Appendix 5: Noise Impact Assessment

RAPT CONSULTING

Acoustic Assessment – 42 Fullerton Cove Road Fullerton Cove, NSW.

Prepared for

Monteath & Powys

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Relationships Attention Professional Trust

Document Details

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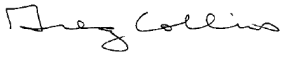
2224549_240221	0	21 February, 2024	Gregory Collins - MAAS	

Table of Contents

Table Index

Figure Index

1. Introduction

1.1 Background

RAPT Consulting has been engaged to undertake an acoustic assessment for Monteath & Powys to inform a Development Application (DA) for a new shopping village at 42 Fullerton Cove Road, Fullerton Cove NSW.

The site and surrounding area is shown in Figure 1-1 and overall site plan is shown in Figure 1-2.

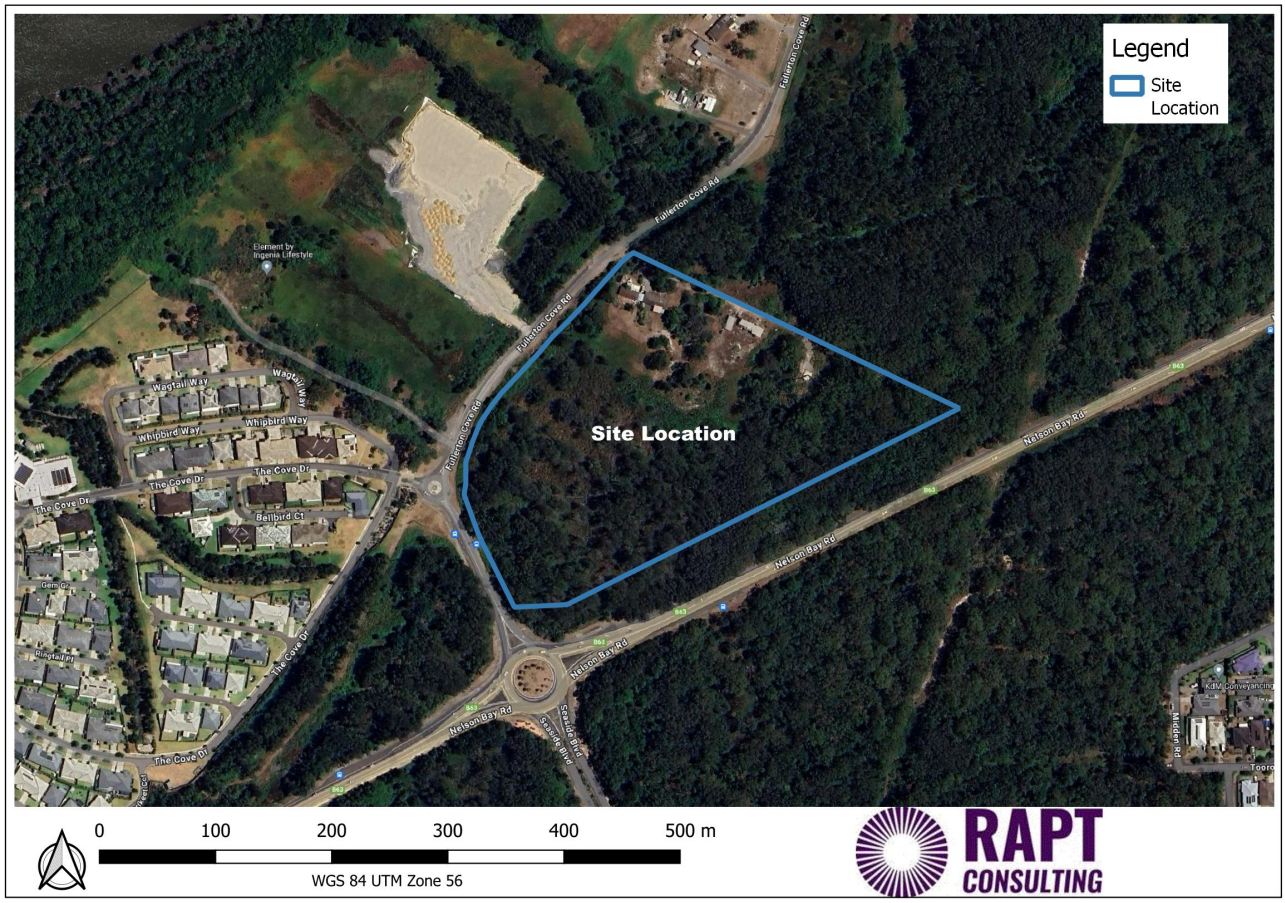


Figure 1-1 Site and Surrounding Area

Figure 1-2 Overall Site Plan (Source: Monteath & Powys)

1.2 Assessment Objectives

This noise assessment considers the potential impacts of the operation of the proposal from an acoustics perspective. The purpose is to assess potential noise from the proposal and to recommend mitigation measures where required.

The outcomes of this assessment include recommendations where necessary for potential noise mitigation and management measures designed to comply with established project noise trigger levels for residential (dwelling) occupants and other receivers surrounding the study area.

1.3 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 operation of the proposal
- Identify the likely principal noise sources during operation and their associated noise levels
- assessment of potential noise impacts associated with operation aspects of the project
- provide recommendations for feasible and reasonable noise mitigation and management measures, where noise objectives may be exceeded.

1.4 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:

- Noise Policy for Industry (NPfI), Environment Protection Authority (EPA), 2017
- NSW Road Noise Policy (RNP), Department of Environment, Climate Change and Water (DECCW), 2011
- Interim Construction Noise Guideline (ICNG), Department of Environment and Climate Change, 2009
- Assessing Vibration: A Technical Guideline, Department of Environment and Conservation (DEC), 2006
- British Standard BS7385.2 - 1993 Evaluation and Measurement for Vibration in Buildings, Part 2 - Guide to damage levels from ground borne vibration 1993
- DIN 4150: Part 3-1999 Structural vibration – Effects of vibration on structures 1999

1.5 Limitations

The purpose of this report is to provide an independent noise 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 noise 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 currently zoned E1 Local Centre and C2 Environmental Conservation.

A map showing the land use zonings in the vicinity of the proposal are shown in Figure 2-1.

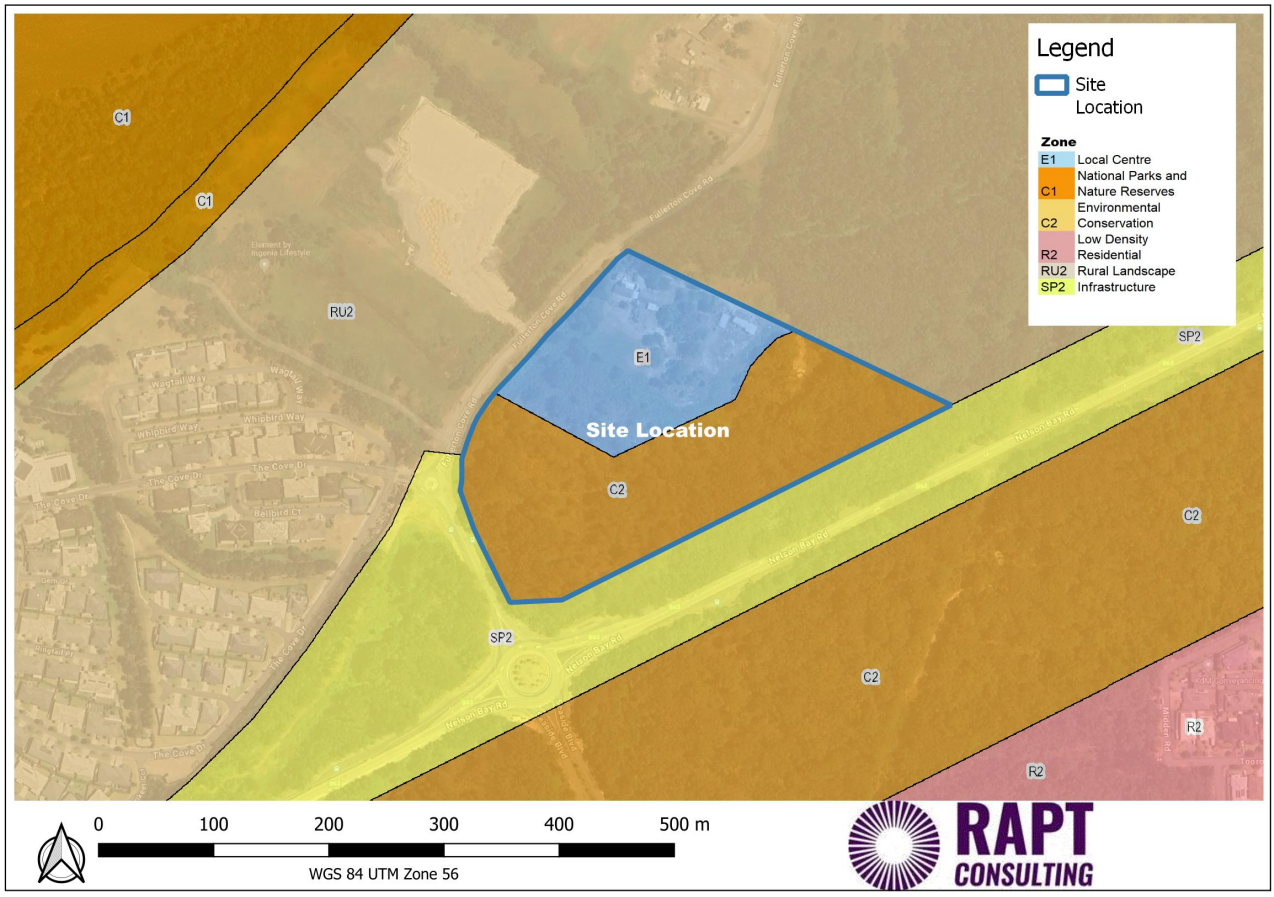


Figure 2-1 Land Use Zonings

Nearest receptors to the proposal assessed in this acoustic assessment are identified in Table 2-1 and Figure 2-2. Other receptors are located in these areas however the locations selected are considered representative of the localised noise environment in the vicinity of the locations selected.

Table 2-1 Nearest Assessed Receptors to Study Area

Receiver ID	Location	Receptor Type	Easting	Northing
R1	69 Fullerton Cove Road	Residential	388171	6364433
R2	2 The Cove Drive	Residential	387858	6364089
R3	9 Midden Road	Residential	3885667	6363866
R4	TBC West of Site Current Development	Residential	387961	6364251

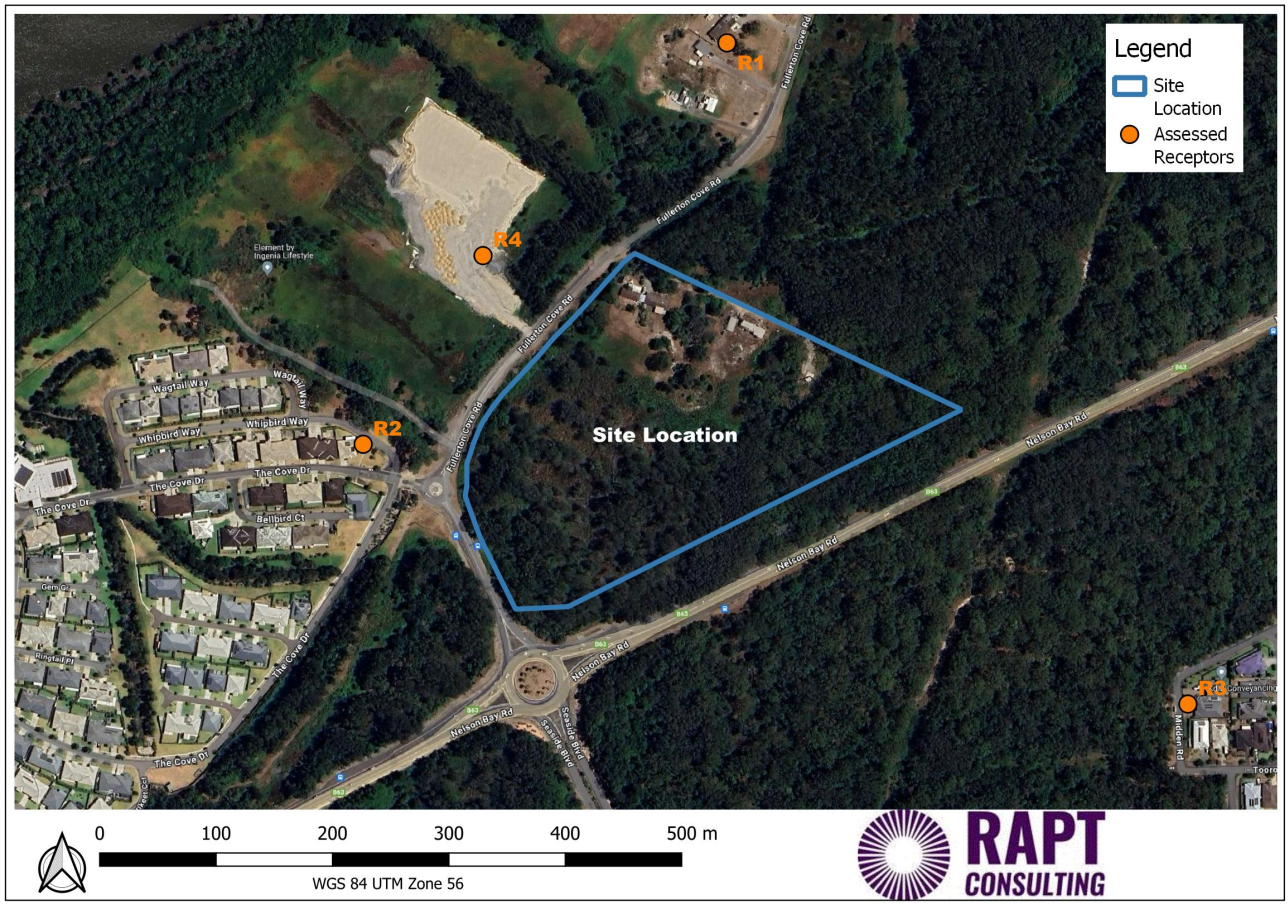


Figure 2-2 Nearest Receptors to the Proposal

2.2 Background and Ambient Noise

To establish background and ambient noise levels, noise monitoring was undertaken by RAPT Consulting from 8 February to 14 February 2024. The monitoring was undertaken in the near the western boundary of the site in the vicinity of residences located to the west on Fullerton Cove Road. Site observations noted the location was considered indicative of the local ambient noise environment and these sites also presented as secure locations 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 local and distant road traffic, and natural wildlife primarily described the ambient noise environment and is indicative of a Sub-Urban noise environment.

The monitoring location is shown in Figure 2-3 and 2-4.

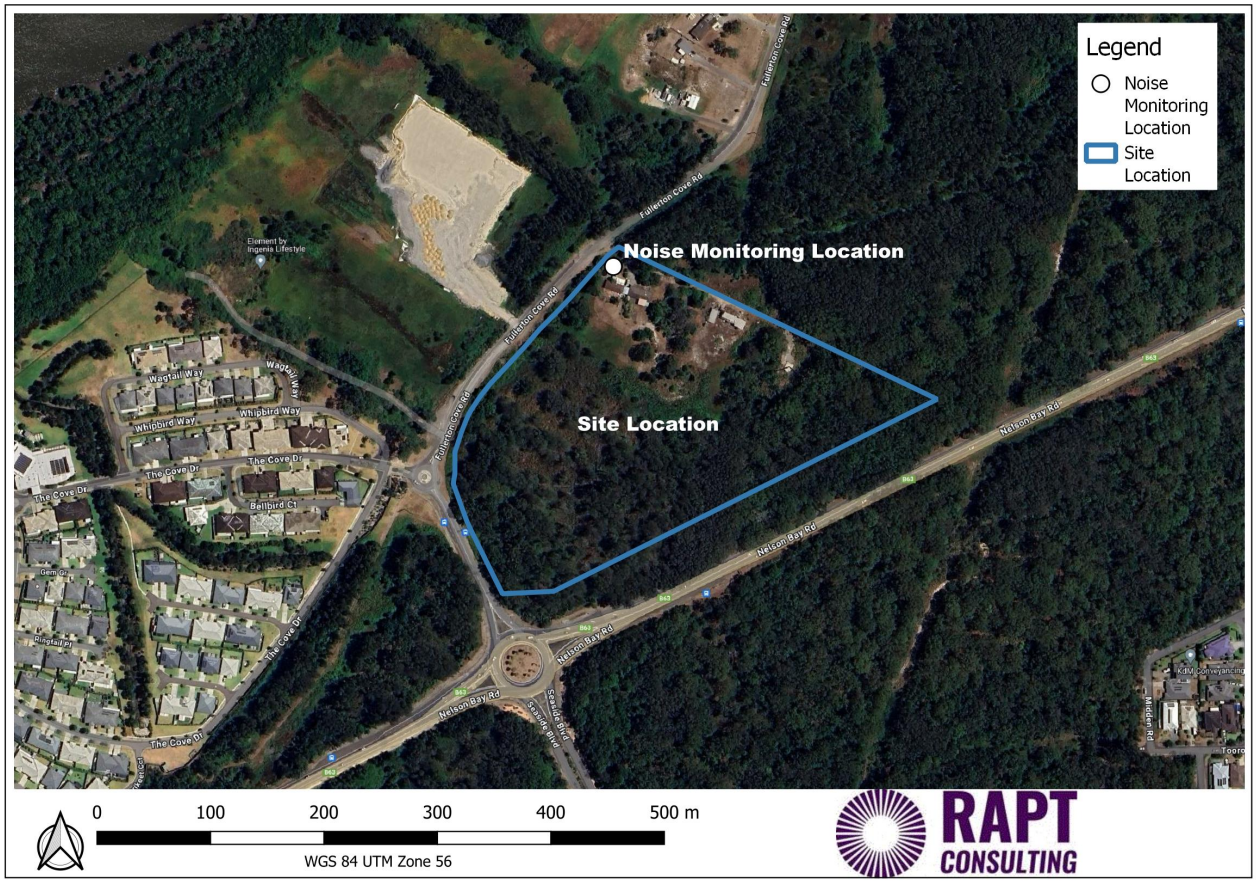


Figure 2-3 Noise Monitoring Location

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 L_{Amin}, L_{A90}, L_{A10}, L_{Amax} and L_{Aeq} noise descriptors. The instrument was programmed to accumulate environmental noise data continuously over sampling periods of 15 minutes for the entire monitoring period.

The noise surveys were conducted with consideration to the procedures described in Australian Standard AS 1055:2018, "Acoustics – Description and Measurement of Environmental Noise" and the NSW Noise Policy for Industry (NPfI). Calibration was checked before and after each measurement and no significant drift occurred. The acoustic instrumentation used carries current NATA calibration and complies with AS/NZS IEC 61672.1-2019-Electroacoustics – Sound level meters – Specifications.

The L_{A90} descriptor is used to measure the background noise level. This descriptor represents the noise level that is exceeded for 90 percent of the time over a relevant period of measurement. In line with the procedures described in the EPA's NPfI, the assessment background level (ABL) is established by determining the lowest tenth-percentile level of the L_{A90} noise data acquired over each period of interest. The background noise level or rating background level (RBL) representing the day, evening and night-time assessment periods is based on the median of individual ABL's determined over the entire monitoring duration. The RBL is representative of the average minimum background sound level, or simply the background level.

The L_{Aeq} 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.

Weather information for the unattended noise logging was obtained from the Bureau of Meteorology Nobbys AWS for the monitoring period and any data adversely affected by rain, wind (more than 5 m/s as per NPfI) or extraneous noise were discarded.

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

Table 2-2 Background and Ambient Noise Monitoring Results

	Rating background level, L_{A90}, dB(A)			Ambient noise levels, L_{Aeq} dB(A)		
Location	**Day[1]**	**Evening[1]**	**Night[1]**	**Day[1]**	**Evening[1]**	**Night[1]**
NM 1	41	36	32	57	48	45

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. Acoustic Objectives

3.1 Construction Noise

Construction noise is assessed with consideration to DECCW Interim Construction Noise Guidelines (ICNG) (July 2009). The ICNG is a non-mandatory guideline that is 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.
Blasting	Monday to Friday: 9 am to 5 pm. Saturday: 9 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 ICNG Noise Guidelines at Receivers

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
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
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)	65 dB(A)
Offices, retail outlets (external)	70 dB(A)
industrial premises (external)	75 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 construction is planned for standard hours. Based on the above and the RBL's determined from site monitoring, construction noise management levels (NML's) have been derived, as shown in Table 3-3.

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

Receiver	Within Recommended Standard Hours
Residential	51

3.2 Vibration Guidelines

3.2.1 Human Exposure

Vibration goals 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).*

Vibration, at levels high enough, has the potential to cause damage to structures and disrupt human comfort. Vibration and its associated effects are usually classified as continuous, impulsive or intermittent as follows:

- continuous vibration continues uninterrupted for a defined period and includes sources such as machinery and continuous construction activities
- impulsive vibration is a rapid build up to a peak followed by a damped decay. It may consist of several cycles at around the same amplitude, with durations of typically less than two seconds and no more than three occurrences in an assessment period. This may include occasional dropping of heavy equipment or loading activities
- intermittent vibration occurs where there are interrupted periods of continuous vibration, repeated periods of impulsive vibration or continuous vibration that varies significantly in magnitude. This may include intermittent construction activity, impact pile driving, jack hammers.

The preferred and maximum values for continuous and impulsive vibration are defined in Table 2.2 of the guideline and are reproduced in Table 3-4 for the applicable receivers.

Table 3-4 Preferred and Maximum Levels for Human Comfort

Location	Assessment Period[3]	Preferred Values		Maximum Values	
		z-axis	x- and y-axis	z-axis	x- and y-axis
Continuous vibration (weighted RMS acceleration, m/s^2, 1-80Hz)					

Location	Assessment Period[3]	Preferred Values		Maximum Values	
		z-axis	x- and y-axis	z-axis	x- and y-axis
Residences	Daytime	0.010	0.0071	0.020	0.014
	Night-time	0.007	0.005	0.014	0.010
Impulsive vibration (weighted RMS acceleration, m/s^2, 1-80Hz)					
Residences	Daytime	0.30	0.21	0.60	0.42
	Night-time	0.10	0.071	0.20	0.14

Note 2 Daytime is 7:00am to 10:00pm and Night-time is 10:00pm to 7:00am

The acceptable vibration dose values (VDV) for intermittent vibration are defined in Table 2.4 of the guideline and are reproduced in Table 3-5 for the applicable receiver type.

Table 3-5 Acceptable Vibration Dose Values for Intermittent Vibration (m/s1.75)

Location	Daytime [3]		Night-time [3]	
	Preferred value	Maximum value	Preferred value	Maximum value
Critical areas[4]	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 3 Daytime is 7:00 to 22:00 and night-time is 22:00 to 7:00: and
Note 4 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.

3.2.2 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
- 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 may occur are presented in Table 3-6 for DIN 4150-3: 1999-02 and Table 3-7 for BS7385.2 – 1993.

Table 3-6 DIN 4150-3 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[5]	
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 5 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[7]	Peak component particle velocity in frequency range of predominant pulse	
	4 Hz to 15 Hz[6]	15 Hz and above[6]
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 6 Values referred to are at the base of the building: and
Note 7 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.

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.

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 20 of the CNVS. The minimum distances are quoted for both “cosmetic” damage (refer BS 7385) and human comfort (refer OH&E’s Assessing Vibration - a technical guideline). DIN 4150 has criteria of particular reference for heritage structures. While this is not a transport project, Table 3-8 provides the recommended minimum safe working distances for vibration intensive plant from sensitive receivers.

Table 3-8 Recommended Minimum Safe Working Distances for Vibration Intensive Plant from Sensitive Receiver

Plant Item	Rating / Description	Minimum Distance Cosmetic Damage		Minimum Distance Human Response (NSW EPA Guideline)
		Residential and Light Commercial (BS 7385)	Heritage Items (DIN 4150, Group 3)	
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

While significant vibration generating activities are not expected as part of the proposal, during construction it is recommend if any of the above activities are planned, the contractor use the above table as a guide for when selecting equipment.

3.3 Operational Noise

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 noise levels outlined in Table 2-2, The intrusiveness noise levels for residential receivers are provided in Table 3-9.

Table 3-9 Intrusiveness Noise Levels

Period	RBL. L_{A90}, dB(A)	Intrusiveness noise level (RBL + 5), dB(A)
Day	41	46
Evening	36	41
Night	32	37

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 3-10 below.

Table 3-10 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
		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)

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 3-10) – 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 sub-urban residences and other receptors applied for this project are shown in Table 3-11.

Table 3-11 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	Sub-Urban	Day	55 – 5 = 50	50 + 3 = 53
		Evening	45 – 5 = 40	40 + 3 = 43
		Night	40 – 5 = 35	35 + 3 = 38
Active Recreation Area (e.g. school playground, golf course)	All	When in use	55 – 5 = 50	50 + 3 = 53
Commercial Premises	All	When in Use	65 – 5 = 60	60 + 3 = 63
Industrial Premises	All	When in Use	70 – 5 = 65	65 + 3 = 68

Project Noise Trigger Levels

The project noise trigger level is the lower of the intrusiveness and the amenity noise levels. Table 3-12 presents the project noise trigger levels for the day, evening, and night-time periods.

Table 3-12 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 Sub-Urban	Day	46	53	**46**
	Evening	41	43	**41**
	Night	37	38	**37**
Active Recreation Area (e.g. school playground, golf course)	When in use	-	53	**53**
Commercial Premises	When in Use	-	63	**63**
Industrial Premises	When in Use	-	68	**68**

Maximum Noise Level Assessment

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 3-5.

Table 3-13 Night-Time Sleep Disturbance Screening Levels

Receiver type	Assessment Level $L_{Aeq,15min}$, dB(A)	Assessment Level L_{AFmax}, dB(A)
Residential	40	52

The NSW Road Noise Policy (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.

3.4 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, Fullerton Cove Road is considered to be a Sub-Arterial Road. Based on this, the following noise goals for residences taken from Table 3 of the RNP are provided in Table 3-6 Below.

Table 3-14 Road Noise Policy Goals

Road Category	Day	Night
Existing residences affected by additional traffic on existing Freeway / Arterial / Sub-Arterial roads generated by land use development	60 $L_{Aeq(15hr)}$ External	55 $L_{Aeq(9hr)}$ 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'.

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 office building. 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.
- Building of site facilities.

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 %[14]
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
Diesel Generator	61	Table 4 Ref 75	90

Note 13The 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.

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.

Other Key assumptions in the model include:

- topographical information was obtained from NSW Government Spatial Services

- all areas were modelled considering a conservative ground factor of 0.8
- all residential receivers were modelled at 1.5 metres above the ground surface

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.

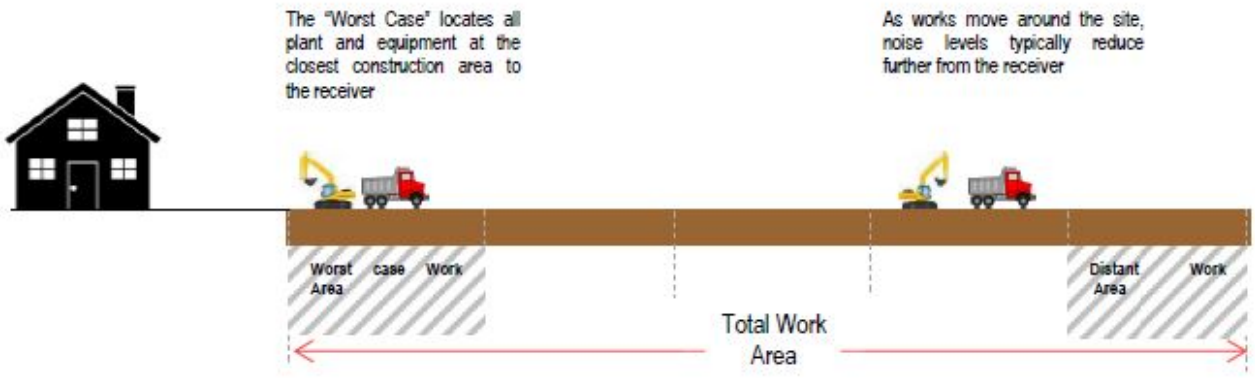


Figure 4-1 Example of Differing Work Areas

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 reasonable worst-case scenario. Two scenarios were assessed, one for the west and one for the east of the site. These scenarios also demonstrate how received noise levels can change due to location of construction activity.

Construction Noise Impact Assessment Results

Noise levels were predicted to each assessed receptor assuming receiver heights of 1.5m above ground level for typical construction activities. Table 4-2 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) Leq(15min)

Receiver	Excavation East	Excavation West	Building East	Building West	Standard Hours NML	Highly Affected Noise Level
R1	42	47	32	36	51	75
R2	41	44	31	33	51	75
R3	37	34	26	24	51	75
R4	48	54	37	43	51	75

The results of the construction noise assessment indicate excavation works could comply with NML's in all assessed situations with the exception of R4 which had a predicted exceedance of 3 dB(A) which is widely considered as 'just noticeable'. The Build scenarios indicate NML's can be met in all assessed situations.

While in most instances the construction NML's are anticipated to be complied with, the results of the construction assessment indicate exceedances of NML's may occur depending on work location, work activity and proximity to receivers. Certain types of construction machinery would be present in the study area for only brief periods during construction. Therefore, noise predictions are considered conservative. The highly affected noise level is expected to be complied with in all situations.

With this in mind it is recommended a construction noise management plan be implemented as part of the proposal to minimise noise emanating upon the community.

Modelled scenarios are shown in Figures 4-2 – 4-5.

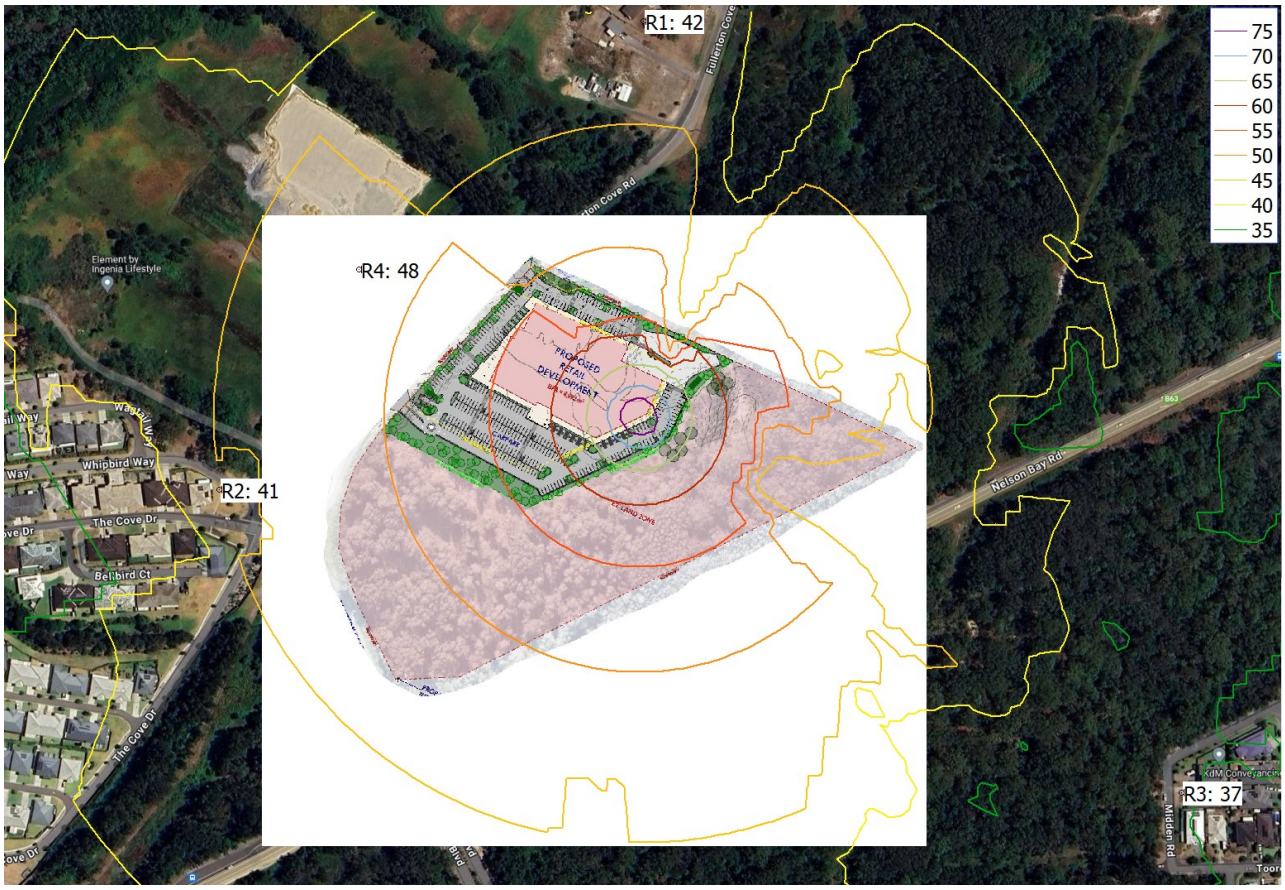


Figure 4-2 Excavation East dB(A) Leq(15min

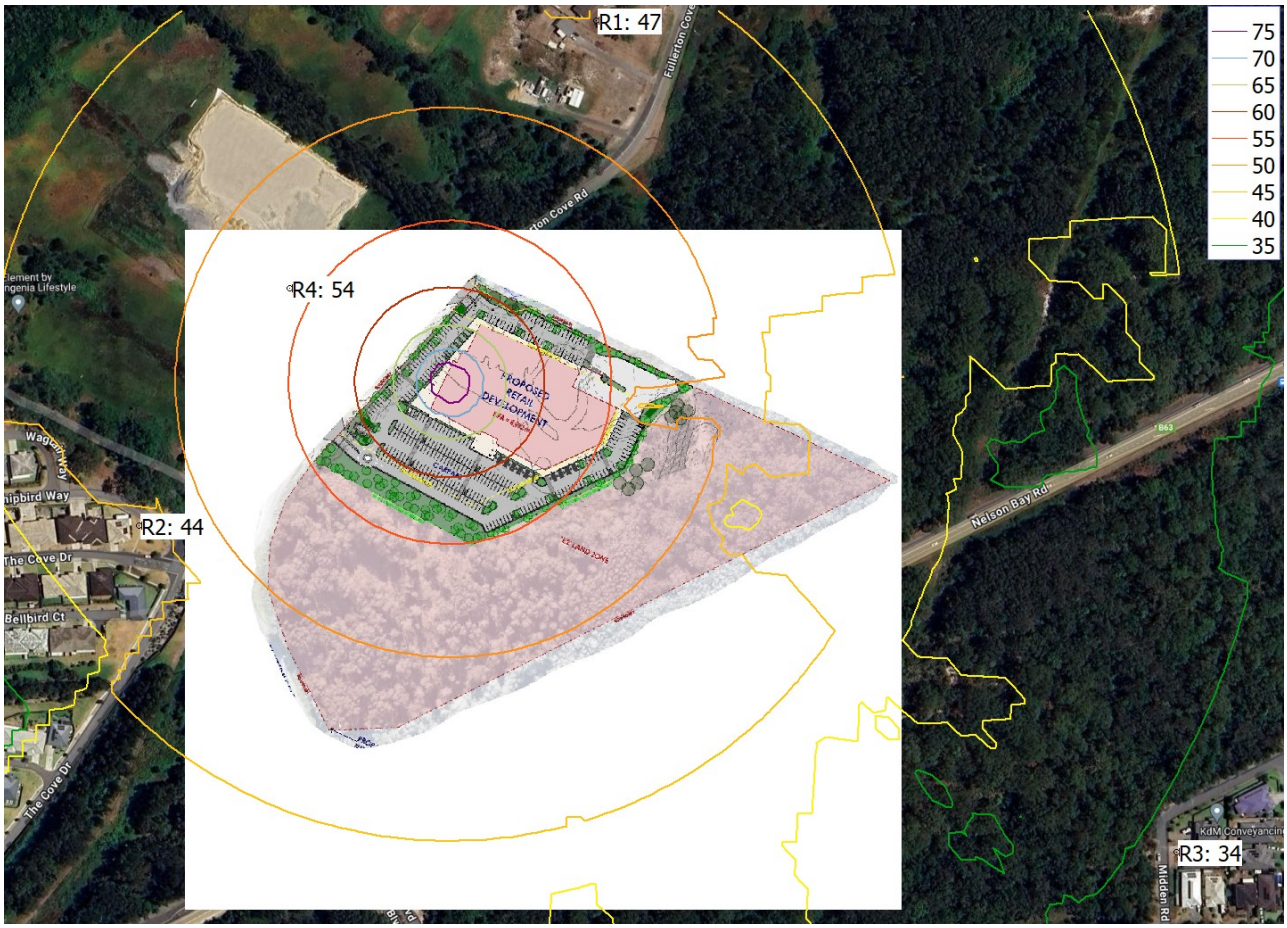


Figure 4-3 Excavation West dB(A) Leq(15min)

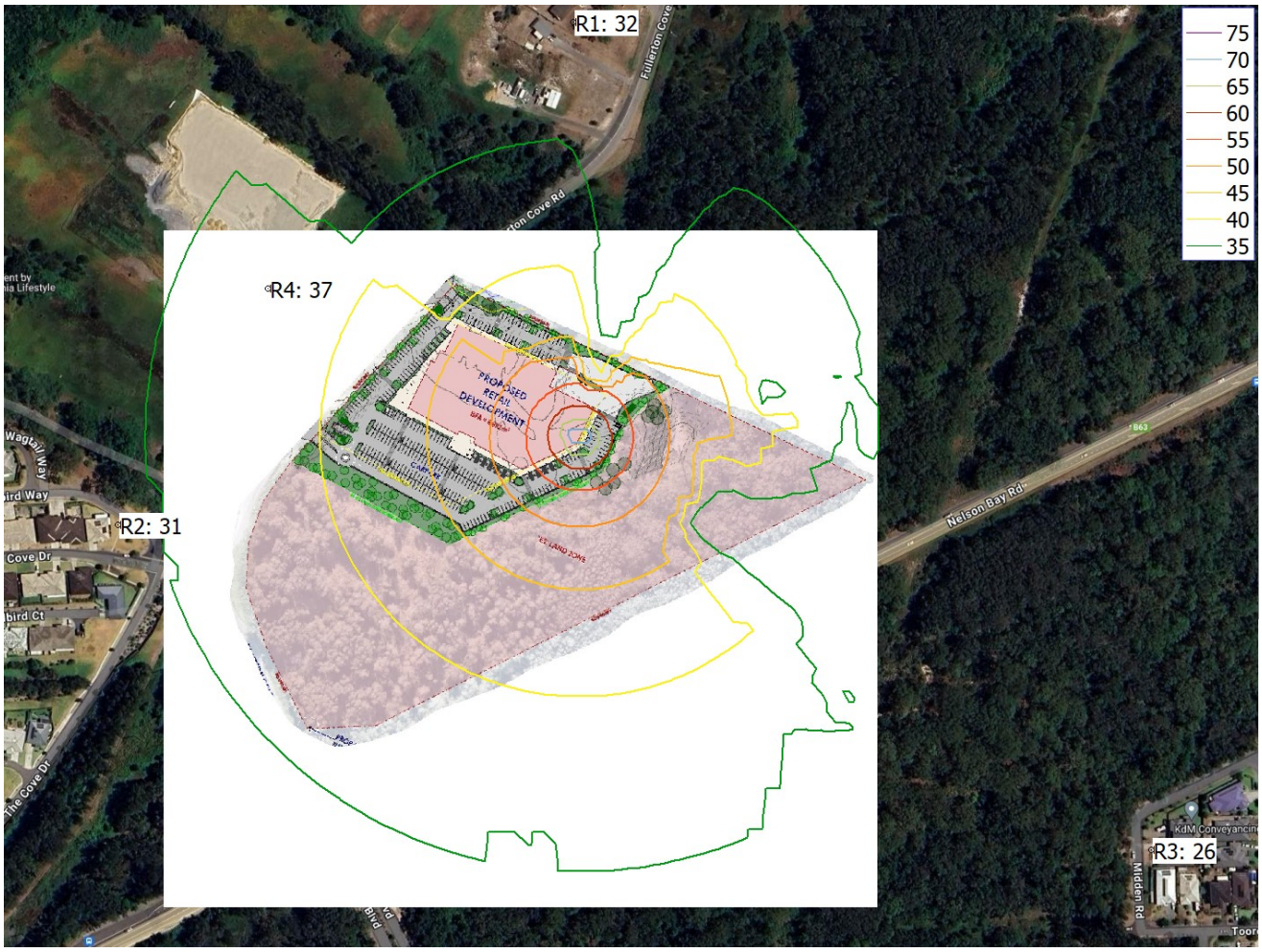


Figure 4-4 Building East dB(A) Leq(15min)

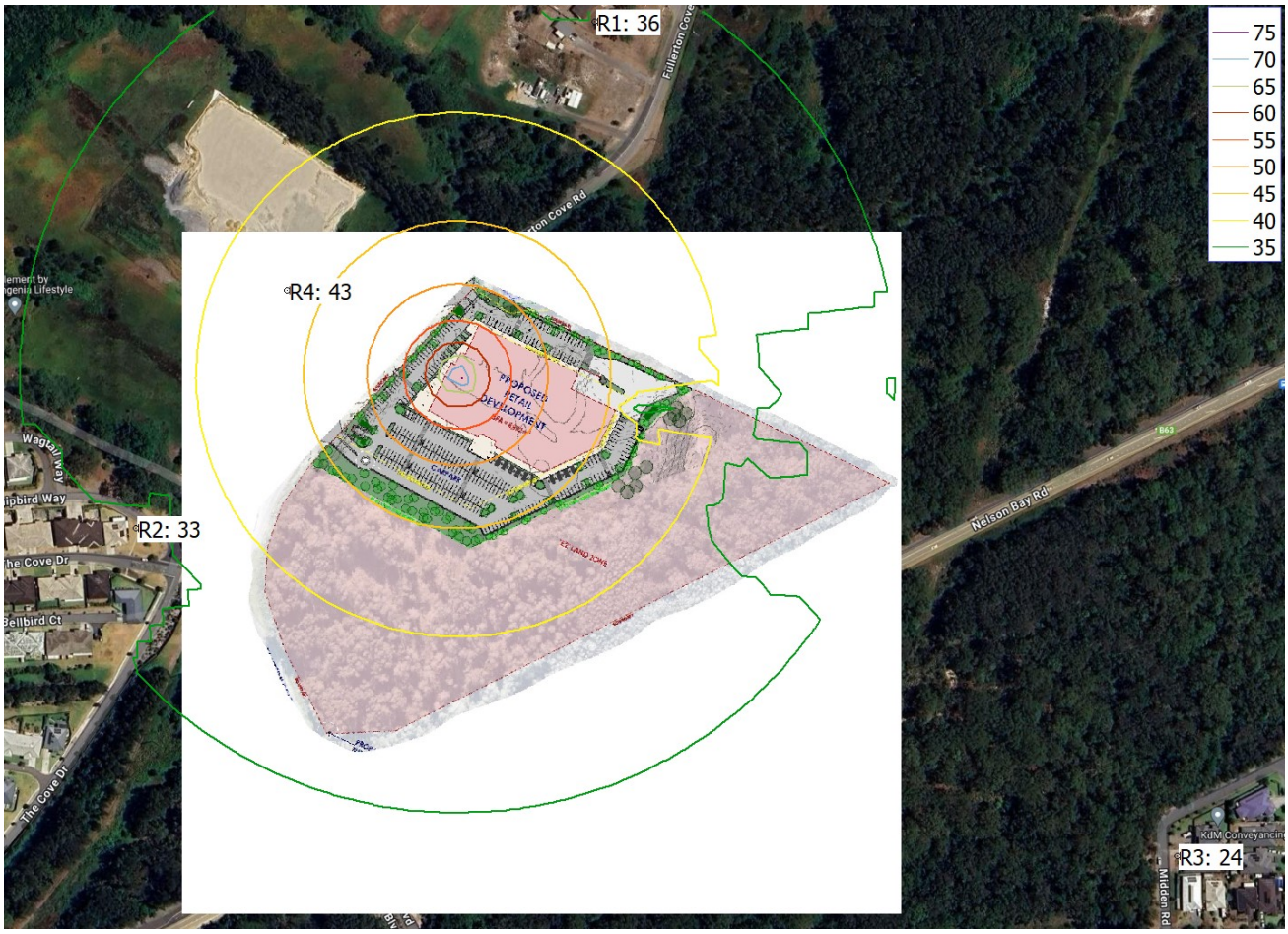


Figure 4-5 Building West dB(A) Leq(15min)

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 Operational Noise

Assessment approach

Acoustic modelling was also undertaken using Bruel and Kjaer's "Predictor" to predict the effects of site operational noise.

Modelling results are based on available information provided and should only be used as a guide for comparative purposes. Plant layout and building structures were based on information provided at the time of the assessment. Noise model setup are as outlined in section 4.1.

Modelling results are based on available information provided and should only be used as a guide for comparative purposes. Site layout and building structures were based on information provided at the time of the assessment.

4.4 Noise Sources

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 4-1 below.

Table 4-3 Typical Mechanical Plant Sound Power Levels

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

For the purposes of this assessment it has been assumed the equivalent of 5large double fan condenser are on the roof top of the building modelled within the site. The location of the condenser deck is shown in Figure 4-6.

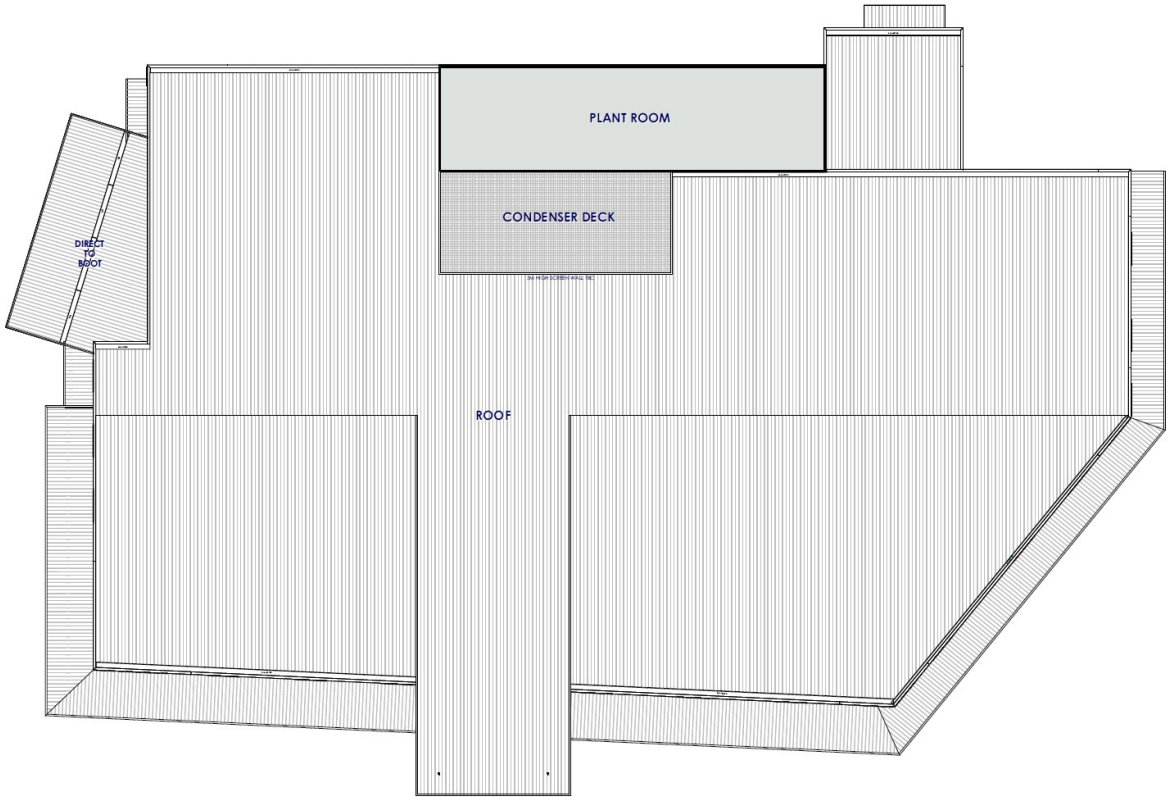


Figure 4-6 First Floor Plan (Source: Monteath & Powys)

Industrial Noise

SafeWork NSW refers to exposure standards for occupational noise from The NSW Work Health and Safety Regulation Chapter 4 Part 4.1 Clause 56 which states:

In this Regulation, ***exposure standard for noise***, in relation to a person, means:

- $L_{Aeq,8h}$ of 85 dB(A), or
- $L_{C,peak}$ of 140 dB(C).

$L_{Aeq,8h}$ means the eight-hour equivalent continuous A-weighted sound pressure level in decibels (dB(A)) referenced to 20 micropascals, determined in accordance with AS/NZS 1269.1:2005 *(Occupational noise management—Measurement and assessment of noise immission and exposure)*.

$L_{C,peak}$ means the C-weighted peak sound pressure level in decibels (dB(C)) referenced to 20 micropascals, determined in accordance with AS/NZS 1269.1:2005 *(Occupational noise management—Measurement and assessment of noise immission and exposure)*.

Based on Safe Work NSW exposure standards, an internal noise level of 85 dB(A) for the building site has been conservatively adopted for this assessment. Based on the provided intended use of the site, this is considered a conservative approach as internal noise levels would be expected be much lower for the anticipated usages.

The ground Floor layout is shown in Figure 4-7.

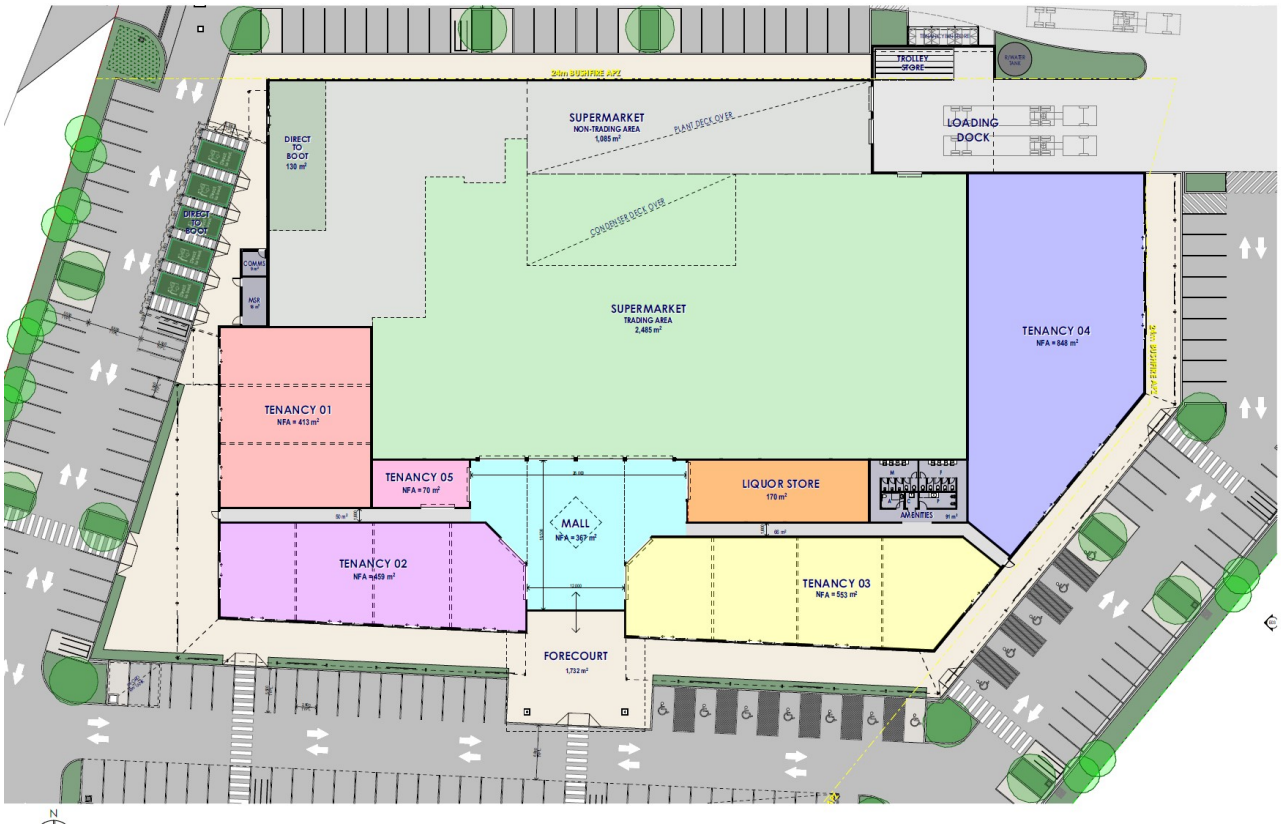


Figure 4-7 Ground Floor Plan (Source: Monteath & Powys)

As it is unknown what the the building materials will be at the time of the assessment, it has conservatively been assumed the buildings facades constructed of corrugated steel panel with 90mm rock wool and 6mm glazing. The roof has also been assumed to be corrugated steel panel with 90mm rock wool. The sound reduction properties adopted applied is shown in Table 4.4 below.

Table 4-4 Material Sound Reductions

	Octave Band Centre Frequency, Hz								
	31.5	**63**	**125**	**250**	**500**	**1K**	**2K**	**4K**	**8K**
Corrugated Steel 90mm rock wool Roof	6	11	16	31	40	46	48	48	48
6mm Glazing	11	16	21	25	28	31	27	27	27

Site Deliveries and Removal

For site deliveries and removal a truck has been assessed as 1 per 15 minutes travelling at 20km/hr onsite with a sound power level of 103 SWL dB(A) which has been sourced from RAPT Consulting's database.

4.5 Results

Received noise produced by outlined activities have been modelled. Table 4-5 shows the results of the operational noise assessment. Any predicted exceedances are shown in RED. Commercial Buildings have been simulated throughout the site. Figure 4-8 also shows the results of the operational noise assessment.

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

Receiver	Building Operations	Roof Top Mechanical Plant	Site Trucking Deliveries / Removal	Cumulative Operational Results	Project Noise Trigger Level Day/Evening/Night	Comply Yes / No
R1	18	23	30	31	46 / 41 / 37	Yes / Yes / Yes
R2	13	21	26	27	46 / 41 / 37	Yes / Yes / Yes
R3	5	14	16	18	46 / 41 / 37	Yes / Yes / Yes
R4	20	26	35	36	46 / 41 / 37	Yes / Yes / Yes

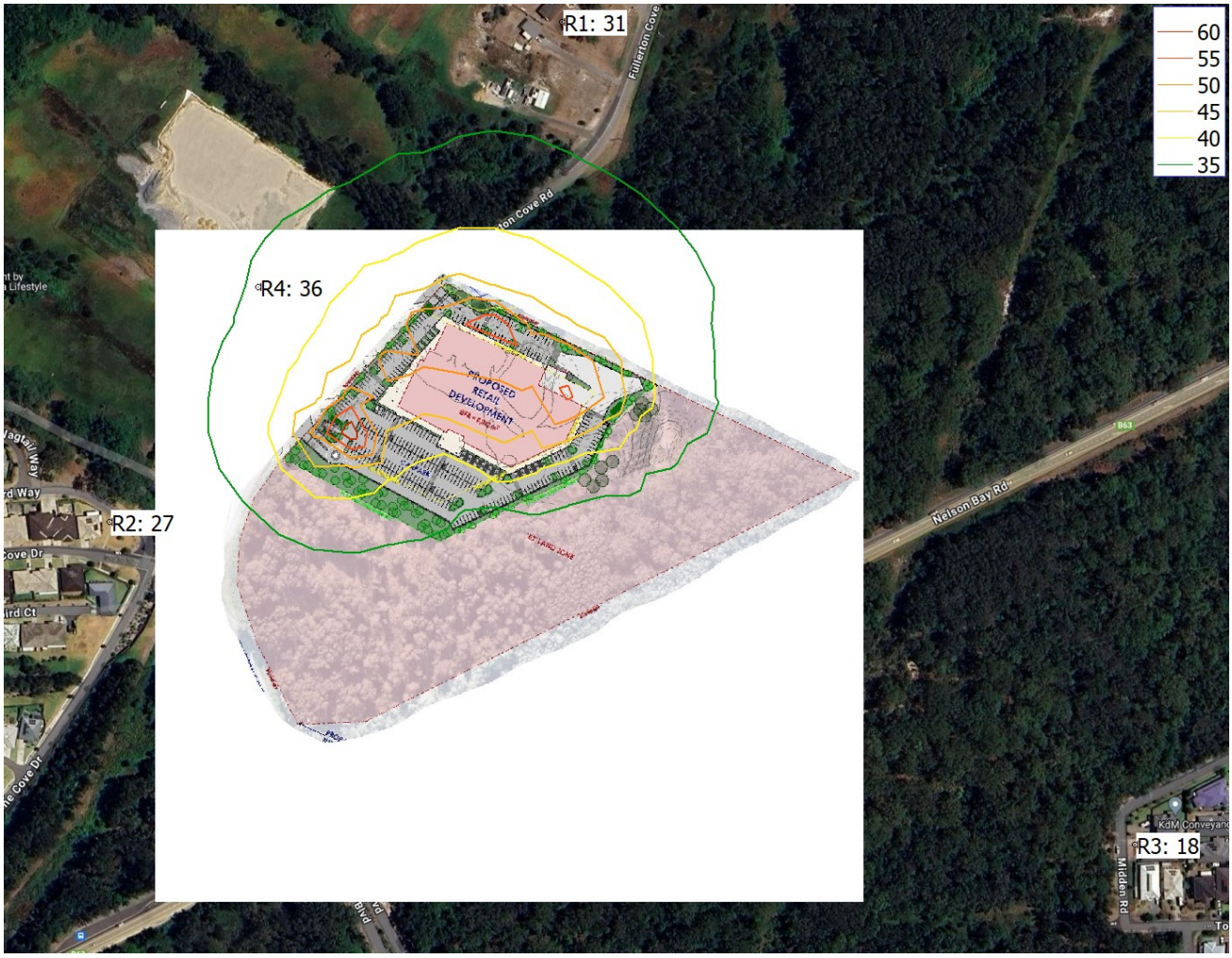


Figure 4-8 Operational Noise Modelling Results Leq(15min) dB(A)

The results of the assessment indicate compliance is expected at all residential and commercial / industrial receptors during operations. Additionally, as this was a maximum noise level assessment, sleep disturbance noise goals are expected to be met in all situations.

This assessment is based on a reasonable worst-case situation, i.e. all items being used simultaneously, while in reality interior building noise levels would be expected to be much lower than what was conservatively assessed. Therefore, actual received noise levels are expected in most cases to be significantly less than the predictions shown in this report.

Road Noise

Fullerton Cove road and the associated road network is heavily trafficked, and it is expected the traffic generated by the development would be primarily due to localised vehicles using the center in the continuing developing area. To increase noise levels by 2dB(A) one would have to increase the cumulative traffic volume by 60%. The number of vehicles on the road network created by the addition of the proposal would be negligible and will not increase overall traffic noise levels on the surrounding road network. Therefore, compliance is expected.

5. Conclusion

This noise assessment has been undertaken to inform a Development Application (DA) for a new shopping village at 42 Fullerton Cove Road, Fullerton Cove NSW.

Construction

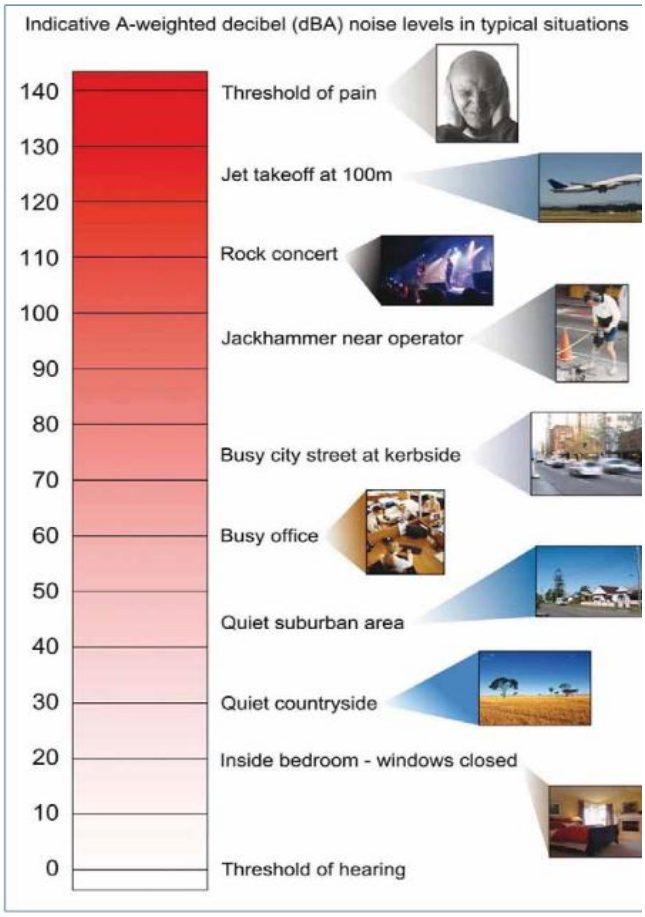
The assessment outlined in this report indicates that construction noise management levels will be complied with in most situations. However, there is the potential for exceedances for some receivers assessed in certain situations. The highly noise affected level of 75dB(A) $L_{Aeq(15min)}$ is expected 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 through the implementation of a CNMP similar to what has been recommended in this report.

Operation

The results of the assessment indicate the proposal is predicted to comply with established project noise trigger levels.

Based on the results and the information provided regarding the development, compliance with all noise goals is expected for the development on neighbouring residences, and commercial / industrial operators. Therefore, from an acoustics perspective the findings suggest the proposal is acceptable.

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).