

Multi-Storey Carpark, Liverpool Hospital

Stage 1 - Construction Noise and Vibration Management Plan

Project ID	20200931.1
Document Title	Stage 1 - Construction Noise and Vibration
Attention To	ADCO Constructions Pty Ltd

Revision	Date	Document Reference	Prepared By	Checked By	Approved By
0	29/09/2020	20200931.1/2909A/R0/SN	SN		GW
1	4/11/2020	20200931.1/0411A/R1/SN	SN		GW
2	24/11/2020	20200931.1/2411A/R2/SN	SN		GW
3	4/12/2020	20200931.1/0412A/R3/SN	SN		GW
4	30/04/2021	20200931.1/3004A/R4/SN	SN		GW

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1 INTRODUCTION

Acoustic Logic has been engaged to prepare a noise and vibration management plan for stage 1 of the Multi-Storey Carpark to be constructed as part of the redevelopment of the Liverpool Hospital Health and Academic Precinct.

This document presents a discussion of the processes which will be followed in order to manage the noise and vibration from the proposed construction works of the multi-storey carpark and has been undertaken in accordance with the requirements of condition B14:

"B14. 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 B14(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 management measures in accordance with condition B14(d)."*

The principal issues, which will be addressed in this report, are:

- Identification of sensitive receivers near to the site.
- Description of hours of work and what work will be undertaken.
- Identification of the noise and vibration standards which will be applicable to this project.
- Identify likely sources of noise generation and predicted noise levels at nearby development and sensitive receiving locations.
- Formulation of a strategy for construction to comply with the standards identified in the above point.

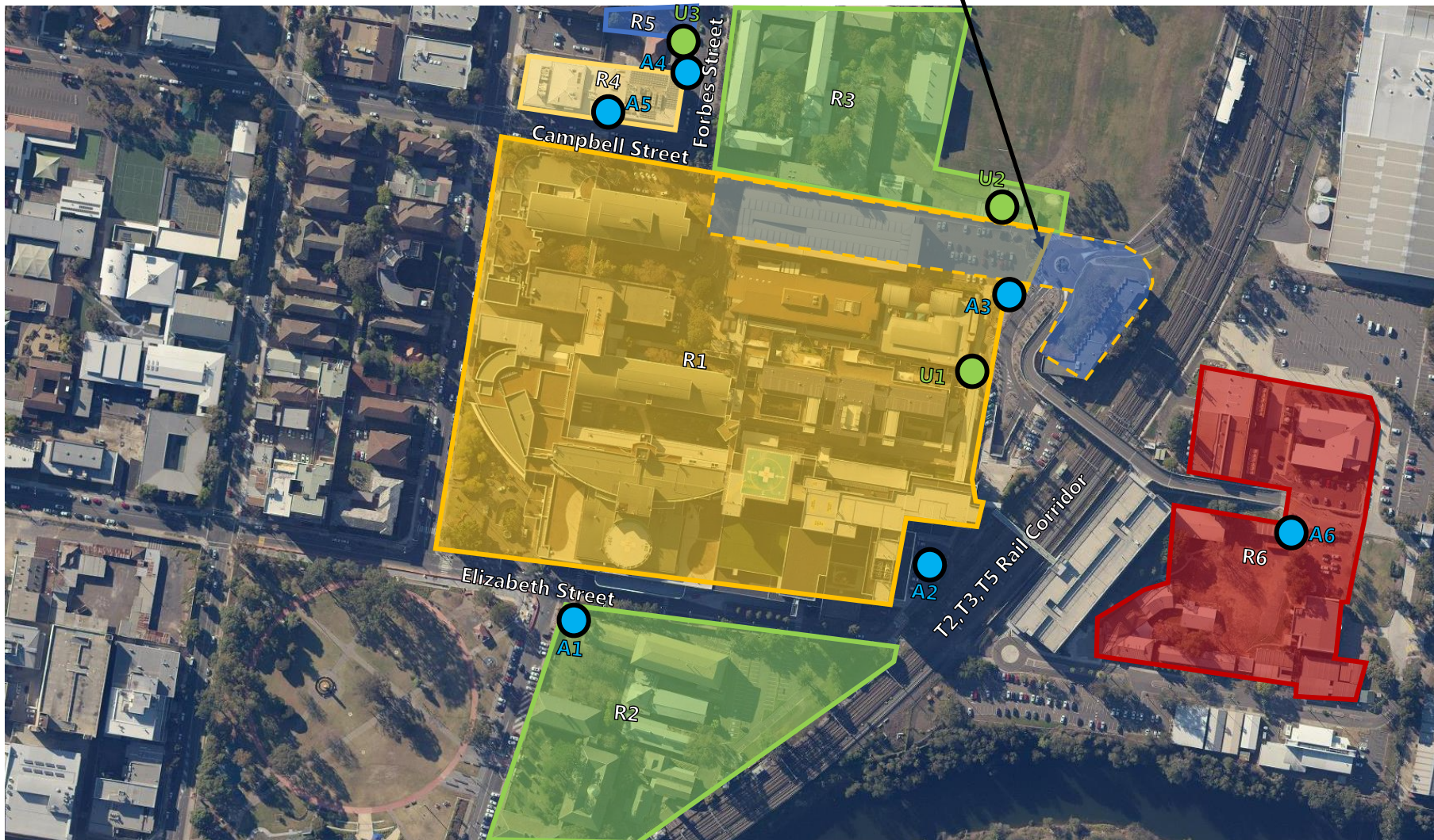
2 SITE DESCRIPTION

The land uses surrounding the multi-storey carpark are the existing hospital, commercial, residential and educational receivers. Site investigation has been carried out and the nearest potentially most affected receivers are:

- **Receiver 1:** Liverpool Hospital Development to the South.
- **Receiver 2:** Tafe NSW Liverpool located at 14 College Street to the South. Educational receiver is double storey.
- **Receiver 3:** Liverpool Girls High School located at 96 Forbes Street to the North. Educational receiver is double storey.
- **Receiver 4:** Health Services Building and Ingham Institute located at 1 Campbell Street to the North. Receivers are multi-storey.
- **Receiver 5:** Residential receiver located at 41 Forbes Street to the North-West. Residential receiver is multi-storey.
- **Receiver 6:** South Western Sydney Local Health District to the South-East, Across the T2, T3 and T5 Rail Corridor.

See Figure 1 below for a site survey and noise monitoring and measurement locations.

Multi-Story Car Park and On Grade Car Park Redevelopment Project Site



- Attended Noise Measurement
- Unattended Noise Monitor

Figure 1: Aerial Map and Noise Monitor Location

- Commercial Receiver
- Health Services Building/Ingham Institute
- Residential Receiver
- Educational Receiver
- Health/Medical Receiver

3 CONSTRUCTION ACTIVITIES

The information provided to this office of the primary noise producing activities (and estimated duration) associated with the site are as follows below:

- **Stage 1 - Construction Stage (14 Months)**
 - Earthworks of the existing foundation using excavators, loaders and static rollers.
 - CFA piling will be conducted on site for foundation footings.
 - Erection of the external structure.
 - Internal works.
 - General hand and power tools will be used on the site.

An electric tower crane will be used on site along with the use of tower concrete boom pumps.

4 CONDITIONS OF CONSENT

The following conditions are applicable to noise and vibration of construction activities to be undertaken at the Multi-storey carpark project site:

Condition 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:

"Construction activities may be undertaken outside of the hours in condition C4 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;*
- (d) where a variation is approved in advance in writing by the Planning Secretary or his nominee if appropriate justification is provided for the works; or*
- (e) for the delivery, set-up and removal of construction cranes, where notice of the crane related works is provided to the Planning Secretary and affected residents at least seven days prior to the works."*

Condition C6:

"Notification of such construction activities as referenced in condition C5 must be given to affected residents before undertaking the activities or as soon as is practical afterwards."

Condition C7:

"Concrete finishing works (including the use of a helicopter float) may be undertaken outside of the hours in condition C4, unless directed otherwise by the Planning Secretary, between the following hours:

- (a) Saturday: 1pm to 3pm."*

Condition 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*
- (c) 9am to 12pm, Saturday."*

Condition C16:

"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 in the approved Construction Noise and Vibration Management Plan."

Condition C17:

"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."

Condition C18:

"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 C19:

"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 C20:

"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 C19."

Condition C21:

"The limits in conditions C19 and C20 apply unless otherwise outlined in a Construction Noise and Vibration Management Plan, approved as part of the CEMP required by condition B15 of this consent."

5 HOURS OF WORK

5.1 PROPOSED HOURS OF WORK

The above scope of work is proposed to be undertaken during the 'Recommended Standard Hours of Work' period provided by the NSW 'Interim Construction Noise Guideline':

Monday to Friday: 7:00am to 6:00pm;

Saturday: 8:00am to 1:00pm; and

Sunday/Public Holidays: No Works.

See Figure 1 for a detailed location where the construction works are to be undertaken and the nearest surrounding receivers to the project site.

5.2 NOISE MANAGEMENT LEVEL

Establishment of criteria for construction noise requirements will be in accordance with the following documents.

- NSW Environmental Protection Authority, 'Interim Construction Noise Guideline';
- Australian Standard AS2107:2016; and
- Australian Standards AS2436:2010 Guide to Noise Control on Construction, Maintenance and Demolition Sites.

5.2.1 NSW EPA Interim Construction Noise Guideline

Given the scale of the proposed works, the "quantitative" assessment procedure, as outlined in the Interim Construction Noise Guideline (ICNG) will be used (as opposed to the simpler "qualitative" assessment method outlined in the guidelines). The quantitative assessment method requires:

- Determination of noise generation management levels (based on background noise levels on site).
- Prediction of operational noise levels at nearby development.
- If necessary, recommendation of noise controls strategies in the event that compliance with noise emission management levels is not possible.

5.2.1.1 At Residential Receivers

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

Recommended Standard Hours

Monday to Friday (7am – 6pm) & Saturday (8am – 1pm)

- "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) $L_{eq(15min)}$.
- "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) $L_{eq(15min)}$ at nearby residences.

Table 1 – Construction Noise Management Levels to Residential Receivers

Location	Recommended Standard Hours “Noise Affected” Level - dB(A)_{Leq(15min)}	“Highly Noise Affected” Level - dB(A)_{Leq(15min)}
Residential Receivers	BG 42 + 10 = 52	75

5.2.1.2 To Educational Receivers

Table 3 of the ICGN outlines the following management noise levels to internal areas of classrooms at schools and other educational institutions:

Table 2 – Noise Management Level for Educational Buildings (ICGN)

Space	Internal Management Level dB(A)_{Leq (15 min)}
Within Classrooms at schools and other educational institutions	45

5.2.1.3 To Commercial Receivers

Section 4.1.3 “Commercial and industrial premises” of the ICGN outlines the following external management noise levels to the most-affected occupied point of the premises:

Table 3 – Noise Management Level for Commercial Premises (ICGN)

Space	Management Level dB(A)_{Leq (15 min)}
Facade of Offices, retail outlets	70

5.2.1.4 To Hospital Noise Receivers

Table 3 of the ICGN outlines the following management noise levels to internal areas of hospital buildings:

Table 4 – Noise Management Level for Hospital Buildings (ICGN)

Space	Internal Management Level dB(A)_{Leq (15 min)}
Within Hospital Wards and operating theatres	45

The ICGN does not have management noise levels for other areas of the nearby hospital receivers (offices, consulting rooms etc. as discussed in Section 2). Section 4.1.3 of the ICGN states:

“4.1.3 Commercial and industrial premises

... The proponent should undertake a special investigation to determine suitable noise levels on a project-by-project basis; the recommended ‘maximum’ internal noise levels in AS 2107 Acoustics – Recommended design sound levels and reverberation times for building interiors may assist in determining relevant noise levels (Standards Australia 2000).”

5.2.2 Australian Standard AS2107:2016

Excavation/Construction noise management levels for noise sensitive spaces in the nearby hospital buildings not covered in the ICGN will be based on the maximum recommended noise levels presented in section AS2107:2016. These are presented in the table below:

Table 5 – Noise Management Level for Hospital Buildings (Internal - AS2107:2016)

Space	Management Level dB(A)L_{eq} (15 min)
Consulting Rooms	45
Treatment Rooms	45
Office Areas	45
Operating Theatres	50
X-Ray Areas	50

5.2.3 Australian Standard AS2436:2010 “Guide to noise control on construction, maintenance and demolition sites”

Australian Standard AS2436 provides guidance on noise and vibration control in respect to construction and demolition sites, and the preparation of noise and vibration management plans, work method statements and impact studies. The Standard states that:

- “Some construction and demolition activities are by their very nature noisy. The authorities responsible for setting noise level criteria for essential works will take note of the constraints imposed by such activities, especially when they are of short duration.”
- Construction, demolition and maintenance works pose different problems of noise and vibration control when compared with most other types of industrial activity, since
 - (a) they are mainly carried on in the open;
 - (b) they are often temporary in nature although they may cause considerable disturbance whilst they last;
 - (c) the noise and vibration arise from many different activities and kinds of plant, and their intensity and character may vary greatly during different phases of the work; and
 - (d) the sites cannot be separated by planning control, from areas that are sensitive to noise and vibration.

The standard provides advice and guidelines for the prediction of impacts and the methods available to manage impacts. It guideline promulgates feasible and reasonable mitigation strategies and controls, and stakeholder liaison, in the effort to reach a realistic compromise between site activities and impacts on neighbouring properties.

Based on the above, the following procedure will be used to assess noise emissions:

- Predict noise levels produced by typical construction activities at the sensitive receivers.
- Develop a suitable noise criterion based on the NSW Environmental Protection Authority Interim Construction Noise Guideline.
- Adopt management conditions as per AS 2436 in the event of a non-compliance.

5.2.4 Summarised Noise Management Levels

The summarised noise management levels for the proposed demolition/excavation/construction activities are presented in the table below.

Table 6 – Summarised Noise Management Levels

Location	Management Level dB(A)L_{eq} (15 min)
Residential Receivers	<p align="center"><u>Recommended Standard Hours</u> "Noise Affected" Level - 52 "Highly Noise Affected" Level – 75</p>
Commercial Receivers	70
Educational Receivers Bedroom Wards Consulting Rooms Treatment Rooms Office Areas Operating Theatres	45 (Internal)
X-Ray Areas	50 (Internal)

5.3 CONSTRUCTION VIBRATION CRITERIA

Vibration criteria for the nearest receivers will be based on the following documents:

- DIN 4150, 'Vibration in Buildings (1999-02)';
- EPA "Assessing Vibration: A technical guideline"; and
- ASHRAE Handbook 2007.

5.3.1 DIN 4150

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 the table below.

It is noted that the peak velocity is the absolute 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 7 – DIN 4150-3 (1999-02) Safe Limits for Building Vibration

TYPE OF STRUCTURE		PEAK PARTICLE VELOCITY (mms ⁻¹)			
		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

5.3.2 Assessing Amenity

Table 2.2 of EPA "Assessing Vibration: A technical guideline" specified the following vibration goal for human comfort:

Table 8 – Preferred and Maximum Weighted RMS Values for Vibration Acceleration (m/s²) 1-80 Hz

Location	Assessment Period	Preferred Values Z-axis	Preferred Values X & Y-axis	Maximum Values Z-axis	Maximum Values X & Y-axis
Continuous Vibration					
Critical Areas	Day time	0.005	0.0036	0.010	0.0072
Residences	Day time	0.010	0.0071	0.020	0.014
Office	Day time	0.020	0.014	0.040	0.028
Impulsive Vibration					
Critical Areas	Day time	0.005	0.0036	0.010	0.0072
Residence	Day time	0.3	0.21	0.6	0.42
Office	Day time	0.64	0.46	1.28	0.92

Acceptable values for intermittent vibration shall comply with the requirements in Table 2.4 of EPA "Assessing Vibration: A technical guideline" detailed as below.

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

Location	Day time preferred value	Day time maximum value
Critical Areas	0.10	0.20
Residences	0.20	0.40
Office	0.40	0.80

5.3.3 Hospital Specific Vibration Limits

This office has been advised that vibration sensitive equipment is located within the existing hospital.

No specific allowable vibration levels have been provided to this office. Given this, the appropriate vibration curve from the American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) Handbook based on the equipment type will be used.

The ASHRAE Handbook specifies vibration levels associated with potential disruption to the use of sensitive equipment within a building. The maximum vibration velocities [$\text{mm}\cdot\text{s}^{-1}$] recommended from 1-100Hz is given in Figure 37 of the ASHRAE used in conjunction with recommended equipment requirements curves given in table 46. Figure 37 and table 46 from the 2007 ASHRAE document is presented below in Figure 6 and Table 10 respectively.

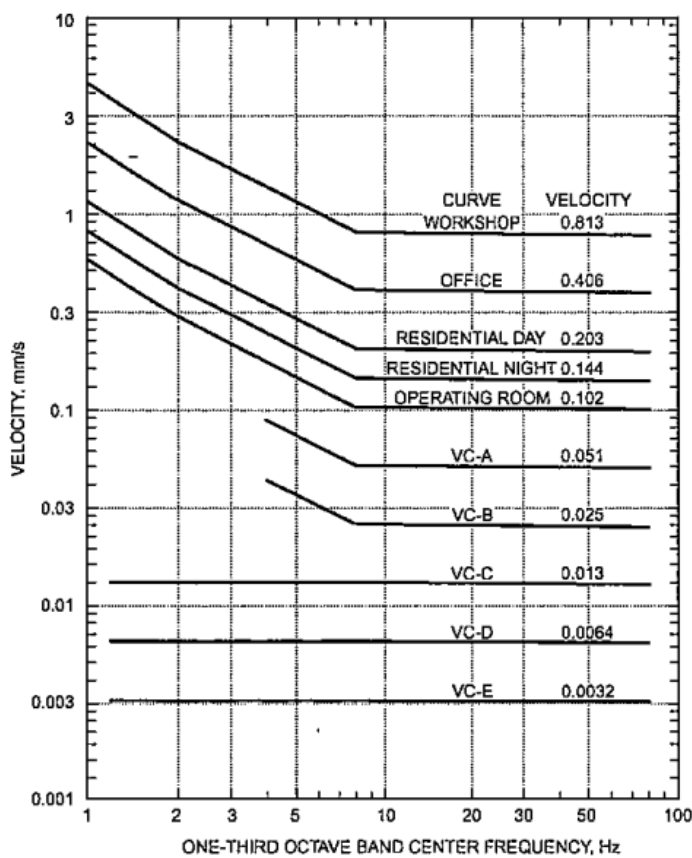


Fig. 37 Building Vibration Criteria for Vibration Measured on Building Structure

Figure 6 – Fig. 37 from 2007 ASHRAE Handbook: Vibration Criteria Curves

Table 10 – Tab. 46 from 2007 ASHRAE Handbook: Equipment Vibration Criteria

Equipment Requirements	Curve
Adequate for computer equipment, probe test equipment, and microscopes less than 40x magnification	0.203 (Residential – day)
Bench Microscopes up to 100x magnification; laboratory robots	0.102 (Operating Room)
Bench microscopes up to 400x magnification; optical and other precision balances; coordinate measuring machines; metrology laboratories; optical comparators; microelectronics manufacturing equipment; proximity and projection aligners, etc.	0.051 (VC – A)
Microsurgery, eye surgery, neurosurgery; bench microscopes at magnification greater than 400x magnification; optical equipment on isolation tables; microelectronic manufacturing equipment, such as inspection and lithography equipment (including steppers) to 3mm line widths	0.025 (VC – B)
Electron microscopes up to 30,000x magnification; microtomes; magnetic resonance imagers; microelectronics manufacturing equipment, such as lithography and inspection equipment to 1mm detail size	0.013 (VC – C)
Electron microscopes at magnification greater than 30,000x magnification; mass spectrometers; cell implant equipment; microelectronic manufacturing equipment such as, aligners, steppers and other critical equipment for photolithography with line widths of 1/2µm; includes electron beam systems	0.0064 (VC – D)
Un-isolated laser and optical research systems; microelectronics manufacturing equipment, such as aligners, steppers and other critical equipment for photolithography with line widths of 1/4µm; includes electron beam systems	0.0032 (VC – E)

a. See Figure for corresponding vibration curve.

We note that that Table 46 of ASHRAE does not have any vibration criteria for X-Ray imaging machines. **Given this, vibration criteria for the X-ray imaging will be based on the “Operating Room” Curve of Figure 37 of the ASHRAE vibration criteria.**

All vibration monitoring results recorded on site are presented against the vibration curves listed above. The appropriate level of vibration will ultimately be determined by the staff operating the equipment and whether or not the level of distortion created by the excavation works is acceptable. We note that the VC curves are a representation of the level of disruption to the activities and/or operations undertaken by the machine and not the limit where damage would be expected to occur to the unit.

5.3.4 Summarised Recommended Vibration Limits

The summarised vibration criteria are presented in the table below.

Table 11 – Recommended Vibration Limit

Vibration Receiver	Recommended Vibration Limits PPV (mm/s)
Operating Theatres	VC – B Curve of Figure 37 of the ASHRAE vibration criteria
X-Ray Imaging Room	“Operating Theatre” Curve of Figure 37 of the ASHRAE vibration criteria
Residential Buildings	5
Commercial/Other Hospital Buildings	20

6 PRELIMINARY CONSTRUCTION NOISE EMISSION ASSESSMENT (STANDARD CONSTRUCTION HOURS)

6.1 PROPOSED SCOPE OF WORK DURING STANDARD CONSTRUCTION HOURS

The proposed scope of work to be undertaken during this stage is detailed as follows:

- Earthworks of the existing foundation using excavators, loaders and static rollers.
- CFA piling will be conducted on site for foundation footings.
- Erection of the external structure.
- Internal works.

6.2 PROPOSED STANDARD CONSTRUCTION HOURS OF WORK

The above scope of work is proposed to be undertaken during the following standard construction hour periods:

Monday to Friday: 7:00am to 6:00pm;

Saturday: 8:00am to 1:00pm; and

Sunday/Public Holidays: No Works.

See Figure 1 for a detailed location where the construction works are to be undertaken and the nearest surrounding receivers to the project site.

6.3 ACTIVITIES TO BE CONDUCTED AND THE ASSOCIATED NOISE SOURCES

Preliminary construction methodology has been discussed with ADCO to determine a typical worst-case scenario for noise emissions from construction activities. The typical worst-case scenario and associated Sound Power Level noise data is detailed below:

- 2 x excavators with hydraulic hammers.
- 2 x excavators with buckets.
- 2 x semi-trailers.
- 3 x concrete trucks.
- 2 x concrete pumps.
- 1 x demolition saw.
- 1 x stationary crane.
- 2 x CFA piling rigs.

Table 12 – Sound Power Levels of the Proposed Equipment

EQUIPMENT / PROCESS	SOUND POWER LEVEL dB(A)
Excavator with Hydraulic Hammer	123*
Excavator with Bucket	105
Semi-Trailer	105
Demolition Saw	118*
Concrete Pump	105
Cement Mixing Truck	105
Electric Tower Crane	96
CFA Piling	103

* Includes 5dB(A) addition for characteristics of noise source.

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

- On site measurements;
- Table A1 of Australian Standard 2436-2010 & Table A1 of Australian Standard 2436-2010; and
- Data held by this office from other similar studies.

6.4 PRELIMINARY NOISE ASSESSMENT DURING STANDARD CONSTRUCTION HOURS

6.4.1 Methodology

Noise from the loudest typical construction activities have been predicted to the nearest most affected sensitive receivers. The predicted noise levels are presented in this section and are based on the areas on site in which the plant is likely to be used.

Where the position of the construction activity is variable, a range of predicted noise levels is presented to take into account the change in noise impact depending on where on the site the work is conducted.

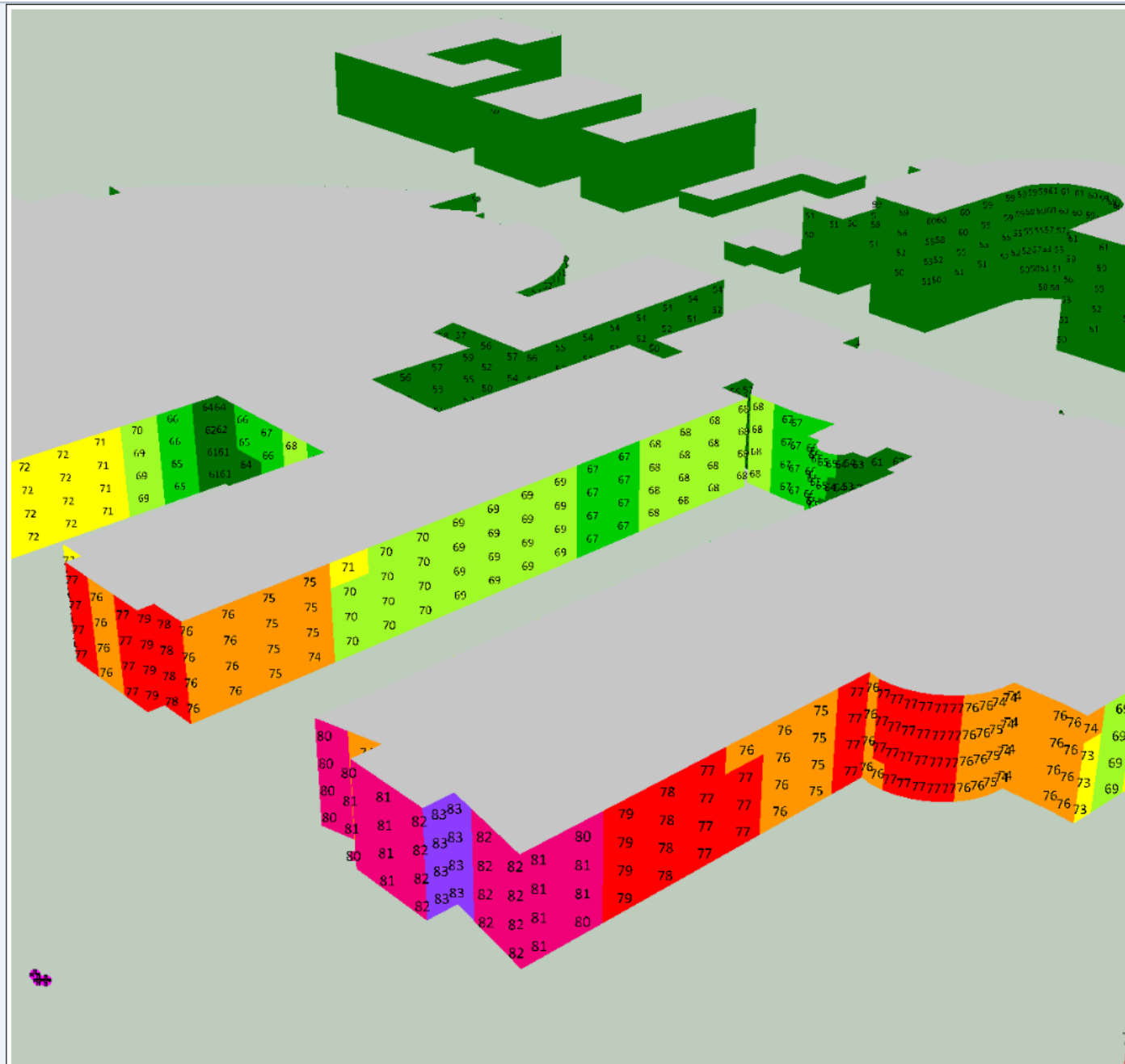
Predictions take into account:

- The distance between the noise source and the receiver; and
- The screening effect provided by barriers or building structures (where relevant).

6.4.2 Predicted Noise Levels

SoundPLAN noise modelling has been undertaken based on information provided to this office of construction methodology and activities likely to be undertaken simultaneously at the project site and therefore resulting in the 'worst-case' scenario.

The soundPLAN noise modelling presents the cumulative predicted external noise levels to the nearest surrounding receivers. In addition, see the tables below for the predicted noise level range. Where the receiver has an internal noise management level, this has been corrected for external to internal transmission loss of approximately R_w30 .



Liverpool Hospital

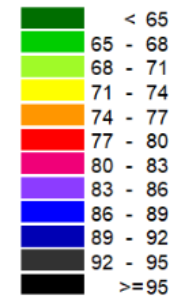
Multi Storey Car Park Construction Standard Hours

Noise Sources LAeq SWL

- CFA Piling Rig 103dB(A)
- Excavator w Hammer 123dB(A)
- Excavator w Bucket 105dB(A)
- Concrete Pump 105dB(A)
- Concrete Truck 105dB(A)
- Demolition Saw 118dB(A)
- Semi-Trailer 105dB(A)
- Stationary Crane 96dB(A)

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Noise Level LAeq in dB(A)



Liverpool Hospital

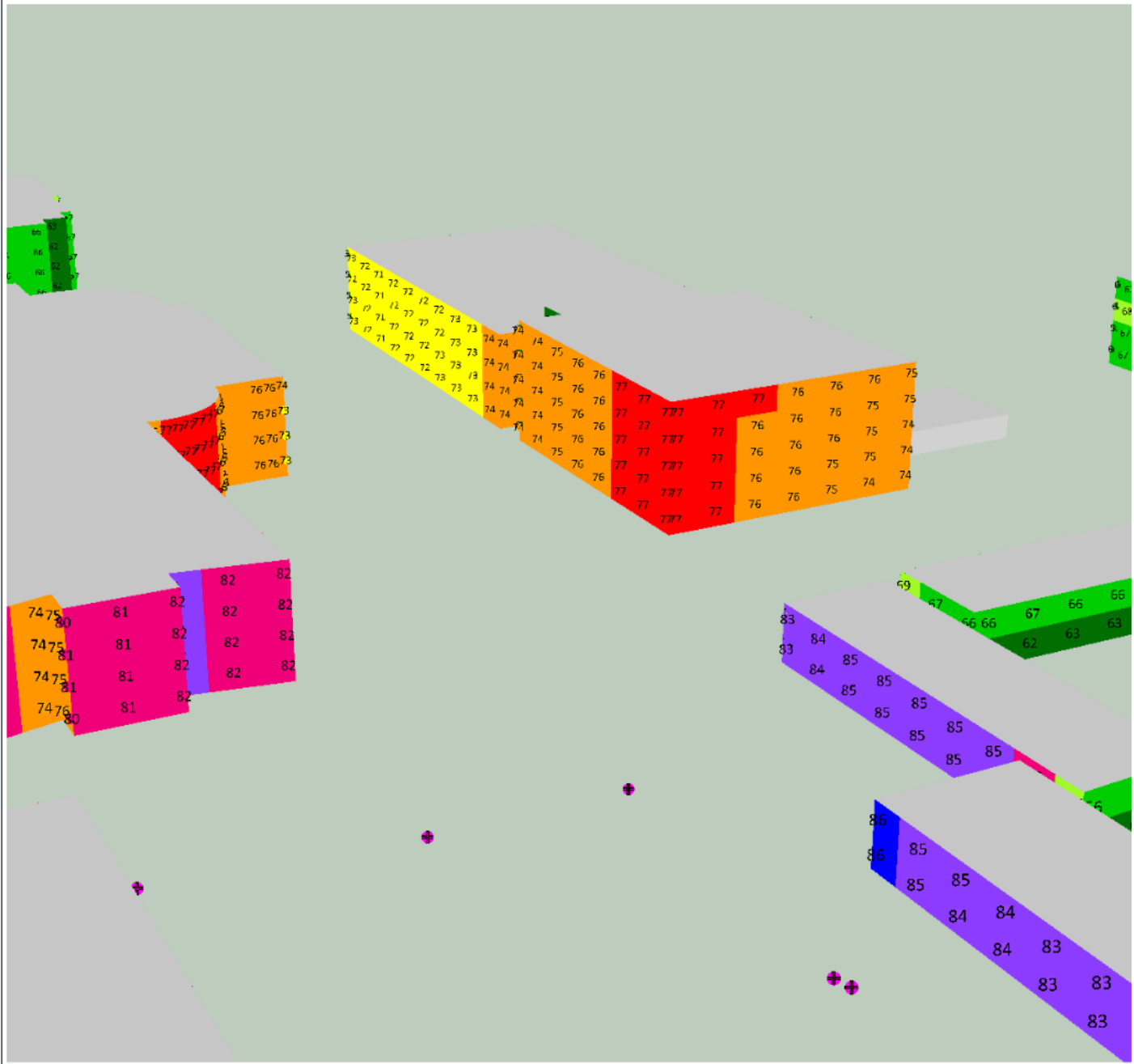
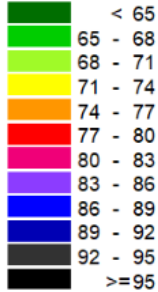
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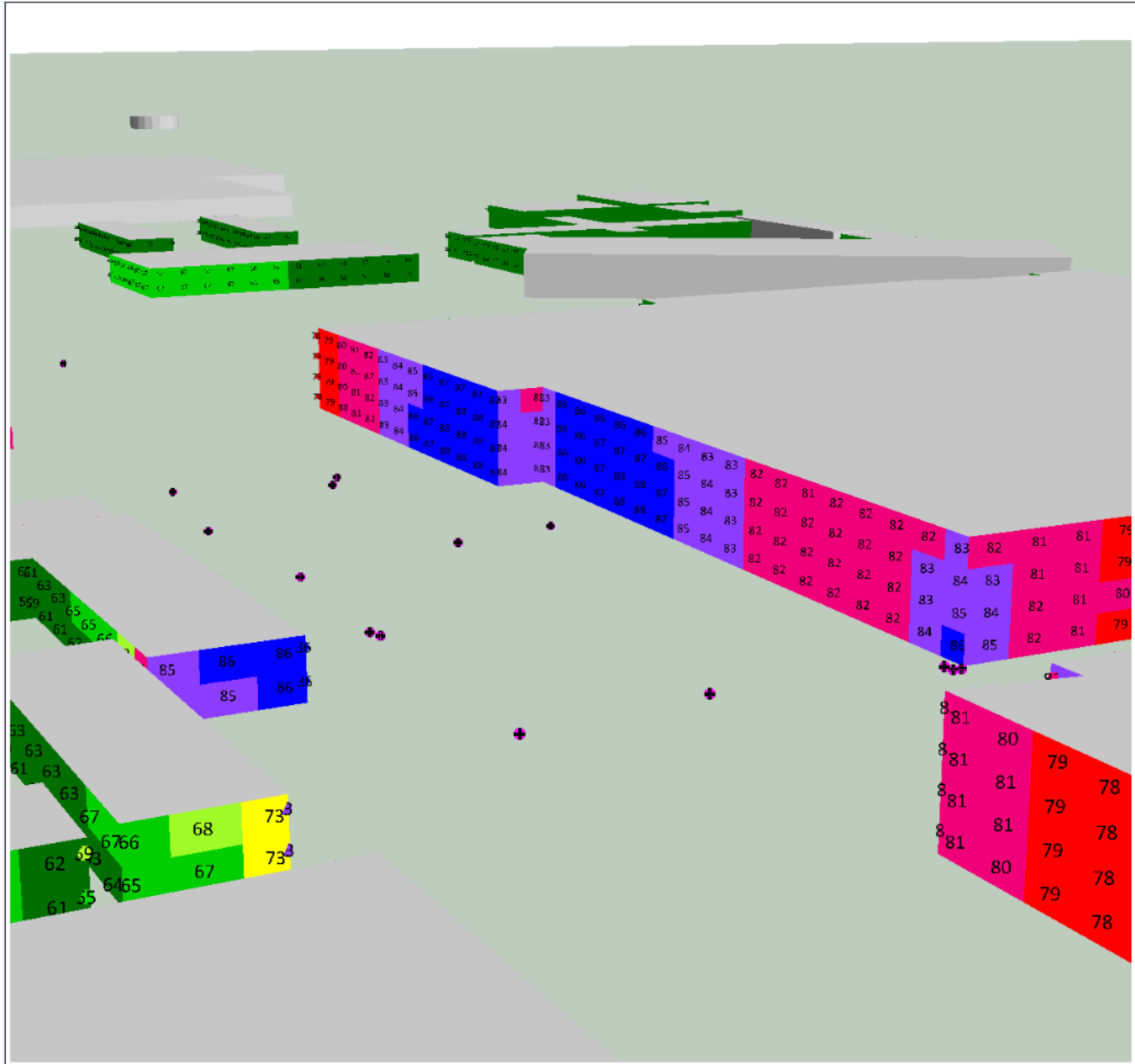
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Noise Level LAeq in dB(A)





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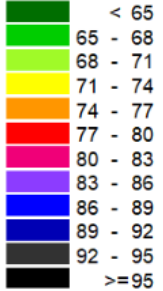
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Noise Level LAeq in dB(A)



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Noise Sources LAeq SWL

- CFA Piling Rig 103dB(A)
- Excavator w Hammer 123dB(A)
- Excavator w Bucket 105dB(A)
- Concrete Pump 105dB(A)
- Concrete Truck 105dB(A)
- Demolition Saw 118dB(A)
- Semi-Trailer 105dB(A)
- Stationary Crane 96dB(A)

Prepared by: OB
Date: 03/11/2020

Noise Level LAeq in dB(A)

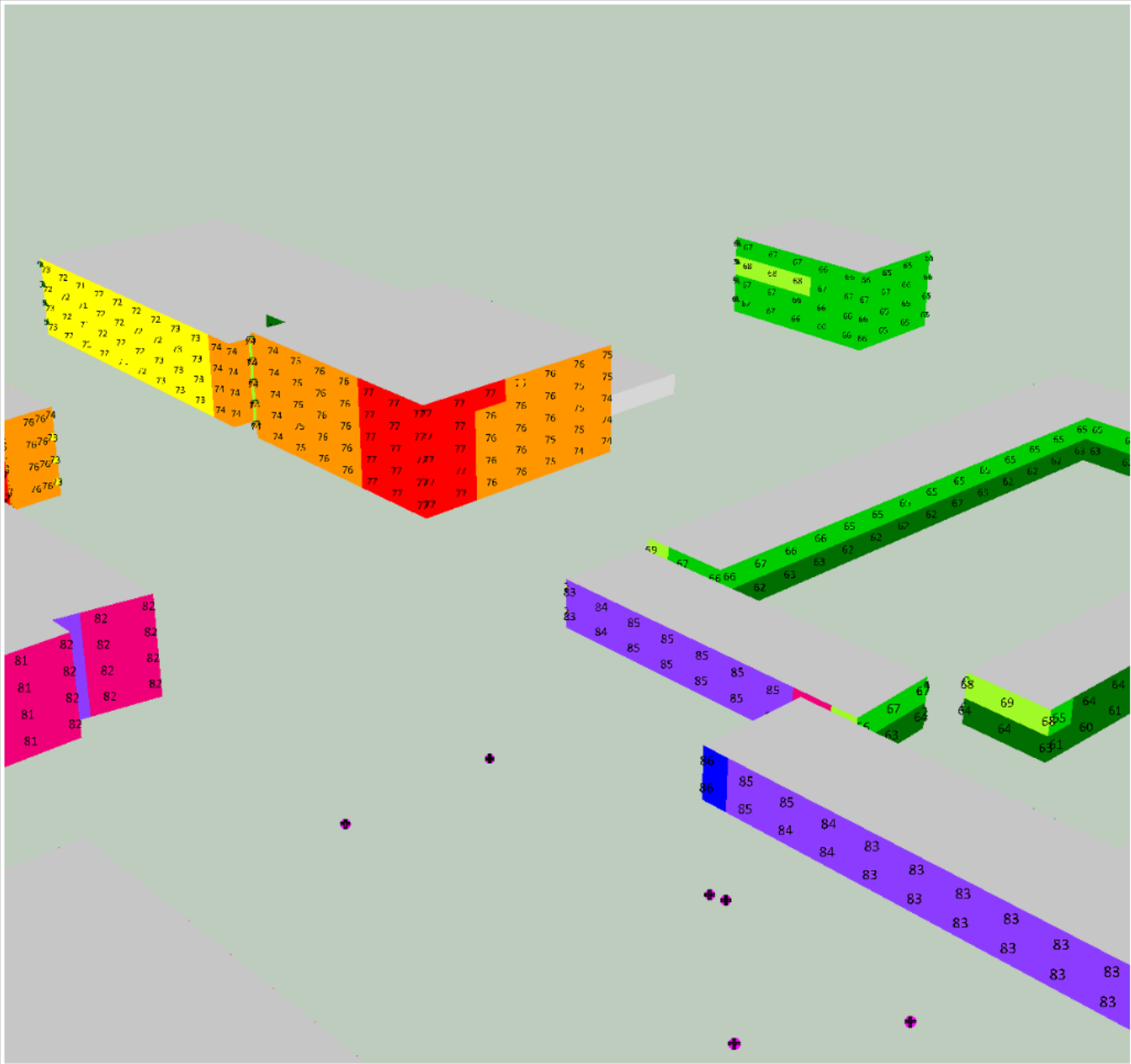
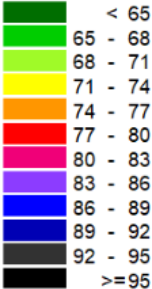


Table 13 – Predicted Noise Generation to Receiver 1 – Remaining Liverpool Hospital Development

Activity	Internal Noise Management Level dB(A) L_{eq} (15min)	Predicted Noise Level dB(A)L_{eq}(15min) (Internal Areas)	Below Internal Noise Management Level?
2 x excavators with hydraulic hammers 2 x excavators with buckets 2 x semi-trailers 3 x concrete trucks 2 x concrete pumps 1 x demolition saw 1 x stationary crane 2 x CFA piling rigs	<u>Bedroom Wards/ Consulting Rooms/Treatment Rooms/Office Areas/Operating Theatres</u> 45dB(A) <u>X-Ray Areas</u> 50dB(A)	37-58	No – Noise mitigation treatments are recommended

Table 14 – Predicted Noise Generation to Receiver 2 – Tafe NSW Liverpool

Activity	Internal Noise Management Level dB(A) L_{eq} (15min)	Predicted Noise Level dB(A)L_{eq}(15min) (Internal Areas)	Below Internal Noise Management Level?
2 x excavators with hydraulic hammers 2 x excavators with buckets 2 x semi-trailers 3 x concrete trucks 2 x concrete pumps 1 x demolition saw 1 x stationary crane 2 x CFA piling rigs	<u>Classrooms/Teaching Spaces</u> 45dB(A)	≤45	Yes

Table 15 – Predicted Noise Generation to Receiver 3 – Liverpool Girls High School

Activity	Internal Noise Management Level dB(A) L_{eq} (15min)	Predicted Noise Level dB(A)L_{eq}(15min) (Internal Areas)	Below Internal Noise Management Level?
2 x excavators with hydraulic hammers 2 x excavators with buckets 2 x semi-trailers 3 x concrete trucks 2 x concrete pumps 1 x demolition saw 1 x stationary crane 2 x CFA piling rigs	<u>Classrooms/Teaching Spaces</u> 45dB(A)	30-55	No – Noise mitigation treatments are recommended

Table 16 – Predicted Noise Generation to Receiver 4 – Health Services Building/Ingham Institute

Activity	Internal Noise Management Level dB(A) L_{eq} (15min)	Predicted Noise Level dB(A)L_{eq}(15min) (Internal Areas)	Below Internal Noise Management Level?
2 x excavators with hydraulic hammers 2 x excavators with buckets 2 x semi-trailers 3 x concrete trucks 2 x concrete pumps 1 x demolition saw 1 x stationary crane 2 x CFA piling rigs	<u>Consulting Rooms/Treatment Rooms/Office Areas</u> 45dB(A)	41-47	No – Noise mitigation treatments are recommended

Table 17 – Predicted Noise Generation to Receiver 5 – Residents at 41 Forbes Street

Activity	External Noise Management Level dB(A) L_{eq} (15min)	Predicted Noise Level dB(A)L_{eq}(15min) (External Areas)	Below External Noise Management Level?
2 x excavators with hydraulic hammers 2 x excavators with buckets 2 x semi-trailers 3 x concrete trucks 2 x concrete pumps 1 x demolition saw 1 x stationary crane 2 x CFA piling rigs	<p>Standard Construction Hours</p> <p>(Monday – Friday) <u>7:00am – 6:00pm</u> 52dB(A)</p> <p>(Saturday) <u>8:00am – 1:00pm</u> 52dB(A)</p>	57-68	No – Noise mitigation treatments are recommended

Table 18 – Predicted Noise Generation to Receiver 6 – South Western Sydney Local Health District

Activity	External Noise Management Level dB(A) L_{eq} (15min)	Predicted Noise Level dB(A)L_{eq}(15min) (External Areas)	Below External Noise Management Level?
2 x excavators with hydraulic hammers 2 x excavators with buckets 2 x semi-trailers 3 x concrete trucks 2 x concrete pumps 1 x demolition saw 1 x stationary crane 2 x CFA piling rigs	<p>(Monday – Friday) <u>7:00am – 6:00pm</u> 70dB(A)</p> <p>(Saturday) <u>8:00am – 1:00pm</u> 70dB(A)</p>	51-67	Yes

6.5 AMELIORATIVE MEASURES

6.5.1 Site Specific Recommendations

Detailed site-specific recommendations to mitigate noise and vibration impacts on surrounding receivers are detailed below.

- Excavation is to be done using an excavator as much as possible with a bucket (as opposed to using hydraulic hammering).
- Stationed equipment shall be located as far as possible from residences as practicable and are to be screened by an enclosure.
- Vehicle Noise:
 - Truck movements should not commence prior to 7am.
 - Trucks must turn off their engines during idling to reduce impacts on nearby residential receivers (unless truck ignition needs to remain on during concrete pumping).
 - Avoid careless dropping of construction materials into empty trucks.
- Equipment shall be well maintained.

Hand tools would only be typically used sporadically. Additionally, we recommend the following controls:

- In the event of a complaint, the use of hand-held jackhammers, grinders, and electric saws should be screened from surrounding receiver locations with localised acoustic barriers such as an Eco Barrier or plywood hoarding fixed to temporary fencing.
- Time Control: Limit hammering, saw cutting and grinding activities to between 9am to 12pm and 2pm to 5pm Monday to Friday and 9am to 12pm Saturday to provide respite to surrounding residents.

6.6 GENERAL RECOMMENDATIONS

General noise management practices which may be adopted are discussed below. In addition, notification, reporting and complaints handling procedures should be adopted as recommended in section in this report.

6.6.1 Acoustic Barrier

Barriers or screens can be an effective means of reducing noise. Barriers can be located either at the source or receiver.

The placement of barriers at the source is generally only effective for static plant. Equipment which is on the move or working in rough or undulating terrain cannot be effectively attenuated by placing barriers at the source.

Barriers can also be placed between the source and the receiver.

The degree of noise reduction provided by barriers is dependent on the amount by which line of sight can be blocked by the barrier. If the receiver is totally shielded from the noise source reductions of up to 15 dB(A) can be affected. Where only partial obstruction of line of sight occurs, noise reductions of 5 to 8 dB(A) may be achieved. Where no line of sight is obstructed by the barrier, generally no noise reduction will occur.

As barriers are used to provide shielding and do not act as an enclosure, the material they are constructed from should have a noise reduction performance which is approximately 10dB(A) greater than the maximum reduction provided by the barrier. In this case the use of a material such as 10 or 15mm plywood would be acceptable for the barriers.

6.6.2 Silencing Devices

Where construction process or appliances are noisy, the use of silencing devices may be possible. These may take the form of engine shrouding, or special industrial silencers fitted to exhausts.

6.6.3 Material Handling

The installation of rubber matting over material handling areas can reduce the sound of impacts due to material being dropped by up to 20dB(A).

6.6.4 Treatment of Specific Equipment

In certain cases, it may be possible to specially treat a piece of equipment to reduce the sound levels emitted. These may take the form of engine shrouding, or special industrial silencers fitted to exhausts.

6.6.5 Establishment of Site Practices

This involves the formulation of work practices to reduce noise generation. This includes locating fixed plant items as far as possible from residents as well as rotating plant and equipment to provide respite to receivers.

Construction vehicles accessing the site should not queue in residential streets and should only use the designated construction vehicle routes. Loading of these vehicles should occur as far as possible from any sensitive receiver.

6.7 NOISE MONITORING (IF REQUIRED)

In the event that complaints are made from neighbouring properties regarding noise impacts from the subject site, noise monitors will be installed at the property boundaries of the neighbouring properties nearest to the subject site to monitor noise levels.

6.7.1 Downloading of Noise Monitor Data

Downloading of the noise monitor data will be conducted on a regular basis. In the event of consistent high noise level periods, downloading of the noise monitor data will be conducted more frequently. Results obtained from the noise monitor will be presented in a graph format and will be forwarded to the client for review. It is proposed that reports are provided fortnightly, presenting the measured noise levels in reference to the noise management levels detailed in this report.

6.7.2 Presentation of Noise Monitor Results

A fortnightly report will be submitted to the client via email summarising the measured noise level events. Complete results of the continuous noise logging will be presented in fortnightly reports including graphs of the collected data.

7 PRELIMINARY CONSTRUCTION VIBRATION ASSESSMENT (STANDARD CONSTRUCTION HOURS)

7.1 VIBRATION PRODUCING ACTIVITIES

Proposed activities that have the potential to produce significant ground vibration include:

- Demolition Work; and
- Excavation Work.

7.2 SAFEGUARDS TO PROTECT SENSITIVE STRUCTURES

It is impossible to predict the vibrations induced by the demolition and excavation operations on site at potentially affected receivers. This is because vibration levels are principally proportional to the energy impact which is unknown, the nature of the terrain in the area (type of soil), drop weight, height etc.

Note: Sample testing of vibration impacts from the demolition and excavation works to the sensitive receiving spaces of the Liverpool Hospital is recommended prior to commencement of the multi-storey car park works.

7.3 VIBRATION MONITORING (IF REQUIRED)

In the event that complaints are made from neighbouring properties regarding vibration impacts from the subject site, vibration monitors will be installed at the property boundaries of the neighbouring properties nearest to the subject site to monitor vibration levels.

7.3.1 Downloading of Vibration Monitor Data

Downloading of the vibration monitor data will be conducted on a regular basis. In the event of exceedance of the vibration criteria, downloading of the vibration monitor data will be conducted more frequently. Results obtained from the vibration monitor will be presented in a graph format and will be forwarded to the client for review. It is proposed that reports are provided fortnightly with any exceedances in the vibration criteria reported as detailed in this report.

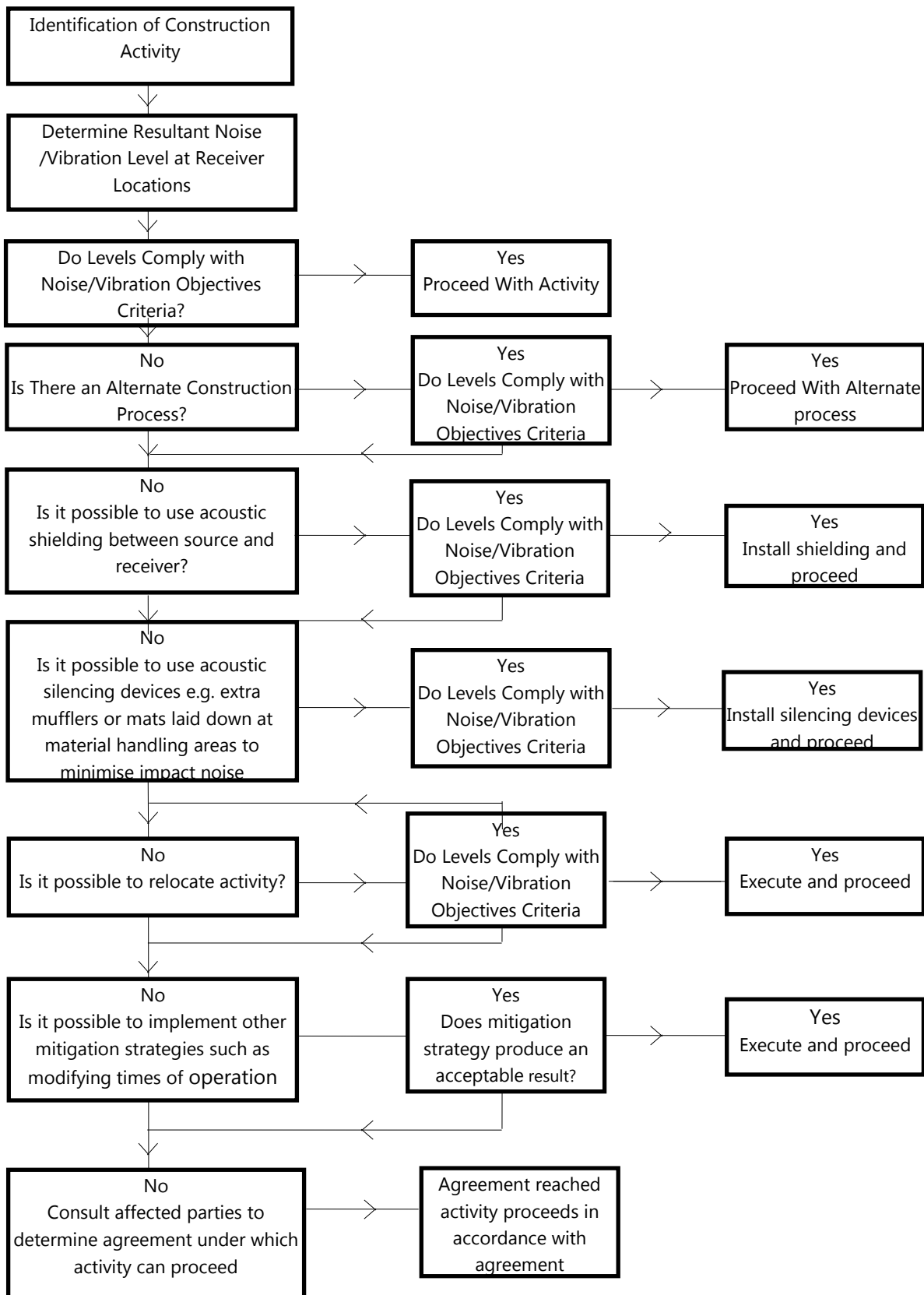
7.3.2 Presentation of Vibration Monitor Results

A fortnightly report will be submitted to the client via email summarising the vibration events. The vibration exceedance of criteria is recorded, and the report shall be submitted within 24 hours. Complete results of the continuous vibration logging will be presented in fortnight reports including graphs of the collected data.

8 ASSESSMENT METHODOLOGY AND MITIGATION METHODS

The flow chart that follows illustrates the process to be followed to minimise the impact associated with these activities.

Noise sources with the potential to exceed the criteria set out in section 7 have been identified and discussed in section 8.



9 COMMUNITY INTERACTION AND COMPLAINTS HANDLING

9.1 ESTABLISHMENT OF DIRECT COMMUNICATION WITH AFFECTED PARTIES

In order for any construction noise management programme to work effectively, continuous communication is required between all parties, which may be potentially impacted upon, the builder and the regulatory authority. This establishes a dynamic response process which allows for the adjustment of control methods and criteria for the benefit of all parties.

The objective in undertaking a consultation processes is to:

- Inform and educate the groups about the project and the noise controls being implemented;
- Increase understanding of all acoustic issues related to the project and options available;
- Identify group concerns generated by the project, so that they can be addressed; and
- Ensure that concerned individuals or groups are aware of and have access to the Site Complaints Register which will be used to address any construction noise related problems should they arise.

To ensure that this process is effective, regular scheduled meetings will be required for a finite period, until all issues have been addressed and the evidence of successful implementation is embraced by all parties.

An additional step in this process is to produce a newsletter informing nearby residents of upcoming activities that are likely to generate higher noise/vibration levels.

9.2 DEALING WITH COMPLAINTS

Should ongoing complaints of excessive noise, vibration or dust occur, immediate measures shall be undertaken to investigate the complaint, the cause of the exceedances and identify the required changes to work practices. In the case of exceedances of the vibration and dust limits, all work potentially producing vibration or dust shall cease until the exceedance is investigated. The effectiveness of any changes shall be verified before continuing. Documentation and training of site staff shall occur to ensure the practices that produced the exceedances are not repeated.

If a noise complaint is received the complaint should be recorded on a Noise Complaint Form. The complaint form should list:

- The name and address of the complainant (if provided);
- The time and date the complaint was received;
- The nature of the complaint and the time and date the noise was heard;
- The name of the employee who received the complaint;
- Actions taken to investigate the complaint, and a summary of the results of the investigation;
- Required remedial action, if required;
- Validation of the remedial action; and
- If necessary, setup vibration monitoring at the location representing the nearest affected vibration receiver, with alarm device which can inform the project manager on site if the vibration exceedance happened.
- Summary of feedback to the complainant.

A permanent register of complaints should be held.

All complaints received should be fully investigated and reported to management. The complainant should also be notified of the results and actions arising from the investigation.

The investigation of a complaint shall involve where applicable;

- noise measurements at the affected receiver;
- an investigation of the activities occurring at the time of the incident;
- inspection of the activity to determine whether any undue noise is being emitted by equipment; and
- Whether work practices were being carried out either within established guidelines or outside these guidelines.

Where an item of plant is found to be emitting excessive noise, the cause is to be rectified as soon as possible. Where work practices within established guidelines are found to result in excessive noise being generated then the guidelines should be modified so as to reduce noise emissions to acceptable levels. Where guidelines are not being followed, the additional training and counselling of employees should be carried out.

Measurement or other methods shall validate the results of any corrective actions arising from a complaint where applicable.

10 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.

11 CONCLUSION

This report presents a noise and vibration management plan for the excavation and construction activities proposed to be conducted for stage 1 of the multi-storey carpark of the Liverpool Hospital Health and Academic Precinct.

Provided that the practices and recommendations in this report are implemented, the noise and vibration impact during the excavation and construction stages will be minimised.

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

Yours faithfully,

A handwritten signature in black ink that reads "S. Nichols". The signature is written in a cursive, slightly slanted style.

Acoustic Logic Pty Ltd
Shane Nichols