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38-42 ANDERSON STREET, 3 MCINTOSH STREET AND 2 DAY STREET, CHATSWOOD

Noise and Vibration Impact Assessment

3 April 2025

3 McIntosh Street Pty Ltd

TP150-01F02 Noise and Vibration Impact Assessment (r3).docx

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03.04.2025	Update Project description (Section 2.1)	-	3	T. Wong		T. Wong

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1 Introduction

1.1 Overview and Purpose of Report

Renzo Tonin & Associates was engaged by 3 McIntosh Street Pty Ltd to undertake an acoustic assessment for a State Significant Development Application (SSDA) for the mixed-use residential development at 38-42 Anderson Street, 3 McIntosh Street and 2 Day Street, Chatswood.

In this report we will:

- Identify noise emission goals applicable to the site
- Identify nearby noise sensitive development
- Provide advice with respect to building shell construction to address road and rail noise impacts on the development
- Assess potential ground-borne noise impacts from Sydney Trains commuter trains and the Metro trains and determine if building isolation is required to ensure compliance with relevant NSW guidelines
- Provide advice on noise & vibration treatment of proposed podium level gym.
- Provide advice on acoustic separation indoor communal rooms from residential spaces
- Provide advice on vibration isolation of private swimming pools
- Provide advice with respect to treatment of plant and equipment noise/vibration to ensure compliance relevant EPA noise guidelines.

The work documented in this report was carried out in accordance with the Renzo Tonin & Associates Quality Assurance System, which is based on Australian Standard / NZS ISO 9001.

1.2 Secretary's Environmental Assessment Requirements

The Secretary's Environmental Assessment Requirements relating to the project are detailed in the Industry-specific SEARs (In-fill Affordable Housing). The key issues with respect to noise and vibration from are extracted below:

"12. 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."

1.3 Assessment Objectives

As part of preparing this assessment, the following policies, guidelines and standards have been considered:

- NSW EPA Noise Policy for Industry (NPfI) 2016
- NSW EPA Interim Construction Noise Guideline (ICNG) 2009
- State Environmental Planning Policy (Infrastructure) 2007 (the "ISEPP')
- Department of Planning publication "Development Near Rail Corridors & Busy Roads – Interim Guideline" 2008
- State Environmental Planning Policy No 65 – Design Qualify of Residential Flat Development (Amendment No. 3)"
- SEPP 65 Apartment Design Guide 2015
- Australian Standard AS2107:2016 "Recommended Design Sound Levels and Reverberation Times for Building Interiors"

1.4 Reference Material

This report is prepared based on:

- Architectural drawings prepared by Carter Williamson Architects dated 14/03/2025.

2 The Proposal

2.1 Project Description

The proposed development (SSD-74670720) is located on Gamaraygal Country in the Metropolitan LALC and seeks approval to construct a shop top housing development that includes in-fill affordable housing, comprising the following:

- Site preparation works including demolition of existing structures, vegetation clearing, and bulk earthworks.
- Anderson Street Building (Tower A) - Construction of a 33-storey shop-top housing development comprising:
  - 155 residential dwellings.
  - Private penthouse rooftop terraces.
  - Top of podium (level 2) communal open space and amenities.
- McIntosh Street Building (Tower M): Construction of a 23-storey shop-top housing development comprising:
  - 103 residential dwellings.
  - Private rooftop terraces.
  - Top of podium (level 2) communal open space and amenities.
  - Construction of a two-to three storey non-residential podium with substation, lift core, lobbies and building services.
- Construction of a seven-level basement with waste storage, services, and loading, and 494 carparking spaces comprising:
  - 386 residential spaces (including 19 accessible spaces).
  - 36 residential visitor spaces (including 1 accessible spaces).
  - 72 commercial and retail spaces (including 2 accessible spaces).
  - 28 motorcycle spaces; and
  - 73 bicycle spaces.
- Associated landscaping and public domain works, and

- Services and infrastructure improvements, as required.

The proposed penthouses include a rooftop terrace and private swimming pool.

2.2 Site and Noise Monitoring Locations

The site is bounded by Day Street to north, Anderson Street to the east, McIntosh Street to the south and pedestrian throughfare to the west. The Sydney Trains / Metro rail corridor is located 31m west of site and is partially underground as indicated in Figure 2-1 below.

Long-term and short-term noise and vibration monitoring have been undertaken on site to determine the existing acoustic environment. Figure 2-1 below shows location of noise surveys and surrounding noise sensitive neighbours.

Figure 2-1: Monitoring Locations and Site Surrounds

2.3 Nearby Noise Sensitive Receivers

The nearest noise-sensitive receivers to subject development have been identified as follows and indicated in Figure 2-1 above.

Table 2-1: Noise Sensitive Receiver Locations

Receiver ID	Address	Description
Residential Receivers		
R1	44 Anderson Street, Chatswood	3 storey residential flat north of site across Day Street
R2	3-5 Help Street and 28 Anderson Street, Chatswood	2 to 12 storey residential buildings to the south of site across McIntosh Street

Receiver ID	Address	Description
R3	1 Day Street, Chatswood	4 storey residential buildings to the west of site across public thoroughfare
Non-residential Receivers		
C1	43 Anderson Street, Chatswood	1 Storey Church building east of site across Anderson Street
C2	39-41 Anderson Street, Chatswood	2 storey commercial building east of site across Anderson Street

Notes.

1. Approximately from centre of development to receiver property boundary or 30m from the dwelling (whichever is further).

3 Ambient and Background Noise Surveys

3.1 Noise Surveys

The proposed development is potentially affected by road traffic noise from Anderson Street and airborne rail noise from rail corridor to the west of the site.

Environmental noise loggers were installed on the east and west boundary of site from 19/11/2024 to 26/11/2024 to measure the existing ambient and background noise surrounding the site. In addition, operator attended rail noise & vibration survey was conducted on the western site boundary nearest to the rail corridor on 26/11/2024. Noise and vibration monitoring locations are indicated in Figure 2-1 above.

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

The results of the background and ambient noise monitoring conducted on site are presented in APPENDIX B.

3.2 Measured Road Traffic and Rail Noise Levels

Road traffic and rail noise levels at the site were quantified using a combination of long-term noise logging and attended noise measurements.

The design noise levels are taken from the representative L_{Aeq} for the week for both the day time (7am to 10pm) and night time (10pm-7am) periods. The design external noise levels are presented Table 3-1 below.

Table 3-1: Day and Night Road Traffic and Rail Noise Levels

Monitoring Location	Survey Period	Measured Traffic Noise Levels over Day (15 hour) and Night (9 hour) Periods in dB(A)	
		$L_{Aeq, 15hour}$ [1]	$L_{Aeq, 9hour}$ [1]
L1 – Front yard of 40 Anderson Street at 3.5m from existing building on site (road traffic noise)	Day (7am to 10pm) 19/11/2024 to 26/11/2024	61	-
	Night (10pm to 7am) 19/11/2024 to 26/11/2024	-	55
L2 – Backyard of 2 Day Street at 1m from western site boundary[2] (airborne rail noise)	Day (7am to 10pm) 19/11/2024 to 26/11/2024	51	-
	Night (10pm to 7am) 19/11/2024 to 26/11/2024	-	45

Notes:

1. Noise levels presented are facade values.
2. Airborne rail noise was audible at Location L2

3.3 Site Ambient and Background Noise Level

The results of the long-term noise monitoring have been summarised in accordance with Noise Policy for Industry requirements published by NSW Environmental Protection Authority (EPA) and are presented in the following tables.

Table 3-2: Measured Site Background Noise Levels (L_{A90})

Noise Monitoring		Representative L_{A90} Background Noise Levels in dB(A)		
Location	**Duration**	**Day[1]**	**Evening[2]**	**Night[3]**
L1 – Front yard of 40 Anderson Street at 3.5m from existing building on site (road traffic noise)	19/11/2024 to 26/11/2024	47	46	37
L2 – Backyard of 2 Day Street at 1m from western site boundary (airborne rail noise)	19/11/2024 to 26/11/2024	45	43	38

Notes:

Day, Evening & Night assessment periods are defined in accordance NSW EPA's Industrial Noise Policy as follows.

1. Day is defined as 7:00am to 6:00pm, Monday to Saturday; 8:00am to 6:00pm Sundays & Public Holidays.
2. Evening is defined as 6:00pm to 10:00pm, Monday to Sunday & Public Holidays.
3. Night is defined as 10:00pm to 7:00am, Monday to Saturday; 10:00pm to 8:00am Sundays & Public Holidays

Table 3-3: Measured Site Ambient Noise Levels

Noise Monitoring		Representative L_{Aeq} Ambient Noise Levels in dB(A)		
Location	**Duration**	**Day[1]**	**Evening[2]**	**Night[3]**
L1 – Front yard of 40 Anderson Street at 3.5m from existing building on site (road traffic noise)	19/11/2024 to 26/11/2024	59	58	53
L2 – Backyard of 2 Day Street at 1m from western site boundary (airborne rail noise)	19/11/2024 to 26/11/2024	50	47	43

Notes:

Day, Evening & Night assessment periods are defined in accordance NSW EPA's Noise Policy for Industry as follows.

1. Day is defined as 7:00am to 6:00pm, Monday to Saturday; 8:00am to 6:00pm Sundays & Public Holidays. As results were affected by construction noise weekend day and Saturday morning, Sunday results have been presented for the Day time period
2. Evening is defined as 6:00pm to 10:00pm, Monday to Sunday & Public Holidays
3. Night is defined as 10:00pm to 7:00am, Monday to Saturday; 10:00pm to 8:00am Sundays & Public Holidays

The measured overall background (L_{A90}) and ambient (L_{Aeq}) noise levels obtained from location L1 & L3 and outlined in Table 3-2 and Table 3-3 are representative of surrounding neighbours and are used in defining external noise emission criteria from the development such as mechanical ventilation and air-conditioning, carpark activities in accordance with EPA Noise Policy for Industry (NPfI).

4 Acoustic Criteria

4.1 Rail and Road Traffic Noise Criteria

Table 3-1 below presents internal noise criteria recommended for this development which was based on the following documentations.

- State Environmental Planning Policy (Transport & Infrastructure) 2021
- Department of Planning publication "Development Near Rail Corridors & Busy Roads – Interim Guideline" 2008
- State Environmental Planning Policy No 65 – Design Qualify of Residential Flat Development (Amendment No. 3)"
- SEPP 65 Apartment Design Guide 2015
- Australian Standard AS2107:2016 "Recommended Design Sound Levels and Reverberation Times for Building Interiors"

The Department of Planning provides a guideline for assessing noise and vibration impacts on developments in proximity of busy roads and/or rail corridors to the requirements of the State Environmental Planning Policy (Transport & Infrastructure) 2021 or SEPP (T&I).

The internal noise criteria for this development as per SEPP (T&I) 2021 and DoP Guideline are presented in Table 4-1 below.

Table 4-1: Recommended Maximum Internal Road Traffic and Rail Noise Levels

Type of Occupancy	Windows & Doors Condition	Maximum Design Noise Levels	
		Day, L_{Aeq} (15hour)	Night, L_{Aeq} (9hour)
Sleeping areas	Closed	-	35dB(A)
	Open	-	45dB(A)
All other habitable rooms	Closed	40dB(A)	40dB(A)
	Open	-	50dB(A)
Bathrooms and en-suites [1]	Closed	45dB(A)	45dB(A)
	Open	55db(A)	55db(A)
Lobbies and communal areas [1]	Closed	50dB(A)	50dB(A)
Small retail stores (general) [1]	Closed	50dB(A)	-

Notes:

1. Design sound pressure levels for spaces not coved in the SEPP (T&I) or DoP Guideline are adopted from Australian Standard AS2107

Relevant sections of the State Environment Planning Policy, Australia Standard AS2107 are presented in APPENDIX A of this report. Results and location of the background and ambient noise monitoring conducted on site are presented in APPENDIX C.

4.2 Ground-borne Rail Noise

The Department of Planning's "Development near Rail Corridors & Busy Roads – Interim Guideline" 2008 provides recommended criteria for ground-borne or regenerated rail noise. Table 4-2 summaries these noise limits for sleeping and living spaces.

Table 4-2: Recommended Internal Noise Criteria for Ground-borne Rail Noise

Occupancy	Time Period	L_{ASmax} Noise Limit [1]
Living areas (includes open-plan kitchens, dining, family room, media and study rooms)	7am – 10pm	40 dB(A)
Sleeping areas	10pm – 7am	35 dB(A)

Notes: 1. L_{ASmax} – is a-weighted maximum sound pressure level measures using "Slow" response time

4.3 Rail Tactile Vibration

In addition to regenerated rail noise, Section 3.6.3 of the Department of Planning publication "Development Near Rail Corridors & Busy Roads – Interim Guideline", also provides recommended vibration criteria documents to refer to when establishing train vibration criteria for residential buildings.

1. Assessing Vibration: A technical guideline (DECC 2006)
2. German Standard DIN 4150, Part 3 1999
3. British Standard BS 7385 Part 2 1993
4. Australian Standard AS2670.2 1990

The above documents have been reviewed and the criterion for assessment tactile vibration from train pass-bys affecting the proposed development is quantified using:

- Assessing Vibration: A technical guideline (DECC 2006)
- British Standard BS6472:1992 "*Evaluation of Human Exposure to Vibration in Buildings (1Hz to 80Hz)*"

The criteria curves presented in BS6472:1992 are identical to those in Australian Standard AS2670.2 1990 and the International Standard 2631-2:1989.

Criteria for continuous vibration from the British Standard BS6472:1992 for residential spaces, offices and commercial workshop environments are shown in Figure 4-1 below.

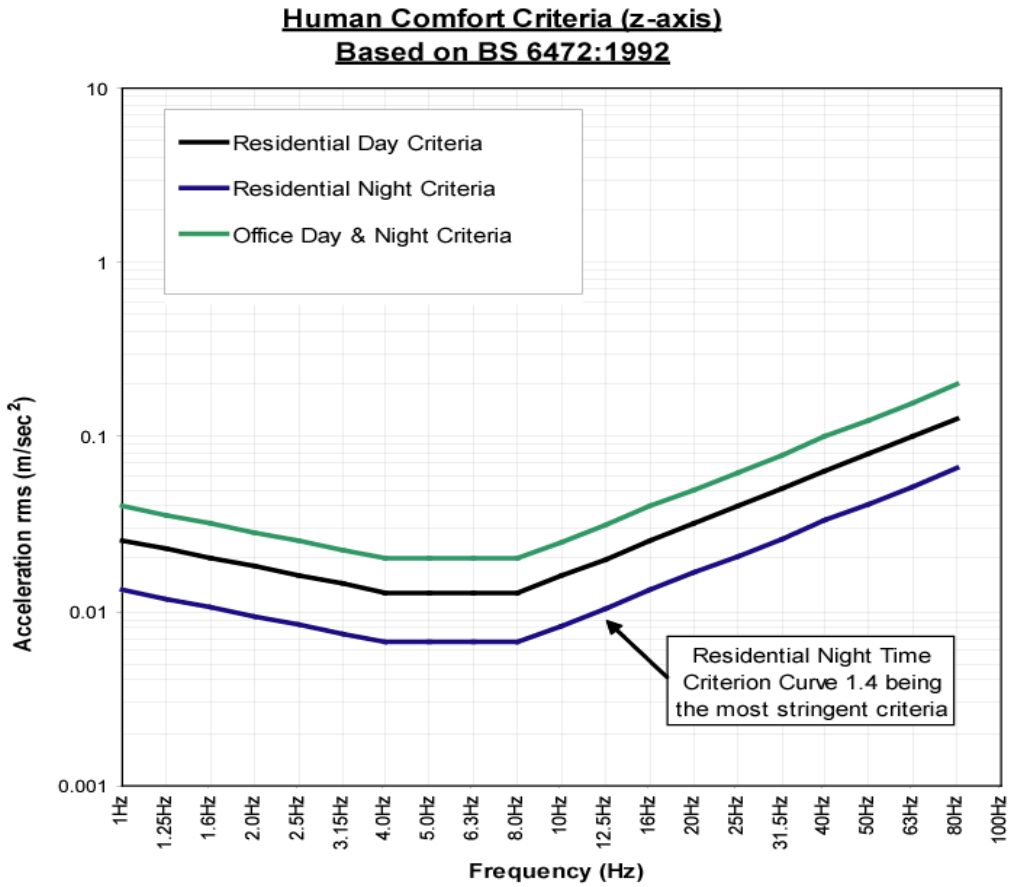

Figure 4-1:Tactile Vibration Criteria for Residential Buildings

Table 2.4 of the Department of Environment Climate Change and Water) document "Assessing Vibration: A technical guideline (DECCW 2006)" presents acceptable vibration dose values for intermittent vibration. Table 4-3 below outlines DECC's requirements.

Table 4-3: Acceptable VDVs for intermittent vibration in residential buildings m/s1.75

Location	Period	Preferred VDV m/s1.75
Residence	Day time (7am – 10pm)	0.20
	Night time (10pm – 7am)	0.13

5 Noise Intrusion Assessment

5.1 External Noise Sources

This section addresses external noise impacts on the proposed development being,

- Road traffic noise from Anderson Street to the east of the development and airborne rail noise from the Sydney Train and Metro rail corridor to west of the development.

The target interior noise levels from ingress of the above external sources have been defined in Table 3-1 in accordance with the applicable noise guidelines.

To meet the internal noise levels outlined Table 3-1 in the recommendations for glazing and façade are provided in Section 5.2 and 5.4 below.

5.2 Glazing Recommendations

Table 5-1 below presents recommended glazing treatment for the building facades to achieve compliance with the maximum noise levels nominated in Table 3-1 above.

Table 5-1: Recommended Glazing Treatment

Levels	Facades	Occupancy Type	Recommended Minimum Sound Insulation Rating of Glazing Assembly	Typical Compliance Glazing Thickness, Type and Configuration	Laboratory Test Reference
Podium					
Ground	All facades	Retails & lobbies	Rw25	4mm monolithic glass or equivalent	ESTIMATE
		Gym	Rw45	Double glazing 6.38mm laminated glass / 100mm air gap / 10.38mm laminated glass	ESTIMATE
Level 1	All facades	Gym	Rw45	Double glazing 6.38mm laminated glass / 100mm air gap / 10.38mm laminated glass	ESTIMATE
Tower A (Anderson Street)					
Level 2	North, east and south	Bedrooms	Rw27	6mm monolithic glass or equivalent	ESTIMATE
		Open plan living/dining/kitchen including media and study	Rw27	6mm monolithic glass or equivalent	ESTIMATE
		Communal spaces and lobbies	Rw25	4mm monolithic glass or equivalent	ESTIMATE
	West	Bedrooms	Rw25	4mm monolithic glass or equivalent	ESTIMATE

Levels	Facades	Occupancy Type	Recommended Minimum Sound Insulation Rating of Glazing Assembly	Typical Compliance Glazing Thickness, Type and Configuration	Laboratory Test Reference
		Open plan living/dining/kitchen including media and study	Rw25	4mm monolithic glass or equivalent	ESTIMATE
		Communal spaces and lobbies	Rw25	4mm monolithic glass or equivalent	ESTIMATE
Level 3 to 39	North, east and south	Bedrooms	Rw27	6mm monolithic glass or equivalent	ESTIMATE
		Open plan living/dining/kitchen including media and study	Rw27	6mm monolithic glass or equivalent	ESTIMATE
		Lobbies	Rw25	4mm monolithic glass or equivalent	ESTIMATE
	West	Bedrooms	Rw25	4mm monolithic glass or equivalent	ESTIMATE
		Open plan living/dining/kitchen including media and study	Rw25	4mm monolithic glass or equivalent	ESTIMATE
		Lobbies	Rw25	4mm monolithic glass or equivalent	ESTIMATE
Tower M (McIntosh Street)					
Ground	All facades	Retails & lobbies	Rw25	4mm monolithic glass or equivalent	ESTIMATE
Level 1	All facades	Retails, communal spaces and lobbies	Rw25	4mm monolithic glass or equivalent	ESTIMATE
Level 2	All facades	Bedrooms	Rw25	4mm monolithic glass or equivalent	ESTIMATE
		Open plan living/dining/kitchen including media and study	Rw25	4mm monolithic glass or equivalent	ESTIMATE
		Communal spaces and lobbies	Rw25	4mm monolithic glass or equivalent	ESTIMATE
Levels 3 to 22	All facades	Bedrooms	Rw25	4mm monolithic glass or equivalent	ESTIMATE
		Open plan living/dining/kitchen including media and study	Rw25	4mm monolithic glass or equivalent	ESTIMATE
		Lobbies	Rw25	4mm monolithic glass or equivalent	ESTIMATE

By way of explanation, the Sound Insulation Rating Rw is a measure of the noise reduction property of the partition, a higher rating implying a higher sound reduction performance.

Note that the Rw rating of systems measured as built on site (R'w Field Test) may be up to 5 points lower than the laboratory result.

Levels	Facades	Occupancy Type	Recommended Minimum Sound Insulation Rating of Glazing Assembly	Typical Compliance Glazing Thickness, Type and Configuration	Laboratory Test Reference

LEGEND where no appropriate test certificate exists:

1. ESTIMATE: The client is advised not to commence detailing or otherwise commit to partition construction systems which have not been tested in an approved laboratory or for which an opinion only is available. Testing of partition construction systems is a component of the quality control of the design process and should be viewed as a priority because there is no guarantee the forecast results will be achieved thereby necessitating the use of an alternative which may affect the cost and timing of the project. No responsibility is taken for use of or reliance upon untested partition construction systems, estimates or opinions. The advice provided here is in respect of acoustics only.
2. ESTIMATE – APPROVED FOR CONSTRUCTION: Use of the form of construction is approved prior to laboratory certification. To complete the quality control of the design process and confirm the acoustical performance of the construction, we recommend testing in a laboratory to confirm the Rw rating as soon as practicable. In the case of impact rating for floor systems, no particular impact rating is guaranteed to comply with either the Building Code of Australia or Strata Scheme Management Act and hence carpet runners may still be required.
3. ESTIMATE – TEST NOT REQUIRED: Use of the form of construction is approved without laboratory certification. The STC/Rw of the form of construction exceeds the project requirements.
4. The advice provided here is in respect of acoustics only. Supplementary professional advice may need to be sought in respect of fire ratings, structural design, buildability, fitness for purpose and the like.

NOTES FOR GLAZING CONSTRUCTIONS:

5. The information in this table is provided for the purpose of Council approvals process and cost planning and shall not be used for construction unless otherwise approved in writing by the acoustic consultant.
6. The design in this table is preliminary and a comprehensive assessment shall be conducted prior to Construction Certification.
7. 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.
8. The glazing supplier shall ensure that installation techniques will not diminish the Rw performance of the glazing when installed on site.
9. All openable glass windows and doors shall incorporate full perimeter acoustic seals equivalent to Q-Lon, which enable the Rw rating performance of the glazing to not be reduced.
10. 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.

GENERAL

11. The sealing of all gaps in partitions is critical in a sound rated construction. Use only sealer approved by the acoustic consultant.
12. Check design of all junction details with acoustic consultant prior to construction.
13. Check the necessity for HOLD POINTS with the acoustic consultant to ensure that all building details have been correctly interpreted and constructed.
14. The information provided in this table is subject to modification and review without notice.
15. The advice provided here is in respect of acoustics only. Supplementary professional advice may need to be sought in respect of fire ratings, structural design, buildability, fitness for purpose and the like.

5.3 Building Ventilation

Table 5-2 below shows the assessment of external noise intrusion to the "Windows Open" noise criteria nominated in Table 4-1 above.

Table 5-2: Noise Assessment to Windows Open Criteria at Worst Affected Facades

Period	Room/Occupancy	Predicted Noise Level in dB(A)		Windows Open Internal Noise Criteria $L_{Aeq,}$	Compliance (Yes/No)
		At Worst Affected facade	Inside Apartment with Windows Open, L_{Aeq}		
East Tower (Anderson Street)					
Day	Open plan Living/Dining/Kitchen	61	49	50	Yes

Period	Room/Occupancy	Predicted Noise Level in dB(A)		Windows Open Internal Noise Criteria $L_{Aeq,}$	Compliance (Yes/No)
		At Worst Affected facade	Inside Apartment with Windows Open, L_{Aeq}		
Night	Bedrooms	55	43	45	Yes
West Tower					
Day	Open plan Living/Dining/Kitchen	54	42	50	Yes
Night	Bedrooms	48	36	45	Yes

Notes:

1. Noise levels presented are facade values.

Based on results of our long-term noise surveys, our calculations have shown the internal noise levels will comply with the "Windows Open" scenario outlined in Table 4-1 for worst affected habitable rooms. Therefore, all residential spaces within development can be naturally ventilated and achieving compliance with internal noise levels outlined in Table 4-1 above.

5.4 Facade & Roof Sound Insulation

In principle advice is provided below for the acoustic requirements of the roofs and external walls.

5.4.1 External Walls

All external walls shall have sound isolation ratings, $R_{w,}$ of at least 15dB higher acoustic performance than that of the acoustic glazing specified in Table 5-1 above.

This will typically be achieved for external walls having masonry elements. Detailed acoustic design of light weight cladding systems to be conducted at CC stage.

5.4.2 Roof and Ceiling

Roof/ceiling construction shall have a sound isolation rating, R_w, at least 10dB higher than that of the acoustic glazing on its facade walls.

This will typically be achieved for roof systems consisting of concrete slab without need for further acoustic upgrade.

5.4.3 Glazing Assembly Requirements

The following acoustic measures should also be incorporated into the building design:

s1. All operable glass windows and doors shall incorporate full perimeter acoustic seals equivalent to Q-Lon, which enable the R_w rating performance of the glazing to not be reduced.

s2. The glazing thicknesses outlined in Table 5-1 should be considered the minimum thicknesses to achieve acoustical ratings. Greater glazing thicknesses may be required for structural loading, wind loading etc.

s3. The glazing supplier shall ensure that installation techniques will not diminish the R_w performance of the glazing when installed on site. Sliding door meeting stiles should form an airtight seal when closed and locked.

s4. The perimeter of all window and door frames are to be sealed airtight in the external facade using the following methods:

- For gaps less than 10mm - Fill all gaps around the window perimeter with an acoustic mastic sealer (minimum specific gravity 1.6sg) equivalent to Promat Promaseal. The depth of sealer shall be at least equal to the width of the gap.
- If the gap is greater than 10mm, fill the cavity with polyester insulation and a backing rod. Seal the gap airtight an acoustic mastic sealer (min specific gravity 1.6sg) equivalent to Promat Promaseal. The depth of sealer shall be at least equal to the width of the gap. The gaps between frames shall also be sealed using aluminium angle brackets (approximately 25 x 25 x 3mm).

6 Train Vibration & Ground-borne Noise Assessment

6.1 Train Vibration Measurement Location

An operator-attended rail vibration survey was conducted on site at approximately 1.1m setback from the site western boundary (Location V1) as indicated in Figure 2-1 on Tuesday 26/11/2024 from 11:50am to 1pm. The rail corridor runs parallel to site western boundary and is approximately 31m west of the site. The monitoring location V1 is closer to the rail corridor than proposed building footprint, which is typically setback 3m from the site boundaries, thus measurements obtained are conservative.

The vibration survey captured commuters operating on the Sydney Trains T1 & T9 lines between Chatswood and Roseville and Metro trains operating between Chatswood and North Ryde. Fast and slow response measurements of train by-pass were measured.

6.1.1 Instrumentation

Train vibration levels were measured using the Sinus SoundBook multi-channel analyser and three PCB accelerometers (x, y & z) which is fixed atop a steel disc/spike hammered into the ground.

The weather conditions were fine and sunny during the site visit. All instruments were calibrated before and after measurement. No significant drift in calibration was observed.

6.2 Tactile Train Vibration Assessment

Results of the train vibration survey (fast response measurements) at Location V1 were plotted against night and day criterion of British Standard BS6472-1992 "Evaluation of Human Exposure to Vibration in Buildings (1Hz to 80Hz)" as show in Figure 6-1 and Figure 6-2 below. In addition, the measured train vibration levels were used to calculate the vibration dosage values (VDV) and then compared to the acceptable levels from the Table 2.4 of DECC guideline.

The graphs below demonstrate that the floor induced vibration within the proposed building from each of the measured train pass-bys complied with the British Standard BS6472:1997 for human comfort in a residential environment during the day and night. Similarly, the calculated vibration dosage values (VDV) from our measurements complied with the preferred day and night VDV criterion as defined in the DECC guideline.

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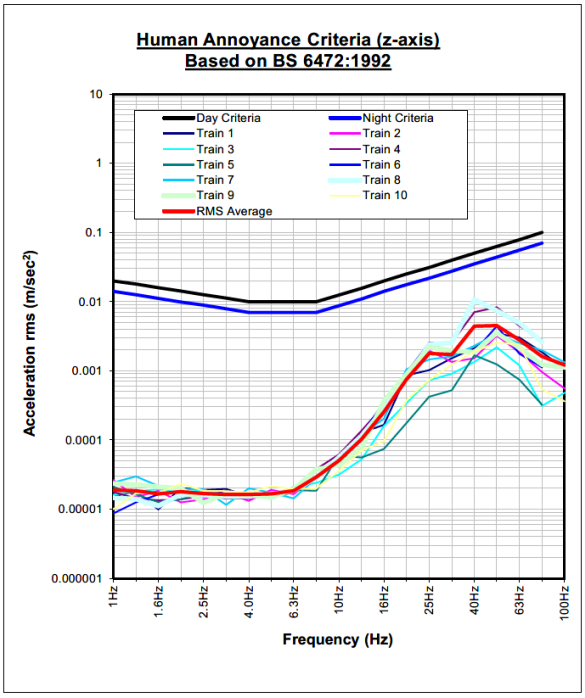
Vibration Survey Results

Vibration Assessment for Human Annoyance BS6472-1992 & DECCW

Project No.:	TP150-01
Location:	V1: Backyard of 2 Day St, Chatswood at 1.1m from site western boundary
Source:	Sydney Train commuter trains on the T1 & T9 Lines, and Metro trains on the Metro North West Line

Assessment Location:	Residential	Axis	Z	Total secs of Vib per Day (t):	18,607
Type of Vibration:	Intermittent			Total secs of Vib per Night (t):	4,324



Legend														
Measurement		Train 1	Train 2	Train 3	Train 4	Train 5	Train 6	Train 7	Train 8	Train 9	Train 10	RMS Ave	Preferred DECCW Criterion	Maximum DECCW Criterion
Acceleration rms (m/sec²)	1Hz	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		
	1.25Hz	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		
	1.6Hz	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		
	2.0Hz	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		
	2.5Hz	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		
	3.15Hz	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		
	4.0Hz	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		
	5.0Hz	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		
	6.3Hz	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		
	8.0Hz	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		
	10Hz	0.0001	0.0000	0.0000	0.0001	0.0001	0.0001	0.0000	0.0001	0.0000	0.0000	0.0001		
	12.5Hz	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001		
	16Hz	0.0002	0.0003	0.0002	0.0003	0.0001	0.0004	0.0002	0.0003	0.0004	0.0001	0.0003		
	20Hz	0.0009	0.0007	0.0003	0.0008	0.0002	0.0009	0.0011	0.0008	0.0009	0.0004	0.0007		
	25Hz	0.0010	0.0020	0.0007	0.0026	0.0004	0.0025	0.0015	0.0024	0.0022	0.0007	0.0018		
	31.5Hz	0.0015	0.0013	0.0009	0.0026	0.0005	0.0018	0.0016	0.0026	0.0020	0.0012	0.0017		
	40Hz	0.0021	0.0015	0.0013	0.0071	0.0017	0.0019	0.0023	0.0107	0.0019	0.0019	0.0044		
	50Hz	0.0035	0.0032	0.0022	0.0083	0.0012	0.0044	0.0034	0.0074	0.0035	0.0026	0.0045		
	63Hz	0.0030	0.0019	0.0012	0.0044	0.0007	0.0018	0.0025	0.0049	0.0022	0.0024	0.0028		
	80Hz	0.0019	0.0010	0.0003	0.0028	0.0003	0.0011	0.0020	0.0026	0.0012	0.0005	0.0016		
	100Hz	0.0011	0.0006	0.0005	0.0020	0.0006	0.0008	0.0013	0.0023	0.0011	0.0004	0.0012		
Weighted rms	Day	0.0010	0.0010	0.0006	0.0023	0.0005	0.0013	0.0011	0.0028	0.0012	0.0008	0.0014	0.0100	0.0200
	Night	0.0010	0.0010	0.0006	0.0023	0.0005	0.0013	0.0011	0.0028	0.0012	0.0008	0.0014	0.0070	0.0140
eVDV	Day	0.0169	0.0168	0.0098	0.0380	0.0075	0.0217	0.0181	0.0450	0.0198	0.0126	0.0235	0.20	0.40
	Night	0.0117	0.0117	0.0068	0.0264	0.0052	0.0150	0.0126	0.0313	0.0137	0.0087	0.0163	0.13	0.26

NOTE: Red indicates exceedence of Preferred DECCW Criterion
NOTE: Gray indicates continous vibration levels and criteria if intermittent criteria is selected

QTS-01 Human Annoyance Vibration Assessment BS6472-DECCW (r13)

Figure 6-1:Vibration Assessment for Human Annoyance BS6472 in Vertical Plane

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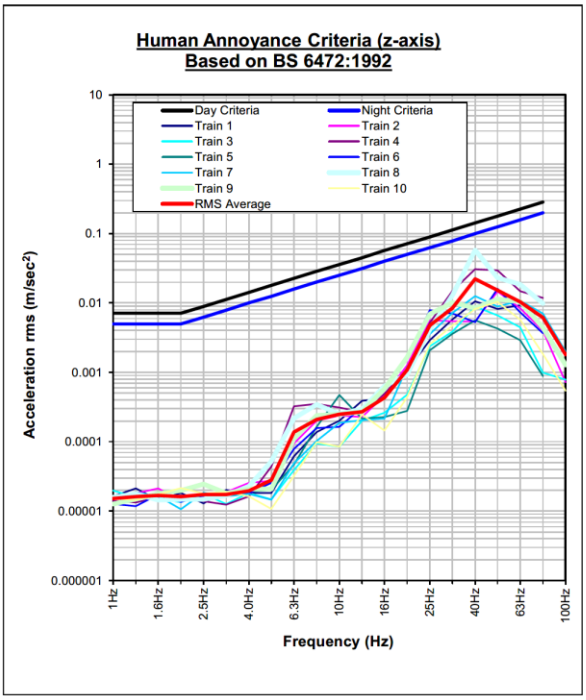
Vibration Survey Results

Vibration Assessment for Human Annoyance BS6472-1992 & DECCW

Project No.:	TP150-01
Location:	V1: Backyard of 2 Day St, Chatswood at 1.1m from site western boundary
Source:	Sydney Train commuter trains on the T1 & T9 Lines, and Metro trains on the Metro North West Line

Assessment Location:	Residential	Axis	X&Y	Total secs of Vib per Day (t):	18,607
Type of Vibration:	Intermittent			Total secs of Vib per Night (t):	4,324



Legend														
Measurement		Train 1	Train 2	Train 3	Train 4	Train 5	Train 6	Train 7	Train 8	Train 9	Train 10	RMS Ave	Preferred DECCW Criterion	Maximum DECCW Criterion
Acceleration rms (m/sec²)	1Hz	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		
	1.25Hz	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		
	1.6Hz	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		
	2.0Hz	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		
	2.5Hz	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		
	3.15Hz	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		
	4.0Hz	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		
	5.0Hz	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000		
	6.3Hz	0.0001	0.0001	0.0000	0.0003	0.0000	0.0001	0.0000	0.0002	0.0001	0.0000	0.0001		
	8.0Hz	0.0001	0.0002	0.0001	0.0004	0.0002	0.0002	0.0001	0.0003	0.0002	0.0001	0.0002		
	10Hz	0.0002	0.0002	0.0001	0.0003	0.0005	0.0002	0.0002	0.0003	0.0002	0.0001	0.0002		
	12.5Hz	0.0004	0.0002	0.0002	0.0003	0.0002	0.0003	0.0002	0.0003	0.0003	0.0002	0.0003		
	16Hz	0.0004	0.0005	0.0003	0.0005	0.0002	0.0006	0.0002	0.0006	0.0006	0.0001	0.0004		
	20Hz	0.0011	0.0013	0.0005	0.0011	0.0003	0.0016	0.0012	0.0009	0.0016	0.0004	0.0011		
	25Hz	0.0029	0.0056	0.0024	0.0052	0.0021	0.0079	0.0036	0.0041	0.0069	0.0026	0.0047		
	31.5Hz	0.0058	0.0054	0.0039	0.0149	0.0036	0.0071	0.0072	0.0130	0.0102	0.0047	0.0084		
	40Hz	0.0106	0.0054	0.0089	0.0308	0.0056	0.0053	0.0126	0.0580	0.0084	0.0082	0.0221		
	50Hz	0.0082	0.0146	0.0066	0.0295	0.0043	0.0160	0.0089	0.0231	0.0113	0.0104	0.0152		
	63Hz	0.0093	0.0084	0.0045	0.0148	0.0029	0.0073	0.0108	0.0186	0.0105	0.0057	0.0103		
	80Hz	0.0061	0.0040	0.0010	0.0119	0.0009	0.0037	0.0071	0.0098	0.0044	0.0018	0.0062		
	100Hz	0.0018	0.0007	0.0008	0.0025	0.0005	0.0010	0.0020	0.0039	0.0013	0.0005	0.0018		
Weighted rms	Day	0.0008	0.0009	0.0006	0.0023	0.0005	0.0011	0.0010	0.0032	0.0011	0.0007	0.0015	0.0071	0.0140
	Night	0.0008	0.0009	0.0006	0.0023	0.0005	0.0011	0.0010	0.0032	0.0011	0.0007	0.0015	0.0050	0.0100
eVDV	Day	0.0138	0.0150	0.0102	0.0372	0.0075	0.0177	0.0162	0.0530	0.0184	0.0117	0.0241	0.20	0.40
	Night	0.0096	0.0104	0.0071	0.0258	0.0052	0.0123	0.0112	0.0368	0.0128	0.0081	0.0168	0.13	0.26

NOTE: Red indicates exceedence of Preferred DECCW Criterion
NOTE: Gray indicates continous vibration levels and criteria if intermittent criteria is selected

QTS-01 Human Annoyance Vibration Assessment BS6472-DECCW (r13)

Figure 6-2: Vibration Assessment for Human Annoyance BS6472 in Horizontal Plane

The assessments above demonstrated that ground vibration from each of the measured train pass-bys at the location nearest to the rail corridor (Location V1) complied with day and night criteria in the British Standard BS6472:1992 for human comfort in residential environments.

6.3 Ground-borne Rail Noise Assessment

Regenerated or ground-borne rail noise is the low rumble heard inside buildings with vicinity of railway tunnels or railway tracks due to ground vibration generated by passing trains which propagate through soil and rock up into building elements such as foundation, wall and floors which re-radiates as audible sound.

6.3.1 Predicted Ground-borne Noise inside Proposed Building

Vibration levels from Sydney Trains commuter trains operating on the T1 & T9 Lines and Metro trains operating on the North-West Metro Line were measured on site on Tuesday 26/11/2024 were used to predict the regenerated rail noise inside the proposed building. These calculated noise levels inside the basement, podium levels and apartment floors are summarised in Table 6-1 below and compared to ground-borne noise criteria defined in Table 4-2. Slow response vibration measurements were used for the ground-borne noise prediction.

Table 6-1: Predicted Ground-borne Noise Levels Inside Proposed Development

Floor Level	Proposed Occupancy/Space	Calculated [1] Ground-borne Rail Noise	DOP Criteria for Ground-borne Rail Noise	Comply? (Yes/No)
Level 3 and above	Living, Dining and Kitchen areas	Less than 25 dB(A)	40 dB(A)	Yes
	Bedrooms	Less than 25 dB(A)	35 dB(A)	Yes
Level 2	Living, Dining and Kitchen areas	27 dB(A)	40 dB(A)	Yes
	Bedrooms	27 dB(A)	35 dB(A)	Yes
	Communal indoor spaces	27 dB(A)	N/A	N/A
Level 1	Retail tenancies	29 dB(A)	N/A	N/A
Ground floor	Retail tenancies and lobby	32 dB(A)	N/A	N/A
Basement Levels 1 to 7	Carpark	30 to 36 dB(A)	N/A	N/A

Notes:

1. Ground-borne noise calculations were based upon the measured $L_{Max\ (Slow)}$ of 95% of train pass-events as per DOP Guideline 2008.

The above assessment demonstrates ground-borne rail noise inside habitable rooms of the development due train pass-bys on the adjoining rail corridor (Syndey Trains T1 & T9 Lines and Metro North-West Line) to comply with the $L_{Amax\ (Slow)}$ criteria stipulated in the DOP Guideline 2008.

7 Noise Emission Assessment

This section examines noise emission from the development and their potential impacts on surrounding neighbours and noise-sensitive occupancies within the development.

7.1 Noise Emission Criteria

7.1.1 EPA Noise Policy for Industry (NPfI) – Plant and Equipment Noise

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

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

- Controlling intrusive noise impacts in the short term for residences; and
- Maintaining noise level amenity for particular land uses for residences and other land uses.

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

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

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

Table 7-1: NPfI Amenity Noise Levels - Recommended L_{Aeq} Amenity Noise Levels from Industrial Noise Sources [EPA NPfI Table 2.1]

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

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

Notes:

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

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

1. In areas with high traffic noise levels (see Section 2.4.1 of the NPfI).
2. In proposed developments in major industrial clusters (see Section 2.4.2 of the NPfI).
3. Where the resultant project amenity noise level is 10dB, or more, lower than the existing industrial noise level. In this case the project amenity noise levels can be set at 10dB below existing industrial noise levels if it can be demonstrated that existing industrial noise levels are unlikely to reduce over time.
4. Where cumulative industrial noise is not a necessary consideration because no other industries are present in the area, or likely to be introduced into the area in the future. In such

cases the relevant amenity noise level is assigned as the project amenity noise level for the development.

The following table below presents the site-specific noise production criteria from industrial noise sources, namely mechanical plant noise to neighbouring residential properties (R1 and R2) identified in Section 2 and Figure 2-1.

Table 7-2: Project noise trigger levels for noise emission from mechanical plant to residential neighbours (R1 & R2)

Time of Day	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7	Column 8	Column 9
	Rating Background Level (RBL) L_{A90}	Intrusiveness Trigger Level, $L_{Aeq, 15minute}$ (RBL+5)	Recommended Amenity Noise Level (RANL), $L_{Aeq, period}$	Project Amenity Noise Level (PANL), $L_{Aeq, period}$	Measured $L_{Aeq, period}$ existing noise levels	Traffic noise exceed RANL by more than 10dB?	Existing noise level likely to decrease in future?	Exceptions to PANL $L_{Aeq, period}$?	Project Noise Trigger Level, $L_{Aeq, 15minute}$
Day (7am to 6pm)	47	52	55	50	59	No	No	None	52
Evening (6pm to 10pm)	46	51	45	40	58	Yes	No	None	43
Night (10pm to 7am)	37	42	40	35	53	Yes	No	None	38

Explanatory notes:

Column 1 – RBL measured in accordance with the NPfI and outlined in the results of the long-term noise monitoring has been summarised in accordance with NPfI requirements and are presented in The results of the long-term noise monitoring have been summarised in accordance with Noise Policy for Industry requirements published by NSW Environmental Protection Authority (EPA) and are presented in the following tables.

Table 3-2 above. Where the evening time criterion is greater than the daytime criterion, the evening time goal is amended to be the same as the daytime criteria.

Column 4 – Project Amenity Noise Level determined based on 'Residential - Suburban' area in Table 2.2 (Amenity noise levels) of the EPA's NPfI minus 5dB

Column 5 – Measured in accordance with the NPfI

Column 8 - Determined in accordance with Section 2.4 of the NPfI.

Column 9 – Project Noise Trigger Level is the lower value of project intrusiveness noise level and project amenity noise level. In accordance with Section 2.2 of the NPfI, $L_{Aeq, 15minute}$ is calculated as $L_{Aeq, period}$ + 3dB(A)

Notes: Intrusiveness noise level for Evening must be set at no greater than the intrusiveness level for daytime in accordance with NPfI Section 2.3.

The following table below presents the site-specific noise production criteria from industrial noise sources, namely mechanical plant noise to neighbouring residential properties (R3) identified in Section 2 and Figure 2-1.

Table 7-3: Project noise trigger levels for noise emission from mechanical plant to residential neighbours (R3)

Time of Day	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7	Column 8	Column 9
	Rating Background Level (RBL) L_{A90}	Intrusiveness Trigger Level, $L_{Aeq, 15minute}$ (RBL+5)	Recommended Amenity Noise Level (RANL), $L_{Aeq, period}$	Project Amenity Noise Level (PANL), $L_{Aeq, period}$	Measured $L_{Aeq, period}$ existing noise levels	Traffic noise exceed RANL by more than 10dB?	Existing noise level likely to decrease in future?	Exceptions to PANL $L_{Aeq, period}$?	Project Noise Trigger Level, $L_{Aeq, 15minute}$
Day (7am to 6pm)	45	50	55	50	50	No	No	None	50
Evening (6pm to 10pm)	43	48	45	40	47	No	No	None	43
Night (10pm to 7am)	38	43	40	35	43	No	No	None	38

Explanatory notes:

Column 1 – RBL measured in accordance with the NPfI and outlined in the results of the long-term noise monitoring has been summarised in accordance with NPfI requirements and are presented in The results of the long-term noise monitoring have been summarised in accordance with Noise Policy for Industry requirements published by NSW Environmental Protection Authority (EPA) and are presented in the following tables.

Table 3-2 above. Where the evening time criterion is greater than the daytime criterion, the evening time goal is amended to be the same as the daytime criteria.

Column 4 – Project Amenity Noise Level determined based on 'Residential - Suburban' area in Table 2.2 (Amenity noise levels) of the EPA's NPfI minus 5dB

Column 5 – Measured in accordance with the NPfI

Column 8 - Determined in accordance with Section 2.4 of the NPfI.

Column 9 – Project Noise Trigger Level is the lower value of project intrusiveness noise level and project amenity noise level. In accordance with Section 2.2 of the NPfI, $L_{Aeq, 15minute}$ is calculated as $L_{Aeq, period}$ + 3dB(A)

Notes: Intrusiveness noise level for Evening must be set at no greater than the intrusiveness level for daytime in accordance with NPfI Section 2.3.

The following table below presents the site-specific noise production criteria from industrial noise sources, namely mechanical plant noise to neighbouring non-residential properties (C1 & C2) identified in Section 2 and Figure 2-1.

Table 7-4: Project noise trigger level for noise emission from mechanical plant to non-residential neighbours (C1 & C2)

Assessment / Receiver location	Intrusiveness criteria, $L_{Aeq,15min}$			Amenity criteria, $L_{Aeq, period}$ in dB(A)		
	Day	Evening	Night	Day	Evening	Night
Church west of development across Anderson Street (C1)	N/A	N/A	N/A	40 – Internally (when in use) and/or 50 – Externally[1] (when in use)		
Commercial building west of development across Anderson Street (C2)	N/A	N/A	N/A	65 (when in use)		

Notes:

1. Typical noise reduction through an open window is 10dB

Where necessary, noise amelioration treatment to mechanical plant such as carpark exhaust fans and air conditioning systems will be incorporated in the design to ensure that noise levels comply with the recommended NPfI noise emission criteria defined in Table 7-2, Table 7-3, and Table 7-4 above.

7.1.2 Sleep Disturbance Noise Levels (10pm-7am)

The potential for sleep disturbance from maximum noise level events from premises during the night-time period (between 10pm and 7am next day) needs to be considered. In accordance with NPfI, a detailed maximum noise level event assessment should be undertaken where the subject development night-time noise levels at a residential location exceed:

- $L_{Aeq,15min}$ 40dB(A) or the prevailing RBL plus 5dB, whichever is the greater, and/or
- L_{AFmax} 52dB(A) or the prevailing RBL plus 15dB, whichever is the greater.

Where there are noise events found to exceed the initial screening level, further analysis is undertaken to identify:

- The likely number of events that might occur during the night assessment period,
- The extent to which the maximum noise level exceeds the rating background noise level.

The sleep disturbance noise levels for the project are presented below.

Table 7-5: Sleep Disturbance Assessment Levels

Receiver Type	Assessment Level $L_{Aeq,15min}$ in dB(A)	Assessment Level L_{AFmax} in dB(A)
Residential receivers R1 & R2	37 + 5 = 42	37 + 15 = 52
Residential receivers R3	38 + 5 = 43	38 + 15 = 53

Notes:

1. Based on representative background noise levels presented in Table 3-2

7.2 Assessment of Noise Emissions

7.2.1 Mechanical Plant Noise

Mechanical plant such as carpark exhaust systems and air-conditioning associated with the development has the potential to impact on nearby residential and commercial properties. As details of mechanical plant and equipment such as location, quantity, make & model are not available at this stage of the development the following in principle noise control advice is provided.

- Acoustic assessment of mechanical services will be required to be undertaken during the detail design phase of the development to ensure that they shall not either singularly or in total emit noise levels which exceed the noise limits in established Table 7-2, Table 7-3, and Table 7-4 above.
- Mechanical plant noise emission can be controllable by appropriate mechanical system design and implementation of common engineering methods that may include any of the following;
  - procurement of 'quiet' plant

- strategic positioning plant equipment away from sensitive neighbouring premises, maximising the intervening shielding between the plant and sensitive neighbouring premises
- installation of commercially available silencers or acoustic attenuators for air discharge and air intakes of plant
- acoustically lined and lagged ductwork
- provide acoustic screens and/or acoustic louvres between plant and sensitive neighbouring premises
- provide partially enclosed or fully enclosed acoustic enclosure over plant
- Mechanical plant shall have their noise specifications and proposed locations checked prior to installation
- Fans shall be mounted on vibration isolators and balanced in accordance with Australian Standard 2625 "Rotating and Reciprocating Machinery - Mechanical Vibration"

7.2.1.1 Compliance Certification

s1. The levels shall be measured using a sound level meter complying with AS 1259, Part 2 – Sound Level Meters, Type 1 – Precision.

s2. Internal noise compliance tests shall be conducted over a 1-minute period with all plant operating at normal rated speed. The ambient noise level shall also be obtained with all plant turned off. The measurements shall be carried out when ambient noise levels are sufficiently low to obtain a valid measurement and corrected for the ambient noise level. The noise level contribution from all plant when operating in isolation or in combination with any other plant shall not exceed the criteria in Section 4.

s3. An allowance of 3 dB(A) (subtracted from the noise level contribution determined in accordance with the preceding clause) may be applied when measurements are made in rooms which are uncarpeted for the time being. However, this does not preclude the Sub-Contractor from complying with the requirements of Section 4 when the rooms are finally carpeted.

s4. Where both mechanical and hydraulic plant noise are audible, the total noise level from all plant operating shall include noise contribution from all mechanical and all hydraulic plant running contemporaneously at normal rated speed.

s5. Noise levels shall be conducted in typical spaces on every level within the building as directed by the Principal's acoustic consultant.

s6. External noise compliance measurements shall be conducted over a 15-minute period with all plant operating at normal rated speed. The ambient noise level will all plant turned off

shall be measured immediately after. Measurements shall only be conducted when ambient noise levels are sufficiently low to obtain a valid measurement and shall be corrected for the ambient noise level. The noise contribution from all measured mechanical services plant when operating in isolation or in combination with any other plant shall not exceed the criteria in Section 7.1.

s7. The external noise emission criteria specified in Section 7.1 are applicable at any boundary or other noise sensitive location as determined by the Principal's acoustic consultant.

s8. Where the ambient external noise level prevents noise levels being measured at the boundary of nearby affected premises, extrapolation of measurements closer to the noise source is permitted.

s9. The Principal reserves the right to test plant noise emission and noise intrusion in order to determine their conformance with each of the criteria nominated in this specification.

s10. A Noise Compliance Report detailing the results of mechanical plant noise levels measured in accordance with this specification shall be presented to the Principal.

7.2.2 Operational Noise

The usage of the communal amenities such gym and has potential to impact residences within the development, the following mitigation measures are recommended.

7.2.2.1 Gym (Podium Ground and Level 1)

Structure-borne noise associated with impacts such as dropping weights and loud music/instructor vocals from usage of the gym has the potential to cause disturbances to noise-sensitive spaces within the development and external neighbours. To mitigate the transfer of structure-borne and airborne noise to adjoining spaces, and breakout noise to external environment, the following in-principle acoustic treatment are recommended.

Control of Airborne Noise Transfer to Apartments Above

s1. Provide an acoustic ceiling to Level 1 of the gym consisting of 2 layers of 13mm sound-rated plasterboard suspended a minimum 200mm off slab soffit using resilient hangers with minimum 100mm insulation in ceiling cavity. Services such as A/C duct work to be installed in a false ceiling beneath the acoustic ceiling. No acoustic requirement is required for the ground floor ceiling.

s2. Concrete slab separating the Level 2 apartments and the gym shall be minimum 200mm thick.

Control of Breakout Noise to External Environment

s1. External walls of the gym (ground floor and level 1) shall have a minimum sound reduction index of Rw50 typically achieved using masonry with internal plasterboard wall lining or lightweight construction consisting of 2 layers of sound-rated plasterboards internally, 92mm steel stud framing, 90mm insulation and 1 layer of 6mm Villaboard and cladding externally.

s2. Glazed external walls of the gym on ground and Level 1 shall have a minimum sound reduction index of Rw45 typically achieved using double glazing.

s3. External doors accessing Level 1 terrace should have minimum sound reduction index of Rw40 typically achieved using acoustic laminate or double glazing with full perimeter seals.

s4. Level 1 terrace access doors shall not be located on the western façade.

Control of Vibration/Structure-borne Noise to Apartments above

s5. Table 7-6 below outlines the recommended acoustic treatment to the floor of the gym fit-out to prevent vibration and structure-borne noise intrusions to the adjoining noise-sensitive spaces.

Table 7-6: Typical acoustic treatment of gym floors and equipment

Occupancy / Activity	Floor Treatment
Cardio area	Provide minimum 10mm thick rubber pads or isolation pads such as Getzner g-fit Gear T300 treadmill isolation pads underneath treadmills, elliptical cross trainers and upright cycles
General exercise area	Install minimum 10mm thick rubber underlay over concrete slab. Where synthetic grass used, the 10mm rubber underlay is to be install underneath the synthetic grass.
Group exercise room	Install minimum 25mm thick acoustic rubber tiles equivalent to Tarkett Droptile over concrete slab.
Pin-loaded machine area	Install minimum 50mm thick acoustic rubber tiles equivalent to Regupol Sonusfit M513 over concrete slab. In addition, install of coil springs beneath the weight stacks in the pin-weight machines to prevent the sudden impact of weights falling on the supporting steel frame.
Free-weight area	Install sprung floor system such as the Embelton damped NXS spring system consisting of, - 1 layer of 15mm Embelton Impact Tile loose laid over - 1 layer of 30mm Embelton Olympmat loose laid over - 2 layers of structural plywood loose laid at 90 degrees over - Embelton damped NXS springs spaced at 300mm centres - Minimum 75mm acoustic insulation infill in floor cavity

s6. Install coil springs beneath the weight stacks in the pin-weight machines to prevent the sudden impact of weights falling on the supporting steel frame.

s7. Exercise equipment (such as battle ropes, punching bags etc) and equipment racks shall not be fixed to Level 2 slab soffit.

s8. Equipment racks and cross frames shall be mounted to the floor and vibration isolated off building structure. Frame and equipment fasteners shall be decoupled from building structure using rubber gromet and pads.

s9. Loudspeakers shall not be fixed to Level 2 slab soffit. Loudspeakers fixed to walls, columns and Level 1 slab soffit shall be vibration isolated of the building structure.

s10. In addition to the above physical measures the following management measures shall be considered,

a. Display signs reminding members not to move exercise equipment away from designated areas,

b. Display signs reminding members not to drop weights or equipment on the floor,

c. Provide induction to new members and go through rules and policies of the facility and emphasis on weight training behaviours and not to conduct activities likely to generate excessive noise & vibration such as dropping of weights

We recommend a detailed acoustic assessment of be undertaken by the gym operator when details of the gym layout, operating time, type of equipment and exercised machines that will be installed are known to determine site specific acoustic treatment. This may involve in acoustic testing of sample gym floor systems.

7.2.2.2 Communal Rooms

Vocals, music and/or TV sounds from communal rooms have the potential to cause disturbances to apartments on the same floor. To mitigate the transfer of airborne noise to adjoining non-sensitive spaces, the following in-principle acoustic treatment are recommended,

s11. Corridor walls of the communal room shall have a minimum sound reduction index of Rw50 such as 76mm steel stud wall with 2 layers of 13mm standard plasterboard on both sides and minimum 75mm insulation.

s12. Entry doors into the communal rooms shall consist of minimum 45mm solid-core timber door with full-perimeter acoustic seals include a drop seal. Glazed sections of door shall be minimum fixed 10.38mm laminated glass.

s13. For control of footfall noise impacts to surrounding apartments, we recommend a carpet floor finish in the communal rooms.

7.2.2.3 Private Swimming Pools

Displacement of water from diving into swimming pools can generate vibration in the pool structure which is transmitted into the building structure and re-radiated as structure-borne noise in the adjoining

spaces. The following acoustic treatment is recommended for the swimming pool to reduce potential structure-borne noise impacts to noise-sensitive spaces below:

s1. Pool shell to be vibration isolated off the structural slab using Embelton Triple layer Supershearflex pads (3 layers of 17mm ribbed elastomeric pads with aluminium shims between layers).

s2. We note that private swimming pools are located on roof levels and reside directly over the respective penthouse. If a private pool is located (completely or partially) over the internal spaces of another sole-occupancy-unit then high-performance spring isolators are recommended in lieu of Supershearflex pads.

s3. Sides of the pool shell to be laterally restrained using Embelton 17mm elastomer buffer pads. 20mm Embelton foam may be used to fill spaces between buffer pads.

8 Internal Sound Insulation

Internal walls, floors, services, doors and risers of the sole occupancy units shall comply with the relevant version of the National Construction Code of Australia (formally Building Code of Australia). At time of writing the current version is NCC 2022.

APPENDIX B presents a summary of acoustic provisions outlined in Part F7 of the NCC 2022.

Detailed acoustic design of internal walls, floor/ceiling system, riser walls, treatment of pipework is to be undertaken after development approval ie. at Construction Certificate stage. Acoustic design of internal walls, floors, risers and services treatments is a routine part of acoustic design and should be undertaken at CC stage.

9 Construction Noise and Vibration Assessment

This section presents the applicable criteria for construction noise and vibration along with an in-principle noise and vibration impact assessment based on typical construction equipment and methodologies and an outline of noise management strategies to be employed during excavation and construction. A follow-up assessment should be undertaken during detail design stage (prior CC) with input from the building contractor.

9.1 Construction noise objectives

9.1.1 Noise management levels (NMLs)

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

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

- Use of L_{Aeq} as the descriptor for measuring and assessing construction noise.
- Application of reasonable and feasible noise mitigation measures.
- As stated in the ICNG, a noise mitigation measure is feasible if it is capable of being put into practice and is practical to build given the project constraints.
- Selecting reasonable mitigation measures from those that are feasible involves making a judgement to determine whether the overall noise benefit outweighs the overall social, economic and environmental effects.

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

Table 9-1 reproduces from the ICNG, sets out the airborne noise management levels and how they are to be applied for residential receivers.

Table 9-1: Noise management levels at residential receivers

Time of day	Management level $L_{Aeq\ (15\ min)}$ *	How to apply
Recommended standard hours: Monday to Friday 7am to 6pm Saturday 8am to 1pm No work on Sundays or public holidays	Noise affected RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. • Where the predicted or measured LAeq (15 min) is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. • The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dB(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: 1. times identified by the community when they are less sensitive to noise (such as before/ after school for works near schools, or mid-morning or mid-afternoon for works near residences 2. 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 + 5 dB	• 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 *ICNG* section 7.2.2.

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

The table below sets out the ICNG noise management levels for other noise sensitive receiver locations.

Table 9-2: Noise management levels at other noise sensitive land uses

Land use	Time of day	Where objective applies	Management level $L_{Aeq\ (15\ min)}$
Classrooms at schools and other educational institutions	When in use	Internal noise level	45 dB(A) internally Or 55 dB(A) externally
Hospital wards and operating theatres	When in use	Internal noise level	45 dB(A)
Places of worship	When in use	Internal noise level	45 dB(A) internally or 55 dB(A) externally
Active recreation areas	When in use	Outdoor noise level	65 dB(A)
Passive recreation areas	When in use	Outdoor noise level	60 dB(A)
Commercial premises	When in use	Outdoor noise level	70 dB(A)
Industrial premises	When in use	Outdoor noise level	75 dB(A)

Notes: 1. Outdoor noise level based on internal noise level in ICNG and assumes 10 dB loss through an open window

9.1.2 Summary of construction noise management levels

A summary of construction noise management levels is presented below.

Table 9-3: Construction noise management levels (NML)

Receiver ID	Location description	Noise management level $L_{Aeq(15min)}$ [1, 2] Monday to Fridays (7:00am to 6:00pm) Saturdays (8:00am to 1:00pm)
R1	Residential premises at 44 Anderson Street, Chatswood	47[3] +10 = 57
R2	Residential premises at 3-5 McIntosh Street and 28 Anderson Street, Chatswood	
R3	Residential premises at 1 Day Street, Chatswood	45[4] + 10 = 55
C1	Church at 43 Anderson Street, Chatswood – externally on worst affected facade	55
C2	Commercial premises at 39-41 Anderson Street, Chatswood	70

Notes:
1. Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5m above ground level. If the property boundary is more than 30m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30m of the residence. Noise levels may be higher at upper floors of the noise affected residence.
2. Noise management levels apply when receiver areas are in use only.
3. Based on day background noise level at Location L1 (Table 3-2)
4. Based on day background noise level at Location L2 (Table 3-2)

9.2 Proposed construction noise sources

The schedule of items of plant and equipment likely to be used during the construction phases of the development is presented in the table below.

Table 9-4: Typical construction equipment & sound power levels, dB(A) re 1pW

Plant item	Plant description	Sound power levels
Demolition		
1.	Truck (> 20 tonnes)	104
2.	20 tonne Excavator with Bucket	106
3.	Bobcat	102
Excavation		
4.	30 tonne excavators with bucket	107
5.	Truck - Dump	109
6.	Delivery trucks	108
7.	50 tonne mobile telescopic crane	95
Civil		
8.	45 tonne bored piling rigs	111
9.	30 tonne excavators with bucket	106

Plant item	Plant description	Sound power levels
10.	Concrete trucks	108
11.	Delivery trucks	108
12.	50 tonne mobile telescopic crane	95
Substructure and building works		
13.	Concrete trucks	108
14.	Delivery trucks	108
15.	Hand tools	108
16.	Mobile/Tower crane	105
17.	Concrete pump	103
18.	Bobcat	102
19.	Concrete vibrator	99

The sound power levels for the majority of construction plant and equipment 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', the Interim Construction Noise Guideline (ICNG), information from past projects and/or information held in our library files.

9.3 Construction noise assessment

Noise levels at any receiver locations resulting from construction works would depend on the location of the receiver with respect to the area of construction, shielding from intervening topography and structures, and the type and duration of construction being undertaken. Furthermore, noise levels at receivers would vary significantly over the total construction program due to the transient nature and large range of plant and equipment that could be used.

Table 9-5 presents noise levels likely to be experienced at the nearby affected receivers based on the construction activities, and plant and equipment associated with the proposed site compound at a range from the furthest to the closest proximity to each receiver location. Noise levels were calculated taking into consideration attenuation due to distance between the construction works and the receiver locations and any intervening structures.

Table 9-5: Predicted $L_{Aeq(15min)}$ noise levels for typical construction plant, dB(A)

Plant description	Predicted $L_{eq(15min)}$ construction noise levels				
	Receiver R1	Receiver R2	Receiver R3	Receiver C1	Receiver C2
Noise Management Levels	*57*	*57*	*55*	*55*	*70*
Demolition					
Truck - Dump	62-74	**64-77**	**63-78**	63-72	61-71
20 tonne Excavator with Bucket	59-71	61-74	**60-75**	60-69	58-68
Bobcat	55-67	57-70	56-71	56-65	54-64

Plant description	Predicted $L_{eq(15min)}$ construction noise levels				
	Receiver R1	Receiver R2	Receiver R3	Receiver C1	Receiver C2
Excavation					
30 tonne excavators with bucket	60-71	62-75	61-74	61-70	59-70
Truck - Dump	62-73	**64-77**	**63-76**	63-72	61-72
Delivery trucks	61-72	**63-76**	62-75	62-71	60-71
Civil					
45 tonne bored piling rigs	63-76	**66-79**	**65-79**	65-74	63-74
Concrete trucks	60-73	**63-76**	**62-76**	62-71	60-71
Delivery trucks	60-73	**63-76**	**62-76**	62-71	60-71
Substructure and building works					
Concrete trucks	60-73	**63-76**	**62-76**	62-71	60-71
Delivery trucks	60-73	**63-76**	**62-76**	62-71	60-71
Hand tools	60-73	**63-76**	**62-76**	62-71	60-71

Based on results of the assessment in Table 9-5 above management noise levels at the residential neighbours (R1, R2 & R3) and non-residential receivers (C1 & C2) would be exceeded when the demolition, excavation, civil and construction works are conducted in close proximity to the corresponding receiver location.

Furthermore, construction noise levels are predicted to be greater than the highly noise affected level of 75dB(A) when the three noisiest plant and equipment items are used concurrently in close proximity to the following receiver locations.

Table 9-6: Receivers predicted to be highly noise affected

Site Activity	Receiver locations exceeding highly affected noise level of 75dB(A)
Demolition	R2, R3
Excavation	R2, R3
Civil	R2, R3
Substructure and building works	R2, R3

In light of the predicted noise levels above, it is recommended that a feasible and reasonable approach towards noise management measures be applied to reduce noise levels as much as possible to manage the impact from construction noise.

Further details on construction noise mitigation and management measures are provided in Section 9.4 below.

9.4 Construction noise mitigation and management measures

The following recommendations provide in-principle feasible and reasonable noise control solutions to reduce noise impacts to sensitive receivers. Where actual construction activities differ from those assessed in this report, more detailed design of noise control measures may be required once specific items of plant and construction methods have been chosen and assessed on site.

The advice provided here is in respect of acoustics only. Supplementary professional advice may need to be sought in respect of fire ratings, structural design, buildability, fitness for purpose and the like.

9.4.1 General engineering noise controls

Implementation of noise control measures, such as those suggested in Australian Standard 2436-2010 "Guide to Noise Control on Construction, Demolition and Maintenance Sites", are expected to reduce predicted construction noise levels. Reference to Australian Standard 2436-2010, Appendix C, Table C1 suggests possible remedies and alternatives to reduce noise emission levels from typical construction equipment. Table C2 in Appendix C presents typical examples of noise reductions achievable after treatment of various noise sources. Table C3 in Appendix C presents the relative effectiveness of various forms of noise control treatment.

Table 9-7 below presents noise control methods, practical examples and expected noise reductions according to AS2436 and according to Renzo Tonin & Associates' opinion based on experience with past projects.

Table 9-7: Relative effectiveness of various forms of noise control, dB(A)

Noise control method	Practical examples	Typical noise reduction possible in practice		Maximum noise reduction possible in practice	
		AS 2436	Renzo Tonin & Associates	AS 2436	Renzo Tonin & Associates
Distance	Doubling of distance between source and receiver	6	6	6	6
Screening	Acoustic barriers such as earth mounds, temporary or permanent noise barriers	5 to 10	5 to 10	15	15
Acoustic Enclosures	Engine casing lagged with acoustic insulation and plywood	15 to 25	10 to 20	50	30
Engine Silencing	Residential class mufflers	5 to 10	5 to 10	20	20
Substitution by alternative process	Use electric motors in preference to diesel or petrol	-	15 to 25	-	40

The Renzo Tonin & Associates' listed noise reductions are conservatively low and should be referred to in preference to those of AS2436.

Table 9-8 below identifies possible noise control measures, which are applicable for the construction plant likely to be used on site.

Table 9-8: Noise control measures for likely construction plant

Plant description	Screening	Acoustic enclosures	Silencing	Alternative process
Truck - dump	✔	✖	✔	✖
Excavator with bucket	✔	✖	✔	✖
Bobcat	✔	✖	✔	✖
Piling drilling rig	✔	✖	✔	✖
Machine mounted hydraulic drill	✔	✖	✔	✖
Concrete trucks	✔	✖	✔	✖
Delivery trucks	✔	✖	✔	✖
Mobile crane	✔	✖	✔	✖
Concrete pump	✔	✖	✔	✖
Concrete vibrator	✔	✖	✔	✖
Hand tools	✔	✖	✔	✖

9.4.2 Physical noise controls

Physical noise control measures are recommended for implementation at the worst affected neighbouring receiver locations. The following in-principal noise mitigation measure is provided to reduce noise impacts to the neighbouring receivers.

- Erect solid hoarding/ noise screens around the perimeter of the construction site to break the line of site between the high noise generating activities and the windows of the receiver locations.

9.4.3 Regular periodic noise monitoring

The following approach would be adopted with regard to noise monitoring procedures during the construction works.

- Where potential noise impacts are predicted to be within 10 to 15dB(A) of the noise management level, the potential construction noise nuisance is considered to be moderate. Noise monitoring should be carried out to confirm predicted noise impacts within two weeks of commencement of construction. Reasonable and feasible noise reduction measures would be investigated, where necessary.

- Where potential noise impacts are predicted to be more than 15dB(A) above the noise management levels, the potential construction noise nuisance is considered to be high. All reasonable and feasible noise control measures should be implemented prior to the commencement of construction works. Noise compliance monitoring for all major equipment and activities on the site should be undertaken prior to their commencement of work on site. Finally, noise levels during construction should be monitored and where exceeded, further noise reduction measures (where reasonable and feasible) should be implemented eg. restrict working hours, use silencing equipment, etc.

9.4.4 General noise management measures

In addition to physical noise controls, the following general noise management measures should be followed:

- Use less noisy plant and equipment, where feasible and reasonable.
- Plant and equipment should be properly maintained.
- Provide special attention to the use and maintenance of 'noise control' or 'silencing' kits fitted to machines to ensure they perform as intended.
- Strategically position plant on site to reduce the emission of noise to the surrounding neighbourhood and to site personnel.
- Avoid any unnecessary noise when carrying out manual operations and when operating plant.
- Any equipment not in use for extended periods during construction work should be switched off.
- In addition to the noise mitigation measures outlined above, a management procedure would need to be put in place to deal with noise complaints that may arise from construction activities. Each complaint would need to be investigated and appropriate noise amelioration measures put in place to mitigate future occurrences, where the noise in question is in excess of allowable limits. See Appendix D for an example of a complaint handling procedure and form.
- Good relations with people living and working in the vicinity of a construction site should be established at the beginning of a project and be maintained throughout the project, as this is of paramount importance. Keeping people informed of progress and taking complaints seriously and dealing with them expeditiously is critical. The person selected to liaise with the community should be adequately trained and experienced in such matters.

Where noise level exceedances cannot be avoided, then consideration may be given to implementing time restrictions and/or providing periods of repose for residents, where feasible and reasonable. That is, daily periods of respite from noisy activities may also be scheduled for building occupants during business hours.

Some items of plant may exceed noise limits even after noise treatment is applied. To reduce the overall noise impact, the use of noisy plant may be restricted to within certain time periods, where feasible and reasonable and to be negotiated with Council and the residents. For example, between 10am and 3pm (with one-hour break for lunch between 12pm and 1pm), noisy activities could occur with no noise level restrictions over a limited time period. Residents would be notified of the potential noise impact during this time period so that they can organise their day around the noisy period. Allowing the construction activities to proceed, despite the noise exceedance may be the preferred method in order to complete the works expeditiously.

9.5 Vibration management plan

9.5.1 Vibration criteria

Construction vibration is associated with three main types of impact:

- disturbance to building occupants
- potential damage to buildings, and
- potential damage to sensitive equipment in a building.

Generally, if disturbance to building occupants is controlled, there is limited potential for structural damage to buildings.

Vibration amplitude may be measured as displacement, velocity, or acceleration.

- Displacement (x) measurement is the distance or amplitude displaced from a resting position. The International System of Units (SI unit) for distance is the metre (m), although common industrial standards include mm.
- Velocity ($v=\Delta x/\Delta t$) is the rate of change of displacement with respect to change in time. The SI unit for velocity is metres per second (m/s), although common industrial standards include mm/s. The Peak Particle Velocity (PPV) is the greatest instantaneous particle velocity during a given time interval. If measurements are made in 3-axis (x, y, and z) then the resultant PPV is the vector sum (i.e. the square root of the summed squares of the maximum velocities) regardless of when in the time history those occur.
- Acceleration ($a=\Delta v/\Delta t$) is the rate of change of velocity with respect to change in time. The SI unit for acceleration is metres per second squared (m/s^2). Construction vibration goals are summarised below.

Construction vibration goals are summarised below.

9.5.2 Disturbance to buildings occupants

Assessment of potential disturbance from vibration on human occupants of buildings is made in accordance with the DECC '*Assessing Vibration; a technical guideline*' (DECC, 2006). The 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 9-9 provides definitions and examples of each type of vibration.

Table 9-9: Types of vibration

Type of vibration	Definition	Examples
Continuous vibration	Continues uninterrupted for a defined period (usually throughout the day-time and/or night-time)	Machinery, steady road traffic, continuous construction activity (such as tunnel boring machinery).

Type of vibration	Definition	Examples
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.

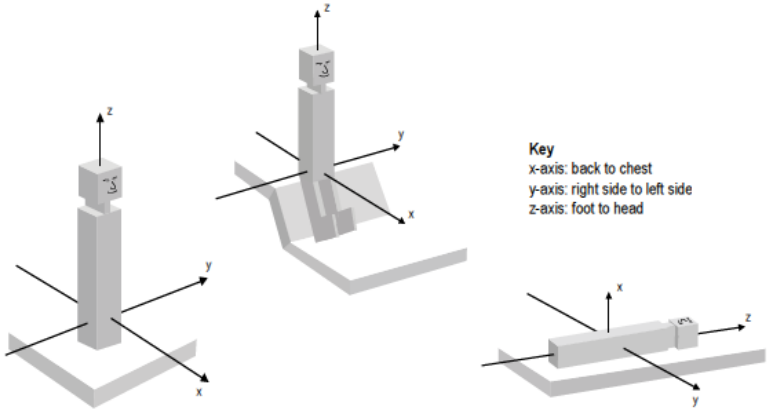
Source: Assessing Vibration; a technical guideline, Department of Environment & Climate Change, 2006

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 9-1. 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 9-1: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 are reproduced in Table 9-10.

Table 9-10: Preferred and maximum levels for human comfort

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 are reproduced in Table 9-11.

Table 9-11: 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

9.5.3 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 Part 2 and German Standard DIN4150-3. 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:

> "*that 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. " (DIN4150.3, 1990, p.3)*

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*', 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 9-12 sets out the BS7385 criteria for cosmetic, minor and major damage.

Table 9-12: 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	Reinforced or framed structures Industrial and heavy commercial buildings	Cosmetic		50	
		Minor[2]		100	
		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 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*' (DIN 4150-3), 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 criteria are presented in Table 9-13.

Table 9-13: 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

9.5.4 Potential vibration impacts to residential and commercial uses

Based on the proposed plant items presented in Section 9.2, vibration generated by construction plant was estimated and potential vibration impacts are summarised in Table 9-14 below. The assessment is relevant to the identified buildings and other similar type structures in the project area.

Table 9-14: Potential vibration for residential and non-residential properties

Receiver Location	Approx. distance to nearest buildings from works	Type of nearest sensitive buildings	Assessment on potential vibration impacts		
			Structural damage risk	Human disturbance - risk of adverse comment	Vibration monitoring
R1	25m	Residential	Low risk of structural damage from construction works	Low risk of adverse comment as a result of construction works	Vibration monitoring not required
R2	18m	Residential	Low risk of structural damage from construction works	Low risk of adverse comment as a result of construction works	Vibration monitoring not required
R3	14m	Residential	Low risk of structural damage from construction works	Low risk of adverse comment as a result of construction works	Vibration monitoring not required
C1	28m	Church	Low risk of structural damage from construction works	Low risk of adverse comment as a result of construction works	Vibration monitoring not required
C2	28m	Commercial	Low risk of structural damage from construction works	Low risk of adverse comment as a result of construction works	Vibration monitoring not required

Based on the above assessment neighbouring receivers surrounding the site are unlikely to be impacted by vibration generated from activities during demolition, excavation, and constructions works.

9.5.5 Vibration management measures

The following vibration management measures are provided to minimise vibration impact from construction activities to the nearest affected receivers and to meet the relevant human comfort and building damage vibration limits:

1. A procedure should be implemented to manage any vibration complaints. Each complaint should be investigated and where vibration levels are established as exceeding the set limits, appropriate amelioration measures should be put in place to mitigate future occurrences.
2. 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.
3. Where construction activity occurs in close proximity to sensitive receivers, vibration testing of actual equipment on site would be carried out prior to their commencement of site operation to determine acceptable buffer distances to the nearest affected receiver locations.
4. Dilapidation surveys should be conducted at existing buildings surrounding the construction site. Notification by letterbox drop would be carried out for all occupied buildings surrounding the construction site. These measures are to address potential community concerns that perceived vibration may cause damage to property.

9.6 Complaints management

Noise and vibration levels generated by construction activities associated with the construction of the development must aim to comply with the noise and vibration goals set by the relevant regulations and guidelines.

The contractor is responsible for implementing this Demolition and Excavation Noise and Vibration Management Plan (DENVMP) and ensuring that all reasonable measures are implemented such as the provision of a Noise and Vibration Complaints Program (which forms part of the DENVMP), to minimise the generation of excessive noise and/or vibration levels from the site to nearby sensitive areas. This should be continued as part of the building construction and building fit-out stages.

Owners and occupants of nearby affected properties are to be informed by direct mail or a direct telephone line and contact person where any noise and/or vibration complaints related to the operation of the construction activities are to be reported.

10 Conclusion

Renzo Tonin & Associates have completed an assessment of the potential noise impacts to and from the proposed mixed-use residential development of the 38-42 Anderson Street, 3 McIntosh Street and 2 Day Street, Chatswood.

The study of external noise intrusion into the subject development has found that appropriate controls can be incorporated into the building design to achieve a satisfactory accommodation environment consistent with the intended quality of the building and relevant standards. Recommendations on control of external noise intrusion are presented in Section 5.

The assessment of rail vibration and ground-borne rail noise has found floor induced vibration within the proposed residential spaces due to train pass-bys to comply with day and night acceptable VDV values set by the DECC/EPA Assessing Vibration guideline and ground-borne rail noise inside residential spaces are predicted to comply the borne noise criteria set in the DoP "Development near Rail Corridors & Busy Roads – Interim Guideline" 2008. As such building isolation from rail operations is not required.

The report has quantified operational noise emission from the proposed development and has assessed noise at the nearest sensitive receivers. Based on the assumptions and inputs within this report, it has been established that operation of the site is capable of complying with relevant NSW EPA noise emission requirements. Recommendations with respect to operational noise control are presented in Section 6.

In addition, an assessment of construction noise and vibration impacts to the surrounding noise sensitive neighbours have been undertaken in accordance with EPA Interim Construction Noise Guideline (ICNG) 2009. Construction noise mitigations measures has been provided in Section 8 of the report.

APPENDIX A Criteria and design methodology

A.1 State Environmental Planning Policy (Infrastructure) 2007

The NSW State Environmental Planning Policy (Infrastructure) 2007 (known as 'ISEPP') came into force in NSW on 1 January 2008 to facilitate the effective delivery of infrastructure across the State. The aim of the policy includes identifying the environmental assessment category into which different types of infrastructure and services development fall and identifying matters to be considered in the assessment of development adjacent to particular types of infrastructure.

Pertinent to noise assessment, the ISEPP includes the following clauses:

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

- *This clause applies to development for any of the following purposes that is on land in or adjacent to a rail corridor and that the consent authority considers is likely to be adversely affected by rail noise or vibration:*
  - *a. a building for residential use,*
  - *b. a place of public worship,*
  - *c. a hospital,*
  - *d. an educational establishment or child care centre.*
- *Before determining a development application for development to which this clause applies, the consent authority must take into consideration any guidelines that are issued by the Director-General for the purposes of this clause and published in the Gazette.*
- *If the development is for the purposes of a building for residential use, the consent authority must not grant consent to the development unless it is satisfied that appropriate measures will be taken to ensure that the following LAeq levels are not exceeded:*
  - *e. in any bedroom in the building - 35 dB(A) at any time between 10 pm and 7am,*
  - *f. anywhere else in the building (other than a garage, kitchen, bathroom or hallway) - 40 dB(A) at any time.*

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

- *This clause applies to development for any of the following purposes that is on land in or adjacent to the road corridor for a freeway, a tollway or a transitway or any other road with an annual average daily traffic volume of more than 40,000 vehicles (based on the traffic volume data published on the website of the RTA) and that the consent authority considers is likely to be adversely affected by road noise or vibration:*
  - *g. a building for residential use,*
  - *h. a place of public worship,*

i. a hospital,

j. an educational establishment or child care centre.

- *Before determining a development application for development to which this clause applies, the consent authority must take into consideration any guidelines that are issued by the Director-General for the purposes of this clause and published in the Gazette.*
- *If the development is for the purposes of a building for residential use, the consent authority must not grant consent to the development unless it is satisfied that appropriate measures will be taken to ensure that the following LAeq levels are not exceeded:*

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

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

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

A.1.1 Department of Planning publication 'Development near rail corridors and busy roads – Interim guideline'

To support the Infrastructure SEPP, the NSW Department of Planning released the *Development in Rail Corridors and Busy Roads – Interim Guideline* (December 2008). The Guideline assists in the planning, design and assessment of developments in, or adjacent to, major transport corridors in terms of noise, vibration and air quality. While the ISEPP applies only to roads with an AADT greater than 40,000 vehicles, the guideline is also recommended for other road traffic noise affected sites.

A.1.2 Clarification of ISEPP noise limits

The Guideline clarifies the time period of measurement and assessment. Section 3.4 '*What Noise and Vibration Concepts are Relevant*' and Table 3.1 of Section 3.6.1 confirms that noise assessment is based over the following time periods:

- Daytime 7:00am - 10:00pm $L_{Aeq(15hr)}$
- Night-time 10:00pm - 7:00am $L_{Aeq(9hr)}$

The noise criteria nominated in the ISEPP apply to internal noise levels with windows and doors closed. However, as the preliminary noise assessment is based on measurements/predictions at external locations, equivalent external noise criteria has been established. The equivalent external noise criterion is used to determine which areas of the development may require acoustic treatment in order to meet the internal noise requirements of the ISEPP. The equivalent external goals have been determined on the following basis:

- The ISEPP states: "*If internal noise levels with windows or doors open exceed the criteria by more than 10dBA, the design of the ventilation for these rooms should be such that occupants*

can leave windows closed, if they so desire, and also to meet the ventilation requirements of the Building Code of Australia." The internal criteria with windows open is therefore 10dB(A) above the criteria explicitly outlined in the ISEPP.

- The generally accepted noise reduction through an open window from a free-field external position is 10dB(A). Windows/doors are assumed to be open no more than 5% of room floor area, in accordance with the Building Code of Australia (BCA) ventilation requirements.

Table 10-1 presents the ISEPP internal noise criteria along with the equivalent external noise criteria for residential premises.

Table 10-1: ISEPP noise criteria for new residential development

Room	Location	$L_{Aeq,\ 15hr}$ Day 7am – 10pm	$L_{Aeq\ 9hr}$ Night 10pm – 7am
Living rooms*	Internal, windows closed	40	40
	Internal, windows open	50	50
	External free-field (allowing windows to remain open)^	60	60
Bedrooms*	Internal, windows closed	40	35
	Internal, windows open	50	45
	External free-field (allowing windows to remain open)^	60	55

Notes: * Requisite for 40,000AADT Roads only under ISEPP 2007.

^ ISEPP Guideline states that where internal noise criteria are exceeded by more than 10dB(A) with windows open mechanical ventilation is required. External goals have been calculated on the basis of nominal 10dB(A) reduction through an open window to a free-field position. Windows open to 5% of floor area in accordance with the BCA 2011 requirements.

A.2 Australian/New Zealand Standard AS/NZS 2107:2016

As traffic noise levels are not constant, an L_{eq} noise level descriptor is used when assessing this type of noise source. The L_{eq} is the mean energy level of the noise being measured, and has been found to accurately describe the level of annoyance caused by traffic noise.

This standard provides recommended noise levels for steady state such as noise from building services and quasi-steady state sounds, such as traffic and industrial noise. The noise levels recommended in AS/NZS 2107:2016 take into account the function of the area and apply to the sound level measured within the space unoccupied although ready for occupancy.

This standard recommends the following noise levels for residential buildings.

Table 10-2: Design sound levels and reverberation times for different areas of occupancy in buildings

Item	Type of occupancy/activity	Design sound level (LAeq,t) range	Design reverberation time (T) range, s
7	**RESIDENTIAL BUILDINGS (see Note 5 and Clause 5.2)**		
	Houses and apartments in inner city areas or entertainment districts or near major roads -		
	Apartment common areas (e.g. foyer, lift lobby)	45 to 50	-

Item	Type of occupancy/activity	Design sound level (LAeq,t) range	Design reverberation time (T) range, s
	Living areas	35 to 45	-
	Sleeping areas (night time)	35 to 40	-
	Work areas	35 to 45	-
	Houses and apartments in suburban areas or near minor roads -		
	Apartment common areas (e.g. foyer, lift lobby)	45 to 50	-
	Living areas	30 to 40	-
	Sleeping areas (night time)	30 to 35	-
	Work areas	35 to 40	-
	Houses in rural areas with negligible transportation -		
	Sleeping areas (night time)	25 to 30	-
	Hotels and motels -		
	Bars and lounges	< 50	0.6 to 1.0
	Conference areas -		
	Without sound reinforcement -		
	Up to 50 persons	35 to 40	Curve 1*
	From 50 to 250 persons	30 to 35	Curve 1*
	With sound reinforcement	35 to 45	Curve 1*
	Dining rooms	40 to 45	See Note 1
	Enclosed carparks	< 65	-
	Foyers and recreation areas	45 to 50	See Note 1
	Kitchen, laundry and maintenance areas	< 55	-
	Sleeping areas (night time) -		
	Hotels and motels in inner city areas or entertainment districts or near major roads	35 to 40	-
	Hotels and motels in suburbs or near minor roads	30 to 35	-
	Washrooms and toilets	45 to 55	-
	Hostels, residential halls and barracks -		
	Cafeterias	45 to 50	< 1.0
	Common rooms	40 to 45	< 1.0
	Games rooms	45 to 50	< 1.0
	Kitchens and service areas	45 to 55	-
	Sleeping areas (night time) -		
	Hostels, residential halls and barracks in inner city areas or entertainment districts or near major roads	35 to 40	-
	Hostels, residential halls and barracks in suburbs or near minor roads	30 to 35	-
	Mining camps -		
	Sleeping areas	35 to 40	-
	Other facilities	See Item 3 or Item 5 in this Table	
	Retirement homes/villages	See Houses and apartments; and Clause 5.2	

Item	Type of occupancy/activity	Design sound level (LAeq,t) range	Design reverberation time (T) range, s
* See Appendix A for all references to 'Curve' in this Table.			

NOTES:

1. Reverberation time should be minimized for noise control.
2. Certain teaching spaces, including those intended for students with learning difficulties and students with English as a second language, should have reverberation times at the lower end of the range.
3. Specialist advice should be sought for these spaces.
4. A very wide range of noise levels can occur in the occupied state in spaces housing manufacturing processes, and the levels are primarily subject to control as part of a noise management program (see AS/NZS 1269.2). The possibilities for segregating very noisy processes from quieter ones by partitioning vary between particular industries and plants. For reasons such as these, it is difficult to make generalized recommendations for desirable, or even maximum, design levels for the unoccupied state, but one guiding principle may still be observed- when the activity in one area of a manufacturing plant is halted, it is desirable that the local level should if possible drop to 70 dB(A) or lower to permit speech communication without undue effort.
5. In situations where traffic noise levels may vary widely over a 24 h period, measurement to assess compliance with this Standard should be taken at the relevant time and for an appropriate measurement period according to the area of occupancy or activity in the building. Where traffic noise fluctuates rapidly with the passage of individual vehicles, the community reaction may not correlate well with the equivalent continuous noise level as measured.
6. The overall sound pressure level in dB(A) should conform to the recommended design sound level given in Table 1. In these spaces, a balanced sound pressure level across the full frequency range is essential. These spaces should therefore be evaluated in octave bands across the full frequency spectrum. The recommended maximum sound pressure levels for the individual octave bands corresponding to the overall dB(A) value are given in Appendix C.
7. In spaces in which high quality sound recordings are to be made, the levels set for low frequency octave bands should not be exceeded (see Appendix C). Subsequent replay of the recordings might cause an amplification of the low-frequency sound resulting in an overemphasis of its low-frequency components. Specialist advice should always be sought when these spaces are being designed. In some circumstances, for purposes of very high quality recording, lower levels than those in Table 1 may be necessary.
8. Health requirements for hygiene and infection control may preclude achieving these recommended reverberation times.

APPENDIX B Internal Sound Insulation

B.1 National Construction Code of Australia 2022

The National Construction Code of Australia (NCC) outlines minimum requirements for inter-tenancy (party) walls and ceiling/ floors to maintain privacy. This includes the incorporation of penetration of a service through a floor or through more than one sole-occupancy unit.

NCC nominates required Weighted Sound Reduction Indexes (R_w) and spectrum adaptation factor (C_{tr}) for partition constructions, of different space/ activity types in adjoining units. The R_w and $R_w + C_{tr}$ are single number descriptors for quantifying the attenuating performance of partitions for typical intrusive noises produced inside residences. The higher the rating, the greater the isolation provided by the partition.

Spectrum adaptation factors are commonly used to compensate for the fact that certain kinds of sounds are more readily transmitted through insulating materials than others insulate.

The adaptation factor C_{tr} has now been introduced for most building elements which require an airborne sound insulation rating. The only exception is a wall which separates a dwelling from a plant room, lift shaft, stairway, public corridor, public lobby or the like, or parts of a different classification. Therefore, both the C_{tr} factor and the R_w of the building element will need to be considered in most cases.

The C_{tr} factor takes into account lower frequency level sounds, and has been chosen in large part, in recognition of the problem of the high bass frequency outputs of modern home theatre systems and music reproduction equipment.

The Deemed-to-Satisfy Provisions also have impact sound insulation requirements for floors. The terms to describe the impact sound insulation of the floor is the weighted normalised impact sound pressure level ($L_{n,w}$). The lower the $L_{n,w}$ of the floor, the better the performance of the floor in terms of impact sound insulation.

The following section represents a summary of acoustic provisions outlined in the Part F7 of the NCC.

B.2 Sound Insultion Provision of NCC of Australia

The acoustic provisions for inter-tenancy walls in Class 2 & 3 buildings are outlined in the National Construction Code of Australia and the following is an extract from the NCC:

F7D3 Determination of airborne sound insulation ratings

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

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

(b) comply with Specification 28.

F7D4 Determination of impact sound insulation ratings

(1) A floor in a building required to have an impact sound insulation rating must –

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

(b) comply with Specification 28

(2) A wall in a building required to have an impact sound insulation rating must –

(a) for a Class 2 or 3 building be of discontinuous construction and

(b) for a Class 9c building, must—

(i) for other than masonry, be two or more separate leaves without rigid mechanical connection except at the periphery; or

(ii) be identical with a prototype that is no less resistant to the transmission of impact sound when tested in accordance with Specification 29 than a wall listed in S28C4 to S28C7.

(3) For the purposes of this Part, discontinuous construction means a wall having a minimum 20 mm cavity between 2 separate leaves, and

(a) for masonry, where wall ties are required to connect leaves, the ties are of the resilient type; and

(b) for other than masonry, there is no mechanical linkage between leaves except at the periphery.

F7D5 Sound insulation rating of floors

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

(a) sole-occupancy units; or

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

(2) A floor in a Class 9c building separating sole-occupancy units must have an Rw not less than 45

F7D6 Sound insulation rating of walls

(1) A wall in a Class 2 or 3 building must –

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

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

(c) comply with F7D4(2) if it separates:

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

(ii) a sole-occupancy unit from a plant room or lift shaft.

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

(3) A wall in a Class 9c building must have an Rw not less than 45 if it separates—

(a) sole-occupancy units; or

(b) a sole-occupancy unit from a kitchen, bathroom, sanitary compartment (not being an associated ensuite), laundry, plant room or utilities room.

(4) In addition to (3), a wall separating a sole-occupancy unit in a Class 9c building from a kitchen or laundry must comply with F7D4(2).

(5) Where a wall required to have sound insulation has a floor above, the wall must continue to –

(a) the underside of the floor above; or

(b) a ceiling that provides the sound insulation required for the wall.

(6) Where a wall required to have sound insulation has a roof above, the wall must continue to –

(a) the underside of the roof above; or

(b) a ceiling that provides the sound insulation required for the wall.

F7D7 Sound insulation rating of internal services

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

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

(b) 25 if the adjacent room is a kitchen or non-habitable room.

(2) If a stormwater pipe passes through a sole-occupancy unit, it must be separated in accordance with (1)(a) and (b).

F7D8 Sound isolation of pumps

A flexible coupling must be used at the point of connection between the service pipes in a building and any circulating or other pump.

APPENDIX C Long-term Noise Monitoring Locations and Results

C.1 Ambient and Background Noise Surveys

Unattended Noise Monitoring Location L1: Garden at front of 40 Anderson Street, Chatswood

Monitoring Period: Tuesday 19/11/2024 to Tuesday 26/11/2024

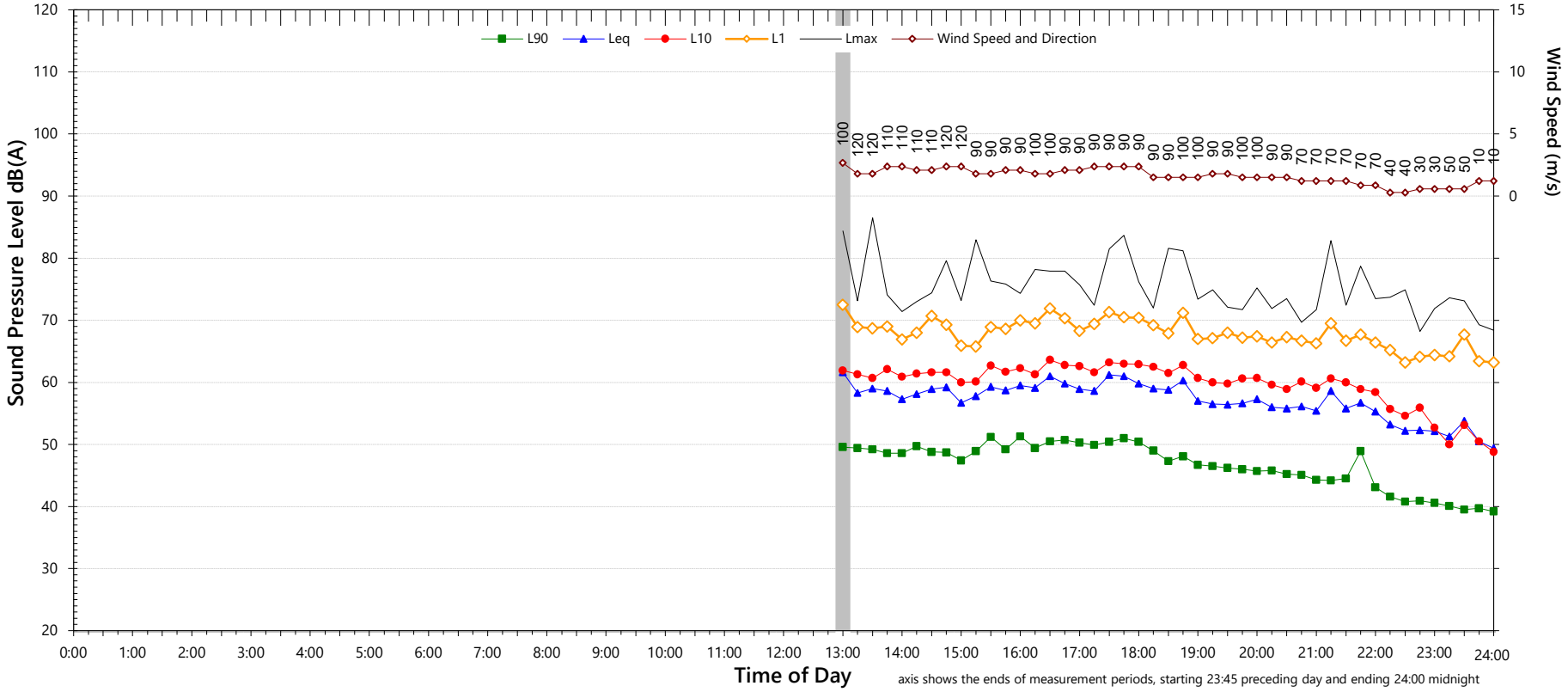
Unattended Noise Monitoring Location L2: Carpark at back of 2 Day Street, Chatswood.

Monitoring Period: Tuesday 19/11/2024 to Tuesday 26/11/2024

Unattended Noise Monitoring Results

40 Anderson St, Chatswood - Frontyard

Tuesday, 19 November 2024



NSW Noise Policy for Industry (Free Field)			
Descriptor	**Day[2]**	**Evening[3]**	**Night[4 5]**
L_{A90} ABL	-	44	37
L_{Aeq}	-	57	53

Night Time Maximum Noise Levels			(see note 7)
L_{AFMax} (Range)	70	to	84
L_{AFMax} - L_{Aeq} (Range)	21	to	25

NSW Road Noise Policy (1m from facade)		(see note 6)
Descriptor	**Day**	**Night[5]**
	7am-10pm	**10pm-7am**
$L_{Aeq\ 15\ hr}$ and $L_{Aeq\ 9\ hr}$	-	56
$L_{Aeq\ 1hr}$ upper 10 percentile	-	60
$L_{Aeq\ 1hr}$ lower 10 percentile	-	46

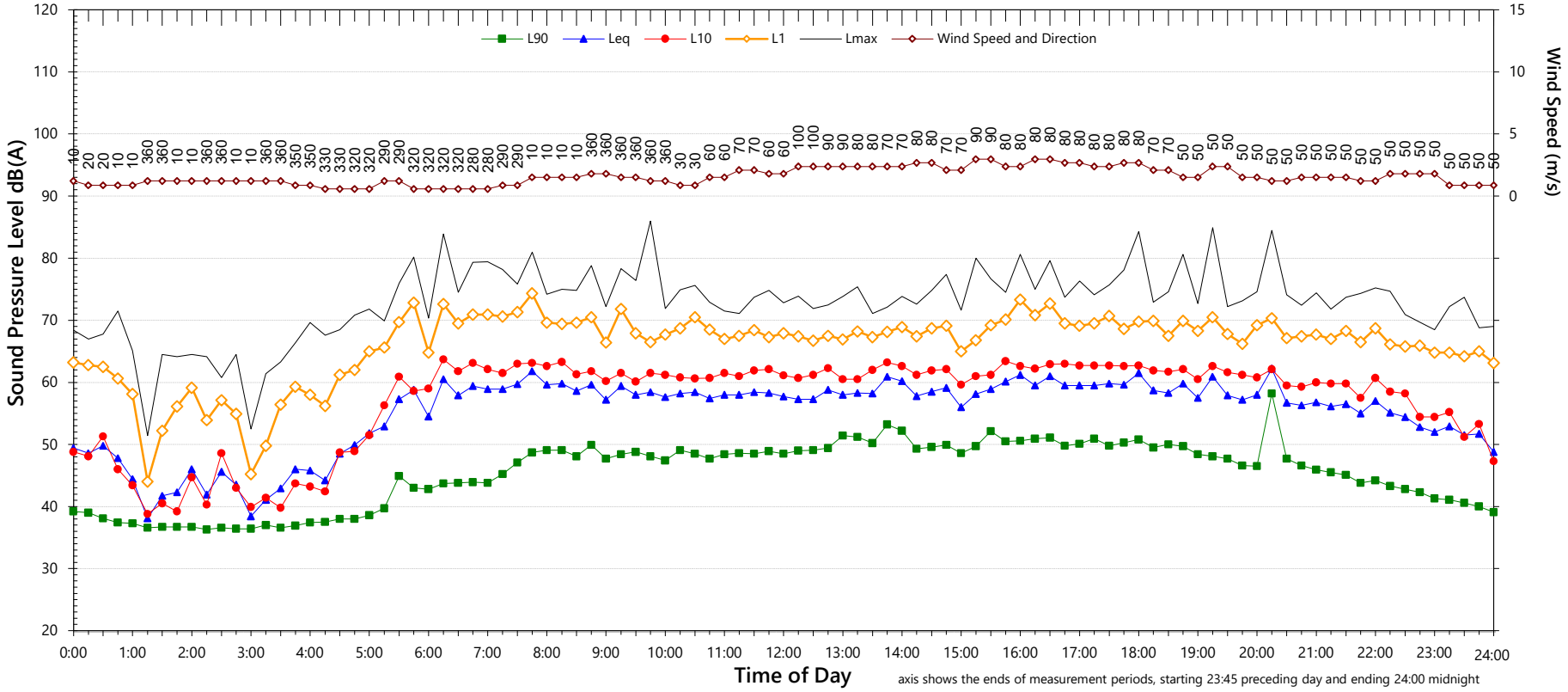
Notes:

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 in free-field; tabulated results facade 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

40 Anderson St, Chatswood - Frontyard

Wednesday, 20 November 2024



NSW Noise Policy for Industry (Free Field)			
Descriptor	**Day[2]**	**Evening[3]**	**Night[4 5]**
L_{A90} ABL	48	45	37
L_{Aeq}	59	58	53

Night Time Maximum Noise Levels			(see note 7)
L_{AFMax} (Range)	69	to	80
L_{AFMax} - L_{Aeq} (Range)	20	to	27

NSW Road Noise Policy (1m from facade)		(see note 6)
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	63	58
$L_{Aeq\ 1hr}$ lower 10 percentile	60	49

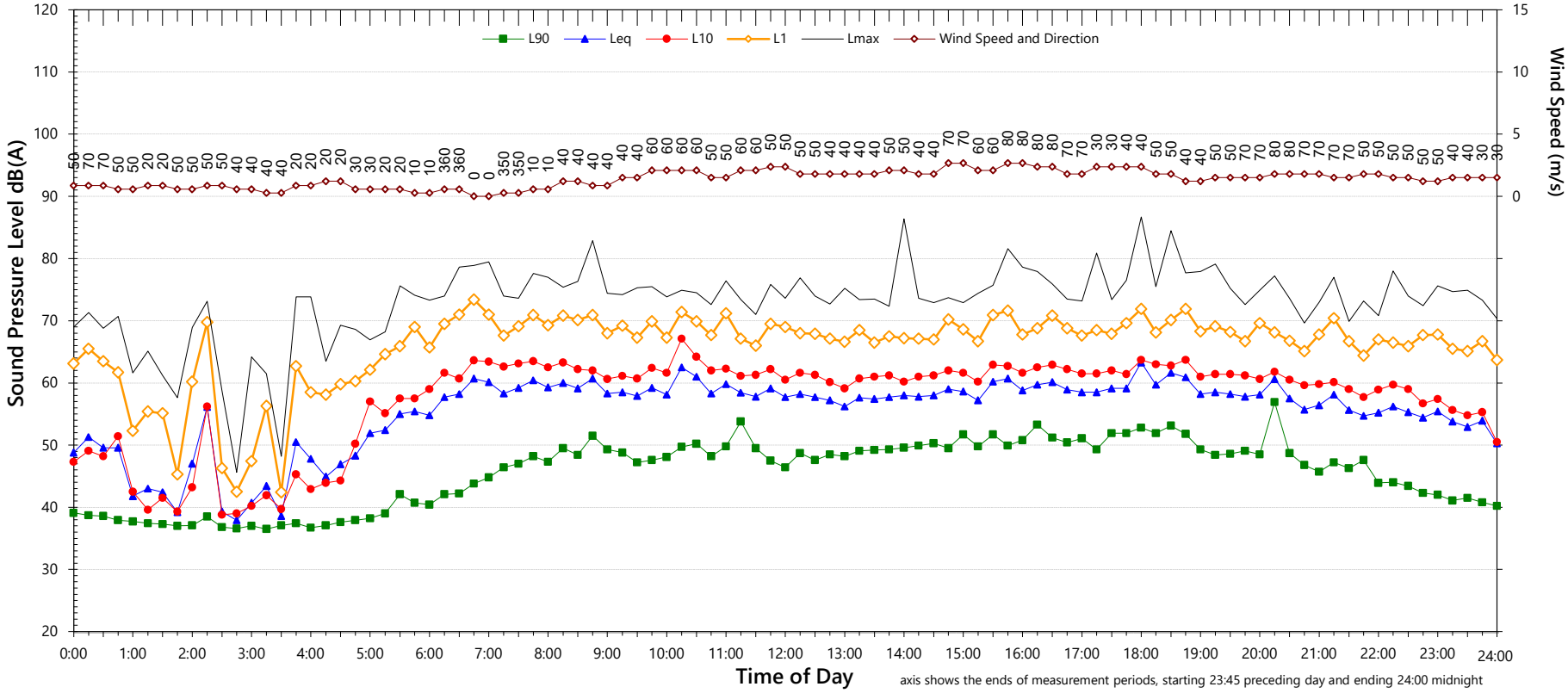
Notes:

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 in free-field; tabulated results facade 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

40 Anderson St, Chatswood - Frontyard

Thursday, 21 November 2024



NSW Noise Policy for Industry (Free Field)			
Descriptor	**Day[2]**	**Evening[3]**	**Night[4 5]**
L_{A90} ABL	47	46	37
L_{Aeq}	59	58	53

NSW Road Noise Policy (1m from facade)		(see note 6)
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	63	59
$L_{Aeq\ 1hr}$ lower 10 percentile	60	47

Night Time Maximum Noise Levels			(see note 7)
L_{AFMax} (Range)	65	to	78
L_{AFMax} - L_{Aeq} (Range)	19	to	27

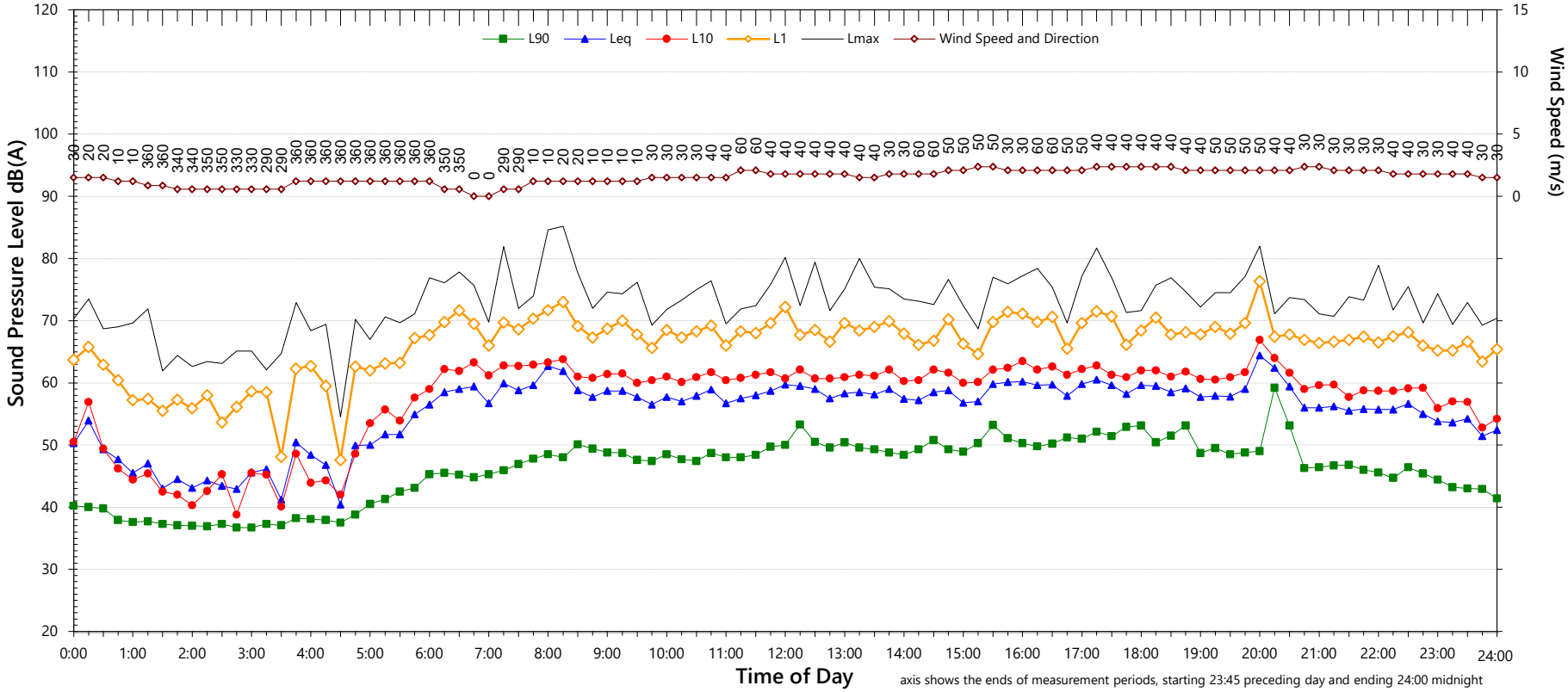
Notes:

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 in free-field; tabulated results facade 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

40 Anderson St, Chatswood - Frontyard

Friday, 22 November 2024



NSW Noise Policy for Industry (Free Field)			
Descriptor	**Day[2]**	**Evening[3]**	**Night[4 5]**
L_{A90} ABL	48	46	37
L_{Aeq}	59	59	52

NSW Road Noise Policy (1m from facade)		(see note 6)
Descriptor	**Day**	**Night[5]**
	7am-10pm	**10pm-7am**
$L_{Aeq\ 15\ hr}$ and $L_{Aeq\ 9\ hr}$	61	55
$L_{Aeq\ 1hr}$ upper 10 percentile	63	58
$L_{Aeq\ 1hr}$ lower 10 percentile	60	47

Night Time Maximum Noise Levels			(see note 7)
L_{AFMax} (Range)	69	to	81
L_{AFMax} - L_{Aeq} (Range)	20	to	25

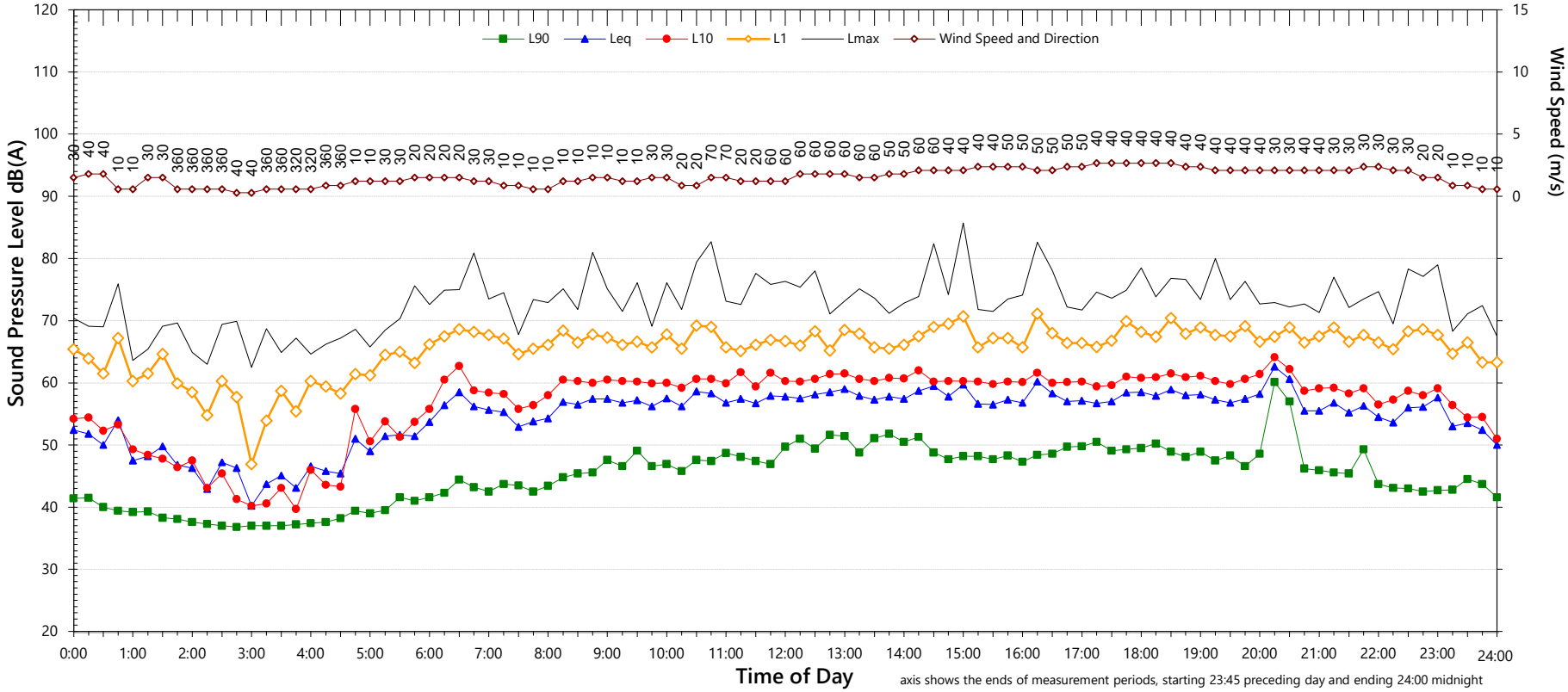
Notes:

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 in free-field; tabulated results facade 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

40 Anderson St, Chatswood - Frontyard

Saturday, 23 November 2024



NSW Noise Policy for Industry (Free Field)			
Descriptor	**Day[2]**	**Evening[3]**	**Night[4 5]**
L_{A90} ABL	45	46	38
L_{Aeq}	58	58	52

NSW Road Noise Policy (1m from facade)		(see note 6)
Descriptor	**Day**	**Night[5]**
	7am-10pm	**10pm-7am**
$L_{Aeq\ 15\ hr}$ and $L_{Aeq\ 9\ hr}$	60	54
$L_{Aeq\ 1hr}$ upper 10 percentile	61	57
$L_{Aeq\ 1hr}$ lower 10 percentile	59	47

Night Time Maximum Noise Levels			(see note 7)
L_{AFMax} (Range)	67	to	79
L_{AFMax} - L_{Aeq} (Range)	20	to	24

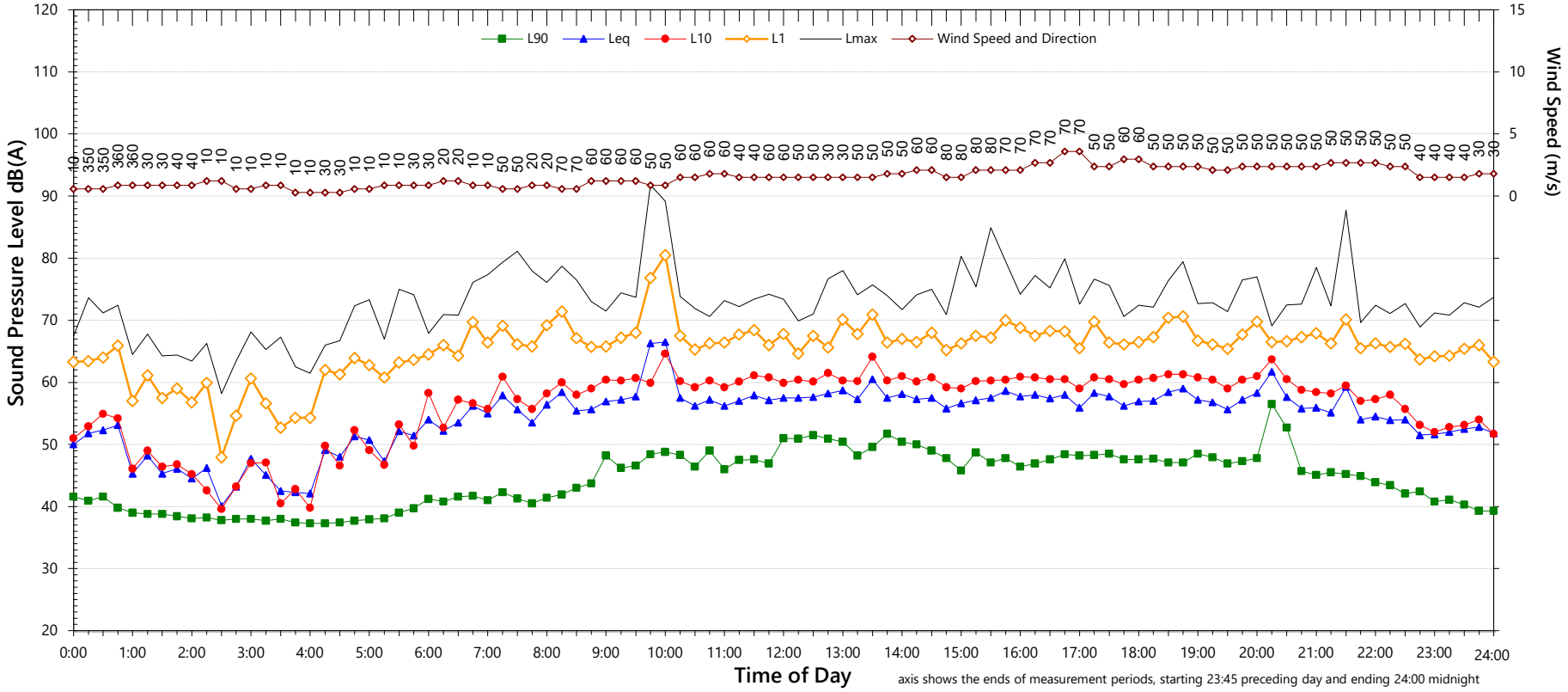
Notes:

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 in free-field; tabulated results facade 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

40 Anderson St, Chatswood - Frontyard

Sunday, 24 November 2024



NSW Noise Policy for Industry (Free Field)			
Descriptor	**Day[2]**	**Evening[3]**	**Night[4 5]**
L_{A90} ABL	46	45	37
L_{Aeq}	59	58	53

NSW Road Noise Policy (1m from facade)		(see note 6)
Descriptor	**Day**	**Night[5]**
	7am-10pm	**10pm-7am**
$L_{Aeq\ 15\ hr}$ and $L_{Aeq\ 9\ hr}$	61	55
$L_{Aeq\ 1hr}$ upper 10 percentile	61	59
$L_{Aeq\ 1hr}$ lower 10 percentile	59	45

Night Time Maximum Noise Levels			(see note 7)
L_{AFMax} (Range)	67	to	85
L_{AFMax} - L_{Aeq} (Range)	20	to	29

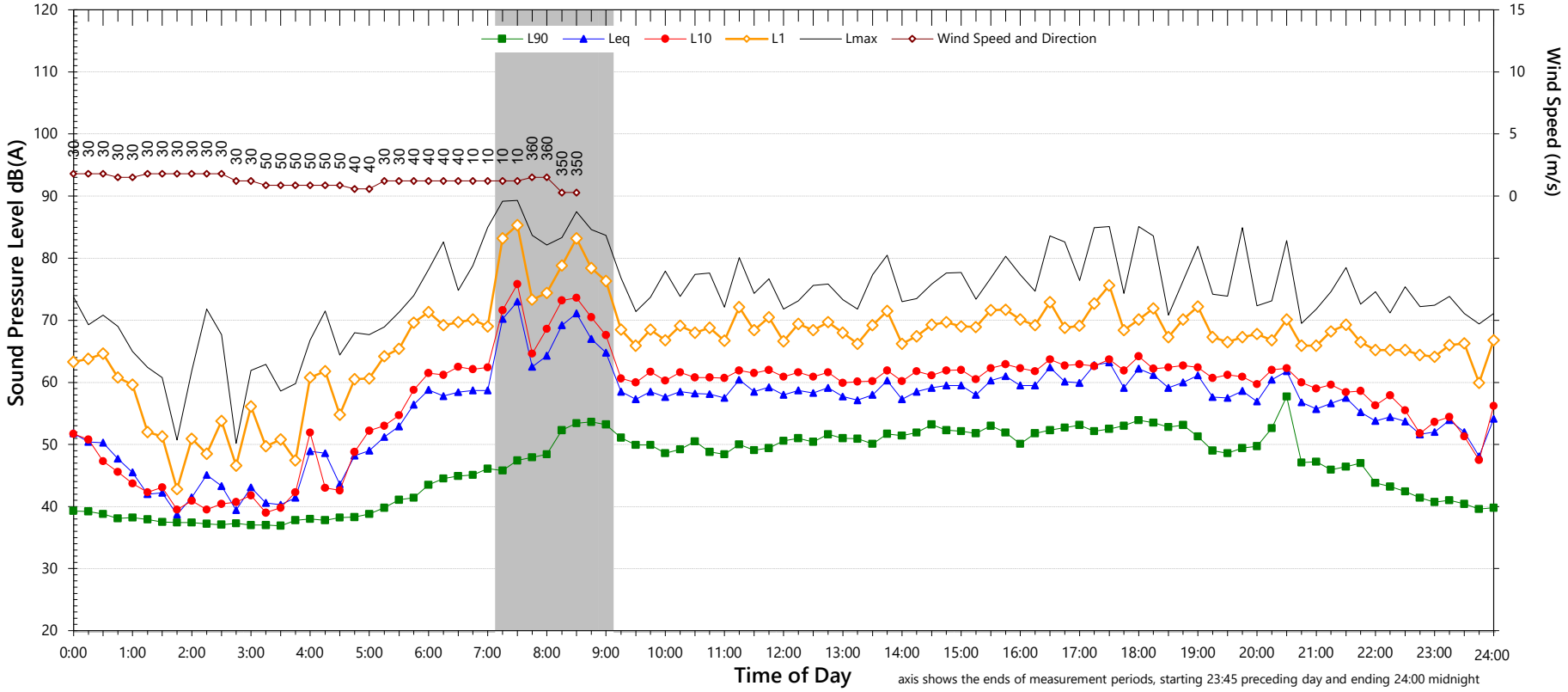
Notes:

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 in free-field; tabulated results facade 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

40 Anderson St, Chatswood - Frontyard

Monday, 25 November 2024



NSW Noise Policy for Industry (Free Field)			
Descriptor	**Day[2]**	**Evening[3]**	**Night[4 5]**
L_{A90} ABL	49	46	38
L_{Aeq}	60	59	52

Night Time Maximum Noise Levels			(see note 7)
L_{AFMax} (Range)	66	to	81
L_{AFMax} - L_{Aeq} (Range)	20	to	26

NSW Road Noise Policy (1m from facade)		(see note 6)
Descriptor	**Day**	**Night[5]**
	7am-10pm	**10pm-7am**
$L_{Aeq\ 15\ hr}$ and $L_{Aeq\ 9\ hr}$	62	55
$L_{Aeq\ 1hr}$ upper 10 percentile	63	57
$L_{Aeq\ 1hr}$ lower 10 percentile	60	47

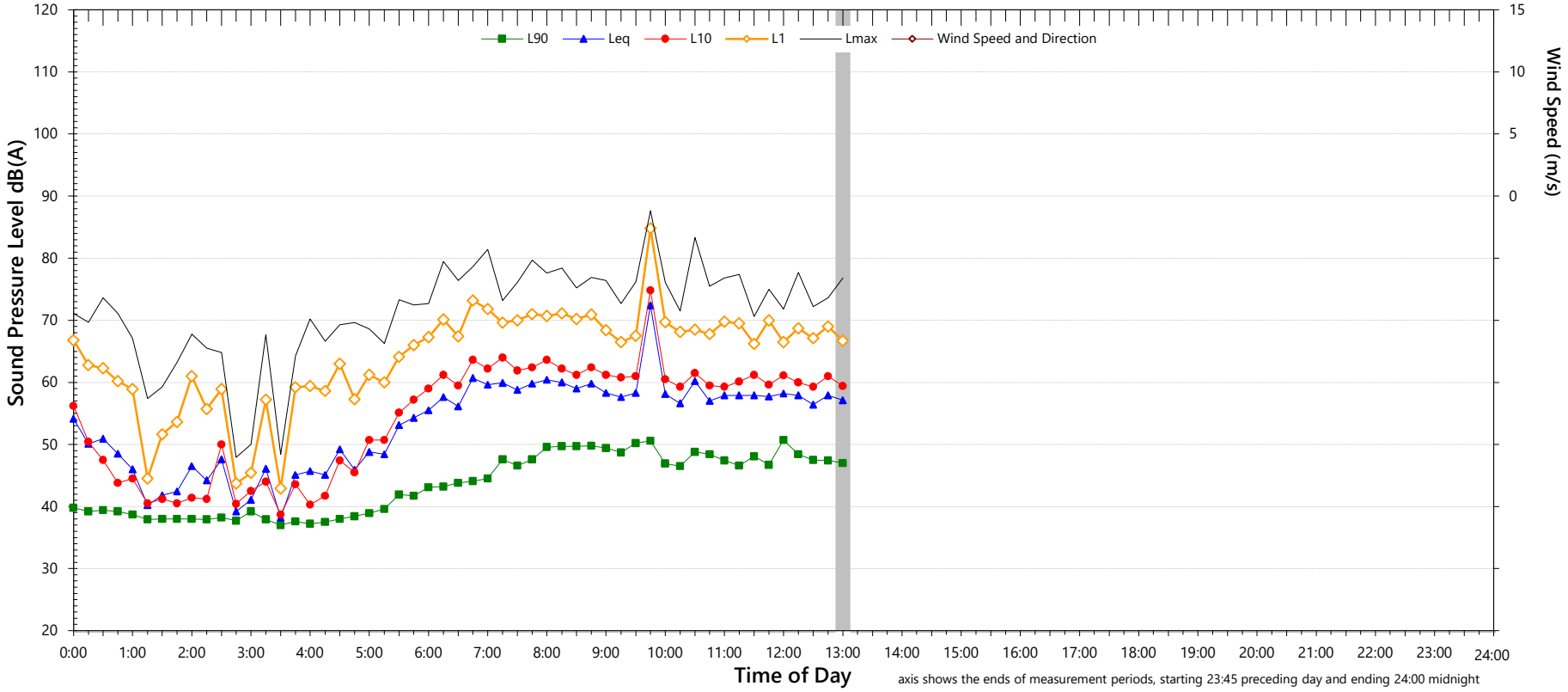
Notes:

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 in free-field; tabulated results facade 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

40 Anderson St, Chatswood - Frontyard

Tuesday, 26 November 2024



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

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)		(see note 6)
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	-	-

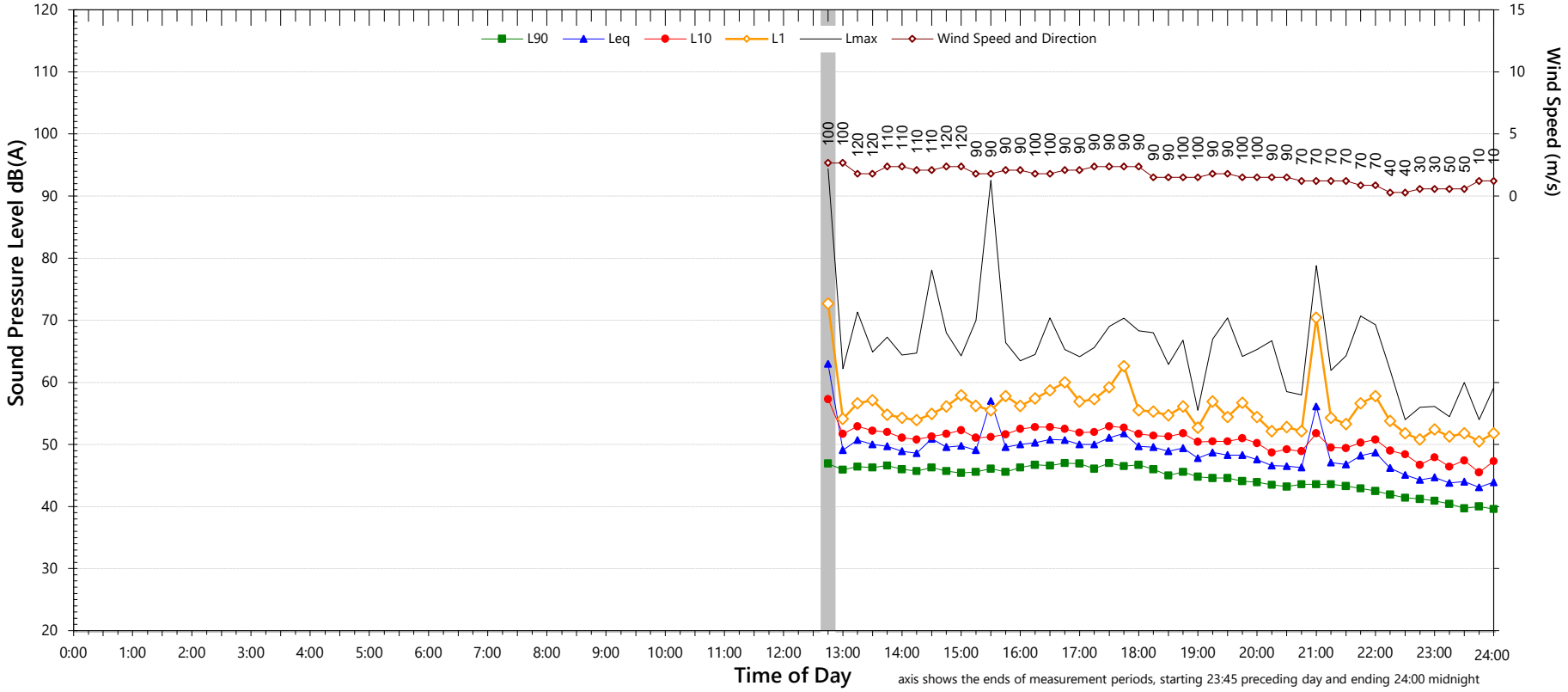
Notes:

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 in free-field; tabulated results facade 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

2 Day Street, Chatswood - Backyard

Tuesday, 19 November 2024



NSW Noise Policy for Industry (Free Field)				
Descriptor		**Day[2]**	**Evening[3]**	**Night[4 5]**
L_{A90} ABL		-	43	38
L_{Aeq}	(see note 6)	-	47	43

Night Time Maximum Noise Levels			(see note 7)
L_{AFMax} (Range)	66	to	77
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 $L_{Aeq\ 9\ hr}$	-	46
$L_{Aeq\ 1hr}$ upper 10 percentile	-	50
$L_{Aeq\ 1hr}$ lower 10 percentile	-	41

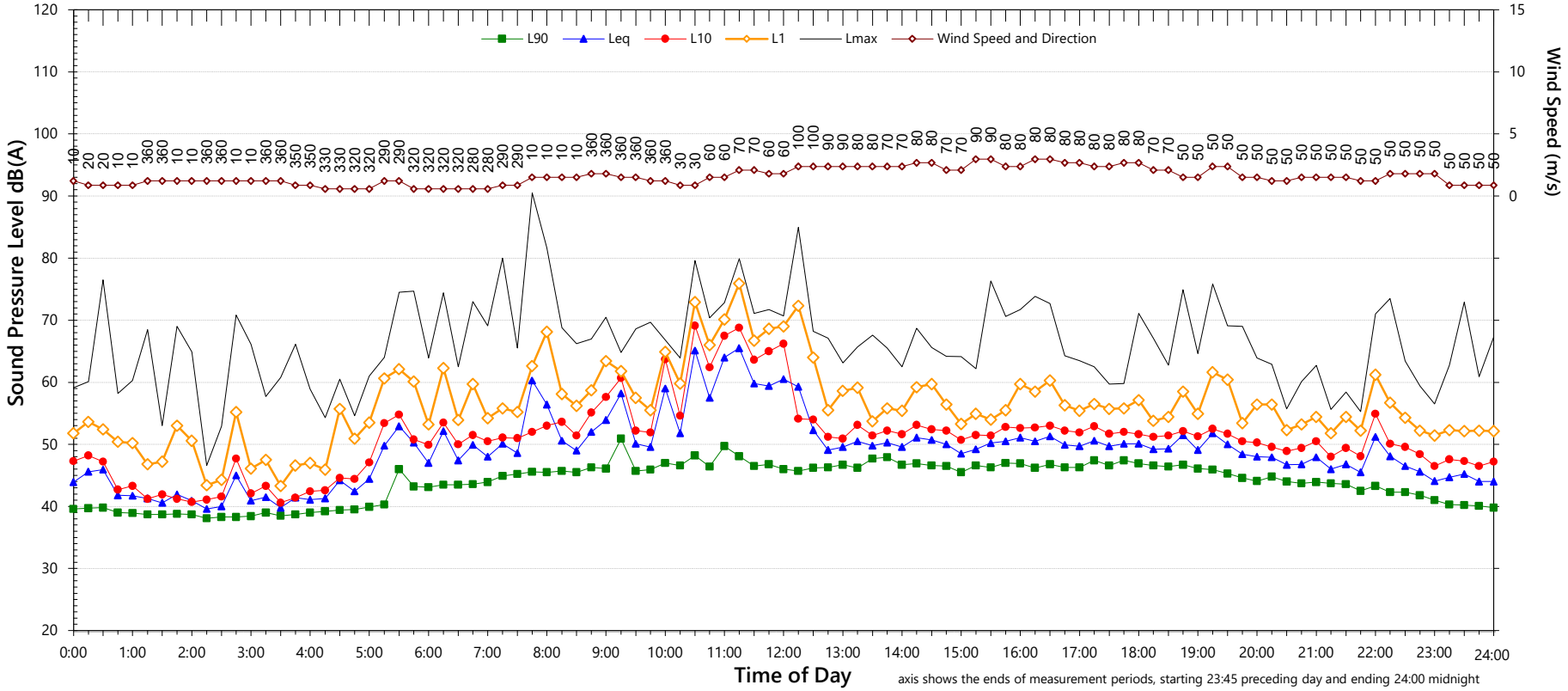
Notes:

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

2 Day Street, Chatswood - Backyard

Wednesday, 20 November 2024



NSW Noise Policy for Industry (Free Field)				
Descriptor		**Day**[2]	**Evening**[3]	**Night**[4 5]
L_{A90} ABL		46	43	38
L_{Aeq}	(see note 6)	54	46	43

Night Time Maximum Noise Levels			(see note 7)
L_{AFMax} (Range)	65	to	74
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 $L_{Aeq\ 9\ hr}$	56	45
$L_{Aeq\ 1hr}$ upper 10 percentile	60	47
$L_{Aeq\ 1hr}$ lower 10 percentile	49	41

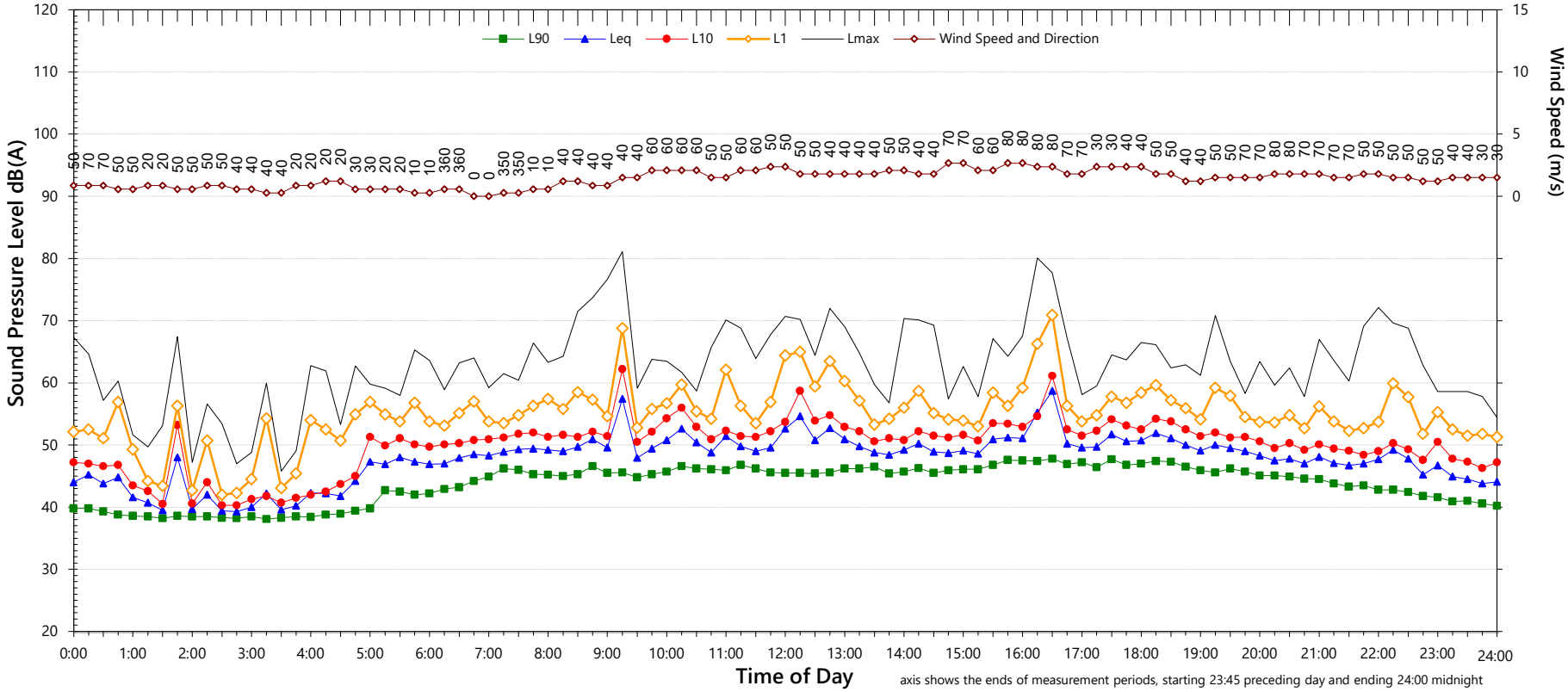
Notes:

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

2 Day Street, Chatswood - Backyard

Thursday, 21 November 2024



NSW Noise Policy for Industry (Free Field)				
Descriptor		**Day[2]**	**Evening[3]**	**Night[4 5]**
L_{A90} ABL		45	43	38
L_{Aeq}	(see note 6)	49	46	43

Night Time Maximum Noise Levels			(see note 7)
L_{AFMax} (Range)	66	to	73
L_{AFMax} - L_{Aeq} (Range)	17	to	30

NSW Road Noise Policy (1m from facade)		
Descriptor	**Day**	**Night[5]**
	7am-10pm	**10pm-7am**
$L_{Aeq\ 15\ hr}$ and $L_{Aeq\ 9\ hr}$	51	45
$L_{Aeq\ 1hr}$ upper 10 percentile	53	48
$L_{Aeq\ 1hr}$ lower 10 percentile	48	41

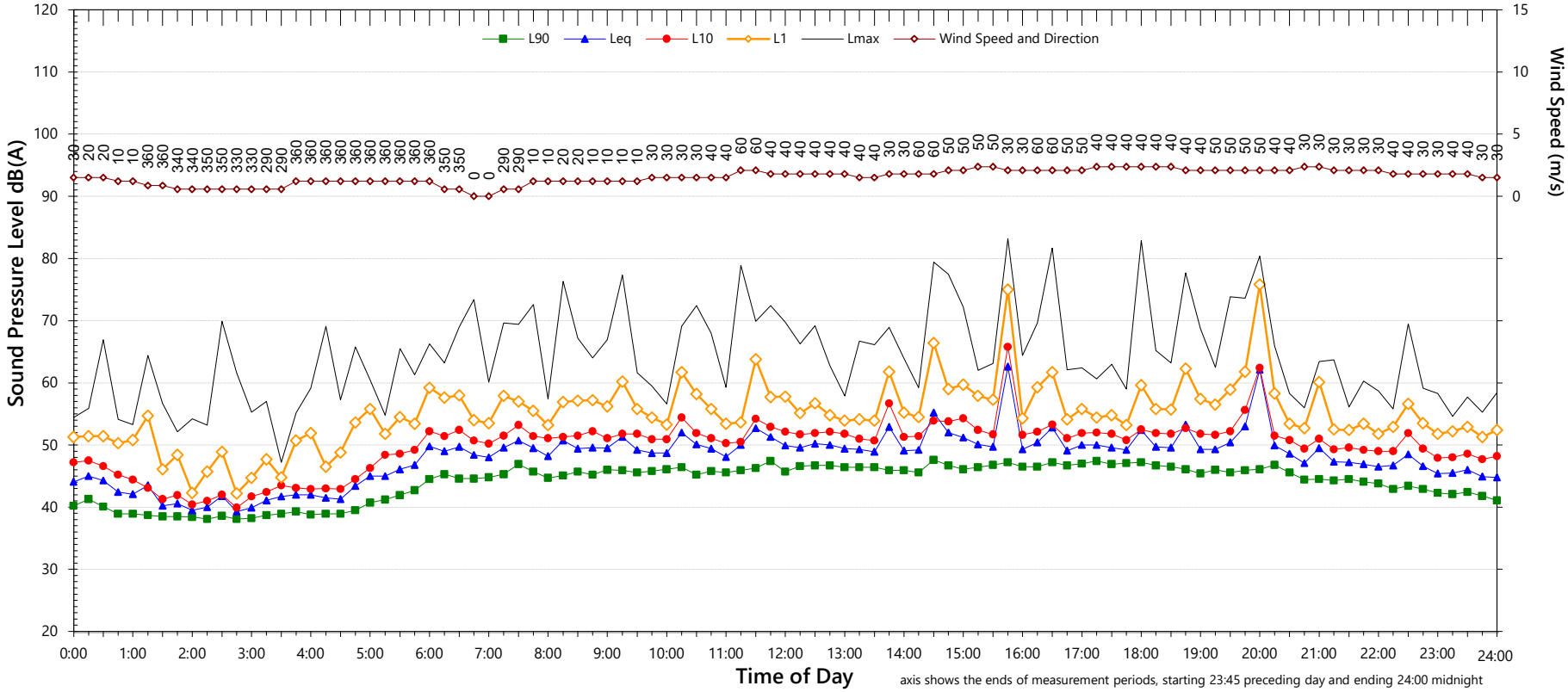
Notes:

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

2 Day Street, Chatswood - Backyard

Friday, 22 November 2024



NSW Noise Policy for Industry (Free Field)				
Descriptor		**Day**[2]	**Evening**[3]	**Night**[4 5]
L_{A90} ABL		45	44	38
L_{Aeq}	(see note 6)	49	50	42

Night Time Maximum Noise Levels			(see note 7)
L_{AFMax} (Range)	69	to	72
L_{AFMax} - L_{Aeq} (Range)	19	to	24

NSW Road Noise Policy (1m from facade)		
Descriptor	**Day**	**Night**[5]
	7am-10pm	**10pm-7am**
$L_{Aeq\ 15\ hr}$ and $L_{Aeq\ 9\ hr}$	52	45
$L_{Aeq\ 1hr}$ upper 10 percentile	55	47
$L_{Aeq\ 1hr}$ lower 10 percentile	49	40

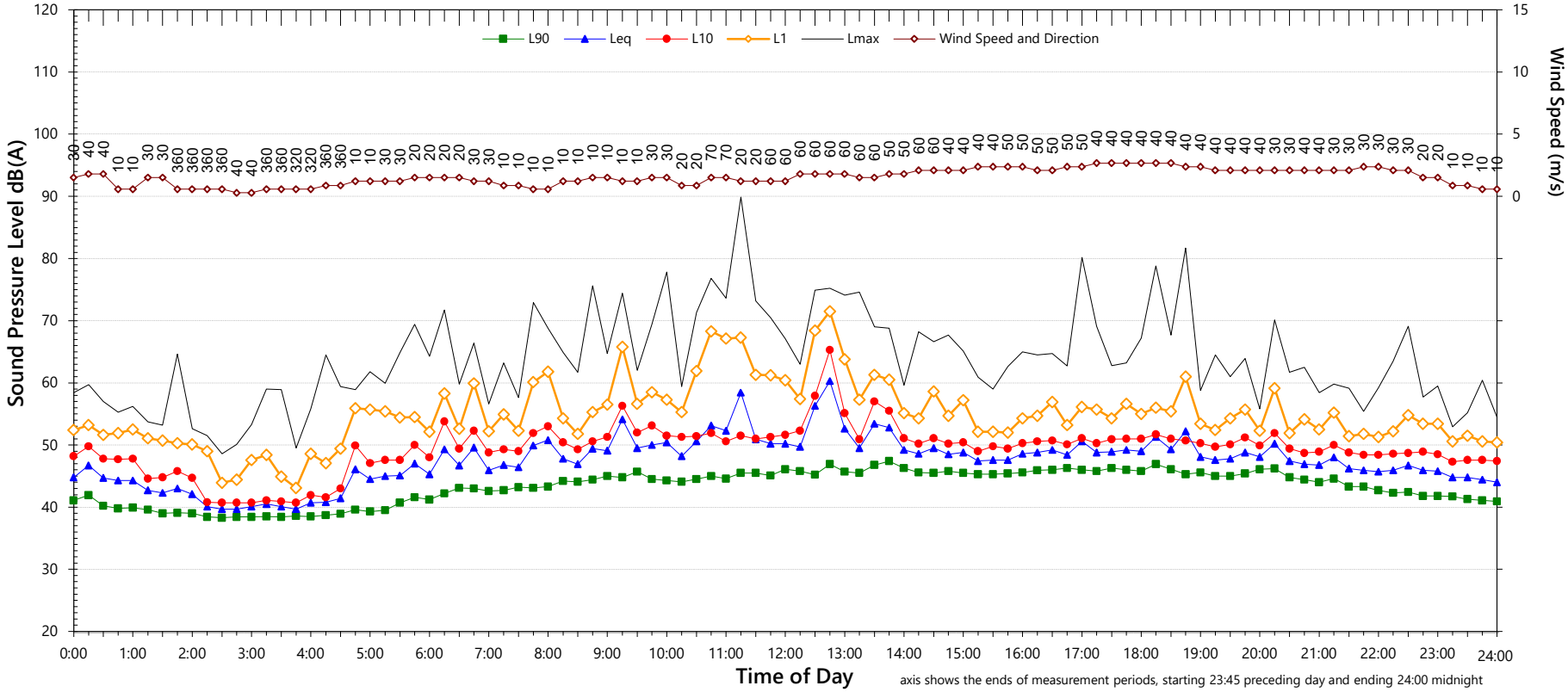
Notes:

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

2 Day Street, Chatswood - Backyard

Saturday, 23 November 2024



NSW Noise Policy for Industry (Free Field)				
Descriptor		**Day[2]**	**Evening[3]**	**Night[4 5]**
L_{A90} ABL		44	43	39
L_{Aeq}	(see note 6)	49	46	42

Night Time Maximum Noise Levels			(see note 7)
L_{AFMax} (Range)	66	to	76
L_{AFMax} - L_{Aeq} (Range)	16	to	29

NSW Road Noise Policy (1m from facade)		
Descriptor	**Day**	**Night[5]**
	7am-10pm	**10pm-7am**
$L_{Aeq\ 15\ hr}$ and $L_{Aeq\ 9\ hr}$	51	45
$L_{Aeq\ 1hr}$ upper 10 percentile	53	47
$L_{Aeq\ 1hr}$ lower 10 percentile	48	41

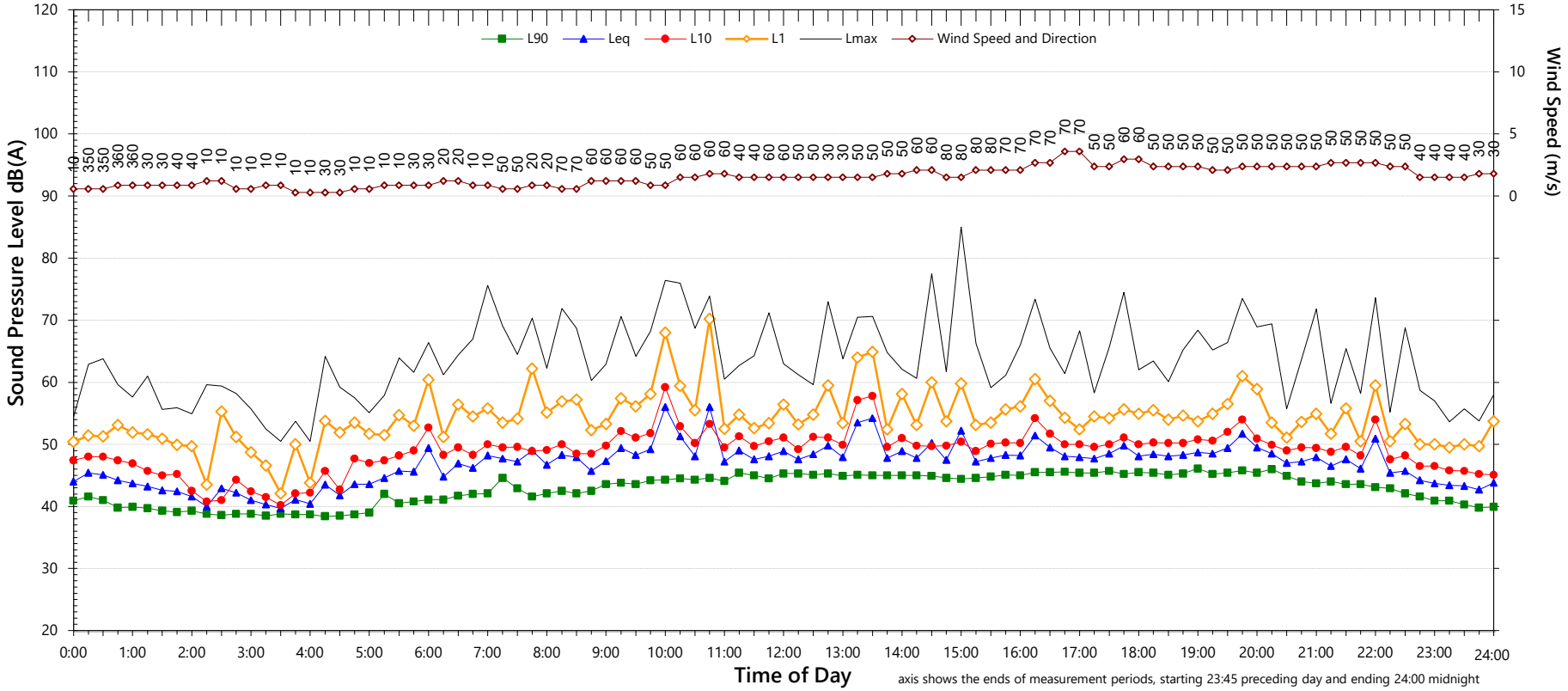
Notes:

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

2 Day Street, Chatswood - Backyard

Sunday, 24 November 2024



NSW Noise Policy for Industry (Free Field)				
Descriptor		**Day[2]**	**Evening[3]**	**Night[4 5]**
L_{A90} ABL		44	44	38
L_{Aeq}	(see note 6)	47	46	43

Night Time Maximum Noise Levels			(see note 7)
L_{AFMax} (Range)	68	to	75
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 $L_{Aeq\ 9\ hr}$	50	46
$L_{Aeq\ 1hr}$ upper 10 percentile	52	49
$L_{Aeq\ 1hr}$ lower 10 percentile	48	40

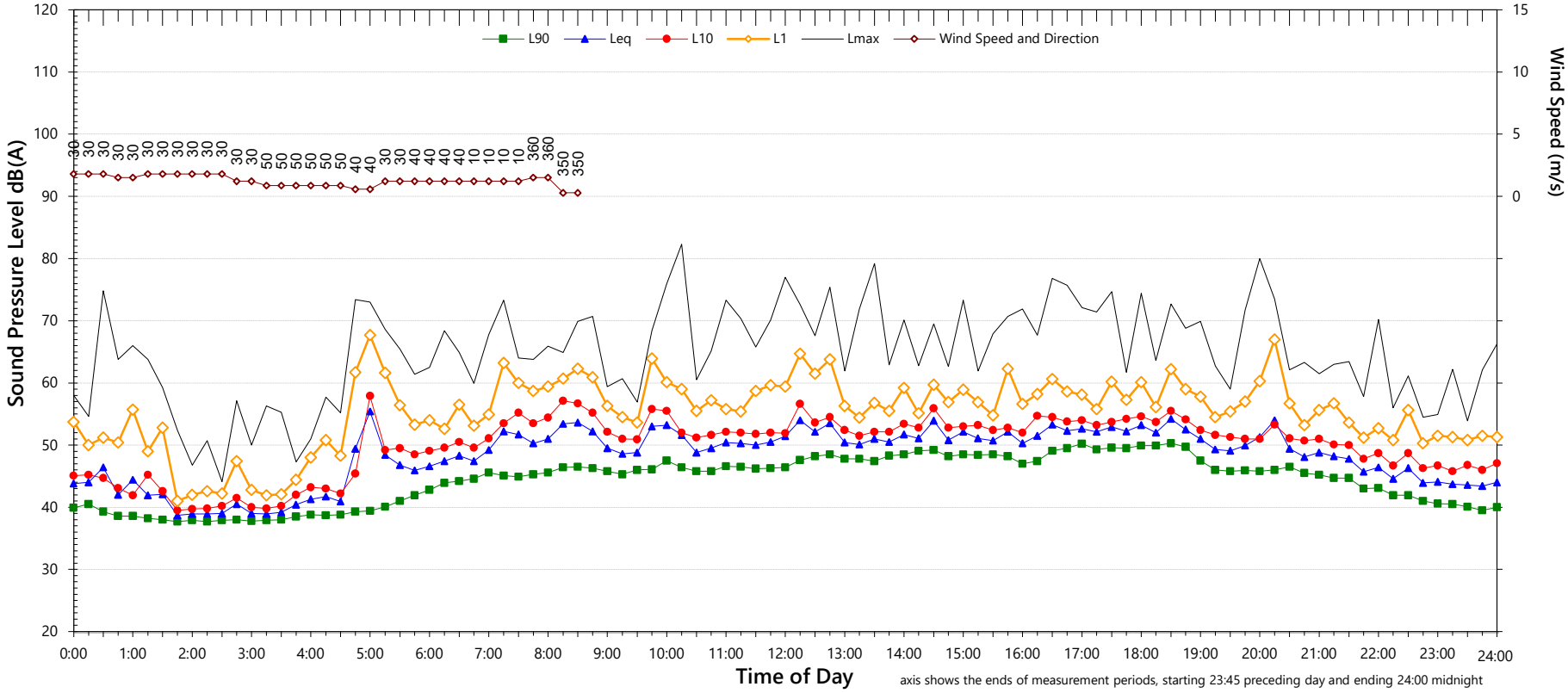
Notes:

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

2 Day Street, Chatswood - Backyard

Monday, 25 November 2024



NSW Noise Policy for Industry (Free Field)				
Descriptor		**Day**[2]	**Evening**[3]	**Night**[4 5]
L_{A90} ABL		46	44	38
L_{Aeq}	(see note 6)	49	48	43

Night Time Maximum Noise Levels			(see note 7)
L_{AFMax} (Range)	66	to	78
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 $L_{Aeq\ 9\ hr}$	51	45
$L_{Aeq\ 1hr}$ upper 10 percentile	53	48
$L_{Aeq\ 1hr}$ lower 10 percentile	50	40

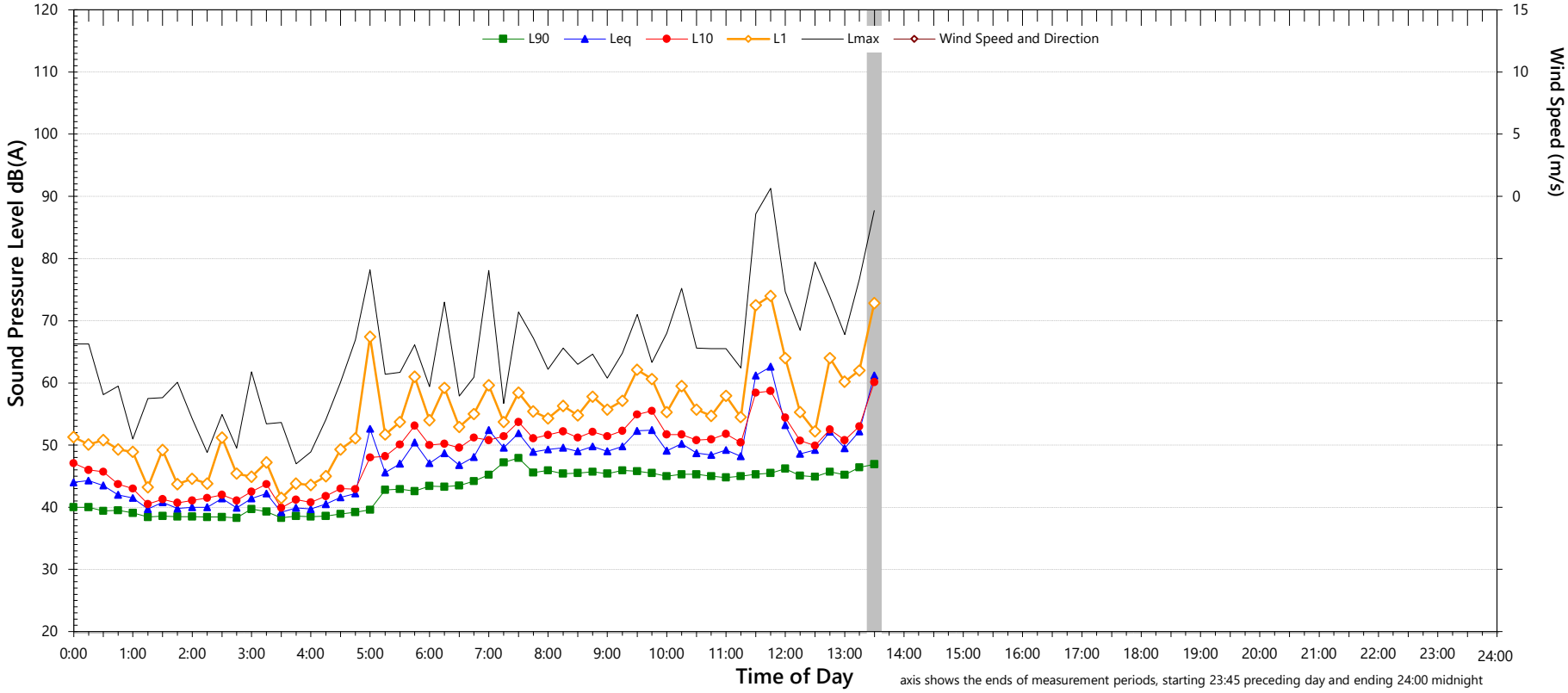
Notes:

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

2 Day Street, Chatswood - Backyard

Tuesday, 26 November 2024



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)