Concord High School Redevelopment

Noise and Vibration Impact Assessment for Development Application

Issued

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Table of Contents

Glossary

Term	Definition
dB	Decibel is the unit used for expressing sound pressure level (SPL) or power level (SWL).
dB(A)	Decibel expressed as an 'A – weighted' sound pressure level, based on the frequency response of the human ear and has been found to correlate well with human subjective reactions to various sounds.
Frequency	The rate of repetition of a sound wave. Frequency is measured Hertz (Hz), or cycles per second. Human hearing ranges approximately from 20 Hz to 20 kHz (2000 Hz).
Ground-borne noise	The transmission of noise energy as vibration of the ground. The energy may then be re-radiated as airborne noise.
$L_{1(period)}$	The sound pressure level that is exceeded for 1% of a measurement period. This is commonly accepted as the maximum noise level.
$L_{10(period)}$	The sound pressure level that is exceeded for 10% of a measurement period. This is commonly accepted as the maximum noise levels.
$L_{90(period)}$	The sound pressure level that is exceeded for 90% of a measurement period. This is commonly accepted as the background noise level.
$L_{Aeq(period)}$	The equivalent continuous sound pressure level. The level of noise equivalent to the energy average of noise levels occurring over a measurement period.
L_{Amax}	The highest sound pressure level recorded over a measurement period.
Octave Band Centre Frequency	The most commonly used frequency bands are octave bands, in which the centre frequency of each band is twice that of the band below it.
Rating Background Level (RBL)	Rating background level is the overall single-figure background level representing each assessment period (day/evening/night) over a measurement period.
Sound Power Level (SWL)	Expressed in dB, it is the total acoustic energy radiated by a plant or equipment to the environment
Sound Pressure Level (SPL)	Expressed in dB, it is the level of noise measured by a standard sound level meter and requires a description of where the noise was measured relative to the source
Vibration	Vibration may be expressed in terms of displacement, velocity and acceleration. Velocity and acceleration are most commonly used when assessing structure-borne noise or human comfort issues respectively.

Initialisms

ACRONYM	Definition
CEMP	Construction Environmental Management Plan
CHS	Concord High School
DA	Development Application
DfMA	Design for Manufacture and Assembly
EFSG	Engineering Facilities Standards and Guidelines
ICNG	Interim Construction Noise Guideline (NSW EPA, 2009)
NMLs	Noise Management Levels
NPI	Noise Policy for Industry (NSW EPA, 2017)
MMC	Modern Methods of Construction
RBL	Rating Background Level
SI NSW	School Infrastructure NSW

Executive Summary

A noise and vibration assessment report has been produced to determine the potential noise impacts and considerations for proposed refurbishment and upgrades at Concord High School.

The existing noise environment has been established based on long-term and short-term monitoring data.

Appropriate criteria for both noise and vibration have been established based on relevant guidelines and standards. A summary of the outcomes and recommendations of this noise and vibration assessment are as follows:

Construction Noise

- 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 works.
- Main Works
    - Construction noise impacts will be highest at the adjacent **Active Recreation** areas to the east of the site with noise levels predicted up to 29 dB above NML's and above Highly Affected Noise Levels. It is noted that based on usage observations from Google, the adjacent St Lukes Oval is typically not in use during the day period and mostly used for early in the evening period on weekdays.
    - Construction works noise at surrounding **residential receivers** will be similar in noise level in all directions, however the highest impact to more sensitive residential noise receivers to the west on Stanley Street. Noise from various plant and equipment operating individually are generally predicted to be above the NMLs due to the proximity to the nearest affected receivers but generally within the "Highly Noise Affected" noise levels. The worst-case noise impacts are for excavators with hammers with noise levels predicted to be above the NMLs by up to 18 to 20 dB.
    - Considering the above typical worst case, it is noted that:
        - the predictions for noise levels above NMLs is not unusual given the heavy plant and equipment that must be used, such as excavators and hammers, and the proximity to sensitive receivers (some of which are within 10m).
        - for the majority of the time, noise levels from operations of various plant and equipment are *predicted to be 3-5 dB lower* when location of activities within the site boundary are further away from a particular receiver.
        - Noise mitigation measures such as hoarding for certain activities can provide another 5 – 10 dB reduction.

- Car Park and Building I Relocations
    - Construction noise impacts will be highest at the adjacent residential noise receiver at **9 Stanley Street** with noise levels predicted up to 29 dB above NMLs and above Highly Affected Noise Levels at the nearest point. However, it is noted that:
        - all other residential locations will be at least 13 dB lower.
        - works for the car par expansion and Building I impacts will be relatively short in duration compared to the main works.
        - the predictions for noise levels above NMLs is not unusual given the heavy plant and equipment that must be used, such as excavators and hammers, and the proximity to sensitive receivers (some of which are within 5m).
        - Noise mitigation measures such as hoarding for certain activities can provide another 5 – 10 dB reduction.
- A CEMP shall be prepared by the contractor. Implementation of all reasonable and feasible mitigation measures for all works will ensure that any adverse noise impacts to surrounding residential, commercial, and recreational receivers are minimised. Project specific mitigation measures shall include:
    - Scheduling, Duration and Respite Periods
    - Noise Barriers or Screening
    - Alternative construction methodology or equipment
    - Communication
    - Complaints management

Construction Vibration

- Based on the scope of works and typical equipment required, there is potential for human perception vibration impacts on nearby Concord HS buildings and the residential dwelling adjacent to the car park (if a vibratory roller is used). There is requirement to review works processes during detailed works planning to ensure that minor cosmetic impacts to structures are avoided – particularly from the use of excavators with hammers near the existing Concord HS buildings. The significance of these impacts will need to be determined as part of the CEMP prepared by the Contractor.
- The Contractor determine whether the existence of significant vibration levels justifies a more detailed investigation.

Construction Environmental Management Plan

- A CEMP shall be prepared further to this assessment by the engaged Contractor.

Operational Noise - Mechanical Plant

Mechanical plant and equipment associated with the operation of the development is to be controlled to ensure external noise emissions are not intrusive and do not impact on the amenity of neighbouring receivers in accordance with the relevant criteria established in Section 5.2 of this report.

Recommendations are provided for noise controls to key plant. During the detailed design stage, the acoustic consultant shall provide detailed design advice to the architect and

mechanical engineer to ensure that noise emissions from mechanical plant are effectively controlled to meet the relevant criteria at the nearest receiver boundaries.

Operational Noise - The Use

Noise emissions have been considered from the following areas:

- Noise emissions from internal spaces in Block Y and Z (including Administration, SELU and GLS)
- Noise emissions from the New Hall Block X noise including Out of Hours Use. Plus Covered Outdoor Learning Area (COLA) to be included as part of the new Hall (Building X).
- New Games Courts to the north.
- Car Park Expansion.

Noise from the above areas are predicted to comply with the relevant project noise emission Criteria and therefore is not expected to have adverse noise impact on noise sensitive receivers surrounding the site.

Where the Hall is used for Out of Hours Use when the adjacent St Lukes Oval is also is used, it is recommended that windows and doors to the hall are kept close to mitigate noise impact.

1 Introduction

Acoustic Studio has been engaged by School Infrastructure NSW (SINSW) to assess the potential noise and vibration impacts of the proposed Concord High School (CHS) Redevelopment Project. The Project Site is located at 5 Stanley Street, Concord, NSW.

This acoustic assessment has been prepared in support of the Development Application for the project.

The objectives of this assessment are to:

- Identify noise sensitive receivers that will potentially be affected by the operation and construction of proposed changes to the school.
- Carry out noise surveys to quantify the existing ambient and background noise levels at noise sensitive receivers on and surrounding the site.
- Establishing the appropriate noise and vibration criteria in accordance with the relevant standards and guidelines.
- A quantitative assessment of main noise and vibration generating sources associated with construction.
- Carrying out a quantitative assessment of the main sources of operational noise including building services associated with the works.
- Assessing whether the relevant criteria can be achieved and, where applicable, recommending measures to minimise and mitigate potential impacts.

This report presents the findings of both the operational and construction noise and vibration assessments. It includes measured environmental noise survey data and environmental noise limits based on the measured noise levels in the area. Compliance with these limits will ensure that any noise from the overall development will not impact negatively on the nearest existing receivers and receivers which have been proposed for development. The report also provides recommendations for appropriate vibration level criteria during construction.

1.1 Project Overview

The Proposed Development comprises the following:

- Demolition of:
    - Existing Block E and an adjacent existing car park.
    - Existing games courts to the south east of the site.
- Construction of:
    - Block X – A new hall
    - Block Y – including a Canteen, Movement Studio, Performing Arts and PE Fitness.
    - Block Z - a new three storey building with Staff and Administration Facilities, Support Learning, Visual arts Workshop and General Learning Spaces (GLS)
    - A new games courts to the north of the site adjacent to Crane Street.
- Upgrades and changes:
    - Car park upgrade and extension to offset existing car park area loss from the proposed new buildings.
    - Relocation of Block I.

1.1.1 Noise and Vibration Assessment Scope

The scope of the noise and vibration assessment is limited to noise impacts associated with the upgrade noted above to include:

- Operational noise associated with new buildings
- Construction noise and Vibration associated with the new works.
- Assessment of existing school operations are excluded.

2 Surrounding Land Uses

2.1 Subject Site

The site is located at 5 Stanley Street Concord, NSW, within a suburban environment. It is primarily bordered by residential properties and park land.

The ambient noise environment is characterised by medium levels of activity throughout the day and evening, plus low noise levels at night.

The following land-uses surround the Project site:

- R2 - Low Density Residential.
- R3 – Medium Density Residential.
- RE1 – Public Recreation.

Figure 1: Concord High School Site (dashed yellow outline) and surrounding land uses - *NSW ePlanning Spatial Viewer*

The following potentially noise sensitive receivers surround the existing the project boundaries:

- Residential receivers
    - Adjacent to the boundary to the west including Stanley Street (nearest) and Burwood Road.
    - Across Stanley Street to the South West.
    - Across Crane Street to the North.
- Public Recreation
    - St Lukes Oval adjacent to the East.
    - St Lukes Park across Stanley Street to the South

Figure 2 presents the project site in context of the surrounding land uses, and displays long-term noise monitoring locations plus off-site, short term monitoring locations.

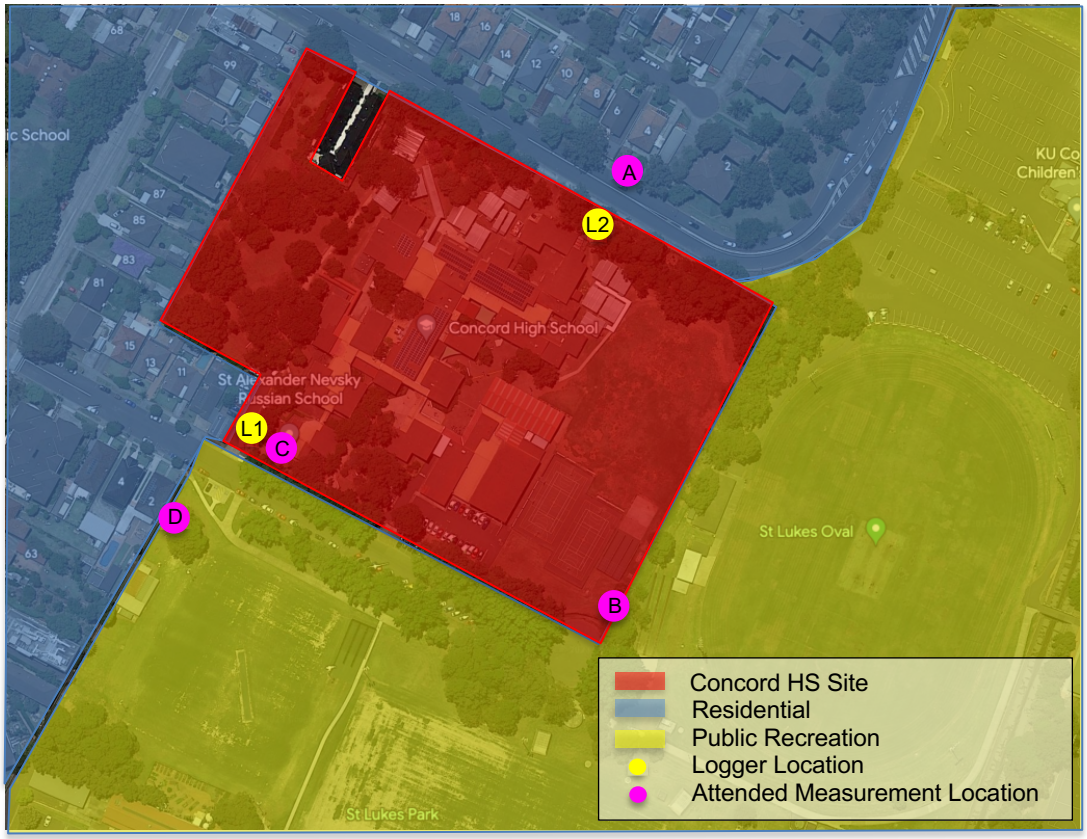


Figure 2: Aerial View showing Concord HS in relation to noise-sensitive receivers

3 Existing Noise Environment

3.1 General Survey Information

A survey of the existing noise environment at and around the site was conducted through unattended noise monitoring to continuously record the noise levels on the site. Unattended long-term noise monitoring was carried out for the following period:

- Logger L1 - Monday 7th to Tuesday 21st March 2023.
- Logger L2 - Tuesday 8th to Friday 17th March 2023.

Unattended long-term noise monitoring was carried out with the following noise loggers:

- Logger L1 - ARL Ngara (Serial Number 878042).
- Logger L2 - Rion NL 42 (Serial Number 810713).

The noise loggers recorded L_{A1}, L_{A10}, L_{A90}, and L_{Aeq} noise parameters at 15-minute intervals continuously for the measurement period. The calibration of the loggers was checked before and after use and no variations were noted.

Operator attended, short-term monitoring was also carried out as follows:

- Monday 7th March 2023

The short-term monitoring was conducted in order to supplement the long-term outdoor data across the site and at key surrounding receivers, and to obtain spectral noise data for traffic noise at the proposed site. These short-term measurements included measurements at the property boundaries of the closest residential properties, which were used to confirm that the long-term monitoring at each location (on the opposite side of the street) is representative of the background and ambient noise levels at the nearest noise sensitive receivers.

Attended short-term measurements were made with two Brüel & Kjær Hand-held Analysers Type 2250 (Serial Numbers 2832406). The calibrations of the analysers were checked before and after the surveys and no variation in levels occurred.

Windshields were used to protect the microphones of all the loggers and analysers. Weather conditions were generally calm and dry during the attended noise surveys, and therefore the data captured was not affected by weather.

Anthony Cano and Isaac Bradbury of Acoustic Studio Pty Ltd carried out the surveys.

3.2 Noise Monitoring Locations

The loggers were located at the proposed site at the following locations:

- Location L1 – At the School Site Adjacent to 11 Stanley Street
- Location L2 – At the School Site at Crane Street across the road from 2 Crane Street.

The unattended long-term noise monitoring location is shown Figure 2.

The detailed results of the unattended long-term noise monitoring at the logger location is shown in Appendix A.

These locations were chosen as they:

- Were secure places to leave the noise loggers unattended, and
- Were judged to provide representative of background and ambient noise levels at the most reasonably affected noise sensitive receivers (both adjacent to the school along Stanley Street and across Crane Street). This was confirmed with comparison against attended measurements across Crane Street.

Review against the Sydney Metro West Environmental Impact Statement for the nearby Burwood North Station site showed similar ambient and background noise measurement results.

3.3 Unattended Long-term Monitoring Results

3.3.1 Background and Ambient Noise

The logged data shows the background and ambient noise levels representative of the area. The recorded background noise levels have been used to establish noise targets for noise emitted from the construction and operation of the new building.

The background sound level is defined as the sound level exceeded 90% of the time, and is designated as the L_{90}.

The Rating Background Noise Level (RBL) provides a single figure that represents the background noise level over the entire monitoring period for assessment purposes. The ambient noise level impacting on the buildings is referred to as the equivalent continuous sound level (L_{eq}). This parameter is commonly used to describe a time varying noise such as traffic noise.

The background sound levels have been established in general accordance with the methodology described in the NSW Noise Policy for Industry (NPI), i.e. the 10^{th} percentile background sound level for each period for each day of the ambient noise survey.

The median of these levels is then presented as the background sound level for each assessment period.

These background noise levels are shown in Table 1 below, together with the L_{Aeq} ambient noise levels measured for each period.

Logger	Background Noise Levels (RBL), dB(A)			Leq Ambient Noise Levels, dB(A)		
	Day 7am-6pm	Evening 6pm-10pm	Night 10pm-7am	Day 7am-6pm	Evening 6pm-10pm	Night 10pm-7am
L1	44	42	38	61	54	50
L2	53	44	34	67	66	59

Table 1: Long-term background and ambient noise levels

Based on our observations during the site inspections, both ambient and background noise levels around the Project Site are generally dominated by local and distant traffic noise plus general suburban hum around the site.

3.3.2 Traffic Noise (NSW EPA Road Noise Policy (RNP), 2011)

Measured noise levels in accordance with the time periods and relevant road types defined by the NSW EPA *Road Noise Policy, 2011* (RNP) are presented below, with reference to School Classrooms.

Logger	Traffic Noise Levels, dB(A)
	Day 7am-10pm (1 hr)
L2 Crane Street	66

Table 2: Measured Traffic Noise Levels

Measured noise levels were taken at approximately 1m from the kerb, and approximately 6m from the middle of the road.

3.4 Short-term Monitoring Results

Four (4) short-term noise monitoring locations were chosen as representative of the site and surrounds as follows:

- **Location A** – 6 Crane Street
- **Location B –** St Luke Oval Boundary
- **Location C** – 9 Stanley Street (school boundary)
- **Location D** – 2 Stanley Street (across from school)

A summary of the measured values of the short-term background and ambient noise monitoring around the existing site is provided in Table 3.

Location	Time	Descriptor	Measured sound level, dB re 20 µPa								
			Overall dB(A)	Octave band centre frequency[1], Hz							
				63	125	250	500	1k	2k	4k	8k
A	Between 11am - 12pm 7th March 2023	L_{eq}	66	70	66	62	61	63	59	54	47
		L_{90}	54	55	49	47	46	47	41	51	40
C	Between 11am - 12pm 7th March 2023	L_{eq}	50	61	54	48	45	43	43	43	30
		L_{90}	45	58	50	44	38	39	36	36	22
D	Between 11am - 12pm 7th March 2023	L_{eq}	53	56	50	43	38	40	43	50	39
		L_{90}	48	54	47	40	33	37	35	46	34
E	Between 12pm – 12:30pm 7th March 2023	L_{eq}	53	62	56	44	43	43	43	50	38
		L_{90}	48	56	5	42	38	39	37	46	33

Table 3: Summary of short-term traffic, background and ambient noise levels

4 The Key Acoustic Considerations

The following acoustic considerations are to be addressed as part of the assessment:

External Noise Emissions - Noise emissions from the Project will need to be managed to limit environmental noise impacts on nearby buildings resulting from the operation of the proposed development. In particular, this applies to:

- Building services and plant - The impact of mechanical noise generated by any new mechanical plant and services.
- Operational noise – associated with noisy activities, particularly noise associated with new playground areas.

External Noise Emissions associated with the Operation - Noise emissions from the Project are to be managed to limit environmental noise impacts on sensitive receivers resulting from the operation of the proposed development.

Construction Noise and Vibration - The impact of noise and vibration generated during the construction stages of the Project on surrounding noise and vibration sensitive premises.

- The development will contribute to an increase in noise and vibration to the surrounding environment during construction. Typically, this will result from a combination of intermittent and continuous noise from construction and excavation equipment, construction traffic and plant commonly used on construction sites.
- Design noise and vibration targets have been set for the Project and construction noise impacts have been anticipated from standard construction procedures.
- The noise and vibration targets and expected impacts are reported in Section 4 and Section 8 of this report. Where the noise and vibration impacts are predicted to be above the NMLs, then all reasonable and feasible noise and vibration mitigation measures must be considered as detailed in Section 8.5.

The engaged Contractor would be required to prepare a Construction Environmental Management Plant (CEMP) based on their proposed plant, equipment and construction methodology, prior to the commencement of any works.

The CEMP is to provide the following:

- A quantitative construction noise and vibration assessment, which includes:
    - Identifying noise and vibration sensitive receivers potentially affected by the proposed works.
    - Reference the appropriate construction noise and vibration criteria outlined in Section 5.4 of this report.
    - Identifying noise and vibration sources associated with the proposed works.
    - Providing an assessment of noise and vibration generated by the proposed works against the relevant management levels.
    - Determining the likely need for noise and vibration mitigation and management measures.
- A control strategy for construction noise and vibration mitigation to best minimise potential impacts through implementation of reasonable and feasible measures.
- Noise and vibration monitoring as required, using monitors equipped with alert/notification systems to ensure works are carried out in accordance with the applicable Guidelines and Standards.

5 Project Noise and Vibration Targets

5.1 Relevant Standards and Guidelines

The following acoustic standards and guidelines have been considered in establishing noise and vibration criteria and assessment for this project.

- Canada Bay Council Local Environmental Plan (LEP) 2013.
- Canada Bay Council Development Control Plan (DCP) 2013.
- NSW EPA Noise Policy for Industry (NSW NPI) 2017.
- NSW EPA Road Noise Policy (RNP) 2011.
- NSW Department of Environment and Climate Change (DECC) "Interim Construction Noise Guideline" (ICNG) 2009.
- NSW Department of Environment and Conservation (DEC) "Assessing Vibration: A Technical Guideline" (AVTG) 2006.
- NSW Department of Planning "Development Near Rail Corridors and Busy Roads – Interim Guideline" 2008.
- NSW Protection of the Environmental Operations (POEO) Act 1997.
- Australian Standard "AS 2436 : Guide to Noise and Vibration Control on Construction, Demolition & Maintenance Sites" 2010.
- Australian Standard "AS 1055 : Acoustics – Description and Measurement of Environment Noise" 1997.
- NSW School Infrastructure "Educational Facilities Standards and Guidelines".

5.2 Operational Noise Emissions

5.2.1 General Noise

NSW Noise Policy for Industry

The NSW NPI provides guidance on the methodology for determining project-specific noise trigger levels or targets for external noise emissions from plant associated with a development.

The criteria have two components:

- Intrusiveness Noise Level – controlling intrusive noise impacts in the short term for residences.
- Amenity Noise Level (ANL) – maintaining noise level amenity for particular land uses for residences and other land uses.

Applying the more stringent of the two criteria provides the Project Noise Trigger Level (PNTL).

The NSW NPI considers the following when establishing the criteria:

- The existing Ambient (L_{eq}) and Background noise levels (L_{90}) that surround the site.
- The time of day that the noise generating development will be in operation, defined by the following:
    - Day (7am to 6pm).
    - Evening (6pm to 10pm).
    - Night (10pm to 7am).
- The type of receivers.
- The type of area that the development site and its nearest receivers are located. The NSW NPI provides recommended noise levels for specific receiver types and the type of area they are located within.
- The type of noise source and its characteristics. The NSW NPI provides modifying factors for noise sources with certain characteristics that may potentially cause greater annoyance than other noise sources of the same level.

Further guidance on establishing the criteria can be found in the NSW NPI.

Noise Impacts on the Surrounding Community

Based on the measured noise levels detailed in Section 3 and in accordance with the methodology outlined in the NSW NPI (further described in Appendix B), Table 4 details the corresponding targets of allowable noise emission from external plant and equipment at the nearest receiver boundaries from the School.

Receiver (External)	Period	Project Noise Trigger Level (PNTL) $L_{eq(15min)}$ dB(A)
Residential (Stanley St)	Day	49
	Evening	43
	Night	38
Residential (Crane Street)	Day	52
	Evening	49
	Night	39
Active Recreation	When in use	53

Table 4: NSW NPI Project Noise Trigger Levels for external noise emissions from proposed development

5.2.2 Mechanical Plant and Equipment

The design of mechanical plant and equipment shall achieve the requirements of Table 4.

5.2.3 Traffic Noise

The project (once in operation) is anticipated to have a marginal increase from 1,335 to 1,360 students. This will have a negligible impact on traffic noise generation on surrounding roads.

The western car park will be upgraded and extended to offset existing car park area loss from the proposed new buildings. A detailed assessment of traffic noise is provided in Section 6.3.6.

5.2.4 Playground Noise

There is no clearly defined criteria for school playground noise. The following guidelines for outdoor play areas in childcare centres are considered relevant as the industry best practice for school playground noise assessment.

Association of Australasian Acoustical Consultants Guidelines for Child Care Acoustic Assessment

The AAAC Guideline for Child Care Centre Acoustic Assessment states the following:

"… 3.2 Criteria – Residential Receptors

3.2.1. Outdoor Play Area

The noise impact from children at play in a child care centre differs from the domestic situation in that it is a business carried out for commercial gain, the number of children can be far greater than in a domestic situation and the age range of the children at the centre does not significantly vary over time as it would in a domestic situation. However, the noise from children is vastly different, in both character and duration, from industrial, commercial or even domestic machine noise. The sound from children at play, in some circumstances, can be pleasant, with noise emission generally only audible during the times the children play outside. Night time, weekend or public holiday activity is not typical and child care centres have considerable social and community benefit.

Base Criteria *– With the development of child care centres in residential areas, the background noise level within these areas can at certain times, be low. Thus, a base criterion of a contributed Leq,15min 45 dB(A) for the assessment of outdoor play is recommended in locations where the background noise level is less than 40 dB(A). Association of Australasian Acoustical Consultants Guideline for Child Care Centre Acoustic Assessment Version 3.0 6*

Background Greater Than 40 dB(A) *– The contributed Leq,15min noise level emitted from an outdoor play and internal activity areas shall not exceed the background noise level by more than 5 or 10 dB at the assessment location, depending on the usage of the outdoor play area. AAAC members regard that a total time limit of approximately 2 hours outdoor play per morning and afternoon period should allow an emergence above the background of 10 dB (ie background +10 dB if outdoor play is limited to 2 hours in the morning and 2 hours in the afternoon).*

Up to 4 hours (total) per day *– If outdoor play is limited to no more than 2 hours in the morning and 2 hours in the afternoon, the contributed Leq,15 minute noise level emitted from the outdoor play shall not exceed the background noise level by more than 10 dB at the assessment location.*

More than 4 hours (total) per day *– If outdoor play is not limited to no more than 2 hours in the morning and 2 hours in the afternoon, the contributed Leq,15 minute noise level emitted from the outdoor play area shall not exceed the background noise level by more than 5 dB at the assessment location.*

The assessment location is defined as the most affected point on or within any residential receiver property boundary. Examples of this location may be:

- *1.5 m above ground level;*
- *On a balcony at 1.5 m above floor level;*
- *Outside a window on the ground or higher floors...”*

5.3 External Noise Intrusion

5.3.1 Traffic Noise to Buildings

SEPP INFRASTRUCTURE 2007

Clause 102 of SEPP 2007 outlines requirements related to the assessment of noise impact from non-road developments that are adjacent to road corridors with traffic volumes of more than 40,000 vehicles.

Objective criteria for internal noise levels that must be achieved are provided for residential development only.

In the absence of objective criteria for the educational facilities, reference is made to NSW Department of Planning (DoP), *Development Near Busy Roads and Rail Corridors – Interim Guideline* and Australian Standard AS2107, which recommend internal design noise levels within occupied spaces and are detailed below.

NSW DoP, Development Near Busy Roads and Rail Corridors

For airborne noise from road traffic, the NSW DoP Interim Guideline sets an internal noise target of 40 dB(A)[1] for educational institutions.

5.3.2 Traffic Noise to Outdoor Areas

When considering outdoor areas of a school where it is affected by external noise, the following guidelines are relevant.

NSW EPA Road Noise Policy (RNP)

The RNP provides assessment criteria for assessment of road impact on noise residential land uses including school playground areas as follows:

- Open space (active land use) – External $L_{Aeq\ (15\ hour)}$ - 60 dB(A).
- Open space (passive land use) – External $L_{Aeq\ (15\ hour)}$ - 55 dB(A)

5.3.3 Aircraft Noise

The site is located outside the Australian Noise Exposure Forecast (ANEF) 20 and therefore no further assessment is required.

[1] Airborne noise is from traffic is calculated as $L_{eq\ 15\ hr}$ Day and $L_{eq\ 9\ hr}$ night.

5.4 Construction Noise and Vibration

5.4.1 Noise Management Levels

The relevant guideline applied for the assessment of construction noise is the ICNG. This guideline provides construction NMLs for Residential, Commercial and Industrial noise receivers as follows.

Residential Receivers

Section 4 of the ICNG provides recommendations for standard hours of work and suggests construction NMLs that aim to minimise the likelihood of annoyance caused to noise sensitive receivers. These consider both airborne and ground borne noise level impacts.

Table 5 outlines the methodology for determining construction NMLs at nearby residential receivers surrounding the development site based on existing background noise levels.

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

Table 5: Residential construction Noise Management Levels for airborne noise as outlined in the ICNG

The project-specific construction Noise Management Levels are shown in Table 6 based on the measured background noise levels at the site (in Section 3 – also refer to Appendix B).

Location	Period		Rating Background Level RBL, dB(A)	Noise Management Level $L_{eq\ (15\ min)}$ dB(A)
Residential (Stanley St)	Recommended Standard Hours	Monday to Friday 7am to 6pm	44	RBL + 10 = 54
		Saturday 8am to 1pm	42	RBL + 10 = 52
Residential (Crane Street)	Recommended Standard Hours	Monday to Friday 7am to 6pm	53	RBL + 10 = 63
		Saturday 8am to 1pm	52	RBL + 10 = 62

Table 6: Project Specific residential construction Noise Management Levels for airborne noise

Non-Residential Receivers:

The ICNG also provides recommended construction NMLs for non-residential receivers surrounding a construction site, which are as follows:

Occupancy	Management level $L_{eq\ (15\ min)}$ dB(A)
Active Recreation Area	55 dB(A) - External

Table 7: Active Recreation Area Noise Management Levels for airborne noise

5.4.2 Vibration Criteria

Construction vibration is to be assessed in terms of:

- Human comfort
- Disruption to sensitive equipment
- Structural damage

Relevant management levels for each of these are detailed in the sections that follow.

Human Comfort

The DEC AVTG provides suitable criteria that can be applied to the assessment of vibration and human comfort. The guideline makes reference to the British Standard BS 6472: 1992, which shares many similarities to the Australian Standards AS 2670.2: 1990. This guideline presents preferred and maximum vibration values for use in assessing human responses to vibration plus targets for critical areas in hospital and educational buildings, and provides recommendations for measurement and evaluation techniques.

Vibration and its associated effects are usually classified as continuous, impulsive or intermittent:

- **Continuous vibration** continues uninterrupted for a defined period (usually throughout daytime and/or night-time). This type of vibration is assessed on the basis of weighted rms acceleration values.
- **Impulsive vibration** is a rapid build-up to a peak followed by a damped decay that may or may not involve several cycles of vibration (depending on frequency and damping). It can also consist of a sudden application of several cycles at approximately the same amplitude, providing that the duration is short, typically less than 2 seconds.
- **Intermittent vibration** can be defined as interrupted periods of continuous (e.g. a drill) or repeated periods of impulsive vibration (e.g. a pile driver), or continuous vibration that varies significantly in magnitude. It may originate from impulse sources (e.g. pile drivers and forging presses) or repetitive sources (e.g. pavement breakers), or sources which operate intermittently, but which would produce continuous vibration if operated continuously (for example, intermittent machinery, railway trains and traffic passing by). This type of vibration is assessed on the basis of vibration dose values.

Examples of these vibration types are provided in Table 8 below.

Continuous	Impulsive	Intermittent
Machinery, steady road traffic, continuous construction activity (such as tunnel boring machinery).	Infrequent: Activities that create up to 3 distinct vibration events in an assessment period, e.g. occasional dropping of heavy equipment, occasional loading and unloading.	Trains, nearby intermittent construction activity, passing heavy vehicles, forging machines, impact pile driving, jack hammers. Where the number of vibration events in an assessment period is three or fewer this would be assessed against impulsive vibration criteria.

Table 8: Examples of vibration types

The relevant criteria for human exposure to continuous and impulsive vibration are detailed in Table 9. Vibration levels are assessed through the consideration of the summation of effects for vibration levels at frequencies from 1 to 80 Hz for all axes.

Location	Assessment period	Preferred Values		Maximum Values	
		z-axis	x- and y-axes	z-axis	x- and y-axes
Continuous vibration					
Critical areas	Day or night time	0.10	0.072	0.20	0.14
Residences	Day time	0.20	0.14	0.40	0.28
	Night time	0.14	0.10	0.28	0.2
Offices, schools, educational institutions and places of worship	Day or night time	0.40	0.28	0.80	0.56
Workshops	Day or night time	0.80	0.58	1.6	1.16
Impulsive vibration					
Critical areas	Day or night time	0.10	0.072	0.20	0.14
Residences	Day time	6.0	4.2	12.0	8.4
	Night time	2.0	1.4	4.0	2.8
Offices, schools, educational institutions and places of worship	Day or night time	13.0	9.2	26.0	18.4
Workshops	Day or night time	13.0	9.2	26.0	18.4

Table 9: Preferred and maximum weighted rms values for continuous and impulsive vibration velocity (mm/s) 1-80 Hz

Human exposure to intermittent vibration is assessed using the Vibration Dose Value (VDV). The VDV accumulates the vibration energy experienced over an extended period (daytime and night-time periods) from intermittent events. Table 10 sets out the acceptable VDV values for intermittent vibration.

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

Table 10: Acceptable vibration dose values for intermittent vibration ($m/s^{1.75}$)

Sensitive Equipment

Areas with sensitive equipment are likely to require a higher degree of vibration isolation than the values in Table 9 & Table 10.

Vibration Criterion (VC) curves are used to provide the basis for the design and protection of highly vibration sensitive equipment. Table 11 details the VC curves applicable to a range of highly sensitive equipment that is to be referred to and considered in conjunction with manufacturer guidelines specific to each type of equipment.

Curve	Max Value 8-80Hz	Detail Size	Equipment Types / Requirements
	Microns / sec, rms	Microns	
VC-A	50	8	Bench Microscopes < 400 x Magnification, optical and other precision balances, coordinate measuring machines and optical comparators
VC-B	25	3	Bench Microscopes > 400 x Magnification, microsurgery and neurosurgery
VC-C	12.5	1	Electron Microscopes < 30,000 x magnification, magnetic resonance imagers and microelectronics manufacturing equipment
VC-D	6	0.3	Electron Microscopes > 30,000 x magnification, mass spectrometers and cell impact equipment
VC-E	3	0.1	Un Isolated laser and optical research systems

Table 11: VC Curves for Highly Sensitive Equipment

Figure 3 shows the relationship between criteria for highly sensitive equipment and human exposure criteria shown in Table 9.

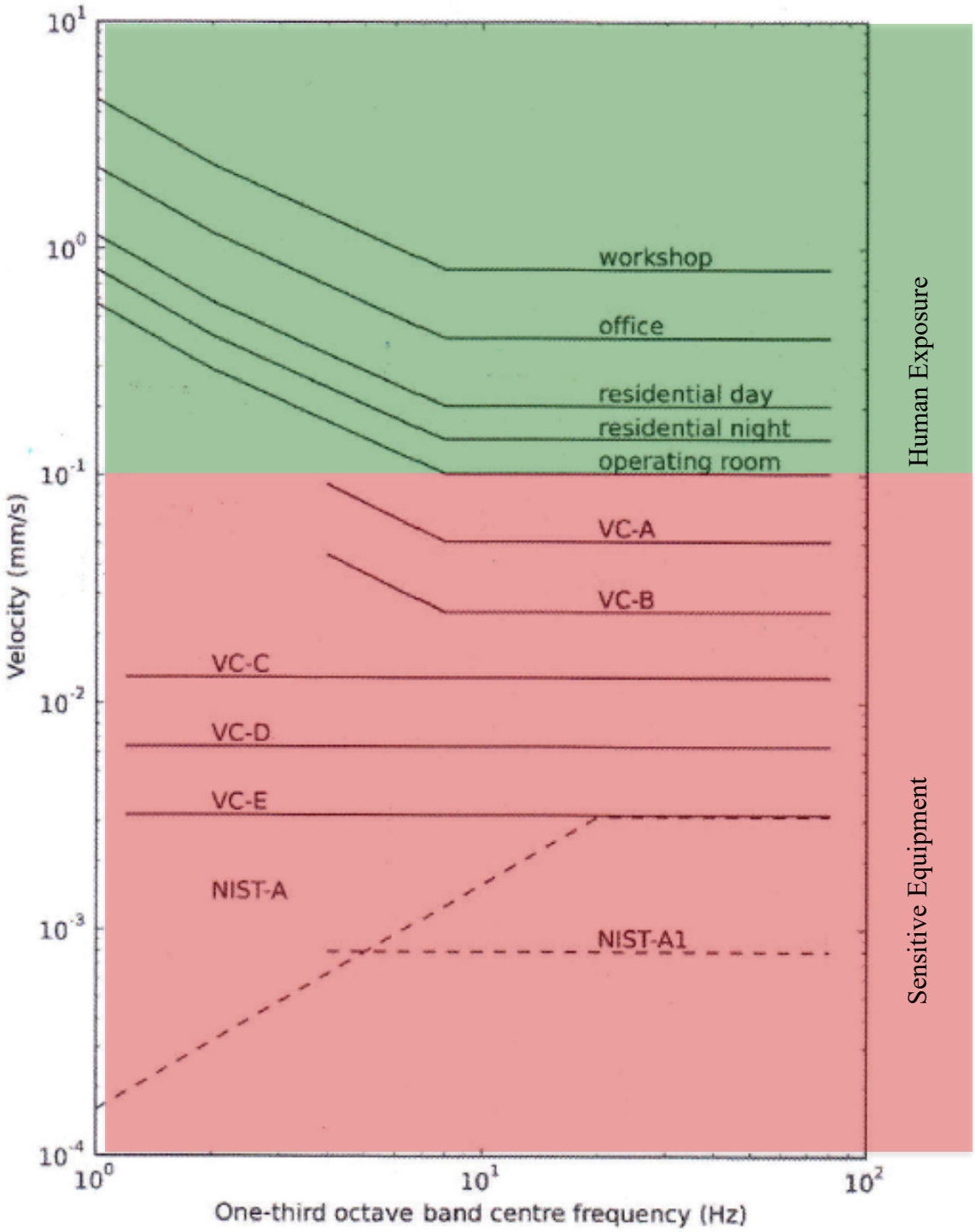


Figure 3: VC Curves - Source: ANC Guidelines – Measurement and Assessment of Ground-borne Noise & Vibration, Association of Noise Consultants (2012)

At this stage no potentially sensitive receivers at or surrounding the site have been identified as having particularly vibration sensitive equipment.

Structural Damage

Vibration-induced damage of buildings and structures is a common concern, but it is actually rare in practice. This explains why there is limited reliable data on the threshold of vibration-induced damage in buildings and there is no directly relevant Australian Standard. There are guidelines available in a number of international standards, although these vary significantly. Criteria to prevent building damage and disruption to equipment and processes are discussed in Appendix C.

Recommendations

The criteria given in Table 9 for Human Comfort shall generally form the limiting vibration criteria for the Project.

It is recommended that a precautionary approach for managing vibration-induced damage be taken for this project, whereby conservative vibration criteria are adopted in the first instance. It would be possible to relax these criteria if required, subject to review of specific buildings by a structural engineer and a regime of vibration monitoring.

The recommended precautionary vibration management levels are:

- 3 mm/s (130 dB re 10^{-6} mm/s) for buildings surrounding the Project identified as "sensitive". At this stage no structures at or surrounding the site have been identified as particularly sensitive to vibration-induced damage.
- 5 mm/s (134 dB re 10^{-6} mm/s) for residential dwellings.
- 20 mm/s (146 dB re 10^{-6} mm/s) for classrooms, and commercial premises.

These vibration management levels apply across the full frequency range of relevance (i.e. typically 1 Hz – 100Hz encountered in building construction).

6 Operational Noise and Vibration Assessment

6.1 Operating Hours

Existing and future operations will be as follows:

- **School hours** are between 8:55am – 2:55pm
- **Recess and lunch times**
    - Recess 10:35am – 11:05am
    - Lunch 12:45pm – 1:15pm
- **Administration and Office** (applicable to the new building) hours are between 8.00am and 3.30pm.
- **Cleaners** can be on site from 5am till 7pm. Note: air conditioning will not operate before 7am.

6.2 Operational Noise Emissions – Mechanical Services

Plant associated with the operation of new building at CHS will be controlled to ensure external noise emissions are not intrusive and do not impact on the amenity of neighbouring receivers with the relevant criteria in Section 5.2 of this report.

At this stage, final plant selections have not been made; therefore, a detailed assessment has not been carried out. Any new items of plant will be reviewed to ensure that noise emissions meet the applicable environmental noise criteria.

During the Detailed Design phase, acoustic detailed design advice will provide to the architect and services engineers to ensure that noise emissions from plant and equipment are effectively controlled to meet the relevant criteria at the nearest receiver boundaries.

General design considerations and controls that may need to be implemented typically include, but are not limited to:

- Strategic selection and location of plant to ensure the cumulative noise contribution at the receiver boundary is achieved, and/or
- Noise control measures to be put in place to minimise noise impacts such as:
    - Noise enclosures or barriers/screening as required.
    - Acoustic louvres as required.
    - In-duct attenuation.
    - Sound absorptive panels.

The following outlines allowances that have been included based on the current proposals.

Actual treatments may change (and still achieve the relevant noise emissions targets) depending on final locations, orientation and equipment selections.

Acoustic Studio has carried out a review of current design strategy for key plant (including condenser units) proposals and make the following comments:

6.2.1 General

- Key plant is currently proposed to be located in the following areas (as shown on the Architectural DA drawings):
    - Block Y : Condenser units located on roof.
    - Block Z : Condenser units located on roof.
- The nearest potentially affected receivers are:
    - The residential dwellings adjacent to the school site to the west on Stanley Street and Burwood Road.
    - Public recreation area adjacent to the east
- The plant will be restricted to operate during normal day time hours only (7am to 6pm) unless otherwise stated below.
- The most restrictive criterion for the plant operating is as follows (unless otherwise noted below).

- 49 dB(A) during the day period (7am to 6pm) at the nearest residential receivers. Achieving this criterion will ensure compliance with the relevant criteria at all other receivers.

- Two separate condenser unit to supply communications rooms will be installed within the new rooftop plant enclosure for each school and operated 24 hours per day. In addition, some minor exhausts such as for dark room chemical stores and hazardous goods stores will operate 24 hours per day. The final selection for this plant, plus its locations and acoustic treatments, shall ensure that this plant achieves the night time criteria of 38 dB(A) at the nearest residential receivers.

6.2.2 New Building Condenser Units

The current condenser design has been assessed based on units selected with a sound pressure level of 70 dB(A) at 1m.

Based on the selections and current placement of rooftop plant no additional treatment is required to control noise to *residential receivers* due to distance and shielding already achieved.

6.2.3 Fans - Fresh Air and Exhaust Fans (including toilet, smoke and general)

Details of the selections have not yet been finalised at this stage. We note the following:

- Internally lined ductwork for the exhaust / discharge side of the fan will be allowed for to ensure the selected fans meet the noise criteria at the boundary.
- Larger fans such as outside air and relief air fans for the Hall will allow for attenuators as required to ensure the selected fans meet the noise criteria at the boundary.

6.2.4 Cumulative Noise Impact

The assessment and design consider all existing plant and equipment that will be retained for existing buildings.

The recommendations provided (and detailed designs to be developed) will ensure that the noise emissions are achieved when considering the cumulative noise impact from existing and proposed plant.

During the detailed design phased, acoustic detailed design advice will be provided to the architect and services engineers to ensure that noise emissions from all plant and equipment selections are effectively controls to meet the relevant criteria at the nearest receiver boundaries.

6.3 Operational Noise – The Use

Operational noise emissions associated with the use of the Project has considered the following:

- Public Address System Upgrades.
- Noise emissions from internal spaces in Block Y and Z (including Administration, SELU and GLS)
- Noise emissions from the New Hall Block X noise including out of hours use. Plus Covered Outdoor Learning Area (COLA) to be included as part of the new Hall (Building X).
- New Games Courts to the north.
- Upgrade and expansion to the existing western car park.

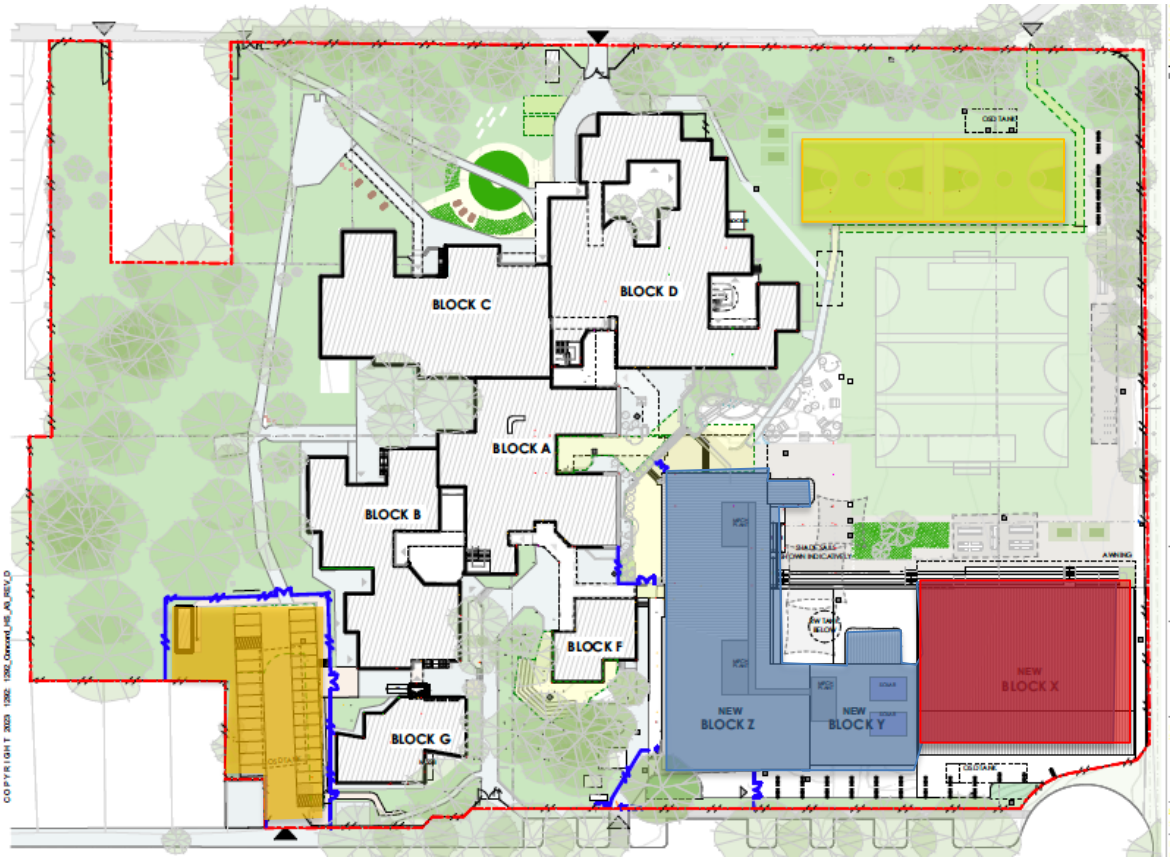


Figure 4: Proposed Site Plan – Block X (red), Block Y and Z (blue), Games Courts (yellow), Expanded Car Park (orange)

6.3.1 Public Address Systems

Upgrades to the existing Public Address system will include new speakers on the proposed buildings.

To manage potential noise spill to the surrounding receivers, we the following is recommended for all public address systems:

- Limit times to daytime only (7am to 6pm)
- Good practice design including directional speakers, facing inwards to the school away from residents, and focussing on required coverage area
- Noise levels set and limited to the lowest level whilst still being audible and intelligible requirements for the coverage areas as defined by the EFSG section DG64 (communications)

6.3.2 COLA

The proposed COLA will provide shelter to enable outdoor learning for groups as well as access to the canteen during recess and lunch.

Based on the proposed location of the COLA at the furthest position from Crane Street residents and shielded from residents on Stanley Street and Burwood Road, noise emissions from the COLA will be less than or equal to existing playground noise and / or outdoor learning carried out at the existing sport field.

6.3.3 Classroom Noise Emission

An assessment of noise emission from internal spaces has been carried out which considers the following:

- **Noise Source** - Noise from within internal areas within the new buildings including administration and learning areas is expected to range between 70-75 dB(A), which considers a typical worst case noisy learning activity / setting.
- **Windows Open –** to provide natural ventilation.
- **Residential Noise Sensitive Receivers –** nearest being adjacent to the school site on Stanley Street with line of sight to the façade. Compliance achieved at these locations will ensure compliance is achieved at all other locations.
- **Time Period –** noise during Day period – 7am to 6pm (inclusive of school hours).

The following presents the results of the assessment of the expected noise impact from internal spaces within the new building.

Receiver	Predicted Noise Level $L_{eq\ (15\ min)}$ dB(A)	Classroom PNTL $L_{eq\ (15\ min)}$ dB(A)	Complies?
Residential (Stanley Street)	< 30	49	Yes

Table 12: Noise Emissions from Assessment from Classrooms

Noise emissions from classrooms and internal areas of the proposed buildings are predicted to comply with the relevant noise targets.

6.3.4 Games Courts

New Games Courts are proposed to be located to the north of the site to offset the lost Games Courts replaced by Block X.

An assessment of noise emissions associated with the Games Courts are as follows:

- **Noise Source** - Noise from use of Games Court areas are expected to be in the range of 55-58 dB(A) $L_{eq\ (15\text{-}minute)}$ @10m (based on historical measured data).
- **Residential Noise Sensitive Receivers** – across Crane Street, with line of sight to the façade. Compliance achieved at these locations will ensure compliance is achieved at all other locations.
- **Time Period –** noise during Day period – 7am to 6pm (inclusive of school hours).

The following presents the results of the assessment of the expected noise impact from the Games Courts.

Receiver	Predicted Noise Level $L_{eq\ (15\ min)}$ dB(A)	Playground Noise Target $L_{eq\ (15\ min)}$ dB(A)	Complies?
Residential (Crane Street)	45 - 48	RBL + 5 = 58	Yes

Table 13: Noise Emissions Assessment from Games Courts

Noise emissions from the proposed Games Courts are predicted to comply with the relevant noise targets for school playground noise emissions.

6.3.5 Hall Noise Emissions

Daytime / School Use

An assessment of noise from the Hall, has assumed the following:

- **Noise Source** - Noise from within internal hall areas is expected to be up to 75dB(A), which considers a typical worst case noisy learning activity / setting from sports and music.
- **Windows open** – this includes roller doors and high-level louvres for natural ventilation.
- **Noise Sensitive Receivers**
    - Residential – across Crane St, with line of sight to the façade (approx. 125m).
    - Active recreation – adjacent to the site at St Luke's Oval
- **Time Period** – noise during Day period – 7am to 6pm which includes school hours.

The following presents the results of the assessment of the expected noise impact from internal spaces within the new hall building to affected receivers.

Receiver	Predicted Noise Level $L_{eq\ (15\ min)}$ dB(A)	Day PNTL $L_{eq\ (15\ min)}$ dB(A)	Complies?
Residential (Crane Street)	32	53	Yes
Active Recreation	50	53 (when in use)	Yes

Table 14: Hall Noise Emission Assessment (Day - 7am to 6pm)

Noise emissions from the Hall during the day are predicted to comply with the relevant noise targets.

Out of Hours Use

An assessment of noise from the Hall has assumed the following:

- **Noise Source** and Levels
    - Noise sources for out of hours hall usage may include performances, presentations, community meetings, discos, fundraisers or similar.
    - Noise levels from within internal hall areas is expected to be up to 85dB $L_{Aeq\ (15\text{-}minute)}$ during the evening, which considers a typical worst case noisy setting from amplified music.
- **Windows and doors open and closed scenarios** – this includes panel lift / roller doors. Acoustic performance of the façades facing residents are expected to achieve a minimum sound insulation performance of R_w30.
- **Residential Noise Sensitive Receivers** – with line of sight to the façade. Compliance achieved at these locations will ensure compliance is achieved at all other locations.
    - Residential – across Crane St, with line of sight to the façade (approx. 125m).
    - Active recreation – adjacent to the site at St Lukes Oval
- **Time Period** – noise during the evening period of 6pm to 10pm.

Receiver	Predicted Noise Level $L_{eq\ (15\ min)}$ dB(A)	Evening PNTL $L_{eq\ (15\ min)}$ dB(A)	Complies?
Residential (Crane Street)	42	49	Yes
Active Recreation	60 - windows / doors **open** 35 – windows / doors **closed**	53 (when in use)	Yes (doors and windows to be closed when St Lukes Oval is in use)

Table 15: Noise Emissions from Internal Areas Buildings (Out of Hours Use / Evening - 6pm to 10pm)

Based on the above, doors and windows will need to be kept closed for Out of Hours Use when the St Lukes Oval is in use. Operation of the Hall Out of Hours (between 6pm and 10pm) complies with the relevant noise targets when the St Lukes Oval is not in use.

6.3.6 Car park upgrade and expansion

The Traffic Impact Assessment and data provided by PTC summarises vehicle activity within the CHS Western Car Park.

This car park will be expanded to offset lost space from the eastern car park which will be removed as part of the redevelopment:

CHS CAR PARK			
AM		PM	
Vehicles at car park	29	Vehicles at car park	29
Vehicles during peak 60 minutes	**29**	Vehicles during peak 60 minutes	**29**
Vehicles during peak 15 minutes	**12**	Vehicles during peak 15 minutes	**15**

Vehicles accessing the new Car Park will enter via Stanley Street.

There is no change to traffic generated on Stanley Street which will remain the same. Only the location of parking will change.

Assessment of Noise Impact on Surrounding Receivers

The predicted operational noise levels associated with the CHS Car Park are provided below.

Receiver	Predicted Noise Level $L_{eq\ (15\ min)}$ dB(A)	Day PNTL $L_{eq\ (15\ min)}$ dB(A)	Complies?
Residential (9 Crane Street)	45 (am) / 46 (pm)	49	Yes

Table 16: CWPS Car Park operational noise assessment results

This assessment considers the western boundary fence along the length of the car park which is a solid, 1.8 m high fence.

6.3.7 Block I Relocation

Block I is an existing uniform shop in a demountable building that is served by two wall mounted air conditioning units.

This will be relocated to allow for the car park expansion to the location identified in Figure 5. Noise from the existing demountable was measured to be 55 dB(A) at 1m from the condenser units.

Based on the proposed location, the noise at the nearest residential boundary is predicted to be 38 dB(A) which is compliant with the Daytime PTNL (of 49 dB(A)) for the project.

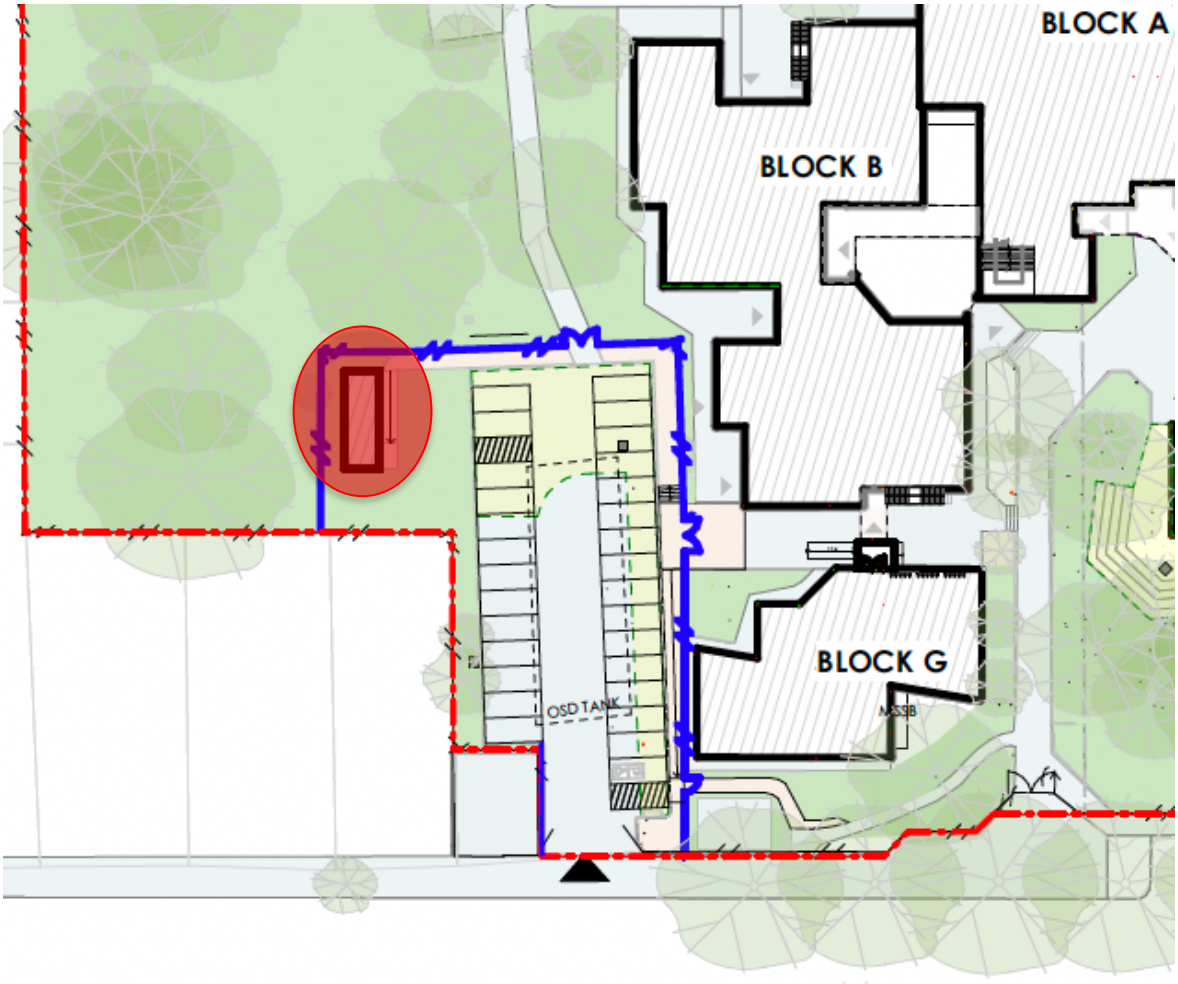


Figure 5: Car park expansion and Block I new location (in red)

7 External Noise Intrusion

Acoustic studio has carried out a high-level review of traffic noise around the proposed site. Traffic noise is identified as the main source of regular, continuous external noise.

Traffic noise levels were measured in the order of 66dB(A) $L_{eq\ 1hr.}$ at the Crane Street boundary of the school.

Based on the setback to the proposed buildings at the southern end of the school site, a standard façade (including standard single glazing with a performance of R_w 30-32) is sufficient to achieve internal recommended noise levels from traffic noise intrusion.

8 Construction Noise and Vibration Assessment

8.1 Proposed Hours

Proposed construction hours for the Project are during Standard Construction Hours outlined in the ICNG as follows:

8.1.1 Proposed Construction Hours

- Monday to Friday - 7:00am to 6:00pm
- Saturday - 8:00am to 1:00pm
- Sunday and Public Holidays – No works.

8.2 Description of Proposed Works

An indicative construction works summary has been developed by the Project Manager that outlines the key activities in each location. Based on this, it is anticipated that the key activities to occur for each area / stage are as shown in Table 17.

Main Tasks/ Activities	Typical Plant
Site establishment	Delivery Trucks (semi trailer) / Mobile Crane / Hand tools / Drills / Angle Grinders / Forklifts
Demolish Buildings	Excavator with hammer / Skip Trucks
Excavation / clearing	Excavators / Bobcats /Skip Trucks
Structure	Delivery Trucks (semi trailer) / Mobile Crane / Hand Tools / Drills Nail Gun / Saw / Concrete mixer trucks / Concrete Pump / Concrete Vibrator / Bore Piling
Façade & Roof	Delivery Trucks (semi-trailer) / Mobile Crane / Hand tools / Drills / Scissor Lift
Fit out	Hand tools / circular saw / angle grinders / Nail Gun / Hand tools / Drills
Remove Existing Demountable / Relocation of Building I	Delivery Trucks (semi trailer) / Mobile Crane / Hand tools / Drills / Angle Grinders
Landscaping	Masonry saw / excavators / Jackhammer / hand tools / drills / angle grinders / hammer drill / mobile crane
Car Park Extension	Excavators / Bobcats /Skip Trucks / Mobile Crane / Hand Tools / Drills / Nail Gun / Concrete mixer trucks / Concrete Pump / Concrete Vibrator

Table 17: Proposed Construction Tasks / Activities and Typical Plant

8.3 Construction Noise

The following sections outline the preliminary assessment carried out for construction noise emissions.

8.3.1 Noise Sources

The key noise sources for the activities occurring during construction works and the associated equipment sound power levels are listed in Table 18. These values are based on Acoustic Studio's database and the relevant Australian and International Standards including AS2436:2010 and BS5228-1:2009.

Equipment Type	Item	Typical Noise Level $L_{eq,15min}$ dB(A) SWL
Heavy Vehicles	Concrete Mixer trucks	109
	Hiab Truck	111
	Dump Truck (20 Tonne 35-50 Tonne)	107
	Dump Truck (Tipping Material)	117
	Delivery trucks (semi-trailers, rigid trucks)	105
	Tipper / Skip Truck	111
Site Machinery	Mobile Crane	111
	Bobcat	110
	Excavator (w/bucket)	113
	Excavator (with hammer)	119
	Forklift	104
	Piling / Drill Rig	116
	Concrete pump	110
	Concrete Vibrator	101
	Vibratory Roller	109
	Scissor Lift	98
Hand Tools	Angle Grinder	101
	Drill	91
	Hammer Drill	104
	Jackhammer	110
	Hand Tools (Electric)	99
	Circular saw	115

Table 18: Anticipated airborne noise levels for equipment / plant during construction works

Potential sources of vibration and ground-borne noise during the Project works include:

- Excavation and concrete hammering.
- Vibratory Rollers
- Piling Works.

Vibration and ground-borne noise impacts are likely to be highest during demolition and excavation, when equipment such as hammer attachments are used. Where practical, the contractor should aim to implement alternative low noise and vibration methods.

8.3.2 Sensitive receivers

Nearest sensitive receivers to the Project Site that will be potentially affected by noise and vibration are surrounding residential, commercial and educational premises as presented in Section 2.

Table 19 outlines the most critical receivers surrounding the site for each type of impact.

Receiver	Impact	Location	Typical Distance from construction site
Residential	Airborne + Vibration	West	3m[1] to 80m
	Airborne	South West	100m
	Airborne	North	35m[2] to 100m
Active Recreation	Airborne	East	10 to 50m
	Airborne	South	50 to 80m

Notes
1 – Location of Car park expansion works adjacent to 9 Stanley Street.
2 – Locations of Games Court works.

Table 19: Noise sensitive receivers and approximate distance to project construction works site

8.3.3 Construction Noise Assessment Methodology

A preliminary assessment of the likely noise impacts of the proposed works on the most-affected receivers surrounding the site has been carried out.

The assessment has considered the following:

- Typical activities considered in the noise impact assessment are as detailed in Section 0.
- Project specific Noise Management Levels at each sensitive receiver location as outlined in Section 5.4.1.
- Noise level predictions are calculated using the noise data provided in Table 18. Where multiple plant types exist (such as trucks) typical worst-case levels are applied.
- Noise level predictions consider:
    - Distance attenuation (nearest position on site to receiver)
    - Shielding
    - Ground and building reflections
    - Façade loss (for fit out works)
- The noise level predictions are based on assumptions that represent the worst-case scenario.
- L_{Aeq} noise levels are predicted for the operations of the nearest works area on the site to each of the nearest sensitive receiver location.
- Predictions consider the typical worst-case distances in Table 19.
- The predictions consider individual tasks and associated equipment from the nearest construction site boundary.
- The predictions assume continuous operation of equipment / plant over the 15-minute assessment period to provide a worst-case assessment, unless otherwise stated.

8.3.4 Assessment Results

Construction Noise – Main Works

Table 20 presents the results for the construction noise assessment at surrounding receivers based on typical plant and equipment outlined in Section 8.3.1 operating within the boundary of the construction works site.

Location		Residential			Active Recreation		Comments
		West	South West	North	East	South	
NML		**54**[2] **/ 52**[3]	**54**Error! Bookmark not defined. **/ 52**Error! Bookmark not defined.	**62**Error! Bookmark not defined. **/ 63**Error! Bookmark not defined.	**65**	**65**	
Construction		**Predicted equipment noise levels at surrounding community receivers, in $L_{eq,15min}$ dB(A)**					
Site Establishment	Trucks	61	59	59 - 68	79	65	Primary noise contributors above NMLs are lifting machinery (forklift and crane).
	Mobile Crane	65	63	63	83	69	
	Hand Tools / Drills	56	54	54	74	60	
	Grinder	55	53	53	70	62	
	Forklift	60	58	58	87	76	
Demolition	Excavator with Hammer	73	71	71	91	77	Primary noise contributors above NMLs are excavators with hammer attachments. Use the smallest excavator and hammer that is practical whilst remaining efficient (i.e. reduce noise level without significantly extending duration)
	Excavator with bucket / Backhoe / Front loader	67	65	65	84	71	
	Skip Trucks	61	59	59 - 68	79	65	
Excavation Clearing	Excavator with bucket / Backhoe / Front loader	67	65	65	84	71	Primary noise contributors above NMLs are excavators. Use the smallest excavator that is practical whilst remaining efficient (i.e. reduce noise
	Bobcat	64	62	62- 70	82	68	
	Skip Trucks	61	59	59 - 68	79	65	

[2] Project specific "Recommended Standard Hours" NMLs for Monday to Friday

[3] Project specific ""Recommended Standard Hours" NMLs for Saturday

Location		Residential			Active Recreation		Comments
		West	South West	North	East	South	
NML		54[2] / 52[3]	54Error! Bookmark not defined. / 52Error! Bookmark not defined.	62Error! Bookmark not defined. / 63Error! Bookmark not defined.	65	65	
Construction		Predicted equipment noise levels at surrounding community receivers, in $L_{eq,15min}$ dB(A)					
							level without significantly extending duration)
Structure	Drilling / Piling Rig	70	68	68	88	74	Primary noise contributors above NMLs are Piling Rig / Concrete mixer and pumps. Consider location of equipment and site hoarding / localised hoarding that can reduce noise by 5- 10 dB.
	Mobile Crane	65	63	63	83	69	
	Concrete Mixer Truck / Delivery trucks	61	59	59 - 68	80	66	
	Concrete Pump	67	65	65 - 73	82	71	
	Concrete Vibrator	61	59	59	73	65	
Façade and Roof	Delivery trucks	61	59	59 - 68	80	66	Primary noise contributors above NMLs are mobile cranes and trucks. Consider locations, loading / parking bays and lifting points to minimise noise impact on surrounding receivers. Use equipment without beepers where practical (i.e. with 'quacker' alarms)
	Mobile Crane	65	63	63	83	69	
	Hand Tools / Drills	56	54	54	74	60	
	Scissor Lift	56	54	54	74	60	
Fit out	Hand Tools / Drills	31	29	29	59	36	Minor excess at the St Luke's Oval Boundary.
	Circular Saw	47	45	45	69	55	
	Grinder	30	28	28	45	38	
	Nail Gun	38	36	36	56	59	

Location		Residential			Active Recreation		Comments
		West	South West	North	East	South	
NML		54[2] / 52[3]	54Error! Bookmark not defined. / 52Error! Bookmark not defined.	62Error! Bookmark not defined. / 63Error! Bookmark not defined.	65	65	
Construction		**Predicted equipment noise levels at surrounding community receivers, in $L_{eq,15min}$ dB(A)**					
Removal of Existing Demountable	Trucks	61	59	59 - 68	79	65	Primary noise contributors above NMLs are mobile cranes and trucks. Consider locations, loading / parking bays and lifting points to minimise noise impact on surrounding receivers. Use equipment without beepers where practical (i.e. with 'quacker' alarms)
	Mobile Crane	65	63	63	83	69	
	Hand Tools / Drills	56	54	54	74	60	
	Grinder	55	53	53	70	62	
	Forklift	60	58	58	87	76	
Landscape	Jackhammer	67	65	65	82	71	Primary noise contributors above NMLs are jackhammers. Consider minimising usage or alternative quieter methods and localised hoarding that can reduce noise by 5-10 dB.
	Hand Tools / Drills	56	54	54	74	60	
	Circular Saw	72	70	70	94	80	
	Grinder	55	53	53	70	62	
	Mobile Crane	65	63	63	83	69	

Table 20: Predicted equipment/plant noise levels at the nearest surrounding community receiver locations – Levels predicted to exceed the NMLs are in red

Construction Noise – Car Park Expansion and Building I Relocation

Location		Residential			Active Recreation		Comments
		West	South West	North	East	South	
NML		**54 / 52**	**54 / 52**	**62 / 63**	**65**	**65**	
Construction		**Predicted equipment noise levels at surrounding community receivers, in $L_{eq,15min}$ dB(A)**					
Car Park	Concrete Mixer Truck	72 - 80	67	52	50	67	Noise levels are high due to the proximity of works to the nearest house. Relative to other works, the duration of the car park works will be shorter. Noise levels at all other houses to the west are predicted to be at least 13 dB quieter. Consider localised hoarding around the works including portable systems such as 'Echo Barrier'.
	Excavator with bucket / Backhoe / Front loader	77 - 90	72	57	55	71	
	Bobcat	74 -83	69	54	53	69	
	Concrete Pump	77 - 85	72	57	55	72	
	Concrete Vibrator	65 - 78	61	45	43	61	
	Vibratory Roller	74 -83	69	54	53	69	
Building I Relocations	Mobile Crane	75 - 80	70	55	53	70	Primary noise contributors above NMLs are mobile cranes. This noise impact will be of short duration for the Building I relocation.
	Grinder	60 - 65	59	40	38	59	
	Hand Tools / Drills	61 - 66	57	41	39	57	
	Nail Gun	73 - 78	68	53	51	68	

Table 21: Predicted equipment/plant noise levels at the nearest surrounding community receiver locations – Levels predicted to exceed the NMLs are in red

Construction Traffic Noise

Construction-related general road traffic is a temporary noise source but one which requires assessment and management, particularly for heavy vehicles accessing the site.

Truck arrivals to, and departures from, site should be scheduled to occur outside the busiest traffic periods, but where possible should also avoid noise-sensitive time periods.

Separately from the noise impacts quantified in Section 8, potential noise impacts from general construction traffic needs to be considered.

The temporary additional traffic increase due to construction will be minimal, totaling less than 50% additional vehicles to the existing traffic. The increases in road traffic due to construction will result in below the 2 dB increase considered to be noticeable from the RNP.

However, it is also important to recognise that heavy vehicles associated with construction can generate maximum noise levels which are higher than general car traffic, and can lead to greater disturbance than cars.

Access routes should be limited to main roads and avoid local residential streets. Engine braking should be avoided, speed limits strictly observed, and heavy braking and accelerating avoided.

These noise avoidance driver behaviours may need to be enforced through observation and monitoring, and all contractors and subcontractors are to be made aware of the need for noise-considerate driver behaviour when travelling to and from the work site.

Noise from construction traffic should be dealt with by appropriate management measures that minimise noise impact. This includes:

- Staging and managing arrival of trucks to avoid queueing and idling on public streets;
- Arriving at and departing from the site via designated routes that avoid or minimise the use of local roads;
- Minimising reversing to minimise the use of movement alarms (“reversing beepers”) and / or incorporating quacker alarms;
- Minimise the use of engine braking and to avoid noise actions such as slamming doors, loud radios, shouting or the use of truck horns for signalling.

Further information on construction traffic is addressed in the Construction Traffic Management Plan, prepared by the traffic consultant for the project.

8.3.5 Summary of Noise Assessment Findings and Discussion of Noise Controls During Construction

Based on the results from the high-level assessment based on the indicative works, we make the following comments:

- Main Works
    - Construction noise impacts will be highest at the adjacent **Active Recreation** areas to the east of the site with noise levels predicted up to 29 dB above NML's and above Highly Affected Noise Levels. It is noted that based on usage observations from Google, the adjacent St Lukes Oval is typically not in use during the day period and mostly used for early in the evening period on weekdays.
    - Construction works noise at surrounding **residential receivers** will be similar in noise level in all directions, however the highest impact to more sensitive residential noise receivers to the west on Stanley Street. Noise from various plant and equipment operating individually are generally predicted to be above the NMLs due to the proximity to the nearest affected receivers but generally within the "Highly Noise Affected" noise levels. The worst-case noise impacts are for excavators with hammers with noise levels predicted to be above the NMLs by up to 18 to 20 dB.
    - Considering the above typical worst case, it is noted that:
        - the predictions for noise levels above NMLs is not unusual given the heavy plant and equipment that must be used, such as excavators and hammers, and the proximity to sensitive receivers (some of which are within 5m).
        - for the majority of the time, noise levels from operations of various plant and equipment are *predicted to be 3-5 dB lower* when location of activities within the site boundary are further away from a particular receiver.
        - Noise mitigation measures such as hoarding for certain activities can provide another 5 – 10 dB reduction.
- Car Park and Building I Relocations
    - Construction noise impacts will be highest at the adjacent residential noise receiver at **9 Stanley Street** with noise levels predicted up to 29 dB above NMLs and above Highly Affected Noise Levels at the nearest point. However, it is noted that:
        - all other residential locations will be at least 13 dB lower.
        - works for the car par expansion and Building I impacts will be relatively short in duration compared to the main works.
        - the predictions for noise levels above NMLs is not unusual given the heavy plant and equipment that must be used, such as excavators and hammers, and the proximity to sensitive receivers (some of which are within 5m).
        - Noise mitigation measures such as hoarding for certain activities can provide another 5 – 10 dB reduction.

Project Noise Mitigation Measures

Based on the above the following noise control measures shall be incorporated and included in an updated Construction Site Management Plan.

The following mitigation controls shall be implemented:

- Consider the specific noise mitigation measures outlined in Table 20 and Table 21.
- **Scheduling, Duration and Respite Periods**
    - Where practical and feasible, schedule noisier activities that cannot be shielded by acoustic curtains / hoarding to occur at less sensitive periods of the day (i.e. not early morning or late afternoon) .
    - Including Respite Periods where activities are found to exceed the 75 dB(A) Highly Affected Noise Level at receivers, such as 3 hours on and 1 hour off.
- **Noise Barriers or Screening** – Incorporate shielding via site hoarding around the site and / or operate equipment behind localised hoarding or a noise curtain for up to 10 dB noise reduction (depending on how well the curtains block line of sight to the receiver. This is generally effective for most activities and can bring some activities to within the project NMLs.
- **Alternative construction methodology or equipment**
    - Use electric handheld tools where possible, rather than petrol or diesel tools.
    - Select the quietest available plant and equipment capable of carrying out the activity efficiently.
- **Communication -** Inform affected residential receivers about the timing and duration of planned works.
- **Complaints management** shall be addressed as noted in Section 8.6.3
- Implementation of all reasonable and feasible mitigation measures for all works will ensure that any adverse noise impacts to surrounding residential receivers are minimised when NMLs cannot be met due to safety or space constraints.
- Further general noise controls are discussed in the following sections.

Other Considerations

It is important to recognise that the actual noise levels generated during the construction works are likely to vary considerably depending on many factors including:

- Number of items of plant and equipment operating simultaneously.
- Location of equipment on the site – relative to the noise-sensitive receivers.
- Shielding of noise provided by structures and hoardings on and around the site.
- Reflections provided by existing structures on and around the site.
- Meteorological conditions.

When construction and excavation works are likely to exceed stated criteria at nearest sensitive receivers, particularly when works occur in the areas closer to the nominated receiver, all feasible and reasonable noise control measures are to be considered.

If, during construction works, an item of equipment exceeds either the NML at any location or the maximum recommended equipment noise levels, the following noise control measures, together with construction best practices presented in Section 8.5 shall be considered to minimise the noise impacts on the neighbourhood:

- Consider implementing equipment-specific temporary screening for noisy equipment, or other noise control measures recommended in Appendix E of AS2436. This is most likely to apply to noisier items such as jackhammers.
- For large work areas, solid screening or hoarding as part of the worksite perimeters would be beneficial.
- Locate specific activities such as carpentry areas (use of circular saws etc) to internal spaces or where shielding is provided by existing structures or temporary screening.
- Managing the arrival of trucks and heavy vehicles on site at any given time (through scheduling deliveries at different times).
- Unnecessary idling of vehicles and equipment is to be avoided.
- Traffic routes are to be prepared to minimise the noise impact on the community (such as entry and exit point at different locations on the site and access via separate roads where practical).
- When loading and unloading trucks, adopt best practice noise management strategies to avoid materials being dropped from a height.
- Adopt quieter methodologies. For example, where possible, use concrete sawing and removal of sections as opposed to jackhammering.
- Ensure that any miscellaneous equipment (extraction fans, hand tools, etc), not specifically identified in this assessment, incorporates silencing/shielding equipment as required to meet the noise criteria.

Implementation of all reasonable and feasible mitigation measures for all works will ensure that any adverse noise impacts to surrounding residential, commercial and recreational receivers are minimised when Noise Management Levels cannot be met due to safety or space constraints.

It is recommended that a comprehensive CEMP is prepared further to this assessment. The engaged Contractor would be required to prepare a comprehensive CEMP based on their proposed plant, equipment and construction methodology, prior to the commencement of any works.

8.4 Construction Vibration

When considering the vibration impact associated with construction works, the following is to be taken into account.

- The type of vibration generating equipment.
- Geotechnical characteristics of the site.
- The layout of the site, including the location of static sources of vibration.
- Techniques used in construction to minimise generated vibration levels.
- Hours of work with regard to the nature of operations in the affected buildings and the duration of the works.

8.4.1 Summary of Vibration Assessment and Discussion of Vibration Controls During Construction

A detailed vibration assessment has not been carried out at this stage, as actual vibration levels experienced will be dependent upon:

- Site and strata characteristics
- Specific construction equipment used
- Vibration requirements of sensitive equipment
- Activities that have the potential to generate ground-borne vibration during the construction works include:
    - Excavator hammer
    - Jackhammer
    - Piling
    - Vibratory Roller (if used)
- The above is based on typical equipment expected to be required for the scope of works and it is noted that alternatives may be used. There is potential for human perception vibration impacts on nearby Concord HS buildings and the residential dwelling adjacent to the car park (if a vibratory roller is used for the car park works). For the above equipment, the Contractor should consider all feasible and reasonable options or alternative options to minimise vibration impact. There is requirement to review works processes during detailed works planning to ensure that minor cosmetic impacts to structures are avoided – particularly from the use of excavators with hammers near the existing Concord HS. The significance of these impacts will need to be determined as part of the CEMP prepared by the Contractor.

Final details of the vibration management controls required for the works would be determined when the CEMP is prepared by the Contractor.

On campus buildings present the most stringent vibration criteria, particularly given their proximity to the Project Site. Controlling vibration at these receivers will also ensure that vibration criteria at all other receivers will also be satisfied.

The Contractor would be required to prepare a final CEMP based on their proposed plant, equipment and construction methodology.

8.5 General Control elements

8.5.1 Noise

As a general rule, prevention is to be applied as universal work practice at any time of day, but especially for the occasional construction works to be undertaken at critical times outside normal daytime/weekday periods.

It is noted that the reduction of noise at the source and the control of the transmission path between the construction site and the receiver(s) are the preferred options for noise mitigation/minimisation. Providing treatments at the affected residences or other sensitive land uses is to be only considered as a last resort. Construction noise shall be managed by implementing the strategies listed below:

- Plant and equipment
    - Use quieter methods.
    - Use quieter equipment.
    - Operate plant in a quiet and effective manner.
    - Where appropriate, limit the operating noise of equipment.
    - Maintain equipment regularly.
    - Where appropriate, obtain acoustic test certificates for equipment.
- On-site noise management
    - Strategically locate equipment and plant.
    - Avoid the use of tonal reversing alarms or provide for alternative systems (such as broadband reversing alarms).
    - Maximise shielding in the form of existing structures or temporary barriers.
    - Schedule the construction of barriers and structures so they can be used as early as possible.
    - Brief Project staff and workers on the noise sensitivity of the neighbours to the site, particularly the residents nearby. The staff and workers need to be mindful of the noise from their discussions and colour of the language, particularly in sensitive periods, for example, during the pre-start times or "toolbox talk" as they gather to commence for work in the morning.
- 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.
- Work scheduling
    - Schedule activities to minimise noise impacts.

- Ensure periods of respite are provided in the case of unavoidable maximum noise levels events.
- Keep truck drivers informed of designated routes, parking locations and delivery hours.

8.5.2 Vibration

At this stage, we anticipate that there is potential for construction works to result in some human perception vibration impacts – particularly from the use of excavators with hammers near existing buildings.

Vibration management controls required for the works would be determined when the CEMP is prepared by the Contractor.

All practical means are to be used to minimise impacts on the affected buildings and occupants from activities generating significant levels of vibration on-site.

The following considerations shall be taken into account:

- Modifications to excavation and construction equipment used.
- Modifications to methods of excavation and construction.
- Rescheduling of activities to less sensitive times.

If the measures given above cannot be implemented or have no effect on vibration levels or impact generated, a review of the vibration criteria is to be undertaken and the vibration management strategy amended.

8.5.3 Vibration surveys

Since the actual vibration levels experienced will be dependent upon the site characteristics and the specific equipment being used, early vibration level checks are to be carried out on site at the outset of each key vibration generating activity (if vibration is considered to be an issue).

8.5.4 Additional Noise and Vibration Control Measures

All practical means should be used to minimise impacts on the affected buildings and occupants from activities generating significant levels of vibration on site.

If, during construction, an item of equipment exceeds either the NML at any location or the maximum recommended equipment noise levels, the following noise control measures, together with construction best practices presented in Section 8.5.1, shall be considered to minimise the noise impacts on the neighbourhood.

- Modifications to construction equipment used:
    - Avoid the use of large excavators – use the smallest size practicable;
    - Avoid the use of vibratory rollers – switch off vibration mode, or use the smallest size practicable if vibration must be employed;
    - Avoid the use of tracked vehicles on site, where practicable, particularly large tracked excavators and cranes – use vehicles with tyres.
- Modifications to methods of construction:
    - Saw cutting can be considered for rock removal rather than conventional rock hammering techniques to limit vibration when close to vibration sensitive locations.
- Schedule noisy activities to occur outside of the most sensitive times of the day for each nominated receiver. For example, residential receivers are likely to be more sensitive to noise before 9 am than the other receivers.
- Consider implementing equipment-specific screening or other noise control measures recommended in Appendix E of AS2436.
- 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 assessment incorporates silencing/shielding equipment as required to meet the noise criteria.
- Minimise noise from workers as discussed in Section 8.5.1.

Implementation of all reasonable and feasible mitigation measures for all construction works will ensure that any adverse noise impacts to surrounding residential, commercial and recreational receivers are minimised when noise goals cannot be met due to safety or space constraints.

8.6 Noise and vibration monitoring

8.6.1 Noise monitoring

The Contractor is to consider implementing environmental noise monitoring at the reasonably most affected residential noise receivers from the construction works (adjacent to the school at 9 Stanley Street).

8.6.2 Vibration monitoring

A vibration monitoring system is to be implemented if required. This system would monitor vibration levels when there is potential for them to change. This could happen in various situations, such as, changes in equipment and activities or changes to work procedures that might affect existing vibration control measures. The monitoring procedure would be carried out with appropriate equipment so that results obtained are readily comparable with results obtained earlier. If results indicate vibration levels exceeding VMLs appropriate action is to be taken.

8.6.3 Communication and complaints

The Contractor is to establish a communication register for recording incoming complaints. The registration of a particular item will remain open until the complaint has been appropriately dealt with.

In addition, the following procedures are an example of the procedures that are to be specifically adopted for complaints relating to noise.

Upon receipt of a complaint the Contractor is to:

- Try to ascertain from the complaint which appliance is causing the problem i.e. inside or outside the site and in what position.
- Move machinery if the allowable levels have been exceeded or take other acoustic remedial action.

If the activity is occurring outside normal working hours, the activity is to be immediately stopped. Where stopping the activity would create a safety issue the activity may be permitted to continue only as long as is necessary to make the area safe. The activity is to then cease.

Any activity that is directed to cease due to excessive noise is not to recommence until the Project Manager is satisfied that the noise and vibration target requirements can be met and has given permission to recommence the activity.

The Site Supervisor is to ensure that a report of any incident is provided to the Project Manager.

The Contractor is to provide a 24-hour telephone contact number and this number is to be prominently displayed on the site.

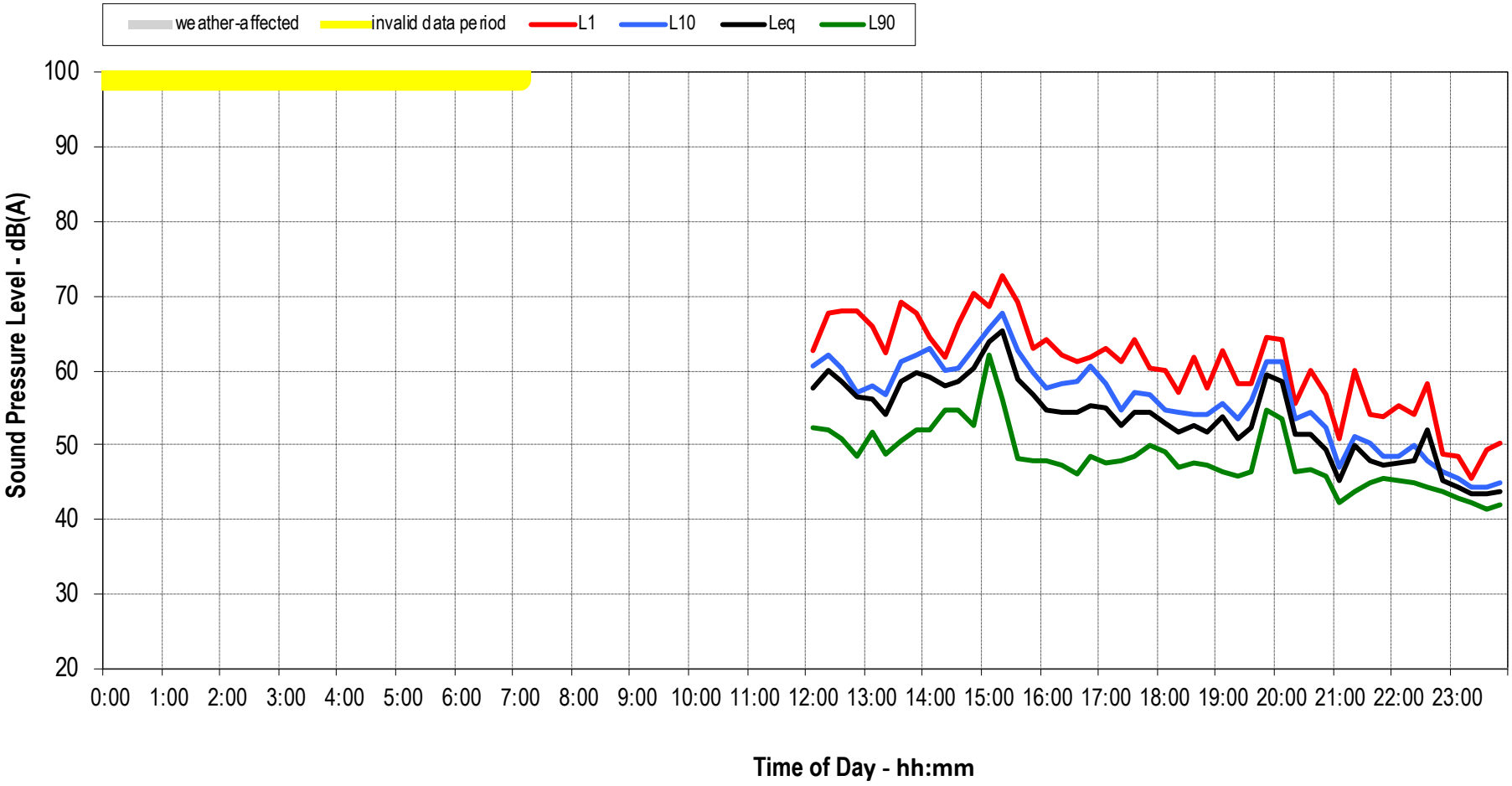
8.7 Non-compliances

Non-compliance reports can be used as appropriate to deal with failures to meet the construction noise and vibration management and control requirements.

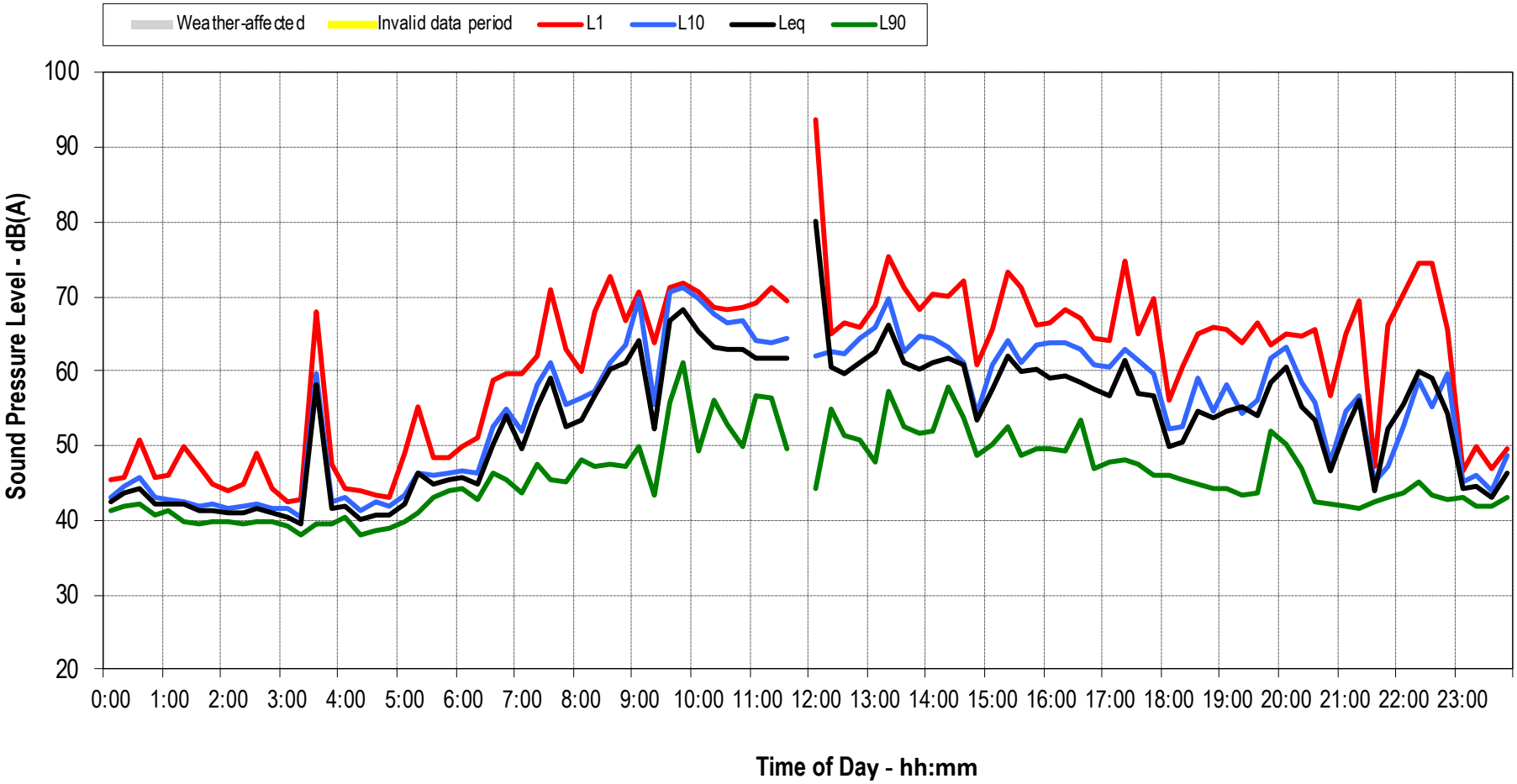
Appendix A – Ambient Noise Monitoring Data

Stanley Street

Stanley Street - Monday 06 March 2023



Stanley Street - Tuesday 07 March 2023



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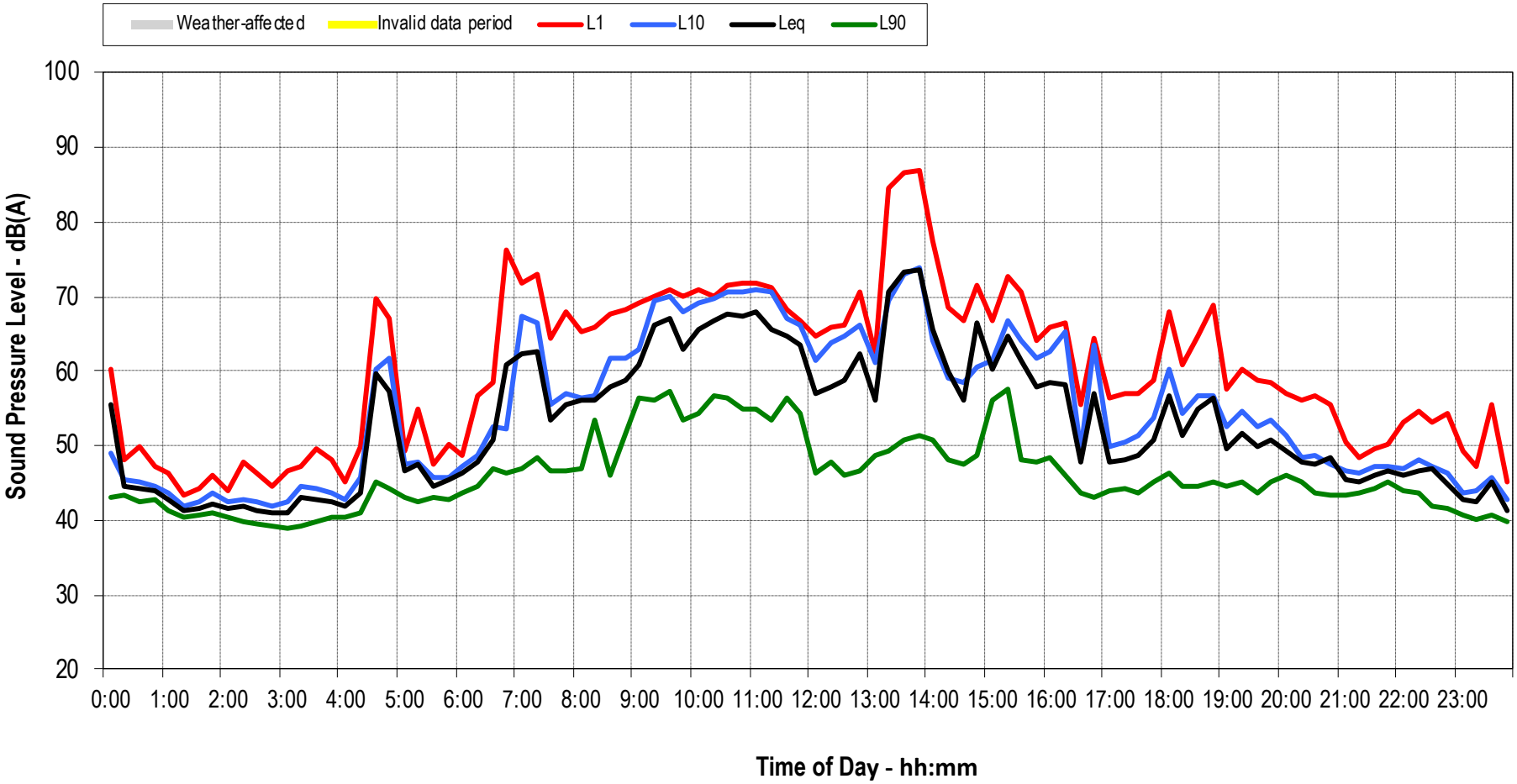

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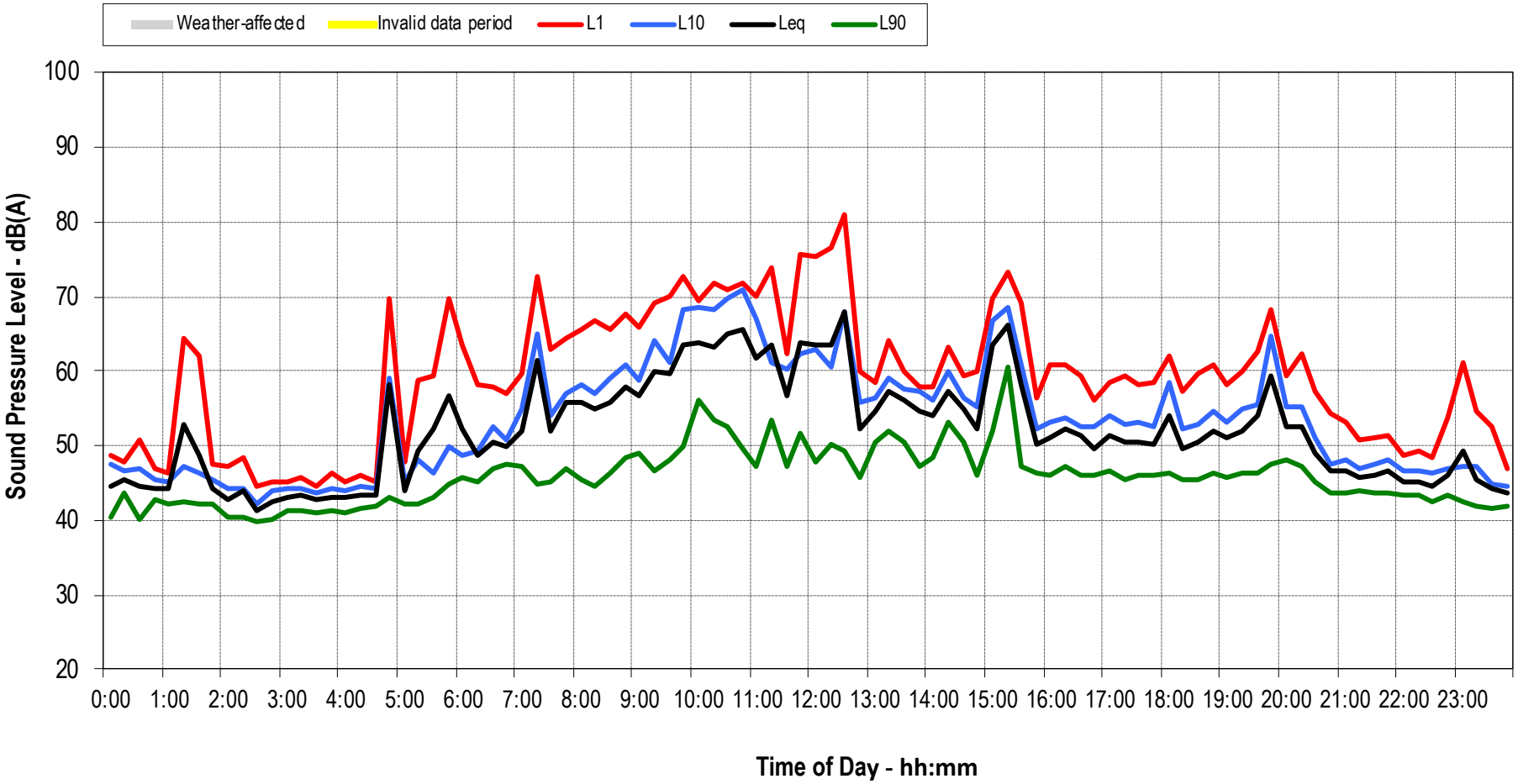

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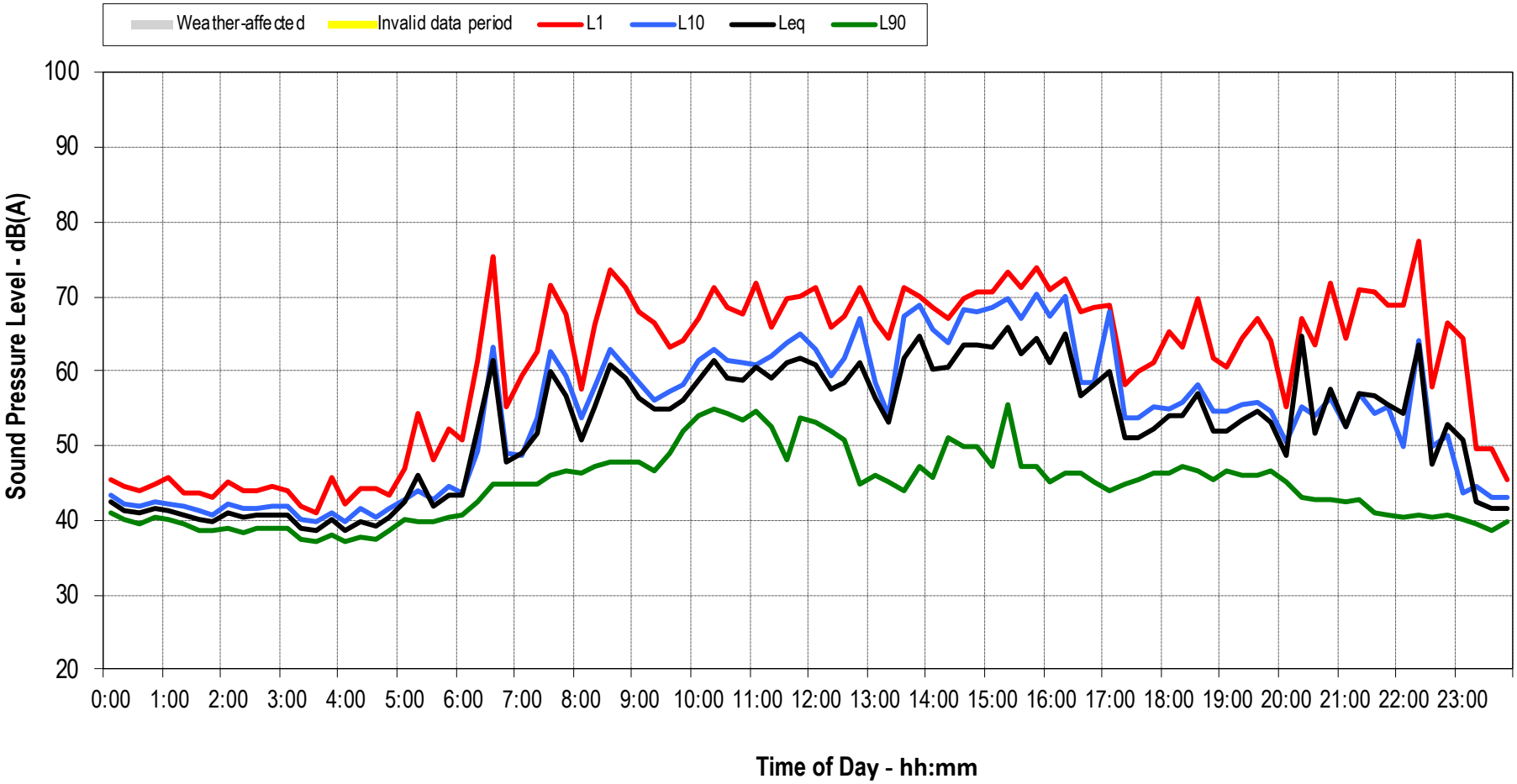

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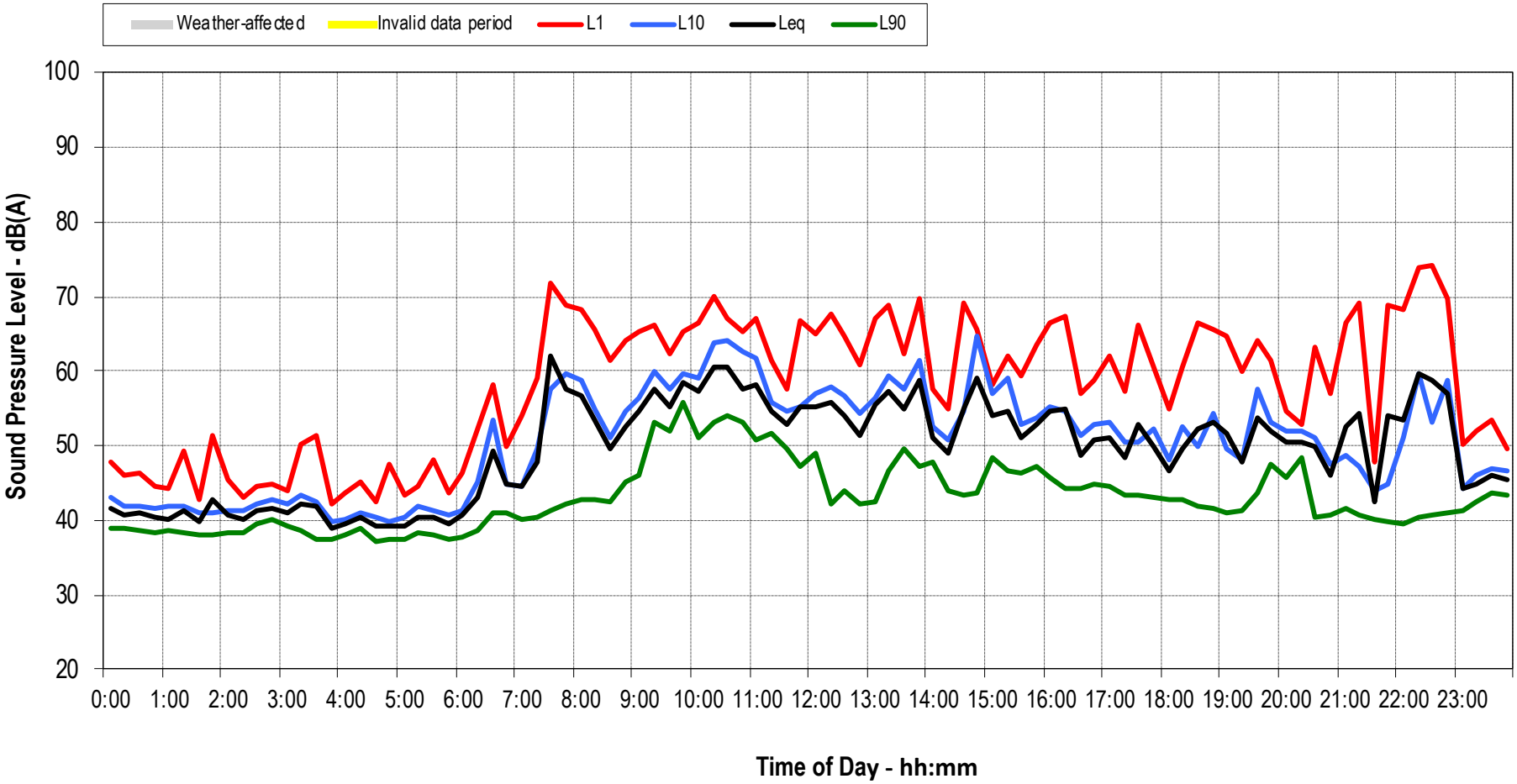

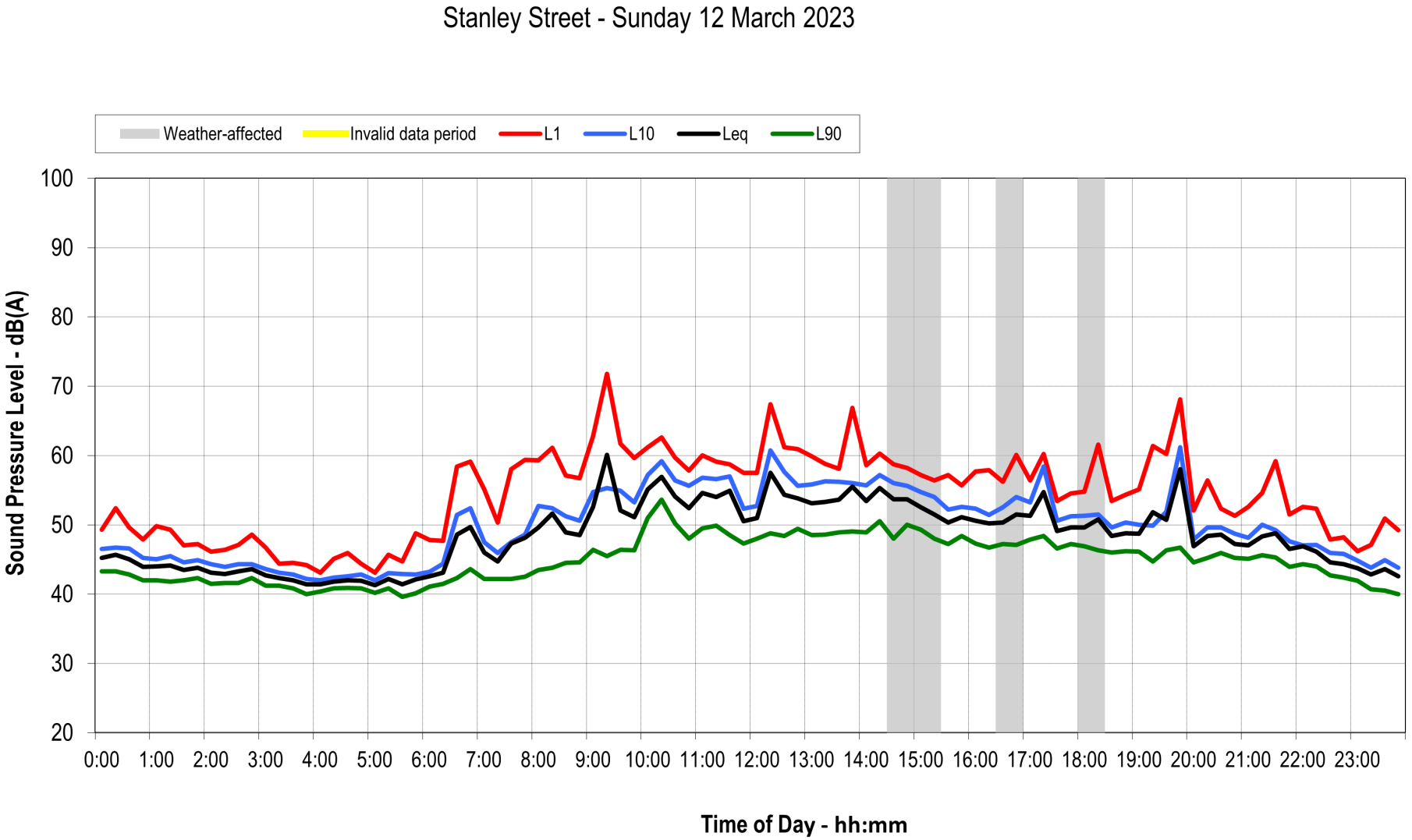
Stanley Street - Sunday 12 March 2023
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Leq
L90
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30
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4:00
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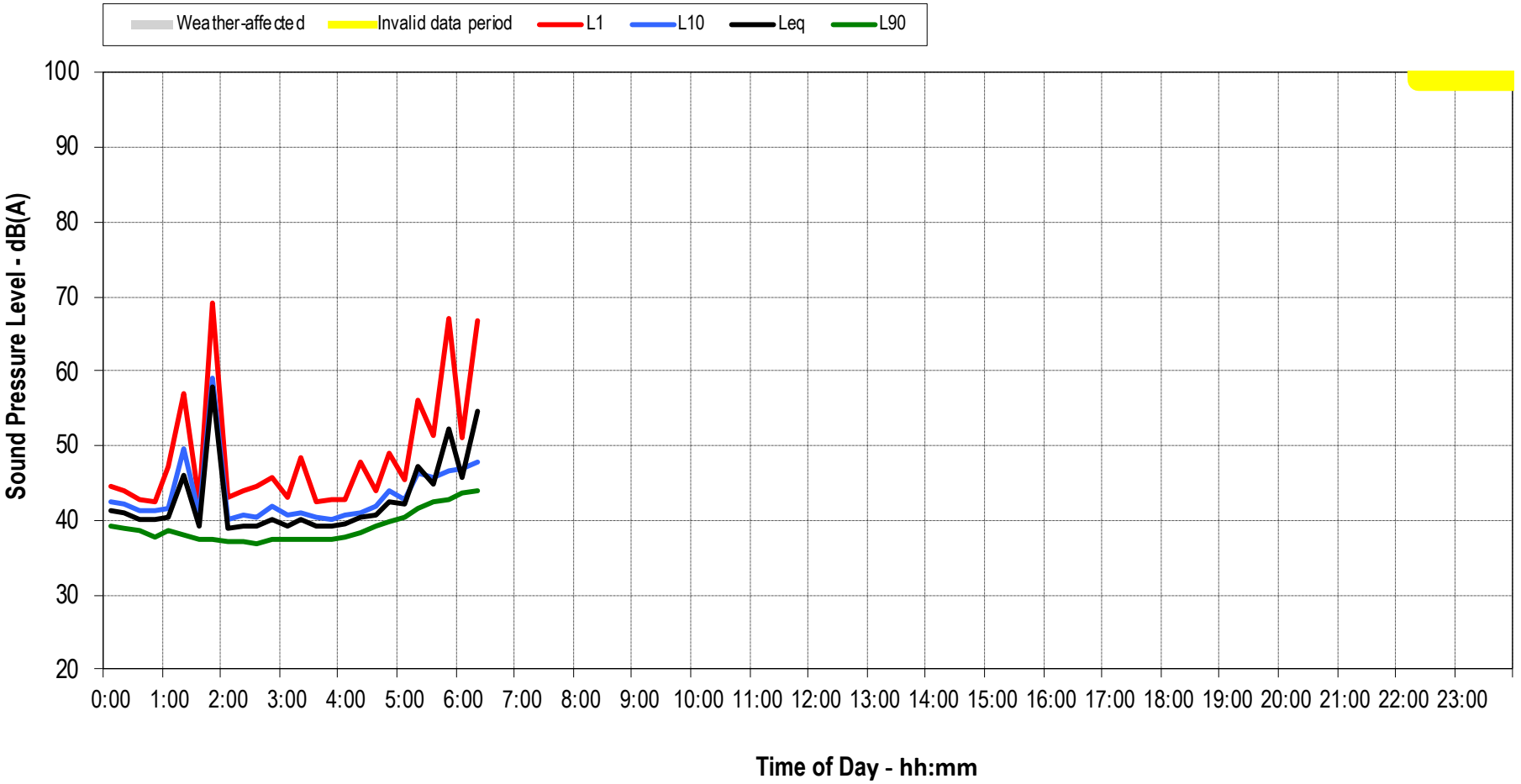
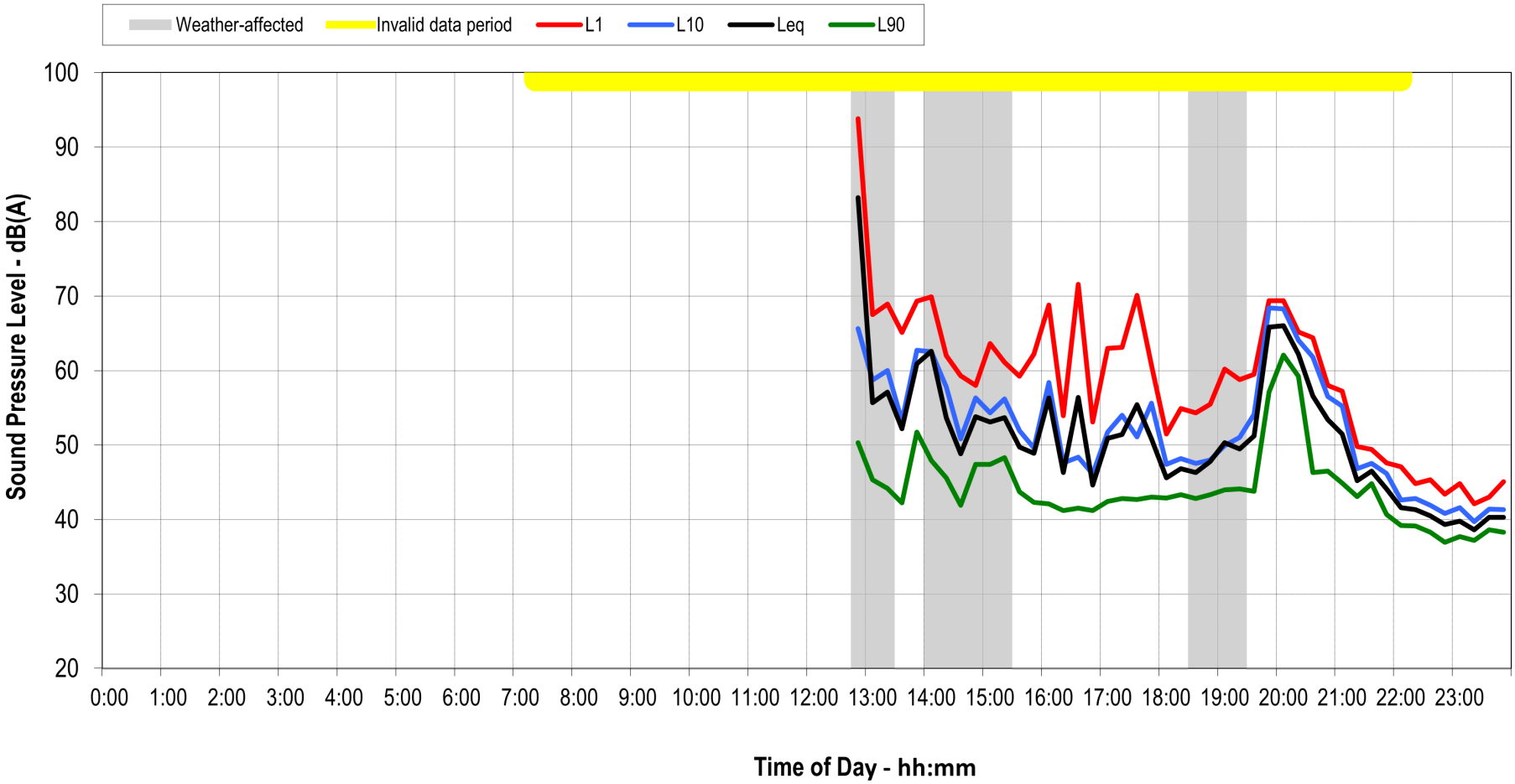
Stanley Street - Monday 13 March 2023

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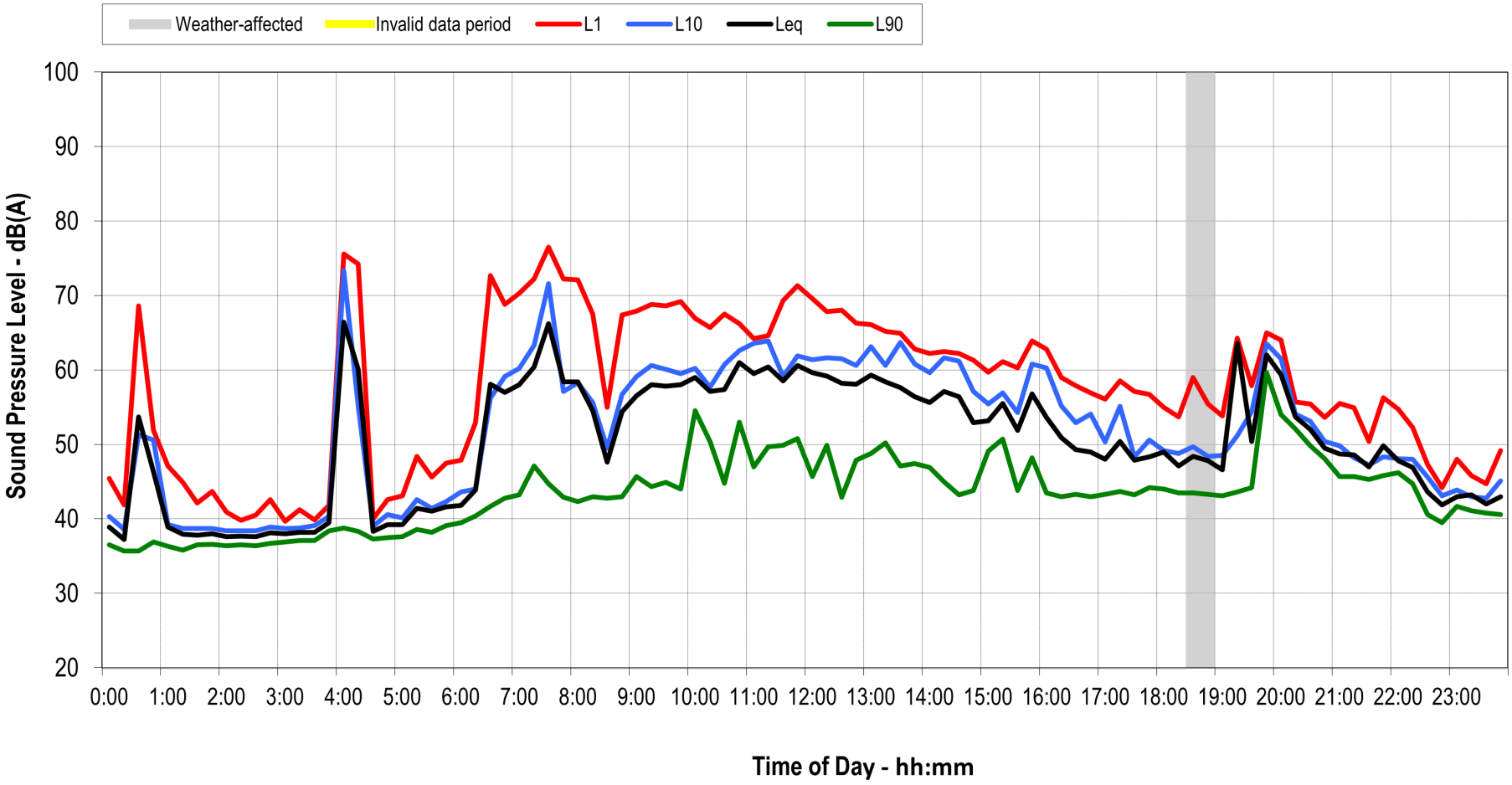

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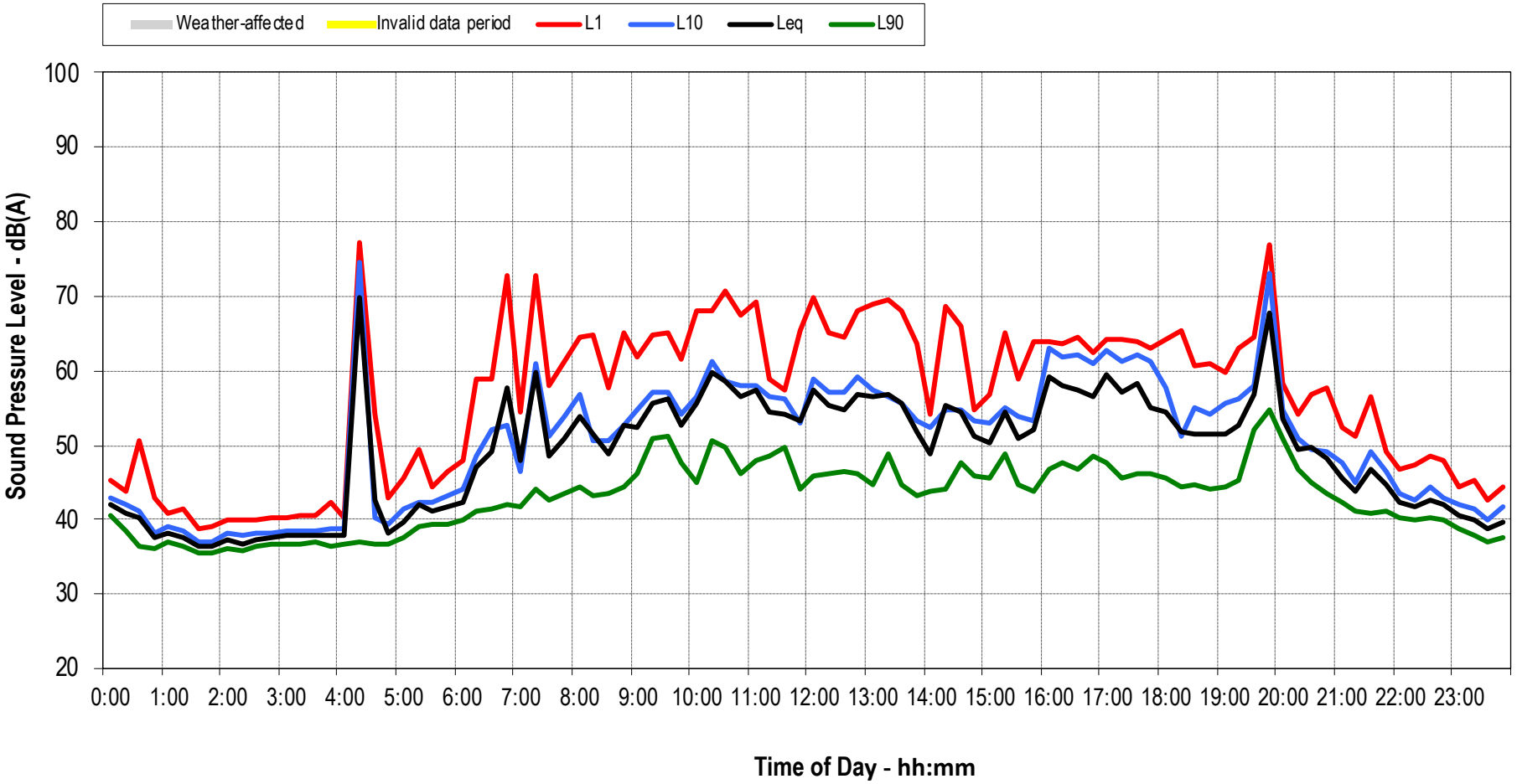

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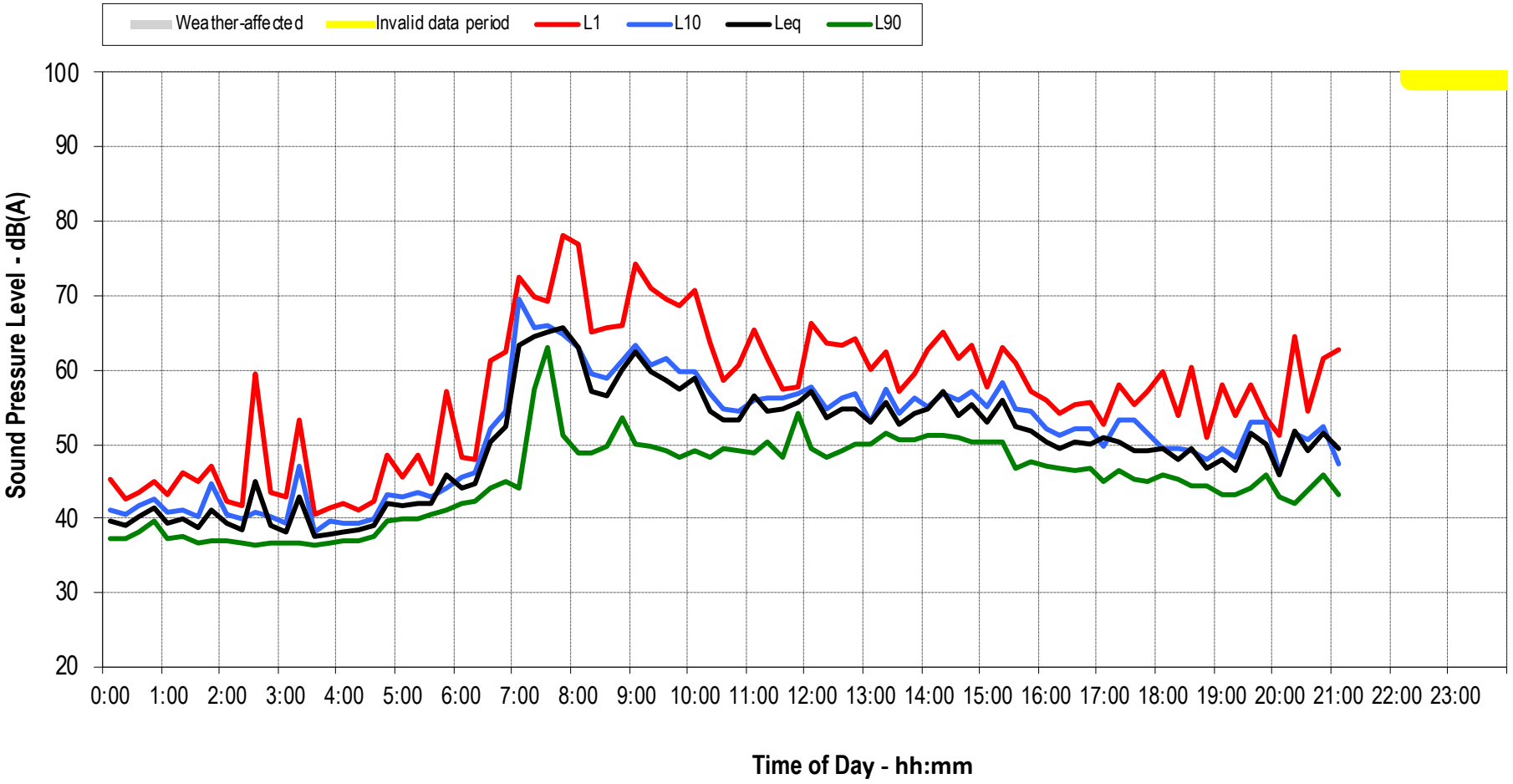

Crane Street

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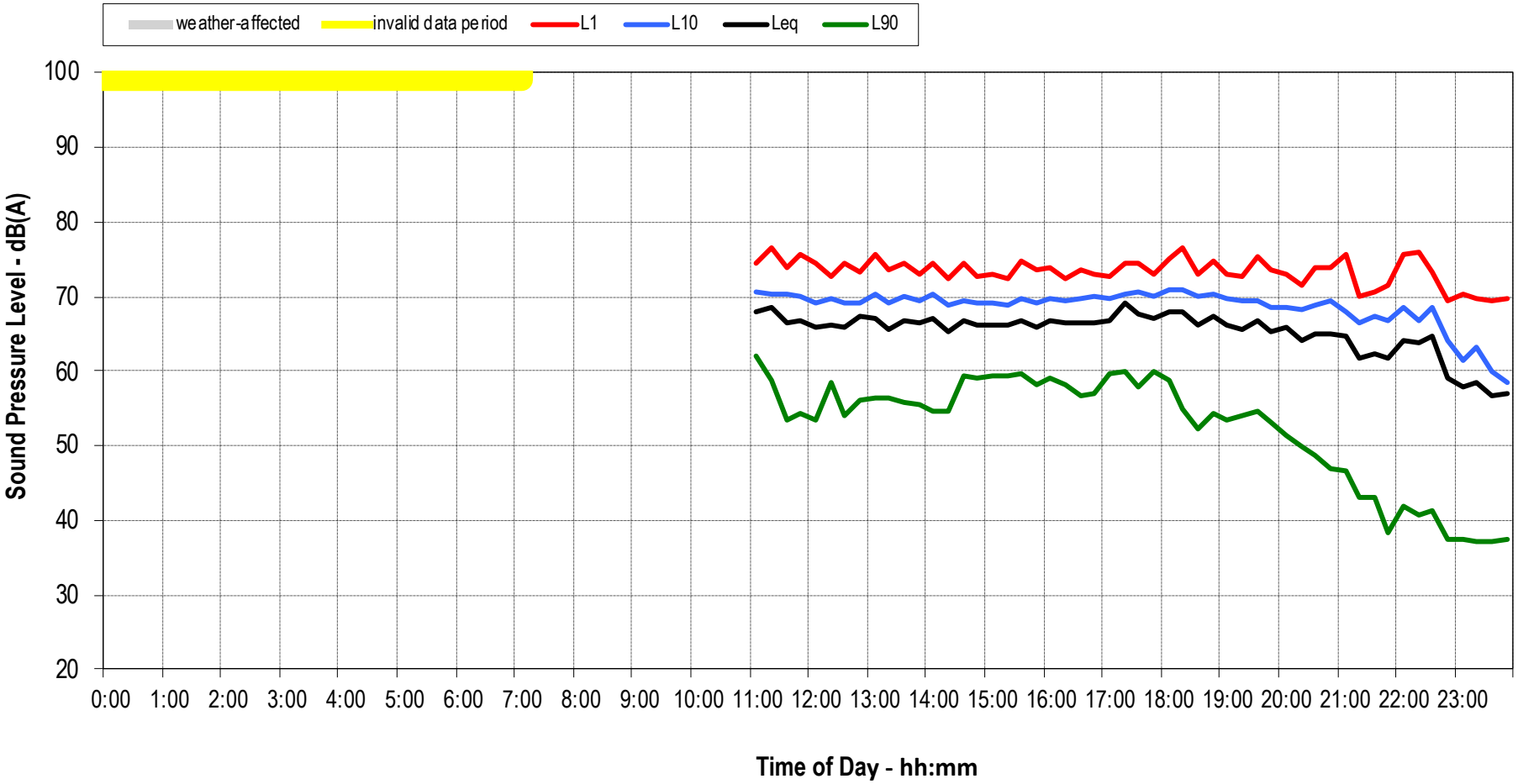

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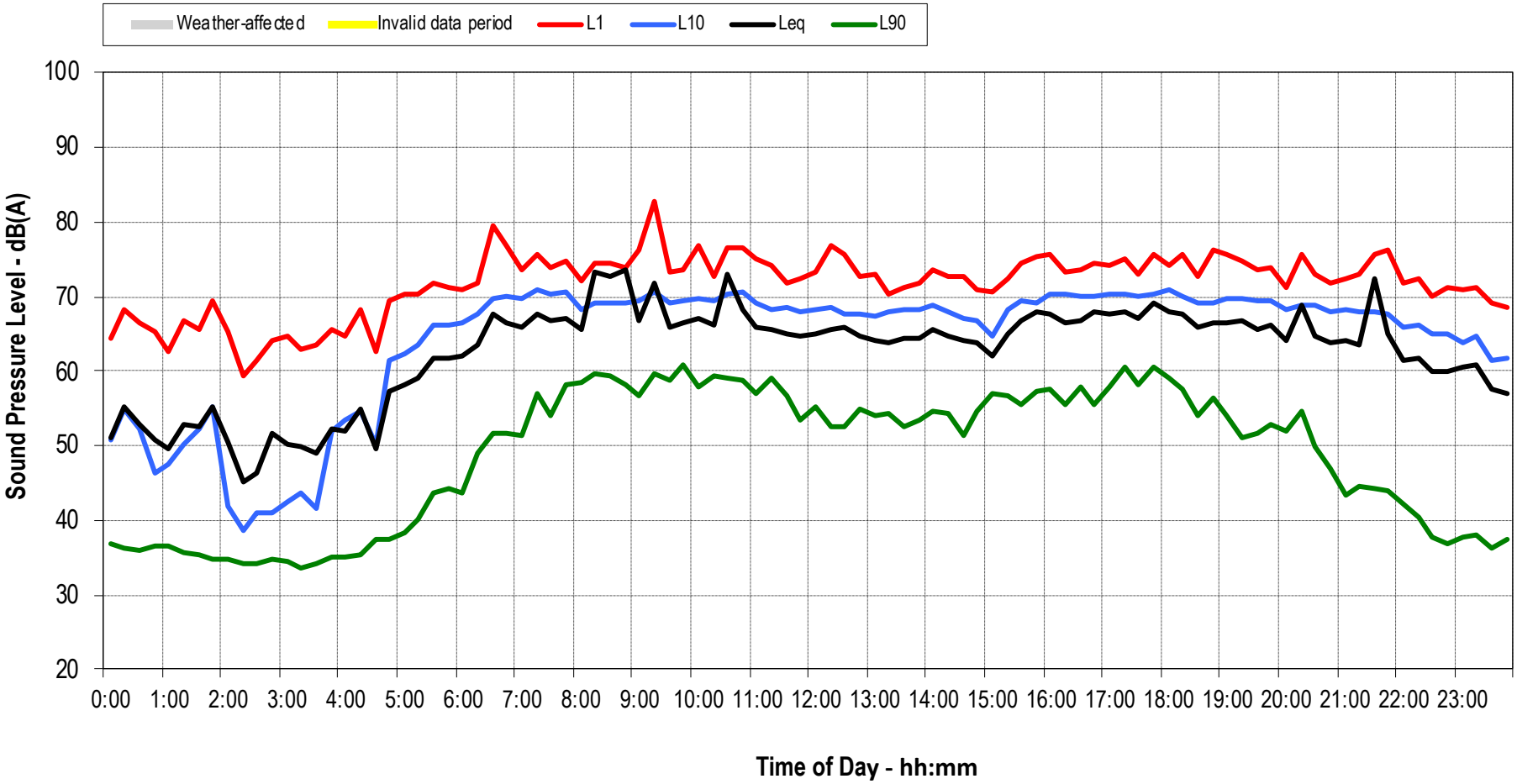

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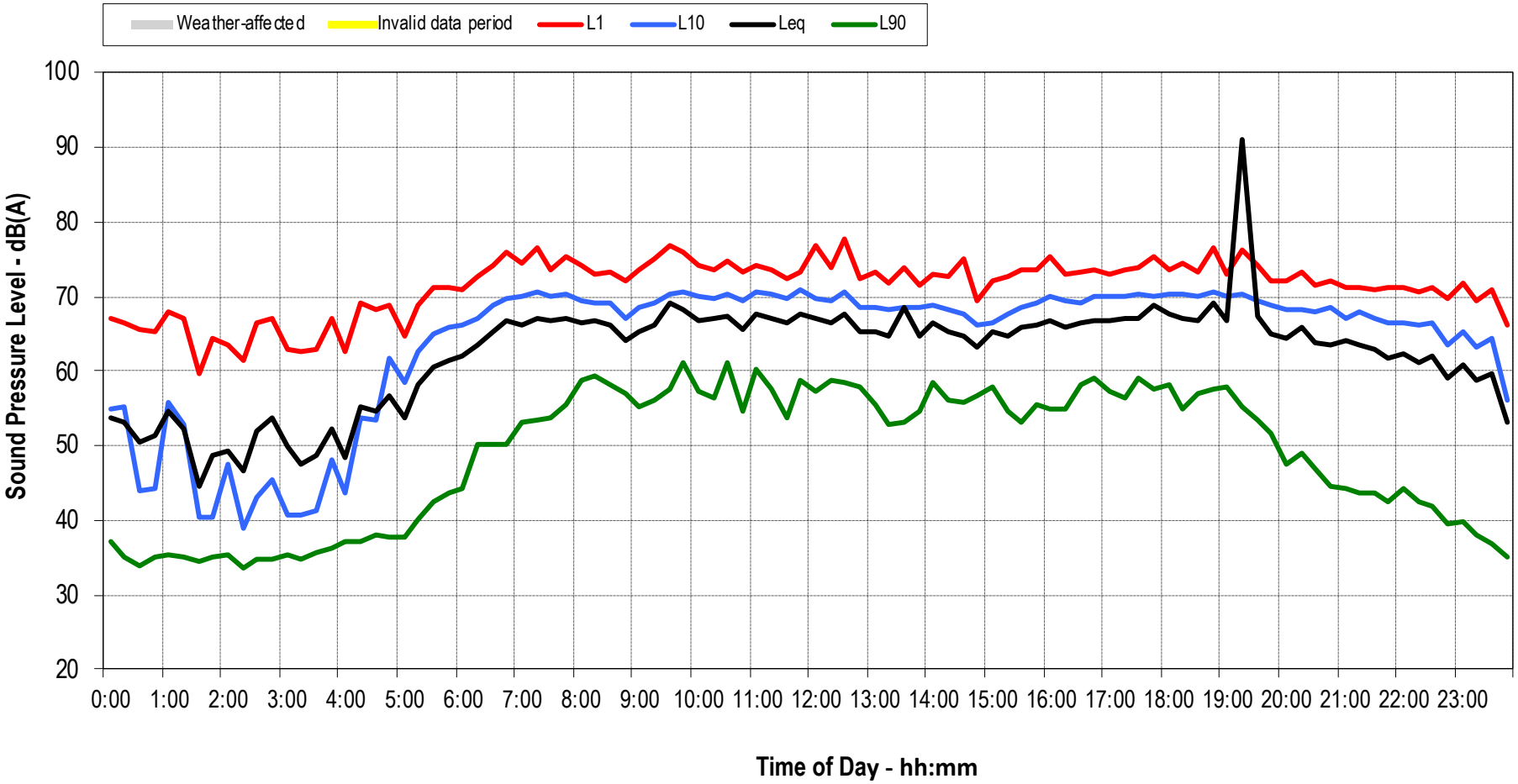

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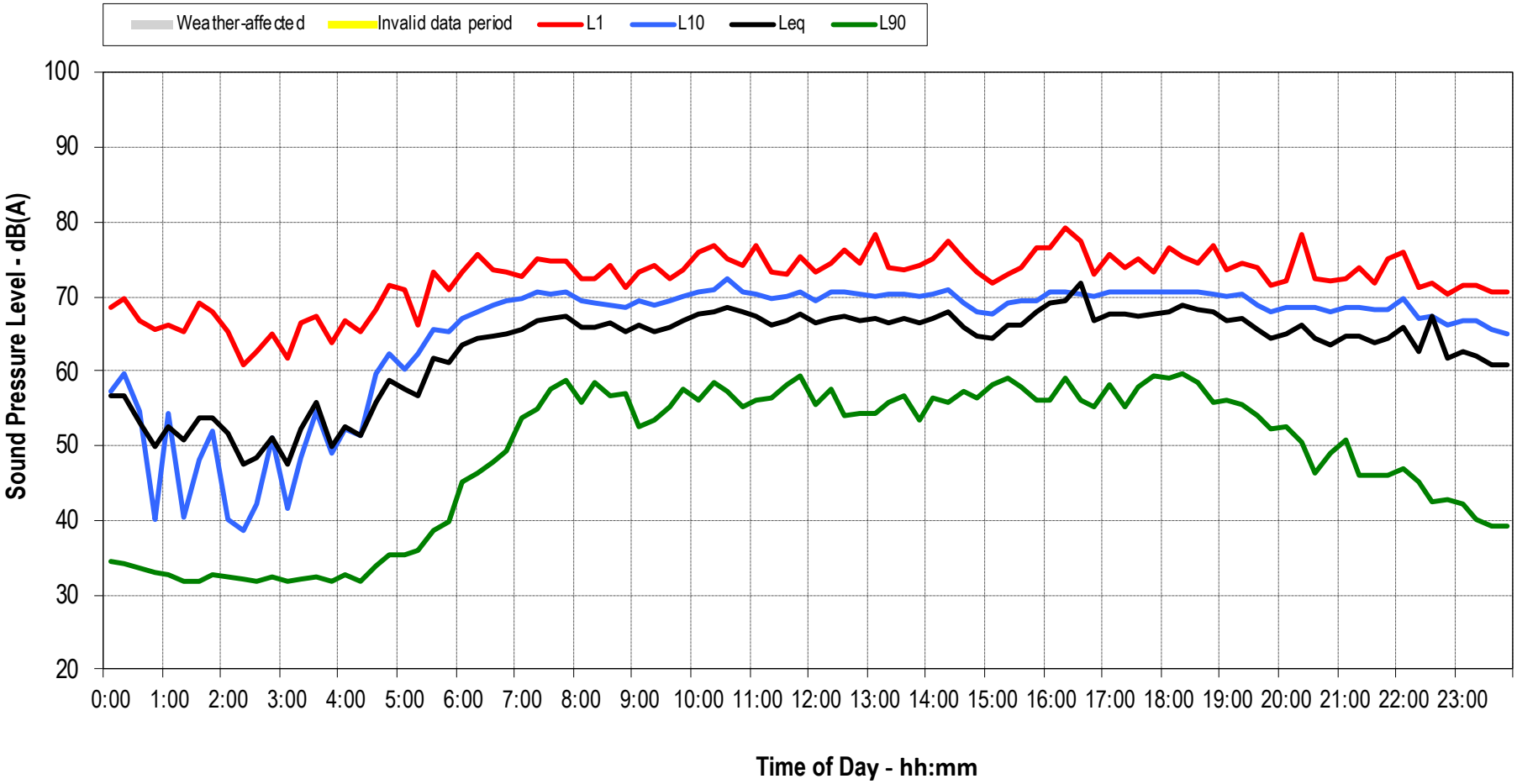

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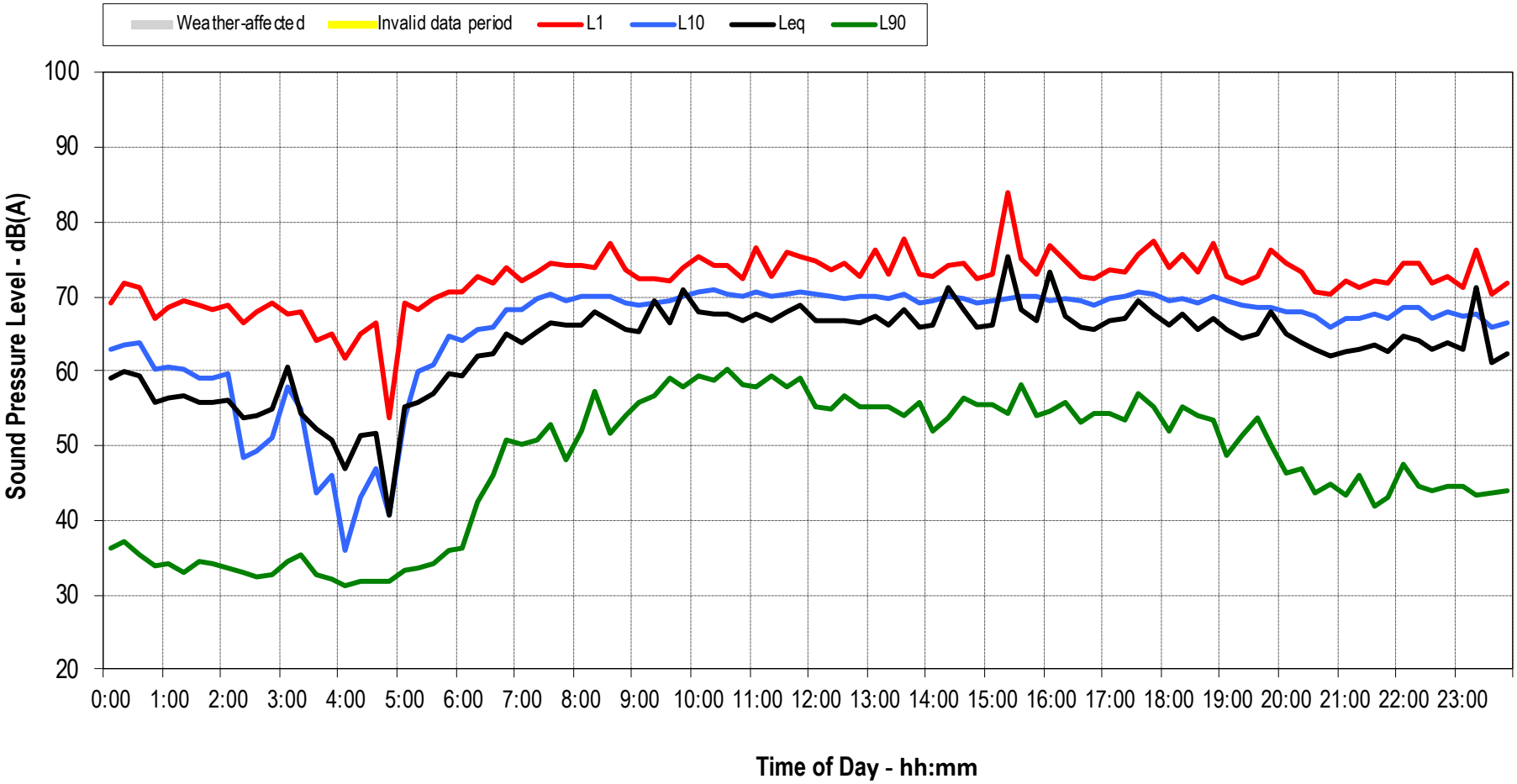

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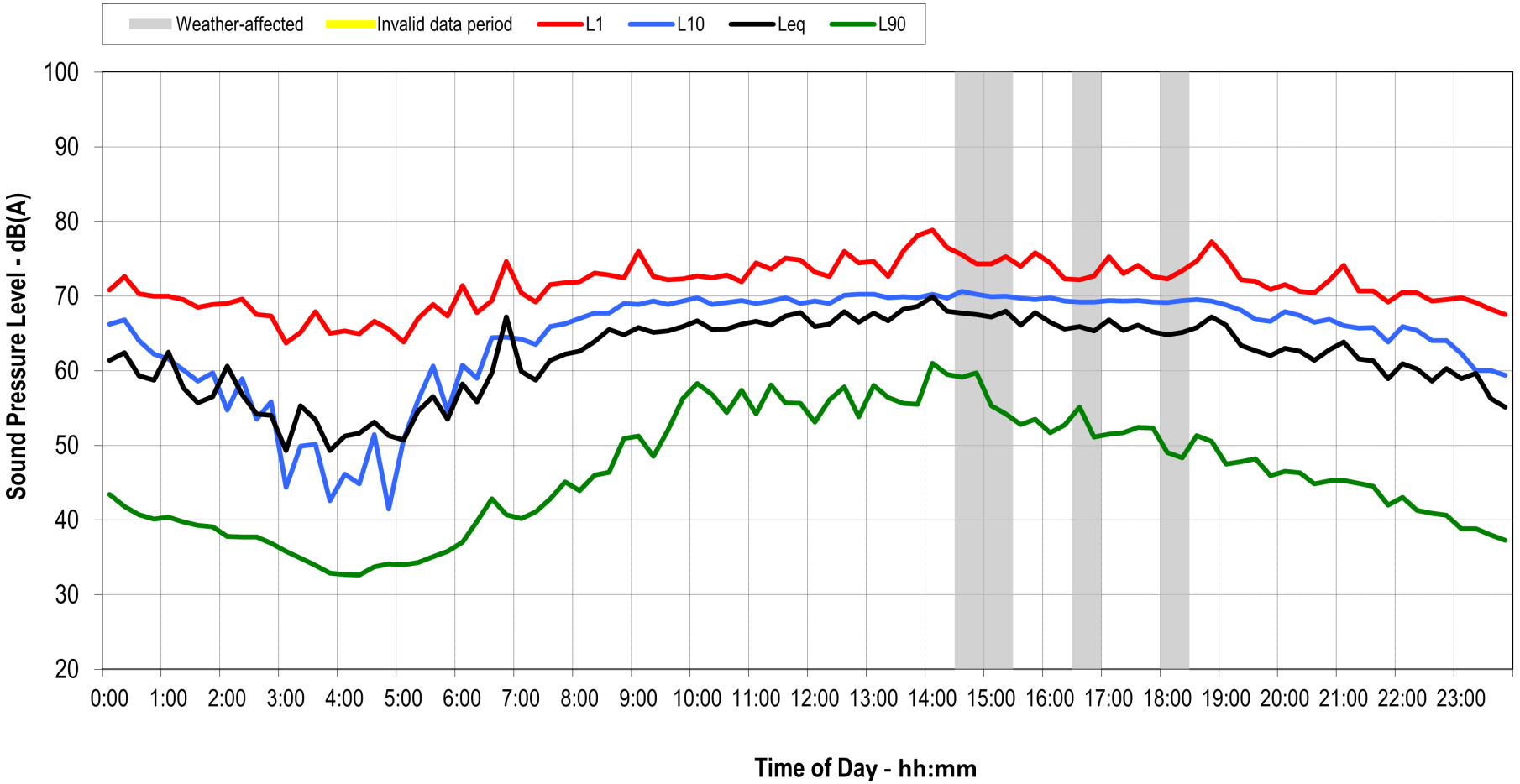
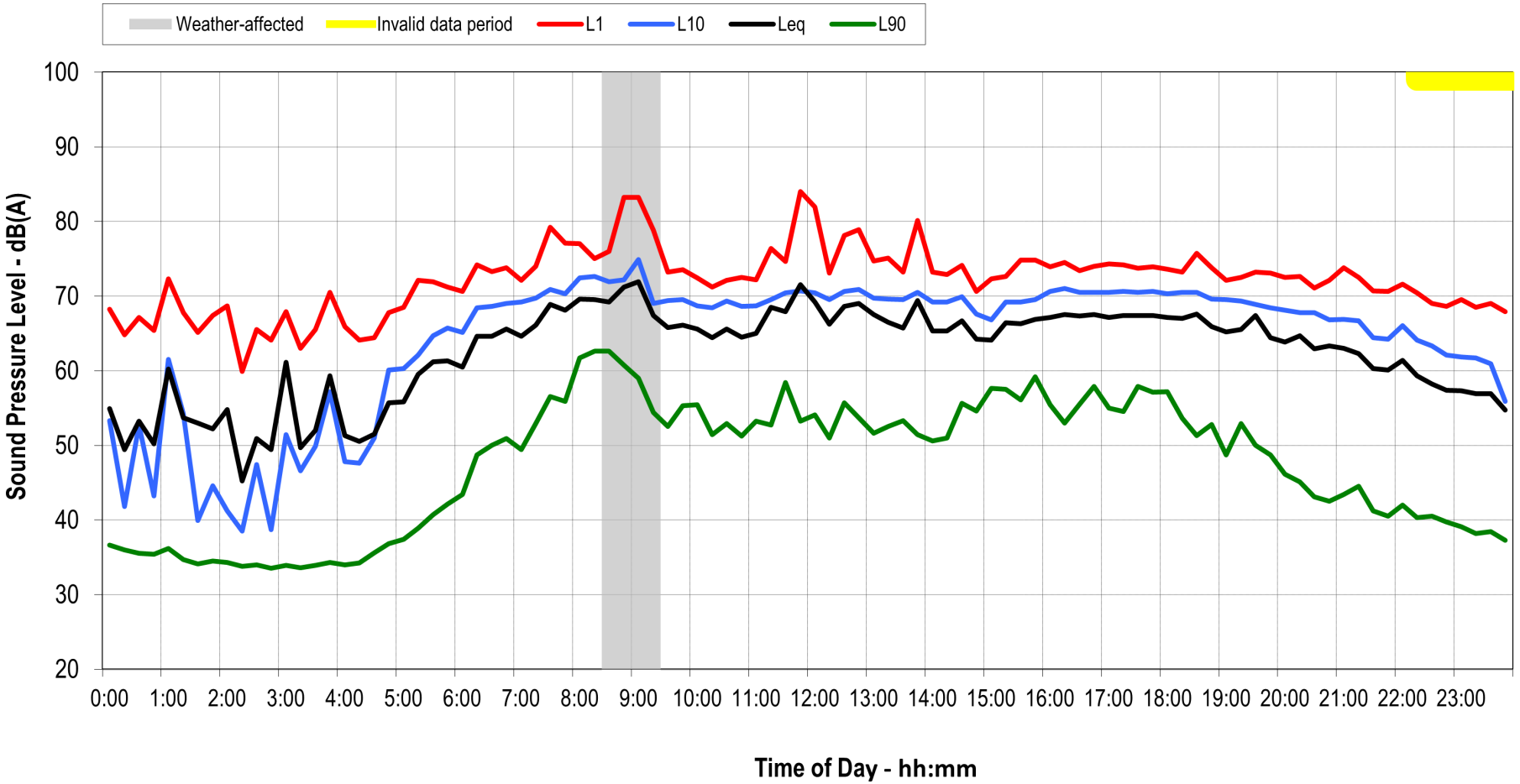
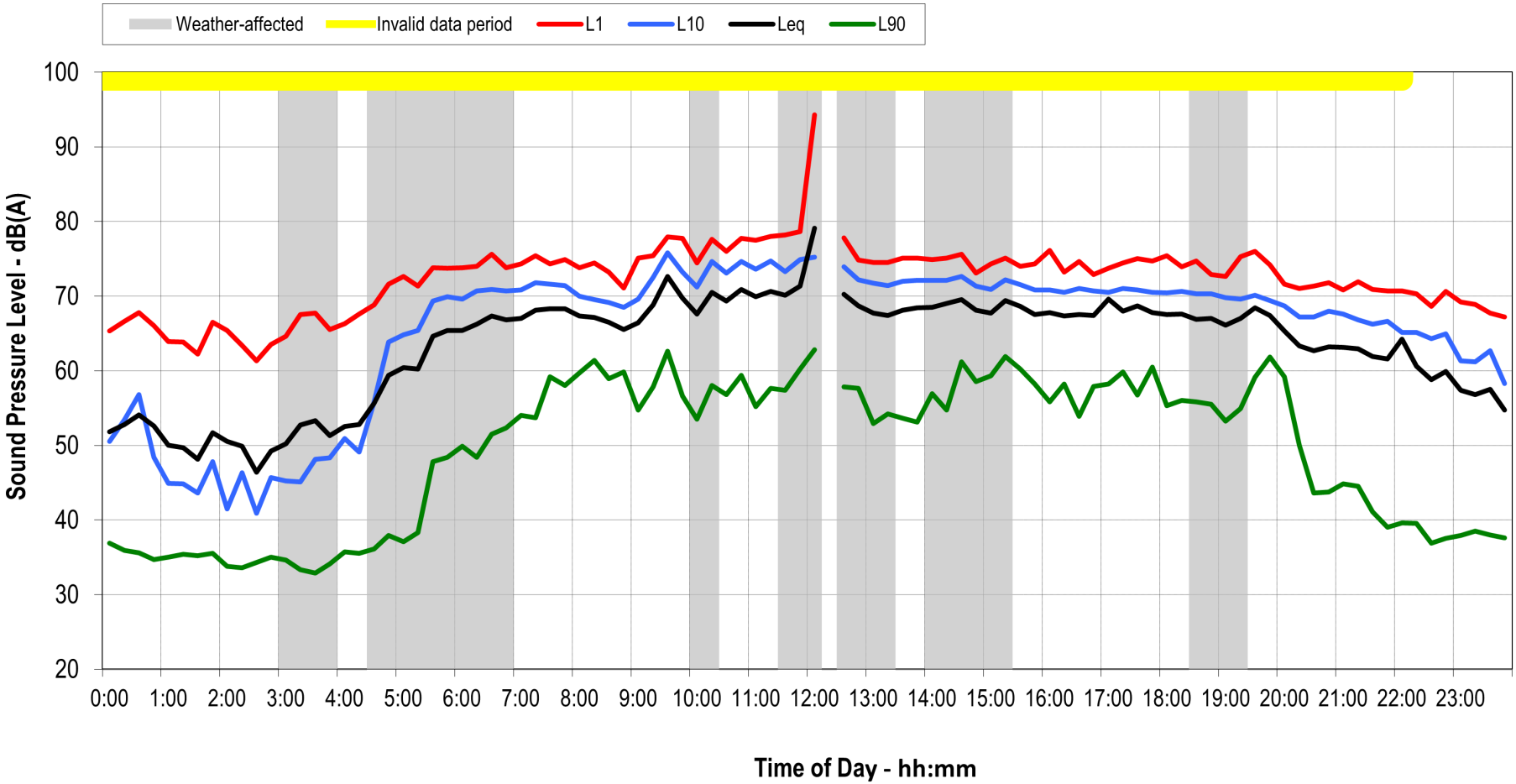


Crane Street - Monday 13 March 2023




Crane Street - Tuesday 14 March 2023
Weather-affected
Invalid data period
L1
L10
Leq
L90
Sound Pressure Level - dB(A)
100
90
80
70
60
50
40
30
20
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
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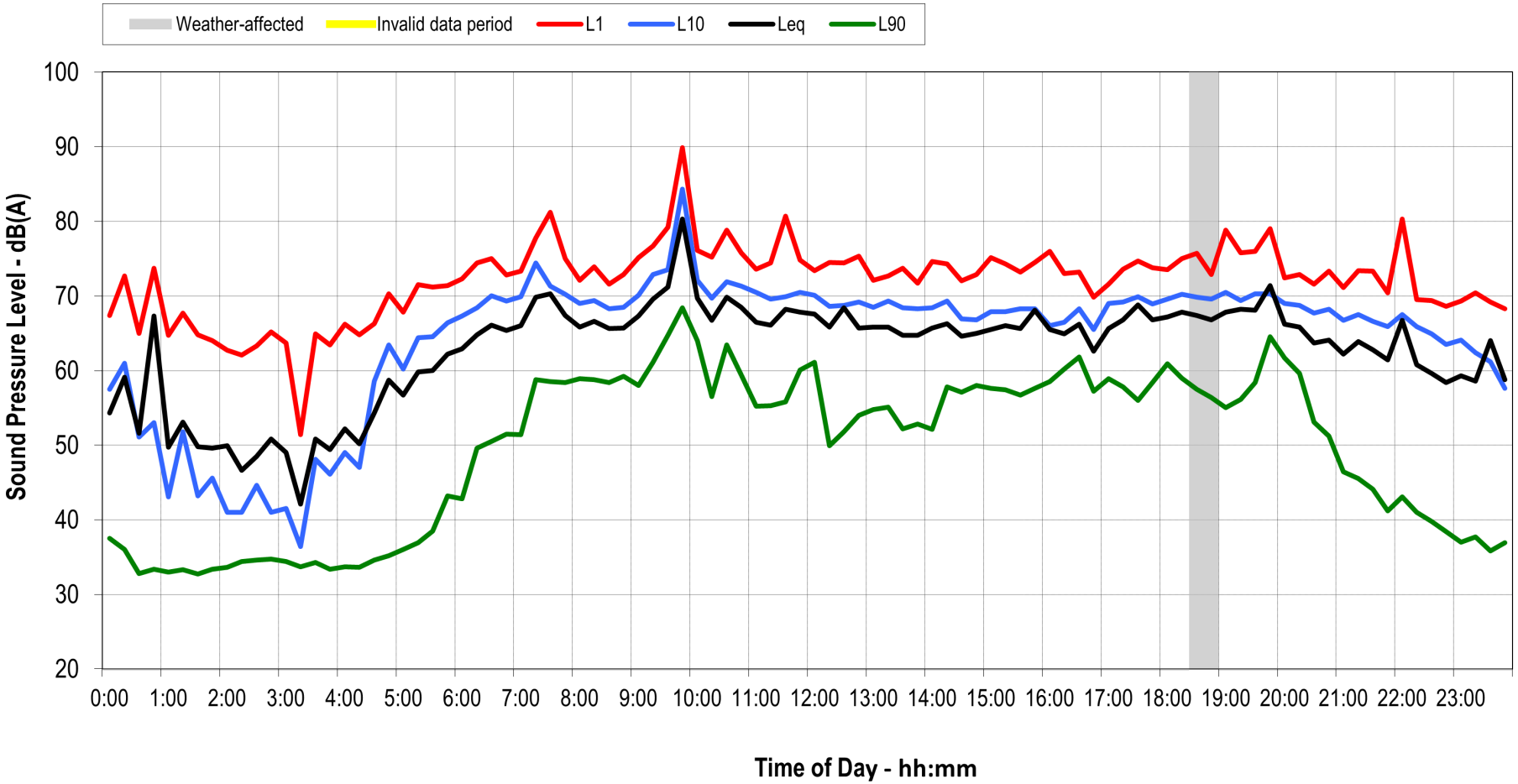
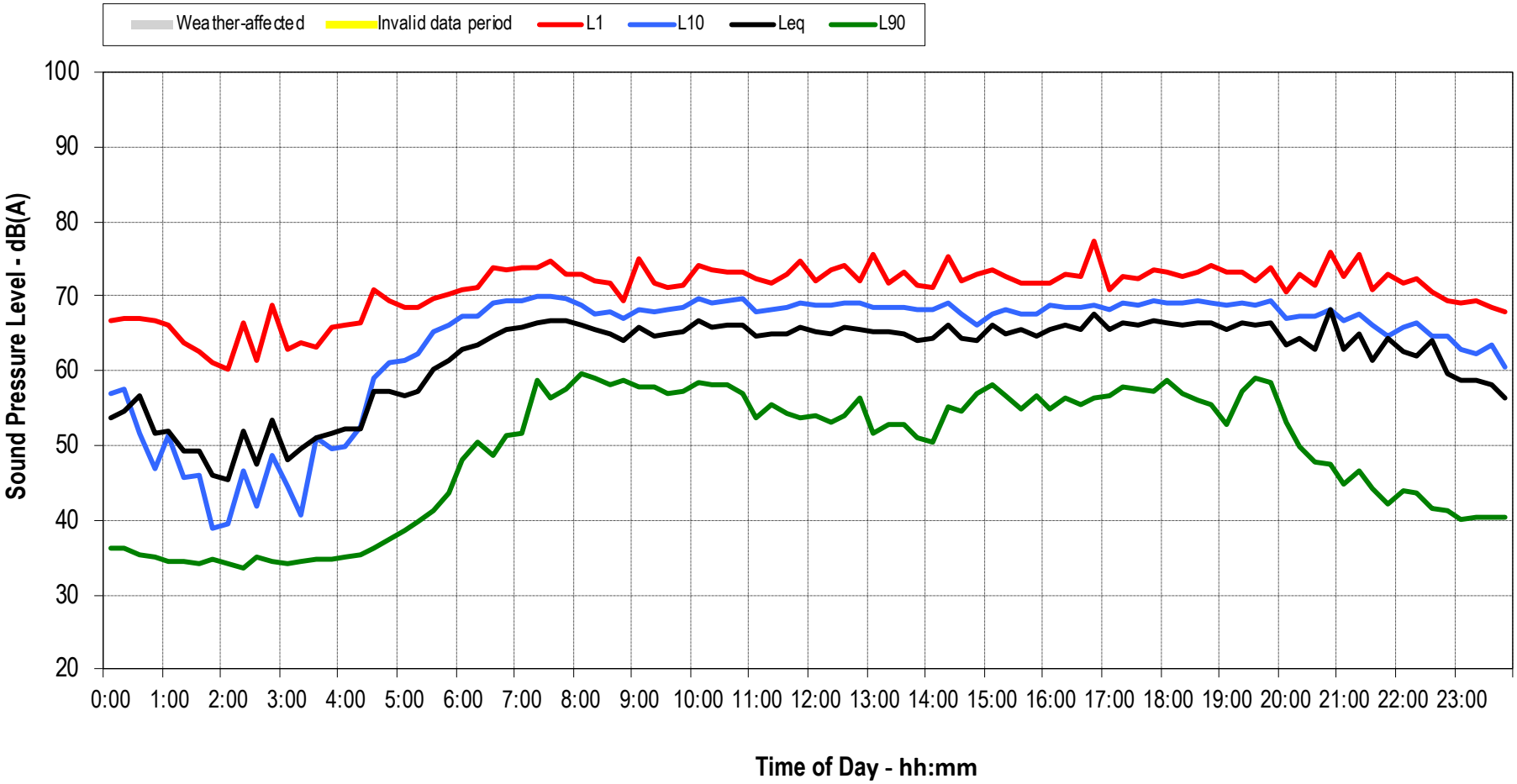
22:00
23:00
Time of Day - hh:mm

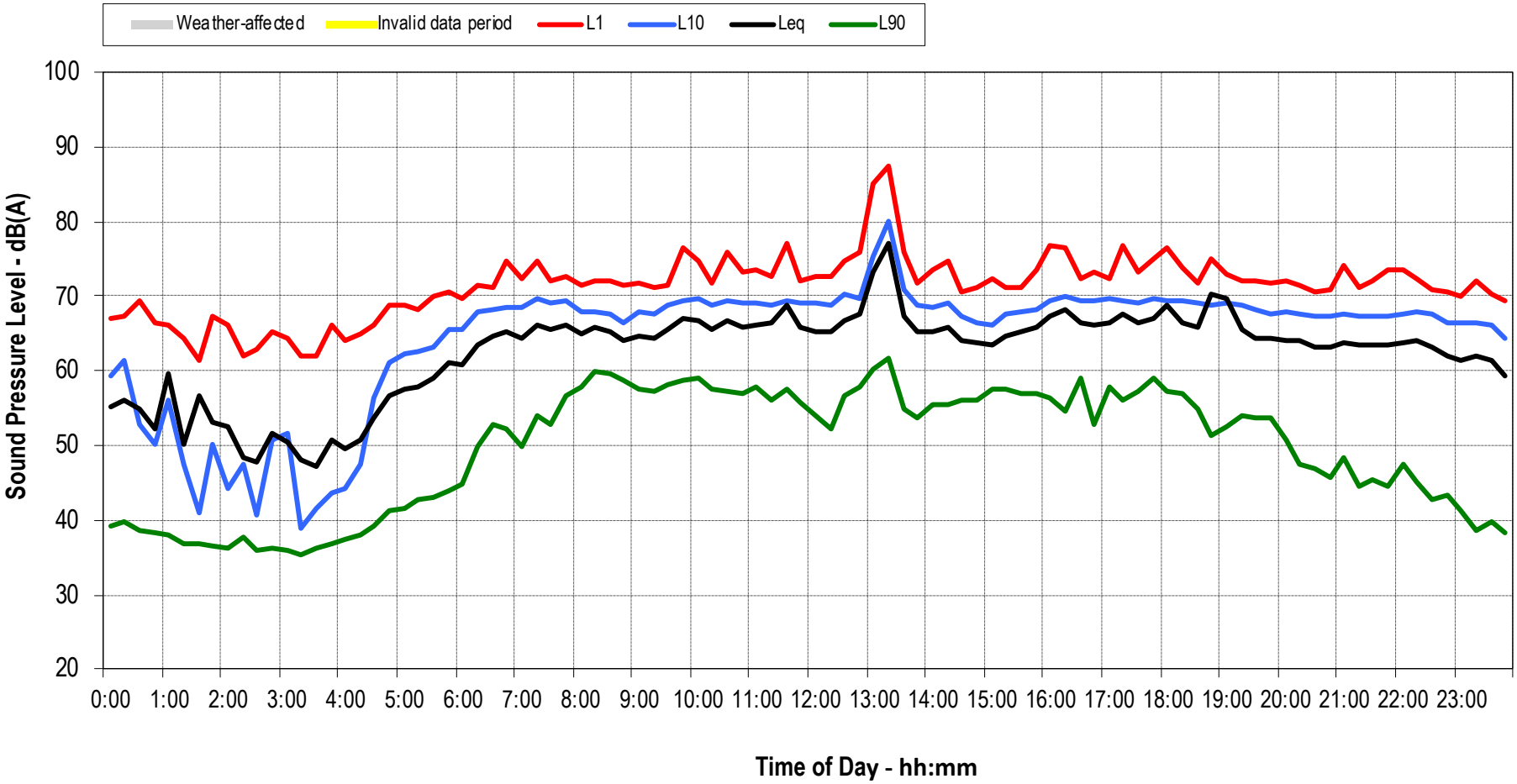
Crane Street - Wednesday 15 March 2023



Crane Street - Thursday 16 March 2023



Crane Street - Friday 17 March 2023



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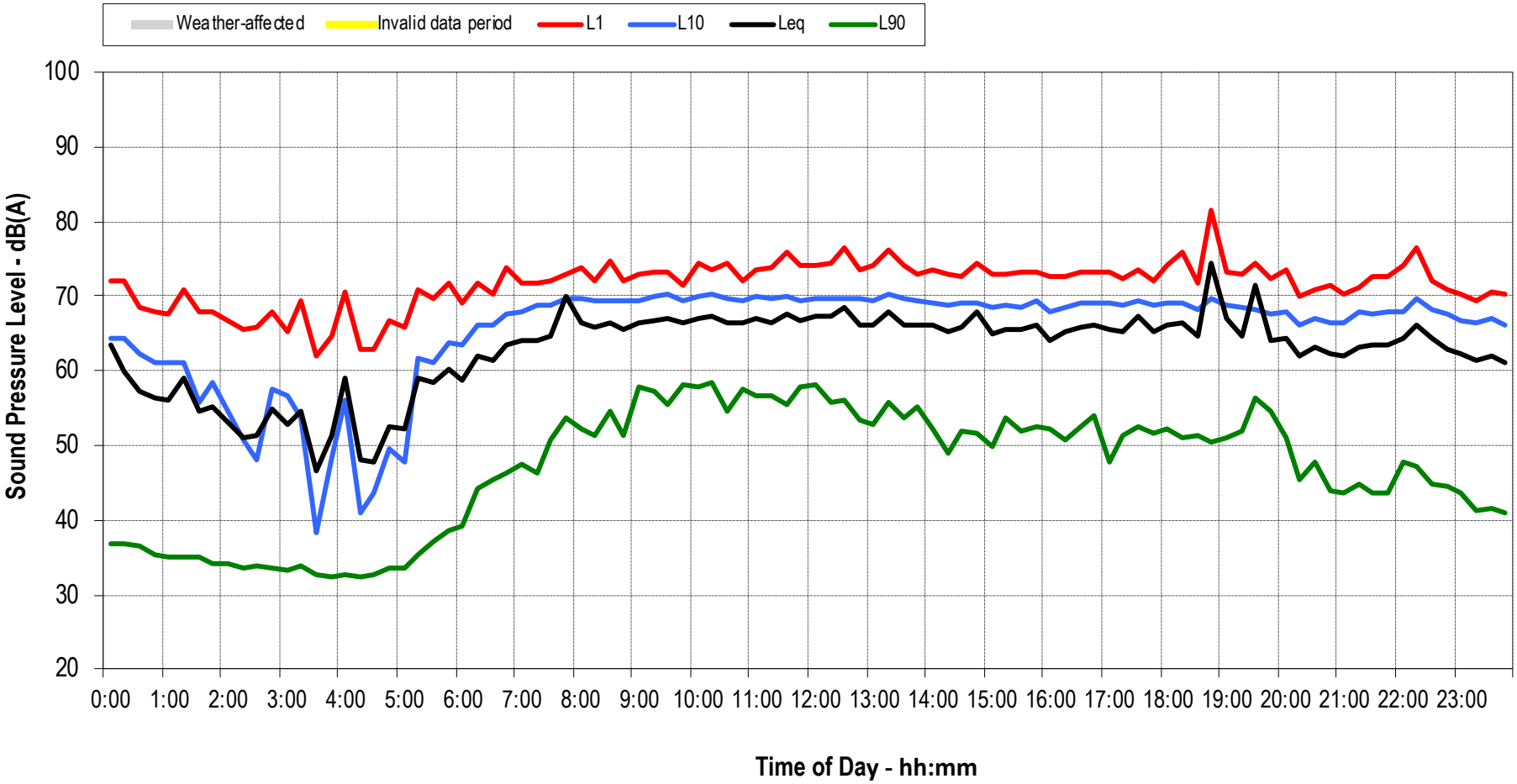

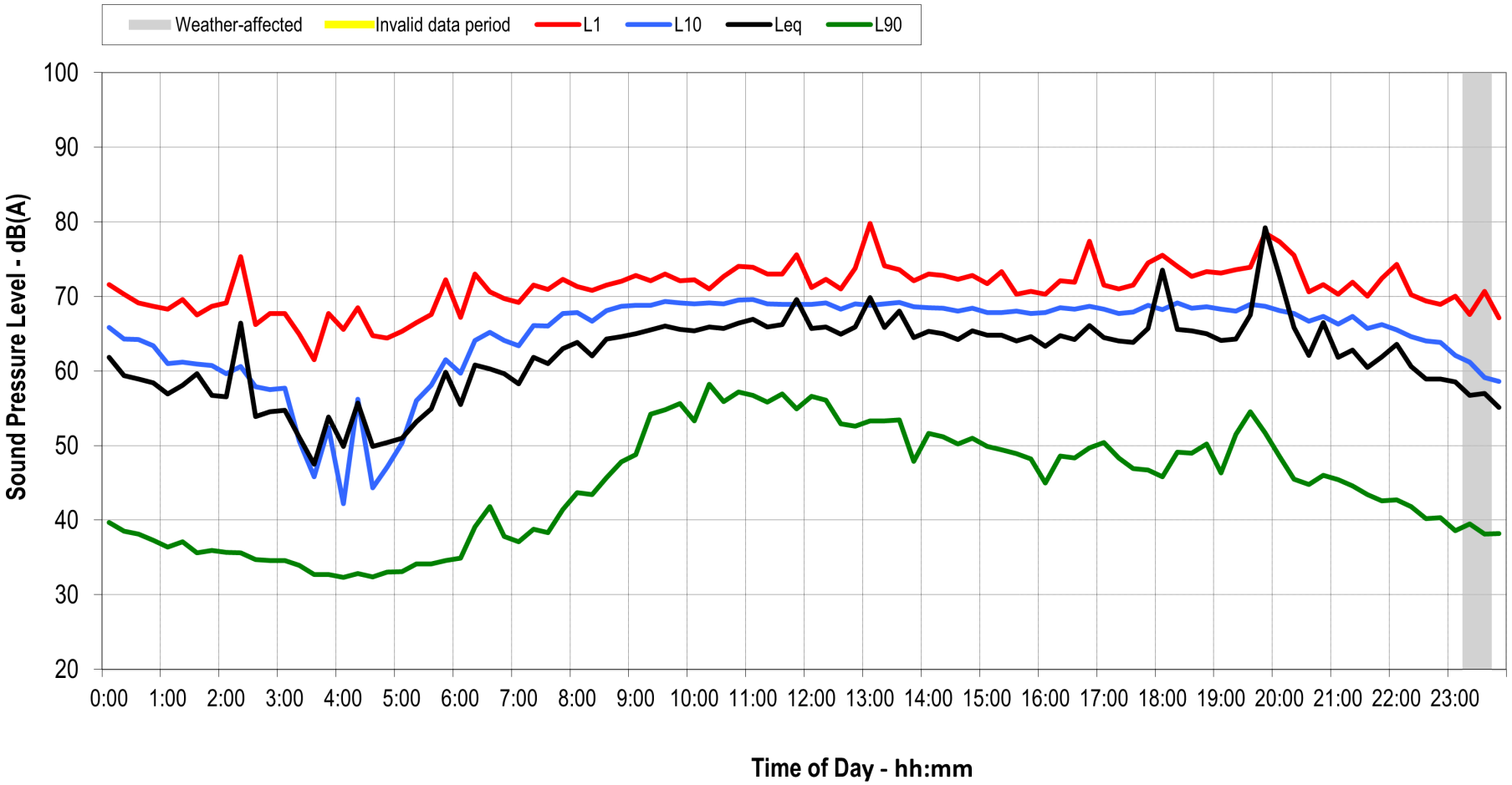
Crane Street - Sunday 19 March 2023
Weather-affected
Invalid data period
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L10
Leq
L90
Sound Pressure Level - dB(A)
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70
60
50
40
30
20
0:00
1:00
2:00
3:00
4:00
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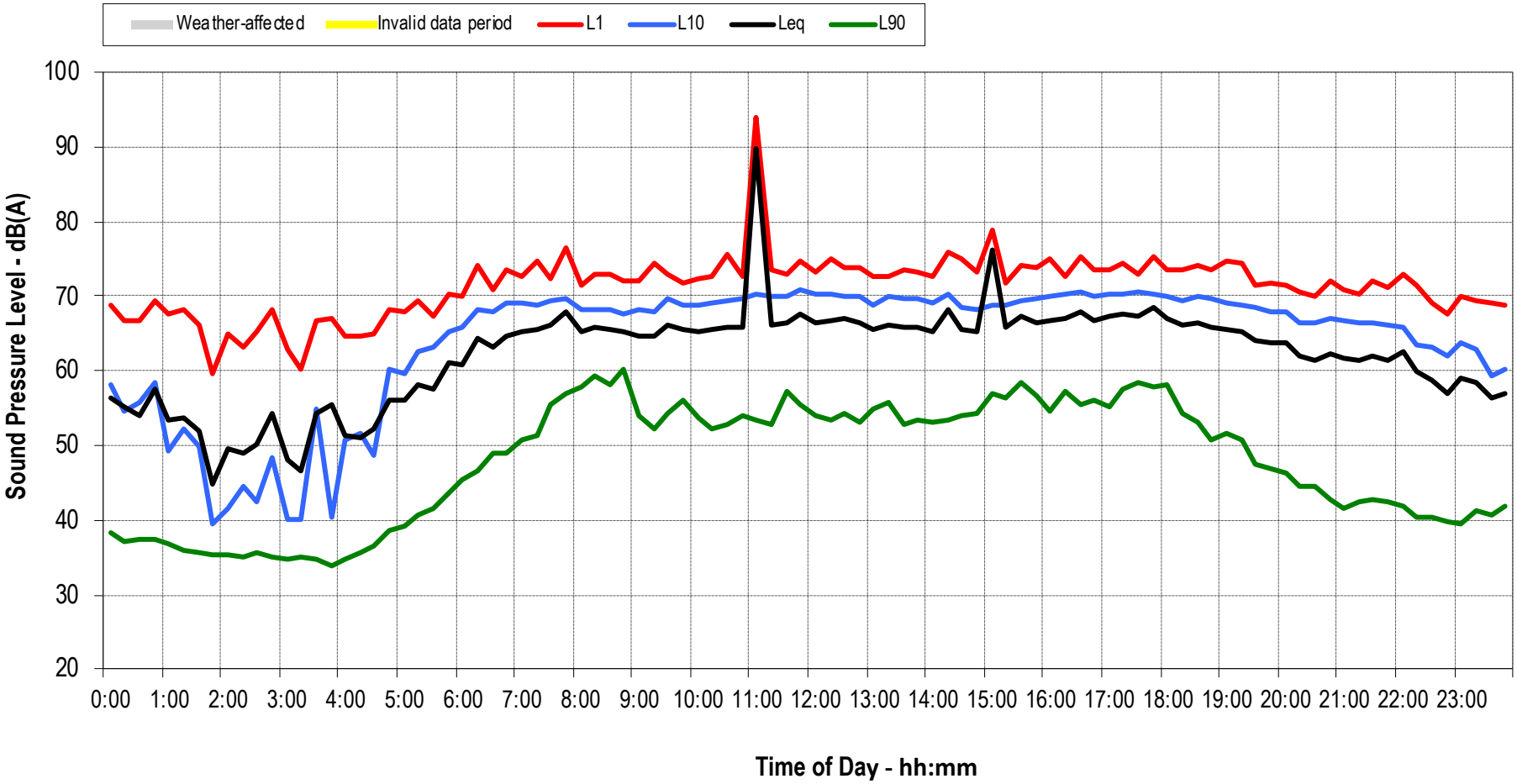
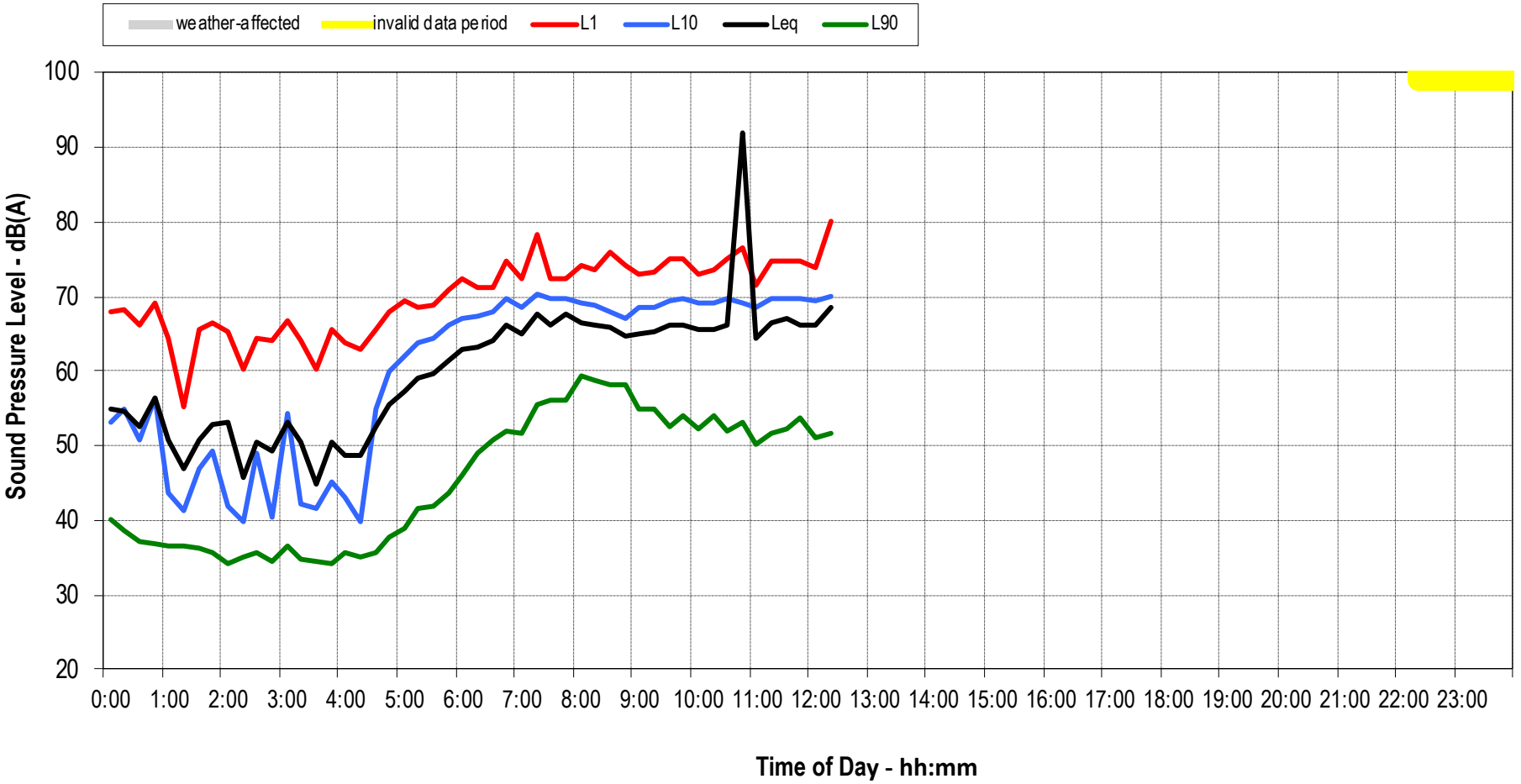
Time of Day - hh:mm

Crane Street - Monday 20 March 2023




Crane Street - Tuesday 21 March 2023
weather-affected
invalid data period
L1
L10
Leq
L90
Sound Pressure Level - dB(A)
100
90
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2:00
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4:00
5:00
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Time of Day - hh:mm

Appendix B – Establishing NSW NPI Criteria

The main source of noise break-out from the proposed development to the environment will be activities noise from the premises and noise from the mechanical plant.

The environmental noise impact of the site has been assessed in accordance with the NSW EPA Noise Policy for Industry 2017 (NSW NPI).

The NSW NPI sets two separate noise criteria to meet environmental noise objectives: one to account for intrusive noise and the other to protect the amenity of particular land uses. Both are used to derive the Project Noise Trigger Level (PNTL).

Assessing intrusiveness

The intrusiveness criterion essentially means that the equivalent continuous noise level of the source is not to be more than 5 dB above the measured existing background noise level.

Assessing amenity

The amenity assessment is based on noise criteria specific to land use and associated activities. The criteria only relate to industrial-type noise, including plant. The existing noise level from industry (or plant) is measured – if it approaches the criterion value, then the noise levels from new plant need to be designed so that the cumulative effect does not produce noise levels that would significantly exceed the criterion.

The cumulative effect of noise from all industrial or plant sources is considered in assessing impact.

Project noise trigger level

For the new plant in ASB premises, the more stringent of the intrusive and the amenity criteria sets the PNTL.

The derivation of the PNTL is provided below.

B.1 Existing Background and Ambient Noise Levels

The Rating Background Level (RBL) has been determined from $L_{A90,15min}$ measured during the long-term noise survey in accordance with the methodology prescribed in NSW NPI.

Three time periods are considered (consistent with the operating times and the time of day classifications in the NSW NPI):

- Day - 7am to 6pm
- Evening - 6pm to 10pm
- Night - 10pm to 7am

The estimated RBL's and ambient noise levels are shown below in Table B1.

Location	L_{90} RBL Background Noise Levels, dB(A)			L_{eq} Ambient Noise Levels, dB(A)		
	Day 7am-6pm	Evening 6pm-10pm	Night 10pm-7am	Day 7am-6pm	Evening 6pm-10pm	Night 10pm-7am
L1	44	42	38	61	54	50
L2	53	44	34	67	66	59

Table B1 : Long-term background and ambient noise levels based on NSW NPI around the site

We make the following comments with regard to the summary above:

- Data and weather observations have been reviewed during the monitoring period and affected data has been excluded when determining the PTNLs.
- Monitoring was carried out during school term and during school holidays. For a conservative assessment, noise data captured during the school holidays (Period 2) has been considered for establishing the relevant criteria.

B.2 Determination of project intrusiveness noise level

The intrusiveness noise level is defined as:

$L_{Aeq,15minute}$ = RBL plus 5 dB(A) (Equation 1)

The intrusiveness noise level has been determined from the RBL's presented in table B1 for each period.

Logger L1

- Day Intrusiveness criterion of - 44 + 5 = **49 dB(A)**
- Evening Intrusiveness criterion of - 42 + 5 = **48 dB(A)**
- Night Intrusiveness criterion of - 38 + 5 = **43 dB(A)**

Logger L2

- Day Intrusiveness criterion of - 53 + 5 = **58 dB(A)**
- Evening Intrusiveness criterion of - 44 + 5 = **49 dB(A)**
- Night Intrusiveness criterion of - 34 + 5 = **39 dB(A)**

The Intrusiveness noise levels are only applied to residential receivers.

B.3 Determination of project amenity noise levels

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 is to remain below the recommended Amenity Noise Levels (ANL) specified in Table 2.2 of the NSW NPI 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 recommended ANL represents the objective for total industrial noise at a receiver location, whereas the project ANL represents the objective for noise from a single industrial development at a receiver location.

To ensure that industrial noise levels (existing plus new) remain within the recommended ANL for an area, a project ANL applies for each new source of industrial noise from an industrial development as follows:

- Project ANL = Recommended ANL minus 5 dB(A) (Equation 2)

The nearest residential receivers to the project are considered to be – as per NSW NPI Table 2.3 – in a Noise Amenity Area characterised by the NSW NPI as urban.

The recommended ANLs relevant to this project are specified in Table B3.

Receiver[4]	Time of Day	L_{Aeq}, dB(A)
		Recommended ANL
Residential (Suburban)	Day	55
	Evening	45
	Night	40
Place of Worship - Internal	When in use	40

Table B3 : Recommended L_{Aeq} noise levels from industrial noise sources at residential and non-residential receivers

[4] The NSW NPI states, "Where internal noise levels are specified, they refer to the noise level at the centre of the habitable room that is most exposed to the noise and are to apply with the windows opened sufficiently to provide adequate ventilation, except where means of ventilation complying with the Building Code of Australia are provided. In cases where gaining internal access for monitoring is difficult, then external noise levels 10 dB(A) above internal levels apply".

The following exceptions to the above method to derive the project ANL apply:

Exception A – In areas with high traffic noise levels

The level of transport noise, road traffic noise in particular, may be high enough to make noise from an industrial source effectively inaudible, even though the LAeq noise level from that industrial noise source may exceed the project amenity noise level. In such cases the project amenity noise level may be derived from the $L_{Aeq,\ period(traffic)}$ minus 15 dB(A).

This high traffic project amenity noise level may be applied only if all the following apply:

- traffic noise is identified as the dominant noise source at the site,
- the existing traffic noise level (determined using the procedure outlined in Section A2, Fact Sheet A of NSW NPI, measuring traffic instead of industrial noise) is 10 dB or more above the recommended ANL for the area, and
- it is highly unlikely traffic noise levels will decrease in the future,

for each assessment period where these traffic noise provisions apply, the High Traffic Project ANL is to be used for industrial development, derived from the $L_{Aeq,period(traffic)}$ as:

- High Traffic Project ANL = $L_{Aeq,period(traffic)}$ minus 15 dB(A) (Equation 3)

Exception B – In proposed developments in major industrial clusters

The recommended amenity noise level from Table B3 represents the total industrial noise level from all sources (new and proposed) that is sought to be achieved using feasible and reasonable controls.

The approach of deriving the project amenity noise level resulting from a new development on the basis of the recommended amenity noise level minus 5 dB is based on a receiver not being impacted by more than three to four individual industrial noise sources.

Where an existing cluster of industry, for example, an industrial estate or port area, is undergoing redevelopment and/or expansion and the development constitutes a single premises addition or expansion, with no other redevelopment planned in the foreseeable future, the project amenity noise level approach procedure in Section B.3 can be applied.

However, where a greenfield or redevelopment of an existing cluster of industry consisting of multiple new noise-generating premises is proposed, the approach for determining the project amenity noise level in Section B.3 is not applicable and the approach below is to be applied.

For the new multiple premises or redevelopment of existing clusters of industry, for each individual premise,

- Individual Project ANL = $10\text{Log}_{10}(10^{(L - 5\ dB/10)}/N)$ dB(A)(Equation 4)

where L is the relevant recommended ANL from Table B3 and N is the number of proposed additional premises.

Where a greenfield development is proposed and it can be demonstrated that existing L_{Aeq} industrial noise levels are more than 5 dB lower than the relevant recommended ANL, the above equation can be modified to reflect "L" in lieu of "L – 5 dB".

Exception C

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

Exception D

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

Where the project ANL applies and it can be met, no additional consideration of cumulative industrial noise is required. However, in circumstances where this level cannot be feasibly and reasonably met, an assessment of existing industrial noise, and the combined resulting noise level from existing and the proposed industries, is required so the impact of the residual noise levels can be determined in accordance with Section 4.2 of the NSW NPI.

Receiver - External	Time of Day	Recommended ANL	Adjustment	Project ANL[5]
Residential *L1*	Day	55	Equation 2	53
	Evening	45	Equation 2	43
	Night	40	Equation 2	38
Residential *L2*	Day	55	Equation 3	52
	Evening	45	Equation 3	51
	Night	40	Equation 3	44
Place of Worship	When in use	50	Equation 2	48

Table B4: Determination of Project Amenity Noise Levels for residential and place of worship receivers

[5] The L_{Aeq} is determined over a 15-minute period for the project intrusiveness noise level and over an assessment period (day, evening and night) for the Project ANL. This leads to the situation where, because of the different averaging periods, the same numerical value does not necessarily represent the same amount of noise heard by a person for different time periods. To standardize the time periods for the intrusiveness and amenity noise levels, the Policy assumes that the $L_{Aeq,15min}$ will be taken to be equal to the $L_{Aeq,period}$ + 3dB(A).

B.4 Project noise trigger level

The PNTL is defined as the lower of the project intrusiveness and amenity noise levels. On this basis, the PNTL are shown in Table B5 below (PNTLs shown shaded).

Receiver - External	Period	Project Intrusiveness Noise Level	Project Amenity Noise Level
Residential L1	Day	49	53
	Evening	48	43
	Night	43	38
Residential L2	Day	58	52
	Evening	49	51
	Night	39	44
Place of Worship	When in use	-	48

Table B5 : Determination of Project Noise Trigger Levels for the site

Appendix C : Building damage vibration criteria

There is little reliable data on the threshold of vibration-induced damage in buildings. Although vibrations induced in buildings by ground-borne excitation are often noticeable, there is little evidence that they produce even cosmetic damage. This lack of data is one of the reasons that there is variation between international standards, why the British Standards Institution (BSI) did not provide guidance before 1992 and why there are still no International Organisation for Standardisation (ISO) guidance limits.

There are however several standards that can be referred to.

German Standard

The relevant German standard is DIN 4150: Part 3: 19862. This standard gives guidelines for short-term and steady state structural vibration. For short-term vibration in buildings the following limits are given:

Structural type	Vibration Velocity, v_i, in mm/s			
	Foundation			Plane of floor of uppermost full storey
	less than 10Hz	10 to 50 Hz	50 to 100 Hz	Frequency mixture
Commercial, Industrial or Similar	20	20 to 40	40 to 50	40
Dwellings or Similar	5	5 to 15	15 to 20	15
Particularly Sensitive	3	3 to 8	8 to 10	8

Table C1: Guideline Values of Vibration Velocity, vi, for Evaluating the Effects of Short-term Vibration

The guidelines state that:

Experience to date has shown that, provided the values given in Table D2 are observed, damage due to vibration, in terms of a reduction in utility value, is unlikely to occur. If the values of table D2 are exceeded, it does not necessarily follow that damage will occur. Should these values be significantly exceeded, further investigation is necessary.

Swiss Standard

The relevant Swiss standard is SN 640 312:1978. For steady state vibration, form machines, traffic and construction in buildings the following limits are given:

Structural type	Vibration Velocity, v_i, in mm/s	
	Foundation	
	10 to 30Hz	30 to 60Hz
Commercial, Industrial including retaining walls	12	12 to 18
Foundation walls and floors in concrete or masonry. Retaining walls and ashlar construction	8	8 to 12
Foundations and basement floors concrete, with wooden beams on upper floors. Brick walls.	5	5 to 8
Particularly sensitive	3	3 to 5

Table C2: Guideline Values of Vibration Velocity, vi, for Evaluating the Effects of Steady State Vibration

British Standard

The relevant standard is BS7385: Part 2: 1993[6]. This standard was developed from an extensive review of UK data, relevant national and international documents and other published data, which yielded very few cases of vibration-induced damage. This standard contains the most up-to-date research on vibration damage in structures. Part 2 of the standard gives specific guidance on the levels of vibration below which building structures are considered to be at minimal risk.

The Standard proposes the following limits on the foundations of the building:

Structural type	Peak component particle velocity in frequency range of predominant pulse	
	4 Hz to 15 Hz	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 C3: Transient Vibration Guide Values for Cosmetic Damage

The standard states in Annex A, that … the age and existing condition of a building are factors to consider in assessing the tolerance to vibration. If a building is in a very unstable state, then it will tend to be more vulnerable to the possibility of damage arising from vibration or any other ground-borne disturbance. It is recommended that buildings of importance be considered on a case-by-case basis with detailed engineering analysis being carried out if necessary.

Annex B of the Standard gives a breakdown of data that should be recorded. Included in this are details of the building structure, such as general condition of the structure, list of defects, photographs, details of all major extensions, repairs and renovations. A crack

[6] British Standards 7385:1993 Part 2 "Evaluation and Measurement for vibration in Buildings. Guide to damage levels from ground-borne vibration"

exposure report should be prepared both pre and post exposure, both internally and externally.

Australian Standard

There is no specific Australian Standard referring to structural vibration in buildings. There is however AS 2187.2 - 1993[7], which, in Appendix J, recommends maximum peak particle velocities, measured at the ground surface due to blasting. The lower recommended peak particle velocity is 10 mm/s. The standard states however, that structures that may be particularly susceptible to ground-borne vibration should be examined on an individual basis. It is suggested that in the absence of a particular site-specific study then a maximum peak particle velocity of 5 mm/s is used.

[7]AS 2187.2 - 1993 Explosives - Storage, transport and use. Part 2: Use of explosives