Caddens Corner

Noise & Vibration Impact Assessment

4th March 2024

Ref: 301351062

PREPARED FOR:

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Stantec

Revision

Revision	Date	Comment	Prepared By	Approved By
001	28/11/2022	Draft Issue	James Ashpole	Mathew McGrory
002	06/02/2023	Results from Unattended Monitoring + Updates as per comments.	James Ashpole	Mathew McGrory
003	23/02/2023	Final Updates	James Ashpole	Mathew McGrory
004	01/03/2024	Revised scheme	James Ashpole	Mathew McGrory
005	04/03/2024	Update of references	James Ashpole	Mathew McGrory

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1. Introduction

This Acoustic Report has been prepared by Stantec (Australia) Pty Ltd to accompany the Development Application (DA) for the proposed multi-residential development located at along O'Connell Street, Kingswood, NSW 2747.

The main objectives of this acoustic assessment are:

- Identify the noise and vibration sources that will potentially affect the noise sensitive receivers surrounding the proposed development.
- Carry out noise surveys to determine the existing ambient and background noise levels on the site as well as any external noise sources that will potentially impact the proposed development.
- Establish the appropriate noise level and vibration criteria in accordance with the relevant standards, guidelines and legislation for the following items:
    - Noise emissions from mechanical plant from the development to the surrounding receivers.
    - Noise emissions from traffic generated by the proposed development.
    - Noise and vibration impacts during construction
- Carry out an acoustic assessment to determine whether the relevant criteria can be achieved and, where applicable, comment on noise control measures required to achieve compliance with the relevant noise level criteria.
- Identify and assess the noise and vibration sources that will potentially affect the proposed development.

This report provides:

- A statement of compliance with the relevant statutory criteria for the proposed use development within the vicinity of the nearest potentially affected receivers.
- Recommendations for noise mitigation measures for the proposed development in order to meet the relevant criteria when compliance is not achieved.
- Recommendations for noise and vibration criteria and best practices during construction phase.

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

- Architectural drawings of the proposed development provided by Turner dated 28th February 2024.
- Noise data collected on site through the use of a noise logger and a hand held spectrum analyser.
- Caddens Corner Carpark Zoning provided by Turner
- Traffic and Parking Assessment prepared by Transport and Traffic Planning Associates dated February 2024.

This document and related work has been prepared following Stantec's Quality and Environmental Management Systems, which are based on AS/NZS ISO 9001:2015 and ISO 14001:2015 respectively.

2. Project Overview

The proposed development is located within Lots 68 & 80 along O'Connell Street, Kingswood. The project comprises of a total of 469 apartments across the site as identified in Figure 2 below. Each of the proposed buildings are between 4 and 6 storeys, with the tallest of the proposed buildings being Building F. The ground floor of Buildings R, S,T U and P are reserved for retail tenancies.

The site is bound by an existing Local Shopping Centre 'Caddens Corner' immediately to the West, O'Connell Street to the South, and an unnamed collector road to the North. Currently the land located to the North is unoccupied land, but is zoned as 'Medium Density Residential' land. The land to the East is currently unoccupied and attached to the existing Western Sydney University Werrington South Campus.

The nearest, most affected residential receivers are located approximately 20m to the South, across O'Connell St have been identified in the figure below (R1) and have been considered the most affected noise-sensitive receivers for the acoustic impact assessment.

2.1 Site Description

The site location of the proposed development is shown in Figure 1. Also included is the identification of sensitive receivers and their classification as well as both attended and unattended noise monitoring locations.

Figure 1: Aerial Photo showing an Overview of the Site, sensitive receivers, and measurement locations

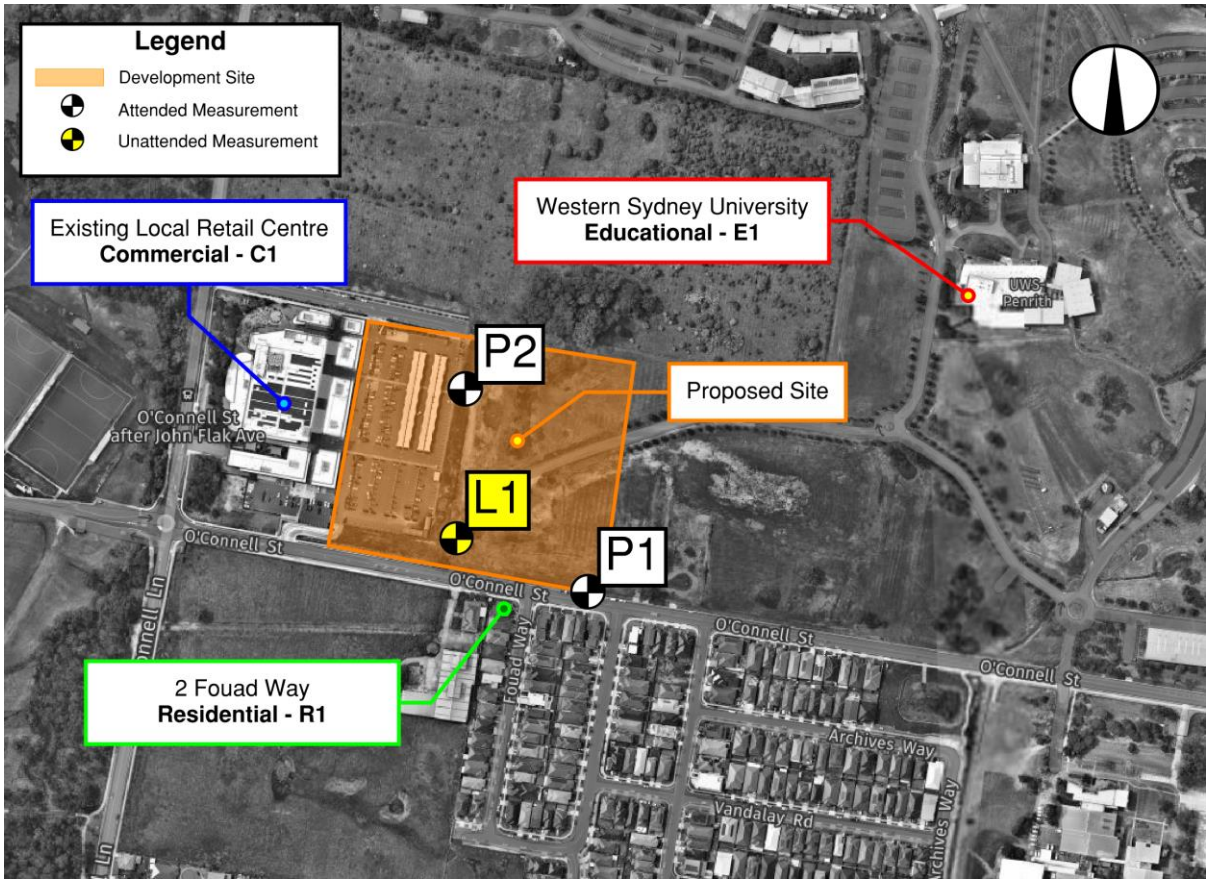
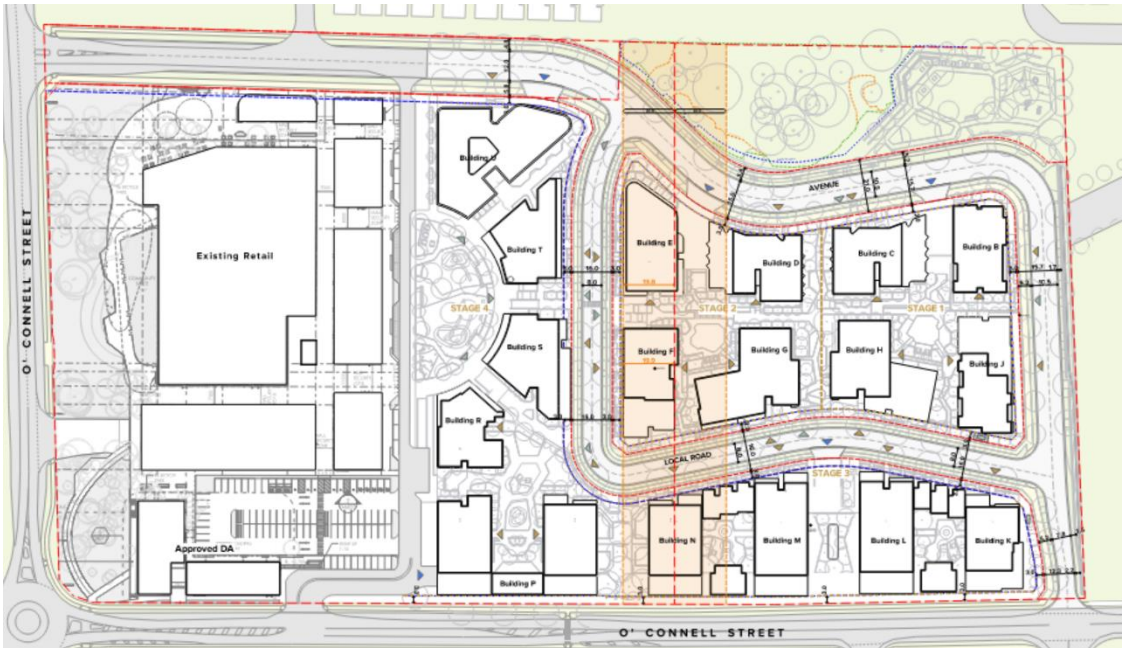


Figure 2: Caddens Corner - Overall Site Plan



2.1.1 Acoustic Considerations

Noise Impact from the Development on the Environment

The proposed development will generate noise which may adversely impact the surrounding environment, such as the nearby residential and commercial receivers.

The main noise sources generated by the development that may impact the local community and environment include:

- Noise emissions from the operation of mechanical plant servicing the proposed development to the surrounding noise-sensitive receivers
- Traffic generated by the development, including, vehicle movements entering and exiting the basement carpark spaces
- Noise generated from the operation of the loading docks (unloading/loading activities).

Noise Impact from the Environment on the Development

The local acoustic environment may have an adverse impact on the development itself. This aspect of the assessment will aim at providing acoustic amenity to the building occupant once completed from noise sources including:

- Noise from vehicle movements along O'Connell Street intruding into the habitable spaces within the proposed development.
- Noise from the operation of the existing retail development intruding into the habitable spaces within the proposed development.

3. Noise Survey

3.1 Overview

Attended and unattended noise surveys were conducted in the locations shown in Figure 1 to establish the ambient and background noise levels of the site and surrounds. Noise surveys have been carried out in accordance with the method described in the AS/NZS 1055:2018 *'Acoustics – Description and measurement of environmental noise'*.

The purpose of the unattended monitoring is to understand the local noise environment and to establish the noise criteria to the nearest noise sensitive receivers surrounding the site. Refer to Figure 1 for locations of monitoring on site.

3.1.1 Instrumentation

The following equipment was used for the noise surveys conducted by Stantec:

- ARL Environmental Noise Logger, Type NL-42, S/N: 3011814
- Type 1 Hand-held sound spectrum analyzer, Brüel & Kjær, S/N 3027679
- Sound Calibrator Svan SV30A, S/N 17556;

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

3.2 Unattended Noise Survey Results

Unattended noise surveys were conducted in on-site, refer to Figure 1 for the locations of loggers on-site. Results of the monitoring are presented in the following subsections and graphs of these logged results provided in Appendix A.

3.2.1 Background & Ambient Noise Monitoring

A noise monitor was placed at position L1 as shown in Figure 1 to measure the background and ambient noise that is representative of the surrounding noise-sensitive receivers. Noise monitor L1 was installed from the 21st of November to the 29th of November 2022. The results of the unattended background and ambient noise survey is shown in Table 1 below (for the day, evening and night periods). The local ambient noise environment is dominated by noise from the local wildlife (birds), vehicle movements along O'Connell Street, activities within the carpark of the adjacent retail complex, construction noise in the local area and operational noise from Commercial/Retail tenancies throughout the majority of the day periods. As required in the NSW NPI, any data likely to be affected by rain, wind or other extraneous noise has been excluded from the calculations.

Table 1: Long-term noise survey summary – Background noise

Location	Equivalent Continuous Noise Level $L_{Aeq,period}$ - dB(A)			Background Noise Level RBL - dB(A)		
	Day	Evening	Night	Day	Evening	Night
L1	53	55	46	43	42	36

3.3 Attended Noise Survey Results

Attended noise measurements of 15-minute duration were conducted on site to characterise the traffic noise intruding into the development and to validate the results of the unattended noise monitoring. The locations of the attended noise measurements close to the proposed development site are shown in Figure 1.

The SLM microphone was mounted 1.5 metres above the ground and a windshield was used to protect the microphone. Measurements were undertaken in the free-field – i.e. more than 3 metres away from any building façade or vertical reflective surface. Weather conditions were calm and dry during the attended noise monitoring. Table 2 below shows the summary of the attended noise measurements.

Table 2: Short-term (Attended) Traffic Noise Survey Results

Measurement Location	Measurement Time	$L_{Aeq, 15mins}$ dB(A)	$L_{A90, 15mins}$ dB(A)	Comments
P2	11:14am 15/11/2022	61	41	Noise from movements within the carpark – Car door slams, distant voices, horns, car start up, trolley movements. Operation of the carwash (pumps for hoses) is audible. Distant road noise from O'Connell Street. Dominant noise in the environment is from wildlife (birds)
P1	10:56am 15/11/2022	50	46	Along O'Connell Street. Moderate vehicle movements – intermittent in nature. Ambient hum from works on site (piling activities for ground survey) Wildlife noise from birds is audible, as well as distant construction works in the environment.

4. Noise & Vibration Criteria

4.1 Council Specific Requirements

4.1.1 Penrith Development Control Plan (DCP) 2014

The Penrith DCP states the following regarding Noise and Vibration Controls associated with the proposed development:

> *"Council will not grant consent to development, particularly residential development, including subdivisions, unless the impact of traffic noise from freeway, arterial, designated or collector roads complies with the standards and guidelines for road traffic noise prepared by the relevant State Government authorities or agencies, as well as relevant Australian Standards."*

The criteria outlined by the NSW Road Noise Policy for traffic noise criteria will address the requirements of the Penrith DCP. In addition to this council requirements, the Penrith DCP also states the following regarding Internal Noise levels for Residential Developments:

> "*The recommended night-time internal noise levels in living and sleeping areas is 35 – 40 dB(A)"*

The criteria established in accordance with the Australian Standard AS/NZS 2107:2016 in Section 4.3.1 will address this council requirement.

Further to this, the criteria outlined in the NSW EPA Noise Policy for Industry 2017 presented in Section 4.2.1 will satisfy the requirements of the Penrith DCP with regard to external noise emissions.

4.1.2 Penrith Local Environment Plan (LEP) 2010

Relevant Planning Documents of Penrith Council Legislation have been reviewed for any noise requirement or criteria. The Penrith-LEP 2010 sets the Land Zoning as shown in Figure 3 as per information extracted from the maps provided by the NSW Government legislation web service. The proposed site is categorised as B2 (Local Centre) and R4 (High Density Residential), additionally the residential land use to the North and South is noted as R3 (Medium Density Residential) and R1 (General Residential) respectively. The land to the East of the proposed development is noted as RE1 (Public Recreation) and B7 (Business Park).

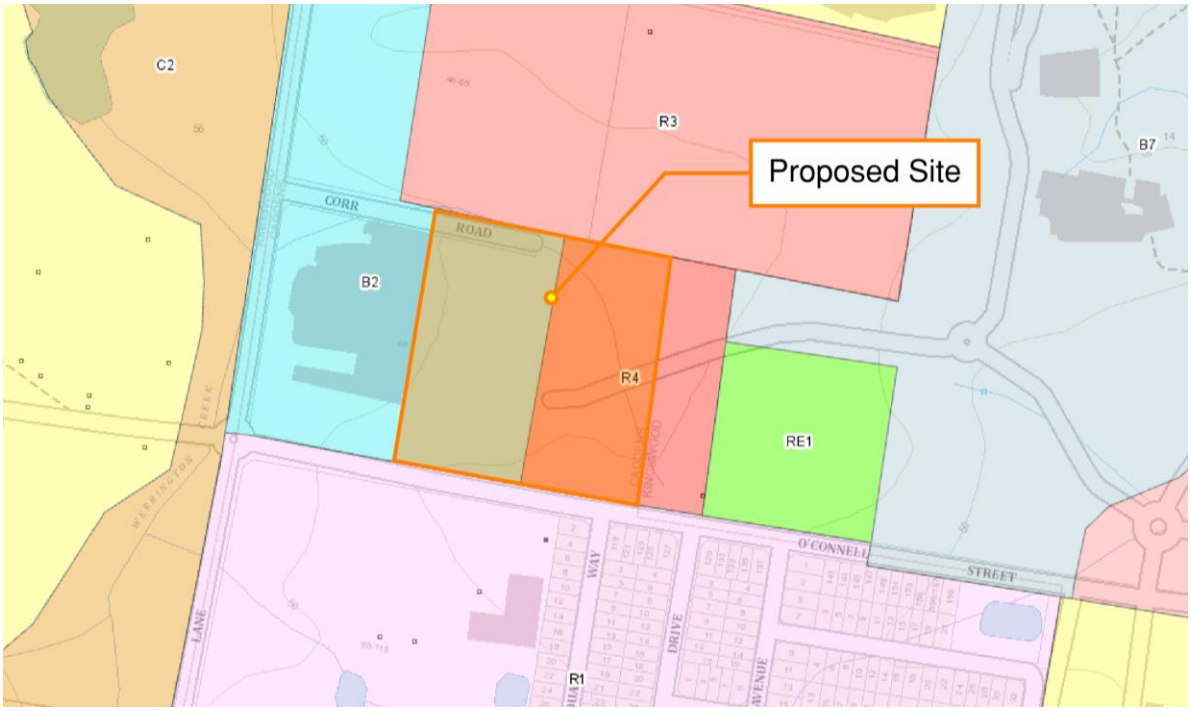


Figure 3: Land Zoning of the site and surroundings.

4.2 External Noise Emissions

4.2.1 NSW EPA Noise Policy for Industry (2017)

The *NSW Noise Policy for Industry* has been applied to address the noise emissions from the development to the surrounding noise-sensitive receivers. The NSW NPI sets out noise criteria to control the noise emission from industrial noise sources generated by the proposed development. Operational noise emissions from the development shall be addressed following the guideline in the NSW NPI.

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

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

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

4.2.2 Intrusiveness Criteria

The NSW EPA NPI states the following:

> *"The intrusiveness of an industrial 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} descriptor), measured over a 15-minute period, does not exceed the background noise level measured in the absence of the source by more than 5 dB(A)."*

The intrusiveness criterion can be summarised as follows:

$L_{Aeq,\ 15\ minute} \leq$ RBL background noise level + 5 dB(A)

The intrusiveness criterion for the closest residential receivers is presented in Table 3 below.

Table 3: Intrusiveness Criteria

Receiver	Period	Measured Rating Background Level L_{A90} dB(A)	Intrusiveness Criteria L_{Aeq} dB(A)
Residential	Day	43	48
	Evening	42	47
	Night	36	41

4.2.3 Amenity Criteria

The NSW NPI states the following:

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

To ensure that industrial noise levels (existing plus new) remain within the recommended amenity noise levels for an area, a project amenity noise level applies for each new source of industrial noise as follows, "Project amenity noise level for industrial developments = recommended amenity noise level (Table 2.2) minus 5 dB(A), +3 dB(A) to convert from a period level to a 15-minute level".

The applicable parts of Table 2.2: Amenity noise levels from Industrial Noise Sources – L_{Aeq}, dB(A) which are relevant to the project are reproduced below:

Table 4: NSW NPI Table 2.2 amenity criteria for external noise levels

Receiver	Noise Amenity Area	Time of Day	L_{Aeq}, dB(A)	$L_{Aeq, period}$ dB(A)
			Recommended amenity noise level	Project amenity noise level
Residential (R1)	Urban	Day	60	58
		Evening	50	48
		Night	45	43
Commercial premises (C1)	All	When in use	65	63
School classroom – internal (E1)	All	Noisiest 1-hour	35	33

Note that where the resultant project amenity noise level is 10dB or more lower than the existing industrial noise level the project amenity noise levels can be set at 10dB below existing industrial noise levels if it can be demonstrated that existing industrial noise levels are unlikely to reduce over time.

Note 2: Where a source emits tonal and low-frequency noise, only one 5-dB correction should be applied if the tone is in the low-frequency range, that is, at or below 160 Hz.

Note 3: Where narrow-band analysis using the reference method is required, as outlined in column 5, the correction will be determined by the ISO1996-2:2007 standard.

4.2.4 Project Noise Trigger Levels

The project noise trigger levels for industrial noise sources such as mechanical plant etc. are provided in Table 5. These noise levels have been derived from the Noise Policy for Industry 2017.

Table 5: Project noise trigger levels for industrial noise emissions

Receiver	Period	Descriptor	Project Noise Trigger Levels dB(A)
Residential R1	Day (7:00am to 6:00pm)	$L_{Aeq,15min}$	**48**
	Evening (6:00pm to 10:00pm)	$L_{Aeq,15min}$	**47**
	Night (10:00pm to 7:00am)	$L_{Aeq,15min}$	**41**
Commercial C1	When in Use	$L_{Aeq,15min}$	**63**
Education E1	Noisiest 1-hour	L_{Aeq}	**35**

4.2.5 Traffic Generation Noise Criteria

The noise impacts from traffic generation are assessed in accordance with the NSW Road Noise Policy. The criterion (Table 3 – Road Traffic Noise Assessment Criteria for Residential Land Uses) divides land use developments into different categories and lists the respective criteria for each case. The category that is relevant to the proposed use of the site is shown below in Table 6.

Table 6: NSW Road Noise Policy – Traffic noise assessment criteria

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

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

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

4.3 Internal Noise Levels

4.3.1 AS/NZS 2107:2016

Australian Standard AS/NZS 2107:2016 – *'Acoustics- Recommended design sound levels and reverberation times for building interiors'* will be used to specifies target noise levels for internal spaces to the development for noise sources and particular spaces that are not covered in the other standards. Traffic noise intrusion AS 3671 refers to internal noise compliance with AS/NZS2107:2016. Refer to Table 7 for the values corresponding to residential spaces near major roads.

Table 7: Recommended internal noise levels extracted from AS/NZS 2107:2016

Type of occupancy / activity	Design sound level L_{Aeq}, dB(A) range
Residential Buildings	
Apartment common areas (e.g. foyer, lift lobby)	45 to 50
Living areas	30 to 40
Sleeping areas (night time)	30 to 35
Work areas	35 to 40

4.4 Construction Noise and Vibration Criteria

4.4.1 Construction Noise

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

However, in undertaking the assessment of potential noise intrusion associated with the proposed construction activities, *Chapter 4 of the NSW EPA ICNG (July 2009)* were specifically referenced. The limits presented in Table 8 apply.

Table 8: NSW EPA ICNG Construction Noise Criteria

Time of Day	Management Level $L_{Aeq,15min}$ *	How to Apply
Recommended Standard Hours: Mon – Fri (7am – 6pm)	Noise Affected RBL + 10dB(A)	The noise affected level represents the point above which there may be some community reaction to noise. • Where the predicted or measured $L_{Aeq,15min}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. • The proponent should also inform all potentially impacted residences of the nature of works to be carried out, the expected noise levels and duration as well as contact details.
Sat (8am – 1pm) No work on Sunday & Public Holidays	Highly Noise Affected 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. • Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur in, taking into account: • Times identified by the community when they are less sensitive to noise (such as before and after school, for works near schools, or mid-morning or mid-afternoon for works near residences) • If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside Recommended Standard Hours	Noise Affected RBL + 5dB(A)	• 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.

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

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

4.4.2 Construction Vibration

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

4.4.1 Human Comfort – Continuous and Impulsive Vibration Criteria

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

Maximum allowable magnitudes of building vibration with respect to human response are shown in Table 9. It should be noted that the human comfort levels for vibration are more stringent than the building damage criteria.

Table 9: RMS values for continuous and impulsive vibration acceleration (m/s^2) 1-80Hz

Location	Assessment period[1]	Preferred values		Maximum values	
		z-axis	x- and y-axis	z-axis	x- and y-axis
Continuous vibration					
Residences	Daytime	0.010	0.0071	0.020	0.014
	Night time	0.007	0.005	0.014	0.010
Offices, schools, educational institutions and places of worship	Day- or night-time	0.020	0.014	0.040	0.028
Impulsive vibration					
Residences	Daytime	0.30	0.21	0.60	0.42
	Night time	0.10	0.071	0.20	0.14
Offices, schools, educational institutions and places of worship	Day- or night-time	0.64	0.46	1.28	0.92

4.4.2 Human Comfort – Intermittent Vibration Criteria

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

Table 10: Acceptable Vibration Dose Values for Intermittent Vibration (m/s$^{1.75}$)

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

4.4.3 Structural Damage – Vibration Criteria

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

Most commonly specified structural vibration criteria are defined to minimise the risk of cosmetic surface cracks and are set below the levels that have the potential to cause damage to the main structure. Structural damage criteria are presented in German Standard DIN4150-Part 3 “Structural vibration in buildings – Effects on structures” and British Standard BS7385-Part 2: 1993 “Evaluation and Measurement for Vibration in Buildings”. Table 11 shows the vibration limits presented in DIN4150-Part 3 to minimise the risk structural damage doesn’t occur.

Table 11: Guideline value of vibration velocity, vi, for evaluating the effects of short-term vibration

Line	Type of Structure	Vibration velocity, vi, in mm/s			
		Foundation			Plane of floor of uppermost full storey
		At a frequency of			
		Less than 10Hz	10 to 50Hz	50 to 100*Hz	All Frequencies
1	Buildings used for commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40
2	Dwellings and buildings of similar design and/or use	5	5 to 15	15 to 20	15
3	Structures that, because of their particular sensitivity to vibration, do not correspond to those	3	3 to 8	8 to 10	8

	listed in lines 1 and 2 and are of great intrinsic value (e.g. buildings that are under a preservation order)				

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

Table 12 presents guide values for building vibration, based on the lowest vibration levels above which cosmetic damage has been demonstrated as per BS7385-Part 2:1993.

Table 12: Transient vibration guide values for cosmetic damage

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

4.4.4 Construction Vibration Objectives

Table 13 indicates the construction vibration criteria applicable to the other residential properties located within the development site.

Table 13: Construction vibration criteria summary

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

5. Operational Noise & Vibration Assessment

5.1 Traffic Noise Intrusion

To provide acoustic amenity to occupants of the proposed development and comply with the project specific internal noise limits, the noise impacts of surrounding roads were assessed at the façade of the residential spaces within the proposed development in accordance with the Penrith Council DCP and AS/NZS 2107:2016.

Noise levels from the road were calculated in accordance with the Calculation of Road Traffic Noise (CoRTN) methodology using the attended noise measurements to characterise vehicle movements along O'Connell Street. A façade analysis was conducted using EN 12354-3:2000: "Building Acoustics – Estimation of Acoustic Performance of Buildings from the Performance of Elements – Part 3: Airborne Sound Insulation against Outdoor Sound".

To achieve the internal noise levels established in the Section 4.3, the minimum recommended glazing types for the façades of the proposed development are presented in Table 14. The glazing types presented below should be considered as the minimum to achieve the required internal noise levels. Greater glazing thicknesses may be required for structural loading, wind loading, thermal requirements etc.

A summary of the acoustic performance requirements to achieve the required internal noise levels is summarised below in Table 14.

Table 14: Acoustic performances & required locations of glazing systems

Buildings	Level	Location	Room Type	Required Acoustic Rating, Rw	Typical Glazing System
All	All	All Façade	Bedrooms	32	6.38mm laminated glass
			Living Space	30	6mm glass

5.2 Mechanical Plant and Equipment Assessment

Noise sources from general operation of the development site typically include mechanical services noise from air-conditioning equipment serving the retail and residential portions of the development, as well as car park exhaust fans. These noise sources have been used to predict the noise impact at on-site residential noise sensitive receivers in addition to other nearby off-site noise sensitive receivers. These noise-sensitive receivers include the following and are identified in Figure 1:

- Residential receiver R1
- Existing Local Retail Centre C1
- Western Sydney University E1

The following noise sources are considered the most likely to cause an adverse noise impact to noise sensitive receivers if not treated effectively:

- External Condenser units located centrally on the rooftop of each respective apartment building to supply fresh air-conditioned air to each of the apartments within the proposed residential development. The units are enclosed on all side by screens.
- Retail Exhaust Fans with discharges at the rooftop of each respective building of the development site, enclosed on all sides by screens.
- Carpark exhaust fans with discharges at the rooftop plant of each respective building and enclosed on all sides by screens.

In order to assess the worst-case scenario, it is assumed that the air conditioning units associated with the proposed development are running at any time throughout a 24hr period. With all, night time is the most stringent period for the noise generated by the operation of the mechanical plant, therefore this criterion was used as the noise target at the boundary of the nearest sensitive receivers for the project.

5.2.1 Proposed Equipment Noise Levels

Table 15 presents the proposed maximum sound power levels for individual mechanical units to achieve the noise criteria shown at the nearest sensitive receiver of the site. At this stage, no specific mechanical plant selections have been made. As such, typical spectra have been implemented into the calculations, and the assessment will need to be amended once specific units and locations have been refined later in the design stage.

Table 15: Proposed acoustic power for individual mechanical units

Item	SWL re 10^{-12} W, dB(A)								
	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	Overall dB(A)
Carpark exhaust air fan at exhaust grille/ louvre	65	60	58	58	57	51	44	37	61
Balcony Condenser Unit (typical)	69	66	65	60	59	56	51	44	64
Retail Condenser Unit (typical)	74	74	71	68	64	61	58	50	70

5.2.2 Condensers on Rooftops

Air-conditioning to the apartments is proposed to be provided via individual condenser units located in a central rooftop plant. It should be noted that these are the assumptions made to conduct a preliminary assessment on the proposed noise from the development, and positions below may not be indicative of the final proposed locations of condenser equipment.

Typically, centrally located rooftop plant condenser plant should be enclosed on all sides by a barrier which at a minimum extends beyond the height of the plant equipment. The barrier can be in the form of a screen or acoustic louvre to simultaneously achieve airflow and acoustic attenuation requirements.

Condenser units are generally not noisy, however, correct selection of a quiet unit, will be important to minimise the risk of an adverse noise impact to the adjacent apartment buildings within the development sites. Many of these units also have a night-time mode which reflects a lower operating capacity when the ambient temperature is lower at night. The night-mode can reduce noise emission levels by up to 9dB(A), depending on the unit selection.

5.2.3 Car Park Supply and Exhaust Fans

Specific locations of the car park exhaust fans are currently not noted. In lieu of locations, a preliminary assessment has been conducted assuming a worst case scenario of exhaust grilles located on the southern boundary (nearest the noise sensitive receivers) has been conducted. It should be noted that the noise levels outlined in Table 15 have been implemented into the calculations, and is representative of the noise level at the discharge/grille location, and not representative of the total sound power level of the fan itself.

As it is too early to have duct and riser reticulation designed, as is in the early stages of development it is considered useful to set a maximum noise level of 63 dB(A) to be achieved at the intake and discharge grills/louvres for the carpark and general exhaust fans respectively, to protect the amenity of apartments and adjacent residential receivers to the proposed development. Provided this can be achieved, it is expected that the PNTL for the day, evening and night-time periods will be achieved.

Typical noise control may consist of:

- Attenuators
- Internally lined duct work and bends
- Acoustic louvres.

Reasonable assumptions have been made based on the current design and in-principle noise control solutions are recommended to meet the criteria. Further detailed assessment should take place as the design progresses when duct reticulation is more resolved. However, any adverse noise impact can be easily mitigated through the application of one or more of the noise control methods stated above.

5.2.4 General Mechanical Equipment – Noise Mitigation Measures

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

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

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

A detailed acoustic assessment of the mechanical plant noise is recommended prior to Construction Certificate to ensure no adverse noise impacts from external mechanical plant in accordance with the criteria outlined in Section 4.2.4.

5.2.5 Predicted Noise Levels

Table 16 presents the predicted noise levels anticipated from operation of the mechanical equipment to the nearest noise sensitive receivers. The assessment has been based on the equipment provided in Table 15 in addition to the assumptions and mitigation measures outlined above.

Table 16: Predicted noise level at noise sensitive receivers – Mechanical Equipment

Receiver	Criteria Period	Predicted Noise Level (worst case) $L_{Aeq, 15min}$ – dB(A)	Night-time criteria (worst case) $L_{Aeq, 15min}$ – dB(A)	Compliance (Yes/No)
R1	Night-time (10:00pm – 7:00am)	41	43	Yes
C1	When in Use	45	63	Yes
E1	Noisiest 1-hour (Internal)	<10	33	Yes

5.3 Traffic Generation Noise

A traffic generation noise assessment has been undertaken in order to determine the potential noise impact of traffic generated by the proposed development. The existing peak hour traffic count and traffic generation for the site was based on the Traffic and Parking Assessment prepared by Transport and Traffic Planning Associates. This data has been used to calculate the expected noise increase due to traffic associated with the development on the surrounding local environment. The results are summarized below in Table 17

Table 17: Existing and predicted traffic flow volumes (peak hour)

Road	Existing vehicles	Existing vehicles	Predicted Increase	Predicted Increase	Noise Level Increase dB	Noise Level Increase dB
	AM	PM	AM	PM	AM	PM
O'Connell Street	581	575	213	256	1.4	1.6

As noted in Section 4.2.5 when considering land use development and the impact on sensitive land uses, the NSW RNP states that an increase up to 2.0dB in relation to existing noise levels in anticipated to be insignificant.

Based on the results of the assessment, there is predicted to be less than a 2dB increase in traffic noise levels, therefore the proposed development is expected to comply with the requirements of the NSW RNP as outlined in Section 4.2.5.

5.4 Loading Dock & Waste Collection Noise Emissions

An assessment of the noise generated by activities within the Ground Level loading docks (such as, garbage collections and deliveries) has been conducted to determine the impacts on the surrounding noise-sensitive receivers. Table 18 outlines the sound power level (SWL) and typical duration (minutes) associated with each of the standard loading dock activities.

Table 18: Typical sound power levels and duration of loading dock activities

Loading Dock Activity	Typical Duration of Activity	Sound Power Level ($L_{Aeq, 15min}$)
Garbage truck unloading bins	2 minutes	88
Medium rigid truck accelerating	15 seconds	57

It is recommended that the waste collection and loading area activities shall be conducted with the implementation of the following management practices where feasible:

- Waste collection should only be performed during the day period (7:00am to 6:00pm)
- Rubbish trucks and braking materials of vehicles associated with the operation of the facility should be maintained to minimize or eliminate noise (e.g., squeaky brakes, hoppers etc).
- Patrons and drivers should implement quiet work practices

The noise generated by the activities during a 15-minute period have been predicted to the facades of the nearest surrounding noise-sensitive receivers. Using the assessment methods outlined above, the predicted noise levels at the nearest noise-affected premises are summarised below in Table 19. The following assumptions have been made for the assessment:

- Service vehicles are assumed to be either medium rigid trucks or garbage trucks.
- Two (2) service vehicle movements, i.e. entering and exiting, within a 15-minute period; and
- Loading and unloading activities will take place in the loading dock area, shielded from the residential receivers

Table 19: Loading dock and waste collection predicted noise levels at most affected receiver

Most Affected Receiver	Predicted Noise Level $L_{Aeq,15min}$ - dB(A)	Project Noise Trigger Level $L_{Aeq,15min}$ - dB(A)	Compliance
Residential R1	40	48	Yes
Commercial C1	36	63	Yes
Education E1	<10	33	Yes

Table 19 shows that the predicted noise levels of the loading dock satisfy the design criteria at the nearest residential receivers

6. Conclusion

An acoustic assessment for the proposed multi-residential development located at O'Connell Street, Kingswood has been conducted. This document forms part of the documentation package to be submitted to local authorities as part of the Development Application process.

This report has provided criteria, in-principle treatment and design requirements which aim to achieve the statutory criteria discussed in Section 4. In terms of noise criteria, we have provided the following:

- Noise criteria for external noise emissions from the development in accordance with the NPI
- Noise criteria for internal noise within the development in accordance with the Penrith DCP and AS/NZS 2107:2016.
- Construction noise and vibration criteria provided in Section 4.4

Acoustic performance requirements for the façade elements have been provided to achieve internal noise levels in accordance with the recommendations of AS/NZS 2107:2016. These requirements are based on the noise monitoring conducted on the site. The preliminary glazing performance requirements are presented in Section 5.1.

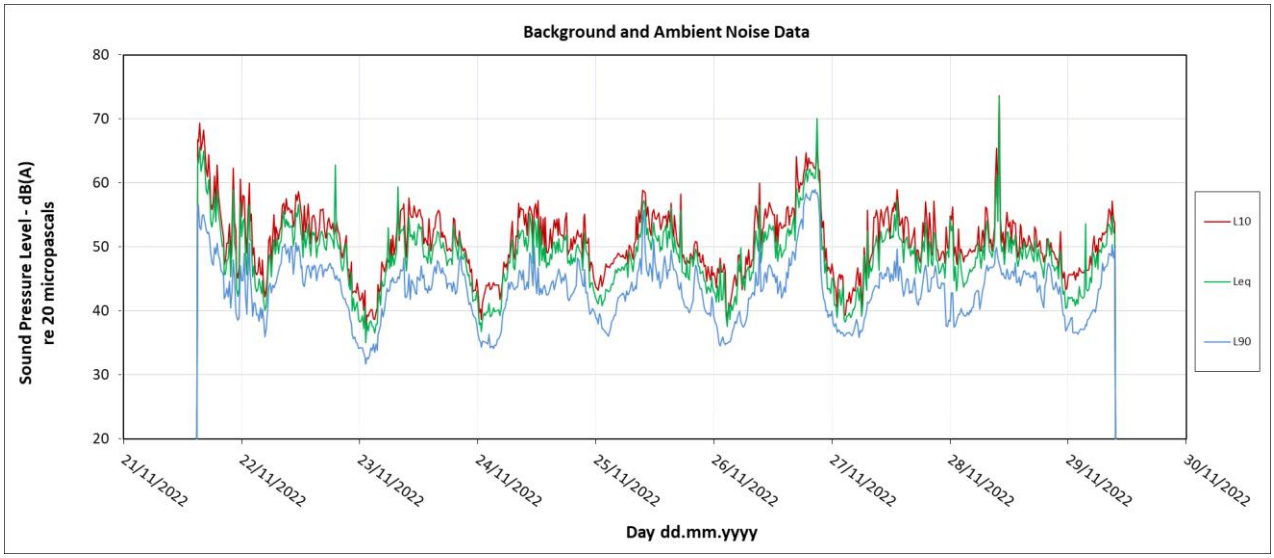
A preliminary noise assessment of mechanical plant has been carried out as shown in Section 5.2. Based on the application of good plant selection and standard noise control methods the noise criteria are expected to be met. A detailed assessment is recommended prior to Construction Certificate to ensure compliance with the outlined noise criteria.

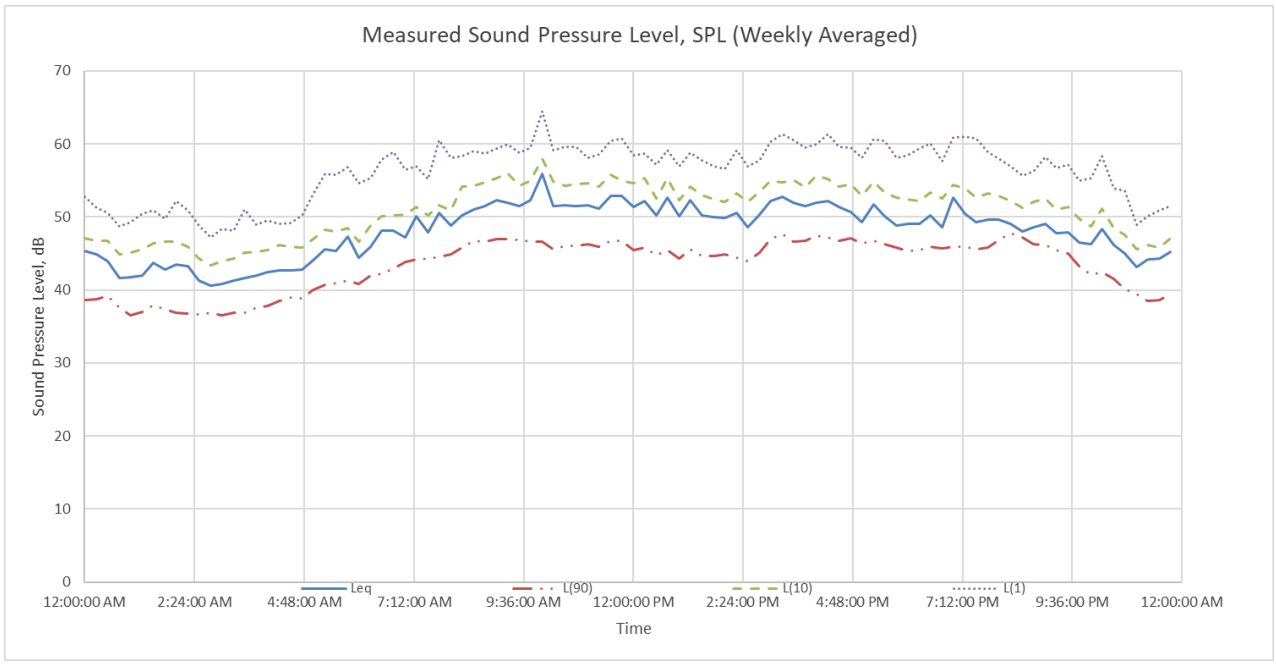
A traffic generation noise assessment has been undertaken in order to determine the potential noise impact of traffic generated by the proposed development. Based on the results of the assessment, there is predicted to be less than a 2dB increase in traffic noise levels, therefore the proposed development is expected to comply with the requirements of the NSW RNP as outlined in Section 4.2.5.

Assessment of the operation of the loading docks associated with the retail and residential components of the development have been assessed in Section 5.4. Provided operation of the loading docks (i.e. goods delivery and waste collection) are conducted during the daytime hours, it is not expected to cause any discernible impacts to the surrounding noise sensitive receivers.

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

Appendix A Noise Monitoring Graphs





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