

New Maitland Hospital  
State Significant Infrastructure Application - Stage 2  
Noise and Vibration Assessment

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# 1 INTRODUCTION

Acoustic Logic Consultancy has been engaged by Multiplex to undertake an acoustic assessment of potential operation and proposed construction noise and vibration from the New Maitland Hospital (NMH) project.

In this report, we will:

- Identify nearby noise sensitive receivers and anticipated noise and vibration sources with the potential to adversely impact nearby development.
- Identify relevant EPA acoustic criteria applicable to the development for operational and construction noise.
- Identify proposed construction hours and provide details of the instances where it is expected that works will be required to be carried out outside the standard construction hours
- Predict noise emissions and assess them against acoustic criteria.
- If necessary, determine management controls necessary to mitigate noise and vibration impacts.

In order to satisfy the following SEARs requirements:

- SSI 9975 SEARS 9. Noise and Vibration
- SSI 9975 SEARS 18. Construction Hours
- SSI 9022 Approval Conditions – Sch.2, Part.B, Item.B5, Requirements for Future Stages
- SSI 9022 Approval Conditions – Sch.2, Part.B, Item.B6, Requirements for Future Stages

## 2 SITE DESCRIPTION

New Maitland Hospital is located on the eastern side of Metford Road (on Lot 7314 DP 1162607 and part Lot 401 DP 755237). The site is bound by industrial development and active recreation facilities to the west, an existing CSR rehabilitation site to the north, and residential properties to the south.

### 2.1 PROJECT DESCRIPTION

The NMH will provide the infrastructure required to adequately meet the anticipated growth in demand and enhance an integrated patient journey from acute, subacute and ambulatory care services to community-based services in partnership with other health providers.

The Project generally includes the following:

- 289 beds for day and overnight medical, surgical, paediatric, short stay, maternity and mental health services
- 8 bed critical care service (ICU);
- 12 cot Special Care Nursery for neonates;
- 24 day and overnight rehabilitation beds in addition to the existing beds at Kurri Kurri Hospital to meet overall rehabilitation demand;
- New Emergency department;
- 24 bed Mental health inpatient services and a new 6 bed psychiatric emergency care center (PECC);
- Satellite renal dialysis;
- A new chemotherapy service and expanded oral health service;
- Ambulatory care and outpatient clinics;
- Support spaces including operating theatres and recovery stage 1 and 2, delivery suites and assessment rooms;
- Imaging modalities including MRI, x-ray, CT, Orthopantomogram (OPG), ultrasound; and
- Clinical support services including Central Sterile Services Department, pharmacy, pathology, fluoroscopy, isolation rooms where required, plaster rooms and gyms to support both general and mental health services for residents.

### 2.2 CONSTRUCTION ACTIVITIES AND METHODOLOGY

Following is a description of the activities and methodology proposed to be employed to complete the construction of the New Maitland Hospital.

Construction will consist primarily of the following:

- Stage 1 Early Works
- Excavation will be required. Given the geological conditions at the site, excavation is expected to be conducted using rippers (noise/vibration intensive equipment such as rock saws and hydraulic hammers is not expected to be required).
- Materials handling area (deliveries) and concrete pumping stations are proposed along the northern boundary of the site. Vehicular access is via a driveway on Metford Road.
- Construction will be typical concrete frame building construction, with glass facade and cladding installation.

## **2.3 RECEIVERS**

Noise sensitive development in the vicinity of the site, consists of:

- Residential developments to the south;
- Active recreation space to the west (sports field); and
- Industrial developments to the west.

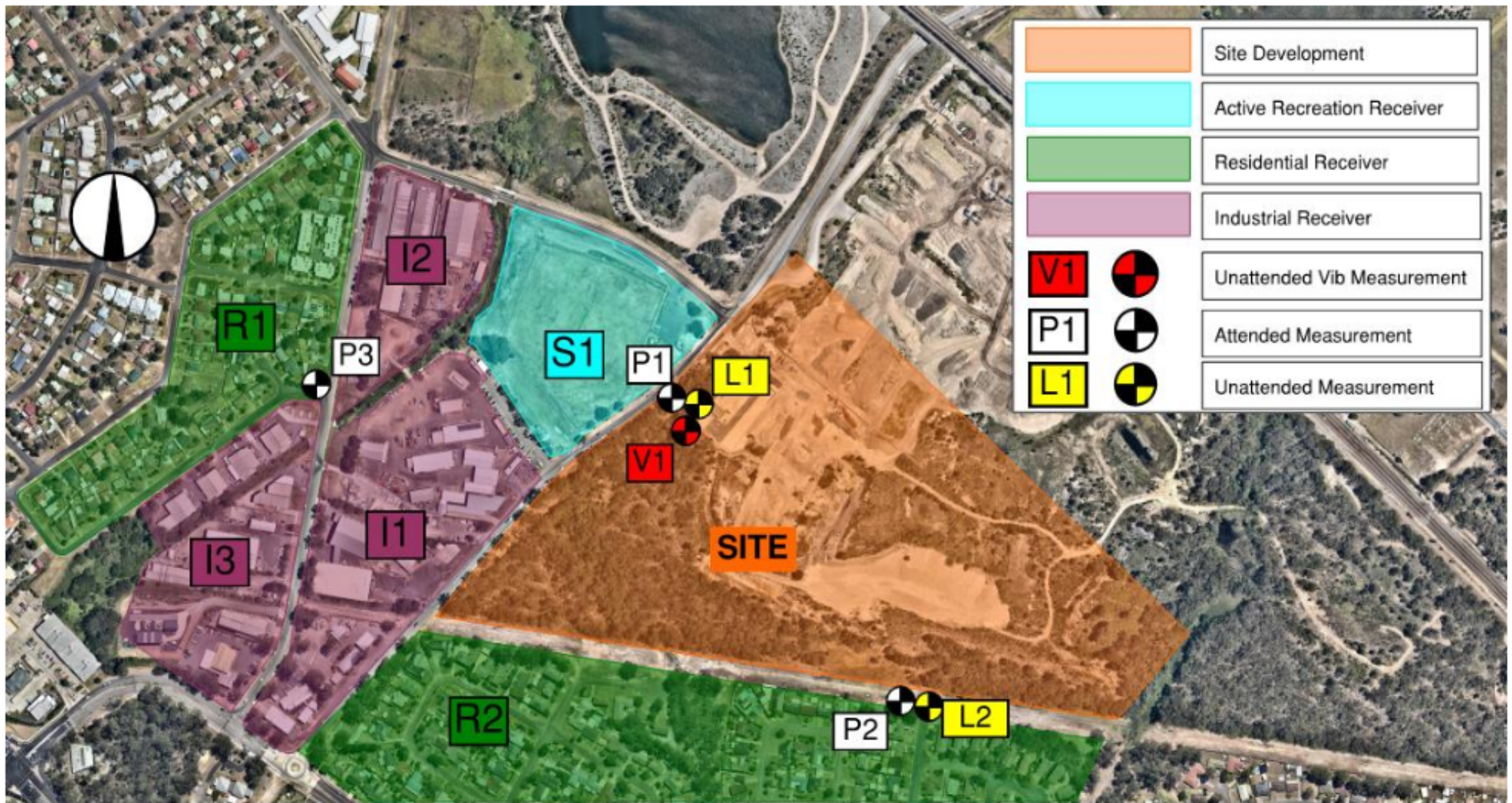
See aerial photograph below, in Figure 1 showing the site and receiver locations. The site plan is shown in Figure 2.

## **2.4 HOURS OF CONSTRUCTION**

Works are proposed to be undertaken during the following construction hours:

- Monday to Friday 7:00am to 6:00pm
- Saturday 7:00am to 5:00pm
- No work on Sundays and Public Holidays; and
- Low noise activities carried out (e.g. handheld tools (including power tools), painting etc) may be carried out at all times provided the activities do not cause offensive noise

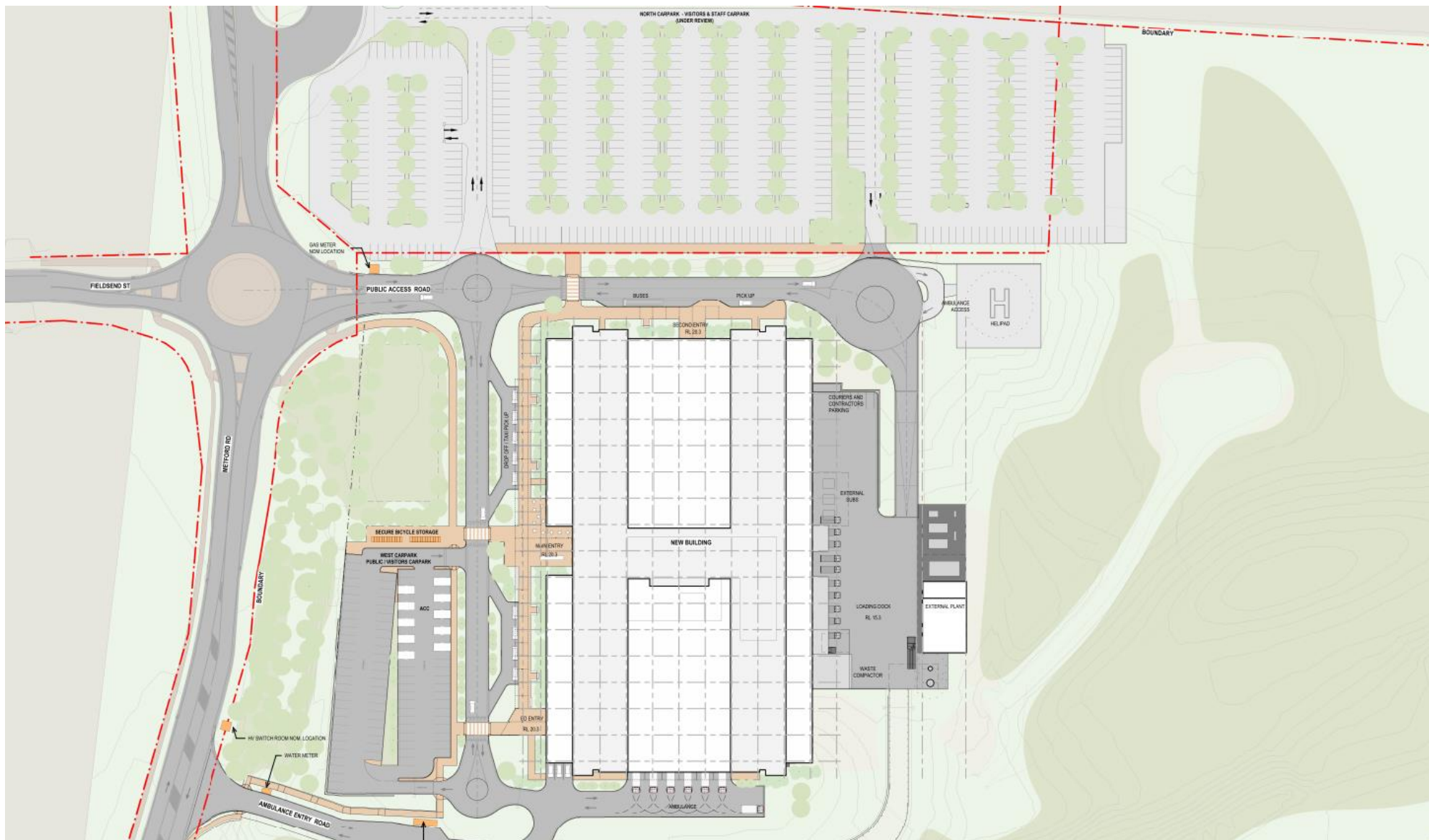




Source: [nearmap.com](https://nearmap.com)

Figure 1 – Aerial View of Site and Receivers





**Figure 2 – Site Plan**



### 3 SURVEY OF AMBIENT NOISE

Both long term unattended noise logging and attended noise measurements were conducted to quantify the existing acoustic environmental and have been presented in the *Noise & Vibration Impact Assessment for Stage 1* prepared by Wood & Grieves, dated 8 May 2018. The location of the monitors and measurements are outlined in Figure 1. See Wood & Grieves Report (Project-No. 32489-1, dated: 08/05/18) for detailed assessment of background noise levels.

The resultant long term noise logging data is presented below.

**Table 1 – Long Term Noise Logging Data**

Location	Time of Day		
	Daytime (7am-6pm)	Evening (6pm-10pm)	Night (10pm-7am)
Residential Properties to the South	49dB(A) <sub>Leq(Day)</sub> 42dB(A) <sub>L90</sub>	48dB(A) <sub>Leq(Evening)</sub> 42dB(A) <sub>L90</sub>	45dB(A) <sub>Leq(Night)</sub> 37dB(A) <sub>L90</sub>

### 4 NEW MAITLAND HOSPITAL (STAGE 2) SSI 9775 APPLICATION

#### SSI 9975 SEARS 9. Noise and Vibration

- *Identify and provide a quantitative assessment of the main noise and vibration generating sources during construction and operation and outline measures to minimise and mitigate the potential noise impacts on surrounding occupiers of land.*

#### SSI 9975 SEARS 18. Construction Hours

- *Identify proposed construction hours and provide details of the instances where it is expected that works will be required to be carried out outside the standard construction hours*

#### SSI 9022 Approval Conditions – Sch.2, Part.B, Item.B5, Requirements for Future Stages

- *The SSI application for the detailed design and construction of the NMH must be accompanied by a detailed noise and vibration impact assessment prepared by a suitably qualified person, which details the main construction and operational noise and vibration sources and activities, including future mechanical plant. Details are also to be included outlining all feasible and reasonable noise and vibration mitigation and management measures.*

#### SSI 9022 Approval Conditions – Sch.2, Part.B, Item.B6, Requirements for Future Stages

- *The noise and vibration impact assessment, as required by condition B5 of Schedule 2, must demonstrate that the location and operation of the helipad has been designed to minimise noise impacts on sensitive land uses.*

## 5 OPERATIONAL NOISE & VIBRATION

### 5.1 NOISE CRITERIA

Wood & Grieve's 'Acoustic Performance Specification' (Project No. 32489-1, Dated 20<sup>th</sup> June 2018) and 'Noise & Vibration Impact Assessment for Stage 1' (Project No. 32489-1, Dated 8<sup>th</sup> May 2018) outlines external acoustic criteria for NMH. These criteria have been restated below.

Noise and vibration emissions from the operation of the hospital shall comply with the following criteria.

#### 5.1.1 Sleep Disturbance

Wood & Grieve's 'Acoustic Performance Specification' states the following with reference to sleep disturbance:

*"The NSW NPI, the NSW RNP and the NSW ENCM address the issue of sleep arousal. The NSW ENCM makes the general observation that a person's sleep can be significantly disrupted by noise. Scientific research has established that short duration or intermittent noise is more disturbing to sleep than continuous noise of similar acoustic energy. The following is concluded from interim research discussed in these documents:*

- *L<sub>Amax</sub> noise levels less than 50-55dB(A) are unlikely to cause sleep disturbance*
- *One or two events per night with 65-70dB(A) L<sub>Amax</sub> noise levels are not likely to cause adverse health effects*

*Chapter 19 of the NSW ENCM provides guidelines for assessing sleep disturbance resulting from short-duration high-level noises which occur at night (10:00pm to 7:00am according to the NSW EPA) as follows:*

*"Noise control should be applied with the general intent to protect people from sleep arousal. To achieve this, the L<sub>1</sub> level of any specific noise source should not exceed the background noise level (L<sub>90</sub>) by more than 15dB(A) when measured outside the bedroom window."*

*Furthermore, the NSW NPI and the NSW RNP provide guidelines to indicatively assess sleep arousal events based on maximum internal noise levels. The application notes of the previous version of the NSW NPI state that the current sleep disturbance criterion of an L<sub>A1,1min</sub> not exceeding the L<sub>A90,15min</sub> by more than 15dB(A) is not ideal. Nevertheless, as there is insufficient evidence to determine what should replace it, the NSW EPA will continue to use it as a guide to identify the likelihood of sleep disturbance. This means that where the criterion is met, sleep disturbance is not likely to occur, but where it is not met, a more detailed analysis is required. The current NSW NPI external noise level criteria are as follows:*

- *L<sub>Aeq,15min</sub> less than 40 dB(A) or the prevailing background noise level plus 5 dB, whichever is the greater, and/or*
- *L<sub>AFmax</sub> less than 52 dB(A) or the prevailing background noise level plus 15 dB, whichever is the greater.*

*According to the application notes of the previous version of the NSW NPI, the assessment can be undertaken using the L<sub>A1(1 minutes)</sub> or the L<sub>Amax</sub> noise descriptors provided these are obtained under 'fast' time response.*

*Therefore, based on the guidelines discussed herein, an external L<sub>Amax</sub> noise level of 50dB(A) at the residences will ensure that the internal noise level requirements for sleep arousal will also be achieved. Please note this criterion should be confirmed with further measurements of existing ambient noise levels on site and at the nearest affected residences.*

*It should also be noted that compliance with this criterion will influence mitigation measures for plant items which operate during the night time period and emergency equipment such as stand-by generators.”*

### 5.1.2 External Noise Criteria

Wood & Grieve’s ‘Acoustic Performance Specification’ states the following with reference to external noise criteria:

*“The noise being emitted from the development into the surroundings must be considered to preserve the existing noise environment for the nearby sensitive receivers. Generally, most of the operational noise comes from various mechanical equipment and plant, but the noise from vehicle movements etc. should also be taken into account.*

*A noise survey including both unattended and attended measurements was conducted from the 15<sup>th</sup> to the 24<sup>th</sup> of June 2017. The results and the determination of the external noise level criteria following the NSW NPI (year 2000 issue) have been detailed in the previous Wood & Grieve report for Stage 1 Town Planning submission.”* The resulting project specific noise levels (PSNL) have been reproduced in Table 2.

**Table 2 - External Noise Emissions**

Type of Receiver	Time of Day	Descriptor	PSNL. dB(A)
Residential - R1, R2	Day	L <sub>Aeq,15min</sub>	47
	Evening	L <sub>Aeq,period</sub>	45
	Night	L <sub>Aeq,period</sub>	40
		L <sub>A,max</sub>	< 45
Industrial - I1-I3	When in use	L <sub>Aeq,period</sub>	70
Active Recreation Area - S1	When in use	L <sub>Aeq,period</sub>	55

*“The overall external noise level criteria (defined in the NSW NPI as project specific noise levels) apply to all external noise emissions by the hospital, such as mechanical plant items and car parking. Hence, an assessment based on these criteria should determine any necessary treatment to these mechanical plant items and other sources in order to achieve compliance. Typically, these apply to all outdoor plant units and external air paths (i.e. outside air, relief air, exhaust air). The assessment should be conducted at all external noise sensitive receivers identified in Section 3.4 of this report.”*

### 5.1.3 Traffic Noise Generation Criteria

Wood & Grieve’s ‘Noise & Vibration Impact Assessment for Stage 1’ (Project No. 32489-1, Dated 8<sup>th</sup> May 2018) states the following with reference to traffic noise generation criteria:

*“The L<sub>Aeq</sub> noise level or the “equivalent continuous noise level” correlates best with the human perception of annoyance associated with traffic noise. Road traffic noise impact is assessed in accordance with the NSW Road Noise Policy (RNP, Office of Environment and Heritage 2011). The criterion (Table 3 – Road Traffic Noise Assessment Criteria for Residential Land Uses) divides land use developments into different categories and lists the respective criteria for each case. The category that is relevant to the proposed use of the site is shown below in Table 13 (Table 3 in this report).”*

**Table 3 – NSW Road Noise Policy - Traffic Noise Assessment Criteria**

Road Category	Type of project/land use	Assessment Criteria – dB(A)	
		Day (7am – 10pm)	Night (10pm – 7am)
Freeway/ arterial/ sub- arterial roads	1. Existing residences affected by noise from new freeway/arterial/sub-arterial road corridors	L <sub>Aeq</sub> , (15 hour) 55	L <sub>Aeq</sub> , (9 hour) 50
	2. Existing residences affected by noise from redevelopment of existing freeway/arterial/subarterial roads	L <sub>Aeq</sub> , (15 hour) 60	L <sub>Aeq</sub> , (9 hour) 55
	3. Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments		
Local Roads	4. Existing residences affected by noise from new local road corridors	L <sub>Aeq</sub> , (1 hour) 55	L <sub>Aeq</sub> , (1 hour) 50
	5. Existing residences affected by noise from redevelopment of existing local roads		
	6. Existing residences affected by additional traffic on existing local roads generated by land use developments		

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

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

*Also, the inherent quality of noise from vehicles on public roads arriving to and departing from the site would be indistinguishable from other traffic noise on public roads."*

## 5.2 VIBRATION CRITERIA

Wood & Grieve's 'Noise & Vibration Impact Assessment for Stage 1' (Project No. 32489-1, Dated 8<sup>th</sup> May 2018) states the following with reference to vibration criteria:

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

### 5.2.1 Human Comfort – Continuous and Impulsive Vibration Criteria

*"Structural vibration in buildings can be detected by occupants and can affect them in many ways including reducing their quality of life and also their working efficiency. Complaint levels from occupants of buildings subject to vibration depend upon their use of the building and the time of the day. Maximum allowable magnitudes of building vibration with respect to human response are shown*

in Table 17 (Table 4 in this report). It should be noted that the human comfort for vibration are more stringent than the building damage criteria.”

**Table 4 – Preferred and Maximum Weighted RMS Values for Continuous and Impulsive Vibration Acceleration (m/s<sup>2</sup>) 1-80Hz**

Location	Assessment Period	Preferred Values		Maximum Values	
		z-axis	x & y-axis	z-axis	x & y-axis
CONTINUOUS VIBRATION					
Residences	Daytime	0.010	0.0071	0.020	0.014
	Night time	0.007	0.005	0.014	0.010
Offices, schools, educational institutions and place of worship	Day or night time	0.020	0.014	0.040	0.028
IMPULSIVE VIBRATION					
Residences	Daytime	0.30	0.21	0.60	0.42
	Night time	0.10	0.071	0.20	0.014
Offices, schools, educational institutions and place of worship	Day or night time	0.64	0.46	1.28	0.92

### 5.2.2 Human Comfort – Intermittent Vibration Criteria

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

**Table 5 – Acceptable Vibration Dose Values for Intermittent Vibration (m/s<sup>1.75</sup>)**

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

### 5.2.3 Structural Damage – Vibration Criteria

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

Most commonly specified structural vibration levels are defined to minimize the risk of cosmetic surface cracks and are set below the levels that have the potential to cause damage to the main structure. Structural damage criteria are presented in German Standard DIN4150-Part 3 “Structural



vibration in buildings – Effects on structures” and British Standard BS7385-Part 2: 1993 “Evaluation and Measurement for Vibration in Buildings”. Table 19 (Table 6 in this report) indicates the vibration limits presented in DIN4150-Part 3 to ensure structural damage doesn’t occur.”

**Table 6 – Guideline value of vibration velocity,  $v_i$ , for evaluating the effects of short-term vibration**

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

## 5.3 OPERATIONAL NOISE ASSESSMENT

### 5.3.1 External Car park, Loading Dock & Waste Collection

Wood & Grieve's 'Noise & Vibration Impact Assessment for Stage 1' (Project No. 32489-1, Dated 8<sup>th</sup> May 2018) looks at external car park noise using the methodologies as presented in the NSW Noise Policy for Industry. It was found that noise generated from use of the car park and loading dock were less than 45dB(A) during the evening time, and thus compliant with the noise emission criteria outlined in section 5.1.

Acoustic Logic concurs with these findings.

### 5.3.2 Traffic Noise Generation

Wood & Grieve's 'Noise & Vibration Impact Assessment for Stage 1' (Project No. 32489-1, Dated 8<sup>th</sup> May 2018) looks at traffic noise generation. It was found the maximum increase in traffic noise due to the development is 0.3dB(A), and thus compliant with the noise emission criteria outlined in section 5.1.

Acoustic Logic concurs with these findings.

### 5.3.3 Helicopter

#### Location

We confirm that the helipad has been located in the north-eastern portion of the site, which is the furthest feasible location for the helipad from the residents located to the south. It is also located more than 50-meters from the closest hospital building façade. See figure 2 for site map.

#### Frequency of Use

AviPro (Helicopter Landing Site (HIS) Concept Design Report For Ssi Stage 1 ) have noted the following with regards to the helicopter landing site frequency of use:

*"The number of helicopter movements for the existing Maitland Hospital is approximately 2 per month being for emergency aeromedical transfers. It is anticipated, given the growth of the area and the availability of increased clinical capability at the NMH, that the use of the helicopter landing site moving forward may increase, albeit not substantially. The frequency of use will depend on patient needs and clinical transfer policies. Whilst the exact figure is unknown, it is anticipated that the frequency may be approximately three flights per month. "*

#### Noise Emission

There are no mandatory acoustic criteria with respect to noise from emergency vehicles.

Acoustic guidelines such as the EPA Noise Policy for Industry and Australian Standard 2021:2015 are commonly adopted guidelines for noise emissions and for aircraft noise respectively. However, neither are appropriate for use in assessment of emergency helicopter noise, which is much more infrequent than industrial noise or noise from commercial aircraft.

Other relevant (although not mandatory) guidelines are:

- The EPA Noise Control Manual. Although no longer used by the EPA, the Noise Control Manual provides some guidance for helicopter noise. The Noise Control Manual recommends:
  - Peak noise events – noise not exceed 82dB(A)<sub>L<sub>max</sub></sub> at residential properties and 85dB(A)<sub>L<sub>max</sub></sub> at commercial properties.

- Average noise levels (ie – the noise level averaged over the entire day) should not exceed 55dB(A) at residential properties and 65dB(A) at commercial properties.

The Noise Control Manual, however, does not apply to emergency vehicles.

- Air Services Australia *Environmental Principles and Procedures for Minimising the Impact of Aircraft Noise*. Principle 7 states – *There should be a current agreed aircraft noise exposure level above which no person should be exposed, and agreement that this level should be progressively reduced. The goal should be 95dB(A).* (This performance goal was adopted at Royal North Shore, where there are typically 3-4 helicopter movements per week).

We note, however, that the above guidelines are not intended to be applied to emergency vehicles. Regardless, given the location of the helipad and proposed flight movements, a worst-case helicopter movement is predicted to not exceed 85dB at the nearest residential receivers. Which is 10dB less than the Air Services Australia noise guideline of 95dB(A).

#### **5.3.4 Mechanical Plant Equipment Noise**

As detailed plant selections for the NMH are not available at this stage, it is not possible to carry out a detailed examination of the ameliorative measures that may be required to achieve the noise targets.

Plant will be acoustically treated to prevent noise emissions from adversely impacting the surrounding properties in conjunction with the criteria detailed in this report. This may include selecting the quietest plant practicable, or treating the plant with enclosures, barriers, duct lining and silencers, etc as required to comply with the sound level recommendations.

Experience with similar projects indicates that it would be possible to achieve the requirement with appropriate treatment of the plant. General requirements for a number of potential plant items on the site are expanded on below. A preliminary review of the major plant items and general fans has been provided below.

##### **5.3.4.1 Air Handling Units**

The Air Units (AHU) are proposed to be installed within an enclosed plant rooms located on basement 1 on the northern corner and north-western end of the building.

The plant rooms will provide good acoustic shielding. In regard to air flow; outside air to and exhaust from the AHU's will be ducted to the externals via rigid ducts which have the potential to be treated using lining, bends and silencers/attenuators. Thus, all AHUs are capable of meeting the noise emission criteria, set out in section 5.1 of this report

#### **5.3.4.2 Chillers**

The chillers are proposed to be installed within an enclosed plant room located on basement 1 on the northern-eastern end of the building.

The plant rooms will provide sufficient acoustic attenuation, and should not have any external ventilation opening/louvre.

If ventilation is required, attenuators must be implemented on façade louvres (indicatively 1200mm long 45% open area rectangular attenuators based on a 1500 x 1500mm opening size).

Light weight cladding to plant room walls and ceiling will potentially require internal plasterboard sheeting to ensure noise breakout through wall/roof are compliant with NPfI requirements. Final plant room building shell design to be conducted following final chiller section and plant room location.

All chillers are capable of meeting the noise emission criteria, set out in section 5.1 of this report

#### **5.3.4.3 Cooling Tower**

The cooling towers are proposed to be installed on the on the roof on the southern end of the building.

All cooling towers are to have variable speed drives, to allow for reduced fan speed during periods of low load. Typically, a fan speed of no more than 50% would be expected at night time

These cooling towers are located more than 100-meters from the nearest residential receiver, and their elevated location allows the building structure to provide a barrier affect, further shielding the residential receivers from the cooling towers. Thus, all cooling towers are capable of meeting the noise emission criteria, set out in section 5.1 of this report.

#### **5.3.4.4 Emergency Generators**

Generators are located externally on the north-eastern side of site, and are proposed to be used only in emergency.

Generators are to be selected such that the noise level measured within the adjacent loading dock is equal or less than 65dB(A).

Generators are to be installed on a concrete plinth. Plinth is to be isolated from the structural slab by two layers of 10mm thick Vibramat (from Acoustic Supplies) or equal. There should be no rigid connection between plinth and structural slab.

Generator should be isolated from the plinth using 50mm static deflection spring vibration isolators.

#### **5.3.4.5 Fans and Other General Plant Items**

All fans are capable of meeting the noise emission criteria, set out in section 5.1 of this report, with the implementation of lined duct work and bends.

##### **Supply / Exhaust fans**

Supply and exhaust fans may be located within the underground plant rooms or in rooftop plant areas. These units typically emit high noise levels and require acoustic treatment such as silencers and internal lined ductwork. Silencer requirements would be determined once fan selections have been completed.

##### **Minor Plant**

Other minor plant items, such as bathroom or kitchen exhaust fans, may also be required. These items typically emit relatively low noise levels and may require minimal acoustic treatment of a standard nature, such as internally lining of ductwork.

##### **Major Plant**

It is at the construction design stage that consideration should be given to the placement of equipment including intake and discharge air locations. In addition to the location of the equipment acoustic treatments to the major plant items may include silencers, treatment to ducting, time control, operational limitations, vibration isolation and the like.



## 6 CONSTRUCTION NOISE & VIBRATION

### 6.1 MANAGEMENT LEVELS & CRITERIA

#### 6.1.1 EPA Interim Construction Noise Guidelines

##### 6.1.1.1 Standard Construction Hours

Section 2.2 of the NSW Environmental Protection Authority's (EPA) Interim Construction Noise Guideline (ICNG) recommends the following standard hours of construction. Certain activities can be performed outside of these hours, and these are detailed in section 2.3 of the ICNG.

- Monday to Friday 7:00am to 6:00pm
- Saturday 8:00am to 1:00pm
- No work on Sundays and Public Holidays

The SSI 9975, SEARS 18 states: *"Identify proposed construction hours and provide details of the instances where it is expected that works will be required to be carried out outside the standard construction hours."* As such, it is proposed to implement the following construction hours:

- Monday to Friday 7:00am to 6:00pm
- Saturday 7:00am to 5:00pm
- No work on Sundays and Public Holidays; and
- Low noise activities carried out (e.g. handheld tools (including power tools), painting etc) may be carried out at all times provided the activities do not cause offensive noise

The reasons for the proposed construction hours are:

- The EPA guidelines are general guidelines that would be applicable in more sensitive situations. In this particular case, the affected residential properties are located a significant distance away from the construction site.
- Adopting the proposed hours will allow for efficient construction on Saturdays and the entire construction timetable will be expedited which will benefit the surrounding community.
- Noise restrictions are proposed to limit noise impacts outside the standard hours.
- Hospitals, such as Nepean Hospital, Wagga Wagga Hospital, and other recent major projects in the area, including Stockland Green Hills approximately 2km away, were afforded similar construction hours.
- Whilst the proponent will be encouraging local workforce with all projects of this size there is a portion of workforce that travel further than a daily commute to the site and have to stay in local temporary accommodation. Working a full day on Saturday would provide these workers with the ability to capture a productive day on a Saturday. This would in turn make travelling workers more likely to stay in the local area on a Friday and would have an economical benefit for local businesses.
- Providing a full working day on Saturdays would allow heat policies to be more manageable during warm weather as workers would be less likely to push through warm weather without breaks if they know they have more time to achieve their work goals on a Saturday.

- Providing workers with extended working hours on a Saturday could actually provide better flexibility for them socially by being able to attend their child sport in the morning and get some productive work hours later in the day.

#### 6.1.1.2 Construction Noise Emission

EPA guidelines adopt differing strategies for noise control depending on the predicted noise level at the nearest residences:

- *"Noise affected" level.* Where construction noise is predicted to exceed the "noise affected" level at a nearby residence, the proponent should take reasonable/feasible work practices to ensure compliance with the "noise affected level". For residential properties, the "noise affected" level occurs when construction noise exceeds ambient levels by more than 10dB(A)<sub>Leq(15min)</sub> for work during standard construction hours (7am-6pm Monday to Friday and 8am to 1pm on Saturdays); and
- *"Highly noise affected level".* Where noise emissions are such that nearby properties are "highly noise affected", noise controls such as respite periods should be considered. For residential properties, the "highly noise affected" level occurs when construction noise exceeds 75dB(A)<sub>Leq(15min)</sub> at nearby residences.

A summary of noise emission management levels for the proposed hours of construction are presented.

**Table 7 - Construction Noise Affected Management Levels**

<b>Location</b>	<b>"Noise Affected" Management Level - dB(A)<sub>Leq(15min)</sub></b>	<b>"Highly Noise Affected" Management Level - dB(A)<sub>Leq(15min)</sub></b>
Residences (south of the site)	52dB(A)/47dB(A)*	75dB(A)
Industrial Development (east of site)	75dB(A)	75dB(A)
Active Recreation Space (east of site)	65dB(A)	75dB(A)

\*During the proposed extension on Saturdays from 1pm to 5pm, and 6pm to 7pm period on Monday to Fridays, all noise affected levels are to be background plus 5dB(A) instead of background plus 10dB(A)

## 6.2 VIBRATION

Vibration caused by construction at any residence or structure outside the subject site must be limited to:

- For structural damage vibration, German Standard DIN 4150-3 *Structural Vibration: Effects of Vibration on Structures*; and
- For human exposure to vibration, the evaluation criteria presented in the British Standard BS 6472:1992 *Guide to Evaluate Human Exposure to Vibration in Buildings (1Hz to 80Hz)* for low probability of adverse comment.

### 6.2.1 Structure Borne Vibrations (Building Damage Criteria)

German Standard DIN 4150-3 (1999-02) provides vibration velocity guideline levels for use in evaluating the effects of vibration on structures. The criteria presented in DIN 4150-3 (1999-02) are presented in Table 4.

It is noted that the peak velocity is the value of the maximum of any of the three orthogonal component particle velocities as measured at the foundation, and the maximum levels measured in the x- and y-horizontal directions in the plane of the floor of the uppermost storey.

**Table 8 – DIN 4150-3 (1999-02) Safe Limits for Building Vibration**

TYPE OF STRUCTURE		PEAK PARTICLE VELOCITY (mms <sup>-1</sup> )			
		At Foundation at a Frequency of			Plane of Floor of Uppermost Storey
		< 10Hz	10Hz to 50Hz	50Hz to 100Hz	All Frequencies
1	Buildings used in commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40
2	Dwellings and buildings of similar design and/or use	5	5 to 15	15 to 20	15
3	Structures that because of their particular sensitivity to vibration, do not correspond to those listed in Lines 1 or 2 and have intrinsic value (e.g. buildings that are under a preservation order)	3	3 to 8	8 to 10	8

The surrounding commercial and residential buildings would be considered Type 1 structures.

### 6.2.2 Assessing Amenity

Table 2.2 of EPA "Assessing Vibration: A technical guideline" specifies the following vibration criteria for the protection of human comfort:

**Table 9 – Construction Vibration Goals**

Location	Time	Peak velocity (mm/s)	
		Preferred	Maximum
Continuous Vibration			
Residences	Daytime	0.28	0.56
Offices	When in use	0.56	1.1
Impulsive Vibration			
Residences	Daytime	8.6	17
Offices	When in use	18	36

### 6.3 ACTIVITIES TO BE CONDUCTED AND THE ASSOCIATED NOISE SOURCES

Typical works expected during the construction phase are set out below.

**Table 10 – Sound Power Levels of the Proposed Equipment**

<b>EQUIPMENT /PROCESS</b>	<b>SOUND POWER LEVEL dB(A)</b>
Pneumatic Hammer	115
Remediation Plant	115
Asphalting	110
Compactor (Vibratory)	110
Piling Rig	110
General Trucks	108
Concrete Pump	105
Concrete Truck	105
Electric Hammer	105
Site Crane	105
Impact drill	105
Concrete Float/Vibrators	105
Excavator (bucket attachment)	105
Compactor (Roller)	105
Forklifts	100
Bobcat	100
Powered Hand Tools	95
Air compressor	86

The noise levels presented in the above table are derived from the following sources, namely:

- Table A1 of Australian Standard 2436-2010.
- Data held by this office from other similar studies.

Noise levels take into account correction factors (for tonality, intermittency where necessary).

## 6.4 NOISE AND VIBRATION EMISSION ASSESSMENT

### 6.4.1 Noise emission Assessment

With respect to general construction noise, the impacts on nearby development will be dependent on the activity in question and where on the site the activity is undertaken. Predictions of the construction noise levels for these key activities are presented below:

**Table 11 – Construction Noise Emission to Residences to the South**

<b>Activity</b>	<b>Predicted Level – dB(A)<sub>Leq(15min)</sub> (External Areas)</b>	<b>Comment</b>
Pneumatic Hammer	57 – 75	Exceeds 52dB(A) Noise Management Level. Does not exceed 75dB(A) Highly Noise Affected level.
Remediation Plant	57 – 75	
Asphalting	52 – 70	
Compactor (Vibratory)	52 – 70	
Piling	52 – 70	
Truck	50 – 68	
Concrete Pump	47 – 65	Exceeds 52dB(A) Noise Management Level when working near the southern property boundary. Does not exceed 75dB(A) Highly Noise Affected level.
Concrete Truck	47 – 65	
Electric Hammer	47 – 65	
Site Crane	47 – 65	
Impact drill	50 – 65	
Concrete Float/Vibrators	47 – 65	
Excavator (bucket attachment)	47 – 65	
Compactor (Roller)	47 – 65	
Forklifts	42 – 60	
Bobcat	42 – 60	
Powered Hand Tools	40 – 55	Marginal exceedance of the 52dB(A) Noise Management Level when working on the southern property boundary. Does not exceed 75dB(A) Highly Noise Affected level.
Air compressor	31 – 46	Does not exceed 52dB(A) Noise Management Level.



**Table 12 – Construction Noise Emission to Industrial Premises**

<b>Activity</b>	<b>Predicted Level – dB(A)<sub>Leq(15min)</sub> (External Areas)</b>	<b>Comment</b>
Pneumatic Hammer	57 – 75	Does not exceed 75dB(A) Noise Management Level.
Remediation Plant	57 – 75	
Asphalting	52 – 71	
Compactor (Vibratory)	52 – 71	
Piling	52 – 71	
Truck	50 – 69	
Concrete Pump	47 – 66	
Concrete Truck	47 – 66	
Electric Hammer	47 – 66	
Site Crane	47 – 66	
Impact drill	50 – 66	
Concrete Float/Vibrators	47 – 66	
Excavator (bucket attachment)	47 – 66	
Compactor (Roller)	47 – 66	
Forklifts	42 – 61	
Bobcat	42 – 61	
Powered Hand Tools	40 – 56	
Air compressor	31 – 47	

**Table 13 – Construction Noise Emission to Active Recreation Space**

<b>Activity</b>	<b>Predicted Level – dB(A)<sub>Leq(15min)</sub> (External Areas)</b>	<b>Comment</b>
Pneumatic Hammer	57 – 75	Exceedance of the 65dB(A) Noise Management Level when working on the western property boundary. Does not exceed 75dB(A) Highly Noise Affected level.
Remediation Plant	57 – 75	
Asphalting	52 – 71	Marginal exceedance of the 65dB(A) Noise Management Level when working on the western property boundary. Does not exceed 75dB(A) Highly Noise Affected level.
Compactor (Vibratory)	52 – 71	
Piling	52 – 71	
Truck	50 – 69	
Concrete Pump	47 – 66	1dB exceedance of the 65dB(A) when working unscreened on the western property boundary. Noise Management Level. Does not exceed 75dB(A) Highly Noise Affected level.
Concrete Truck	47 – 66	
Electric Hammer	47 – 66	
Site Crane	47 – 66	
Impact drill	50 – 66	
Concrete Float/Vibrators	47 – 66	
Excavator (bucket attachment)	47 – 66	
Compactor (Roller)	47 – 66	
Forklifts	42 – 61	Does not exceed 65dB(A) Noise Management Level.
Bobcat	42 – 61	
Powered Hand Tools	40 – 56	
Air compressor	31 – 47	

#### **6.4.2 Vibration Emission Assessment**

Equipment items typically associated with high levels of vibration generation are sheet/impact piling, extensive excavation in rock and vibratory compaction. Of these activities, it is only vibratory compaction which is likely to be used extensively. Given the distance from the proposed works and the residential properties, the vibration criteria in Section 5 is not expected to be exceeded during the construction activities.

All other construction items are also not expected to generate vibration exceeding building damage or amenity acoustic criteria.

#### **6.4.3 Recommendations**

The following specific noise controls are recommended:

- No works are to commence on site prior to 7am.
- All excavation and construction equipment shall be well maintained.
- Where possible, excavation using hydraulic hammers is to be avoided
- Stationed equipment shall be located as far as practicable from residents.
- Vehicle Noise:
  - Truck movements should not commence prior to 7am. Trucks are not to idle with their engines running outside the site prior to 7am.
  - Trucks and concrete trucks must turn off their engines during idling to reduce impacts on adjacent residential receivers (unless truck ignition needs to remain on during concrete pumping).
- In the event of complaint, noise management techniques identified in this report should be employed to minimise the level of noise impact. This may include community consultation and scheduling of loud construction processes which will be undertaken in accordance with Multiplex Communications Management Plan. Additionally, Section 8 of this report outlines procedures for community consultation.
- Notwithstanding above, general management techniques and acoustic treatments are included below which may be implemented on a case-by-case basis to reduce noise emissions to surrounding receivers.

## 6.5 CONTINGENCY PLANS

Where non-compliances or noise complaints are raised the following methodology will be implemented.

1. Determine the offending plant/equipment/process
2. Locate the plant/equipment/process further away from the affected receiver(s) if possible.
3. Implement additional acoustic treatment in the form of localised barriers, silencers etc. where practical.
4. Selecting alternative equipment/processes where practical
5. If necessary, setup noise/vibration and dust monitoring devices at locations representing the nearest noise/vibration and dust affected receivers and provide data for each complain time period. Analysis is required to determine suitable mitigation measures.

Complaints associated with noise /vibration and dust generated by site activities shall be recorded on a Complaint Form. The person(s) responsible for complaint handling and contact details for receiving of complaints shall be established on site prior to construction works commencing. A sign shall be displayed at the site indicating the Site Manager to the general public and their contact telephone number.

## 7 CONCLUSION

An acoustic assessment of the potential operational noise from the proposed New Maitland Hospital has been conducted. This document forms part of the documentation package to be submitted to the Department of Planning as part of the SSII application. This report has provided:

- criteria, in-principle treatment and design requirements which aim to ensure operational noise is compliant with criteria set out in this report.
- management process for managing noise and vibration impacts on the surrounding receivers due to excavation and construction activities for the main works of the New Maitland Hospital.

The assessment of noise and vibration indicates that:

- For at least part of the excavation/construction work period, some processes are likely to generate noise levels that will require additional management. Adoption of the controls outlined in this report will ensure that noise impacts will be minimised.
- Ground vibration criteria have been set in this report to safeguard existing structures and vibration sensitive receivers close to the project site. Vibration associated with the construction package is not expected to exceed building damage or amenity acoustic criteria.

We trust this information is satisfactory. Please contact us should you have any further queries.

Yours faithfully,



Acoustic Logic Consultancy Pty Ltd  
Jenna MacDonald