Former Shoalhaven Anglican School

Noise and Vibration Impact Assessment for Development Application

Stantec

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1 Introduction

This acoustic report has been prepared to accompany a Development Application for the Former Shoalhaven Anglican School. This site is located at 17 Croobyar Road, Milton NSW and this site will be repurposed as an educational and sports facility for use by the existing primary and secondary schools within the Ulladulla/Milton SCG.

This assessment has been prepared considering the following documents:

- Shoalhaven Development Control Plan (DCP) 2014
- Shoalhaven Local Environment Plan (LEP) 2014
- The Department of Planning, Housing and Infrastructure Development near Rail Corridors and Busy Roads – Interim Guideline
- NSW Environment Protection Authority (EPA) Noise Policy for Industry, 2017 (NPI 2017).
- NSW Road Noise Policy, 2011 (RNP 2011).
- NSW Environment Protection Authority (EPA) Interim Construction Noise Guideline (ICNG July 2009).

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

- Site drawings presenting the location of the proposed development in relation to the nearest receivers.
- Noise data collected on site through the use of a noise logger and a handheld spectrum analyser.
- Development Application (DA) architectural drawings prepared by Edmiston Jones dated 9th December 2025.

This report provides:

- A statement of compliance with the Shoalhaven Development Control Plan (DCP) 2014 acoustic requirements for the reference design
- Indicative recommendations for noise mitigation measures for the proposed development in order to meet the relevant criteria.

The work documented in this report was carried out in accordance with the Stantec Quality Assurance system, which is based on Australian Standard / NZS ISO 9001.

2 Project Overview

2.1 Site Description

The site is located at 17 Croobyar Road, Milton NSW, and is legally described as Lot 200 in Deposited Plan 1192140 (Lot 200/DP1192140). It falls within the Shoalhaven Local Government Area (LGA) and is zoned RU1 Primary Production under the Shoalhaven Local Environmental Plan (LEP) 2014, as shown in Figure 1. According to the NSW EPA's Noise Policy for Industry (NPI), RU1 Primary Production is classified under the rural residential category. Areas within this category typically feature an acoustic environment dominated by natural sounds (i.e. insects, birds & etc), with minimal road traffic noise and generally has a low background noise levels.

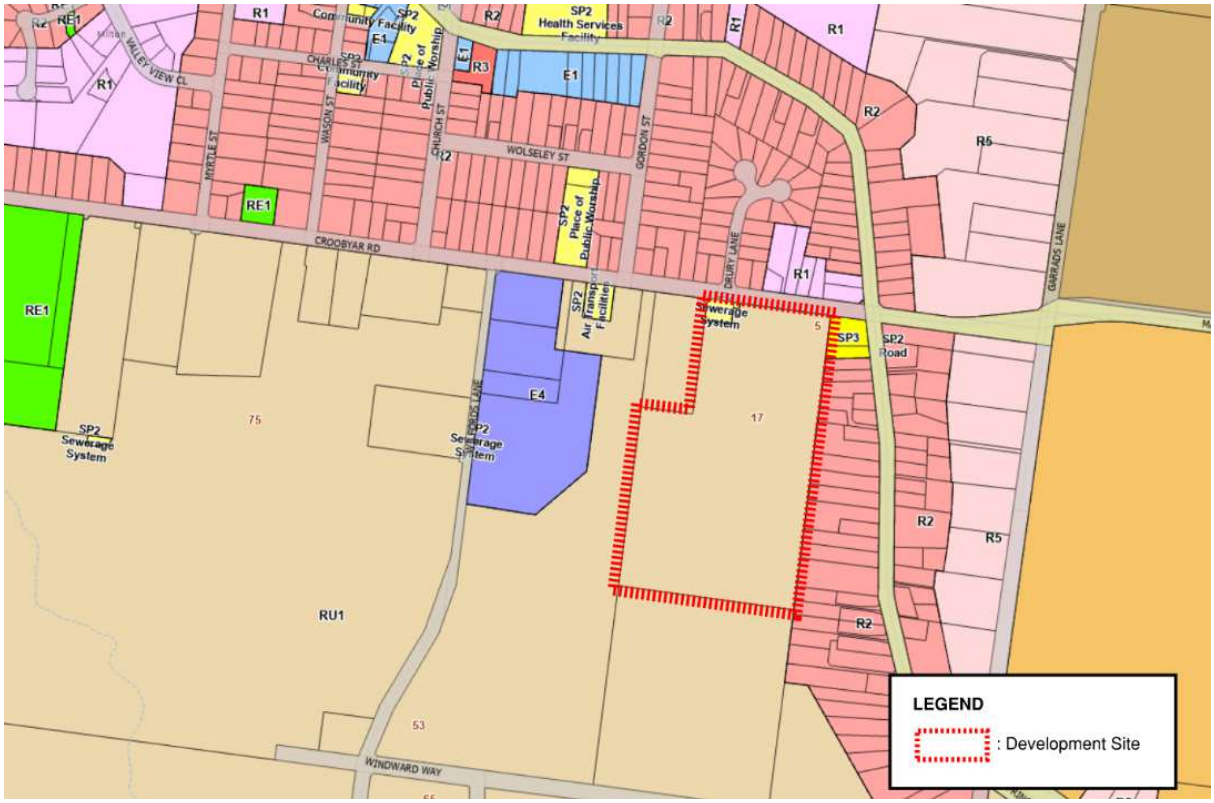


Figure 1: Land Zoning of the Site. (Shoalhaven LEP, 2014)

The site is located along Croobyar Road and is bordered by residential areas to the north and east, and open grassland to the west and south. The surrounding environment is acoustically influenced by natural elements, including birds, insects and small animals activities, which contribute to the ambient noise levels. Currently, the nearest existing sensitive receiver is a residential property situated directly west of the site. The Princes Highway is separated from the proposed development site by the residential area. The development site and the nearest receivers are illustrated in Figure 2 and summarised in Table 1.

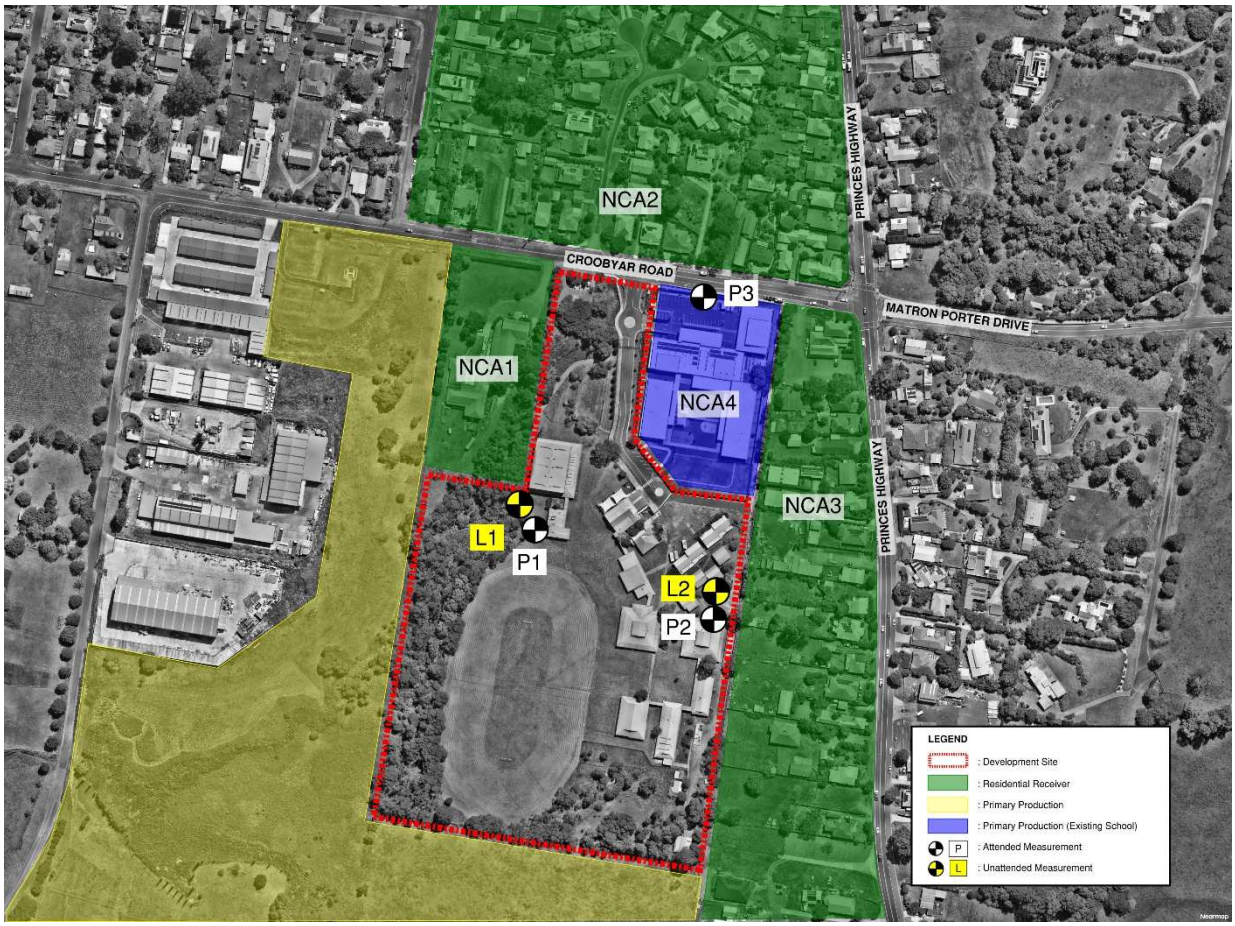


Figure 2: Aerial Identification of the Site and Surrounding Receivers including Measurement Location (Source: Nearmap.com)

Table 1: Summary of receivers surrounding.

Receivers	Address	Land Zoning[1]	Distance to the Site (m)
NCA1	21 Croobyar Road	RU1 Primary Production (Existing Residential[2])	40
NCA2	2 - 28 Croobyar Road	R2 Low Density Residential	130
NCA3	203 – 237A Princes Highway	R2 Low Density Residential	20
NCA4	17 Croobyar Road	RU1 Primary Production (Existing School[2])	40

Note:

1. As per NSW EPA Noise Policy for Industry.
2. As per existing plan that are currently. In our assessment, we are taking into account the current receivers in the surrounding area.

2.2 Scope of Works

The Former Anglican school was closed in 2016, following which the Department of Education purchased the site. Upgrades for sporting use include the refurbishment of the existing sports field to accommodate 8-track athletics track and rectangular playing field, a hall refurbishment and two new sports courts. Upgrades to teaching spaces include refurbishment of the existing kitchen facility, general learning spaces and specialist learning spaces. Seven buildings are proposed for demolition due to their low retention value and parking infrastructure will be established to cater for the increased usage of the site.

The proposed development for an educational establishment at 17 Croobyar Road, Milton NSW 2538 comprises a Development Application lodged with Shoalhaven City Council for the refurbishment and upgrade of the decommissioned Shoalhaven Anglican School site for public education, and includes:

- Demolition of seven existing buildings to provide a new car park and landscaping/arrival plaza
- Upgrade of the existing playing court to two basketball courts
- Refurbishment and upgrade of existing Building "I" for gymnasium facilities
- Refurbishment and upgrade of existing Building "H" for VET kitchen facilities
- Refurbishment and upgrade of existing oval to provide track and field facilities
- Refurbishment and upgrade of existing Buildings “A” and “V” for classroom and administration use
- Ancillary landscaping, stormwater, civil and associated site works

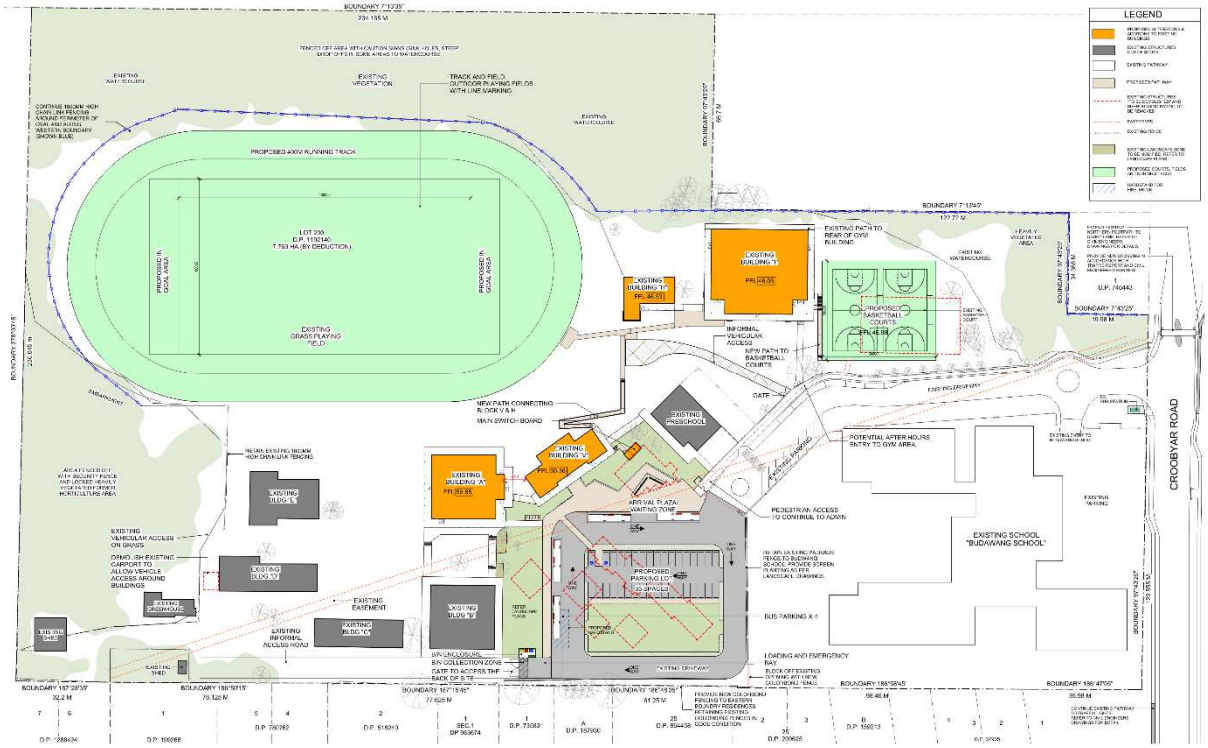


Figure 3: Site Analysis of the Development Site (Edmiston Jones, 9th December 2025).

2.3 Acoustic Issues

The acoustic issue relating to the proposed activity has been identified as follows:

- Noise emission from Building I (Gymnasium/Hall) to the nearest noise-sensitive receivers.
- Noise emissions from the external carpark to the nearest noise-sensitive receivers.
- Noise emissions from the mechanical plant servicing the proposed activity to the surrounding noise-sensitive receivers.
- Noise emissions from construction works of the surrounding receivers
- Increased traffic noise generated by the proposed activity affects the surrounding residential receivers.

3 Noise Survey

Attended and unattended noise surveys were conducted in the locations shown in Figure 2 to establish the ambient and background noise levels of the site and surrounds. 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'.

The noise survey was undertaken on the site between 10th September and 16th September 2025. It is aimed to understand the local noise environment and to establish the noise criteria to the nearest noise sensitive receivers surrounding the site. Refer to Figure 2 for locations of monitoring on-site.

3.1 Instrumentation

The following equipment was used for the noise surveys:

- Hand-held sound spectrum analyser B&K 2250, S/N 3011864
- Hand-held sound spectrum analyser B&K 2250, S/N 3011814
- Hand-held sound spectrum analyser B&K 2250, S/N 3027679
- Sound Calibrator B&K Type 4231, S/N 2709826

All equipment was calibrated before and after the measurements and no significant drift was found. All equipment carries current traceable calibration certificates that can be provided upon request.

3.2 Unattended Noise Survey Results

This assessment will consider the method for determining the RBL background for each period of the day in accordance with the NSW Noise Policy for Industry (NPI). The NPI defines background and ambient noise for the daytime, evening and night time periods as follows:

Day: is defined as 7:00am to 6:00pm, Monday to Saturday and 8:00am to 6:00pm Sundays & Public Holidays.

Evening: is defined as 6:00pm to 10:00pm, Monday to Sunday & Public Holidays.

Night: is defined as 10:00pm to 7:00am, Monday to Saturday and 10:00pm to 8:00am Sundays & Public Holidays**.**

3.2.1 Background and Ambient Noise Monitoring

Two (2) noise loggers were placed at position L1 and L2 as shown in Figure 2 to measure the background and ambient noise that is representative of the surrounding receivers. This development site is located quite a distant from the busy road. Both loggers were installed from the 10th September 2025 to 16th September 2025.

The results of the unattended background noise survey are shown in Table 2 below (for the day, evening and night periods). Note that any extraneous data or rain affected data has been excluded from the calculations.

Table 2: Unattended noise measurements.

Location	Equivalent Continuous Noise Level $L_{Aeq,period}$ – dB(A)			Background Noise Level RBL – dB(A)		
	Day	Evening	Night	Day	Evening	Night
L1	47	50	46	37	33	30
L2	55	50	51	36	33	30

3.3 Attended Noise Survey Results

Attended noise measurements of 15-minute duration were conducted on site to validate the results of the unattended noise monitoring and to measure the traffic noise located next to the development site (Croobyar Road). The locations of the attended noise measurements close to the proposed development site are shown in Figure 2.

The Sound Level Meter (SLM) microphone was mounted 1.5 metres above the ground, and a windshield was used to protect the microphone and limit the wind noise. Measurements were undertaken in the free-field, more than 3 metres away from any building façade or vertical reflective surface. Weather conditions were calm and dry during the noise monitoring. Table 3 below shows the summary of the attended noise measurements.

Table 3: Attended noise measurements.

Measurement Location	Measurement Time	$L_{Aeq,\ 15mins}$, dB(A)	$L_{A90,\ 15mins}$, dB(A)	Comments
P1	23/09/2025 1.46pm	44	35	Environment noises dominate (i.e. wind noises & birds).
P2	23/09/2025 1.16pm	54	48	Environmental noises dominate (i.e., wind and birds). Audible sounds of children playing from the court in the distance. A very faint traffic noise from Princes Highway.
P3	23/09/2025 2.06pm	68	48	Noise from Croobyar Road is dominant, with faint traffic sounds from Princes Highway also audible.

4 Noise Criteria

4.1 Internal Noise Levels & Reverberation Times

Background sound level and reverberation time design targets were obtained from the NSW Department of Education (EFSG NSW). These criteria will affect the design of air conditioning plant and other mechanical services, and the design of sound isolation requirements between occupied areas.

4.1.1 The Educational Facilities Standards & Guidelines

Table 4 presents the background noise levels and reverberation times that are the basis of the acoustic design for each type of space. These levels are in accordance with the EFSG and note that these levels are generally based on the satisfactory recommended levels by Australian Standard (AS) 2107:2016 – *'Acoustics- Recommended design sound levels and reverberation times for building interiors.*

Table 4: Internal noise levels according to EFSG

Room	Internal Noise Level, L_{Aeq}, dB(A)	Reverberation time RT60 (average 500Hz and 1000Hz)
Art/craft studios	40	<0.8
Assembly halls up to 250 seats	35	See Note 1
Assembly halls over 250 seats	35	See Note 1
Audio-visual areas	35	<0.8
Computer rooms – Teaching	40	<0.6
Computer rooms – Laboratories	45	<0.6
Conference room	35	<0.7
Corridors and lobbies	45	Minimise
Dance studios	40	<1.2
Dining rooms	45	<1
Drama Studios	30	<1
Duplicating rooms/stores	50	-
Engineering workshops	50	Minimise
Gymnasiums	40	<1.5
Interview/counselling rooms	35	<0.6
Kitchens	50	-
Laboratories – Teaching	40	<0.7
Laboratories – Working	45	<0.8
Lecture rooms – up to 50 seats	35	See Note 1
Lecture theatres – without speech reinforcement and >50 seats	30	See Note 1
Lecture theatres – with speech reinforcement	35	See Note 1
Libraries – General areas	40	<0.6

Room	Internal Noise Level, L_{Aeq}, dB(A)	Reverberation time RT60 (average 500Hz and 1000Hz)
Libraries – Reading areas	35	<0.6
Libraries – Stack areas	45	<0.6
Manual arts workshops	40	Minimise
Medical rooms (First aid)	40	<0.8
Music practice rooms	35	See Note 1
Music studios	30	See Note 1
Office areas	40	<0.8
Open plan teaching areas	40	<0.8
Professional and Administrative offices	35	<0.8
Staff common rooms	40	<0.6
Study Rooms	35	<0.8
Teaching spaces – Hearing impaired	30	<0.4
Teaching spaces – Primary schools	35	<0.5
Teaching spaces – Secondary schools	35	<0.6
Toilet/change/showers	50	-

General Note: The appropriate reverberation time shall be influenced by the internal volume and intended use of the space. Guidance from an acoustical engineer shall be sought. Also refer to AS/NZS 2107:2000 Figure A1 for guidance values.

4.1.2 SEPP Transport and Infrastructure (2021)

Transport and Infrastructure SEPP guidelines (Section 2.120) encompasses any development for an educational establishment that is on land in or adjacent to a road corridor for a freeway, tollway or a transitway or any other road with an annual average daily traffic (AADT) volume of more than 20,000 vehicles (based on data published by Transport for NSW).The recommended maximum noise level in an educational establishment is outlined below, in Table 5.

Table 5: SEPP guidelines for Educational Developments.

Type of Occupancy	Recommended Max Level (dB(A))
Educational Establishment	40

4.2 External Noise Emissions

4.2.1 NSW Noise Policy for Industry (NPI)

The NSW Environment Protection Authority (EPA) sets out criteria in its Noise Policy for Industry (NPI) to control the noise emission from industrial noise source or continuous steady state noise. The external noise due to the mechanical services from the proposed development will later be addressed in order to ensure the compliances with NSW EPA's NPI guidelines.

The calculation is based on the results of the ambient and background noise unattended monitoring, addressing two components:

- Controlling intrusive noise into nearby residences (Intrusiveness Criteria)
- Maintaining noise level amenity for particular land uses (Amenity Criteria)

Once both criteria are established the most stringent for each considered assessment period (day, evening, night) is adopted as the Project Noise Trigger Level (PNTL).

4.2.1.1 Intrusiveness Criteria

The NSW EPA NPI states the following:

> *"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. This intrusiveness noise level seeks to limit the degree of change a new noise source introduces to an existing environment"*

The intrusiveness criterion can be summarised as $L_{Aeq,15\ minute} \leq$ RBL background noise level plus 5 dB(A).

Table 6: NSW NPI Intrusiveness Criteria.

Receiver	Period	Measured Rating Background Level L_{A90} dB(A)	Intrusiveness Criteria L_{Aeq} dB(A)
Residential	Day	36	41
	Evening	33	38
	Night	30	35

4.2.1.2 Amenity Criteria

The NSW NPI states the following:

> *"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."*

The applicable parts of Table 2.1: Recommended L_{Aeq} Noise Levels from Industrial Noise Sources – dB(A) which are relevant to the project are reproduced below:

Table 7: NSW NPI Amenity Criteria for External Noise Level

Type of Receiver	Indicative Noise Amenity Area	Time of Day	Recommended $L_{Aeq,period}$ Noise Level, dB(A)	Project Amenity Noise Level[1], $L_{Aeq, 15mins}$, dB(A)
Residential	Suburban	Day	55	53
		Evening	45	43
		Night	40	38

Notes:

1. Project amenity noise level is Recommended Noise Level minus 5 dB(A) plus 3 dB(A) to convert from period level to a 15-minute level.

4.2.1.3 'Modifying Factor' Adjustments

The NSW NPI also states:

> *"Where a noise source contains certain characteristics, such as tonality, impulsiveness, intermittency, irregularity or dominant low-frequency content, there is evidence to suggest that it can cause greater annoyance than other noise at the same noise level."*

In order to take into account the potential annoying character of the noise an adjustment of 5 dB(A) for each annoying character aspect and cumulative of up to a total of 10 dB(A), is to be added to the measured value to penalise the noise for its potentially greater annoyance aspect.

Table 4.1 of Chapter 4 of the NSW DECCW NPI (see Table 8 below) provides procedures for determining whether an adjustment should be applied for greater annoyance aspect.

Table 8: Table 4.1 from the NSW DECCW NPI – Modifying factor corrections.

Factor	Assessment / Measurement	When to Apply	Correction[1]	Comments
Tonal Noise	One-third octave or narrow band analysis	Level of one-third octave band exceeds the level of the adjacent bands on both sides by: • **5 dB** or more if the centre frequency of the band containing the tone is above 400 Hz • **8 dB** or more if the centre frequency band containing the tone is 160 to 400 Hz inclusive • **15 dB** or more if the centre frequency of the band containing	5 dB[2]	Narrow-band frequency analysis may be required to precisely detect occurrence.

Factor	Assessment / Measurement	When to Apply	Correction[1]	Comments
		the tone is below 160 Hz		
Low Frequency Noise	Measurement of C-weighted and A-weighted level	Measure / assesses C- and A- weighted levels over same time period. Correction to be applied if the difference between the two levels is 15 dB or more	5 dB[2]	C-weighting is designed to be more responsive to low-frequency noise, especially at higher overall levels
Impulsive Noise	A-weighted fast response and impulsive response	If difference in A-weighted maximum noise levels between fast response and impulse response is greater than 2 dB	Apply difference in measured levels as the correction, up to a maximum of 5 dB.	Characterised by a short rise time of 35 milliseconds (ms) and decay time of 1.5 s.
Intermittent Noise	Subjectively assessed	Level varies by more than 5 dB	5 dB	Adjustment to be applied for **night-time only.**
Duration	Single-event noise duration may range from 1.5 min to 2.5 h	On event in any 24-hour period	0 to – 20 dB(A)	The acceptable noise level may be increased by an adjustment depending on duration of noise.
Maximum Adjustment	Refer to individual modifying factors	Where two or more modifying factors are indicated	Maximum correction of 10dB(A)[2] (excluding duration correction)	

Notes:

1. Corrections to be added to the measured or predicted levels.
2. Where a source emits tonal and low-frequency noise, only one 5 dB correction should be applied if the tone is in the low-frequency range.

4.2.2 Project Noise Trigger Levels (PNTL)

The following criteria is applicable for the external noise emissions from the development, as detailed below in Table 9 These project noise trigger levels are in accordance with the requirements of the NSW NPI and shall be assessed to the reasonably most affected point on or within the residential boundary.

Table 9: Project noise trigger levels.

Period	Descriptor	PNTL dB(A)
Residential receivers (Suburban)		
Day (7:00am to 6:00pm)	$L_{Aeq,15min}$	41
Evening (6:00pm to 10:00pm)	$L_{Aeq,15min}$	38
Night (10:00pm to 7:00am)	$L_{Aeq,15min}$	35

Where necessary, noise mitigation measures will be incorporated in the design to ensure that noise levels comply with the recommended noise emission criteria noted above.

4.3 Traffic Noise Generation Criteria

The L_{Aeq} noise level or the "equivalent continuous noise level" correlates best with the human perception of annoyance associated with traffic noise.

Road traffic noise impact is assessed in accordance with the introduced NSW Road Noise Policy (Office of Environment and Heritage July 2011) which supersedes the *NSW Environmental Criteria for Road Traffic Noise* (ECRTN, Department of Environment Climate Change and Water 1999). The criterion (Table 3 – Road Traffic Noise Assessment Criteria for Residential Land Uses) divides land use developments into different categories and lists the respective criteria for each case. The category that is relevant to the proposed use of the site is shown below in Table 10.

Table 10: NSW Road Noise Policy – Traffic noise assessment criteria.

Road Category	Type of project/land use	Assessment Criteria – dB(A)	
		Day (7am – 10pm)	Night (10pm – 7am)
Arterial roads	Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments	$L_{Aeq,1\ hour}$ 60 (external)	$L_{Aeq,1\ hour}$ 55 (external)
Local roads	Existing residences affected by additional traffic on existing local roads generated by land use developments	$L_{Aeq,1\ hour}$ 55 (external)	$L_{Aeq,1\ hour}$ 50 (external)

In the event that the traffic noise at the site is already in excess of the criteria noted above, the NSW RNP states that the primary objective is to reduce the existing level through feasible and reasonable measures to meet the criteria above.

If this is not achievable, Section 3.4.1 Process for applying the criteria – Step 4 states that for existing residences affected by additional traffic on existing roads generated by land use developments, any increase in the total traffic noise should be limited to 2dB above that of the corresponding 'no build option'.

4.4 Construction Noise Criteria

Noise criteria for construction sites are established in accordance with the Interim Construction Noise Guideline (*ICNG July 2009*) by the NSW Office of Environment & Heritage (NSW OE&H) currently under The NSW Environment Protection Authority (EPA). It is important to note that the recommended criteria are for planning purposes only. Numerous other factors need to be considered when assessing potential noise impacts from construction works.

However, in undertaking the assessment of potential noise intrusion associated with the proposed construction activities, Chapter 4 of the NSW EPA ICNG (July 2009) were specifically referenced. The noise limits are presented in Table 11, and are applicable to the development.

Table 11: NSW ICNG Construction noise criteria.

Time of Day	Management Level $L_{Aeq,15min}$ *	How to Apply
Recommended Standard Hours: Mon – Fri (7am – 6pm) Sat (8am – 1pm) No work on Sunday & Public Holidays	Noise Affected RBL + 10dB	The noise affected level represents the point above which there may be some community reaction to noise. • Where the predicted or measured $L_{Aeq,15min}$ 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 residences 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 in, taking into account: • Times identified by the community when they are less sensitive to noise (such as before and after school, for works near schools, or mid-morning or mid-afternoon for works near residences) • If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside Recommended Standard Hours	Noise Affected RBL + 5dB	• A strong justification would typically be required for works outside the recommended standard hours. • The proponent should apply all feasible and reasonable work practices to meet the noise affected level. • Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community. o For guidance on negotiating agreements see section 7.2.2. of NSW EPA ICNG (July 2009).

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

Source: Chapter 4 (Table 2 Sec 4.1.1) of NSW EPA ICNG

4.5 Construction Vibration Criteria

The NSW Environment Protection Authority (EPA) developed a document, “Assessing vibration: A technical Guideline” in February 2006 to assist in preventing people from exposure to excessive vibration levels within buildings. The guideline does not however address vibration induced damage to structures or structure-borne noise effects. Vibration and its associated effects are usually classified as continuous, impulsive or intermittent.

4.5.1 Human Comfort – Continuous and Impulsive Vibration Criteria

Structural vibration in buildings can be detected by occupants and can affect them in many ways including reducing their quality of life and also their working efficiency. Complaint levels from occupants of buildings subject to vibration depend upon their use of the building and the time of the day.

Maximum allowable magnitudes of building vibration with respect to human response are shown in Table 12. It should be noted that the human comfort for vibration criteria are more stringent than the building damage criteria.

Table 12: Preferred and maximum weighted RMS values for continuous and impulsive vibration acceleration (m/s2) 1-80Hz.

Location	Assessment period[1]	Preferred values		Maximum values	
		z-axis	x- and y-axis	z-axis	x- and y-axis
Continuous vibration					
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 place of worship	Day or night time	0.020	0.014	0.040	0.028
Impulsive vibration					
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 place of worship	Day or night time	0.64	0.46	1.28	0.92

4.5.1.1 Human Comfort – Intermittent Vibration Criteria

Disturbance caused by vibration will depend on its duration and its magnitude. This methodology of assessing intermittent vibration levels involves the calculation of a parameter called the Vibration Dose Value (VDV) which is used to evaluate the cumulative effects of intermittent vibration. Various studies support the fact that VDV assessment methods are far more accurate in assessing the level of disturbance than methods which is only based on the vibration magnitude.

Table 13: Acceptable Vibration Dose Values for Intermittent Vibration (m/s1.75)

Location	Daytime (7:00am to 10:00pm)		Night-time (10:00pm to 7:00am)	
	Preferred value	Maximum value	Preferred value	Maximum value
Residences	0.20	0.40	0.13	0.26
Offices, schools, educational institutions and place of worship	0.40	0.80	0.40	0.80

4.5.2 Structural Damage – Vibration Criteria

Ground vibration criteria are defined in terms of levels of vibration emission from construction activities which will avoid the risk of damaging surrounding buildings or structures. It should be noted that human comfort criteria are normally expressed in terms of acceleration whereas structural damage criteria are normally expressed in terms of velocity.

Most commonly specified structural vibration levels are defined to minimize the risk of cosmetic surface cracks and are set below the levels that have the potential to cause damage to the main structure. Structural damage criteria are presented in German Standard DIN4150-Part 3 “Structural vibration in buildings – Effects on structures” and British Standard BS7385-Part 2: 1993 “Evaluation and Measurement for Vibration in Buildings”. Table 14 indicates the vibration limits presented in DIN4150-Part 3 to ensure structural damage doesn’t occur.

Table 14: Guideline value of vibration velocity, vi, for evaluating the effects of short-term vibration

Line	Type of Structure	Vibration velocity, vi, in mm/s			
		Foundation			Plane of floor of uppermost full storey
		At a frequency of			
		Less than 10Hz	10 to 50Hz	50 to 100*Hz	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 lines 1 and 2 and are of great intrinsic value (e.g. buildings that are under a preservation order)	3	3 to 8	8 to 10	8

*For frequencies above 100Hz, at least the values specified in this column shall be applied

Table 15 presents guide values for building vibration, based on the lowest vibration levels above which cosmetic damage has been demonstrated as per BS7385-Part 2:1993.

Table 15: Transient vibration guide values for cosmetic damage.

Type of Building	Peak Particle Velocity in frequency range of predominant pulse (PPV)	
	4 Hz to 15 Hz	15 Hz and above
Residential or light commercial type buildings	15mm/s at 4Hz increasing to 20mm/s at 15Hz	20mm/s at 15Hz increasing to 50mm/s at 40Hz and above

4.5.3 Vibration Objectives

Table 16 indicates the vibration criteria for the nearest residential and commercial properties to the development.

Table 16: Construction vibration criteria summary.

Location	Period	Human Comfort Vibration Objectives			Building damage Objectives – Velocity (mm/s)
		Continuous mm/s^2 (RMS)		Intermittent m/s$^{1.75}$ (VDV)	
		z-axis	x- and y-axis		
Residential	Daytime	10 - 20	7 - 14	0.20 - 0.40	5
	Night time	7 - 14	5 - 10	0.13 - 0.26	5
Commercial	Any time	20 - 40	14 - 28	0.40 – 0.80	20

5 Operational Noise Assessment

5.1 Mechanical Noise Emissions

There is no confirmed mechanical plant selection or layout at this stage of development. However, it is Stantec's opinion that with appropriate unit selection, considerate mechanical layout and standard acoustic treatments, mechanical noise emissions will be in compliance with the criteria established in Section 4.2.

Section 5.1.1 below presents general acoustic mitigation measures as guidance for the mechanical services design. A more detailed mechanical assessment will be conducted during the detailed design Stage once documentation of the mechanical design is available for review including unit selections and the mechanical plant layout.

5.1.1 General Mechanical Equipment – Noise Mitigation Measures

Noise generation by mechanical equipment in association with the proposed development is to be managed to ensure external noise emissions are not intrusive and do not impact the amenity of the nearest sensitive receivers.

At this stage, selections for mechanical equipment have not been made; therefore it is not possible to undertake a detailed assessment of the noise emissions generated by mechanical plant. Nevertheless, to meet the external noise emissions requirements for noise generated by the mechanical plant and equipment the following are some typical practices to mitigate noise from operation of mechanical plant and equipment on rooftop plantrooms.

- Where possible, locate plant as far away from possible noise sensitive receivers as practical to minimise the aggregate noise level.
- Select low noise mechanical equipment.
- Acoustic louvres or solid barriers may be required, surrounding plant items on the rooftop. This mitigation will likely be driven by internal noise criteria within the residential spaces of the proposed development.
- Where possible, locate noisy plant within an enclosed plant space.
- Carpark exhaust is to be included in the mechanical assessment. Carpark exhaust fans are typically located in a plant room in a basement allowing for sufficient ductwork to allow for acoustic internal lining or an attenuator for supply and exhaust to meet environmental noise criteria.

A detailed acoustic assessment of the mechanical plant noise is recommended prior to Construction Certificate to ensure no adverse noise impacts from external mechanical plant in accordance with the criteria outlined in Section 4.2.

5.2 Gymnasium/Hall Operation

In this project, there is a gymnasium/hall space that is located inside of Building, I as shown in the red box in Figure 4. From the architectural drawings, it is forecasted that the activities that will be held in this space are sports activities and hall events.

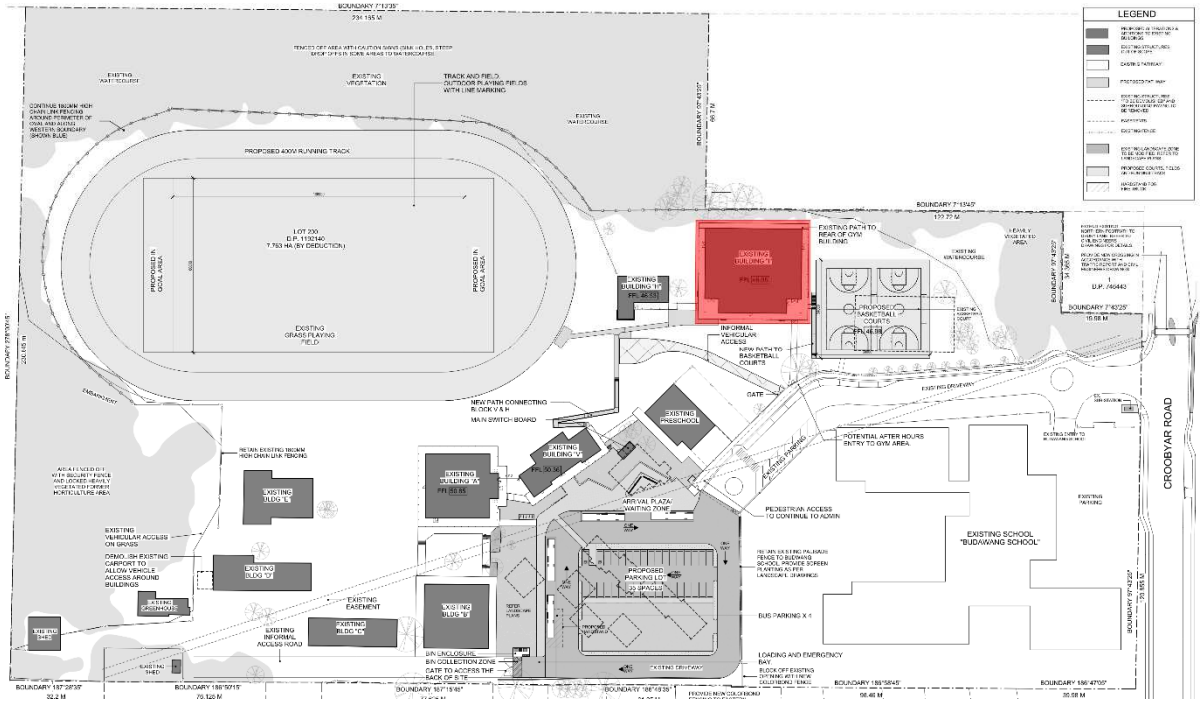


Figure 4: The location of Gymnasium/Hall in Building I in the development site.

A noise assessment has been conducted based on operation of event that will be holding in this space. The following assumptions had been made for the assessment:

- The area of the gymnasium/hall is: 626m2
- Number of occupants in the gymnasium/halls with assumptions of 2m^2 of each occupant
    - Expected number of occupants: 313 occupants
- 50% of the occupants are talking at a time using a raised voice
- The sound power level of male, female and children speaking with raised voice had been assumed as per Table 17 in the assessment
- Noise source of male, female and children were evenly distributed inside hall
- The external façade that meets the minimum performance of R_w50.
- Reverberant noise level inside the hall shall not exceed 80dB(A)
- Two scenarios of assessment:
    - All doors open for ventilation
    - All door closed
- The nearest residential receiver that had been considered for this assessment is NCA1. The other residential receivers are located far away from this proposed gymnasium/hall. Therefore, a significant amount of attenuation is predicted, and the compliance will be achieved.
- Evening (6pm - 10pm) criteria are the stringent criteria. This is due to the operation of the gymnasium/hall will not be expected to be operating at night.

Table 17: Sound Power Levels (L_W) of Noise Sources in Proposed Gymnasium/Halls.

Item	Frequency (Hz) dB								Overall dB(A)
	63	125	250	500	1000	2000	4000	8000	
1 Male raised voice	-	66	70	75	69	65	60	55	75
1 Female raised voice	-	47	66	71	69	65	60	55	73
1 Child raised voice	-	43	67	72	71	67	63	59	75
Music Noise	84	88	90	90	90	85	85	84	94

The predicted noise level at the nearest residential receiver NCA1 will be as shown as below:

Table 18: Predicted Noise Level Contribution from the Gymnasium of Building I.

Assessment Scenario	Predicted Noise Level $L_{Aeq,15mins}$,dB(A)	Evening Criteria dB(A)	Compliance (✓/✖)
Scenario 1: All Door Open for Ventilation	38	≤ 38	✓
Scenario 2: All Door Closed	< 30	≤ 38	✓

From the assessment above, the events can be happening inside this hall during the day and evening time and the operational noise emission from this hall to the nearest residential receiver (NCA1) will comply with door open and door closed. If the event need to be held at night, it is highly recommended to close all doors to ensure the compliance to the nearest receivers.

5.3 Basketball Court

In this project, there are two proposed basketball courts that is located next to Building I, as shown in the green box in Figure 5. A noise assessment has been conducted to the nearest residential receivers located west side of the basketball court, which is categorised as NCA1. The typical overall noise level emitted from the basketball court is as shown in Table 19.

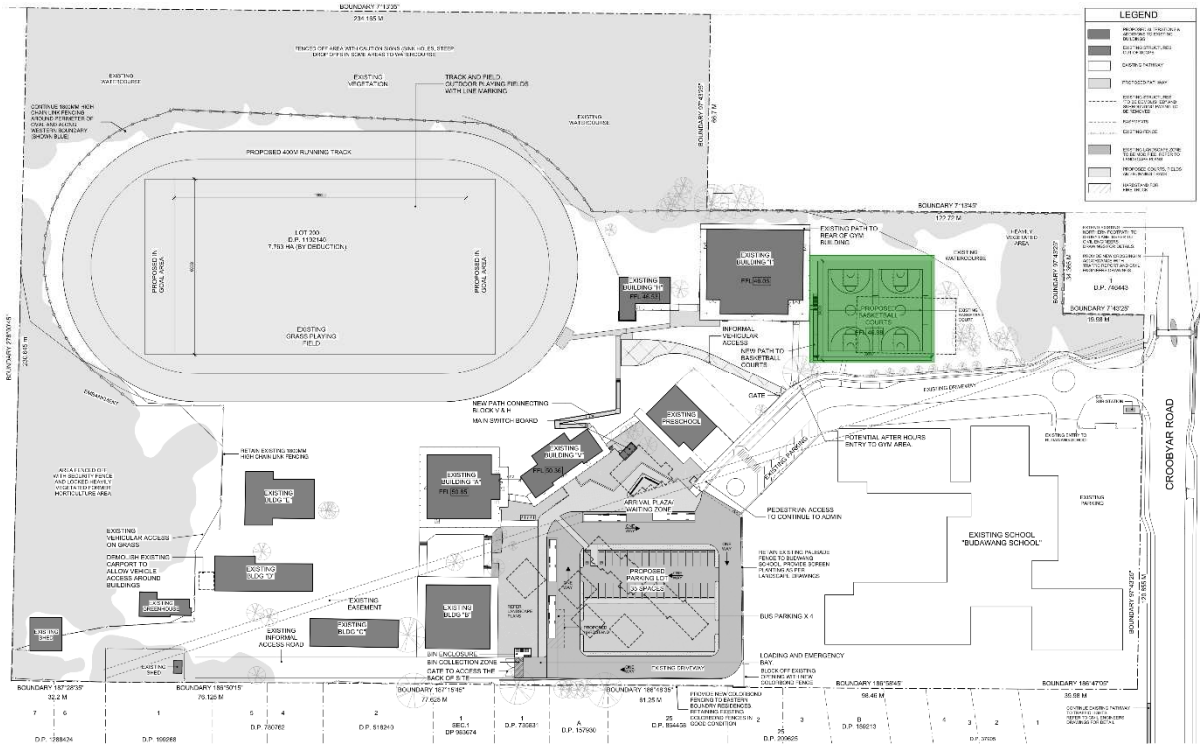


Figure 5: The location of the proposed Basketball Court in the development site.

Table 19: Typical noise sources of the Basketball Games.

Source	Type	Height	Measurement Distance	Measured SPL L_{Aeq} (dBA)	Descriptions
Basketball games	Area sources	1.5m	10m	70	Measured noise from basketball games approximately 10m from the edge of the court
Shooting of ball	Point source	3m	10m	50	Noise from impact of ball against the backboard and the hoop.
Basketball games	Area sources	1.5m	10m	72	Typical noise from basketball games with frequent whistle blowing

The predicted noise level contribution at the nearest residential receiver NCA1, will be as shown in Table 20.

Table 20: Predicted Noise Level Contribution from the Basketball Court to NCA1 without acoustic mitigation.

Time	Predicted Noise Level Contribution to the NCA1, $L_{Aeq,15mins}$ – dB(A)
Day[1] (7:00am to 6:00pm)	53

Note: 1. Since the proposed basketball courts will be used by the schools, it is expected that they will only operate during daytime

In the absence of specific noise emission criteria for outdoor sports areas within school grounds, Stantec has applied the noise guidelines provided by the EPA for local government to assess whether sports-related noise at the receiver could be considered offensive.

To determine if noise from outdoor play may be regarded as a nuisance at nearby residential receivers, an Offensive Noise Test was conducted in accordance with the NSW Noise Guideline for Local Government. Table 21 below provides comments on each checklist item of the test."

Table 21: NSW Noise Guideline for Local Government Offensive Noise Checklist

Question	Stantec Comment
Q1: Is the noise loud in an absolute sense? Is it loud relative to other noise in the area?	**No** - The noise from the use of the basketball court is not expected to be any louder than typical school children in play areas.
Q2: Does the noise include characteristics that make it particularly irritating?	**No** - Play areas are not considered to generate characteristics that are particularly irritating when assessed against the modifying factors in the NPI.
Q3: Does the noise occur at times when people expect to enjoy peace and quiet?	**No** - Noise from sports activities will occur during the day period only.
Q4: Is the noise atypical for the area?	**No** – An existing childcare facility is located within the development site. Additionally, there is an outdoor sports court within the Budawang School, which is situated in NCA 03.
Q5: Does the noise occur often?	**No** – Play noise will occur during weekdays, during limited daytime hours
Q6: Are a number of people affected by the noise?	**Yes** – Noise from sports play activities will be experienced by the nearest bordering residential properties at limited levels.

Based on the above assessment, outdoor sports area is not expected to generate offensive noise to the surrounding environment, with limited impact on the one nearest residential receiver to the west of the proposed activity.

5.4 Proposed Carpark

In this redevelopment, there will be a new carpark that will be built. It is expected that this carpark will be in operation during the daytime and evening time only. Therefore, the Sleep Disturbance assessment will not be conducted for this new proposed carpark as it will not be used during nighttime.

5.5 Road Traffic Noise Generation

A traffic generation noise assessment has been undertaken to determine the potential noise impacts of additional traffic generated by the proposed development. The existing and expected AM/PM peak-hour trips have been based on information provided by the Transport Engineering Team at SCT Consulting.

Based on the assessment, the maximum site capacity is confirmed to be 197 people (184 students and 13 staff). All staff and students will travel from their original schools to the site by bus. To accommodate 197 people, four buses are required. For the worst-case scenario, it is assumed that there will be both morning and afternoon sessions, resulting in an additional eight bus trips in each peak period (including inbound and outbound traffic). Although it is unlikely that the site will be fully occupied for most of the year, this assumption reflects a worst-case scenario on back-to-back booking days. In the acoustic assessment, each bus has been assumed to generate double the sound power level of a light vehicle.

Given the low number of vehicle trips during peak hours and the existing conditions, the level of noise from traffic generated by the proposed redevelopment is expected to be minimal (≤2 dB), as presented in Section 4.3. It is not anticipated to cause any discernible or adverse noise impacts to the nearest noise-sensitive receivers and complies with the criteria outlined in the NSW Road Noise Policy.

6 Construction Noise & Vibration Impact Assessment

6.1 Overview

A detailed construction program is not yet fully defined. This section provides general recommendations only and provides applicable criteria together with feasible and reasonable noise and vibration control practices to be observed during the construction of the proposed activity.

This preliminary advice provided within this assessment shall form the basis for the Contractor's detailed Construction Noise and Vibration Management Plan (CNVMP) which shall identify any noise criteria exceedances and relevant mitigation measures once construction methods are known.

6.2 Proposed Construction Hours

The proposed construction hours are as follows:

- Monday to Friday: 7:00am to 6:00pm
- Saturday: 8:00am to 1:00pm
- Sunday and public holidays: No work

6.3 Construction Noise Assessment

A preliminary construction noise assessment has been carried out based on typical plants and machinery expected throughout the construction stages. The preliminary noise assessment has been considered at the surrounding noise-sensitive receivers as identified in Figure 2. For this assessment, the construction equipment is located and distributed in the middle of the site. The average-case scenario is the typical time usage for each piece of construction equipment, and the worst-case scenario is the longer time usage of the equipment.

Note that a more detailed assessment needs to be carried out for the construction noise assessment after the Construction Management Plan has been developed as the design stage progresses.

6.3.1 Expected Construction Equipment

The noise sources likely to be associated with the works listed in the previous section of this report are presented in Table 22. The equipment noise levels have been extracted from *AS 2436:2010* Guide to *Noise and Vibration Control on Construction, Demolition and Maintenance Sites.*

Table 22: Cumulative impact - Construction equipment noise levels.

Stages	Equipment	Sound Power Level, dB(A)	Average Case		Worst Case	
			Quantity	Usage in 15-minute period	Quantity	Usage in 15-minute period
Site Establishment	Excavator (8 tonnes) with bucket attachment	116	1	5 minutes	1	8 minutes
	20 tonnes Truck	104	1	5 minutes	1	8 minutes
	Mobile Crane (55 tonnes)	108	1	5 minutes	1	8 minutes
	Electrical Hand Tools	99	3	8 minutes	3	10 minutes
	Hammer Drill	104	1	8 minutes	1	10 minutes
	Circular Saw	112	1	8 minutes	1	10 minutes
Demolition	Excavator (5 – 20 tonnes) with rock breaker	116	1	5 minutes	1	8 minutes
	Jackhammer	110	1	3 minutes	1	5 minutes
	Bobcat	110	1	3 minutes	1	5 minutes
	Delivery Truck	105	1	5 minutes	1	8 minutes
	Electrical Hand Tools	99	5	5 minutes	5	8 minutes
	Demolition Saw	119	1	3 minutes	1	6 minutes
Structure	Electrical Hand Tools	99	5	8 minutes	5	10 minutes
	Concrete Pump	110	1	8 minutes	1	10 minutes
	Mobile Crane	108	1	5 minutes	1	8 minutes
	20 tonnes Truck	104	1	8 minutes	1	10 minutes
	Concrete Mixer Truck	109	1	5 minutes	1	8 minutes
	Grinder	101	2	5 minutes	2	8 minutes
Fitout Installation	Mobile Crane	108	1	5 minutes	1	8 minutes
	Grinder	101	1	5 minutes	1	8 minutes

Stages	Equipment	Sound Power Level, dB(A)	Average Case		Worst Case	
			Quantity	Usage in 15-minute period	Quantity	Usage in 15-minute period
	Electrical Hand Tools	99	3	8 minutes	3	10 minutes
	Hammer Drill	104	1	5 minutes	1	8 minutes
	Skip Truck	111	1	5 minutes	1	8 minutes

6.3.2 Predicted Noise Levels

The predicted noise levels have been presented in Table 23, Table 24, Table 25 and Table 26 and have been assessed against the construction noise criteria established in Section 4.4.

Table 23: Predicted noise levels – Site Establishment

Receiver	Predicted Noise Level without Any Acoustic Mitigation $L_{Aeq,15min}$		Predicted Noise Level with Acoustic Mitigation[2] $L_{Aeq,15min}$		Noise Management Level[1] $L_{Aeq,15min}$ dB	Noise Management Level Exceedance[3] (dB)		Complies with Highly Noise Affected Criteria[2] (≤ 75dB(A))	
	Average Case	Worst Case	Average Case	Worst Case		Average Case	Worst Case	Average Case	Worst Case
NCA1	73	74	65	66	47	18	19	✓	✓
NCA2	64	65	56	57	47	9	10	✓	✓
NCA3	69	70	61	62	47	14	15	✓	✓
NCA4	68	69	60	61	47	13	14	N/A	N/A

Note:

1. Noise Management Level = RBL +10dB
2. The predicted noise level at the receivers with the presence of the 2.4m hoarding around the development site.
3. The Noise Management Level Exceedance from the Predicted Noise Level at the receivers with the presence of the 2.4m hoarding around the development site.

Table 24: Predicted noise levels – Demolition

Receiver	Predicted Noise Level without Any Acoustic Mitigation $L_{Aeq,15min}$		Predicted Noise Level with Acoustic Mitigation[2] $L_{Aeq,15min}$		Noise Management Level[1] $L_{Aeq,15min}$ dB	Noise Management Level Exceedance[3] (dB)		Complies with Highly Noise Affected Criteria[2] (≤ 75dB(A))	
	Average Case	Worst Case	Average Case	Worst Case		Average Case	Worst Case	Average Case	Worst Case
NCA1	76	78	68	70	47	21	23	✓	✓
NCA2	69	70	60	62	47	13	15	✓	✓
NCA3	73	75	65	67	47	18	20	✓	✓
NCA4	72	75	64	67	47	17	20	N/A	N/A

Note:

1. Noise Management Level = RBL +10dB
2. The predicted noise level at the receivers with the presence of the 2.4m hoarding around the development site.
3. The Noise Management Level Exceedance from the Predicted Noise Level at the receivers with the presence of the 2.4m hoarding around the development site.

Table 25: Predicted noise levels – Structure

Receiver	Predicted Noise Level without Any Acoustic Mitigation $L_{Aeq,15min}$		Predicted Noise Level with Acoustic Mitigation[2] $L_{Aeq,15min}$		Noise Management Level[1] $L_{Aeq,15min}$ dB	Noise Management Level Exceedance[3] (dB)		Complies with Highly Noise Affected Criteria[2] (≤ 75dB(A))	
	Average Case	Worst Case	Average Case	Worst Case		Average Case	Worst Case	Average Case	Worst Case
NCA1	73	74	65	66	47	18	19	✓	✓
NCA2	64	65	56	57	47	9	10	✓	✓
NCA3	66	70	58	62	47	11	15	✓	✓
NCA4	66	70	58	61	47	11	14	N/A	N/A

Note:

1. Noise Management Level = RBL +10dB
2. The predicted noise level at the receivers with the presence of the 2.4m hoarding around the development site.
3. The Noise Management Level Exceedance from the Predicted Noise Level at the receivers with the presence of the 2.4m hoarding around the development site.

Table 26: Predicted noise levels – Fitout

Receiver	Predicted Noise Level without Any Acoustic Mitigation $L_{Aeq,15min}$		Predicted Noise Level with Acoustic Mitigation[2] $L_{Aeq,15min}$		Noise Management Level[1] $L_{Aeq,15min}$ dB	Noise Management Level Exceedance[3] (dB)		Complies with Highly Noise Affected Criteria[2] (≤ 75dB(A))	
	Average Case	Worst Case	Average Case	Worst Case		Average Case	Worst Case	Average Case	Worst Case
NCA1	51	52	43	44	47	-	-	✓	✓
NCA2	41	43	33	35	47	-	-	✓	✓
NCA3	49	50	40	42	47	-	-	✓	✓
NCA4	46	48	38	40	47	-	-	N/A	N/A

Note:

1. Noise Management Level = RBL +10dB
2. The predicted noise level at the receivers with the presence of the 2.4m hoarding around the development site.
3. The Noise Management Level Exceedance from the Predicted Noise Level at the receivers with the presence of the 2.4m hoarding around the development site.

Based on the predicted noise level above, it is highly recommended to implement acoustic mitigation, such as installing a hoarding with 2.4m high around the development site, to help in attenuating construction noise to the nearest sensitive receivers. More acoustic mitigation regarding the construction noise is detailed in Section 6.4. A more detailed assessment needs to be undertaken as part of CNVMP for more details as the design progresses.

6.4 General Acoustic Recommendations for Construction

According to AS 2436 – 2010 “Guide to noise and vibration control on construction, demolition and maintenance sites” the following techniques could be applied to minimize the spread of noise and vibrations to the potential receivers.

6.4.1 Noise

If a process that generates significant noise levels cannot be avoided, the amount of noise reaching the receiver should be minimized. Two ways of achieving this are to either increase the distance between the noise source and the receiver or to introduce noise reduction measures such as screens.

Physical methods to reduce the transmission of noise between the site works and residences, or other sensitive land uses, are generally suited to works where there is longer-term exposure to the noise. Practices that will reduce noise from the site include:

- Increasing the distance between noise sources and sensitive receivers.
- Reducing the line-of-sight noise transmission to residences or other sensitive land uses using temporary barriers (stockpiles, shipping containers and site office transportable can be effective barriers).
- Installing purpose-built noise barriers, acoustic sheds and enclosures.

6.4.2 Screening

On sites where distance is limited, the screening of noise may be beneficial, and this should be taken into account during the planning stages.

If structures such as stores, site offices and other temporary buildings are situated between the noisiest part of the site and the nearest dwellings, some of the noise emission from the site can be reduced. If these buildings are occupied, sound insulation measures may be necessary to protect workers inside the buildings.

A hoarding that includes a site office on an elevated structure offers superior noise reduction when compared with a standard (simple) hoarding. The acoustic performance is further enhanced when the hoarding is a continuous barrier.

Storage of building materials or the placement of shipping containers between the noise source and any noise-sensitive area may also provide useful screening and the same is true of partially completed or demolished buildings. A noisy, stationary plant can be placed in a basement, the shell of which has been completed, provided reverberant noise can be controlled. Where compressors or generators are used in closed areas, it is necessary to ensure that the exhaust gases are discharged directly to the outside air and that there is good cross-ventilation to prevent the build-up of poisonous carbon monoxide fumes and to allow an adequate air supply to maintain efficiency when operating the equipment.

Where such noise barriers are not practical, a worthwhile reduction in noise can be obtained by siting the plant behind and as close as possible to mounds of earth, which may effectively screen any noise-sensitive areas from the plant. These can often be designed into the construction schedule or site arrangement for future landscaping.

Water pumps, fans and other plant equipment that operate on a 24-hour basis may not be an irritating source of noise during the day but may be problematic at night. They should therefore be effectively screened by either situating them behind a noise barrier or by being positioned in a trench or a hollow in the ground provided this does not generate reverberant noise. In such cases, however, adequate

ventilation should also be ensured. Long, temporary earth embankments can provide quite an effective noise screen for mobile equipment moving, for example, on a haulage road. When the earthworks are complete, the earth mounds should be removed if possible, with smaller, quieter excavators. A noise barrier may be a more reliable method of noise control than the imposition of restrictions on throttle settings.

In many cases it may not be practical to screen earthmoving operations effectively, but it may be possible to partially shield a construction plant or to build-in at the early stages protective features required to screen traffic noise. Where earth noise barriers are not practical due to lack of space, consideration should be given to the possibility of constructing temporary screens from wood or any equivalent material in surface density.

The usefulness of a noise barrier will depend upon its length, its height, its position relative to the source and to the receiver, and the material from which it is made. A barrier designed to reduce noise from a moving source should extend beyond the last property to be protected to a distance of not less than ten times the shortest measurement from the property to the barrier. A barrier designed to reduce noise from a stationary source should, where possible, extend to a distance beyond the direct line between the noise source and the receiver to a distance equal to ten times the effective barrier height, which is the height above the direct line between source and receiver.

If the works are predominately within nominally closed structures, careful consideration should be given to reducing noise breakout at any openings.

6.4.3 Crane (diesel operated)

An appropriate silencer on the muffler and acoustic screen around the engine bay are recommended to attenuate the noise emission.

6.4.4 Reversing and warning alarms

Community complaints often involve the intrusive noise of alarms commonly used to provide a safe system of work for vehicles operating on a site. Beeper reversing alarm noise is generally tonal and may cause annoyance at significant distances from the work site.

There are alternative warning alarms capable of providing a safe system of work that are equal to or better than the traditional ‘beeper’, while also reducing environmental noise impacts. The following alternatives should be considered for use on construction sites as appropriate:

(a) Broadband audible alarms incorporating a wide range of sound frequencies (as opposed to the tonal frequency ‘beep’) are less intrusive when heard in the neighborhood.

(b) Variable-level alarms reduce the emitted noise levels by detecting the background noise level and adjusting the alarm level accordingly.

(c) Non-audible warning systems (e.g. flashing lights, reversing cameras) may also be employed, providing safety considerations, are not compromised.

(d) Proximity alarms that use sensors to determine the distance from objects, such as people or structures, and generate an audible alarm in cabin for the driver.

(e) Spotters or observers.

The above methods should be combined, where appropriate.

6.5 Construction Vibration Assessment

The vibration associated with construction is dependent on several variables including the types of machinery, the proximity to the nearby receivers as well as the ground type.

Generally speaking, vibration can be more difficult to control than noise, and there are few generalizations that can be made about its control. It should be kept in mind that vibration may cause disturbance by causing structures to vibrate and radiate noise in addition to perceptible movement. Impulsive vibration can, in some cases, provide a trigger mechanism that could result in the failure of building components that had previously been in a stable state. Regarding equipment expected to have a greater vibrational impact (i.e. hammering), multiple respite periods should be offered per day. Additionally, regular communication with the affected residents should be maintained to schedule any highly vibration inducing activities for suitable time periods.

Further to the above, generic safe working distances for vibration impacts associated with various types of machinery at given distances are presented within the *"Construction Noise Strategy "*document (issued by the Transport Infrastructure Development Corporation, dated November 2007). This document presents the safe construction working limits for Cosmetic Damage to adjacent structures and Human Comfort. It is recommended that the indicative safe working distances should be maintained from vibrating equipment which could be used during demolition and construction tasks.

The following vibration intensive plant that are assumed for the proposed activity are assessed in this Section:

- 30t Excavator - with hammer
- 30t Excavator - with bucket
- Vibratory Roller
- Jackhammer (hand held)

Indicative recommended 'Safe working' distances for the above vibration intensive plant boundaries are provided in Table 27. At distances beyond the Safe working distances, the recommended targets are unlikely to be exceeded.

Table 27: Recommended Safe Working distances for vibration intensive plant.

Plant Item	Rating / Description	Safe Working Distance (m)	
		Structural Cosmetic Damage	Human Comfort
Vibratory Roller	< 100 kN (Typically 2 – 4 tonnes)	6	20
Small hydraulic hammer	300 kg, typically 5-12 tonnes excavator	2	7
Medium hydraulic hammer	900 kg, typically 12-18 tonnes excavator	7	23
Large hydraulic hammer	1,600 kg, typically 18-34 tonnes excavator	22	73
Vibratory Pile Driver	Sheet piles	2m to 20m	20m
Pile Boring	≤ 800mm	2m (nominal)	N/A
Jackhammer	Hand held	1m (nominal)	Avoid contact with structure

At receivers within the recommended 'Safe Working' a more detailed analysis of the building structure, vibration source, dominant frequencies and dynamic characteristics of the structure is needed to determine the applicable safe vibration level. Additionally, site measurements and alternative equipment or methodologies, should be considered. This exercise would be undertaken by the contactor as part of an updated CNVMP.

6.6 Noise & Vibration Monitoring Strategy

6.6.1 General Methodology

Noise and vibration levels should be monitored from time to time to ensure that noise generated as a result of remediation and construction activities does not disturb the environment.

Monitoring may be in the form of regular checks by the builder or indirectly by an acoustic consultant engaged by the builder and in response to any noise or vibration complaints. Where noise and vibration criteria are being exceeded or in response to valid complaints, noise and / or vibration monitoring should be undertaken. This would be performed inside the premises of the affected property and on site adjacent to the affected receivers.

Monitoring is to be undertaken by an experienced noise and vibration monitoring professional or an acoustic consultant. The results of any noise or vibration monitoring are to be provided to the relevant party or person in a timely manner allowing the builder to address the issue and respond to the complaints.

Noise and vibration monitoring can take two forms:

- Short term monitoring
- Long-term monitoring

6.6.1.1 Short-term monitoring

Short-term monitoring consists of attended monitoring when critical stages of the construction are occurring. This normally provides real-time assistance and guidance to the subcontractor on site letting them know when the noise and vibration criteria are exceeded allowing the selection of alternative method on construction or equipment selection to minimise noise and vibration impacts.

6.6.1.2 Long-term monitoring

Similarly, long-term monitoring uses noise and vibration loggers providing real-time alerts to the builder / site manager when the noise and vibration criteria are exceeded.

Typically, the noise and vibration loggers stay on site for a period of several months for the critical construction stages of the activity. Sometimes the period of construction noise and vibration monitoring is dictated by the local authorities through the DA conditions.

Both methods are complementary and normally used simultaneously providing a significant amount of data via the long-term monitoring but also providing information on the sources of noise and vibration generating exceedances via the short-term or attended monitoring.

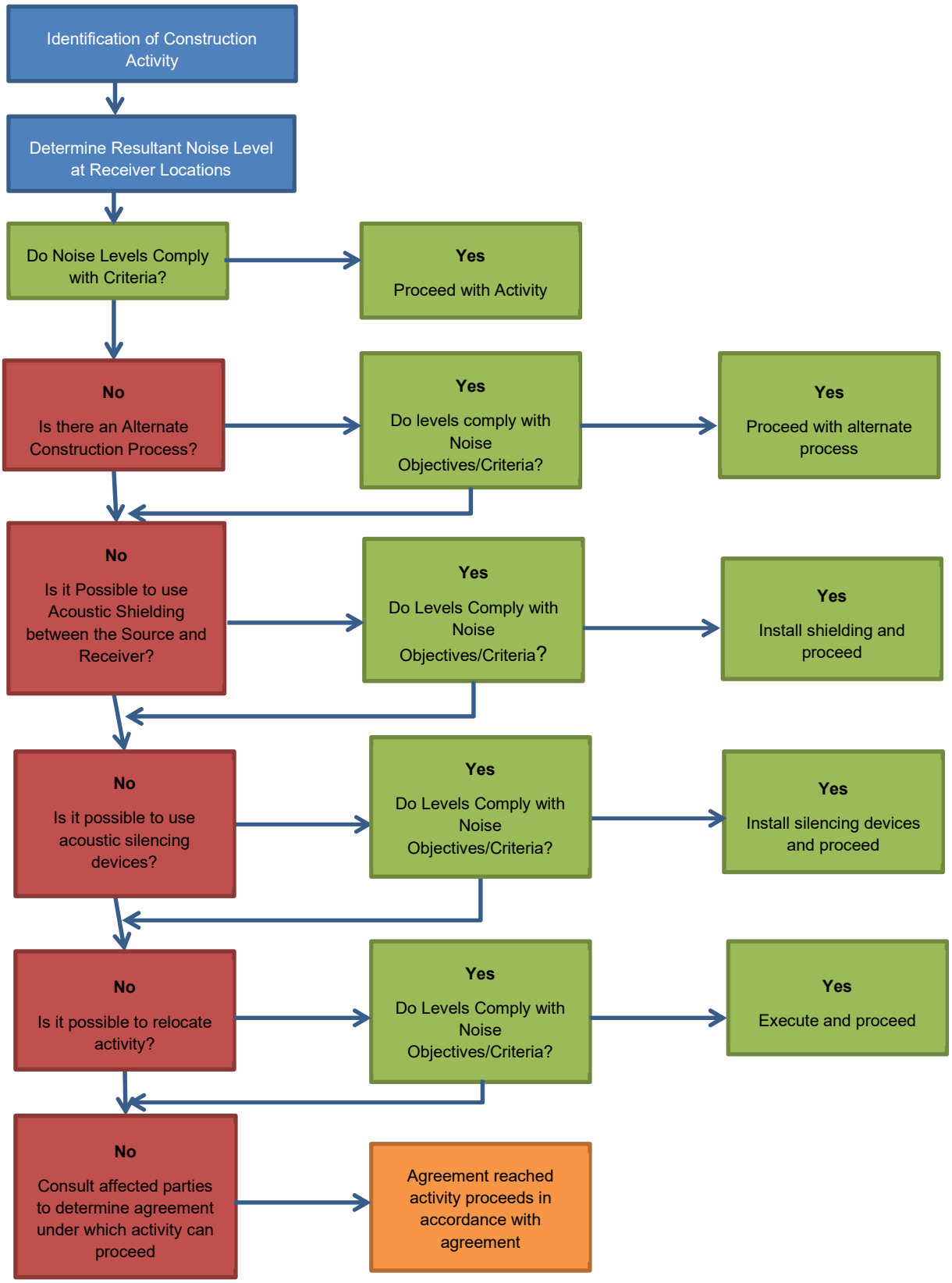


Figure 6: Noise mitigation management flow chart

7 Conclusion

An acoustic assessment for the proposed redevelopment of the Former Anglican School has been conducted. This report has provided criteria, in-principal treatment and design requirements which aim to achieve the statutory criteria discussed in Section 4. In terms of noise and vibration criteria, we have provided the following:

- Noise survey and results that identify the existing noise environment provided in Section 3
- Noise criteria for internal noise levels according to Transport and Infrastructure SEPP (2021) and EFSG-0001C, provided in Section 4.1
- Traffic noise criteria for additional vehicle movements on roads generated by the proposed activity are presented in Section 4.3
- Construction noise & vibration criteria provided in Section 4.4 and Section 4.5 .
- Noise emission from the gymnasium / hall, basketball court, and carparks, shown in Section 5.2, Section 5.3 and Section 5.4 respectively.
- Expected traffic generation noise presented in Section 5.5.
- Construction noise and vibration impact assessment and mitigation measures, presented in Section 6.

A preliminary noise assessment of the mechanical plant has been carried out as shown in Section 5.1. Based on the application of good plant selection and standard noise control methods, the noise criteria are expected to be met. A detailed assessment is recommended at a later stage, when more information is available, to ensure compliance with the outlined noise criteria.

A traffic-generation noise assessment has been undertaken to determine the potential noise impact from traffic generated by the proposed Primary School and Public Preschool developments. As outlined in Section 5.5 the expected traffic noise generated by the proposed activity is not expected to impact the nearby residential receivers meaningfully.

The noise emitted from the gymnasium/hall and carpark has been assessed in Section 5.2 and Section 5.4 respectively. Based on the data presented, the redevelopment site is expected to comply with the established noise criteria outlined in the relevant sections.

As mentioned in Section 5.3, in the absence of specific noise emission criteria for outdoor sports areas within school grounds, Stantec has applied the noise guidelines provided by the EPA for local government to assess whether sports-related noise at the receiver could be considered offensive. Based on the assessment, outdoor play is not expected to generate offensive noise to the surrounding environment, with limited impact on the one nearest residential receiver to the west of the proposed activity.

Appendices

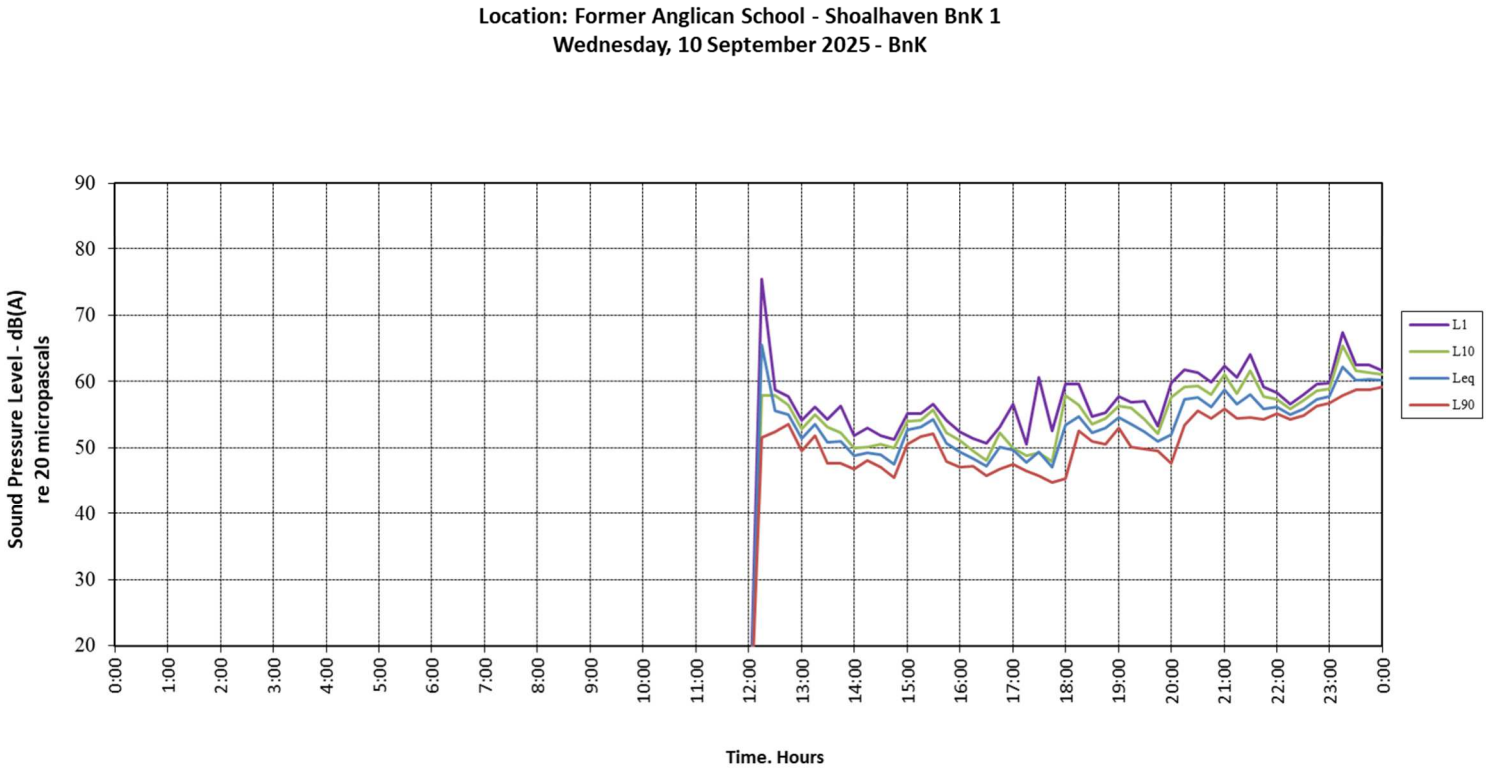
Appendix A Glossary of Acoustic Terms

Noise	
Acceptable Noise Level:	The acceptable L_{Aeq} noise level from industrial sources, recommended by the EPA (Table 2.1, INP). Note that this noise level refers to all industrial sources at the receiver location, and not only noise due to a specific project under consideration.
Adverse Weather:	Weather conditions that affect noise (wind and temperature inversions) that occur at a particular site for a significant period of time. The previous conditions are for wind occurring more than 30% of the time in any assessment period in any season and/or for temperature inversions occurring more than 30% of the nights in winter).
Acoustic Barrier:	Solid walls or partitions, solid fences, earth mounds, earth berms, buildings, etc. used to reduce noise.
Ambient Noise:	The all-encompassing noise associated within a given environment at a given time, usually composed of sound from all sources near and far.
Assessment Period:	The period in a day over which assessments are made.
Assessment Location	The position at which noise measurements are undertaken or estimated.
Background Noise:	Background noise is the term used to describe the underlying level of noise present in the ambient noise, measured in the absence of the noise under investigation, when extraneous noise is removed. It is described as the average of the minimum noise levels measured on a sound level meter and is measured statistically as the A-weighted noise level exceeded for ninety percent of a sample period. This is represented as the L_{A90} noise level.
Decibel [dB]:	The units of sound pressure level.
dB(A):	A-weighted decibels. Noise measured using the A-filter.
Extraneous Noise:	Noise resulting from activities that are not typical of the area. Atypical activities include construction, and traffic generated by holidays period and by special events such as concert or sporting events. Normal daily traffic is not considered to be extraneous.
Free Field:	An environment in which there are no acoustic reflective surfaces. Free field noise measurements are carried out outdoors at least 3.5m from any acoustic reflecting structures other than the ground
Frequency:	Frequency is synonymous to pitch. Frequency or pitch can be measured on a scale in units of Hertz (Hz).
Impulsive Noise:	Noise having a high peak of short duration or a sequence of such peaks. A sequence of impulses in rapid succession is termed repetitive impulsive noise.
Intermittent Noise:	Level that drops to the background noise level several times during the period of observation.
L_{Amax}	The maximum A-weighted sound pressure level measured over a period.
L_{Amin}	The minimum A-weighted sound pressure level measured over a period.
L_{A1}	The A-weighted sound pressure level that is exceeded for 1% of the time for which the sound is measured.

L_{A10}	The A-weighted sound pressure level that is exceeded for 10% of the time for which the sound is measured.
L_{A90}	The A-weighted level of noise exceeded for 90% of the time. The bottom 10% of the sample is the L_{A90} noise level expressed in units of dB(A).
L_{Aeq}	The A-weighted "equivalent noise level" is the summation of noise events and integrated over a selected period of time.
$L_{Aeq,T}$	The constant A-weighted sound which has the same energy as the fluctuating sound of the traffic, averaged over time T.
Reflection:	Sound wave changed in direction of propagation due to a solid object met on its path.
R_w:	The Sound Insulation Rating R_w is a measure of the noise reduction performance of the partition.
SEL:	Sound Exposure Level is the constant sound level which, if maintained for a period of 1 second would have the same acoustic energy as the measured noise event. SEL noise measurements are useful as they can be converted to obtain L_{eq} sound levels over any period of time and can be used for predicting noise at various locations.
Sound Absorption:	The ability of a material to absorb sound energy through its conversion into thermal energy.
Sound Level Meter:	An instrument consisting of a microphone, amplifier and indicating device, having a declared performance and designed to measure sound pressure levels.
Sound Pressure Level:	The level of noise, usually expressed in decibels, as measured by a standard sound level meter with a microphone.
Sound Power Level:	Ten times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power.
Tonal noise:	Containing a prominent frequency and characterised by a definite pitch.

Appendix B Unattended Noise Monitoring Graphs

Noise Logger 1



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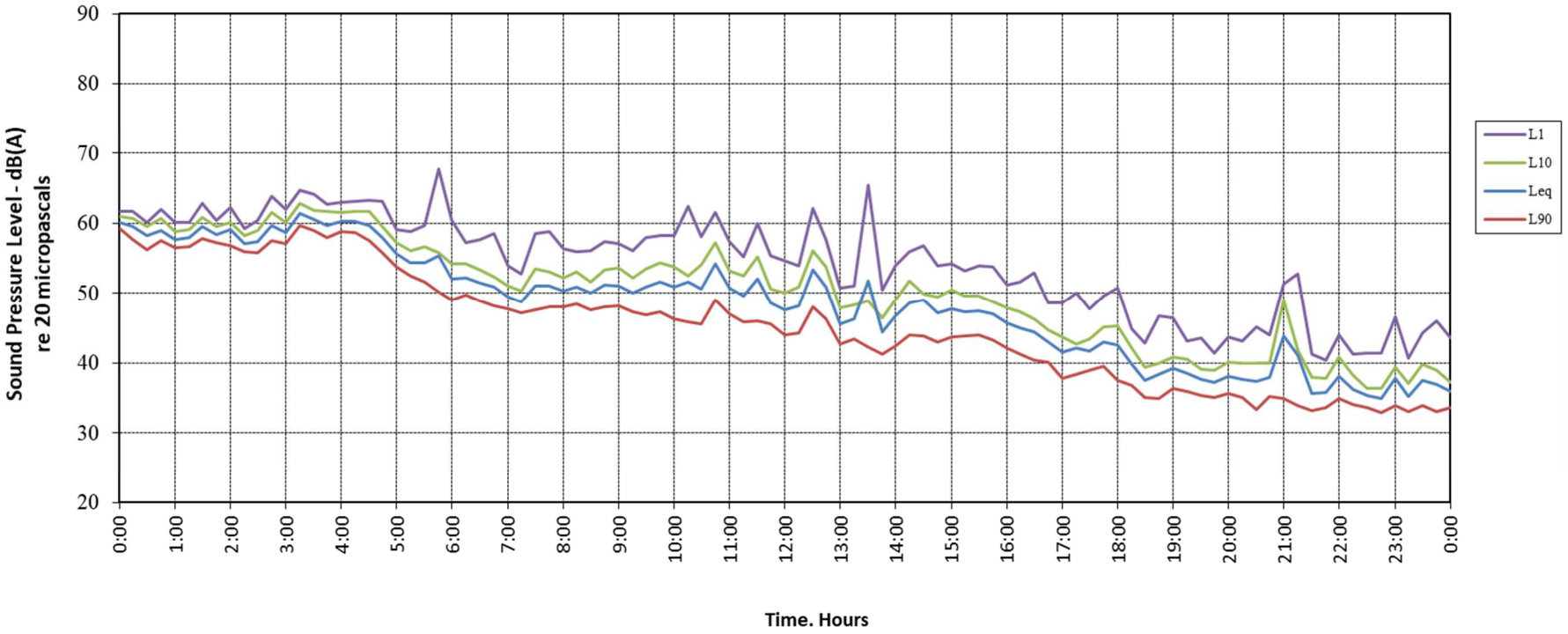

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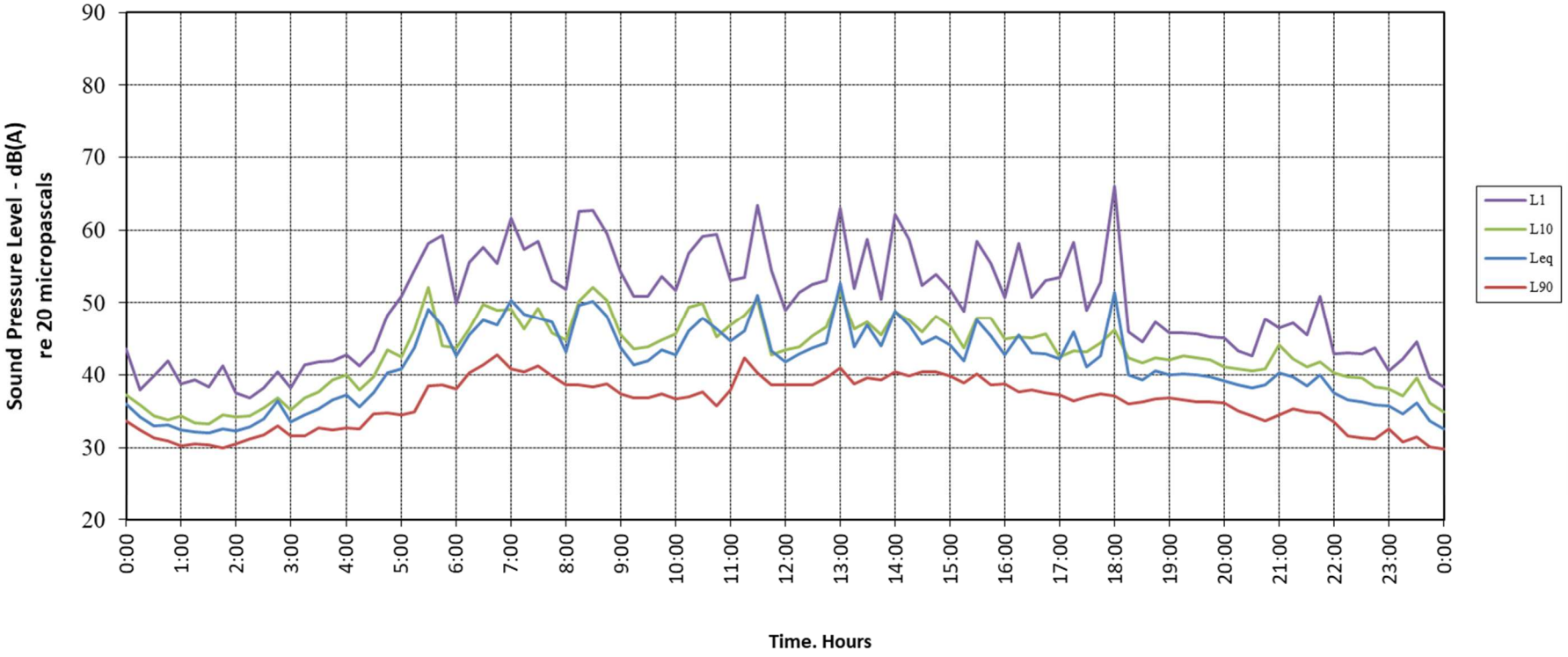
Friday, 12 September 2025 - BnK



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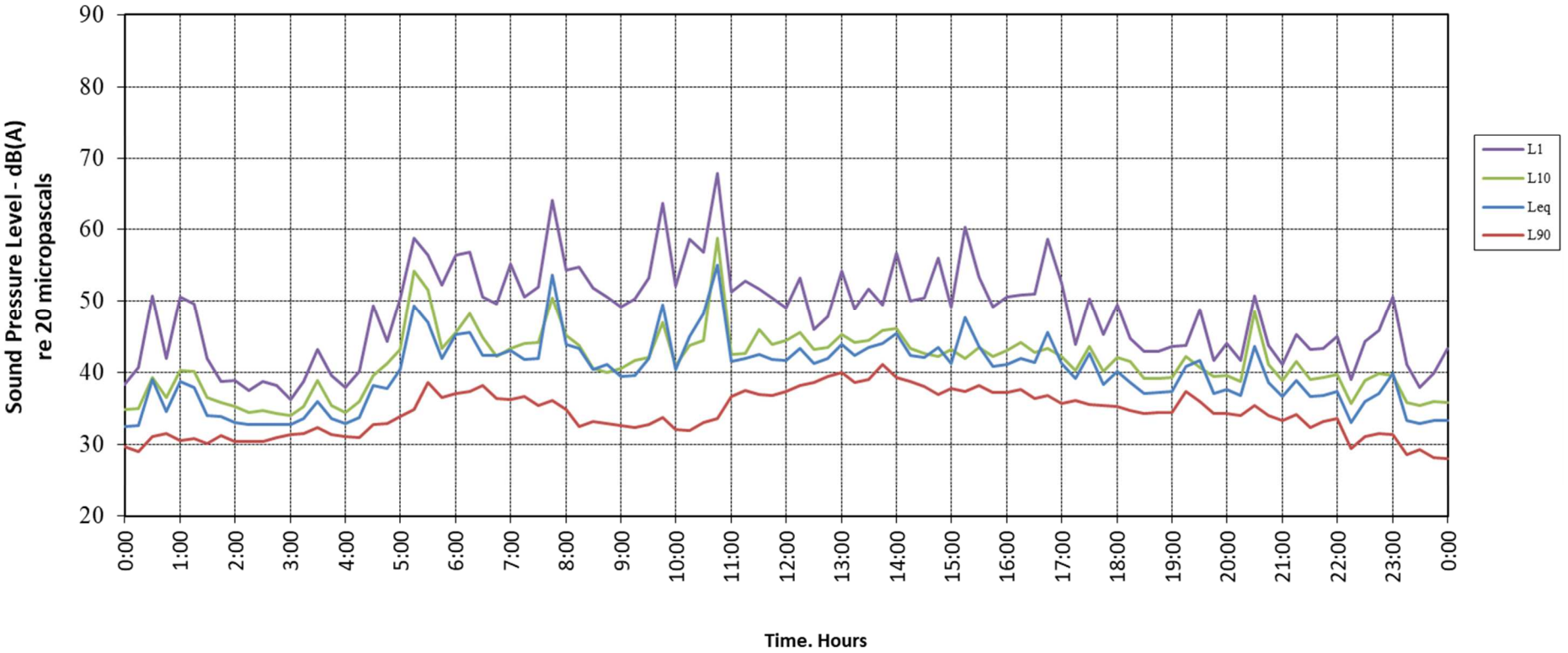

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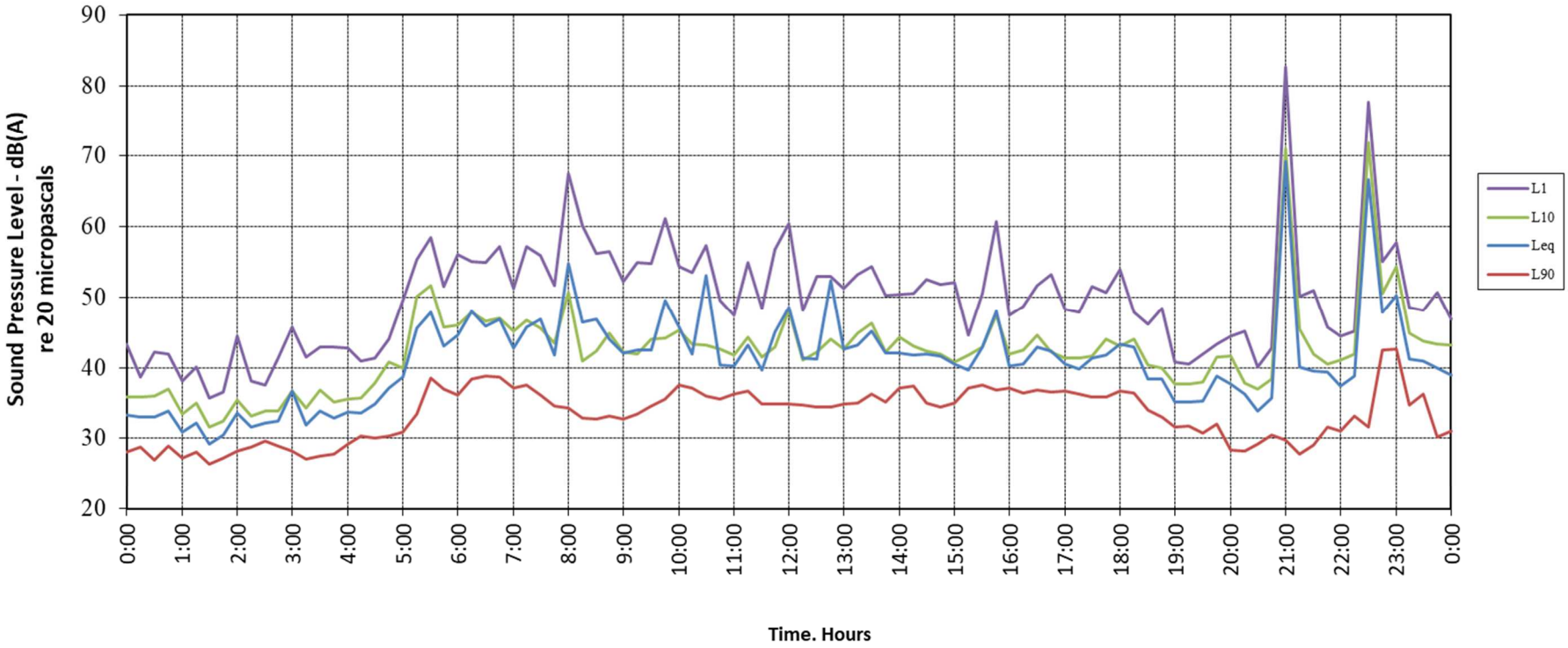
Sunday, 14 September 2025 - BnK



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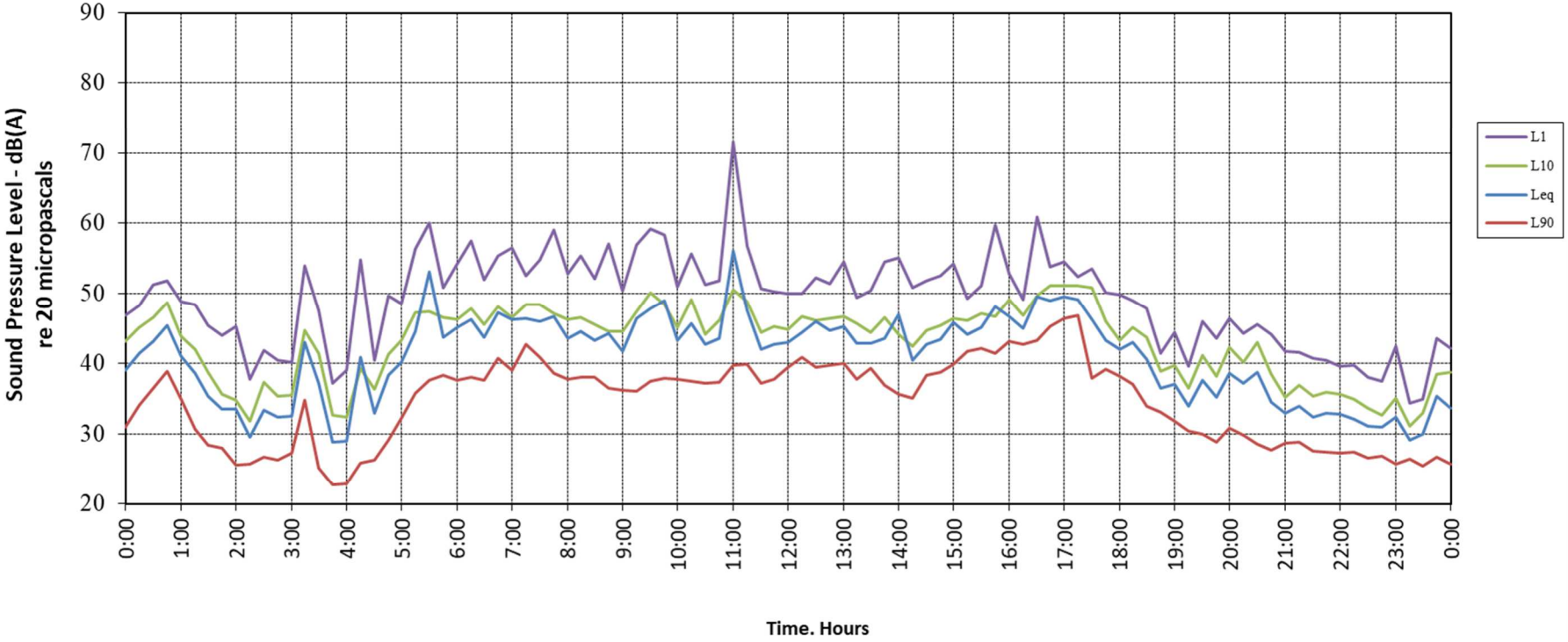

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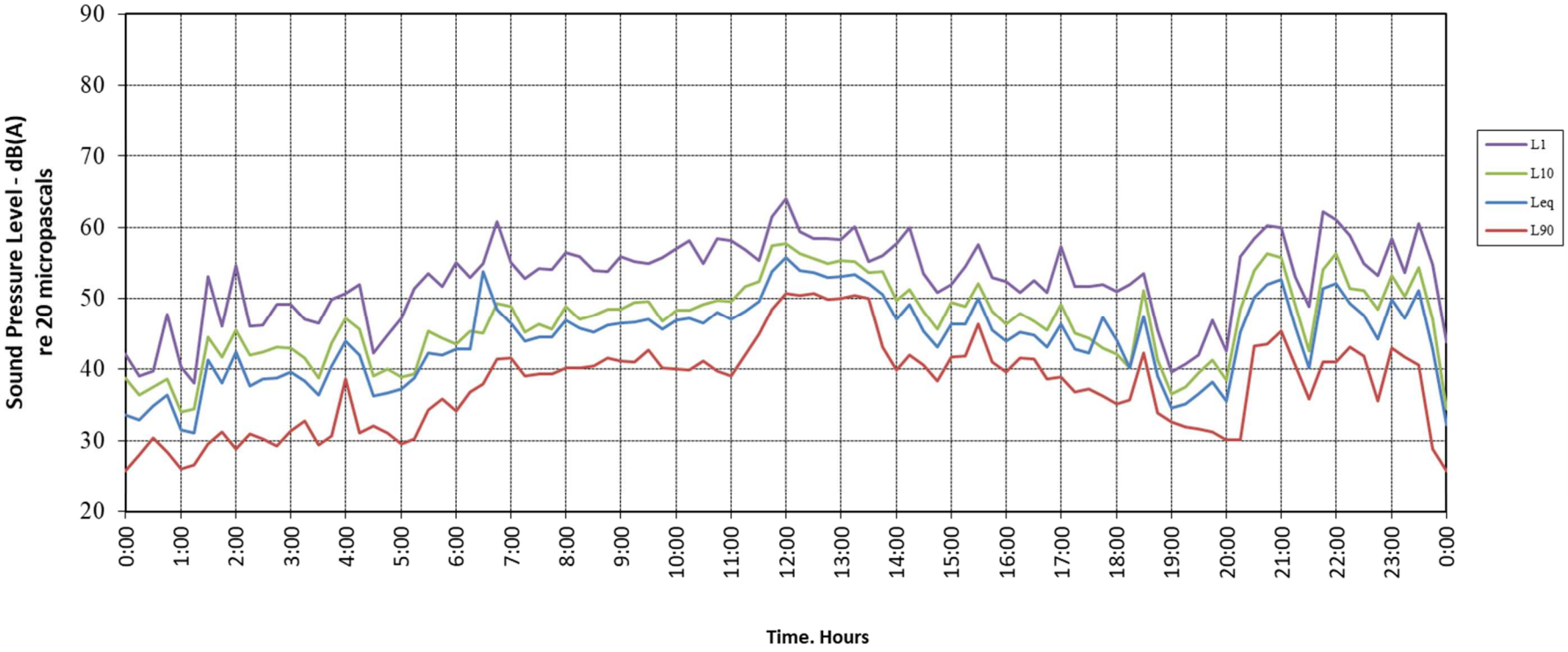

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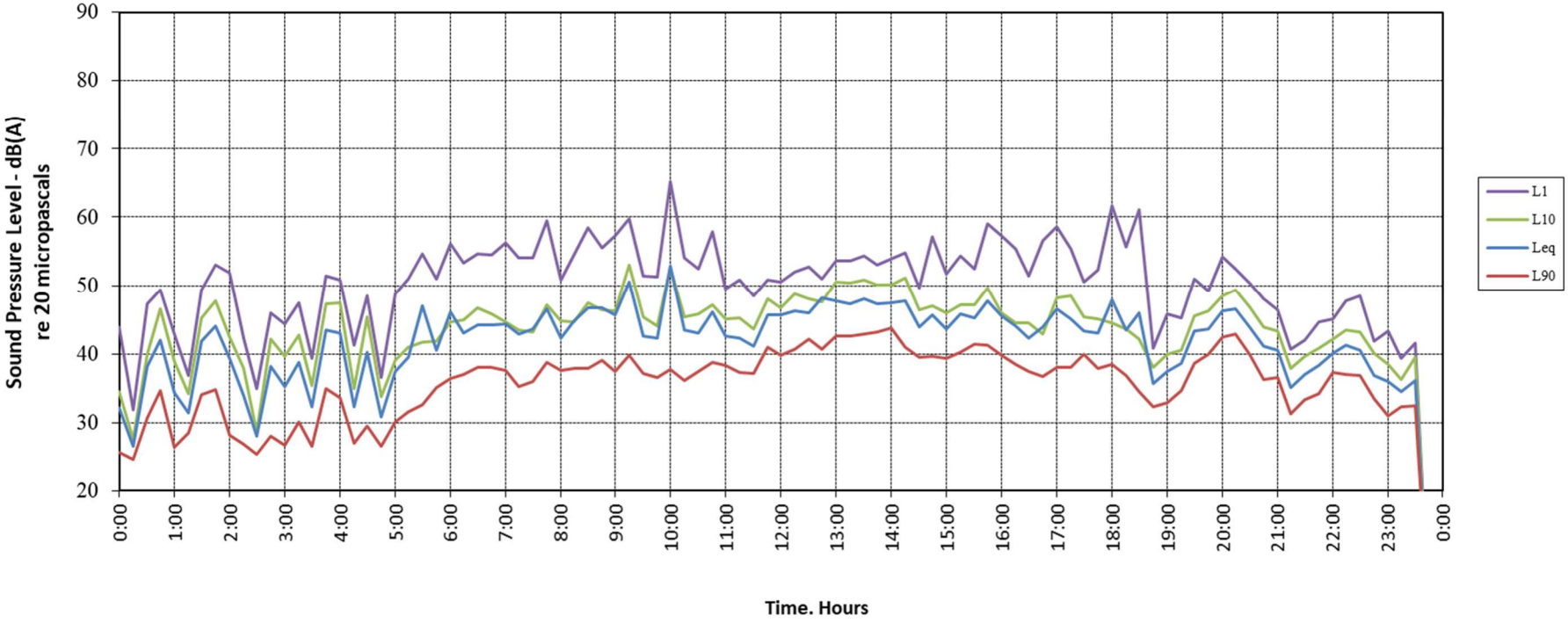

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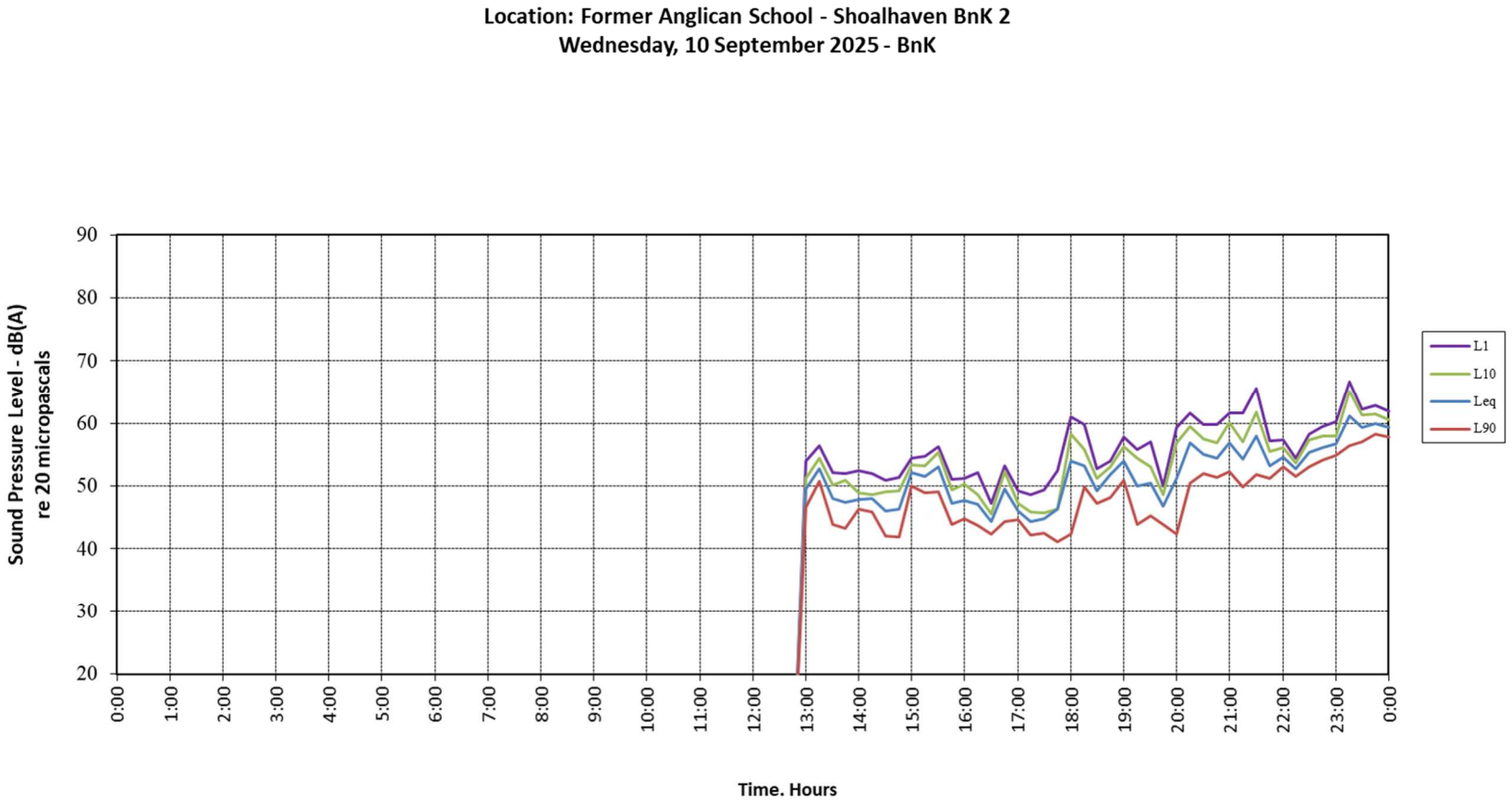

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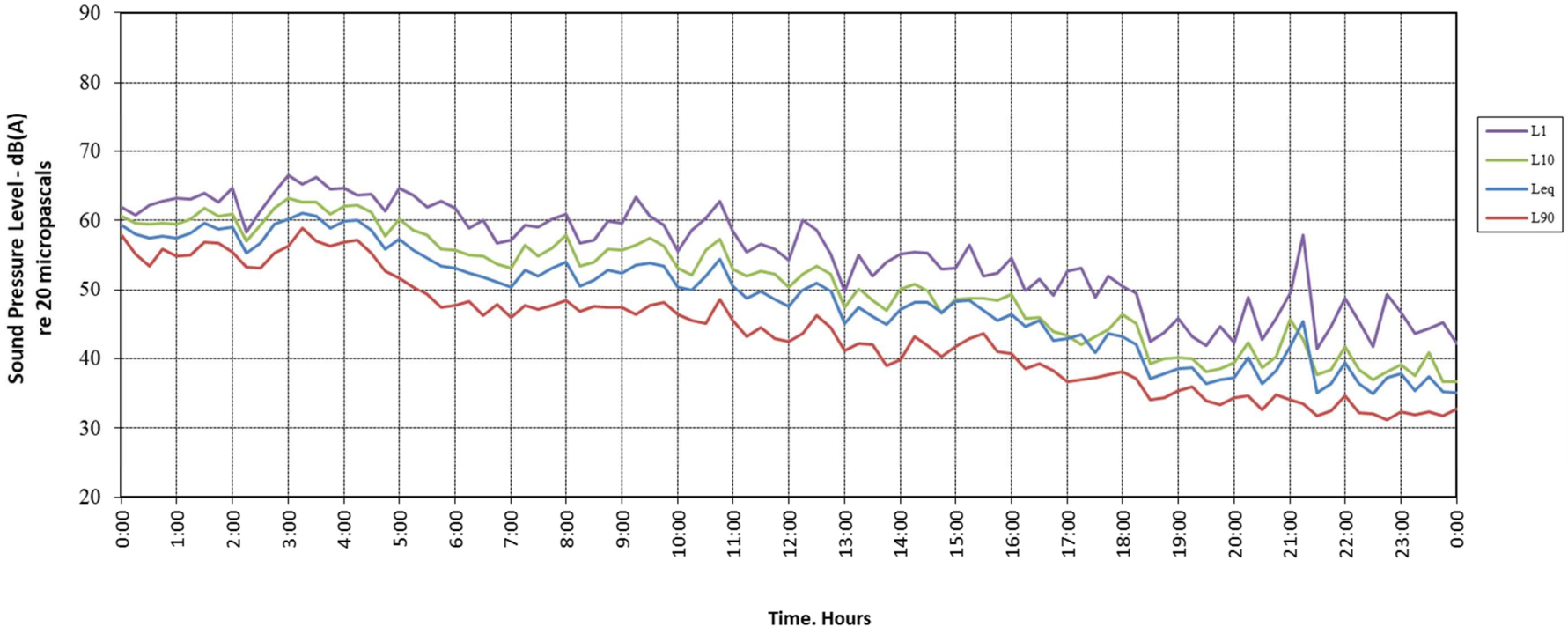

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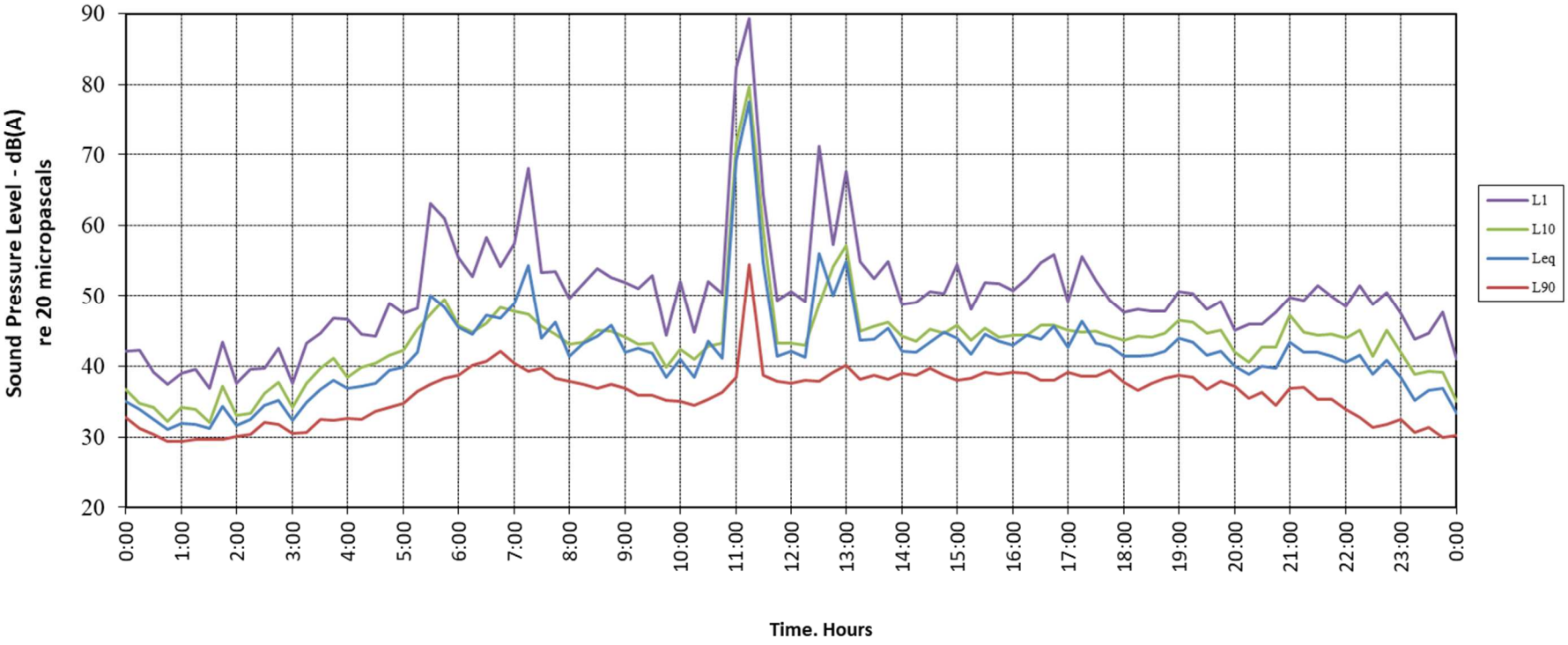

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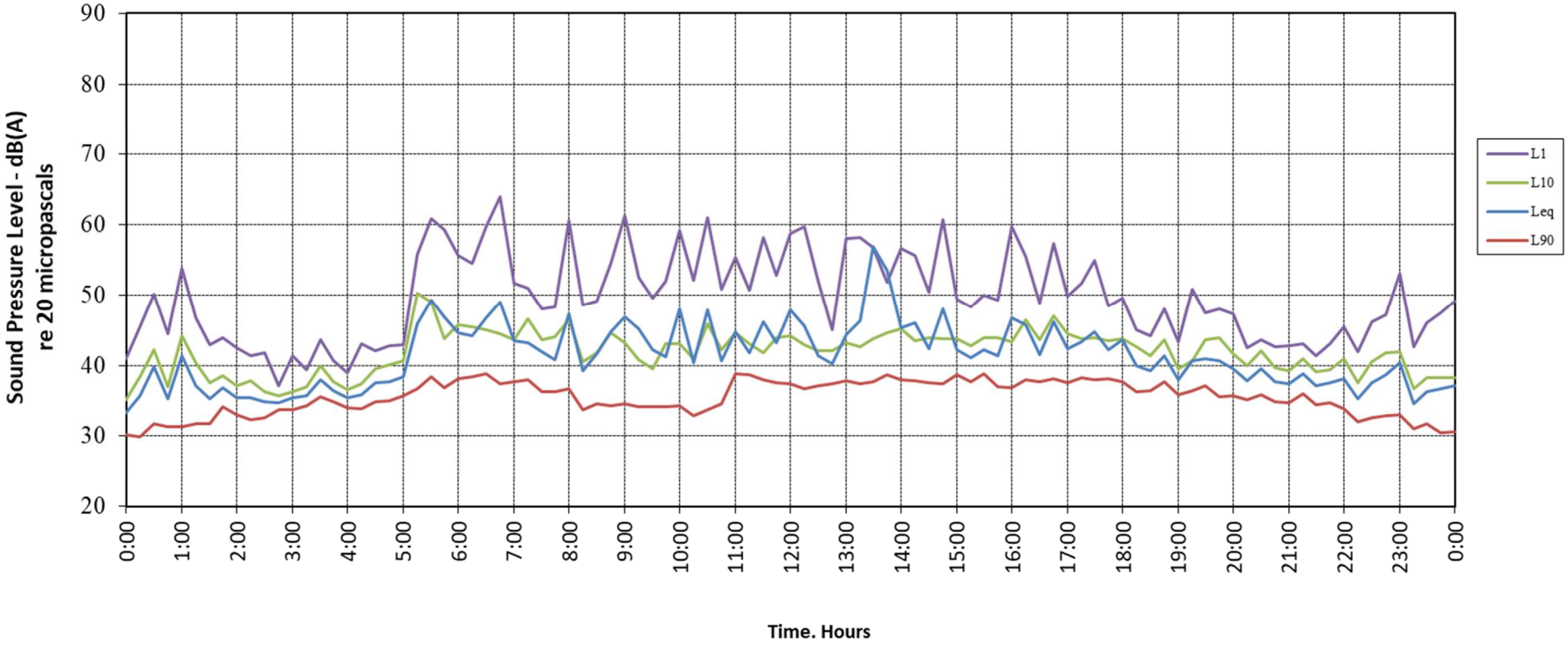

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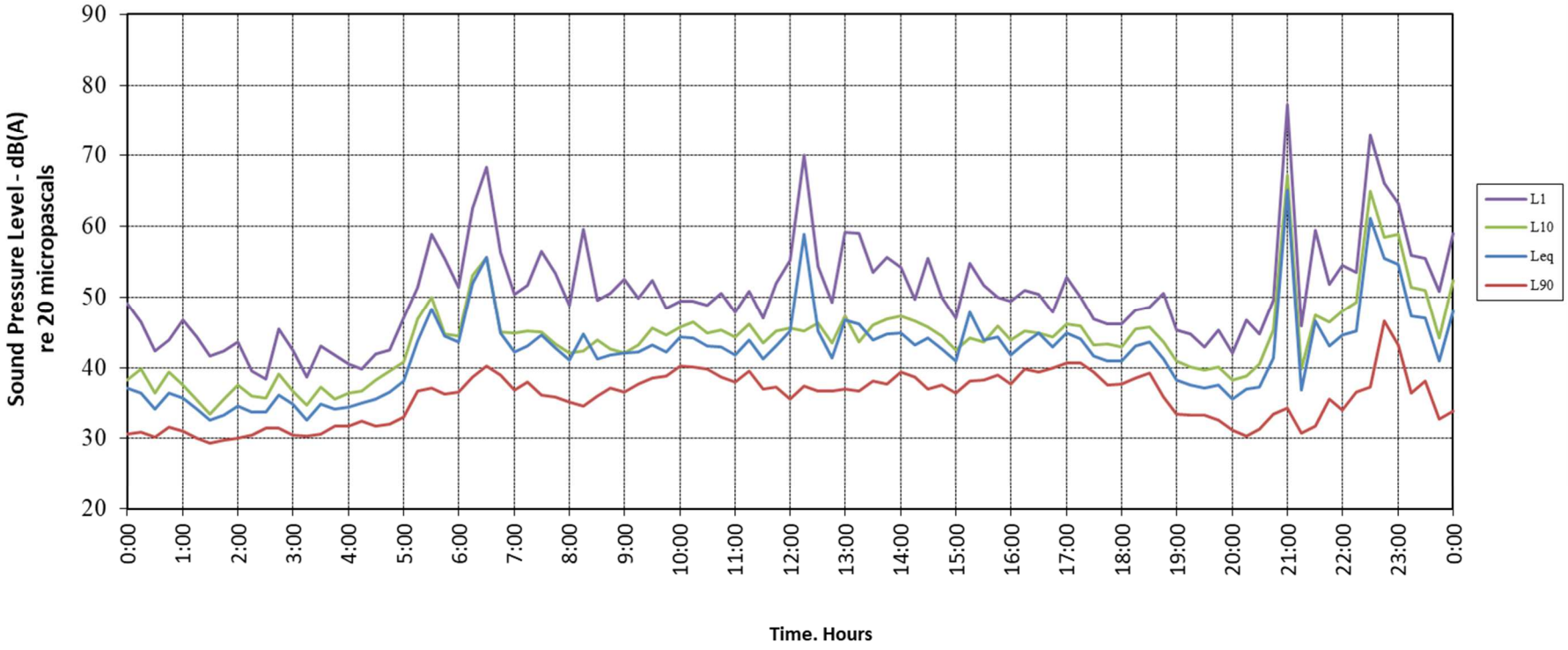

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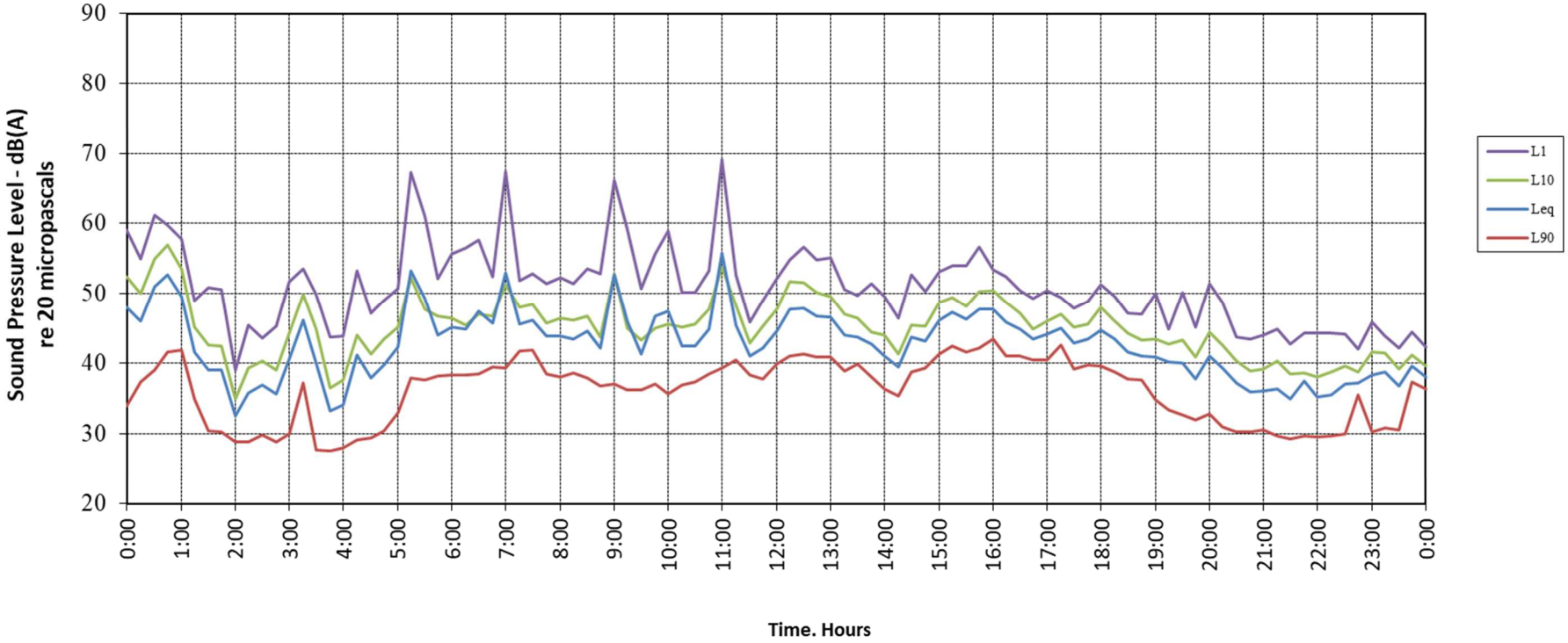

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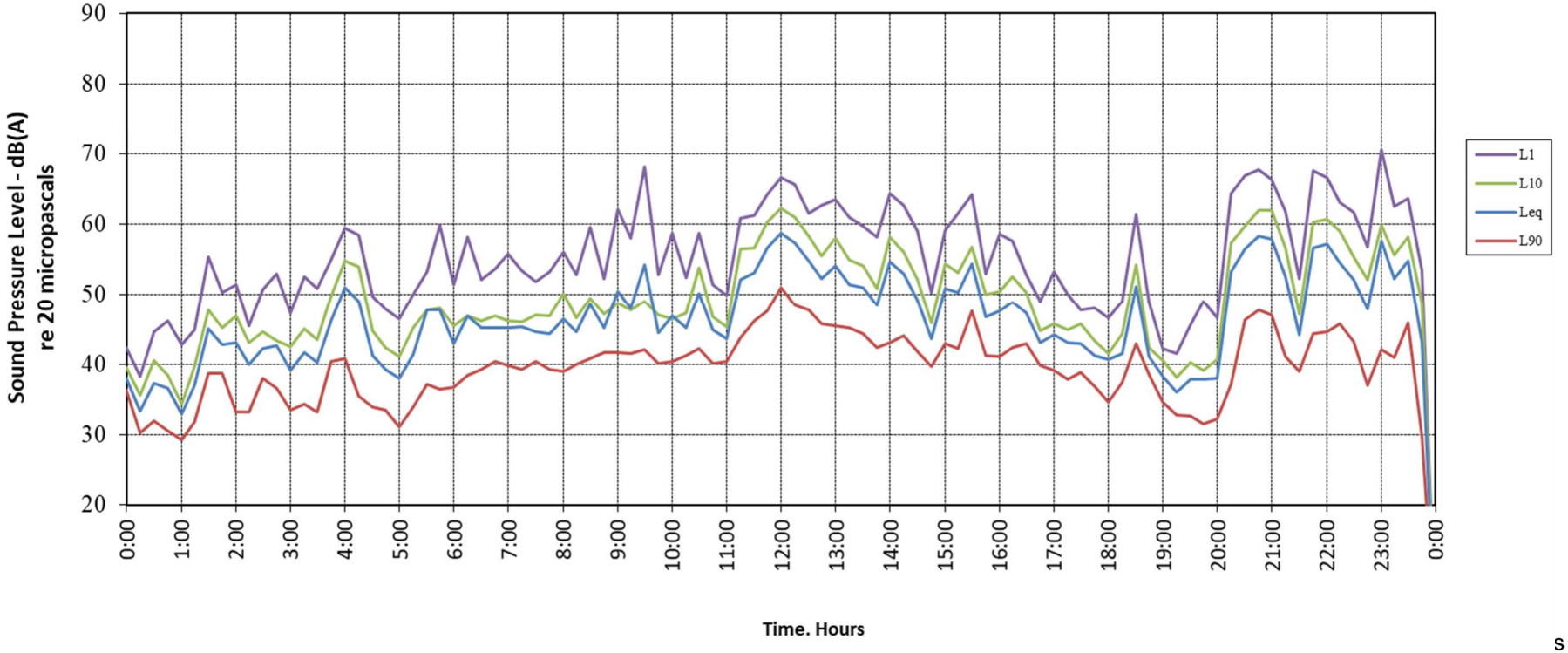

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