIC LOGIC

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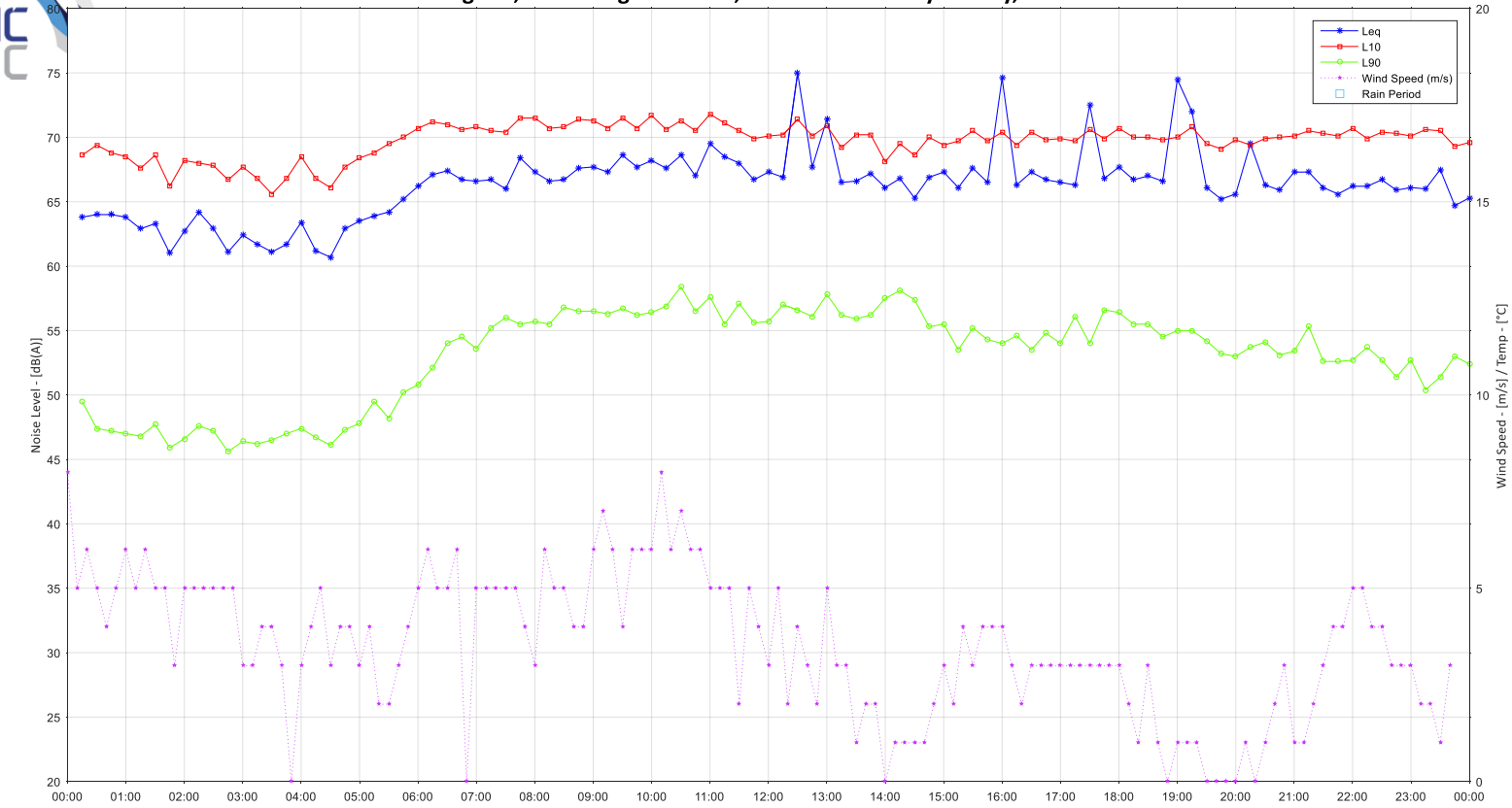
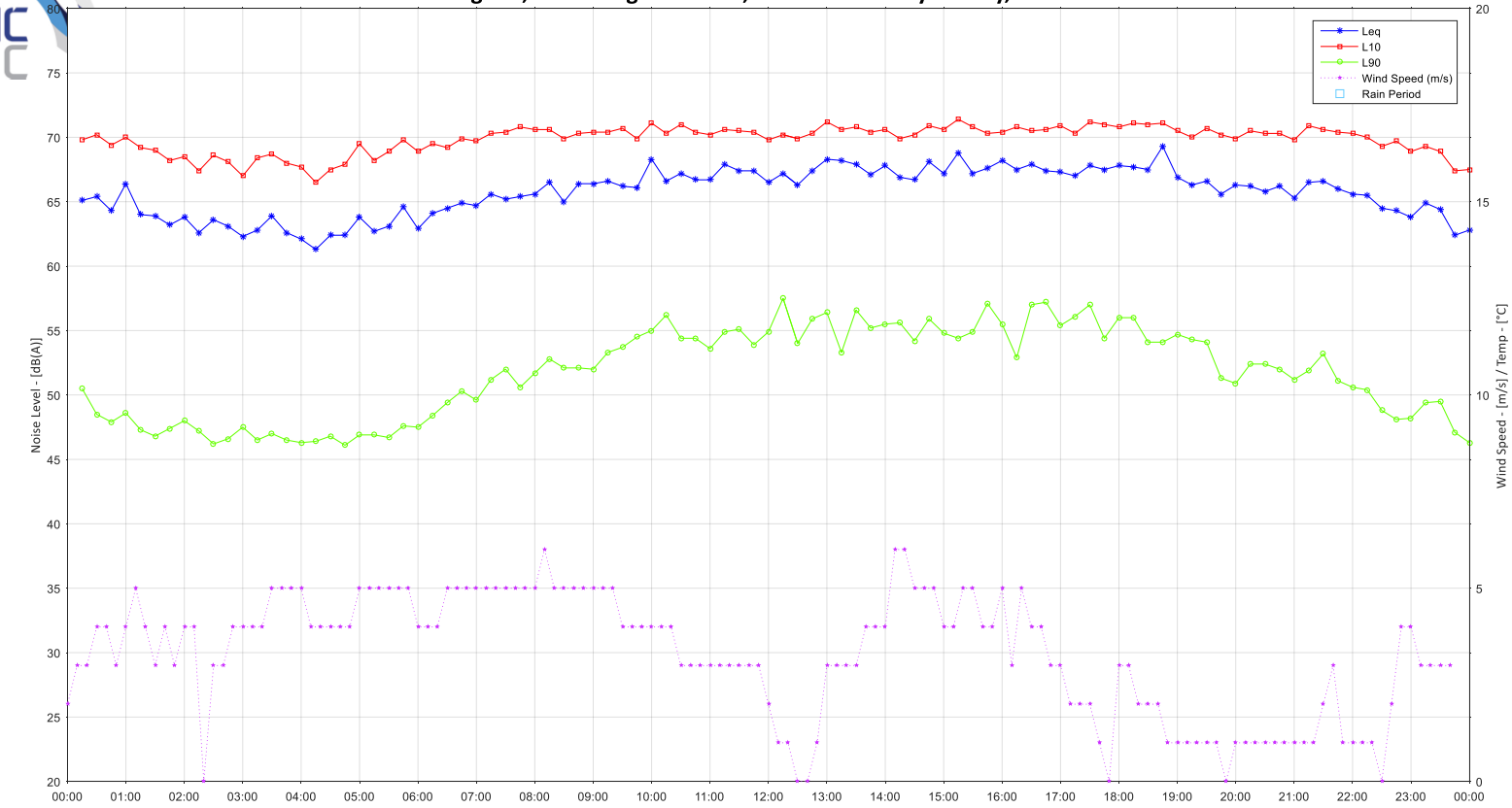


ACOUSTIC LOGIC

Iglu II, 80-88 Regent Street, Redfern: Sunday 22 July, 2018



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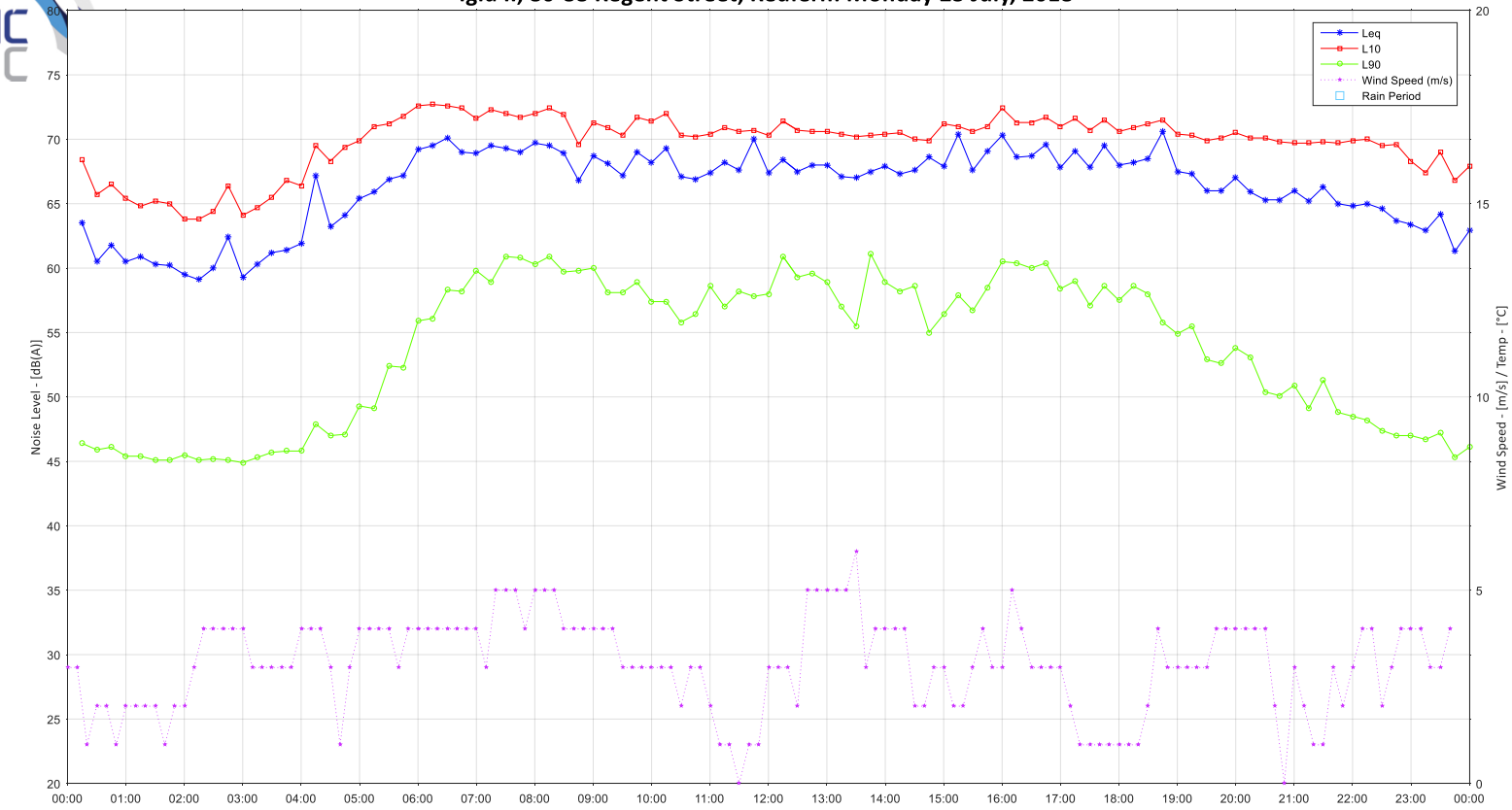
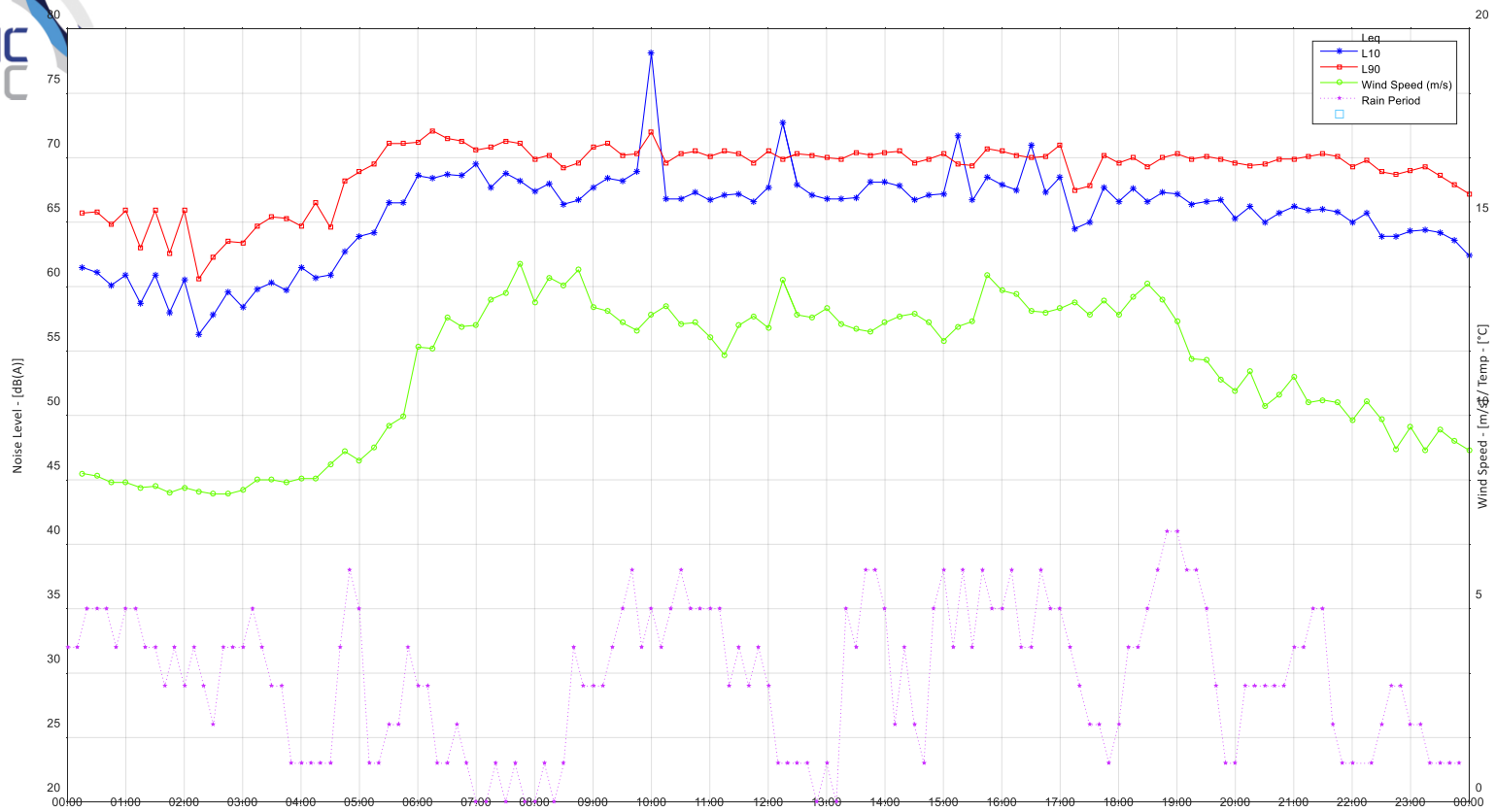
Iglu II, 80-88 Regent Street, Redfern: Monday 23 July, 2018



Iglu II, 80-88 Regent Street, Redfern: Tuesday 24 July, 2018



ACOUSTIC LOGIC

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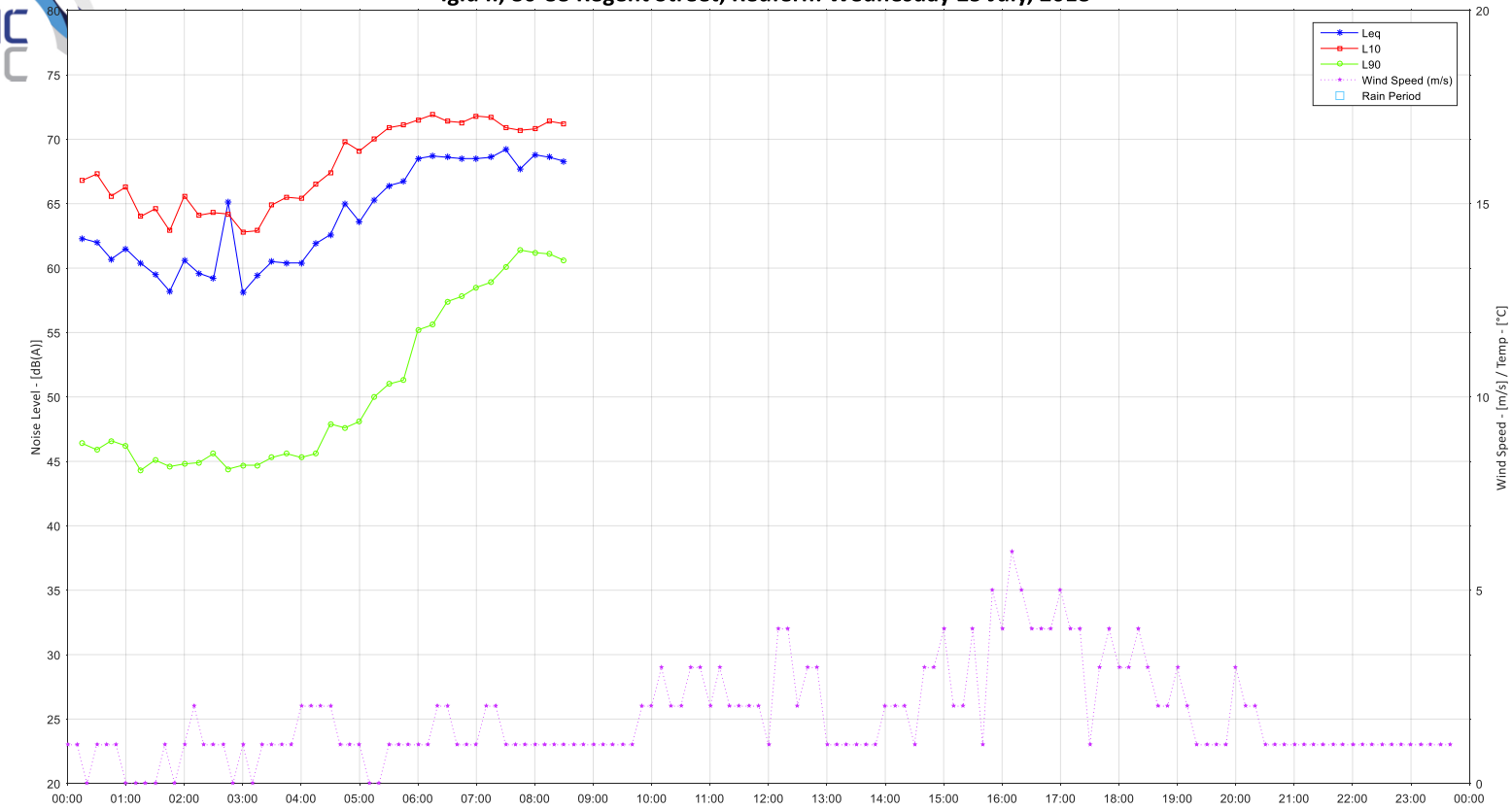

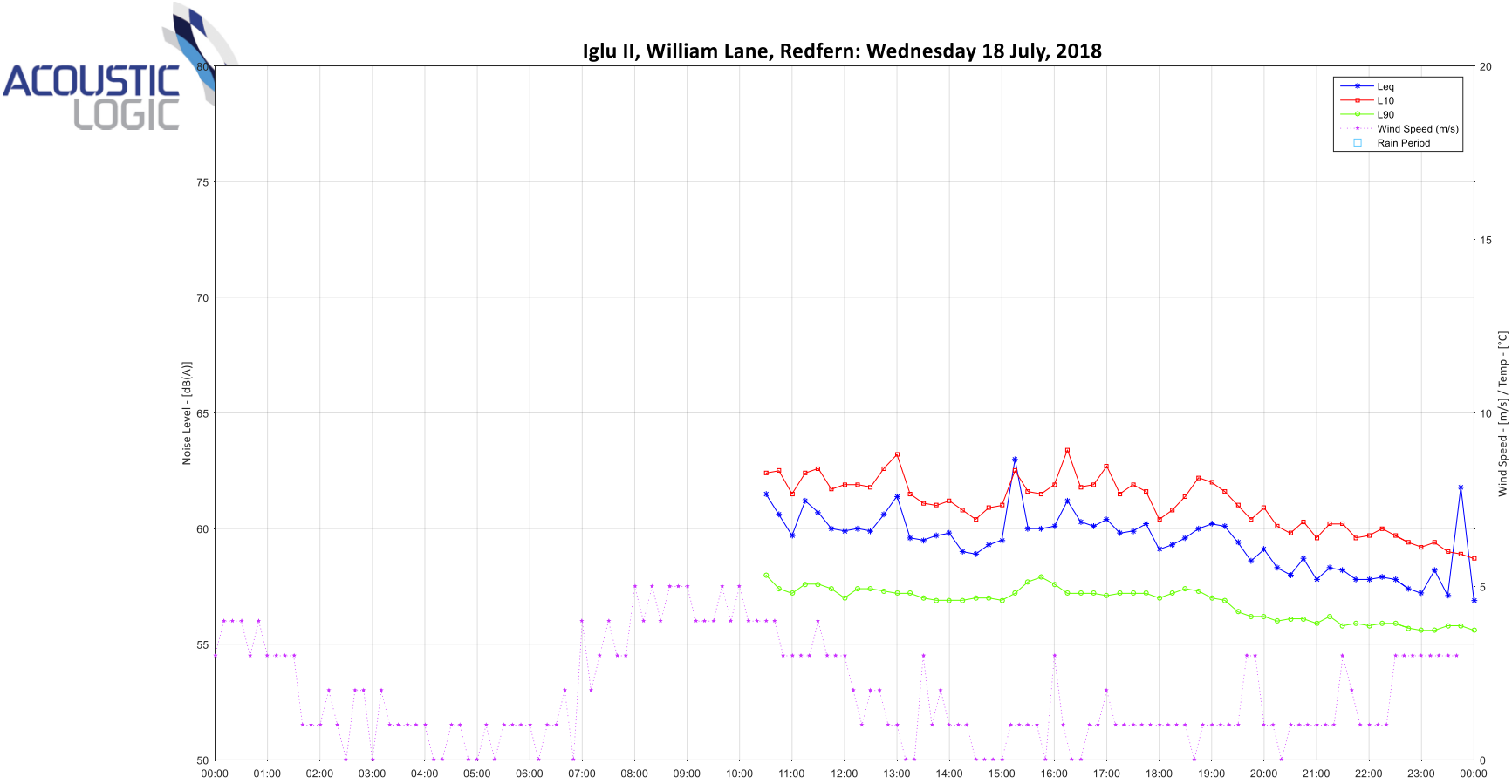
Iglu II, William Lane, Redfern: Wednesday 18 July, 2018
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Wind Speed (m/s)
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Wind Speed - [m/s] / Temp - [°C]
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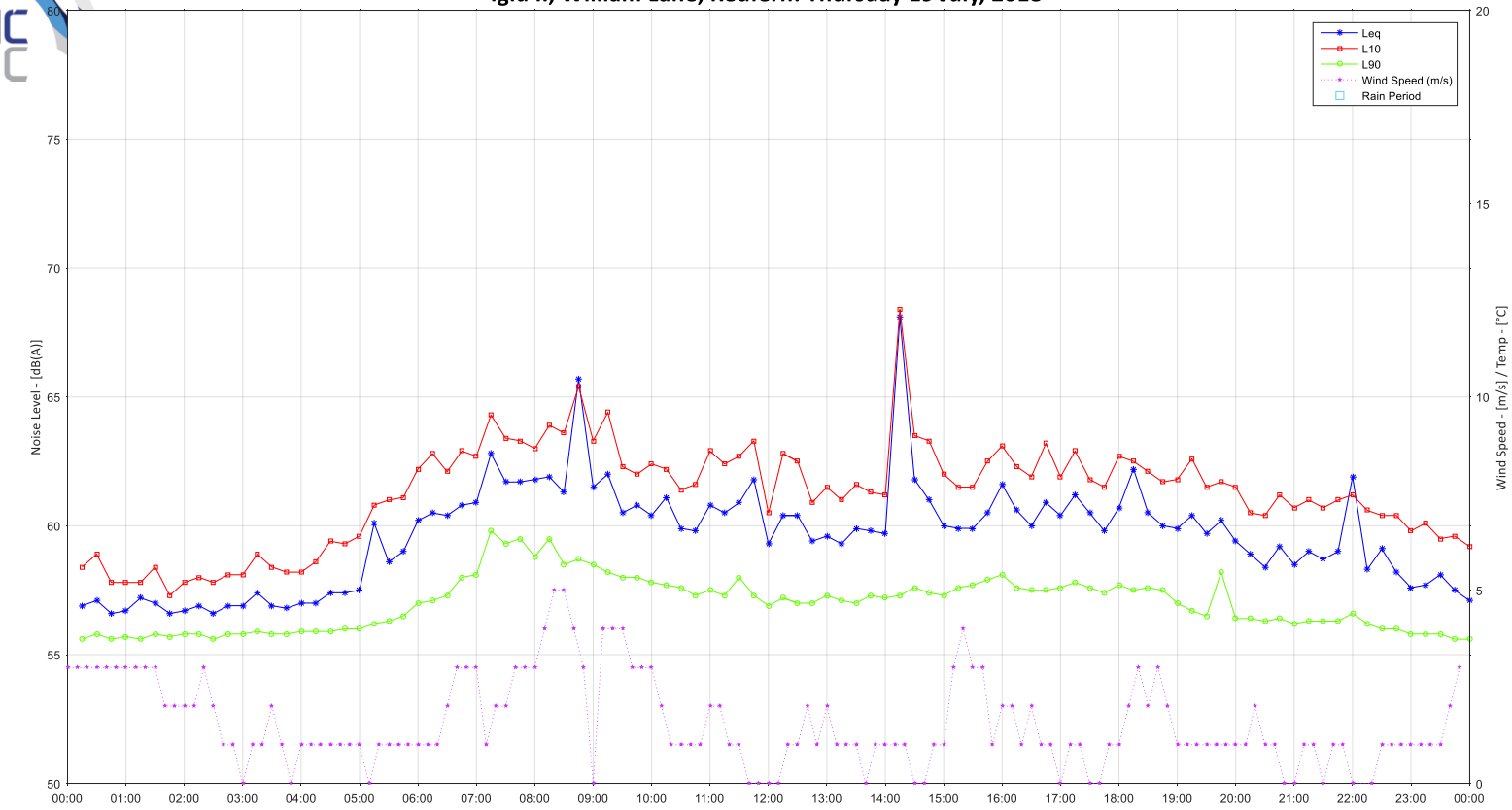
Iglu II, William Lane, Redfern: Thursday 19 July, 2018
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Wind Speed (m/s)
Rain Period
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
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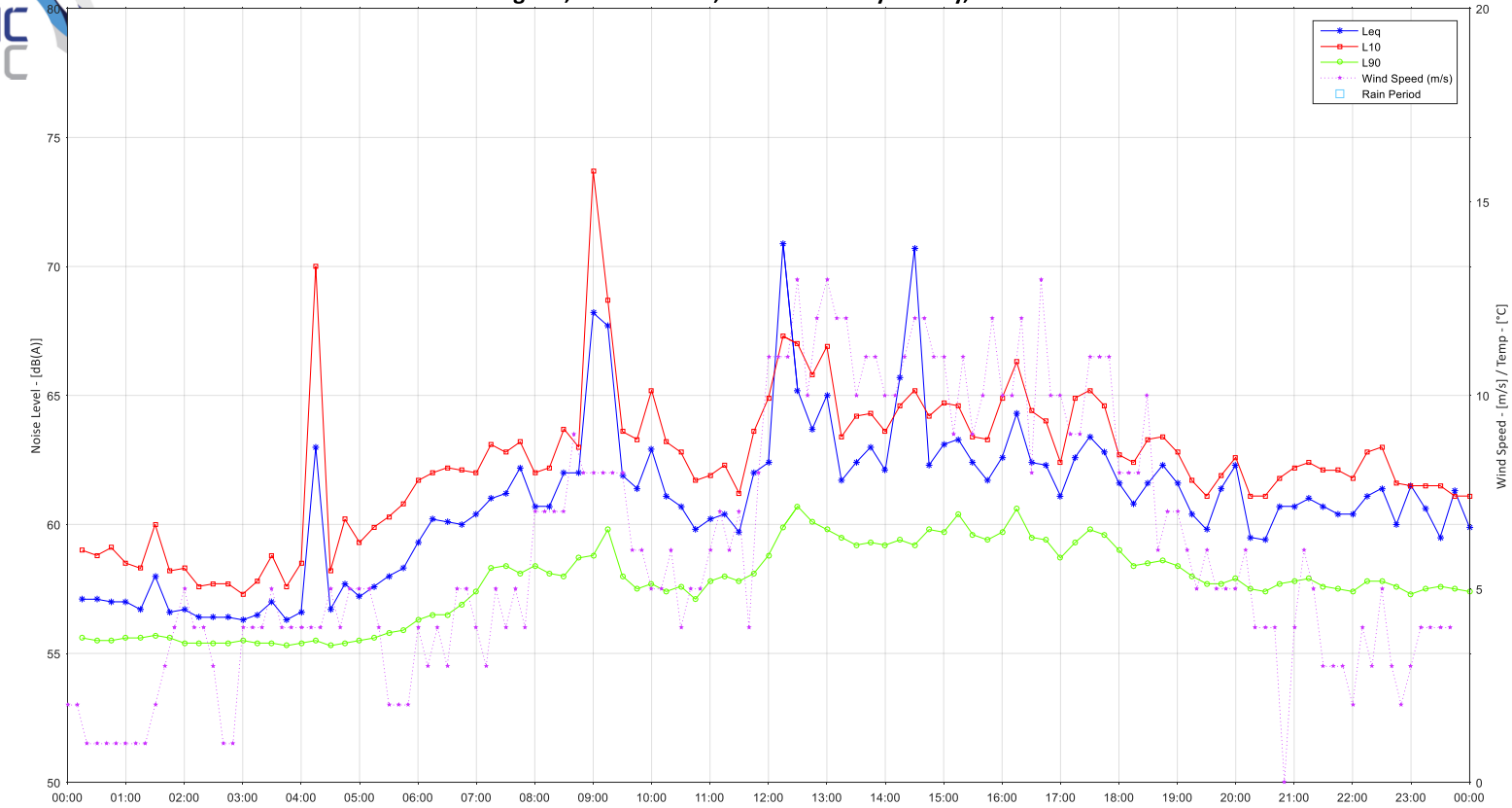
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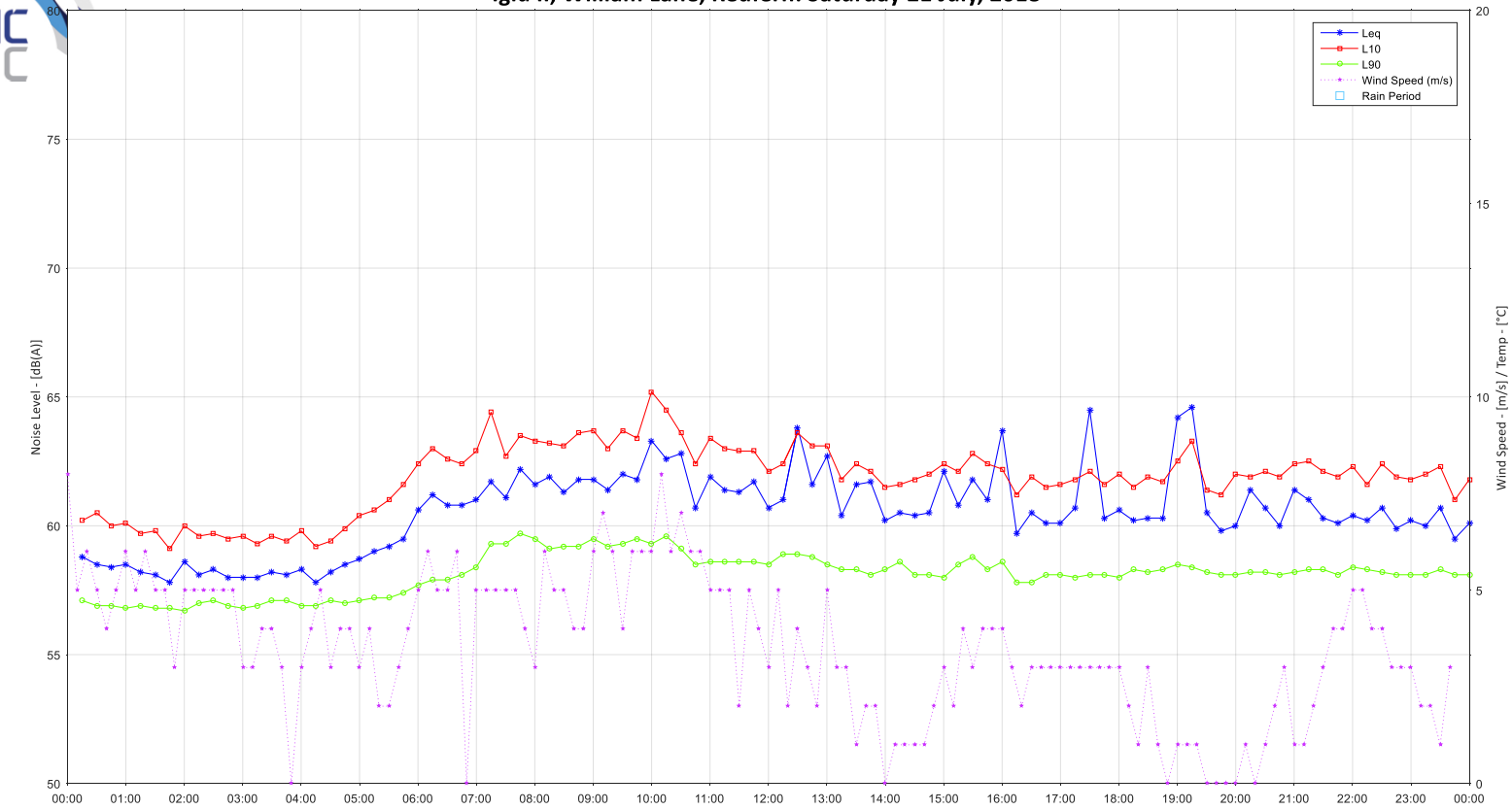
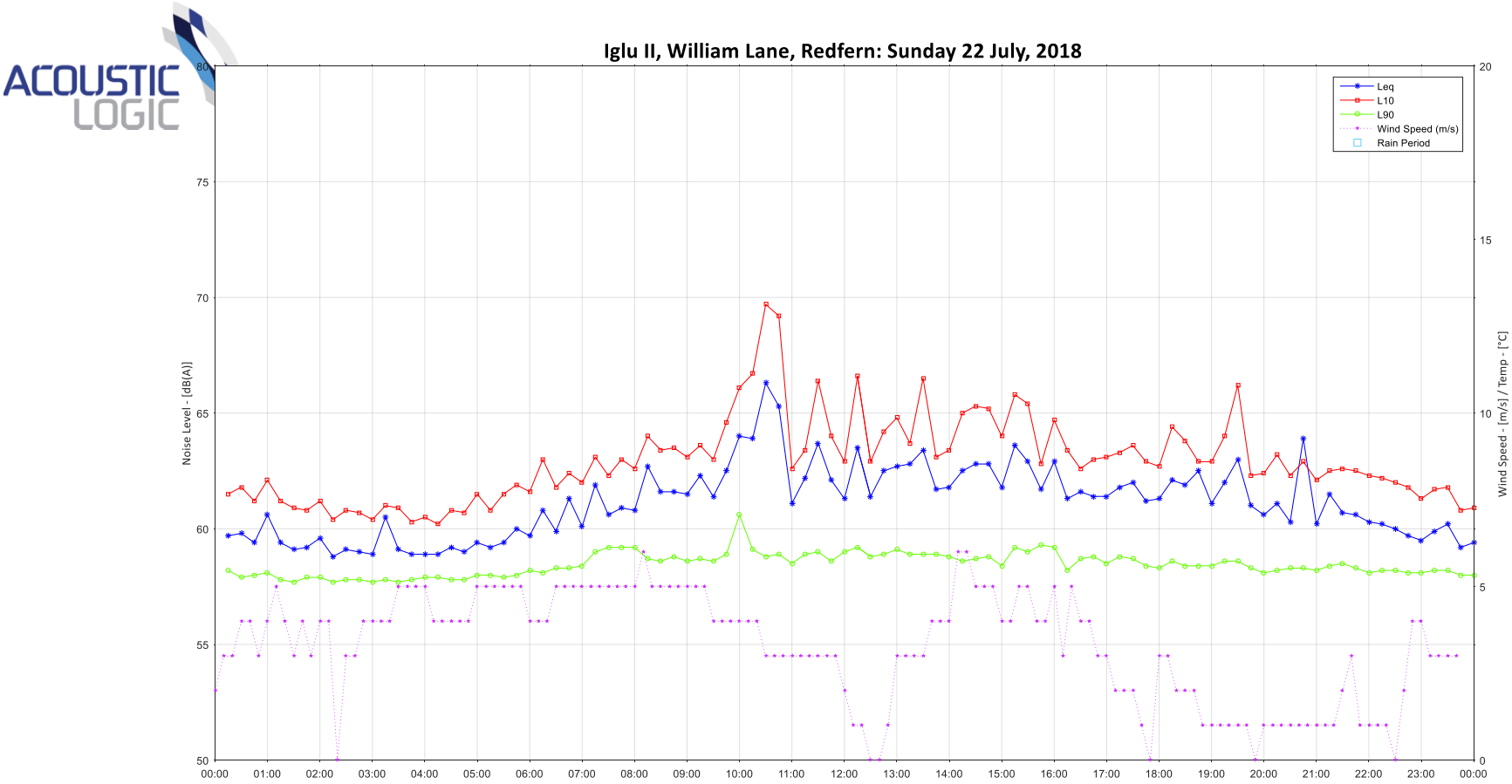
ACOUSTIC LOGIC

Iglu II, William Lane, Redfern: Saturday 21 July, 2018

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Wind Speed (m/s)
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Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
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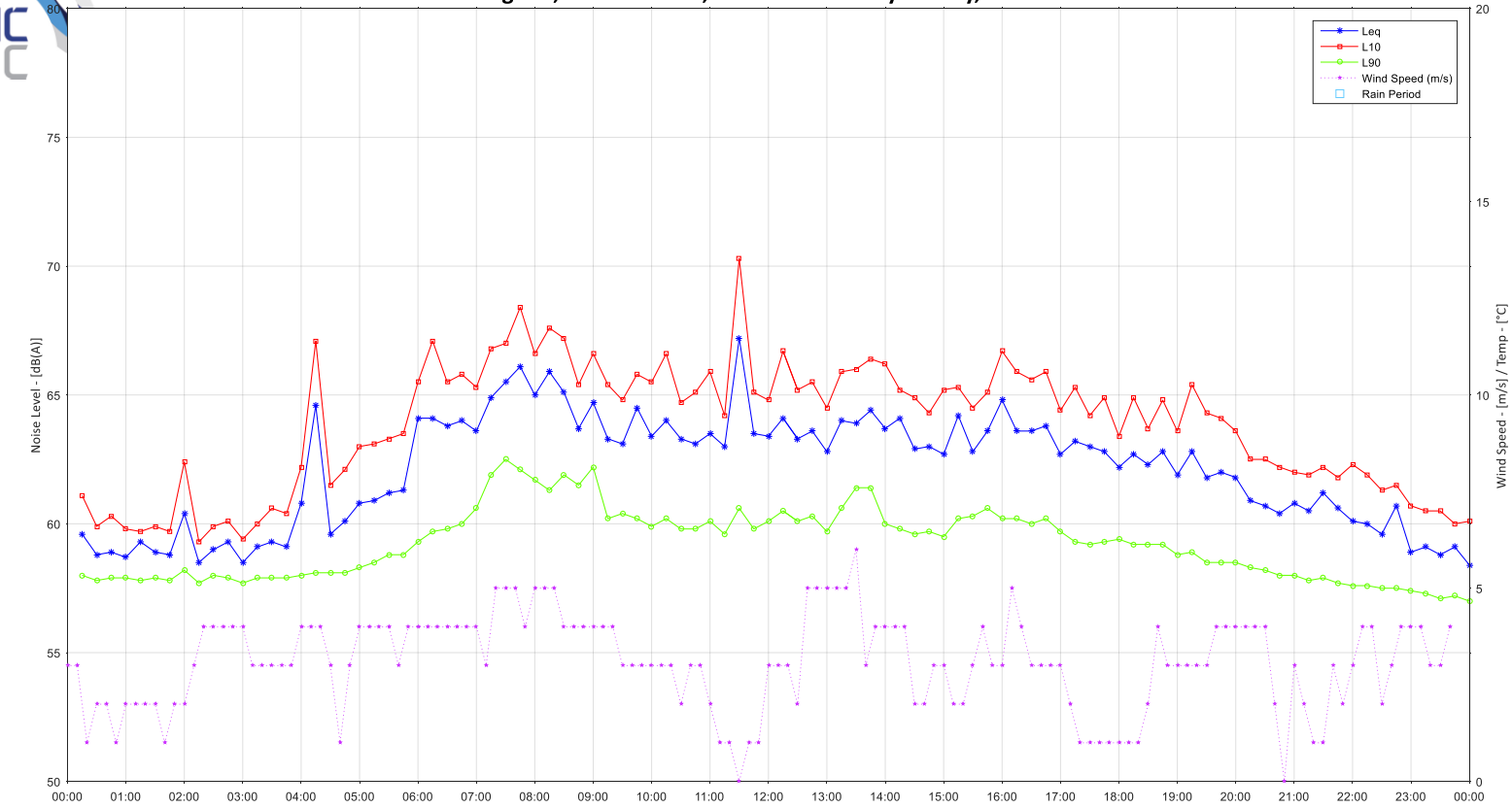
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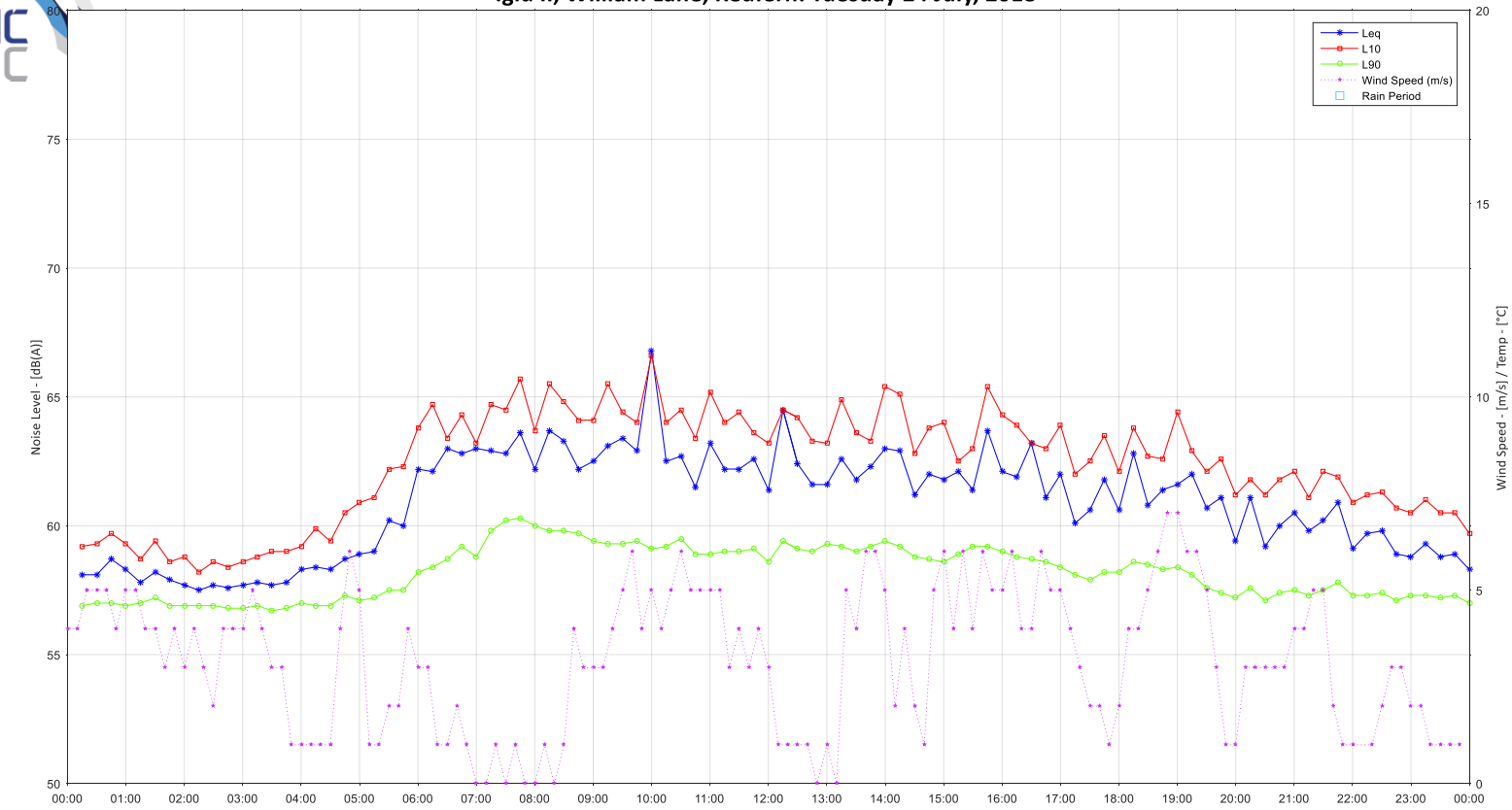
Iglu II, William Lane, Redfern: Tuesday 24 July, 2018
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Wind Speed (m/s)
Rain Period
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
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ACOUSTIC LOGIC

Iglu II, William Lane, Redfern: Wednesday 25 July, 2018