RAPT CONSULTING

Ramboll

Noise and Vibration Assessment – 46 Fitzroy & 65 Denison Street Carrington, NSW

March 2021

Relationships Attention Professional Trust

Document Details

Noise and Vibration Assessment – 46 Fitzroy & 65 Denison Street Carrington, NSW

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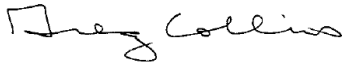
2221294_210317	0	Gregory Collins	Gregory Collins	

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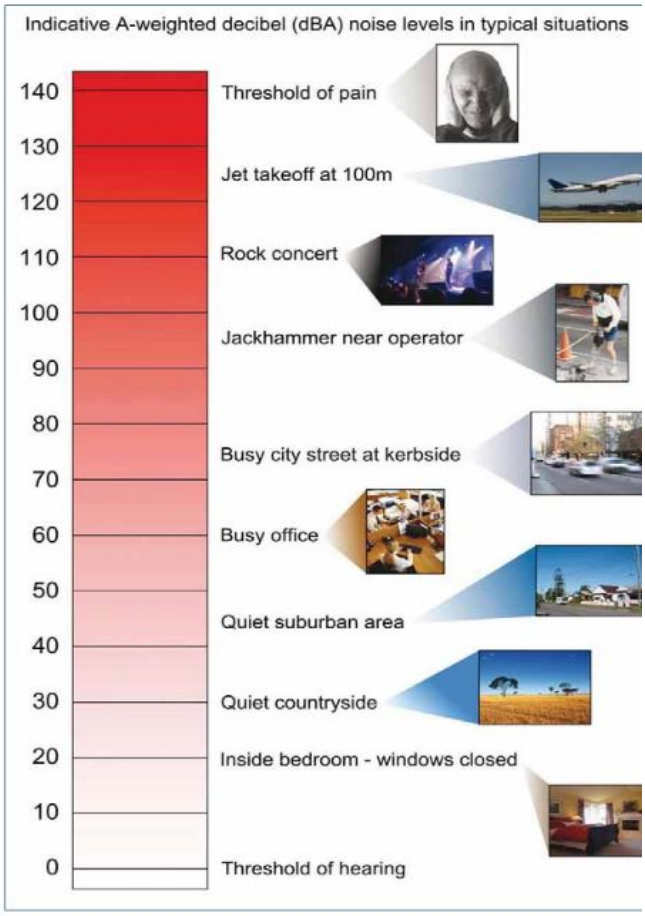
Glossary of Acoustic Terms

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).

1. Introduction

1.1 Background

RAPT Consulting has been engaged to undertake a construction and operational Noise and Vibration Impact Assessment (NVIA) for Ramboll to inform a Development Application for a proposed commercial / industrial development at 46 Fitzroy Street Carrington, NSW.

1.2 Purpose

The purpose of this NVIA is to consider both onsite noise generation during construction and operation and any potential impacts to neighbouring properties. Further, with consideration to the pre-DA advice, provided by the Department of planning, Industry and Environment (18/12/2020). This NVIA also considers any noise and vibration impacts to building tenants from adjacent industrial land uses and makes recommendations on attenuation measures required.

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

1.3 Scope

The NVIA scope of work included:

- Initial desk top review to identify key environmental noise catchment areas and noise sensitive receptors from aerial photography
- Undertake attended noise measurements to determine ambient and background noise levels
- Establish project specific noise goals for the construction and operation of the proposed proposal
- Identify the likely principal noise sources during construction and operation, and their potential impacts on noise receptors
- undertake noise calculations to predict noise levels that may occur as a result of the construction of the proposal at the closest and/or potentially most affected receivers
- provide a comparison of predicted noise levels (and likely vibration events) to the construction NMLs and construction vibration objectives
- assessment of potential impacts associated with construction noise and vibration; and operational noise aspects of the proposal, and
- provide in-principle recommendations for feasible and reasonable noise and vibration mitigation and management measures, where NMLs or vibration objectives may be exceeded.

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

Figure 1 Site and Surrounding Area

This assessment has been undertaken with consideration to:

- *Road Noise Policy* (RNP, DECCW, 2011)
- *Noise Policy for Industry* (NPfI) (NSW EPA, 2017)
- *Interim Construction Noise Guideline* (ICNG) (NSW DECC, 2009)
- *Draft Construction Noise Guideline* (DCNG) (NSW EPA, 2020)
- German Standard DIN 4150, Part 3: *Structural Vibration in Buildings: Effects on Structures*
- British Standard BS *7385 Part 2-1993 Evaluation and measurement for vibration in buildings*
- *Assessing Vibration: A Technical Guideline* (DECC, 2006)
- Australian Standard AS2107:2016 - *Recommended design sound levels and reverberation times for building interiors*

1.4 Limitations

The purpose of the 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 and vibration were referred to. This work has been conducted in good faith with RAPT Consulting's understanding of the client's brief and the generally accepted consulting practice.

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

2. Existing Environment

Attended measurements to collect background and ambient noise levels were conducted on 3 February 2021 at the south-western corner of the site adjacent to Fitzroy Street, the north-eastern corner of the site adjacent to Denison Street and residential property of 59 Denison Street. Measurements were conducted using a RION NL-42 Sound Level Meter with Type 2 Precision. 15-minute measurements were undertaken for the Daytime Periods as it is understood the development will not be operating during evening and night-time periods and construction is expected to be during standard hours only. The attended 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). The acoustic instrumentation employed during the monitoring complies with the requirements of AS 1259.2 – 1990, “Sound Level Metres” and is within current calibration. Calibration was checked before and after the measurements with no significant drift. The acoustic instrumentation used carries current NATA calibration.

During site visits it was noted that existing road traffic, distant road traffic, natural wildlife, and an underlying urbuan ‘hum’ primarily described the ambient noise environment and is indicative of an urban noise environment.

The monitoring locations are provided in Figures 2 – 4 below.

Figure 2 Noise Monitoring Locations.

Figure 3 Fitzroy Street Noise Monitoring Location

Figure 4 Denison Street Monitoring Location

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

The 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.

Logged data was reviewed and filtered to exclude any extraneous data during the monitoring period.

The RBL's and ambient L_{Aeq} levels are provided in Table 1 Background and Ambient Noise Monitoring Results below.

Table 1 Background and Ambient Noise Monitoring Results

Location	Noise Period	Noise Level dB(A)		Noise Sources SPL dB(A)
		$L_{Aeq(15min)}$	$L_{A90(15min)}$	
Fitzroy Street Carrington	2:45-3:00pm	52	45	Car Pass-by 52 -60 Underlying Industrial / Commercial 45 Birds 45 – 50 Cicadas 48 Thales Ship Building Operations 48 - 58
Denison Street Carrington	3:20 – 3:35pm	50	47	Underlying Industrial / Commercial 47 Helicopter 52 Birds 45 - 50 Cicadas 50 Car Pass-by 52-59 Thales Ship Building Operations 40

In line with the NPfI, for conservatism, the RBL recorded at the Fitzroy Street location will be utilised for establishing construction noise management levels and operational project noise trigger levels.

3. Noise and Vibration Objectives

3.1 Construction Noise

Construction noise is assessed with consideration to DECCW *Interim Construction Noise Guidelines* (ICNG) (2009) and the Draft Construction Noise Guideline (DCNG) (2020) . The ICNG and DCNG are non-mandatory guidelines that are usually referred to by local councils and other NSW government entities when construction / demolition works require development approval. The ICNG and DCNG recommend standard hours for construction activity as detailed in Table 2.

Table 2 ICNG and DCNG Recommended Construction Hours

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

The ICNG and DCNG 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.

Table 3 Recommended Construction Noise Management Levels

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

Period	Management Level $L_{Aeq(15\ min)}$
Passive recreation areas (characterised by contemplative activities that generate little noise and where benefits are compromised by external noise intrusion, for example, reading, meditation)	External noise level 60 dB(A)
Offices, retail outlets	70 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 most works required for the proposal would be undertaken during standard construction hours. Based on the above and the RBL's established from site monitoring construction noise management levels (NML's) for residential receivers have been derived, as shown in Table 4.

Table 4 Construction NML's dB(A) Leq(15min)

Period	RBL L_{A90}, dB(A)	Standard hours NML's,$L_{Aeq,15min}$, dB(A)
Day	45	55

3.2 Vibration Guidelines

Vibration during construction and operational activity is expected to primarily originate from trucks and machinery during stages of construction and associated activities. RAPT Consulting also understand that blasting and heavy ground impact activities is not expected to occur during the construction works.

3.2.1 Human Exposure

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

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

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

Location	Daytime [1]		Night-time [1]	
	Preferred value	Maximum value	Preferred value	Maximum value
Critical areas [2]	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

3.3 Building Damage

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

- British Standard BS7385.2 - 1993 *Evaluation and Measurement for Vibration in Buildings*, Part 2 - Guide to damage levels from ground borne vibration. and
- German Standard DIN 4150-3: 1999-02 *Structural Vibration – Part 3*: *Effects of vibration on structures*.

DIN 4150-3: 1999-02 is utilised in this case in the assessment of potential building damage resulting from ground borne vibration produced by the proposed activity.

The recommended Peak Particle Velocity (PPV) guidelines for the possibility of vibration induced building damage are derived from the minimum vibration levels above which any damage has previously been encountered and are presented in Table 6.

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

Type of Structure	Peak Component Particle Velocity, mm/s			
	Vibration at the foundation at a frequency of			Vibration of horizontal plane of highest floor at all frequencies
	1 Hz to 10 Hz	10 Hz to 50 Hz	50 Hz to 100 Hz*	
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

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 7. 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.

Table 7 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

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.

3.4 Operational Noise

The New South Wales *Noise Policy for Industry* (NPfI) provides guidance on the assessment of operational noise impacts. The guidelines include both intrusive and amenity criteria that are designed to protect receivers from noise significantly louder than the background level and to limit the total noise level from all sources near a receiver.

Intrusive noise levels set by the NPfI control the relative audibility of operational noise compared to the background level. Amenity criteria limit the total level of extraneous noise. Both sets of criteria are calculated and the lower of the two in each time period normally apply. Intrusive criteria are simply 5 decibels above the measured (or adopted) background level with a minimum of 40 dB(A) for daytime and 35 dB(A) for evening and night time.

Amenity noise levels are determined based on the overall acoustic characteristics of the receiver area and the existing level of noise excluding other noises such as traffic and insects. Residential receiver areas are characterised into ‘urban’, ‘suburban’, ‘rural’ or other categories based on land uses, the existing level of noise from industry, commerce, and road traffic. Project amenity noise levels are the recommended amenity noise level (Table 2.1 of the NPfI) minus 5 dB(A) and plus 3 dB(A) to convert from a period level to a 15-minute level. The project noise trigger level is the lower value between the intrusive and the amenity noise levels.

The NPfI noise criteria are planning levels and are not mandatory limits required by legislation however the noise criteria assist the regulatory authorities to establish licensing conditions. Where noise criteria are predicted to be exceeded, feasible and reasonable noise mitigation strategies should be considered. In circumstances where noise criteria cannot be achieved negotiation is required to evaluate the economic, social and environmental costs and benefits of the development against the noise impacts.

The NPfI is generally intended for large and complex industrial sources and recommends considerable monitoring and assessment measures that may not always be applicable to certain situations. However, the NPfI will be referred to for determining operational noise goals for this proposal.

Nearest residential receptors are considered urban. Target noise levels are provided for residences and commercial premises in Table 8.

Table 8 Project Noise Trigger Levels

	Day 7 am to 6 pm
Rating Background Level $L_{A90(Period)}$	45
Project Intrusive Noise Level, $L_{Aeq(15min)}$	50
Project Amenity Noise Level (Urban), $L_{Aeq(Period)}$	55
Project Amenity Noise Level $L_{Aeq(15min)}$	58
Project Trigger Level Residential $L_{Aeq(15min)}$	**50**
Commercial Premises (When in use) $L_{Aeq(15min)}$	**63**
Active Recreation (When in use) $L_{Aeq(15min)}$	**53**

3.5 Road Noise Criteria

The NSW *Road Noise Policy* (RNP) recommends various criteria for different road and residential developments and uses. Although it is not mandatory to achieve the noise assessment criteria in the RNP, proponents will need to provide justification if it is not considered feasible or reasonable to achieve them. Based on the definitions in the RNP, the Fitzroy Street and Denison Street are local roads. The following noise goals provided in Table 9 Below.

Table 9 Road Noise Policy Goals

Road Category	Day	Night
Local roads: Existing residences affected by additional traffic on existing local roads generated by land use developments	55 $L_{Aeq(1\ hour)}$ (External)	50 $L_{Aeq(1\ hour)}$ (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'.

3.6 AS/NZS 2107:2016 – Recommended Design Sound Levels and Reverberation Times for Building Interiors

AS/NZS 2107:2016 Acoustics – Recommended design sound levels and reverberation times for building interiors (AS2107) provides guidance on satisfactory acoustic conditions for a variety of spaces and occupancies.

AS2107 recommends design criteria for conditions affecting the acoustic environment within occupied spaces. The ambient sound levels recommended take into account the function of the area and apply to the sound level measured within the space unoccupied but ready for occupancy. The sound level during occupancy will usually be increased as a result of the activities of the occupants.

Recommended design sound levels are expressed as equivalent continuous A-weighted (LAeq) sound pressure levels.

AS2107 is applicable to steady-state sounds, the recommended reverberation times are for the unoccupied state of the space described. Recommended design sound levels and reverberation times relevant to the proposal office space interior areas, as outlined in Table 1 of AS2107, are shown in Table 10.

Table 10 Recommended design sound levels and reverberation times

Type of Occupancy	Recommended design sound levels, L_{Aeq}, dB(A)		Recommended Reverberation Time (T) s
	Satisfactory	Maximum	
General Office Areas	40	45	0.4 to 0.6
Corridors and Lobbies	45	50	0.4 to 0.6

4. Assessment of Potential Impacts

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 office building.

Table 11 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 11 Plant and Equipment Noise Levels

Plant Item	Activity Noise Level L_{Aeq} @ 10m	DEFRA Construction Noise Database	Anticipated Usage %
Excavation			
Dozer	80	Table 2 Ref 10	50
Tracked Excavator	79	Table 2 Ref 14	50
Articulated Dump Truck	74	Table 2 Ref 32	50
Roller	73	Table 2 Ref 38	50
CFA Piling	79	Table 3 REF 21	50
Building			
Concrete Pump & Cement Mixer	67	Table 4 Ref 24	50
Poker Vibrator	69	Table 4 Ref 34	50

Plant Item	Activity Noise Level L_{Aeq} @ 10m	DEFRA Construction Noise Database	Anticipated Usage %
Mobile Telescopic Crane	67	Table 4 Ref 36	50
Diesel Generator	61	Table 4 Ref 75	90

Note 1The 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". Terrain topography, ground absorption, atmospheric absorption and relevant shielding objects are taken into account in the calculations.

Construction noise levels have been predicted based on the potential construction noise levels provided in Table 11. 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 5.

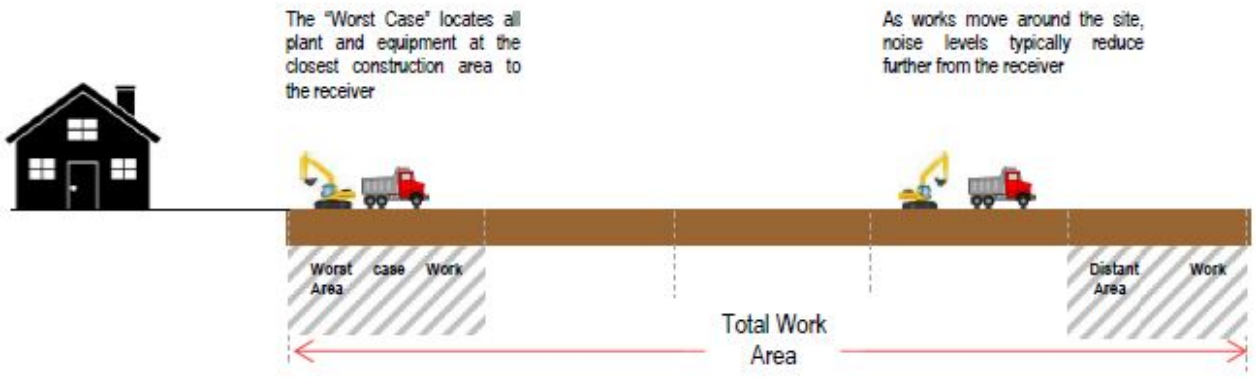


Figure 5 Example of Differing Work Areas

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

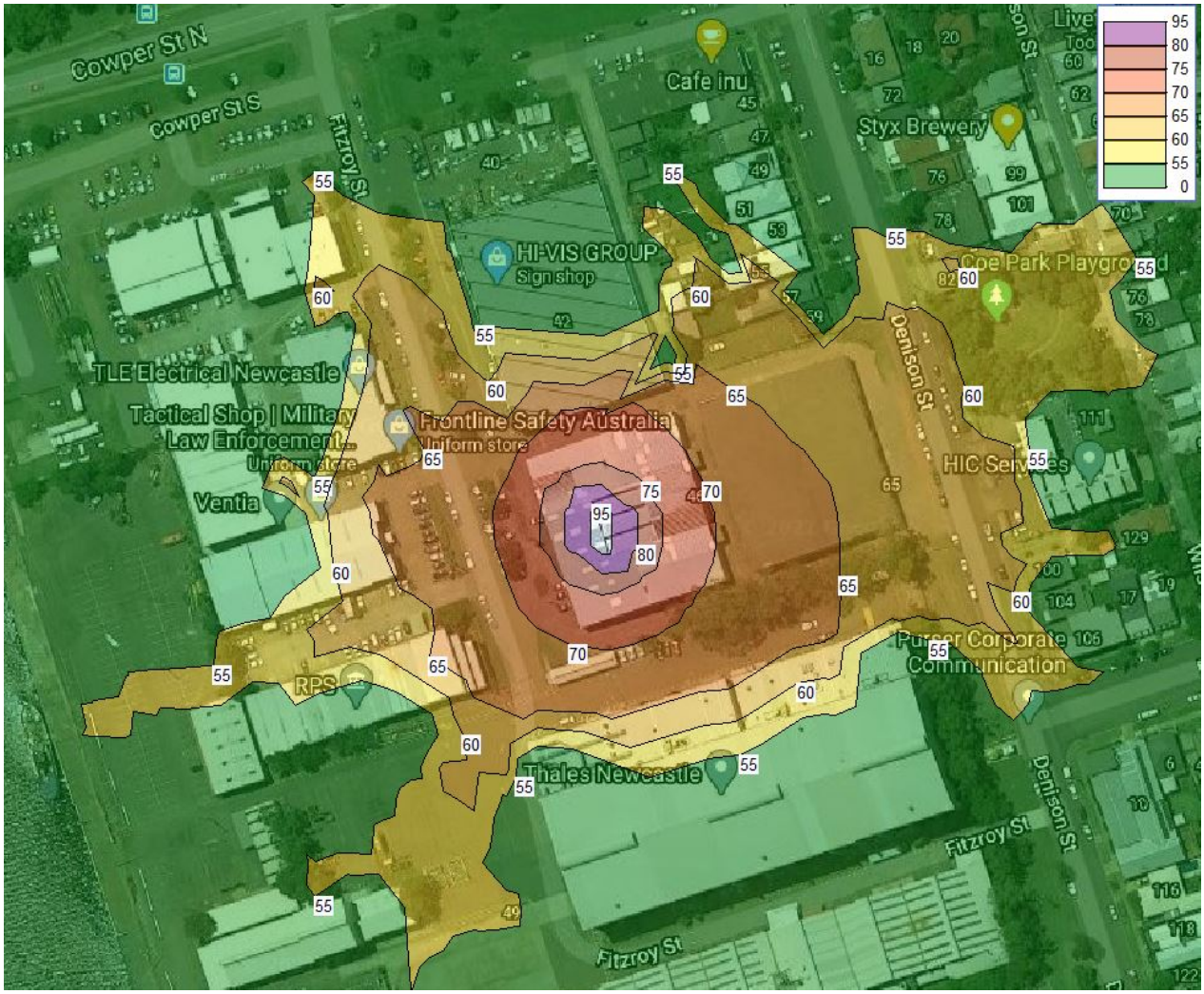


Figure 6 Building Construction dB(A) Leq(15min)

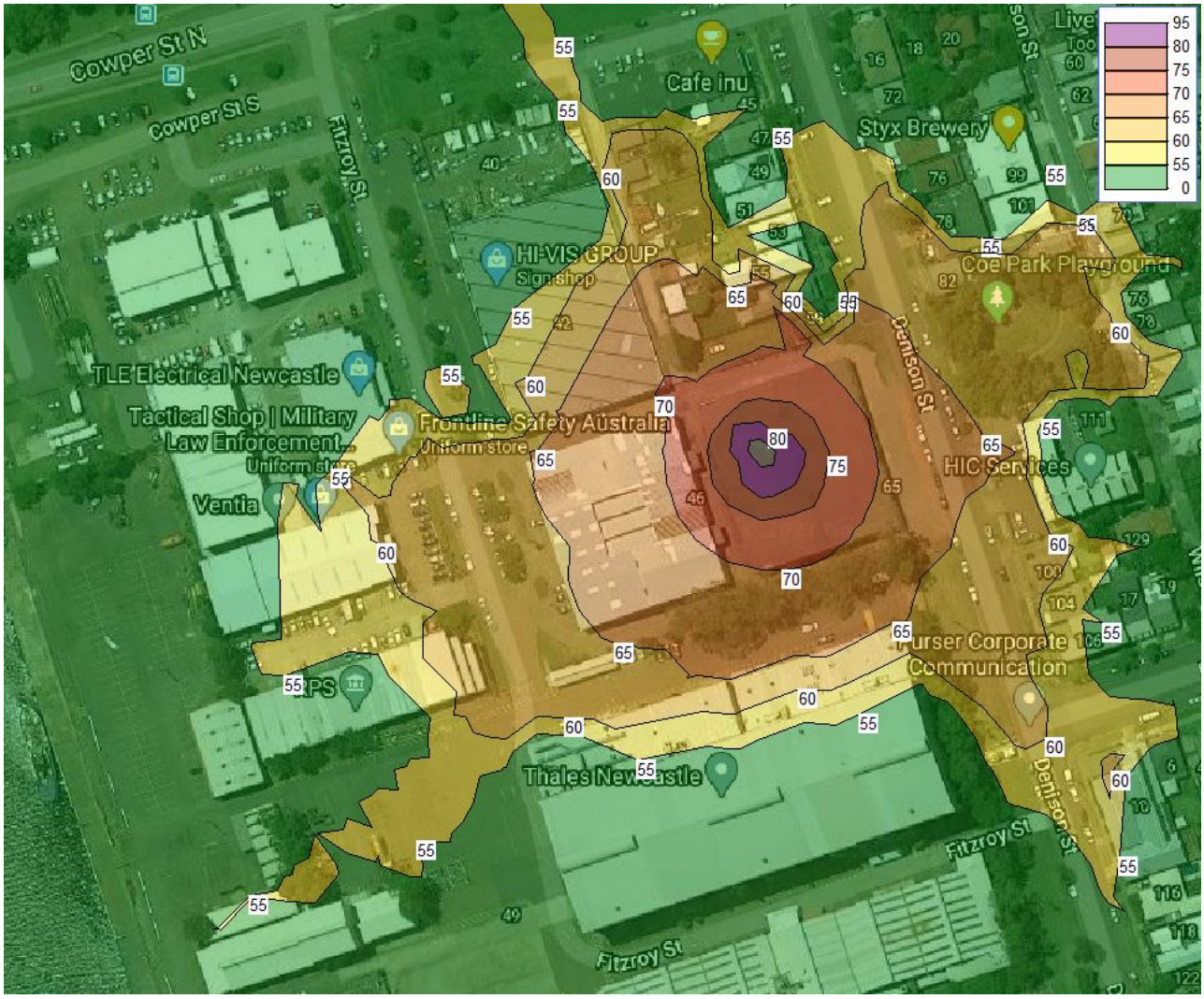


Figure 7 Carpark Construction dB(A) Leq(15min)

The results of the construction assessment indicate exceedances of NML's has the potential to be exceeded particularly for closest residences located on Denison Street. However, the highly affected noise level is expected to be complied with. Additionally, NML's for offices and retail outlets and other industries is expected to be complied with. While NML's can be achieved in most cases for residential, office and retail outlets, and industrial receivers, there is a risk for NML's to be exceeded depending on work activities and locations. With this in mind it is recommended a construction noise management plan be implemented as part of the proposal to minimise the risk of adverse noise emanating upon the community.

4.2 Construction Noise Management Plan

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

4.2.1 Planning and design of construction works

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

Notification before and during construction

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

Best practice measures when operating on construction site

- Construction works should adopt Best Management Practice (BMP) and Best Available Technology Economically Achievable (BATEA) practices as addressed in the ICNG. BMP includes factors discussed within this report and encouragement of a project objective to reduce noise emissions. BATEA practices involve incorporating the most advanced and affordable technology to minimise noise emissions.
- Ensure that all construction works scheduled for standard construction hours comply with the start and finish time.
- Where practical, simultaneous operation of dominant noise generating plant should be managed to reduce noise impacts, such as operating at different times or increase the distance between plant and the nearest identified receiver.
- High noise generating activities such as jack hammering should only be carried out in continuous blocks, not exceeding 3 hours each, with a minimum respite period of one hour between each block.
- Where possible, reversing beepers on mobile equipment would be replaced with low-pitch tonal beepers (quackers). Alternatives to reversing beepers include the use of spotters and designing the site to reduce the need for reversing may assist in minimising the use of reversing beepers.
- Equipment which is used intermittently should be shut down when not in use.
- All engine covers should be kept close while equipment is operating.

- The construction site would be arranged to minimise noise impacts by locating potentially noisy activities away from the nearest receivers wherever possible.
- 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.

Complaints handling

Noise and vibration monitoring should be undertaken upon receipt of a complaint to identify and quantify the issue and determine options to minimise impacts.

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

4.3 Construction Vibration

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

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

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

- The ground type and topography.

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

Based on information provided, it is expected that Continuous flight auger piles (CFA) are planned to be utilised. This method creates minimal vibration. However, if hammering is to occur, it is recommended this activity does not exceed the small hydraulic hammer specification. Additionally vibratory rolling is recommended to not exceed the <50 kN (1-2 tonne) specification when in close proximity to the nearest residences. .

Ground Vibration – Minimum Working Distances from Sensitive Receivers

The Transport for NSW 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 12. The minimum distances are quoted for both "cosmetic" damage (refer BS 7385) and human comfort (refer DECC's Assessing Vibration - a technical guideline). DIN 4150 has criteria of particular reference for heritage structures. The minimum working distances are indicative and will vary depending on the particular item of plant and local geotechnical conditions. They apply to cosmetic damage of typical buildings under typical geotechnical conditions.

Table 12 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

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)	
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

Given the proximity of nearest residential receptors from the proposal, where vibratory rollers are proposed it is recommended <50 kN (1-2 tonne) be utilised. Additionally, if hydraulic hammering were to occur, it is recommended no larger than small 300kg (5 to 12t excavator) be utilised.

4.4 Operational Noise

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'. Traffic data for this assessment has been obtained from SECA Solution Traffic Impact Statement for the proposed Commercial Development, 46 Fitzroy Street, Carrington *P1893 Ramboll PoN Carrington TIA*. Peak hour flows on Denison Street are as follows.

Table 13 Current Denison Street Peak Hour Traffic Flows

Street	Direction of Flow	AM	PM
Denison Street	Northbound	51	37
	Southbound	54	25

The report indicated Fitzroy Street would have a similar rate of traffic as Denison Street. The development would see two-way peak hour flows on both Denison Street and Fitzroy Street increase. Flows on both of these roads however are low with flows on Denison Street increasing to 153 vph two way in the AM and 118 vph two way in the PM. Fitzroy Street would be similar. Denison Street has daily flows in the order of 840vpd which could increase to 1,175vpd. Based on this, the AM peak hour traffic would increase by 74% and PM peak hour traffic would increase by 49%. This would generally mean traffic noise levels on Denison

Street could increase by 2.5 dB(A) during AM peak and 1.7dB(A) during PM peak. These levels are generally regarded as indiscernible to the human ear.

As the intent of the development is for offices, there is no expected significant noise to be generated from the development, rather people will be located indoors and therefore operational noise is not considered further in this assessment.

4.5 Car Park Operational Noise

To assess the potential noise impacts associated with the operation of the proposal, two key scenarios were assessed:

- general operational noise from normal car park usage; and
- transient noise events such as car door slams, boot slams or horn and alarm emissions and wheel squeals.

For the assessment of operational noise, a sound power for general car usage (i.e. car movement and engine noise) of 75dB(A) $L_{eq(15min)}$ was adopted.

Predicted noise levels from the general operation of the car park are less than 47dB(A) $L_{eq(15min)}$ at all existing identified residential receivers. Based on this, it is expected project noise trigger levels can be met for the proposal.

4.6 Internal Noise

The NSW Environmental Noise Management Manual specifies that standard window glazing of a building will typically attenuate the external noise levels by at least 20dB(A) with the windows closed and 10 dB(A) with the windows open (allowing for natural ventilation). This means that an external noise level of 65 Leq dB(A) for corridors and lobbies and 60 Leq dB(A) for general office areas would result in compliance with the internal noise goals outlined in Table 10.

The predicted internal noise levels for standard façade glazing are presented in Table 14 based on the noise monitoring results.

Table 14 Internal Noise Goal Comparison

Type of Occupancy	Recorded Ambient Noise Level	Internal Noise Level	Noise Goal Level
General Office Areas	52 dB(A)	32 dB(A)	40 – 45 dB(A) Windows Closed
Corridors and Lobbies	52 dB(A)	32 dB(A)	45 – 50 dB(A) Windows Closed

The predicted internal noise levels particularly for the closest facades to the ambient environment are expected to meet internal noise goals. While internal noise goals are expected to be met, the following minimum building treatments are recommended to be investigated for the development.

Table 15 Minimum External Building Treatment Recommendations

Component	Minimum Configuration
Wall Rw40	**Timber Frame or cladding:** 6mm fibre cement sheeting or weatherboards or plank cladding externally, 90mm deep timber stud or 92mm metal stud, 13mm standard plasterboard internally **Brick Veneer:** 110mm brick, 90mm timber stud or 92mm metal stud, minimum 50mm clearance between masonry and stud frame, 10mm standard plasterboard internally
Glazing Rw35	Minimum 10.38mm laminated glass with acoustic seals
Doors Rw30	Minimum 45mm solid core timber door fitted with acoustic seals

All external walls to have minimum sound insulation ratings of Rw40. Other options exist provided the minimum Rw ratings are met or exceeded.

5. Conclusion

RAPT Consulting has undertaken a construction and operational noise and vibration assessment (NVIA) for Ramboll to inform a Development Application for a proposed commercial / industrial development at 46 Fitzroy Street Carrington, NSW.

Construction

The assessment outlined in this report indicates that construction noise management levels may be exceeded for some receivers assessed. However, 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 acceptable to the local community 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 marginally increase traffic noise levels by less than 3dB(A). Additionally, predicted noise levels from the general operation of the car park are less than 47dB(A) Leq(15min) at all existing identified residential receivers, satisfying project noise trigger levels.

Internal Noise

Internal noise levels for the development are expected to achieve minimum recommendations. Minimum external façade treatments have been recommended to aid in achieving the internal noise objectives.