Lennox Village Shopping Centre

Acoustic Report

Development Application

Prepared for: Challenger Investment Partners

Attention: Martin Abell

Date: 22 June 2020

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Ref: 46986

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Document Set ID: 9232296
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Revision

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Document Set ID: 9232296
Version: 1, Version Date: 29/07/2020

Contents

Certified System
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ISO 9001
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Document Set ID: 9232296
Version: 1, Version Date: 29/07/2020

1. Introduction

As part of the DA documentation process, Stantec Australia Pty Ltd has been engaged by Challenger Investment Partners to provide an acoustic assessment for the expansion of the Lennox Village Shopping Centre, located on Corner Great Western Highway & Pyramid Street, Great Western Hwy, Emu Plains NSW 2750

The proposed work is to include:

- Approximately 234m^2 of additional commercial spaces;
- 16 additional new carparks;
- Approximately 82m^2 external plantrooms
- Approximately 48m^2 external compactor area

This assessment has been prepared considering the following documents:

- Penrith Development Control Plan 2014
- Pre-lodgement Advise by Penrith City Council, dated 05th May 2020.
- AS/NZS 2107:2016: Acoustics – Recommended design sound levels and reverberation times for building
- NSW Noise Policy for Industry 2017 (NPI 2017)
- NSW Road Noise Policy 2011 (RNP, 2011)

This assessment discusses the likely noise impact of the proposed development upon the nearest most-affected receivers.

This report provides:

- A statement of compliance with the Penrith Council requirements for the proposed development within the vicinity of the nearest potentially affected residential and commercial receivers.
- Recommendations for achieving the outlined criteria.

This report is based on our understanding of the proposed project, application of the relevant state guidelines and professional experience within the acoustic field. Therefore, this report shall not be relied upon as providing any warranties or guarantees.

1.1 Information sources

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

- Site drawings presenting the location of the proposed development in relation to the nearest receivers.
- Architectural drawings provided by i2c Preliminary Drawings, revision, P7, dated 20.04.2020
- Noise data collected on site through the use of a noise logger and a hand held type 1 spectrum analyser.

Document Set ID: 9232296
Version: 1, Version Date: 29/07/2020

2. Project Overview

2.1 Site Description

The proposed development is located on Corner Great Western Highway & Pyramid Street, Great Western Hwy, Emu Plains NSW 2750. The property is bound by residential properties across Water Street to the North, residential and commercial properties across the Pyramid Street to the East, residential properties across Great Western Highway to the South, and residential properties along Martin Street to the West.

The site location, measurement positions and surrounding residential receivers are shown in Figure 1.

2.1.1 Acoustic Issues

The acoustic issues relating to the development are as follows:

- Noise emissions from the proposed development to the surrounding residential receivers
- Noise emission from mechanical plant from the redevelopment to the surrounding residential receivers
- Traffic noise generation from increased number of traffic accessing the car-park

Figure 1: Overview of the site and measurement locations (Source: nearmap.com)

Document Set ID: 9232296
Version: 1, Version Date: 29/07/2020

3. Noise Survey

3.1 Instrumentation

The following equipment was used for the noise surveys:

- Hand-held sound spectrum analyzer B&K 2250, S/N 2709742
- Sound Calibrator B&K Type 4231, S/N 2709826
- CASELLA Environmental Noise Loggers, CEL-63X, S/N 1488204
- CASELLA Environmental Noise Loggers, CEL-63X, S/N 4257387

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

3.2 Unattended Noise Survey Results

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

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

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

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

3.2.1 Background and Ambient Noise Monitoring

A noise logger was placed at position L1 and L2 as shown in Figure 1 to measure the background and ambient noise that is representative of the surrounding residential receivers which are most affected by noise from the existing supermarket, and future re-development. Both loggers were installed from the 7th to the 15th of May 2020.

The results of the unattended background noise survey are shown in Table 1 below (for the day, evening and night periods). Note that any extraneous data or rain affected data has been excluded from the calculations.

Table 1: Unattended noise measurements L1 and L2

Location	Equivalent Continuous Noise Level $L_{Aeq,period}$ – dB(A)			Background Noise Level RBL – dB(A)		
	Day	Evening	Night	Day	Evening	Night
L1	61	58	52	46	41	37
L2	56	50	49	44	40	35

Document Set ID: 9232296
Version: 1, Version Date: 29/07/2020

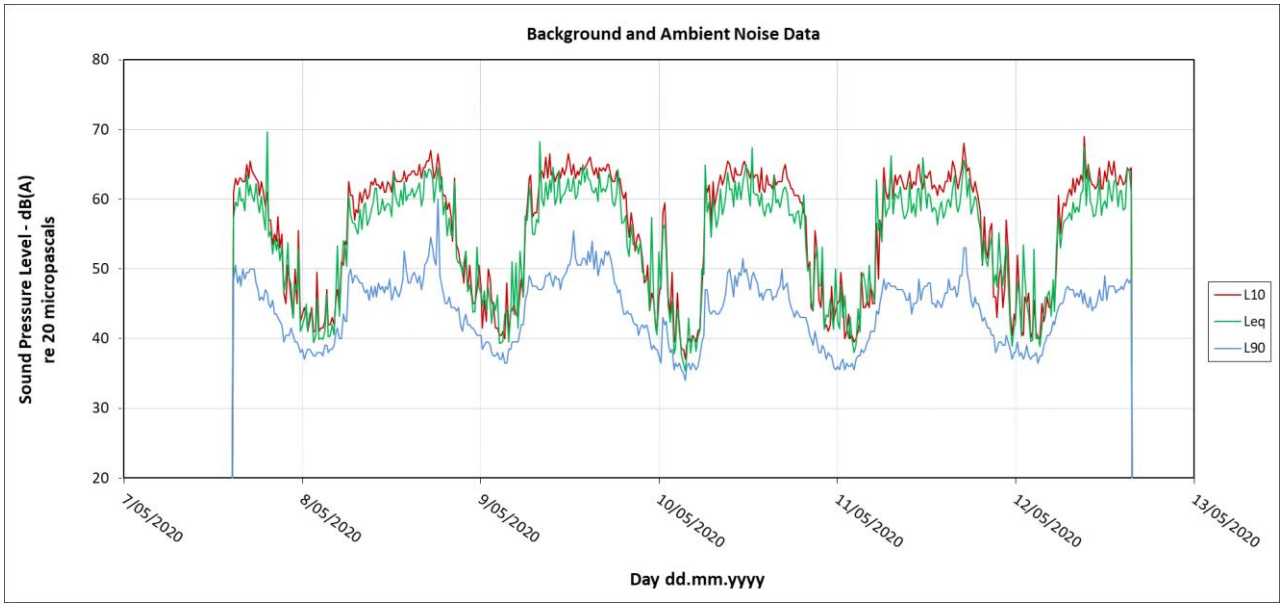

Figure 2: Logger data L1

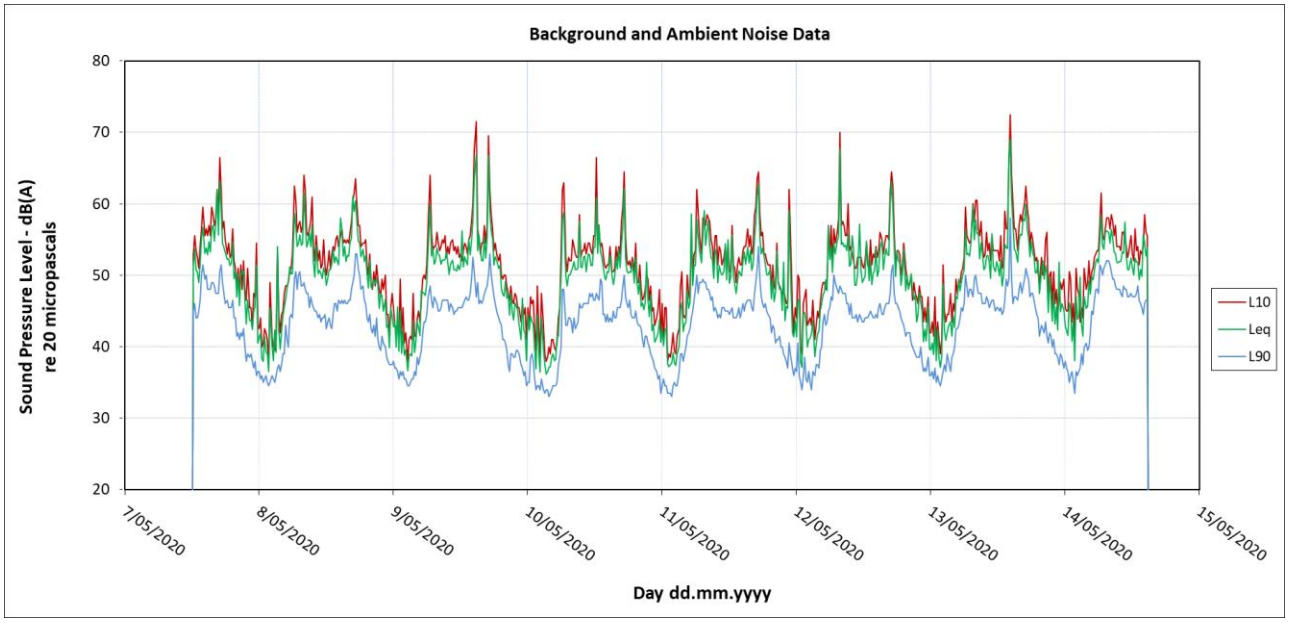

Figure 3: Logger data L2

Document Set ID: 9232296
Version: 1, Version Date: 29/07/2020

3.3 Attended Noise Survey Results

Attended noise measurements of 15-minute period were conducted on site in order to characterize the acoustic environment for the noise intrusion into the development and to determine any noise impact on the surrounding receivers. A summary of the attended noise measurements taken at the site are shown on Table 2. Refer to Figure 1 for the measurements location.

Table 2: Attended noise measurements

Measurement Location	Measurement Time	LAeq, 15mins, dB(A)	LAmax, 15mins, dB(A)	Comments
P1	07/05/2020 – 11:27am	58.8	79.6	Intermittent traffic along Pyramid Street, foot traffic, local ambient noise
	14/05/2020 – 03:34pm	63.4	92.2	
P2	07/05/2020 – 12:12pm	50.9	70.9	Intermittent traffic along Lawson Street, foot traffic, local ambient noise
	14/05/2020 – 02:53pm	53.7	77.5	
P3	07/05/2020 – 12:53pm	58.2	74.6	Intermittent traffic along Pyramid Street, foot traffic, local ambient noise

Document Set ID: 9232296
Version: 1, Version Date: 29/07/2020

4. Noise Criteria

4.1 Internal Noise Levels

4.1.1 AS/NZS 2107:2016 – 'Acoustics- Recommended design sound levels and reverberation times for building interiors

In the absence of any specific internal noise criteria on Penrith DCP 2011 for the commercial spaces, Australian Standard AS/NZS 2107:2016 – *'Acoustics- Recommended design sound levels and reverberation times for building interiors'* will be used to specify target noise levels for internal spaces to the development. Traffic noise intrusion AS 3671 refers to internal noise compliance with AS/NZS2107:2016. Refer to Table 3 for the values corresponding to commercial spaces.

Table 3: Recommended noise levels according to AS/NZS 2107:2016

Type of occupancy/activity	Recommended Design Sound Level, $L_{Aeq,t}$, dB(A)	
	Satisfactory	Maximum
Public buildings		
Public Spaces	40	50
Parking stations (carpark areas)	55	65
Cafeterias	40	50
Food courts	45	55
Coffee shops	40	50
Restaurants	40	50

4.2 External Noise Emission Criteria

4.2.1 Penrith Development Control Plan (DCP) 2014

Penrith DCP is applicable to this development. Chapter 12: C1 - Controls, states the following objectives in regards to control of noise emission levels:

> *"Council will not grant consent to any noise generating industrial development, commercial development or licensed premises unless it can be demonstrated that:*
>
> *i) The development complies with the relevant State Government authority or agency standards and guidelines for noise, as well as any relevant Australian Standards;*
> *ii) The development is not intrusive (as defined in the EPA's Industrial Noise Policy);*
> *iii) Road traffic noise generated by the development complies with the provisions of Section 12.1 Road Traffic Noise of this Section;*
> *iv) The development complies with rail noise and vibration criteria (refer Section 12.2 Rail Traffic Noise and Vibration of this Section); and Penrith Development Control Plan 2014 C12 Noise and Vibration C12-9*
> *v) The development does not adversely impact on the amenity of the area or cause sleep disturbance."*

Document Set ID: 9232296
Version: 1, Version Date: 29/07/2020

4.2.2 NSW Noise Policy for Industry (NPI)

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

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

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

Once both criteria are established the most stringent for each considered assessment period (day, evening, night) is adopted as the project-specific noise level (PSNL).

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 Laeq 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 L_{Aeq}, 15 minute ≤ RBL background noise level plus 5 dB(A).

Table 4: NSW NPI intrusiveness criteria1

Period	Noise Descriptor – dB(A)	Noise Criteria – dB(A)
Day (7:00am to 6:00pm)	$L_{Aeq,15min}$ ≤ RBL + 5	49
Evening (6:00pm to 10:00pm)	$L_{Aeq,15min}$ ≤ RBL + 5	45
Night (10:00pm to 7:00am)	$L_{Aeq,15min}$ ≤ RBL + 5	40

Amenity Criteria

The NSW NPI states the following:

> "To limit continuing increases in noise levels, the maximum ambient noise level within an area from industrial noise sources should not normally exceed the acceptable noise levels specified in Table 2.1 of the NPI. Meeting the acceptable noise levels in table 2.1 will protect against noise impacts such as speech interference, community annoyance and to some extent sleep disturbance. These levels represent best practice for assessing industrial noise sources, based on research and a review of assessment practices used overseas and within Australia."

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

[1] See Section 3.2 for noise survey results.

Document Set ID: 9232296
Version: 1, Version Date: 29/07/2020

Table 5: NSW NPI amenity criteria for external noise levels2

Type of Receiver	Indicative Noise Amenity Area	Time of Day	Recommended LAeq,period Noise Level, dB(A)	Project Amenity Noise Level1, LAeq, 15mins, dB(A)
Residential	Suburban[2]	Day	55	53
		Evening	45	43
		Night	40	38
Commercial	All	When in use	65	62

Notes:

1. Project amenity noise level is Recommended Noise Level minus 5 dB(A) plus 3 dB(A) to convert from period level to a 15-minute level.
2. Urban area as defined in EPA NSW NPI Table 2.3

'Modifying Factor' Adjustments

The NSW NPI also states:

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

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

Table 4.1 of Chapter 4 of the NSW DECCW NPI (see Table 6 below) provides procedures for determining whether an adjustment should be applied for greater annoyance aspect.

Table 6: Table 4.1 from the NSW DECCW NPI – Modifying factor corrections

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

[2] See Section 3.2 for noise survey results.

Document Set ID: 9232296
Version: 1, Version Date: 29/07/2020

Factor	Assessment / Measurement	When to Apply	Correction[1]	Comments
		the tone is 160 to 400 Hz inclusive - **15 dB** or more if the centre frequency of the band containing the tone is below 160 Hz		
Low Frequency Noise	Measurement of C-weighted and A-weighted level	Measure / assesses C- and A- weighted levels over same time period. Correction to be applied if the difference between the two levels is 15 dB or more	5 dB[2]	C-weighting is designed to be more responsive to low-frequency noise, especially at higher overall levels
Impulsive Noise	A-weighted fast response and impulsive response	If difference in A-weighted maximum noise levels between fast response and impulse response is greater than 2 dB	Apply difference in measured levels as the correction, up to a maximum of 5 dB.	Characterised by a short rise time of 35 milliseconds (ms) and decay time of 1.5 s.
Intermittent Noise	Subjectively assessed	Level varies by more than 5 dB	5 dB	Adjustment to be applied for **night-time only.**
Duration	Single-event noise duration may range from 1.5 min to 2.5 h	On event in any 24-hour period	0 to – 20 dB(A)	The acceptable noise level may be increased by an adjustment depending on duration of noise.
Maximum Adjustment	Refer to individual modifying factors	Where two or more modifying factors are indicated	Maximum correction of 10dB(A)[2] (excluding duration correction)	

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

4.2.3 Project-Specific Noise Levels (PSNL)

The following criteria is applicable for the external noise emissions from the development, as detailed below in Table 7. These project specific noise levels are in accordance with the requirements of the NSW NPI, and shall be assessed to the most affected point on or within the residential boundary.

Table 7: Project specific noise levels

Period	Descriptor	PSNL dB(A)
Residential receivers		
Day (7:00am to 6:00pm)	$L_{Aeq,15min}$	49
Evening (6:00pm to 10:00pm)	$L_{Aeq,15min}$	43
Night (10:00pm to 7:00am)	$L_{Aeq,15min}$	38
Commercial receivers		
When in use	$L_{Aeq,duration}$	65

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

Document Set ID: 9232296
Version: 1, Version Date: 29/07/2020

4.3 Traffic Noise Generation Criteria

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

Road traffic noise impact is assessed in accordance with the introduced NSW Road Noise Policy (Office of Environment and Heritage July 2011) which supersedes the *NSW Environmental Criteria for Road Traffic Noise* (ECRTN, Department of Environment Climate Change and Water 1999). The criterion (Table 3 – Road Traffic Noise Assessment Criteria for Residential Land Uses) divides land use developments into different categories and lists the respective criteria for each case. The category that is relevant to the proposed use of the site is shown below in Table 8.

Table 8: NSW Road Noise Policy – Traffic noise assessment criteria

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

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

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

4.4 Construction Noise Criteria

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

However, in undertaking the assessment of potential noise intrusion associated with the proposed construction activities, Chapter 4 of the NSW EPA ICNG (July 2009) were specifically referenced. The noise limits are presented in Table 9, and are applicable to the development.

Document Set ID: 9232296
Version: 1, Version Date: 29/07/2020

Table 9: NSW ICNG Construction noise criteria

Time of Day	Management Level $L_{Aeq,15min}$ *	How to Apply
Recommended Standard Hours: Mon – Fri (7am – 6pm) Sat (8am – 1pm) No work on Sunday & Public Holidays	Noise Affected RBL + 10dB	The noise affected level represents the point above which there may be some community reaction to noise. • Where the predicted or measured $L_{Aeq,15min}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. • The proponent should also inform all potentially impacted residences of the nature of works to be carried out, the expected noise levels and duration as well as contact details.
	Highly Noise Affected 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. • Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur in, taking into account: • Times identified by the community when they are less sensitive to noise (such as before and after school, for works near schools, or mid-morning or mid-afternoon for works near residences) • If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside Recommended Standard Hours	Noise Affected RBL + 5dB	• A strong justification would typically be required for works outside the recommended standard hours. • The proponent should apply all feasible and reasonable work practices to meet the noise affected level. • Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community. • For guidance on negotiating agreements see section 7.2.2. of NSW EPA ICNG (July 2009).

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

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

4.5 Construction Vibration Criteria

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

4.5.1 Human Comfort – Continuous and Impulsive Vibration Criteria

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

Maximum allowable magnitudes of building vibration with respect to human response are shown in Table 10. It should be noted that the human comfort for vibration are more stringent than the building damage criteria.

Document Set ID: 9232296
Version: 1, Version Date: 29/07/2020

Table 10: Preferred and maximum weighted RMS values for continuous and impulsive vibration acceleration (m/s2) 1-80Hz

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

Human Comfort – Intermittent Vibration Criteria

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

Table 11: Acceptable Vibration Dose Values for Intermittent Vibration (m/s1.75)

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

4.5.2 Structural Damage – Vibration Criteria

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

Most commonly specified structural vibration levels are defined to minimize the risk of cosmetic surface cracks and are set below the levels that have the potential to cause damage to the main structure. Structural damage criteria are presented in German Standard DIN4150-Part 3 “Structural vibration in buildings – Effects on structures” and British Standard BS7385-Part 2: 1993 “Evaluation and Measurement for Vibration in Buildings”. Table 12 indicates the vibration limits presented in DIN4150-Part 3 to ensure structural damage doesn’t occur.

Document Set ID: 9232296
Version: 1, Version Date: 29/07/2020

Table 12: 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 At a frequency of			Plane of floor of uppermost full storey
		Less than 10Hz	10 to 50Hz	50 to 100*Hz	All Frequencies
1	Buildings used for commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40
2	Dwellings and buildings of similar design and/or use	5	5 to 15	15 to 20	15
3	Structures that, because of their particular sensitivity to vibration, do not correspond to those listed in lines 1 and 2 and are of great intrinsic value (e.g. buildings that are under a preservation order)	3	3 to 8	8 to 10	8
*For frequencies above 100Hz, at least the values specified in this column shall be applied					

Table 13 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 13: Transient vibration guide values for cosmetic damage

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

4.5.3 Vibration Objectives

Table 14 indicates the vibration criteria for the nearest residential and commercial properties to the development.

Table 14: Construction vibration criteria summary

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

Document Set ID: 9232296
Version: 1, Version Date: 29/07/2020

5. Noise Impact Assessment

5.1 Mechanical Noise Emissions

The main mechanical sources associated with the development will include:

- Condenser units
- Compressor units
- Compactor units

In order to assess the worst-case scenario, it was assumed that all of the condenser units associated with the facilities are running at any time throughout the day and night time.

Using this approach, we can determine the combined Sound Power Level of all plant equipment which can emit a maximum sound pressure level of **72dB(A)** when measured at 1m from the new plant room façade/louvre which is located at the northern section of the new development located 28m away from the closest residential receiver.

Refer to Table 15 for the proposed sound power levels for the mechanical plant associated with the proposed development provided by the project manager on Monday, 25th May 2020.

Table 15: Sound power levels for mechanical plant (typical)

Item	SWL re 10^{-12} W dB								
	63 Hz	125 Hz	250 Hz	500 Hz	1 KHz	2 KHz	4 KHz	8 KHz	Overall dB(A)
Condenser unit[1] (GUNTNER GCHV RD090) SPL 61dB(A) at 3m	75	77	76	77	74	68	64	61	78
R134a Chiller pack[1] SPL 64dB(A) at 3m	78	80	79	80	77	71	67	67	81
Compactor[2]	77	76	75	76	84	83	75	75	88

Note:

1. Typical noise spectrum has been used – further reviewed will be required during the detail design phase.
2. Based on the noise measurement conducted by Marshall Day for D2 Compactor located at ALDI store in Queanbeyan, QLD

Document Set ID: 9232296
Version: 1, Version Date: 29/07/2020

Figure 4 presents the proposed plantroom layout.

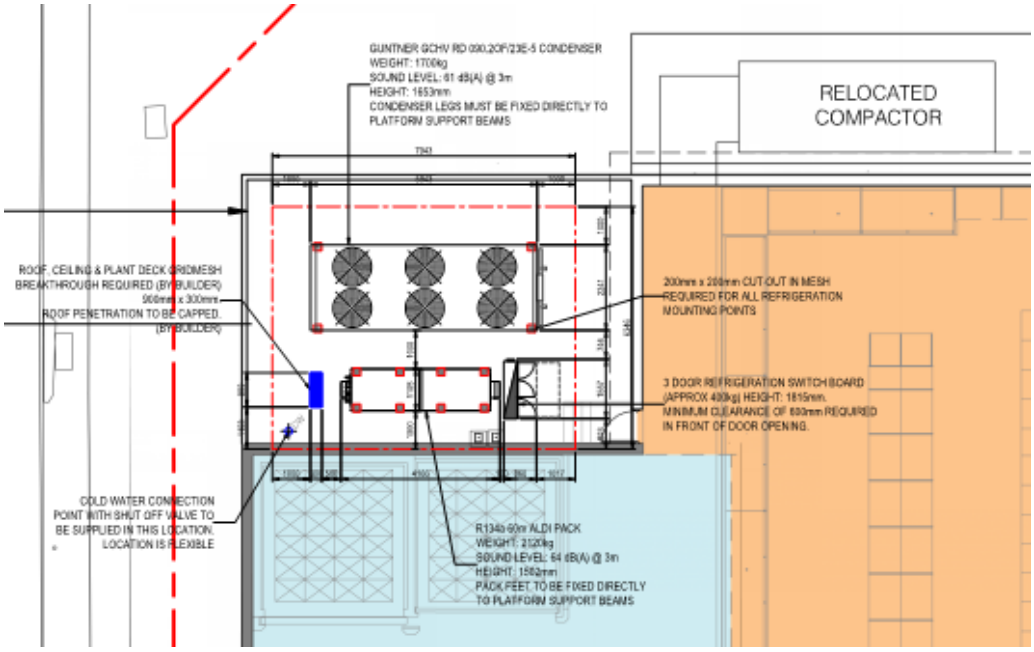

Figure 4: Proposed plantroom layout

5.1.1 New Condenser Plant Room Noise Mitigation Measures

Attenuating high levels of low frequency noise such as that generated by mechanical equipment is extremely difficult to achieve without fully enclosed space. Therefore, the recommended course of action is to increase the transmission loss through the plant room louvers as much as possible in order to reduce as much noise during its transfer to the adjacent structure/space. This can be achieved by utilizing acoustic louvers (Acran 200-series) on the plant room walls where some openings are required to allow the air circulation to the plant room. This louver should have a minimum transmission loss as per Table 16.

Table 16: Minimum Transmission Loss Required (Acran 200 Series)

Louver Type	Transmission Loss (dB)					
	125	250	500	1000	2000	4000
Acran 200-Series	8	6	10	17	17	12

The construction of the acoustic barrier/louvers must be at least 1m higher than the height of the any mechanical plants and impervious of gaps and cracks, which would compromise its performance.

Document Set ID: 9232296
Version: 1, Version Date: 29/07/2020

Figure 5 presents the proposed acoustic treatments to the plantroom.

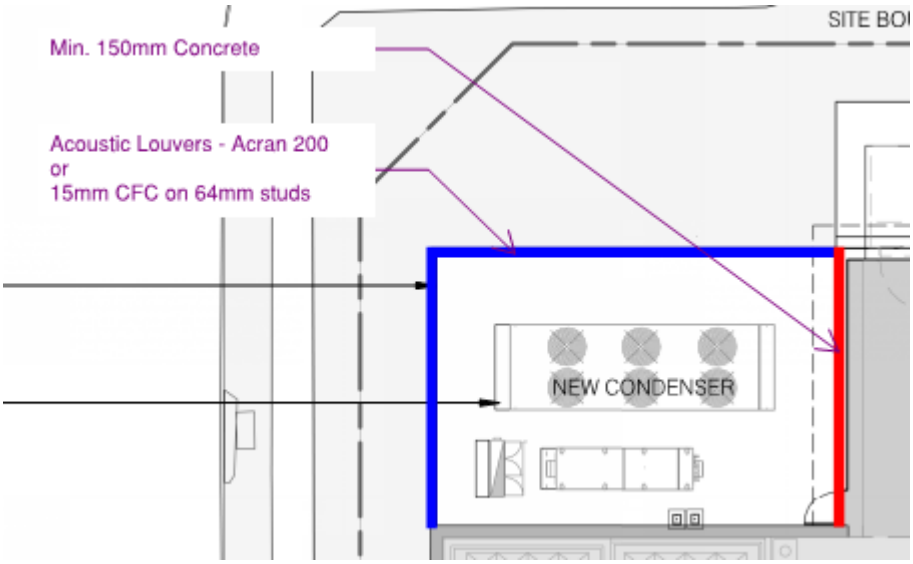

Figure 5: Proposed acoustic treatment to the new plant room

It is important to note that this is a preliminary solution as the design and selection of plants is yet to be finalized. A detailed acoustic assessment will be required as more information becomes available regarding performance data of specific mechanical equipment or any further mechanical design information. Treatment will be proposed to ensure the project specific criteria for mechanical, electrical and hydraulic services noise at the site boundary is complied with.

Table 17 presents the predicted sound pressure level of the from the plant equipment at the nearest receivers. Please note that the predicted noise level shown in Table 17 have been conservatively assessed, it assumes that all of the plant room equipment to run at its full capacity during the night-time period.

Table 17: Predicted typical noise level at the nearest receivers

Receiver	NPI Criteria dB(A)[1]	Predicted Noise Level, dB(A)	Compliance (Y/N)
Residential across Pyramid St. (Approximately 30m away)	38[1]	34	Yes
Residential across Water St. (Approximately 27m away)	38[1]	35	Yes

Notes:

1. Night time criteria have been used.

Document Set ID: 9232296
Version: 1, Version Date: 29/07/2020

5.1.2 Compactor Noise Mitigation Measures

The new compactor will be located at the northern side of the extended shopping centre as shown previously on Figure 4. As a conservative approach, it was assumed that the compactor will be running at any time throughout the day and night time. Therefore, in order to ensure the compliances with the most stringent noise criteria (night time period) the recommended course of action is to build a solid acoustic barrier between the compactor and the adjacent receivers.

Stantec recommend for this barrier to be constructed using a minimum of 140mm brick/concrete blockwork or a 15mm Compressed Fibre Cement (CFC) on a 64mm steel studs with 50mm acoustic insulations. The construction of the barrier must be at least 1m higher than the height of the compactor and impervious of gaps and cracks, which would compromise its performance.

Figure 6 presents the proposed acoustic treatments for the compactor site.

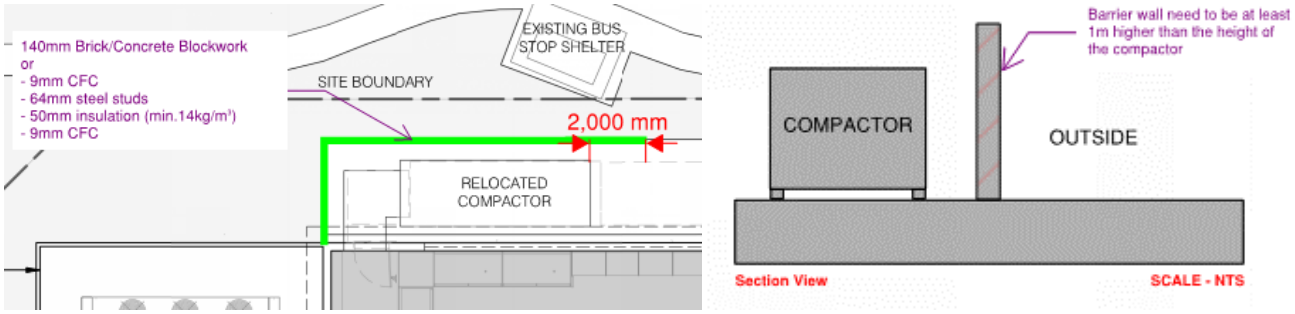

Figure 6: Proposed acoustic treatment to the new plant room

Table 18 presents the predicted sound pressure level of the compactor at the nearest receivers.

Table 18: Predicted typical noise level at the nearest receivers during the operation of the compactor

Receiver	NPI Criteria dB(A)[1]	Predicted Noise Level, dB(A)	Compliance (Y/N)
Residential across Pyramid St. (Approximately 28m away)	38[1]	36	Yes
Residential across Water St. (Approximately 52m away)	38[1]	30	Yes

Notes:

2. Night time criteria have been used.

Document Set ID: 9232296
Version: 1, Version Date: 29/07/2020

5.1.3 External Façade

The general limiting factor of the performance of a building façade in term of noise attenuation is the glazing. The occasional use of the compactor and the traffic noise along the Pyramid Street provides the most acoustic demand on the facilities within the development site.

In order to achieve the internal noise levels specified, the minimum recommended glazing selection for the façades of the proposed development is presented Table 19. The required Rw ratings have been provided which takes into account the performance when installed in a frame. This glazing as presented below has been designed to meet both the internal noise requirements.

The glazing thicknesses corresponding to the Rw ratings are presented below in Table 19, and should be considered as the minimum thicknesses to achieve acoustical ratings. Greater glazing thicknesses may be required for structural loading, wind loading, thermal requirements etc.

The calculation of the proposed Rw rating has assumed with typical room correction factors.

Table 19: Recommended acoustic performance of glazing system

Façade Location	Glazing configuration	Required Acoustic Rating of Glazing Assembly, Rw[3]
All	6.38mm Laminated Glass	Rw32

5.2 Road Traffic Noise Generation

The current redevelopment will also involve an additional 16 carparks to be added unto the existing 421 carparks. As the additional carparks is less than 5% of the capacity of the existing carparks, the increase noise due to the additional traffic generated noise will be neglectable (<0.2dB). Therefore, the proposed development is expected comply with the requirements of the NSW RNP.

5.3 Waste Collection

Based on the information given by ALDI through the project manager on Thursday, 18th May 2020, the compactor collection bins are to be unloaded approximately once every fortnight. Therefore, due to the low frequency of the collection activities, we do not expect the noise associated with the vehicles servicing the compactor is enough to entail a noise assessment and as such a noise assessment has not been conducted.

[3] See Appendix 1 for Rw definition

Document Set ID: 9232296
Version: 1, Version Date: 29/07/2020

6. Conclusion

An acoustic assessment for the proposed expansion of the Lennox Village Shopping Centre, located on Corner Great Western Highway & Pyramid Street, Great Western Hwy, Emu Plains has been conducted. This document forms part of the documentation package to be submitted to local authorities as part of the DA process.

This report has provided criteria, in-principle treatment and design requirements which aim to achieve the statutory criteria discussed in section 5. In terms of noise criteria, we have provided the following:

- Noise criteria for internal noise levels according to AS/NZS2107:2016, provided in section 4.1.
- Noise criteria for emissions from the development to receivers in accordance with the NSW EPA NPI and Penrith DCP provided in section 4.2.
- Construction noise criteria provided in section 4.4.
- Construction vibration criteria provided in section 4.5
- Traffic noise criteria presented in section 5.2.

Glazing acoustic performance requirements for the building has been provided to achieve internal noise levels in accordance with the requirements of AS/NZS2107:2016. The initial in principle glazing systems are presented in section 5.1.3.

The maximum sound power levels presented in this report show that the day, evening and night noise criteria is expected to be met. Should the plant sound power levels exceed the levels presented in this report noise mitigation measures will be required. In such an event, these measures will be developed and implemented during the detailed design stages of the project.

As presented on Section 5.2 of this report, the traffic noise impact on the post-development generated traffic will be negligible (the relative increase in noise is at most 0.2dB during the peak hours). Therefore, the proposed development complies with the requirements of the NSW RNP.

Even though no assessment can be considered as being thorough enough to preclude all potential environmental impacts, having given regard to the above listed conclusions, it is the finding of this assessment that the development application should not be refused on the grounds of excessive noise generation, as it can comply with all applicable regulations.

The information presented in this report shall be reviewed if any modifications to the features of the development specified in this report occur, including and not restricted to selection of air-conditioning units, layout of equipment, modifications to the building and introduction of any additional noise sources.

Document Set ID: 9232296
Version: 1, Version Date: 29/07/2020

Appendix A Glossary of Acoustic Terms

NOISE	
Acceptable Noise Level:	The acceptable LAeq noise level from industrial sources, recommended by the EPA (Table 2.1, INP). Note that this noise level refers to all industrial sources at the receiver location, and not only noise due to a specific project under consideration.
Adverse Weather:	Weather conditions that affect noise (wind and temperature inversions) that occur at a particular site for a significant period of time. The previous conditions are for wind occurring more than 30% of the time in any assessment period in any season and/or for temperature inversions occurring more than 30% of the nights in winter).
Acoustic Barrier:	Solid walls or partitions, solid fences, earth mounds, earth berms, buildings, etc. used to reduce noise.
Ambient Noise:	The all-encompassing noise associated within a given environment at a given time, usually composed of sound from all sources near and far.
Assessment Period:	The period in a day over which assessments are made.
Assessment Location	The position at which noise measurements are undertaken or estimated.
Background Noise:	Background noise is the term used to describe the underlying level of noise present in the ambient noise, measured in the absence of the noise under investigation, when extraneous noise is removed. It is described as the average of the minimum noise levels measured on a sound level meter and is measured statistically as the A-weighted noise level exceeded for ninety percent of a sample period. This is represented as the L90 noise level.
Decibel [dB]:	The units of sound pressure level.
dB(A):	A-weighted decibels. Noise measured using the A filter.
Extraneous Noise:	Noise resulting from activities that are not typical of the area. Atypical activities include construction, and traffic generated by holidays period and by special events such as concert or sporting events. Normal daily traffic is not considered to be extraneous.
Free Field:	An environment in which there are no acoustic reflective surfaces. Free field noise measurements are carried out outdoors at least 3.5m from any acoustic reflecting structures other than the ground
Frequency:	Frequency is synonymous to pitch. Frequency or pitch can be measured on a scale in units of Hertz (Hz).
Impulsive Noise:	Noise having a high peak of short duration or a sequence of such peaks. A sequence of impulses in rapid succession is termed repetitive impulsive noise.
Intermittent Noise:	Level that drops to the background noise level several times during the period of observation.
LAmax	The maximum A-weighted sound pressure level measured over a period.
LAmin	The minimum A-weighted sound pressure level measured over a period.

Document Set ID: 9232296
Version: 1, Version Date: 29/07/2020

LA1	The A-weighted sound pressure level that is exceeded for 1% of the time for which the sound is measured.
LA10	The A-weighted sound pressure level that is exceeded for 10% of the time for which the sound is measured.
LA90	The A-weighted level of noise exceeded for 90% of the time. The bottom 10% of the sample is the L90 noise level expressed in units of dB(A).
LAeq	The A-weighted "equivalent noise level" is the summation of noise events and integrated over a selected period of time.
LAeqT	The constant A-weighted sound which has the same energy as the fluctuating sound of the traffic, averaged over time T.
Reflection:	Sound wave changed in direction of propagation due to a solid object met on its path.
R-w:	The Sound Insulation Rating R-w is a measure of the noise reduction performance of the partition.
SEL:	Sound Exposure Level is the constant sound level which, if maintained for a period of 1 second would have the same acoustic energy as the measured noise event. SEL noise measurements are useful as they can be converted to obtain Leq sound levels over any period of time and can be used for predicting noise at various locations.
Sound Absorption:	The ability of a material to absorb sound energy through its conversion into thermal energy.
Sound Level Meter:	An instrument consisting of a microphone, amplifier and indicating device, having a declared performance and designed to measure sound pressure levels.
Sound Pressure Level:	The level of noise, usually expressed in decibels, as measured by a standard sound level meter with a microphone.
Sound Power Level:	Ten times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power.
Tonal noise:	Containing a prominent frequency and characterised by a definite pitch.

Document Set ID: 9232296
Version: 1, Version Date: 29/07/2020

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Document Set ID: 9232296
Version: 1, Version Date: 29/07/2020