Environmental Acoustic Assessment – UON Gosford, NSW

Prepared for

Lyons / EJE Architecture

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Relationships Attention Professional Trust

Document Details

Environmental Acoustic Assessment – UON Gosford, NSW

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1. Introduction

1.1 Background

RAPT Consulting has been engaged to undertake an environmental acoustic assessment for Lyons / EJE Architecture as part of the University of Newcastle (UON) new health, innovation, and education campus in Gosford, NSW.

The University proposes to develop a 6 Star Green Star, Central Coast Campus comprising a building of approximately 3,840 sqm multi-college academic and innovation facility.

The land for the proposed academic facility at 305 Mann Street Gosford (the former Mitre 10 site) is one of the key sites identified within recent NSW Government planning frameworks. The proposed mixed-use tower Campus on the site will set a high-quality benchmark for further revitalisation projects throughout the city and be required to meet the Design Excellence standard.

The project site and surrounding area is shown in Figure 1-1.

Figure 1-1 Site and Surrounding Area

The Concept Design building sections are provided in Figures 1-2 – 1-5.

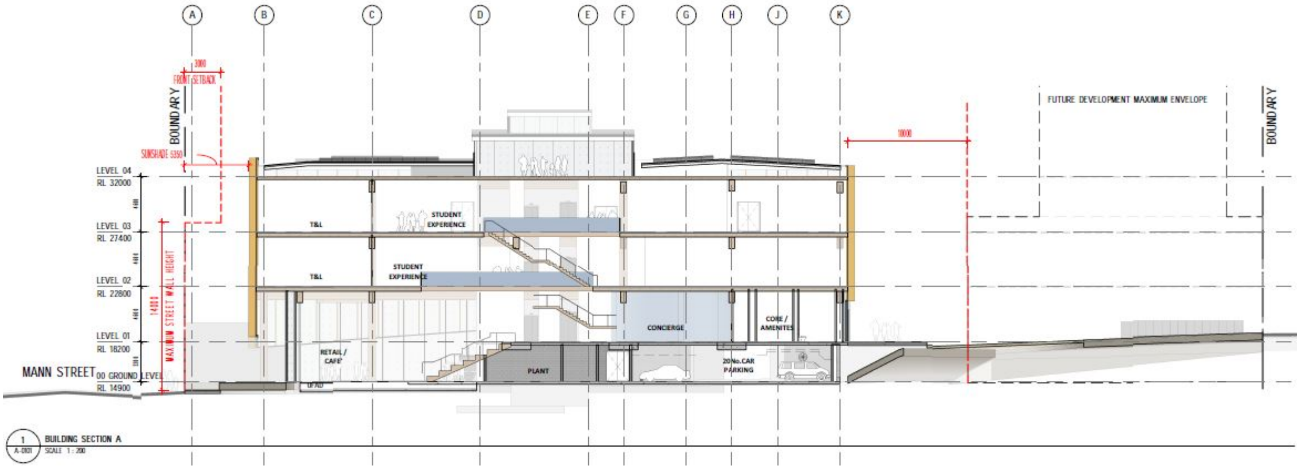


Figure 1-2 Building Section A (Source: Lyons / EJE Architecture)

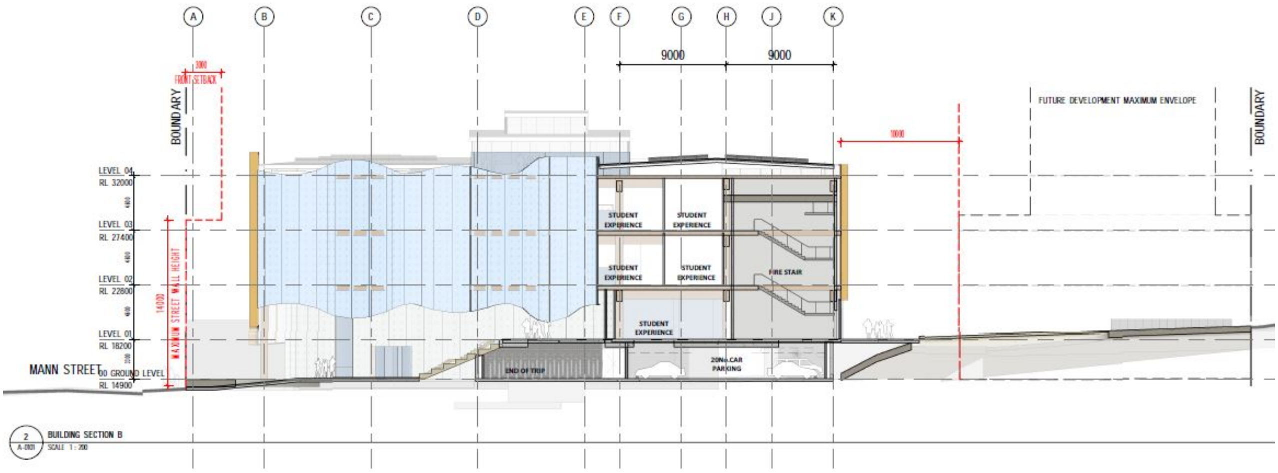


Figure 1-3 Building Section B (Source: Lyons / EJE Architecture)

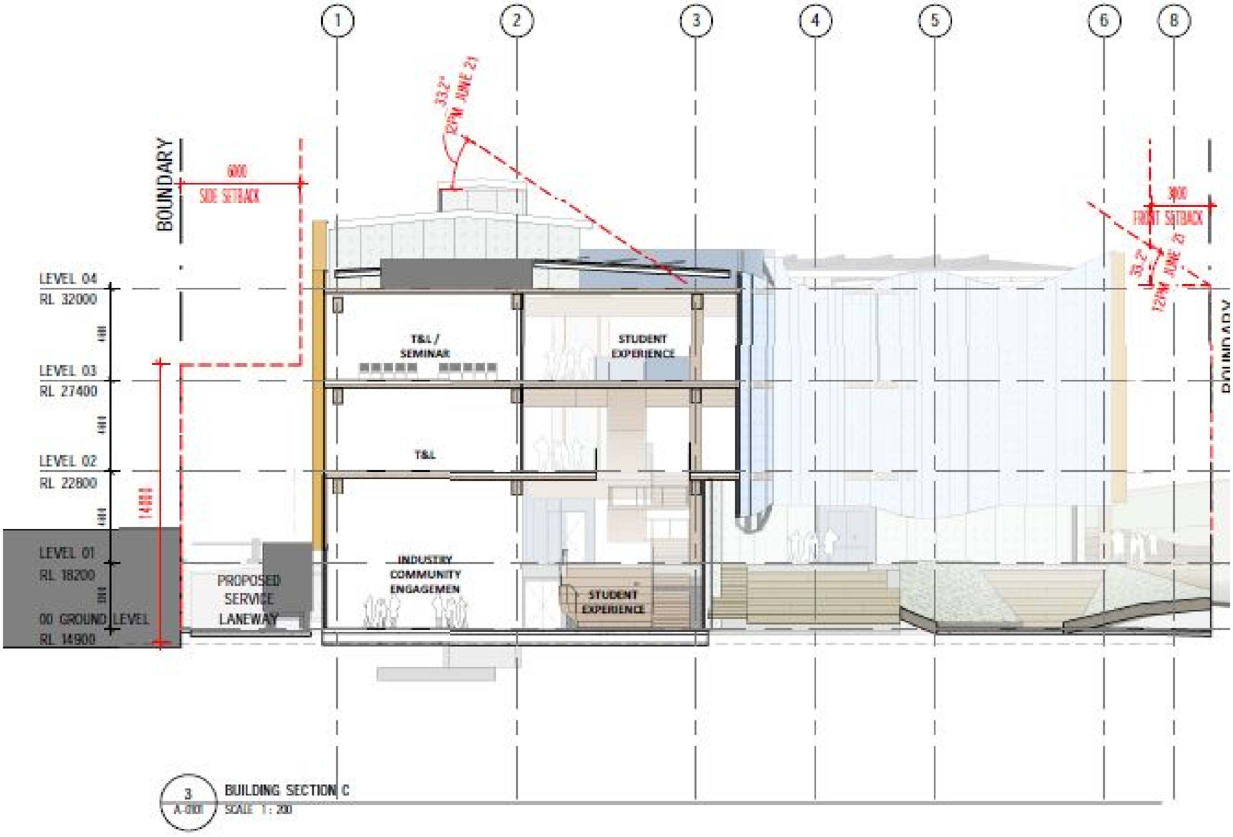


Figure 1-4 Building Section C (Source: Lyons / EJE Architecture)

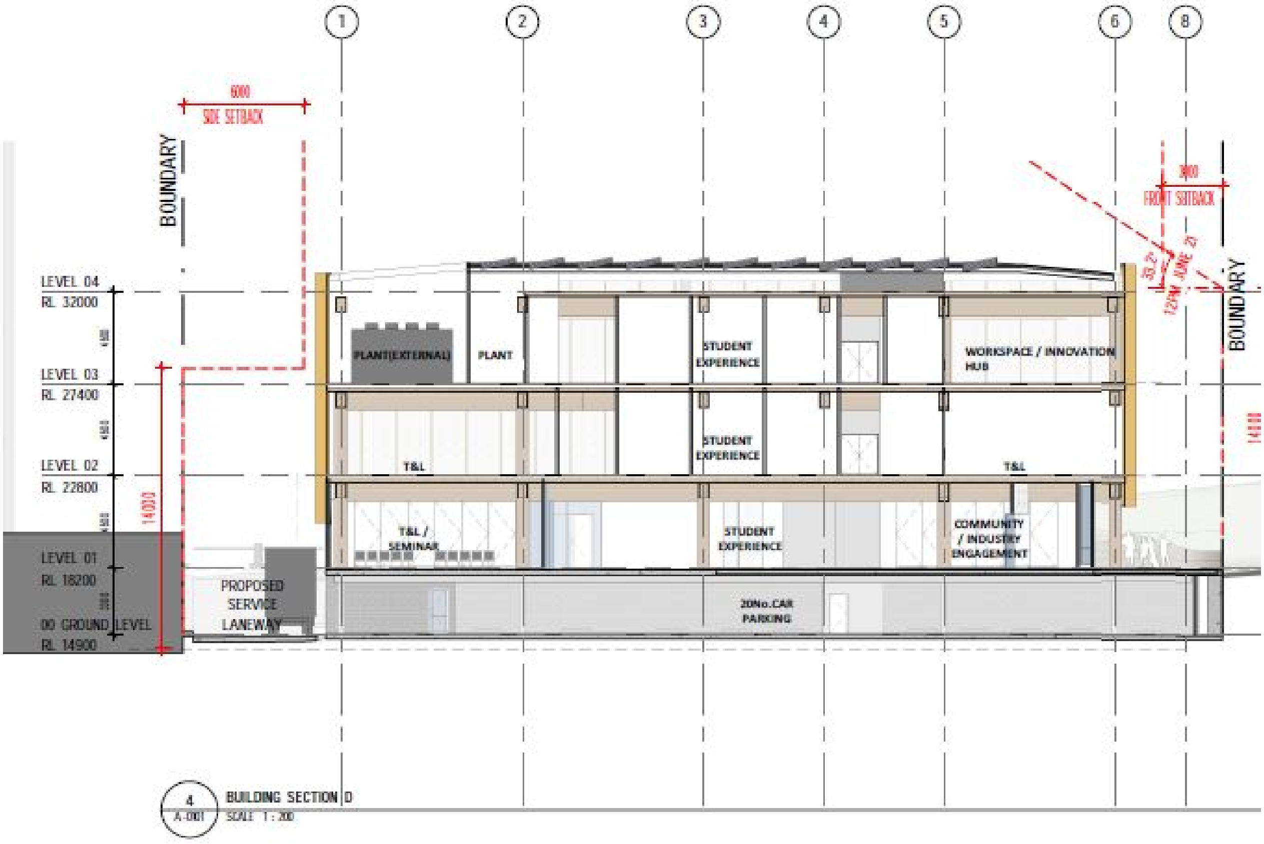


Figure 1-5 Building Section D (Source: Lyons / EJE Architecture)

Key exterior landscaping places are shown in Figure 1-6.

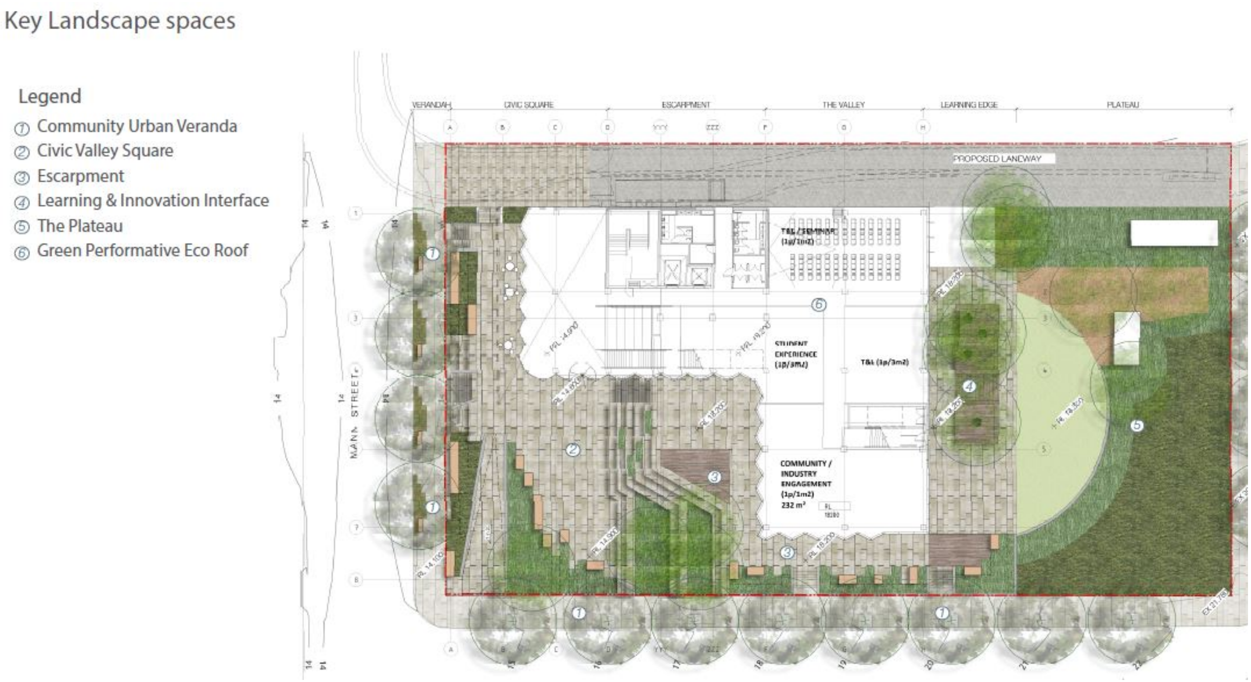


Figure 1-6 Key Landscaping Places (Source: MCGREGOR COXALL)

1.2 SEAR's and where Addressed

In preparing this Noise and Vibration Impact Assessment (NVIA), the Secretary's Environmental Assessment Requirements (SEARs) SSD-47749715, issued for the project on 26 August 2022, have been addressed. The key matters raised by the SEARs for consideration in the NVIA and where this report addresses these matters are outlined in Table 1 1.

Table 1-1 SEARs and where addressed

Requirement	Where addressed
Provide a noise and vibration assessment prepared in accordance with the relevant NSW Environment Protection Authority (EPA) guidelines. The assessment must detail construction and operational noise and vibration impacts on nearby sensitive receivers and structures and outline the proposed management and mitigation measures that would be implemented.	**This Document**

1.3 Assessment Objectives

The purpose of this acoustic assessment is to consider both onsite noise generation during construction and operation and to provide input regarding acoustic issues to consider during the concept design stage of the project.

The outcomes of this assessment include recommendations for potential noise and vibration mitigation and management measures designed to achieve an acceptable noise amenity for residential (dwelling) occupants and other sensitive receivers surrounding the proposal site.

Additionally, this assessment provides recommendations for building performance requirements for the proposed development to achieve appropriate internal amenity standards.

1.4 Scope

The acoustic assessment scope of work included:

- Initial desk top review to identify noise sensitive receptors from aerial photography
- Undertake noise measurements to determine ambient and background noise levels
- Establish project noise goals for the construction and operation of the proposed project
- Identify the likely principal noise sources during construction, operation and their associated noise levels
- assessment of potential noise, vibration and sleep disturbance impacts associated with construction and operation aspects of the project
- Provide recommendations pertaining to external building performance requirements for the proposed development to achieve appropriate internal amenity standards.
- provide recommendations for feasible and reasonable noise and vibration mitigation and management measures, where noise or vibration objectives may be exceeded.

1.5 Relevant Guidelines

The relevant policies and guidelines for noise and vibration assessments in NSW that have been considered during the preparation of this assessment include:

- Road Noise Policy (RNP, DECCW, 2011)
- Noise Policy for Industry (NPfI) (NSW EPA, 2017)
- Interim Construction Noise Guideline (ICNG) (NSW DECC, 2009)
- Development Near Rail Corridors and Busy Roads - Interim Guideline (Department of Planning, 2008)
- German Standard DIN 4150, Part 3: Structural Vibration in Buildings: Effects on Structures
- British Standard BS 7385 Part 2-1993 Evaluation and measurement for vibration in buildings
- Assessing Vibration: A Technical Guideline (DECC, 2006)

- Australian Standard AS2107:2016 - Recommended design sound levels and reverberation times for building interiors

1.6 Limitations

The purpose of the report is to provide an independent acoustic assessment for the proposal.

It is not the intention of the assessment to cover every element of the acoustic environment, but rather to conduct the assessment with consideration to the prescribed work scope.

The findings of the noise assessment represent the findings apparent at the date and time of the assessment undertaken. It is the nature of environmental assessments that all variations in environmental conditions cannot be assessed and all uncertainty concerning the conditions of the ambient environment cannot be eliminated. Professional judgement must be exercised in the investigation and interpretation of observations.

In conducting this assessment and preparing the report, current guidelines for acoustics, noise and vibration were referred to. This work has been conducted in good faith with RAPT Consulting's understanding of the client's brief and the generally accepted consulting practice.

No other warranty, expressed or implied, is made as to the information and professional advice included in this report. It is not intended for other parties or other uses.

2. Existing Environment

2.1 Receptors

The site is zoned B4 Mixed Use. A map showing the land use zonings in the vicinity of the proposal are shown in Figure 2-1.

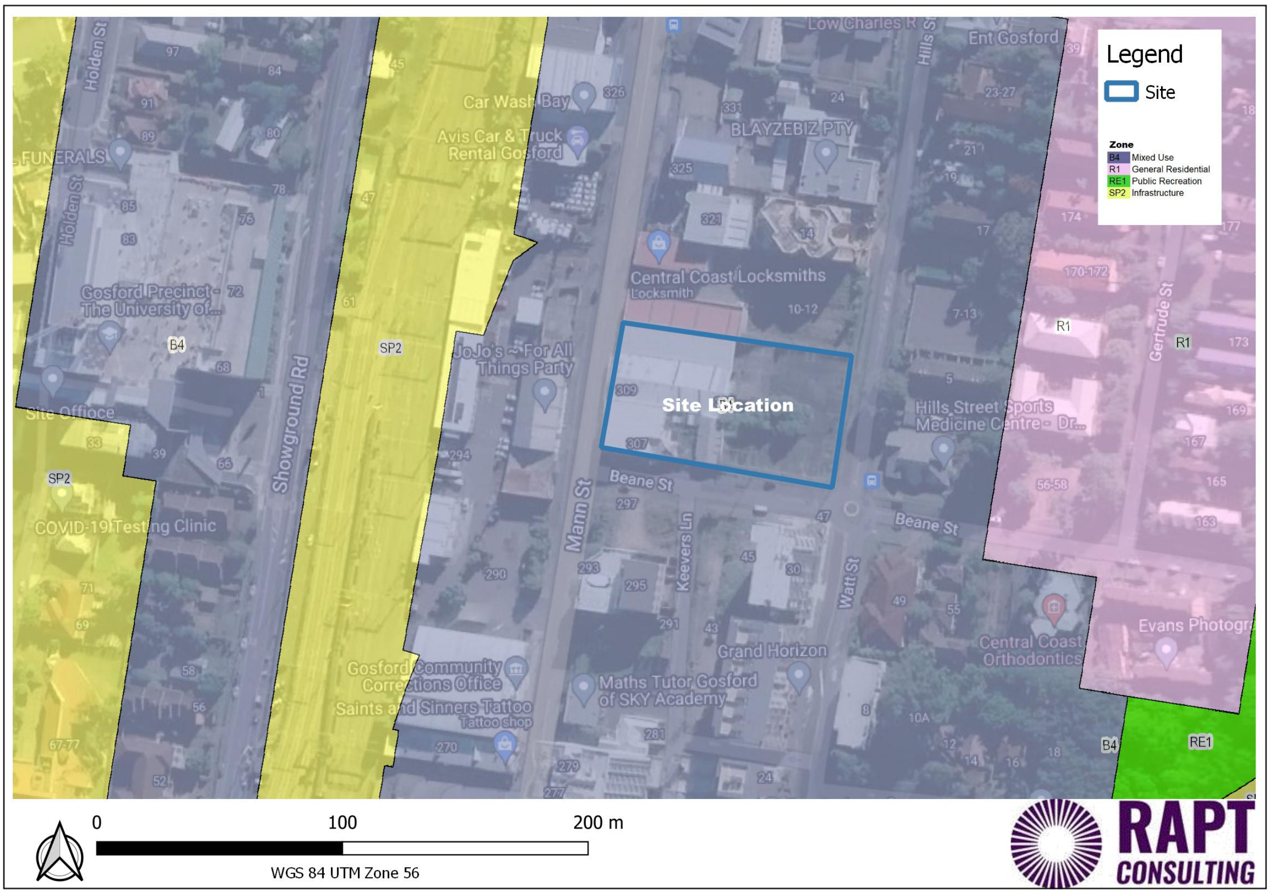


Figure 2-1 Land Use Zonings

Closest receptors to the proposal assessed in this acoustic assessment are identified in Table 2-1 and Figure 2-2.

Table 2-1 Receptors Assessed for the Proposal

Receiver ID	Address	Receptor Type	Easting	Northing
R1	293 Mann Street	Residential	345959	6300782
R2	45 Beane Street	Residential	346011	6300787
R3	49 Beane Street	Residential	346068	6300780
R4	55 Beane Street	Residential	346096	6300776
R5	Central Coast Orthodontics	Commercial	346130	6300768
R6	Evans Photography	Commercial	346158	6300763
R7	Hill Street Sports Medicine	Commercial	346072	6300814
R8	Stop Smoking Central Coast	Commercial	346076	6300836
R9	168 Gertrude Street	Residential	346126	6300855
R10	17 Hills Street	Residential	346092	6300905
R11	Hemp Straw Silk	Commercial	346131	6300885
R12	AJ’s Automotive	Commercial	346013	6300871
R13	Central Coast Locksmiths	Commercial	345989	6300888
R14	14 Hills Street	Residential	346023	6300901
R15	19 Hills Street	Residential	346092	6300927
R16	321 Mann Street	Commercial	345984	6300909
R17	326 Mann Street	Commercial	345956	6300954
R18	Avis Car Rental	Commercial	345946	6300931
R19	Jo Jo’s	Commercial	345941	6300844
R20	Network Base Gosford	Commercial	345911	6300882
R21	UON Gosford 72 Showground Road	Educational	345822	6300873
R22	64 Showground Road	Residential	345808	6300793
R23	Gosford Community Corrections Office	Commercial	345922	6300743

Figure 2-2 Receptor Locations Surrounding the Proposal Site

To establish background and ambient noise levels, noise monitoring was undertaken by RAPT Consulting at the Avis Car and Truck Rental Gosford to the north of the site from 21 July to 27 July 2022. Site observations noted the location is considered indicative of the local ambient noise environment and this site also presented as secure location whereby minimising the risk of theft or vandalism to the monitoring equipment. Additionally, they are considered as acceptable locations for determination of the background noise with consideration to the NSW Environment Protection Authority's (EPA's) – Noise Policy for Industry (NPfI). During site visits it was noted that existing road and rail traffic, distant road traffic, natural wildlife, and an underlying urbuan 'hum' primarily described the ambient noise environment and is indicative of an urban noise environment.

The monitoring location is shown in Figures 2-1 and 2-2.

Figure 2-3 Monitoring Location with the site in the Background

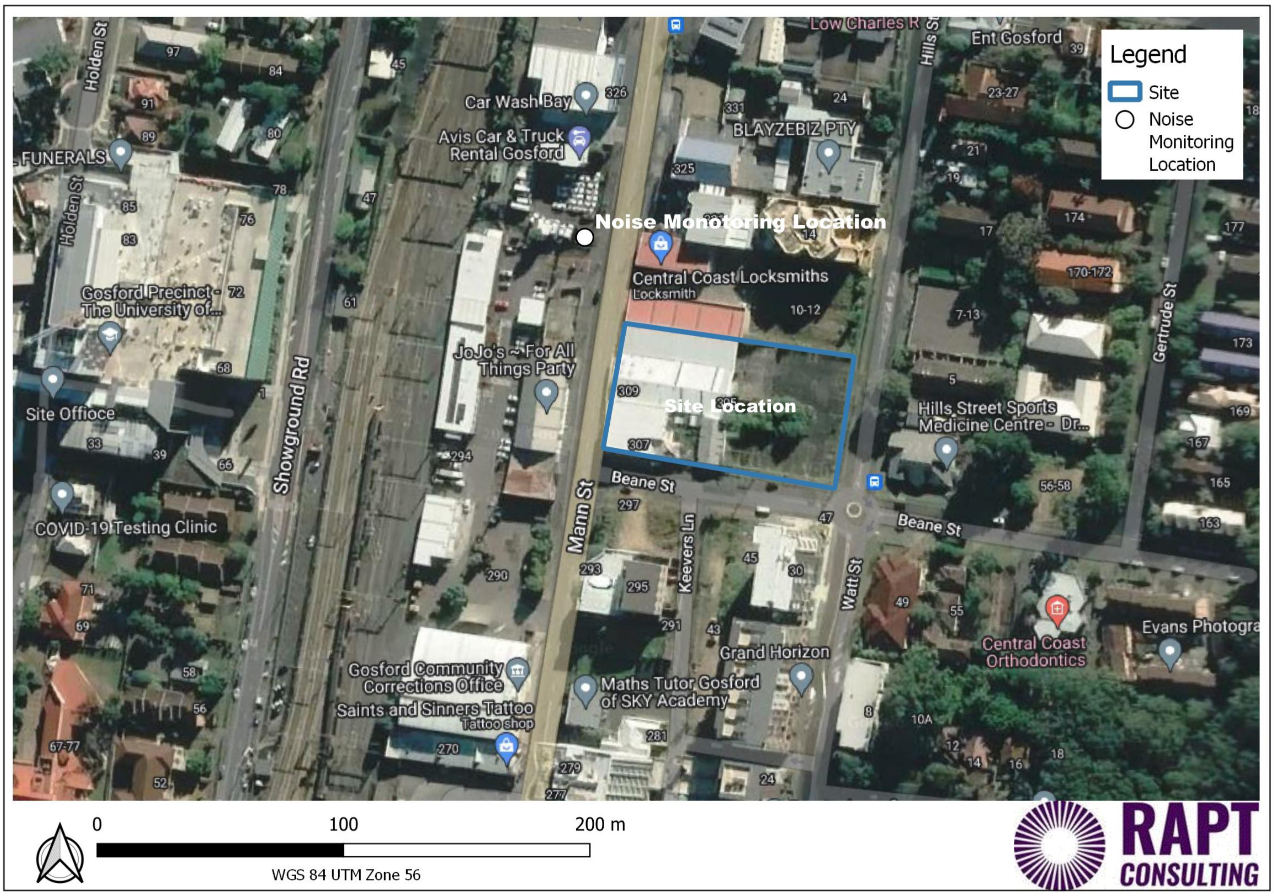


Figure 2-4 Noise Monitoring Location

Monitoring was undertaken using a RION NL-42 noise logger with Type 2 Precision. Calibration was checked prior to and at the conclusion of the measurements with no significant drift. These loggers are capable of measuring continuous sound pressure levels and are able to record LAmin, LA90, LA10, LAmax and LAeq noise descriptors. The instrument was programmed to accumulate environmental noise data continuously over sampling periods of 15 minutes for the entire monitoring period.

The LA90 descriptor is used to measure the background noise level. This descriptor represents the noise level that is exceeded for 90 per cent of the time over a relevant period of measurement. The LA90 descriptor is used to establish the Rating Background Noise Level (RBL), which is the overall single-figure background level representing each assessment period (day/evening/night) over the whole monitoring period. The RBL has been calculated, according to the procedures described in the EPA's NPfI and by following the procedures and guidelines detailed in Australian Standard AS1055-1997, "Acoustics - Description and Measurement of Environmental Noise, Part 1 General Procedures."

The LAeq is the equivalent continuous noise level which would have the same total acoustic energy over the measurement period as the varying noise actually measured, so it is in effect an energy average.

Logged data was reviewed and filtered to exclude any extraneous data during the monitoring period. Weather information for the unattended noise logging was obtained from the Bureau of Meteorology Gosford all weather station for the monitoring period and any data adversely affected by rain, wind (more than 5 m/s as per NPfI) were discarded.

The RBL and ambient LAeq levels are provided in Table 2-1 below.

Table 2-2 Background and Ambient Noise Monitoring Results

Descriptor	Noise Level dB(A)	Time Interval
$L_{A90(11hr)}$	51	7:00am - 6:00pm
$L_{A90(4hr)}$	42	6:00pm – 10:00pm
$L_{A90(9hr)}$	36	10:00pm – 7:00am
$L_{Aeq(11hr)}$	65	7:00am - 6:00pm
$L_{Aeq(4hr)}$	63	6:00pm - 10:00pm
$L_{Aeq(9hr)}$	59	10:00pm – 7:00am

3. Acoustic Objectives

3.1 Construction Noise

Construction noise is assessed with consideration to DECCW *Interim Construction Noise Guidelines* (ICNG) (2009) The ICNG are non-mandatory guidelines that are usually referred to by local councils and other NSW government entities when construction / demolition works require development approval. The ICNG recommend standard hours for construction activity as detailed in Table 3-1.

Table 3-1 ICNG Recommended Construction Hours

Work type	Recommended standard hours of work
Normal construction	Monday to Friday: 7 am to 6 pm. Saturday: 8 am to 1 pm. No work on Sundays or Public Holidays.

The ICNG provides noise management levels for construction noise at residential and other potentially sensitive receivers. These management levels are to be calculated based on the adopted rating background level (RBL) at nearby locations, as shown in Table 3-2.

Table 3-2 Recommended Construction Noise Management Levels

Period	Management Level $L_{Aeq(15\ min)}$
Residential Recommended standard hours	Noise affected level: RBL + 10 Highly noise affected level: 75 dB(A)
Residential Outside recommended standard hours	Noise affected level: RBL + 5 Highly noise affected level: 75 dB(A)
Classrooms at schools and other educational institutions	Internal Noise Level 45 dB(A) (applies when properties are being used) Outdoor Noise Level 55 dB(A) (assumes 10dB(A) loss through an open window
Hospital wards and operating theatres	Internal Noise Level 45 dB(A) (applies when properties are being used) Outdoor Noise Level 55 dB(A) (assumes 10dB(A) loss through an open window
Places of worship	Internal Noise Level 45 dB(A) (applies when properties are being used)
Active recreation areas (characterised by sporting activities and activities which generate their own noise or focus for participants, making them less sensitive to external noise intrusion)	External noise level 65 dB(A)
Industrial Premises	External noise level 75 dB(A)

Period	Management Level $L_{Aeq(15\ min)}$
Offices, retail outlets	External noise level 70 dB(A)
Passive recreation areas (characterised by contemplative activities that generate little noise and where benefits are compromised by external noise intrusion, for example, reading, meditation)	External noise level 60 dB(A)

The above levels apply at the boundary of the most affected residences / offices or within 30 m from the residence where the property boundary is more than 30 m from the residence.

The *noise affected level* represents the point above which there may be some community reaction to noise. Where the *noise affected level* is exceeded all feasible and reasonable work practices to minimise noise should be applied and all potentially impacted residents should be informed of the nature of the works, expected noise levels, duration of works and a method of contact. The *noise affected level* is the background noise level plus 10 dB(A) during recommended standard hours and the background noise level plus 5 dB(A) outside of recommended standard hours.

The *highly noise affected level* represents the point above which there may be strong community reaction to noise and is set at 75 dB(A). Where noise is above this level, the relevant authority may require respite periods by restricting the hours when the subject noisy activities can occur, considering:

- Times identified by the community when they are less sensitive to noise (such as 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.

It is understood works required for the proposal would be undertaken during standard construction hours. However, construction noise management levels (NML's) for standard and out of hours situations are provided for completeness. NML's for residential receivers have been derived, as shown in Table 3-3.

Table 3-3 Construction NML's dB(A) Leq(15min)

Period	RBL L_{A90}, dB(A)	Standard hours noise management levels, $L_{Aeq,15min}$, dB(A)	Out-of-hours noise management levels, $L_{Aeq,15min}$, dB(A)
Day[1]	51	61	56
Evening[1]	42	-	47
Night[1]	36	-	41

Note 1 Day: 7:00 to 18:00 Monday to Saturday and 8:00 to 18:00 Sundays & Public Holidays, Evening: 18:00 to 22:00 Monday to Sunday & Public Holidays , Night: 22:00 to 7:00 Monday to Saturday and 22:00 to 8:00 Sundays & Public Holidays

3.2 Construction Sleep Disturbance

The ICNG requires a sleep disturbance assessment to be undertaken where construction works are planned to extend over more than two consecutive nights. The ICNG makes reference to the EPA's NSW Environment Criteria for Road Traffic Noise (ECRTN), now superseded by the NSW RNP, for the assessment of sleep disturbance. The RNP references the recommendations in the ECRTN as providing the most appropriate assessment guidance.

The guidance provided in the RNP for assessing the potential for sleep disturbance recommends that to minimise the risk of sleep disturbance during the night-time period (10pm to 7am), the $L_{A1(1\ min)}$ noise level outside a bedroom window should not exceed the $L_{A90(15\ min)}$ background noise level by more than 15 dB(A). The EPA considers it appropriate to use this metric as a screening criterion to assess the likelihood of sleep disturbance. If this screening criterion is found to be exceeded, then a more detailed analysis must be undertaken that should include the extent that the maximum noise level exceeds the background noise level and the number of times this is likely to happen during the night-time period.

The RNP contains a review of research into sleep disturbance which represents NSW EPA advice on the subject of sleep disturbance due to noise events. It concludes that having considered the results of research to date that, 'Maximum internal noise levels below 50-55 dB(A) are unlikely to cause awakening reactions. Therefore, given that an open window provides around 10 dB(A) in noise attenuation from outside to inside, external noise levels of 60-65 dB(A) are unlikely to result in awakening reactions.

Construction is expected to take place during standard hours, and therefore sleep disturbance is not expected to be an issue nor is it assessed further. However, sleep disturbance assessment levels are presented in Table 3-4.

Table 3-4 Construction Noise Sleep Disturbance Assessment Levels

Night-time rating background level, dB(A)	Sleep disturbance screening $L_{A1(1min)}$ criteria, dB(A)	Sleep disturbance awakening reaction $L_{A1(1min)}$ criteria, dB(A)
36	51	60

3.3 Vibration Guidelines

Vibration during construction and operational activity is expected to primarily originate from trucks and machinery during stages of construction and associated activities. RAPT

Consulting also understand that blasting and heavy ground impact activities is not expected to occur during the construction works.

3.3.1 Human Exposure

Vibration goals during the were sourced from the DECCW's *Assessing Vibration: a technical guideline*, which is based on guidelines contained in British Standard (BS) 6472–1992, *Evaluation of human exposure to vibration in buildings (1–80 Hz).*

Intermittent vibration is assessed using the vibration dose value (VDV), fully described in BS 6472 – 1992. Acceptable values of vibration dose are presented in Table 3-5.

Table 3-5 Acceptable Vibration Values for Intermittent Vibration ($m/s^{1.75}$)

Location	Daytime [2]		Night-time [2]	
	Preferred value	Maximum value	Preferred value	Maximum value
Critical areas [3]	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

Note 2 Daytime is 7:00 to 22:00 and night-time is 22:00 to 7:00: and

Note 3 Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. These criteria are only indicative, and there may be needed to assess intermittent values against the continuous or impulsive criteria for critical areas.

3.4 Building Damage

Currently, there is no Australian Standard that sets the criteria for the assessment of building damage caused by vibration. Guidance of limiting vibration values is attained from reference to the following International Standards and Guidelines:

- British Standard BS7385.2 - 1993 *Evaluation and Measurement for Vibration in Buildings*, Part 2 - Guide to damage levels from ground borne vibration. and

- German Standard DIN 4150-3: 1999-02 Structural Vibration – Part 3: Effects of vibration on structures.

The recommended Peak Particle Velocity (PPV) guidelines for the possibility of vibration induced building damage are derived from the minimum vibration levels above which any damage has previously been encountered and are presented in Table 3-6 for DIN 4150-3: 1999-02 and Table 3-7 for BS7385.2 – 1993.

Table 3-6 Guideline values for vibration velocity to be used when evaluating the effects of short-term vibration on structures

Type of Structure	Peak Component Particle Velocity, mm/s			
	Vibration at the foundation at a frequency of			Vibration of horizontal plane of highest floor at all frequencies
	1 Hz to 10 Hz	10 Hz to 50 Hz	50 Hz to 100 Hz[4]	
Buildings used for commercial purposes, industrial buildings, and buildings of similar design	20	20-40	40-50	40
Dwellings and buildings of similar design and/or occupancy	5	5-15	15-20	15
Structures that, because of their sensitivity to vibration, do not correspond to those listed in lines 1 and 2 of table 5-7 and are of great intrinsic value (e.g. buildings that are under a preservation order)	3	3 to 8	8 to 10	8

Note 4 At frequencies above 100Hz, the values given in this column may be used as minimum values

Table 3-7 BS7385.2 Transient Vibration Guideline Values for Potential building - Cosmetic Damage

Building Type[6]	Peak component particle velocity in frequency range of predominant pulse	
	4 Hz to 15 Hz[5]	15 Hz and above[5]
Reinforced or framed structures. Industrial and heavy commercial buildings	50 mm/s at 4 Hz and above	
Unreinforced or light framed structures. Residential or light commercial type buildings.	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above

Note 5 Values referred to are at the base of the building: and
Note 6 For transient vibration effecting unreinforced or light framed structures at frequencies below 4 Hz, a maximum displacement of 0.6 mm (zero to peak) should not be exceeded.

3.5 Operational Noise – NSW Noise Policy for Industry

The NPfI provides guidance on the assessment of operational noise impacts associated with the projects operation. The NPfI assessment procedure has two components:

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

Project Intrusiveness Noise Levels

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

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

Based on the measured and adopted noise levels outlined in Table 2-2, The intrusiveness noise levels for residential receivers are provided in Table 3-8.

Table 3-8 Intrusiveness Noise Levels

Period	RBL. L_{A90}, dB(A)	Intrusiveness noise level (RBL + 5), dB(A)
Day[7]	51	56
Evening[7]	42	47
Night[7]	36	41

Note 7 Day 7:00 to 18:00 Monday to Saturday and 8:00 to 18:00 Sundays & Public Holidays
Evening: 18:00 to 22:00 Monday to Sunday & Public Holidays
Night: 22:00 to 7:00 Monday to Saturday and 22:00 to 8:00 Sundays & Public Holidays

Amenity Noise Levels

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

The NPfI recommended amenity noise levels are shown in Table 3-9 below.

Table 3-9 NPfI Recommended Amenity Noise Levels

Type of Receiver	Noise Amenity Area	Time of Day[8, 9]	Recommended amenity noise level, LAeq, dB(A)[10, 11]
Residential	Rural	Day	50
		Evening	45
		Night	40
	Suburban	Day	55
		Evening	45
		Night	40
	Urban	Day	60

Type of Receiver	Noise Amenity Area	Time of Day[8, 9]	Recommended amenity noise level, LAeq, dB(A)[10, 11]
		Evening	50
		Night	45
Hotels, motels, caretakers' quarters, holiday accommodation, permanent resident caravan parks	See column 4	See column 4	5 dB(A) above the recommended amenity noise level for a residence for the relevant noise amenity area and time of day
School classroom (internal)	All	Noisiest 1-hour period when in use	35[12]
Hospital ward	All		
- Internal		Noisiest 1-hour	35
- External		Noisiest 1-hour	50
Place of worship (internal)	All	When in use	40
Passive recreation (e.g. national park)	All	When in use	50
Active recreation (e.g. school playground, golf course)	All	When in use	55
Commercial premises	All	When in use	65
Industrial premises	All	When in use	70
Industrial interface (applicable only to residential noise amenity areas)	All	When in use	Add 5 dB(A) to recommended noise amenity area

Note 8 Daytime 7.00 am to 6.00 pm; Evening 6.00 pm to 10.00 pm; Night-time 10.00 pm to 7.00 am.

Note 9 On Sundays and Public Holidays, Daytime 8.00 am - 6.00 pm; Evening 6.00 pm - 10.00 pm; Night-time 10.00 pm - 8.00 am.

Note 10 The LAeq index corresponds to the level of noise equivalent to the energy average of noise levels occurring over a measurement period.

Note 11 The recommended amenity noise levels refer only to noise from industrial sources. However, they refer to noise from all such sources at the receiver location, and not only noise due to a specific project under consideration. The levels represent outdoor levels except where otherwise stated

Note 12 In the case where existing schools are affected by noise from existing industrial noise sources, the acceptable LAeq noise level may be increased to 40 dB LAeq(1hr)

High Traffic

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 LAeq, 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 is 10 dB or more above the recommended amenity noise level for the area
- it is highly unlikely traffic noise levels will decrease in the future.

In this case based on noise measurements and attended observations when comparing to the above critieria, the high traffic application does apply for evening and night time situations.

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

Project amenity noise level = Recommended amenity noise level (Table 3-8) – 5dB(A)

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

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

The project amenity noise levels ($L_{Aeq,15min}$) for urban residences and other receptors applied for this project are shown in Table 3-10.

Table 3-10 Project Amenity Noise Levels

Type of Receiver	Noise Amenity Area	Time of Day	Recommended Noise Level, dB(A)	
			$L_{Aeq, Period}$	$L_{Aeq, 15min}$
Residence	Urban	Day	60 – 5 = 55	55 + 3 = **58**
		Evening[13]	63 – 15 = 48	48 + 3 = **51**
		Night[13]	59 – 15 = 44	44 + 3 = **47**
Commercial Premises	All	When in use	65 – 5 = 60	60 + 3 = **63**
School Classroom	All	Noisiest 1hour When in use	35 – 5 = 30	30 + 3 = 33

Note 13 High Traffic Provision Applied

Project Noise Trigger Levels

The project noise trigger level is the lower of the intrusiveness and the amenity noise levels. Provided in Table 3-11 are the established project noise trigger levels for the assessment locations within the study area. Table 3-11 presents the project noise trigger levels for the day, evening, and night-time periods.

Table 3-11 Project Noise Trigger Levels

Type of receiver	Assessment period	Intrusiveness noise levels, $L_{Aeq,15min}$, dB(A)	Amenity noise levels, $L_{Aeq,15min}$, dB(A)	Project noise trigger levels, $L_{Aeq,15min}$, dB(A)
Residential Urban	Day	56	58	**56**
	Evening	47	51	**47**
	Night	41	47	**41**
Commercial premises	When in use	-	63	**63**
School Classroom(External)[14]	When in use	-	43	**43**

Note 14 Conversion of trigger levels from internal to external for school classroom and assumes 10dB(A) loss from outside to inside through open window (Section 2.6 NPfI).

Maximum Noise Level Assessment

It is understood the proposal will not be generating any significant outdoor noise during night time, however maximum noise level assessment provisions are provided below for completeness.

The NPfI requires the potential for sleep disturbance to be assessed by considering maximum noise levels events during the night-time period.

Where the subject development/premises night-time noise levels at a residential location exceed the following screening levels a detailed maximum noise level event assessment should be undertaken:

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

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

Based on the adopted background noise levels during the night, the sleep disturbance criteria for the nearest noise sensitive residential receivers are provided in Table 3-12.

Table 3-12 Night-Time Sleep Disturbance Screening Levels

Receiver type	Assessment Level $L_{Aeq,15min}$, dB(A)	Assessment Level L_{AFmax}, dB(A)
Residential	41	52

The RNP (DECCW 2011) provides additional information on sleep disturbance and concludes that:

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

The above references identify that internal noise levels of 50 to 55 dB(A), are unlikely to cause awakenings. On the assumption that there is a 10 dB(A) outside-to-inside noise loss through an open window (see Section 2.6 of the NPfI, p15), this indicates that external noise levels of LAmax 60 to 65 dB(A) are unlikely to cause awakening reactions.

3.6 NSW Road Noise Policy (RNP)

The NSW Road Noise Policy (RNP) recommends various criteria for different road and residential developments and uses. Although it is not mandatory to achieve the noise assessment criteria in the RNP, proponents will need to provide justification if it is not considered feasible or reasonable to achieve them. Based on the definitions in the RNP, The Mann Road is considered to be an sub-arterial road and Beane Street is considered to be a local road. Based on this, the following noise goals for residences taken from Table 3 of the RNP are provided in Table 3-13 Below.

Table 3-13 Road Noise Policy Goals

Road Category	Day	Night
Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use development	60 $L_{Aeq(15hr)}$ External	55 $L_{Aeq(9hr)}$ External
Existing residences affected by additional traffic on existing local roads generated by land use developments	55 $L_{Aeq(1hr)}$ External	50 $L_{Aeq(1hr)}$ External

For existing residences and other sensitive land uses affected by additional traffic on existing roads generated by land use developments, any increase in the total traffic noise level should be limited to 2 dB above that of the corresponding 'no build option'.

To increase noise levels by 2dB(A) one would have to increase the cumulative traffic volume by 60%. The proposal provisions for 20 underground car parks and 4 EV parks. The number of vehicles on the road network created by the proposal is negligible and will not increase overall traffic noise levels on the surrounding road network. Therefore, compliance is expected and is not considered further in this report.

3.7 Australian Standard 2107:2016

Australian Standard (AS) AS2107 – Acoustics – Recommended design sound levels and reverberation times for building interiors provides recommended design sound levels for different areas of occupancy in educational buildings which are presented in Table 3-14.

Table 3-14 Recommended Design Sound Levels and Reverberation Times

Type of Occupancy	Recommended design sound levels, L_{Aeq}, dB(A)		Recommended Reverberation Time (T) s
	Satisfactory	Maximum	
Art/Craft Studios	40	45	0.6 to 0.8
Assembly Halls Up to 250 Seats	30	40	Curve 1*
Assembly Hall over 250 seats	30	35	0.6 to 0.8
Audio-Visual Areas	35	45	0.6 to 0.8
Computer Rooms Teaching	40	45	0.4 to 0.6
Computer Room Laboratories	45	50	0.4 to 0.6
Conference Rooms	35	40	0.6 to 0.7
Corridors and Lobbies	45	50	0.6 to 0.8
Drama Studios	35	40	See Note 2
Duplicating Rooms / Stores	45	50	0.6 to 0.8
Engineering Workshops	50	60	See Note 3
Gymnasiums	45	55	See Note 2
Interview / Counselling Rooms	40	45	0.3 to 0.6

Type of Occupancy	Recommended design sound levels, L_{Aeq}, dB(A)		Recommended Reverberation Time (T) s
	Satisfactory	Maximum	
Laboratories Teaching	35	45	0.5 to 0.7
Laboratories Working	40	50	0.6 to 0.8
Lecture Rooms up to 50 Seats	30	35	Curve 1*
Lecture Theatres without speech Reinforcement	30	35	Curve 1*
Lecture Theatres with speech Reinforcement	35	45	Curve 1*
Library General Areas	40	50	0.4 to 0.6
Library Reading Areas	40	45	0.4 to 0.6
Library Stack Areas	45	50	See Note 3
Manual Arts Worships	40	45	Seen Note 3
Medical Rooms (First Aid)	40	45	0.6 to 0.8
Music Practice Rooms	40	45	0.7 to 0.9
Music Studios	30	35	Curve 2*
Office Areas	40	45	0.4 to 0.6
Professional and administrative offices	35	40	0.6 to 0.8
Teaching Spaces Primary Schools	35	45	0.4 to 0.5 See Note 4
Teaching Spaces Secondary Schools	35	45	0.5 to 0.6 See Note 4

Type of Occupancy	Recommended design sound levels, L_{Aeq}, dB(A)		Recommended Reverberation Time (T) s
	Satisfactory	Maximum	
Staff Common Rooms	40	45	0.4 to 0.6
Toilet / Change / Showers	45	55	-

Note 1: Reverberation should be minimised for noise control

4. Acoustic Assessment

4.1 Construction Noise

Construction can occur in the vicinity of residences or other sensitive land uses and be variable in times of occurrence. These aspects of construction can exacerbate noise levels and their effects. Construction noise by its nature is temporary, may not be amenable to purpose-built noise control measures applied to industrial processes, and may move as construction progresses. With these constraints in mind, the ICNG was developed to focus on applying a range of work practices most suited to minimise construction noise impacts, rather than focusing only on achieving numeric noise levels. While some noise from construction sites is inevitable, the aim of the Guideline is to protect much of residences and other sensitive land uses from noise pollution most of the time.

While it is unknown at this stage what specific plant and equipment are planned to be used, generally the typical construction activity on the proposal will be in the form of construction of the buildings. Other equipment may be used however it is anticipated that they would produce similar noise emissions. Therefore, an assumed construction sequence would be:

- Excavation/Site preparation.
- Construction of building.

Table 4-1 provides general plant and machinery data that has been used to predict noise levels at the neighbouring properties. The noisiest data has been chosen for each piece of plant/machinery to present a worst-case scenario.

Table 4-1 Plant and Equipment Noise Levels

Plant Item	Activity Noise Level L_{Aeq} @ 10m	DEFRA Construction Noise Database	Anticipated Usage %
Excavation			
Dozer	80	Table 2 Ref 10	50
Tracked Excavator	79	Table 2 Ref 14	50
Articulated Dump Truck	74	Table 2 Ref 32	50
Roller	73	Table 2 Ref 38	50
Building			
Concrete Pump & Cement Mixer	67	Table 4 Ref 24	50
Poker Vibrator	69	Table 4 Ref 34	50
Mobile Telescopic Crane	67	Table 4 Ref 36	50

Plant Item	Activity Noise Level L_{Aeq} @ 10m	DEFRA Construction Noise Database	Anticipated Usage %
Diesel Generator	61	Table 4 Ref 75	90

Note 15 The sound power levels for the individual plant items are worst-case levels representative of the equipment operating at maximum capacity. In practice, not all plant items would operate at maximum capacity at the same time and therefore the estimated usage has been adjusted to reflect this. This adjustment is consistent with RAPT Consulting experience on similar projects.

It is understood the proposed work would be undertaken during standard work hours:

- Monday to Friday, 7am to 6pm
- Saturday, 8am to 1pm
- No works on public holidays.

Construction Operations

Acoustic modelling was undertaken using Bruel and Kjaer's "Predictor" to predict the effects of construction noise. Predictor is a computer program for the calculation, assessment and prognosis of noise propagation. Predictor calculates environmental noise propagation according to ISO 9613-2, "Acoustics – Attenuation of sound during propagation outdoors". the method predicts the sound pressure level under meteorological conditions favourable to propagation from sources of known sound emission. These conditions are for downwind propagation or equivalently under a well developed moderate ground based temperature inversion.' Terrain topography, ground absorption, atmospheric absorption and relevant shielding objects are taken into account in the calculations.

Construction noise levels have been predicted based on the potential construction noise levels provided in Table 4-1. These noise levels represent different equipment noise levels and give an idea how noise levels may change across the proposal area with different activities being undertaken.

The magnitude of off-site noise impact associated with construction would be dependent upon several factors:

- The intensity of construction activities
- The location of construction activities
- The type of equipment used
- Intervening terrain, and
- The prevailing weather conditions.

In addition, construction machinery would likely move about the study area, variously altering the directivity of the noise source with respect to individual receivers and their distances. Noise levels at sensitive receivers can be significantly lower than the worst-case scenario when the construction works move to a more distant location in the work area. An example of this is shown in Figure 4-1.

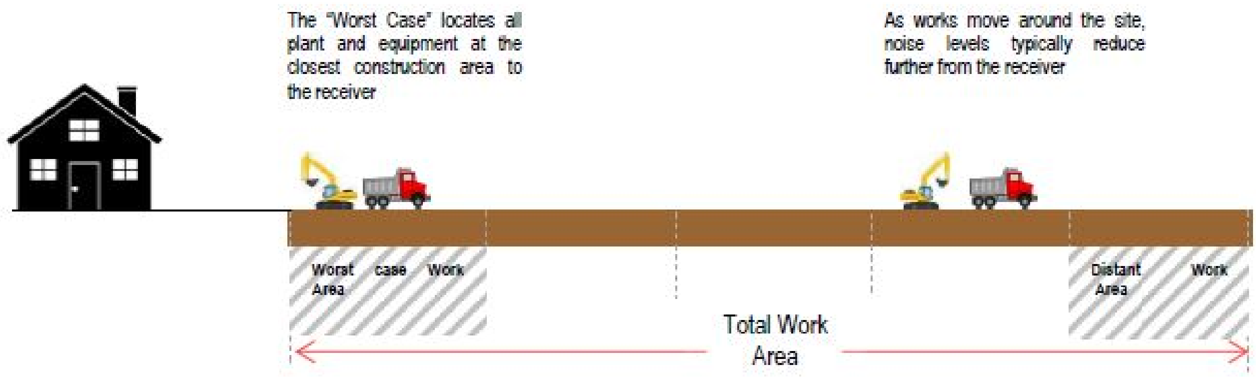


Figure 4-1 Example of Differing Work Areas

During any given period, the machinery items to be used in the study area would operate at maximum sound power levels for only brief stages. At other times, the machinery may produce lower sound levels while carrying out activities not requiring full power. It is highly unlikely that all construction equipment would be operating at their maximum sound power levels at any one time. Finally, certain types of construction machinery would be present in the study area for only brief periods during construction. Therefore, the modelled construction noise results are considered to represent a worst-case scenario. four scenarios were assessed, one for excavation and one for building to the west of the site and one for the excavation and building to the east of the site.

Other key assumptions and inputs in the model include:

- topographical information was obtained from NSW Government Spatial Services
- all cleared areas were modelled considering a conservative ground factor of 0.0 to account for hard surfaces
- all receivers were modelled at 1.5 metres above the ground surface

Construction noise assessment results

Noise levels were predicted to each assessed receptor assuming receiver heights of 1.5m above ground level for typical construction activities. Table 4-3 summarises the maximum predicted noise level from each of the construction scenarios at identified residential receptors. Predicted exceedances of NML's are highlighted in RED.

Table 4-2 Predicted Construction Noise Levels dB(A) LAeq(15min)

Receiver	Excavation East	Build East	Excavation West	Build West	Standard Hours NML	Highly Affected Noise Level
R1	58	47	65	55	61	75

Receiver	Excavation East	Build East	Excavation West	Build West	Standard Hours NML	Highly Affected Noise Level
R2	65	54	65	55	61	75
R3	64	53	60	50	61	75
R4	62	52	60	50	61	75
R5	50	38	54	43	70	-
R6	49	41	51	40	70	-
R7	69	58	64	54	70	-
R8	70	59	64	54	70	-
R9	61	51	58	49	61	75
R10	64	54	61	51	61	75
R11	63	52	58	47	70	-
R12	72	62	46	35	70	-
R13	55	44	57	45	70	-
R14	65	55	46	36	61	75
R15	63	53	34	24	61	75
R16	39	29	43	33	70	-
R17	52	41	43	34	70	-

Receiver	Excavation East	Build East	Excavation West	Build West	Standard Hours NML	Highly Affected Noise Level
R18	45	34	43	34	70	-
R19	64	53	72	61	70	-
R20	61	51	65	54	70	-
R21	45	34	51	41	55	-
R22	49	38	46	35	61	75
R23	37	26	62	52	70	-

Construction noise results are also presented in Figures 4-2 – 4-5.

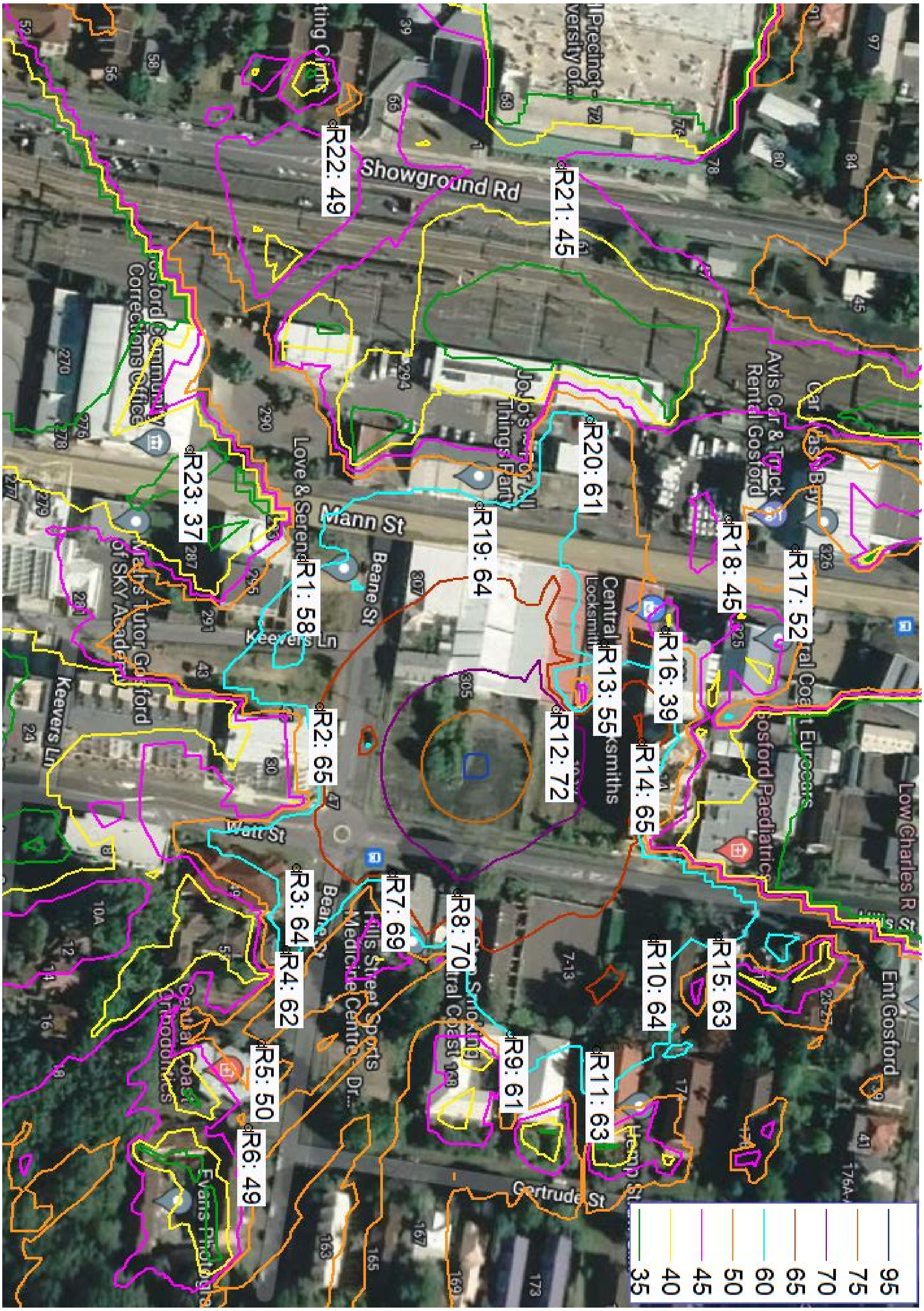


Figure 4-2 Construction Excavation East dB(A) Leq,15min

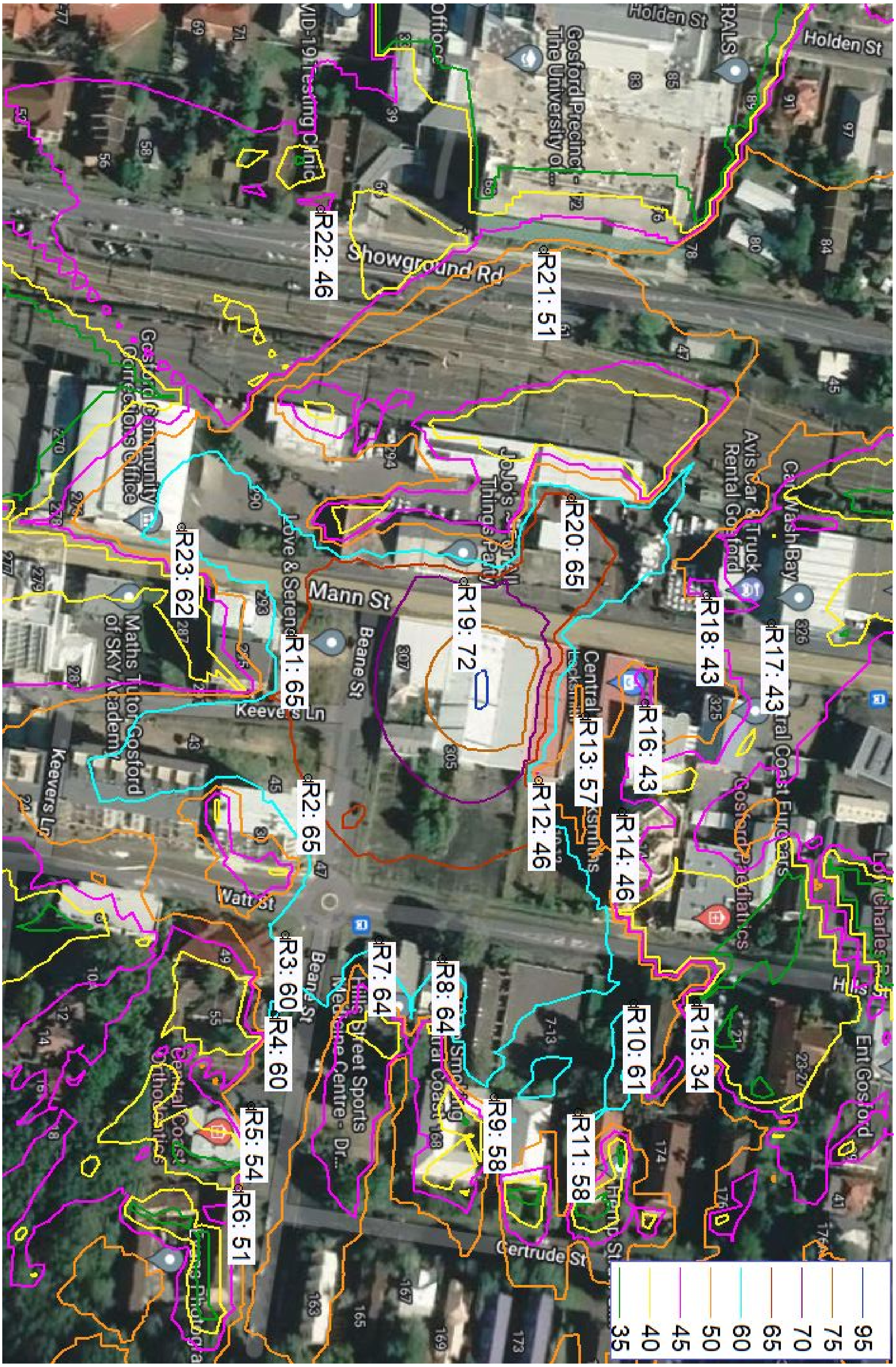


Figure 4-3 Construction Excavation West dB(A) Leq,15min

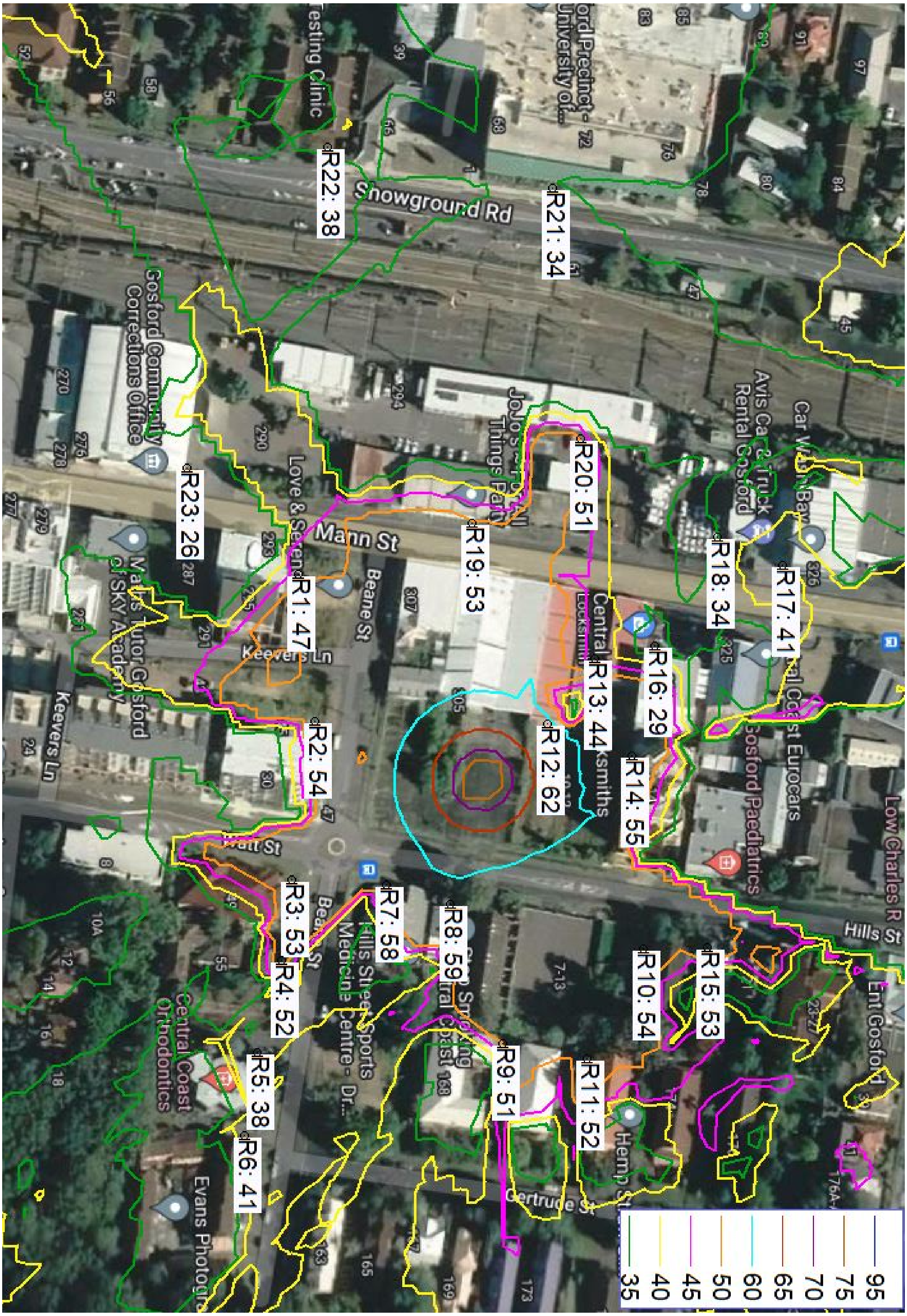


Figure 4-4 Construction Build East dB(A) Leq,15min

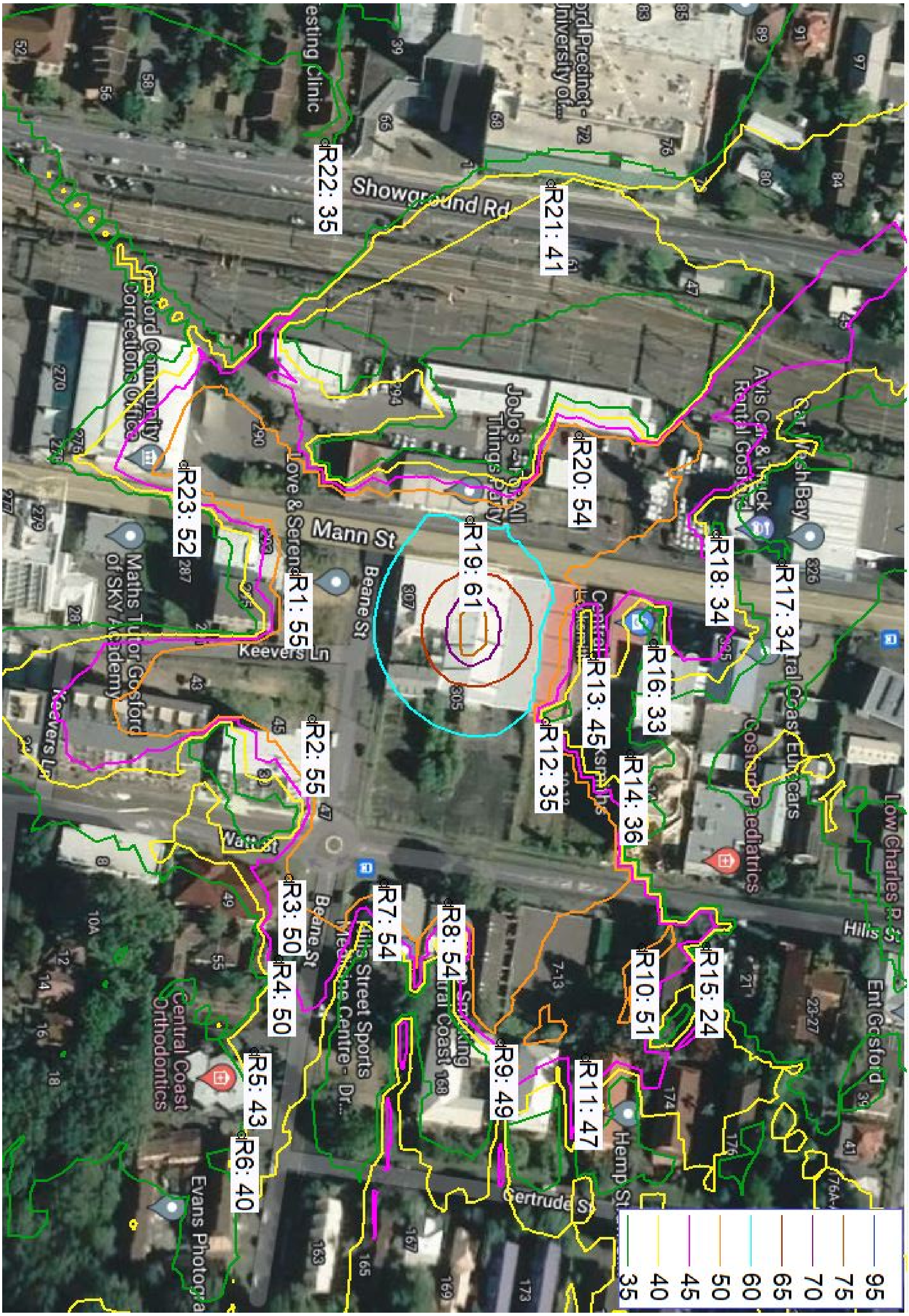


Figure 4-5 Construction Build West dB(A) Leq,15min

The results of the construction assessment indicate compliance with all NML's with the exception of excavation works in the east and west of the site at limited receivers as shown in Table 4-3. The highly affected noise level is expected to be complied with in all situations. While NML's can be achieved in most cases, there is a risk for NML's to be exceeded depending on work activities and locations. With this in mind it is recommended a construction noise management plan be implemented as part of the proposal to minimise the risk of adverse noise emanating upon the community.

4.2 Construction Noise Management Plan

A Construction Noise Management Plan (CNMP) could be prepared prior to the commencement of works and implemented through all phases of the proposed construction works. The CNMP would provide the framework for the management of all potential noise impacts resulting from the construction works and would detail the environmental mitigation measures to be implemented throughout the construction works.

4.2.1 Planning and design of construction works

During the detailed planning, scheduling and design of the construction works the following noise management and mitigation measures should be investigated and, as required, implemented prior to the commencement of noise generating works.

Notification before and during construction

- Affected neighbours to the construction works would be advised in advance of the proposed construction period at least 1 week prior to the commencement of works.
- Consultation and communication between the site and neighbours to the site would assist in minimising uncertainty, misconceptions and adverse reactions to noise.
- All site workers (including subcontractors and temporary workforce) should be familiar with the potential for noise impacts upon residents and encouraged to take all practical and reasonable measures to minimise noise during their activities.
- The constructor or site supervisor (as appropriate) should provide a community liaison phone number and permanent site contact so that the noise related complaints, if any, can be received and addressed in a timely manner.
- The constructor (as appropriate) should establish contact with the residents and communicate, particularly when noisy activities are planned.

Best practice measures when operating on construction site

- Construction works should adopt Best Management Practice (BMP) and Best Available Technology Economically Achievable (BATEA) practices as addressed in the ICNG. BMP includes factors discussed within this report and encouragement of a project objective to reduce noise emissions. BATEA practices involve incorporating the most advanced and affordable technology to minimise noise emissions.
- Ensure that all construction works scheduled for standard construction hours comply with the start and finish time.

- Where practical, simultaneous operation of dominant noise generating plant should be managed to reduce noise impacts, such as operating at different times or increase the distance between plant and the nearest identified receiver.
- High noise generating activities such as jack hammering should only be carried out in continuous blocks, not exceeding 3 hours each, with a minimum respite period of one hour between each block.
- Where possible, reversing beepers on mobile equipment would be replaced with low-pitch tonal beepers (quackers). Alternatives to reversing beepers include the use of spotters and designing the site to reduce the need for reversing may assist in minimising the use of reversing beepers.
- Equipment which is used intermittently should be shut down when not in use.
- All engine covers should be kept close while equipment is operating.
- The construction site would be arranged to minimise noise impacts by locating potentially noisy activities away from the nearest receivers wherever possible.
- To minimise heavy equipment handling noise, material stockpiles should be located as far as possible from the nearest receptors
- Loading and unloading areas should be located as far as possible from the nearest receptors.
- Where possible, trucks associated with the work area should not be left standing with their engine operating in a street adjacent to a residential area.
- All vehicular movements to and from the site should comply with the appropriate regulatory authority requirement for such activities.

Complaint handling

- Noise and vibration monitoring should be undertaken upon receipt of a complaint to identify and quantify the issue and determine options to minimise impacts.
- If valid noise and/or vibration data for an activity is available for the complainant property, from works of a similar severity and location, it is not expected that monitoring will be repeated upon receipt of repeated complaints for these activities, except where vibration levels are believed to be potentially damaging to the building.
- Any noise and/or vibration monitoring should be undertaken by a qualified professional and with consideration to the relevant standards and guidelines. Attended noise and/or vibration monitoring should be undertaken upon receipt of a noise and/or vibration complaint. Monitoring should be undertaken and reported within a timely manner (say 3 to 5 working days). If exceedance is detected, the situation should be reviewed to identify means to reduce the impact to acceptable levels.

4.3 Construction Vibration

The relationship between vibration and the probability of causing human annoyance or damage to structures is complex. This complexity is mostly due to the magnitude of the vibration source, the particular ground conditions between the source and receiver, the foundation-to-footing interaction and the large range of structures that exist in terms of design (e.g. dimensions, materials, type and quality of construction and footing conditions). The intensity, duration, frequency content and number of occurrences of vibration, are all important aspects in both the annoyances caused and the strains induced in structures.

Energy from construction equipment is transmitted into the ground and transformed into vibrations, which attenuates with distance. The magnitude and attenuation of ground vibration is dependent on the following:

- The efficiency of the energy transfer mechanism of the equipment (i.e. impulsive, reciprocating, rolling or rotating equipment).
- The Frequency content.
- The impact medium stiffness.
- The type of wave (surface or body).
- The ground type and topography.

Due to the above factors, there is inherent variability in ground vibration predictions without site-specific measurement data.

Ground Vibration – Minimum Working Distances from Sensitive Receivers

The Transport for NSW Construction Noise and Vibration Strategy (CNVS) provides guidance for minimum working distances. As a guide, minimum working distances from sensitive receivers for typical items of vibration intensive plant are listed in Table 4-3. The minimum distances are quoted for both “cosmetic” damage (refer BS 7385) and human comfort (refer DECC’s Assessing Vibration - a technical guideline). DIN 4150 has criteria of particular reference for heritage structures. The minimum working distances are indicative and will vary depending on the particular item of plant and local geotechnical conditions. They apply to cosmetic damage of typical buildings under typical geotechnical conditions.

Table 4-3 Recommended Minimum Safe Working Distances for Vibration Intensive Plant from Sensitive Receiver

Plant Item	Rating / Description	Minimum Distance Cosmetic Damage Residential and Light Commercial (BS 7385)	Minimum Distance Cosmetic Damage Heritage Items (DIN 4150, Group 3)	Minimum Distance Human Response (NSW EPA Guideline)
Vibratory Roller	<50 kN (1-2 tonne)	5m	11m	15m to 20m
	<100 kN (2-4 tonne)	6m	13m	20m
	<200 kN (4-6 tonne)	12m	15m	40m
	<300kN (7-13 tonne)	15m	31m	100m
	>300kN (13-18 tonne)	20m	40m	100m
	>300kN (>18 tonne)	25m	50m	100m
Small Hydraulic Hammer	300kg (5 to 12 t excavator)	2m	5m	7m
Medium Hydraulic Hammer	900kg (12 to 18 t excavator)	7m	15m	23m
Large Hydraulic Hammer	1600kg (18 to 34 t excavator)	22m	44m	73m
Vibratory Pile Driver	Sheet Piles	2m to 20m	5m to 40m	20m
Pile Boring	≤ 800mm	2m (nominal)	5m	4m
Jack Hammer	Hand Held	1m (nominal)	3m	2m

Unlike noise which travels through air, the transmission of vibration is highly dependent on substratum conditions between the source/s and receiver. Also dissimilar to noise travelling through air, vibration levels diminish quickly over distance, thus an adverse impact from vibration on the broader community is not typically expected. Vibration during works is considered an intermittent source associated with two main types of impact, disturbance at receivers and potential architectural/structural damage to buildings. Generally, if disturbance issues are controlled, there is limited potential for structural damage to buildings.

Contractors are recommended to use Table 4-4 as a guide when selecting plant given proximities to receivers.

4.4 Operational Noise

Noise modelling was also undertaken for operational noise. Key model set up inputs conditions were consistent with the construction noise assessment.

Mechanical Plant

At this stage, the mechanical plant has not been selected for the development. However, it is not uncommon for the mechanical plant not to be selected prior to submitting a development application. Mechanical plant may consist of an air conditioning system and exhaust fans. A typical range of sound power levels for mechanical plant is given in Table 4-4 below.

Table 4-4 Sound Power Levels of Mechanical Plant

Plant Type	SWL dB(A)
Small (single fan) condenser	65
Medium (double fan) condenser	70
Large (double fan) condenser	80

For conservatism, is has been assumed that four large double fan condenser units will be operating as outdoor sources on the rooftop the new building.

Student Outdoor Noise

The facility has a capacity of 200 persons in the Civic Threshold and 215 students in the Learning and Innovation Interface as shown in Figures 4-6 and 4-7.

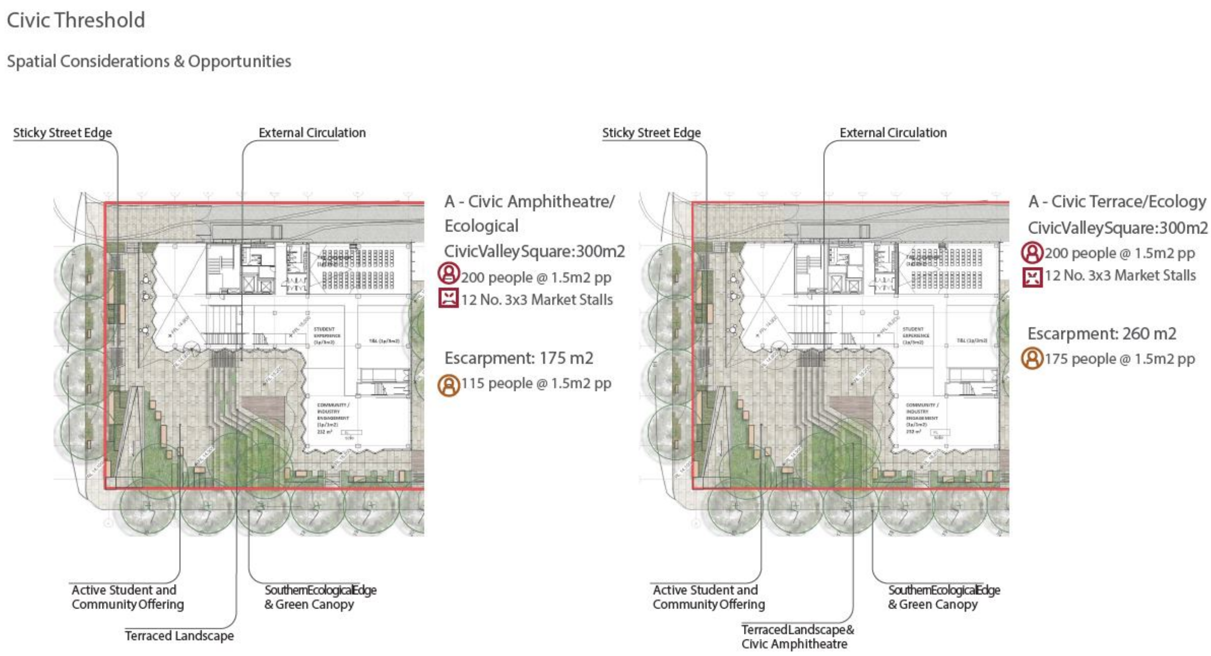


Figure 4-6 Civic Outdoor Area (Source: MCGREGOR COXALL)

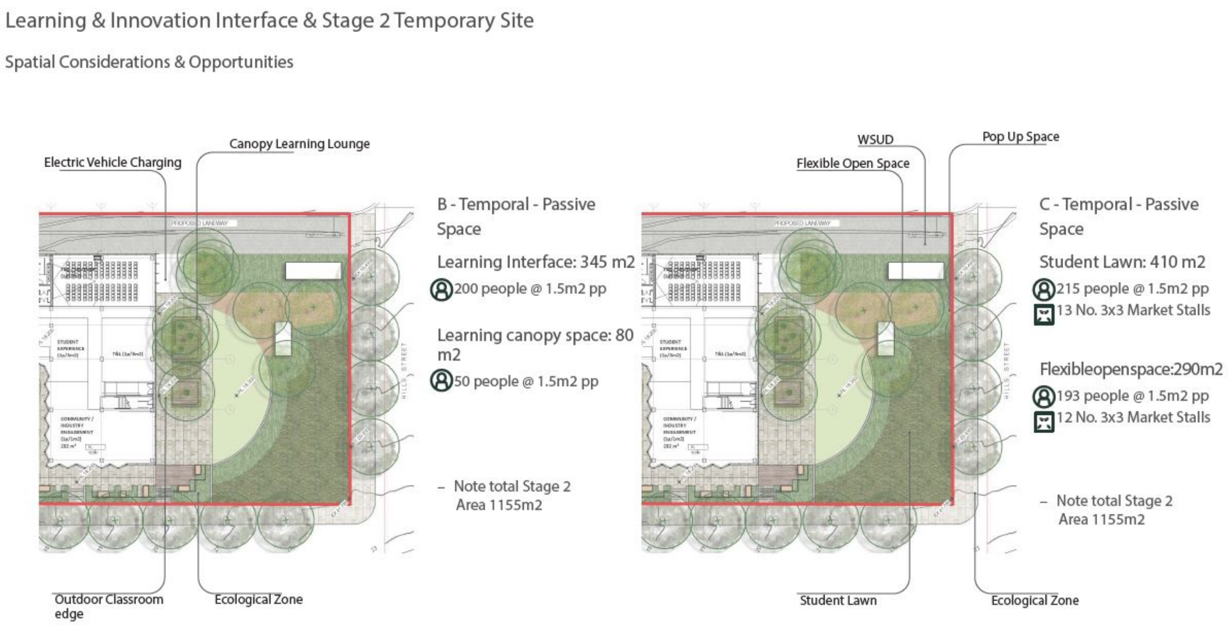


Figure 4-7 Learning and Innovation Space (Source: MCGREGOR COXALL)

Student noise in the form of human raised voice has been sourced from RAPT Consulting's database and has been assessed with a sound power level of 70 dB(A). Student noise has been assumed to be operating from the above-mentioned areas. It has been assumed that 50% of persons are conversing at any one time as not all persons will be speaking simultaneously. It is understood the students would be in these outdoor areas during daytime and potentially evening periods and not expected to be congregating in these areas during night time periods. For completeness night time periods have been assessed.

The results of the operational assessment are shown in Table 4-6 and Figure 4-6 with any predicted exceedances highlighted in RED.

Table 4-5 Predicted Operational Noise Results dB(A) Leq(15min)

Receiver	Civic Outdoor Area	Learning and Innovation Space	Rooftop Mechanical Plant	Cumulative Operations	Project Noise Trigger Level Day/Evening/Night
R1	39	47 (Night)	27	48 (Eve/Night)	56/47/41
R2	48 (Eve/Night)	47 (Night)	23	51 (Eve/Night)	56/47/41
R3	47 (Night)	32	25	47 (Night)	56/47/41
R4	45 (Night)	30	28	46 (Night)	56/47/41
R5	36	28	29	37	63
R6	33	17	29	35	63
R7	53	21	25	53	63
R8	52	21	24	52	63
R9	40	17	24	40	56/47/41

Receiver	Civic Outdoor Area	Learning and Innovation Space	Rooftop Mechanical Plant	Cumulative Operations	Project Noise Trigger Level Day/Evening/Night
R10	45 (Night)	18	32	45 (Night)	56/47/41
R11	44	27	27	44	63
R12	49	24	29	49	63
R13	28	26	31	34	63
R14	45 (Night)	24	31	45 (Night)	56/47/41
R15	44(Night)	15	30	44 (Night)	56/47/41
R16	20	21	22	26	63
R17	33	16	31	35	63
R18	26	27	30	33	63
R19	20	51	26	51	63
R20	27	39	24	40	63
R21	11	31	23	32	43
R22	27	30	26	33	56/47/41
R23	18	41	26	41	63

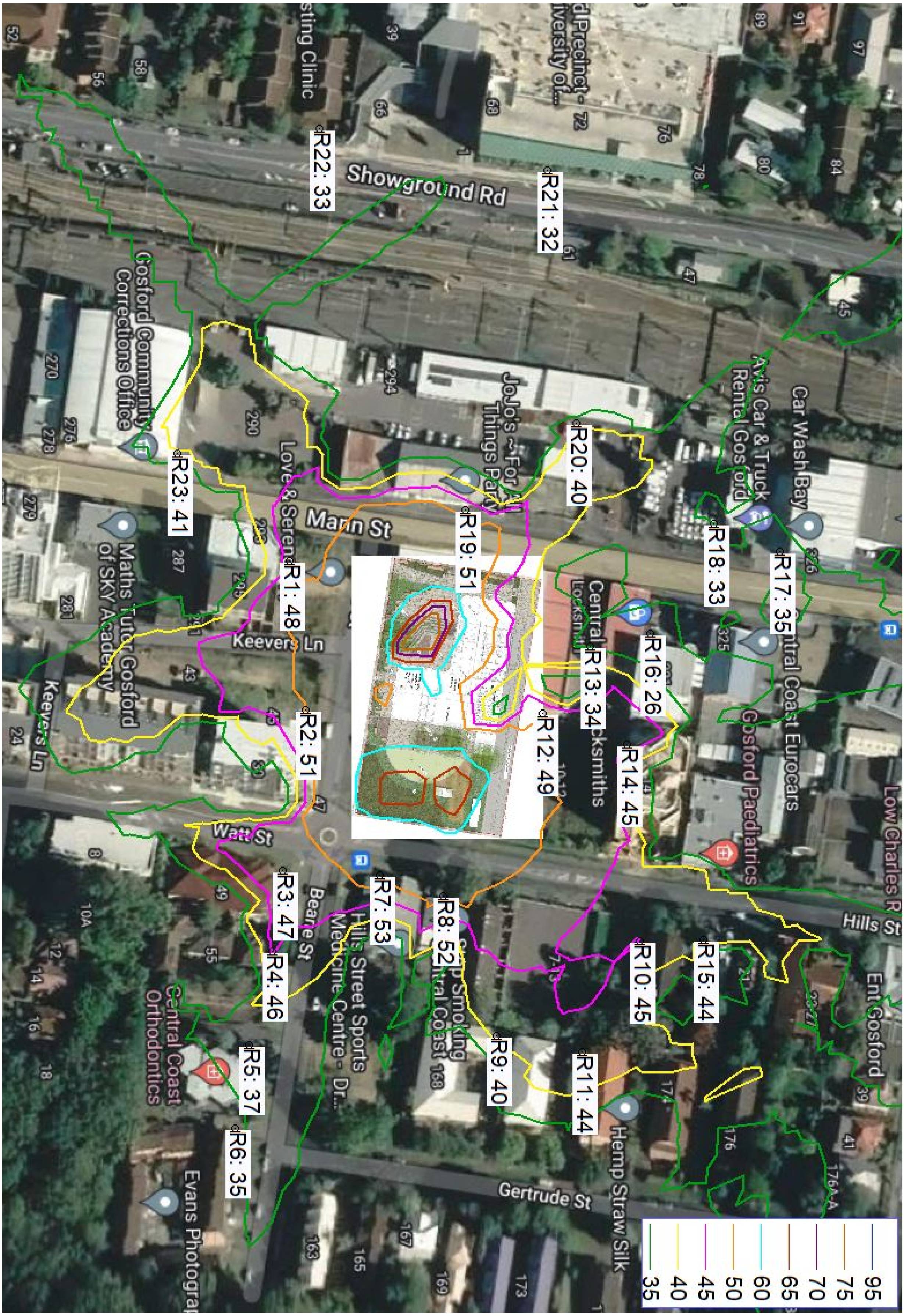


Figure 4-8 Cumulative Operational Noise Results dB(A) Leq(15min)

Figure 4-9 Learning and Innovation Space dB(A) Leq(15min)

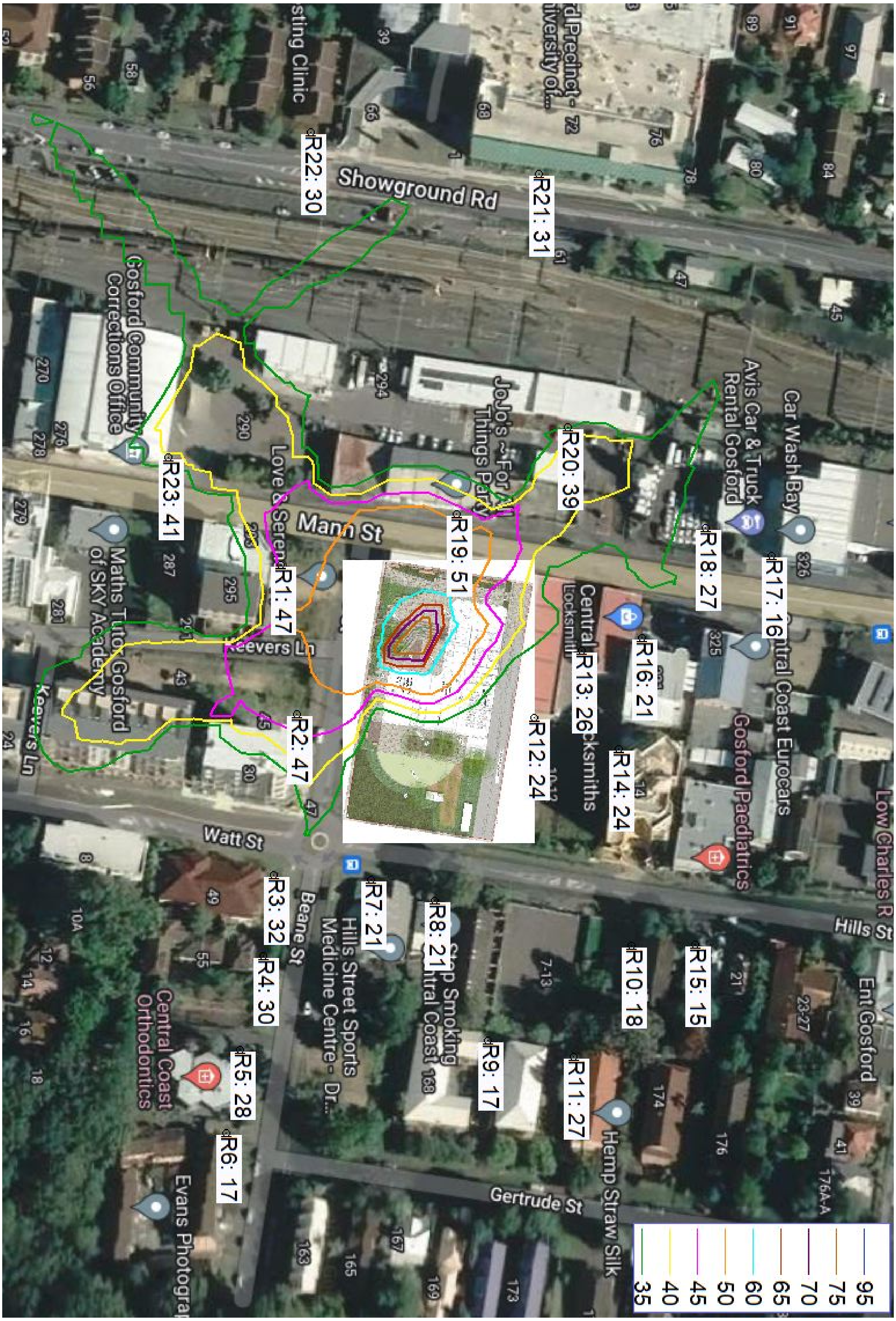


Figure 4-10 Civic Outdoor Area dB(A) Leq(15min)

The results of the assessment indicate compliance with daytime and evening project noise trigger levels can be achieved in all situations with the exception of R2 which has a predicted exceedance of 1 dB(A) during evening resulting from outdoor noise in the Civic Outdoor Area. 1 dB(A) is widely regarded as indiscernible to the human ear and generally lies within the threshold tolerance of acoustic models. Additionally, this was considered as a reasonable worst case scenario is it would be unlikely for university students to be engaging in raised voice activities given the intended use of the outdoor areas.

A night-time noise assessment was undertaken for completeness however outdoor student congregations are not expected during night-time situations. Mechanical plant is expected to comply in all situations. Therefore, compliance with all operational situations assessed for the proposal.

4.5 External Noise Intrusion

Noise from external sources such as road traffic, mechanical plant and other natural sources may potentially impact on the proposal. Based on the noise monitoring undertaken, it is recommended the following minimum configurations are considered in Table 4-6.

Table 4-6 External Configuration Recommendations

Component	Minimum Configuration
Wall Rw45	**Timber Frame or cladding:** 6mm fibre cement sheeting or weatherboards or plank cladding externally, 90mm deep timber stud or 92mm metal stud, 13mm standard plasterboard internally **Brick Veneer:** 110mm brick, 90mm timber stud or 92mm metal stud, minimum 50mm clearance between masonry and stud frame, 10mm standard plasterboard internally
Glazing Rw35	Minimum 10.38mm laminated glass with acoustic seals
Entry Doors Rw33	Minimum 45mm solid core timber door fitted with acoustic seals

Other options exist provided the Rw ratings are satisfied.

5. Conclusion

This acoustic assessment has been undertaken for Lyons / EJE Architecture as part of the University of Newcastle (UON) new health, innovation, and education campus located at 305 Mann Street Gosford, NSW.

Construction Noise and Vibration

No detailed construction plan or schedule is available at this stage of the proposal, therefore prediction of construction noise levels should be regarded as indicative. Two work stage scenarios have been considered, with an overall sound power level adopted for each based upon the likely plant operating. Predictions for surrounding residential and other receivers have been carried out.

The NMLs at nearby assessed receivers are expected to comply in most situations, at times there is the potential for NML's to be exceeded mainly during periods of intensive high noise level works associated with site preparation excavation and depending on work location. During general construction works, the NMLs would be generally achieved at all surrounding receivers. The highly noise affected level of 75dB(A) LAeq(15min) is expected to be complied with. A set of standard mitigation measures for construction noise and vibration have been provided based on anticipated requirements of the proposal. It is believed construction noise can be minimised and managed to be acceptable to the local community through the implementation of a CNMP similar to what has been recommended in this report.

Vibration is unlikely to be an impact given the distances between surrounding receivers and plant exceed those recommended for safe work in terms of structural damage and human response.

Operational Noise

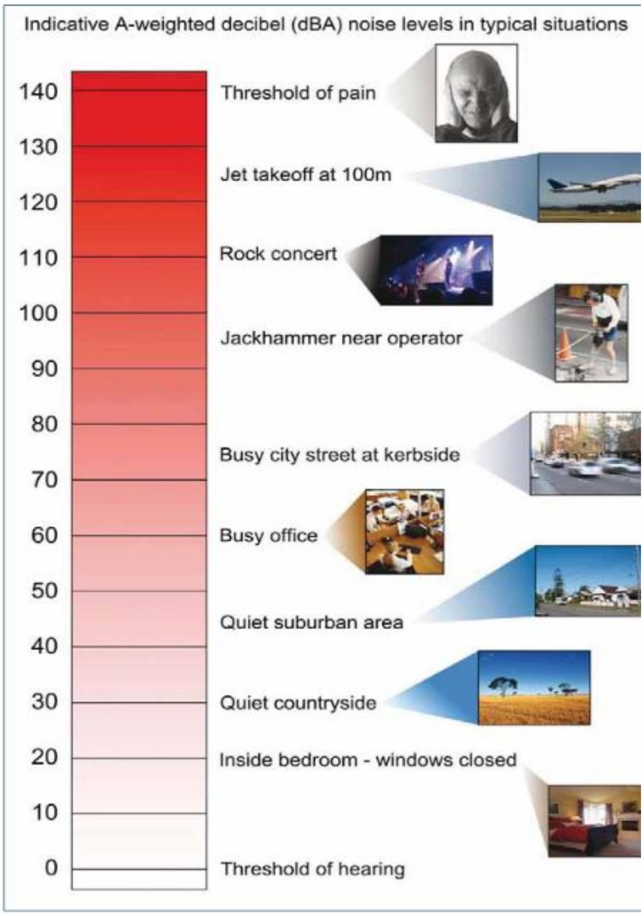
The results of calculations of continuous operational noise sources were compared with design goals for environmental noise. The results of the assessment indicate project noise trigger levels can be achieved by the development. Detailed mechanical plant selection will take place during the detailed design phase. Project noise levels due to plant operation are expected to be achieved given the location of plant within services zones and the distance between plant locations and receivers.

Noise from outdoor activities held on the site are expected to comply with project noise trigger levels.

Internal Acoustics

External building performance recommendations have been provided for the proposed development to achieve appropriate internal amenity standards.

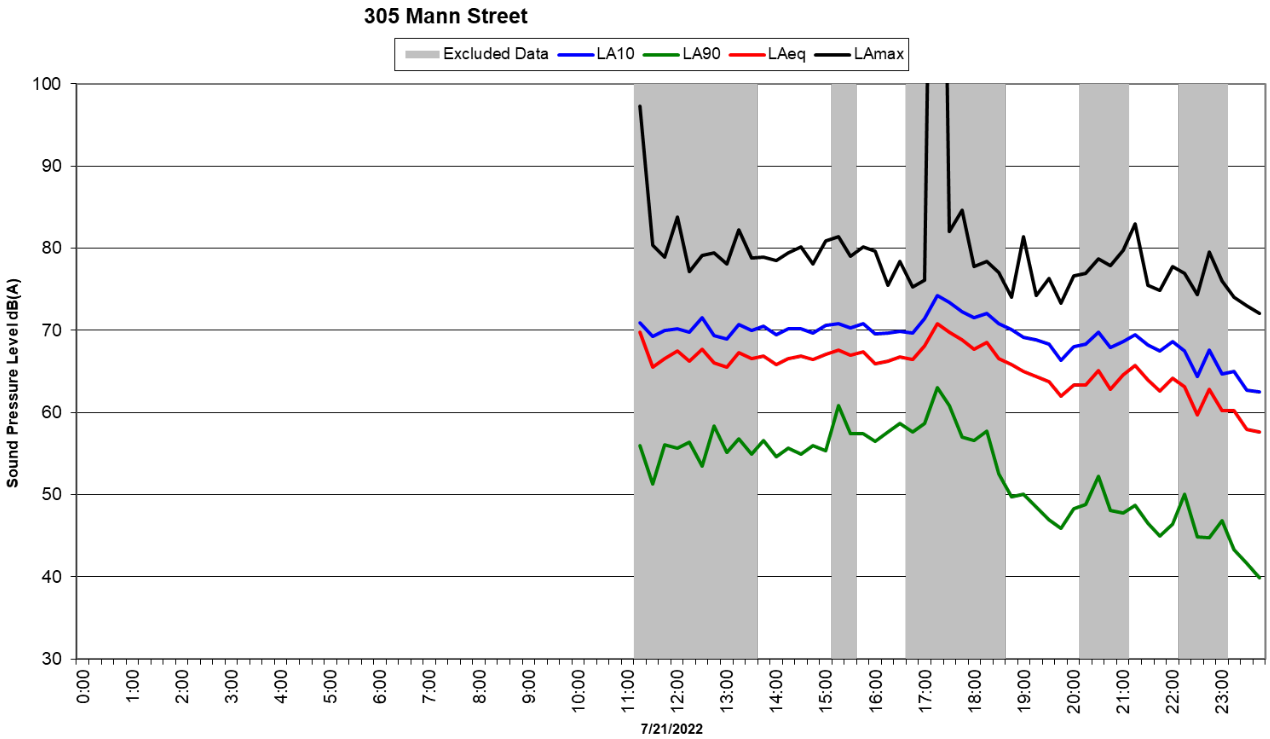
Glossary of Acoustic Terms

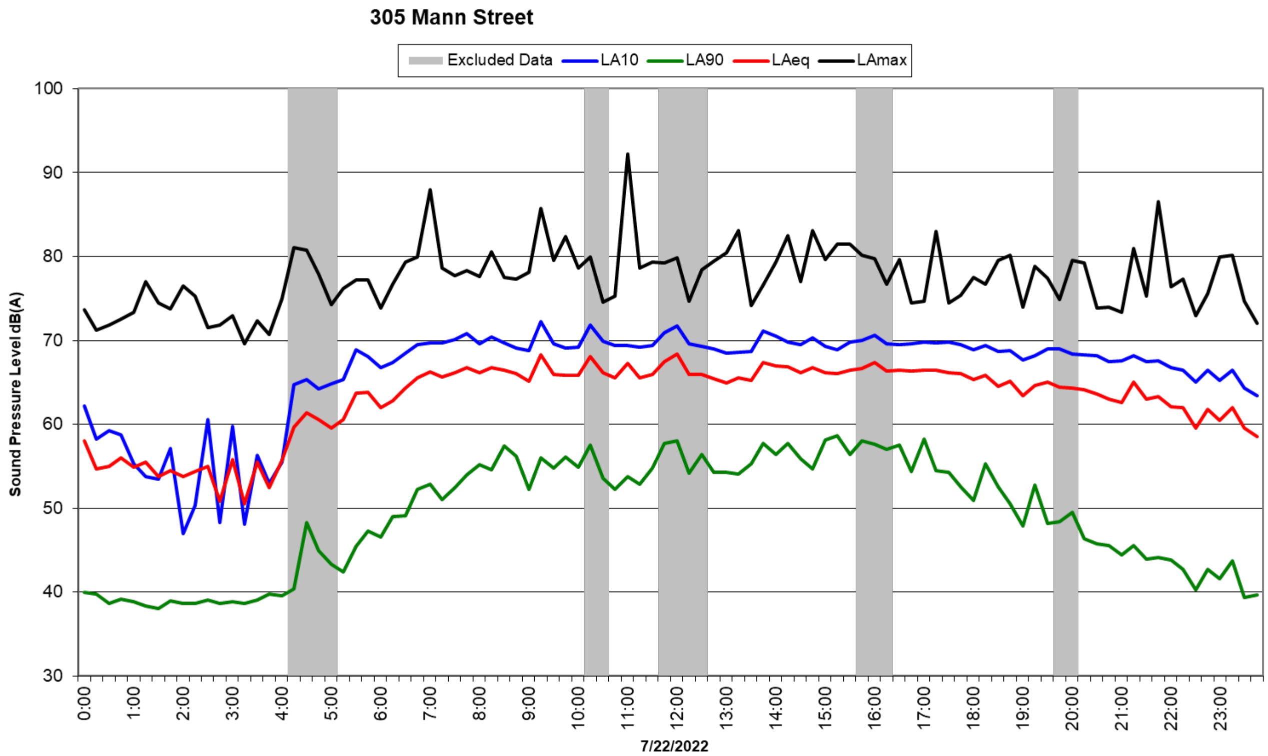
Term	Definition
dB	Decibel is the unit used for expressing the sound pressure level (SPL) or power level (SWL) in acoustics. The picture below indicates typical noise levels from common noise sources. 
dB(A)	Frequency weighting filter used to measure 'A-weighted' sound pressure levels, which conforms approximately to the human ear response, as our hearing is less sensitive at very low and very high frequencies.
$L_{Aeq(period)}$	Equivalent sound pressure level: the steady sound level that, over a specified period of time, would produce the same energy equivalence as the fluctuating sound level actually occurring.
$L_{A10(period)}$	The sound pressure level that is exceeded for 10% of the measurement period.
$L_{A90(period)}$	The sound pressure level that is exceeded for 90% of the measurement period.
L_{Amax}	The maximum sound level recorded during the measurement period.
Noise sensitive receiver	An area or place potentially affected by noise which includes:

	A residential dwelling. An educational institution, library, childcare centre or kindergarten. A hospital, surgery or other medical institution. An active (e.g. sports field, golf course) or passive (e.g. national park) recreational area. Commercial or industrial premises. A place of worship.
Rating Background Level (RBL)	The overall single-figure background level representing each assessment period (day/evening/night) over the whole monitoring period.
Feasible and Reasonable (Noise Policy for Industry Definition)	**Feasible** mitigation measure is a noise mitigation measure that can be engineered and is practical to build and/or implement, given project constraints such as safety, maintenance and reliability requirements. Selecting **Reasonable** measures from those that are feasible involves judging whether the overall noise benefits outweigh the overall adverse social, economic and environmental effects, including the cost of the mitigation measure. To make a judgement, consider the following: Noise impacts Noise mitigation benefits Cost effectiveness of noise mitigation Community views.
Sound power level (SWL)	The sound power level of a noise source is the sound energy emitted by the source. Notated as SWL, sound power levels are typically presented in dB(A).
DnT,w	Weighted Standardised Level Difference A single number rating of the sound level difference between two rooms. DnT,w is typically used to measure the on-site sound insulation performance of a building element such as a wall, floor or ceiling
Dw	Weighted Sound Level Difference A single number rating of the sound level difference between two rooms. Dw is typically used to measure the on-site sound insulation performance of a building element such as a wall, floor or ceiling
Impact sound	Sound produced by an object impacting directly on a building structure, such as footfall noise or chairs scrapping on a floor
L’nT,w	Weighted, Standardised Impact Sound Pressure Level A single number rating of the impact sound insulation of a floor/ceiling when impacted on by a standard ‘tapper’ machine. L’nT,w is measured on site. The lower the L’nT,w, the better the acoustic performance.
Lw (or SWL)	Sound Power Level. The level of total sound power radiated by a sound source.
Masking Noise	Intentional background noise that is not disturbing, but due to its presence causes other unwanted noises to be less intelligible, noticeable and distracting.

NRC	Noise Reduction Coefficient A single number rating between 0 and 1 of the ability of a material to absorb sound. It is the average of the absorption coefficients in the 250-2000Hz octave bands rounded to the nearest 0.05. The larger the number, the more absorptive the material.
Octave Band	Octave Band A range of frequencies where the highest frequency included is twice the lowest frequency. Octave bands are referred to by their logarithmic centre frequencies, these being 31.5 Hz, 63 Hz, 125 Hz, 250 Hz, 500 Hz, 1 kHz, 2 kHz, 4 kHz, 8 kHz, and 16 kHz for the audible range of sound.
Room Criterion (RC)	The Room Criteria (RC) Method is a HVAC related background noise acceptability rating method. The RC method is a family of criterion curves (specifying sound levels by octave bands) intended to establish HVAC system design goals and a rating procedure.
RT or T60	Reverberation Time The time (in seconds) taken for the sound pressure level generated by a particular noise incident to decay by 60 decibels following the conclusion of the noise event (hence T60 abbreviation). Reverberation Time is used for assessing the acoustic qualities of a space, describing how quickly sound decays within a space. The reverberation time is related to the room volume and total absorption.
Rw	Weighted Sound Reduction Index A single number rating of the sound insulation performance of a specific building element. Rw is measured in a laboratory. Rw is commonly used by manufacturers to describe the sound insulation performance of building elements such as plasterboard and concrete.
Speech transmission	(STI) is a measure for the transmission quality of speech with respect to intelligibility. A value of 0 indicates completely unintelligible speech while a value of 1 indicates perfectly intelligible speech.

Noise Monitoring Charts





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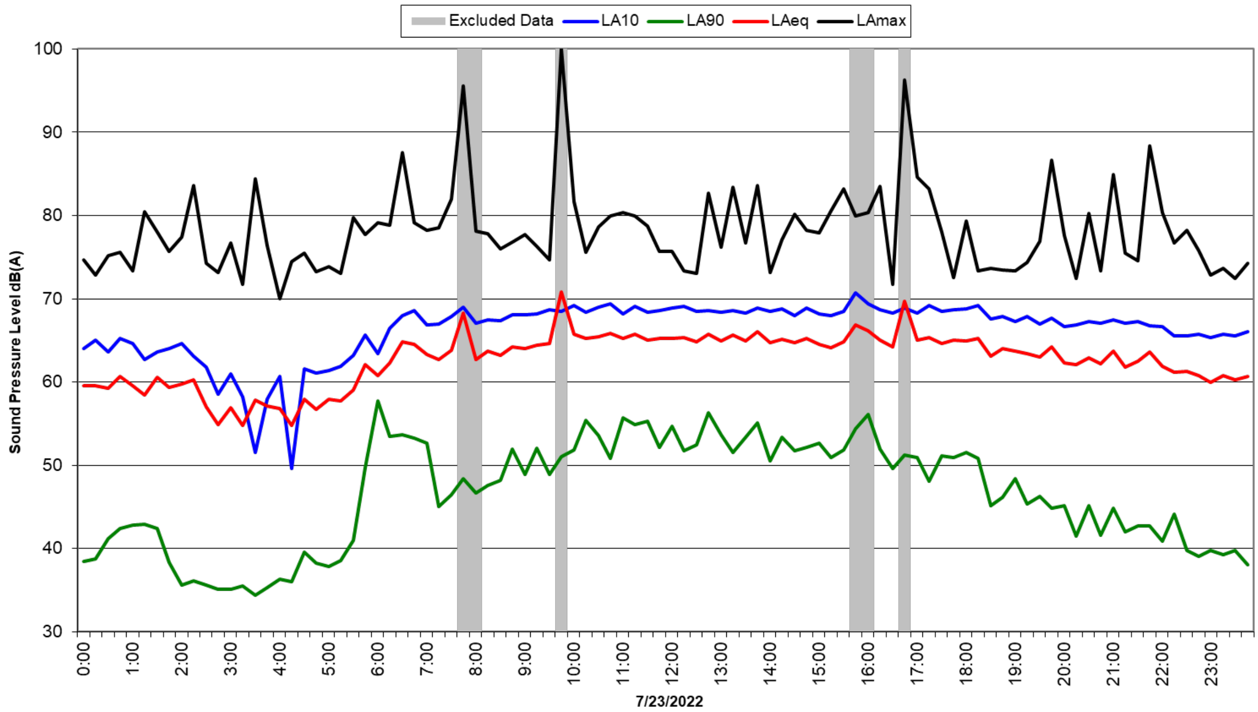

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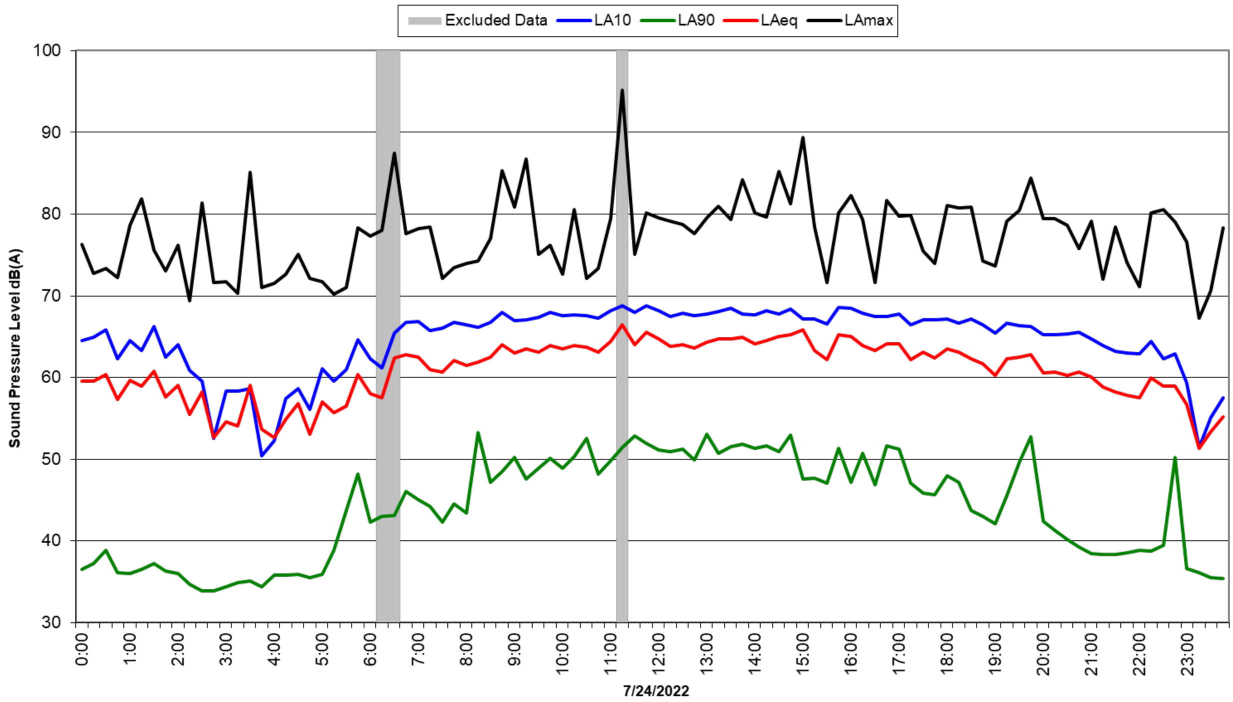

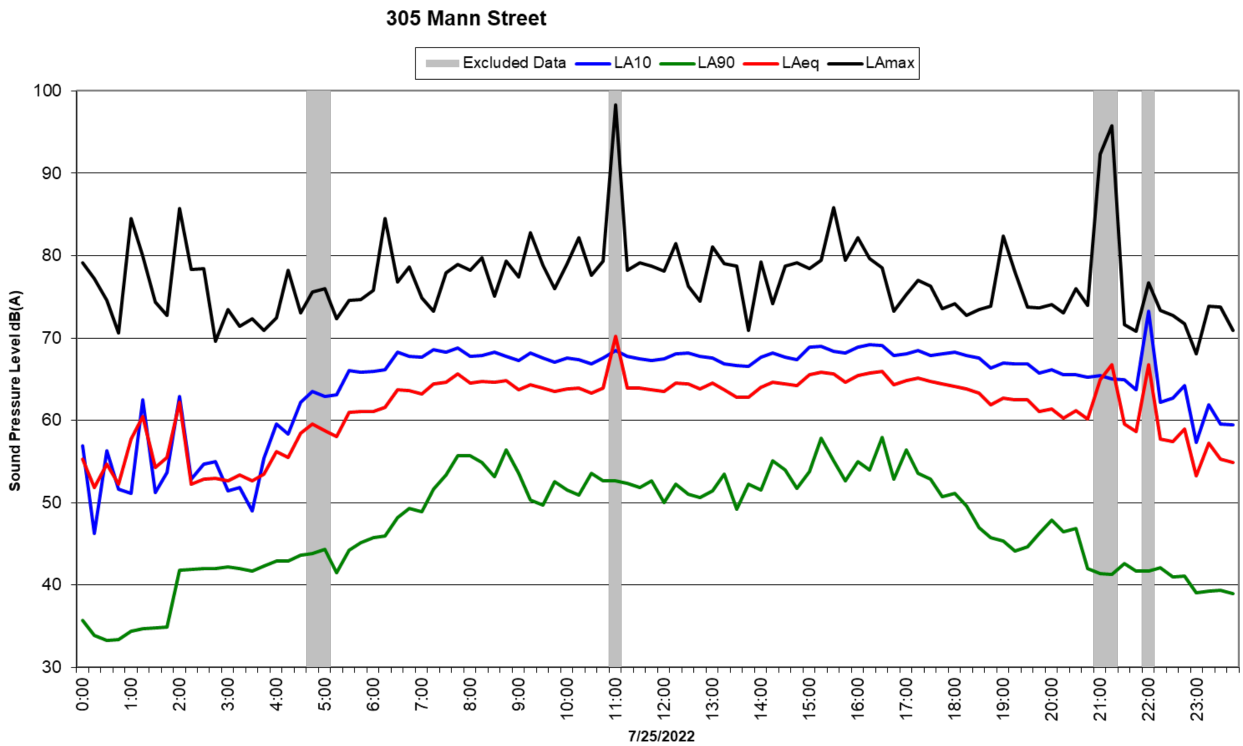
305 Mann Street
Excluded Data
LA10
LA90
LAeq
LAmax
Sound Pressure Level dB(A)
7/25/2022
100
90
80
70
60
50
40
30
0:00
1:00
2:00
3:00
4:00
5:00
6:00
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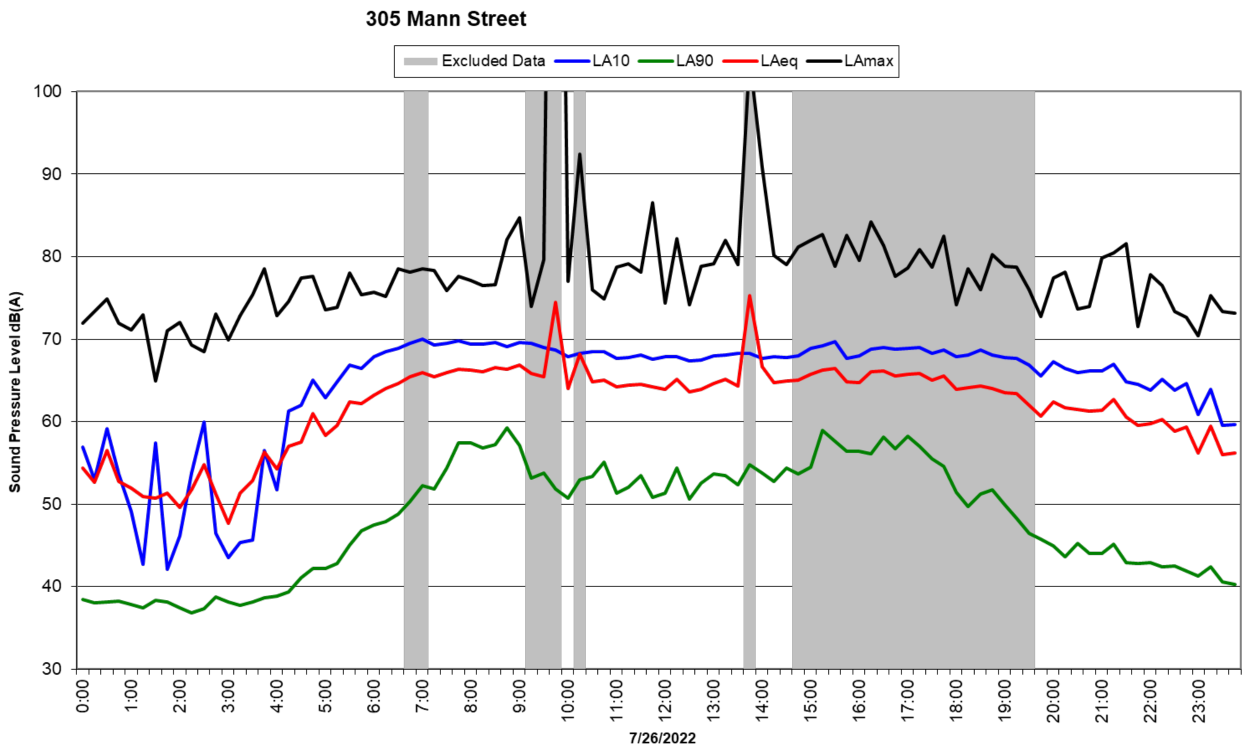
305 Mann Street
Excluded Data
LA10
LA90
LAeq
LAmax
Sound Pressure Level dB(A)
7/26/2022
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50
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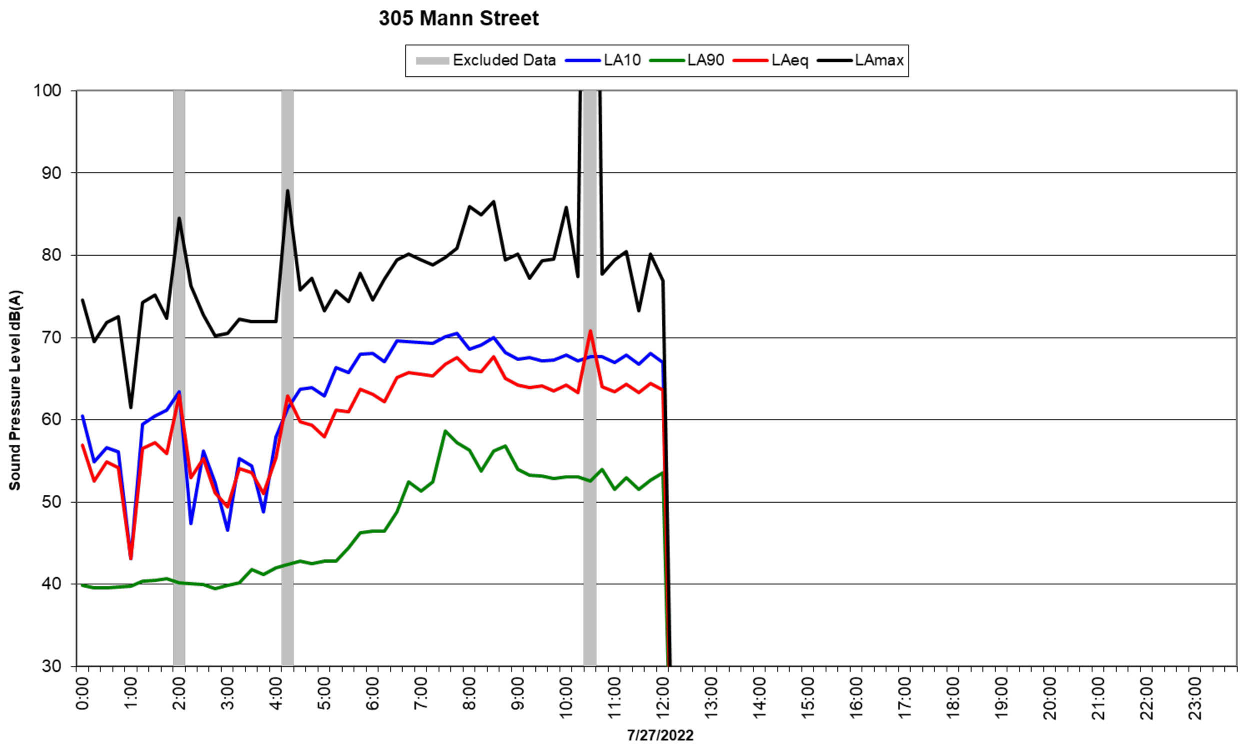

305 Mann Street
Excluded Data
LA10
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LAeq
LAmax
Sound Pressure Level dB(A)
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7/27/2022