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TOGA CENTRAL, 2 LEE STREET, HAYMARKET

NOISE AND VIBRATION ASSESSMENT

13 December 2022

Toga

RENZ-AC-REP-00000001[C] Toga Central Noise and Vibration Assessment

35 1982-2017 ACOUSTIC ENGINEERING EXCELLENCE

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1 Introduction

Renzo Tonin & Associates (RTA) has been commissioned by TOGA Group (TOGA) to prepare a noise and vibration assessment report to accompany a SSD DA for the mixed-use redevelopment proposal at TOGA Central, located at 2 & 8A Lee Street, Haymarket.

The Minister for Planning, or their delegate, is the consent authority for the SSD DA and this application is lodged with the NSW Department of Planning and Environment (DPE) for assessment.

This report has been prepared in response to the requirements contained within the Secretary's Environmental Assessment Requirements (SEARs) dated 17 December 2021 and issued for the SSD DA. Specifically, this report has been prepared to respond to the noise and vibration requirements of the SEARs, referenced in Table 1-1 below.

Table 1-1: Secretary's Environmental Assessment Requirements (SSD-33258337)

Item	Description Of Requirement	Section Reference (this report)
13. Noise and Vibration	Provide a noise and vibration assessment prepared in accordance with the relevant NSW Environment Protection Authority (EPA) guidelines. The assessment must detail construction and operational noise and vibration impacts on nearby sensitive receivers and structures and outline the proposed management and mitigation measures that would be implemented	Sections 7.3, 7.4, 8 & 9

1.1 Background and Proposal

The purpose of the SSD DA is to complete the restoration of the heritage-listed building on the site, delivery of new commercial floorspace and public realm improvements that will contribute to the realisation of the Government's vision for an iconic technology precinct and transport gateway.

The application seeks consent for the conservation, refurbishment and adaptive re-use of the Adina Hotel building (also referred to as the former Parcel Post building (fPPb)), construction of a 45-storey tower above and adjacent to the existing building and delivery of significant public domain improvements at street level, lower ground level and within Henry Deane Plaza. Specifically, the SSD DA seeks development consent for:

- Site establishment and removal of landscaping within Henry Deane Plaza.
- Demolition of contemporary additions to the fPPb and public domain elements within Henry Deane Plaza.
- Conservation work and alterations to the fPPb for retail premises, commercial premises, and hotel and motel accommodation. The adaptive reuse of the building will seek to accommodate:
  - Commercial lobby and hotel concierge facilities,
  - Retail tenancies, a food and beverage tenancy and convenience retail with back of house areas,
  - 4 levels of co-working space,

  - Function and conference area with access to level 6 outdoor rooftop space, and
  - Reinstatement of the original fPPb roof pitch form in a contemporary terracotta materiality.
- Provision of retail floor space including a supermarket tenancy, smaller retail tenancies, and back of house areas below Henry Deane Plaza (at basement Level 1 (RL12.10) and lower ground (RL 16)).
- Construction of a 45-storey hotel and commercial office tower above and adjacent to the fPPb. The tower will have a maximum building height of RL 202.108m, and comprise:
  - 10 levels of hotel facilities between level 10 – level 19 of the tower, including 204 hotel keys and 2 levels of amenities including a pool, gymnasium and day spa, to operate ancillary to the hotel premises. A glazed atrium and hotel arrival is accommodated adjacent to the fPPb, accessible from Lee Street.
  - 22 levels of commercial office space between level 23 – level 44 of the tower, accommodated within a connected floor plate with a consolidated side core.
  - Rooftop plant, lift overrun, servicing and BMU.
- Provision of vehicular access into the site via a shared basement, with connection points provided to both Block A (at RL5) and Block B (at RL5.5) basements. Primary access will be accommodated from the adjacent Atlassian site at 8-10 Lee Street, Haymarket, into 4 basement levels in a split-level arrangement. The basement will accommodate:
  - Car parking for 106 vehicles, 4 car share spaces and 5 loading bays.
  - Hotel, commercial and retail and waste storage areas.
  - Plant, utilities and servicing.
- Provision of end of trip facilities and 165 employee bicycle spaces within the fPPb basement, and an additional 72 visitor bicycle spaces within the public realm.
- Delivery of a revitalised public realm across the site that is coordinated with adjacent development, including an improved public plaza linking Railway Square (Lee Street), and Block B (known as 'Central Place Sydney'). The proposal includes the delivery of a significant area of new publicly accessible open space at street level, lower ground level, and at Henry Deane Plaza, including the following proposed elements:
  - Provision of equitable access within Henry Deane Plaza including stairways, ramp access and a publicly accessible lift.
  - Construction of an elevated pavilion within Henry Deane Plaza at RL21.
  - Landscaping works within Henry Deane Plaza and along Lee Street.
- Utilities and service provision.
- Realignment of lot boundaries.

2 Methodology

The following methodology is adopted to undertake this noise and vibration assessment:

- Characterise features of the project site, including existing environmental noise and vibration sources, surrounding land uses and terrain features.
- Identify and classify the potentially nearest affected noise and vibration sensitive receivers.
- Undertake detailed noise surveys around the site, to quantify the existing noise environment.
- Identify relevant noise and vibration legislation and guidelines applicable to the subject proposal and formulate project specific criteria for operational and construction impacts (in accordance with SEARs requirements).
- Assess potential noise and vibration impacts associated with the operations of the subject proposal. Noise and vibration risks evaluated in this assessment include:
  - Noise impacts associated with the operation of retail and F&B areas.
  - Noise impacts associated with the use of the rooftop terrace (on top of existing Adina Hotel building on site).
  - Noise and vibration impacts from building services plant and equipment serving the proposed development.
  - Noise impacts from the operation of loading dock and waste collection.
  - Noise impacts of additional traffic on surrounding public roads generated by the proposed development.
- Undertake a preliminary assessment of potential noise and vibration impacts associated with the construction of the proposed development.
- Develop mitigation measures and management controls as required to control noise and vibration impacts associated with the operation and construction of the subject proposal.

3 Site Description

The site is located within the City of Sydney Local Government Area (LGA). The site is situated 1.5km south of the Sydney CBD and 6.9km north-east of the Sydney International Airport within the suburb of Haymarket.

The site is located within the Western Gateway sub-precinct, an area of approximately 1.65ha that is located immediately west of Central Station within Haymarket on the southern fringe of the Sydney CBD. Immediately north of Central Station is Belmore Park, to the west is Haymarket (including the University of Technology, Sydney and Chinatown), to the south and east is rail lines and services and Prince Alfred Park and to the east is Elizabeth Street and Surry Hills.

Central Station is a public landmark, heritage building, and the largest transport interchange in NSW. With regional and suburban train services, connections to light rail, bus networks and to Sydney Airport, the area around Central Station is one of the most-connected destinations in Australia.

The site is located at 2 & 8A Lee Street, Haymarket and is legally described as Lot 30 in Deposited Plan 880518 and Lot 13 in Deposited Plan 1062447. The land that comprises the site under the Proponent's control (either wholly or limited in either height or depth) comprises a total area of approximately 4,159sqm.

The location of the TOGA Central site is illustrated in Figure 3-1.

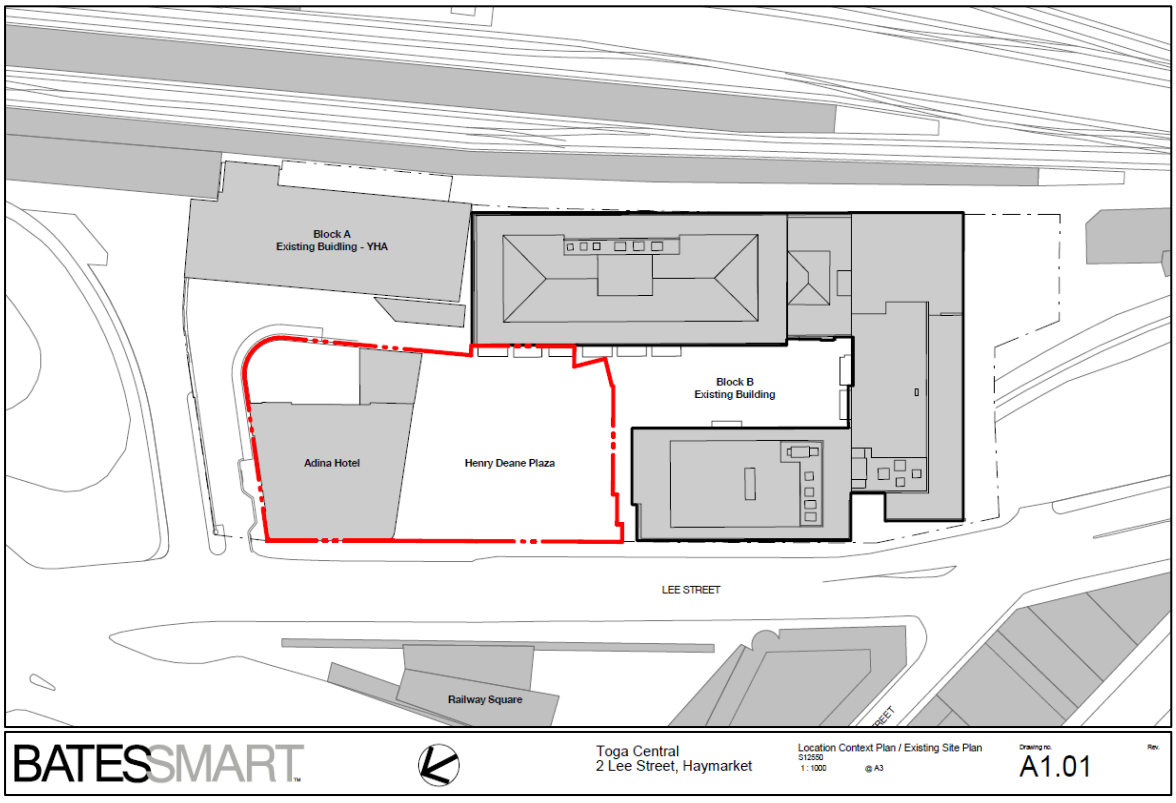

Figure 3-1: Site identification plan (source: Bates Smart)

The site currently comprises the following existing development:

- Lot 30 in Deposited Plan 880518 (Adina Hotel building): the north-western lot within the Western Gateway sub-precinct accommodates a heritage-listed building which was originally developed as the Parcels Post Office building. The building has been adaptively re-used and is currently occupied by the Adina Hotel Sydney Central. The eight-storey building provides 98 short-stay visitor apartments and studio rooms with ancillary facilities including a swimming pool and outdoor seating at the rear of the site.
- Lot 13 in Deposited Plan 1062447 and part of Lot 14 in Deposited Plan 1062447 (Henry Deane Plaza): the central lot within the Western Gateway sub-precinct adjoins Lot 30 to the south. It accommodates 22 specialty food and beverage, convenience retail and commercial service tenancies. The lot also includes publicly accessible space which is used for pop-up events and a pedestrian thoroughfare from Central Station via the Devonshire Street Tunnel. At the entrance to Devonshire Street Tunnel is a large public sculpture and a glazed structure covers the walkway leading into Railway Square. This area forms part of the busy pedestrian connection from Central Station to Railway Square and on to George and Pitt Streets, and pedestrian subways.

The site is listed as an item of local significance under Schedule 5 of the *Sydney Local Environmental Plan 2012* 'Former Parcels Post Office including retaining wall, early lamp post and building interior', Item 855.

The site is also included within the Central Railway Station State heritage listing. This is listed on the State Heritage Register 'Sydney Terminal and Central Railway Station Group', Item SHR 01255, and in Schedule 5 of the *Sydney Local Environmental Plan 2012* 'Central Railway Station group including buildings, station yard, viaducts and building interiors' Item 824.

The site is not however listed independently on the State Heritage Register. There is an array of built forms that constitute Central Station, however the Main Terminal Building (particularly the western frontage) and associated clocktower constitute key components in the visual setting of the Parcel Post building.

3.1 Acoustical Context

Road traffic noise from vehicle movements along George and Lee Streets and rail noise from train movements associated with the Central Station rail corridors, are the primary external noise sources surrounding the subject site. Vibration from the underground future Sydney Metro line is also a consideration.

Existing developments in the vicinity of the site comprise a mix of hotel, hostel, commercial, residential and educational buildings. The potentially nearest affected land uses surrounding the subject proposal, including the adjoining future commercial developments forming the Western Gateway Sub-precinct, are identified and illustrated in Table 3-1 and Figure 3-2 respectively. Locations of noise surveys are also illustrated in Figure 3-2.

Table 3-1: Potentially nearest affected receivers and noise survey locations

Type	ID	Description
Residential	R1	St Helens Site, 849-855 George Street, Ultimo 14-storey residential apartment building
Hotel	H1	Mercure Hotel, 818-820 George Street, Chippendale
	H2	New Sydney Railway Square YHA (part of Atlassian Central project – first six levels), 8-10 Lee Street, Sydney
	H3	Centra Studio Hotel Sydney, 803-813 George Street, Haymarket
	H4	Wake Up! Sydney, 509 Pitt Street, Sydney
Commercial	C1	Future Atlassian Central mixed-use tower (32 levels of commercial occupancy, commencing level 7), 8-10 Lee Street, Sydney
	C2	Proposed Central Place mixed-use commercial tower, 14-30 Lee Street, Sydney
	C3	Mixed-use commercial property, 827-837 George Street, Haymarket
Education	E1	Mixed-use commercial property with educational tenancies Charles Darwin University, Level 10, 815 George Street, Sydney TAFE NSW, Marcus Clarke Building, 817/827-837 George Street, Haymarket
RTA long-term noise survey locations	RTA1	Balcony of room 84 on level 6 of Adina Hotel
	RTA2	Balcony of room 94 on level 6 of Adina Hotel
	RTA3	Balcony of room 536 on level 5 of Mercure Hotel
Reference long-term noise survey locations [1]	Atlassian Central [17]	
	AC1	Between Atlassian development site and Adina Hotel
	Central Place [1]	
	CP1	Corner of 7th storey balcony in Henry Deane Building
	CP2	Edge of 2nd Storey patio in SRA House

Notes:

1. These noise measurements were conducted by others and are presented in publicly available acoustic reports and are included in this report for reference. (Central Place and Atlassian Central (Arup [1] and Stantec [17] respectively)).

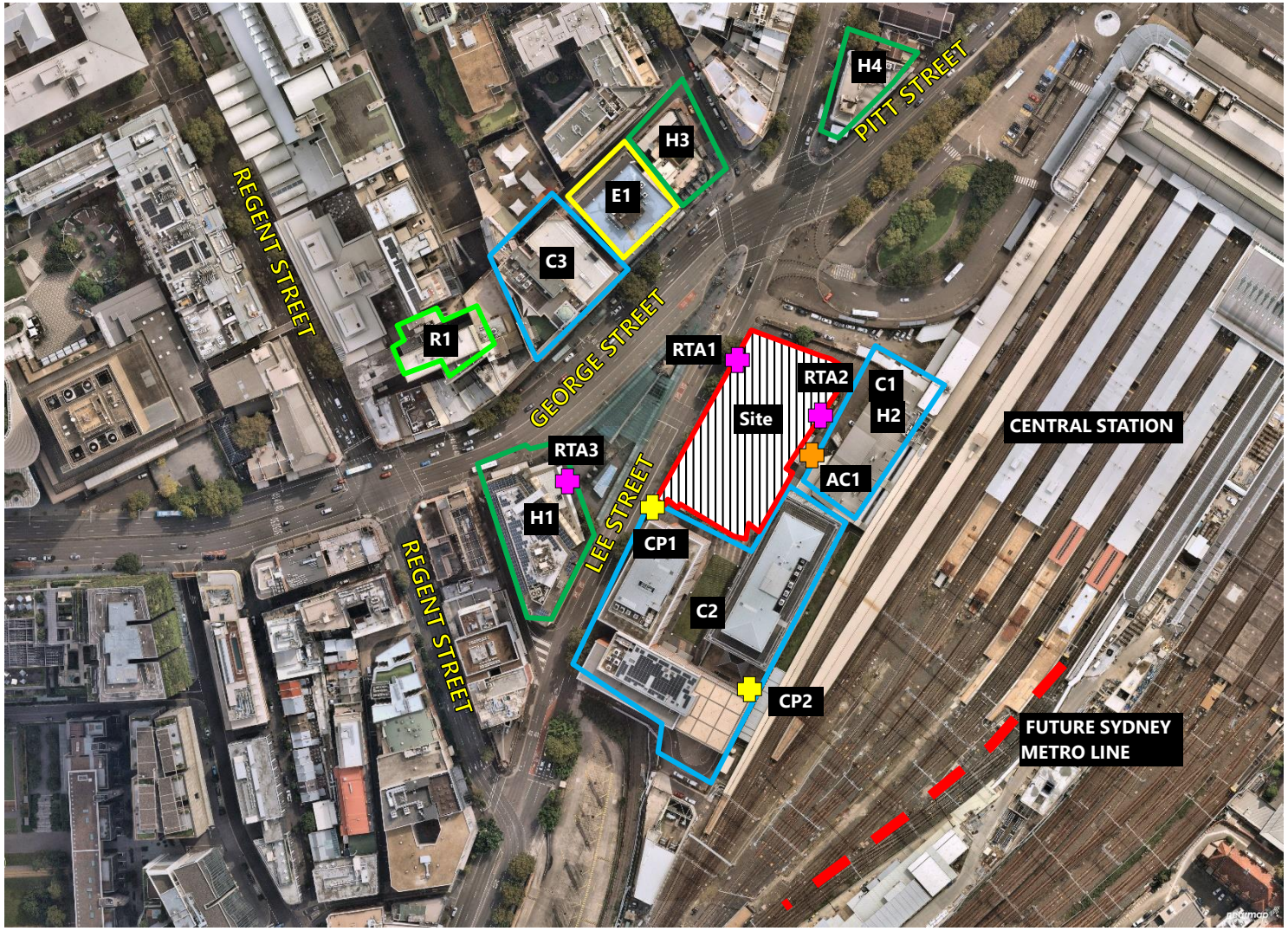

Figure 3-2: Locations of project site, potentially nearest affected receivers and noise surveys (source: Nearmap Limited)

4 Existing Noise Environment

4.1 Methodology

The noise environment of an area varies over time. The NSW Environmental Protection Authority's (EPA) *Noise Policy for Industry* (NPfI) [13] outlines standard time periods over which the background and ambient noise levels are to be determined, which is as follows:

- Day: 07:00 – 18:00 Monday to Saturday and 08:00 – 18:00 Sundays & Public Holidays
- Evening: 18:00 – 22:00 Monday to Sunday & Public Holidays
- Night: 22:00 – 07:00 Monday to Saturday and 22:00 – 08:00 Sundays & Public Holidays

As such, the existing background and ambient noise levels on the site will be summarised in accordance with the NPfI.

Noise survey location considerations included site topography, contributions from environmental noise sources (road and rail traffic, building services plant and equipment etc.) and representative secure locations for the identified surrounding sensitive receivers (see Section 3.1).

4.2 Long-term (Unattended) Noise Surveys

Long-term noise monitoring was carried out from Thursday, 10 February to Monday, 21 February 2022 to quantify the existing noise environment. Three (3) RTA Technology environmental noise loggers were installed at representative locations within and around the site. Table 4-1 presents a description of the noise monitoring locations, which are also illustrated in Figure 3-2.

Table 4-1: Noise monitoring locations

ID	Description
RTA1	The noise monitor was installed in the balcony of room 84 on level 6 of the Adina Hotel. The balcony is located along the western façade of the Hotel building, with the logger installed in an elevated position in the balcony, to ensure the microphone has a clear unrestricted view of George and Lee Streets. This logger is reflective of traffic noise levels incident on the site and background noise levels of developments facing the Lee Street/Broadway intersection.
RTA2	The noise monitor was installed in the balcony of room 94 on level 6 of the Adina Hotel. The balcony is located along the eastern façade of the Hotel building, with the logger installed in an elevated position in the balcony, to ensure the microphone has a clear unrestricted view of Central Station and rail corridor. This logger is reflective of rail noise levels incident on the site and background noise levels of developments to the east of the site.
RTA3	The noise monitor was installed in the balcony of room 536 on level 5 of the Mercure Hotel. The balcony is located along the eastern façade of the Hotel building, with the logger installed in an elevated position in the balcony, to ensure the microphone has a clear unrestricted view of Railway Square, George Street and Lee Street. This logger is reflective of background noise levels at the Mecure Hotel and nearby residential development.

The noise monitors record noise levels on a continuous basis and stores data every fifteen minutes. The noise loggers were calibrated before and after measurements and no significant deviation in calibration was noted. All noise monitoring equipment used comply with Australian Standard 1259.2-1990 "*Acoustics*

- *Sound Level Meters*" and are designated as Type 2 instruments suitable for field use. The long-term noise monitoring methodology is detailed in APPENDIX B.

A summary of the measured background and ambient noise levels are presented in Table 4-2. Detailed noise level-vs-time graphs of the data are included in APPENDIX C.

Noise measurements conducted for the proposed adjoining Western Gateway Sub-precinct development proposals Central Place and Atlassian Central (Arup [1] and Stantec [17] respectively) are also presented below for reference. These locations are also illustrated in the aerial photo presented in Section 3.1.

Table 4-2: Results of long-term noise surveys

Location	Rating Background Noise Levels, dB(A)$L_{90(period)}$			Measured Average Noise Levels, dB(A)$L_{eq(period)}$		
	Day (7am-6pm)	Evening (6pm-10pm)	Night (10pm-7am)	Day (7am-6pm)	Evening (6pm-10pm)	Night (10pm-7am)
RTA1	61	59	54	64	63	59
RTA2	56	55	53	59	58	55
RTA3	61	61	53	64	64	60
AC1 – Atlassian Central SSDA DA [17]	56	55	53	60	58	56
CP1 – Central Place [1]	63	62	56	68	67	64
CP2 – Central Place [1]	54	51	47	60	57	54

5 External (Rail and Road Traffic) Noise Intrusion Assessment

Given the project site's proximity to existing environmental noise sources (immediately adjacent to Lee Street and the Central Station Railway Square bus stand and approx. 40m from Central Station rail line), there is potential for impacts on the internal acoustic amenity of future commercial and hotel receivers. This section provides a discussion of the relevant acoustic amenity criteria and presents the result of a preliminary noise intrusion assessment.

5.1 Assessment Criteria

5.1.1 Transport for New South Wales

The Transport for New South Wales (TfNSW) publication *Western Gateway Sub-Precinct Design Guide* [22] outlines the following design guidance for noise and vibration:

"Development is to protect current or future residents and workers from noise, vibration and air pollution."

To satisfy this provision of the design guide, the following guidelines and standards are referenced to establish relevant noise impact criteria:

- City of Sydney council's Sydney Development Control Plan 2012 (Sydney DCP 2012) [5]
- NSW DPE State Environmental Planning Policy (Transport and Infrastructure) 2021 (Transport and Infrastructure SEPP) [8]
- NSW DPE Development Near Rail Corridors and busy Roads – Interim Guideline (ISEPP Guideline) [7]
- Australian/New Zealand Standard 2107:206 'Acoustics – Recommended design sound levels and reverberation times for building interiors' (AS/NZS 2107:2016) [16]

5.1.2 Council and DPE publications

The provisions of Sydney DCP 2012 and DPE publications Transport and Infrastructure SEPP and ISEPP Guideline only apply to residential areas (long term stay) of mixed-use developments. There is no guidance for retail, office and hotel areas (including guest rooms i.e. short term stay) of mixed-use developments.

5.1.3 Australian standards

AS/NZS 2107:2016 provides guidance on design criteria for conditions affecting the acoustic environment within building interiors to ensure a healthy, comfortable and productive environment for the occupants and the users. The recommendations of this standard consider the function/use of space(s) within a specific occupancy type and are provided as a range.

In the absence of any relevant criteria for the proposed development in existing State and council policies/guideline, the recommendations of this standard will be adopted to establish internal noise goals for the assessment of external noise impacts on the development.

We have reviewed the standard and have summarised in the table below relevant spaces which we expect could be incorporated into the development, or spaces with similar use which could be used as a benchmark. Where spaces and their acoustic requirements are not specifically listed, the requirements should be based on the recommendations of Table 1 of AS/NZS 2107:2016.

Table 5-1: Recommended external noise intrusion assessment criteria

Type of Occupancy/Activity	Recommended Design Sound Levels, dB(A)L_{eq}
Commercial & Retail Areas	
Supermarkets	< 55
Speciality shops	< 45
Retail stores	< 50
F&B areas/ Food courts	45 to 55
Café & Restaurants	40 to 50
Change rooms	< 50
EOT (Toilet/change/showers)	< 55
Office Areas	
VC, Board and Conference rooms	30 to 40
Meeting rooms and Executive offices	35 to 40
Open plan office areas	40 to 45
General office areas	40 to 45
Reception areas	40 to 45
Corridors and lobbies	45 to 50
Public spaces	40 to 50
Rest rooms and Break-Out spaces	40 to 45
Toilets and Change rooms	45 to 55
Hotel Areas	
Guest rooms	
Dedicated living areas (Daytime)	40
Bedrooms or combined living/bedroom areas (Night-time)	35
Foyers and recreation areas	45 to 50
Indoor pool	50 to 60
Gym and Day Spa	< 50
Enclosed carparks	< 65
Kitchen, laundry and maintenance areas	< 55
Washrooms and toilets	45 to 55

5.2 Measured Noise Levels

As discussed in Section 4.2, long-term noise monitoring at locations RTA1 and RTA2 are representative of the existing road and rail traffic noise (respectively) incident on the site (Table 4-1). The measured ambient noise levels at these locations are summarised in Table 4-2, however these levels are presented in line with EPA NPfI classification of day, evening and night periods.

Internal noise level criteria referenced for the assessment of environmental noise sources (Council DCP, DPE publications and AS/NZS 2107:2016) outline day and night periods only, classified as 7am to 10pm (15hr) and 10pm to 7am (9hr) respectively. Hence, to enable assessment against the recommended project internal noise criteria (

Table 5-1), the measured ambient noise levels are reproduced for these time periods.

Table 5-2: Existing site road and rail traffic noise levels

Location	Measured Average Noise Levels, dB(A)$L_{eq(period)}$ [1]	
	Day (7am-10pm)	Night (10pm-7am)
RTA1	66	62
RTA2	61	58

Notes:

1. Noise monitoring results calculated at 1m from façade.

5.3 Recommended Acoustic Treatments

Internal noise levels were calculated based on the road and rail traffic noise level incident on the building façades, spectral characteristics of the external noise, building fabric design (area of building element exposed to noise) and internal area (room) sound absorption characteristics.

The following acoustic treatments are required to achieve compliance with the noise goals identified in

Table 5-1.

5.3.1 Glazed windows and doors

The minimum glazing specification for the proposed development is detailed in Table 5-3. The installation of façade elements in building openings and the design of window mullions, door frames and perimeter seals, must not reduce the sound insulation of the glazing assembly (i.e. glass, frame and seals) below the values nominated in . Key items to note to prevent this include:

- Acoustic seals nominated for all external windows and doors, are required to be fitted with Q-lon type acoustic seals or equivalent rubber bulb acoustic seals. **Mohair of fin type seals are not acceptable for the windows and doors requiring acoustic seals**.
- Perimeter of opening around façade element is acoustically sealed i.e. space between frame (before architraves are installed for windows) and wall structure is sealed with silicone or polyurethane acoustic sealant and foam backing rod.

The glazing specification is indicative only and other constructions that provide the same or better sound transmission loss performance are also acceptable. The window/door supplier/manufacturer shall provide evidence that the glazing system proposed has been tested in a registered laboratory, with results showing compliance with the minimum listed R_W requirements. Also, the glazing installer should certify that the window/doors have been constructed and installed in a manner equivalent to the tested samples.

Table 5-3: Preliminary façade glazing specification

Level	Space		Minimum Acoustic Performance of Glazing Assembly [1]	Indicative Glazing Configuration	Acoustic Seals
Lower Ground Level & Ground Level	F&B areas, café, restaurant, commercial lobby, BOH areas & supermarket		R_W 32	6mm float or toughened / 12mm airgap/ 6mm float or toughened [2]	Yes
	Hotel arrival/lobby & speciality shops (retail)		R_W 34	8mm float or toughened / 12mm airgap/ 6mm float or toughened	Yes
Levels 2 to 6	General office areas & open plan office		R_W 37	10mm float or toughened / 12mm airgap/ 6mm float or toughened [3] OR *Where secondary glazing is proposed (i.e. existing façade glazing retained)* – 6mm float or toughened / 12mm airgap/ 6mm float or toughened [4]	Yes
Levels 10 & 11	Guest rooms overlooking rooftop terrace		R_w 37	10mm float or toughened / 12mm airgap/ 6mm float or toughened	Yes
	Guest rooms (1B-c type with curved façade)	Sleeping areas	R_W 35	8mm float or toughened / 12mm airgap/ 8mm float or toughened	Yes
		Living areas	R_W 34	8mm float or toughened / 12mm airgap/ 8mm float or toughened	
	Guest rooms (all other areas)		R_W 34	8mm float or toughened / 12mm airgap/ 6mm float or toughened	Yes
Levels 12 to 19	Guest rooms (typical)		R_W 34	8mm float or toughened / 12mm airgap/ 6mm float or toughened	Yes
	Guest rooms (1B-c type with curved façade)	Sleeping areas	R_W 35	8mm float or toughened / 12mm airgap/ 8mm float or toughened	Yes
		Living areas	R_W 34	8mm float or toughened / 12mm airgap/ 8mm float or toughened	
Levels 21 & 22	Hotel amenity areas		R_w 32	6mm float or toughened / 12mm airgap/ 6mm float or toughened	Yes

Level	Space	Minimum Acoustic Performance of Glazing Assembly [1]	Indicative Glazing Configuration	Acoustic Seals
Levels 23 & 24	All office areas	R_w 37	10mm float or toughened / 12mm airgap/ 6mm float or toughened	Yes
Levels 25 to 44	General office areas & open plan office	R_w 32	6mm float or toughened / 12mm airgap/ 6mm float or toughened	Yes
	VC/Board/Meeting/Conference rooms	R_W 34	8mm float or toughened / 12mm airgap/ 6mm float or toughened	Yes

Notes:

1. The minimum acoustic performance corresponds to the cumulative performance of the glazing assembly i.e. glass, frame and seals.
2. If the existing façade elements (northern, southern and western façades) of the Adina Hotel building are retained, the recommended 6mm/12mm airgap/6mm IGU system ($R_W \geq 32$) is also acceptable for use as a secondary glazing (assumed required for building thermal performance). The existing façade glazing assembly must be made good (i.e. ensure airtight seal).
3. Higher specification glazing is likely for sensitive office areas (executive offices, VC/board/meeting/conference rooms etc.) proposed along the façade. These spaces are recommended to be located away from the façade and if this is not feasible, the proposed fitout design will need to be reviewed by an acoustical consultant during subsequent stages of design to determine minimum glazing specification.
4. It is assumed secondary glazing will be installed with a cavity separation (minimum 20mm airgap) from existing glazing. The existing façade glazing assembly must be made good (i.e. ensure airtight seal).

NOTES FOR GLAZING CONSTRUCTIONS:

1. The information in this table is provided for consent/approvals process and cost planning and shall not be used for construction unless otherwise approved in writing by the acoustic consultant.
2. The design in this table is preliminary and a comprehensive assessment shall be conducted prior to Construction Certification.
3. 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.
4. The glazing supplier shall ensure that installation techniques will not diminish the RW performance of the glazing when installed on site.
5. 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.

5.3.2 External walls

All external wall elements are currently proposed to be of masonry construction (in-situ concrete, concrete blockwork or similar), with light-weight cladding and screening elements proposed over the masonry walls. Masonry construction will provide adequate sound insulation (in principle, external wall constructions with a sound isolation rating 15dB higher than the recommended glazing specifications, are sufficient to maintain the acoustic performance of the overall facade system) against the environmental noise sources and no further upgrade is required for acoustic purposes. There should not be vents on the internal skin of external walls. All penetrations in the internal skin of external walls should be acoustically sealed (i.e. airtight).

If light-weight external wall systems are proposed during subsequent stages of design, this will need to be reviewed in detail at the Construction Certificate (CC) stage, to determine minimum constructions (additional insulation and/or linings).

5.3.3 Roof and ceiling

The proposed concrete roof is also acoustically acceptable and does not require any additional treatments.

5.3.4 Ventilation requirements

With the exception of the pool area (hotel amenity levels 21 & 22), all other areas of the development will be mechanically ventilated, with no natural ventilation proposed to any occupied areas.

6 Future Rail Operations (CBDRL tunnels)

6.1 Assessment Criteria

Section 2.100 of the Transport and Infrastructure SEPP, notes the following determination requirements for development within or adjacent to interim rail corridors:

(4) In determining whether to provide concurrence, the relevant rail authority is to take into account the likely effect of the development on—

(a) the practicability and cost of carrying out rail expansion projects on the land in the future, and

(b) without limiting paragraph (a), the structural integrity or safety of, or ability to operate, such a project, and

(c) without limiting paragraph (a), the land acquisition costs and the costs of construction, operation or maintenance of such a project.

To address these requirements, guidance is sourced from recent Sydney Metro projects to establish relevant ground borne noise and vibration goals for the proposed development, for operational noise impacts associated with future rail operations.

Section 9.3.2.2 of the project *Preliminary Rail Infrastructure Easement Interface Report* [2] references the *Sydney Metro Chatswood to Sydney (C2S) EIS Technical Paper 2: Noise and Vibration* [20], which notes:

- For rail tunnels, the ground-borne noise trigger levels almost always require lower vibration levels than the human comfort vibration design objectives.
- Ground-borne noise trigger levels for hotel receivers will be based on criteria for residential land uses. Relevant receiver types outlined in Table 83 are summarised below:

Table 6-1: Ground-borne noise trigger levels for rail operations associated with CBDRL

Type of Occupancy/Activity	Time of Use	Assessment Criteria, dB(A)$L_{max(slow)}$
Hotel guest rooms	Day (7am – 10pm)	35
	Night (10pm – 7am)	40
Private offices and conference rooms	When in use	40
General office areas	When in use	45
Retail areas	When in use	50

6.2 Proposed Location and Alignment of Future Corridor Assets

Section 6 of project rail interface report [2] details the confirmed alignment and vertical alignment of the future CBDRL corridor, relative to the project site.

Figure 6-1: Plan view of CBDRL alignment with reference to proposed development (source: project rail interface report [2])

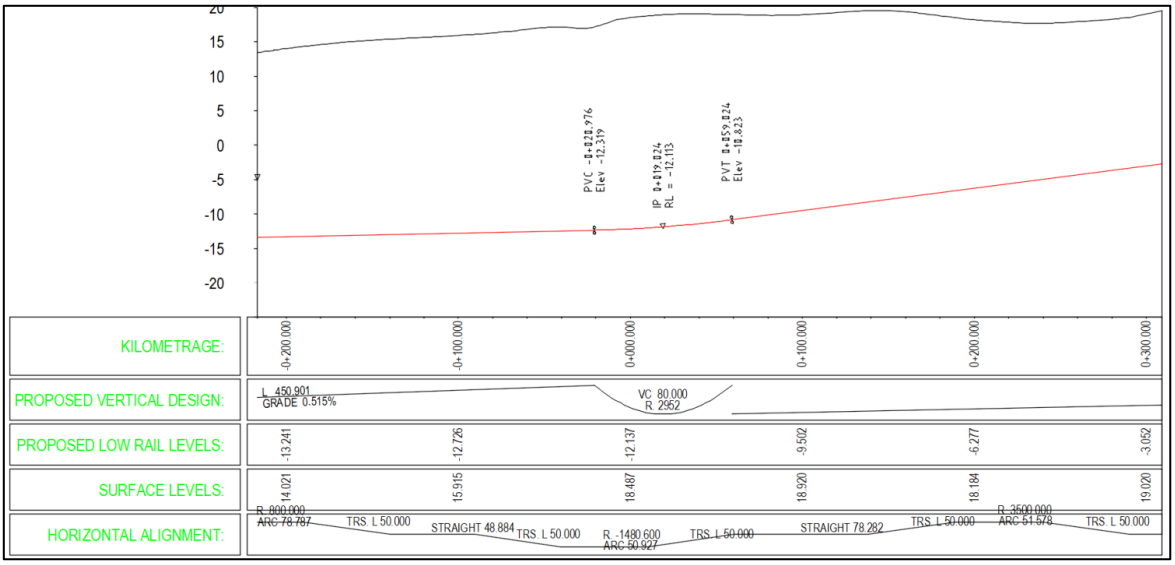

Figure 6-2: CBDRL vertical alignment with reference to proposed development (source: project rail interface report [2])

The proposed development works include a series of varying level basement excavations and footing founding levels as illustrated in Figure 6-3. The CBDRL alignment is located adjacent to and below the southern portion of the site and gradually deviates away from the project footprint to the north. The following horizontal and vertical alignments are illustrated in the project rail interface report [2].

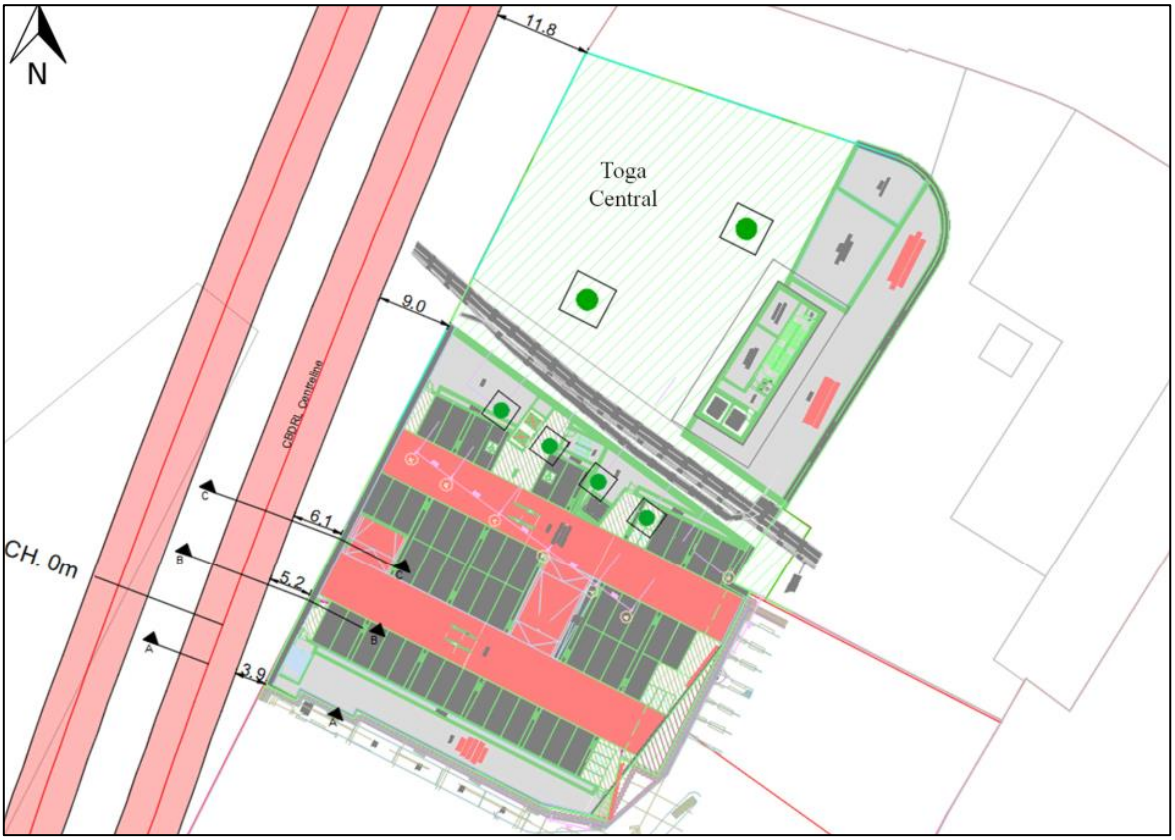

Figure 6-3: Plan view illustrating horizontal distances from the CBDRL tunnels to proposed development (source: project rail interface report [2])

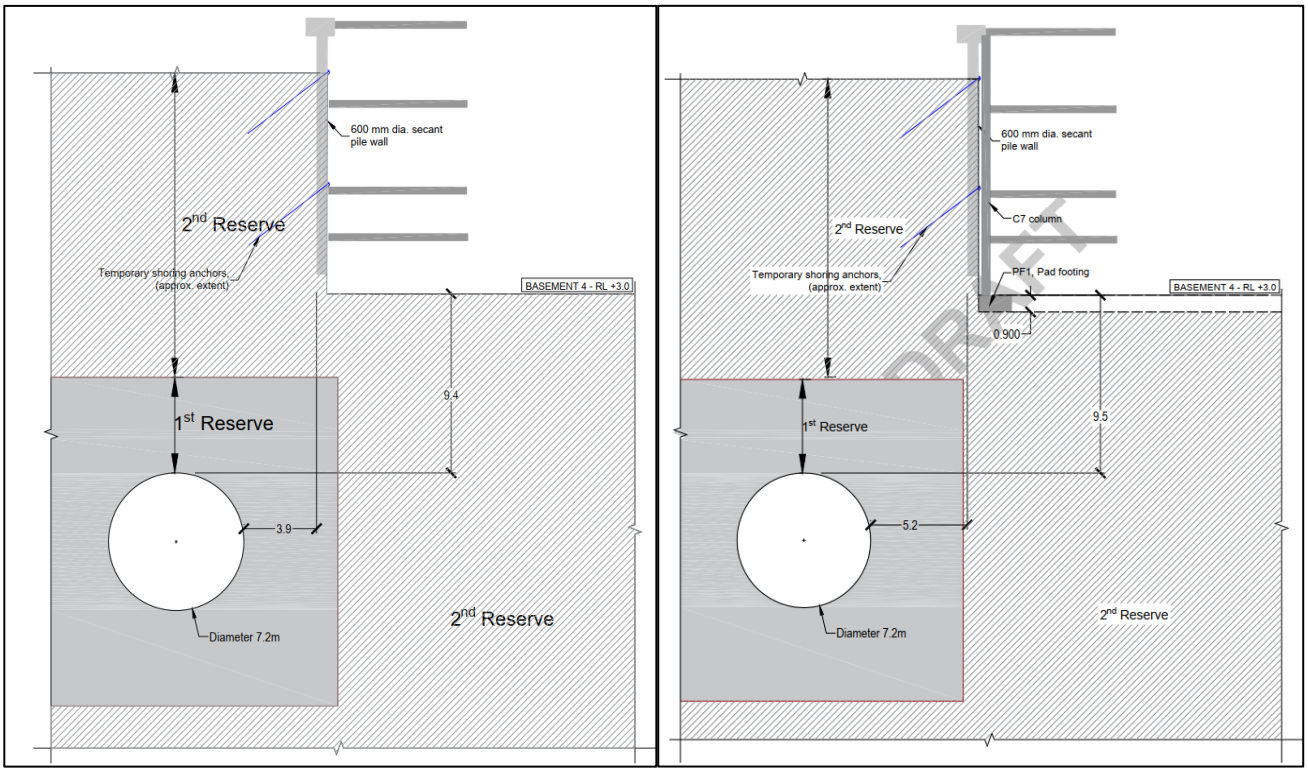

Figure 6-4: Cross section A-A and B-B from Figure 6-3 (source: project rail interface report [2])

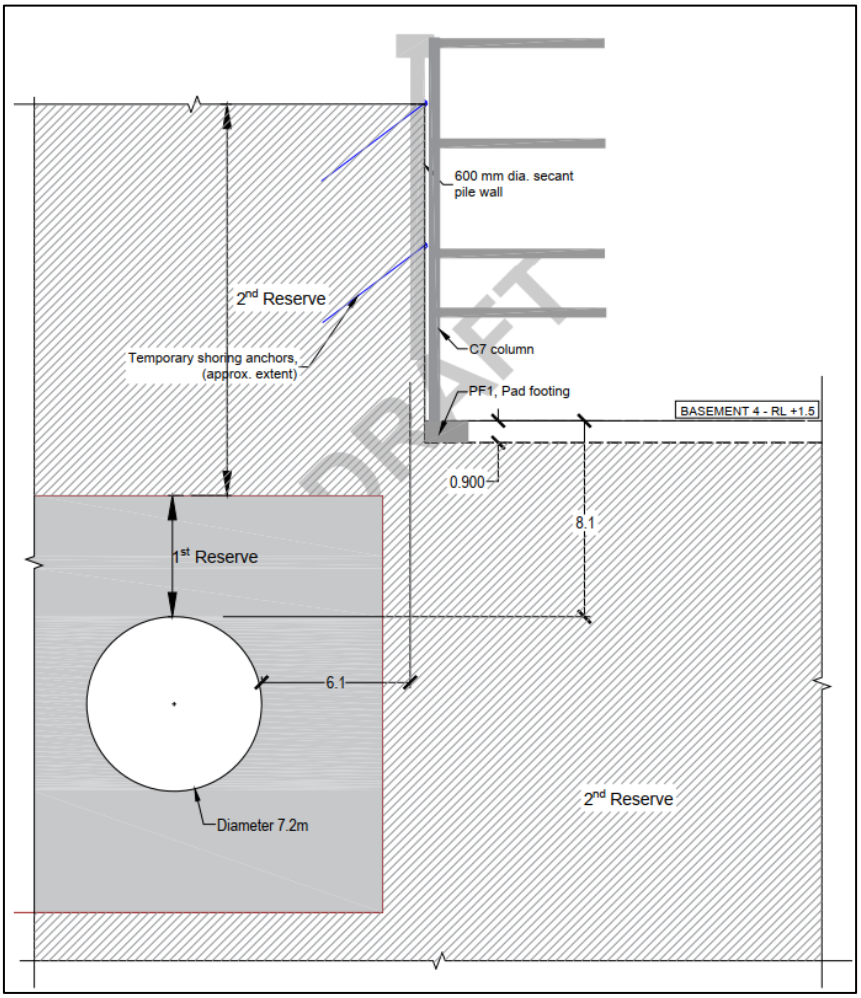

Figure 6-5: Cross section A-A and B-B from Figure 6-3 (source: project rail interface report [2])

- Pad footing PF2 with founding levels at RL+0.2mAHD is the nearest structural column associated with noise sensitive areas of the new tower building (hotel and commercial tenancies). It is located approx. 18.5m horizontal distance to nearest tunnel.
- The existing retaining wall of the fPPB (basement level 1) is the nearest structural element to the rail tunnel (11.8m horizontal distance to nearest tunnel).

6.3 Preliminary Review

To predict ground-borne noise propagation from rail asset operations, reference source vibration levels are required for the likely track forms. The Sydney Metro C2S EIS [20] details three track types for the project:

- Standard attenuation
- High attenuation
- Very High attenuation

Adopting a conservative approach, the standard attenuation source vibration levels are adopted for this assessment and are as follows:

Table 6-2: Reference vibration levels at tunnel wall (at 80 km/hr reference speed)

Location	Overall dB(A)	Vibration Levels (dB_V re 1nm/s) in Octave Bands (Hz), $L_{max, slow, 95\%}$															
		10	12	16	20	25	31.5	40	50	63	80	100	125	160	200	250	315
Standard attenuation	96	77	78	78	77	80	86	86	86	85	84	84	89	86	82	79	78

There is currently no commercially available modelling software to predict ground-borne noise and vibration propagation associated with rail operations.

Preliminary predictions presented below are based on the calculation methodology developed by RTA. The algorithms used for the calculations are in line with those typically used within the acoustical consulting profession. Key inputs for the calculations (e.g. coupling loss, amplification factor etc.) are based on the information provided in the Sydney Metro C2S EIS [20] and with reference to Nelson (1987)[1]. Additionally, in accordance with Nelson (1987) and the ANC Guidelines (2012)[2], an adjustment of -27 dB was used in the calculations to convert each 1/3 octave band vibration level (dB_V re 1 nm/s) to a sound pressure level (dB re 20 µPa). This represents a worst case when compared to other conversion methodologies (reverberation time and radiation efficiency, ISO 14837-31).

Predictions have been carried out for two scenarios:

- **Scenario 1: "*Toga Central No Develop*"** – predictions here are based on the assumption of a no develop scenario of the proposed development, with the nearest affected noise sensitive receivers noted as the hotel guest rooms on level 1 of the Adina hotel property on site (fPPB).
- **Scenario 2: "Toga Centra Develop"** – ground-borne noise levels are predicted to the following areas of the proposed development:
  - Retail tenancy (supermarket) on basement level 01 of the new tower building.
  - Hotel guest rooms on level 10 of the new tower building.
  - Retail tenancies on basement level 01 and ground level (Lee Street level) of the redeveloped fPPB.
  - Office tenancy located on level 2 of the redevelopment fPPB.

[1] *Transportation Noise Reference Book*, Nelson. J (1987)

[2] *ANC Guidelines - Measurement and Assessment of Ground-borne Noise & Vibration*, Association of Noise Consultants (2012)

Table 6-3: Predicted ground-borne noise levels from future CBDRL rail operations

Location	Space	Predicted ground-borne noise levels, dB(A)$L_{max, slow, 95\%}$	Assessment Criteria, dB(A)$L_{max(slow)}$
Scenario 1: Toga Central No Develop			
Adina Hotel	Street level retail (Betty's Burgers)	40	50
	Level 1 hotel guestrooms	37	35 Day (7am – 10pm) 40 Night (10pm – 7am)
Scenario 2: Toga Central Develop			
New tower building	Basement level 01 retail	40	50
	Level 10 hotel guestrooms	<25	35 Day (7am – 10pm) 40 Night (10pm – 7am)
Redeveloped fPPB	Basement level 01 retail	41	50
	Lower ground level retail	40	50
	Level 2 office tenancy	35	40 [1]

Notes:

1. This criterion is applicable to private offices and conference rooms of office tenancies and represents the most stringent requirement for this type of tenancy.

6.3.1 Discussion

The preliminary predictions in Table 6-3 above illustrate compliance with the ground-borne noise trigger levels for future rail operations associated with CBDRL, assuming standard attenuation track form and based on criteria adopted on recent Sydney Metro projects.

Additionally, it should be noted that when compared to a "***Toga Central No Develop***" scenario, ground-borne noise levels from future rail operations to hotel guest rooms in the existing Adina Hotel property, are predicted to be considerably higher than those predicted for new hotel rooms in the "***Toga Central Develop***" scenario. This is also the case when the predicted noise levels are compared to the new commercial tenancies proposed in the redevelopment fPPB (part of "***Toga Central Develop***" scenario).

Therefore, based on the results of this preliminary review, we conclude that the proposed development is likely to reduce the potential ground-borne noise level impacts on sensitive tenancies when compared to a "***Toga Central No Develop***" scenario (i.e. existing Adina Hotel use retained) and hence is not expected to adversely affect the development and operation of future rail assets (including increasing likely cost of development). This demonstrates compliance with requirements of Section 2.100 of the Transport and Infrastructure SEPP.

7 Operational Noise and Vibration Assessment

As detailed in Section 2, key noise and vibration risks associated with the operations of proposed development include:

- Noise impacts associated with the operation of retail and F&B areas.
- Noise impacts associated with the use of the rooftop terrace (on top of existing Adina Hotel building on site).
- Noise and vibration impact from building services plant and equipment serving the proposed development.
- Noise impacts from the operation of the loading dock and waste collection.
- Noise impacts of additional traffic on surrounding public roads generated by the proposed development.

Relevant assessment criteria and a review of potential impacts are discussed in the following sections.

7.1 Assessment Criteria

7.1.1 Entertainment and licensed premises (F&B Areas and rooftop terrace)

Sydney DCP 2012 [5] does not outline any specific noise emission provisions for hotel retail, F&B or commercial/office type developments.

However, standard conditions of consent generally adopted by the Council, outline the following provisions relevant to noise from entertainment / licensed premises.

NOISE – ENTERTAINMENT / LICENSED PREMISES

Noise caused by the approved use including music and other activities must comply with the following criteria:

(a) The $L_{A10,\ 15\ minute}$ noise level emitted from the use must not exceed the background noise level ($L_{A90,\ 15minute}$) in any Octave Band Centre Frequency (31.5 Hz to 8 kHz inclusive) by more than 5dB between the hours of 7.00am and 12.00 midnight when assessed at the boundary of any affected residence.

(b) The $L_{A10,\ 15\ minute}$ noise level emitted from the use must not exceed the background noise level ($L_{A90,\ 15minute}$) in any Octave Band Centre Frequency (31.5 Hz to 8 kHz inclusive) between the hours of 12.00 midnight and 7.00am when assessed at the boundary of any affected residence.

(c) Notwithstanding compliance with (a) and (b) above, noise from the use when assessed as an $L_{A10,\ 15\ minute}$ enters any residential use through an internal to internal transmission path is not to exceed the existing internal $L_{A90,\ 15\ minute}$ (from external sources excluding the use) in any Octave Band Centre Frequency (31.5 Hz to 8 kHz inclusive) when assessed within a habitable room at any affected residential use between the hours of 7am and 12midnight. Where the $L_{A10,\ 15\ minute}$ noise level is below the threshold of

hearing, Tf at any Octave Band Centre Frequency as defined in Table 1 of International Standard ISO 226 : 2003- Normal Equal-Loudness-Level Contours then the value of Tf corresponding to that Octave Band Centre Frequency shall be used instead.

(d) Notwithstanding compliance with (a), (b) and (c) above, the noise from the use must not be audible within any habitable room in any residential use between the hours of 12.00 midnight and 7.00am.

(e) The $L_{A10,\ 15\ minute}$ noise level emitted from the use must not exceed the background noise level ($L_{A90,\ 15\ minute}$) in any Octave Band Centre Frequency (31.5 Hz to 8 kHz inclusive) by more than 3dB when assessed indoors at any affected commercial premises.

Note: The $L_{A10,\ 15\ minute}$ noise level emitted from the use is as per the definition in the Australian Standard AS1055-1997 Acoustics – Description and measurement of environmental noise. The background noise level $L_{A90,\ 15\ minute}$ is to be determined in the absence of noise emitted by the use and be representative of the noise sensitive receiver. Background noise monitoring must be carried out in accordance with the long-term methodology in Fact Sheet B of the NPfl unless otherwise agreed by the City's Area Planning Manager.

7.1.1.1 Resulting project octave band noise emission targets

Table 7-1: Site background noise levels (octave bands)

Location	Time Period	Overall dB(A)	Octave band Centre Frequency – Hz, dB(Z) $L_{90(period)}$								
			31.5	63	125	250	500	1k	2k	4k	8k
RTA1 & 3	Day (7am – 12 midnight)	60	65	63	58	57	59	56	51	42	30
	Night (12 midnight – 7am)	53	56	55	55	52	51	49	44	35	24
RTA 2	Day (7am – 12 midnight)	55	63	58	55	56	53	51	46	39	27
	Night (12 midnight – 7am)	52	55	53	51	52	50	47	42	36	25

Table 7-2: Project entertainment and licensed premises (including rooftop terrace) noise emission goals

Receiver	Time Period	Overall dB(A)	Octave band Centre Frequency – Hz, dB(Z) $L_{10(15\ minute)}$								
			31.5	63	125	250	500	1k	2k	4k	8k
Residential R1 and Hotels H1, H3 & H4 [1]	Day (7am – 12 midnight) (BG + 5 dB)	65	70	68	63	62	64	61	56	47	35
	Night (12 midnight – 7am) (BG + 0 dB)	53	56	55	55	52	51	49	44	35	24
Hotel H2 [1]	Day (7am – 12 midnight) (BG + 5 dB)	60	68	63	60	61	58	56	51	44	32

Receiver		Time Period	Overall dB(A)	Octave band Centre Frequency – Hz, dB(Z) $L_{10(15\ minute)}$								
				31.5	63	125	250	500	1k	2k	4k	8k
		Night (12 midnight – 7am) (BG + 0 dB)	52	55	53	51	52	50	47	42	36	25
Level 2 office areas (internally) – if separately titled [2]		When in use [3] (BG + 3 dB)	43 [4]	57	63	51	44	38	33	32	28	22
Surrounding commercial properties	C1 & rear portion of C2 (along eastern boundary)	When in use [3] (BG + 3 dB)	59 [5]	66	61	60	60	56	53	49	42	32
	C2 (Lee Street frontage) & C3		64 [5]	68	67	63	61	63	60	55	46	35

Notes:

1. As no criteria is specifically stipulated for hotel type of receivers, residential criteria is adopted.
2. Internal to internal transmissions.
3. Typically, only in operation during standard business hours i.e. 9am to 5pm.
4. Based on AS/NZS 2107:2016 recommended internal design level of 40 dB(A) for typical office areas (see Table 1-1) and typical octave band background noise spectrum measured in an office tenancy with air-conditioning.
5. Compliance with the background + 3dB requirement internally within any surrounding affected commercial development, can be achieved if compliance with background + 3dB is achieved externally (i.e. at the development façade). As impacts are only likely during standard business hours, the background noise levels measured during the day period (7am-6pm) of Table 4-2 have been used.

7.1.2 Building services plant/equipment, retail areas, hotel amenity areas and loading dock operations

The EPA publication NPfI [13] is the most commonly adopted noise emission guideline to control general operational noise from developments. The NPfI assessment procedure has two components:

- Controlling intrusive noise impacts in the short-term for residential properties, and
- Maintaining noise level amenity (long-term) for residences and other land uses.

In accordance with the NPfI, noise impact should be assessed against the project noise trigger level, which is the lower value of the project intrusiveness noise levels and project amenity noise levels.

7.1.2.1 Intrusiveness criterion

The intrusiveness of a noise source may generally be considered acceptable if the equivalent continuous (energy-average) A-weighted level of noise from the source (represented by the $L_{Aeq,15min}$ descriptor) does not exceed the background noise level measured in the absence of the source by more than 5dB(A). The project intrusiveness noise level, which is only applicable to residential receivers, is determined as follows:

$L_{Aeq,15min}$ Intrusiveness noise level = Rating Background Level (RBL) plus 5 dB(A)

7.1.2.2 Amenity criterion

The project amenity noise levels for different time periods of the day are determined in accordance with Section 2.4 of the NPfI. The NPfI recommends amenity noise levels ($L_{Aeq,period}$) for various receivers including residential, commercial and industrial receivers and sensitive receivers such as schools, hotels, hospitals, churches and parks. These "recommended amenity noise levels" represent the objective for total industrial noise experienced at a receiver location. However, when assessing a single industrial development and its impact on an area, "project amenity noise levels" apply.

To ensure that the total industrial noise level (existing plus new) remain within the recommended amenity noise levels for an area, the project amenity noise level that applies for each new industrial noise source is determined as follows:

$$L_{Aeq,period}\ Project\ amenity\ noise\ level = L_{Aeq,period}\ Recommended\ amenity\ noise\ level - 5dB(A)$$

Furthermore, given that the intrusiveness noise level is based on a 15-minute assessment period and the project amenity noise level is based on day, evening and night assessment periods, the NPfI provides the following guidance on adjusting the $L_{Aeq,period}$ level to a representative $L_{Aeq,15minute}$ level in order to standardise the time periods.

$$L_{Aeq,15minute} = L_{Aeq,period} + 3dB(A)$$

NPfI recommended amenity noise levels for the project site and surrounding land uses are summarised in Table 7-3.

Table 7-3: NPfI recommended amenity noise levels

Receiver Type	Time of Day [1]	Recommended Amenity Noise Level, dB(A)$L_{eq(period)}$
Residential - Urban	Day	60
	Evening	50
	Night	45
Hotels, motels and holiday accommodation	Day	65
	Evening	55
	Night	50
Classrooms or teaching spaces	Noisiest 1-hour period when in use	35 (internal) [2]
Commercial premises	When in use	65
industrial premises	When in use	70

Notes:

1. Day: 07:00-18:00 Monday to Saturday and 08:00-18:00 Sundays & Public Holidays
   Evening: 18:00-22:00 Monday to Sunday & Public Holidays
   Night: 22:00-07:00 Monday to Saturday and 22:00-08:00 Sundays & Public Holidays
2. In the case where existing schools are affected by noise from existing industrial noise sources, the acceptable L_{Aeq} noise level may be increased to 40 dB $L_{Aeq(}1hr_{)}$.

7.1.2.3 Amenity noise levels in areas of high traffic noise

The NPfI notes the following exceptions in determining project amenity noise levels in areas with high traffic noise levels.

The level of road traffic noise may be high enough in areas with high volumes of traffic, to make noise from industrial source effectively inaudible, even when L_{Aeq} noise level from industrial source may exceed the project amenity noise level. In such cases, section 2.4.1 of the NPfI recommends the derivation of the project amenity noise levels based on the measured $L_{Aeq,\ period(traffic)}$ levels i.e.

Project amenity levels for high traffic environment = $L_{Aeq\ period(traffic)}$ – 15dB(A)

The applicability of these traffic noise provisions needs to be determined for each assessment period (day, evening & night), only if all of the following apply:

- traffic noise is identified as the dominant noise source at the site
- the existing traffic noise level is 10 dB or more above the recommended amenity noise level for the area
- it is highly unlikely traffic noise levels will decrease in the future.

7.1.2.4 Resulting project noise trigger levels

Based on the results of the long-term noise survey (see Section 4.2), project noise trigger levels have been determined (lower i.e. more stringent value of the project intrusiveness and amenity noise levels) and are shown in below.

Table 7-4: Project building services plant/equipment, hotel amenity areas and loading dock operations noise emission goals

Receiver		Project Specific Noise Limits, dB(A)$L_{eq(15min)}$		
		Day (7am-6pm)	Evening (6pm-10pm)	Night (10pm-7am)
Residential (R1)		58 [1]	52 [2]	48 [2]
Hotel premises	H1, H3 & H4	63 [1]	53 [1]	48 [2]
	H2	63 [1]	53 [1]	48 [1]
Classrooms or teaching spaces (E1)		40 [3]		
Commercial premises (C1, C2 & C3)		63 [4]	-	-

Notes:

1. Based on NPfI recommended amenity levels. Converted from $L_{Aeq(period)}$ to $L_{Aeq(15mins)}$ in accordance with the guidance provided in Fact Sheet E of the NPfI.
2. Based on Section 2.4.1 of the NPfI, existing traffic noise dominant and higher than recommended amenity levels, hence resulting criterion is measured $L_{Aeq(period)}$ – 15 dB(A). Converted to $L_{Aeq(15mins)}$ as noted above.
3. Internal criteria accounting for impacts from existing industrial sources.
4. Typically, only in operation during standard business hours i.e. 9am to 5pm.

7.2 Traffic Noise Generation Criteria

For land use developments with the potential to create additional traffic on public streets, noise impacts to surrounding existing sensitive land uses as a result of the additional traffic are assessed with reference to the EPA publication *Road Noise Policy* (RNP) [12]. Section 2.3 of this policy sets out road traffic noise assessment criteria for various land uses.

No criteria is noted in the RNP for the surrounding hotel or commercial receiver types. Table 4 of Section 2.3.2 of the RNP outlines a criterion for "school classrooms", which based on the additional consideration note in this table also applies to educational buildings. On this guidance, this criterion is adopted for the receiver E1 (see Section 3.1).

Table 7-5: NSW EPA RNP noise goals for additional traffic generated by the site

Existing Sensitive Land Use	Time of Use	Assessment Criteria, dB(A)$L_{eq(1hour)}$
E1 (teaching spaces)	Day (7am to 10pm)	40 (internal – when in use)

7.3 Operational Noise Assessment

7.3.1 Retail areas and site activation

The assessment of individual retail tenancies (basement and lower ground levels) are generally deferred to tenancy specific development applications. However, given the extent of development proposed within the Sydney Gateway Sub-precinct, it is important to provide an assessment in principle to demonstrate that the tenancies are capable of being used for their intended purpose, without excessive noise impacts.

7.3.2 Entertainment/licensed premises

Based on the current design documentation, the following areas of the development will fall under this classification:

- Lower ground level café
- Basement, lower ground level and ground level F&B tenancies

It is noted that all these tenancies are proposed internally within the building shell of the development and completely enclosed (i.e. no outdoor seating areas).

Lower ground level café

The lower ground level café is proposed adjacent to the lower ground link zone and is completely enclosed.

Typical activity noise sources associated with cafés include background amplified music, patron speech and commercial grade coffee machines. For the purpose of noise prediction and assessment, we have assumed:

- Background amplified music is generally measured between 60-65 dB(A)L_{10} SPL (Sound Pressure Level) in a café space.
- Patron speech is typically noted as 70 dB(A)L_{10} SWL (Sound Power Level) for occasional raised speech in a café space. Total of 50 patrons are assumed in the café space at any given time (25 seats shown and assumed an additional 25 standing), with 1 in 2 talking.
- Operations of a commercial grade coffee machine are typically between 70-73 dB(A)L_{10} SPL (measured at 1.5m distance from the machine – RTA database).
- The resulting cumulative SPL in the café space is assumed as 75-77 dB(A)L_{10} SPL, detailed below:

Table 7-6: Lower link café operational noise sources

Source	Overall dB(A)	Octave band Centre Frequency – Hz, dB(Z) $L_{10(15\ minute)}$								
		31.5	63	125	250	500	1k	2k	4k	8k
Background amplified music (SPL)	65	68	68	68	60	60	60	58	54	47
Patron speech (SPL) [1]	74	60	60	68	67	73	70	64	54	41
Commercial grade coffee machine (SPL)	73	66	66	68	75	72	67	63	59	54
Combined SPL within the tenancy	**77**	**71**	**71**	**73**	**76**	**76**	**72**	**67**	**61**	**55**

Notes:

1. SWL per patron converted to SPL considering volume of the café space and 50 patrons in total, with 1 in 2 talking.

- Minimum R_W 32 rated glazing assembly is recommended for the façade glazing on the lower ground and ground levels adjoining the café space (see Table 5-3). The typical transmission loss that is achieved by the nominated indicative glazing configuration (6mm float or toughened / 12mm airgap/ 6mm) is presented below.

Table 7-7: Transmission loss of R_w32 rated glazing assembly

	R_W	Octave band Centre Frequency – Hz,								
		31.5	63	125	250	500	1k	2k	4k	8k
IGU glazing assembly	32	-22	-22	-24	-22	-32	-35	-34	-39	-51

The following preliminary noise impacts are predicted to the adjacent future mixed-use development (Atlassian Central, C1 & H2 receiver in Section 3.1):

Table 7-8: Lower link café operational noise emissions – Redeveloped Railway Square YHA (H2)

Receiver	Time Period	Overall dB(A)	Octave band Centre Frequency – Hz, dB(Z) $L_{10(15\ minute)}$								
			31.5	63	125	250	500	1k	2k	4k	8k
H2 (Redeveloped Railway Square YHA)	When in use (typically daytime)	<26	<28	<28	<28	<33	<23	<16	<12	<1	0
Criteria	**Day (7am – 12 midnight) (BG + 5 dB)**	**60**	**68**	**63**	**60**	**61**	**58**	**56**	**51**	**44**	**32**

Table 7-9: Lower link café operational noise emissions – Redeveloped Railway Square YHA (H2)

Receiver	Time Period	Overall dB(A)	Octave band Centre Frequency – Hz, dB(Z) $L_{10(15\ minute)}$								
			31.5	63	125	250	500	1k	2k	4k	8k
H2 (Redeveloped Railway Square YHA)	When in use (typically daytime)	<26	<28	<28	<28	<33	<23	<16	<12	<1	0
Criteria	**Day (7am – 12 midnight) (BG + 5 dB)**	**60**	**68**	**63**	**60**	**61**	**58**	**56**	**51**	**44**	**32**

Table 7-10: Lower link café operational noise emissions – Commercial receivers C1

Receiver	Time Period	Overall dB(A)	Octave band Centre Frequency – Hz, dB(Z) $L_{10(15\ minute)}$								
			31.5	63	125	250	500	1k	2k	4k	8k
C1 (Atlassian Central)	When in use	<20	<21	<21	<21	<26	<16	<10	<6	0	0
Criteria	**When in use**	**59**	**66**	**61**	**60**	**60**	**56**	**53**	**49**	**42**	**32**

Basement, lower ground and ground level F&B tenancies

These areas are proposed across the entire floorplate of the existing fPPB on site, with façade glazing along the northern, southern and western façades. It is likely that existing façade elements will be retained and potentially new secondary glazing provided (for building thermal performance).

Given the proximity of the nearest affected receivers (H3, C3 and E1 – at least 65m away; see Figure 3-2) and the closed façade of the tenancy, operational noise impacts from the F&B tenancies are expected to be below 45 dB(A) at these receivers and will not be audible internally.

Ground level F&B tenancy (internal to internal transmission – noise impacts to office areas above)

There is also potential for noise impacts via internal transmission from the ground level F&B tenancy to the proposed level 2 commercial office areas above, if separately titled.

- Typical activity noise sources associated with restaurants include background amplified music and patron speech.
  - Background amplified music is generally measured between 60-65 dB(A)L_{10} SPL (Sound Pressure Level) in a café space.
  - Patron speech is typically noted as 77 dB(A)L_{10} SWL (Sound Power Level) for raised speech in a restaurant space. Total of 200 patrons are assumed in the F&B space at any given time with 1 in 2 talking.
  - The resulting cumulative SPL in the restaurant space is assumed as 80-82 dB(A)L_{10} SPL, detailed below:

Table 7-11: Ground level F&B tenancy operational noise sources

Source	Overall dB(A)	Octave band Centre Frequency – Hz, dB(Z) $L_{10(15\ minute)}$								
		31.5	63	125	250	500	1k	2k	4k	8k
Background amplified music (SPL)	65	68	68	68	60	60	60	58	54	47
Patron speech (SPL) [1]	77	62	62	70	70	76	73	68	59	47
Combined SPL	**82**	**70**	**70**	**75**	**74**	**80**	**78**	**72**	**62**	**48**

Notes:

1. SWL per patron converted to SPL considering volume of the restaurant space and 2000 patrons in total, with 1 in 2 talking.

- Minimum 200m thick concrete slab is assumed separating level 2 from level 1. Adopting a conservative approach, no additional ceiling treatments are assumed within the F&B tenancy, with the following transmission loss typical for a 200mm thick slab:

Table 7-12: Transmission loss of 200mm thick concrete slab

	Octave band Centre Frequency – Hz,								
	31.5	63	125	250	500	1k	2k	4k	8k
200mm thick slab	-44	-44	-44	-47	-54	-61	-66	-71	-71

- Additionally, the following areas are proposed with glazed partitions:
  - between the F&B tenancy and high-rise lift lobby on ground level and between office areas (levels 2 to 6) and void (overlooking the high-rise lift lobby), and
  - internal void between the office areas (levels 2 to 6, adjacent to central lift core) overlooking the ground level F&B tenancy.
- The following transmission loss spectrums have been assumed for single- and double-glazed fixed partition systems, sources from RTA database:

Table 7-13: Transmission loss of R_W35 glazed partition

	Octave band Centre Frequency – Hz,								
	31.5	63	125	250	500	1k	2k	4k	8k
Thick single glazed fixed partition (indicatively 10.38mm laminate glass and acoustic performance R_W 35)	-17	-19	-24	-29	-33	-34	-36	-45	-50
Large airgap double glazed fixed laminate partition (single frame like Capral 419 series Flushline; indicatively 10.5mm hush laminate/107mm airgap/ 10.5mm hush laminate system and acoustic performance R_W 50)	-15	-15	-29	-40	-47	-53	-58	-68	-72

The following cumulative noise impacts (contribution form transmission via floor slab and glazed partitions) are predicted internally within the level 2 office areas:

Table 7-14: Level 1 restaurant operational noise emissions (internal to internal transmission) – Level 2 office areas

Receiver	Overall dB(A)	Octave band Centre Frequency – Hz, dB(Z) $L_{10(15\ minute)}$								
		31.5	63	125	250	500	1k	2k	4k	8k
Level 2 office areas (transmission via soffit slab)	<30	<31	<31	<36	<32	<31	<21	<10	0	0
Level 2 office areas (transmission via void to high-rise lift lobby)	<25	<41	<41	<36	<24	<21	<17	<7	0	0
Level 2 office areas (transmission via internal void overlooking F&B tenancy)	31	52	52	43	31	30	21	10	0	0
Combined	35	53	53	44	35	34	25	14	0	0
Criteria	**43**	**57**	**63**	**51**	**44**	**38**	**33**	**32**	**28**	**22**

7.3.3 Level 7 rooftop terrace

This area is proposed to be used as a terrace space for commercial tenancies and as a breakout space for the level 6 function areas. Activity noise associated with function breakout space operations is likely be the worst-case noise use of this space. A dedicated kitchen or bar area is not proposed for this space, and it will not operate as an independent F&B tenancy.

The proposed new mixed-use tower on site will largely screen this area from the Atlassian Central tower (C1 & H2, see Figure 3-2). The north-west corner of the Atlassian Central tower (pending confirmation on final design and tower footprint) may have partial line of sight to the north-west corner of this rooftop space.

Typical activity noise sources associated with a commercial function breakout space includes background amplified music and patron speech.

- The following amplified background music spectrum was previously measured by RTA in similar outdoor venues.

Table 7-15: Outdoor area amplified music spectrum

	Octave band Centre Frequency – Hz, dB(Z) $L_{10(15\ minute)}$								
	31.5	63	125	250	500	1k	2k	4k	8k
Amplified music in outdoor setting	73	73	73	65	65	65	63	59	52

- Patron speech (raised voice) is assumed as 80 dB(A)L_{10} SWL (Sound Power Level). This is typical for raised speech in an outdoor beer garden with amplified music. Though speech levels are likely to be lower in a terrace space, this assumption represents a conservative approach. The following spectrum is used in this assessment, based on historical data from RTA database.

Table 7-16: Outdoor area patron raised voice

	Overall dB(A)	Octave band Centre Frequency – Hz, dB(Z) $L_{10(15\ minute)}$								
		31.5	63	125	250	500	1k	2k	4k	8k
Patron raised voice (outdoor) SWL	80	65	65	73	73	79	76	71	62	50

- Total of 75 patrons are assumed in the north-west corner of the rooftop space (approx. 150m^2 total area and one person per 2m^2), with 1 in 2 talking at any given time.
- In total approx. 200 patrons are assumed in the rooftop space at any given time (appro. 400m^2 total area), with 1 in 2 talking at any given time.

The following preliminary noise impacts are predicted to the surrounding nearest affected receivers:

Table 7-17: Rooftop terrace operational noise emissions – Redeveloped Railway Square YHA (H2)

Receiver	**Time Period**	**Overall dB(A)**	**Octave band Centre Frequency – Hz, dB(Z) $L_{10(15\ minute)}$**								
			31.5	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
H2 (Redeveloped Railway Square YHA)	When in use	52	38	38	45	45	50	48	42	33	21
Criteria	**Up to midnight (7am – 12am) (BG + 5 dB)**	**60**	**68**	**63**	**60**	**61**	**58**	**56**	**51**	**44**	**32**
	Overnight (12am – 7am) (BG + 0 dB)	**52**	**55**	**53**	**51**	**52**	**50**	**47**	**42**	**36**	**25**

Table 7-18: Rooftop terrace operational noise emissions – Mercure Hotel (H1) & Central Studio Hotel Sydney (H3)

Receiver	Time Period	Overall dB(A)	Octave band Centre Frequency – Hz, dB(Z) $L_{10(15\ minute)}$								
			31.5	63	125	250	500	1k	2k	4k	8k
H1 (Mercure Hotel)	When in use	48	33	33	41	41	47	44	39	30	18
H3 (Central Studio hotel Sydney)		52	37	37	45	45	51	48	43	34	22
Criteria	**Up to midnight (7am – 12am) (BG + 5 dB)**	**65**	**70**	**68**	**63**	**62**	**64**	**61**	**56**	**47**	**35**
	Overnight (12am – 7am) (BG + 0 dB)	**53**	**56**	**55**	**55**	**52**	**51**	**49**	**44**	**35**	**24**

Item (d) of council's standard conditions of consent (Section 7.1.1) and typical liquor licence conditions to limit noise impacts to local neighbourhood, notes the following condition in addition to the octave band noise assessment detailed in Section 7.1:

Notwithstanding compliance with the above, the noise from the licensed premises shall not be audible within any habitable room in any residential premises between the hours of 12:00 midnight and 07:00 am.

Assuming this condition also applies to hotel type receivers (short term stay), the SSDA acoustic report for the Atlassian Central development proposal [17], illustrates minimum R_w 34 acoustic performance for façade glazing along the western façade, requiring alternative means of ventilation (i.e. windows not open for natural ventilation).

- The typical transmission loss that is achieved by a R_w 34 rated glazing assembly is presented below.

Table 7-19: Transmission loss of R_w34 rated glazing assembly

	R_W	Octave band Centre Frequency – Hz,								
		31.5	63	125	250	500	1k	2k	4k	8k
Single glazed assembly	34	-19	-22	-25	-30	-33	-32	-33	-43	-53

- Section 8.2 of the SSDA Atlassian Central acoustic report [17] notes an internal design noise level of 35dB(A)L_{eq} for hotel rooms, with windows closed. We note that to comply with the "inaudibility" requirement, noise impacts from terrace operations must be at least 10dB below ambient noise conditions. The resulting octave band internal criteria is presented below.

Table 7-20: Typical internal ambient level within a hotel guest room (with A/C operating at design speed) and resulting noise criteria to achieve inaudibility

Space	Measurement	Overall dB(A)	Octave band Centre Frequency – Hz, dB(Z) $L_{10(15\ minute)}$								
			31.5	63	125	250	500	1k	2k	4k	8k
Hotel guest room	Internal background spectrum	35	49	46	43	34	32	29	24	21	18
	Inaudibility criteria (BG-10 dB)	25	39	36	33	24	22	19	14	11	8

The following internal noise levels are predicted within guest rooms of the YHA:

Table 7-21: Predicted impacts to YHA (H2) guestrooms (internally, transmission via façade)

Receiver	Time Period	Overall dB(A)	Octave band Centre Frequency – Hz, dB(Z) $L_{10(15\ minute)}$								
			31.5	63	125	250	500	1k	2k	4k	8k
YHA guest room	When in use	23	24	20	25	20	22	19	14	0	0
Criteria	**When in use**	**25**	**39**	**36**	**33**	**24**	**22**	**19**	**14**	**11**	**8**

Therefore, based on the proposed use of the rooftop terrace and the minimum façade requirements for the redeveloped YHA levels in the SSDA Atlassian Central acoustic report [17], operational noise impacts from the terrace are not expected to be audible inside the YHA guestrooms, with windows closed.

7.3.4 Building services plant and equipment

Noise from building services plant and equipment is assessed with reference to the EPA NPfI (Section 7.1.2) and must comply with the noise emission goals presented in Table 7-4.

The proposed building services design and associated plant/equipment selections are not known at this stage of development and are yet to be finalised. Therefore, review and recommendation of noise control treatments and mitigation measures are not possible at this stage. Provisions for suitable noise and vibration control treatments should be considered during the early stages of design development, with a detailed review undertaken when the design and plant/equipment selections are sufficiently progressed (typically detailed design stage).

Based on the current design documentation, building services plant/equipment serving the proposed development are largely expected to be located internally within the building shell of the development (dedicated plant levels 8, 19 & 44 and plantrooms across the basement levels), with façade openings and/or ducted connections to the environment (intake or exhaust). This design facilitates the incorporation of typical acoustic control treatments (acoustic louvres, acoustic attenuators, internally lined ductwork etc.) required to ensure compliance with the project noise emission goals detailed in Table 7-4. Indicative mitigation measures for typical building services plant/equipment likely for a development of this size, are detailed in Section 9.1.2.

7.3.5 Hotel amenity areas (pool and gym/fitness centre)

Pool

A swimming pool is proposed on levels 21 and 22 of the new tower building. The pool is proposed within the building envelope but with façade glazed louvres (not operable) to facilitate natural ventilation.

Typical noise sources associated with a swimming pool include activity noise (patrons jumping into pool, splashing associated with swimming), patron voice (raised voice and occasional screaming from kids) and stage speech (amplified voice) associated with classes/instruction events. Typical internal noise levels in a semi-enclosed public pool have been measured between 74-77 dB(A)SPL (RTA database). Assuming the highest measured levels, the following operational noise impacts are predicted to the surrounding nearest affected receivers:

Table 7-22: Predicted impacts from pool operations

Receiver	Predicted Noise Level, dB(A)$L_{eq(15mins)}$	Project Specific Noise Limits, dB(A)$L_{eq(15min)}$
R1	<28	48 [1]
H1	31	48 [1]
H2	35	48 [1]
H3	30	48 [1]
H4	<28	48 [1]
C1	44	63 [2]
C3	30	63 [2]

Notes:

1. Compliance with night period (10pm-7am) noise limits will also result in compliance during day and evening periods.
2. Typically, only in operation during standard business hours i.e. 9am to 5pm.

Gym/fitness centre

The gym/fitness centre (also levels 21 & 22) is proposed internally within the building envelope of the new mixed-use tower, completely enclosed. Minimum R_W 32 façade glazing system is recommended for these levels, to control external noise impacts (see Table 5-3; to achieve a suitable level of internal acoustic amenity, enabling function/use).

Given the proximity of the nearest affected receivers (H1, C1+H2 and C2; see Figure 3-2) and closed façade glazing, operational noise impacts from these internal amenity areas are expected to be below 30 dB(A) at these receivers.

7.3.6 Loading dock and waste collection

A loading dock is currently proposed in basement level 3. Waste rooms for the commercial, retail and hotel areas of the development, are also proposed on the level, adjacent to the loading dock.

This level is located below ground, is a fully enclosed space and is not directly adjacent to an outdoor space. Hence, no acoustic impact is anticipated from the operation of loading dock.

7.3.7 Additional traffic generation

Given the current high volumes of traffic on Lee and George Streets (carriageways with >20,000 and >40,000 AADT respectively [3]), the primary objective to assess any potential noise impacts associated with additional traffic generated by the subject proposal, is to reduce these impacts through feasible and reasonable measures (in line with the provisions of Section 3.4 of the RNP).

The RNP notes that in assessing feasible and reasonable mitigation measures, an increase of up to 2 dB represents a minor impact that is considered barely perceptible to the average person.

In order for traffic noise to increase by more than the permissible 2dB, additional road traffic on the street associated with the proposed development, would need to increase by more than 60 percent. The current design incorporates 110 parking spaces across three split basement levels. Section 4.7.1 of the traffic and transport assessment for the site [18] predicts up to 88 vehicle trips (driver + taxi/rideshare) in any weekday peak hour. Hence, the projected traffic generation associated with the site are not expected to increase the existing traffic noise levels and no adverse impacts are predicted.

7.4 Operational Vibration Assessment

Given the sites proximity to surrounding properties (existing and future) and the proposed function/use of internal areas, no vibration intensive activities are identified, and hence operational vibration impacts are not expected from the operations of the proposed development.

All building services plant/equipment will be adequately vibration isolated to control impacts to users within the building (ensuring project quality and function/use) and hence will also be vibration ameliorated against impacts to surrounding sensitive receivers.

[3] Map 16 of Traffic Volume Maps for Infrastructure SEPP (source: https://roads-waterways.transport.nsw.gov.au/about/environment/reducing-noise/traffic-volume-maps-for-infrastructure-sepp.html)

8 Construction Noise and Vibration Assessment

Noise and vibration criteria for construction sites in NSW are typically governed by the provisions of the EPA publication *Interim Construction Noise Guideline* (ICNG) [11] and *Assessing Vibration: a technical guideline* [10]. However, as the subject site is location within the City of Sydney LGA, council's *Construction Hours /Noise within the Central Business District – Code of Practice 1992* [5] guideline is also referenced for this assessment.

8.1 Construction Noise Criteria

8.1.1 Interim construction noise guideline

The ICNG generally applies to the management of construction noise in NSW. This guideline provides recommendations on standard construction hours and construction noise management levels (NMLs).

Recommended standard hours of work

Section 2.2. of the ICNG recommends standard hours for construction work as follows:

- Monday to Friday: 7am to 6pm
- Saturday: 8am to 1pm, and
- No work on Sunday and public holidays

The ICNG notes that the recommended standard hours of work are not mandatory and acknowledges that some activities could be undertaken outside the recommended standard hours of work, assuming all feasible and reasonable mitigation measures are implemented to minimise the impacts to any surrounding sensitive land uses. These activities include:

- the delivery of oversized plant or structures that police or other authorities determine requires special arrangements to transport along public roads
- emergency work to avoid the loss of life or damage to property, or to prevent environmental harm
- maintenance and repair of public infrastructure where disruption to essential services and/or considerations of worker safety do not allow work within standard hours
- public infrastructure works that shorten the length of the project and are supported by the affected community
- works where a proponent demonstrates and justifies a need to operate outside the recommended standard construction hours
- works which maintain noise levels at receivers to below the noise management levels outside of the recommended standard construction hours.

Construction noise management levels

Recommended construction NMLs for residential receivers and non-residential receivers are presented in Table 8-1 and Table 8-2 respectively. The NMLs represent a noise level that, if exceeded, would require management measures including the following:

- reasonable and feasible work practices
- contact with residences to inform them of the nature of works to be carried out, the expected noise levels and durations and contact details.

The management measures aim to reduce noise impacts on the residential receivers; however, it may not be reasonable and feasible to reduce noise levels to below the noise affected management level. The construction NMLs during recommended standard hours of work are not intended as a noise limit but rather a level where noise management is required. The construction NMLs outside of recommended standard hours would be considered as noise limits unless a private agreement has been reached with the affected residential receivers.

Table 8-1: Noise management levels at residential receivers

Time of day	Management Level $L_{Aeq\ (15\ min)}$ [1]	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	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured $L_{Aeq\ (15\ min)}$ 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 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.

Notes:

1. Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5 m above ground level. If the property boundary is more than 30 m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30 m of the residence. Noise levels may be higher at upper floors of the noise affected residence.

Table 8-2: 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)
Active recreation areas	External noise level	65 dB(A)
Passive recreation areas	External noise level	60 dB(A)
Commercial premises	External noise level	70 dB(A)

8.1.2 City of Sydney construction noise code

Council's construction noise code sets noise goals specific to the Central Business District. The noise criteria are intended to allow for the planning and undertaking of construction activities without unduly affecting the amenity of residents, commercial operators, and other city users. A summary of the noise criteria is set out in Table 8-3.

Table 8-3: Summary of council construction noise criteria

Category	Time Period	Permissible Noise Level, dB(A)$L_{Av\ Max}$ [1]
Mondays To Fridays		
4	00:00 to 07:00	Background + 0
1	07:00 to 08:00	Background + 5
1	08:00 to 19:00	Background + 5 + 5 to be determined on a site basis
2	19:00 to 23:00	Background + 3
4	23:00 to 24:00	Background + 0
Saturdays		
4	00:00 to 07:00	Background + 0
1	07:00 to 08:00	Background + 5
1	08:00 to 17:00	Background + 5 + 5 to be determined on a site basis
2	17:00 to 23:00	Background + 3
4	23:00 to 24:00	Background + 0
Sundays & Public Holidays		
4	00:00 to 07:00	Background + 0
3	07:00 to 17:00	Background + 3
4	17:00 to 24:00	Background + 0

Notes:

1. The construction code notes LA av max descriptor, which is deemed to be equivalent to LA10 as mentioned in Part 1 Paragraph 18 Item g of the code. For acoustic assessment purposes, the LA10, instead of LA av max, is adopted in this assessment.

8.1.3 Project construction hours and noise management levels

As the ICNG notes that recommended standard hours are not mandatory (Section 2.2 of the guideline and summarised in Section 8.1.1 above), given the site's location in the City of Sydney LGA and the LGA governed by its own construction noise code, the recommended standard hours of this local noise code

is adopted for this assessment. This approach is also consistent with the RTS comments received from the DPE.

"Category 1 Hours" of the council construction noise code are generally assumed as the recommended standard construction hours (based on guidance provide in Part 3 of the code) and hence the project construction hours (standard hours of work) are as follows:

- Monday to Friday – 7am to 7pm
- Saturday – 7am to 5pm

The resulting project specific NMLs for the surrounding potentially nearest affected receives, in accordance with the provisions of the ICNG (as directed by RTS comments by DPE), are detailed Table 8-4. In the event these NMLs are exceeded, reasonable and feasible construction noise mitigation is required.

Table 8-4: Project construction noise management levels

Receiver	Receiver Type	Time of Day		Where Objective Applies	Construction NMLs, $L_{Aeq(15min)}$
R1	Residential	Monday to Friday	7am to 6pm	External noise level	71 dB(A)
			6pm to 7pm	External noise level	66 dB(A)
		Saturday	8am to 1pm	External noise level	71 dB(A)
			7am to 8am and 1pm to 5pm	External noise level	66 dB(A)
H1, H2, H3 & H4	Hotel	When in use		External noise level	70 dB(A) [1]
E1	Education tenancies in mixed-use commercial property	When in use		Internal noise level	45 dB(A)
				External noise level	70 dB(A) [2]
C1, C2 & C3	Commercial premises (office and retail)	When in use		External noise level	70 dB(A)

Notes:

1. Hotels and backpacker accommodation have been treated as commercial premises in line with guidance provided in the NPfI.
   a. The NPfI notes that premises where a person resides but which is associated with a commercial undertaking is not classified as a residential receiver, but as a commercial receiver. This includes developments such as caretakers' quarters, hotels, motels, transient holiday accommodation and caravan parks.
   b. If approval for outside recommended standard hours construction works is pursued during subsequent stages, construction impacts during the night period shall for sleeping areas shall be assessed against a night-time internal noise level of 40 dB(A) assuming closed windows with a 25 dB(A) outside to inside difference.
2. This is based on 25 dB(A) outside to inside difference provided by the closed windows (modern building with operable façade elements installed with weather/acoustic seals).

8.2 Construction Vibration Criteria

8.2.1 Human comfort

Assessment of potential disturbance from construction vibration on human occupants of buildings, is made in accordance with the EPA publication *Assessing Vibration; a technical guideline* [10]. This guideline

provides criteria which are based on the British Standard BS 6472-1992 *'Evaluation of human exposure to vibration in buildings (1-80Hz)'*. Sources of vibration are defined as either 'Continuous', 'Impulsive' or 'Intermittent'. Table 8-5 provides definitions and examples of each type of vibration.

Table 8-5: Types of vibration

Type of Vibration	Definition	Examples
Continuous vibration	Continues uninterrupted for a defined period (usually throughout the daytime and/or night-time)	Machinery, steady road traffic, continuous construction activity (such as tunnel boring machinery).
Impulsive vibration	A rapid build-up to a peak followed by a damped decay that may or may not involve several cycles of vibration (depending on frequency and damping). It can also consist of a sudden application of several cycles at approximately the same amplitude, providing that the duration is short, typically less than 2 seconds	Infrequent: Activities that create up to 3 distinct vibration events in an assessment period, e.g. occasional dropping of heavy equipment, occasional loading and unloading.
Intermittent vibration	Can be defined as interrupted periods of continuous or repeated periods of impulsive vibration that varies significantly in magnitude	Trains, nearby intermittent construction activity, passing heavy vehicles, forging machines, impact pile driving, jack hammers. Where the number of vibration events in an assessment period is three or fewer, this would be assessed against impulsive vibration criteria.

The vibration criteria are defined as a single weighted root mean square (rms) acceleration source level in each orthogonal axis. Section 2.3 of the guideline states:

Evidence from research suggests that there are summation effects for vibrations at different frequencies. Therefore, for evaluation of vibration in relation to annoyance and comfort, overall weighted rms acceleration values of the vibration in each orthogonal axis are preferred (BS 6472).

When applying the criteria, it is important to note that the three directional axes are referenced to the human body, i.e. x-axis (back to chest), y-axis (right side to left side) or z-axis (foot to head). Vibration may enter the body along different orthogonal axes and affect it in different ways. Therefore, application of the criteria requires consideration of the position of the people being assessed, as illustrated in Figure 8-1. For example, vibration measured in the horizontal plane is compared with x- and y-axis criteria if the concern is for people in an upright position, or with the y- and z- axis criteria if the concern is for people in the lateral position.

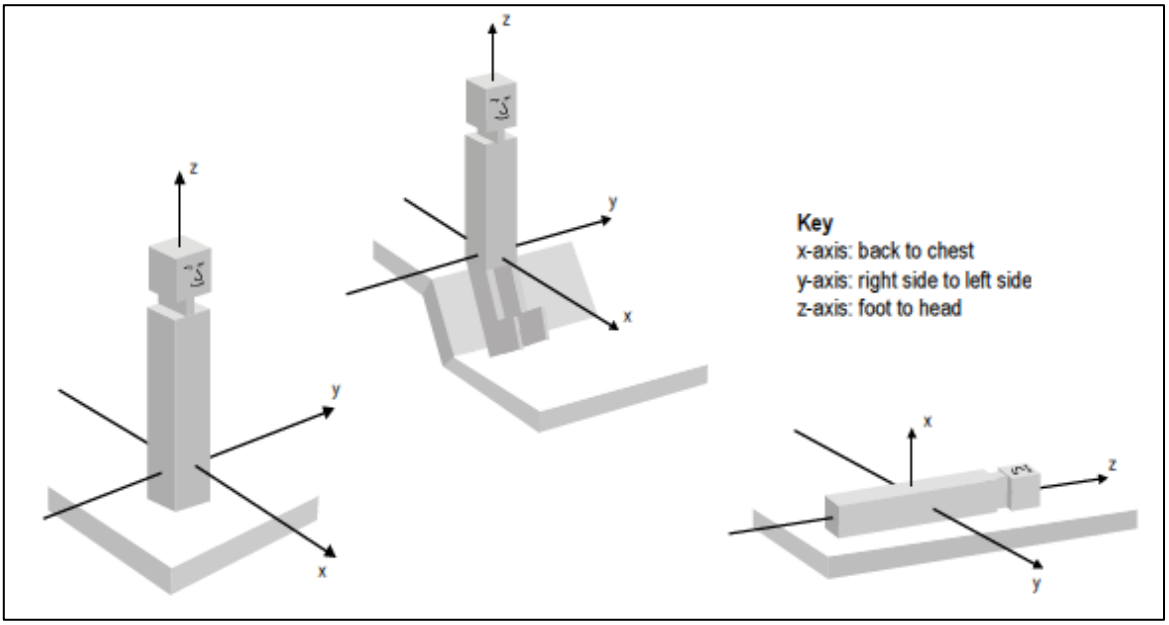

Figure 8-1: Orthogonal Axes for Human Exposure to Vibration

The preferred and maximum values for continuous and impulsive vibration are defined in Table 2.2 of the guideline and the locations applicable to receivers surrounding the site are reproduced in Table 8-6.

Table 8-6: Preferred and maximum levels of construction vibration for human comfort impacts

Location	Assessment period [1]	Preferred Values		Maximum Values	
		z-axis	x- and y-axis	z-axis	x- and y-axis
Continuous vibration (weighted RMS acceleration, m/s ^{2}, 1-80Hz)					
Critical areas [2]	Day- or night-time	0.005	0.0036	0.010	0.0072
Residences	Daytime	0.010	0.0071	0.020	0.014
	Night-time	0.007	0.005	0.014	0.010
Offices, schools, educational institutions and places of worship	Day- or night-time	0.020	0.014	0.040	0.028
Workshops	Day- or night-time	0.04	0.029	0.080	0.058
Impulsive vibration (weighted RMS acceleration, m/s ^{2}, 1-80Hz)					
Critical areas [2]	Day- or night-time	0.005	0.0036	0.010	0.0072
Residences	Daytime	0.30	0.21	0.60	0.42
	Night-time	0.10	0.071	0.20	0.14
Offices, schools, educational institutions and places of worship	Day- or night-time	0.64	0.46	1.28	0.92
Workshops	Day- or night-time	0.64	0.46	1.28	0.92

Notes:

1. Daytime is 7:00am to 10:00pm and night-time is 10:00pm to 7:00am.
2. Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. There may be cases where sensitive equipment or delicate tasks require more stringent criteria than the human comfort criteria specify above. Stipulation of such criteria is outside the scope of their policy and other guidance documents (e.g. relevant standards) should be referred to. Source: BS 6472-1992.

The acceptable vibration dose values (VDV) for intermittent vibration are defined in Table 2.4 of the guideline and the locations applicable to receivers surrounding the site are reproduced in Table 8-7.

Table 8-7: Acceptable Vibration Dose Values for Intermittent Vibration (m/s$^{1.75}$)

Location	Daytime [1]		Night-time [1]	
	Preferred Value	Maximum Value	Preferred Value	Maximum Value
Critical areas [2]	0.10	0.20	0.10	0.20
Residences	0.20	0.40	0.13	0.26
Offices, schools, educational institutions and places of worship	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60

Notes:

1. Daytime is 7:00am to 10:00pm and night-time is 10:00pm to 7:00am
2. Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. These criteria are only indicative, and there may be a need to assess intermittent values against the continuous of impulsive criteria for critical areas. Source: BS 6472-1992

8.2.2 Building damage

Potential structural damage of buildings as a result of vibration is typically managed by ensuring vibration induced into the structure does not exceed certain limits and standards, such as British Standard 7385-2:1993 [4] and German Standard DIN4150-3:2016 [14]. Currently there is no existing Australian Standard for assessment of structural building damage caused by vibration energy.

Within British Standard 7385 Part 1: 1990, different levels of structural damage are defined:

- ***Cosmetic*** – The formation of hairline cracks on drywall surfaces, or the growth of existing cracks in plaster or drywall surfaces; in addition, the formation of hairline cracks in mortar joints of brick/concrete block construction.
- ***Minor*** – The formation of large cracks or loosening of plaster or drywall surfaces, or cracks through bricks/concrete blocks.
- ***Major*** – Damage to structural elements of the building, cracks in supporting columns, loosening of joints, splaying of masonry cracks, etc.

The vibration limits in Table 1 of British Standard 7385 Part 2 (1993) are for the protection against cosmetic damage, however guidance on limits for minor and major damage is provided in Section 7.4.2 of the Standard:

7.4.2 Guide values for transient vibration relating to cosmetic damage

Limits for transient vibration, above which cosmetic damage could occur are given numerically in Table 1 and graphically in Figure 1. In the lower frequency region where strains associated with a given vibration velocity magnitude are higher, the guide values for the building types corresponding to line 2 are reduced. Below a frequency of 4 Hz, where a high displacement is associated with a relatively low peak component particle velocity value a maximum displacement of 0.6 mm (zero to peak) should be used.

Minor damage is possible at vibration magnitudes which are greater than twice those given in Table 1, and major damage to a building structure may occur at values greater than four times the tabulated values.

Within DIN4150-3, damage is defined as "*any permanent effect of vibration that reduces the serviceability of a structure or one of its components*" (p.2). The Standard also outlines:

For structures as in lines 2 and 3 of Table 1, the serviceability is considered to have been reduced if

- *cracks form in plastered surfaces of walls;*
- *existing cracks in the building are enlarged;*
- *partitions become detached from loadbearing walls or floors.*

These effects are deemed 'minor damage'.

While the DIN Standard defines the above damage as 'minor', based on the definitions provided in BS7385, the DIN standard is considered to deal with cosmetic issues rather than major structural failures.

British Standard

British Standard 7385: Part 2 '*Evaluation and measurement of vibration in buildings*' [4], can be used as a guide to assess the likelihood of building damage from ground vibration. BS7385 suggests levels at which 'cosmetic', 'minor' and 'major' categories of damage might occur.

The cosmetic damage levels set by BS 7385 are considered 'safe limits' up to which no damage due to vibration effects has been observed for certain particular building types. Damage comprises minor non-structural effects such as hairline cracks on drywall surfaces, hairline cracks in mortar joints and cement render, enlargement of existing cracks and separation of partitions or intermediate walls from load bearing walls. 'Minor' damage is considered possible at vibration magnitudes which are twice those given and 'major' damage to a building structure may occur at levels greater than four times those values.

BS7385 is based on peak particle velocity and specifies damage criteria for frequencies within the range 4Hz to 250Hz, being the range usually encountered in buildings. At frequencies below 4Hz, a maximum displacement value is recommended. The values set in the Standard relate to transient vibrations and to low-rise buildings. Continuous vibration can give rise to dynamic magnifications due to resonances and may need to be reduced by up to 50%. Table 8-8 sets out the BS7385 criteria for cosmetic, minor and major damage.

Regarding heritage buildings, British Standard 7385 Part 2 (1993) notes that "*a building of historical value should not (unless it is structurally unsound) be assumed to be more sensitive*" (p.5).

Table 8-8: BS 7385 Structural damage criteria

Group	Type of Structure	Damage Level	Peak Component Particle Velocity [1], mm/s		
			4Hz to 15Hz	15Hz to 40Hz	40Hz and above
1		Cosmetic	50		
		Minor [2]	100		

Group	Type of Structure	Damage Level	Peak Component Particle Velocity [1], mm/s		
			4Hz to 15Hz	15Hz to 40Hz	40Hz and above
	Reinforced or framed structures Industrial and heavy commercial buildings	Major [2]		200	
2	Un-reinforced or light framed structures Residential or light commercial type buildings	Cosmetic	15 to 20	20 to 50	50
		Minor [2]	30 to 40	40 to 100	100
		Major [2]	60 to 80	80 to 200	200

Notes:

1. Peak Component Particle Velocity is the maximum peak particle velocity (PPV) in any one direction (x, y, z) as measured by a tri-axial vibration transducer
2. Minor and major damage criteria established based on British Standard 7385 Part 2 (1993) Section 7.4.2

German Standard

German Standard DIN 4150 - Part 3 '*Structural vibration in buildings - Effects on Structure*' [14], also provides recommended maximum levels of vibration that reduce the likelihood of building damage caused by vibration and are generally recognised to be conservative.

DIN 4150-3 presents the recommended maximum limits over a range of frequencies (Hz), measured in any direction, and at the foundation or in the plane of the uppermost floor of a building or structure. The vibration limits increase as the frequency content of the vibration increases.

The structural damage vibration criteria adopted for this project is presented in Table 8-9.

Table 8-9: DIN 4150-3 Structural damage criteria

Group	Type of Structure	Vibration Velocity, mm/s			
		At Foundation at Frequency of			Plane of Floor Uppermost Storey
		1Hz to 10Hz	10Hz to 50Hz	50Hz to 100Hz	All Frequencies
1	Buildings used for commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40
2	Dwellings and buildings of similar design and/or use	5	5 to 15	15 to 20	15
3	Structures that because of their particular sensitivity to vibration, do not correspond to those listed in Group 1 or 2 and have intrinsic value (eg buildings under a preservation order)	3	3 to 8	8 to 10	8

8.2.3 Damage to buried services

Section 5.3 of DIN 4150-3:2016 also sets out guideline values for vibration velocity to be used when evaluating the effects of vibration on buried pipework. These values, which apply at the wall of the pipe, are reproduced and presented in Table 8-10 below.

Table 8-10: DIN 4150-3 Guideline values for vibration velocity to be used when evaluating the effects of short-term vibration on buried pipework

Line	Pipe Material	Guideline Values for Vibration Velocity Measured on the Pipe, mm/s
1	Steel (including welded pipes)	100
2	Vitrified clay, concrete, reinforced concrete, prestressed concrete, metal (with or without flange)	80
3	Masonry, plastics	50

For long-term vibration the guideline levels presented in Table 8-10 should be halved.

Recommended vibration goals for electrical cables and telecommunication services such as fibre optic cables range from between 50 mm/s and 100 mm/s. It is noted however that although the cables may sustain these vibration levels, the services they are connected to, such as transformers and switch blocks, may not. It is recommended that should such equipment be encountered during the construction process an individual vibration assessment should be carried out. This may include a specific vibration impact statement addressing impact on the utility and consultation with the utility provider to confirm specific vibration requirements.

8.2.4 Rail corridor and assets

Section 9.4.1 of the NSW Transport Asset Standards Authority's publication *Development Near Rail Tunnels* [19] notes the following provisions for the effects of development on rail tunnels:

Any development that occurs within a distance of 25 m horizontally from first reserve shall assess the vibration on the rail tunnels. The assessment criteria shall be a maximum peak particle velocity (PPV) of 15 mm/s at the tunnel lining for brick or mass concrete in good condition or a maximum PPV of 20 mm/s at the tunnel lining for cast iron, steel or concrete segment lining.

8.2.5 Project construction vibration limits

Table 8-11 presents the relevant construction vibration limits applicable to the identified surrounding sensitive receivers and rail infrastructure assets.

Table 8-11: Project construction noise management levels

Receiver	Time Period [1]	Human Comfort Vibration Limits					Structural Damage Criteria
		Continuous Vibration (RMS), m/s^2		Impulsive Vibration (RMS), m/s^2		Intermittent Vibration (VDV), m/s^2	Peak Velocity, mm/s
		z-axis	x- and y-axis	z-axis	x- and y-axis		
H1 & H2 Guest Rooms (sleeping areas)	Day	0.01-0.02	0.0071-0.014	0.3-0.6	0.21-0.42	0.2-0.4	5
	Night	0.007-0.014	0.005-0.010	0.1-0.2	0.071-0.14	0.13-0.26	

Receiver	Time Period [1]	Human Comfort Vibration Limits					Structural Damage Criteria
		Continuous Vibration (RMS), m/s^2		Impulsive Vibration (RMS), m/s^2		Intermittent Vibration (VDV), m/s^2	Peak Velocity, mm/s
		z-axis	x- and y-axis	z-axis	x- and y-axis		
H2/C1 (Parcel Sheds heritage structures)	At any time	-	-	-	-	-	3 [2]
H1, H2, C1 & C2	At any time	0.02-0.04	0.014-0.028	0.64-1.28	0.46-0.92	0.4-0.8	20
Rail Corridor and Assets	At any time	-	-	-	-	-	15-20 [3]

Notes:

1. Daytime is 7:00am to 10:00pm and night-time is 10:00pm to 7:00am.
2. Dilapidation surveys must be conducted for the adjacent heritage properties, to determine whether the site buildings are structurally unsound, The results of the survey will determine the adoption of the criteria for major or minor damage, rather than cosmetic damage, in line with the provisions of BS 7385 Part 2 (see Section 8.2.2).
3. Dependant on tunnel lining type (brick or mass concrete vs. cast iron, steel or concrete).

8.3 Indicative Construction Noise Assessment

8.3.1 Loudest typical construction noise sources

A list of the loudest typical construction equipment/activity expected for the proposed development, are presented in Table 8-12 below.

Table 8-12: Typical construction equipment & sound power levels

Equipment/Activity	Sound power levels, dB(A) re 1pW
Excavator (with hydraulic hammer, stop/start use)	120 (inclusive of 5dB(A) penalty for irritating characteristics)
Excavator (no hydraulic hammer)	105
Tower crane (electric)	100
Concrete pump	105
Piling (augured)	105

The sound power levels for the construction equipment/activity presented in the above table are based on maximum noise levels given in Table A1 of Australian Standard 2436 - 2010 '*Guide to Noise Control on Construction, Demolition and Maintenance Sites*' [15], TfNSW publication *Construction Noise and Vibration Strategy [19]*, information from past projects and/or information held in our library files.

8.3.2 Predicted noise levels

Table 8-13 below presents an indicative range of noise impacts likely to be experienced at the nearby affected receivers, based on the loudest typical construction equipment/activity associated with the

proposed site. The noise level range presented represents equipment/activity operating at locations nearest and furthest (respectively) to the receiver.

Table 8-13: Predicted noise levels for typical construction works

Equipment/Activity		Predicted dB(A)$L_{eq(15min)}$ Construction Noise Levels				
		R1	**H1**	**C1 & H2**	**C2**	**H3, E1 & C3**
Project Construction NMLs (external) – Typical Standard Hours of Works [1]	*Monday to Saturdays – 7am to 8am*	**66**	**66**	**61**	**66**	**66**
	Monday to Friday – 8am to 7pm *Saturdays – 8am to 5pm*	**71**	**71**	**66**	**71**	**71**
Excavator (with hydraulic hammer)		58-69	63-80	62-87	58-93	60-72
Excavator (no hydraulic hammer)		43-54	46-65	47-72	43-78	45-57
Tower crane (electric)		47-50	49-56	54-62	48-64	48-53
Concrete pump		43-53	48-63	47-66	43-68	45-56
Piling (augured)		43-54	48-65	47-72	43-78	45-57

Notes:

1. Category 1 of council's construction noise code [5].
2. Future Atlassian Central (including new Sydney Railway Square YHA) and Central Place Commercial Towers or existing commercial properties and YHA on site.

The predictions above indicate that the noise levels during the excavation and construction stages are likely exceed the construction NMLs, when working near the eastern and southern boundaries of the site. Exceedances are predicted for hammering, sawing and rock breaking operations, when they occur near any site boundary during the early morning period of 7am-8am.

It is likely that reasonable and feasible noise mitigation will be required. This would typically be addressed in a Construction Noise and Vibration Management Plan (CNVMP), prepared at construction certificate (CC) stage (when construction program and methodology is confirmed). Mitigation measures and management strategies to control construction noise impacts, are detailed in Section 9.2.

8.3.3 Cumulative construction project noise

The management of cumulative construction noise should be undertaken consistent with the DPE guideline *Cumulative Impact Assessment Guidelines for State Significant Projects* [8], as detailed in Section 3.5 of that document.

The subject proposal is located within The Western Gateway sub-precinct, which includes the development of three major mixed-use projects; Block A-Atlassian Central, Block B-Dexus/Frasers property Central Place Sydney and Block C-Toga Central. As such, there will be multiple construction projects undergoing noise generating construction works concurrently with stages of the proposed development (Block C).

While impacts from one project or one construction site may be relatively short-term or comprised of intermittent noise intensive periods, when viewed in the context of other nearby major construction works, the overall duration of construction noise impacting a particular receiver may be longer and cumulative construction noise impacts can occur. Typically, impacts from concurrent projects can impact nearby receiver locations in one of two ways, as illustrated in Figure 8-2:

- Situation 1 – For receivers in close proximity to work areas, noise impacts would typically be dominated by the nearest construction work area. However, construction noise impacts at lower levels from the more distant work area can also impact these receivers, increasing the frequency and duration of total construction noise impacts
- Situation 2 – For receivers further away from work areas, but between the two sets of noise generating work areas, the total construction noise level that they could be exposed to from cumulative construction noise may be slightly more than from a single work area, by up to 3 dB(A). They are also likely to be exposed to a greater frequency of construction noise impacts.

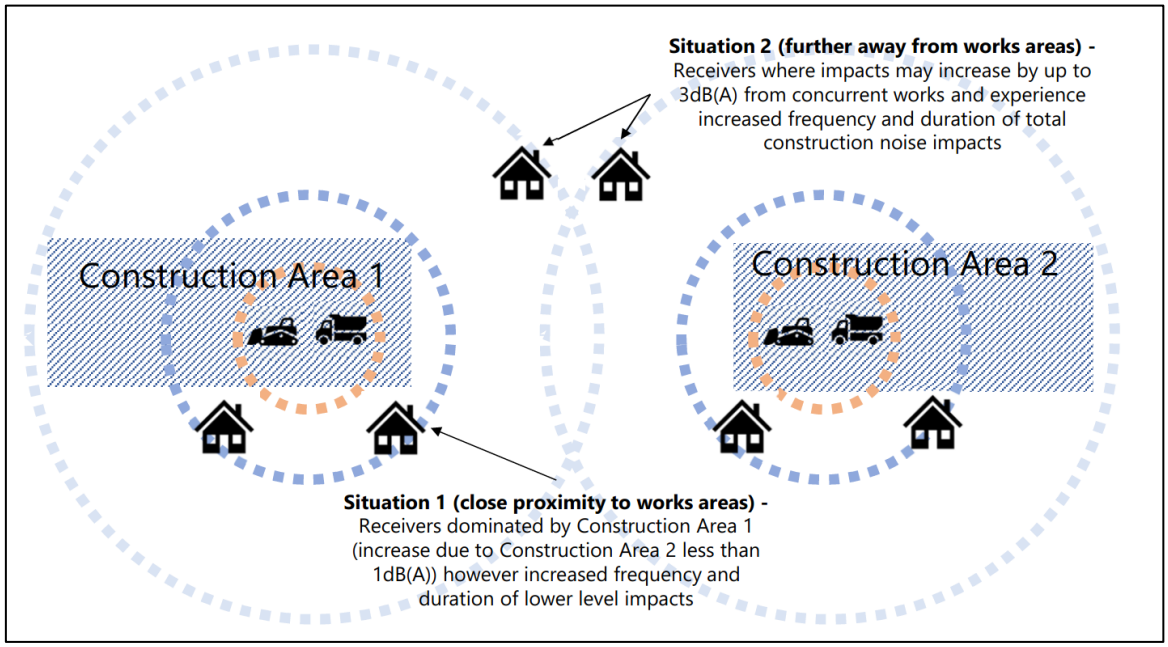

Figure 8-2: Cumulative constriction noise impacts

The preliminary construction program (proposed as part of SSD submission) for Block A outlines completion of demolition, bulk excavation & piling and approx. first ten months of core superstructure works, when construction works for the proposed development (Block C) is proposed to commence.

- As such noise intensive stages of demolition, piling, rock-breaking and heavy excavation are note expected to overlap for the Block A and C projects.
- All demolition and excavation work associated with Block A are forecasted to be complete by October 2023, with piling and excavation works for Block C forecasted to commence after March 2024.
- There will be an overlap of the superstructure and core construction stage of Block A with the excavation stage of Block C, however noise impacts from the subject proposal's excavation and piling works is likely to dominate the noise environment at the surrounding sensitive receives (see Section

3.1). Noise impact from Block A works is unlikely to contribute to cumulative levels but lower level impacts are likely to be perceived as more frequent and longer in duration (see Figure 8-2).

However, the preliminary construction program for Central Place Sydney (proposed as part of DA submission) for Block B outlines completing of demolition and bulk excavation works by April and December of 2024 respectively.

- There is likely to be an overlap between the bulk excavation stages of both Block B & C developments. Additionally, an overlap of the core and superstructure construction stage is also likely for the two projects.
- Hence cumulative construction noise impacting a particular sensitive receiver is likely to be up to 3 dB(A) louder than from individual project works (similar activity contributions from one other project), with the overall duration of exposure longer or impacts more frequent.
- Based on the identified potentially nearest affected receives (see Section 3.1), cumulative construction noise impacts are likely to be at their highest when works for both projects occur along the Lee Street frontage of the project boundaries. However, give the proposed staging of the Central Place Sydney development (Stage 1: north tower and connector building; Stage 2: south tower):
  - Works associated with the north tower are proposed to occur first (Stage 1) with the tower located further away from Lee Street. Hence significant cumulative contribution (i.e up to 3 dB(A)) is not expected from this project on the noise impacts resulting from similar phase of works associated with subject development (Block C) at the receivers along Lee and George Streets.
  - Similarly works associated with the construction of the southern tower (Stage 2) is expected to dominant noise source at receiver H1, with only a minor (likely short duration) period of contribution expected from the subject proposal, when works across along the south-west corner of site (Henry Dean Plaza demo works).

As such, because there is potential for cumulative noise impacts as a result of the subject proposal combined with other future concurrent construction projects, it is recommended that where this is the case that mitigation and management measures are implemented in order to minimise cumulative impacts, as detailed in Section 9.3.1.

8.4 Indicative Construction Vibration Assessment

8.4.1 Minimum working distances

The recommended minimum working distances for vibration intensive equipment/machinery are presented in Table 8-14.

Table 8-14: Recommended minimum working distances for vibration intensive equipment

Plant item	Minimum Working Distance, m					
	Cosmetic Damage			Human Disturbance		
	Commercial and Industrial Buildings [1]	Dwellings and Similar Structures [1]	Sensitive Structures (e.g. heritage) [1]	Residences (including Hotel Guest Rooms) Day [2]	Offices	Workshops
5 Tonne Excavator w/Hydraulic Breaker, Vibratory Compactor	5	5	10	20	15	10

Notes:

1. Vibration limits referenced from DIN 4150 Structural Damage - Safe Limits for Short-term Building Vibration.
2. Daytime is 7 am to 10 pm.

Site specific buffer distances for vibration intensive activity must be measured on site, where equipment/machinery are likely to operate close to or within the minimum working distances for cosmetic damage.

8.4.2 Rail corridor and assets

Map 8 of the DPE Transport and Infrastructure SEPP (formerly known as *State Environment Planning Policy (Infrastructure) 2007) Interim Rail Corridor CBD Rail Link and CBD Metro Maps*, illustrates CBD Rail Link & Metro (Zone B-Tunnel) corridors directly below the site. This is reproduced below.

Figure 8-3: Interim Rail Corridor CBD Rail Link and CBD Metro Map 8 (source: NSW DPE SEPP Infrastructure 2007)

However, the alignment for Sydney Metro City & Southwest line is approx. 150m to the east of the site (see below).

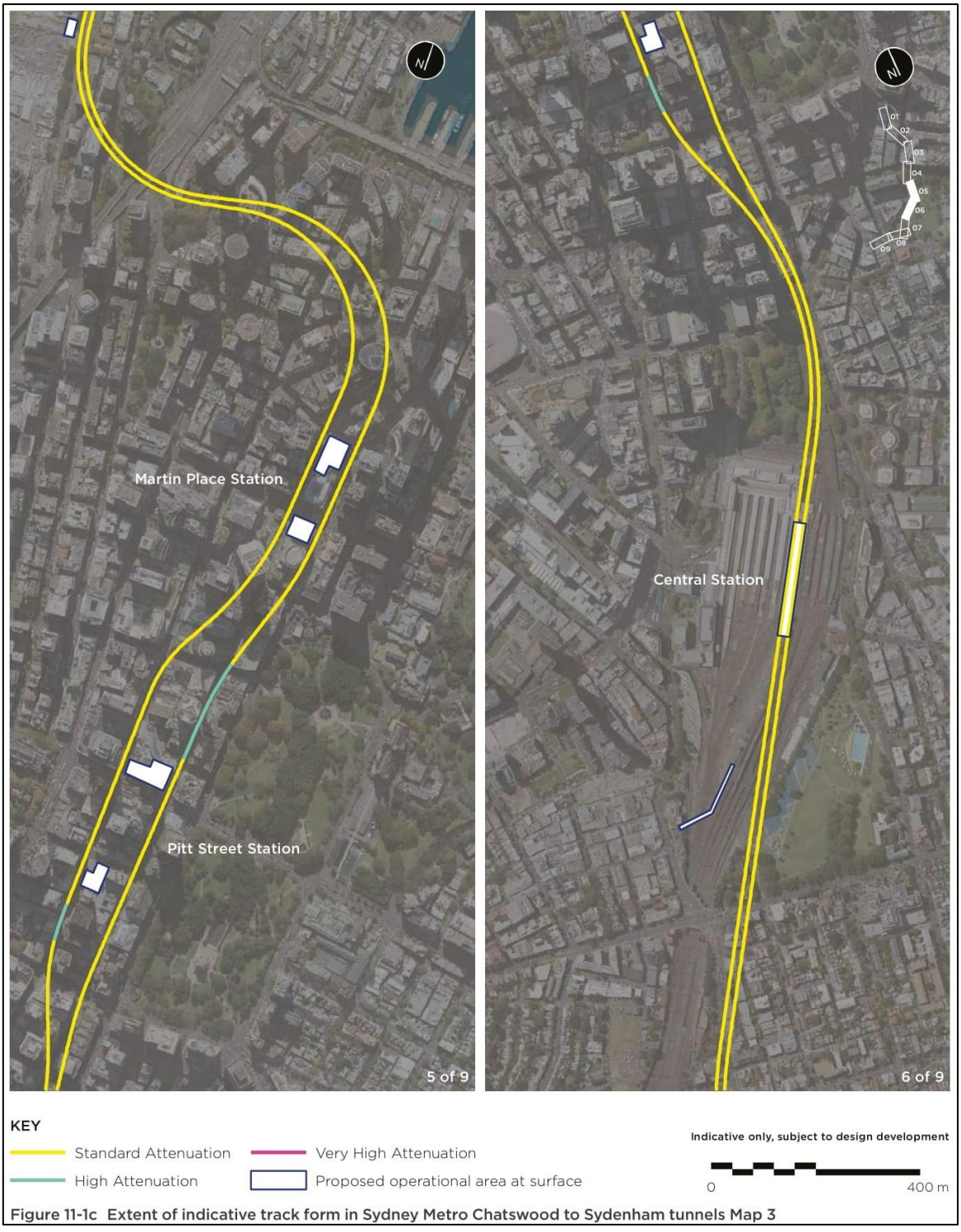

Figure 8-4: Metro City & South-west alignment in the vicinity of site (source: Sydney Metro Chatswood to Sydney EIS)

With the exception of Central Station building along Railway Colonnade Drive (approx. 35m from the site) and Central Station Platform 1 (approx. 55m from the site), no other rail corridors or assets are located within 150m of the site. Therefore, construction vibration impacts are not expected to rail corridors and assets.

In any case, clarification must be obtained from Sydney Trains/TfNSW, if acceptable vibration impact limits are applicable to the site (typically provided at approvals stage).

9 Mitigation Measures

9.1 Operational Noise Mitigation

9.1.1 Entertainment and licensed premises (F&B areas and rooftop terrace)

Operational noise emissions from all the proposed entertainment and licensed premises of the development must be reviewed during subsequent stages of design (when fitout design and operations are confirmed), to confirm compliance with the noise emission goals presented in Table 7-2. Noise control treatments and management controls must be established, as required, and summarised in CC stage certification documentation, for approval/sign-off by consent authority.

A list of indicative mitigation measures based on the current level of design documentation and operational noise predictions (see Section 7.3.2) are detailed below. These measures must be reviewed and updated (as required) during subsequent stages of design, as the internal fitout and function/operation of the spaces are further developed.

- Basement. lower ground and ground level F&B tenancies
  - The recommended preliminary façade glazing specification detailed in Table 5-3 must be installed at a minimum. Where the existing façade system is proposed to be retained, this must be made good (i.e. acoustically seal all gaps to enable as close to airtight seal as practicable).
  - Indicatively thick single glazed partition systems (e.g. Criterion Gallium 45 / Gallium 100 / Svelte 75 / 10.5 VLam Hush glass systems) with an acoustic performance equivalent to R_W 35 or higher are recommended for the glazed partitions between the F&B tenancies and lift lobbies (low rise or high-rise)/void.
  - Reverberation control treatments in the form of soft finishes and furnishings and acoustic absorptive panels must be considered during subsequent stages of design (confirmation of fitout design and proposed operations), to control additional impacts to operational noise emissions.
  - If a suspended solid ceiling system is proposed for the ground level F&B tenancy, the concrete soffit slab thickness assumed in Section 7.3.2 can potentially be reduced, following review by an acoustic consultant (updated noise emission predictions based on the developed design and operations of the space).

    Any perforated or open ceiling systems proposed for reverberation noise control, must be installed below the solid suspended ceiling system.
  - Speakers or amplification equipment proposed to be fixed to ground level soffit slab must be positioned at least 1m from the façade, angled downwards (45° angle to the floor) and mounted to the soffit using Embelton NRD vibration isolators or equal.
- Level 2 to 6 commercial office tenancies
  - Indicatively single frame large airgap double glazed partition systems (e.g. Capral 419 series Flushline 10.5mm hush laminate/107mm airgap/ 10.5mm hush laminate system) with an acoustic performance equivalent to R_W 50 or higher are recommended for the internal void glazing of the office levels, overlooking the ground level restaurant.

- Rooftop terrace
  - The maximum capacity must be limited to 200 patrons.
  - Only background amplified music is proposed for this space in the event of commercial/office functional use (assumed as a typical level of 70dB(A) SPL @ 1m from amplification equipment) and this is acoustically acceptable, with no additional treatments required.

In summary:

- F&B tenancies would be subject to their own development applications for use. Section 7.3.2 indicates that the internal areas of these spaces would be capable of being used at any time (up to midnight and after midnight) using background music or similar without excessive noise impact.
- In the event that a specific tenancy wanted to trade with music above background noise levels or is proposed with external areas, it would be expected that the tenancy would be required to provide an acoustic report to demonstrate that the more noise intensive use of the site can be accommodated without excessive noise impact on neighbours.

9.1.2 Building services plant/equipment

Typical major building services plant/equipment associated with a development of this size are discussed below. Indicative noise control treatments are also discussed and must be reviewed during detailed design stage, to ensure operational noise emissions (cumulative) comply with the noise emission goals presented in Table 7-4.

- It is likely that primary building services plant/equipment will consist of carpark/basement ventilation plant, major ventilation fans serving the commercial/hotel air handling system, kitchen exhausts associated with F&B tenancies and cooling towers/chillers.
- Major fans located either in the basement (for carpark) , mid-level (Levels 8 & 19) / Level 44 / roof level plantrooms (typically 75dB(A) at 3m), are likely to require induct acoustic treatment between fan and external intake/discharge. This will consist of lined ducting or acoustic attenuators. The extent of treatment will depend on fan selection and position relative to the nearest affected receiver. Similar treatment will be needed for F&B tenancies kitchen exhausts and centralised ventilation fans for the hotel and commercial levels.
- Mid-level plantrooms (levels 8 & 19) containing air-cooled/water cooled chillers, cooling towers or generators will potentially need to be designed such that these sections of the plantroom are not directly open to atmosphere (there would be dedicated ventilation openings which can be acoustically treated if needed, with the rest of the plantroom louvre being blanked off).
- Rooftop/Level 44 cooling towers will require careful equipment selection (indicatively 93dB(A) SWL) to ensure that noise impacts on adjacent commercial towers are compliant with NPfI targets (see Table 7-4). Rooftop cooling towers will typically require variable speed drives to operate at reduced capacity/noise during the evening, night-time periods.
- Stair pressure fans will typically require minimal treatment on the intake (atmosphere) side as they operate only in fire emergency.

In summary:

- Acoustic treatment of plant and equipment for commercial / hotel buildings in a high ambient/urban area is relatively routine. Indicative acoustic treatments discussed above will be necessary (final design pending equipment design and selection).
- Noise impact to the redeveloped Sydney Railway Square YHA (part of Atlassian Central project) to the east is a particular consideration.
- A condition of consent regulating building services plant/equipment noise emissions to levels complying with NPfI provisions, will ensure that plant noise can be regulated and controlled to acceptable levels.

9.1.3 Loading dock and waste collection

Checker plate loading dock decks and noise from use of pallet jacks in back of house areas can in some circumstances give riser to structure borne noise in occupied areas above. Given the proposed location of the loading dock within the building (more than three levels of separation to first Hotel level), specific vibration isolation treatment is not likely to be required.

The following management controls are recommended as best practice:

- All loading dock operations, including supermarket deliveries, must be limited to the daytime period (7am to 6pm).
- Alternative to beeper warning alarms must be considered for all heavy vehicles accessing the loading (e.g. broadband alarms, variable level alarms).

9.2 Swimming pool and gym/fitness centre

- Swimming pool
  - Reverberation control treatments in the form of acoustic absorptive panels must be considered during subsequent stages of design, to control excessive reverberant noise build-up in the space.
  - Speakers or amplification equipment must be positioned at least 2m from the proposed louvred façades. Where these equipment are proposed to be fixed to the soffit slab, they must be suspended at least 1.5m from the slab, angled downwards (45° angle to the floor) and mounted using Embelton NRD vibration isolators or equal.
  - Pools have a risk of creating structure borne noise from patrons jumping in, pushing off pool walls etc.
  - The primary noise impact associated with the proposed pool on Level 20 will be on commercial levels above and hotel levels below (although we note that there is a plant room directly below the pool level).
  - The pool shell will be required to be vibration isolated using rubber bearings or steel springs, with lateral buffers. These are typically developed in detail during the Detailed Design phase of the project.

- Gym/fitness centre
  - Speakers or amplification equipment proposed to be fixed to soffit slab must be positioned at least 1m from the façade, angled downwards (45° angle to the floor) and mounted to the soffit using Embelton NRD vibration isolators or equal.
  - Like the pool, a gym/fitness centre space creates a risk of structure borne noise from weight drops (free weights, pin loaded weights machines etc).
  - The gym/fitness centre is also proposed to be located on Level 20 and will typically require:
    - minimum 45mm thick acoustic underlay (Regupol 4020 or similar) to the free weights area
    - spring floor with vibration isolators (steel spring) to aerobics/cross-fit/functional training studios
    - pad vibration isolators (Embleton Supershearflex or similar) to treadmills, rowing machines, exercise bikes and similar
  - These are typically developed in detail during the Detailed Design phase of the project.

9.3 Construction Noise and Vibration Mitigation

The following mitigation measures and management strategies are recommended to control construction noise and vibration impacts associated with the project.

Table 9.1: Construction noise and vibration mitigation measures and management strategies

Mitigation Measure/Management Strategy	Description
CNVMP	A project specific CNVMP must be developed to assist in planning and mitigation/management of potential noise and vibration impacts throughout the construction of the project. The CNVMP shall typically be prepared prior to the commencement of any demolition, excavation or construction activities on site. At a minimum it shall include: • Identification and classification of surrounding sensitive receivers • Relevant construction noise management levels (NMLs) for the identified surrounding sensitive receivers • Location of work zones and activities which are predicted to exceed the construction NMLs • Project specific mitigation measures and management strategies • Monitoring methodology (if required) • Complaints handing procedure and community consultation
Equipment selection and maintenance	• Select low noise alternatives of plant and equipment where practical (e.g. electric cranes in place of diesel models and bored/CFA piling in place of sheet piling). • Ensure all plant and equipment are in good working order, with regular maintenance checks. • Appropriately select plant and equipment of the necessary size and power (avoid overspecification).

Mitigation Measure/Management Strategy	Description
Site planning and location of works	• Undertake appropriate site planning i.e. select site access points (for example: locating construction site access along Lee Street or western end of Ambulance Avenue will help mask some of the construction vehicle noise impacts with existing traffic noise), location of loading/unloading zones and stationary construction equipment locations (tower crane, concrete pumps, generators etc.), so they are strategically located to maximise distance to surrounding sensitive receivers and use any barrier/screening provided by structures on site (existing building shell, site sheds etc.). • Scheduling of works should consider staggering noisy activities (rock breaking, ripping, sawing and pneumatic hammering) by moving these activities to other locations around the site (increasing distance to the affected receiver) and reducing prolonged noise impacts to any particular receiver.
Equipment specific mitigation	• Barriers or shrouding shall be considered as temporary mitigation to enclose particularly noisy equipment. Resilient mats in material handling areas can also greatly reduced noise impacts. • For certain construction equipment/machinery, the use of silencing devices may be possible. These may take the form of engine shrouding, or special industrial silencers fitted to exhausts. • Throttle down intermittently used plant and shut down where practicable. • Turn off all plant and equipment, including truck engines (where practicable) when not in use. Heavy vehicles must not be left idling if not in use (e.g. concrete pumping truck). • All construction vehicles and mobile equipment requiring warning systems must be fitted with non-tonal warning alarms (e.g. broadband alarms, variable level alarms).
Respite offers	Consider respite periods for noise intensive activities (pneumatic hammering, rock breaking, sawing etc.) in consultation with proponent, contractor and relevant stakeholders. This can be +1 hour start in the morning (i.e. noisy activities commencing at 8am), or 1-hour respite period during lunch time (given extent of surrounding commercial receivers).
Good site practices	• Avoid use of amplification equipment or radios outdoors • Use of designated access pathways and routes for materials handling. • Avoid manual handling of heavy materials or equipment • Periodic training of all site personnel (e.g. toolbox talks) to review site mitigation measures and investigate alternative approaches of equipment handling to minimise noise • Avoid the overuse of public address systems and shouting within the site • Avoid idling of equipment/machinery when not in use, turn off where practicable.

Mitigation Measure/Management Strategy	Description
Specific vibration mitigation	• Dilapidation surveys should be conducted around the fPPb on site and at the heritage former Parcel Sheds to the east of the site. This will inform if these heritage structures should be subject to vibration criteria different to those identified in Section 8.2.2. • Identify safe working vibration levels within the fPPB building (in consultation with structural and heritage engineer). Identify where vibration monitoring within the building is necessary to ensure there is no damage of heritage items (for example, areas of proposed structural demolition). • Similarly, where construction activity is proposed within proximity to the heritage listed former Parcel Sheds, vibration testing of actual equipment on site is recommended to determine acceptable buffer distances to the nearest affected receiver locations. • Where vibration is found to be excessive, management measures should be implemented to ensure vibration compliance is achieved. Management measures may include modification of construction methods such as using smaller equipment, establishment of safe buffer zones as mentioned above, and if necessary, time restrictions for the most excessive vibration activities. Time restrictions are to be negotiated with affected receivers.
Community consultation and complaints handling	The contractor must be committed to ensure that the local community is well informed about the construction activities. A Community and Stakeholder Management Plan and communication method is recommended to be established to respond to all construction related enquiries and to ensure complaints (noise and vibration) resulting from the construction activities are recorded and investigated. • Provide in the form of notification letters, information pamphlets, and/or progress updates in due time with information such as overall project timeline, what works are expected to be noisy, duration and frequency of noisy works, what is being done to minimise noise and when respite periods will occur. • Maintain good communication between the community and project staff and appoint a community liaison officer to facilitate where required. • Complaints should be treated sensibly and be given a fair hearing in consultation with communications personnel and stakeholders and an acoustic consultant. • Have a documented complaint process, including an escalation procedure so that if a complainant is not satisfied there is a clear procedure. • Provide a quick response to complaints, with complaint handling staff having both a good knowledge of the project and ready access to information. • Implement all feasible and reasonable measures to address the source of complaint. • Keep a register of any complaints, including details of the complaint such as date, time, person receiving complaint, complainant's contact number, person referred to, description of the complaint, time of verbal response and timeframe for written response where appropriate.

9.3.1 Cumulative noise impacts

As discussed in Section 8.3.3, where there is potential for concurrent construction associated with multiple projects, these noise impacts could result in overall greater construction noise impacts, either in terms of level or overall duration/frequency of exposure.

The following measures are to be used to mitigate and manage cumulative noise impacts along with potential construction fatigue:

- Reasonable endeavours to coordinate work between construction sites (adjacent owners), to minimise cumulative noise impacts where feasible and reasonable (i.e. to ensure that the same sensitive receivers are not impacted on multiple consecutive nights from different projects without consideration of appropriate respite for these receivers).
- Additional feasible and reasonable at-source mitigation when there is the potential for cumulative construction impacts, where programming is not practical to avoid cumulative noise impacts.
- Community consultation to gauge key noise impacts and issues and identify any unknown impacts from concurrent or consecutive sets of constructions works
- Consideration of cumulative construction noise impacts during the development of noise mitigation and management measures for the worksites as part of their respective CNVIS/CNVMP, including coordination between construction projects, where reasonable and feasible.

These mitigation measures would be included in each construction support site's detailed design and site-specific Construction Noise and Vibration Impact Statement (CNVIS). The project CNVMP would include how the above measures would be incorporated during the works.

10 Conclusion

RTA was commissioned by TOGA to undertake an acoustic assessment of the potential noise and vibration impacts associated with the mixed-use redevelopment proposal at TOGA Central, located at 2 & 8A Lee Street, Haymarket.

- Impacts from existing environmental noise sources (road and trail traffic) surrounding the site have been assessed in Section 5.
  - Preliminary indicative façade acoustic treatments are provided in Section 5.3.1, to ensure a suitable level of internal acoustic amenity is achieved across various areas of the project.
  - This will meet the noise and vibration provision of the *Western Gateway Sub-Precinct Design Guide* [22].
- A preliminary review of potential ground-borne noise impacts from rail operations associated with the future TfNSW CBDR rail corridor have been assessed in Section 6.
  - Ground-borne noise levels were predicted based on standard attenuation track form source vibration levels adopted on recent Sydney Metro project (Sydney Metro C2S EIS [20]).
  - In addition to complying with the ground-borne noise trigger levels for all sensitive tenancies within the proposed development (see Table 6-3), ground-borne noise levels to existing hotel rooms of the Adina Hotel under a "***Toga Central No Develop***" scenario are predicted to be higher than those predicted for sensitive areas (either commercial tenancies in redeveloped fPPB or new hotel tenancies in tower building) of the proposed development under a "***Toga Central Develop***" scenario.
  - Therefore, it can be concluded that the proposed development is not expected to adversely affect the development and operation of future rail assets (including increasing likely cost of development) and hence demonstrates compliance with requirements of the Transport and Infrastructure SEPP.
- Operational noise impacts associated with the redevelopment project have assessed in Section 7.
  - Relevant noise emission criteria for the key risks associated with the project are detailed in Sections 7.1, 7.1.2 & 7.2.
  - A preliminary assessment of operational noise impacts is detailed in Section 7.3.

  In principle, consideration and implementation of the mitigation measures detailed in Section 9.1 will facilitate compliance with relevant EPA provisions for operational noise emissions.
- Given the sites proximity to surrounding properties (existing and future) and the proposed function/use of internal areas, no vibration intensive activities are identified, and hence operational vibration impacts are not expected from the operations of the proposed development.
- A preliminary assessment of potential noise and vibration impacts from construction activities was also undertaken (Sections 8.3 & 8.3.3), in line with the requirements of the EPA *Interim Construction Noise Guideline* (Sections 8.1 & 8.2). While noise and vibration impacts from the development have the potential to warrant reasonable and feasible mitigation, noise/vibration impacts are not out of keeping with typical major development and can be suitably managed through the creation of a site

specific CNVMP. Mitigation measures and management strategies to control impacts are detailed in Section 9.2.

As such, the proposed development is suitable at the site from an acoustic viewpoint.

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APPENDIX A 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 (particularly wind and temperature inversions) occurring at a site for a significant period of time. In the NSW INP this occurs when wind occurs for more than 30% of the time in any assessment period in any season and/or temperature inversions occurring more than 30% of 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.		
Amenity	A desirable or useful feature or facility of a building or place.		
Assessment period	The time period in which an assessment is made. e.g. Day 7am-10pm & Night 10pm-7am.		
Assessment Point	A location at which a noise or vibration measurement is taken or estimated.		
Attenuation	The reduction in the level of sound or vibration.		
Audible Range	The limits of frequency which are audible or heard as sound. The normal hearing in young adults detects ranges from 20 Hz to 20 kHz, although some people can detect sound with frequencies outside these limits.		
A-weighting	A filter applied to the sound recording made by a microphone to approximate the response of the human ear.		
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. 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 LA90 noise level if measured as an overall level or an L90 noise level when measured in octave or third-octave bands.		
Decibel [dB]	The units that sound is measured in. The following are examples of the decibel readings of common sounds in our environment:		
	threshold of hearing	0 dB	The faintest sound we can hear, defined as 20 micro Pascal
		10 dB	Human breathing
	almost silent	20 dB	
		30 dB	Quiet bedroom or in a quiet national park location
	generally quiet	40 dB	Library
		50 dB	Typical office space or ambience in the city at night
	moderately loud	60 dB	CBD mall at lunch time
		70 dB	The sound of a car passing on the street
	loud	80 dB	Loud music played at home
		90 dB	The sound of a truck passing on the street
	very loud	100 dB	Indoor rock band concert
		110 dB	Operating a chainsaw or jackhammer
	extremely loud	120 dB	Jet plane take-off at 100m away
	threshold of pain	130 dB	
		140 dB	Military jet take-off at 25m away

dB(A)	A-weighted decibel. 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 is denoted as dB(A). Practically all noise is measured using the A filter.
Field Test	A test of the sound insulation performance in-situ. See also 'Laboratory Test' The sound insulation performance between building spaces can be measured by conducting a field test, for example, early during the construction stage or on completion. A field test is conducted in a non-ideal acoustic environment. It is generally not possible to measure the performance of an individual building element accurately as the results can be affected by numerous field conditions.
Ground-borne noise	Vibration propagated through the ground and then radiated as noise by vibrating building elements such as wall and floor surfaces. This noise is more noticeable in rooms that are well insulated from other airborne noise. An example would be vibration transmitted from an underground rail line radiating as sound in a bedroom of a building located above.
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.
Intrusive noise	Refers to noise that intrudes above the background level by more than 5 dB(A).
L10	The sound pressure level that is exceeded for 10% of the time for which the given sound is measured.
L90	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).
LAeq or Leq	The "equivalent noise level" is the summation of noise events and integrated over a selected period of time, which would produce the same energy as a fluctuating sound level. When A-weighted, this is written as the LAeq.
Lmax	The maximum sound pressure level measured over a given period. When A-weighted, this is usually written as the LAmax.
Lmin	The minimum sound pressure level measured over a given period. When A-weighted, this is usually written as the LAmin.
Laboratory Test	The performance of a building element when measured in a laboratory. The sound insulation performance of a building element installed in a building however can differ from its laboratory performance for many reasons including the quality of workmanship, the size and shape of the space in which the measurement is conducted, flanking paths and the specific characteristics of the material used which may vary from batch to batch.
RBL	Rating Background Level is the representative LA90 background noise level for a period, as defined in the NSW EPA's noise ploicies.
Rw	Weighted Sound Reduction Index A measure of the sound insulation performance of a building element. It is measured in very controlled conditions in a laboratory. The term supersedes the value STC which was used in older versions of the Building Code of Australa. Rw is measured and calculated using the procedure in ISO 717-1. The related field measurement is the DnT,w. The higher the value the better the acoustic performance of the building element.
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 by conversion to thermal energy.
Sound Insulation	Sound insulation refers to the ability of a construction or building element to limit noise transmission through the building element. The sound insulation of a material can be described by the Rw and the sound insulation between two rooms can be described by the DnT,w.

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 of 1 pico watt.
Sound pressure level	The level of noise, usually expressed in decibels, as measured by a standard sound level meter with a microphone referenced to 20 mico Pascal.
STC	Sound Transmission Class A measure of the sound insulation performance of a building element. It is measured in controlled conditions in a laboratory. The term has been superseded by Rw.
Structure-borne Noise	Audible noise generated by vibration induced in the ground and/or a structure. Vibration can be generated by impact or by solid contact with a vibrating machine. Structure-borne noise cannot be attenuated by barriers or walls but requires the isolation of the vibration source itself. This can be achieved using a resilient element placed between the vibration source and its support such as rubber, neoprene or springs or by physical separation (using an air gap for example). Examples of structure-borne noise include the noise of trains in underground tunnels heard to a listener above the ground, the sound of footsteps on the floor above a listener and the sound of a lift car passing in a shaft. See also 'Impact Noise'.
Tonal Noise	Sound containing a prominent frequency and characterised by a definite pitch.
Transmission Loss	The sound level difference between one room or area and another, usually of sound transmitted through an intervening partition or wall. Also the vibration level difference between one point and another. For example, if the sound level on one side of a wall is 100dB and 65dB on the other side, it is said that the transmission loss of the wall is 35dB. If the transmission loss is normalised or standardised, it then becomes the Rw or R'w or DnT,w.
Vibration	A mechanical phenomenon whereby oscillations occur about an equilibrium point; a periodic back-and-forth motion of an elastic body or medium, commonly resulting when almost any physical system is displaced from its equilibrium condition.

APPENDIX B Methadology for Long-term Noise Monitoring

B.1 Noise monitoring equipment

A long-term unattended noise monitor consists of a sound level meter housed inside a weather resistant enclosure. Noise levels are monitored continuously with statistical data stored in memory for every 15-minute period.

Long term noise monitoring was conducted using the following instrumentation:

Description	Type	Octave band data	Logger location
RTA06 (NTi Audio XL2, with low noise microphone)	Type 1	1/1	RTA1, RTA2 & RTA3

Note: All meters comply with AS IEC 61672.1 2004 "Electroacoustics - Sound Level Meters" and designated either Type 1 or Type 2 as per table and are suitable for field use.

The equipment was calibrated prior and subsequent to the measurement period using a Brüel & Kjær Type 4230 calibrator. No significant drift in calibration was observed.

B.2 Meteorology during monitoring

Measurements affected by extraneous noise, wind (greater than 5m/s) or rain were excluded from the recorded data in accordance with the NSW NPfI. Determination of extraneous meteorological conditions was based on data provided by the Bureau of Meteorology (BOM), for a location considered representative of the noise monitoring location(s). However, the data was adjusted to account for the height difference between the BOM weather station, where wind speed and direction is recorded at a height of 10m above ground level, and the microphone location, which is typically 1.5m above ground level (and less than 3m). The correction factor applied to the data is based on Table C.1 of ISO 4354:2009 '*Wind actions on structures*'.

B.3 Noise vs time graphs

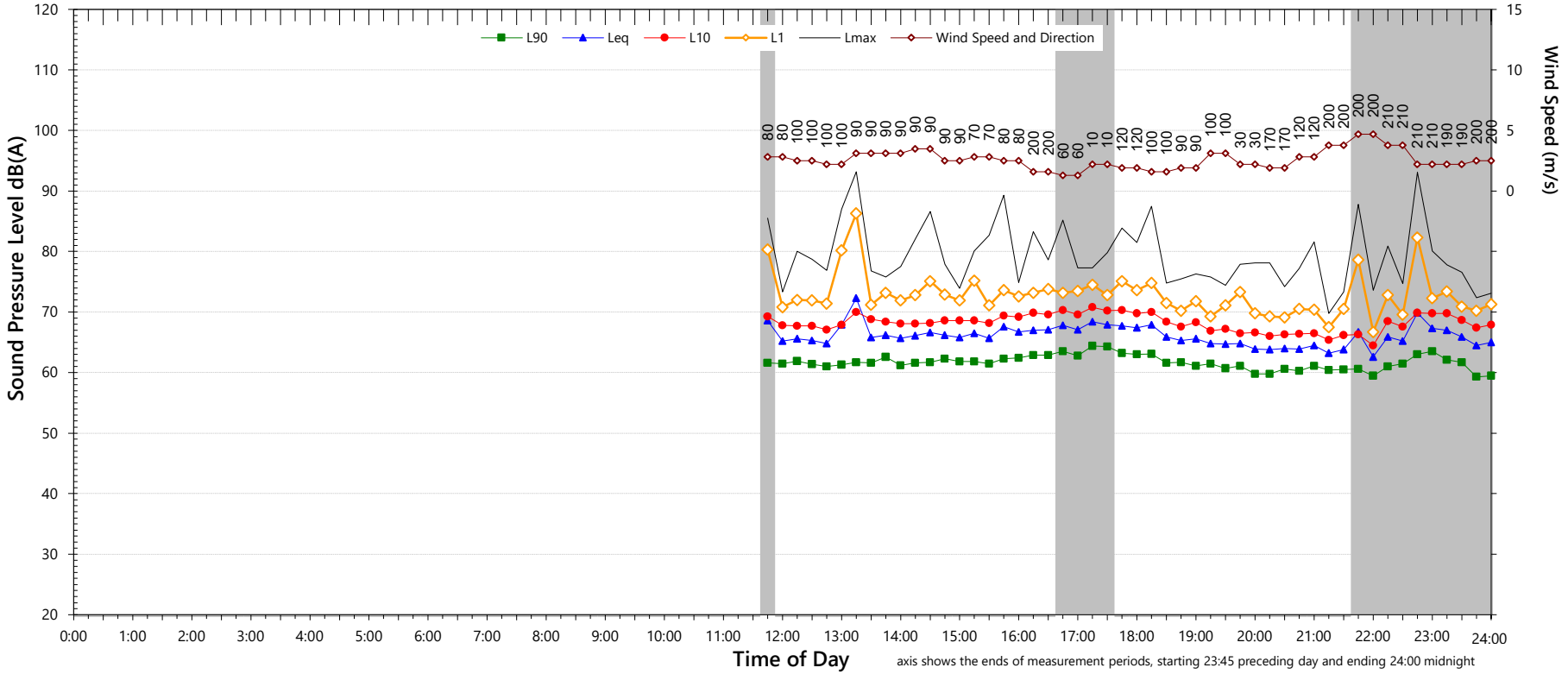
Noise almost always varies with time. Noise environments can be described using various descriptors to show how a noise ranges about a level. In this report, noise values measured or referred to include the L_{10}, L_{90}, and L_{eq} levels. The statistical descriptors L_{10} and L_{90} measure the noise level exceeded for 10% and 90% of the sample measurement time. The L_{eq} level is the equivalent continuous noise level, or the level averaged on an equal energy basis. Measurement sample periods are usually ten to fifteen minutes. The Noise -vs- Time graphs representing measured noise levels, as presented in this report, illustrate these concepts for the broadband dB(A) results.

APPENDIX C Results of Long-term Noise Monitoring

Unattended Noise Monitoring Results

RTA1 - Adina Hotel Room 84 Balcony

Thursday, 10 February 2022



NSW Noise Policy for Industry (Free Field)				
Descriptor		**Day**[2]	**Evening**[3]	**Night**[4 5]
L_{A90} ABL		-	60	-
L_{Aeq}	(see note 6)	-	62	-

Night Time Maximum Noise Levels			**(see note 7)**
L_{AFMax} (Range)	76	to	89
L_{AFMax} - L_{Aeq} (Range)	15	to	27

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

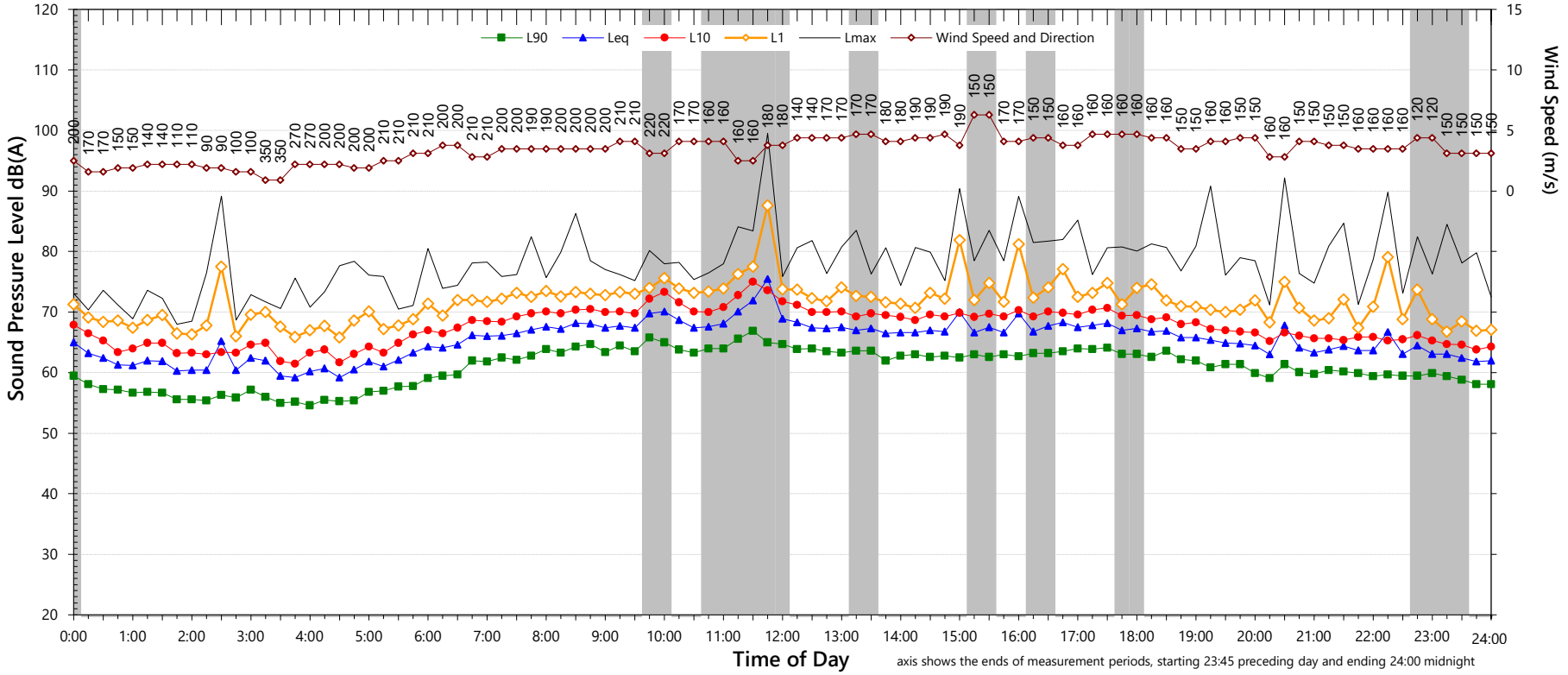
Notes:

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 till 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. 1-hour values for L_{AFMax} are shown only where L_{AFMax} >65dB(A) and where L_{AFMax}- L_{Aeq} ≥15dB(A)

Unattended Noise Monitoring Results

RTA1 - Adina Hotel Room 84 Balcony

Friday, 11 February 2022



NSW Noise Policy for Industry (Free Field)				
Descriptor		**Day**[2]	**Evening**[3]	**Night**[4 5]
L_{A90} ABL		-	60	54
L_{Aeq}	(see note 6)	-	63	59

Night Time Maximum Noise Levels			**(see note 7)**
L_{AFMax} (Range)	79	to	90
L_{AFMax} - L_{Aeq} (Range)	15	to	25

NSW Road Noise Policy (1m from facade)		
Descriptor	**Day**	**Night**[5]
	7am-10pm	**10pm-7am**
$L_{Aeq\ 15\ hr}$ and $L_{Aeq\ 9\ hr}$	67	62
$L_{Aeq\ 1hr}$ upper 10 percentile	68	64
$L_{Aeq\ 1hr}$ lower 10 percentile	65	59

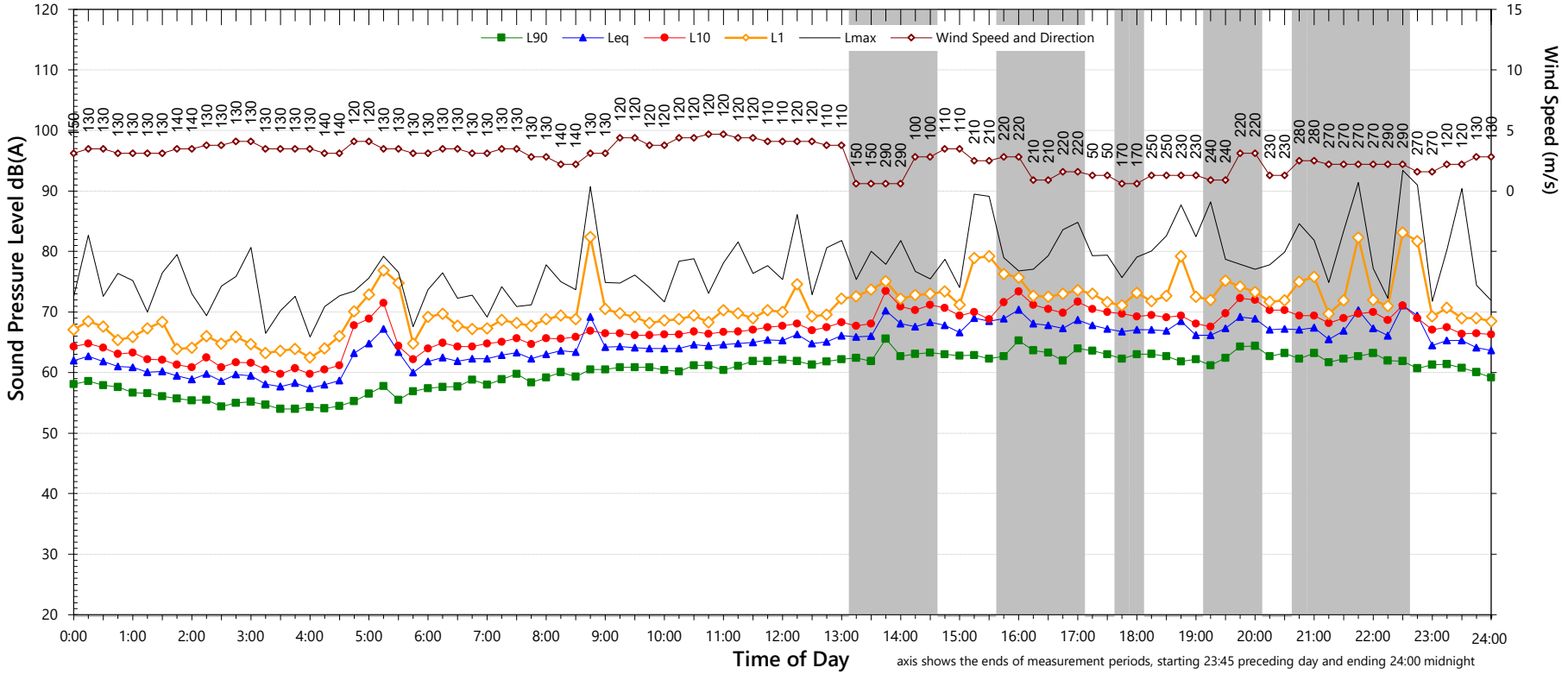
Notes:

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 till 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. 1-hour values for L_{AFMax} are shown only where L_{AFMax} >65dB(A) and where L_{AFMax}- L_{Aeq} ≥15dB(A)

Unattended Noise Monitoring Results

RTA1 - Adina Hotel Room 84 Balcony

Saturday, 12 February 2022



NSW Noise Policy for Industry (Free Field)				
Descriptor		**Day**[2]	**Evening**[3]	**Night**[4 5]
L_{A90} ABL		-	-	55
L_{Aeq}	(see note 6)	-	-	60

Night Time Maximum Noise Levels			(see note 7)
L_{AFMax} (Range)	79	to	93
L_{AFMax} - L_{Aeq} (Range)	17	to	29

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

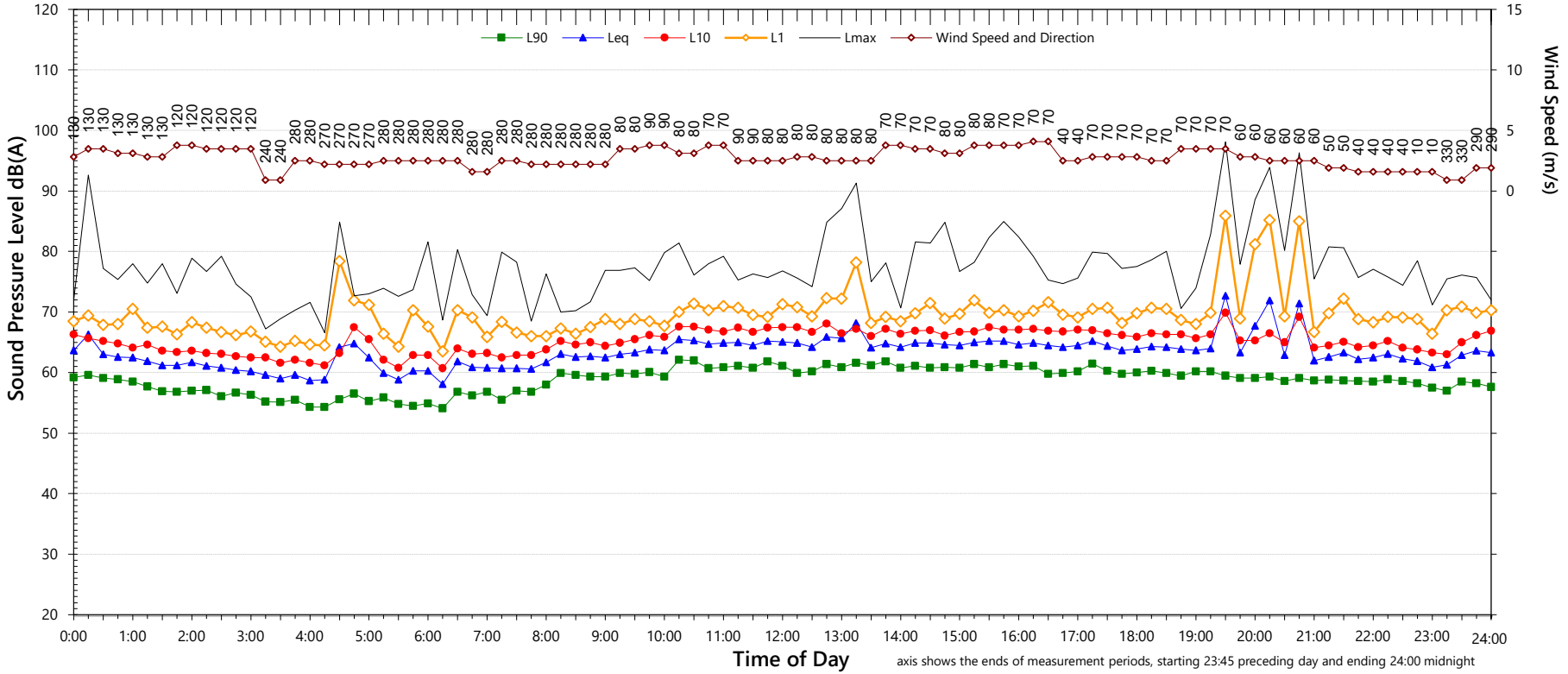
Notes:

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 till 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. 1-hour values for L_{AFMax} are shown only where L_{AFMax} >65dB(A) and where L_{AFMax}- L_{Aeq} ≥15dB(A)

Unattended Noise Monitoring Results

RTA1 - Adina Hotel Room 84 Balcony

Sunday, 13 February 2022



axis shows the ends of measurement periods, starting 23:45 preceding day and ending 24:00 midnight

NSW Noise Policy for Industry (Free Field)				
Descriptor		**Day**[2]	**Evening**[3]	**Night**[4 5]
L_{A90} ABL		60	59	53
L_{Aeq}	(see note 6)	62	64	59

Night Time Maximum Noise Levels			(see note 7)
L_{AFMax} (Range)	76	to	89
L_{AFMax} - L_{Aeq} (Range)	16	to	24

NSW Road Noise Policy (1m from facade)		
Descriptor	**Day**	**Night**[5]
	7am-10pm	**10pm-7am**
$L_{Aeq\ 15\ hr}$ and $L_{Aeq\ 9\ hr}$	65	61
$L_{Aeq\ 1hr}$ upper 10 percentile	67	63
$L_{Aeq\ 1hr}$ lower 10 percentile	63	58

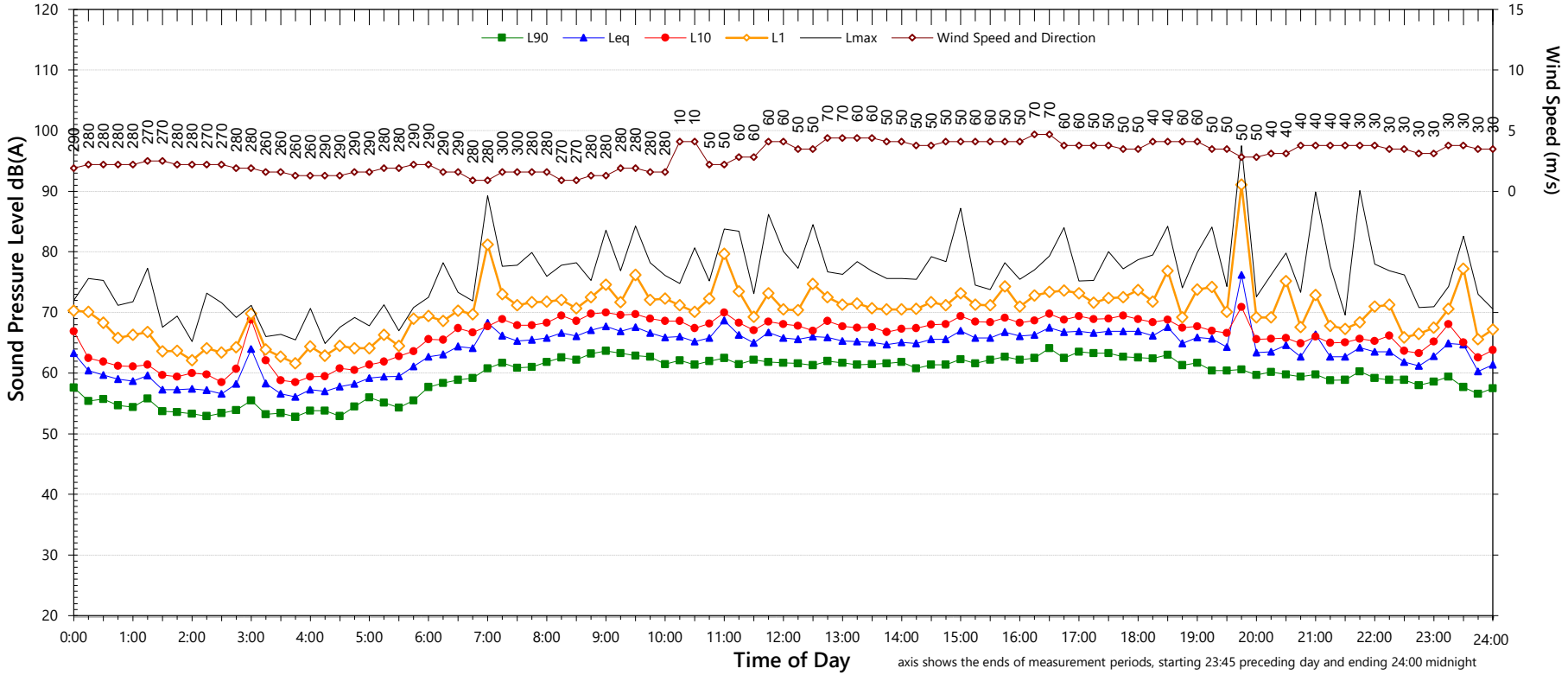
Notes:

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 till 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. 1-hour values for L_{AFMax} are shown only where L_{AFMax} >65dB(A) and where L_{AFMax}- L_{Aeq} ≥15dB(A)

Unattended Noise Monitoring Results

RTA1 - Adina Hotel Room 84 Balcony

Monday, 14 February 2022



NSW Noise Policy for Industry (Free Field)				
Descriptor		**Day**[2]	**Evening**[3]	**Night**[4 5]
L_{A90} ABL		61	59	54
L_{Aeq}	(see note 6)	64	65	59

Night Time Maximum Noise Levels			(see note 7)
L_{AFMax} (Range)	76	to	94
L_{AFMax} - L_{Aeq} (Range)	16	to	30

NSW Road Noise Policy (1m from facade)		
Descriptor	**Day**	**Night**[5]
	7am-10pm	**10pm-7am**
$L_{Aeq\ 15\ hr}$ and $L_{Aeq\ 9\ hr}$	67	62
$L_{Aeq\ 1hr}$ upper 10 percentile	67	64
$L_{Aeq\ 1hr}$ lower 10 percentile	65	59

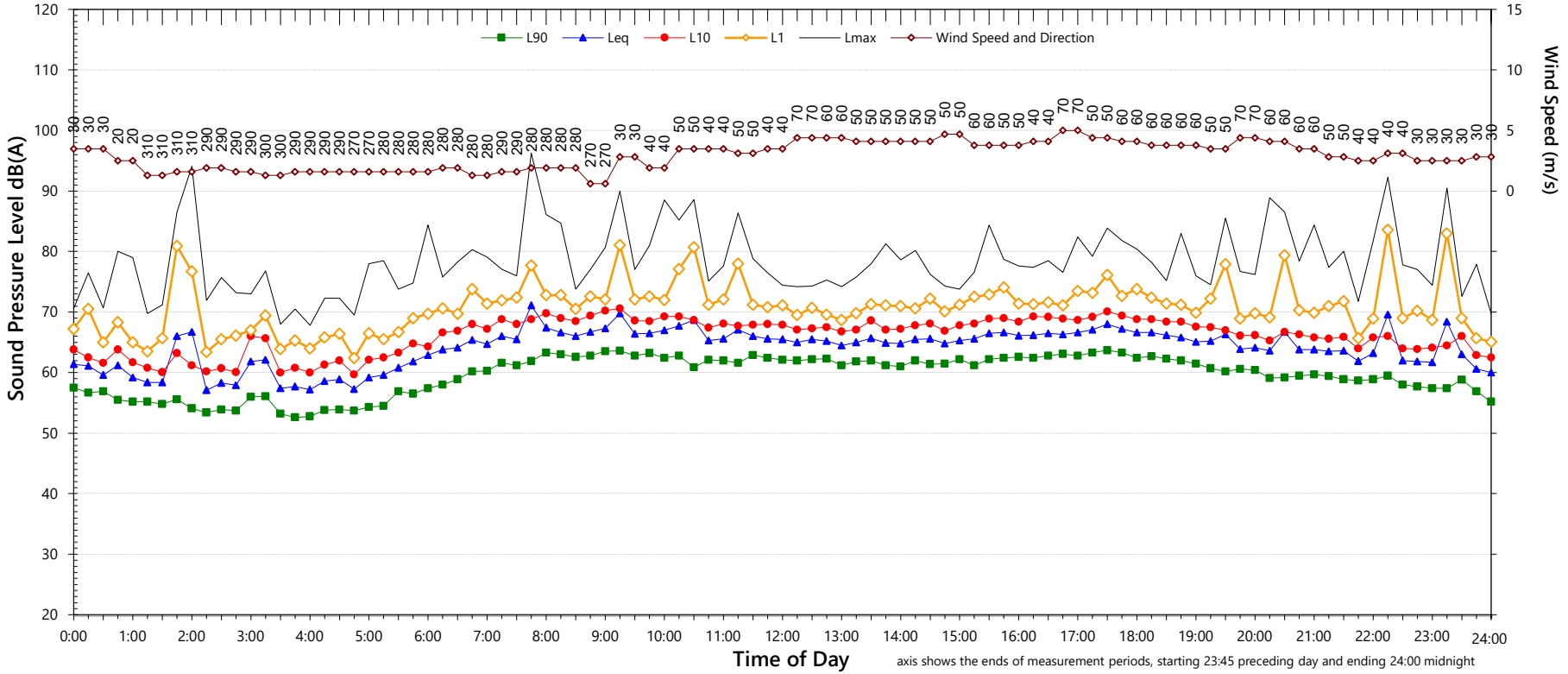
Notes:

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 till 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. 1-hour values for L_{AFMax} are shown only where L_{AFMax} >65dB(A) and where L_{AFMax}- L_{Aeq} ≥15dB(A)

Unattended Noise Monitoring Results

RTA1 - Adina Hotel Room 84 Balcony

Tuesday, 15 February 2022



axis shows the ends of measurement periods, starting 23:45 preceding day and ending 24:00 midnight

NSW Noise Policy for Industry (Free Field)				
Descriptor		**Day**[2]	**Evening**[3]	**Night**[4 5]
L_{A90} ABL		61	59	53
L_{Aeq}	(see note 6)	64	62	59

Night Time Maximum Noise Levels			(see note 7)
L_{AFMax} (Range)	73	to	92
L_{AFMax} - L_{Aeq} (Range)	15	to	27

NSW Road Noise Policy (1m from facade)		
Descriptor	**Day**	**Night**[5]
	7am-10pm	**10pm-7am**
$L_{Aeq\ 15\ hr}$ and $L_{Aeq\ 9\ hr}$	66	62
$L_{Aeq\ 1hr}$ upper 10 percentile	68	65
$L_{Aeq\ 1hr}$ lower 10 percentile	65	58

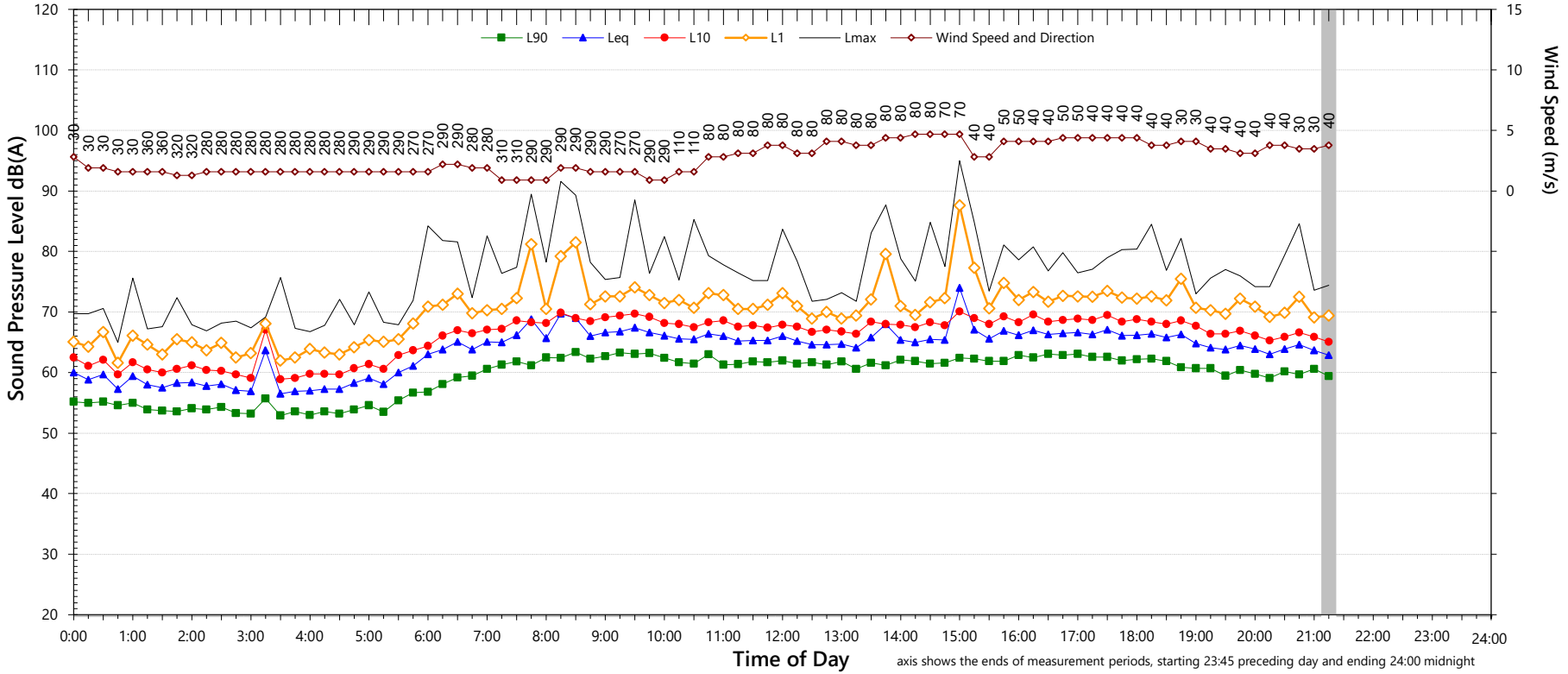
Notes:

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 till 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. 1-hour values for L_{AFMax} are shown only where L_{AFMax} >65dB(A) and where L_{AFMax}- L_{Aeq} ≥15dB(A)

Unattended Noise Monitoring Results

RTA1 - Adina Hotel Room 84 Balcony

Wednesday, 16 February 2022



NSW Noise Policy for Industry (Free Field)				
Descriptor		**Day**[2]	**Evening**[3]	**Night**[4 5]
L_{A90} ABL		61	-	-
L_{Aeq}	(see note 6)	64	-	-

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

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

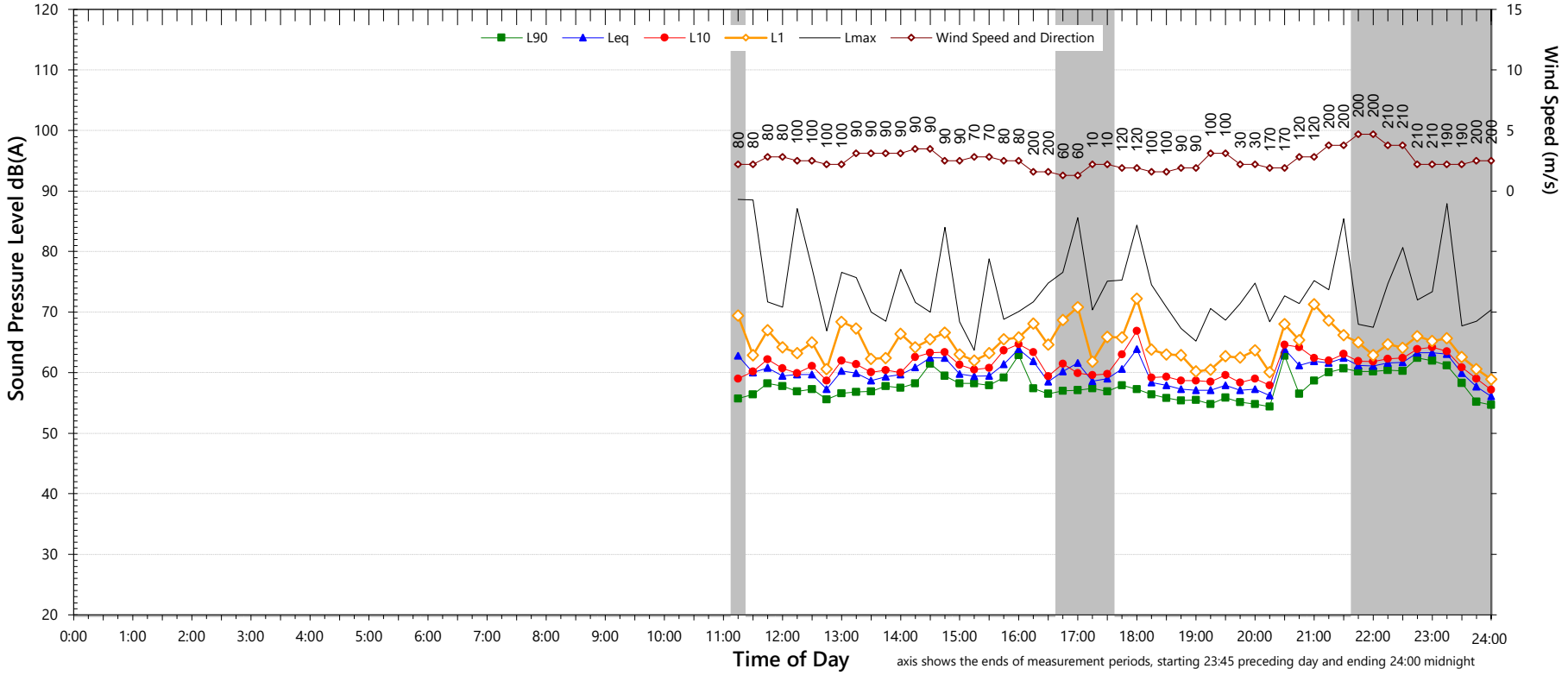
Notes:

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 till 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. 1-hour values for L_{AFMax} are shown only where L_{AFMax} >65dB(A) and where L_{AFMax}- L_{Aeq} ≥15dB(A)

Unattended Noise Monitoring Results

RTA2 - Adina Hotel Room 94 Balcony

Thursday, 10 February 2022



NSW Noise Policy for Industry (Free Field)				
Descriptor		**Day**[2]	**Evening**[3]	**Night**[4 5]
L_{A90} ABL		-	55	-
L_{Aeq}	(see note 6)	-	57	-

Night Time Maximum Noise Levels			**(see note 7)**
L_{AFMax} (Range)	78	to	85
L_{AFMax} - L_{Aeq} (Range)	18	to	28

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

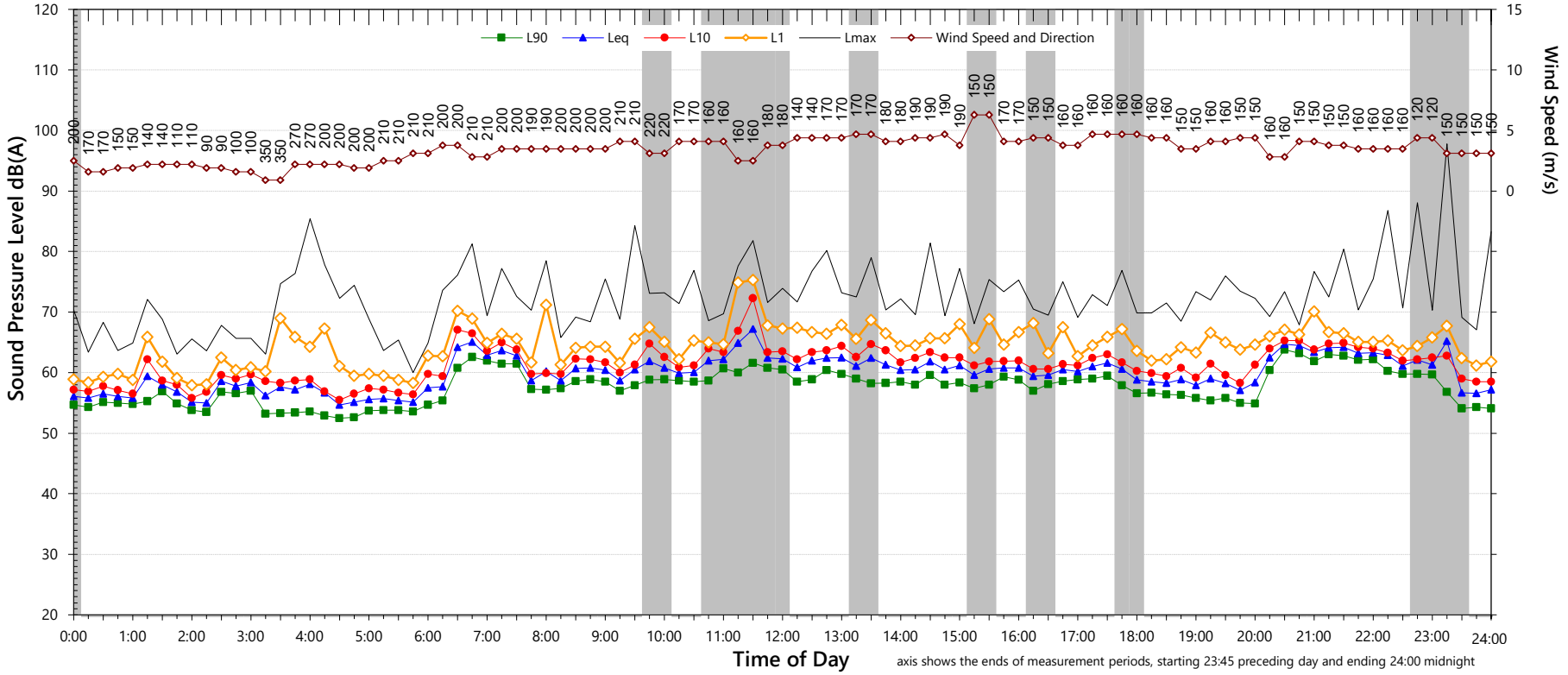
Notes:

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 till 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. 1-hour values for L_{AFMax} are shown only where L_{AFMax} >65dB(A) and where L_{AFMax}- L_{Aeq} ≥15dB(A)

Unattended Noise Monitoring Results

RTA2 - Adina Hotel Room 94 Balcony

Friday, 11 February 2022



NSW Noise Policy for Industry (Free Field)				
Descriptor		**Day**[2]	**Evening**[3]	**Night**[4 5]
L_{A90} ABL		-	55	53
L_{Aeq}	(see note 6)	-	59	55

Night Time Maximum Noise Levels			(see note 7)
L_{AFMax} (Range)	72	to	87
L_{AFMax} - L_{Aeq} (Range)	16	to	27

NSW Road Noise Policy (1m from facade)		
Descriptor	**Day**	**Night**[5]
	7am-10pm	**10pm-7am**
$L_{Aeq\ 15\ hr}$ and $L_{Aeq\ 9\ hr}$	61	58
$L_{Aeq\ 1hr}$ upper 10 percentile	63	61
$L_{Aeq\ 1hr}$ lower 10 percentile	59	55

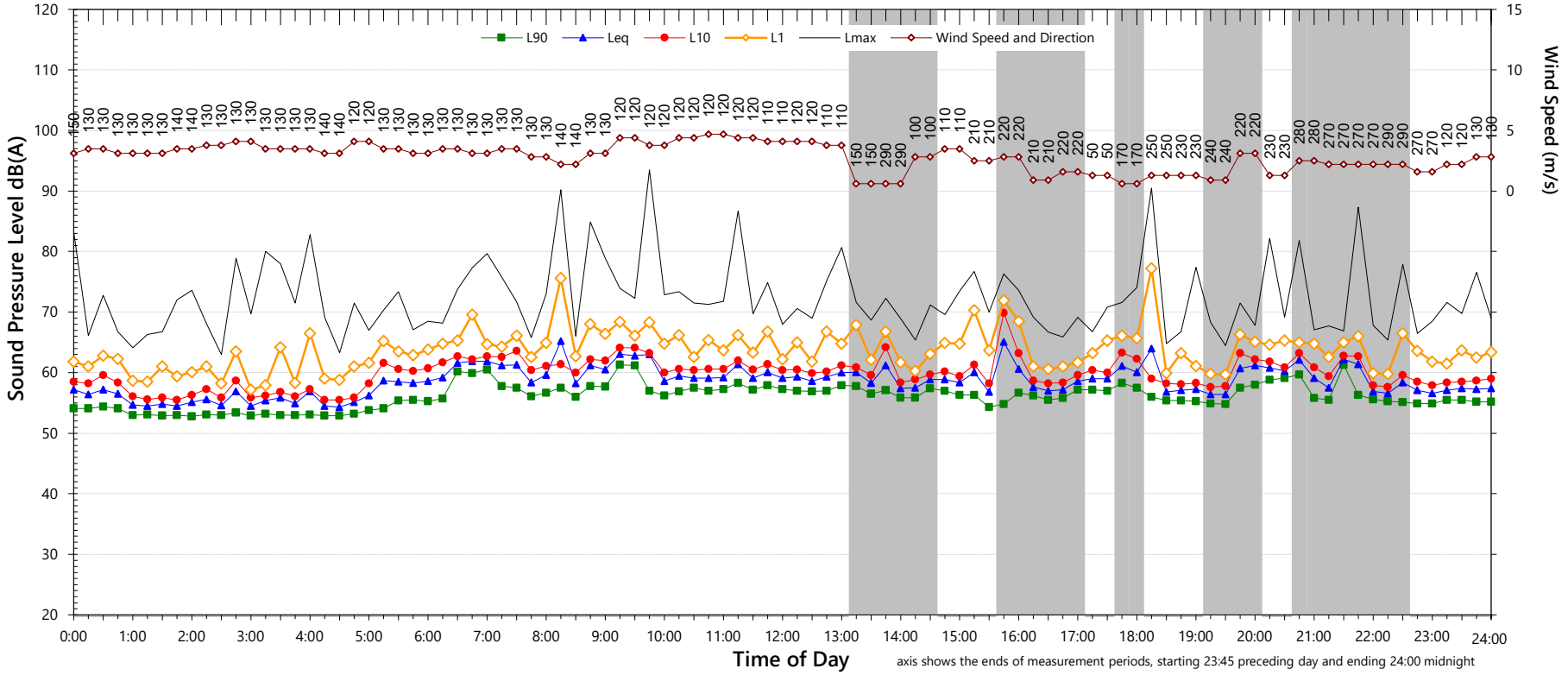
Notes:

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 till 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. 1-hour values for L_{AFMax} are shown only where L_{AFMax} >65dB(A) and where L_{AFMax}- L_{Aeq} ≥15dB(A)

Unattended Noise Monitoring Results

RTA2 - Adina Hotel Room 94 Balcony

Saturday, 12 February 2022



NSW Noise Policy for Industry (Free Field)				
Descriptor		**Day**[2]	**Evening**[3]	**Night**[4 5]
L_{A90} ABL		-	-	53
L_{Aeq}	(see note 6)	-	-	54

Night Time Maximum Noise Levels			(see note 7)
L_{AFMax} (Range)	76	to	87
L_{AFMax} - L_{Aeq} (Range)	19	to	28

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

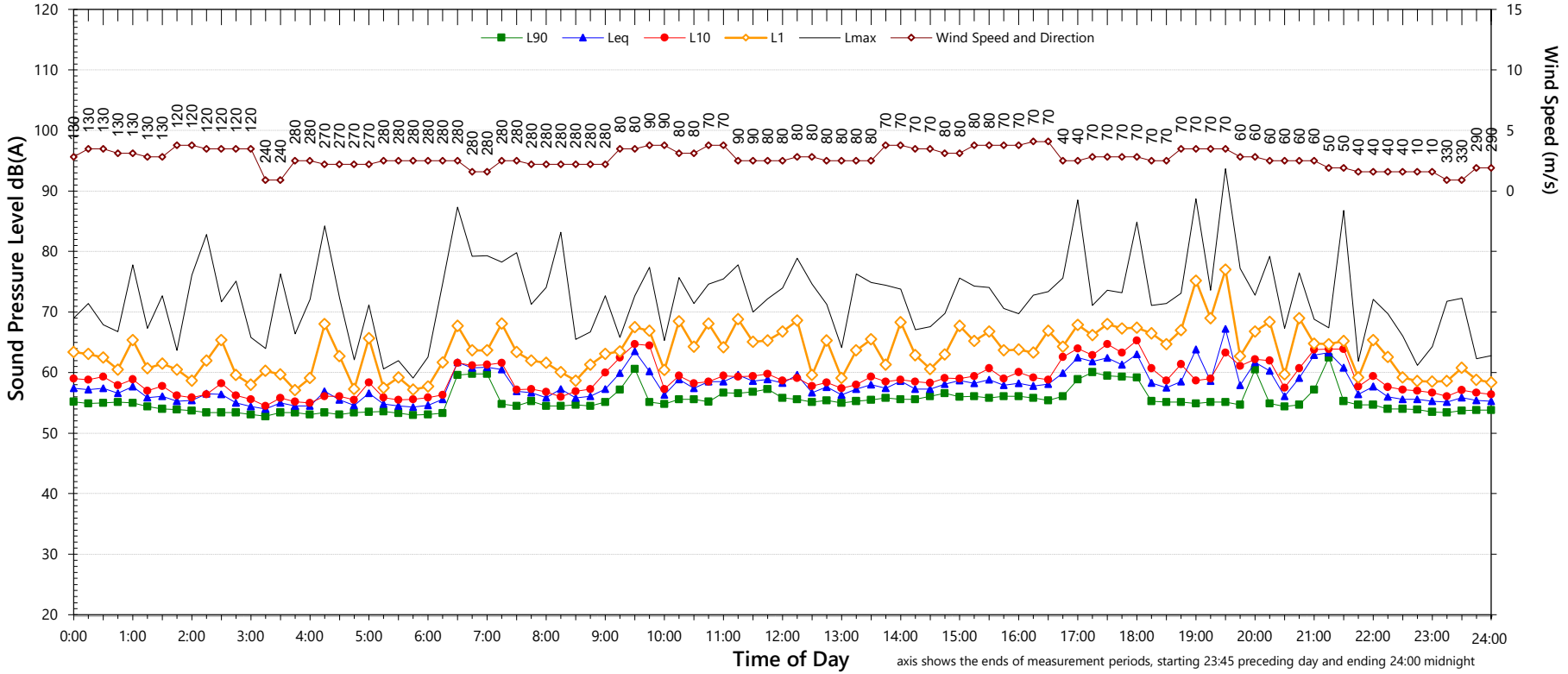
Notes:

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 till 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. 1-hour values for L_{AFMax} are shown only where L_{AFMax} >65dB(A) and where L_{AFMax}- L_{Aeq} ≥15dB(A)

Unattended Noise Monitoring Results

RTA2 - Adina Hotel Room 94 Balcony

Sunday, 13 February 2022



NSW Noise Policy for Industry (Free Field)				
Descriptor		**Day**[2]	**Evening**[3]	**Night**[4 5]
L_{A90} ABL		55	55	51
L_{Aeq}	(see note 6)	57	59	55

Night Time Maximum Noise Levels			(see note 7)
L_{AFMax} (Range)	71	to	85
L_{AFMax} - L_{Aeq} (Range)	17	to	29

NSW Road Noise Policy (1m from facade)		
Descriptor	**Day**	**Night**[5]
	7am-10pm	**10pm-7am**
$L_{Aeq\ 15\ hr}$ and $L_{Aeq\ 9\ hr}$	60	58
$L_{Aeq\ 1hr}$ upper 10 percentile	62	59
$L_{Aeq\ 1hr}$ lower 10 percentile	58	53

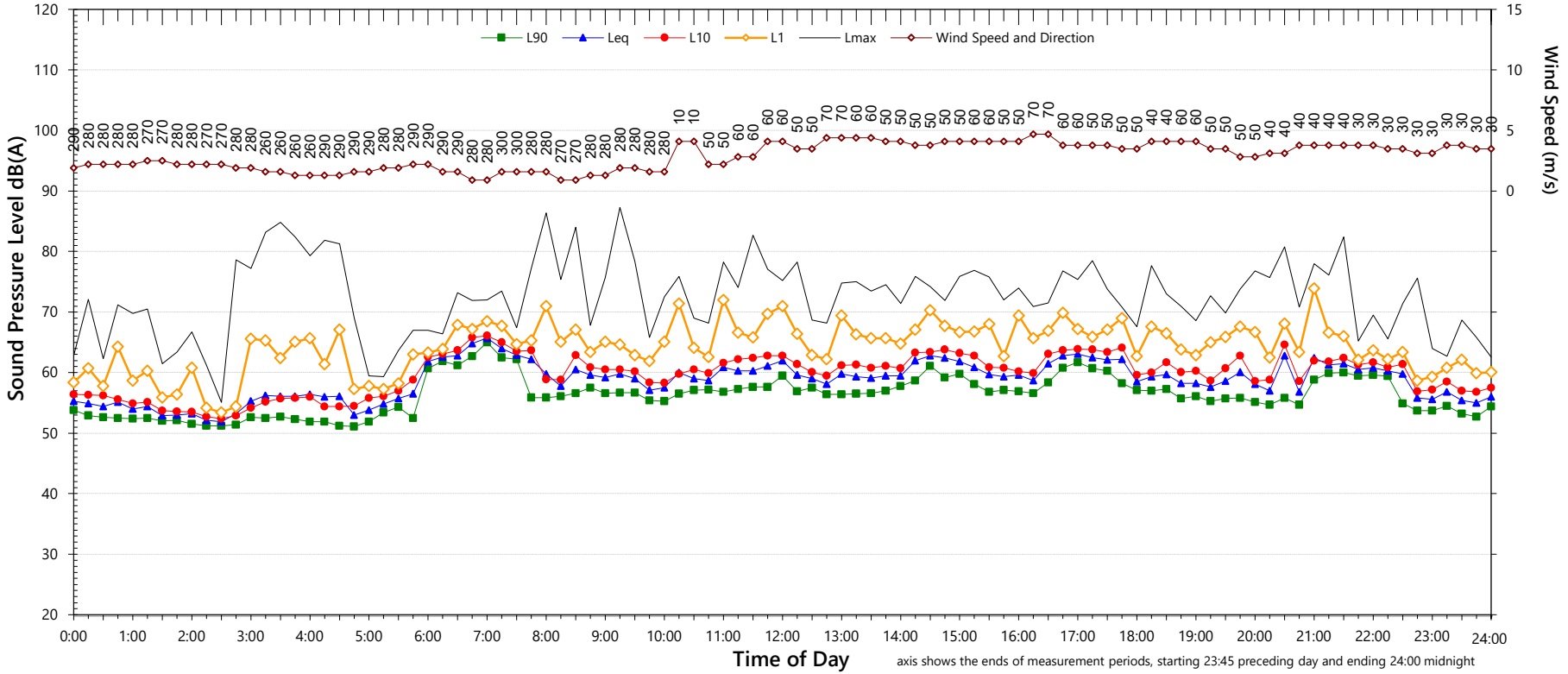
Notes:

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 till 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. 1-hour values for L_{AFMax} are shown only where L_{AFMax} >65dB(A) and where L_{AFMax}- L_{Aeq} ≥15dB(A)

Unattended Noise Monitoring Results

RTA2 - Adina Hotel Room 94 Balcony

Monday, 14 February 2022



axis shows the ends of measurement periods, starting 23:45 preceding day and ending 24:00 midnight

NSW Noise Policy for Industry (Free Field)				
Descriptor		**Day**[2]	**Evening**[3]	**Night**[4 5]
L_{A90} ABL		56	55	52
L_{Aeq}	(see note 6)	58	57	55

Night Time Maximum Noise Levels			(see note 7)
L_{AFMax} (Range)	73	to	88
L_{AFMax} - L_{Aeq} (Range)	16	to	32

NSW Road Noise Policy (1m from facade)		
Descriptor	**Day**	**Night**[5]
	7am-10pm	**10pm-7am**
$L_{Aeq\ 15\ hr}$ and $L_{Aeq\ 9\ hr}$	60	57
$L_{Aeq\ 1hr}$ upper 10 percentile	62	59
$L_{Aeq\ 1hr}$ lower 10 percentile	59	54

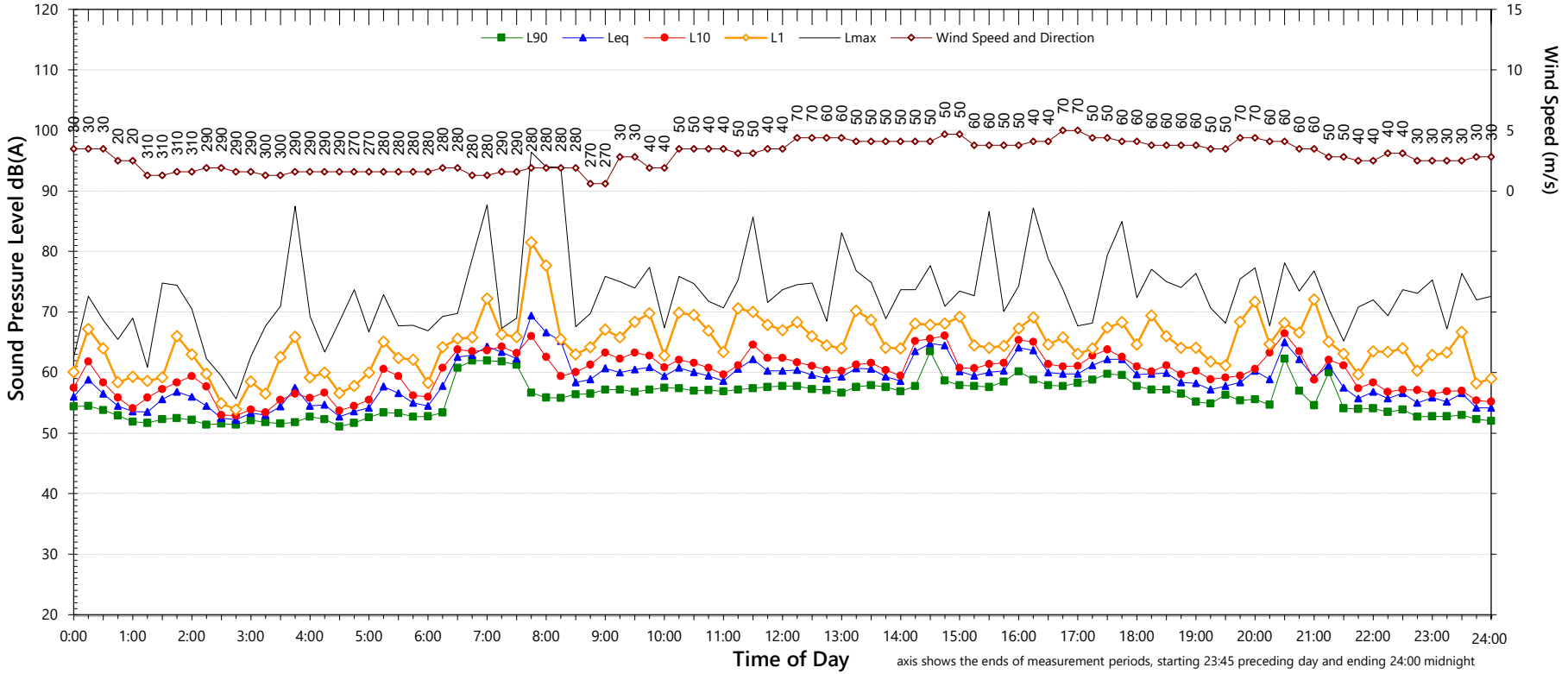
Notes:

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 till 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. 1-hour values for L_{AFMax} are shown only where L_{AFMax} >65dB(A) and where L_{AFMax}- L_{Aeq} ≥15dB(A)

Unattended Noise Monitoring Results

RTA2 - Adina Hotel Room 94 Balcony

Tuesday, 15 February 2022



NSW Noise Policy for Industry (Free Field)				
Descriptor		**Day**[2]	**Evening**[3]	**Night**[4 5]
L_{A90} ABL		57	54	51
L_{Aeq}	(see note 6)	59	57	55

Night Time Maximum Noise Levels			(see note 7)
L_{AFMax} (Range)	69	to	88
L_{AFMax} - L_{Aeq} (Range)	15	to	32

NSW Road Noise Policy (1m from facade)		
Descriptor	**Day**	**Night**[5]
	7am-10pm	**10pm-7am**
$L_{Aeq\ 15\ hr}$ and $L_{Aeq\ 9\ hr}$	61	57
$L_{Aeq\ 1hr}$ upper 10 percentile	63	58
$L_{Aeq\ 1hr}$ lower 10 percentile	59	53

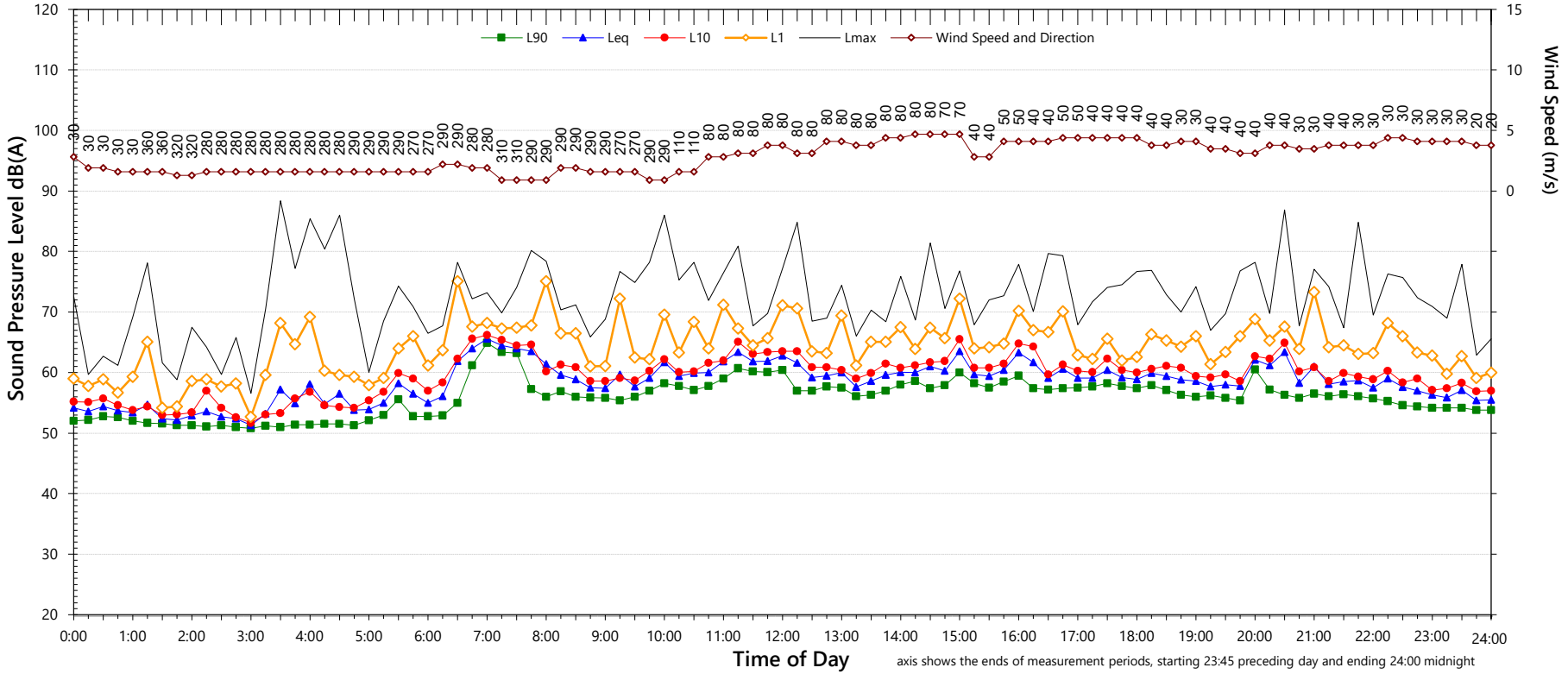
Notes:

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 till 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. 1-hour values for L_{AFMax} are shown only where L_{AFMax} >65dB(A) and where L_{AFMax}- L_{Aeq} ≥15dB(A)

Unattended Noise Monitoring Results

RTA2 - Adina Hotel Room 94 Balcony

Wednesday, 16 February 2022



axis shows the ends of measurement periods, starting 23:45 preceding day and ending 24:00 midnight

NSW Noise Policy for Industry (Free Field)				
Descriptor		**Day**[2]	**Evening**[3]	**Night**[4 5]
L_{A90} ABL		56	56	53
L_{Aeq}	(see note 6)	58	57	56

Night Time Maximum Noise Levels			**(see note 7)**
L_{AFMax} (Range)	76	to	84
L_{AFMax} - L_{Aeq} (Range)	18	to	27

NSW Road Noise Policy (1m from facade)		
Descriptor	**Day**	**Night**[5]
	7am-10pm	**10pm-7am**
$L_{Aeq\ 15\ hr}$ and $L_{Aeq\ 9\ hr}$	61	59
$L_{Aeq\ 1hr}$ upper 10 percentile	62	60
$L_{Aeq\ 1hr}$ lower 10 percentile	59	56

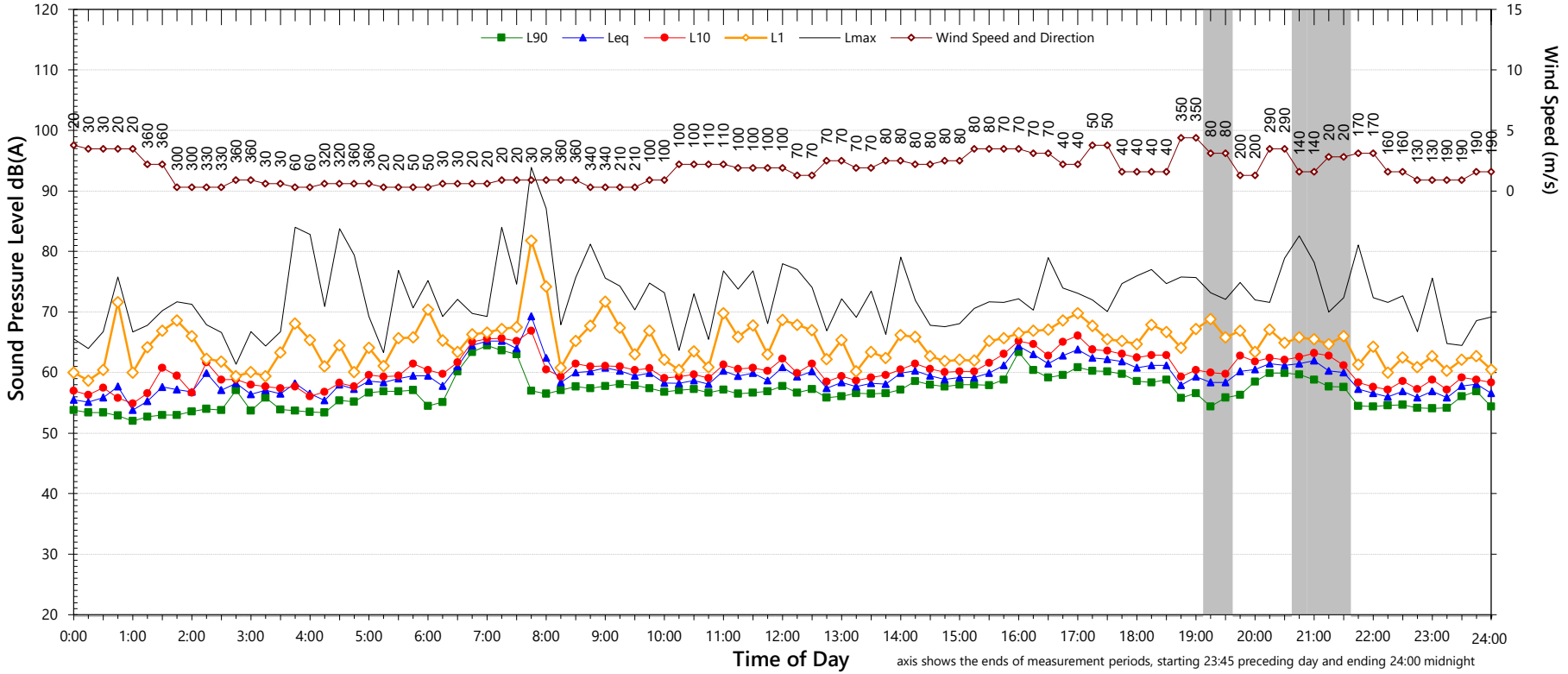
Notes:

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 till 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. 1-hour values for L_{AFMax} are shown only where L_{AFMax} >65dB(A) and where L_{AFMax}- L_{Aeq} ≥15dB(A)

Unattended Noise Monitoring Results

RTA2 - Adina Hotel Room 94 Balcony

Thursday, 17 February 2022



axis shows the ends of measurement periods, starting 23:45 preceding day and ending 24:00 midnight

NSW Noise Policy for Industry (Free Field)				
Descriptor		**Day**[2]	**Evening**[3]	**Night**[4 5]
L_{A90} ABL		57	-	54
L_{Aeq}	(see note 6)	59	-	56

Night Time Maximum Noise Levels			(see note 7)
L_{AFMax} (Range)	75	to	88
L_{AFMax} - L_{Aeq} (Range)	16	to	30

NSW Road Noise Policy (1m from facade)		
Descriptor	**Day**	**Night**[5]
	7am-10pm	**10pm-7am**
$L_{Aeq\ 15\ hr}$ and $L_{Aeq\ 9\ hr}$	61	58
$L_{Aeq\ 1hr}$ upper 10 percentile	62	59
$L_{Aeq\ 1hr}$ lower 10 percentile	59	55

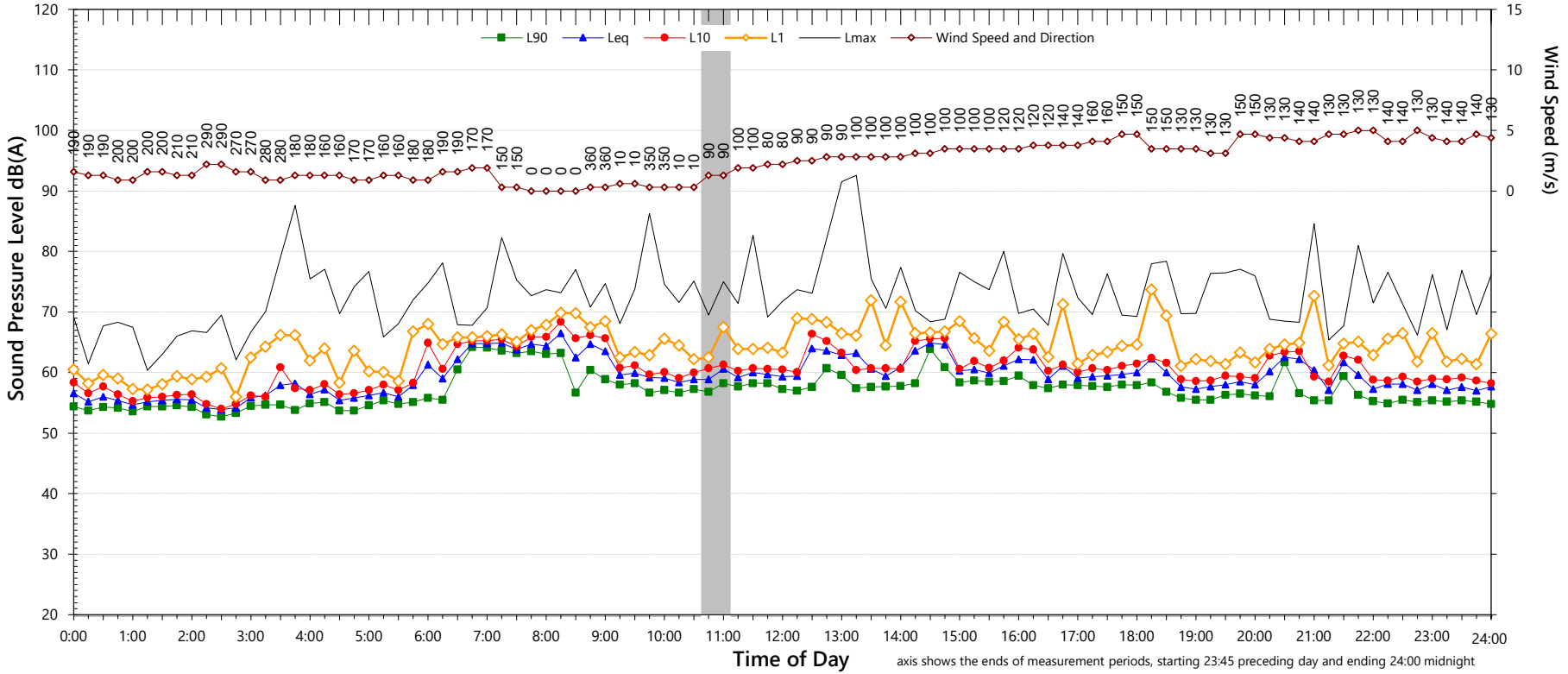
Notes:

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 till 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. 1-hour values for L_{AFMax} are shown only where L_{AFMax} >65dB(A) and where L_{AFMax}- L_{Aeq} ≥15dB(A)

Unattended Noise Monitoring Results

RTA2 - Adina Hotel Room 94 Balcony

Friday, 18 February 2022



NSW Noise Policy for Industry (Free Field)				
Descriptor		**Day**[2]	**Evening**[3]	**Night**[4 5]
L_{A90} ABL		57	55	54
L_{Aeq}	(see note 6)	60	57	54

Night Time Maximum Noise Levels			**(see note 7)**
L_{AFMax} (Range)	72	to	83
L_{AFMax} - L_{Aeq} (Range)	16	to	27

NSW Road Noise Policy (1m from facade)		
Descriptor	**Day**	**Night**[5]
	7am-10pm	**10pm-7am**
$L_{Aeq\ 15\ hr}$ and $L_{Aeq\ 9\ hr}$	62	57
$L_{Aeq\ 1hr}$ upper 10 percentile	64	58
$L_{Aeq\ 1hr}$ lower 10 percentile	59	55

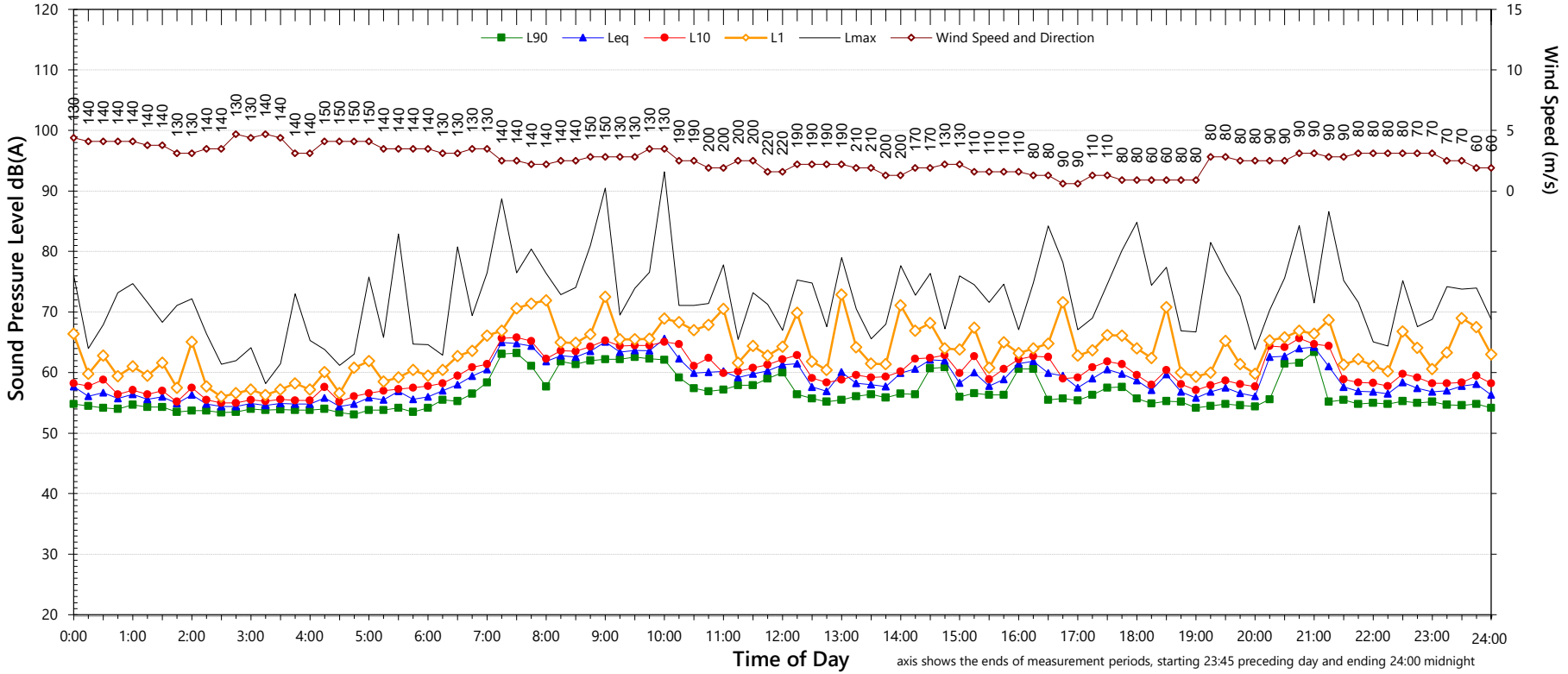
Notes:

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 till 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. 1-hour values for L_{AFMax} are shown only where L_{AFMax} >65dB(A) and where L_{AFMax}- L_{Aeq} ≥15dB(A)

Unattended Noise Monitoring Results

RTA2 - Adina Hotel Room 94 Balcony

Saturday, 19 February 2022



axis shows the ends of measurement periods, starting 23:45 preceding day and ending 24:00 midnight

NSW Noise Policy for Industry (Free Field)				
Descriptor		**Day**[2]	**Evening**[3]	**Night**[4 5]
L_{A90} ABL		56	54	52
L_{Aeq}	(see note 6)	59	57	55

Night Time Maximum Noise Levels			(see note 7)
L_{AFMax} (Range)	69	to	76
L_{AFMax} - L_{Aeq} (Range)	15	to	21

NSW Road Noise Policy (1m from facade)		
Descriptor	**Day**	**Night**[5]
	7am-10pm	**10pm-7am**
$L_{Aeq\ 15\ hr}$ and $L_{Aeq\ 9\ hr}$	61	56
$L_{Aeq\ 1hr}$ upper 10 percentile	64	57
$L_{Aeq\ 1hr}$ lower 10 percentile	58	53

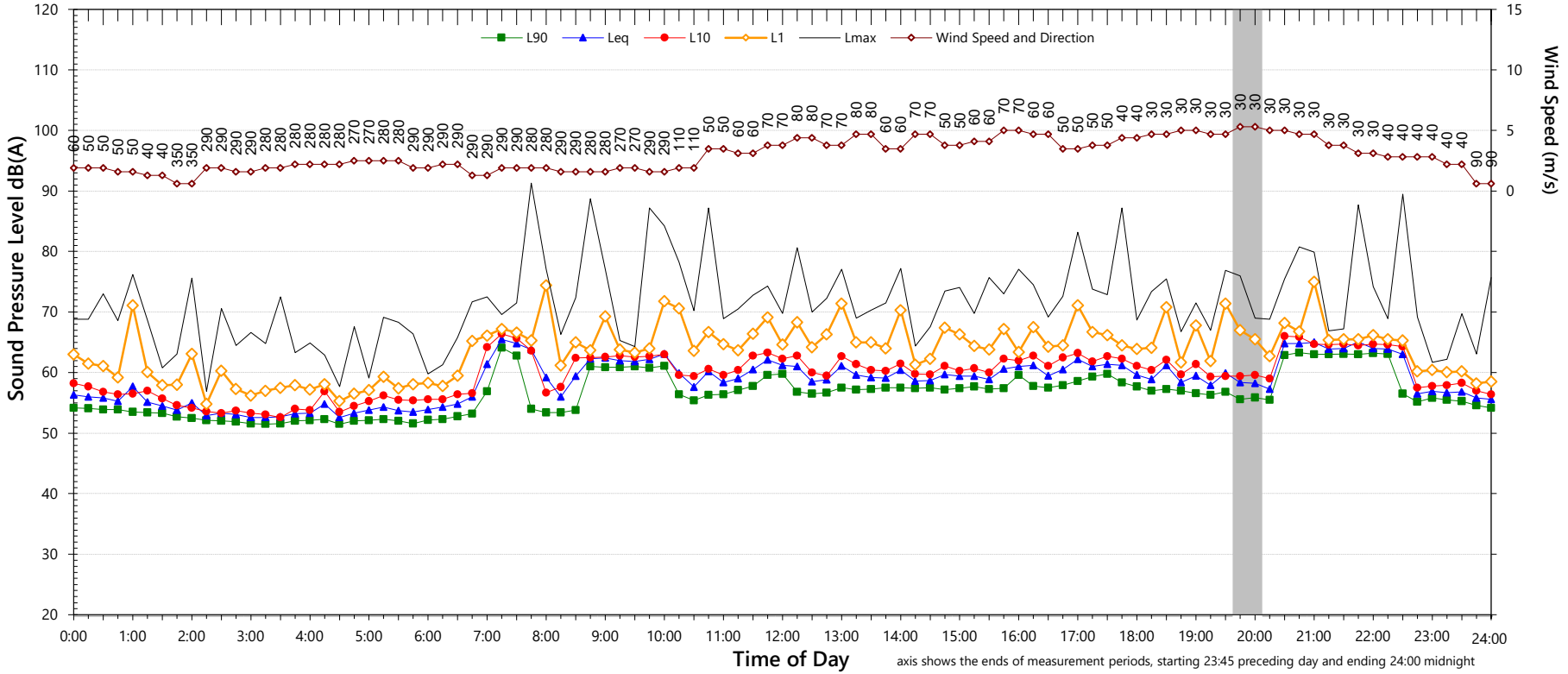
Notes:

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 till 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. 1-hour values for L_{AFMax} are shown only where L_{AFMax} >65dB(A) and where L_{AFMax}- L_{Aeq} ≥15dB(A)

Unattended Noise Monitoring Results

RTA2 - Adina Hotel Room 94 Balcony

Sunday, 20 February 2022



NSW Noise Policy for Industry (Free Field)				
Descriptor		**Day**[2]	**Evening**[3]	**Night**[4 5]
L_{A90} ABL		56	56	53
L_{Aeq}	(see note 6)	58	60	54

Night Time Maximum Noise Levels			(see note 7)
L_{AFMax} (Range)	72	to	90
L_{AFMax} - L_{Aeq} (Range)	16	to	28

NSW Road Noise Policy (1m from facade)		
Descriptor	**Day**	**Night**[5]
	7am-10pm	**10pm-7am**
$L_{Aeq\ 15\ hr}$ and $L_{Aeq\ 9\ hr}$	61	-
$L_{Aeq\ 1hr}$ upper 10 percentile	64	-
$L_{Aeq\ 1hr}$ lower 10 percentile	59	-

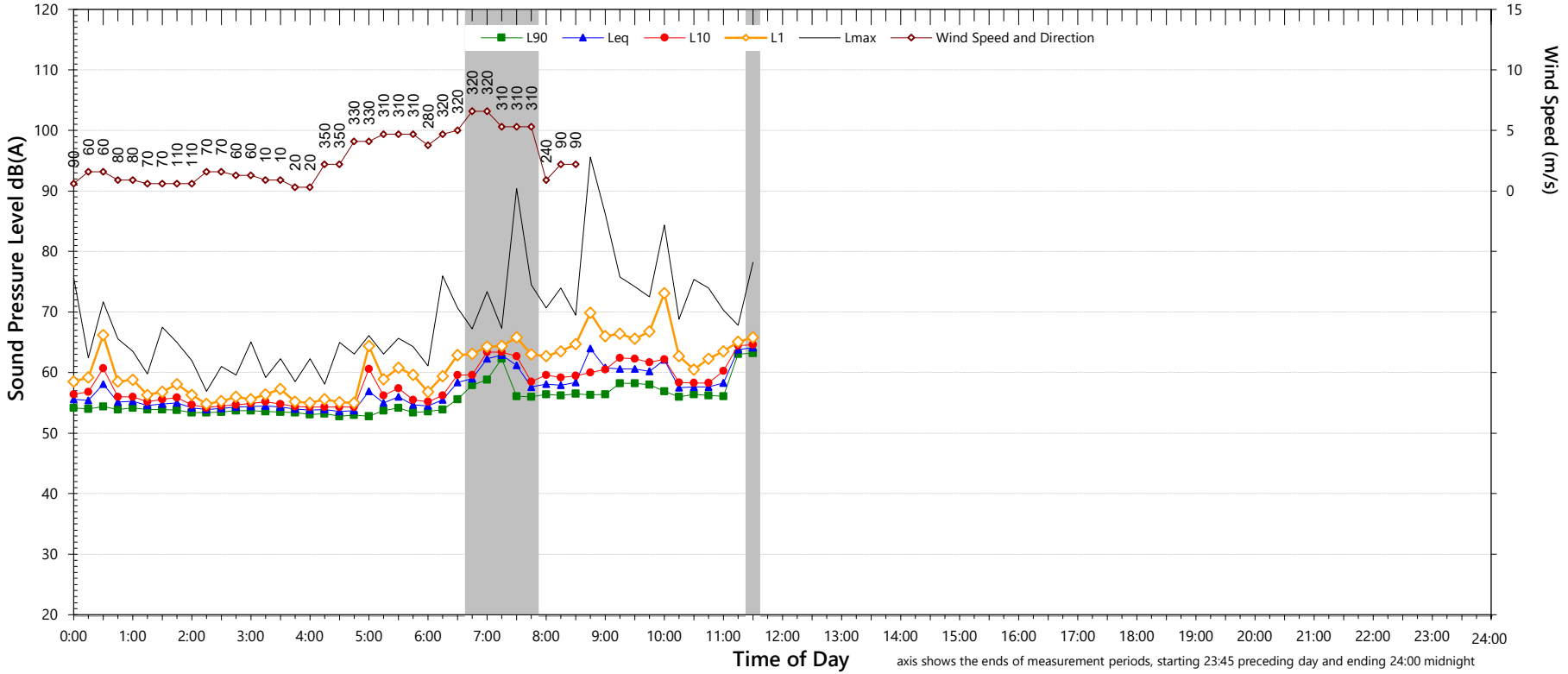
Notes:

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 till 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. 1-hour values for L_{AFMax} are shown only where L_{AFMax} >65dB(A) and where L_{AFMax}- L_{Aeq} ≥15dB(A)

Unattended Noise Monitoring Results

RTA2 - Adina Hotel Room 94 Balcony

Monday, 21 February 2022



axis shows the ends of measurement periods, starting 23:45 preceding day and ending 24:00 midnight

NSW Noise Policy for Industry (Free Field)				
Descriptor		**Day[2]**	**Evening[3]**	**Night[4 5]**
L_{A90} ABL		-	-	-
L_{Aeq}	(see note 6)	-	-	-

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

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

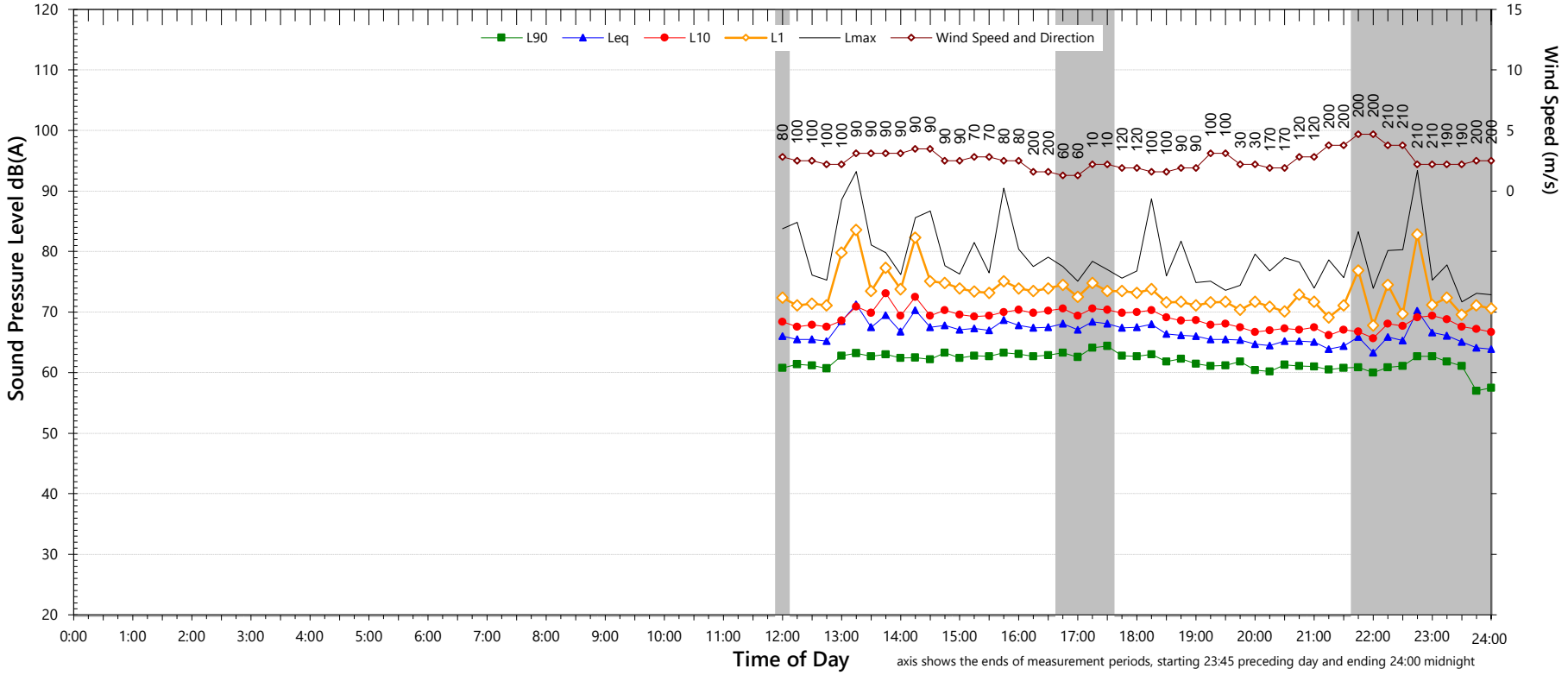
Notes:

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 till 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. 1-hour values for L_{AFMax} are shown only where L_{AFMax} >65dB(A) and where L_{AFMax}- L_{Aeq} ≥15dB(A)

Unattended Noise Monitoring Results

RTA3 - Mercure Hotel Room 536 Balcony

Thursday, 10 February 2022



NSW Noise Policy for Industry (Free Field)				
Descriptor		**Day**[2]	**Evening**[3]	**Night**[4 5]
L_{A90} ABL		-	60	-
L_{Aeq}	(see note 6)	-	63	-

Night Time Maximum Noise Levels			**(see note 7)**
L_{AFMax} (Range)	75	to	92
L_{AFMax} - L_{Aeq} (Range)	15	to	29

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

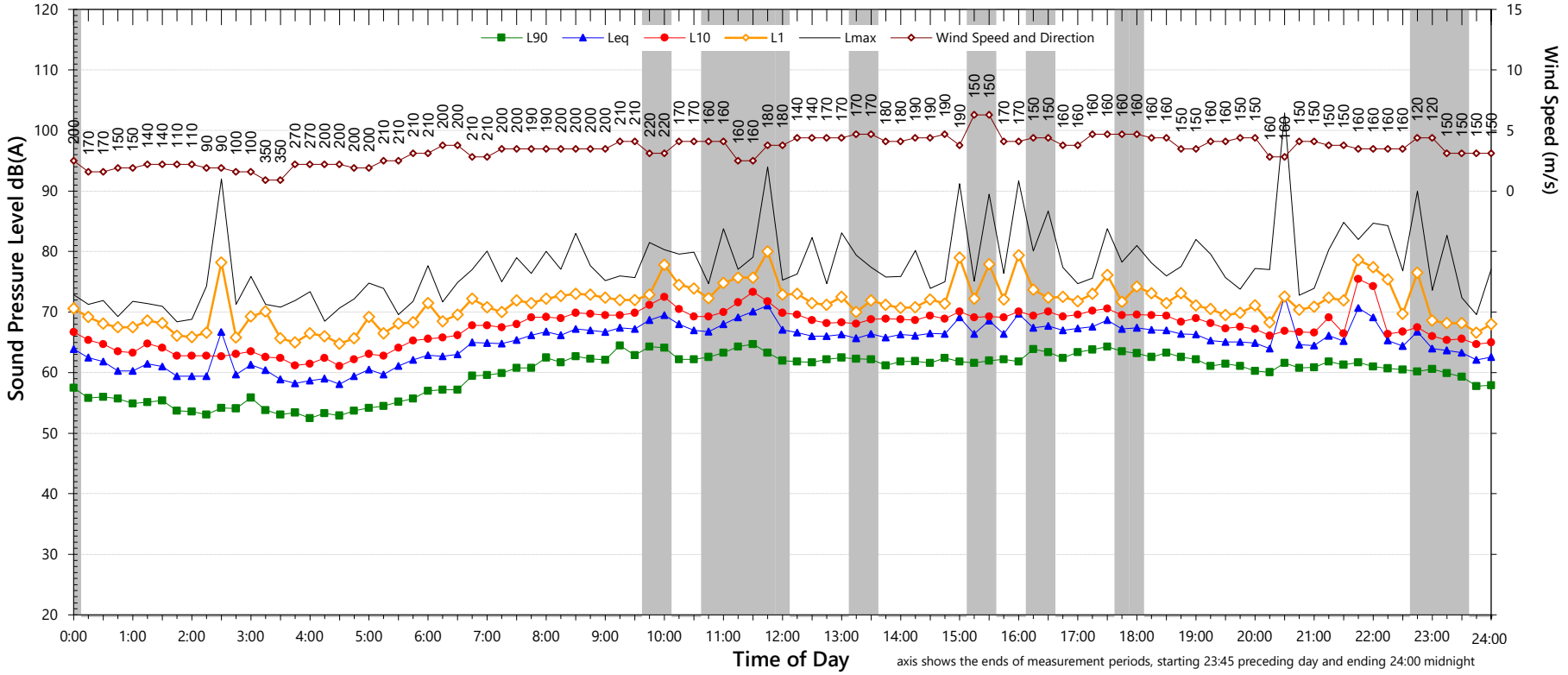
Notes:

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 till 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. 1-hour values for L_{AFMax} are shown only where L_{AFMax} >65dB(A) and where L_{AFMax}- L_{Aeq} ≥15dB(A)

Unattended Noise Monitoring Results

RTA3 - Mercure Hotel Room 536 Balcony

Friday, 11 February 2022



NSW Noise Policy for Industry (Free Field)				
Descriptor		**Day**[2]	**Evening**[3]	**Night**[4 5]
L_{A90} ABL		-	61	54
L_{Aeq}	(see note 6)	-	65	60

Night Time Maximum Noise Levels			(see note 7)
L_{AFMax} (Range)	75	to	84
L_{AFMax} - L_{Aeq} (Range)	16	to	19

NSW Road Noise Policy (1m from facade)		
Descriptor	**Day**	**Night**[5]
	7am-10pm	**10pm-7am**
$L_{Aeq\ 15\ hr}$ and $L_{Aeq\ 9\ hr}$	67	62
$L_{Aeq\ 1hr}$ upper 10 percentile	68	64
$L_{Aeq\ 1hr}$ lower 10 percentile	66	60

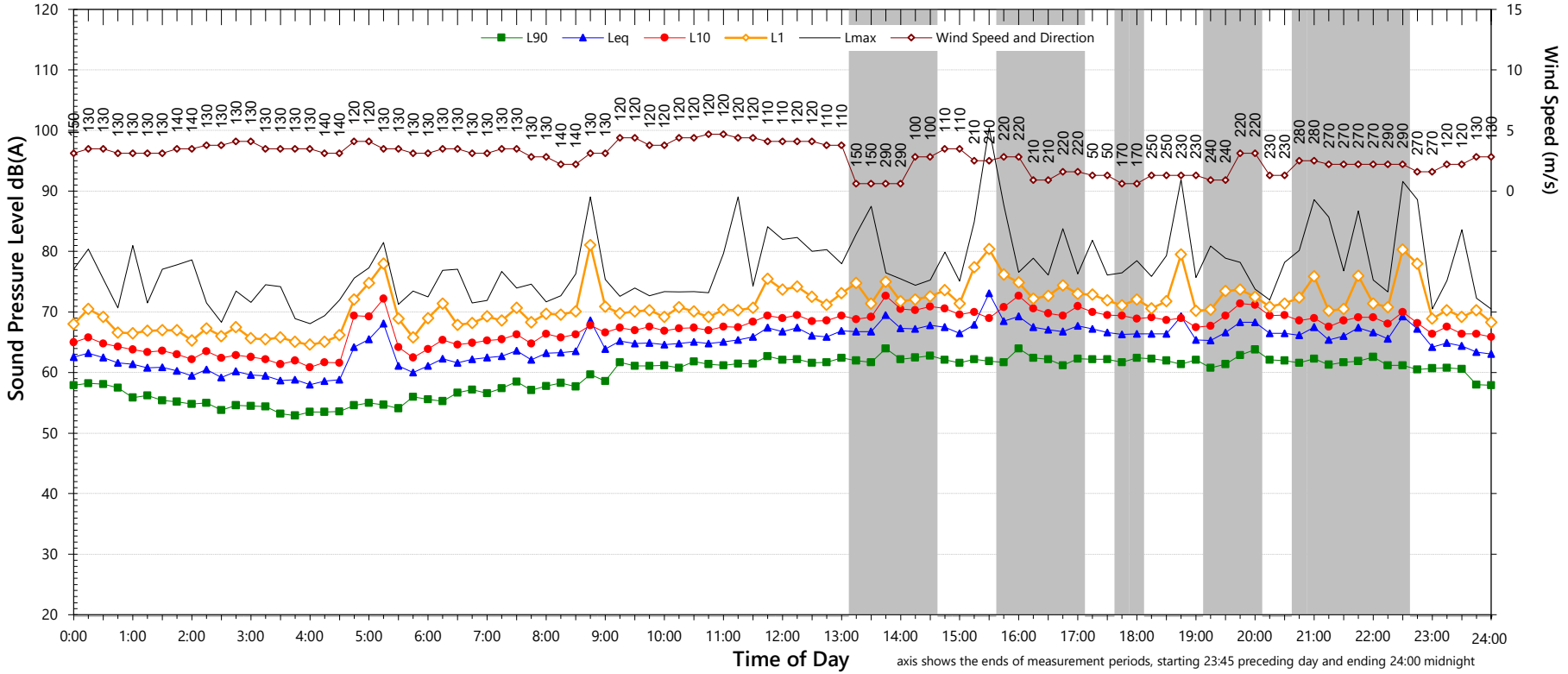
Notes:

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 till 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. 1-hour values for L_{AFMax} are shown only where L_{AFMax} >65dB(A) and where L_{AFMax}- L_{Aeq} ≥15dB(A)

Unattended Noise Monitoring Results

RTA3 - Mercure Hotel Room 536 Balcony

Saturday, 12 February 2022



NSW Noise Policy for Industry (Free Field)				
Descriptor		**Day**[2]	**Evening**[3]	**Night**[4 5]
L_{A90} ABL		-	-	53
L_{Aeq}	(see note 6)	-	-	60

Night Time Maximum Noise Levels			**(see note 7)**
L_{AFMax} (Range)	77	to	89
L_{AFMax} - L_{Aeq} (Range)	17	to	24

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

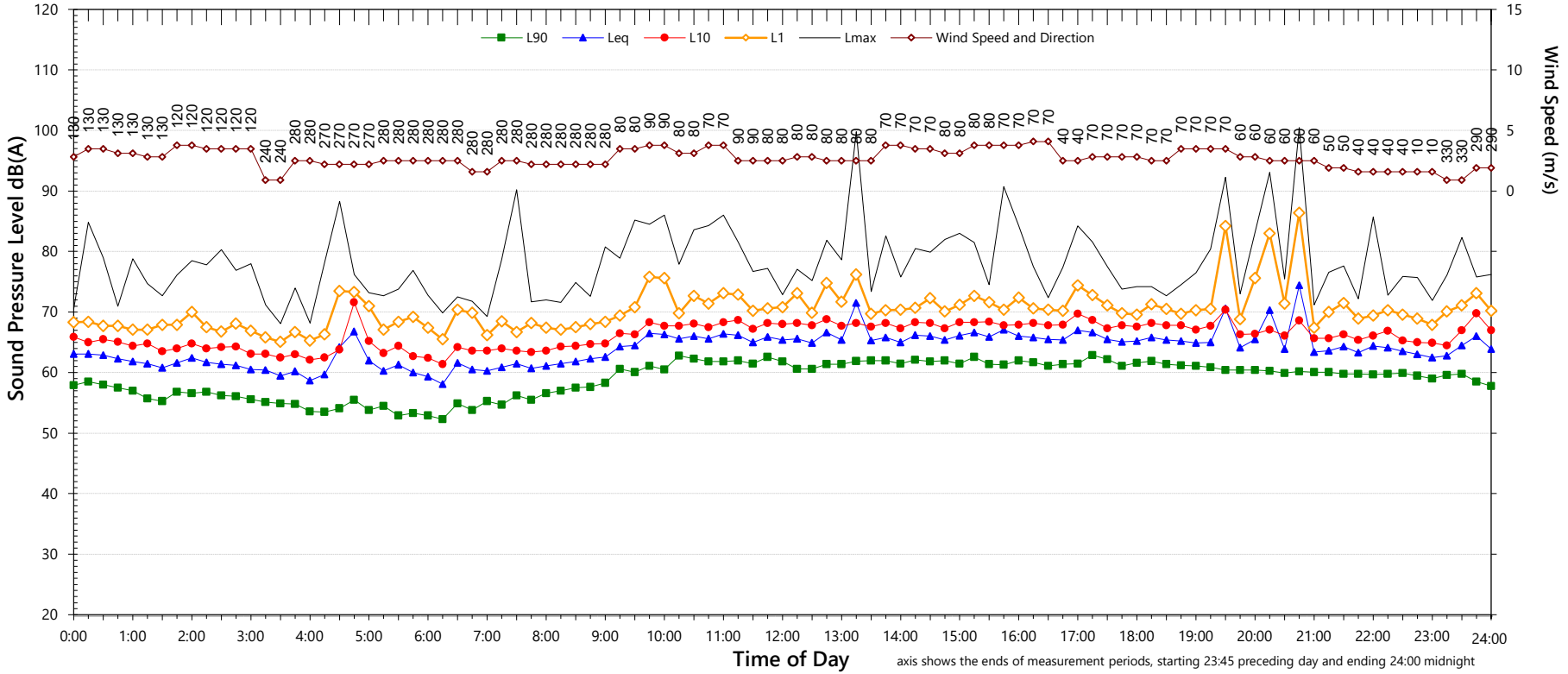
Notes:

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 till 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. 1-hour values for L_{AFMax} are shown only where L_{AFMax} >65dB(A) and where L_{AFMax}- L_{Aeq} ≥15dB(A)

Unattended Noise Monitoring Results

RTA3 - Mercure Hotel Room 536 Balcony

Sunday, 13 February 2022



NSW Noise Policy for Industry (Free Field)				
Descriptor		**Day**[2]	**Evening**[3]	**Night**[4 5]
L_{A90} ABL		60	60	52
L_{Aeq}	(see note 6)	63	65	59

Night Time Maximum Noise Levels			(see note 7)
L_{AFMax} (Range)	75	to	87
L_{AFMax} - L_{Aeq} (Range)	16	to	22

NSW Road Noise Policy (1m from facade)		
Descriptor	**Day**	**Night**[5]
	7am-10pm	**10pm-7am**
$L_{Aeq\ 15\ hr}$ and $L_{Aeq\ 9\ hr}$	66	62
$L_{Aeq\ 1hr}$ upper 10 percentile	68	65
$L_{Aeq\ 1hr}$ lower 10 percentile	63	58

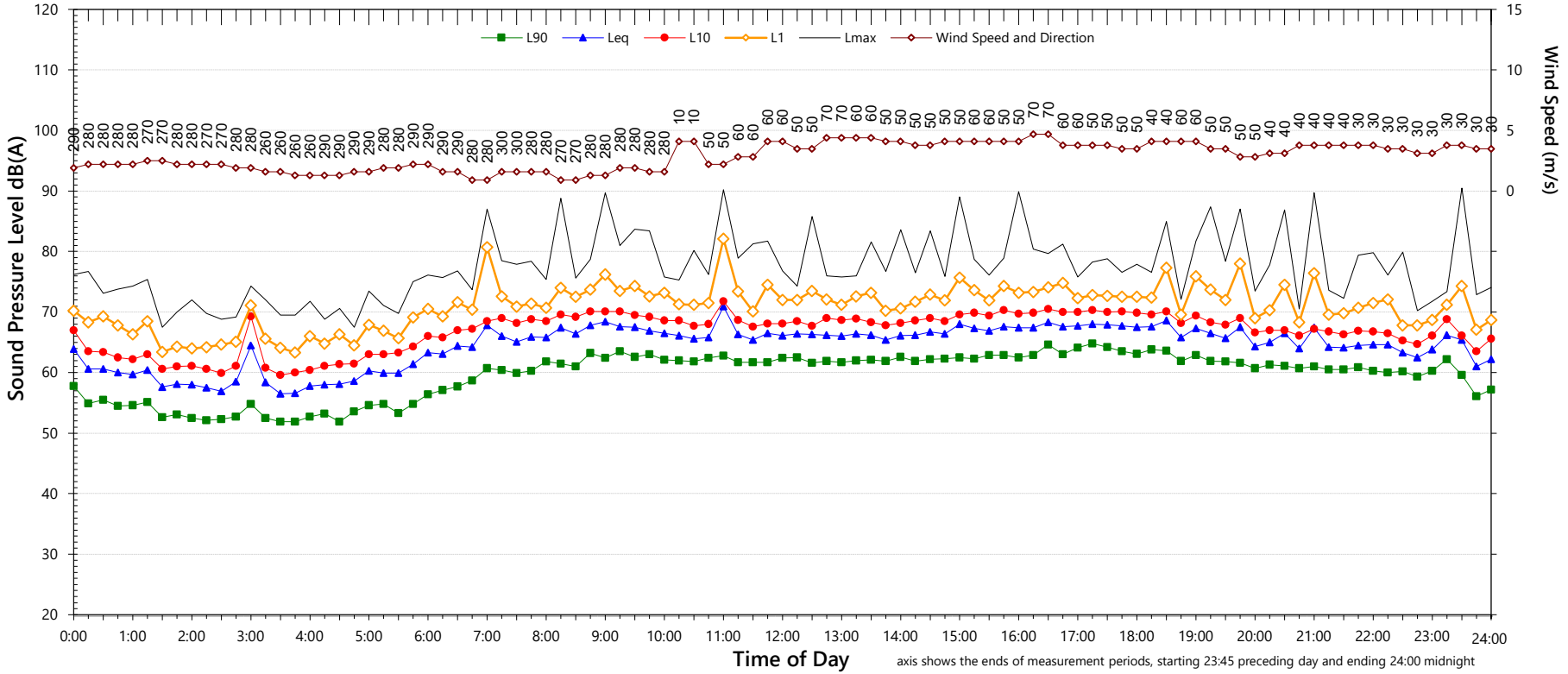
Notes:

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 till 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. 1-hour values for L_{AFMax} are shown only where L_{AFMax} >65dB(A) and where L_{AFMax}- L_{Aeq} ≥15dB(A)

Unattended Noise Monitoring Results

RTA3 - Mercure Hotel Room 536 Balcony

Monday, 14 February 2022



NSW Noise Policy for Industry (Free Field)				
Descriptor		**Day**[2]	**Evening**[3]	**Night**[4 5]
L_{A90} ABL		62	61	52
L_{Aeq}	(see note 6)	64	64	60

Night Time Maximum Noise Levels			(see note 7)
L_{AFMax} (Range)	77	to	100
L_{AFMax} - L_{Aeq} (Range)	16	to	33

NSW Road Noise Policy (1m from facade)		
Descriptor	**Day**	**Night**[5]
	7am-10pm	**10pm-7am**
$L_{Aeq\ 15\ hr}$ and $L_{Aeq\ 9\ hr}$	67	63
$L_{Aeq\ 1hr}$ upper 10 percentile	68	65
$L_{Aeq\ 1hr}$ lower 10 percentile	66	60

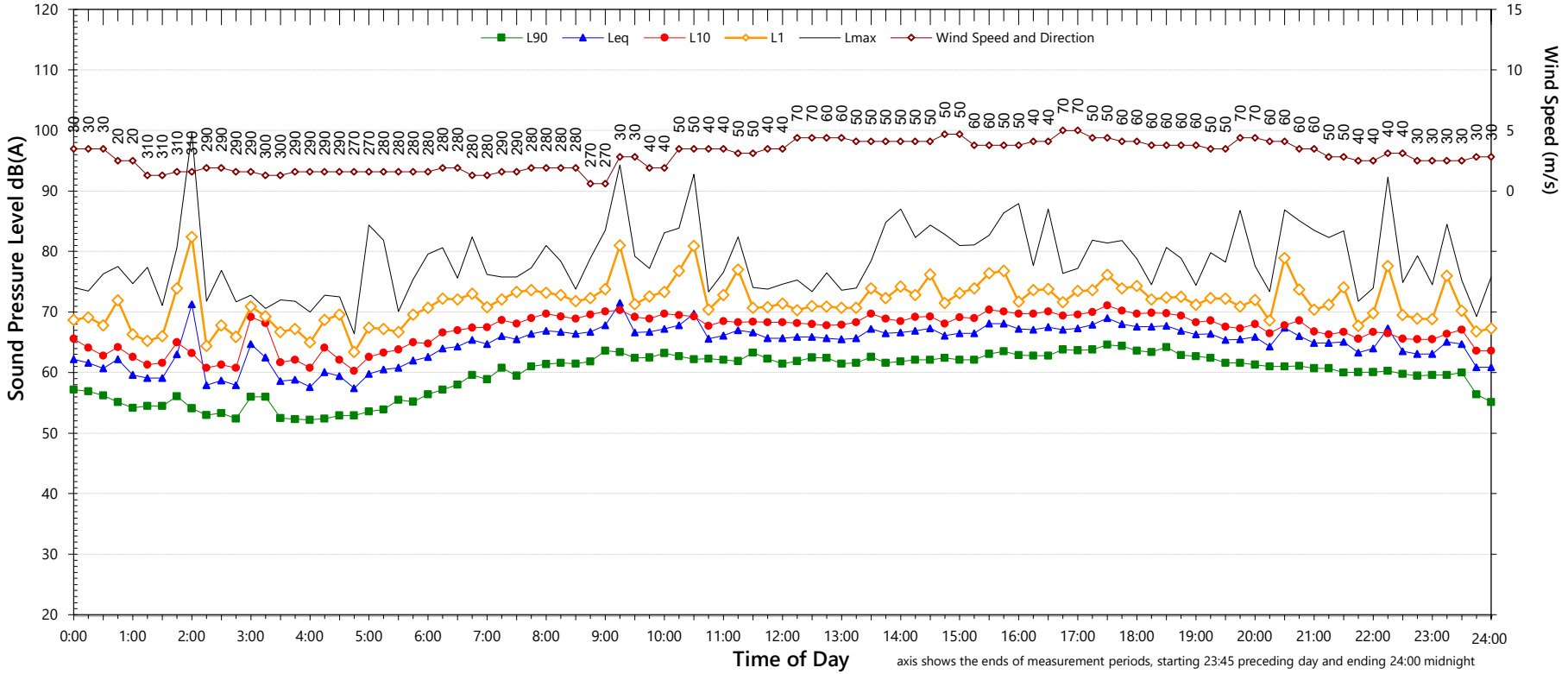
Notes:

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 till 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. 1-hour values for L_{AFMax} are shown only where L_{AFMax} >65dB(A) and where L_{AFMax}- L_{Aeq} ≥15dB(A)

Unattended Noise Monitoring Results

RTA3 - Mercure Hotel Room 536 Balcony

Tuesday, 15 February 2022



NSW Noise Policy for Industry (Free Field)				
Descriptor		**Day**[2]	**Evening**[3]	**Night**[4 5]
L_{A90} ABL		62	60	53
L_{Aeq}	(see note 6)	65	63	59

Night Time Maximum Noise Levels			**(see note 7)**
L_{AFMax} (Range)	75	to	92
L_{AFMax} - L_{Aeq} (Range)	16	to	28

NSW Road Noise Policy (1m from facade)		
Descriptor	**Day**	**Night**[5]
	7am-10pm	**10pm-7am**
$L_{Aeq\ 15\ hr}$ and $L_{Aeq\ 9\ hr}$	67	62
$L_{Aeq\ 1hr}$ upper 10 percentile	68	65
$L_{Aeq\ 1hr}$ lower 10 percentile	66	59

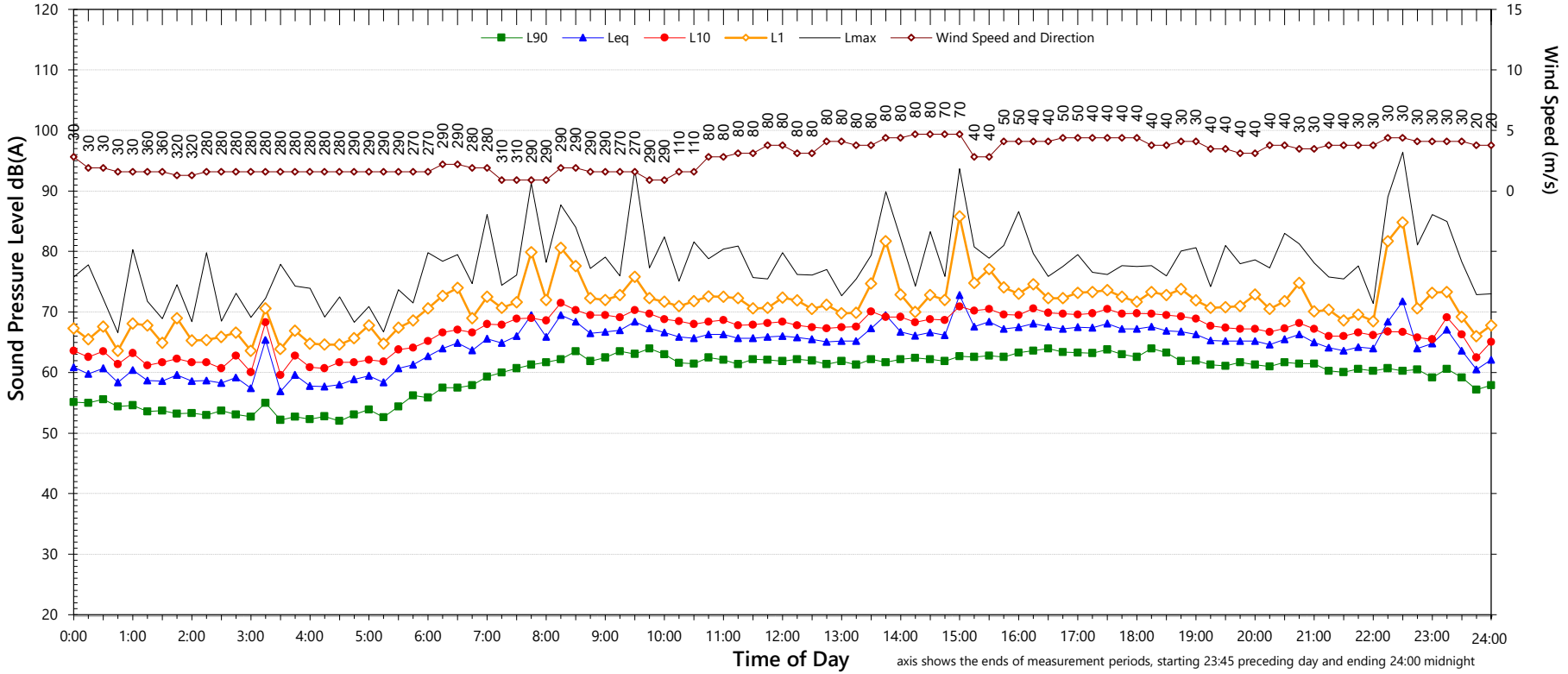
Notes:

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 till 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. 1-hour values for L_{AFMax} are shown only where L_{AFMax} >65dB(A) and where L_{AFMax}- L_{Aeq} ≥15dB(A)

Unattended Noise Monitoring Results

RTA3 - Mercure Hotel Room 536 Balcony

Wednesday, 16 February 2022



NSW Noise Policy for Industry (Free Field)				
Descriptor		**Day**[2]	**Evening**[3]	**Night**[4 5]
L_{A90} ABL		61	60	53
L_{Aeq}	(see note 6)	65	63	60

Night Time Maximum Noise Levels			**(see note 7)**
L_{AFMax} (Range)	76	to	96
L_{AFMax} - L_{Aeq} (Range)	17	to	28

NSW Road Noise Policy (1m from facade)		
Descriptor	**Day**	**Night**[5]
	7am-10pm	**10pm-7am**
$L_{Aeq\ 15\ hr}$ and $L_{Aeq\ 9\ hr}$	67	63
$L_{Aeq\ 1hr}$ upper 10 percentile	68	65
$L_{Aeq\ 1hr}$ lower 10 percentile	65	59

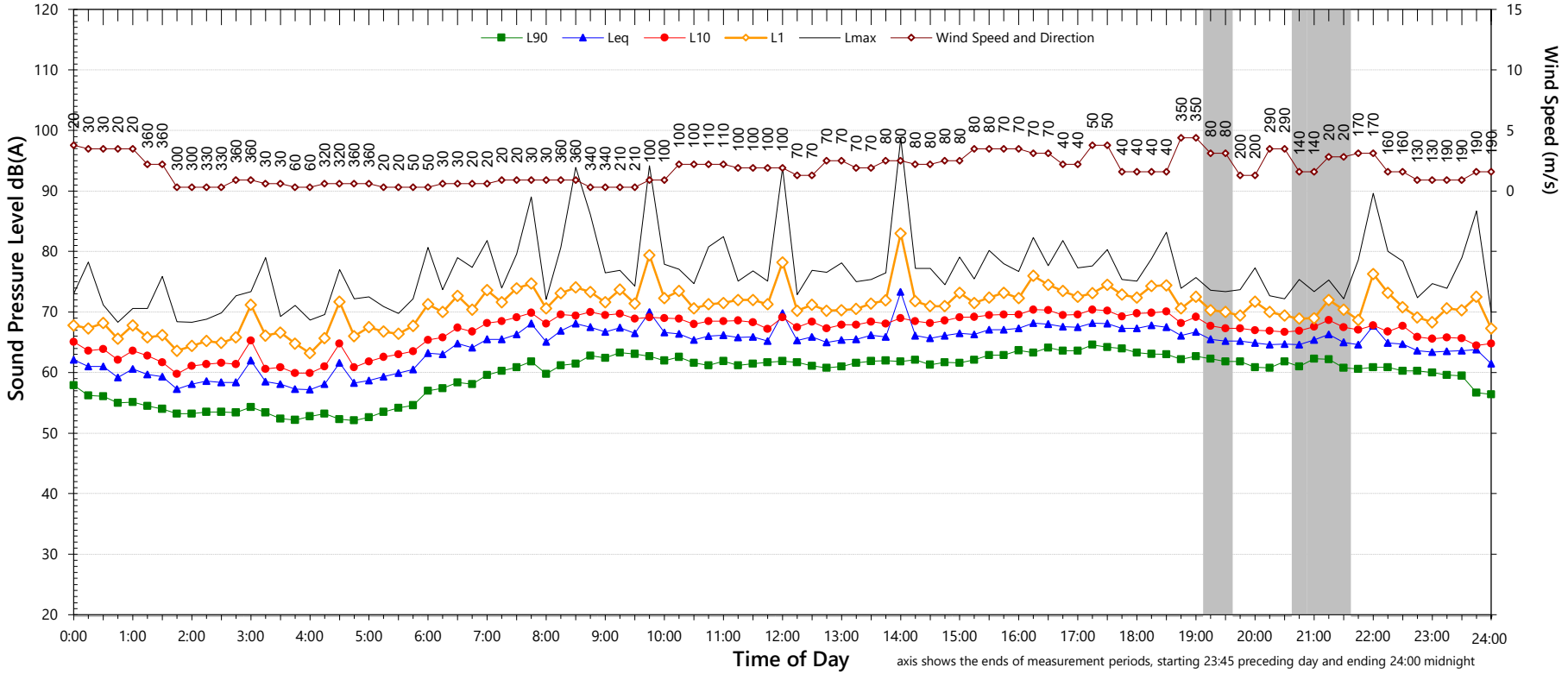
Notes:

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 till 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. 1-hour values for L_{AFMax} are shown only where L_{AFMax} >65dB(A) and where L_{AFMax}- L_{Aeq} ≥15dB(A)

Unattended Noise Monitoring Results

RTA3 - Mercure Hotel Room 536 Balcony

Thursday, 17 February 2022



NSW Noise Policy for Industry (Free Field)				
Descriptor		**Day**[2]	**Evening**[3]	**Night**[4 5]
L_{A90} ABL		61	-	53
L_{Aeq}	(see note 6)	65	-	59

Night Time Maximum Noise Levels			(see note 7)
L_{AFMax} (Range)	74	to	94
L_{AFMax} - L_{Aeq} (Range)	15	to	28

NSW Road Noise Policy (1m from facade)		
Descriptor	**Day**	**Night**[5]
	7am-10pm	**10pm-7am**
$L_{Aeq\ 15\ hr}$ and $L_{Aeq\ 9\ hr}$	67	62
$L_{Aeq\ 1hr}$ upper 10 percentile	68	65
$L_{Aeq\ 1hr}$ lower 10 percentile	65	59

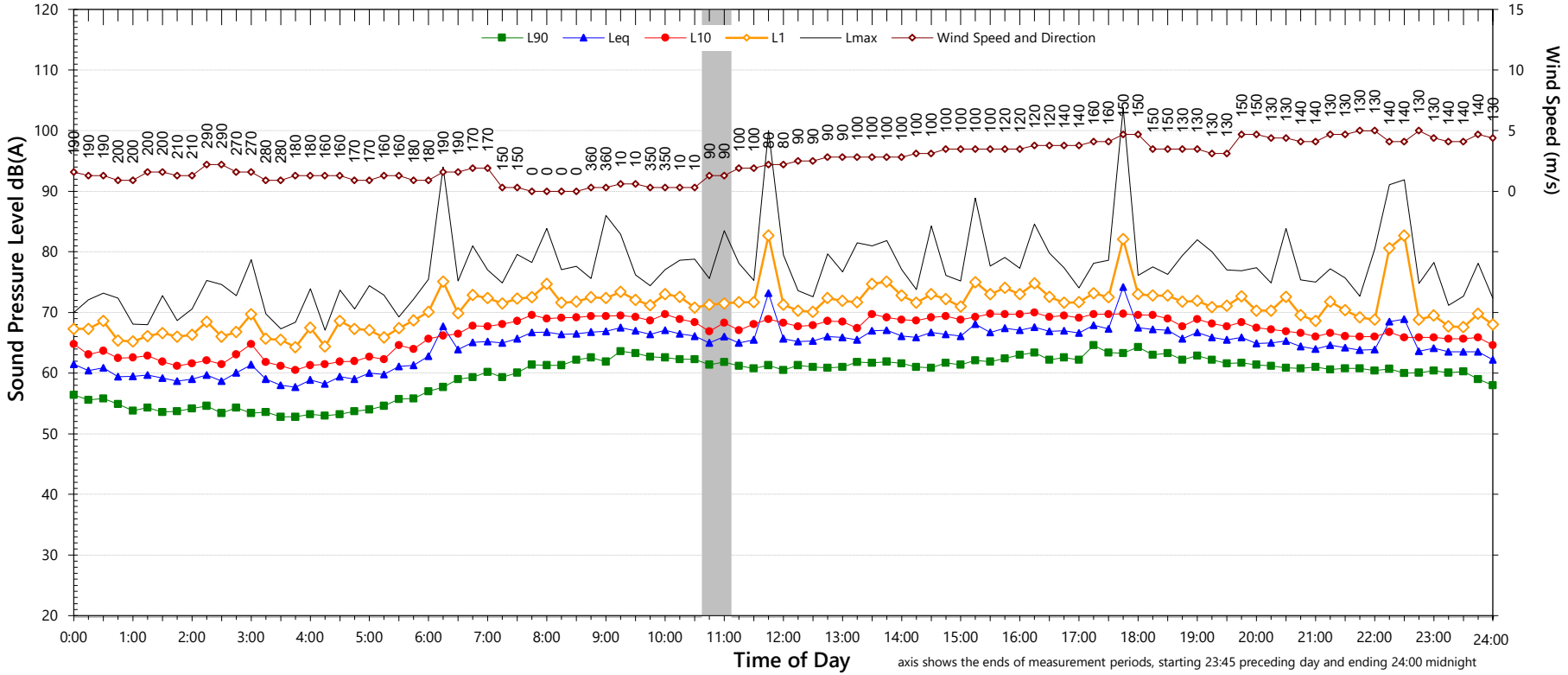
Notes:

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 till 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. 1-hour values for L_{AFMax} are shown only where L_{AFMax} >65dB(A) and where L_{AFMax}- L_{Aeq} ≥15dB(A)

Unattended Noise Monitoring Results

RTA3 - Mercure Hotel Room 536 Balcony

Friday, 18 February 2022



NSW Noise Policy for Industry (Free Field)				
Descriptor		**Day**[2]	**Evening**[3]	**Night**[4 5]
L_{A90} ABL		61	61	54
L_{Aeq}	(see note 6)	65	63	61

Night Time Maximum Noise Levels			**(see note 7)**
L_{AFMax} (Range)	77	to	92
L_{AFMax} - L_{Aeq} (Range)	17	to	27

NSW Road Noise Policy (1m from facade)		
Descriptor	**Day**	**Night**[5]
	7am-10pm	**10pm-7am**
$L_{Aeq\ 15\ hr}$ and $L_{Aeq\ 9\ hr}$	67	63
$L_{Aeq\ 1hr}$ upper 10 percentile	68	65
$L_{Aeq\ 1hr}$ lower 10 percentile	65	60

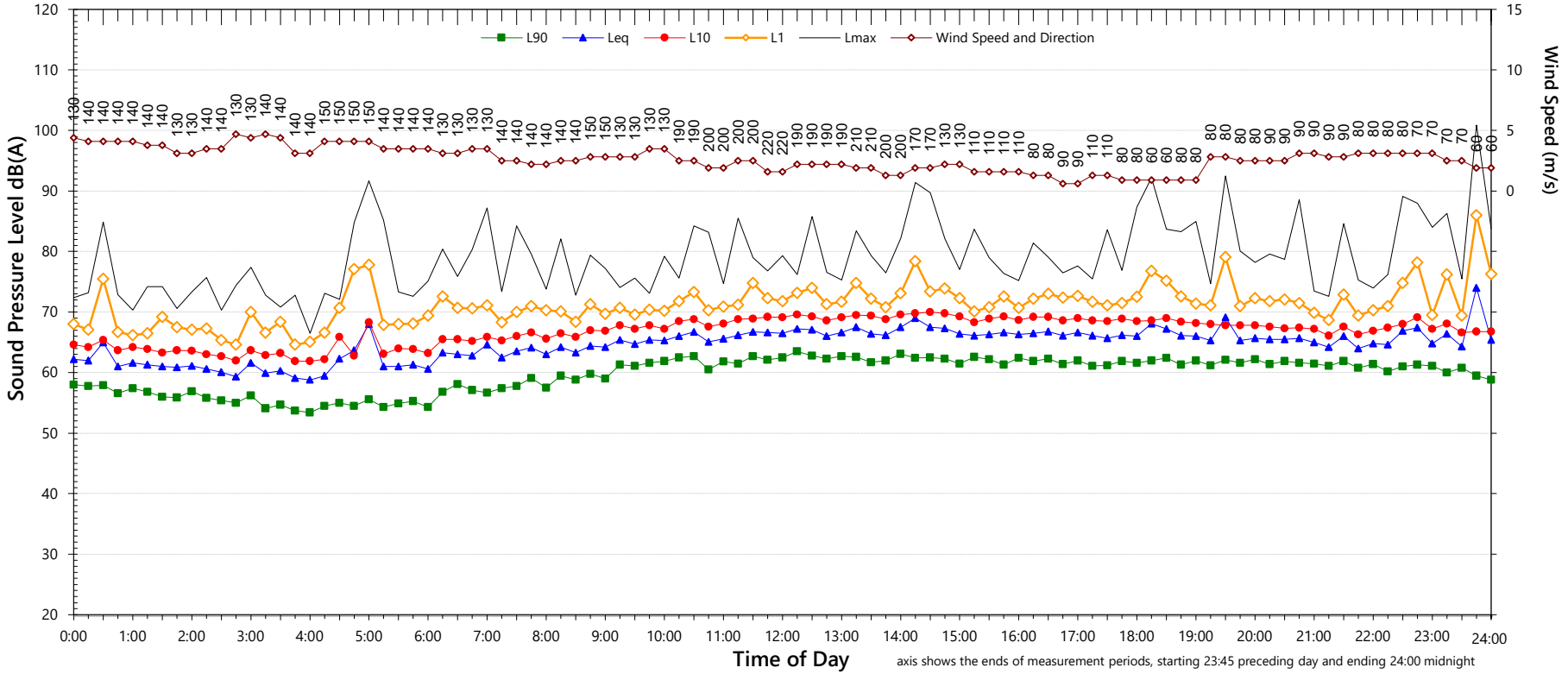
Notes:

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 till 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. 1-hour values for L_{AFMax} are shown only where L_{AFMax} >65dB(A) and where L_{AFMax}- L_{Aeq} ≥15dB(A)

Unattended Noise Monitoring Results

RTA3 - Mercure Hotel Room 536 Balcony

Saturday, 19 February 2022



NSW Noise Policy for Industry (Free Field)				
Descriptor		**Day**[2]	**Evening**[3]	**Night**[4 5]
L_{A90} ABL		59	61	54
L_{Aeq}	(see note 6)	64	64	62

Night Time Maximum Noise Levels			(see note 7)
L_{AFMax} (Range)	76	to	101
L_{AFMax} - L_{Aeq} (Range)	16	to	31

NSW Road Noise Policy (1m from facade)		
Descriptor	**Day**	**Night**[5]
	7am-10pm	**10pm-7am**
$L_{Aeq\ 15\ hr}$ and $L_{Aeq\ 9\ hr}$	66	64
$L_{Aeq\ 1hr}$ upper 10 percentile	67	67
$L_{Aeq\ 1hr}$ lower 10 percentile	64	61

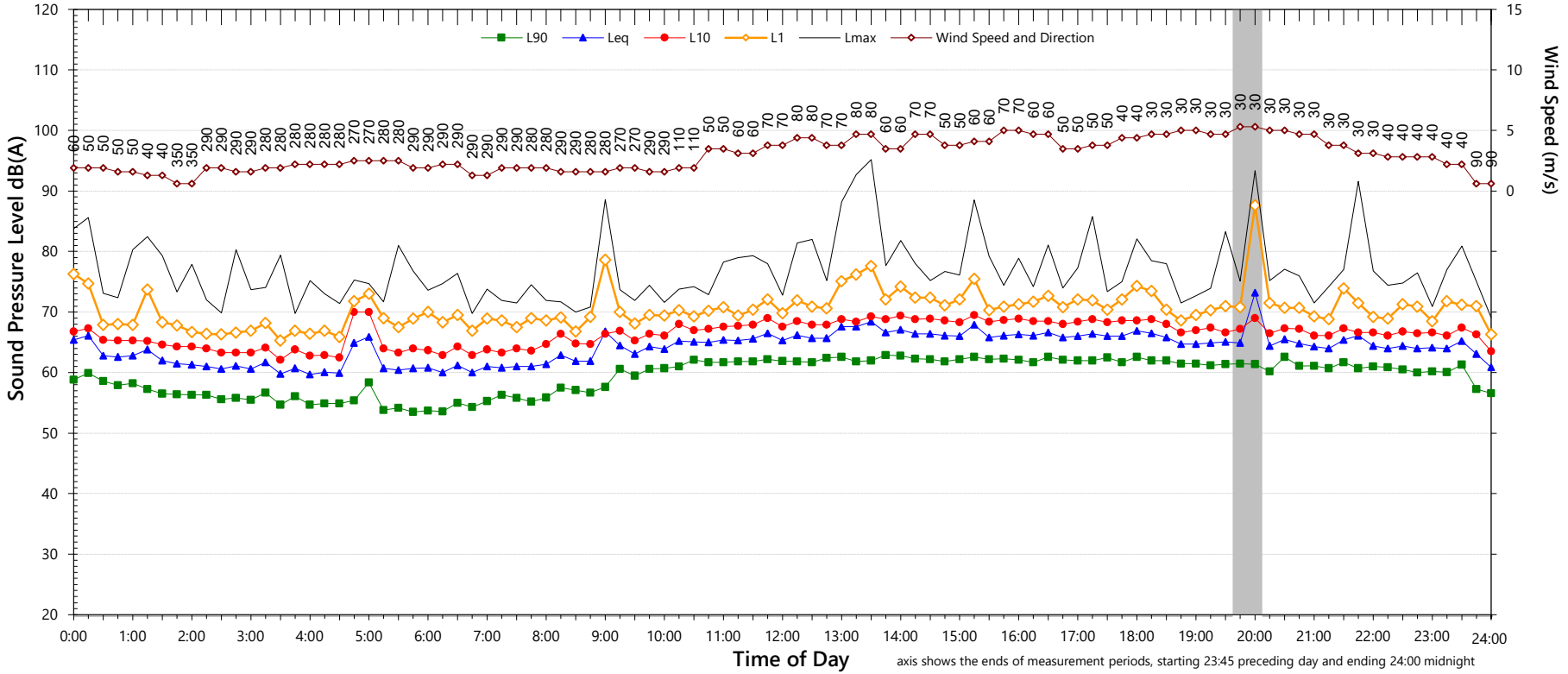
Notes:

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 till 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. 1-hour values for L_{AFMax} are shown only where L_{AFMax} >65dB(A) and where L_{AFMax}- L_{Aeq} ≥15dB(A)

Unattended Noise Monitoring Results

RTA3 - Mercure Hotel Room 536 Balcony

Sunday, 20 February 2022



axis shows the ends of measurement periods, starting 23:45 preceding day and ending 24:00 midnight

NSW Noise Policy for Industry (Free Field)				
Descriptor		**Day**[2]	**Evening**[3]	**Night**[4 5]
L_{A90} ABL		59	61	53
L_{Aeq}	(see note 6)	63	63	59

Night Time Maximum Noise Levels			(see note 7)
L_{AFMax} (Range)	75	to	81
L_{AFMax} - L_{Aeq} (Range)	16	to	21

NSW Road Noise Policy (1m from facade)		
Descriptor	**Day**	**Night**[5]
	7am-10pm	**10pm-7am**
$L_{Aeq\ 15\ hr}$ and $L_{Aeq\ 9\ hr}$	66	-
$L_{Aeq\ 1hr}$ upper 10 percentile	67	-
$L_{Aeq\ 1hr}$ lower 10 percentile	64	-

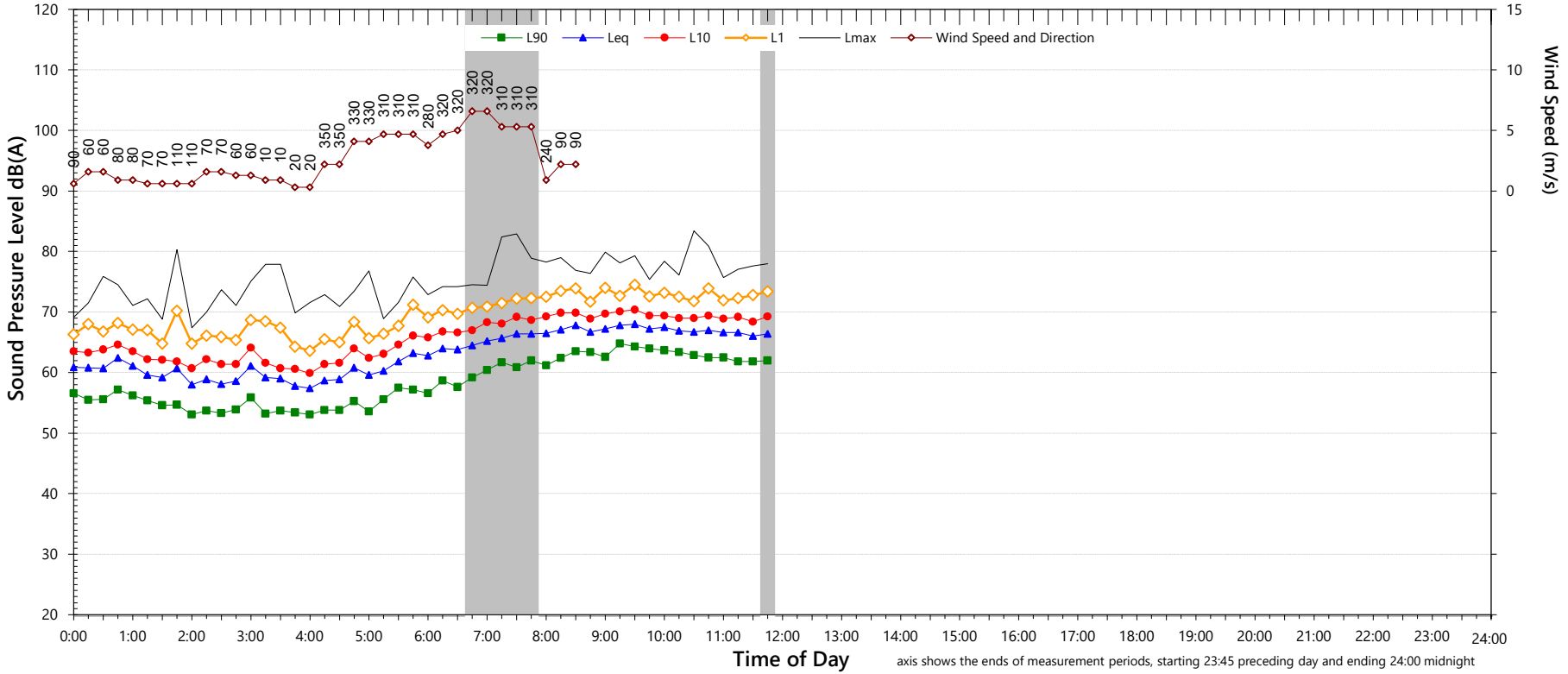
Notes:

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 till 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. 1-hour values for L_{AFMax} are shown only where L_{AFMax} >65dB(A) and where L_{AFMax}- L_{Aeq} ≥15dB(A)

Unattended Noise Monitoring Results

RTA3 - Mercure Hotel Room 536 Balcony

Monday, 21 February 2022



NSW Noise Policy for Industry (Free Field)				
Descriptor		**Day**[2]	**Evening**[3]	**Night**[4 5]
L_{A90} ABL		-	-	-
L_{Aeq}	(see note 6)	-	-	-

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

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

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 till 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. 1-hour values for L_{AFMax} are shown only where L_{AFMax} >65dB(A) and where L_{AFMax}- L_{Aeq} ≥15dB(A)