

MANAGING DIRECTORS

MATTHEW PALAVIDIS
VICTOR FATTORETTO

DIRECTORS

MATTHEW SHIELDS



The Ribbon, Hotel and Serviced Apartments

Noise 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

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1 INTRODUCTION

This report presents an assessment of potential environmental noise impacts associated with the Ribbon development at 1 Wheat Road, Sydney development, located within the Darling Harbour precinct Sydney.

In this report we will:

- Identify environmental noise sources which may impact on the site (road traffic, precinct/entertainment noise) and recommend acoustic treatments to reduce these impacts to acceptable levels.
- Identify potential noise sources generated by the site, and determine noise emission goals for the development to ensure that nearby developments are not adversely impacted.

This report has been prepared to address the reporting requirements of condition of consent B5, and E9.

Condition B5 states:

Prior to issue of a Construction Certificate for Stage 2, a detailed Noise Impact Assessment shall be prepared that provides an assessment of noise levels associated with internal and external noise sources including:

- (a) traffic noise from adjoining roadways;
- (b) external noise within the tourist and entertainment precinct including major events; and
- (c) future internal noise impacts associated with non-hotel/serviced apartment uses and mechanical plant.

The Noise Impact Assessment shall provide an assessment of internal acoustic amenity of the hotel and serviced apartment uses having regard to internal and external noise sources and if necessary provide specific recommendations to ensure an acceptable level of acoustic amenity is provided for the serviced apartment and hotel uses in accordance with the *NSW Industrial Noise Policy, Interim Guidelines for Development near Rail Corridors and Busy Roads* and relevant Australian Standards.

The Noise Impact Assessment and amended plans showing any required noise mitigation measures shall be submitted for the Secretary's approval

Condition E9 states:

Prior to the issue of the Stage 2 Occupation Certificate, certification from a suitably qualified person shall be submitted to the Certifying Authority confirming the development complies with the recommendations of the noise impact assessment prepared by Acoustic Logic dated 21 December 2015 and the noise impact assessment required as part of Condition R19.

2 SITE DESCRIPTION

The proposed development is located within the Darling Harbour precinct on the existing IMAX Theatre site.

The site is bounded by the Western Distributor to the north and south. The Western Distributor carries high volumes of traffic during all times of the day and night.

The following noise sources potentially impact on the project site:

- Traffic noise from the Western Distributor.
- Noise from within the Darling Harbour/Tumblong Park/Darling Square precincts (entertainment noise etc).
- Noise from non-residential uses within the development itself (most critically, the IMAX theatre located below residential/serviced apartment use).

Noise potentially generated by the site will consist primarily of noise from the proposed mechanical plant serving the project site, as well as any operational noise from future tenants.

There is a proposed rooftop bar and pool area on levels 22 & 23 of the development, with the sky deck and pool areas largely uncovered. The proposed capacity of the venue would be up 300 patrons and it is expected that amplified music would be played within the space. It is likely that the rooftop bar area would operate past 12am (midnight)

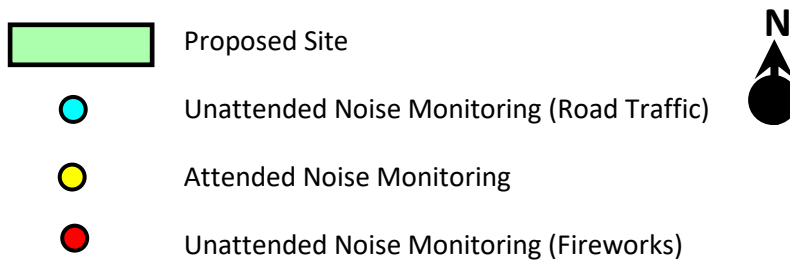
The nearest potentially affected noise receivers are the commercial/hotel areas within Darling Harbour and Darling Square Precincts.

The nearest residential development to the site is located at Millennium Towers on the corner of Bathurst, Sussex and Day Streets.

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



Figure 1 – Site Map



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.

L_{max} noise levels are the maximum noise levels recorded in a measurement period.

4 EXTERNAL NOISE INTRUSION ASSESSMENT

This section of the report presents the internal environmental noise assessment conducted into the proposed development.

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

- Traffic noise on the Western Distributor (City Bound and Westbound lanes).
- To a lesser degree, general patron/activity noise from the Darling Harbour/Tumbalong entertainment precincts.

4.1 ACOUSTIC OBJECTIVES

4.1.1 Commercial Areas

Australian Standard AS/NZS2107:2000 “*Recommended Design Sound Levels and Reverberation Times for Building Interiors*”, will be used to determine recommended design sound levels for commercial buildings.

Table 1 below, details the criteria applicable to this development.

Table 1 – Internal Noise Level Criteria

Space/ Activity Type	Recommended design sound level (AS2107)
Commercial Developments (retail and open plan offices - excluding Imax Theatre)	45 dB(A) $L_{eq}(1 \text{ hour})$

Note – internal noise levels within the Imax Theatre to be determined in consultation with Imax operators.

4.1.2 Residential Areas

4.1.2.1 City of Sydney DCP

The Sydney DCP 2012 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) | <i>for closed windows and doors::
bedrooms (10pm-7am),
main living area (24 hours)</i> | <i>35dB; and
45dB</i> |
| ii) | <i>for open windows and doors:
bedrooms (10pm-7am), 45dB; and
main living area (24 hours), 55dB.</i> | <i>45dB
55dB</i> |

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.”

4.1.2.2 State Environmental Planning Policy (SEPP Infrastructure) 2007 and NSW Planning Document Development Near Rail Corridors and Busy Roads

Although not directly referred to in the City of Sydney Council DCP (2012) the road traffic noise criteria, as specified in the State Environmental Planning Policy (SEPP Infrastructure) 2007, additionally applies to this site.

Clause 102 of the SEPP states:

“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 LAeq 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.”

These criteria are mirrored in the NSW Planning document *Development near Rail Corridors and Bus Roads*.

4.1.3 Entertainment Precinct Noise

There are three primary scenarios to consider with respect to noise from major events:

- Vocal noise from patrons.
- Noise played over PA system from a major event.
- Noise from fireworks over Darling Harbour (typically at 9pm on Saturday night).

With respect to these noise sources:

- Vocal Noise - At the windows of the hotel/serviced apartments, vocal noise from patrons within the entertainment precinct will be significantly lower than the noise level from the Western distributor (an arterial road, located approximately 3m from the building façade). The glazing systems used to address road traffic noise impacts will easily address vocal noise from large groups of patrons in the entertainment precinct.
 - The lowest residential level is located approximately 25m above the concourse. In the event that a large crowd of up to 400 people speaking with raised voice were to gather on the concourse in the immediate vicinity of the footprint of the hotel, the sound pressure level resulting at lowest residential levels would be up to 61 dB(A) $L_{eq}(15min)$.
 - We note that the deck level of the Western Distributor is approximately 12m above the concourse level, and as such the deck level of the Western Distributor sits between any activity on the concourse and the lowest level of guestroom. The night time road traffic noise level incident on the façade of the lowest level of guestrooms is approximately 71 dB(A), which is significantly louder than what would be generated by a given very large crowd in the vicinity of the building.
 - We note that the façade to the guestrooms has been designed such that the internal noise level as a result of road traffic noise will be 35 dB(A) L_{eq} or less as a result of road traffic noise (which is consistent with target internal noise levels for sleeping areas for sites impacted by significant external noise sources).
 - The internal noise level as a result of activity noise from the concourse will be significantly less than this. As such the activity noise from the concourse will be attenuated to ensure a reasonable level of amenity within guestrooms.
- PA System Noise:
 - The location and volume of a PA system speaker is not known and the noise level incident on the façade of the Ribbon development is therefore also not known.
 - It would be expected, however, that any special event would be subject to noise limits at existing residential/hotel development (Oaks Goldsbrough Apartment to the west, Parkroyal Hotel to the east).
 - Given the extremely high level of acoustic treatment required to the Ribbon façade to address traffic noise (see section 4.3), the noise impact to internal areas of the Ribbon will be equal or less than those at the Parkroyal/Oaks Goldsbrough apartments, which although further away, would be expected to have a lower acoustic performance façade.

- Fireworks
 - The acoustic criteria set out in section 4.1.2 do not address short term special events, instead, they are focussed on long term traffic noise impacts. In setting a noise goal for this event the following is taken into account:
 - Can conversation readily be maintained in the internal area during the fire works (window closed).
 - The chance of sleep disturbance.
 - Taking these items into account, an internal noise goal of 55-60dB(A) is reasonable in that:
 - Speech can easily be maintained with these noise levels and
 - The fireworks are typically quite early in the evening, and for short duration.
 - The chance of sleep disturbance is relatively low (In this regard we note that EPA guidelines in the Road Noise Policy states with respect to sleep disturbance):

For the research on sleep disturbance to date it can be concluded that:

 - *Maximum internal noise levels below 50-55dB(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.*

4.2 NOISE MEASUREMENTS

4.2.1 Attended Noise Measurements

As part of the noise impact assessment attended traffic noise measurements were conducted at the site at the locations shown above in Figure 1.

The noise measurements were obtained using a Norsonic 140 Sound Level Analyser, set to A-weighted fast response. The sound level meter was calibrated before and after the measurements using a Norsonic 1251 Sound Level Calibrator. No significant drift was recorded.

Attended traffic noise levels were conducted on the 20 and 24 August 2018 during the AM and PM peak periods:

- 9am-10am on 20 August 2018 and
- 4pm-5.30pm on 24 August 2018.

Measurements were made at the following locations:

- 1.5m from the City-bound road of the Western distributor (adjacent to the northern façade of the development and
- 1.5m from the West-bound road of the Western distributor (adjacent to the southern façade of the development and

Measurements were made both above and below the road deck levels to ensure that all relevant noise impacts on the site were quantified.

4.2.2 Unattended Long Term Noise Measurements

Unattended traffic noise measurements were conducted at the site as detailed in figure 1.

The noise logger records all external noise impacting the site (traffic noise, precinct noise etc) however given the proximity of the Western Distribute to the site, it is overwhelmingly road traffic noise that is the dominant external noise impacting the facades of the development.

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 noise 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. There were no significant periods of adverse weather conditions during the measurement period.

The unattended noise level measurements were conducted between from 20 to 24 August 2018. The results of unattended noise logging are included in Appendix A. The logger was located at a location which was not affected by other noise sources such as plant and equipment.

4.2.3 External Noise Measurement Results

4.2.3.1 Road Traffic

Measurements were performed generally in accordance with the Australian Standard AS1055 – Description and Measurement of Environmental Noise – General Procedures.

The traffic noise levels were determined based on the attended measurements and using the long term noise logger data to determine the different between daytime/night time noise levels.

Measurement results are presented below.

Table 2 – External Noise Levels - Worst One Hour - dB(A)_{Leq(1hr)}

LOCATION	TRAFFIC/EXTERNAL NOISE LEVEL	
	Day time 7am-10pm	Night time 10pm-7am
Proposed Northern Façade (1.5m from Western Distributor - City bound)	Above road deck - 79dB(A) _{Leq(worst 1 hour)}	Above road deck - 78dB(A) _{Leq(worst 1 hour)}
	Below road deck - 73dB(A) _{Leq(worst 1 hour)}	Below road deck - 72dB(A) _{Leq(worst 1 hour)}
Proposed Southern Façade (1.5m from Western Distributor – Westbound)	Above road deck - 76dB(A) _{Leq(worst 1 hour)}	Above road deck - 75dB(A) _{Leq(worst 1 hour)}
	Below road deck - 72dB(A) _{Leq(worst 1 hour)}	Below road deck - 71dB(A) _{Leq(worst 1 hour)}

Table 3 – External Noise Levels - Daytime/Night Time Average Levels - dB(A)_{Leq(15/9hr)}

LOCATION	TRAFFIC/EXTERNAL NOISE LEVEL	
	Day time 7am-10pm	Night time 10pm-7am
Proposed Northern Façade (1.5m from Western Distributor - City bound)	Above road deck - 78dB(A) _{Leq(15 hour)}	Above road deck - 74dB(A) _{Leq(9 hour)}
	Below road deck - 72dB(A) _{Leq(15 hour)}	Below road deck - 68dB(A) _{Leq(9 hour)}
Proposed Southern Façade (1.5m from Western Distributor – Westbound)	Above road deck - 75dB(A) _{Leq(15 hour)}	Above road deck - 71dB(A) _{Leq(9 hour)}
	Below road deck - 71dB(A) _{Leq(15 hour)}	Below road deck - 67dB(A) _{Leq(9 hour)}

4.2.3.2 Entertainment Precinct Noise

Measurements of fireworks were conducted on 13/10/2018 by noise monitor placed on the top of the partially constructed lift core at the ribbon site, with direct line of sight to the fireworks (over darling harbour) – see aerial photo, section 2.

The logger was an NGARA model with audio recording enabled to distinguish fire works for any other noise source.

The fireworks period lasted from approximately 9.00pm to 9.07pm and generated momentary noise levels at the northern façade of the ribbon development of up to 102dB(A)_{L_{Max}}.

Noise logging results are attached, Appendix 2.

4.3 RECOMMENDATIONS

Noise intrusion into the proposed development has been assessed using the measured external noise level reported above as the basis. Recommendations have been determined taking into account the orientation of windows, barrier effects (where applicable), the total area of glazing, facade transmission loss and room sound absorption characteristics.

Recommended treatments are set out below.

4.3.1 Glazing

The table below indicates the glazing types that will be required to achieve the recommended internal noise levels.

Table 3 – Recommended Glazing Constructions

Level	Façade	Glazing	Seals
All Residential and Serviced Apartment Levels	All Façade orientations	IGU 11.52mm Laminated Glass / 24mm Argon Filled Cavity / 13.52mm Laminated Glass	Yes

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

In addition to complying with the minimum scheduled glazing thickness, the STC rating of the glazing fitted into openable frames and fixed into the building opening should not be lower than the values listed in Table 5. Where nominated, this will require the use of acoustic seals around the full perimeter of openable frames and the frame will need to be sealed into the building opening using a flexible sealant. Note that mohair seals in windows and doors are not acceptable where acoustic seals are required.

Table 4 – Minimum STC of Glazing

Glazing Assembly	Acoustic Seals	Approximate R_w of Installed Façade System
11.52mm Laminated Glass / 24mm Argon Filled Cavity / 13.52mm Laminated Glass	Yes	44

Any façade system is to be reviewed by Acoustic Logic prior to procurement.

4.3.2 Roof/Ceiling

Any roof of concrete construction will not require upgrading in order to satisfy the project acoustic objectives.

4.3.3 External Walls

External walls are of masonry construction and do not require upgrading in order to satisfy the project acoustic objectives.

5 NOISE FROM INTERNAL AREAS OF THE DEVELOPMENT

The primary potential noise sources within the development itself will be from:

- Plant and equipment noise.
- Operational noise from the Imax Theatre (located directly below some serviced apartments).

Australian Standard 2107 sets appropriate noise levels for internal spaces. Applicable noise levels from AS2107 are as follows:

Table 7 – Internal Noise Goals from Plant/Equipment and Other Areas within the Ribbon Development

SPACE/ACTIVITY TYPE	NOISE LEVEL
Hotel Rooms	35 dB(A) from apartment a/c unit on medium speed 25 dB(A) from all other plant other than apartment a/c unit
Hotel room Bathrooms	40 dB(A)
Offices/ Conference rooms	40 dB(A)
Restaurant and Bars	40 dB(A)
Public Lobbies	40 dB(A)
Hotel kitchens and associated areas	55 dB(A)
Basement and Garbage Rooms	65 dB(A)

With respect to the above, we note:

- Plant and Equipment Noise:
 - Plant and equipment noise will be acoustically treated through typical acoustic treatments (in-duct lining/attenuators, plant room design and equipment vibration isolation. Detailed design of plant specific items is undertaken as an ongoing process, as mechanical services design is progressed.
 - Compliance with the criteria identified in the table above will be achievable.
- Imax Theatre:
 - The Imax theatre auditorium sits below a number of proposed services apartments
 - Floor system separating the Imax theatre from a services apartment above is to consist of min 200mm thick concrete slab and 2x16mm resiliently suspended ceiling (min 100mm thick insulation to cavity, and a ceiling cavity size of no less than 1000mm).
 - With this ceiling construction, internal noise level of below 25dB(A) will be achieved within the services apartments assuming a sound pressure level of up to 105dB(c) is achieved within the Imax theatre auditorium (typical audio specification for a theatre of this nature – THX typical specification).

6 EXTERNAL 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.

The nearest potentially affected noise receivers are:

- Commercial properties within the Darling Harbour Precinct.

6.1 BACKGROUND NOISE MONITORING

6.1.1 Time of Measurement

One unattended noise monitor was installed on site between the 15th and the 23rd May, 2012.

An additional unattended noise monitor was installed at the closest residential location to the site, being Millennium Towers located on the corner of Bathurst, Sussex and Day Streets. The noise monitor was located on an external terrace on Level 23 of Tower 1 and had an unobstructed view to the north of the Western Distributor and the Darling Harbour precinct. This location is representative of background noise levels for the most sensitive residents of the development, being those situated with direct line of sight to any potential noise emissions from the development.

6.1.2 Measurement Equipment

Unattended noise monitoring was conducted using an Acoustic Research Laboratories Pty Ltd series 315 noise monitor. The monitor was programmed to store 15-minute statistical noise levels throughout the unmanned monitoring period. Equipment was calibrated at the beginning and the end of the measurement using a Rion NC-74 calibrator; no significant drift was detected. All measurements were taken on A-weighted fast response mode. See Figure 1 for location.

Measured background noise levels are presented below. Weather affected data has been excluded from the assessment in accordance with Factsheet A & B of the NSW EPA Noise Policy for Industry. Refer to Appendix 1 & 3 for unattended background noise monitoring data.

Table 8 – Measured Background Noise Levels

Location	Time of Day	Background noise Level – dB(A)L ₉₀
Monitor Location – Site	Day Time (7am - 6pm)	60
	Evening (6pm - 10pm)	58
	Night (10pm - 7am)	53
Monitor Location – Millennium Towers (Nearest Residential Receiver)	Day Time (7am - 6pm)	64
	Evening (6pm - 10pm)	62
	Night (10pm - 7am)	58

6.2 ACOUSTIC OBJECTIVES

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.

These requirements are outlined below.

6.2.1 Mechanical Plant Noise

6.2.1.1 Condition F9

Condition F9 states:

The emission of noise associated with the use of the premises including the operation of any mechanical plant and equipment shall comply with the following criteria:

- (a) The L_{Aeq} , 15 minute noise level emitted from the use must not exceed the background noise level L_{A90} , 15 minute by more than 5dB when assessed at the boundary of any affected residence;
- (b) The L_{Aeq} , 15 minute noise level shall be adjusted for modifying factors in accordance with Appendix 2 of the Noise Guide For Local Government published by DECCW.
- (c) The background noise level shall be measured in the absence of noise emitted from the use in accordance with Australian Standard AS 1055.1-1997-Description and measurement of environmental noise; and
- (d) The use of the premises shall be controlled so that any emitted noise is at a level so as not to create an "offensive noise" as defined in the Protection of the Environment Operations Act 1997 to any affected residence.

Table 9 – Condition F9 Noise Limits

Location	Time of Day	Background noise Level – $dB(A)L_{90}$	BG+ 5 Noise Objective $dB(A)L_{eq(15min)}$
Monitor Location – Site	Day Time (7am - 6pm)	60	65
	Evening (6pm - 10pm)	58	63
	Night (10pm - 7am)	53	58
Monitor Location – Millennium Towers (Nearest Residential Receiver)	Day Time (7am - 6pm)	64	69
	Evening (6pm - 10pm)	62	67
	Night (10pm - 7am)	58	63

6.2.1.2 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.

INP - Intrusiveness Assessment

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

Table 10 – Industrial Noise Policy - Intrusiveness Assessment

Location	Time of Day	Background noise Level – dB(A) _{L₉₀}	Intrusiveness Noise Objective dB(A) _{L_{eq}(15min)} (Background + 5dB)
Monitor Location – Site	Day Time (7am - 6pm)	60	65
	Evening (6pm - 10pm)	58	63
	Night (10pm - 7am)	53	58
Monitor Location – Millennium Towers (Nearest Residential Receiver)	Day Time (7am - 6pm)	64	69
	Evening (6pm - 10pm)	62	67
	Night (10pm - 7am)	58	63

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 11 – Industrial Noise Policy - Amenity Criteria

Receiver Location	Land Type	Time of Day	Amenity Noise Objective dB(A) _{L_{eq}(Period)}
All Potentially Affected Residential Properties	Urban	Day Time (7am – 6pm)	60
		Evening (6pm – 10pm)	50
		Night (10pm-7am)	45
Commercial	All	When in use	65

6.2.1.3 Operational Noise to Commercial Receivers (Condition F10)

Condition F10 limits permissive noise emissions as follows:

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 commercial premises provided that;

- (e) 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 retail premises closed;
- (f) The L_{A90} , 15 minute noise level shall be measured in the absence of noise emitted from the use but with the ventilation equipment (including air conditioning equipment) normally servicing the commercial premises operating;
- (g) The use of the premises shall be controlled so that any emitted noise is at a level so as not to create an "offensive noise" as defined in the Protection of the Environment Operations Act 1997 to any affected residence;
- (h) In this clause, the term "noise level emitted from the use" means the contributing noise level from the use in isolation to any other ambient noise and account must therefore be taken of the L_{Aeq} , 15 minute when the use is not in operation; and
- (i) In circumstances where this development application refers to a modification or addition to an existing use, the background noise level referred to in this clause pertains to the L_{A90} , 15 minute noise level measured in the absence of all noise from the site.

6.2.2 Operational Noise to Residential Receivers from Rooftop Bar

When assessing noise emissions from licensed premises, noise emissions must comply with the acoustic requirements generally imposed by the NSW Department of Industry, Office of Liquor and Gaming guidelines. These guidelines relate to noise generated by patrons and music from a licensed venue. The requirements are set out below:

- *The L_{10} noise level emitted from the premises shall not exceed 5dB above the background L_{90} sound level in any Octave Band Centre Frequency (31.5kHz to 8kHz inclusive) between the hours of 7.00am to 12.00 midnight when assessed at the boundary of the nearest affected residential premises.*
- *L_{10} noise level emitted from the premises shall not exceed the background L_{90} sound level in any Octave Band Centre Frequency (31.5kHz to 8kHz inclusive) after midnight when assessed at the boundary of the nearest affected residential premises.*

After midnight, noise emissions from the Place of Public Entertainment are to be inaudible within any habitable rooms in nearby residential properties.

We note that these criteria are typically adopted by the City of Sydney in the assessment of entertainment venues.

6.3 RECOMMENDATIONS

6.3.1 General Recommendations

Operational noise from the Imax theatre (or other tenancy fitout) would be the responsibility of the operator of that tenancy.

Final equipment selection and mechanical layouts are not available at this stage. Acoustic treatments should be determined in order to control plant noise emissions such that compliance with council criteria as detailed in the section above is achieved.

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.

Experience with similar developments indicates that acoustic treatment of the buildings mechanical equipment and services will be both possible and practical.

6.3.2 Recommendations for the Rooftop Bar Area

Noise emissions from the operation of the rooftop bar will be a combination of patron noise and amplified noise from installed speakers. Recommendations for the rooftop bar area are as follows;

- Any installed speakers are to be installed within a covered area of the bar, such that the building form acts as a screen to nearby residential receivers (to the south).
- Patron numbers are to be limited to the following;
 - Between 7am – 12am – up to 300 patrons within the rooftop bar at any one time.
 - Between 12am – 7am – Up to 200 patrons within the rooftop bar at any one time.
- Noise levels from speakers are to be limited to the following sound pressure levels;
 - Between 7am – 12am: 80 dB(A) L_{10} sound pressure level when measured at 3m distance from speakers.
 - Between 12am – 7am: 65 dB(A) L_{10} sound pressure level when measured at 3m distance from speakers.

7 CONCLUSION

This report presents the results from the acoustic assessment of noise impacts associated with the proposed Ribbon development (1 Wheat Road, Sydney development Darling Harbour).

Noise impacts on the site (noise generated by traffic movements on the Western Distributor, entertainment precinct noise) have been assessed with reference to relevant Australian Standards, Green Star and Council codes.

Noise from primary internal noise sources within the development (in particular the Imax theatre) and its potential impact on residential/serviced apartments within the development has been considered, and appropriate acoustic design incorporated (section 5).

External noise emission criteria have been developed in Section 6 of this report based on the requirements of Sydney City Council. Detailed plant noise emission shall be designed to comply with this criterion during CC stage. Recommendations have been provided to address noise emissions from the proposed rooftop bar.

As such, the reporting/assessment requirements of condition of consent B5, E9, F9 and F10 are addressed.

Please contact us should you have any further queries.

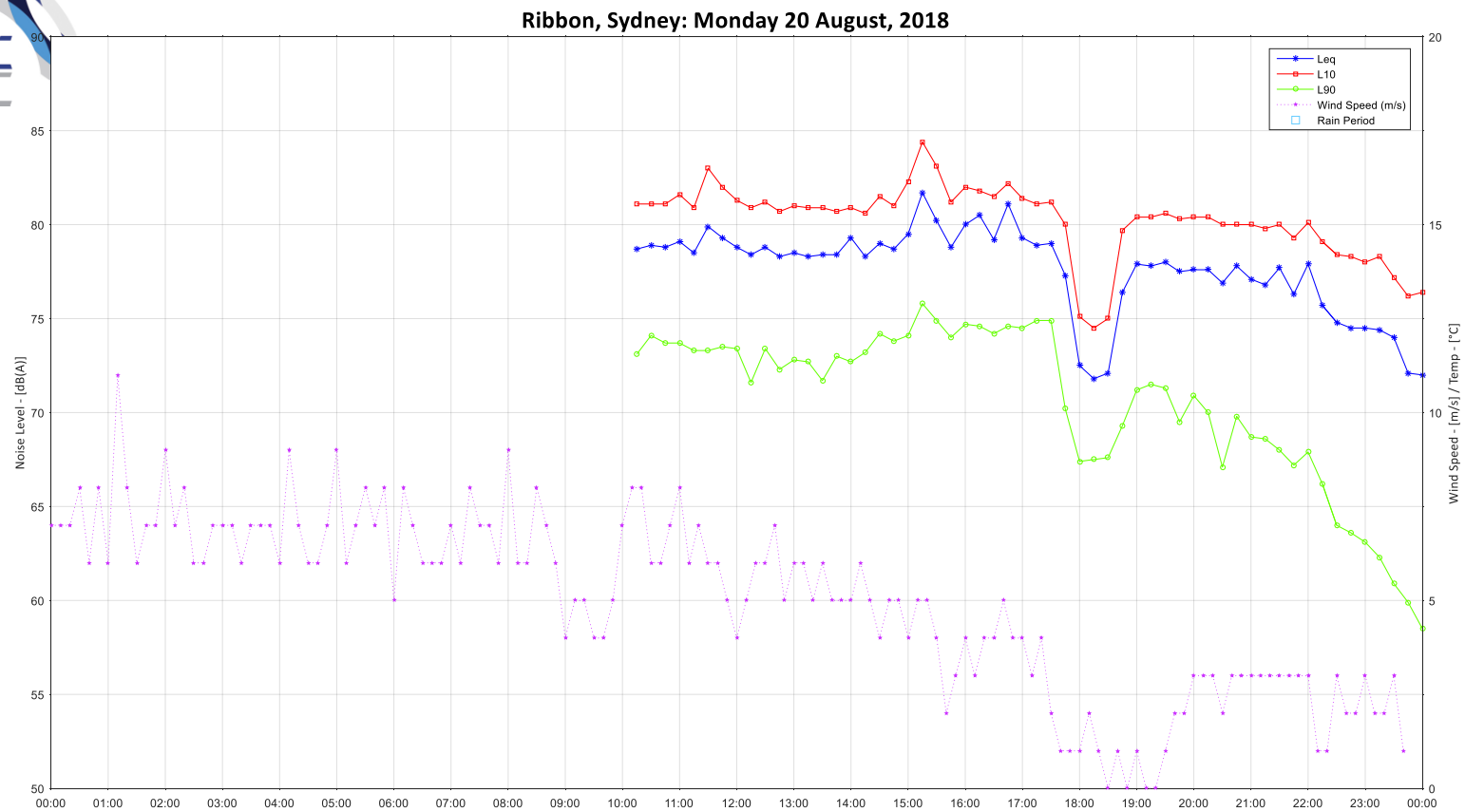
Yours faithfully,

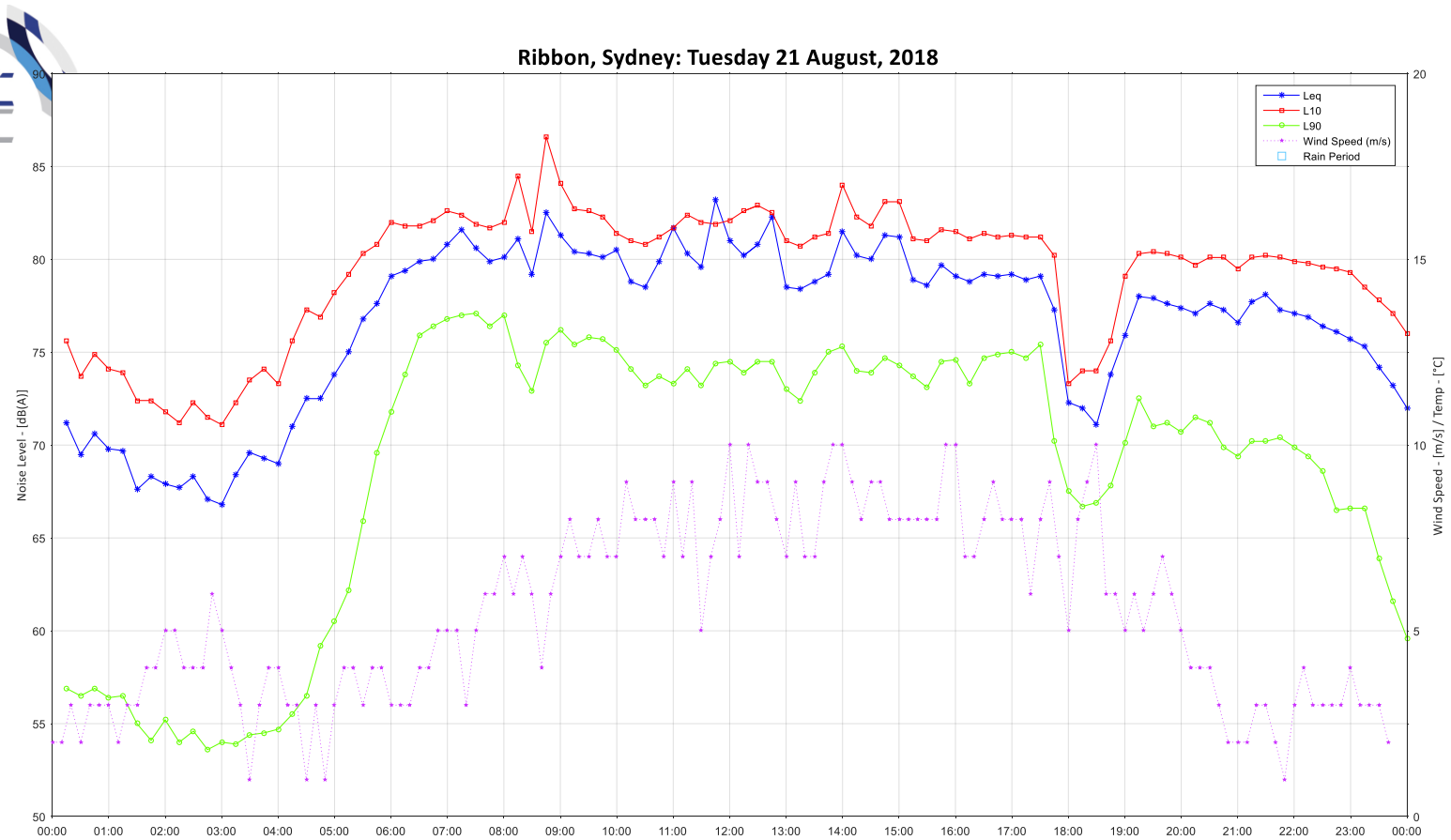


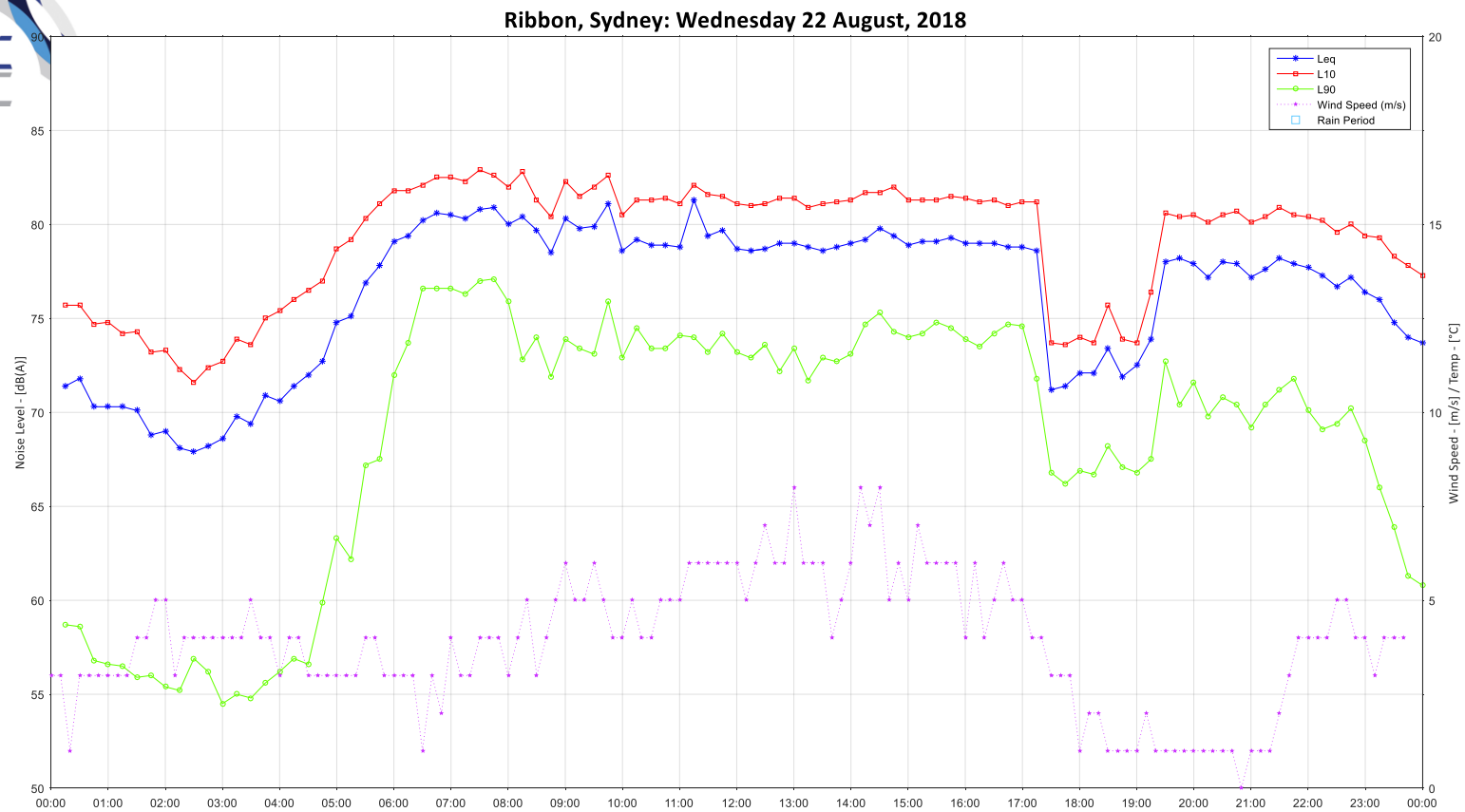
Acoustic Logic Consultancy Pty Ltd
Thomas Taylor
B. Eng (Civil)

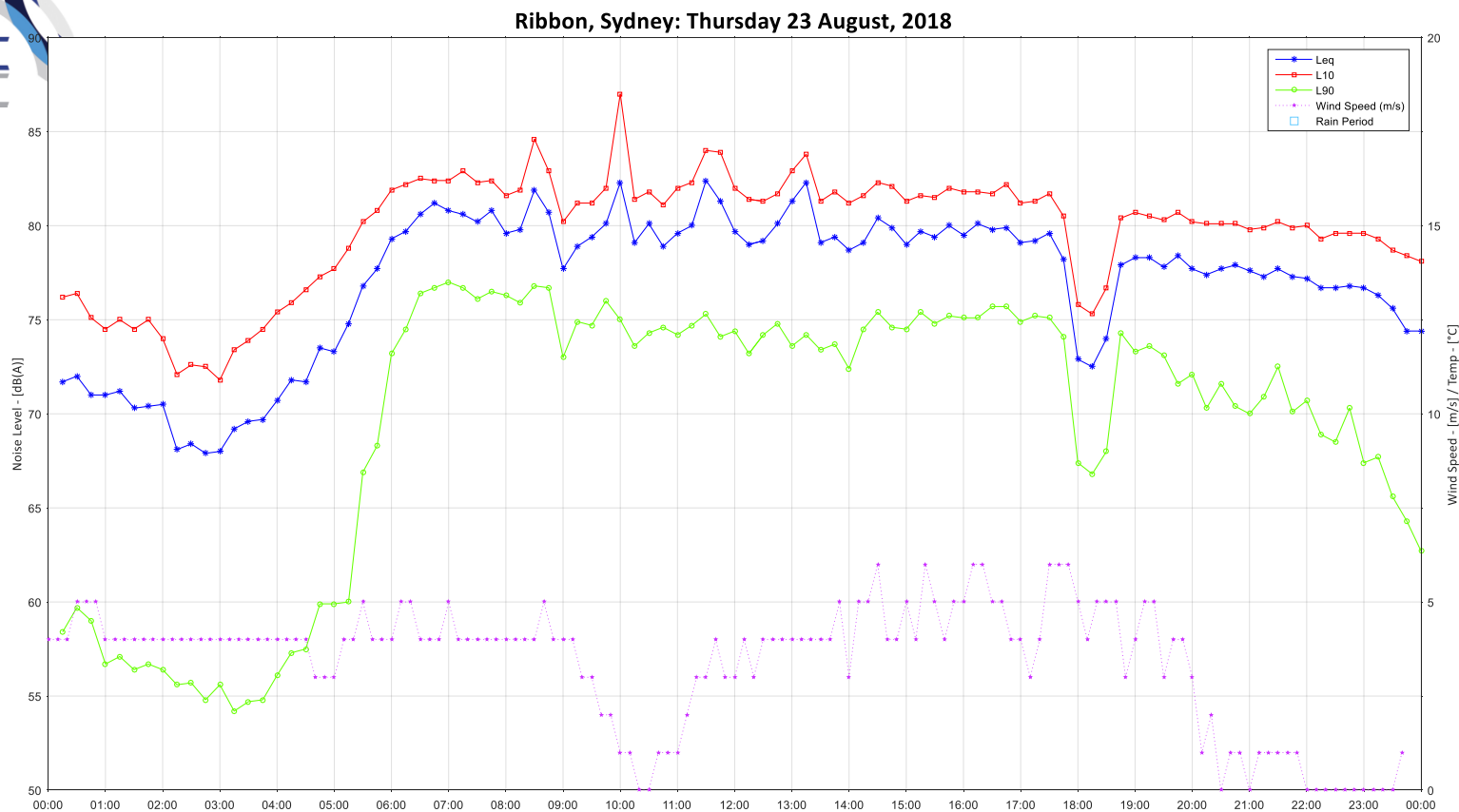
APPENDIX 1

Noise Monitoring Data – Road Traffic

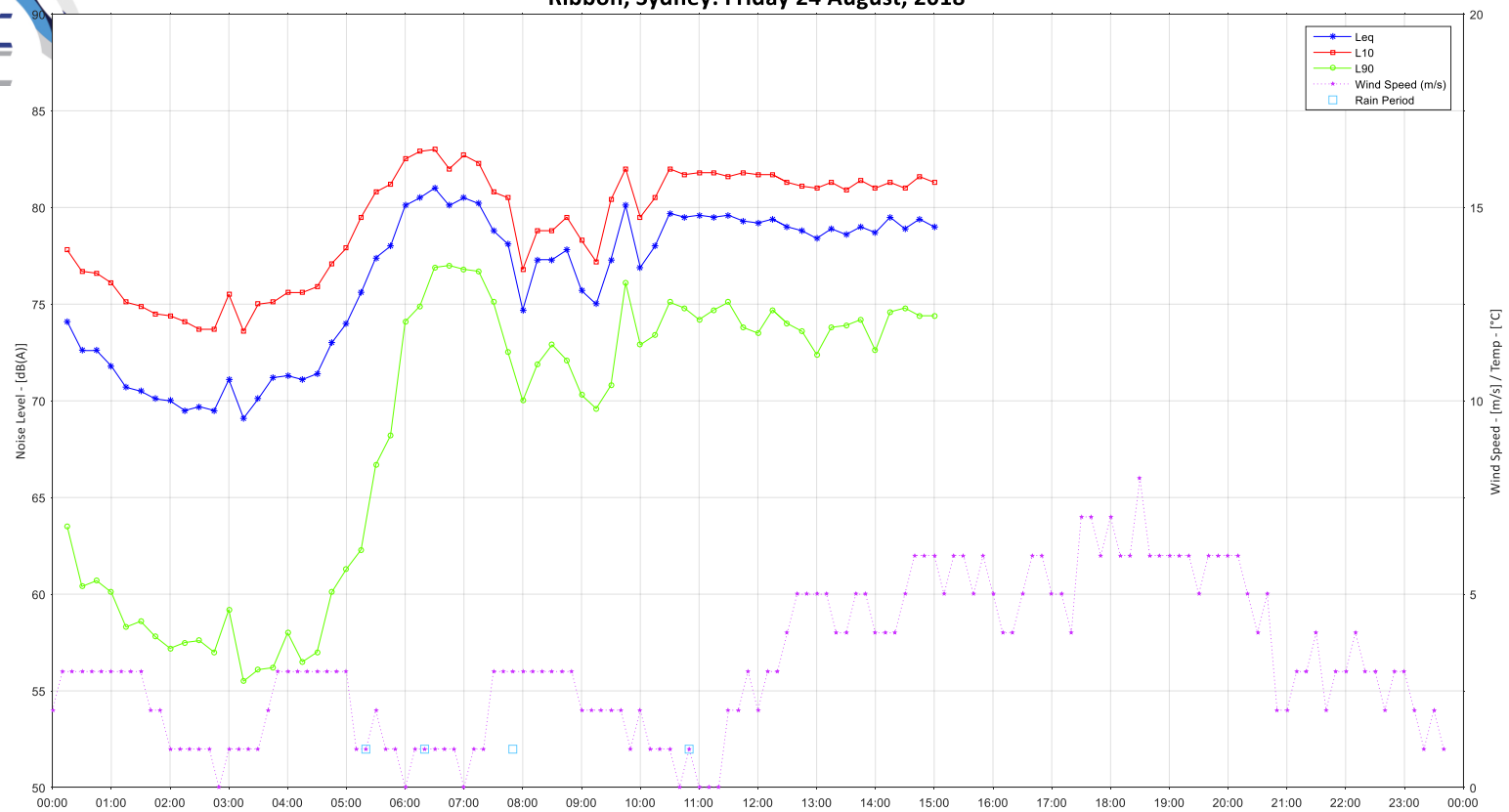








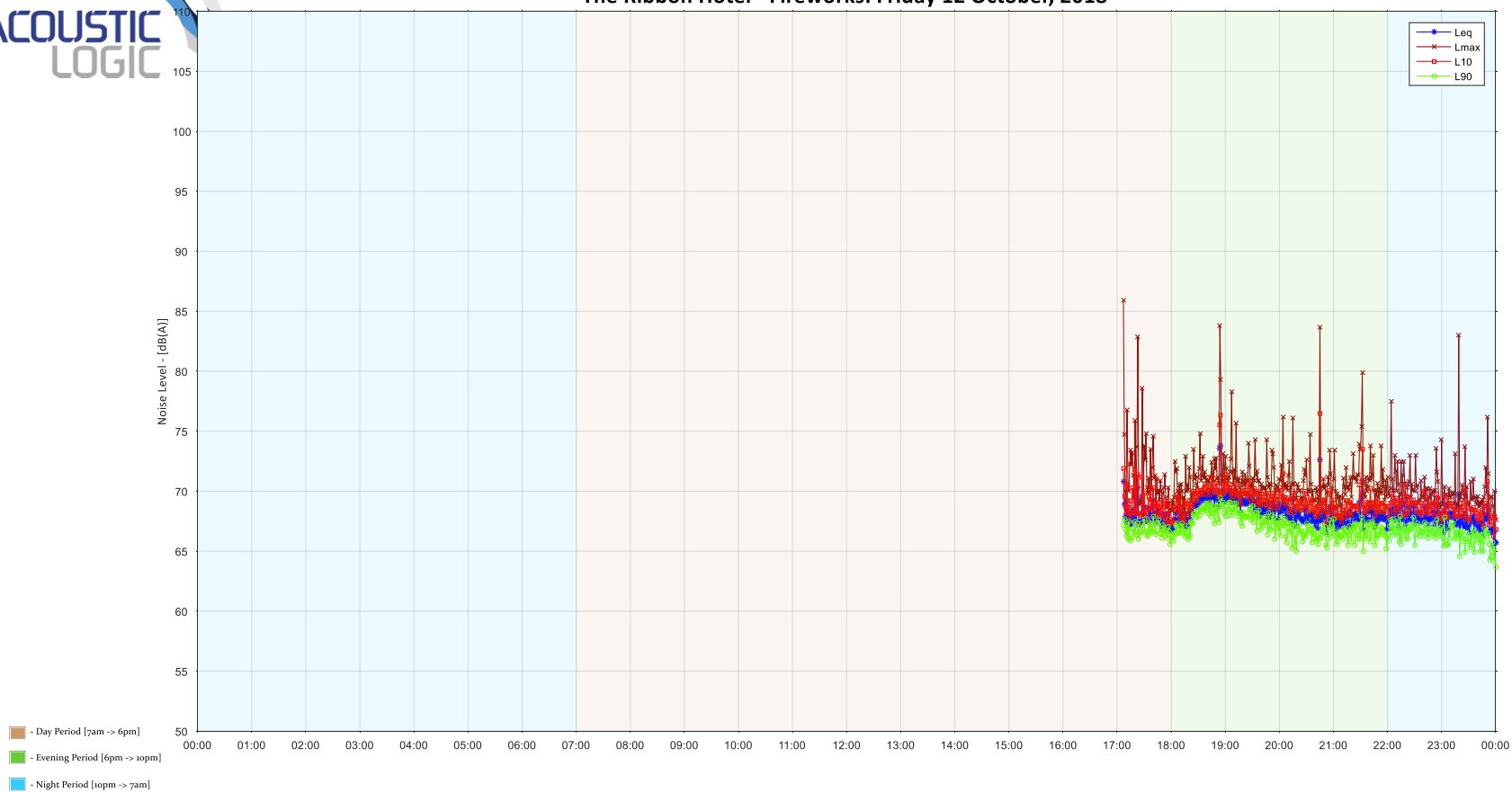
Ribbon, Sydney: Friday 24 August, 2018



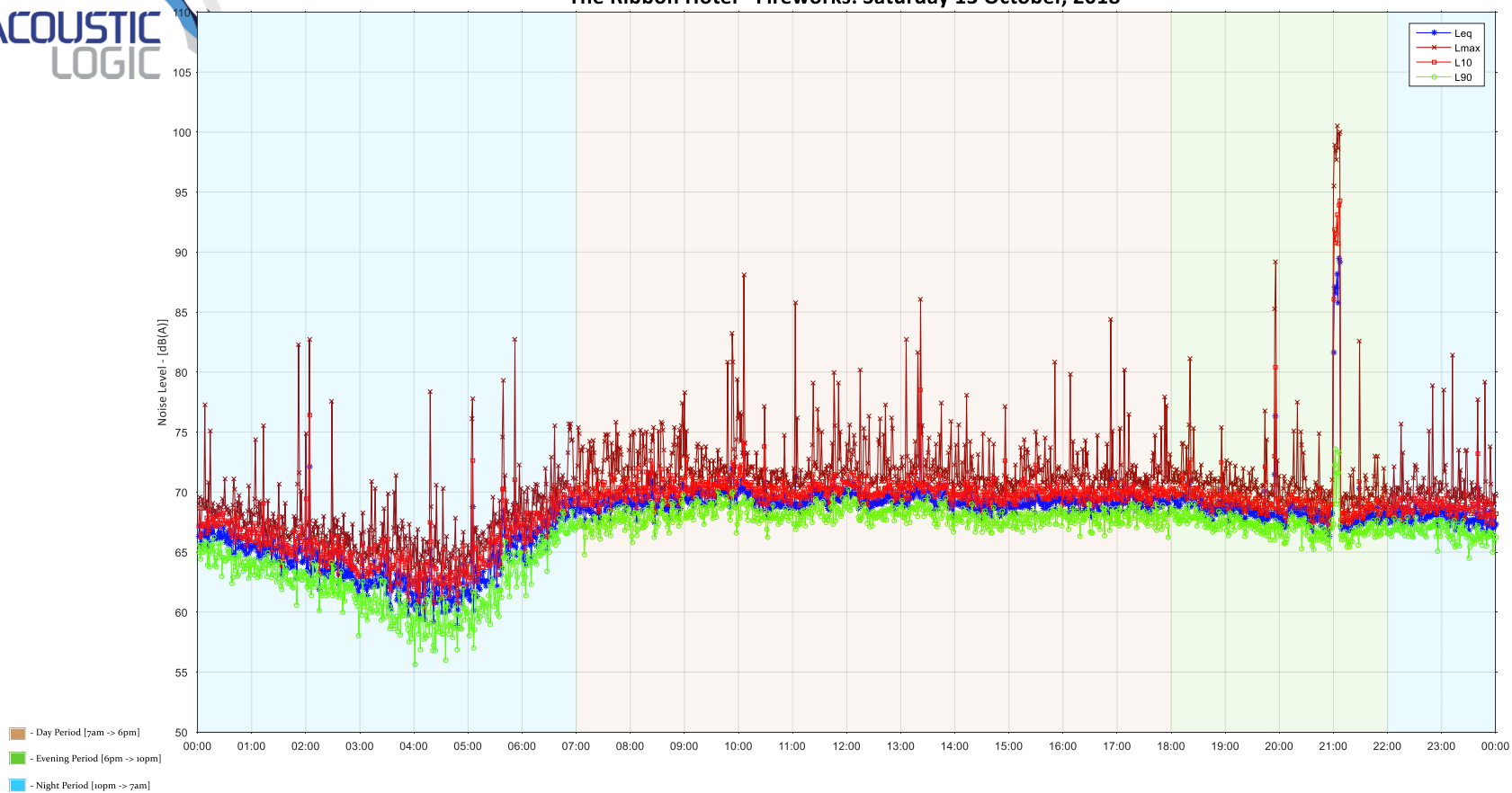
APPENDIX 2

Noise Monitoring Data – Darling Harbour Fireworks

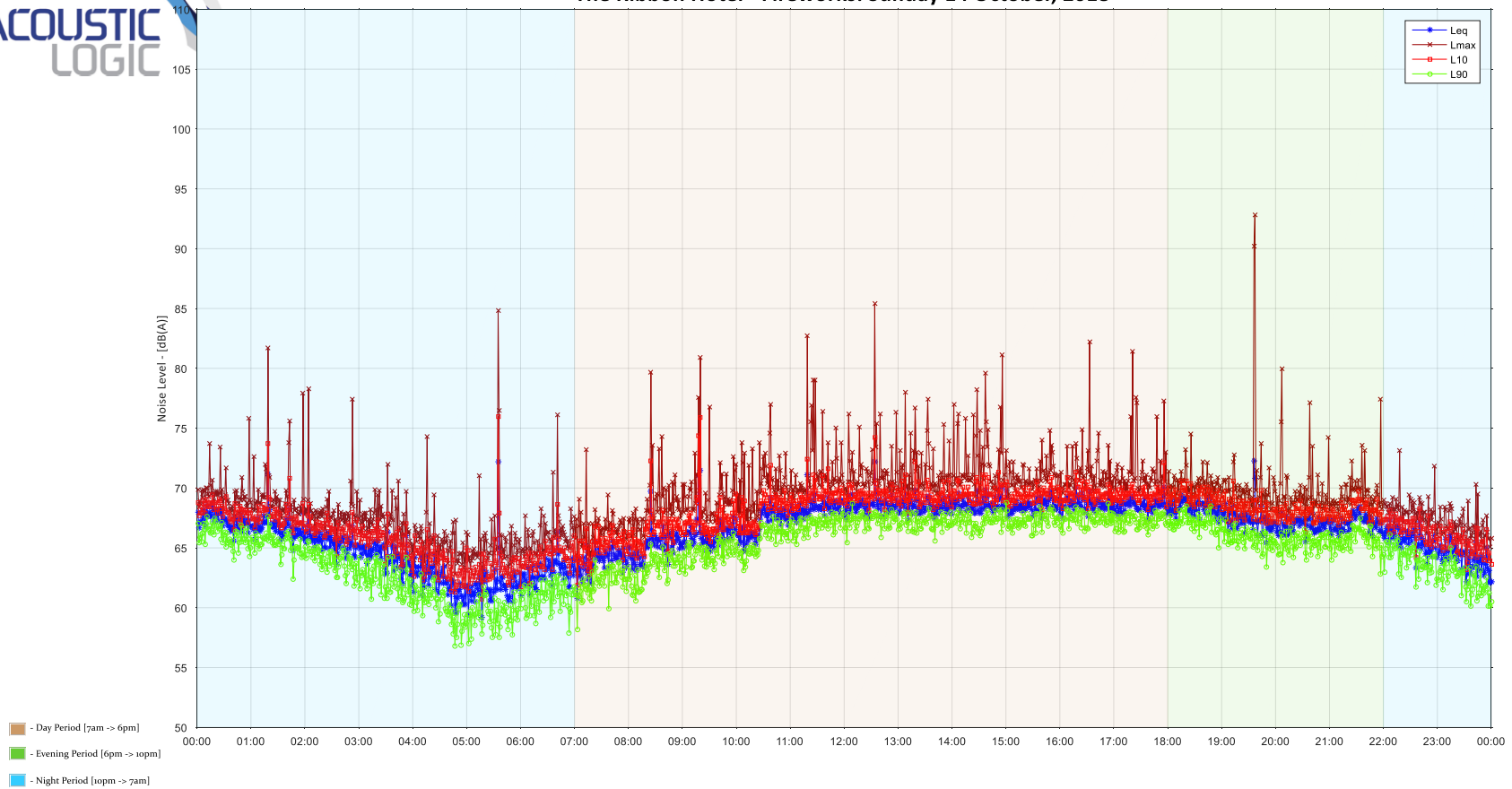
The Ribbon Hotel - Fireworks: Friday 12 October, 2018



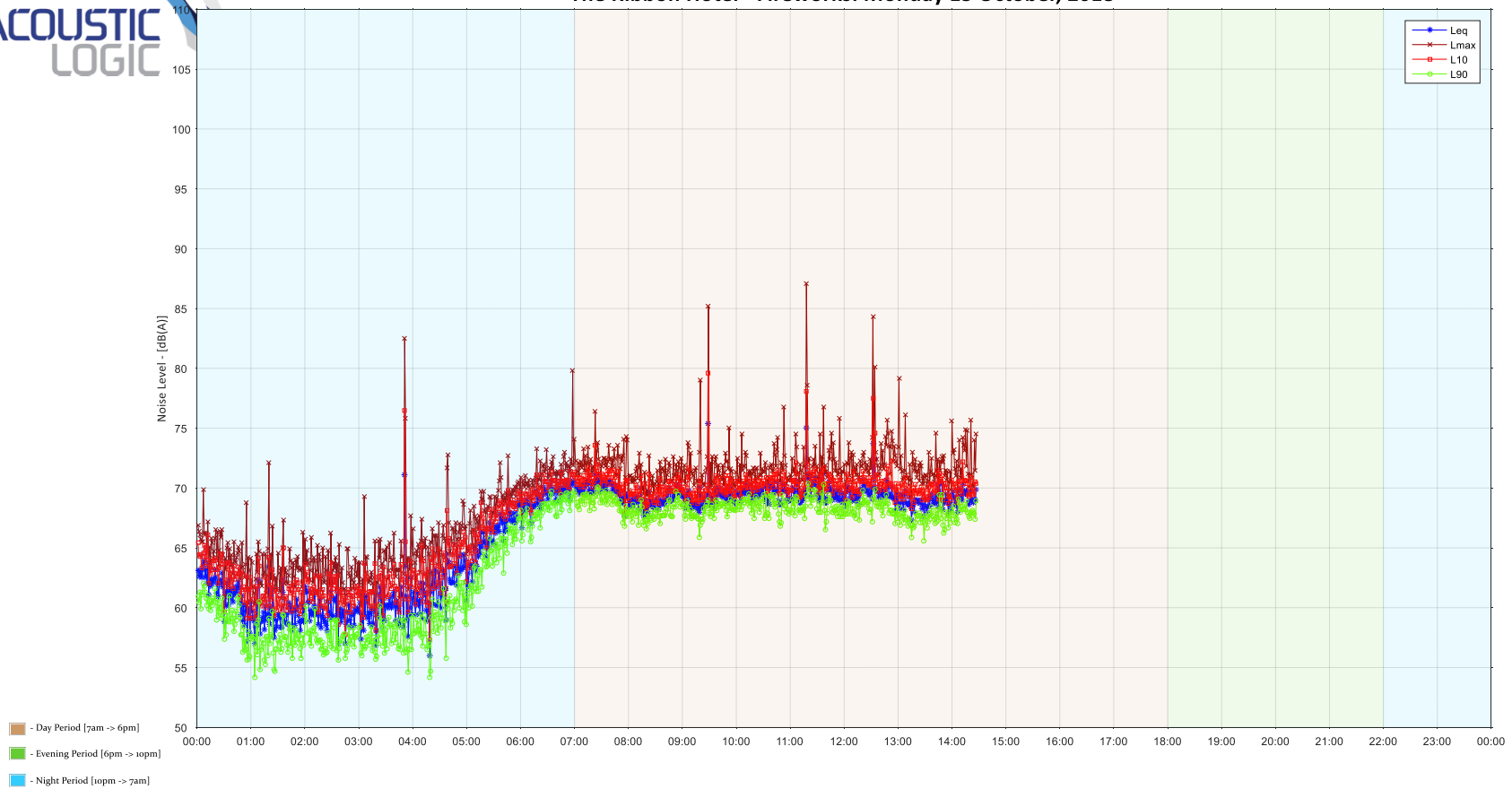
The Ribbon Hotel - Fireworks: Saturday 13 October, 2018



The Ribbon Hotel - Fireworks: Sunday 14 October, 2018



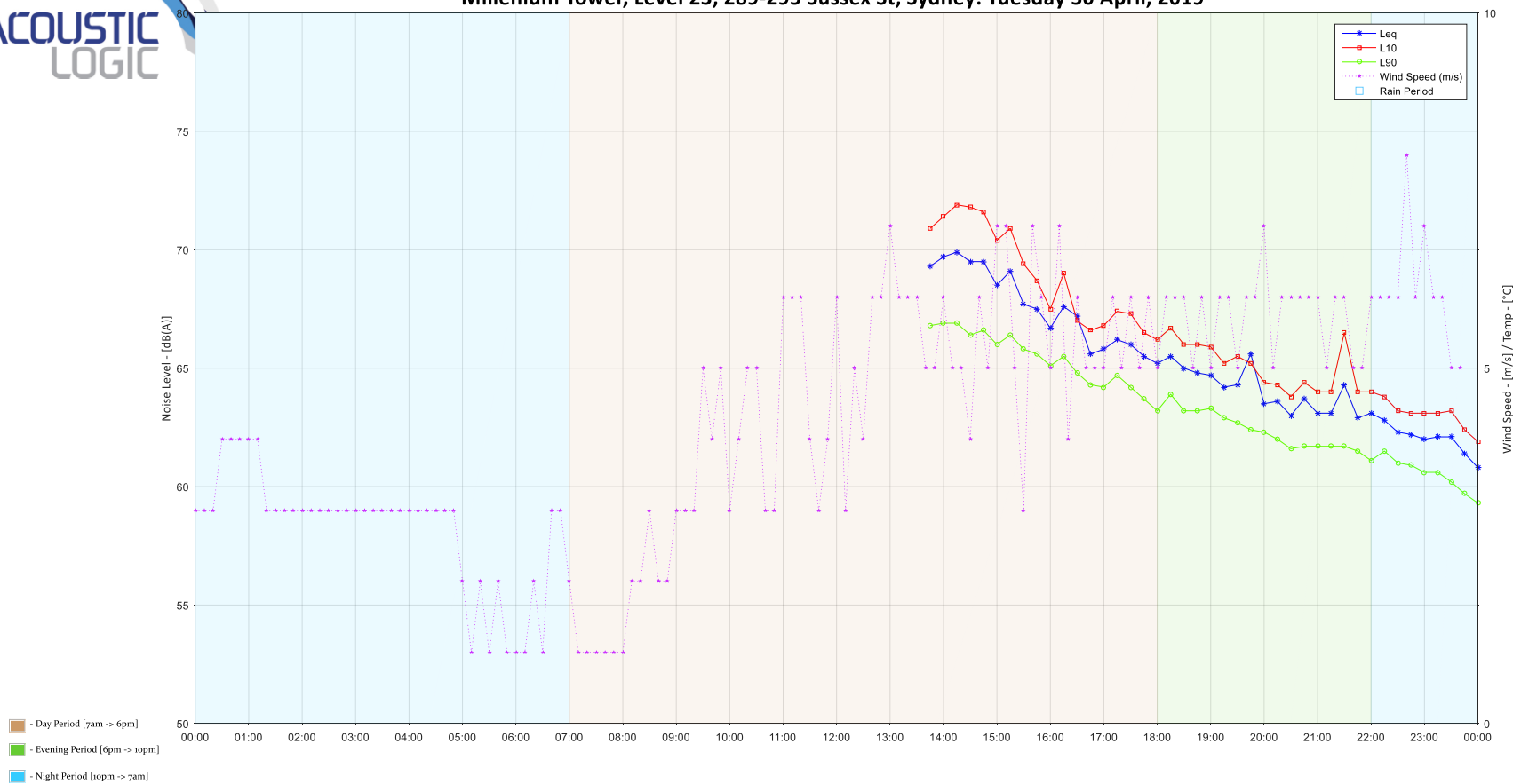
The Ribbon Hotel - Fireworks: Monday 15 October, 2018



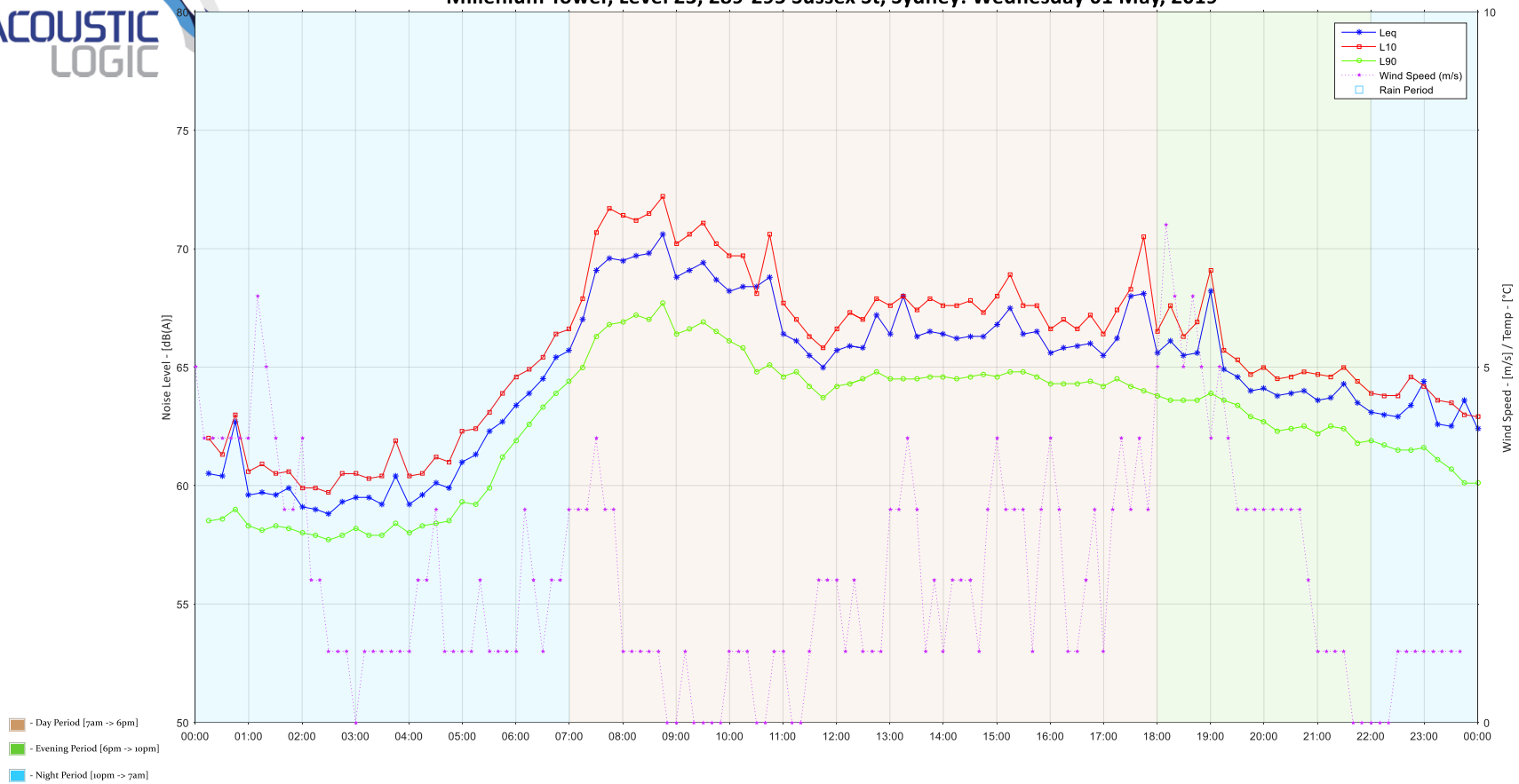
APPENDIX 3

Noise Monitoring Data – Millennium Towers Background Noise Monitoring

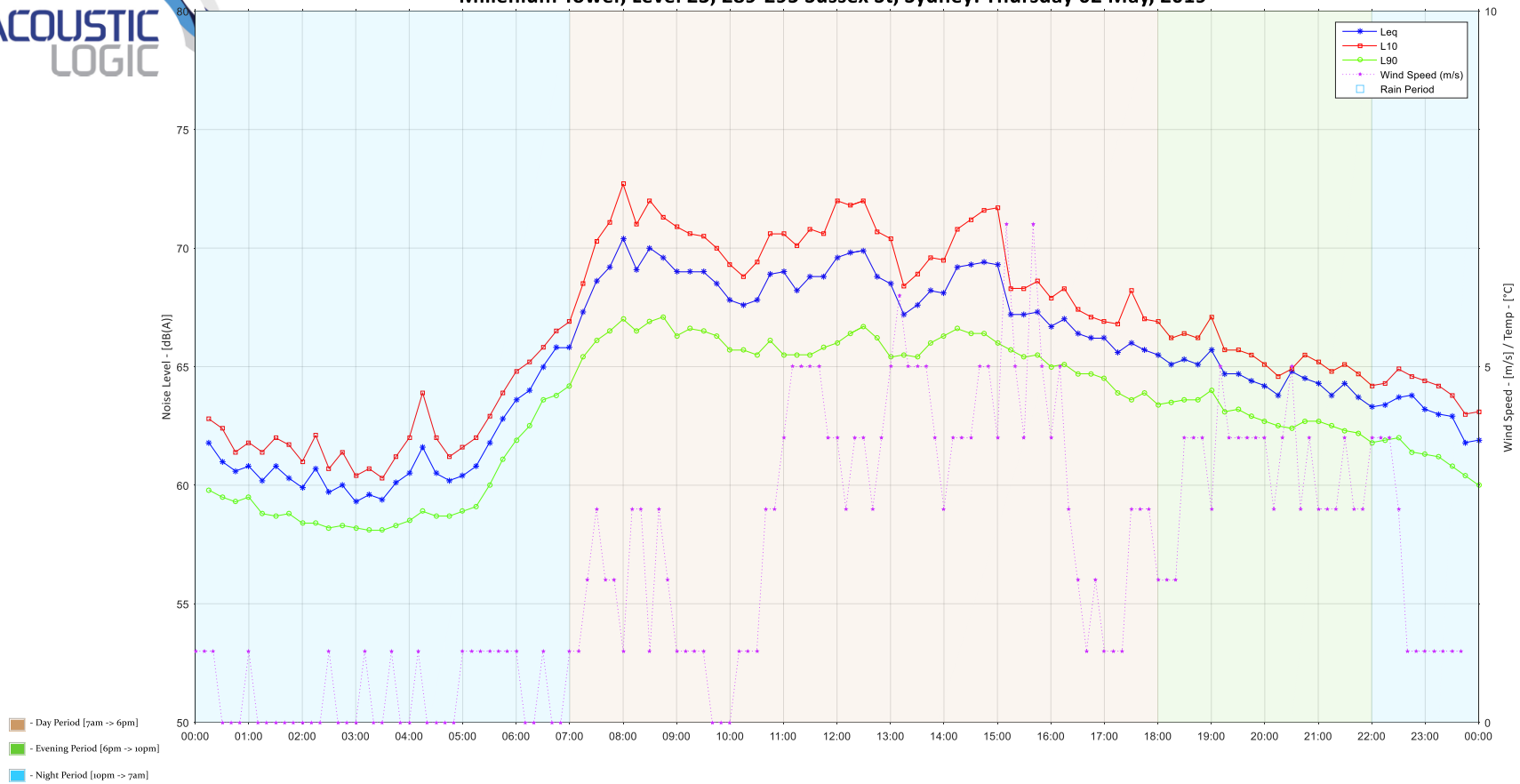
Millenium Tower, Level 23, 289-295 Sussex St, Sydney: Tuesday 30 April, 2019



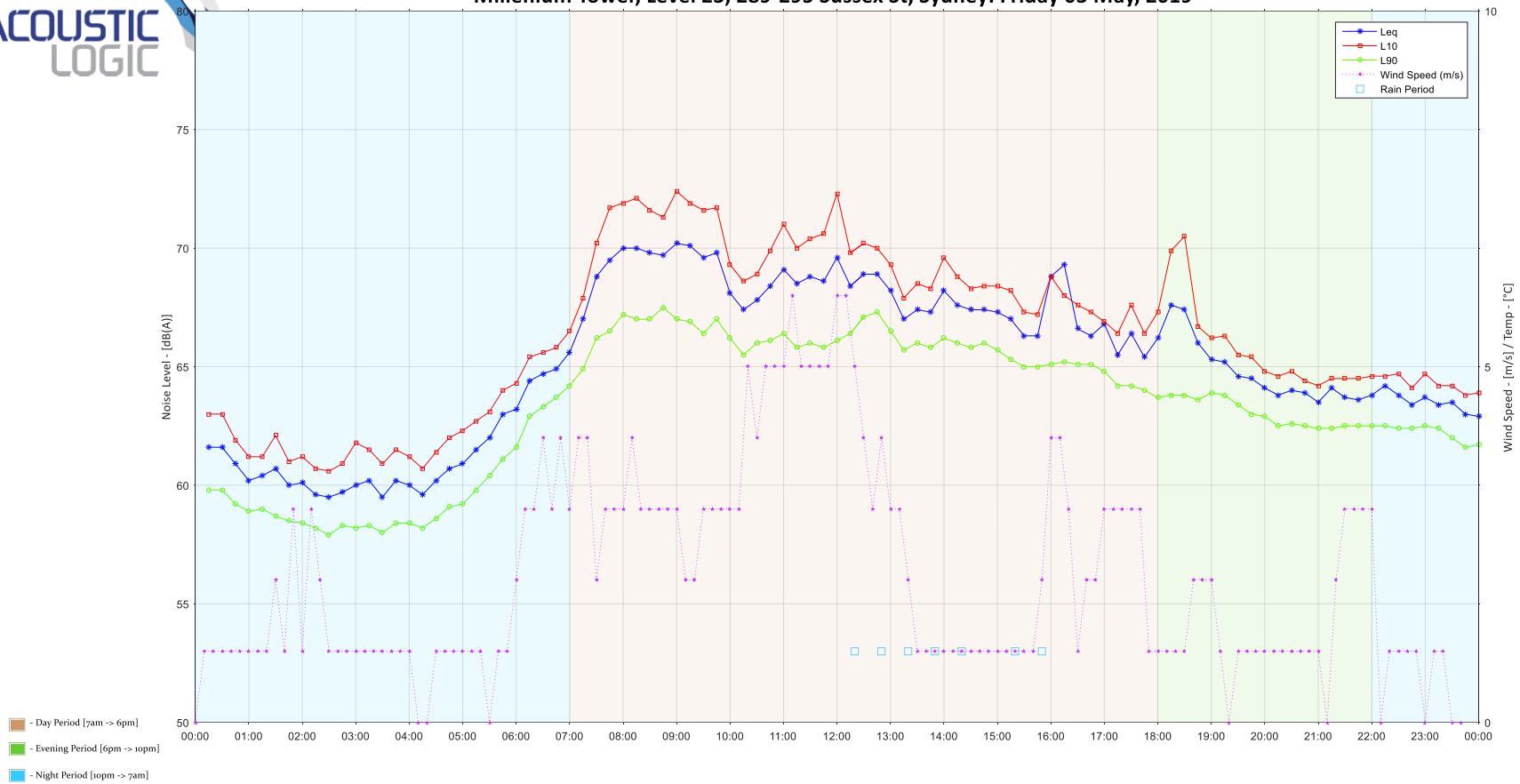
Millenium Tower, Level 23, 289-295 Sussex St, Sydney: Wednesday 01 May, 2019



Millenium Tower, Level 23, 289-295 Sussex St, Sydney: Thursday 02 May, 2019

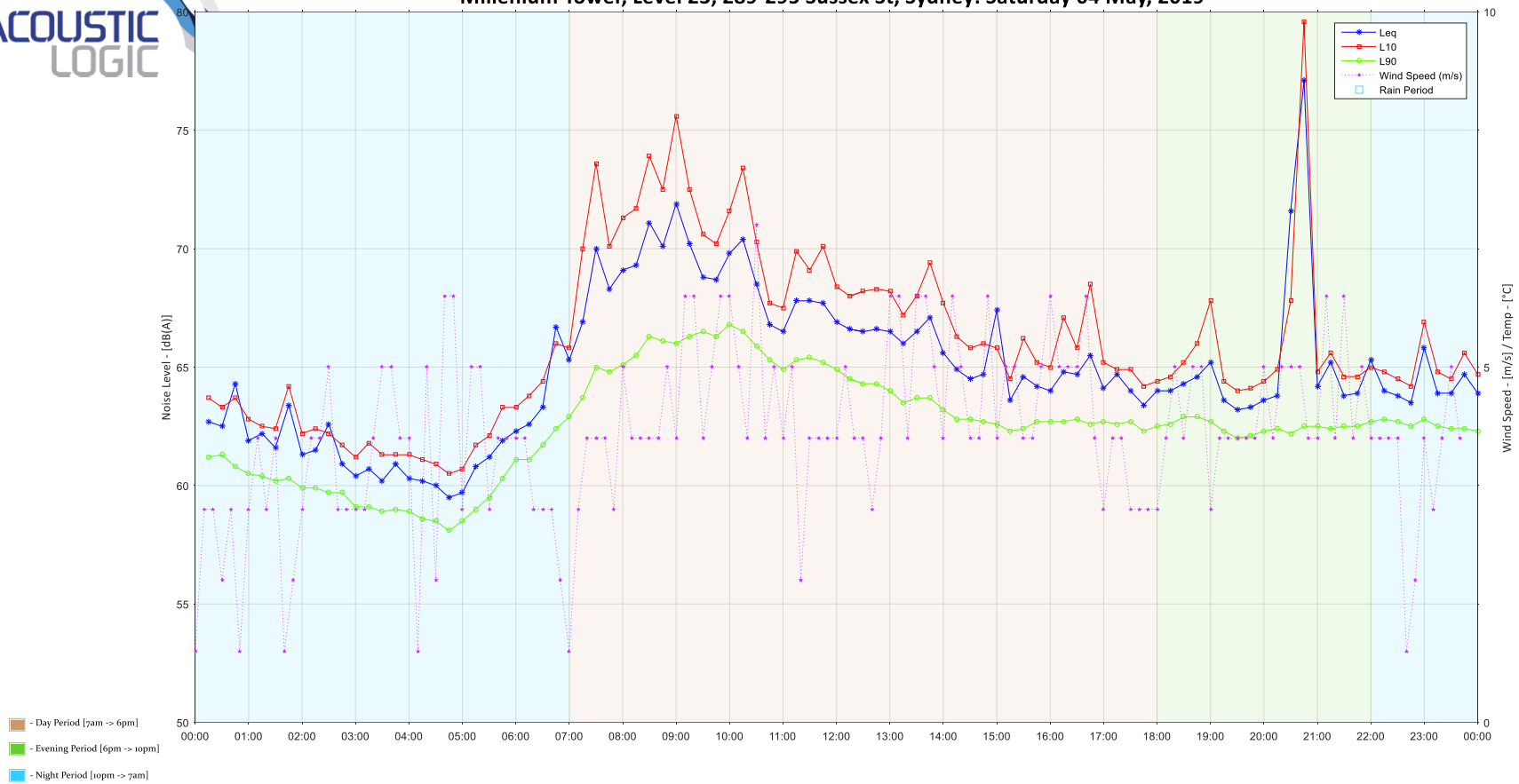


Millenium Tower, Level 23, 289-295 Sussex St, Sydney: Friday 03 May, 2019

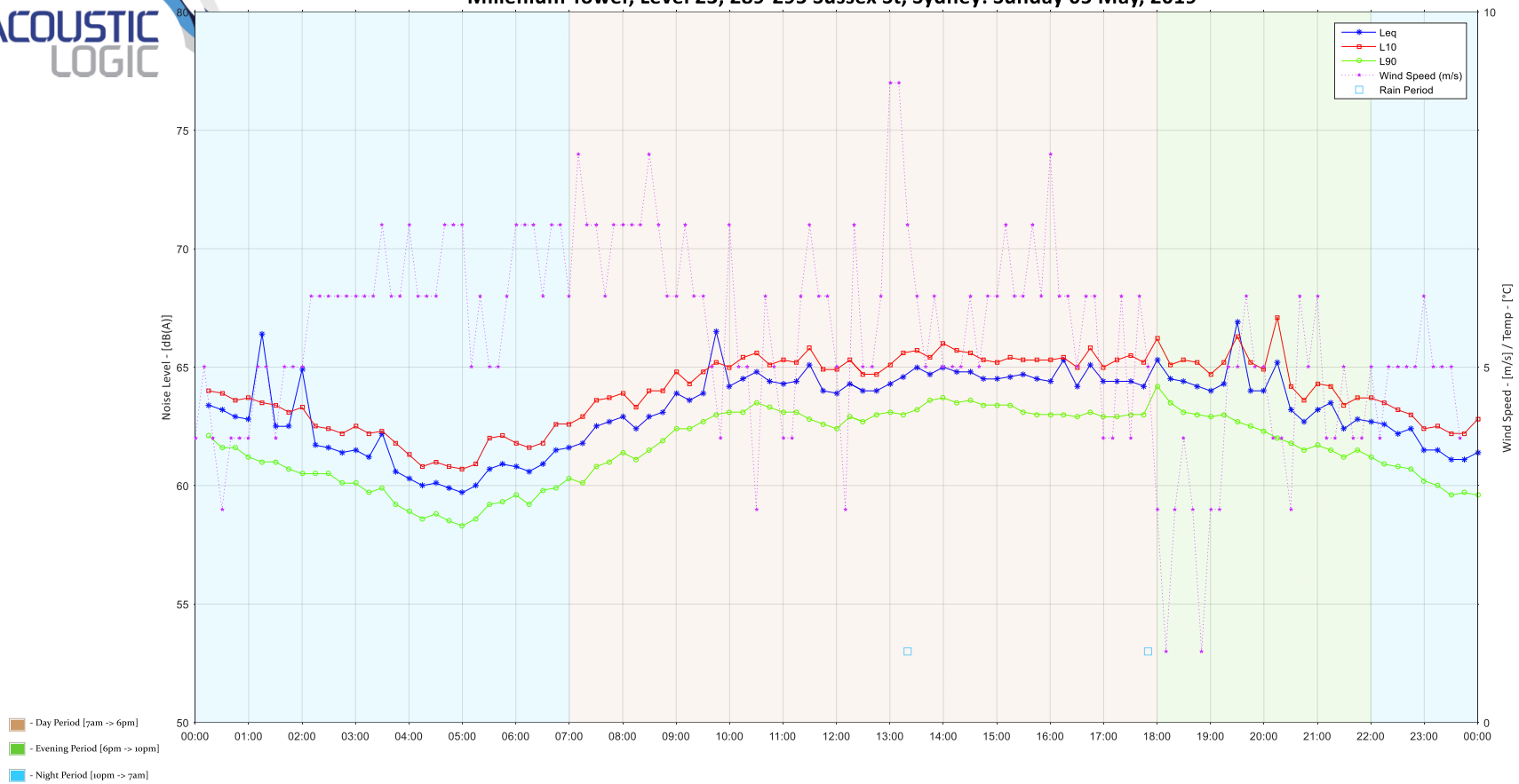




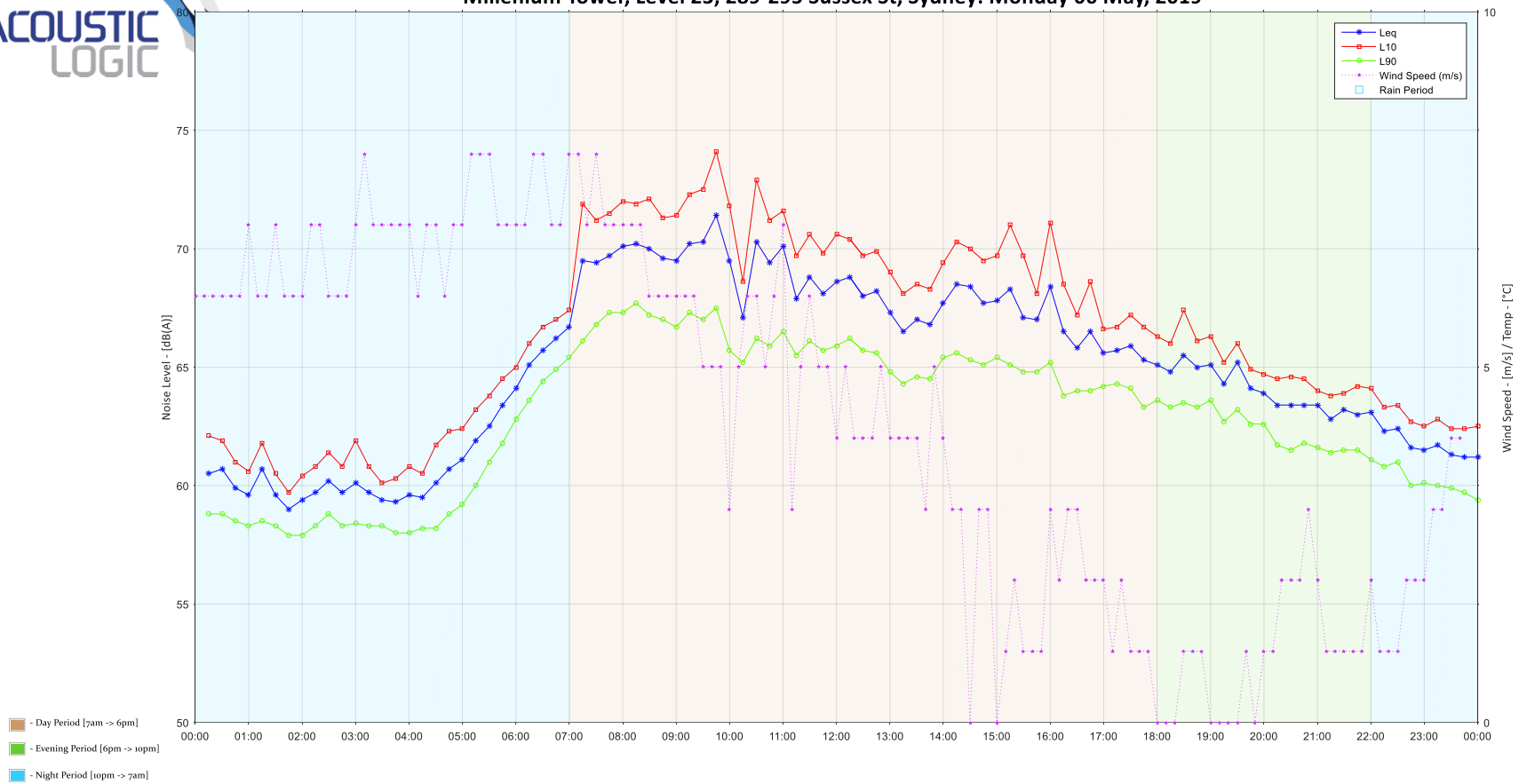
Millenium Tower, Level 23, 289-295 Sussex St, Sydney: Saturday 04 May, 2019



Millenium Tower, Level 23, 289-295 Sussex St, Sydney: Sunday 05 May, 2019



Millenium Tower, Level 23, 289-295 Sussex St, Sydney: Monday 06 May, 2019



Millenium Tower, Level 23, 289-295 Sussex St, Sydney: Tuesday 07 May, 2019

