RAPT CONSULTING

Construction Noise and Vibration Management Plan – UON Central Coast Campus

Prepared for

Hansen Yunken Pty Ltd

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Relationships Attention Professional Trust

Document Details

Construction Noise and Vibration Management Plan – University of Newcastle Central Coast Campus Gosford, NSW.

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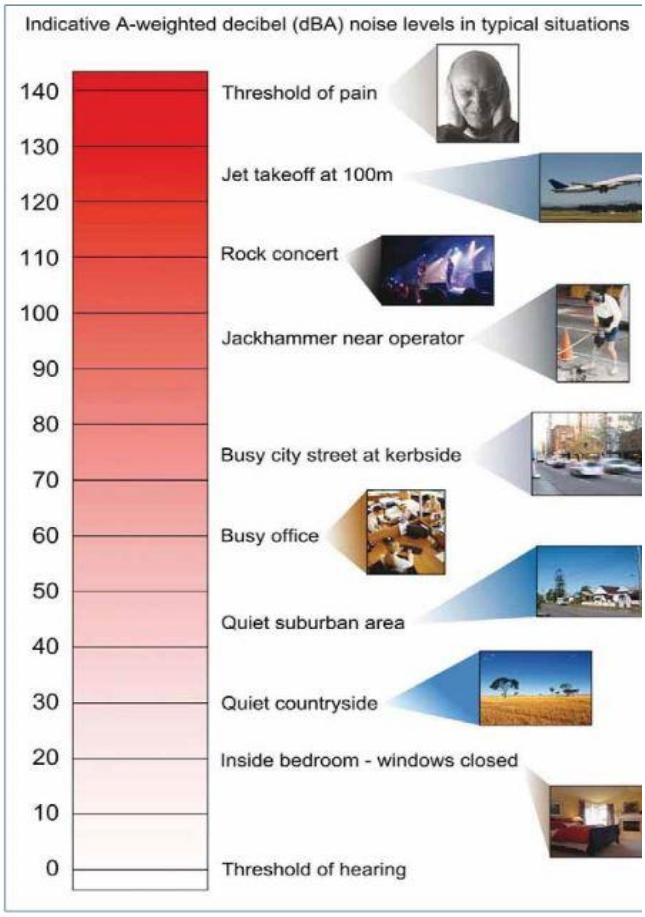
Glossary of Acoustic Terms

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 prepare a construction noise and vibration management plan (CNVMP) on behalf of Hansen Yunken as part of their project at the University of Newcastle (UON) Central Coast Campus (CCC).

Condition B25 of the approval states a Construction Noise and Vibration Management Plan (CNVMP) is required as shown in Figure 1-1.

B25. A Construction Noise and Vibration Management Sub-Plan must be submitted to the Planning Secretary for approval and address, but not be limited to, the following:

(a) be prepared by a suitably qualified and experienced noise expert;

(b) describe procedures for achieving the noise management levels in the EPA's Interim Construction Noise Guideline (DECC, 2009);

(c) describe the measures to be implemented to manage high, noise generating works such as piling, in close proximity to sensitive receivers;

(d) include a complaints management system implemented for the duration of construction;

(e) include a program to monitor and report on the impacts and environmental performance of the development and the effectiveness of the implemented management measures in accordance with the requirements of condition **B21.**

(f) is to predict noise and vibration at the nearest receivers based on the proposed plant.

(g) the efficacy of sound blankets or hoarding around the construction site is to be investigated as a noise barrier to protect the amenity of adjacent and nearby receivers.

(h) impacted receivers are to be consulted regarding the nature and timing of the works, including predicted noise and vibration impacts at their property and the mitigation measures that will be adopted, noting that the project hours of work will overlap with hours of occupation for both residential and commercial premises, and noting that the programme/s of works should seek to create the least possible disruption to the community.

(i) nearby receivers are also to be provided with a site contact for the lodgement of any noise or vibration complaints.

(j) Investigation of any complaints received and measurements to be undertaken and compared with predictions made in the CNVMP. If the measurements are not in accordance with those predictions, additional reasonable and feasible mitigation measures are to be investigated.

(k) plant selected with consideration of the sound and vibration output. Selected plant will not be any larger than that required to undertake the activity.

(l) sound barriers (either, plywood hording or sound barrier mats hung from site fencing) will be erected around the site perimeter and extend to at least 1.8 m above ground level.

Figure 1-1 Condition B25 CNVMP Requirements

1.2 Purpose of this plan

This CNVMP has been prepared in response to the requirements outlined in Section 1.1.

This CNVMP should be read in conjunction with the Construction Management Plan and other management plans.

This Plan is to ensure all members of the project team and other project stakeholders understand the objectives and the procedures and processes in place as necessary for the successful execution of works under the contract.

1.3 Objectives

The primary objective of this plan is to comply with the noise and vibration requirements of the Contract and to ensure that no works significantly impact on local background noise and vibration levels.

The objective of the CNVMP can be summarised as follows:

- Ensure that construction works do not significantly impact background noise levels around the site, and that applicable guidelines and regulations are met
- Identification and management of critical locations for noise and vibration levels in neighbouring properties
- Ensure all equipment operates within the applicable noise levels
- Ensure that construction works do not cause sufficient vibration to damage surrounding buildings and comply with the applicable guidelines and regulations
- Cooperative and responsive management principles.

2. Legislation and Guidelines

2.1 Legislation

Key environmental legislation relating to noise and vibration management includes:

- Protection of the Environment Operations Act (1997)
- Environment Planning and Assessment Act (1979)
- Local Government Act (1993)
- Protection of the Environment Operations (Noise Control) Regulation 1999 NSW EPA Environmental Noise Control Manual

2.2 Guidelines and Standards

The key references relevant to noise and vibration management of project include:

- DIN 1999, DIN 4150: Part 3 – 1999 Effects of vibration on structures, DIN, Germany
- EPA Interim Construction Noise Guideline
- DEC 2006, Assessing vibration – a technical guideline, Department of Environment and Conservation, Sydney NSW
- DECC 2009, Interim Construction Noise Guideline, NSW Department of Environment and Climate Change, Sydney NSW
- RTA 2001, Environmental Noise Measurement Manual, Roads and Traffic Authority, Sydney NSW
- EPA 2017 Noise Policy for Industry
- AS 1055 Parts 1 to 3 Acoustics: Description and management of environmental noise;
- AS 2659 Sound level metres
- AS 2659.1 Guide to the use of sound measuring equipment
- AS 2072 Acoustics: Methods for measurement of traffic noise.

3. Communication

Following the completion and implementation of an approved CNVMP, there are several key measures, which will be undertaken by the site team to ensure effective and positive communication with all affected parties.

3.1 Ongoing Cooperative Management

The site teams will apply a pro-active approach to all aspects of the project to ensure a high level of control is exercised and any potential problems can be identified (and responded to) as early as possible.

The project team pro-actively manage the project by focusing closely on planning, programming, forecasting and monitoring activities. This focus minimises the potential for problems to occur. The team will continue to develop contingency plans to address the possibility of problems actually arising. This approach is fundamental to the successful delivery of the project.

Despite the best endeavours of all stakeholders, problems or unforeseen circumstances may arise. The team will actively resolve or help to resolve such problems in the most expedient and efficient way possible. Project staff with the experience and skills needed to solve complex problems in projects of this nature will remain committed to this project. In the event that unforseen problems are encountered, the team will immediately initiate and implement a problem resolution plan to minimise any impacts.

The team will encourage and promote a co-operative and harmonious project environment. This applies to relationships between clients, employees, consultants, suppliers, subcontractors, unions and other stakeholders. The objective will be to eliminate conflict wherever possible and at all levels, as this can be a major impediment to progress and meeting project objectives.

3.2 Response Management

While noise and vibration management and mitigation measures will assist in meeting project objectives, it is understood the potential exists for concerns from affected parties throughout different stages of the project.

Efficiently and effectively providing comprehensive response management procedures for each individual concern throughout the project will be fundamental to complete the works to the satisfaction of all parties.

An obligation exists to quickly and adequately act on concerns if and when they arise. it is the site responsibility to effectively close out these issues and concerns regardless of liability, ensuring affected parties are completely satisfied in a timely manner to the best of our ability.

3.3 Forecasting and Notification

A key communication tool is the provision of ongoing forecasting and early notification of activities to potentially affected parties. This provides early warning of the stages of the projects, provides an opportunity for review and comment by affected parties and helps

outside parties generally understand the construction process and why certain activities occur.

By providing this open form of communication affected parties have a higher level of understanding of the works and it encourages feedback into other party's activities, which may affect scheduled works or change for whatever reason. Through early warning site management can assist in re-programming works to suit the requirements of the affected party without affecting the overall construction programme. Early warning and notifications both ways is necessary for the ongoing success of the project.

3.4 Contractor Management

The site team will ensure the CNVMP will be a contract document for its contractors, notably civil works, and will be further developed and amended in conjunction with leading contractors. Site management will listen to their concerns and innovations with consideration to the requirements of the contract to ensure an effective balance of community management, environmental management and onsite production.

Site Management will ensure that the noise and vibration requirements and plans are;

- Contract documents for all contractors
- An integral part of individual project site inductions
- Monitored daily through site environmental hazard sheets
- Adequate site management resources throughout all project phases
- An assessment criteria for the selection of contractors
- Are continually updated throughout the course of the works as required

The transfer of knowledge and requirements, while maintaining overall project responsibility, will be integral to ensuring effective site management. Site management recognise this communication link with site contractors is important to maintaining effective overall management of the project to the satisfaction of all affected parties.

4. Noise and Vibration Guidelines

4.1 Site and Surrounding Area

The site and surrounding area including nearest receptors and noise monitoring location is shown in Figures 4-1 and 4-2 .

Figure 4-1 Site Location and Nearest Receptors.

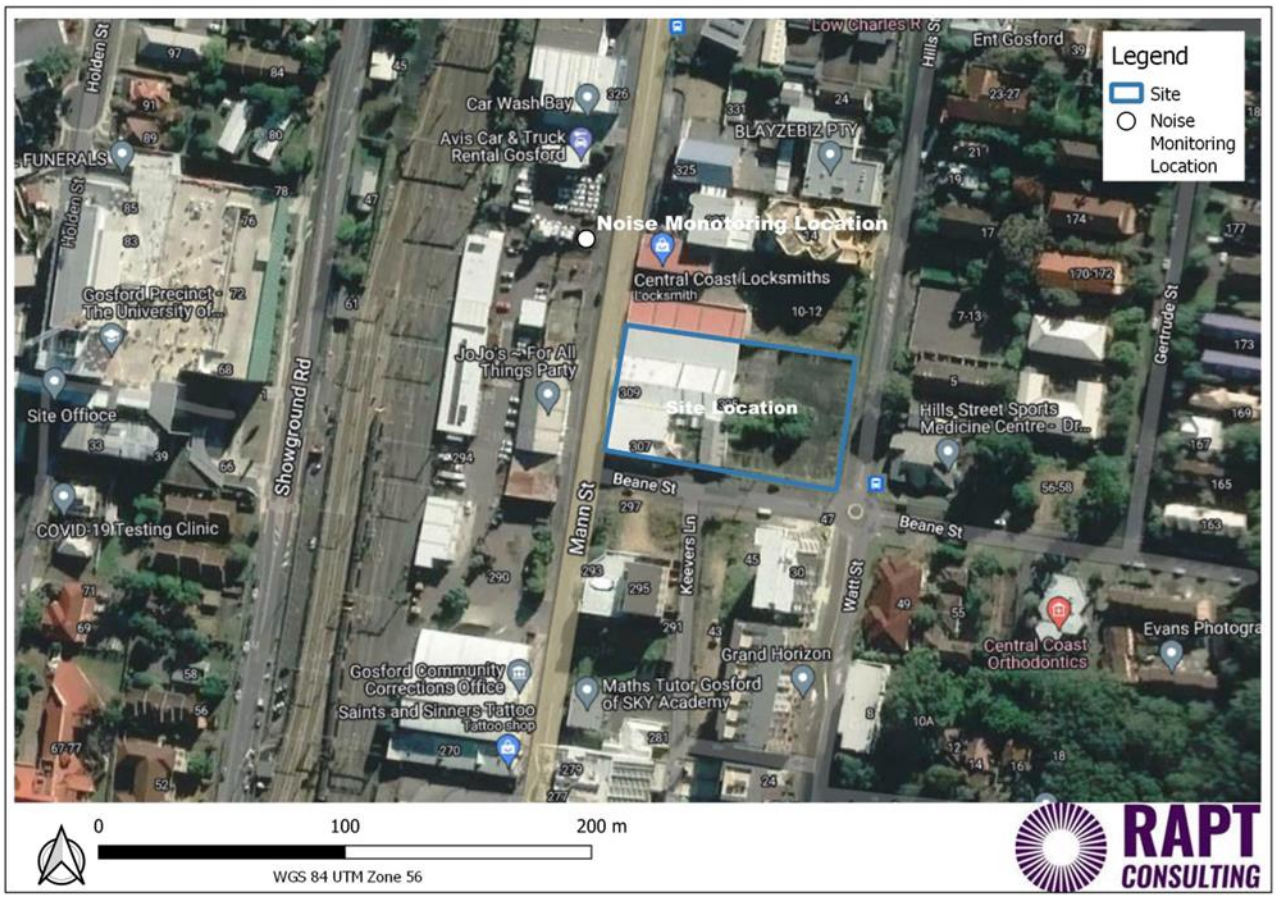


Figure 4-2 Site and Noise Monitoring Location

4.2 Construction Noise

Construction noise is assessed with consideration to DECCW Interim Construction Noise Guidelines (ICNG) (July 2009). The INCG 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 4-1.

Table 4-1 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 4-2.

Table 4-2 Recommended Construction Noise Management Levels

Period	Management Level $L_{Aeq(15\ min)}$
Residential Recommended standard hours	Noise affected level: RBL + 10 Highly noise affected level: 75 dB(A)
Residential Outside recommended standard hours	Noise affected level: RBL + 5 Highly noise affected level: 75 dB(A)
Classrooms at schools and other educational institutions	Internal Noise Level 45 dB(A) (applies when properties are being used) Outdoor Noise Level 55 dB(A) (assumes 10dB(A) loss through an open window
Hospital wards and operating theatres	Internal Noise Level 45 dB(A) (applies when properties are being used) Outdoor Noise Level 55 dB(A) (assumes 10dB(A) loss through an open window
Places of worship	Internal Noise Level 45 dB(A) (applies when properties are being used)
Active recreation areas (characterised by sporting activities and activities which generate their own noise or focus for participants, making them less sensitive to external noise intrusion)	External noise level 65 dB(A)
Industrial Premises	External noise level 75 dB(A)
Offices, retail outlets	External noise level 70 dB(A)
Passive recreation areas (characterised by contemplative activities that generate little noise and where benefits are compromised by external noise intrusion, for example, reading, meditation)	External noise level 60 dB(A)

The above levels apply at the boundary of the most affected residences / offices or within 30m 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.

As part of the development application, noise monitoring was undertaken by RAPT Consulting *2222408_221201 Environmental Acoustic Assessment UON Gosford, NSW* from 21 to 27 July 2022. The noise monitoring location is shown in Figure 4-2 taken from the abovementioned report.

It is understood works required for the proposal would be undertaken during standard construction hours. However, construction noise management levels (NML's) for standard and out of hours situations are provided for completeness. NML's for residential receivers have been derived, as shown in Table 4-3.

Table 4-3 Construction Noise Management Levels dB(A) Leq(15min)

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

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

4.3 Vibration Guidelines

Vibration during construction and operational activity is expected to primarily originate from trucks and machinery during stages of construction and activities. All piling will utilise non-percussive techniques. RAPT Consulting also understand that blasting and heavy ground impact activities is not expected to occur during the works.

4.3.1 Human Exposure

Vibration goals 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 4-4.

Table 4-4 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

4.4 Building Damage

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

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

BS7385.2 – 1993 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 4-5.

Table 4-5 Transient Vibration Guideline Values for Potential Building - Cosmetic Damage

Building Type	Peak component particle velocity in frequency range of predominant pulse	
	4 Hz to 15 Hz	15 Hz and above
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

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.

5. Acoustic Assessment

5.1 Construction Noise

A construction noise assessment was undertaken by RAPT Consulting in report *2222408_221201 Environmental Acoustic Assessment UON Gosford, NSW.* Results of the construction noise assessment are reproduced in this section.

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

- Excavation/Site preparation.
- Construction of building.

Table 5-1 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 reasonable worst-case scenario.

Table 5-1 Plant and Equipment Noise Levels

Plant Item	Activity Noise Level L_{Aeq} @ 10m	DEFRA Construction Noise Database	Anticipated Usage %
Excavation			
Dozer	80	Table 2 Ref 10	50
Tracked Excavator	79	Table 2 Ref 14	50
Articulated Dump Truck	74	Table 2 Ref 32	50
Roller	73	Table 2 Ref 38	50
Building			
Concrete Pump & Cement Mixer	67	Table 4 Ref 24	50
Poker Vibrator	69	Table 4 Ref 34	50
Mobile Telescopic Crane	67	Table 4 Ref 36	50
Diesel Generator	61	Table 4 Ref 75	90

Note 2 The sound power levels for the individual plant items are worst-case levels representative of the equipment operating at maximum capacity. In practice, not all plant items would operate at maximum capacity at the same time and therefore the estimated usage has been adjusted to reflect this. This adjustment is consistent with RAPT Consulting experience on similar projects.

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

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

Construction Operations

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

Construction noise levels have been predicted based on the potential construction noise levels provided in Table 5-1. 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 5-1.

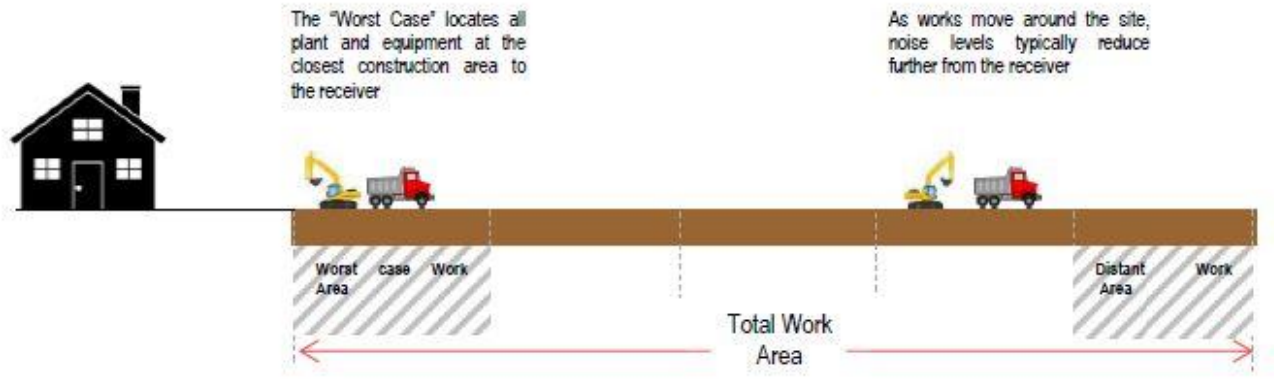


Figure 5-1 Example of Differing Work Areas

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

Other key assumptions and inputs in the model include:

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

Construction noise assessment results

Noise levels were predicted to each assessed receptor assuming receiver heights of 1.5m above ground level for typical construction activities. Table 5-3 summarises the maximum predicted noise level from each of the construction scenarios at identified residential receptors. Predicted exceedances of NML's are highlighted in RED.

Table 5-2 Predicted Construction Noise Levels dB(A) LAeq(15min)

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

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

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

The results of the construction assessment indicate compliance with all NML's with the exception of excavation works in the east and west of the site at limited receivers as shown in Table 5-3. Figure 5-1 also shows how construction moves about a site, sometimes being closer and other times being further away from a receptor. This greatly reduces the viability of using items such as barriers at the perimeter of the site as for a barrier to be effective, it needs to be as close to the noise source as possible. The highly affected noise level is also expected to be complied with in all situations.

5.2 Vibration Sources

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. Due to the nature of the works, the vibration risk is low.

The NSW RMS Publication Construction Noise and Vibration Guideline provides guidance for ground vibration and minimum safe working distances. Table 5-2 outlines recommended safe working distances for vibration intensive plant from sensitive receivers.

Table 5-3 Minimum Working Distances from Sensitive Receivers

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

The minimum working distances are indicative and will vary depending on the particular item of plant and local geotechnical conditions.

Based on distances from the proposal to nearest receivers and items of plant to be used, vibration goals are expected to be met. However, it is recommended Table 5-2 be used as a guide when selecting vibration generating plant and equipment.

6. Mitigation Measures

The following noise mitigation measures will be adopted to minimise any potential noise and vibration impacts for the project.

Table 6-1 Noise and Vibration Mitigation Measures

Action Required	Applies to	Details
Management Measures		
Working Hours	Airborne Noise Ground –borne noise & vibration	Ensure strict compliance with construction hours. This requirement to be communicated to all staff through inductions and toolbox meetings.
Out of Hours Works	Airborne Noise Ground –borne noise & vibration	Where work is required to be conducted outside normal construction hours, the out-of-hours works protocol shall be followed to minimise the impact
Site Induction	Airborne Noise Ground –borne noise & vibration	All employee, contractors and subcontractors are to receive an environmental induction. The induction must at least include: • All relevant project specific and standard noise and vibration mitigation measures • Relevant licence and approval conditions • Permissible hours of work • Any limitations on high noise generating activities • Location of nearest sensitive receivers • Construction employee parking areas • Designated loading/unloading areas and procedures • Site opening/closing times • Environmental incident procedures
Behavioral Practices	Airborne Noise	No swearing or unnecessary shouting or loud radios on site.

Action Required	Applies to	Details
		No dropping of materials from height, throwing of metal items and slamming of doors
Education	Airborne Noise Ground –borne noise & vibration	Provide education of supervisors, operators and sub-contractors on the need to minimise noise through Toolbox meetings and on-site coaching
Noise Monitoring	Airborne Noise Ground –borne noise & vibration	A noise monitoring program is implemented in accordance with this plan any approval and licence conditions. In the event of noise complaints during operations, noise monitoring will be undertaken. A report will be prepared comparing noise results against noise management measures. If noise management levels are exceeded while monitoring, site management will be notified to make adjustments to ensure compliance.
Vibration Monitoring	Vibration	A vibration monitoring program is implemented in accordance with this plan any approval and licence conditions
Consultation	Airborne Noise Ground –borne noise & vibration	A Community and Stakeholder Manager shall to be appointed by the contractor prior to the commencement of any works. The Manager will provide information to neighbours before and during construction to advise of expected noisy works, the duration of the works and what is being done to minimise the noise. A community telephone number and email address will be established for consultation purposes. Community notifications will be prepared and distributed at least 7 days prior to commencement of any works.
Noise & vibration complaints	Airborne Noise Ground –borne noise & vibration	A protocol will be developed for handling noise and vibration complaints that

Action Required	Applies to	Details
		includes recording, reporting and acting on complaints.
Planning		
Dilapidation Survey	Vibration	Prior to commencement of works, undertake a dilapidation survey to detail the current structural condition of the site and adjoining areas, including all existing fences, adjoining buildings, infrastructure, roads, crossovers etc.
Construction hours and scheduling	Airborne Noise Ground –borne noise & vibration	Where feasible and reasonable, construction should be carried out during the standard daytime working hours. Work generating high noise and/or vibration levels should be scheduled during less sensitive time periods and higher levels of neighbourhood noise.
Maximise Shielding	Airborne Noise	Use temporary site buildings and materials stockpiles as noise barriers Where possible, schedule construction of permanent walls so they can be used as early as possible
Equipment selection	Airborne Noise Ground –borne noise & vibration	Use quieter and less vibration emitting construction methods where feasible. Ensure all fixed plant at the work sites is appropriately selected, and where necessary, fitted with silencers, acoustical enclosures and other noise attenuation measures where practicable.
Equipment Placement	Airborne Noise Ground –borne noise & vibration	Position noisy plant and equipment as far apart as is practicable from each other and consider whether orientation and location of the plant can reduce noise impacts at sensitive receivers.
Vehicle Movements	Airborne Noise Ground –borne noise & vibration	Arrange work sites to avoid or minimise truck movements, and ensure vehicles enter and exit work sites in a forward direction.
Reversing Alarms	Airborne Noise	Avoid the use of reversing alarms by designing the site layout to avoid reversing.

Action Required	Applies to	Details
		Where possible, install non-tonal and / or automatically adjusting reversing alarms on site equipment
Maximum noise levels	Airborne Noise	The noise levels of plant and equipment must have operating Sound Power or Sound Pressure levels complaint with the criteria set in OEH guidelines.
Construction		
Rock Breaking	Airborne Noise Ground –borne noise & vibration	Reduce the use of rock-hammering where feasible and use alternative measures such as rock-saws and rippers where possible.
Equipment selection	Airborne Noise Ground –borne noise & vibration	Select appropriate sized equipment for the task, such as vibratory compactors and rock excavation equipment.
Equipment Maintenance	Airborne Noise Ground –borne noise & vibration	Regular maintenance and testing of all plant and equipment onsite to ensure they continue to meet the noise and vibration criteria
Equipment Operation	Airborne Noise Ground –borne noise & vibration	Ensure equipment is operated in the correct manner and adequately maintained - including replacement of engine covers, repair of defective silencing equipment, tightening of rattling components, repair of leakages in air lines and shutting down equipment not in use
Work Methods	Airborne Noise Ground –borne noise & vibration	Careful selection of all work methods to be used on the project to ensure they meet the noise and vibration criteria.
Site Entrances	Airborne Noise Ground –borne noise & vibration	The site entry and egress points will be set as far from receivers as practical and will be designed to distribute the movements rather than directing all movements through a single gate.
Relief Periods	Airborne Noise Ground –borne noise & vibration	Provide periods of relief when practical during noise intensive activities such as rock breaking.

Action Required	Applies to	Details
Noisy fabrication works	Airborne Noise	Carry out noisy fabrication work at another site (for example, within enclosed factory premises) and then transport to site.
Generators/ compressors	Airborne Noise	Use only silenced generators and compressors
Vehicle queuing	Airborne Noise Ground –borne noise & vibration	Prevent vehicles and plant queuing and idling outside the site, particularly prior to the construction start time.
Vehicle maintenance	Airborne Noise	Ensure that equipment is operated in the correct manner including repair of defective mufflers, tightening/correction of rattling parts and components and repair of leakages in compressed airlines.
Auditing and Monitoring		
Noise Monitoring	Airborne Noise Ground –borne noise & vibration	Undertake regular monitoring of overall noise levels at sensitive receivers to check for compliance. Where non-compliances are identified, modify work practices to achieve compliance.
Vibration Monitoring	Vibration	Undertake vibration monitoring during works at sensitive receivers to check for compliance. Where non-compliances are identified, modify work practices to achieve compliance.
Community Consultation	Airborne Noise Ground –borne noise & vibration	Undertake community consultation and respond to complaints in accordance with project procedures

7. Site Specific Management and Mitigation Measures

7.1 Management Measures

Management of Noise and Vibration issues rest in the first instance with the Project Manager. Working closely with the Site Manager and their team the Project Manager will ensure resources and support is available to allow the Site Manager to effectively management of all aspects of this Noise and Vibration Plan and its resulting requirements.

7.2 Planning

Planning for control of Noise and Vibration is the key to successful outcomes. With proper planning in place many potential problems resulting in complaints can be averted thus maintaining confidence with stakeholders that all possible measures are in place.

Where potential problems are anticipated following the planning and risk review process site management will communicate outcomes and potential problems to the stakeholders concerned to avoid surprises.

Examples of planning measures are as follows:

- Careful selection of all work methods to be used on the project to ensure they meet the noise and vibration criteria.
- Where practicable, increase the use of offsite manufactured elements in the design to eliminate site manufacturing.
- Create dedicated truck routes for heavy vehicles. It will be important to establish and agree early in the project approved truck routes, not just for close neighbours, but for the community as a whole. The preferred strategy is to choose a route that minimises disruption to neighbours and the community and enforce it throughout the works.
- Investigate the efficacy of sound blankets or hoarding around the construction site as a noise barrier to protect the amenity of adjacent and nearby receivers.

7.3 Plant and Equipment

- Careful selection of all plant and equipment to be used on the project to ensure they meet the noise and vibration criteria.
- Regular maintenance and testing of all plant and equipment onsite to ensure they continue to meet the noise and vibration criteria.
- Where identified, set up anti vibration pads for any vibrating plant and other temporary plant and equipment.

7.4 Management

In addition to noise and vibration mitigation, site management will establish an emergency contact point for any complaints, should there be an immediate issue, which requires

immediate action. This will enable the public to make a direct phone call to the site manager to stop a work area or address a problem should the need arise.

8. Successful Management of Noise and Vibration

In summary the overall process to be implemented includes:

- Understand the project and contract requirements
- Identify the specific project risks and sensitive locations and provide a detailed risk assessment for each location in specific relation to noise and vibration requirements
- Set clear criteria and guidelines prior to works commencing
- Further develop the Noise and Vibration Management Plan in conjunction with affected parties throughout the course of the works
- Management the implementation of the plan through the allocation of appropriate resources and ensuring the requirements of the plan are transferred to all contractors and site workers
- Provide ongoing cooperative management throughout all phases of the project. Understand that it is our obligation, regardless of contractual requirements, to act in a cooperative manner at all times with all affected parties and stakeholders
- Provide adequate response management for any issue.
- Provide adequate contractor management to ensure common guidelines and restrictions with the managing contractor requirements. Actively monitor the contractors on the project in a detailed and regular fashion through site and contractual management
- Allocate sufficient overall site management resources in all facets of the project to ensure issues are understood, allow correct forecasting and planning, allow adequate consultation and communication, comprehensive daily management and adequate response management
- Implement project monitoring in response to concerns or complaints and provide constant feedback to monitoring data as required
- Implement comprehensive physical mitigation measures in plant and equipment used and construction techniques
- Draw on existing experience on noise and vibration sensitive sites, and experience and methods used in similar confined sites with nearby sensitive receivers.
- Understand site obligations to be cooperative, responsive and constantly adjust processes to suit affected parties, stakeholders and the greater community
- In accordance with the project conditions, approval will be sought to complete any out of hour's works – if required.

9. Training

In addition to other training requirements inductions are required and are to address:

- Sensitivity of the site and proximity to sensitive receivers
- Awareness of noise and vibration created during construction and the requirement to operate equipment is in the quietest possible manner in consideration of surrounding residents / land uses
- Strict adherence to the approved hours of operation
- Delivery hours and locations
- Notification of the Project Manager/Site Supervisor of any works likely to cause significantly high vibration / noise emissions

10. Limitations

The purpose of the CNVMP is to provide an independent set of management measures for the University of Newcastle Central Coast Campus project located at Gosford, NSW.

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

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 preparing this CNVMP, 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.

11. The Author

This plan has been prepared by Gregory Collins of RAPT Consulting. Greg is a member of the Australian Acoustical Society and has over 29 years' experience in a wide range of Acoustics and Air Quality projects. Having previously been the Air and Noise Technical Service line leader and The Global Environmental Technical Sector Leader for international professional service firms, Greg has a reputation for technical excellence, combined with innovative, cost effective solutions for clients. Greg has provided environmental management, assessment and monitoring services for noise and air parameters across a range of sectors including transport, utilities, industry and resources. Greg has significant experience in the assessment of noise and air quality from establishment of goals to calculation, modelling and control of impacts. Greg's noise and air project experience includes; transportation infrastructure including road, rail and port developments, mining, power generation infrastructure from large coal fired power stations and smaller gas fired generators through to power transmission networks and suburban substation facilities, assessment and control from industrial premises, impact and management from construction activities, land use planning and residential and commercial noise control in building design.