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396-402 SYDNEY ROAD, BALGOWLAH

Acoustic Assessment for Development Application

21 September 2018

398 Balgowlah Pty Ltd

TK495-01F02 Acoustic Report for DA (r1).docx

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Document details

Detail	Reference
Doc reference:	TK495-01F02 Acoustic Report for DA (r1).docx
Prepared for:	398 Balgowlah Pty Ltd
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Attention:	Steven Christoforidis

Document control

Date	Revision history	Non-issued revision	Issued revision	Prepared	Instructed	Authorised
11.9.2018	1st Issue		0	RC		RC
21.9.2018	Final Issue		1	RC		RC

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1 Introduction

This report presents an assessment of noise intrusion into and operational noise from the proposed mixed use development at 396-402 Sydney Road, Balgowlah.

This study examines the effects of external noise intrusion on the proposed development from road traffic noise. Noise surveys have been conducted by Renzo Tonin & Associates between Friday 17th August and Friday 24th August 2018 at the development site to determine the existing levels of ambient noise at the site. These levels were used to predict noise levels within the property, and then assessed against the recommended internal noise criteria for the project.

As a result of our assessment of the following potential acoustic items were identified;

- Existing traffic noise from Sydney Road intruding into the development;
- Noise associated with the existing commercial operations intruding into the proposed development;
- Noise emission from proposed mechanical plant impacting on existing residences.

This report presents an assessment of the above acoustic components in terms of Council's Development Control Plans, State Environmental Planning Policy (Infrastructure) 2007 and Australian Standards.

The predicted traffic noise levels at the building facades were used to determine the sound insulation rating requirements for the external building elements in accordance with the acoustic criteria nominated for this development.

In regard to acoustic privacy, this is generally satisfied through the requirements of the National Construction Codes - Building Code of Australia which all new residential developments would need to comply.

Further detailed discussion of the identified acoustic factors is set out within this report.

The work documented in this report was carried out in accordance with the Renzo Tonin & Associates Quality Assurance System, which is based on Australian Standard / NZS ISO 9001. Appendix A contains a glossary of acoustic terms used in this report.

2 Site and Surrounds

The proposed development at 396-402 Sydney Road, Balgowlah is to be a mixed-use development consisting of 2 levels of basement car parking, ground floor commercial, and 4 levels of apartments.

Typically, commercial, retail and residential buildings surround the site.

Long term and short-term noise monitoring has been undertaken at the site to determine the existing acoustic environment.

Figure 1 - Site and Surrounds

3 Internal Noise Criteria

3.1 Road Traffic Noise

A number of documents were taken into account when determining suitable criteria for the proposed development site. These included:

- State Environment Planning Policy (Infrastructure) 2007 - ISEPP
- Department of Planning publication "Development Near Rail Corridors & Busy Roads – Interim Guideline" 2008
- Northern Beaches Council DCP

Sydney Road is identified as a road where an assessment is recommended (greater than AADT 20,000, but less than AADT 40,000) on The Roads and Maritime Services (RMS) Traffic Volume Maps for ISEPP. As a result, the acoustic criteria as determined in The ISEPP Clause 102 (and quantified in the Department of Planning's Guideline) are to be achieved for this development site. This criteria is summarised in the table below.

Table 1: Internal Noise Criteria for Road Traffic Noise - ISEPP and Department of Planning's Guideline

Occupancy	Windows & Doors Condition	Design Noise Level	
		Day, LAeq (T)	Night, LAeq (T)
Bedrooms	Closed	-	35 dB(A), 9 hour
	Open	-	45 dB(A), 9 hour
All Other Habitable Areas	Closed	40 dB(A), 15 hour	40 dB(A), 9 hour
	Open	50 dB(A), 15 hour	50 dB(A), 9 hour

Notes:

Day and Night assessment periods are defined as follows.

1. Day is defined as 7:00am to 10:00pm
2. Night is defined as 10.00pm to 7.00am

Appendix C presents results of the unattended ambient noise survey conducted on site.

4 Measured and predicted noise levels

4.1 Long-term noise survey

One RTA Technology Environmental Noise Logger was set up for the ambient noise survey from Friday 17th August to Friday 24th August 2018. The logger was located protruding from the first-floor window of the existing building at 402 Sydney Road, Balgowlah (refer to Appendix C).

The noise logger records noise levels on a continuous basis and stores data every fifteen minutes. The noise logger was calibrated before and after measurements and no significant deviation in calibration was noted. The noise monitoring equipment used here complies with Australian Standard 1259.2-1990 "Acoustics - Sound Level Meters" and is designated as Type 2 instruments suitable for field use.

The dates of measurement and the results obtained from the logger survey are shown in Appendix C.

Recommendations for the acoustic design of the glazed facades of the development are presented in Section 5 of this report.

The design external traffic noise levels are presented below.

Table 2: Predicted external noise levels

Facade	Time Period	Design Noise Level LAeq,T
Facing Sydney Road	Day time, 15 hour	LAeq, 15 hour 71 dB(A)
	Night time, 9 hour	LAeq, 9 hour 68 dB(A)

Note: 1. at 1m from façade, centrally positioned along the façade width
Day time is considered 7am - 10pm daily
Night time is considered 10pm - 7am daily

4.2 Calculated Noise Levels

Results from the noise surveys were used to calculate internal noise levels within the proposed development. Noise calculations were performed using glazing design software developed in this office which take into account external noise levels, facade transmission loss and room sound absorption characteristics. Noise levels were calculated for each building facade to account for any variation in the external noise levels affecting different parts of the building.

Glazing constructions required to comply with the nominated noise criteria are presented in the body of this report.

5 Control of external noise

5.1 Glazing

The following table presents the recommended glazing selections for facades of the proposed development at 396-402 Sydney Road, Balgowlah. The required acoustic rating of the glazing assembly presented in the table below represents the required acoustic rating of the glazed system as a whole. This includes glass, frames, junctions and seals.

Unit locations are shown in the architectural drawings attached in APPENDIX D.

Table 3 – Recommended Acoustic Performance of Glazing Assembly

Facade	Level	Unit No.	Occupancy	Required Acoustic Rating of Glazing Assembly, Rw
Southern Facade facing Sydney Road	Levels 1 & 2	101, 201	Sleeping Areas (window area <1.5m2)	Rw 35
			Living areas	Rw 35
		102, 202	Sleeping Areas (window area < 6.3m2)	Rw 38
			Living areas	Rw 35
	Level 3	301, 302	Sleeping Areas (window area < 6.8m2)	Rw 35
			Living areas	Rw 35
	Level 4	401	Bedrooms	Rw 32
Northern Facade	Levels 1-4	103, 104, 105, 203, 204, 205, 303, 304, 305, 401	Sleeping Areas	Rw 28
			Living Areas	Rw 28
Within building voids	Levels 1-3	101, 102, 103, 105, 201, 202, 203, 205, 301, 302, 303, 305	Sleeping Areas	Rw 28
			Living Areas	Rw 28

Notes:

The client is advised not to commence detailing or otherwise commit to partition construction systems which have not been tested in an approved laboratory or for which an opinion only is available. Testing of partition construction systems is a component of the quality control of the design process and should be viewed as a priority because there is no guarantee the forecast results will be achieved thereby necessitating the use of an alternative which may affect the cost and timing of the project. No responsibility is taken for use of or reliance upon untested partition construction systems, estimates or opinions. The advice provided here is in respect of acoustics only.

The information in this table is provided for the purpose of Council approvals process and cost planning and shall not be used for construction unless otherwise approved in writing by the acoustic consultant.

The design in this table is preliminary and a comprehensive assessment shall be conducted prior to Construction Certification.

Before committing to any form of construction or committing to any builder, advice should be sought from an acoustic consultant to ensure that adequate provisions are made for any variations which may occur as a result of changes to the form of construction where only an "estimate" is available for the sound insulation properties of recommended materials.

The glazing supplier shall ensure that installation techniques will not diminish the Rw performance of the glazing when installed on site.

All openable glass windows and doors shall incorporate full perimeter acoustic seals equivalent to Q-Lon, which enable the Rw rating performance of the glazing to not be reduced.

The above glazing thicknesses should be considered the minimum thicknesses to achieve acoustical ratings. Greater glazing thicknesses may be required for structural loading, wind loading etc.

The table below presents typical glazing thicknesses and frame construction to comply with the minimum acoustic ratings presented in Table 3 above.

Table 4: Typical Glazing Constructions to Achieve Acoustic Ratings

Rw Rating	Typical Glazing System
Rw 28	6mm float or toughened glass in aluminium frames. Standard weather seals
Rw 32	Minimum 6.38mm laminated glass in an aluminium frame. Acoustic seals installed
Rw 35	Minimum 10.38mm laminated glass in a commercial grade aluminium frame with acoustic seals installed
Rw 38	8.5mm V-Lam acoustic glass in a commercial grade aluminium frame with acoustic seals installed

The table presented above is intended as a guide only and should not be used for construction.

It is the responsibility of the sub-contractor to provide laboratory test reports for the glazed systems proposed for installation at the development site to show compliance with the acoustic ratings.

5.2 Ventilation

In accordance with the Department of Planning publication "Development Near Rail Corridors & Busy Roads – Interim Guideline" 2008:

If internal noise levels with windows or doors open exceed the criteria by more than 10dBA, the design of the ventilation for these rooms should be such that occupants can leave windows closed, if they so desire, and also to meet the ventilation requirements of the Building Code of Australia

However, the Department of Planning's Apartment Design Guide, July 2015 Objective 4B-1 requires that all habitable rooms are naturally ventilated, within an apartment complex.

Section 4J, *Noise and Pollution*, of the Apartment Design Guide nominates design solutions that may assist with delivering both the natural ventilation requirements and the internal noise levels (windows open) through careful design solutions. These may include wintergardens with operable facades, partially shielded and insulated balconies, building design and orientation, apartment setbacks and selection of acoustic materials for the building construction.

Shielding and screening to balconies, wintergardens, absorptive treatments, fresh air supply fans and strategically positioned ventilation windows are being considered for glazed windows and doors to single aspect habitable rooms along noise affected facades heavily impacted on by road traffic noise from Sydney Road to meet the natural ventilation requirements of the Department of Planning's Apartment Design Guide and the Building Code of Australia.

Further assessment of internal noise levels with windows opened is required at detailed design to consider facade design, opening sizes, balcony materials, room volumes, room finishes and shielding.

6 External noise emission from building services

6.1 EPA Requirements

The NSW Environment Protection Authority (EPA) sets out noise criteria in its Noise Policy for Industry (NPfI) to control the noise emission from industrial sources.

The NPfI sets project noise trigger level to protect noise amenity for residential receivers. The project noise trigger level is set as the lower value of the following two assessment components:

Controlling intrusive noise impacts in the short term for residences; and

Maintaining noise level amenity for particular land uses for residences and other land uses.

Noise intrusiveness ensures that industrial noise does not exceed the background noise level by an excessive margin, preventing significant changes in the noise characteristic pertinent to the development site and surrounds. This is commonly referred to as the 'background plus 5' criterion. That is, the noise level from new industrial development, assessed in periods of 15 minutes, should not exceed the existing background noise level (measured in the absence of that development) by more than 5dB(A).

Noise amenity ensures that industrial noise levels do not increase without limit, for if a number of industrial noise sources are permitted to increase the background noise level by 5dB(A), in turn there would be a point where the ultimate noise level is unacceptable. A limit on the ultimate acceptable noise level is therefore included in the NPfI as a way of ensuring that cumulative noise impact from industrial growth is curtailed. This limit is referred to as the project amenity noise level. The appropriate limit in any circumstance relates to the land use category, for example, there are different limits for rural, suburban and urban areas.

The table below presents the recommended amenity noise level relevant to the receivers surrounding the proposed development site. The project amenity noise level is defined as the recommended amenity noise level minus 5dB(A).

Table 5: NPfI Amenity Noise Levels - Recommended L_{Aeq} Amenity Noise Levels from Industrial Noise Sources [EPA NPfI Table 2.1]

Receiver	Noise amenity area	Time of day	L_{Aeq}, dB(A)
			Recommended amenity noise level
Residential	Rural	Day	50
		Evening	45
		Night	40
	Suburban	Day	55
		Evening	45
		Night	40

Receiver	Noise amenity area	Time of day	L_{Aeq}, dB(A) Recommended amenity noise level
	Urban	Day	60
		Evening	50
		Night	45
Hotels, motels, caretakers' quarters, holiday accommodation, permanent resident caravan parks	See column 4	See Column 4	5dB(A) above the recommended amenity noise level for a residence for the relevant noise amenity area and time of day
School classroom - internal	All	Noisiest 1-hour period when in use	35
Hospital ward - internal	All	Noisiest 1-hour	35
Hospital ward - external	All	Noisiest 1-hour	50
Place of worship - internal	All	When in use	40
Area specifically reserved for passive recreation (e.g. national park)	All	When in use	50
Active recreation area (e.g. school playground, golf course)	All	When in use	55
Commercial premises	All	When in use	65
Industrial premises	All	When in use	70
Industrial interface (applicable only to residential noise amenity areas)	All	All	Add 5dB(A) to recommended noise amenity

Notes:

- Daytime 7.00 am to 6.00 pm; Evening 6.00 pm to 10.00 pm; Night-time 10.00 pm to 7.00 am
- On Sundays and Public Holidays, Daytime 8.00 am - 6.00 pm; Evening 6.00 pm - 10.00 pm; Night-time 10.00 pm - 8.00 am.
- The LAeq index corresponds to the level of noise equivalent to the energy average of noise levels occurring over a measurement period.

In accordance with Section 2.4 of the NPfI, the following exceptions to the above method to derive the project amenity noise level apply:

In areas with high traffic noise levels (see Section 2.4.1 of the NPfI).

In proposed developments in major industrial clusters (see Section 2.4.2 of the NPfI).

Where the resultant project amenity noise level is 10dB, or more, lower than the existing industrial noise level. In this case the project amenity noise levels can be set at 10dB below existing industrial noise levels if it can be demonstrated that existing industrial noise levels are unlikely to reduce over time.

Where cumulative industrial noise is not a necessary consideration because no other industries are present in the area, or likely to be introduced into the area in the future. In such cases the relevant amenity noise level is assigned as the project amenity noise level for the development.

The following table presents the site-specific noise production criteria from industrial noise sources, namely mechanical plant.

Table 6: Project noise trigger level for noise emission from mechanical plant (EPA NPfI)

Time of Day	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7	Column 8
	Rating Background Level (RBL) L_{A90}	Intrusiveness Criterion (RBL+5)	Project Amenity Noise Level (PANL)	Measured $L_{Aeq, period}$ existing noise levels	Is PANL 10dB, or more, lower than measured $L_{Aeq, period}$?	Existing noise level likely to decrease in future?	Exceptions to PANL? ^	Project Noise Trigger Level $L_{Aeq, period}$ dB(A)
Day (7am to 6pm)	58	63	50	70	Yes	No	Yes, existing LAeq minus 15dB = 55	55
Evening (6pm to 10pm)	53	58	40	69	Yes	No	Yes, existing LAeq minus 15dB = 54	54
Night (10pm to 7am)	36	41	35	66	Yes	No	Yes, existing LAeq minus 15dB =51	41

Explanatory notes:

Column 1 – RBL measured in accordance with the NPfI and outlined in **Error! Reference source not found.** above

Column 3 – Project Amenity Noise Level determined based on 'Residential - suburban' area in Table 2.2 (Amenity noise levels) of the EPA's NPfI minus 5dB

Column 4 – Measured in accordance with the NPfI and outlined in **Error! Reference source not found.** above

Column 7 - Determined in accordance with Section 2.4 of the NPfI.

Column 8 – Project Noise Trigger Level is the lower value of project intrusiveness noise level and project amenity noise level

^ - In accordance with Section 2.4.1 of the NPfI, the project amenity noise level is derived from measured LAeq where measured traffic noise is 10dB or more above the recommended amenity noise level for the area

6.2 Maximum Noise Level Event Assessment

The potential for sleep disturbance from maximum noise level events, from the proposed development, needs to be considered. Section 2.5 of the NPfI provides sleep disturbance trigger levels, summarised as follows:

Table 7: Sleep disturbance noise trigger levels

Receiver	Sleep Disturbance Trigger Levels, 10:00pm to 7:00am	
	$L_{Aeq, 15 minute}$	L_{AFmax}
All residential	Greater than 40dB(A) or RBL plus 5dB, whichever is the greater	52dB(A) or RBL plus 15dB, whichever is the greater

Where noise from the proposed development is predicted to exceed the sleep disturbance trigger levels above in Table 7, during the night time, a detailed noise level assessment is required. The detailed assessment is required to cover the maximum noise level, the extent to which the maximum noise level exceeds the RBL, and the frequency of events occurring during the night time.

6.3 Recommended Noise Control Measures for Mechanical Plant

Where necessary, noise amelioration treatment will be incorporated in the design to ensure that noise levels comply with the recommended EPA's NPfI noise emission criteria noted above.

At this stage details of mechanical plant have not been finalised, the following in-principal recommendations are provided:

- Acoustic assessment of mechanical services equipment will need to be undertaken during the detail design phase of the development to ensure that they shall not either singularly or in total emit noise levels which exceed the noise limits in EPA's NPfI or Council's requirements;
- As noise control treatment can affect the performance of the mechanical services system, it is recommended that consultation with an acoustic consultant be made during the initial phase of mechanical services system design in order to reduce the need for revision of mechanical plant and noise control treatment;
- Mechanical plant noise emission can be controllable by appropriate mechanical system design and implementation of common engineering methods that may include any of the following:
  - procurement of 'quiet' plant,
  - strategic positioning of plant away from sensitive neighbouring premises, maximising the intervening shielding between the plant and sensitive neighbouring premises,
  - commercially available silencers or acoustic attenuators for air discharge and air intakes of plant;
  - acoustically lined and lagged ductwork;
  - acoustic screens and barriers between plant and sensitive neighbouring premises; and/or
  - Partially-enclosed or fully-enclosed acoustic enclosures over plant.
  - Mechanical plant shall have their noise specifications and their proposed locations checked prior to their installation on site; and
  - Fans shall be mounted on vibration isolators and balanced in accordance with Australian Standard 2625 "Rotating and Reciprocating Machinery – Mechanical Vibration".

We recommend a full and detailed assessment with fully documented acoustic treatments be undertaken at the detailed design phase of the development, followed by construction/installation supervision of mechanical plant and equipment acoustic treatment. Compliance testing following the installation of the plant should also be undertaken.

7 Internal Sound Insulation

As a minimum requirement, walls and floors of the residential development shall comply with Building Code of Australia (BCA). Soil and waste pipes shall comply with the minimum requirements of the Building Code of Australia (BCA).

7.1 BCA 2016 Requirements

The acoustic provisions for inter-tenancy walls in Class 2 buildings are outlined in the Building Code of Australia and the following is an extract from the BCA:

F5.2 Determination of airborne sound insulation ratings

A form of construction required to have an airborne sound insulation rating must –

a. have the required value for weighted sound reduction index (Rw) or weighted sound reduction index with spectrum adaptation term (Rw + Ctr) determined in accordance with AS/NZS 1276.1 or ISO 717.1 using results from laboratory measurements; or

b. comply with Specification F5.2.

F5.3 Determination of impact sound insulation ratings

c. A floor in a building required to have an impact sound insulation rating must –

i. *have the required value for weighted normalised impact sound pressure level (Ln,w) determined in accordance with AS/ISO 717.2 using results from laboratory measurements; or*

ii. *comply with Specification F5.2.*

d. A wall in a building required to have an impact sound insulation rating must –

iii. *for a Class 2 or 3 building be of discontinuous construction;*

e. For the purposes of this part, discontinuous construction means a wall having a minimum 20 mm cavity between 2 separate leaves, and

iv. *for masonry, where wall ties are required to connect leaves, the ties are of the resilient type; and*

v. *for other than masonry, there is no mechanical linkage between leaves except at the periphery.*

F5.4 Sound insulation rating of floors

f. A floor in a Class 2 or 3 building must have an Rw + Ctr (airborne) not less than 50 and an Ln,w (impact) not more than 62 if it separates –

vi. *sole-occupancy units; or*

vii. *a sole-occupancy unit from a plant room, lift shaft, stairway, public corridor, public lobby or the like, or parts of a different classification.*

F5.5 Sound insulation rating of walls

g. A wall in a Class 2 or 3 building must –

viii. *have an Rw + Ctr (airborne) not less than 50, if it separates sole-occupancy units; and*

ix. *have an Rw (airborne) not less than 50, if it separates a sole-occupancy unit from a plant room, lift shaft, stairway, public corridor, public lobby or the like, or parts of a different classification; and*

x. *comply with F5.3(b) if it separates:*

xi. *a bathroom, sanitary compartment, laundry or kitchen in one sole-occupancy unit from a habitable room (other than a kitchen) in an adjoining unit; or*

xii. *a sole-occupancy unit from a plant room or lift shaft.*

h. A door may be incorporated in a wall in a Class 2 or 3 building that separates a sole-occupancy unit from a stairway, public corridor, public lobby or the like, provided the door assembly has an Rw not less than 30.

i. Where a wall required to have sound insulation has a floor above, the wall must continue to –

xiii. *the underside of the floor above; or*

xiv. *a ceiling that provides the sound insulation required for the wall.*

F5.6 Sound insulation rating of services

j. If a duct, soil, waste or water supply pipe, including a duct or pipe that is located in a wall or floor cavity, serves or passes through more than one sole-occupancy unit, the duct or pipe must be separated from the rooms of any sole-occupancy unit by construction with an Rw+Ctr (airborne) not less than –

xv. *40 if the adjacent room is a habitable room (other than a kitchen); or*

xvi. *25 if the adjacent room is a kitchen or non-habitable room.*

k. If a storm water pipe passes through a sole-occupancy unit it must be separated in accordance with (a).

8 Construction Noise

APPENDIX A Construction Noise

The NSW *Interim Construction Noise Guideline* (ICNG, 2009) provides guidelines for assessing noise generated during the construction phase of developments.

The key components of the guideline that are incorporated into this assessment include:

Use of LAeq as the descriptor for measuring and assessing construction noise.

NSW noise policies, including the NPfI, RNP and RING have moved to the primary use of LAeq over any other descriptor. As an energy average, LAeq provides ease of use when measuring or calculating noise levels since a full statistical analysis is not required as when using, for example, the LA10 descriptor.

Application of reasonable and feasible noise mitigation measures

As stated in the ICNG, a noise mitigation measure is feasible if it is capable of being put into practice, and is practical to build given the project constraints.

Selecting reasonable mitigation measures from those that are feasible involves making a judgement to determine whether the overall noise benefit outweighs the overall social, economic and environmental effects.

The ICNG provides two methods for assessment of construction noise, being either a quantitative or a qualitative assessment. A quantitative assessment is recommended for major construction projects of significant duration, and involves the measurement and prediction of noise levels, and assessment against set criteria. A qualitative assessment is recommended for small projects with a duration of less than three weeks and focuses on minimising noise disturbance through the implementation of reasonable and feasible work practices, and community notification.

Table 8 below (reproduced from Table 2 of the ICNG) sets out the noise management levels and how they are to be applied for residential receivers. The guideline intends to provide respite for residents exposed to excessive construction noise outside the recommended standard hours whilst allowing construction during the recommended standard hours without undue constraints.

The rating background level (RBL) is used when determining the management level. The RBL is the overall single-figure background noise level measured in each relevant assessment period (during or outside the recommended standard hours).

Table 8: Noise management levels at residential receivers

Time of day	Management level $L_{Aeq\ (15\ min)}$	How to apply
Recommended standard hours: Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm No work on Sundays or public holidays	Noise affected RBL + 10dB(A)	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured LAeq (15 min) is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected RBL + 5dB(A)	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5dB(A) above the noise affected level, the proponent should negotiate with the community. For guidance on negotiating agreements see section 7.2.2 of the ICNG.

Sensitive Land Use

Table 9 below (reproduced from Table 3 of the ICNG) sets out the noise management levels for various sensitive land use developments.

Table 9: Noise Management Levels at Other Noise Sensitive Land Uses

Land use	Where objective applies	Management level $L_{Aeq\ (15\ min)}$
Classrooms at schools and other educational institutions	Internal noise level	45 dB(A)
Hospital wards and operating theatres	Internal noise level	45 dB(A)
Places of worship	Internal noise level	45 dB(A)
Active recreation areas	External noise level	65 dB(A)
Passive recreation areas	External noise level	60 dB(A)
Community centres	Depends on the intended use of the centre.	Refer to the 'maximum' internal levels in AS2107 for specific uses.
Commercial premises	External noise level	70 dB(A)
Industrial premises	External noise level	75 dB(A)

Notes: Noise management levels apply when receiver areas are in use only.

9 Conclusion

Renzo Tonin & Associates have completed an assessment of the potential noise impacts to and from the proposed mixed use development at 396-402 Sydney Road, Balgowlah.

In order to control airborne traffic and rail noise intrusion and comply with the nominated criteria, glazing recommendations have been made in Section 5 above.

Recommendations to comply with noise emission criteria for the site, including mechanical plant and construction noise have also been presented in the body of this report.

In conclusion, the proposed site is capable of complying with all relevant acoustic criteria through means of standard acoustic treatment and management.

APPENDIX B Glossary of terminology

The following is a brief description of the technical terms used to describe noise to assist in understanding the technical issues presented.

Adverse weather	Weather effects that enhance noise (that is, wind and temperature inversions) that occur at a site for a significant period of time (that is, wind occurring more than 30% of the time in any assessment period in any season and/or temperature inversions occurring more than 30% of the nights in winter).
Ambient noise	The all-encompassing noise associated within a given environment at a given time, usually composed of sound from all sources near and far.
Assessment period	The period in a day over which assessments are made.
Assessment point	A point at which noise measurements are taken or estimated. A point at which noise measurements are taken or estimated.
Background noise	Background noise is the term used to describe the underlying level of noise present in the ambient noise, measured in the absence of the noise under investigation, when extraneous noise is removed. It is described as the average of the minimum noise levels measured on a sound level meter and is measured statistically as the A-weighted noise level exceeded for ninety percent of a sample period. This is represented as the L90 noise level (see below).
Decibel [dB]	The units that sound is measured in. The following are examples of the decibel readings of every day sounds: 0dB The faintest sound we can hear 30dB A quiet library or in a quiet location in the country 45dB Typical office space. Ambience in the city at night 60dB CBD mall at lunch time 70dB The sound of a car passing on the street 80dB Loud music played at home 90dB The sound of a truck passing on the street 100dB The sound of a rock band 115dB Limit of sound permitted in industry 120dB Deafening
dB(A)	A-weighted decibels. The A- weighting noise filter simulates the response of the human ear at relatively low levels, where the ear is not as effective in hearing low frequency sounds as it is in hearing high frequency sounds. That is, low frequency sounds of the same dB level are not heard as loud as high frequency sounds. The sound level meter replicates the human response of the ear by using an electronic filter which is called the "A" filter. A sound level measured with this filter switched on is denoted as dB(A). Practically all noise is measured using the A filter.
dB(C)	C-weighted decibels. The C-weighting noise filter simulates the response of the human ear at relatively high levels, where the human ear is nearly equally effective at hearing from mid-low frequency (63Hz) to mid-high frequency (4kHz), but is less effective outside these frequencies.
Frequency	Frequency is synonymous to pitch. Sounds have a pitch which is peculiar to the nature of the sound generator. For example, the sound of a tiny bell has a high pitch and the sound of a bass drum has a low pitch. Frequency or pitch can be measured on a scale in units of Hertz or Hz.
Impulsive noise	Having a high peak of short duration or a sequence of such peaks. A sequence of impulses in rapid succession is termed repetitive impulsive noise.
Intermittent noise	The level suddenly drops to that of the background noise several times during the period of observation. The time during which the noise remains at levels different from that of the ambient is one second or more.
L_{Max}	The maximum sound pressure level measured over a given period.
L_{Min}	The minimum sound pressure level measured over a given period.

L_1	The sound pressure level that is exceeded for 1% of the time for which the given sound is measured.
L_{10}	The sound pressure level that is exceeded for 10% of the time for which the given sound is measured.
L_{90}	The level of noise exceeded for 90% of the time. The bottom 10% of the sample is the L90 noise level expressed in units of dB(A).
L_{eq}	The "equivalent noise level" is the summation of noise events and integrated over a selected period of time.
Reflection	Sound wave changed in direction of propagation due to a solid object obscuring its path.
SEL	Sound Exposure Level (SEL) is the constant sound level which, if maintained for a period of 1 second would have the same acoustic energy as the measured noise event. SEL noise measurements are useful as they can be converted to obtain Leq sound levels over any period of time and can be used for predicting noise at various locations.
Sound	A fluctuation of air pressure which is propagated as a wave through air.
Sound absorption	The ability of a material to absorb sound energy through its conversion into thermal energy.
Sound level meter	An instrument consisting of a microphone, amplifier and indicating device, having a declared performance and designed to measure sound pressure levels.
Sound pressure level	The level of noise, usually expressed in decibels, as measured by a standard sound level meter with a microphone.
Sound power level	Ten times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power.
Tonal noise	Containing a prominent frequency and characterised by a definite pitch.

APPENDIX C Assessment and Design Methodology

C.1 Northern Beaches Council's Manly Development Control Plan 2013 - Amendment 11

Northern Beaches Council is the regulatory authority for the proposed development. Council's Manly DCP 2013. Relevant sections of Council's DCP are re-iterated below.

"3.4.2.3 Acoustical Privacy (Noise Nuisance)

See also Noise Guide for Local Government prepared by NSW Department of Environment, Climate Change and Water in 2010.

a) Consideration must be given to the protection of acoustical privacy in the design and management of development.

b) Proposed development and activities likely to generate noise including certain outdoor living areas like communal areas in Boarding Houses, outdoor open space, driveways, plant equipment including pool pumps and the like should be located in a manner which considers the acoustical privacy of neighbours including neighbouring bedrooms and living areas.

c) Council may required a report to be prepared by a Noise Consultant that would assess likely noise and vibration impacts and may include noise and vibration mitigation strategies and measures. See particular requirements for noise control reports for licenced premises below at paragraph g) below.

See also paragraph 3.9.3 Noise from Mechanical Plant.

Notes: Development proposals including changes of use may lead to new or exacerbated noise impacts. For example a new residential development may be located close to existing noisy activities or a new or intensified noisy activity may be proposed close to existing residential areas. Common noisy activities include commercial premises, main roads and some entertainment facilities.

3.9.3 Noise from Mechanical Plant

External mechanical plant systems (for pools, air conditioning and the like) must be acoustically enclosed and located centrally and away from neighbours living areas of neighbouring properties and side and rear boundaries.

See also paragraph 3.4.2.4 Acoustical Privacy.

Note: Excessive noise from the operation of mechanical plant such as air conditioning units, swimming pool pumps, and ventilation and refrigeration systems can disturb residents, disrupt sleep, interfere with normal daily activities or significantly impact on people's health."

C.2 SEPP (Infrastructure) 2007

87 Impact of rail noise or vibration on non-rail development

2. This clause applies to development for any of the following purposes that is on land in or adjacent to a rail corridor and that the consent authority considers is likely to be adversely affected by rail noise or vibration:

l. a building for residential use,

m. a place of public worship,

n. a hospital,

o. an educational establishment or child care centre.

3. Before determining a development application for development to which this clause applies, the consent authority must take into consideration any guidelines that are issued by the Director-General for the purposes of this clause and published in the Gazette.

4. 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:

p. in any bedroom in the building - 35 dB(A) at any time between 10 pm and 7am,

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

102 Impact of road noise or vibration on non-road development

5. 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 transitway 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:

r. a building for residential use,

s. a place of public worship,

t. a hospital,

u. an educational establishment or child care centre.

6. Before determining a development application for development to which this clause applies, the consent authority must take into consideration any guidelines that are issued by the Director-General for the purposes of this clause and published in the Gazette.

7. 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:

v. in any bedroom in the building - 35 dB(A) at any time between 10 pm and 7am,

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

8. In this clause, "freeway", "tollway" and "transitway" have the same meanings as they have in the Roads Act 1993

C.3 Department of Planning publication 'Development near rail corridors and busy roads – Interim guideline'

The Guideline provides direction for developments that may be impacted by rail corridors and/or busy roads and consideration for the Guideline is a requirement for development specified under the Infrastructure SEPP.

The Guideline recommends an acoustic traffic assessment be undertaken for roads having an AADT of greater than 20,000 and less than 40,000 vehicles per day and states an assessment is mandatory for roads having an AADT of greater than 40,000 vehicles per day. It also identifies assessment zones in which a rail noise and vibration assessment is required.

Table 3.1 of the Guideline summaries noise criteria for noise sensitive developments

Residential Buildings		
Type of occupancy	Noise Level dBA	Applicable time period
Sleeping areas (bedroom)	35	Night 10 pm to 7 am
Other habitable rooms (excl. garages, kitchens, bathrooms & hallways	40	At any time

Note: airborne noise is calculated as Leq (9h) (night) and Leq (15h)(day). Ground-borne noise is calculated as Lmax (slow) for 95% of rail pass-by events.

APPENDIX D Monitoring Locations and Results

D.1 Long Term Measurements

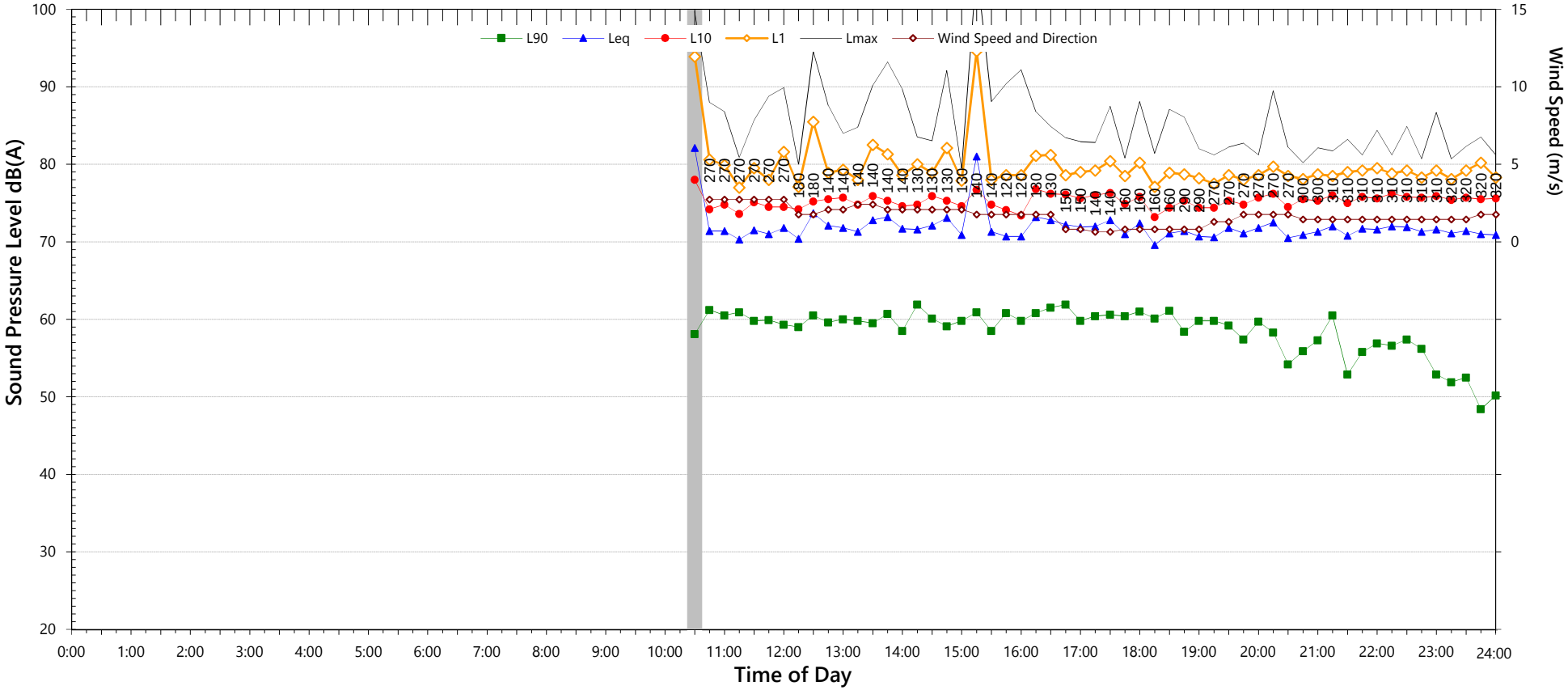
Location: 402 Sydney Road, Balgowlah

Period: Friday 17th August to Friday 24th August 2018

Unattended Noise Monitoring Results

396-402 Sydney Rd, Balgowlah

Friday, 17 August 2018



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day[2]	Evening[3]	Night[4 5]
L_{90}	-	54.2	36.4
LAeq (see note 6)	-	68.8	67.1

Night Time Maximum Noise Levels			(see note 7)
L_{Max} (Range)	85.1	to	92.7
L_{Max} - L_{eq} (Range)	16.7	to	27.4

NSW Road Noise Policy (1m from facade)		
Descriptor	Day	Night[5]
	7am-10pm	10pm-7am
$L_{eq\ 15\ hr}$ and $L_{eq\ 9\ hr}$	72.4	69.6
$L_{eq\ 1hr}$ upper 10 percentile	75.6	72.3
$L_{eq\ 1hr}$ lower 10 percentile	70.8	65.3

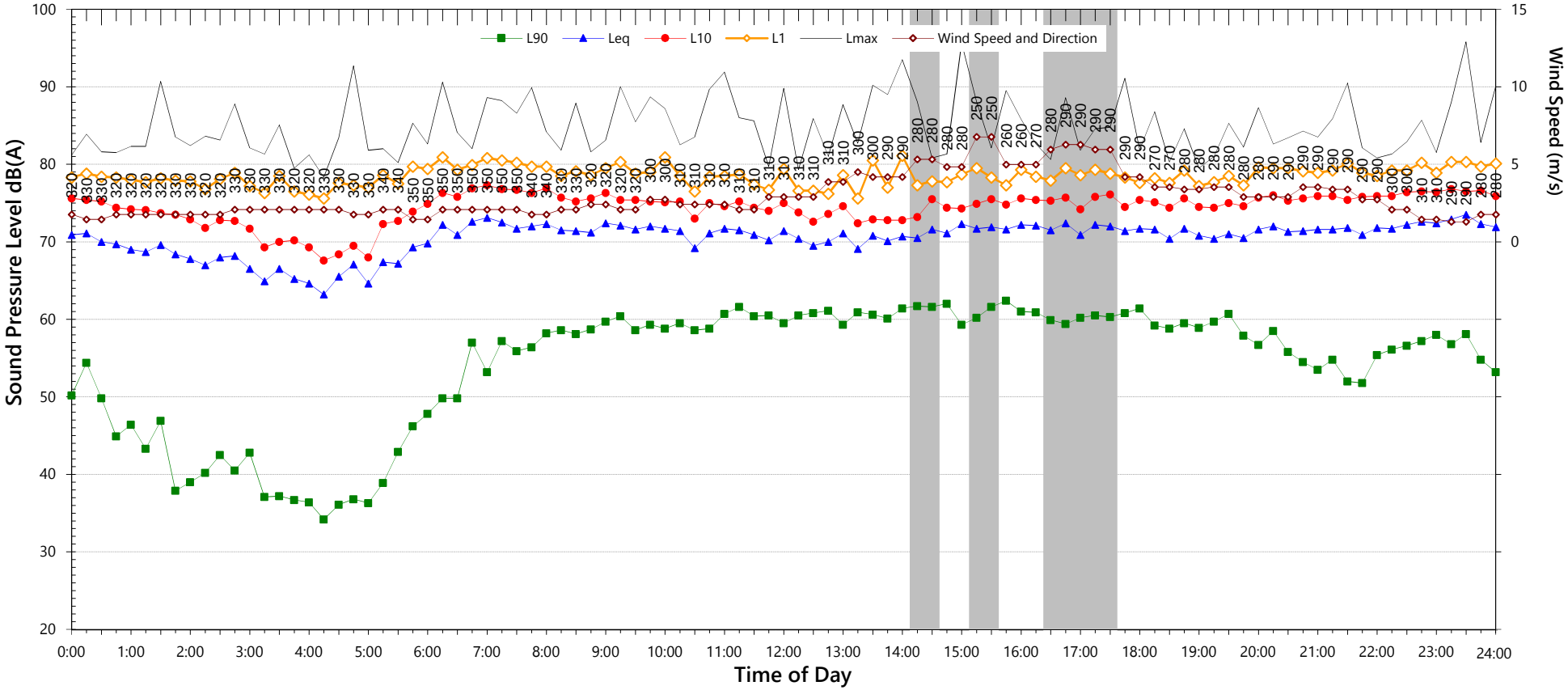
Notes:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Day" is the period from 8am till 6pm on Sundays and 7am til 6pm on other days
3. "Evening" is the period from 6pm till 10pm
4. "Night" relates to the remaining periods
5. "Night" relates to period from 10pm on this graph to morning on the following graph.
6. Graphed data measured 1m from facade; tabulated results free-field corrected
7. Night time L_{Max} values are shown only where L_{Max} >65dB(A) and where L_{Max}- Leq ≥15dB(A)

Unattended Noise Monitoring Results

396-402 Sydney Rd, Balgowlah

Saturday, 18 August 2018



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day[2]	Evening[3]	Night[4 5]
L_{90}	-	52.0	39.8
LAeq (see note 6)	-	68.8	67.6

Night Time Maximum Noise Levels			(see note 7)
L_{Max} (Range)	84.4	to	95.8
L_{Max} - L_{eq} (Range)	15.0	to	23.1

NSW Road Noise Policy (1m from facade)		
Descriptor	Day	Night[5]
	7am-10pm	10pm-7am
$L_{eq\ 15\ hr}$ and $L_{eq\ 9\ hr}$	71.3	70.0
$L_{eq\ 1hr}$ upper 10 percentile	72.1	72.7
$L_{eq\ 1hr}$ lower 10 percentile	70.3	65.3

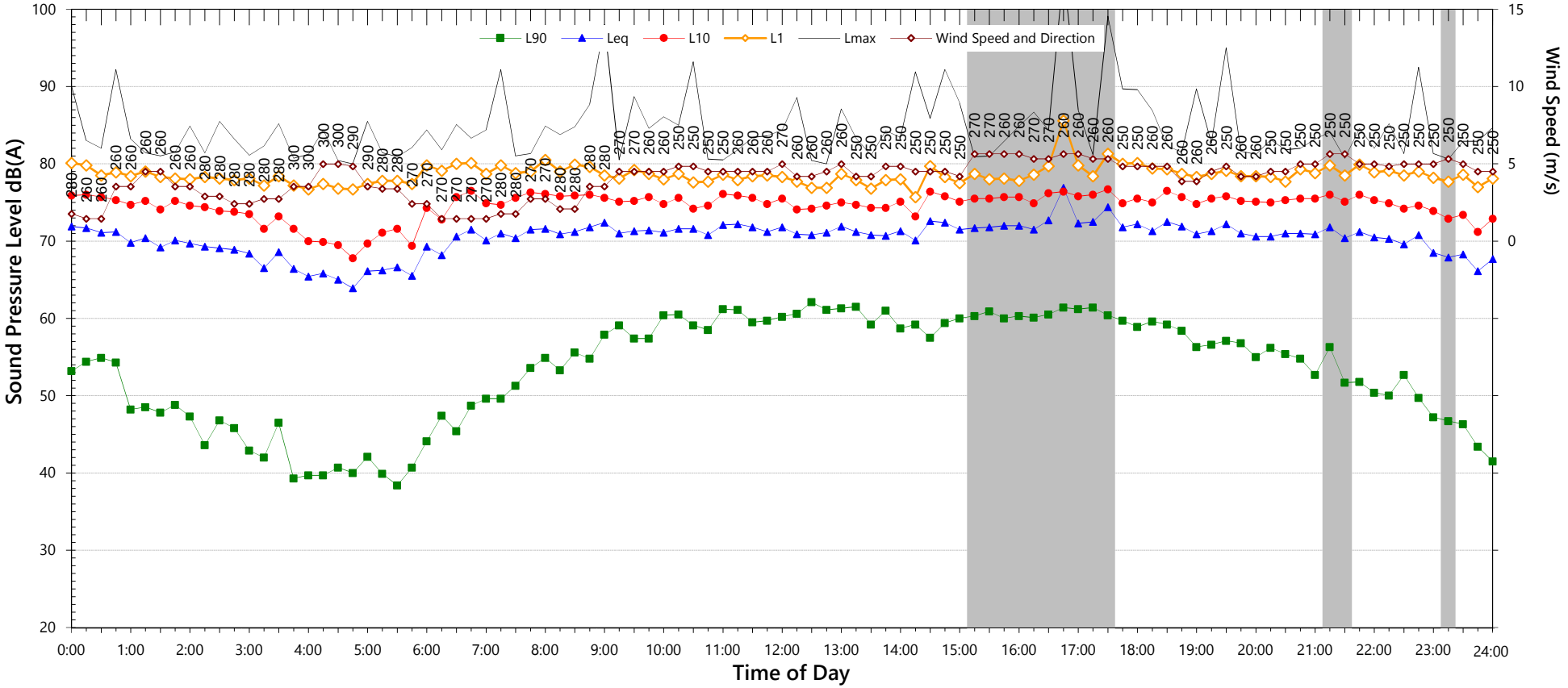
Notes:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Day" is the period from 8am till 6pm on Sundays and 7am til 6pm on other days
3. "Evening" is the period from 6pm till 10pm
4. "Night" relates to the remaining periods
5. "Night" relates to period from 10pm on this graph to morning on the following graph.
6. Graphed data measured 1m from facade; tabulated results free-field corrected
7. Night time L_{Max} values are shown only where L_{Max} >65dB(A) and where L_{Max}- Leq ≥15dB(A)

Unattended Noise Monitoring Results

396-402 Sydney Rd, Balgowlah

Sunday, 19 August 2018



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day[2]	Evening[3]	Night[4 5]
L_{90}	-	51.8	-
LAeq (see note 6)	-	68.7	-

Night Time Maximum Noise Levels			(see note 7)
L_{Max} (Range)	83.1	to	92.5
L_{Max} - L_{eq} (Range)	16.1	to	22.6

NSW Road Noise Policy (1m from facade)		
Descriptor	Day	Night[5]
	7am-10pm	10pm-7am
$L_{eq\ 15\ hr}$ and $L_{eq\ 9\ hr}$	71.4	69.6
$L_{eq\ 1hr}$ upper 10 percentile	71.9	74.7
$L_{eq\ 1hr}$ lower 10 percentile	70.9	62.5

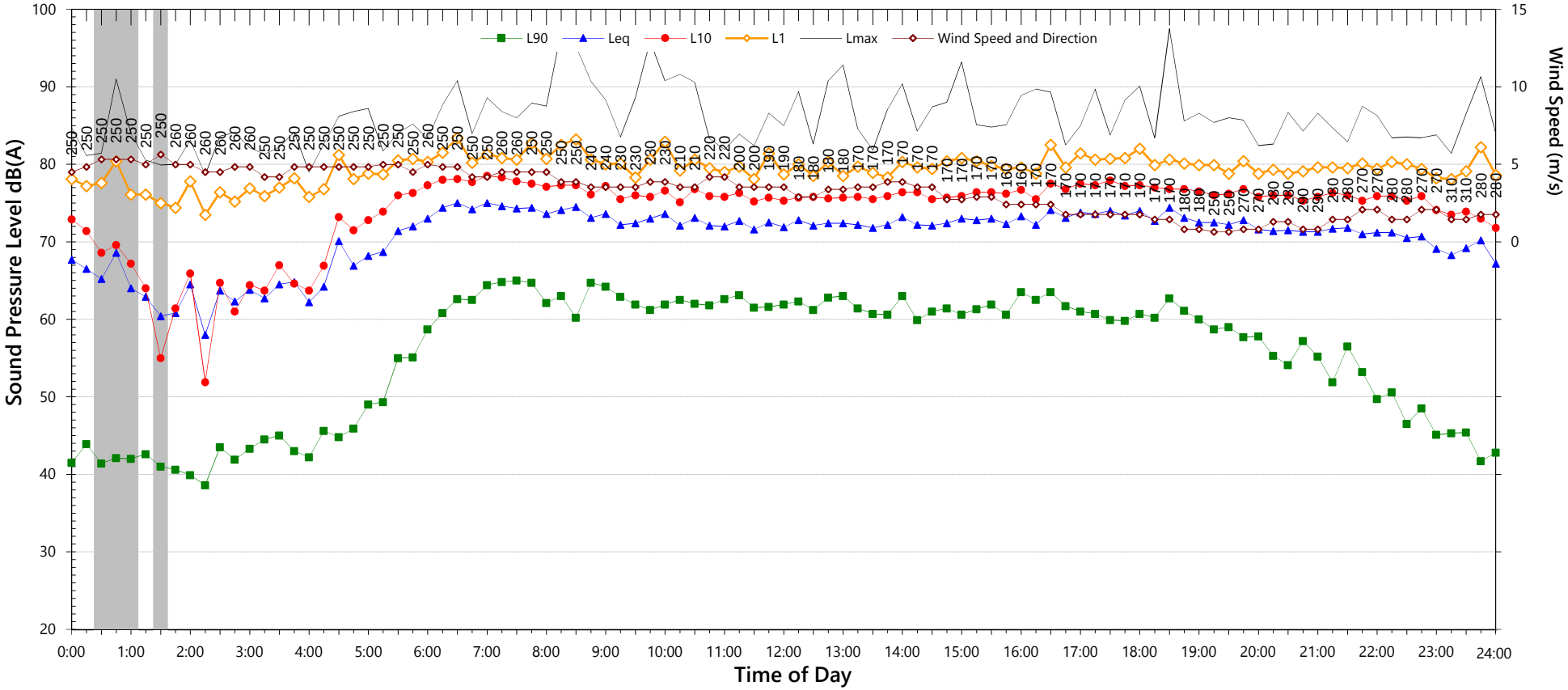
Notes:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Day" is the period from 8am till 6pm on Sundays and 7am til 6pm on other days
3. "Evening" is the period from 6pm till 10pm
4. "Night" relates to the remaining periods
5. "Night" relates to period from 10pm on this graph to morning on the following graph.
6. Graphed data measured 1m from facade; tabulated results free-field corrected
7. Night time L_{Max} values are shown only where L_{Max} >65dB(A) and where L_{Max}- Leq ≥15dB(A)

Unattended Noise Monitoring Results

396-402 Sydney Rd, Balgowlah

Monday, 20 August 2018



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day[2]	Evening[3]	Night[4 5]
L_{90}	60.6	51.9	35.3
LAeq (see note 6)	70.5	69.7	66.5

Night Time Maximum Noise Levels			(see note 7)
L_{Max} (Range)	82.0	to	92.2
L_{Max} - L_{eq} (Range)	17.8	to	24.8

NSW Road Noise Policy (1m from facade)		
Descriptor	Day	Night[5]
	7am-10pm	10pm-7am
$L_{eq\ 15\ hr}$ and $L_{eq\ 9\ hr}$	72.8	69.0
$L_{eq\ 1hr}$ upper 10 percentile	74.1	74.2
$L_{eq\ 1hr}$ lower 10 percentile	71.4	60.9

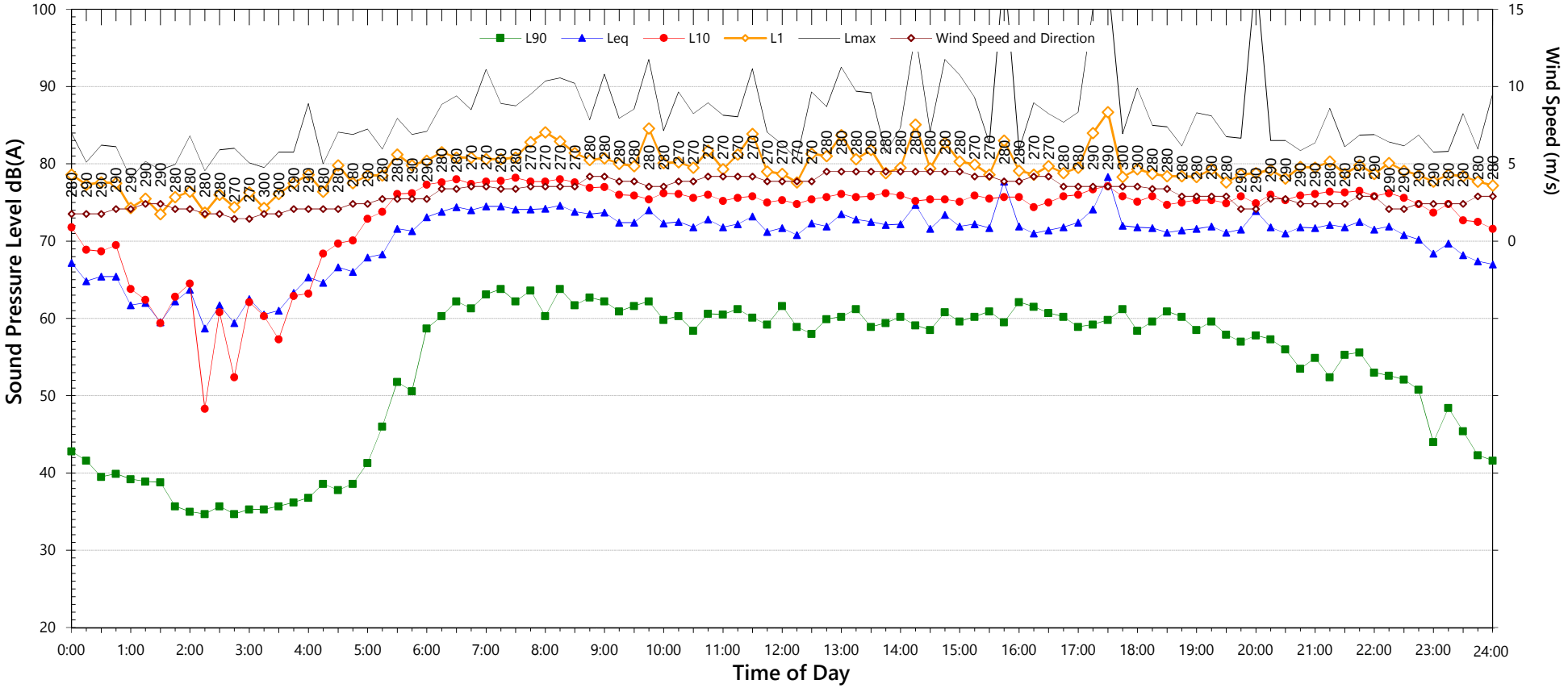
Notes:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Day" is the period from 8am till 6pm on Sundays and 7am til 6pm on other days
3. "Evening" is the period from 6pm till 10pm
4. "Night" relates to the remaining periods
5. "Night" relates to period from 10pm on this graph to morning on the following graph.
6. Graphed data measured 1m from facade; tabulated results free-field corrected
7. Night time L_{Max} values are shown only where L_{Max} >65dB(A) and where L_{Max}- Leq ≥15dB(A)

Unattended Noise Monitoring Results

396-402 Sydney Rd, Balgowlah

Tuesday, 21 August 2018



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day[2]	Evening[3]	Night[4 5]
L_{90}	58.9	53.0	36.5
LAeq (see note 6)	70.7	69.3	66.2

Night Time Maximum Noise Levels			(see note 7)
L_{Max} (Range)	81.5	to	89.5
L_{Max} - L_{eq} (Range)	15.2	to	25.7

NSW Road Noise Policy (1m from facade)		
Descriptor	Day	Night[5]
	7am-10pm	10pm-7am
$L_{eq\ 15\ hr}$ and $L_{eq\ 9\ hr}$	72.9	68.7
$L_{eq\ 1hr}$ upper 10 percentile	74.6	73.8
$L_{eq\ 1hr}$ lower 10 percentile	71.5	61.8

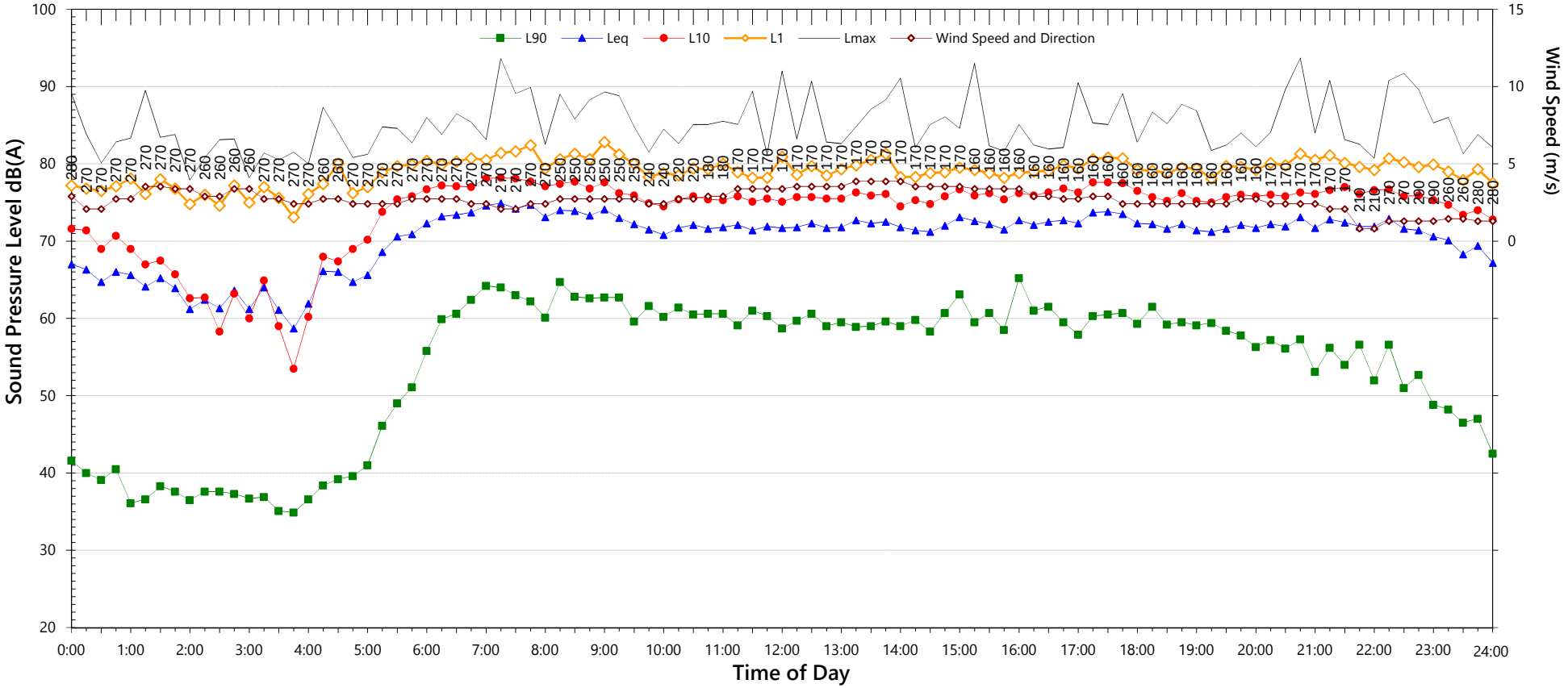
Notes:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Day" is the period from 8am till 6pm on Sundays and 7am til 6pm on other days
3. "Evening" is the period from 6pm till 10pm
4. "Night" relates to the remaining periods
5. "Night" relates to period from 10pm on this graph to morning on the following graph.
6. Graphed data measured 1m from facade; tabulated results free-field corrected
7. Night time L_{Max} values are shown only where L_{Max} >65dB(A) and where L_{Max}- Leq ≥15dB(A)

Unattended Noise Monitoring Results

396-402 Sydney Rd, Balgowlah

Wednesday, 22 August 2018



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day[2]	Evening[3]	Night[4 5]
L_{90}	58.9	53.1	36.9
LAeq (see note 6)	70.1	69.5	66.9

Night Time Maximum Noise Levels			(see note 7)
L_{Max} (Range)	82.4	to	93.0
L_{Max} - L_{eq} (Range)	15.8	to	21.8

NSW Road Noise Policy (1m from facade)		
Descriptor	Day	Night[5]
	7am-10pm	10pm-7am
$L_{eq\ 15\ hr}$ and $L_{eq\ 9\ hr}$	72.5	69.4
$L_{eq\ 1hr}$ upper 10 percentile	74.1	74.2
$L_{eq\ 1hr}$ lower 10 percentile	71.7	63.1

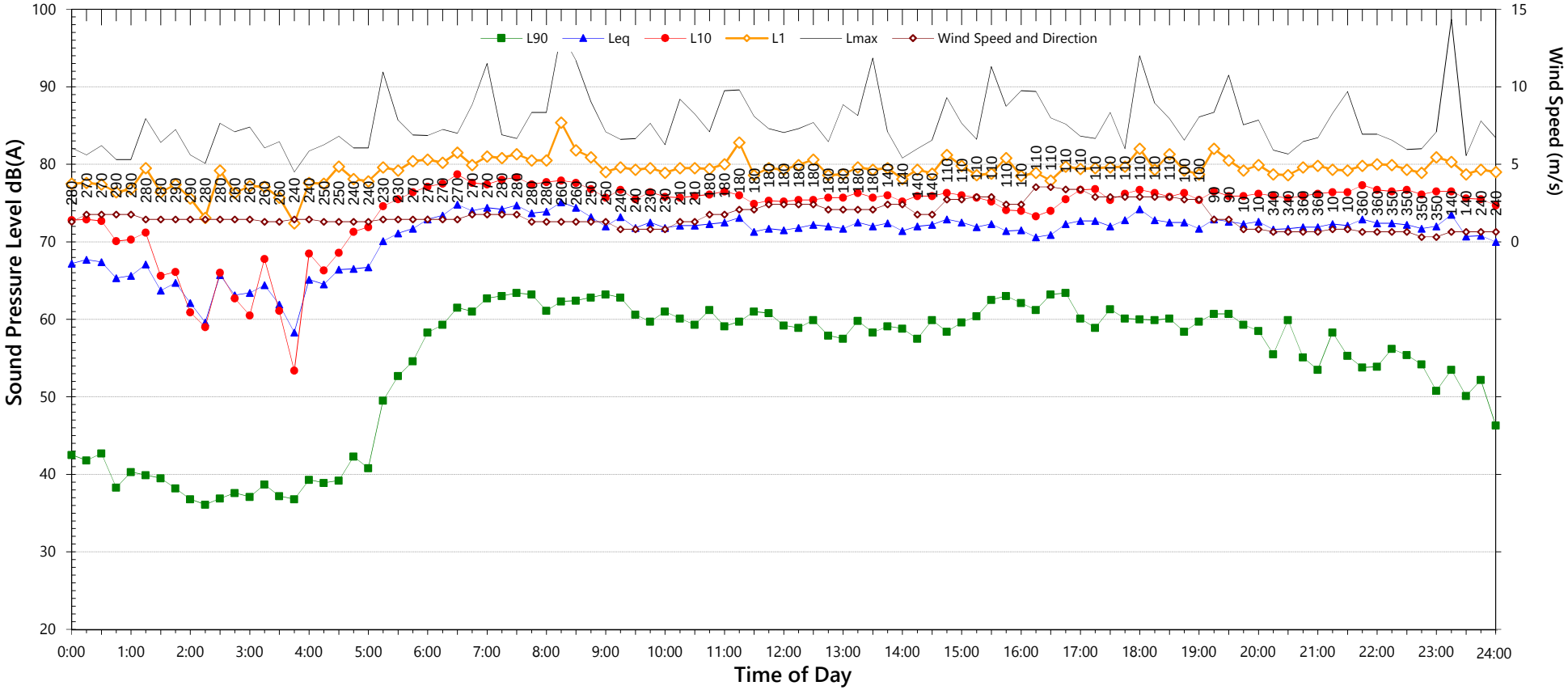
Notes:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Day" is the period from 8am till 6pm on Sundays and 7am til 6pm on other days
3. "Evening" is the period from 6pm till 10pm
4. "Night" relates to the remaining periods
5. "Night" relates to period from 10pm on this graph to morning on the following graph.
6. Graphed data measured 1m from facade; tabulated results free-field corrected
7. Night time L_{Max} values are shown only where L_{Max} >65dB(A) and where L_{Max}- Leq ≥15dB(A)

Unattended Noise Monitoring Results

396-402 Sydney Rd, Balgowlah

Thursday, 23 August 2018



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day[2]	Evening[3]	Night[4 5]
L_{90}	58.4	53.8	-
LAeq (see note 6)	70.1	69.8	-

Night Time Maximum Noise Levels			(see note 7)
L_{Max} (Range)	82.5	to	98.7
L_{Max} - L_{eq} (Range)	17.3	to	27.2

NSW Road Noise Policy (1m from facade)		
Descriptor	Day	Night[5]
	7am-10pm	10pm-7am
$L_{eq\ 15\ hr}$ and $L_{eq\ 9\ hr}$	72.5	69.6
$L_{eq\ 1hr}$ upper 10 percentile	74.0	75.0
$L_{eq\ 1hr}$ lower 10 percentile	71.7	64.0

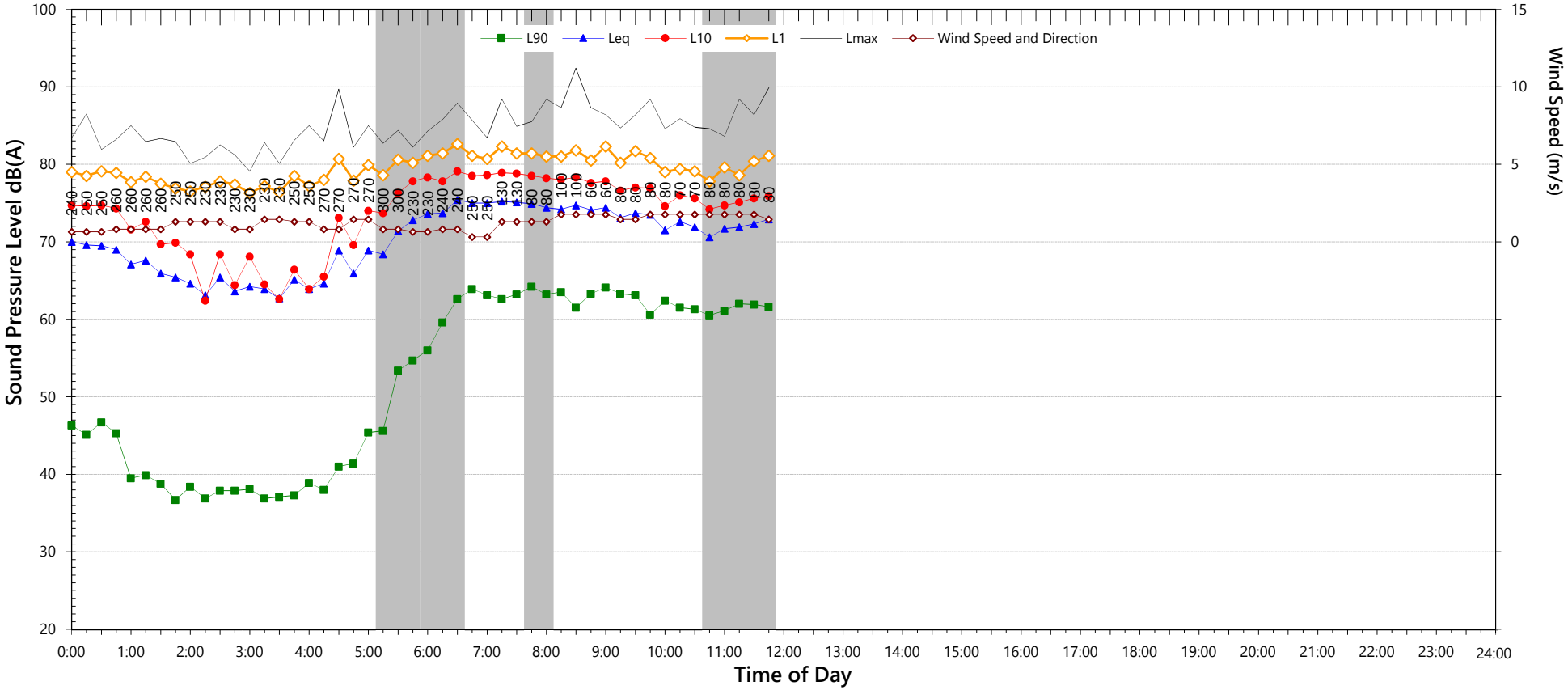
Notes:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Day" is the period from 8am till 6pm on Sundays and 7am til 6pm on other days
3. "Evening" is the period from 6pm till 10pm
4. "Night" relates to the remaining periods
5. "Night" relates to period from 10pm on this graph to morning on the following graph.
6. Graphed data measured 1m from facade; tabulated results free-field corrected
7. Night time L_{Max} values are shown only where L_{Max} >65dB(A) and where L_{Max}- Leq ≥15dB(A)

Unattended Noise Monitoring Results

396-402 Sydney Rd, Balgowlah

Friday, 24 August 2018



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day[2]	Evening[3]	Night[4 5]
L_{90}	-	-	-
LAeq (see note 6)	-	-	-

Night Time Maximum Noise Levels			(see note 7)
L_{Max} (Range)	-	to	-
L_{Max} - L_{eq} (Range)	-	to	-

NSW Road Noise Policy (1m from facade)		
Descriptor	Day	Night[5]
	7am-10pm	10pm-7am
$L_{eq\ 15\ hr}$ and $L_{eq\ 9\ hr}$	73.8	-
$L_{eq\ 1hr}$ upper 10 percentile	75.2	-
$L_{eq\ 1hr}$ lower 10 percentile	72.3	-

Notes:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Day" is the period from 8am till 6pm on Sundays and 7am til 6pm on other days
3. "Evening" is the period from 6pm till 10pm
4. "Night" relates to the remaining periods
5. "Night" relates to period from 10pm on this graph to morning on the following graph.
6. Graphed data measured 1m from facade; tabulated results free-field corrected
7. Night time L_{Max} values are shown only where L_{Max} >65dB(A) and where L_{Max}- Leq ≥15dB(A)