Wentworth Health Services Redevelopment

Operational & Construction Noise Impact Assessment

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Revision

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Contents

1. Introduction

This Acoustic Report has been prepared by Stantec (Australia) Pty Ltd to accompany the Review of Environment Factors REF) for the proposed Hospital redevelopment located at Wentworth, NSW.

The main objectives of this acoustic assessment are:

- Identify the noise and vibration sources that will potentially affect the noise sensitive receivers surrounding the proposed development.
- Carry out noise surveys to determine the existing ambient and background noise levels on the site as well as any external noise sources that will potentially impact the proposed development.
- Establish the appropriate noise level and vibration criteria in accordance with the relevant standards, guidelines and legislation for the following items:
    - Noise emissions from mechanical plant from the development to the surrounding receivers.
    - Noise emissions from traffic generated by the proposed development.
    - Noise and vibration impacts during construction
- Carry out an acoustic assessment to determine whether the relevant criteria can be achieved and, where applicable, comment on noise control measures required to achieve compliance with the relevant noise level criteria.
- Identify and assess the noise and vibration sources that will potentially affect the proposed development.

This report provides:

- A statement of compliance with the relevant statutory criteria for the proposed use development within the vicinity of the nearest potentially affected receivers.
- Recommendations for noise mitigation measures for the proposed development in order to meet the relevant criteria when compliance is not achieved.
- Recommendations for noise and vibration criteria and best practices during construction phase.

The following information has been used for the preparation of this report:

- Architectural drawings of the proposed development provided by NBRS
- Noise data collected on site through the use of a noise logger and a hand held spectrum analyser.

This document and related work has been prepared following Stantec's Quality and Environmental Management Systems, which are based on AS/NZS ISO 9001:2015 and ISO 14001:2015 respectively.

2. Project Overview

The proposed development is a crown land title DP 1136392 and the address is listed as 24Hospital Road, Wentworth, NSW, 2648. The site is an existing hospital site and is zoned RU5 Village in the Wentworth Local Environmental Plan 2011.

The Wentworth Health Service Redevelopment is a $30m project. The project will include full asset replacement of the existing health service's ageing buildings and infrastructure, along with additional health services in line with contemporary models of care and the ongoing needs of the local area.

The nearest, most affected residential receivers are located approximately 260m North-west of the site (R2) and 350m North-east of the site (R1). These locations have been considered the most affected noise-sensitive receivers for the acoustic impact assessment.

2.1 Site Description

The site location of the proposed development is shown in Figure 1. Also included is the identification of sensitive receivers and their classification as well as both attended and unattended noise monitoring locations.

Figure 1: Aerial Photo showing an Overview of the Site, sensitive receivers, and measurement locations

2.1.1 Acoustic Considerations

Noise Impact from the Development on the Environment

The proposed development will generate noise which may adversely impact the surrounding environment, such as the nearby residential and commercial receivers.

The main noise sources generated by the development that may impact the local community and environment include:

- Noise emissions from the operation of mechanical plant servicing the proposed development to the surrounding noise-sensitive receivers
- Traffic generated by the development, including, vehicle movements entering and exiting the basement carpark spaces
- Noise generated from the operation of the loading docks (unloading/loading activities).
- Construction Noise Impacts

3. Noise Survey

3.1 Overview

Attended and unattended noise surveys were conducted in the locations shown in Figure 1 to establish the ambient and background noise levels of the site and surrounds. Noise surveys have been carried out in accordance with the method described in the AS/NZS 1055:2018 *'Acoustics – Description and measurement of environmental noise'*.

The purpose of the unattended monitoring is to understand the local noise environment and to establish the noise criteria to the nearest noise sensitive receivers surrounding the site. Refer to Figure 1 for locations of monitoring on site.

3.1.1 Instrumentation

The following equipment was used for the noise surveys conducted by Stantec:

- 01dB Environmental Noise Logger, Cube 02dB, S/N 11882;
- Type 1 Hand-held sound spectrum analyzer, Brüel & Kjær, S/N 3027679
- Sound Calibrator Svan SV30A, S/N 17556;

All equipment was calibrated before and after the measurements and no significant drift was found. All equipment carries current traceable calibration certificates that can be provided upon request.

3.2 Unattended Noise Survey Results

Unattended noise surveys were conducted in on-site, refer to Figure 1 for the locations of loggers on-site. Results of the monitoring are presented in the following subsections and graphs of these logged results provided in Appendix A.

3.2.1 Background & Ambient Noise Monitoring

A noise monitor was placed at position L1 as shown in Figure 1 to measure the background and ambient noise that is representative of the surrounding noise-sensitive receivers. Noise monitor L1 was installed from the 25th October to 7th November 2022. The results of the unattended background and ambient noise survey is shown in Table 1 below (for the day, evening and night periods). The local ambient noise environment is dominated by noise from the local wildlife (birds) and some vehicle. As required in the NSW NPI, any data likely to be affected by rain, wind or other extraneous noise has been excluded from the calculations.

Table 1: Long-term noise survey summary – Background noise

Location	Equivalent Continuous Noise Level $L_{Aeq,period}$ - dB(A)			Background Noise Level RBL - dB(A)		
	Day	Evening	Night	Day	Evening	Night
L1	51	56	51	37	37	30

3.3 Attended Noise Survey Results

Attended noise measurements of 15-minute duration were conducted on site to characterise the traffic noise intruding into the development and to validate the results of the unattended noise monitoring. The locations of the attended noise measurements close to the proposed development site are shown in Figure 1.

The SLM microphone was mounted 1.5 metres above the ground and a windshield was used to protect the microphone. Measurements were undertaken in the free-field – i.e. more than 3 metres away from any building façade or vertical reflective surface. Weather conditions were calm and dry during the attended noise monitoring. Table 2 below shows the summary of the attended noise measurements.

Table 2: Short-term (Attended) Noise Survey Results

Measurement Location	Measurement Time	$L_{Aeq, 15mins}$ dB(A)	$L_{A90, 15mins}$ dB(A)	Comments
Long Term Logger location	11:44am 25/10/2022	44	40	General environment noise from wildlife (birds)

4. Noise & Vibration Criteria

4.1 Council Specific Requirements

4.1.1 Wentworth Shire Development Control Plan (DCP) 2011

7.1.9 of the Wentworth Shire DCP states the following regarding Noise and Vibration Controls associated with the proposed development:

> *Council recommends applicants utilise the following documents to assist them in making decisions relating to acceptable noise levels for noise generating and noise sensitive developments:*
>
> *- NSW Industrial Noise Policy*
>
> *- Environmental Criteria for Road Traffic Noise*
>
> *- Noise Guide for Local Governmen."*

The impact of noise generated by a proposal can be minimised to comply with the statutory requirement in different ways. The following guidelines address means of achieving the standards: -

- *Incorporate sound proofing for machinery or activities considered likely to create a noise nuisance during design development.*
- *- Locate noisy operational equipment with a noise insulated building away from residential areas*
- *- Design logisticallsy efficient business practises to minimise the use of equipment, movements per site and number of vehicle movements per site per day*
- *- Where sites adjoin a residential area, limit the number of hours and times at which mechanical plant and equipment is used in conjunction with the measured described above. –*
- *Ameliorate the noise and vibration impact of transport operations by using appropriate paving or track mounting and installing acoustic barriers to meet standards on neighbouring uses. –*
- *Incorporate appropriate noise and vibration mitigation measures into the site layout, building materials, design, orientation and location of sleeping recreation/work areas of all developments proposed in areas adversely affected upon by road noise and vibration.*

Further to the above the criteria outlined in the NSW EPA Noise Policy for Industry 2017 presented in Section 4.2.1 will satisfy the requirements of the Wentworth Shire DCP with regard to external noise emissions.

4.1.2 Wentworth Local Environment Plan (LEP) 2011

Relevant Planning Documents of Penrith Council Legislation have been reviewed for any noise requirement or criteria. The Wentworth LEP 2011 sets the Land Zoning as shown in Figure 2 as per information extracted from the maps provided by

Wentworth LEP 2011 and the NSW Government legislation web service. The proposed site is categorised as RU5. Additionally the residential land use to the North-west and North-east are also noted as RU5.

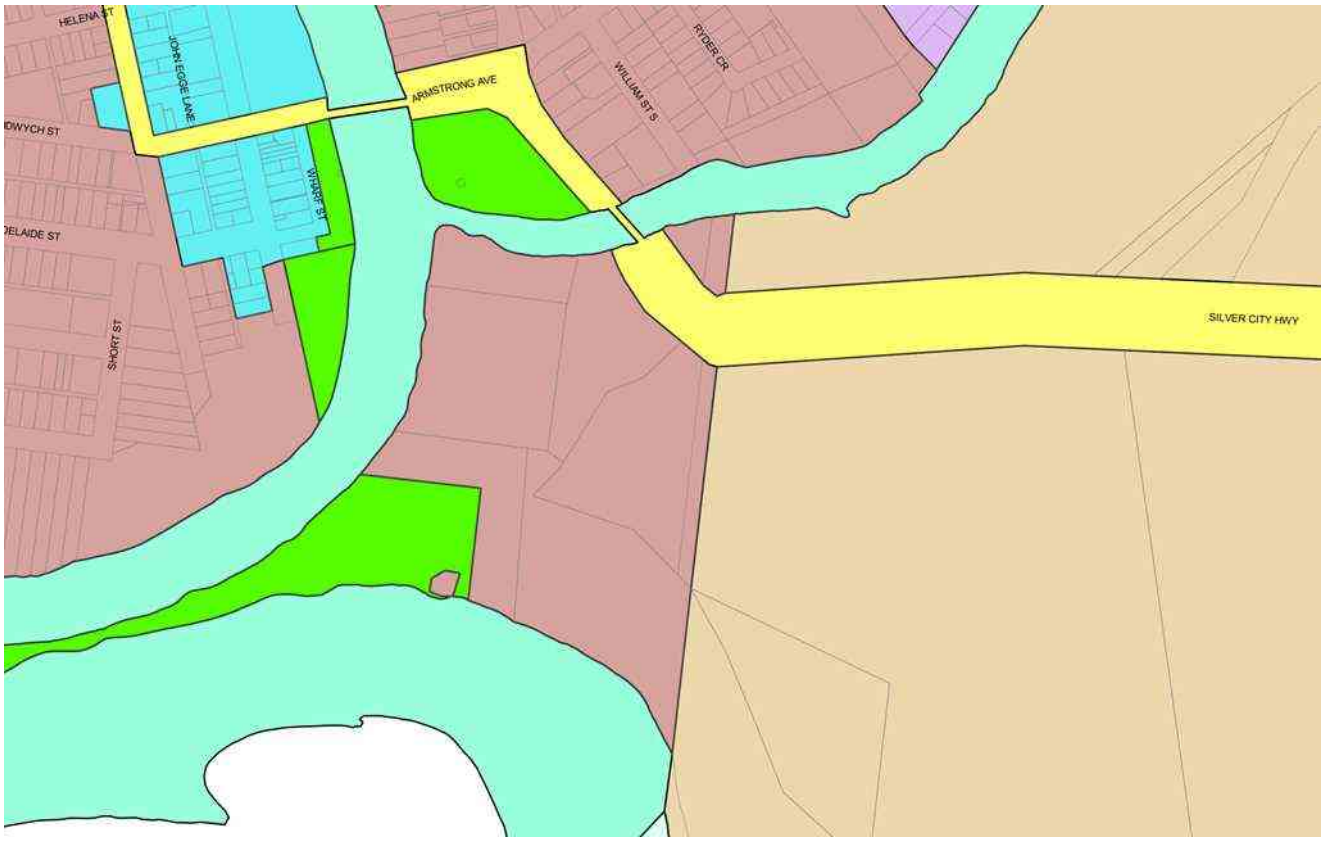


Figure 2: Land Zoning of the site and surroundings.

4.2 External Noise Emissions

4.2.1 NSW EPA Noise Policy for Industry (2017)

The *NSW Noise Policy for Industry* has been applied to address the noise emissions from the development to the surrounding noise-sensitive receivers. The NSW NPI sets out noise criteria to control the noise emission from industrial noise sources generated by the proposed development. Operational noise emissions from the development shall be addressed following the guideline in the NSW NPI.

The calculation is based on the results of the unattended ambient and background noise monitoring, addressing two components:

- Controlling intrusive noise into nearby residences (Intrusiveness Criteria)
- Maintaining noise level amenity for particular land uses (Amenity Criteria)

Once both criteria are established, the most stringent for each considered assessment period (day, evening, night) is adopted as the Project Noise Trigger Level (PNTL).

4.2.2 Intrusiveness Criteria

The NSW EPA NPI states the following:

> *"The intrusiveness of an industrial noise source may generally be considered acceptable if the equivalent continuous (energy-average) A-weighted level of noise from the source (represented by the L_{Aeq} descriptor), measured over a 15-minute period, does not exceed the background noise level measured in the absence of the source by more than 5 dB(A)."*

The intrusiveness criterion can be summarised as follows:

$L_{Aeq,\ 15\ minute} \leq$ RBL background noise level + 5 dB(A)

The intrusiveness criterion for the closest residential receivers is presented in Table 3 below.

Table 3: Intrusiveness Criteria

Receiver	Period	Measured Rating Background Level L_{A90} dB(A)	Intrusiveness Criteria L_{Aeq} dB(A)
Residential	Day	37	42
	Evening	37	42
	Night	30	35

4.2.3 Amenity Criteria

The NSW NPI states the following:

> *"To limit continuing increases in noise levels from application of the intrusiveness level alone, the ambient noise level within an area from all industrial noise sources combined should remain below the recommended amenity noise levels specified in Table 2.2 where feasible and reasonable. The recommended amenity noise levels will protect against noise impacts such as speech interference, community annoyance and some sleep disturbance*

To ensure that industrial noise levels (existing plus new) remain within the recommended amenity noise levels for an area, a project amenity noise level applies for each new source of industrial noise as follows, "Project amenity noise level for industrial developments = recommended amenity noise level (Table 2.2) minus 5 dB(A), +3 dB(A) to convert from a period level to a 15-minute level".

The applicable parts of Table 2.2: Amenity noise levels from Industrial Noise Sources – L_{Aeq}, dB(A) which are relevant to the project are reproduced below:

Table 4: NSW NPI Table 2.2 amenity criteria for external noise levels

Receiver	Noise Amenity Area	Time of Day	L_{Aeq}, dB(A) **Recommended amenity noise level**	$L_{Aeq, period}$ dB(A) **Project amenity noise level**
Residential (R1)	Rural	Day	50	48
		Evening	45	43
		Night	40	38
Commercial premises (C1)	All	When in use	65	63

Note that where the resultant project amenity noise level is 10dB or more lower than the existing industrial noise level the project amenity noise levels can be set at 10dB below existing industrial noise levels if it can be demonstrated that existing industrial noise levels are unlikely to reduce over time.

Note 2: Where a source emits tonal and low-frequency noise, only one 5-dB correction should be applied if the tone is in the low-frequency range, that is, at or below 160 Hz.

Note 3: Where narrow-band analysis using the reference method is required, as outlined in column 5, the correction will be determined by the ISO1996-2:2007 standard.

4.2.4 Project Noise Trigger Levels

The project noise trigger levels for industrial noise sources such as mechanical plant etc. are provided in Table 5. These noise levels have been derived from the Noise Policy for Industry 2017.

Table 5: Project noise trigger levels for industrial noise emissions

Receiver	Period	Descriptor	Project Noise Trigger Levels dB(A)
Residential	Day (7:00am to 6:00pm)	$L_{Aeq,15min}$	**42**
	Evening (6:00pm to 10:00pm)	$L_{Aeq,15min}$	**42**
	Night (10:00pm to 7:00am)	$L_{Aeq,15min}$	**35**

4.2.5 Traffic Generation Noise Criteria

The noise impacts from traffic generation are assessed in accordance with the NSW Road Noise Policy. 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 6.

Table 6: 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)
Local roads	Existing residences affected by additional traffic on existing local roads generated by land use developments	$L_{Aeq,1\ hour}$ 55 (external)	$L_{Aeq,1\ hour}$ 50 (external)

If 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'.

4.3 Construction Noise and Vibration Criteria

4.3.1 Construction Noise

Noise criteria for construction sites are established in accordance with the Interim Construction Noise Guideline (ICNG July 2009) by the NSW Environment Protection Authority (EPA). It is important to note that the recommended criteria are for planning purposes only. Numerous other factors need to be considered when assessing potential noise impacts from construction works.

However, in undertaking the assessment of potential noise intrusion associated with the proposed construction activities, *Chapter 4 of the NSW EPA ICNG (July 2009)* were specifically referenced. The limits presented in Table 7 apply.

Table 7: NSW EPA ICNG Construction Noise Criteria

Time of Day	Management Level $L_{Aeq,15min}$ *	How to Apply
Recommended Standard Hours: Mon – Fri (7am – 6pm) Sat (8am – 1pm) No work on Sunday & Public Holidays	Noise Affected RBL + 10dB(A)	The noise affected level represents the point above which there may be some community reaction to noise. • Where the predicted or measured $L_{Aeq,15min}$ 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 residences of the nature of works to be carried out, the expected noise levels and duration as well as contact details.
	Highly Noise Affected 75 dB(A)	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 in, taking into account: • 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) • If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside Recommended Standard Hours	Noise Affected RBL + 5dB(A)	• 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(A) above the noise affected level, the proponent should negotiate with the community. • For guidance on negotiating agreements see section 7.2.2.

Note: 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 30m of the residence. Noise levels may be higher at upper floors of the noise affected residence.

Source: Chapter 4 (Table 2 Sec 4.1.1) of NSW DECCW ICNG

4.3.2 Construction Vibration

The NSW Environment Protection Authority (EPA) developed a document, "Assessing vibration: A technical Guideline" in February 2006 to assist in preventing people from exposure to excessive vibration levels 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.

4.3.1 Human Comfort – Continuous and Impulsive Vibration Criteria

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. The likelihood of complaints 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 8. It should be noted that the human comfort levels for vibration are more stringent than the building damage criteria.

Table 8: RMS values for continuous and impulsive vibration acceleration (m/s^2) 1-80Hz

Location	Assessment period[1]	Preferred values		Maximum values	
		z-axis	x- and y-axis	z-axis	x- and 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 places 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	0.14
Offices, schools, educational institutions and places of worship	Day- or night-time	0.64	0.46	1.28	0.92

4.3.2 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. The VDV is often used to measure the vibration impact associated with train passbys throughout the day or night.

Table 9: Acceptable Vibration Dose Values for Intermittent Vibration (m/s$^{1.75}$)

Location	Daytime (7:00am to 10:00pm)		Night-time (10:00pm to 7:00am)	
	Preferred value	Maximum value	Preferred value	Maximum value
Residences	0.20	0.40	0.13	0.26
Offices, schools, educational institutions and places of worship	0.40	0.80	0.40	0.80

4.3.3 Structural Damage – Vibration Criteria

Ground vibration criteria is defined in terms of the levels of vibration emission 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 criteria are defined to minimise 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 10 shows the vibration limits presented in DIN4150-Part 3 to minimise the risk structural damage doesn’t occur.

Table 10: Guideline value of vibration velocity, vi, for evaluating the effects of short-term vibration

Line	Type of Structure	Vibration velocity, vi, in mm/s			
		Foundation			Plane of floor of uppermost full storey
		At a frequency of			
		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					

Table 11 presents guide values for building vibration, based on the lowest vibration levels above which cosmetic damage has been demonstrated as per BS7385-Part 2:1993.

Table 11: Transient vibration guide values for cosmetic damage

Type of Building	Peak Particle Velocity in frequency range of predominant pulse (PPV)	
Residential or light commercial type buildings	4 Hz to 15 Hz	15 Hz and above
	15mm/s at 4Hz increasing to 20mm/s at 15Hz	20mm/s at 15Hz increasing to 50mm/s at 40Hz and above

4.3.4 Construction Vibration Objectives

Table 12 indicates the construction vibration criteria applicable to the other residential properties located within the development site.

Table 12: Construction vibration criteria summary

Location	Period	Human Comfort Vibration Objectives			Building damage Objectives – Velocity (mm/s)
		Continuous mm/s^2 (RMS)		Intermittent $mm/s^{1.75}$ (VDV)	
		z-axis	x- and y-axis		
Residential	Day time	10 - 20	7 - 14	0.20 - 0.40	5
	Night-time	7 - 14	5 - 10	0.13 - 0.26	5

5. Operational Noise & Vibration Assessment

5.1 Mechanical Plant and Equipment Assessment

Noise sources from general operation of the development site typically include mechanical services noise from air-conditioning/ventilation plant serving the hospital and residential parts of the development. These noise sources have been used to predict the noise impact to the nearest noise sensitive receivers. These noise-sensitive receivers include the following and are identified in Figure 1:

- Residential receiver R1
- Residential Receiver R2

The following noise sources are considered the most likely to cause an adverse noise impact to noise sensitive receivers if not treated effectively:

- External condenser units located on ground level servicing the new hospital
- Ventilation fans servicing the new hospital

In order to assess the worst-case scenario, it is assumed that the air conditioning units associated with the proposed development are running at any time throughout a 24hr period. With all, night time is the most stringent period for the noise generated by the operation of the mechanical plant, therefore this criterion was used as the noise target at the boundary of the nearest sensitive receivers for the project.

5.1.1 General Mechanical Equipment – Noise Mitigation Measures

Noise generation by mechanical equipment in association with the proposed development is to be managed to ensure external noise emissions are not intrusive and do not impact the amenity of the nearest sensitive receivers.

At this stage, selections for mechanical equipment have not been made; therefore it is not possible to undertake a detailed assessment of the noise emissions generated by mechanical plant. Nevertheless, to meet the external noise emissions requirements for noise generated by the mechanical plant and equipment the following are some typical practices to mitigate noise from operation of mechanical plant and equipment on rooftop plantrooms.

- Where possible, locate plant as far away from possible noise sensitive receivers as practical to minimise the aggregate noise level.
- Select low noise mechanical equipment.
- Acoustic louvres or solid barriers may be required, surrounding plant items on the rooftop. This mitigation will likely be driven by internal noise criteria within the residential spaces of the proposed development.
- Where possible, locate noisy plant within an enclosed plant space.
- Carpark exhaust is to be included in the mechanical assessment. Carpark exhaust fans are typically located in a plant room in a basement allowing for sufficient ductwork to allow for acoustic internal lining or an attenuator for supply and exhaust to meet environmental noise criteria.

A detailed acoustic assessment of the mechanical plant noise is recommended prior to Construction Certificate to ensure no adverse noise impacts from external mechanical plant in accordance with the criteria outlined in Section 4.2.4.

5.2 Traffic Generation Noise

A traffic generation noise assessment has been undertaken in order to determine the potential noise impact of traffic generated by the proposed development.

As noted in Section 4.2.5, when considering land use development and the impact on sensitive land uses, the NSW RNP states that an increase up to 2.0dB in relation to existing noise levels is anticipated to be insignificant. The existing conditions on site demonstrate that the noise in association with local traffic is not above the criteria for each respective period (daytime and night-time).

Based on the Traffic Impact Assessment Report prepared by SCT Consulting, there is proposed to be an additional 14 car spaces from the development. Given the low number of vehicle trips, the level of traffic generation from the proposed development will be minimal and is not expected to generate any discernible or adverse noise impacts to the nearest noise sensitive receivers and is compliant with the criteria outlined in Section 4.2.5.

5.3 Loading Dock & Waste Collection Noise Emissions

An assessment of the noise generated by activities within the Ground Level loading docks (such as, garbage collections and deliveries) has been conducted to determine the impacts on the surrounding noise-sensitive receivers. Table 13 outlines the sound power level (SWL) and typical duration (minutes) associated with each of the standard loading dock activities.

Table 13: Typical sound power levels and duration of loading dock activities

Loading Dock Activity	Typical Duration of Activity	Sound Power Level ($L_{Aeq,\ 15min}$)
Garbage truck unloading bins	2 minutes	88
Medium rigid truck accelerating	15 seconds	57

The noise generated by the activities during a 15-minute period have been predicted to the nearest surrounding noise-sensitive receivers. Using the assessment methods outlined above, the predicted noise levels at the nearest noise-affected premises are summarised below in Table 14. The following assumptions have been made for the assessment:

- Service vehicles are assumed to be either medium rigid trucks or garbage trucks.
- Two (2) service vehicle movements, i.e. entering and exiting, within a 15-minute period; and
- Loading and unloading activities will take place in the loading dock area, shielded from the residential receivers

Table 14: Loading dock and waste collection predicted noise levels at most affected receiver

Most Affected Receiver	Predicted Noise Level $L_{Aeq,15min}$ - dB(A)	Project Noise Trigger Level $L_{Aeq,15min}$ - dB(A)	Compliance
Residential R1	26	35	Yes
Residential R2	28	35	Yes

Table 14 shows that the predicted noise levels of the loading dock satisfy the design criteria at the nearest residential receivers

6. Construction Noise & Vibration Assessment

6.1 Overview

Currently a detailed construction program is not yet full defined. This section provides general recommendations only and provides applicable criteria together with feasible and reasonable noise and vibration control practices to be observed during the construction of the proposed development.

This preliminary advice provided within this assessment shall form the basis for the Contractor's detailed Construction Noise and Vibration Management Plan (CNVMP) which shall identify any noise criteria exceedances and relevant mitigation measures once construction methods and stages are known.

6.2 Proposed Construction Hours

The *Interim Construction Noise Guideline* (ICNG) by NSW DECC recommends the following standard hours of construction, which will be assumed as the construction hours for the project:

- Monday to Friday: 7am to 6pm
- Saturday: 8am to 1pm
- Sunday and public holidays: no work

6.3 Construction Noise Assessment

A preliminary construction noise assessment has been carried out based on typical plant and machinery expected throughout the construction stages. The preliminary noise assessment has been considered at the nearest existing residential receivers.

6.3.1 Expected Construction Equipment

The noise sources likely to be associated with the works listed in the previous section of this report are presented in Table 15. The equipment noise levels have been extracted from *AS 2436:2010* Guide to *Noise and Vibration Control on Construction, Demolition and Maintenance Sites.*

Table 15: Cumulative impact - Construction equipment noise levels

Stages	Equipment	Quantity	Sound Power Level – dB(A)	Acoustical Usage Factor (%)	Usage in 15-minute period (minutes)	Time Corrected Sound Power Level ($L_{Aeq,15min}$)
Early Works – Demolition & Dismantle	Jackhammer	1	113	20	3	106
	Electric hand tools	5	99	50	7.5	96
	Bobcat	1	110	70	7.5	107
	Mobile Crane	1	108	20	3	101
	Truck	2	108	40	6	104
	Excavator with Bucket (30T)	1	113	50	7.5	110
Structural Works	Powered hand tool	5	99	50	15	99
	Concrete pump	1	110	50	7.5	96
	Mobile crane	1	108	16	7.5	105
	Generator	1	110	20	15	110
	Truck	2	104	40	6	104

6.3.2 Predicted Noise Levels

The predicted noise levels have been presented in Table 16 and Table 17, and have been assessed against the construction noise criteria established in Section 4.3.1.

Table 16: Predicted noise levels – Scenario 1: Early Works & Demolition

Receiver	Predicted Noise Level Range $L_{Aeq,15min}$ dB(A)	Noise Management Level $L_{Aeq,15min}$ dB	Noise Management Level Exceedance (dB) With Mitigation	Compliance with Highly Noise Affected Level? (< 75dBA)
R1	41-51	47	Up to 4	Yes
R2	44-54	47	Up to 7	Yes

Table 17: Predicted noise levels – Scenario 2: Structural Works

Receiver	Predicted Noise Level Range - Without Mitigation $L_{Aeq,15min}$	Noise Management Level $L_{Aeq,15min}$	Noise Management Level Exceedance (dB)	Compliance with Highly Noise Affected Level? (< 75dBA)
R1	45-55	47	Up to 8	Yes
R2	42-52	47	Up to 5	Yes

As shown in the results above, the predicted results are expected to be marginally above the Noise Management Levels, nevertheless below the Highly Noise Affected criteria. General construction noise mitigation measures are provided in the following section, which are proposed to further reduce any potential adverse noise impacts.

6.4 General Acoustic Recommendations for Construction

According to AS 2436 – 2010 *"Guide to noise and vibration control on construction, demolition and maintenance sites"* the following techniques could be applied to minimize the spread of noise and vibrations to the potential receivers.

6.4.1 Noise

If a process that generates significant noise levels cannot be avoided, the amount of noise reaching the receiver should be minimized. Two ways of achieving this are to either increase the distance between the noise source and the receiver or to introduce noise reduction measures such as screens.

Physical methods to reduce the transmission of noise between the site works and residences, or other sensitive land uses, are generally suited to works where there is longer-term exposure to the noise. Practices that will reduce noise from the site include:

- Increasing the distance between noise sources and sensitive receivers.
- Reducing the line-of-sight noise transmission to residences or other sensitive land uses using temporary barriers (stockpiles, shipping containers and site office transportable can be effective barriers).
- Constructing barriers that are part of the project design early in the project to introduce the mitigation of site noise.
- Installing purpose-built noise barriers, acoustic sheds and enclosures.

6.4.2 Screening

On sites where distance is limited, the screening of noise may be beneficial, and this should be taken into account during the planning stages.

If structures such as stores, site offices and other temporary buildings are situated between the noisiest part of the site and the nearest dwellings, some of the noise emission from the site can be reduced. If these buildings are occupied, sound insulation measures may be necessary to protect workers inside the buildings.

A hoarding that includes a site office on an elevated structure offers superior noise reduction when compared with a standard (simple) hoarding. The acoustic performance is further enhanced when the hoarding is a continuous barrier.

Storage of building materials or the placement of shipping containers between the noise source and any noise-sensitive area may also provide useful screening and the same is true of partially completed or demolished buildings. A noisy, stationary plant can be placed in a basement, the shell of which has been completed, provided reverberant noise can be controlled. Where compressors or generators are used in closed areas, it is necessary to ensure that the exhaust gases are discharged directly to the outside air and that there is good cross-ventilation to prevent the build-up of poisonous carbon monoxide fumes and to allow an adequate air supply to maintain efficiency when operating the equipment.

Where such noise barriers are not practical, a worthwhile reduction in noise can be obtained by siting the plant behind and as close as possible to mounds of earth, which may effectively screen any noise-sensitive areas from the plant. These can often be designed into the construction schedule or site arrangement for future landscaping.

Water pumps, fans and other plant equipment that operate on a 24-hour basis may not be an irritating source of noise during the day but may be problematic at night. They should therefore be effectively screened by either situating them behind a noise barrier or by being positioned in a trench or a hollow in the ground provided this does not generate reverberant noise. In such cases, however, adequate ventilation should also be ensured. Long, temporary earth embankments can provide quite an effective noise screen for mobile equipment moving, for example, on a haulage road. When the earthworks are complete, the earth mounds should be removed if possible, with smaller, quieter excavators. A noise barrier may be a more reliable method of noise control than the imposition of restrictions on throttle settings.

In many cases it may not be practical to screen earthmoving operations effectively, but it may be possible to partially shield a construction plant or to build-in at the early stages protective features required to screen traffic noise. Where earth noise barriers are not practical due to lack of space, consideration should be given to the possibility of constructing temporary screens from wood or any equivalent material in surface density.

The usefulness of a noise barrier will depend upon its length, its height, its position relative to the source and to the receiver, and the material from which it is made. A barrier designed to reduce noise from a moving source should extend beyond the last property to be protected to a distance of not less than ten times the shortest measurement from the property to the barrier. A barrier designed to reduce noise from a stationary source should, where possible, extend to a distance beyond the direct line between the noise source and the receiver to a distance equal to ten times the effective barrier height, which is the height above the direct line between source and receiver.

If the works are predominately within nominally closed structures, careful consideration should be given to reducing noise breakout at any openings.

6.4.3 Crane (diesel operated)

An appropriate silencer on the muffler and acoustic screen around the engine bay are recommended to attenuate the noise emission.

6.4.4 Reversing and warning alarms

Community complaints often involve the intrusive noise of alarms commonly used to provide a safe system of work for vehicles operating on a site. Beeper reversing alarm noise is generally tonal and may cause annoyance at significant distances from the work site.

There are alternative warning alarms capable of providing a safe system of work that are equal to or better than the traditional 'beeper', while also reducing environmental noise impacts. The following alternatives should be considered for use on construction sites as appropriate:

(a) Broadband audible alarms incorporating a wide range of sound frequencies (as opposed to the tonal frequency 'beep') are less intrusive when heard in the neighborhood.

(b) Variable-level alarms reduce the emitted noise levels by detecting the background noise level and adjusting the alarm level accordingly.

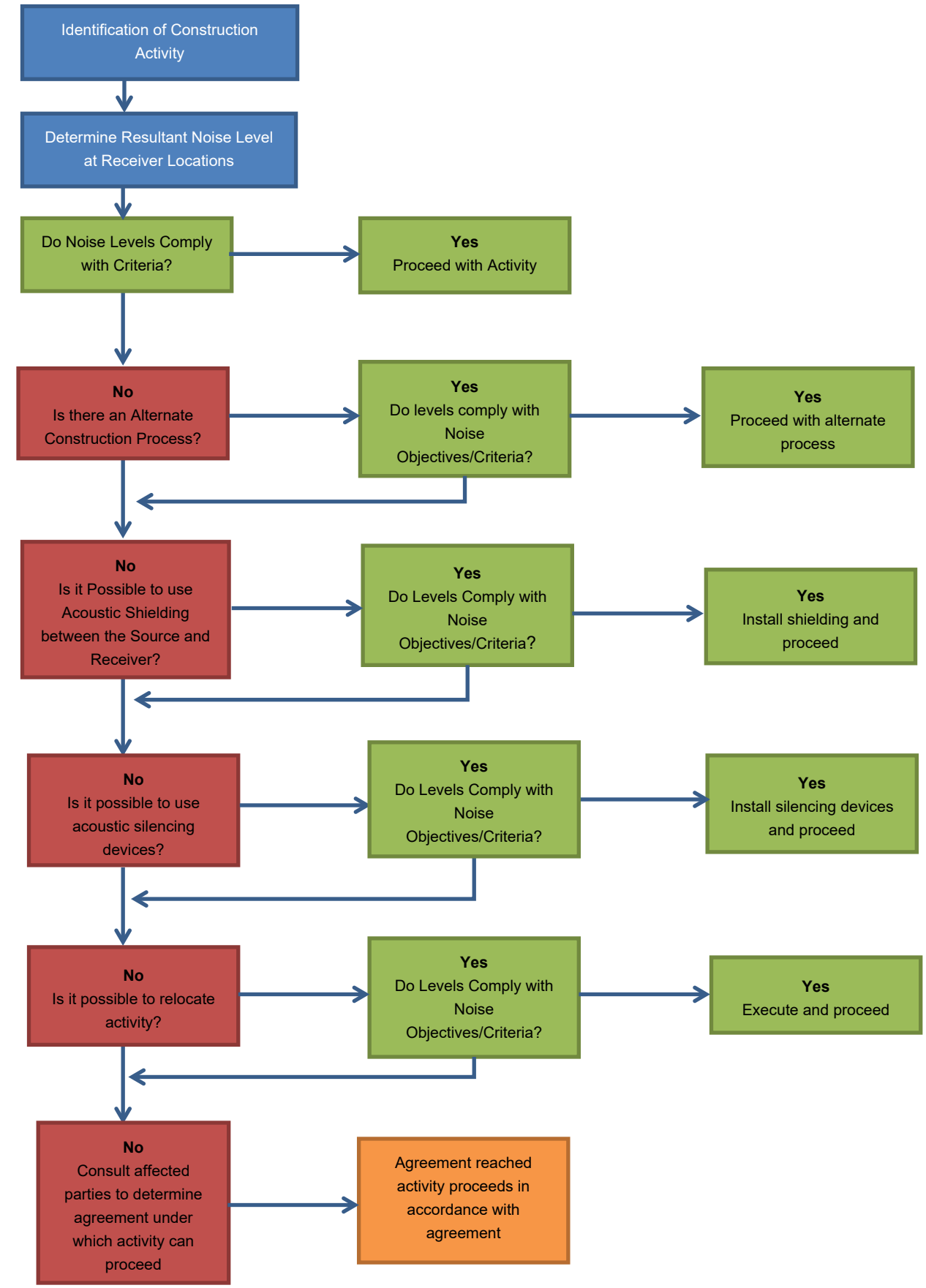
(c) Non-audible warning systems (e.g. flashing lights, reversing cameras) may also be employed, providing safety considerations, are not compromised.

(d) Proximity alarms that use sensors to determine the distance from objects, such as people or structures, and generate an audible alarm in cabin for the driver.

(e) Spotters or observers.

The above methods should be combined, where appropriate.

Figure 3: Noise mitigation management flow chart



6.5 Noise & Vibration Monitoring Strategy

6.5.1 General Methodology

Noise and vibration levels should be monitored from time to time to ensure that noise generated as a result of remediation and construction activities does not disturb local businesses.

Monitoring may be in the form of regular checks by the builder or indirectly by an acoustic consultant engaged by the builder and in response to any noise or vibration complaints. Where noise and vibration criteria are being exceeded or in response to valid complaints, noise and / or vibration monitoring should be undertaken. This would be performed inside the premises of the affected property and on site adjacent to the affected receivers.

Monitoring is to be undertaken by an experienced noise and vibration monitoring professional or an acoustic consultant. The results of any noise or vibration monitoring are to be provided to the relevant party or person in a timely manner allowing the builder to address the issue and respond to the complaints.

Noise and vibration monitoring can take two forms:

- Short term monitoring
- Long-term monitoring

Short-term monitoring

Short-term monitoring consists of attended monitoring when critical stages of the construction are occurring. This normally provides real-time assistance and guidance to the subcontractor on site letting them know when the noise and vibration criteria are exceeded allowing the selection of alternative method on construction or equipment selection to minimise noise and vibration impacts.

Long-term monitoring

Similarly, long-term monitoring uses noise and vibration loggers providing real-time alerts to the builder / site manager when the noise and vibration criteria are exceeded.

Typically, the noise and vibration loggers stay on site for a period of several months for the critical construction stages of the project.

Both methods are complementary and normally used simultaneously providing a significant of amount of data via the long-term monitoring but also providing information on the sources of noise and vibration generating exceedances via the short-term or attended monitoring.

Noise monitoring is proposed to be carried out in the form of short-term and/or long-term following receipt of any noise complaints that may arise. The methodology is to be agreed with and undertaken by a suitably qualified acoustic consultant.

7. Conclusion

An acoustic assessment for the proposed Wentworth Health Services Redevelopment has been conducted. This document forms part of the documentation package to be submitted to local authorities as part of the REF process.

This report has provided criteria, in-principle treatment and design requirements which aim to achieve the statutory criteria discussed in Section 4. In terms of noise criteria, we have provided the following:

- Noise criteria for external noise emissions from the development in accordance with the NPI
- Construction noise and vibration criteria provided in Section 4.3

A preliminary noise assessment of mechanical plant has been carried out as shown in Section 5.1. Based on the application of good plant selection and standard noise control methods the noise criteria are expected to be met. A detailed assessment is recommended prior to Construction Certificate to ensure compliance with the outlined noise criteria.

A traffic generation noise assessment has been undertaken in order to determine the potential noise impact of traffic generated by the proposed development. Based on the assessment, the additional generated traffic is expected to exceed the requirements of the NSW Road Noise Policy.

A preliminary construction noise assessment was carried out and expected to be within the highly noise affected criteria.

Based on the information presented in this report, relevant objectives will be satisfied and therefore approval is recommended to be granted.

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