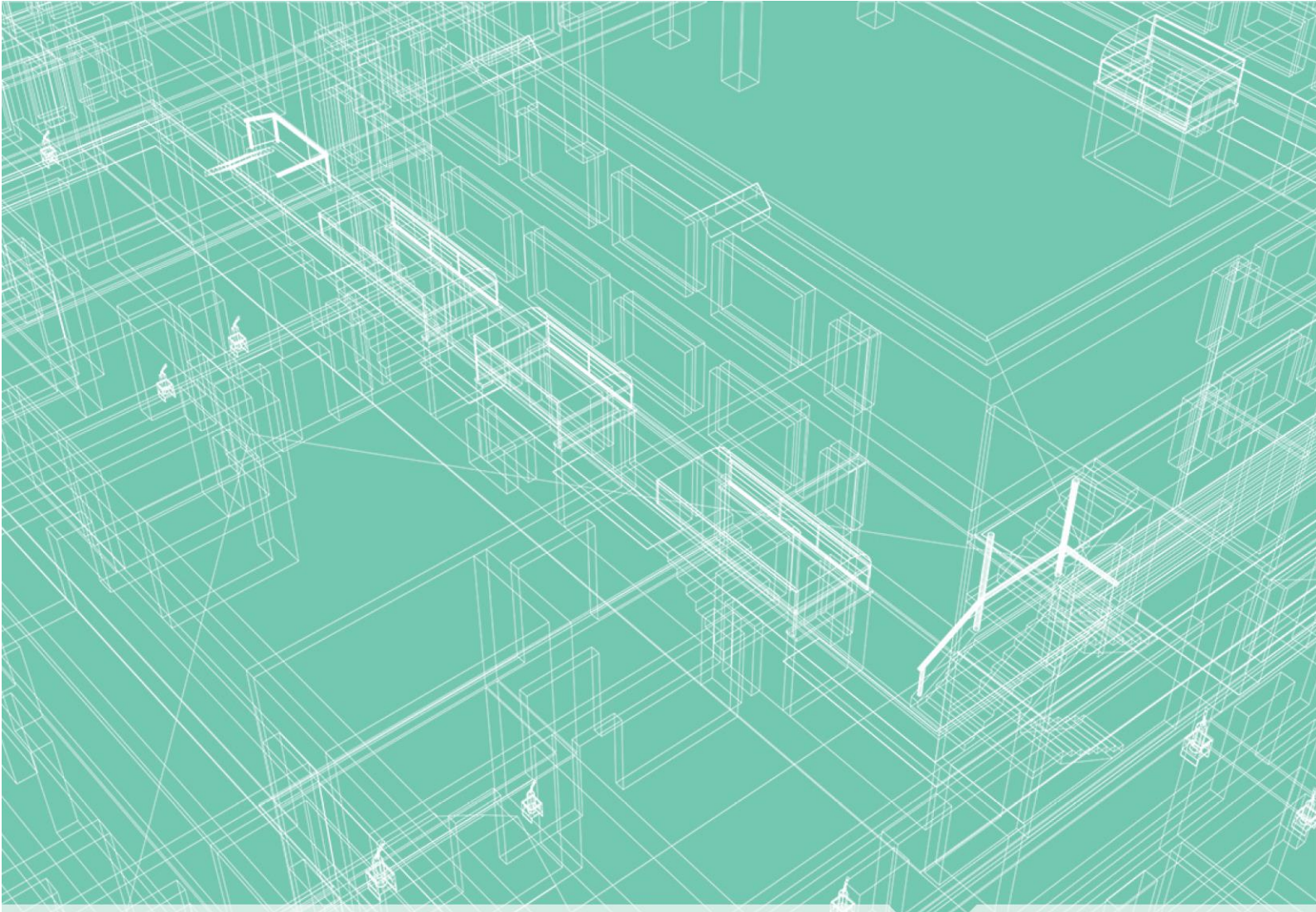

NOISE & VIBRATION IMPACT ASSESSMENT FOR SSDA

TAFE MEADOWBANK MULTI-TRADES AND DIGITAL TECHNOLOGY HUB

JHA

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DOCUMENT CONTROL SHEET

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CONTENTS

1 INTRODUCTION

1.1 OVERVIEW

This acoustic report has been prepared by JHA Consulting Engineers on behalf of TAFE NSW (The Technical and Further Education Commission) c/Gray Puksand Pty Ltd (the Applicant).

It accompanies an Environmental Impact Statement (EIS) in support of State Significant Development Application (SSD 10349) for the TAFE NSW Meadowbank – Multi-Trades and Digital Technology Hub in See Street, in Meadowbank (the site).

The proposed development involves the construction of the Multi-Trades and Digital Technology Hub Building and a Multi-Storey carpark, and includes the following:

- Learning spaces;
- Self-directed learning spaces;
- Workshops – including outdoors;
- Workplaces for academic and administrative staff;
- Specialist rooms for training purposes; and
- Computer rooms.
- Multi-Storey carpark adjacent to Block J

The purpose of this acoustic report is to demonstrate compliance with the SEARs. This report shall be read in conjunction with the Architectural design drawings and other consultant design reports submitted as part of the application. The objectives of this acoustic assessment are:

- Identify noise sensitive receivers that will potentially be affected by the operation and construction of the proposed development.
- Carry out noise surveys to determine existing ambient and background noise levels on site.
- Establish the appropriate noise level and vibration criteria in accordance with the relevant standards, guidelines and legislation for the following noise emissions:
    - Mechanical plant from the development to the surrounding receivers.
    - Public Address System.
    - Use of power tools in workshops and outdoor workshops.
    - External loading yard.
    - Carpark.
- Determine whether the relevant criteria can be achieved based on proposed operations and construction, demolition and excavation methods. Where applicable, provide recommendations for any necessary acoustic control measures that will need to be incorporated into the development or use in order to ensure with the assessment criteria.
- Provide recommendations for Construction Noise and Vibration Planning.

The following documentation has been used for the preparation of this report:

- Architectural drawings and 3D model of the proposed development prepared by Gray Puksand Architects
- Noise data collected on site through the use of noise loggers and a hand held spectrum analyser.
- Transport and Accessibility Impact Assessment prepared by GTA Consultants

This document and related work has been prepared following JHA Consulting Engineers Quality and Environmental Management Systems, which are based on AS/NZS ISO 9001:2016 and ISO 14001:2016.

1.2 RESPONSE TO SEARS

The acoustic report is required by the Secretary's Environmental Assessment Requirements (SEARs) for SSD 10349. This table identifies the relevant SEARs requirement/s and corresponding reference/s within this report.

SEARs Item	*Report Reference*
5. Environmental Amenity • *Detail amenity impacts including solar access, acoustic impacts, visual privacy, view loss, overshadowing and wind impacts. A high level of environmental amenity for any surrounding residential land uses must be demonstrated.*	Section 5
12. Noise and Vibration • *Identify and provide a quantitative assessment of the main noise and vibration generating sources during demolition, site preparation, bulk excavation, construction. Outline measures to minimise and mitigate the potential noise impacts on surrounding occupiers of land.*	Section 6
• *Identify and assess operational noise, including consideration of any public address system, mechanical services (e.g. trade equipment, air conditioning plant), use of facilities for events, and outline measures to minimise and mitigate the potential noise impacts on surrounding occupiers of land.*	Section 5
Relevant Policies and Guidelines: • *NSW EPA Noise Policy for Industry (2017)* • *Interim Construction Noise Guideline (DECC)* • *Assessing Vibration: A Technical Guideline 2006* • *Development Near Rail Corridors and Busy Roads – Interim Guideline (Department of Planning 2008)* • *Australian Standard 2363:1999 'Acoustics – Measurement of noise from helicopter operations'.*	Section 4

Table 1: SEARs and Relevant Reference.

2 DESCRIPTION OF THE PROPOSAL

2.1 PROJECT BACKGROUND

TAFE NSW Meadowbank is one of the largest TAFE facilities in Sydney, which offers an extensive range of educational services. TAFE NSW Meadowbank is located at See St, Meadowbank NSW 2114 adjacent to Meadowbank Train Station, in the local government area of City of Ryde Council.

The project consist in a new Multi-Trades and Digital Technology Hub Building, and a multi-storey carpark adjacent to Block J – part of SSDA scope.

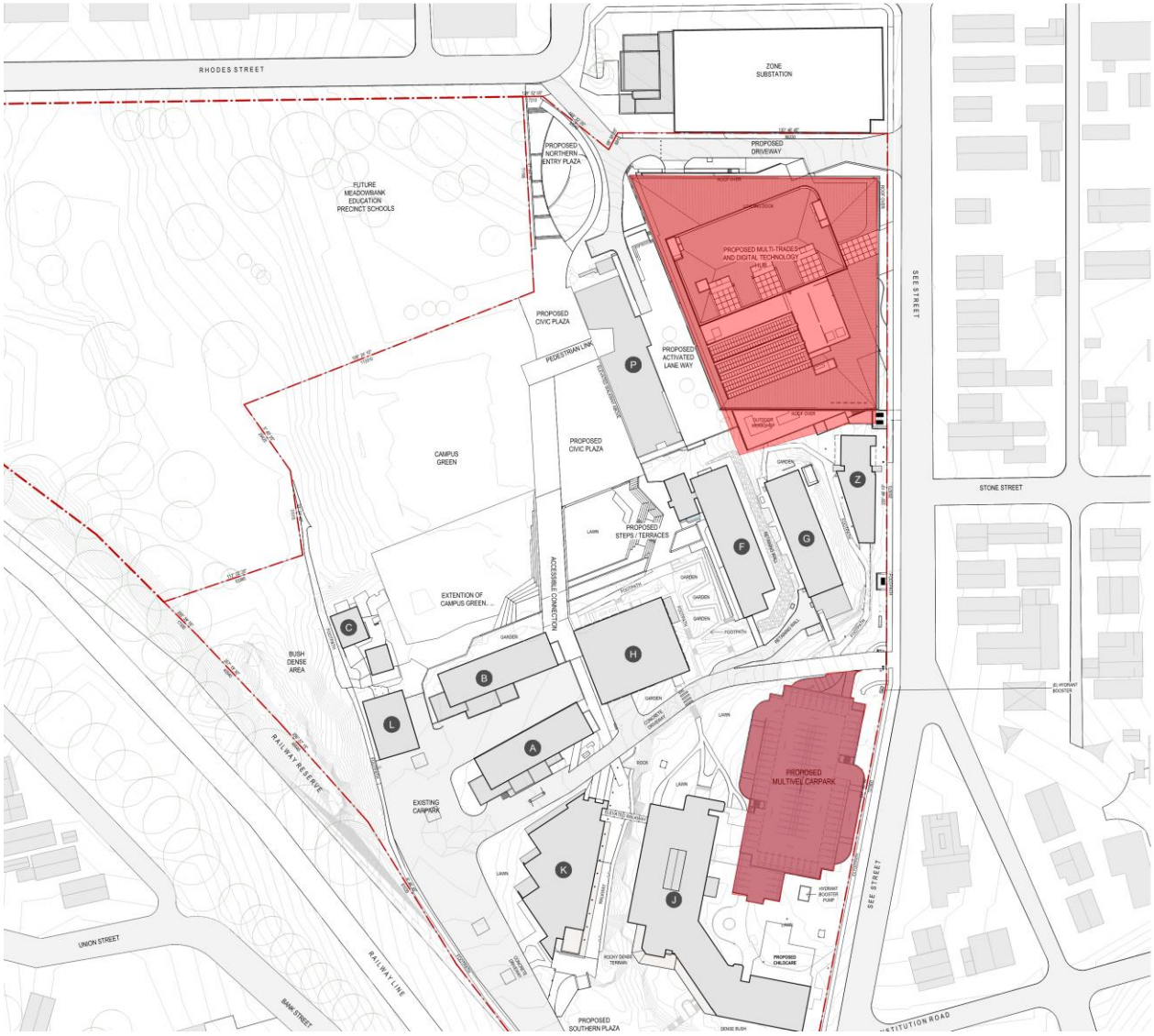


Figure 1: Proposed Multi-Trades and Digital Technology Hub Building (MTH+DTH) and Multi-storey carpark within TAFE NSW Meadowbank.

2.2 SITE DETAILS

Meadowbank is a suburb located 15 kilometres west of Sydney CBD in the Northern Suburbs Area. It belongs to the Local Government Area of City of Ryde. The TAFE NSW Meadowbank campus is bounded to the North, East and South by Rhodes Street, McPherson Street, See Street and Constitution Road. Sydney Trains T1 Northern Line Railway is adjacent to the western boundary of the site.

The local area immediately surrounding the TAFE site has a mix of uses varying from residential, light industrial, educational and local scale retail. A large zone substation shares the northern boundary of the site with associated easements to the TAFE property. A large light industrial are is located to the north of the campus and a minor holding to the south behind the local retail outlets.

The TAFE NSW Meadowbank Campus has significant changes in level across the site, sloping down from See Street and the railway line, forming a North – South orientated gully to the central portion of the site.

There are three main carpark areas on site, one to the north east corner fronting See Street, one to the south-east corner, also fronting See Street and one final area to the south western corner of the site, accessed via See Street and travel along a private roadway from east to west across the campus.

Figure 2 shows the site location and nearest noise sensitive receivers.

Figure 2: Aerial view of site showing the location of the site (red shadow), residential receivers (golden shadow), educational receivers (orange shadow), light industrial (purple shadow) and proposed new K-12 school (green shadow).

2.3 OPERATION HOURS

The Multi-Trades and Digital Technology Hub Building will be operational during semester time periods only. The proposed operating hours for the Multi-Trades and Digital Technology Hub Building are:

- Monday to Thursday: 7.00am to 10.30pm.
- Friday: 7.00am to 7.00pm.
- Saturday: 8.00am to 5.30pm.

3 SITE MEASUREMENTS

3.1 GENERAL

Attended and unattended noise surveys were conducted in the locations shown in Figure 3 in order to establish the ambient and background noise levels of the site and its surroundings. Noise surveys have been carried out in accordance with the method described in the AS/NZS 1055:2018 *'Acoustics – Description and measurement of environmental noise'*.

Figure 3: Aerial view of site showing the location of the measurements.

3.2 UNATTENDED NOISE MONITORING

Long-term noise monitoring surveys were carried out from Friday 26th July to Friday 2nd August 2019 and Friday 29th November 2019 to Friday 6th December 2019. Rion NL-52 were the used noise logger (Serial Numbers 553892 and 873126). The noise loggers recorded L_{A1}, L_{A10}, L_{Aeq} and L_{A90} noise parameters at 15-minute intervals during the measurement period. The calibration of the noise loggers were checked before and after use and no deviations were recorded.

These locations were secure and considered to be representative of the typical ambient and background noise levels for the nearest residential receivers. Second location (L2) was requested by EPA as per their assessment advice letter dated 21st November 2019. The microphones were mounted 1.5 meters above the ground and windshields were used to protect the microphone.

The detailed results of the long-term noise monitoring are presented graphically in Appendix A. The daily results of the unattended noise monitoring are summarised in Table 2 and Table 3 as the Rating Background Level (RBL) and the Assessment Background Level (ABL) noise levels for daytime, evening and night-time periods – as per NSW NPI methodology.

Weather conditions were monitored for the duration of the noise surveys and were typically calm and dry with some wind events having been noted to occur during the measurement periods. As stated in the NSW NPI methodology, any data likely to be affected by rain, wind or other extraneous noise has been excluded from the calculations (shadowed in the Appendix A graphs and noted as Weather in Table 2 and Table 3).

Date	*L_{A90} Background Noise Levels, dB(A)*			*L_{Aeq} Ambient Noise Levels, dB(A)*		
	Day 0700-1800	*Evening 1800-2200*	*Night 2200-0700*	*Day 0700-1800*	*Evening 1800-2200*	*Night 2200-0700*
Friday 26 July 2019	n/a	43	37	n/a	50	46
Saturday 27 July 2019	41	40	37	52	49	47
Sunday 28 July 2019	39	41	35	52	48	47
Monday 29 July 2019	41	Weather	Weather	54	Weather	Weather
Tuesday 30 July 2019	44	43	Weather	53	52	Weather
Wednesday 31 July 2019	42	42	35	53	50	47
Thursday 1 August 2019	40	42	37	54	52	48
Rating Background Levels (RBLs) / Assessment Background Levels (ABLs)	**41**	**42**	**37**	**53**	**50**	**47**

Table 2: Results of long-term noise monitoring at Location L1.

Date	L_{A90} Background Noise Levels, dB(A)			L_{Aeq} Ambient Noise Levels, dB(A)		
	Day 0700-1800	Evening 1800-2200	Night 2200-0700	Day 0700-1800	Evening 1800-2200	Night 2200-0700
Friday 29 November 2019	n/a	41	38	n/a	58	53
Saturday 30 November 2019	43	37	33	59	53	52
Sunday 1 December 2019	37	39	Weather	56	58	Weather
Monday 2 December 2019	Weather	Weather	Weather	Weather	Weather	Weather
Tuesday 3 December 2019	Weather	43	37	Weather	58	57
Wednesday 4 December 2019	41	41	38	60	55	53
Thursday 5 December 2019	43	42	39	60	58	53
Friday 6 December 2019	n/a	n/a	n/a	n/a	n/a	n/a
Rating Background Levels (RBLs) / Assessment Background Levels (ABLs)	**42**	**41**	**37**	**59**	**57**	**54**

Table 3: Results of long-term noise monitoring at Location L2.

3.3 ATTENDED NOISE MONITORING

Short-term noise monitoring was carried out to obtain representative octave band noise levels of the site and noise levels from the site.

On Friday 26th July 2019 and Friday 2nd August 2019, short-term noise measurements were carried out during the day-time period. Short-term noise measurements were carried out with a NTI XL-2 hand-held Sound Level Meter (SLM) (Serial Number A2A-13742-E0). The SLM used a NTI M2230 Class 1 Measurement Microphone (Serial Number 7204 / A15226). The calibration of the SLM was checked before and after each use with a Larson Davis Cal 200 Class 1 Calibrator (Serial Number 15054) and no deviations were recorded.

The SLM microphone was mounted 1.5 metres above the ground and a windshield was used to protect the microphone. Measurement was undertaken in the free-field – i.e. more than 3.5 metres away from any building façade or vertical reflective surface. Weather conditions were calm and dry during the attended noise monitoring.

From observations during the site visit, it is noted that at location 1, the ambient and background noise levels are dominated by low levels of activity and nature. A summary of the results of the short-term noise monitoring are shown in Table 4.

Location	Date and Time	Parameter	Sound Pressure Level, dB re 20μPa							
			Overall dB(A)	Octave Band Centre Frequency, Hz						
				63	125	250	500	1k	2k	4k	8k
S1	26/07/2019 11.20 – 11.35	$L_{90,15min}$	**49**	58	51	46	43	42	38	34	27
		$L_{eq,15min}$	**53**	60	56	53	50	48	44	42	39
		$L_{10,15min}$	**59**	65	61	60	56	54	51	48	45
S2	02/08/2019 11.03 – 11.18	$L_{90,15min}$	**44**	50	44	39	39	36	33	32	22
		$L_{eq,15min}$	**49**	55	51	44	46	47	42	40	33
		$L_{10,15min}$	**51**	58	53	47	47	44	43	41	34
S3	02/08/2019 11.24 – 11.39	$L_{90,15min}$	**49**	51	48	42	42	44	37	34	25
		$L_{eq,15min}$	**57**	57	53	50	48	49	47	52	46
		$L_{10,15min}$	**59**	58	54	49	48	50	49	55	47

Table 4: Results of the short-term noise monitoring.

4 RELEVANT NOISE STANDARDS AND GUIDELINES

4.1 STANDARDS AND GUIDELINES

The following standards and guidelines are considered relevant to the project and have been referenced in developing the project noise level criteria.

Planning:

- City of Ryde Local Environment Plan 2014.
- City of Ryde Council Development Control Plan 2014.

Operational Noise:

- Environmental Planning and Assessment (EP&A) Act 1979.
- Protection of the Environmental Operations (POEO) Act 1997.
- Protection of the Environmental Operations. Noise Regulation Controls (NRC) 2008.
- NSW EPA Noise Policy for Industry (NPI) 2017.
- NSW Department of Environment Climate Change and Water (DECCW) Noise Guide for Local Government (NGLG) 2013.
- NSW DECCW Road Noise Policy (RNP) 2011.

External Noise Intrusion:

- NSW Department of Planning (DoP) Development Near Rail Corridors and Busy Roads – Interim Guideline 2008.
- Australian Standard AS 3671:1989 *'Acoustics – Road Traffic Noise Intrusion – Building sitting and construction'*.

Construction Noise and Vibration:

- NSW DECCW Interim Construction Noise Guideline (ICNG) 2009.
- NSW DECC Assessing Vibration: A Technical Guideline 2006.
- NSW Road Maritime Service (RMS) Construction Noise and Vibration Guideline 2016.
- Australian Standard AS 2436:2010 *'Acoustics – Guide to Noise Control on Construction, Maintenance & Demolition Sites'*.

4.2 REGULATORY FRAMEWORK

4.2.1 ENVIRONMENTAL PLANNING AND ASSESSMENT (EP&A) ACT 1979

The Environmental Planning and Assessment Act 1979 (EP&A Act) provides the regulatory framework for the protection of the environment in NSW. The EP&A Act is relevantly about planning matters and ensuring that "environmental impact" associated with the proposed development is properly considered and reasonable before granting development consent to develop.

The assessment of "environmental impact" relies upon the identification of acceptable noise criteria which may be defined in a Development Control Plan, or derived from principles using guidelines like NSW EPA Noise Policy for Industry (NPI 2017) or Noise Guide for Local Government (NGLG 2013).

4.2.2 PROTECTION OF THE ENVIRONMENTAL OPERATIONS (POEO) ACT 1997

The Protection of the Environment Operations (POEO) Act 1997 has the objective to protect, restore and enhance the quality of the NSW environment. Abatement of noise pollution is underpinned by the definition of "offensive noise" as follows:

"...

(a) that, by reason of its level, nature, character or quality, or the time at which it is made, or any other circumstances:

(i) is harmful to (or is likely to be harmful to) a person who is outside the premises from which it is emitted, or

(ii) interferes unreasonably with (or is likely to interfere unreasonably with) the comfort or repose of a person who is outside the premises from which it is emitted, or

(b) that is of a level, nature, character or quality prescribed by the regulations or that is made at a time, or in other circumstances, prescribed by the regulations.

..."

Noise Guide for Local Government (NGLG) 2013, provides a consideration checklist to determine an "offensive noise".

4.3 NSW NOISE GUIDE FOR LOCAL GOVERNMENT

NGLG 2013 is as guideline that is aimed at councils and planners to provide guidance in the management of local noise problems and in the interpretation of existing policy and legislation.

Table 1.3 of NGLG 2013 contains the management for common neighbourhood noise issues and describes EPA as the Appropriate Regulatory Authority (ARA) for the TAFE NSW Meadowbank campus.

The NGLG 2013 offensive noise test aids in making a systematic judgment about the offensive nature of the noise emissions, considering that noise may be offensive in three ways, according to its:

- Audibility.
- Duration.
- Inherently offensive characteristics.

4.4 CITY OF RYDE COUNCIL LEGISLATION

Relevant Planning Documents of City of Ryde Council Legislation have been reviewed for any noise requirement or criteria.

The City of Ryde Council Local Environmental Plan (CR-LEP 2014) sets the Land Zoning as shown in Figure 4 as per information extracted from the CR-LEP 2014 map 6700_COM_LZN_003_010_20161121. The site is categorized as Infrastructure (SP2) – Educational Establishment and the surroundings as Low Density Residential (R2).

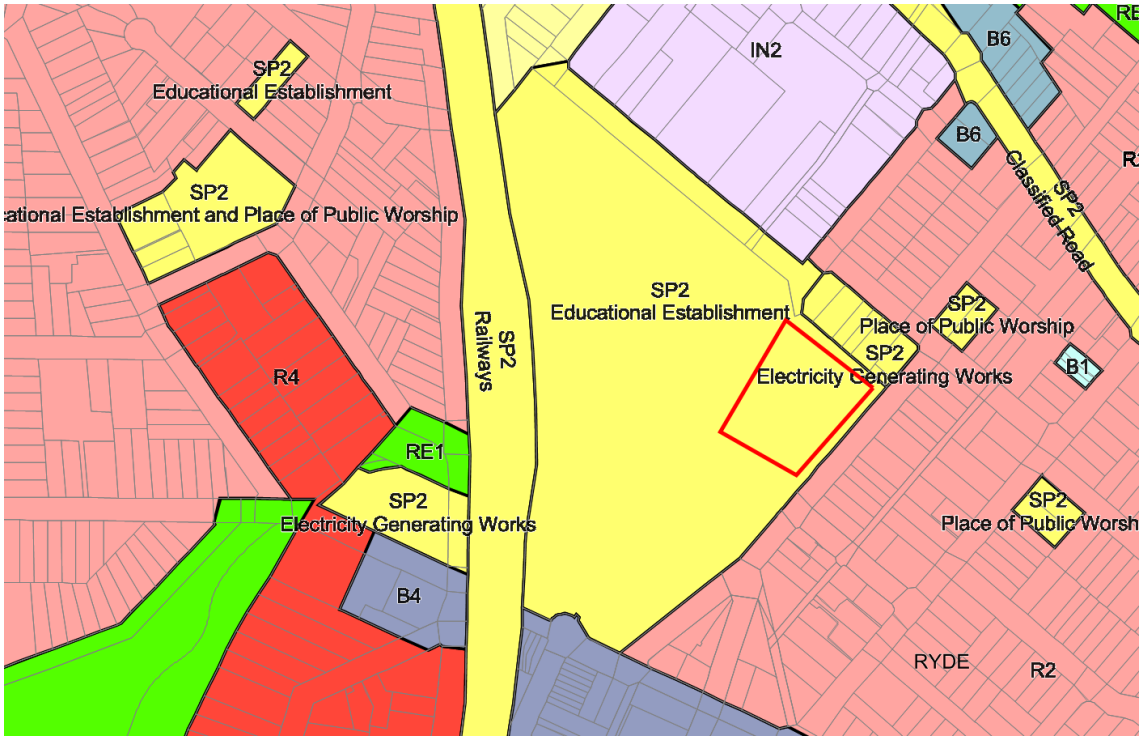


Figure 4: Land Zoning of the site (red shadow) and surroundings.

City of Ryde Development Control Plan (CR-DCP 2014) has been reviewed and no relevant requirements for noise have been found.

4.5 OPERATIONAL NOISE EMISSIONS

4.5.1 NSW EPA NOISE POLICY FOR INDUSTRY

The NSW EPA Noise Policy for Industry 2017 assesses noise from industrial noise sources - scheduled under the POEO. Mechanical noise from the development shall be addressed following the recommendations in the NSW NPI.

The assessment is carried out based on the existing ambient and background noise levels addressing the following:

- Intrusiveness Criteria, to control intrusive noise into nearby sensitive receivers.
- Amenity Criteria, to maintain the noise level amenity for particular land uses.

These criteria are established for each assessment period (day, evening and night) and the more stringent sets the Project Noise Trigger Level (PNTL's).

4.5.1.1 Intrusiveness Criteria

The NSW NPI defines the intrusiveness criteria as follows:

"The intrusiveness of an industrial noise source may generally be considered acceptable if the level of noise from the source (represented by the L_{Aeq} descriptor), measured over a 15 minute period, does not exceed the background noise level by more than 5 dB when beyond a minimum threshold."

Based on the intrusiveness criteria definition and the estimated background noise levels on site, Table 5 shows the intrusiveness criteria for the noise sensitive receivers.

Indicative Noise Amenity Area	*Period*	*Measured Rating Background Level (L_{A90}), dB(A)*	*Intrusiveness Criteria, $L_{Aeq,15min}$ dB(A)*
Residential suburban (R2)	Day	42	47
	Evening	41	46
	Night	37	42

Table 5: Determination of the intrusiveness criterion for residential noise sensitive receivers.

4.5.1.2 Amenity Criteria

The NSW NPI states the following to define the amenity criteria:

"To limit continuing increases in noise levels from application of the intrusiveness level alone, the ambient noise level within an area from all industrial noise sources combined should remain below the recommended amenity noise levels specified in Table 2.2 where feasible and reasonable. The recommended amenity noise levels will protect against noise impacts such as speech interference, community annoyance and some sleep disturbance."

Based on the amenity criteria definition and the land zoning, Table 5 shows the amenity criteria for the noise sensitive receivers.

Indicative Noise Amenity Area	*Period*	*Recommended Amenity Noise Level (L_{Aeq}), dB(A)*	*Amenity Criterion, $L_{Aeq,15min}$ dB(A)*
Residential suburban (R2)	Day	55	53 (55-5+3)
	Evening	45	43 (45-5+3)
	Night	40	38 (40-5+3)
Educational	Noisiest 1-hour period when in use	35 (Internal)	43 (45-5+3) (External)

Table 6: Determination of the amenity criterion for noise sensitive receivers.

4.5.1.3 Project Noise Trigger Levels

The PNTL's are shown in Table 7 and have been obtained in accordance with the requirements of the NSW NPI. These shall be assessed to the most affected point on or within the noise sensitive receiver boundary.

Indicative Noise Amenity Area	*Period*	*Intrusiveness Criterion, $L_{Aeq,15min}$ dB(A)*	*Amenity Criterion, $L_{Aeq,15min}$ dB(A)*
Residential suburban (R2)	Day	47	53
	Evening	46	43
	Night	42	38
Educational	Noisiest 1-hour period when in use	---	43

Table 7: Determination of PNTL's (light grey highlight) for noise sensitive receivers.

4.6 TRANSPORT NOISE

4.6.1 DEVELOPMENT NEAR RAIL CORRIDORS OR BUSY ROADS – INTERIM GUIDELINE

The guideline details the application of clauses 85, 86, 87, 102 and 103 of the Infrastructure State Environmental Planning Policy (SEPP) which is required to be used when a development is adjacent to a rail corridor, a freeway, a toll-way, a transit-way or a road with an annual average daily traffic volume (AADT) of more than 40,000 vehicles.

Railway noise has been considered for the proposed development as the Sydney Trains T1 Northern Line Railway defines the western boundary of the site. An extract of the Acoustic Assessment Zones based in distance of noise sensitive receivers from the operational track is shown below in Figure 5.

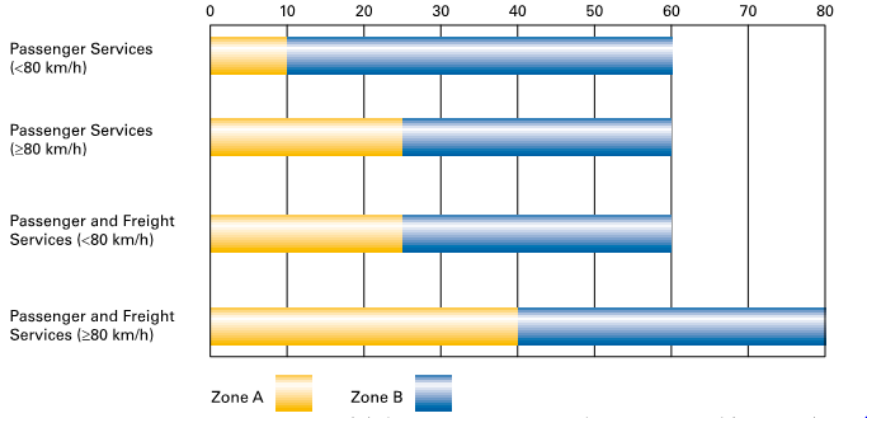


Figure 5: Acoustic Assessment Zones based on distance (m) of noise sensitive development from operational track.

As the development is located approximately 200 metres from the railway track, a detailed acoustic assessment is not required for rail noise.

Similarly rail vibration has also been considered as per the assessment zones shown below in Figure 6.

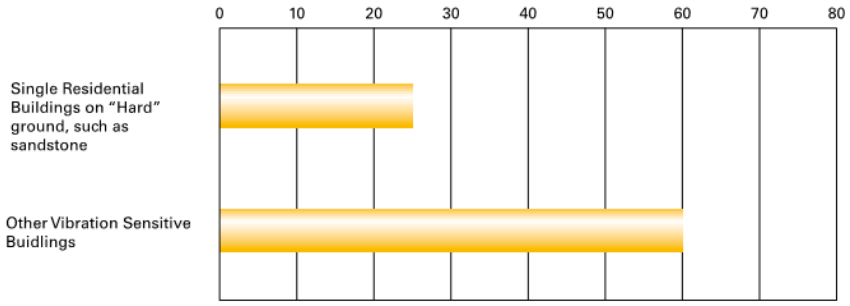


Figure 6: Vibration Assessment Zones based on distance (m) of vibration sensitive development from rail corridor

As the development is located approximately 200 metres from the rail corridor, a detailed acoustic assessment is not required for rail vibration.

Roads surrounding the site do not support an annual average daily traffic volume (AADT) of more than 40,000 vehicles. Therefore, a detailed acoustic assessment is not required for traffic road noise.

4.6.2 TRAFFIC NOISE GENERATED

Road traffic noise impact is assessed in accordance with the introduced NSW OEH Road Noise Policy (RNP) 2011 which supersedes the NSW DECCW Environmental Criteria for Road Traffic Noise (ECRTN) 1999. The NSW Road Noise Policy (RNP) establishes criteria for traffic noise from:

- Existing roads,
- New road projects,
- Road development projects,
- New traffic generated by developments.

For existing residences and other sensitive land uses affected by additional traffic on existing roads generated by land use developments, any increase in the total traffic noise level should be limited to 2.0dB above the existing noise levels. An increase of up to 2dB represents a minor impact that is considered barely perceptible to the average person.

In cases where existing traffic noise levels are above the noise assessment criteria, the primary objective is to reduce these through feasible and reasonable measures to meet the assessment criteria.

4.6.3 SLEEP AROUSAL

The potential of sleep disturbance from short-duration noise events from the proposed development – use of carpark – during the night-time period needs to be considered. Sleep disturbance occurs through changes in sleep state and awakenings. For continuous traffic flow, L_{Aeq} appears to be acceptably correlated with sleep disturbance.

However, for intermittent traffic flow, which often occurs at night-time ($L_{AFmax} – L_{Aeq}$) or ($L_{AFmax} – L_{A90}$) are better correlated with sleep disturbance.

NSW EPA NPI recommends the following criteria:

"Where the subject development night-time noise levels at a residential location exceed:

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

A detailed maximum noise level event assessment should be undertaken.

The detailed assessment should cover the maximum noise level, the extent to which the maximum noise level exceeds the rating background noise level, and the number of times this happens during the night-time period."

The detailed assessment should cover the maximum noise level, the extent to which the maximum noise level exceeds the rating background noise level, and the number of times this happens during the night-time period. Some guidance on possible impact is contained in the review of research results in the NSW Road Noise Policy as follows:

- Maximum internal noise levels below 50–55dB(A) are unlikely to cause awakening reactions.
- One or two noise events per night, with maximum internal noise levels of 65–70dB(A), are not likely to affect health and wellbeing significantly.

Other factors that may be important in assessing the extent of impacts on sleep include:

- How often high noise events will occur.
- The distribution of likely events across the night-time period and the existing ambient maximum events in the absence of the subject development.
- Whether there are times of day when there is a clear change in the noise environment (such as during early morning shoulder periods).
- Current scientific literature available at the time of the assessment regarding the impact of maximum noise level events at night.

Table 8 summarises the noise level criteria for sleep disturbance based on the NSW EPA NPI recommendations and highlight the stringer criteria to apply.

	Sleep Arousal Noise Criteria
Condition 1	$L_{Aeq,15min}$ 40dB(A) || **RBL + 5 = 42dB(A)**
Condition 2	**L_{AFmax} 52dB(A) || RBL + 15 = 52dB(A)**

Table 8: Sleep arousal noise criteria.

These values apply shall be achieved external to the bedroom window of the noise residential sensitive receivers, as opposed to the receiver boundary – which is applied for most other criteria.

4.6.4 HELICOPTER NOISE

The Australian Standard 2363:1999 *'Acoustics – Measurement of noise from helicopter operations'* has been included in the relevant policies and guidelines from the SEARs. This standard provides methods for the measurement of noise from existing or proposed helicopter landing sites and helicopter overflights.

The nearest helicopter landing sites are the Concord Hospital (≈2.8km) to the South and the Macquarie University Hospital (≈5.7km) to the North. Based on the distance between the site and the helicopter landing sites plus the helicopter flying paths, we understand that helicopter noise will not impact in the proposed development and therefore, this standard does not apply to the project.

4.7 CONSTRUCTION NOISE AND VIBRATION

4.7.1 NOISE CRITERIA

The noise criteria in this section are for guidance only and do not form part of any legal obligation on the part of the project proponent. However, compliance with these criteria is considered best practice.

The ICNG suggest construction noise management levels that may minimise the likelihood of annoyance being caused to noise sensitive residential receivers depending on the duration of works. The management levels for long-term duration works are as follows:

Within recommended standard hours.

- The $L_{Aeq,15min}$ level measured at the most exposed boundary of any affected residential receiver when the construction site is in operation must not exceed the background noise level by more than 10dB(A). This noise level represents the point above which there may be some community reaction to noise.
- However, in the case of a highly noise affected area, the construction noise level ($L_{Aeq,15min}$) at the most exposed boundary of any affected residential receiver when the construction site is in operation should not exceed 75dB(A). This level represents the point above which there may be strong community reaction to noise.

Outside recommended standard hours.

- The $L_{Aeq,15min}$ level measured at the most exposed boundary of any affected residential receiver when the construction site is in operation must not exceed the background level by more than 5dB(A). It is noted that a strong justification is required for works outside the recommended standard hours.

In order to establish the airborne construction noise criteria, noise levels from the unattended noise monitoring have been used for the noise sensitive receivers– refer to Section 3.2. Table 9 below summarises the airborne construction noise criteria for most affected noise sensitive receivers surrounding the development site.

Sensitive Receiver		*Airborne Construction Noise Criteria, L_{Aeq} dB(A)*	
		Within Standard Hours	*Outside Standard Hours*
Residential suburban (R2)	Noise affected / External	52	47
	Highly noise affected / External	75	N/A
Educational	Internal	45	45

Table 9: ICNG construction airborne noise criteria for noise sensitive receivers surrounding the site.

Where reference is made to an internal noise level, an external noise level 10dB above the internal noise levels are applied which should achieve the internal noise level where a window is adequately opened to provide natural ventilation.

The ICNG recommends internal ground-borne noise maximum levels at residences affected by nearby construction activities. Ground-borne noise is noise generated by vibration transmitted through the ground into a structure and can be more noticeable than airborne noise for some sensitive receivers. The ground-borne noise levels presented below from the ICNG are for residential receivers during evening and night-time periods only, as the objective is to protect the amenity and sleep of people when they are at home.

- Evening: $L_{Aeq,15min}$ 40dB(A) (internal)
- Night: $L_{Aeq,15min}$ 35dB(A) (internal)

The internal noise levels are assessed at the centre of the most affected habitable room.

4.7.2 VIBRATION CRITERIA

4.7.2.1 Human Comfort

The Department of Environment and Climate Change (DECC) developed the document *'Assessing Vibration: A Technical Guideline'* in February 2006 to assist in preventing people from exposure to excessive vibration levels within buildings. It is based on the guidelines contained in BS 6472.1:2008 *'Guide to evaluation of human exposure to vibration in buildings – Vibration sources other than blasting'*.

The guideline does not however address vibration induced damage to structures or structure-borne noise effects.

Vibration criteria for continuous and impulsive vibration are presented in Table 10, in terms of vibration velocity levels. When assessing intermittent vibration comprising a number of events, it is recommended that the Vibration Dose Value (VDV) is used. Table 11 shows the acceptable VDV values for intermittent vibration.

Place	*Time*	*r.m.s. velocity, mm/s [dB ref 10^{-9}m/s]*			
		Continuous Vibration		*Impulsive Vibration*	
		Preferred	*Maximum*	*Preferred*	*Maximum*
Residences	Day-time	0.20 [106 dB]	0.40 [112 dB]	6.00 [136 dB]	12.00 [142 dB]
	Night-time	0.14 [103 dB]	0.28 [109 dB]	2.00 [126 dB]	4.00 [132 dB]
Offices, schools, educational and worship	When in use	0.40 [112 dB]	0.80 [118 dB]	13.00 [142 dB]	26.00 [148 dB]

Table 10: Continuous and impulsive vibration criteria applicable to the site. *Note: Day-time is 07:00 to 22:00 and night-time is 22:00 to 07:00.*

Place	*Time*	*Vibration Dose Values, $m/s^{1.75}$*	
		Preferred	*Maximum*
Residences	Day-time	0.20	0.40
	Night-time	0.13	0.26
Offices, schools, educational and worship	When in use	0.40	0.80

Table 11: Intermittent vibration criteria applicable to the site.

4.7.2.2 Structural Building Damage

Ground vibration from construction activities can damage surrounding buildings or structures. For unoccupied buildings, or during periods where the buildings are unoccupied, the vibration criteria for building damage suggested by German Standard DIN 4150.3:1993 *'Structural Vibration – Effects of Vibration on Structures'* and British Standard BS 7385.2:1993 *'Evaluation and Measurement for Vibration in Buildings'* are to be adopted. Guideline values from DIN 4150.3:1993 and BS 7385.2:1993 are presented in Table 12 and Table 13 respectively.

Structural type	*r.m.s. velocity, mm/s*			
	Foundation			*Plane of floor uppermost full storey*
	Less than 10Hz	*10 to 50Hz*	*50 to 100Hz*	*Frequency mixture*
Dwellings or similar	5	5 to 15	15 to 20	15
Particularly sensitive	3	3 to 8	8 to 10	8

Table 12: DIN 4150.3:1993 Guideline values of vibration velocity for evaluating the effects of short-term vibration.

Structural type	*Peak particle velocity, mm/s*	
	4 to 15Hz	*15Hz and above*
Unreinforced or light framed structures *Residential or light commercial type buildings*	15mm/s @ 4Hz increasing to 20mm/s @ 15Hz	20mm/s @ 15Hz increasing to 50mm/s @ 40Hz and above

Table 13: BS 7385.2:1993 Guideline values of vibration velocity for evaluating cosmetic damage.

5 NOISE EMISSIONS ASSESSMENT

Noise break-out from the proposed Multi-Trades and Digital Technology Hub Building has the potential to impact on existing noise sensitive receivers. For the purpose of this noise impact assessment, the noise sources are assumed as follows:

- Noise emissions from mechanical plant to the surrounding receivers.
- Noise emissions from public address system.
- Noise emissions from use of power tools in workshops and outdoor workshops.
- Noise emissions from external loading dock.
- Noise emissions from traffic generated by the proposed development.

Each of these noise sources has been considered in the noise impact assessment. The acoustic assessment has considered the following:

- Noise levels have been considered as continuous over assessment time period to provide the worst-case scenario.
- Lowest estimated background noise levels at the nearest noise sensitive receiver have been used to provide a worst-case scenario.
- Distance attenuation, building reflections and directivity.

5.1 EXTERNAL MECHANICAL PLANT

Noise from proposed development mechanical plant rooms should be controlled to ensure external noise emissions are not intrusive and do not impact on the amenity of the noise sensitive receivers.

At this stage, final mechanical plant selections have not been made; therefore, it is not possible to undertake a detailed assessment of the mechanical plant noise emissions. However, a preliminary assessment has been carried out for the external mechanical plant on the roof from which the following is noted:

- Considering the distance from the external mechanical plant on the roof to the nearest residential receivers, at this stage, maximum allowable cumulative noise emissions from the external mechanical plant have been predicted to be limited to $L_{Aeq,15min}$ 80dB(A) at 1 metre from the plant boundary.

Noise controls will need to be incorporated with the design of the mechanical plant rooms to ensure that the cumulative noise levels from plant to the nearest noise sensitive receivers meets the NSW NPI noise level criteria – refer to Table 7. Usual design noise controls that may need to be implemented will typically include, but are not limited to:

- Strategic location and selection of mechanical plant to ensure the cumulative noise levels at the receiver boundaries is met.
- Selection of appropriate quiet plant.
- Acoustic noise control measures to be put in place to minimise noise impacts such as:
  - In-duct attenuation
  - Noise enclosures as required
  - Sound absorptive panels
  - Acoustic louvres as required
  - Noise barriers as required

Acoustic assessment of all mechanical plant shall continue during the detailed design phase of the project in order to confirm any noise control measures to achieve the relevant noise criteria at the nearest noise sensitive receivers.

5.2 PUBLIC ADDRESS SYSTEM

Noise from the proposed development public address system should be controlled to ensure external noise emissions are not intrusive and do not impact on the amenity of noise sensitive receivers.

At this stage, public address system selections have not been made; therefore, it is not possible to undertake a detailed assessment of the public address system noise emissions.

The EPA notes numerous reports of community concern arising from inadequate design and installation as well as inappropriate use of public address system. EPA considers that appropriate design, installation and use of those systems can both:

- Meet the proponent's objectives of proper administration of the school and ensuring safety of students, staff and visitors, and
- Avoid interfering unreasonably with the comfort and repose of occupants of nearby residences.

The Public Address System shall be designed, installed and operated such that the systems does not interfere unreasonably with the comfort and repose of occupants of nearby residences. It is anticipated that the noise impact to the nearest sensitive receivers will be negligible if following measures are implemented:

- Low-powered horn-type speakers shall be located and orientated to provide a good coverage of the areas whilst being directly away from residences and near sensitive receivers. System coverage shall be reviewed during the detailed design phase.
- Speakers shall be mounted with a downward angle and as close to the floor as possible.
- The noise level of the systems shall be adjusted on site so they will be clearly audible on the site without being excessive. The systems shall initially be set sot that the noise at nearby residences and sensitive receivers do not exceed noise level criteria.
- Once the appropriate noise level has been determined on site, the systems shall be limited to these noise levels so that staff cannot increase the noise levels.

5.3 USE OF POWER TOOLS

5.3.1 WITHIN WORKSHOPS

One of the façades of the proposed carpentry workshop is facing the residential receivers in the opposite side of See Street. It is anticipated that noise emissions from the use of power tools in the workshop will be the key noise source. The character of the noise emissions from the use of power tools, such as sound pressure level and spectra, vary in accordance with the type of power tool. Noise emissions from the use of power tools have been assessed at the nearest residential receivers. The noise assessment has considered the following assumptions:

- Workshops will operate during evening time period – worst-case scenario.
- Noise levels have been considered as continuous over a 15-minute assessment period to provide the worst-case scenario.
- Noise levels within the carpentry workshop are based on the maximum acceptable noise level as per National Occupational Health and Safety Commission (NOHSC).
- The noise break-out has been assumed through the weakest building envelope construction of the carpentry workshop, i.e. glazing façade with a sound insulation performance of R_W35.

The noise impact assessment has been based on the following methodology:

$$L_{ext} = L_{int} - R_{comp} + 10\log_{10}(S) - 20\log_{10}(r) - 14$$

where:

L_{ext} is the resultant sound pressure level at the receiver

L_{int} is the internal noise level

R_{comp} is the composite sound reduction for the façade (dB)

S is the surface area of the façade (m^2)

R is the distance to the receiver's boundary from the façade (m)

Predicted noise impact assessment at the nearest residential receivers on See Street is summarised in Table 14.

Calculation	*Overall A-weighted noise level, in dB(A)*
Reverberant Sound Pressure Level (L_{int})	94
Composite Sound Reduction of Façade (R_{comp})	32
Correction for Surface Area of Façade (S)	25
Correction for Distance to Receiver (r)	27
Resulting Sound Pressure Level at Residential Receiver	43
NPI Criteria Evening Time. Complies?	43 / Yes

Table 14: Predicted noise levels at the nearest residential receiver for the use of power tools in the carpentry workshop.

Based on the results of the assessment, noise levels from the workshop are expected to meet the NSW NPI criteria for evening time.

5.3.2 OUTDOOR WORKSHOPS

It is anticipated that power tools / construction plant will be used in the outdoor workshops. There are three outdoor workshops planned in Level 3 (W1 and W2) and Level 6 (W3) in the locations shown in Figure 7. It is assumed that a wide range of power tools / construction plant will be used during learning activities when necessary.

The noise impact assessment has assumed the following:

- The use of outdoor workshops will be limited to day-time and evening-time periods.
- Use of hand-tools / power-tools. Noisy plant to be operated within the internal workshops.

Based on the location of the outdoor workshops, the following noise sensitive receivers are the nearest to these outdoor workshops:

- W1: Future Meadowbank Public School (≈40m). Educational receiver.
- W2: TAFE NSW Meadowbank Building G (≈12m). Educational receiver.
- W3: TAFE NSW Meadowbank Building P (≈17m). Educational receiver.

It shall be noted that, being these noise sensitive receivers the nearest to the outdoor workshops, if noise impacts associated with these spaces are controlled at these receivers, then compliance with the recommended criteria at all noise sensitive receivers will be achieved – as the noise level criteria is the same for all the noise sensitive receivers.

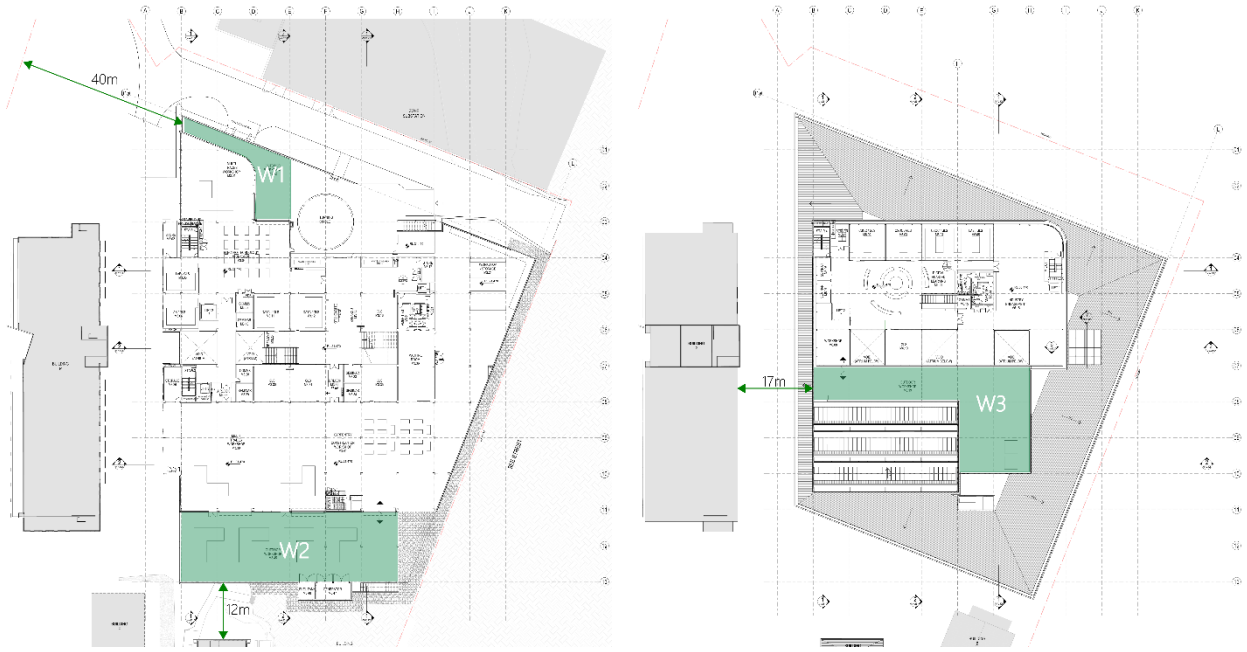


Figure 7: Location of the outdoor workshops in Level 3 (left) and Level 6 (right)

The noise impact assessment for outdoor workshops has been based on the following methodology:

$$L_p = L_W + D_c - (A_{div} + A_{atm} + A_{gr} + A_{bar})$$

where:

L_p is the resultant sound pressure level at the receiver

L_W is the sound power level produced by the noise source

D_c is the directivity correction

A is the attenuation that occurs during propagation from the noise source to the receiver

A_{div} is the attenuation due to geometrical divergence

A_{atm} is the attenuation due to atmospheric absorption

A_{gr} is the attenuation due to the ground effect

A_{bar} is the attenuation due to a barrier

The attenuation term A_{div} is given by:

$$A_{div} = \left[20\log_{10}\left(\frac{d}{d_0}\right) + 11\right]$$

where:

d is the distance from the source to receiver

d_0 is the reference distance (= 1m)

The attenuation term A_{atm} is given by:

$$A_{atm} = \left(\frac{\alpha d}{1000}\right)$$

where:

α is the atmospheric attenuation coefficient

The attenuation term A_{gr} is given by:

$$A_{gr}=4.8-\left(\frac{2h_m}{d}\right)\left[17+\left(\frac{300}{d}\right)\right]$$

where:

h_m is the mean height of propagation path above the ground

Based on the location of the outdoor workshops, the following noise sensitive receivers are the nearest to these outdoor workshops:

- W1: Educational Receiver Future Meadowbank Public School (≈40m). Residential Receiver See Street (≈86m), partially shielded by TAFE building.
- W2: Educational Receiver TAFE NSW Meadowbank Building G (≈12m). Residential Receiver See Street (≈45m), partially shielded by TAFE building (workshop ground level lower than receiver ground level).
- W3: Educational Receiver TAFE NSW Meadowbank Building P (≈17m). Residential Receiver See Street (≈40m), shielded by TAFE building (workshop level higher than receiver ground level).

Predicted noise impact assessments for Workshop 1 (W1) at the nearest receivers are summarised in Table 15.

Calculation	*Overall A-weighted Sound Pressure Level, dB(A)*	
	Educational	*Residential*
L_W Hand Tools	94	94
Directivity Correction (D_c)	3	3
Attenuation geometrical divergence (A_{div})	43 (40m)	50 (88m)
Attenuation atmospheric conditions (A_{atm})	0	0
Attenuation ground effect (A_{gr})	3	3
Attenuation barrier (A_{bar})	9	4
L_p at receiver boundary	42	40
NPI Evening-time Criteria / Complies?	43 / Yes	43 / Yes

Table 15: Noise assessment W1 – sound pressure levels in the worst-case scenario for the nearest noise sensitive receivers

Predicted noise impact assessments for Workshop 2 (W2) at the nearest receivers are summarised in Table 16.

Calculation	*Overall A-weighted Sound Pressure Level, dB(A)*	
	Educational	*Residential*
L_W Hand Tools	94	94
Directivity Correction (D_c)	3	3
Attenuation geometrical divergence (A_{div})	36 (12m)	44 (45m)
Attenuation atmospheric conditions (A_{atm})	0	0
Attenuation ground effect (A_{gr})	3	3
Attenuation barrier (A_{bar})	9	9
L_p at receiver boundary	49	41
NPI Evening-time Criteria / Complies?	43 / No	43 / Yes

Table 16: Noise assessment W2 – sound pressure levels in the worst-case scenario for the nearest noise sensitive receivers

Predicted noise impact assessments for Workshop 3 (W3) at the nearest receivers are summarised in Table 17.

Calculation	*Overall A-weighted Sound Pressure Level, dB(A)*	
	Educational	*Residential*
L_W Hand Tools	94	94
Directivity Correction (D_c)	3	3
Attenuation geometrical divergence (A_{div})	36 (17m)	43 (40m)
Attenuation atmospheric conditions (A_{atm})	0	0
Attenuation ground effect (A_{gr})	3	3
Attenuation barrier (A_{bar})	15	15
L_p at receiver boundary	43	36
NPI Evening-time Criteria / Complies?	43 / Yes	43 / Yes

Table 17: Noise assessment W3 – sound pressure levels in the worst-case scenario for the nearest noise sensitive receivers

Based on the results of the assessment, noise levels from the outdoor workshops are expected to meet the NSW NPI criteria for evening time to the most affected residential receivers. This assessment was based on a 2 meter high barrier on the perimeter of the outdoor workshops.

The noise level criteria is exceeded for the outdoor workshop W2 at the educational receiver. The exceedance of the outdoor workshop W2 is moderate (by 6dB(A)), therefore additional noise controls shall be put in place – i.e. limit use time of the outdoor workshop or providing mobile noise screens. Based on this noise assessment, outdoor workshops operation shall be restricted to day-time and evening-time periods.

5.4 EXTERNAL LOADING YARD

Noise emissions from the operations of the external loading yard will include noise from trucks arriving, reversing, loading/unloading and departing from the external loading yard. It should be noted that it is highly unlikely that some deliveries might occur outside the nominated operating hours.

The proposed external loading yard will be located at Level 3 adjacent to the northern boundary of the site. Access to the underground carpark will be via a driveway over the easement with the Zone Substation to the North from See Street and down a ramp. It is anticipated that noise impacts from operations associated with the external loading yard will break-in to the nearest noise residential receivers in See Street.

Noise levels used for the predictions are based on noise monitoring results obtained to assess similar loading dock operations. The following noise sources assumptions have been used for the prediction of noise emissions from the external loading yard.

Noise Source	*Overall Sound Power Level, L_{WA}, dB(A)*	*Duration, sec*
Rigid Truck arriving at the loading dock	92	15
Rigid Truck idle on turntable	87	60
Rigid Truck reversing	92	10
Load / Unload activities	80	800
Rigid Truck departing	92	15
Equivalent Sound Power Level	85	900

Table 18: Assumed noise source levels of the external loading yard.

Calculation	*SWL, dB(A)*	*Distance Attenuation*	*Duration Adjustment*	*Predicted Sound Pressure Level, $L_{Aeq,15min}$*
Rigid Truck arriving at the loading dock	92	-38	-18	36
Rigid Truck idle on turntable	87	-38	-12	37
Rigid Truck reversing.	92	-38	-20	34
Load / Unload activities	80	-38	-1	41
Rigid Truck departing	92	-38	-18	36
Equivalent Noise Level				**45**
		NPI Day-time Criteria / Complies?		**47 / Yes**

Table 19: Noise assessment of loading dock operations into nearest residential receiver.

Based on the predicted noise level and the relevant noise level criteria, it is recommended that the vehicle engines should be turned off during loading / unloading activities. Acoustic assessment of the external loading yard shall continue during the detailed design phase of the project in order to confirm any noise control measures to achieve the relevant noise criteria at the nearest noise sensitive receivers.

Based on this noise assessment, external loading yard operation shall be restricted to day-time where possible.

5.5 TRAFFIC GENERATION

The traffic impact report for the proposed development prepared by GTA Consultants (dated 24.04.20) provides an analysis of the additional traffic from the proposed development for the years 2022 and 2032. This is summarised in the Table 20.

Road	*Weekday Morning*			*Weekday Afternoon*		
	Existing	*Generated 2022*	*Generated 2032*	*Existing*	*Generated 2022*	*Generated 2032*
See Street	267	+61	+103	219	+55	+91

Table 20: 2022 and 2032 two-way existing peak hour traffic flows plus traffic generated by the proposed development.

As noted in Section 0, when considering land use redevelopment and the impact on sensitive land uses (residential / schools / hospitals / recreational) the NSW Road Noise Policy (RNP) states that an increase up to 2.0dB in relation to existing noise levels is anticipated to be insignificant. As shown in Table 21, the increase of traffic noise levels in the year 2022 due to the proposed development, is less than the maximum allowable increase of 2.0dB.

Road	*Year*	*Weekday Morning*	*Weekday Afternoon*
		Increase $L_{Aeq,1hour}$, dB(A)	
See Street	2022	+0.9	+1.0
	2032	+1.4	+1.5

Table 21: Predicted noise level increase due to traffic movements from the proposed development.

Therefore, the traffic increase due to the proposed development will not result in any noticeable change in traffic noise levels and is expected to meet the NSW Road Noise Policy recommendations.

5.6 MULTI STOREY CARPARK

Noise from the use of the carpark is not regulated by relevant legislation. The main source of noise will be car movements travelling in and out of the carpark during the operation hours of the facilities (refer Section 2.3).

The noise emissions relating to the proposed multi-storey carpark has been assessed using the methodologies as presented in document prepared by the Bavarian State Office for the environment entitled 'Parking Area Noise'. The assumptions used within the assessment have been based from the information as presented within the traffic assessment prepared by the traffic impact report. The assumptions made in the calculations include the following:

- Car parking bays as per the Architectural drawings
- Area of car park as indicated in Architectural drawings
- Smooth concrete car park surface
- Number of vehicles is based on the traffic impact assessment prediction of 132 vehicles during AM peak hour

This assessment has been conducted for the AM peak hour vehicle movements which falls between 7am and 6pm, as worst case scenario assessment. The noise emissions have been assessed to the most affected resident on See Street. The potential noise sources associated with the proposed carpark will be:

- Noise generated by vehicle movements, i.e acceleration up and down access ramps, entering and exiting spaces, and rubber tires rotating on polished concrete etc.
- Noise generated through "slamming" of car doors.

The predicted noise levels associated with the car-park noise are shown below in Table 22 and have been assessed against the PTNLs.

Receiver	*Period*	*Predicted Noise Level* $L_{Aeq\ 15min}$ *dB(A)*	*NPI Day-time criteria*
Most affected resident on See Street	Day (AM Peak)	47	47

Table 22: Assessment of Multi-Storey Carpark

Based on the results of the noise assessment, the predicted noise level within the AM peak hour operation of the multi-storey carpark is expected to comply with the NSW NPI criteria.

5.6.1 SLEEP DISTURBANCE

A sleep disturbance assessment has been conducted for both carparks. The sleep arousal noise assessments have considered the following assumptions:

- Both carparks will operate until 10.30pm.
- Noise levels have been considered as continuous over a 15-minute assessment period to provide the worst-case scenario.
- Car noise level are based on the highest value of the maximum sound power level range for a worst-case scenario.
- Where internal noise levels are predicted, typical residential bedroom size was assumed and a 10dB reduction in noise level applied through open windows for natural ventilation.

5.6.1.1 Hub Building Basement Carpark

Due to the proposed operational hours a sleep arousal noise assessment has been carried out. It is expected that vehicles will be moving slowly (approx. 10km/h) and the number of vehicle movements during night-time will be low (2-3 vehicles as per advice from GTA Consultants) compared to the peak periods. For the sleep arousal assessment purpose, departing car noise impacts from the development are likely to generate the noise level range as per Table 23.

Noise Source	*Maximum Sound Power Level dB(A), ref 1pW*
Car accelerating	82 – 87

Table 23: Noise level range for car departures from the development.

Refer to Table 24 and Table 25 for the results of the sleep disturbance assessment.

Calculation	*Overall A-weighted noise level, in dB(A)*
L_{Aeq} of vehicle movement accelerating at 1 m	82
Distance attenuation (22 m), dB	-27
1 minute over 15 minutes operation time correction, dB	-12
$L_{Aeq,15min}$ resulting at residential receiver façade	43
NPI Sleep Arousal Criteria. Condition 1 / Complies?	42 / (Yes)

Table 24: Sleep arousal noise assessment at residential receiver from vehicle departure during night-time. Condition 1.

Calculation	*Overall A-weighted noise level, in dB(A)*
L_{Amax} of vehicle movement accelerating at 1 m	87
Distance attenuation to façade (22 m), dB	-27
L_{Amax} resulting at residential receiver façade	60
NPI Sleep Arousal Criteria. Condition 2 / Complies?	52 / No

Table 25: Sleep arousal noise assessment at residential receiver from vehicle departure during night-time. Condition 2.

The predicted $L_{Aeq,15\ min}$ noise level at the nearest residential receiver façade exceeds the Condition 1 NPI Sleep Arousal Criteria by 1dB(A). This exceedance can be considered as negligible as it would not be discernible by the average listener. The predicted L_{Amax} noise level at the nearest residential receiver façade exceeds the Condition 2 NPI Sleep Arousal Criteria by 8dB(A). However, guidelines that contain additional advice relating to potential sleep disturbance impacts have been considered, including the Road Noise Policy (RNP). The RNP provides a review of research into sleep disturbance. From the research to date, the RNP concludes that:

- One or two events per night, with maximum internal noise levels of 65dB(A) to 70dB(A), are not likely to affect health and wellbeing significantly.
- Maximum internal noise levels below 50dB(A) to 55dB(A) are unlikely to awaken people from sleep. It is generally accepted that internal noise levels in a dwelling with the windows open are 10dB lower than external noise levels – being opened sufficiently to provide adequate ventilation. Based on this, these noise levels are equivalent to external maximum noise levels of 60dB(A) to 65dB(A).

Based on the above, internal noise levels are at a level that according to NSW RNP are unlikely to cause awakening reactions.

5.6.1.2 Multi-Storey Carpark

A sleep disturbance of the multi-storey carpark has been conducted similarly due to the operational hours up to 10:30pm. For the sleep arousal assessment purpose, departing car noise impact from the development are likely to generate the noise level range as per Table 26.

Noise Source	*Maximum Sound Power Level dB(A), ref 1pW*
Car accelerating (L_{Aeq})	82 – 87
Car door slam (L_{Amax})	95

Table 26: Noise level range for car departures from the multi-storey carpark.

Refer to Table 27 and Table 28 for the results of the sleep disturbance assessment.

Calculation	*Overall A-weighted noise level, in dB(A)*
L_{Aeq} of vehicle movement accelerating at 1 m	82
Distance attenuation (22 m), dB	-27
1 minute over 15 minutes operation time correction, dB	-12
$L_{Aeq,15min}$ resulting at residential receiver façade	**43**
NPI Sleep Arousal Criteria. Condition 1 / Complies?	**42** / (Yes)

Table 27: Sleep arousal noise assessment at residential receiver from vehicle departure during night-time. Condition 1.

Calculation	*Overall A-weighted noise level, in dB(A)*
L_{Amax} of car door slam	95
Distance attenuation (26 m), dB	-29
L_{Amax} resulting at residential receiver façade	**59**
Predicted internal noise level (windows open)	**49**
NPI Sleep Arousal Criteria. Condition 2 / Complies?	**52** / (No)
NSW Road Noise Policy Max Internal Level / Complies?	**50** / (Yes)

Table 28: Sleep arousal noise assessment at residential receiver from vehicle departure during night-time. Condition 2.

Based on the noise assessment, the maximum noise level from car door slams is expected to exceed the NSW NPI criteria. However the NSW Road Noise Policy concludes that the internal noise levels shall be greater than 50-55dB(A) in order to cause awakening reactions. Therefore as the number of occurrences during the night time period, between 10pm and 10:30pm, are expected to be low, and the internal noise levels are predicted to be below 50dB(A) maximum, the sleep disturbance criteria to the most affected residences should be met.

Reasonable and feasible mitigations measures have been considered for both carparks, however they are limited in respect to vehicles entering and exiting onto the road. Nevertheless there is not expected to be any adverse impact on receivers due to the additional vehicle movements associated with this development during the day or night.

6 CONSTRUCTION NOISE AND VIBRATION PLANNING

Currently the project is at an early design stage and a detailed construction program is not yet full defined. This section of the Construction Noise and Vibration Planning provides general recommendations only and provides applicable criteria together with best noise and vibration control practices to be observed during the construction of the proposed development.

This preliminary advice in relation to construction noise and vibration management shall form the basis for the Contractor's Construction Noise and Vibration Management Plan.

Any noise from construction activities to be carried out on site must not result in *'offensive noise'* to any noise sensitive receiver. To this end, the Contractor employed to undertake the construction works is responsible for ensuring that any site noise and, in particular, any complaints shall be monitored, investigated, managed and controlled.

6.1 RELEVANT CODES AND STANDARDS FOR CONSTRUCTION NOISE AND VIBRATION CRITERIA

Section 4.7 of this report contains the relevant legislation, codes and standards plus construction noise and vibration criteria for this project.

6.2 WORKING HOURS

The following construction hours are proposed as follows:

- Monday to Friday: 7am to 7pm.
- Saturday: 8am to 4pm.
- Sundays and Public Holidays: No excavation or construction works.

It shall be noted that due to the extended working hours during weekdays and Saturdays, it shall be demonstrated and justified the need to operate outside the recommended standards hours.

6.3 PRELIMINARY CONSTRUCTION NOISE AND VIBRATION ASSESSMENT

6.3.1 NOISE

At this stage, there is no information regarding construction plant / equipment plus work activities / duration. The Contractor will be responsible for preparing a Works Plan and Schedule which include all relevant noise and vibration information. A detailed noise assessment shall be carried out for the Construction Noise and Vibration Management Plan when details for the construction plant / equipment plus activities / duration will be known.

A preliminary construction noise assessment has been carried out based on typical plant and machinery expected throughout the construction stages. The preliminary noise assessment has been considered at the nearest existing residential receivers.

Typical noise levels of construction plant are based on the database published by the UK Department for Environmental, Food and Rural Affairs (DEFRA) & Australian Standard AS2436:2010 *'Guide to Noise Control on Construction, Maintenance & Demolition Sites'* for a 15-minute period.

6.3.1.1 Multi-Trades and Digital Technology Hub

Refer to Table 29 for the results of the preliminary noise assessment to the most affected receivers. Allowances have been made for distance attenuation, shielding and reflections. This has been predicted to the nearest most affected residential receiver on See Street.

Item	*Typical Noise Level $L_{A10,15m}$ at 7m (dB ref 20μPa)*	*Predicted Noise Level $L_{Aeq,15min}$ at nearest residential receiver*	*Exceedance Standard Hours? / Highly noise affected?*
Angle grinders	76	65	Yes / No
Truck	80	69	Yes / No
Circular saw	87	74	Yes / No
40-50tn Mobile crane	83	72	Yes / No
Concrete pump	86	73	Yes / No
Concrete truck	82	71	Yes / No
Drill	66	55	Yes / No
Piling Rig	92	74	Yes / No
Excavator	89	73	Yes / No

Table 29: Anticipated airborne noise levels for equipment / plant used during construction works.

Based on the results of the preliminary assessment as shown above, the noise associated with the normal construction works is expected to exceed the noise limits in accordance with the ICNG Guideline. Therefore, a detailed acoustic analysis should be carried out within the CNVMP and noise control measures should be defined to minimise the noise impact in the nearest noise sensitive receivers.

Nevertheless, the noise levels are not expected to exceed the highly noise affected criteria. This criteria represents the point above which there may be strong community reaction to noise.

6.3.1.2 Multi-Storey Carpark

Refer to Table 30 for the results of the preliminary noise assessment to the most affected receivers. Allowances have been made for distance attenuation, shielding and reflections. This has been predicted to the nearest most affected residential receiver on See Street directly across from the proposed multi-storey carpark, and the Italian Bilingual School.

Item	*Typical Noise Level $L_{A10,15m}$ at 7m (dB ref 20μPa)*	*Predicted Noise Level $L_{Aeq,15min}$ at nearest receiver*		*Exceedance Standard Hours? / Highly noise affected?*
		Residential	*Educational*	
Truck	80	68	66	Yes / No
40-50tn Mobile crane	83	71	69	Yes / No
Asphalt paver	77	66	63	Yes / No
Vibratory roller	81	69	67	Yes / No
Concrete pump	86	74	72	Yes / No
Concrete truck	82	70	68	Yes / No
Angle grinders	76	66	62	Yes / No
Circular saw	87	74	73	Yes / No
Excavator	89	75	75	Yes / No

Table 30: Anticipated airborne noise levels for equipment / plant used during construction works.

Based on the results of the preliminary assessment of the multi-storey carpark as shown above, the noise associated with the normal construction works is expected to exceed the noise limits in accordance with the ICNG Guideline to the residential receivers and educational receivers across See Street. Therefore, a detailed acoustic analysis should be carried out within the CNVMP and noise control measures should be defined to minimise the noise impact in the nearest noise sensitive receivers.

Nevertheless, the noise levels are not expected to exceed the highly noise affected criteria. This criteria represents the point above which there may be strong community reaction to noise.

6.3.2 VIBRATION

The NSW RMS *'Construction Noise and Vibration Guideline'* provides safe working distances for vibration intensive plant and are quoted for both 'cosmetic' damage (in accordance with BS 7385.2:1993) and human comfort (in accordance with DECC's *'Assessing Vibration: A Technical Guideline'*). The recommended safe working distances for typical construction plant are provided in Table 31.

Plant Item	*Description*	*Cosmetic Damage*	*Human Response*
Small Hydraulic Hammer	5-12 tonne	2m	7m
Medium Hydraulic Hammer	12-18 tonne	7m	23m
Large Hydraulic Hammer	18-34 tonne	22m	73m
Vibratory Pile Driver	Sheet piles	2-20m	20m
Jackhammer	Hand held	1m	Avoid Contact with Structure
Vibratory Roller	< 50kN (Typically 1-2 tonnes)	5m	15m to 20m
	< 100kN (Typically 2-4 tonnes)	6m	20m
	< 200kN (Typically 4-6 tonnes)	12m	40m
	< 300kN (Typically 7-13 tonnes)	15m	100m
	> 300kN (Typically 13-18 tonnes)	20m	100m

Table 31: Recommended minimum working distances for vibration intensive plant from sensitive receivers.

If Contractor has concerns for the disruptions at nearest sensitive receivers due to vibration intensive plant use, it is recommended that prior to the commencement of the works, to undertake a preliminary vibration survey on each key vibration generating activity / equipment.

The preliminary vibration survey and assessment will determine whether the vibration levels might exceed the relevant criteria then vibration mitigation and management measures will need to be put in place to ensure vibration impacts are minimized as far possible.

A vibration monitoring system may be considered to assess the risk of potential structural damage to nearby buildings of concern.

6.4 EXTENDED CONSTRUCTION HOURS

In order to achieve alignment with the proposed neighbouring school development delivery, additional hours for construction works are proposed as per Section 6.2. These works are proposed outside of the standard hours as defined in the ICNG. In order to meet the noise limits for outside of standard hours works the following is proposed:

- Unattended noise monitoring at locations agreed with the project manager and acoustic engineer with real-time alerts to the builder / site manager when the noise criteria are exceeded.
- No noisy works during out-of-hours works i.e. excavation, rock-breaking, piling etc.
- Provide acoustic screening of construction activities through the use of solid Class A hoarding, temporary acoustic curtains and/or careful construction site planning

Further to the above, a detailed assessment in the form of a CNVMP shall be provided prior to Construction Certificate to ensure that the proposed construction works and the mitigation measures satisfy the aforementioned noise criteria.

6.5 CONTROL ELEMENTS

In order to meet the noise and vibration requirements of the site, it is recommended that the Contractor will be required to engage a qualified acoustic consultant to assist in the compilation of a Construction Noise and Vibration Management Plan (CNVMP).

6.5.1 GENERAL CONTROL ELEMENTS

As a general rule, minimising noise and vibration should be applied as universal work practice at any time of day, but especially for any construction works to be undertaken at critical times outside normal daytime/weekday periods.

It is noted that the reduction of noise and vibration at the source and the control of the transmission path between the construction site and the receiver(s) are the preferred options for noise minimisation. Providing treatments at the affected receivers should only be considered as a last resort.

Construction noise and vibration shall be managed by implementing the strategies listed below:

- *Plant and equipment*. In terms of both, cost and results, controlling noise and vibration at the sources is one of the most effective methods of minimising the impacts from any work site activities. Work practices that will reduce noise and vibration at the source include:
  - Employing quieter techniques for all high noise activities such as rock breaking, concrete sawing, and using power and pneumatic tools.
  - Use quieter plant and equipment based on the optimal power and size to most efficiently perform the required tasks.
  - Selecting plant and equipment with low vibration generation characteristics.
  - Operate plant in a quietest and most effective manner.
  - Where appropriate, limit the operating noise of equipment.
  - Regularly inspecting and maintain plant and equipment to minimise noise and vibration level increases, to ensure that all noise and vibration reduction devices are operating effectively.
  - Where appropriate, obtain acoustic test certificates for equipment.
- *On site noise management*. Practices that will reduce noise from the site include:
  - Maximising the distance between noise activities and noise sensitive receivers. Strategically locate equipment and plant.
  - Undertaking noisy fabrication work off-site where possible.
  - Avoid the use of reversing beeping alarms or provide for alternative systems, such as broadband reversing alarms, particularly during night or out-of-hours works.
  - Constructing barriers that are part of the project design early in the project to afford mitigation against site noise.
  - Using temporary site building and material stockpiles as noise barriers. These can often be created using site earthworks and may be included as a part of final landscape design.
  - Installing purpose built noise barriers, acoustic sheds and enclosures.
- *Work scheduling.* Scheduling work during periods when people are least affected is an important way of reducing adverse impacts. The following scheduling aspects may reduce impacts:

- Provide respite periods, including restricting very noisy activities to daytime, restricting the number of nights that after-hours work is conducted near residences, or by determining any specific requirements, particularly those needed for noise sensitive receivers.
- Scheduling activities to minimise impacts by undertaking all possible work during hours that will least adversely affect sensitive receivers and by avoiding conflicts with other scheduled events.
- Scheduling work to coincide with non-sensitive periods.
- Scheduling noisy activities to coincide with high levels of neighbourhood noise so that noise from the activities is partially masked and not as intrusive.
- Planning deliveries and access to the site to occur quietly and efficiently and organising parking only within designated areas located away from sensitive receivers.
- Optimising the number of deliveries to the site by amalgamating loads where possible and scheduling arrivals within designated hours.
- Designating, designing and maintaining access routes to the site to minimise impacts.
- Including contract conditions that include penalties for non-compliance with reasonable instructions by the principal to minimise noise or arrange suitable scheduling.

- *Consultation, notification and complaints handling.*
  - Provide information to neighbours before and during construction.
  - Maintain good communication between the community and Project staff.
  - Have a documented complaints process and keep register of any complaints.
  - Give complaints a fair hearing and provide for a quick response.
  - Implement all feasible and reasonable measures to address the source of complaint. Implementation of all reasonable and feasible mitigation measures for all works will ensure that any adverse noise impacts to surrounding receivers are minimised when noise goals cannot be met due to safety or space constraints.

6.5.2 ADDITIONAL NOISE AND VIBRATION CONTROL MEASURES

If, during construction, an item of equipment exceeds either the noise criteria at any location or the equipment noise level limits, the following noise control measures, together with construction best practices, shall be considered to minimise the noise impacts on the neighbourhood.

- Schedule noisy activities to occur outside of the most sensitive times of the day for each nominated receiver.
- Consider implementing equipment-specific screening or other noise control measures recommended in Appendix C of AS 2436:2010.
- Limit the number of trucks on site at the commencement of site activities to the minimum required by the loading facilities on site.
- When loading trucks, adopt best practice noise management strategies to avoid materials being dropped from height into dump trucks.
- Avoid unnecessary idling of trucks and equipment.
- Ensure that any miscellaneous equipment (extraction fans, hand tools, etc) not specifically identified in this plan incorporates silencing/shielding equipment as required to meet the noise criteria.

7 MANAGEMENT AND COMPLIANCE

Limiting noise nuisance from a premise generally requires management on an ongoing basis. Strategies for the proposed development should consider the following:

- At this stage, final plant selections have not been made. It is recommended that the plant noise associated with the operation of the Multi-Trades and Digital Technology Hub Building to be controlled to ensure external noise emissions are not intrusive and do not impact on the amenity of neighbouring receivers. A detailed assessment should be carried out once the mechanical plant has been selected.
- Whenever possible, power tools / construction plant used in the outdoor workshops shall be operated between 7am to 6pm during weekdays.
- To minimize impact on the surrounding amenity, waste collection and external loading yard movements are recommended to occur during the day-time period.

8 SUMMARY AND CONCLUSIONS

A noise assessment has been carried out for the Multi-Trades and Digital Technology Hub and new multi-storey carpark at TAFE NSW Meadowbank. This report forms part of the documentation package to be submitted to the Department of Planning as part of the State Significant Development Application.

This report establishes relevant noise level criteria, details the acoustic assessment and provides comments and recommendations for the proposed development.

The noise assessment has adopted methodology from relevant guidelines, standards and legislation to assess noise impact. The noise impacts have been predicted at the nearest noise sensitive receiver boundaries, taking in account distance attenuation, building reflections and directivity.

A preliminary review of the mechanical services has been carried out and based on the location of the mechanical plantroom on the roof of the building. Recommendations have been provided to minimise the impact of external noise emissions associated with the mechanical plant of the proposed development to the nearest sensitive receivers.

At this stage, public address system has not been selected. Therefore, recommendations have been provided to minimise the impact of external noise emissions associated with the public address system on the proposed development to the nearest sensitive receivers.

The building envelope of the internal workshops where noisy power and construction tools will be used, will need to provide a minimum sound insulation performance in order to meet the noise level criteria at the nearest residential receivers. Use of power tools in the outdoor workshops will have an impact to the nearest noise sensitive educational receivers. Noise controls shall be provided to minimise the impact. Noise level criteria will be achieved by screen / barriers around the proposed outdoor workshops, except for the outdoor workshop W2 – where time limiting noise control shall be implemented.

External loading yard operations have been assessed. Predictions show that noise level criteria will be met at the nearest noise sensitive receiver during typical semi-trailer loading / unloading operations during day-time period. Therefore, its use shall be restricted to day-time period whenever possible.

Traffic noise impact due to the likely generated vehicle movements of the proposed development – based on the information provided in the traffic report – is anticipated to be insignificant, as the noise levels will not increase more than 2dB at the sensitive noise receivers. Sleep arousal assessment of the car movements during night-time period from the basement and multi-storey carpark is not expected to have an adverse impact on residential receivers.

Potential construction noise and vibration impacts on the surroundings have been presented in this report and recommendations based on the relevant guidelines are provided. If, during construction works, an item of equipment exceeds the stated airborne noise and / or vibration criteria at any sensitive location, the additional noise / vibration control measures presented in this report, together with construction best practices shall be considered to minimise noise and vibration impacts on the sensitive receivers.

The information presented in this report shall be reviewed if any modifications to the features of the development specified in this report occur, including and not restricted to selection of mechanical plant, modifications to the building and introduction of any additional noise sources.

Based on the information presented in this report, relevant objectives will be satisfied and therefore approval is recommended to be granted.

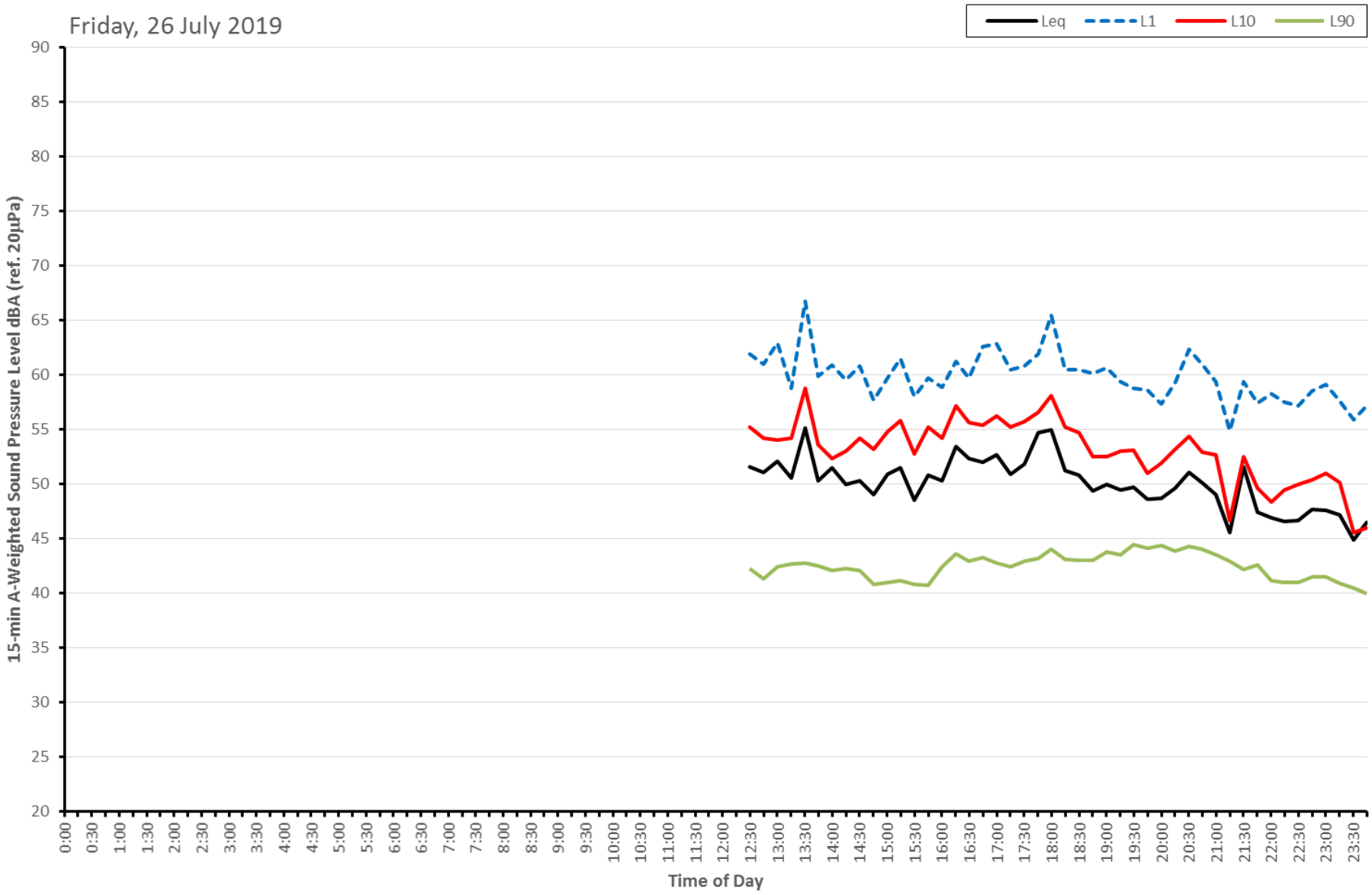
APPENDIX A: LONG TERM NOISE MONITORING

L_{A1} – The L_{A1} level is the noise level which is exceeded for 1% of the sample period. During the sample period, the noise level is below the L_{A1} level for 99% of the time. This measure is commonly referred to as the maximum noise level.

L_{A10} – The L_{A10} level is the noise level which is exceeded for 10% of the sample period. During the sample period, the noise level is below the L_{A10} level for 90% of the time. The L_{A10} is a common noise descriptor for environmental noise and road traffic noise. This measure is commonly referred to as the average maximum noise level.

L_{A90} – The L_{A90} level is the noise level which is exceeded for 90% of the sample period. During the sample period, the noise level is below the L_{A90} level for 10% of the time. This measure is commonly referred to as the background noise level.

L_{Aeq} – The equivalent continuous sound level (L_{Aeq}) is the energy average of the varying noise over the sample period and is equivalent to the level of a constant noise which contains the same energy as the varying noise environment. This measure is also a common measure of environmental noise and road traffic noise.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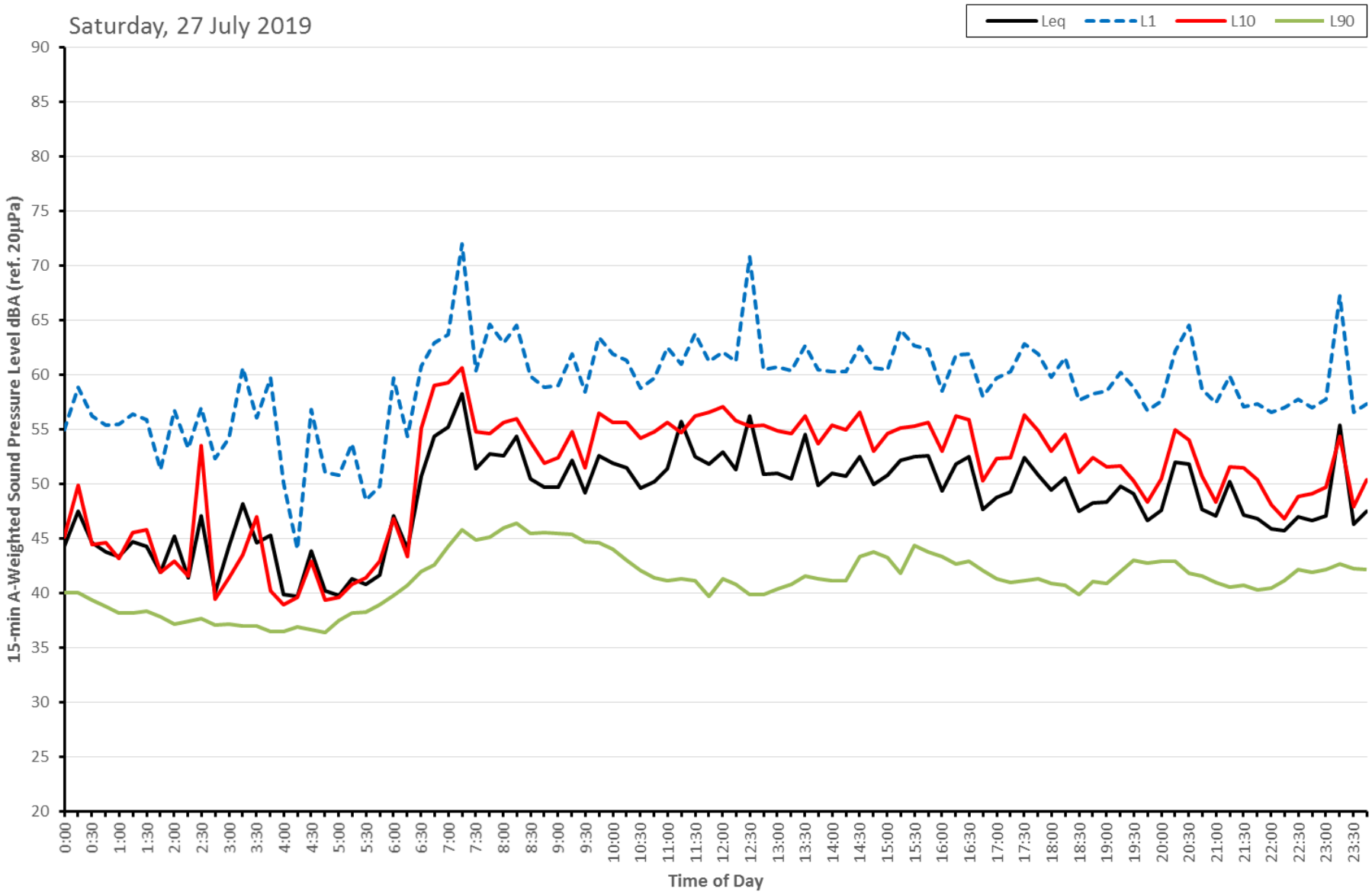
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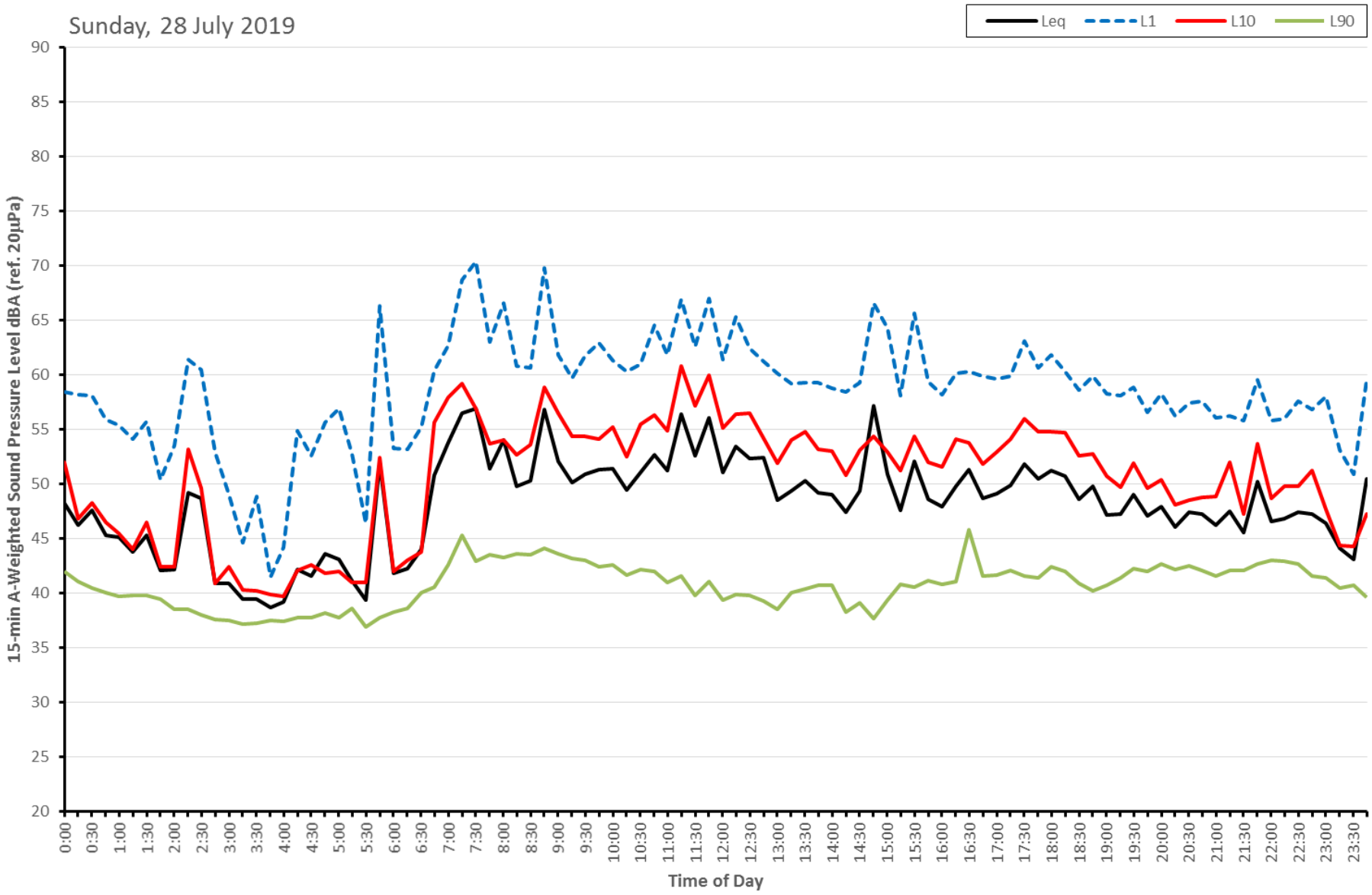
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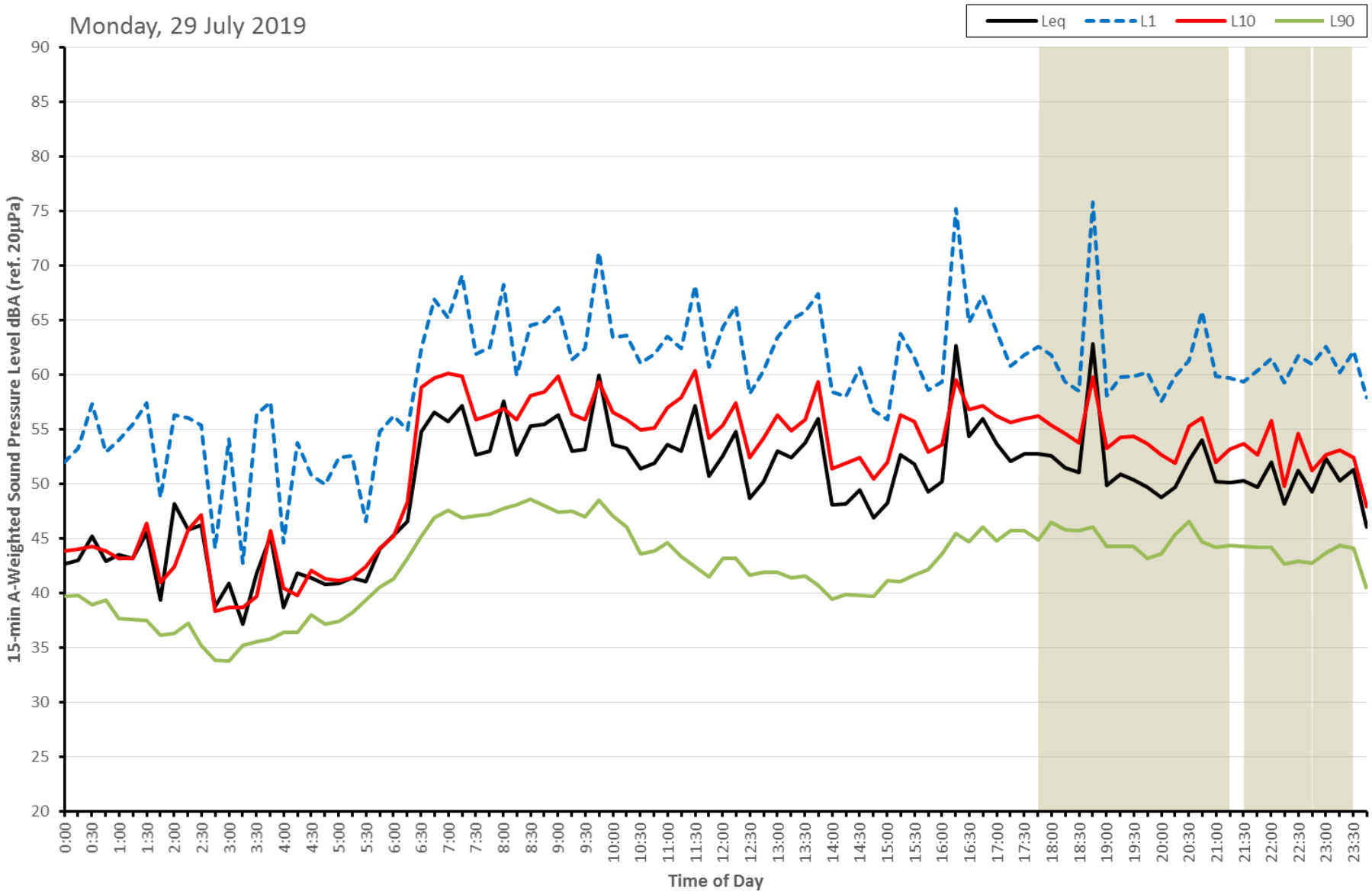
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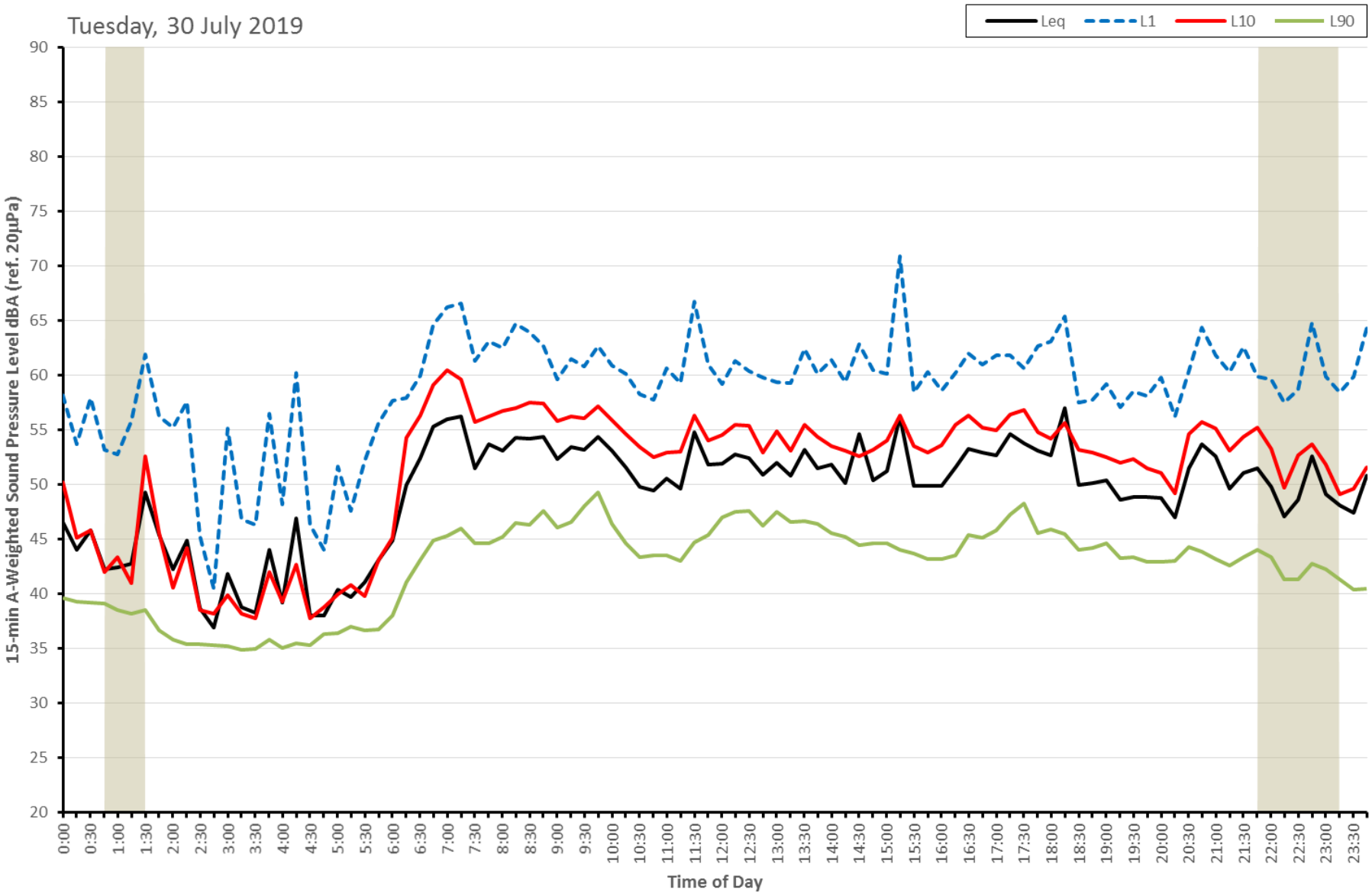
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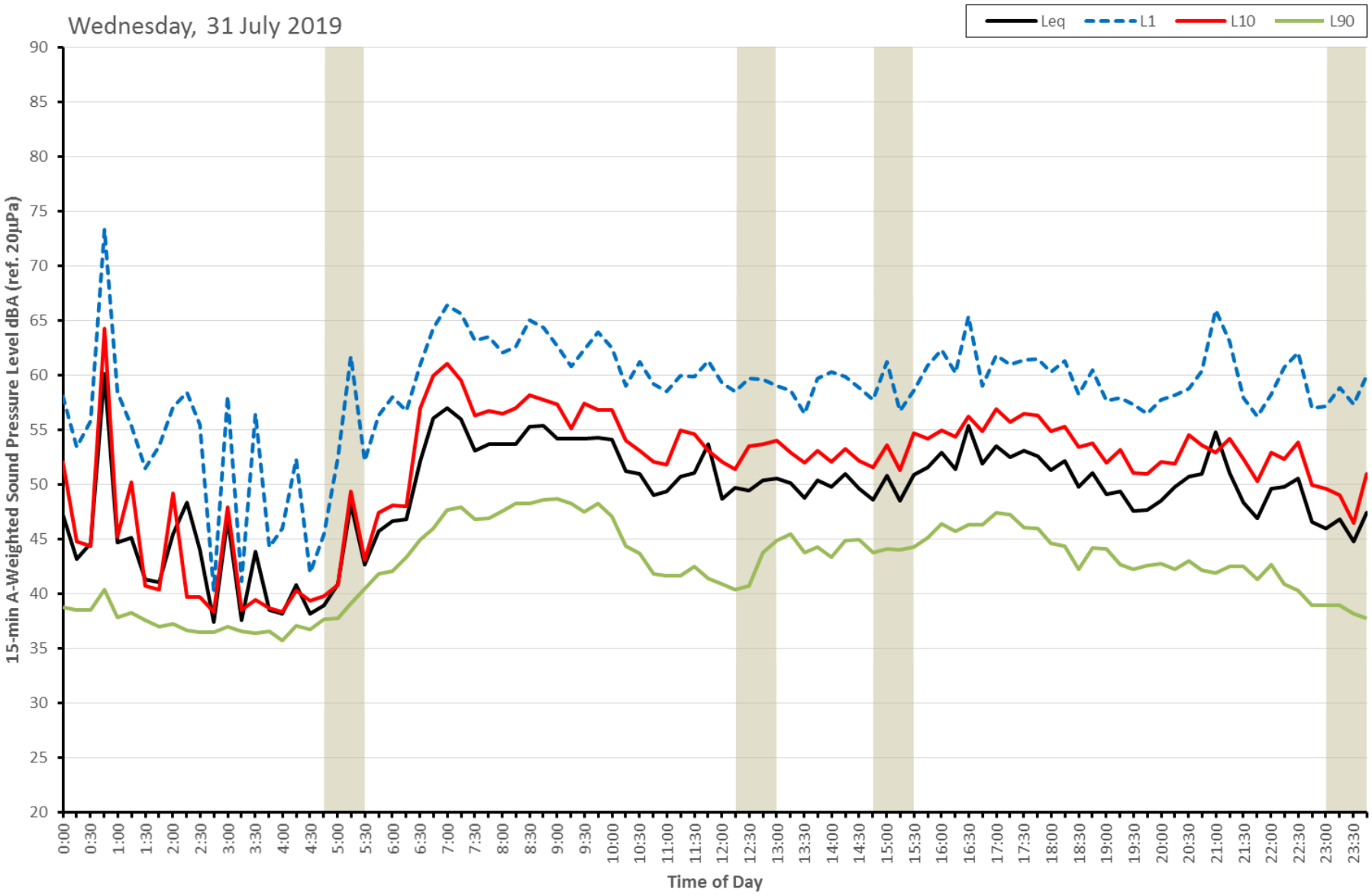
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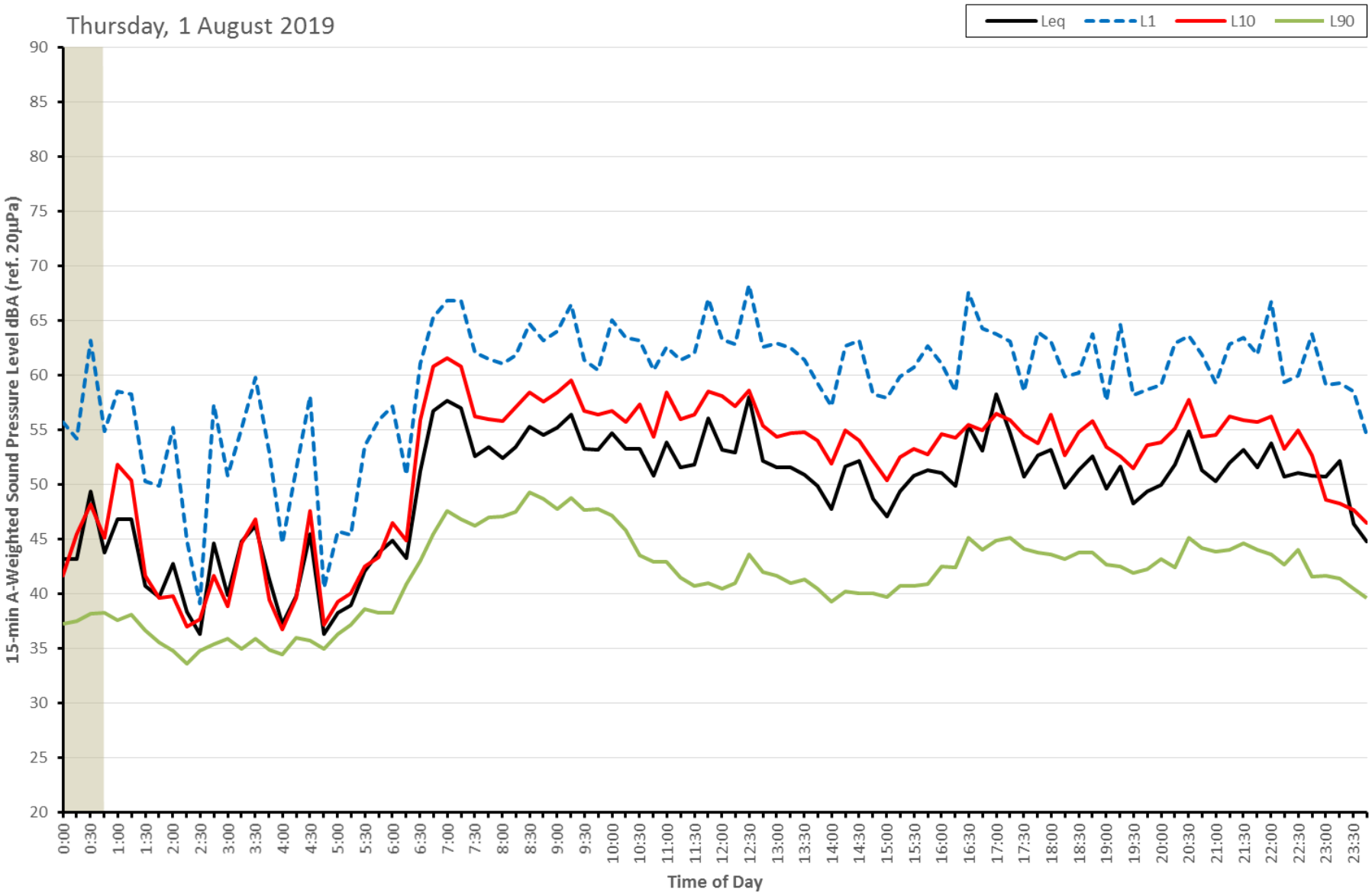
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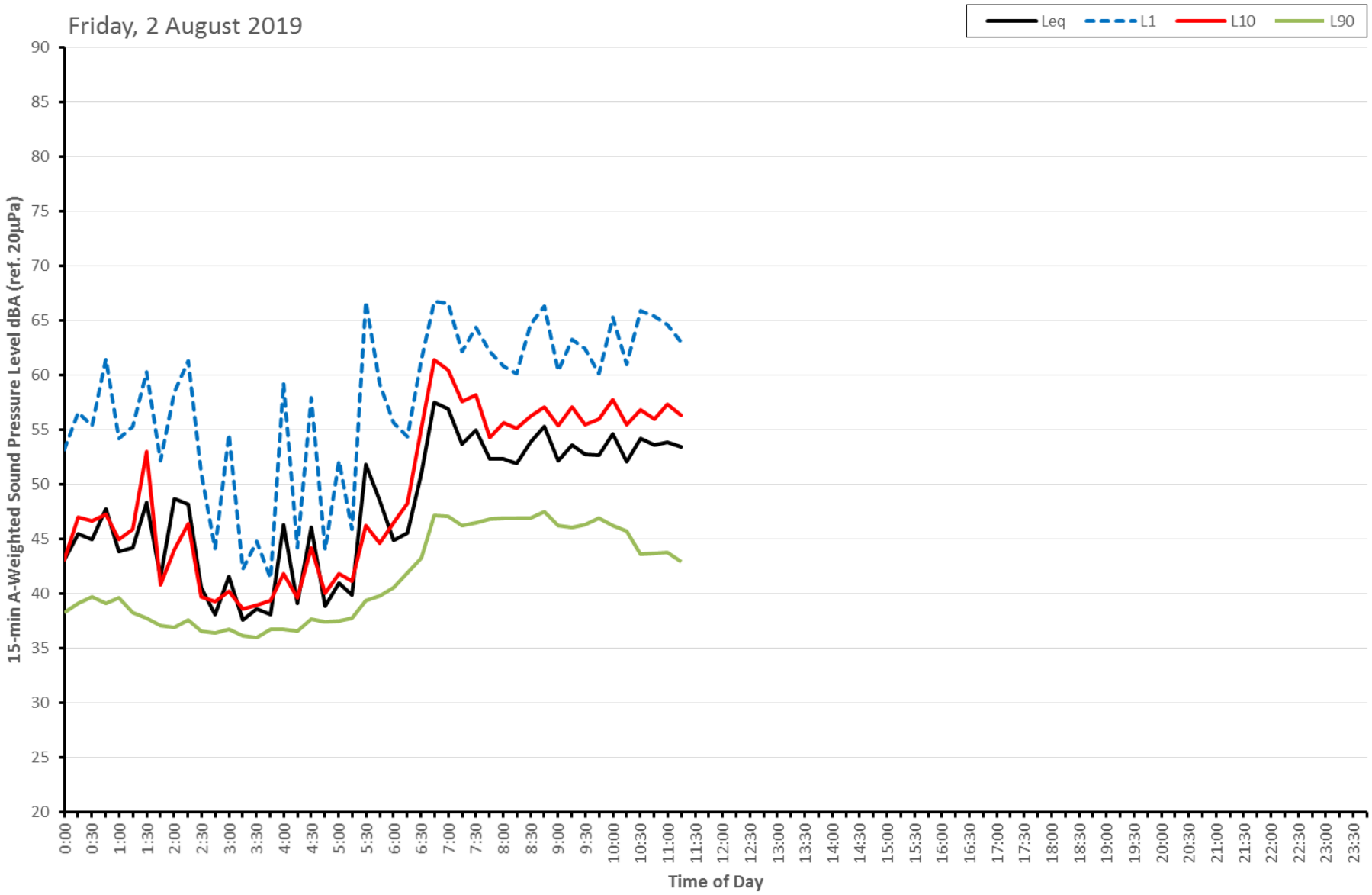
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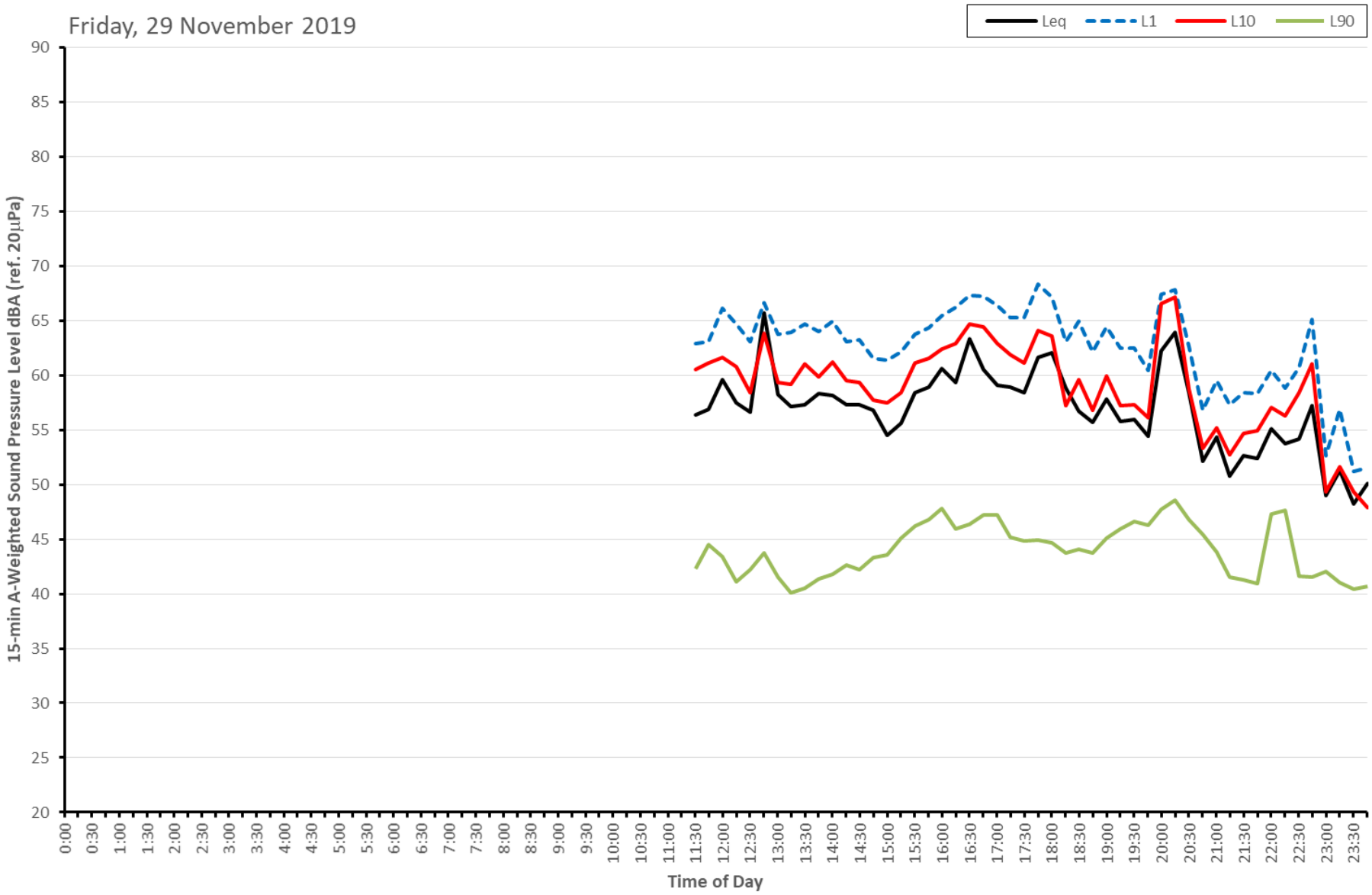
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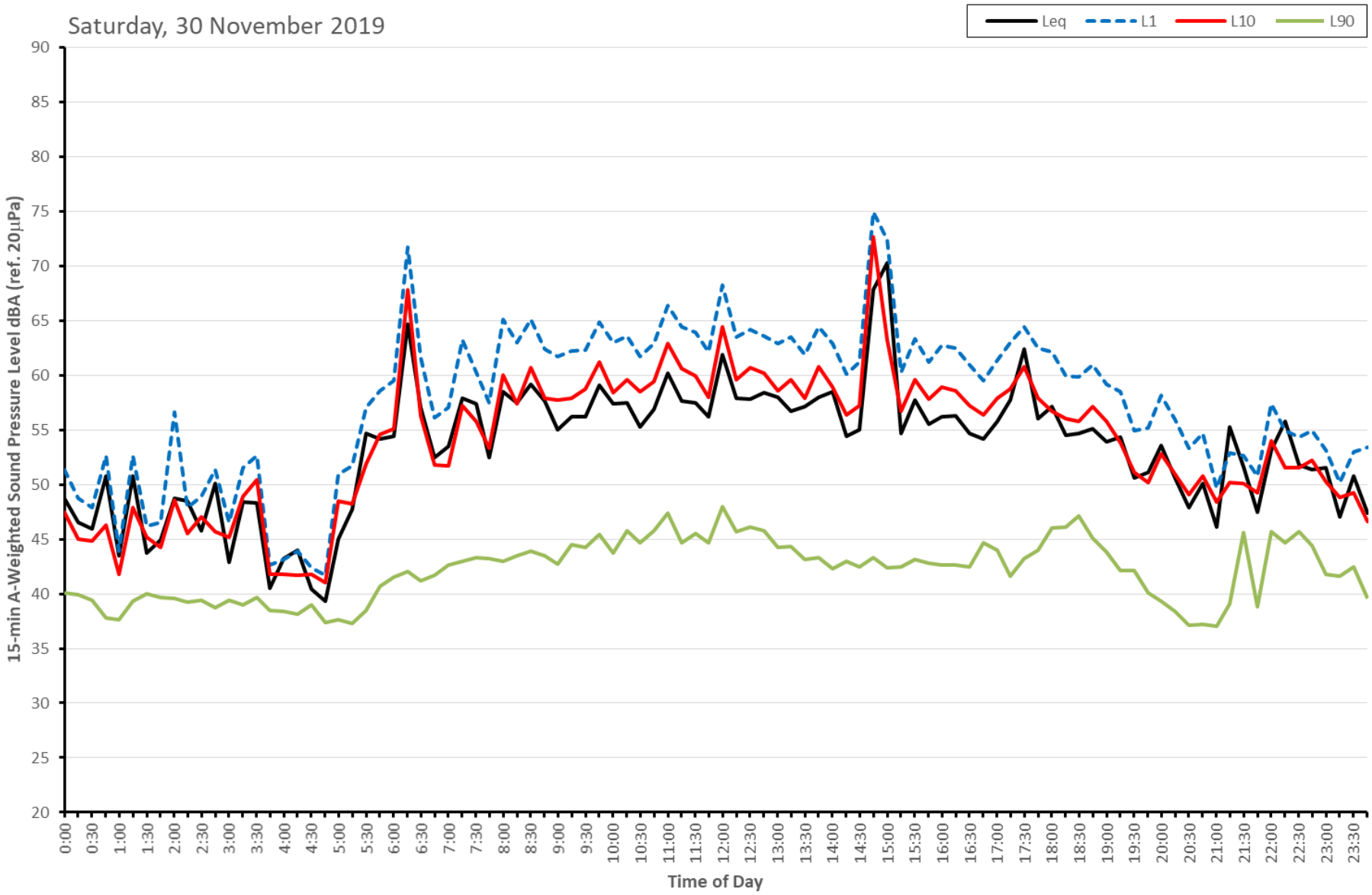
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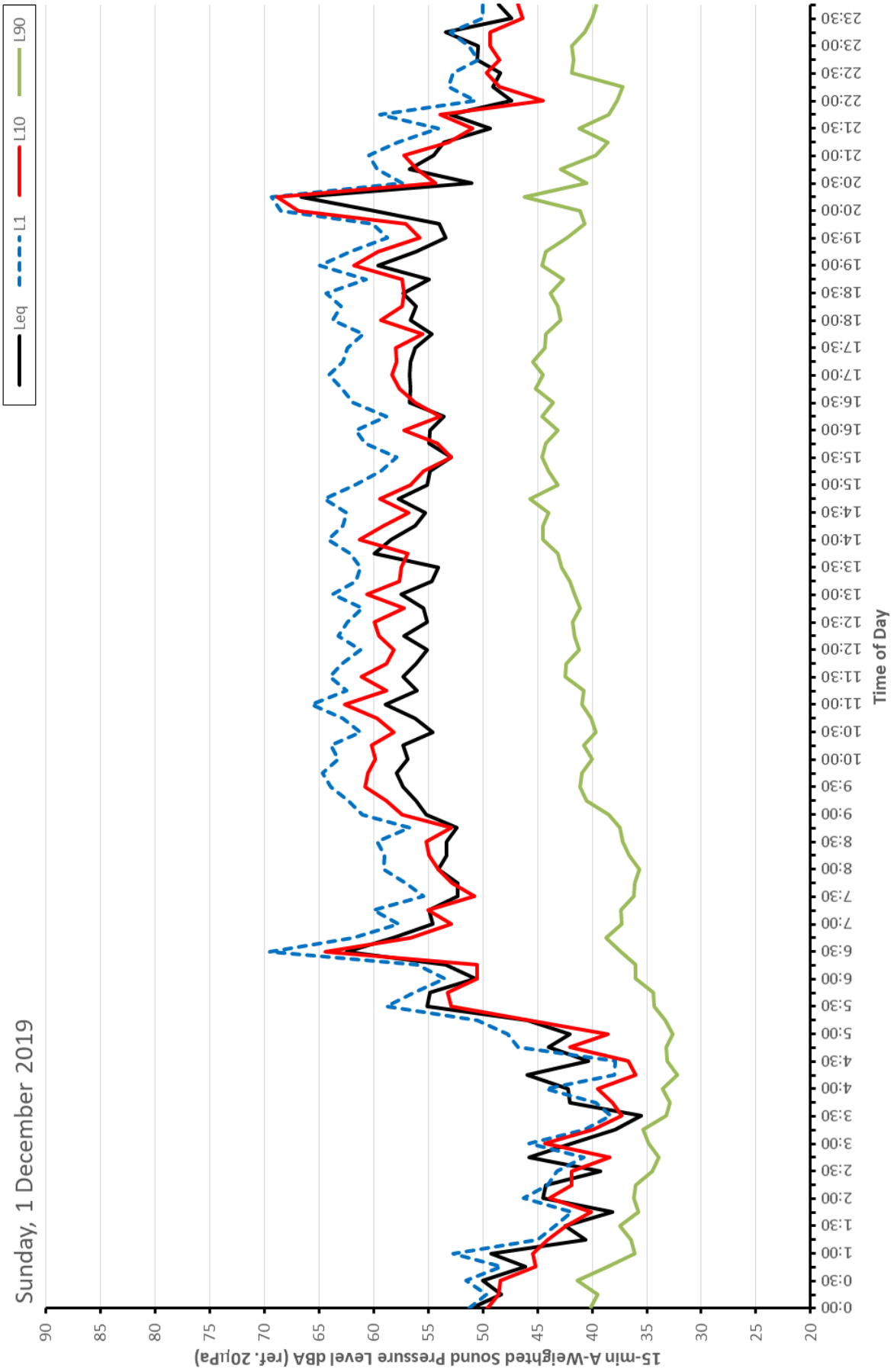
Time of Day


Leq
L1
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L90
Sunday, 1 December 2019
15-min A-Weighted Sound Pressure Level dBA (ref. 20µPa)
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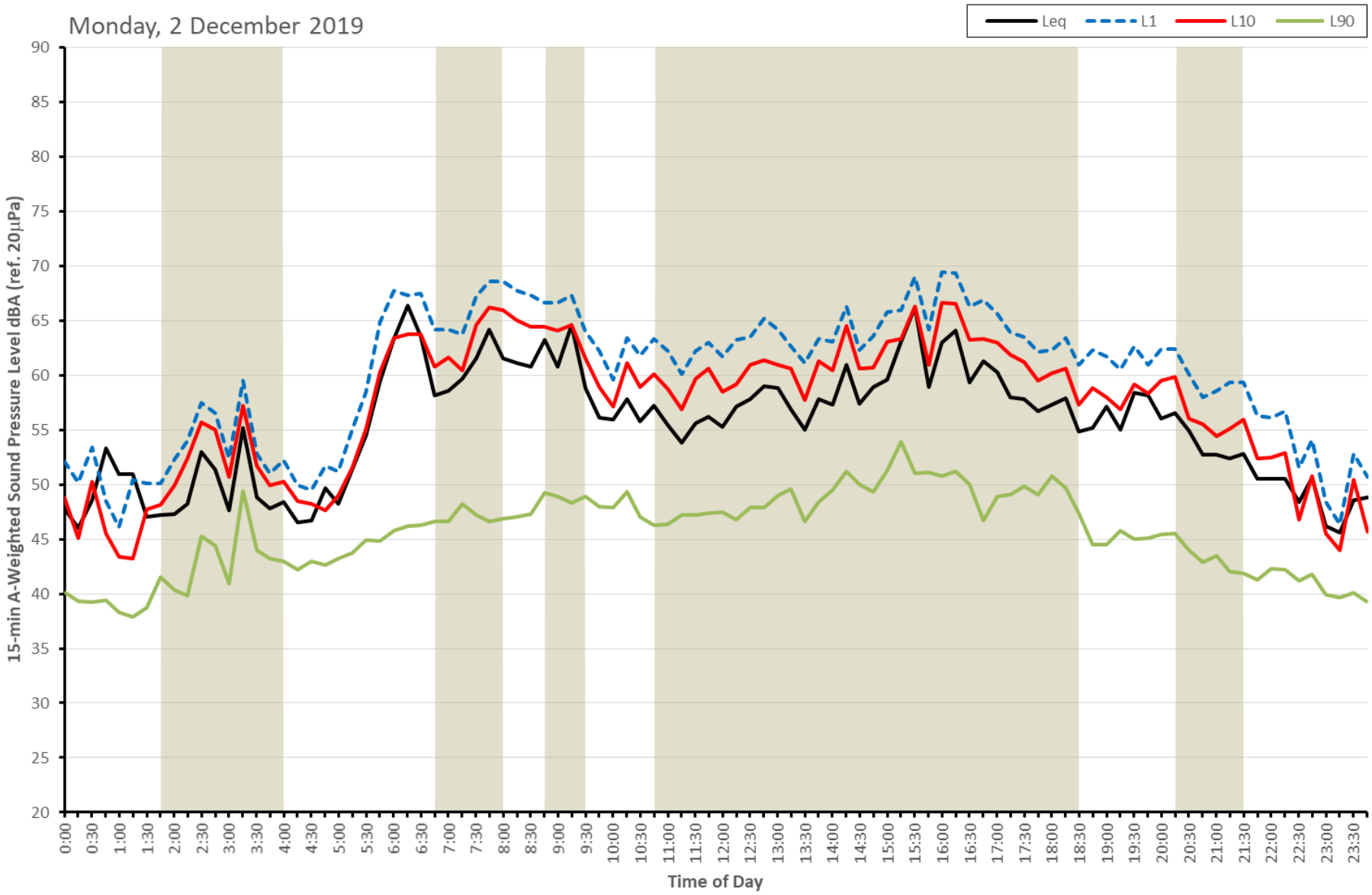
Monday, 2 December 2019
Leq
L1
L10
L90
15-min A-Weighted Sound Pressure Level dBA (ref. 20µPa)
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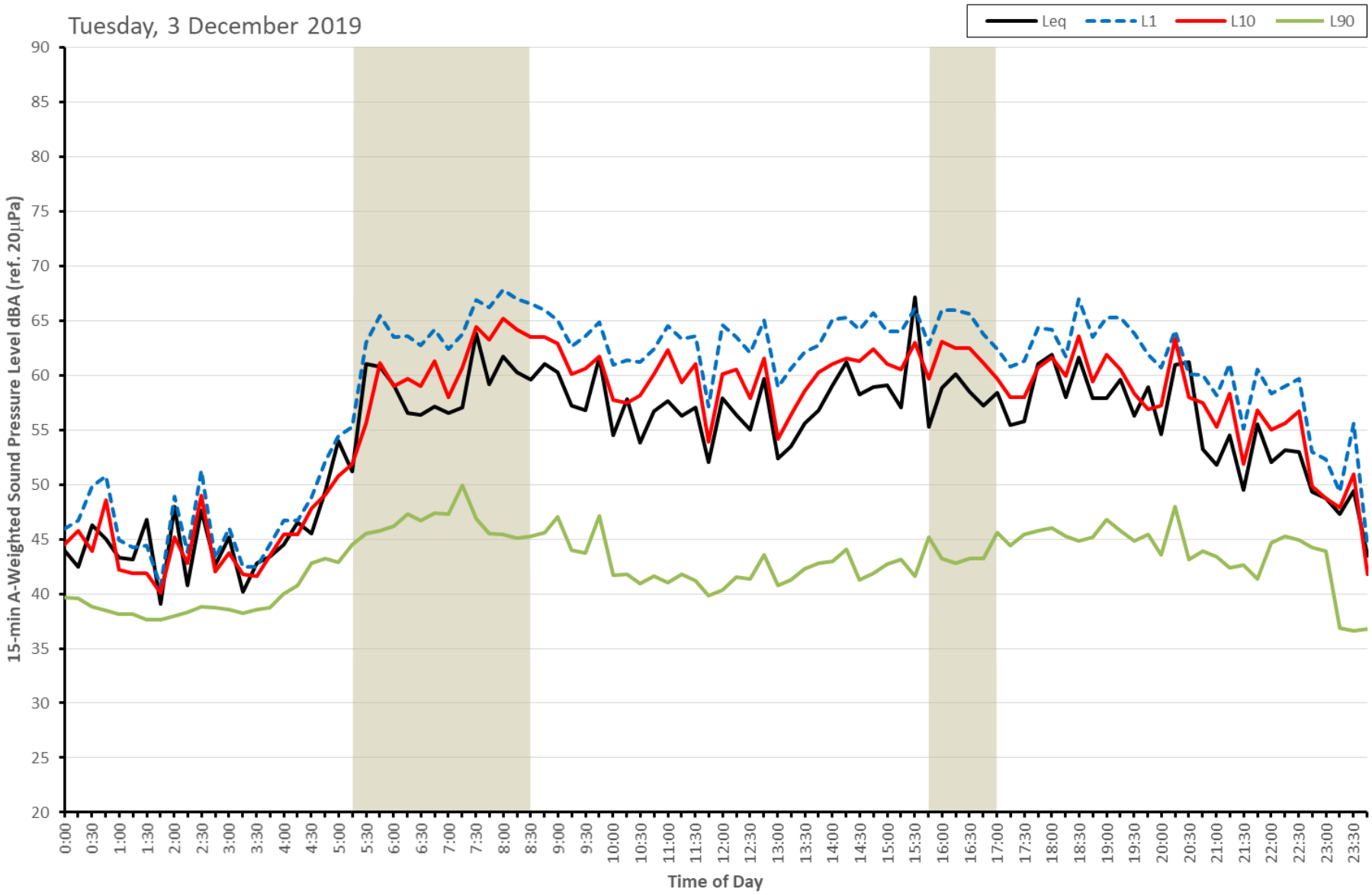
Time of Day


Tuesday, 3 December 2019
Leq
L1
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L90
15-min A-Weighted Sound Pressure Level dBA (ref. 20µPa)
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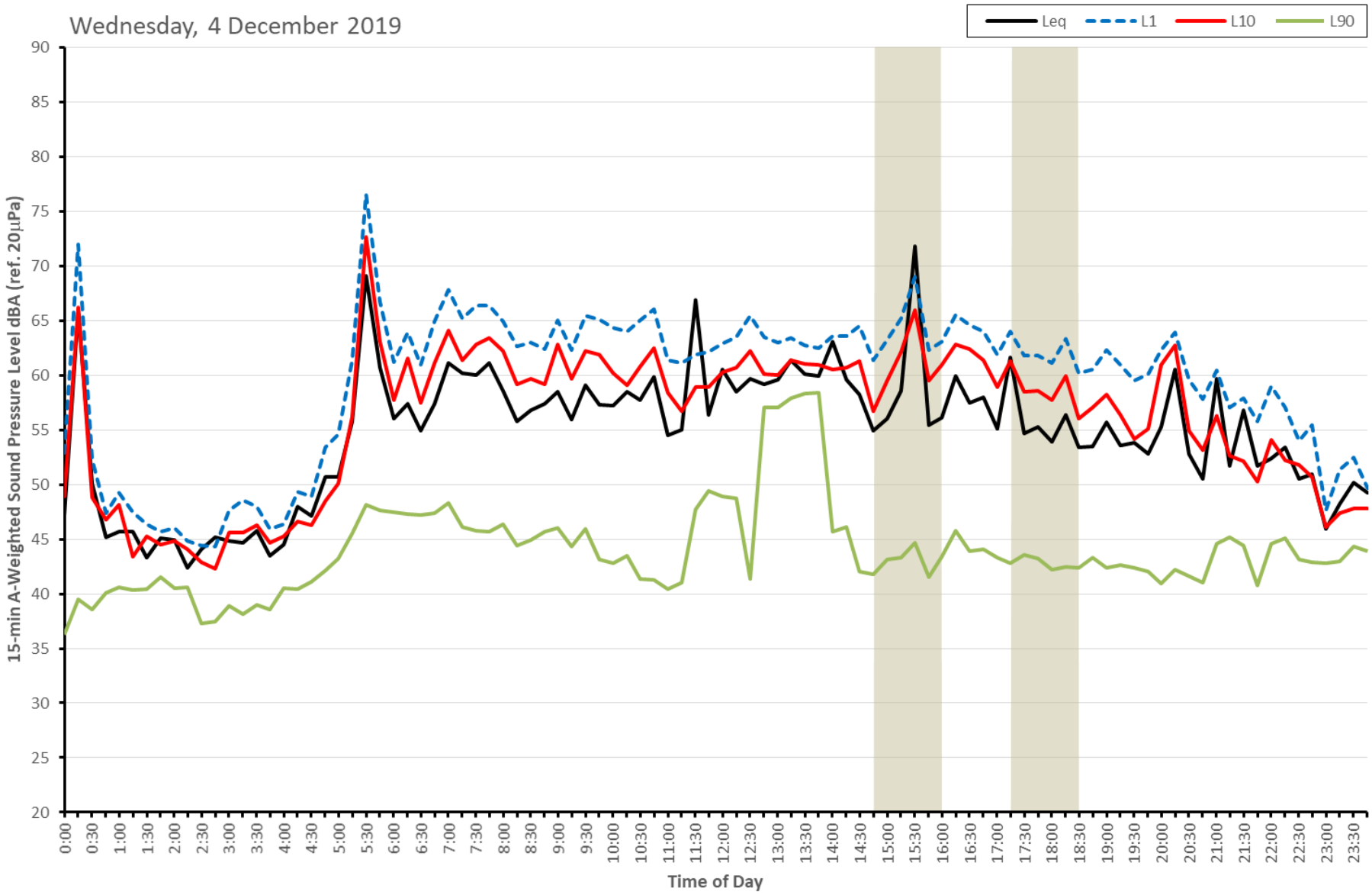
Time of Day


Wednesday, 4 December 2019
Leq
L1
L10
L90
15-min A-Weighted Sound Pressure Level dBA (ref. 20µPa)
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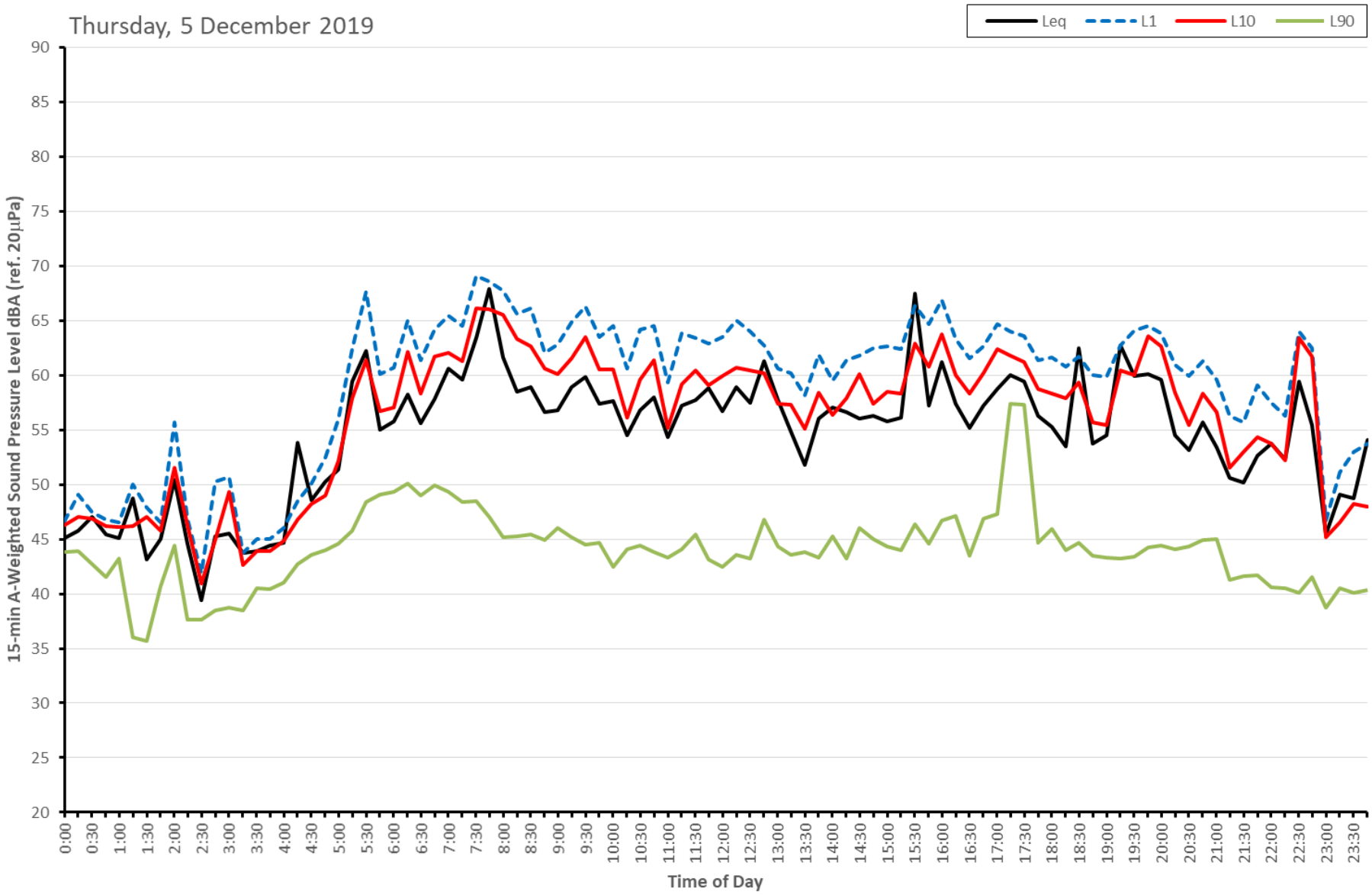
Time of Day


Thursday, 5 December 2019
Leq
L1
L10
L90
15-min A-Weighted Sound Pressure Level dBA (ref. 20µPa)
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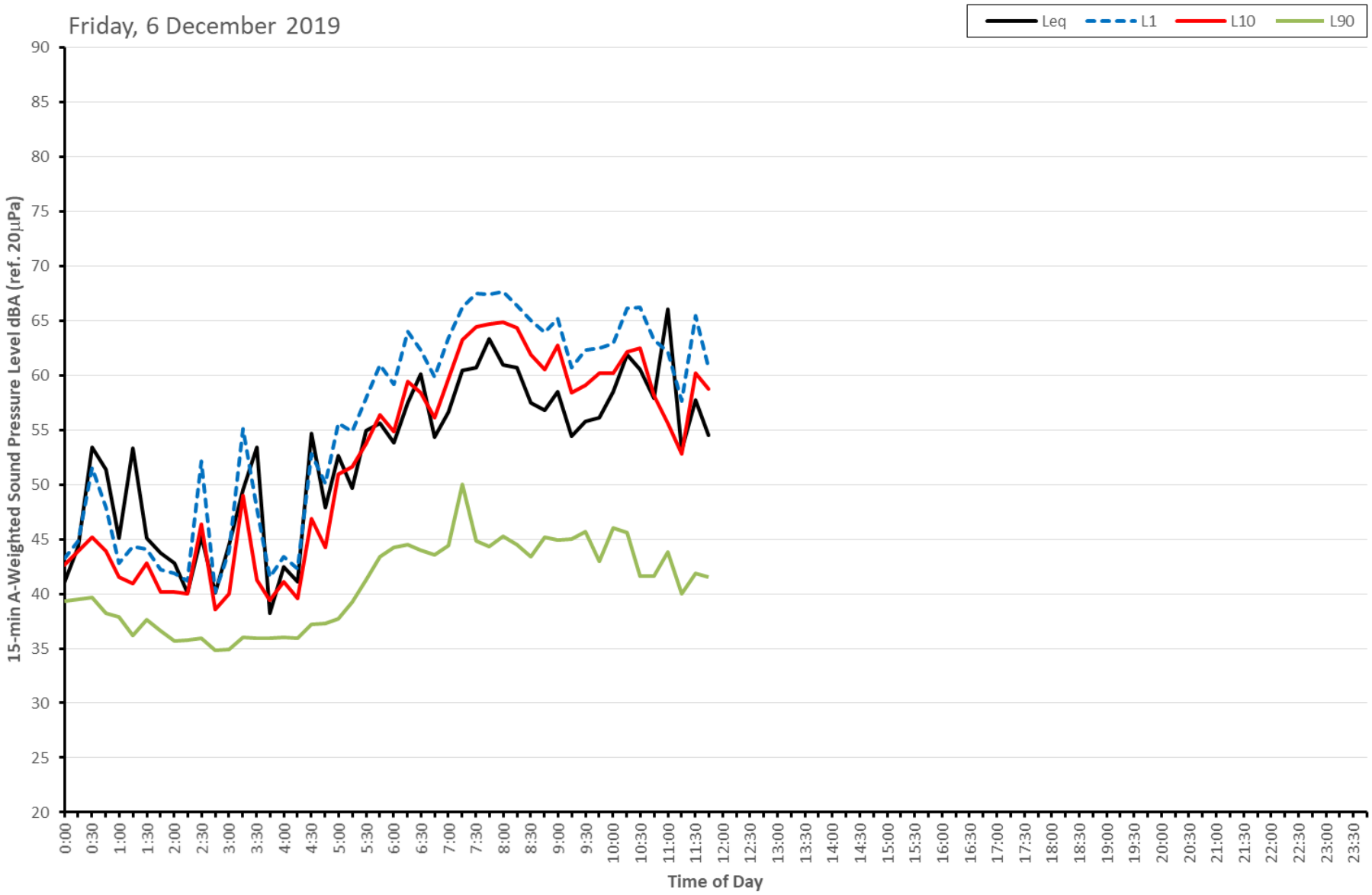
Time of Day


Friday, 6 December 2019
Leq
L1
L10
L90
15-min A-Weighted Sound Pressure Level dBA (ref. 20µPa)
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Time of Day

APPENDIX B: LONG TERM NOISE MONITORING LOCATIONS

LOCATION L1

LOCATION L2