Eurobodalla Regional Hospital – Site Wide CNVMP

Multiplex Constructions Pty Ltd

Report number: 230406 – Eurobodalla Regional Hospital – Site Wide - CNVMP - R0
Date: 1 July 2024
Version: For Information

Project Number: 230406

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DOCUMENT CONTROL

Project Name	Eurobodalla Regional Hospital
Project Number	230406
Report Reference	230406 – Eurobodalla Regional Hospital – Site Wide - CNVMP - R0
Client:	Multiplex Constructions Pty Ltd

Revision	Description	Reference	Date	Prepared	Checked	Authorised
0	For Information	230406 – Eurobodalla Regional Hospital – Site Wide - CNVMP - R0	1 July 2024	Matthew Furlong	Matthew Furlong	Ben White

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1 INTRODUCTION

Pulse White Noise Acoustics (PWNA) has been engaged by Multiplex Constructions Pty Ltd to prepare a Construction Noise and Vibration Management Plan (CNVMP) for the proposed Eurobodalla Regional Hospital Project.

The assessment has been undertaken as per of Condition B17 of the Development Consent provided as part of the planning approval for SSD-56989722. Condition B17 states:

> B17. The Construction Noise and Vibration Management Sub-Plan must 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 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 strategies that have been developed with the community for managing high noise generating works;
>
> (e) describe the community consultation undertaken to develop the strategies in condition B17(d);
>
> (f) include a complaints management system that would be implemented for the duration of the construction; and
>
> (g) 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 B14.

This report includes the recommended noise and vibration mitigations and management controls for the operation of construction activities on the site to ensure impacts to surrounding receivers are minimised in accordance with the relevant requirements.

A glossary of acoustic terminology used throughout this report is included in Appendix A.

1.1 Development Overview

The approved development (through the SSDA pathway) approved a development which included:

- Site establishment and preparation, including bulk earthworks, tree removal, environmental clearing and cut and fill.
- Construction and operation of a three-storey hospital with four wings, which includes the following departments:
    - Emergency Department (including flexible mental health beds).
    - Medical Imaging.
    - Operating Theatres.
    - Intensive Care Unit.
    - Pathology.
    - Pharmacy.
    - Medical and surgical in-patient units.
    - Rehabilitation and Palliative Care in-patient units.

  - Women's Health and Paediatrics.
  - Ambulatory Care for community outpatient services.
  - Administration including Education and Training.
  - Front of House including Retail.
  - Back of House including Mortuary.
- Internal road network and access from Princes Highway.
- Secondary road access (controlled access for Emergency vehicles only) from Caswell Street to north of the project site.
- At grade car parking.
- Loading dock.
- Ancillary landscaping including the Walawanni, Meeting Place and Healing Place.

1.2 Site Overview

The new Eurobodalla Regional Hospital development is located in Moruya on the Princes Highway to the south-east of the Moruya Town Centre, on vacant greenfield land. To the west of the site is Moruya TAFE, and to the north is a small residential subdivision called Mynora Estate. The majority of works will occur on this greenfield site, with some road works proposed in the adjoining Princes Highway and northern access road reserves. The site is legally described as Lot 2, DP 1281576.

The site is currently surrounded by the following:

- The site is bounded by existing residential dwellings along the northern boundary of the site along Caswell Street, Albert Street, Keightley Street and Maunsell Street (as shown in the figure below), these will be known as receiver 1 in this report.
- Located to the southwest of the site is the Moruya TAFE NSW development located along the Princess Highway, as shown in the figure below. TAFE NSW will be known as receiver 2 in this report.
- Situated to the south of the site across the Princess Highway is existing residential dwellings, see below. These will be known as receiver 3 in this report.
- Situated to the south-east of the site along the Princess Highway is existing residential dwelling, see below. This receiver will be known as receiver 4 in this report.
- Situated to the north-east of the site along the S Head Road is existing residential dwelling, see below. This receiver will be known as receiver 5 in this report.

Figure 1 Site Location and Surrounding Receivers – Sourced from Google Earth

2 EXISTING ACOUSTIC ENVIRONMENT

Onsite ambient noise levels have previously been determined during the State significant Development Application (SSDA) phase by ARUP Pty Ltd (report reference 284639-00, dated 7th July 2023). These are provided below.

2 Existing environment

2.1 Assessment locations

In accordance with the *Noise Policy for Industry* [3] (NPfI), the reasonably most-affected residences have been grouped into Noise Catchment Areas (NCAs) based on their acoustic environment as observed on site. For clarity, the assessment of residential receivers presented in this report is isolated to the reasonably most-affected receivers listed in Table 2 and shown in Figure 3.

Table 2: Reasonably most-affected residential receivers

Receiver ID	Address	No. of floors	NCA
R1	2945 Princes Highway, Moruya	1	1
R2	36 Keightley Street, Moruya	1	2

2.2 Noise monitoring

Noise monitoring was undertaken for the purpose of deriving of noise criteria and qualifying the noise environment at nearby receivers.

Long-term unattended and short-term attended monitoring was conducted at locations presented in Table 3 and shown in Figure 4.

Table 3: Monitoring locations

Measurement Type	Purpose	ID	Location
Both long-term unattended and short-term attended	Establish criteria	L1	2945 Princes Highway, Moruya
		L2	36 Keightley Street, Moruya
Short-term attended only	Quantify and qualify noise levels surrounding site	S1	End of Caswell St
		S2	36 Maunsell St

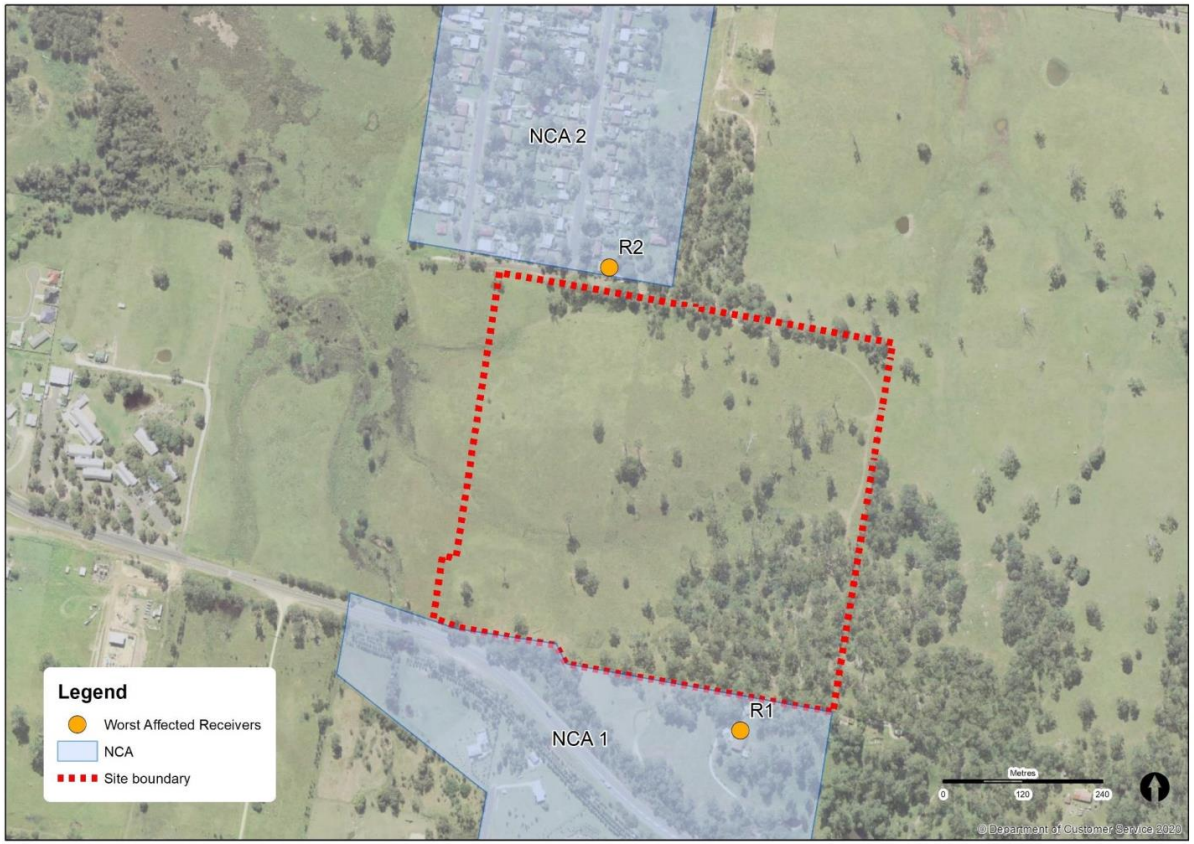


Figure 3: Site map showing noise sensitive receiver locations and NCAs

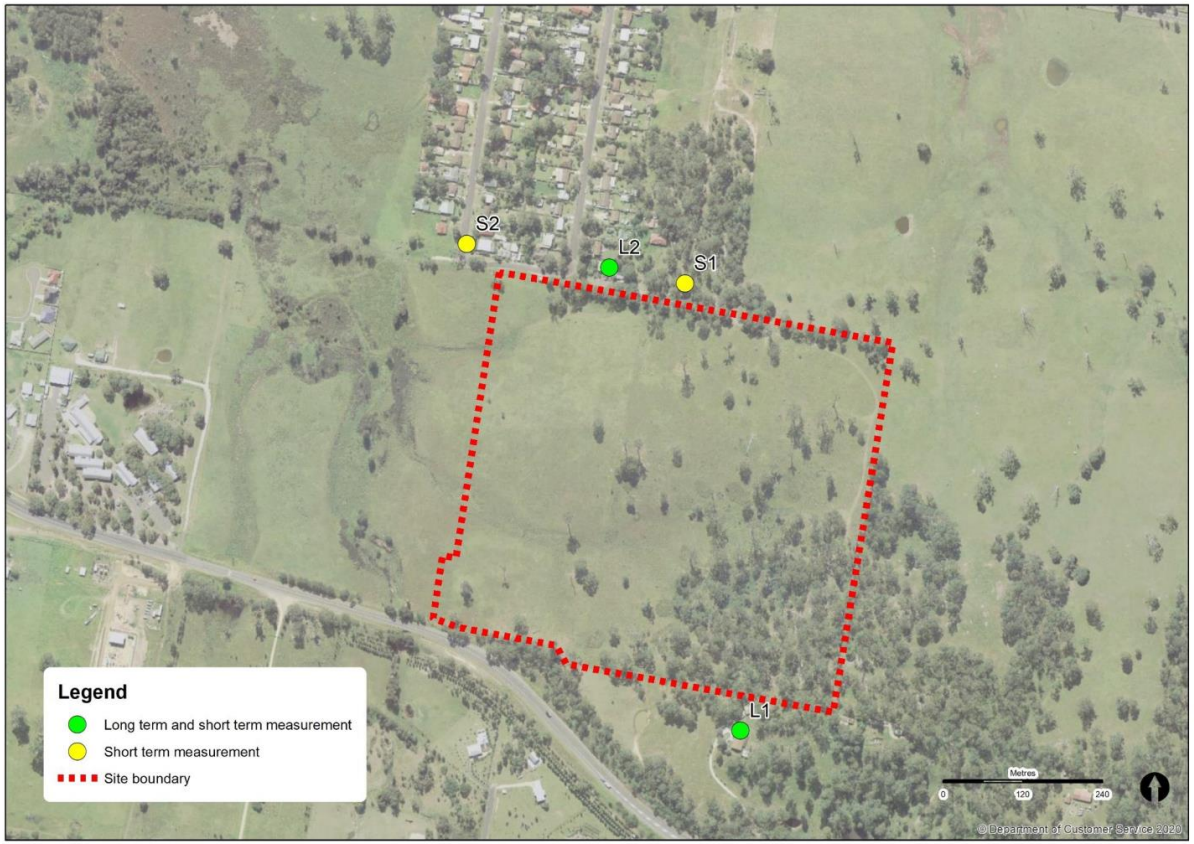


Figure 4: Noise measurement locations

2.2.1 Unattended long-term monitoring

Long-term noise monitoring was carried out on 1st December to 12th December 2021 at two locations shown in Figure 4. However, it is noted that the initial long term noise monitoring only produces 5 full days of valid data due to unfavourable meteorological conditions (i.e. rainfall, wind, flooding) at that time.

To further validate the existing ambient noise levels at the development, additional long-term noise monitoring was carried out on 11th February to 22nd February 2022 at the same two locations shown in Figure 4. During the second round of noise monitoring, it is observed that the background noise levels at the evening and night period was 6 to 12 dB higher compared to the measured levels in the initial round of monitoring. The increase in noise levels are attributed to seasonal changes in wildlife activity such as insects, birds and other fauna.

Therefore, a more conservative approach of using the background and ambient noise levels from the initial round of monitoring were used to ensure the surrounding noise sensitive receiver's amenity.

The long-term noise monitoring methodology and noise level graphs for both rounds of monitoring are included in Appendix B.

Table 4 summarises the background and ambient noise level results.

Table 4: Long-term noise monitoring results, dB(A)

Location ID	NCA	Time period[1]	Rating Background Levels, dBL_{A90}	Ambient dBL_{Aeq} noise levels
L1 2945 Princes Highway	1	Day	40	53
		Evening	36	54
		Night	31	43
L2 36 Keightley Street	2	Day	37	54
		Evening	36	50
		Night	31	47

Notes:

1. The NPfI defines day, evening and night time periods as:
   - Day: the period from 7 am to 6 pm Monday to Saturday; or 8 am to 6 pm on Sundays and Public Holidays.
   - Evening: the period from 6 pm to 10 pm.
   - Night: the remaining period.

As required by the NPfI, the external ambient noise levels presented are free-field noise levels.

2.2.2 Attended short-term monitoring

Short-term 15 minute attended noise measurements were undertaken on 1st December 2021 at four locations shown in Figure 4. The measured noise levels are summarised in Table 5.

Table 5: Short-term noise monitoring results, dB(A).

Loc ID	Date and start time	Measured levels		Noise Sources Contributions
		$dBL_{A90(15min)}$	$dBL_{Aeq(15min)}$	
L1	1 Dec 21 14:50	40	45	Dominated by traffic noise from Princes Highway, with contribution from South Head Road
L2	1 Dec 21 15:34	34	45	Natural sounds, with faint traffic noise from South Head Road and Princes Highway
S1	1 Dec 21 17:38	33	45	Natural sounds, with faint traffic noise from South Head Road and Princes Highway
S2	1 Dec 21 18:01	34	47	Natural sounds, with faint traffic noise from South Head Road and Princes Highway

Results show existing noise levels are similar across the northern site boundary. No industrial noise was noted during measurements.

3 NOISE AND VIBRATION CRITERIA

Relevant noise and vibration criteria for construction activities are detailed below.

3.1 Development Consent – SSD-56989722

Condition B14 states:

> **Environmental Management Plan Requirements**
>
> B14. Management plans required under this consent must be prepared having regard to the relevant guidelines, including but not limited to the *Environmental Management Plan Guideline: Guideline for Infrastructure Projects* (DPIE April 2020).
>
> *Notes:*
> - *The Environmental Management Plan Guideline is available on the Planning Portal at: https://www.planningportal.nsw.gov.au/major-projects/assessment/post-approval*
> - *The Planning Secretary may waive some of these requirements if they are unnecessary or unwarranted for particular management plans.*

Condition B17 states:

> B17. The Construction Noise and Vibration Management Sub-Plan must 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 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 strategies that have been developed with the community for managing high noise generating works;
>
> (e) describe the community consultation undertaken to develop the strategies in condition B17(d);
>
> (f) include a complaints management system that would be implemented for the duration of the construction; and
>
> (g) 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 B14.

Condition C4 states:

> C4. Construction, including the delivery of materials to and from the site, may only be carried out between the following hours:
>
> (a) between 7am and 6pm, Mondays to Fridays inclusive; and
>
> (b) between 8am and 1pm, Saturdays.
>
> No work may be carried out on Sundays or public holidays.

Condition C5 states:

> C5. Notwithstanding condition C4, provided noise levels do not exceed the existing background noise level plus 5dB, works may also be undertaken during the following hours:
>
> (a) between 6pm and 7pm, Mondays to Fridays inclusive; and
>
> (b) between 1pm and 4pm, Saturdays.

Condition C6 states:

> C6. Construction activities may be undertaken outside of the hours in condition C4 and C5 if required:
> (a) by the Police or a public authority for the delivery of vehicles, plant or materials; or
> (b) in an emergency to avoid the loss of life, damage to property or to prevent environmental harm; or
> (c) where the works are inaudible at the nearest sensitive receivers; or
> (d) for the delivery, set-up and removal of construction cranes, where notice of the crane-related works is provided to affected residents at least seven days prior to the works; or
> (e) where a variation is approved in advance in writing by the Planning Secretary or her nominee if appropriate justification is provided for the works.

Condition C8 states:

> C8. Rock breaking, rock hammering, sheet piling, pile driving and similar activities may only be carried out between the following hours:
> (a) 9am to 12pm, Monday to Friday;
> (b) 2pm to 5pm Monday to Friday; and

Condition C13 states:

> C13. The development must be constructed to achieve the construction noise management levels detailed in *the Interim Construction Noise Guideline* (DECC, 2009). All feasible and reasonable noise mitigation measures must be implemented and any activities that could exceed the construction noise management levels must be identified and managed in accordance with the management and mitigation measures identified *'Noise and Vibration Impact Assessment'* (Issue 8), prepared by Arup and dated 16 April 2024.

Condition C14 states:

> C14. The Applicant must ensure construction vehicles (including concrete agitator trucks) do not arrive at the site or surrounding residential precincts outside of the construction hours of work outlined under condition C4, C5, and C6.

Condition C15 states:

> C15. The Applicant must implement, where practicable and without compromising the safety of construction staff or members of the public, the use of 'quackers' to ensure noise impacts on surrounding noise sensitive receivers are minimised.

Condition C16 states:

> C16. Vibration caused by construction at any residence or structure outside the site must be limited to:
> (a) for structural damage, the latest version of *DIN 4150-3 (1992-02) Structural vibration - Effects of vibration on structures* (German Institute for Standardisation, 1999); and
> (b) for human exposure, the acceptable vibration values set out in the *Environmental Noise Management Assessing Vibration: a technical guideline* (DEC, 2006) (as may be updated or replaced from time to time).

Condition C17 states:

> C17. Vibratory compactors must not be used closer than 30 metres from residential buildings unless vibration monitoring confirms compliance with the vibration criteria specified in condition C16.

Condition C18 states:

> C18. The limits in conditions C16 and C17 apply unless otherwise outlined in a Construction Noise and Vibration Management Plan, approved as part of the CEMP required by condition B17 of this consent.

3.2 Construction Noise Objectives

Relevant construction noise objectives applicable to this project are outlined below.

3.2.1 NSW EPA (Former DECC) Interim Construction Noise Guideline (ICNG) 2009

Noise objective for construction and demolition activities are discussed in the *Interim Construction Noise Guideline* (ICNG). The ICNG also recommends procedures to address potential impacts of construction noise on residences and other sensitive land uses. The main objectives of the ICNG are summarised as follows:

- Promote a clear understanding of ways to identify and minimise noise from construction works;
- Focus on applying all "feasible" and "reasonable" work practices to minimise construction noise impacts;
- Encourage construction to be undertaken only during the recommended standard hours unless approval is given for works that cannot be undertaken during these hours;
- Streamline the assessment and approval stages and reduce time spent dealing with complaints at the project implementation stage; and
- Provide flexibility in selecting site-specific feasible and reasonable work practices in order to minimise noise impacts.

The ICNG contains a quantitative assessment method which is applicable to this project. Guidance levels are given for airborne noise at residences and other sensitive land uses.

The quantitative assessment method involves predicting noise levels at sensitive receivers and comparing them with the Noise Management Levels (NMLs). The NML affectation categories for residential receivers have been reproduced from the guideline and are listed in the table below.

Table 1 NMLs for quantitative assessment at residences

Time of Day	Noise Management Level $L_{Aeq(15minute)}$ [1,2]	How to Apply
During approved working hours	Noise affected RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. • Where the predicted or measured LAeq(15minute) is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. • The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dBA	The highly noise affected level represents the point above which there may be strong community reaction to noise. • Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: 1. Times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences. 2. If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside the recommended standard hours above	Noise affected RBL + 5 dB	• A strong justification would typically be required for works outside the recommended standard hours. • The proponent should apply all feasible and reasonable work practices to meet the noise affected level. • Where all feasible and reasonable practices have been applied and noise is more than 5 dB above the noise affected level, the proponent should notify the community.

Note 1 Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5 m above ground level. If the property boundary is more than 30 m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30 m of the residence. Noise levels may be higher at upper floors of the noise affected residence.

Note 2 The RBL is the overall single-figure background noise level measured in each relevant assessment period (during or outside the recommended standard hours). The term RBL is described in detail in the NSW Industrial Noise Policy (EPA 2000).

Construction noise levels at other noise receivers are outlined below:

- Construction noise levels at offices and retail outlets are not recommended to exceed 70 dB(A) $L_{Aeq,15minute}$, when measured externally.
- Construction noise levels at industrial premises are not recommended to exceed 75 dB(A) $L_{Aeq,15minute}$, when measured externally.
- Classrooms at schools and other education institutions are not recommended to exceed 45 dB(A) $L_{Aeq,15minute}$, when measured internally.
- Community centres are not recommended to exceed 45 dB(A) $L_{Aeq,15minute}$, when measured internally

Based on the measured background noise levels summarised in section 2 and the NMLs outlined above, the construction noise criteria to be used in this assessment are listed in Table 2.

Table 2 NMLs as basis for the acoustic assessment

Receiver Types	NML, dB $L_{Aeq(15minute)}$
	During approved working hours
Surrounding Residences	**NAFL: 47** **HNAL: 75** (RBL (37) + 10 dB)
Classrooms at schools and other education institutions	45 dB(A) $L_{Aeq,15minute}$, when measured internally
Community centres	45 dB(A) $L_{Aeq,15minute}$, when measured internally

3.3 Vibration Criteria

Effects of ground borne vibration on buildings may be segregated into the following three categories:

- Human comfort – vibration in which the occupants or users of the building are inconvenienced or possibly disturbed.
- Effects on building contents – where vibration can cause damage to fixtures, fittings and other non-building related objects.
- Effects on building structures – where vibration can compromise the integrity of the building or structure itself.

3.3.1 Vibration Criteria – Human Comfort

Vibration effects relating specifically to the human comfort aspects of the project are taken from AV-TG. This type of impact can be further categorised and assessed using the appropriate criterion as follows:

- Continuous vibration – from uninterrupted sources.
- Impulsive vibration – up to three instances of sudden impact e.g., dropping heavy items, per monitoring period.
- Intermittent vibration – such as from drilling, compacting or activities that would result in continuous vibration if operated continuously.

Table 3 Continuous vibration acceleration criteria (m/s^2) 1 Hz-80 Hz

Location	Assessment period	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

Table 4 Impulsive vibration acceleration criteria (m/s^2) 1 Hz-80 Hz

Location	Assessment period	Preferred Values		Maximum Values	
		z-axis	x- and y-axis	z-axis	x- and y-axis
Residences	Daytime	0.30	0.21	0.60	0.42
	Night-time	0.10	0.071	0.20	0.14

Table 5 Intermittent vibration impacts criteria (m/s$^{1.75}$) 1 Hz-80 Hz

Location	Daytime		Night-time	
	Preferred Values	Maximum Values	Preferred Values	Maximum Values
Residences	0.20	0.40	0.13	0.26

3.3.2 Vibration Criteria – Building Contents and Structure

The vibration effects on the building itself are assessed against international standards as follows:

- For transient vibration: British Standard BS 7385: Part 2-1993 *"Evaluation and measurement for vibration in buildings Part 2: Guide to damage levels from ground borne vibration"* (BSI 1993); and
- For continuous or repetitive vibration: German DIN 4150: Part 3 – 1999 *"Effects of Vibration on Structure"* (DIN 1999).

3.3.3 Standard BS 7385 Part 2 - 1993

For transient vibration, as discussed in standard BS 7385 Part 2-1993, the criteria are based on peak particle velocity (mm/s) which is to be measured at the base of the building. These are summarised below.

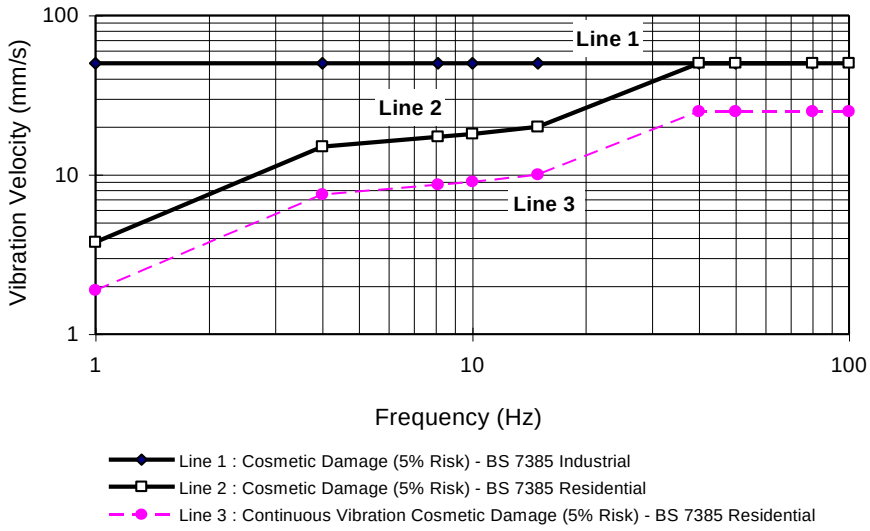
Table 6 Transient vibration criteria as per standard BS 7385 Part 2 - 1993

Line in Figure 2	Type of Building	Peak Component Particle Velocity in Frequency Range of Predominant Pulse	
		4 Hz to 15 Hz	15 Hz and Above
1	Reinforced or framed structures Industrial and heavy commercial buildings.	50 mm/s at 4 Hz and above	
2	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

Standard BS 7385 Part 2 – 1993 states that the values in Table 6 relate to transient vibration which does not cause resonant responses in buildings.

Where the dynamic loading caused by continuous vibration events is such that it results in dynamic magnification due to resonance (especially at the lower frequencies where lower guide values apply), then the values in Table 6 may need to be reduced by up to 50% (refer to Line 3 in Figure 2).

Figure 2 BS 7385 Part 2 – 1993, graph of transient vibration values for cosmetic damage



In the lower frequency region where strains associated with a given vibration velocity magnitude are higher, the recommended values corresponding to Line 2 are reduced. Below a frequency of 4 Hz, where a high displacement is associated with the relatively low peak component particle velocity value, a maximum displacement of 0.6 mm (zero to peak) is recommended. This displacement is equivalent to a vibration velocity of 3.7 mm/s at 1 Hz.

The standard also states that minor damage is possible at vibration magnitudes which are greater than twice those given in Table 6, and major damage to a building structure may occur at values greater than four times the tabulated values.

Fatigue considerations are also addressed in the standard and it is concluded that unless the calculation indicates that the magnitude and number of load reversals is significant (in respect of the fatigue life of building materials) then the values in Table 6 should not be reduced for fatigue considerations.

3.3.4 Standard DIN 4150 Part 3 - 1999

For continuous or repetitive vibration, standard DIN 4150 Part 3-1999 provides criteria based on values for peak particle velocity (mm/s) measured at the foundation of the building; these are summarised in Table 7. The criteria are frequency dependent and specific to particular categories of structures.

Table 7 Structural damage criteria as per standard DIN 4150 Part 3 - 1999

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[1]	
Buildings used for commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40
Dwellings and buildings of similar design and/or use	5	5 to 15	15 to 20	15

Structures that, because of their sensitivity to vibration, do not correspond to those listed in lines 1 and 2 and are of great intrinsic value (e.g. buildings that are under a preservation order)	3	3 to 8	8 to 10	8

Note 1: For frequencies above 100Hz, at least the values specified in this column shall be applied.

3.4 Construction Traffic Noise Criteria

For existing residences and other sensitive land uses affected by additional traffic on existing roads, the NSW *Road Noise Policy (RNP)* states that for noise associated with increased road traffic generated by land use developments, any increase in the total traffic noise level should be limited to 2 dB during both day and night-time periods. An increase of 2 dB represents a minor impact that is considered barely perceptible to the average person.

4 NOISE AND VIBRATION ASSESSMENT

4.1 Construction Noise Assessment

Sound power levels have been predicted for the construction tasks identified in the project program. The equipment anticipated for use in each task is based on previous project experience. The sound power levels for the equipment likely to be used for each of the listed tasks are provided in Table 8 below.

Table 8 Summary of predicted sound power levels

Tasks	Equipment	Sound Power Levels (dBA re 1pW)	Aggregate Sound Power Level per Task (dBA re 1pW)
Site Establishment Works	Mobile crane	110	113
	Power hand tools	109	
	Semi Rigid Vehicle [1]	105	
Ground Works	Excavator	112	120
	Hydraulic Hammer	118	
	Piling Rig	110	
	Handheld jack hammer [1]	111	
	Dump truck [1]	104	
	Concrete saw [1]	114	
	Skid steer	110	
	Power hand tools	109	

Note 1: An assumed time correction has been applied, this being 5 minutes of operation in any 15-minute interval.

4.2 Predicted Construction Noise Levels

Predicted construction noise levels are presented below for each of the surrounding receivers in accordance with the NSW EPA ICNG.

Note:

- Predicted noise levels presented below are given in a range, this includes the expected minimums as well as the maximums.
- With regards to the maximum noise levels in the range, these are typically experienced when plant/works are within close proximity to a boundary. In our experience whilst these levels above NML's and considered intrusive they will only occur for a short time and is not a representation of noise levels during the entire construction period.

Table 9 Receiver 1 – Summary of preliminary predicted construction noise levels

Phase	Activity	Aggregate Sound Power Level (dBA re 1pW)	Predicted Individual Noise Level at Receiver dBA $L_{Aeq\ 15\ minutes}$	Predicted Combined Noise Level at Receiver dBA $L_{Aeq\ 15\ minutes}$	Criteria dBA $L_{Aeq\ 15\ minutes}$	Summary of Result
Site Establishment Works	Mobile crane	113	47 to 69	51 to 73	**Standard Construction Hours:** During Approved Working Hours **47** **Highly Noise Affected Level** During Approved Working Hours **75**	Works indicatively predicted to be non-compliant with the Noise Management Level (BG+10 dBA), and below the Highly Noise Affected Level of 75 dB(A). Noise management required including possible mitigations included in this report.
	Power hand tools		48 to 70			
	Semi Rigid Vehicle		39 to 61			
Ground Works	Excavator	119	51 to 73	59 to 81		
	Handheld jack hammer		57 to 79			
	Dump truck		47 to 69			
	Concrete saw		45 to 67			
	Skid steer		38 to 60			
	Power hand tools		48 to 70			
Main Works	Skid steer	117	49 to 71	56 to 78		
	Power hand tools		48 to 70			
	Handheld jack hammer [1]		40 to 62			
	Concrete saw [1]		48 to 70			
	Power hand tools		48 to 70			
	Welder		40 to 62			
	Concrete pump truck		49 to 71			
	Concrete agitator truck		47 to 69			
Internal Works	Power hand tools	89	28 to 50	28 to 50		
Common and External Works	Concrete agitator truck	114	47 to 69	53 to 75		
	Saw cutter [1]		38 to 60			
	Dump truck [1]		38 to 60			
	Concrete saw [1]		48 to 70			
	Power hand tools		48 to 70			

Table 10 Receiver 2 – Summary of preliminary predicted construction noise levels

Phase	Activity	Aggregate Sound Power Level (dBA re 1pW)	Predicted Individual Noise Level at Receiver dBA $L_{Aeq\ 15\ minutes}$	Predicted Combined Noise Level at Receiver dBA $L_{Aeq\ 15\ minutes}$	Criteria dBA $L_{Aeq\ 15\ minutes}$	Summary of Result
Site Establishment Works	Mobile crane	113	32 to 39	35 to 43	During Approved Working Hours **45 (internally)**	Works indicatively predicted to be non-compliant with the Noise Management Level. Noise management required including possible mitigations included in this report.
	Power hand tools		32 to 40			
	Semi Rigid Vehicle		24 to 31			
Ground Works	Excavator	119	35 to 43	43 to 51		
	Handheld jack hammer		41 to 49			
	Dump truck		32 to 39			
	Concrete saw		30 to 37			
	Skid steer		23 to 30			
	Power hand tools		33 to 40			
Main Works	Skid steer	107	33 to 41	41 to 48		
	Power hand tools		32 to 40			
	Handheld jack hammer [1]		25 to 32			
	Concrete saw [1]		33 to 40			
	Power hand tools		32 to 40			
	Welder		24 to 32			
	Concrete pump truck		33 to 41			
	Concrete agitator truck		31 to 39			
Internal Works	Power hand tools	99	32 to 40	32 to 40		
Common and External Works	Concrete agitator truck	104	31 to 39	37 to 45		
	Saw cutter [1]		23 to 30			
	Dump truck [1]		23 to 30			
	Concrete saw [1]		33 to 40			
	Power hand tools		32 to 40			

Table 11 Receiver 3 – Summary of preliminary predicted construction noise levels

Phase	Activity	Aggregate Sound Power Level (dBA re 1pW)	Predicted Individual Noise Level at Receiver dBA $L_{Aeq\ 15\ minutes}$	Predicted Combined Noise Level at Receiver dBA $L_{Aeq\ 15\ minutes}$	Criteria dBA $L_{Aeq\ 15\ minutes}$	Summary of Result
Site Establishment Works	Mobile crane	113	46 to 60	50 to 64	**Standard Construction Hours:** During Approved Working Hours **50** **Highly Noise Affected Level** During Approved Working Hours **75**	Works indicatively predicted to be non-compliant with the Noise Management Level (BG+10 dBA), and below the Highly Noise Affected Level of 75 dB(A). Noise management required including possible mitigations included in this report.
	Power hand tools		47 to 61			
	Semi Rigid Vehicle		38 to 52			
Ground Works	Excavator	119	50 to 64	58 to 72		
	Handheld jack hammer		56 to 70			
	Dump truck		46 to 60			
	Concrete saw		44 to 58			
	Skid steer		37 to 51			
	Power hand tools		47 to 61			
Main Works	Skid steer	117	48 to 62	55 to 69		
	Power hand tools		47 to 61			
	Handheld jack hammer [1]		39 to 53			
	Concrete saw [1]		47 to 61			
	Power hand tools		47 to 61			
	Welder		39 to 53			
	Concrete pump truck		48 to 62			
	Concrete agitator truck		46 to 60			
Internal Works	Power hand tools	89	27 to 41	27 to 41		
Common and External Works	Concrete agitator truck	114	46 to 60	52 to 66		
	Saw cutter [1]		37 to 51			
	Dump truck [1]		37 to 51			
	Concrete saw [1]		47 to 61			
	Power hand tools		47 to 61			

Table 12 Receiver 4 – Summary of preliminary predicted construction noise levels

Phase	Activity	Aggregate Sound Power Level (dBA re 1pW)	Predicted Individual Noise Level at Receiver dBA $L_{Aeq\ 15\ minutes}$	Predicted Combined Noise Level at Receiver dBA $L_{Aeq\ 15\ minutes}$	Criteria dBA $L_{Aeq\ 15\ minutes}$	Summary of Result
Site Establishment Works	Mobile crane	113	42 to 48	46 to 52	**Standard Construction Hours:** During Approved Working Hours **50** **Highly Noise Affected Level** During Approved Working Hours **75**	Works indicatively predicted to be non-compliant with the Noise Management Level (BG+10 dBA), and below the Highly Noise Affected Level of 75 dB(A). Noise management required including possible mitigations included in this report.
	Power hand tools		43 to 49			
	Semi Rigid Vehicle		34 to 40			
Ground Works	Excavator	119	46 to 52	54 to 60		
	Handheld jack hammer		52 to 58			
	Dump truck		42 to 48			
	Concrete saw		40 to 46			
	Skid steer		33 to 39			
	Power hand tools		43 to 49			
Main Works	Skid steer	117	44 to 50	51 to 57		
	Power hand tools		43 to 49			
	Handheld jack hammer [1]		35 to 41			
	Concrete saw [1]		43 to 49			
	Power hand tools		43 to 49			
	Welder		35 to 41			
	Concrete pump truck		44 to 50			
	Concrete agitator truck		42 to 48			
Internal Works	Power hand tools	89	23 to 29	23 to 29		
Common and External Works	Concrete agitator truck	114	42 to 48	48 to 54		
	Saw cutter [1]		33 to 39			
	Dump truck [1]		33 to 39			
	Concrete saw [1]		43 to 49			
	Power hand tools		43 to 49			

Table 13 Receiver 5 – Summary of preliminary predicted construction noise levels

Phase	Activity	Aggregate Sound Power Level (dBA re 1pW)	Predicted Individual Noise Level at Receiver dBA $L_{Aeq\ 15\ minutes}$	Predicted Combined Noise Level at Receiver dBA $L_{Aeq\ 15\ minutes}$	Criteria dBA $L_{Aeq\ 15\ minutes}$	Summary of Result
Site Establishment Works	Mobile crane	113	40 to 46	44 to 50	**Standard Construction Hours:** During Approved Working Hours **47** **Highly Noise Affected Level** During Approved Working Hours **75**	Works indicatively predicted to be non-compliant with the Noise Management Level (BG+10 dBA), and below the Highly Noise Affected Level of 75 dB(A). Noise management required including possible mitigations included in this report.
	Power hand tools		41 to 47			
	Semi Rigid Vehicle		32 to 38			
Ground Works	Excavator	119	44 to 50	52 to 58		
	Handheld jack hammer		50 to 56			
	Dump truck		40 to 46			
	Concrete saw		38 to 44			
	Skid steer		31 to 37			
	Power hand tools		41 to 47			
Main Works	Skid steer	117	42 to 48	49 to 55		
	Power hand tools		41 to 47			
	Handheld jack hammer [1]		33 to 39			
	Concrete saw [1]		41 to 47			
	Power hand tools		41 to 47			
	Welder		33 to 39			
	Concrete pump truck		42 to 48			
	Concrete agitator truck		40 to 46			
Internal Works	Power hand tools	89	21 to 27	21 to 27		
Common and External Works	Concrete agitator truck	114	40 to 46	46 to 52		
	Saw cutter [1]		31 to 37			
	Dump truck [1]		31 to 37			
	Concrete saw [1]		41 to 47			
	Power hand tools		41 to 47			

4.3 Vibration Assessment

In order to maintain compliance with the human comfort vibration criteria discussed in Section 3.3, it is recommended that the indicative safe distances listed in table below should be maintained. These indicative safe distances should be validated prior to the start of construction works by undertaking measurements of vibration levels generated by construction and demolition equipment to be used on site.

Since the criteria for scientific or medical equipment (should any of these exist close to the site) can be more stringent than those required for human comfort, vibration validating measurements should be conducted at each site to determine the vibration level and potential impact onto this sensitive equipment.

Additionally, any vibration levels should be assessed in accordance with the criteria discussed in Section 3.3.

Table 14 Recommended indicative safe working distances for vibration intensive plant

Plant	Rating / Description	Safe Working Distances (m)	
		Cosmetic Damage (BS 7385: Part 2 DIN 4150: Part 3)	Human Comfort (AVTG)
Vibratory roller	< 50 kN (Typically 1 – 2 tonnes)	5	15 – 20
	< 100 kN (Typically 2 – 4 tonnes)	6	20
	< 200 kN (Typically 4 – 6 tonnes)	12	40
	< 300 kN (Typically 7 – 13 tonnes)	15	100
	> 300 kN (Typically more than 13 tonnes)	20	100
Small hydraulic hammer	300 kg, typically 5 – 12 tonnes excavator	2	7
Medium hydraulic hammer	900 kg, typically 12 – 18 tonnes excavator	7	23
Large hydraulic hammer	1600 kg, typically 18 – 34 tonnes excavator	22	73
Vibratory pile driver	Sheet piles	2 – 20	20
Jackhammer	Hand held	1	Avoid contact with structure and steel reinforcements

5 NOISE AND VIBRATION MANAGEMENT PLAN

5.1 Acoustic Management Procedures

5.1.1 Summary of Management Procedures

Table 15 below summarises the management procedures recommended for airborne noise and vibration impact. These procedures are also further discussed in the report. Hence, where applicable, links to further references are provided in Table 15.

Table 15 Summary of mitigation procedures

Procedure	Abbreviation	Description	Further Reference
General Management Measures	GMM	Introduce best-practice general mitigation measures in the workplace which are aimed at reducing the acoustic impact onto the nearest affected receivers.	Refer to Section 5.4 For noise impact, also refer to Section 5.2 For vibration impact, also refer to Section 5.3
Project Notification	PN	Issue project updates to stakeholders, discussing overviews of current and upcoming works. Advanced warning of potential disruptions can be included. Content and length to be determined on a project-by-project basis.	Refer to Section 5.4
Verification Monitoring	V	Monitoring to comprise attended or unattended acoustic surveys. The purpose of the monitoring is to confirm measured levels are consistent with the predictions in the acoustic assessment, and to verify that the mitigation procedures are appropriate for the affected receivers. If the measured levels are higher than those predicted, then the measures will need to be reviewed and the management plan will need to be amended.	For noise impact, refer to Section 5.2.3. For vibration impact, refer to Section 5.3.2
Complaints Management System	CMS	Implement a management system which includes procedures for receiving and addressing complaints from affected stakeholders	Refer to Section 5.5.
Specific Notification	SN	Individual letters or phone calls to notify stakeholders that noise levels are likely to exceed noise objectives. Alternatively, contractor could visit stakeholders individually in order to brief them in regards to the noise impact and the mitigation measures that will be implemented.	Refer to Section 5.4.
Respite Offer	RO	Offer provided to stakeholders subjected to an ongoing impact.	Refer to section 5.2.1
Alternative Construction Methodology	AC	Contractor to consider alternative construction options that achieve compliance with relevant criteria. Alternative option to be determined on a case-by-case basis. It is recommended that the selection of the alternative option should also be determined by considering the assessment of on-site measurements (refer to Verification Monitoring above).	Refer to section 5.7.

The application of these procedures is in relation to the exceedances over the relevant criteria. For airborne noise, the criteria are based on NMLs. The allocation of these procedures is discussed in Section 5.1.2

For vibration, the criteria either correspond to human comfort, building damage or scientific and medical equipment. The application of these procedures is discussed in Section 5.1.3.

5.1.2 Allocation of Noise Management Procedures

For residences, the management procedures have been allocated based on noise level exceedances at the affected properties, which occur over the designated NMLs (refer to section 3). The allocation of these procedures is summarised in Table 16 below.

Table 16 Allocation of noise management procedures – residential receivers

Construction Hours	Exceedance over NML (dB)	Management Procedures (see definition above)
Standard Hours During approved working hours	0 - 3	GMM
	4 - 10	GMM, PN, V [1], CMS, AC
	> 10	GMM, PN, V, CMS, SN, AC
	> 75dBA	GMM, PN, V, CMS, SN, AC, RO
Outside Standard Hours As required	0 - 10	GMM, AC
	11 - 20	GMM, PN, V [1], CMS, AC
	> 20	GMM, PN, V, CMS, SN, AC

Notes

1. *Verification monitoring to be undertaken upon complaints received from affected receivers*

Please note the following regarding the allocation of these procedures:

- The exceedances have been estimated as part of the acoustic assessment, and these are summarised in Section 4.1.
- The allocation of procedures is based on the assumptions used for noise level predictions (refer to Section 4.1). Consequently, these allocations can be further refined once additional details of the construction program become available.

5.1.3 Allocation of Vibration Management Procedures

Table 17 below summarises the vibration management procedures to be adopted based on exceedance scenarios (i.e., whether the exceedance occurs over human comfort criteria, building damage criteria, or criteria for scientific and medical equipment). Please note these management procedures apply for any type of affected receiver (i.e., for residences as well as non-residential receivers).

Table 17 Allocation of vibration management procedures

Construction Hours	Exceedance Scenario	Management Procedures
Standard Hours During approved working hours	Over human comfort criteria (refer to Section 3)	GMM, PN, V, CMS
	Over building damage criteria (refer to Section 3)	GMM, V, AC, CMS
Outside Standard Hours As required	Over human comfort criteria (refer to Section 3)	GMM, SN, V, CMS
	Over building damage criteria (refer to Section 3)	GMM, V, AC, CMS

5.2 Site Specific Noise Mitigation Measures

5.2.1 Respite Periods

Predicted noise levels outlined in section 4.1 indicate exceedances above the Noise Management Levels (NMLs) as well as the Highly Noise Affected Level (HNAL) when in proximity to a boundary.

To militate against any exceedances, the site will need to introduce periods of respite for activities which are either undertaken in accordance with the *Conditions of Consent* **and/or** are creating noise levels above the HNAL only (i.e., greater than 75dBA).

In the event noise levels exceed 75dBA continuously at a neighbouring property respite periods should be developed in accordance with the ICNG and work on an assumption for every three (3) hours of work, one (1) hour of respite should be provided.

In addition to the recommendation above, condition C8 requires respite for *"Rock breaking, rock hammering, sheet piling and similar activities"* to have the following respite period.

> C8. Rock breaking, rock hammering, sheet piling, pile driving and similar activities may only be carried out between the following hours:
> (a) 9am to 12pm, Monday to Friday;
> (b) 2pm to 5pm Monday to Friday; and

Note: To clarify for any works which exceed 75dBA at a residential receiver for extended periods (approx. 3 hours) must provide 1 hour of respite. In addition to this, any activities listed in C8 must not operate outside times listed.

5.2.2 General Comments

The contractor will, where reasonable and feasible, apply best practice noise mitigation measures. These measures shall include the following:

- Maximising the offset distance between plant items and nearby noise sensitive receivers.
- Preventing noisy plant working simultaneously and adjacent to sensitive receivers.
- Minimising consecutive works in the same site area.
- Orienting equipment away from noise sensitive areas.
- Carrying out loading and unloading away from noise sensitive areas.

In order to minimise noise impacts during the works, the contractor will take all reasonable and feasible measures to mitigate noise effects.

The contractor will also take reasonable steps to control noise from all plant and equipment. Examples of appropriate noise control include efficient silencers and low noise mufflers.

The contractor should apply all feasible and reasonable work practices to meet the NMLs and inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels, duration of noise generating construction works, and the contact details for the proposal.

5.2.3 Noise Monitoring

Noise monitoring, if complaints are received, will be performed by an acoustical consultant directly engaged by the contractor.

Noise monitoring is recommended to be undertaken by attended noise measurements at the start of any new phase of works (i.e. demolition or remediation works etc.). The statistical parameters to be measured should include the following noise descriptors: L_{Amin}, L_{A90}, L_{A10}, L_{A1}, L_{Amax} and L_{Aeq}.

This monitoring should also be complemented by undertaking attended noise measurements in order to:

- Differentiate between construction noise sources and other extraneous noise events (such as road traffic and aircraft noise)
- Note and identify any excessive noise emitting machinery or operation.

In addition to the above detailed measurements, should any complaints be received which have not been determined previously, it should be confirmed by conducting additional attended noise measurements.

The survey methodology and any equipment should comply with the requirements discussed in Standard AS 1055.1-1997.

Based on the proposed works to be undertaken as part of the project the following noise monitoring is recommended:

1. Attended noise monitoring of excavation and construction activities is to be undertaken during the following periods:
    a. In response to any ongoing complaints received from neighbours.

5.2.4 Noise Mitigation Measures for Non-Residential Receivers

Where exceedances have been identified in Section 3, the following mitigation measures are recommended:

- Undertake general mitigation measures as discussed in Section 5.4
- Issue project updates to tenants in affected premises. The updates can include overview of current and upcoming works, as well as advanced warning of potential disruptions. These updates can also be issued through an email distribution list or via social media.
- Signage to be posted in order to provide stakeholders information regarding project details, emergency contacts and enquiry contact information.

5.2.5 Alternate Equipment or Process

Exceedance of the site's NMLs should result in an investigation as to whether alternate equipment could be used, or a difference process could be undertaken.

In some cases, the investigation may conclude that no possible other equipment can be used, however, a different process could be undertaken.

5.2.6 Acoustic Enclosures/Screening

Typically, on a construction site there are three different types of plant that will be used: mobile plant (i.e., excavators, skid steers, etc.), semi mobile plant (i.e., hand tools generally) or static plant i.e. (diesel generators).

For plant items which are static it is recommended that, in the event exceedances are being measured due to operation of the plant item, an acoustic enclosure/screen is constructed to reduce impacts. These systems can be constructed from Fibre Cement (FC) sheeting or, if airflow is required, acoustic attenuators or louvres.

For semi mobile plant, relocation of plant should be investigated to either be operated in an enclosed space or at locations away from a receiver.

With mobile plant it is generally not possible to treat these sources. However, investigations into the machine itself may result in a reduction of noise (i.e., mufflers/attenuators etc).

5.3 Vibration Mitigation Measures

5.3.1 General Comments

As part of the CNVMP, the following vibration mitigation measures should be implemented:

- Any vibration generating plant and equipment is to be in areas within the site in order to lower the vibration impacts.

- Investigate the feasibility of rescheduling the hours of operation of major vibration generating plant and equipment.
- Use lower vibration generating items of construction plant and equipment; that is, smaller capacity plant.
- Minimise conducting vibration generating works consecutively in the same area (if applicable).
- Use only dampened rock breakers and/or "city" rock breakers to minimise the impacts associated with rock breaking works.
- Conduct attended measurements of vibration generating plant at commencement of works in order to validate the indicative safe working distances advised in Table 35 and, consequently, to establish safe working distances suitable to the project. Measurements should be conducted at the nearest affected property boundary. These safe working distances should be defined by considering the vibration criteria discussed in Section 2 (i.e., criteria for structural damage, human comfort and impact to scientific or medical equipment).

5.3.2 Vibration Monitoring

Vibration monitoring, if complaints are received, should be undertaken continuously at the nearest most affected structures.

The monitoring location would be on a stiff part of the structure (at the foundation) on the side of the structure adjacent to the subject demolition and construction works.

The vibration monitoring system will be configured to record the peak vibration levels and to trigger an alarm when predetermined vibration thresholds are exceeded. The thresholds correspond to an "Operator Warning Level" and an "Operator Halt Level", where the Warning Level is 75% of the Halt Level. The Halt Level should be determined based on the vibration criteria for building contents and structure (refer to Section 2).

Exceedance of the "Operator Warning Level" would not require demolition work to cease, but rather, alerts the site manager to proceed with caution at a reduced force or load.

An exceedance of the "Operator Halt Level" would require the contractor to implement an alternative excavation technique pending further analysis of the vibration frequency content in order to determine any potential exceedance of the criteria.

The vibration monitoring equipment would be downloaded and analysed by the acoustical consultant.

Reports of the measured vibration levels and their likely impacts would be prepared by the acoustical consultant and issued to the contractor.

5.4 Community Consultation

Active community consultation and the maintenance of positive relations with local residents and businesses would assist in alleviating concerns and thereby minimising complaint. It is common for construction projects to provide community consultation if an exceedance of noise goals has been predicted. This communication is commonly conducted in the form of a letter box drop or more active engagement with more highly impacted receivers.

This form of notification should provide specific notification of the duration and timing of the construction activities so that residents are informed about the proposed works ahead of time. The letter should also provide the community with a hotline number for a community liaison officer available to adequately respond to all project related enquiries.

Ideally the hotline number should provide concerned locals an opportunity to raise any concerns with the project proponent and provide an opportunity to determine the best method to satisfy all requirements.

Prior to the works onsite being undertaken, it is recommended that community consultation with the neighbouring affected parties be undertaken.

The communication however should not be limited to the beginning of the onsite works but throughout providing the community with constant updates to the progress and upcoming works. In our experience these could include:

- Site noticeboard.
- Email notifications; and

- Letterbox drops.

5.5 Complaints Management System

Should complaints arise they must be delt with in a responsible and uniform manner, therefore a management system to deal with complaints is detailed above.

5.6 Contingency Plans

Contingency plans are required to address noise or vibration problems if excessive levels are measured at surrounding sensitive receivers and/or if justified complaints occur. Such plans include:

- Stop the onsite works.
- Identify the source of the main equipment within specific areas of the site which is producing the most construction noise and vibration at the sensitive receivers; and
- Review the identified equipment and determine if an alternate piece of equipment can be used or the process can be altered.
- In the event an alternate piece of equipment or process can be used, works can re-commence.
- In the event an alternate piece of equipment or process cannot be determined implement a construction assessment to be performed by a suitably qualified acoustic consultant.

The Superintendent shall have access to view the Contractor's noise measurement records on request. The Superintendent may undertake noise monitoring if and when required.

5.7 General Mitigation Measures (Australia Standard 2436-2010)

As well as the above project specific noise mitigation controls, AS 2436-2010 "*Guide to Noise and Vibration Control on Construction, Demolition and Maintenance Sites*" sets out numerous practical recommendations to assist in mitigating construction noise emissions. Examples of strategies that could be implemented on the subject project are listed below, including the typical noise reduction achieved, where applicable.

5.7.1 Adoption of Universal Work Practices

- Regular reinforcement (such as at toolbox talks) of the need to minimise noise and vibration.
- Regular identification of noisy activities and adoption of improvement techniques.
- Avoiding the use of portable radios, public address systems or other methods of site communication that may unnecessarily impact upon nearby sensitive receivers.
- Where possible, avoiding the use of equipment that generates impulsive noise.
- Minimising the need for vehicle reversing for example (particularly at night), by arranging for one-way site traffic routes.
- Use of broadband audible alarms on vehicles and elevating work platforms used on site.
- Minimising the movement of materials and plant and unnecessary metal-on-metal contact.
- Minimising truck movements.

5.7.2 Plant and Equipment

- Choosing quieter plant and equipment based on the optimal power and size to most efficiently perform the required tasks.
- Selecting plant and equipment with low vibration generation characteristics.

- Operating plant and equipment in the quietest and most efficient manner.

5.7.3 On Site Noise Mitigation

- Maximising the distance between noise activities and noise sensitive land uses.
- Installing purpose-built noise barriers, acoustic sheds and enclosures.

5.7.4 Work Scheduling

- Providing respite periods which could include restricting very noisy activities to time periods that least affect the nearby noise sensitive locations, restricting the number of nights that after-hours work is conducted near residences or by determining any specific requirements.
- Scheduling work to coincide with non-sensitive periods.
- Planning deliveries and access to the site to occur quietly and efficiently and organising parking only within designated areas located away from the sensitive receivers.
- Optimising the number of deliveries to the site by amalgamating loads where possible and scheduling arrivals within designated hours.
- Including contract conditions that include penalties for non-compliance with reasonable instructions by the principal to minimise noise or arrange suitable scheduling.

5.7.5 Source Noise Control Strategies

Some ways of controlling noise at the source are:

- Where reasonably practical, noisy plant or processes should be replaced by less noisy alternatives.
- Siting of equipment: locating noisy equipment behind structures that act as barriers, or at the greatest distance from the noise-sensitive area; or orienting the equipment so that noise emissions are directed away from any sensitive areas, to achieve the maximum attenuation of noise.
- Regular and effective maintenance.

5.7.6 Miscellaneous Comments

Deliveries should be undertaken, where possible, during standard construction hours.

Maximise hammer penetration (and reduce blows) by using sharp hammer tips. Keep stocks of sharp profiles at site and monitor the profiles in use.

It is advised that mobile plant and trucks operating on site for a significant portion of the project are to have reversing alarm noise emissions minimised. This is to be implemented subject to recognising the need to maintain occupational safety standards.

No public address system should be used on site (except for emergency purposes).

6 CONCLUSION

Pulse White Noise Acoustics (PWNA) has been engaged by Multiplex Constructions Pty Ltd to prepare a Construction Noise and Vibration Management Plan (CNVMP) for the proposed Eurobodalla Regional Hospital Early Works Project.

This CNVMSP has been prepared to satisfy the requirements of Condition B16 of the Consent given in the Notice of Determination – Approval issued for Development Application No. SSD 56989722, dated 24th May 2024.

An assessment of noise and vibration impacts from the required processes to be undertaken during the construction period of the project (including excavation and construction) has been undertaken and suitable treatments, management controls, perioding measurements and community engagement has been detailed in this report.

Providing the recommendations in this report are included in the construction of the site, compliance with the relevant EPA's Interim Construction Noise Guideline Objectives and condition B17 of the projects Conditions of Consent can be achieved.

For any additional information please do not hesitate to contact the person below.

Regards,

Matthew Furlong
Principal Acoustic Engineer
PULSE WHITE NOISE ACOUSTICS PTY LTD

APPENDIX A: ACOUSTIC GLOSSARY

The following is a brief description of the acoustic terminology used in this report:

Ambient Sound	The totally encompassing sound in a given situation at a given time, usually composed of sound from all sources near and far.
Audible Range	The limits of frequency which are audible or heard as sound. The normal ear in young adults detects sound having frequencies in the region 20 Hz to 20 kHz, although it is possible for some people to detect frequencies outside these limits.
Character, acoustic	The total of the qualities making up the individuality of the noise. The pitch or shape of a sound's frequency content (spectrum) dictate a sound's character.
Decibel [dB]	The level of noise is measured objectively using a Sound Level Meter. The following are examples of the decibel readings of every day sounds; 0 dB the faintest sound we can hear 30 dB a quiet library or in a quiet location in the country 45 dB typical office space. Ambience in the city at night 60 dB Martin Place at lunch time 70 dB the sound of a car passing on the street 80 dB loud music played at home 90 dB the sound of a truck passing on the street 100 dB the sound of a rock band 115 dB limit of sound permitted in industry 120 dB deafening
dB(A)	*A-weighted decibels* The ear is not as effective in hearing low frequency sounds as it is hearing high frequency sounds. That is, low frequency sounds of the same dB level are not heard as loud as high frequency sounds. The sound level meter replicates the human response of the ear by using an electronic filter which is called the "A" filter. A sound level measured with this filter switched on is denoted as dB(A). Practically all noise is measured using the A filter. The sound pressure level in dB(A) gives a close indication of the subjective loudness of the noise.
Frequency	Frequency is synonymous to *pitch*. Sounds have a pitch which is peculiar to the nature of the sound generator. For example, the sound of a tiny bell has a high pitch and the sound of a bass drum has a low pitch. Frequency or pitch can be measured on a scale in units of Hertz or Hz.
Loudness	A rise of 10 dB in sound level corresponds approximately to a doubling of subjective loudness. That is, a sound of 85 dB is twice as loud as a sound of 75 dB which is twice as loud as a sound of 65 dB and so on
LMax	The maximum sound pressure level measured over a given period.
LMin	The minimum sound pressure level measured over a given period.
L1	The sound pressure level that is exceeded for 1% of the time for which the given sound is measured.
L10	The sound pressure level that is exceeded for 10% of the time for which the given sound is measured.
L90	The level of noise exceeded for 90% of the time. The bottom 10% of the sample is the L_{90} noise level expressed in units of dB(A).
Leq	The "equivalent noise level" is the summation of noise events and integrated over a selected period of time.
dB (A)	'A' Weighted overall sound pressure level
Sound Pressure Level, LP dB	A measurement obtained directly using a microphone and sound level meter. Sound pressure level varies with distance from a source and with changes to the measuring environment. Sound pressure level equals 20 times the logarithm to the base 10 of the ratio of the rms sound pressure to the reference sound pressure of 20 micro Pascals.
Sound Power Level, Lw dB	Sound power level is a measure of the sound energy emitted by a source, does not change with distance, and cannot be directly measured. Sound power level of a machine may vary depending on the actual operating load and is calculated from sound pressure level measurements with appropriate corrections for distance and/or environmental conditions. Sound power levels is equal to 10 times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power of 1 picoWatt

APPENDIX B: AUTHOR CURRICLULUM VITAE (CV)

MATTHEW FURLONG

Principal Acoustic Engineer

Qualifications

Bachelor of Creative Technology (Audio Engineering and Sound Production)

Member of the Australian Acoustical Society (AAS)

Matthew Furlong has 10 years' experience in delivering acoustic design on architectural, environmental and infrastructure projects, including conceptual, detailed design, construction, and post-construction stages.

He has consulted for mixed use of education, health commercial and residential developments, developing in-principal recommendations for the client, and managing contractor providing detailed design advice as well as full construction services.

Selected Project Experience

Commercial

- Development Application, Acoustic Design and Construction Services Winston Hills Mall Enabling Works.
- Development Application and Acoustic Design 210-220 George Street Sydney.
- Acoustic Design and Construction Services 151 Clarence Street, Sydney.
- Development Application for 390-396 Pitt Street, Haymarket.
- Acoustic Design and Construction Services Chifley Plaza Internal Works.
- Development Application 371-375 Pitt Street, Sydney.
- Construction Services Fitout of the Department of Premier and Cabinets.
- Noise Investigations for Transport NSW (Chatswood and Burwood).
- Schematic Design for Western Sydney Airport – Nancy Warbird (WSA).
- Schematic Design, Detailed Design, Tender, IFC, Construction Johnson Winter Slattery (JWS) Sydney Office Fitout.
- Schematic Design, Detailed Design, Tender, IFC, Construction UHY Haines Norton Sydney Office Fitout.

Residential

- Acoustic Design for Crown Casino Sydney.
- Acoustic Design and Construction Services 130 Elizabeth Street, Sydney (One30Hyde).
- Acoustic Design and Construction Services Trinity Terraces Rosebery.
- Construction Services 1a Coulson Street, Erskinville.
- Construction Services for the Erko Apartments Erskinville.
- Construction Services for the Eve Apartments Erskinville.
- Acoustic Design 54-56 Riley Street and 1 Crown Lane, Darlinghurst.
- Development Application, Acoustic Design and Construction Services New Life Darling Harbour, 495 Harris Street, Ultimo.

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- Development Application, Acoustic Design and Construction Services Meriton Developments (Mascot, Rosebery, Epping, Parramatta, Pagewood, Bondi, Dee Why, Zetland, Waterloo, North Sydney, Sydney, Macquarie Park).
- Development Application, Acoustic Design and Construction Services Summer Hill Flourmill Stages 1, 2, 3 and 4.
- Acoustic Design and Construction Services Macquarie Park Village.
- Acoustic Design and Construction Services Ryde Gardens.
- Acoustic Design and Construction Services Tempo Apartments Victoria Road Drummoyne.
- Development Application, Acoustic Design and Construction Services Winston Hills Mall Residential.
- Construction Services Presbyterian Aged Care Paddington.
- Acoustic Design and Construction Services Wahroonga Nursing Home.
- Acoustic Design and Construction Anglicare Castle Hill (ARV).
- Acoustic Design and Construction Cardinal Freeman Village, Ashfield.

Education

- Schematic, SSDA, Detailed Design, IFC, Construction Carlingford West Public School
- Masterplan, Concept, Schematic and SSDA Tallawong Station Public School.
- Masterplan, Concept, Schematic and SSDA Tallawong Public School.
- Schematic and SSDA Macquarie Park Public School.
- Detailed Design Neutral Bay Public School.
- SSDA, Acoustic Design, Construction and Commissioning Meadowbank Education Precinct (School + TAFE – certain elements)
- Schematic, SSDA, Detailed Design, IFC, Construction and Commissioning New Primary School in Murrumbateman
- Schematic, SSDA, Detailed Design, IFC, Construction and Commissioning New Primary School in Googong.
- Design Finalisation, IFC, Construction and Commissioning Chatswood High School.
- Design Finalisation, IFC, Construction and Commissioning Chatswood Public School.
- Schematic, Planning Pathway Hurlstone Agricultural High School.
- Schematic, Planning Pathway Yanco Agricultural High School.
- CNVMP and Construction Services Anzac Park Public School.
- CNVMP and Construction Services Alexandria Park Public School.
- Planning Pathway, Detailed Design, Tender, Design Finalisation, Commissioning Aspect Autism Schools Australia.
    - Cardiff Heights School.
    - The Gables School.
    - Corrimal School.
    - Central Coast Primary School.
    - Central Coast Secondary School.
    - Vern Barnett School.

Health Facilities

- Master Planning, Feasibility, Schematic, SSDA, Detailed Design and IFC for Sydney Children's Hospital Stage 1 & Children's Comprehensive Cancer Centre (SCH1/CCCC), Randwick.
- Formulation of the new Victorian Health Engineering Guidelines (Acoustics).
- Construction Services for Wagga Wagga Base Hospital Stage 2.
- SSDA and Acoustic Design for Concord Repatriation General Hospital.
- SSDA and Acoustic Design Nepean Public Hospital.
- CNVMP, Design Finalisation, IFC, Construction Campbelltown Hospital Redevelopment Works

Licensed Premises

- Development Application for The Cauliflower Hotel, Waterloo
- Development Application for Christopher Hanna Salon and Bar, 13-15a Bridge Street, Sydney
- Development Application for the Tilbury Hotel Woolloomooloo.
- Development Application for the Exchange Hotel, Balmain.
- Development Application for the Town Hall Hotel, Balmain.
- Development Application for the Exchange Hotel, Darlinghurst.
- Development Application for 388 George Street, Sydney.
- Development Application for 88 Pitt Street, Sydney.
- Development Application for 92 Pitt Street, Sydney.
- Development Application for Pilu Freshwater.
- Development Applications for the Redevelopment of Ibis Hotels:
    - Enfield NSW.
    - Liverpool NSW.
    - Wentworthville NSW.
    - Sydney Airport NSW.
    - St Peters NSW.
    - Olympic Park NSW.
    - Thornleigh NSW.

Industrial

- Acoustic design Erskine Park Industrial Area.
- CNVMP, Acoustic Design, IFC and Construction Snackbrands Orchard Hills.
- CNVMP, Acoustic Design, IFC and Construction Logos Moorebank (Warehouse 6 & 7).