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Construction Noise and Vibration Management-Sub Plan (CNVMSP)

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1	21/02/2023	20230148.1/2102A/R1/RF	RF		VF
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3	1/06/2023	20230148.1/0106A/R3/RF	RF		VF

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B17 Consent Satisfaction Table

Condition	Condition requirements	Document reference
B17	The Construction Noise and Vibration Management Sub-Plan must address, but not be limited to, the following:	
	(a) be prepared by a suitably qualified and experienced noise expert;	Appendix B
	(b) describe procedures for achieving the noise management levels in EPA's Interim Construction Noise Guideline (DECC, 2009);	Section 9
	(c) describe the reasonable and feasible measures to be implemented to manage high noise generating works such as piling, in close proximity to sensitive receivers;	Section 9.3
	(d) include strategies that have been developed with the community for managing high noise generating works;	Section 10
	(e) describe the community consultation undertaken to develop the strategies in condition B17(d);	Section 10
	(f) include a complaints management system that would be implemented for the duration of the construction; and	Section 10.1, 10.2
	(g) include a program to monitor and report on the impacts and environmental performance of the development and the effectiveness of the implemented management measures in accordance with the requirements of condition B14.	Section 9.7.7 & 9.7.8

Review of Environmental Factors – 'The Children's Hospital at Westmead Stage 2 and Viral Vector Manufacturing Facility – Refurbishment Works' Satisfaction Table

REF reference	Requirement	Document Reference
12. Noise Management Measures		
12.1	During preparation of the construction program, consult with the hospital to determine what areas (if any) of the hospital is particularly noise sensitive, and at what time (ward rooms, operating theatres, etc.).	Section 7, Section 10. Appendix A
12.2	Identify feasible acoustic controls or management techniques (use of screens, scheduling of noisy works, notification of adjoining land users, respite periods) when excessive levels may occur.	Section 9
12.3	For activities where acoustic controls and management techniques still cannot guarantee compliant noise levels, implement a notification process whereby nearby development is made aware of the time and duration of noise intensive construction processes.	Section 10

1 INTRODUCTION

This report presents our assessment of the processes which will be followed in order to manage noise and vibration from construction activities associated with the redevelopment of The Children's Hospital, Westmead. This report is pursuant to development consent SSD conditions B17 for the provision of a Construction Noise and Vibration Management Sub-Plan.

The principal objective of this study is to undertake an evaluation of work to be performed during construction phases and forecast potential impacts of noise and vibration. The evaluation will be used to formulate and streamline effective regulation and mitigation measures.

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

- Specific activities that will be conducted and the associated noise/vibration sources.
- Identification of potentially affected noise/ vibration sensitive receivers.
- The development, hours of work and excavation period.
- The construction noise requirements specified in consent condition B17.
- Noise/ vibration response procedures.
- Assessment of potential noise/ vibration from the proposed construction activities; and

Contingency plans to be implemented in the event of non-compliances and/or noise complaints.

2 SITE DESCRIPTION & PROPOSED DEVELOPMENT

The site is located at the Westmead Health precinct, with the bulk of the works occurring near the Redbank Rd side of the complex. There will be interface with the public in several areas throughout the project. The building is a multi-storey live public hospital. The hospital is comprised of multiple buildings spread over a large area of land and joined by means of internal & external roads, walkways and link bridges. They consist of concrete, brick and steel structures. Interior fit out includes typical commercial environments with both brick, lightweight & glazed walls and ceiling treatments.

The following scope of works is proposed:

- Demolition of the Eastern Airlock (Milestone 1)
- Demolition of the Galleria Airlock (Milestone 1)
- Demolition of the Galleria Stair (Milestone 1)
- Demolition of the Clinical research Centre (Milestone 2)
- Demolition of the Gait Lab and Dining areas (Milestone 3)
- Demolition of the CSRA Blood Bank (Milestone 4)
- Demolition of the Pathology Expansion (Milestone 5)
- Demolition of the Kids Research rooftop (Milestone 6).
- Corridor widening works.
- Demolition of concrete ramp including supporting steel structure to the Kids Research building (Milestone 8).
- Innovation Centre Fitout.

Sensitive receivers surrounding the site have been identified as follows:

- **R1:** Residential receivers north of Redbank Creek, east of Redbank Road.
- **R2:** 'Ronald McDonald House' short-term accommodation, to the north east.
- **R3:** Residential receivers to the south along Hawkesbury Road.
- **H1:** CHW Development site. We note that the CHW will be operational during redevelopment, Areas within CHW still operating are considered sensitive receivers.
- **H2:** Cumberland Hospital to the east.
- **H3:** Children's medical Research Institute (CMRI) to the south west.
- **H4:** Westmead Institute of Medical Research (WIMR) to the south west.
- **H5:** Central Acute Services Building (CASB) to the west. We note that development also encompasses CASB Innovation Centre.
- **H6:** Paediatric Services Building (PSB) to the west (currently under construction).
- **H7:** Kids Research (KR) to the west. We note that development also encompasses part of KR.

An aerial photo of the site, monitoring locations and surrounding receivers is shown below in Figure 1. Detailed site map showing locations of proposed works is provided in Figure 2.

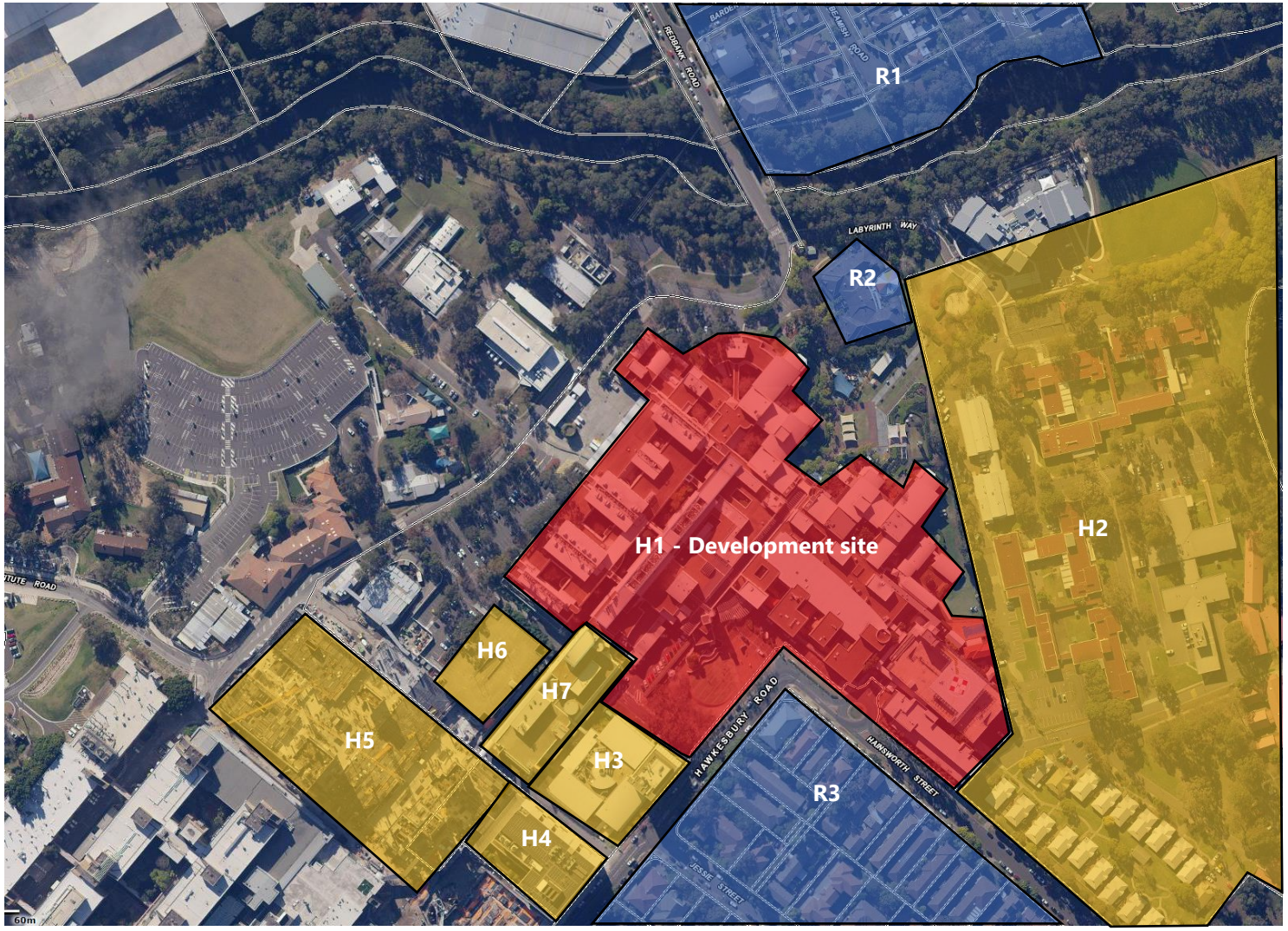


Figure 1 – Overview of site and surrounding developments (Source: Six Maps)

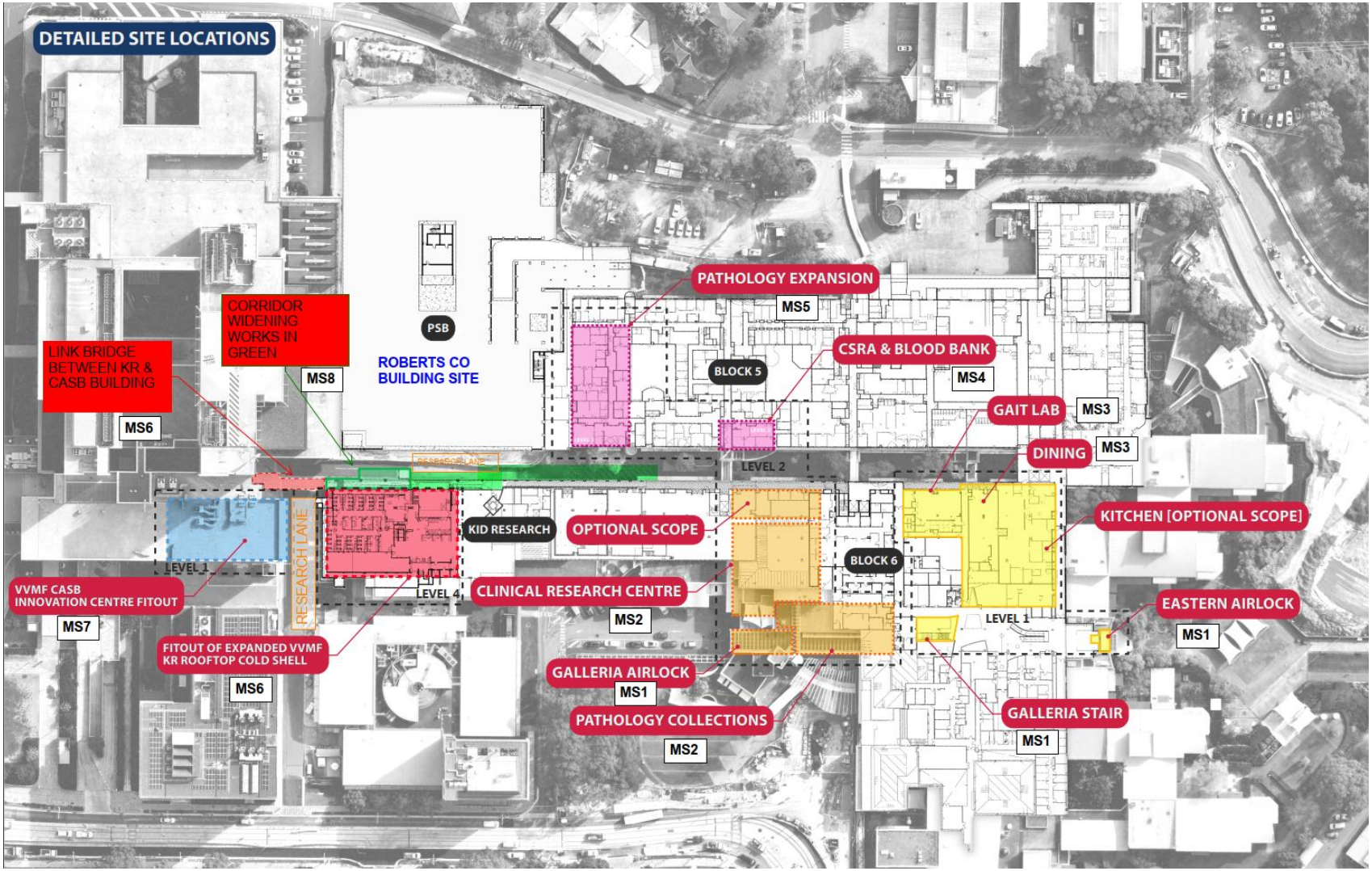


Figure 2 – Detailed Site Locations (Source: Kane Constructions)

3 ACTIVITIES TO BE CONDUCTED AND ASSOCIATED NOISE SOURCES

The primary noise producing equipment and activities likely to occur during the works have been provided by Kane Constructions and outlined below.

For internal works, the following noise generating activities/equipment are anticipated:

- Internal demolition using hand/power tools
- Trucks for material delivery/removal

For the demolition of concrete foot ramp entrance to kid's research facility, the following noise generating activities/equipment are anticipated:

- Crane
- Demolition road saw
- Excavators (3-5 tonne)
- Hand/power tools
- Trucks for material removal
- Erection of scaffolding

For the structural demolition of concrete awning to Kids Research facility, the following noise generating activities/equipment are anticipated:

- High frequency demolition saw or track mounted wall saw
- Core drilling
- Jackhammering
- 30-50 tonne crane
- Hand/power tools
- Trucks for material removal

4 HOURS OF WORK AND DURATION

4.1 HOURS OF WORK

Consent conditions C4-C8 stipulates that construction hours are limited as follows:

Construction Hours

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.

C5. Notwithstanding condition C4, provided noise levels do not exceed the existing background noise level plus 5dB, works may also be undertaken during the following hours:

(a) between 6pm and 7pm, Mondays to Fridays inclusive; and

(b) between 1pm and 5pm, Saturdays.

C6. Construction activities may be undertaken outside of the hours in condition C4 and C5 if required:

(a) by the Police or a public authority for the delivery of vehicles, plant or materials; or

(b) in an emergency to avoid the loss of life, damage to property or to prevent environmental harm; or

(c) where the works are inaudible at the nearest sensitive receivers; or

(d) for the delivery, set-up and removal of construction cranes, where notice of the crane-related works is provided to the Planning Secretary and affected residents at least seven days prior to the works; or

(e) where a variation is approved in advance in writing by the Planning Secretary or her nominee if appropriate justification is provided for the works.

C7. Notification of such construction activities as referenced in condition C6 must be given to affected residents before undertaking the activities or as soon as is practical afterwards.

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.

A summary of approved construction hours is provided in Table 1 below:

Table 1 – Summary of Approved Construction Hours

Construction Activity	Development Consent Condition	Day of the Week – Permitted Times		
		Monday - Friday	Saturday	Sunday & Public Holidays
Construction and delivery of materials to and from site	C4	7:00am – 6:00pm	8:00am – 1:00pm	None permitted.
Construction and delivery of materials to and from site	C5 (BG+5 noise limit)	N/A	1:00pm – 5:00pm	None permitted
Rock breaking, rock hammering, sheet piling, pile driving	C8	9:00am – 12:00pm, and 2:00pm – 5:00pm	9:00am – 12:00pm	None permitted

5 EXISTING BACKGROUND NOISE LEVELS

Existing background noise levels for receivers external to the site are based on data provided in the detailed Design Acoustic Report for the project prepared by Stantec (Ref: 44311, dated 25/2/22).

Table 2 – Rating Background Noise Levels

Location	RBL – Time of Day		
	Daytime (7am – 6pm)	Evening (6pm -10pm)	Night (10pm – 7am)
Surrounding residential receivers	43 dB(A)$L_{90(Period)}$	43* dB(A)$L_{90(Period)}$	42 dB(A)$L_{90(Period)}$

*44dB(A) measured.

6 CONSTRUCTION NOISE AND VIBRATION EMISSION MANAGEMENT LEVELS

6.1 NOISE MANAGEMENT LEVELS

Noise emissions associated with construction activities on the project site to external areas of receivers will be assessed in with reference to the following:

- Development Consent Condition B17
- NSW EPA's I*nterim Construction Noise Guideline (DECC, 2009),*
- Protection of the Environment Operations Act 1997,
- Australian Standard AS2436:2010 "Guide to Noise Control on Construction, Maintenance and Demolition Sites.

6.1.1 Development Consent Condition C13

Consent conditions state the following with respect to construction nose limits:

Construction Noise Limits

C13. Construction must be undertaken in accordance with 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.

We note that DECC noise management levels as detailed in the Interim construction Noise Guideline (ICNG) are *not* regulatory stop-work limits. This is discussed further in section 6.1.2 below.

6.1.2 2009 NSW Environmental Protection Authority (EPA) document – "Interim Construction Noise Guideline (ICNG) 2009"

The EPA's ICNG assessment requires:

- Review of noise levels at nearby development
- If necessary, recommendation of noise control strategies in the event that compliance with noise emission goals is not possible.

EPA guidelines adopt differing strategies for noise control depending on the predicted noise level at the nearest residences for construction during the recommended standard hours:

- "*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 the rating background noise level by more than 10dB.
- "*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.

The guideline also provides external management levels for land used for commercial or industrial purposes to be assessed at the most affect occupied point of the premises. EPA guidelines recommend a construction noise management level for industrial receivers of 75dB(A)$L_{eq(15\text{-}minute)}$.

Section 4.1.2 of the guideline provides that, for other sensitive land uses such as classrooms at educational institutions, the noise management level should not exceed 45 dB(A) internally.

6.1.3 Protection of the Environment Operations Act 1997,

We note that, in the absence of specific noise limits provided in the Protection of the Environment Operations Act 1997 with respect to construction noise, it is considered that adherence to the requirements of the NSW EPA's ICNG is sufficient in the assessment of 'offensive noise'.

6.1.4 Report entitled 'Westmead Hospital N&V Noise Monitoring', prepared by ARUP ref: 28312-16, 21/4/23

The ARUP report (refer Appendix A) provides noise management levels for mice holding rooms based in a review of applicable research findings as follows:

- L_{Amax} 85 dB (for short duration high noise levels)
- L_{Aeq}(1minute) 69 dB (for more continuous noise generation)

6.1.5 Construction Noise Management Levels Summary

Nosie management levels applicable to the development site and surrounding receivers are summarised in the following tables.

Table 3 – Construction Noise Emission Management Levels – External of Westmead Hospital Precinct

Receiver Type	"Noise Affected" Level - dB(A)$L_{eq(15min)}$	"Highly Noise Affected" Level - dB(A)$L_{eq(15min)}$
Residential Receivers (R1,R2,R3)	53 Background + 10dB(A) (Standard Construction Hours)	75

Construction noise management levels for areas within the hospital precinct are provided below based on the requirements of the ICNG and other applicable reports and guidelines:

Table 4 – Construction Noise Emission Management Level (Other)

Receiver Type	Noise Management Level - dB(A)$L_{eq(15min)}$
Hospitals (when in use)	45 (Internal) 75* (external)
Research Buildings** (when in use)	Laboratories: 55 (Internal) 85* (external) Office areas: 50 (Internal) 80* (External)
WIMR Mice Holding Rooms (refer Section 6.1.4)	L_{Amax} 85 dB (for short duration high noise levels) L_{Aeq}(1minute) 69 dB (for more continuous noise generation)

*Based on a 30dB(A) reduction across a fixed/closed façade.

**The ICNG does not specify noise level requirements for research buildings. As such, an NML of ambient noise + 5db(A) has been adopted, with ambient noise levels based on those specified in AS2107:2106.

6.1.6 Australian Standard AS2436:2010 "Guide to Noise Control on Construction, Maintenance and Demolition Sites

Australian Standard AS2436 does not provide specific noise management targets. The guideline focuses on strategies for developing feasible and reasonable mitigation methodologies, management controls and community liaison to reach realistic compromises between the needs of construction activities and potentially affected receivers.

For the control and regulation of noise from construction sites AS2436:2010 *Guide to noise control on construction, maintenance and demolition sites* nominates the following:

- That reasonable suitable noise management objectives are established.
- That all practicable measures be taken on the building site to regulate noise emissions, including the siting of noisy static processes to locations of the site where they can be shielded, selecting less noisy processes, and if required regulating demolition hours, and

6.2 VIBRATION OBJECTIVES

Development consent conditions state the following with respect to vibration:

Vibration Criteria

C16. Vibration caused by construction at any residence or structure outside the site must be limited to:

(a) for structural damage, the latest version of *DIN 4150-3 (1992-02) Structural vibration - Effects of vibration on structures* (German Institute for Standardisation, 1999); and

(b) for human exposure, the acceptable vibration values set out in the *Environmental Noise Management Assessing Vibration: a technical guideline* (DEC, 2006) (as may be updated or replaced from time to time).

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

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

The criteria and the application of the guidelines mentioned in condition C16-18 are discussed in separate sections below.

6.2.1 German Standard DIN 4150-3 (1999-02) - Ground Borne Vibrations and Damage Limits

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 5.

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 5 – 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

6.2.2 Environmental Noise Management Assessing Vibration: a technical guideline (DEC, 2006) - Managing Assessing Impacts

Department of Environment and Conservation NSW "Assessing Vibration: A Technical Guideline" (Feb 2006) is based on the guidelines contained in BS 6472:1992. This guideline provides procedures for assessing tactile vibration and regenerated noise within potentially affected buildings.

The recommendations of this guideline should be adopted to assess and manage vibration within the excavation/construction site.

Table 6 – EPA Recommended Vibration Criteria

Place	Time	RMS acceleration (m/s^2)		RMS velocity (mm/s)		Peak velocity (mm/s)	
		Preferred	Maximum	Preferred	Maximum	Preferred	Maximum
Continuous Vibration							
Critical Working Areas	**Daytime**	0.005	0.01	0.1	0.2	0.14	0.28
Residences		0.01	0.02	0.2	0.4	0.28	0.56
Offices		0.02	0.04	0.4	0.8	0.56	1.1
Workshops		0.04	0.08	0.8	1.6	1.1	2.2
Impulsive Vibration							
Critical Working Areas	**Daytime**	0.005	0.01	0.1	0.2	0.14	0.28
Residences		0.3	0.6	6.0	12.0	8.6	17.0
Offices		0.64	1.28	13.0	26.0	18.0	36.0
Workshops		0.64	1.28	13.0	26.0	18.0	36.0

6.2.3 Additional Vibration Criteria

While not referenced in the consent, we have been advised of the requirements of a number of vibration sensitive uses surrounding the development site based on client consultation with key stakeholders. Vibration criteria are detailed Appendix A and summarised as follows.

Table 7 -Vibration Requirements for Surrounding Sensitive Spaces

Building	Space	Criteria	
		PPV	RMS Velocity
Children's Hospital Westmead	Level 1 Laboratories	-	Curve VC-C (1/3rd Octave band VRMS to be below 0.0125mm/s), based on the two analysers
	Level 1 Mental Health Unit	-	Curve 2 Australian Standard AS2670.2 (1/3rd Octave band VRMS to be below 0.204mm/s), based on daytime residence human comfort limit
Central Acute Services Building (CASB)	Level 2 MRI Scanner	-	Curve VC-A (1/3rd Octave band VRMS to be below 0.051mm/s)
	Level 3 Surgical Suite	-	Curve 1 Australian Standard AS2670.2 (1/3rd Octave band VRMS to be below 0.102mm/s)
Kids Research (KR)	Level 1 Animal House	1.0mm/s	Curve 1 Australian Standard AS2670.2 (1/3rd Octave band VRMS to be below 0.102mm/s)
	Level 4 Lab 9	-	Curve VC-B (1/3rd Octave band VRMS to be below 0.025mm/s)
Westmead Institute for Medical Research (WIMR)	Level 1 Animal Holding	-	¼ of human perception curve for vibration

7 ASSESSMENT OF NOISE EMISSIONS

7.1 ACTIVITIES TO BE CONDUCTED AND THE ASSOCIATED NOISE SOURCES

We have been advised of the typical equipment/processes anticipated to be used on the project site. Noise impacts from these activities on the amenity of the surrounding identified sensitive receivers will be predicted based on the A-weighted sound power levels outlined in the table below.

Table 8 – Equipment Sound Power Levels

EQUIPMENT /PROCESS	SOUND POWER LEVEL dB(A)
Internal works	
Hand/Power Tools	100
External works	
Concrete Saw	105
Excavator with Bucket (5 tonne)	100
Hand/Power Tools (Used Externally)	100
Jackhammer	120
Trucks	105
Crane (electric)	95

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

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

1. On-site measurements;
2. Table D2 of Australian Standard 2436-1981 & Table A1 of Australian Standard 2436-2010; and
3. Data held by this office from other similar studies.

7.2 NOISE EMISSION PREDICTIONS AND ASSESSMENT

7.2.1 Methodology

Noise generated by plant and equipment will be managed to generally comply with the nominated noise management levels, and where this noise goal may be exceeded, noise will be managed based on principles consistent with Australian Standard 2436.

Predictions of noise levels at the sensitive receivers identified have been made of the construction processes with the potential to produce significant noise.

It is noted that many of the noise sources are present over a small period of the day or may be present for a few days with a significant intervening period before the activity occurs again.

7.2.2 Predicted Noise Levels

An assessment of the principal sources of noise emission has been undertaken to identify the activities that may produce noise and/or vibration impacts so that appropriate ameliorative measures can be formulated.

Noise levels from construction works have been predicted at the surrounding receivers and assessed against the construction noise management levels set out in Section 6. Refer to tables below for predicted noise levels for each receiver.

Predictions take into account the following:

- The distance between the noise source and the receiver.
- The screening effect provided by building structure/shell.
- For receivers external to the site, an external noise level is predicted at the receiver boundary.
- For receivers within the Westmead health Precinct, an internal noise level is predicted at the most affected space within the building.

Table 9 – Predicted Construction Noise Emissions to Surrounding Receivers

Phase of work	Receiver									
	R1	**R2**	**R3**	**H1 CHW**	**H2 Cumberland Hospital**	**H3 CMRI**	**H4 WIMR**	**H5 CASB**	**H6 PSB**	**H7 KR**
Demolition of Eastern Airlock	<30	<30	<30-61	See Discussion Section 7.3.1	<30	<30	<30	<30	<30	<30
Demolition of Galleria Airlock	<30	<30	<30-61	See Discussion Section 7.3.1	<30	<30	<30	<30	<30	<30
Demolition of Galleria stair	<30	<30	<30-61	See Discussion Section 7.3.1	<30	<30	<30	<30	<30	<30
Demolition of the Clinical research Centre	<30	<30	<30-61	See Discussion Section 7.3.1	<30	<30	<30	<30	<30	<30
Demolition of the Gait Lab and Dining areas	<30	<30	<30-61	See Discussion Section 7.3.1	<30	<30	<30	<30	<30	<30
Demolition of the CSRA Blood Bank	<30	<30	<30-61	See Discussion Section 7.3.1	<30-35	<30	<30	<30	<30	<30
Pathology Expansion	<30	<30	<30-61	See Discussion Section 7.3.1	<30-35	<30	<30	<30	<30	<30
Demolition of the Kids Research rooftop	40-45	43-49	53-61	See Discussion Section 7.3.1	<30	40	<30	<30	<30	See Discussion Section 7.3.1
Corridor widening works	<30	<30	<30-61	47-53	<30	<30	<30-35	37-43	43-53	43-53
Demolition of concrete ramp including supporting steel structure to the Kids Research building	<30-40	<30-43	45-70	48-68	<30	<30-48	<30-48	37-62	43-68	43-68
VVMF CASB Innovation Centre Fitout	<30	<30	<30-57	<30-47	<30	<30	See Discussion Section 7.3.1	See Discussion Section 7.3.1	<30-41	<30-53
NML	**53 (External)**	**53 (External)**	**53 (External**	**45 (Internal)**	**45 (Internal)**	**Laboratories: 55 (Internal) Office areas: 50 (Internal)**	**Laboratories: 55 (Internal) Office areas: 50 (Internal)**	**45 (Internal) Office areas: 50 (Internal)**	**45 (Internal) Office areas: 50 (Internal)**	**Laboratories: 55 (Internal) Office areas: 50 (Internal)**
HANML	**75**	**75**	**75**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**

7.3 DISCUSSION – NOISE

Predicted construction noise levels to surrounding receivers, as presented in tables above, are summarised and discussed below:

7.3.1 Predicted Noise Levels for Works Occurring Within Receiver Building

We note that the hospital and surrounding health buildings will be operational for the duration of works. Where demolition or fitout works are occurring within a building, noise from the works to occupied internal spaces within the same building will be a combination of airborne and structure borne noise. It is impossible to predict noise levels generated by structure borne noise. As such, internal noise level predictions have not been presented. It is likely that occupied spaces within a building will experience exceedances of noise management levels while works are taking place within that building. Given the nature of the works, this is unavoidable. All reasonable and feasible measures should be taken to mitigate noise as much as possible consistent with the measures outlined in this plan.

7.3.2 R1, R2 & R3 - Residential Receivers

Construction noise to residential receivers R1 and R2 to are expected to be below noise management levels.

Noise emissions to residential receivers along Hawkesbury Road, particularly from trucks and the use of jackhammers, are expected to intermittently exceed the noise affected level (NAL), however it is not expected that the 'Highly Noise Affected Level' (HNAL) will be exceeded from any process at surrounding residential locations.

All reasonable and feasible measures should be taken to mitigate noise as much as possible consistent with the measures outlined in this plan.

7.3.3 H1, H2, H5 & H6 – Hospital Receivers

Noise levels are expected to intermittently exceed noise management levels particularly in areas adjacent to works occurring internally, and during the use of jackhammers externally (Refer Discussion Section 7.3.1).

All reasonable and feasible measures should be taken to mitigate noise as much as possible consistent with the measures outlined in this plan.

7.3.4 H3 & H7 – Research Buildings

Noise from construction activities to research buildings are generally below noise management levels with the exception of noise generated by works internal to these buildings (Refer Discussion Section 7.3.1) and exceedances that may occur at the Kids Research during the corridor widening and concrete ramp demolition stages. All reasonable and feasible measures should be taken to mitigate noise as much as possible consistent with the measures outlined in this plan.

7.3.5 H4 WIMR

Sample attended and unattended construction noise measurements have been conducted within the VVMF site and WIMR mice holding room I.1.20 and detailed in the ARUP report entitled 'Westmead hospital N&V Noise Monitoring' with reference 28312-16, dated 21/4/23 (Refer Appendix A). The report notes:

- 'Noise readings taken during construction show that all levels that can potentially be attributed to construction sources do not exceed the 69 dBL_{Aeq} and 85dBL_{Amax} triggers'.

Notwithstanding the above, all reasonable and feasible measures should be taken to mitigate noise as much as possible consistent with the measures outlined in this plan.

8 VIBRATION IMPACTS

The proposed works are not typically associated with heavy vibration and as such are expected to be acceptable to receivers external to the site. We note however, that the CHW itself and adjoining and adjacent buildings to the site contain highly sensitive spaces, equipment and animal houses. Some of the works may have impacts. Vibration monitoring requirements (criteria, reporting and procedures) for the site and adjacent/adjoining buildings to the site are outlined in the memos attached in Appendix A. The following section summarises which receivers are affected by the various stages of works.

8.1.1 Receivers Within Hospital Precinct

Vibration monitoring requirements (criteria, reporting and procedures) for the site and adjacent/adjoining buildings to the site are outlined in the memos attached in Appendix A. Vibration monitoring to the spaces identified is not required for the duration of the build, only when works are occurring in close proximity to the building, within the building or in an adjoining building. The following table outlines when vibration monitoring should occur based on proximity of works to the sensitive areas identified.

Table 10 – Vibration Monitoring Recommendations

Building	Space with monitoring requirement	Stage of works where monitoring is recommended
Children's Hospital Westmead (CHW)	Level 1 Laboratories	All works except Innovation Centre Fitout
	Level 1 Mental Health Unit	
Central Acute Services Building (CASB)	Level 2 MRI Scanner	Innovation Centre Fitout Corridor widening works Demo of concrete ramp
	Level 3 Surgical Suite	
Kids Research (KR)	Level 1 Animal House	Demo of KR Roof Corridor widening works Demo of concrete ramp
	Level 4 Lab 9	
Westmead Institute for Medical Research (WIMR)	Level 1 Animal Holding	Innovation Centre Fitout Corridor widening works Demo of concrete ramp

We note that that ambient vibration levels may already exceed the nominated limits for the spaces identified above. As such, is recommended that baseline vibration monitoring be undertaken within these spaces prior to the commencement of works. In addition, given the critical nature of the Kids Research Level 1 Animal House, we recommend that simulation measurements of typical construction activities are recommended to be carried out within this space prior to the commencement of works.

8.1.2 Other Internal/External Receivers

For external receivers or receivers internal to the Westmead health Precinct but not identified at this stage as requiring monitoring, vibration monitors can be installed during the key stages in the event of complaints or concern for structural damage.

The monitors are proposed to be fitted with GSM modem and remotely signal up to five mobile phones indicating any exceedance of the prescribed vibration criteria to enable immediate notification to be sent to the contractor when vibration thresholds are approached.

We note, it is impossible to predict the vibrations induced by the construction operations on site at potentially affected receivers. However, the total vibration emissions are to be limited with real-time alarm notification given to the plant operators to ensure that the vibration limits are not exceeded. Based on feedback from the real-time monitoring system, the plant operators will be able to modify their operations to ensure the vibrations are kept within acceptable limits.

8.1.2.1 Vibration Monitoring Download

Downloading of the vibration logger will be conducted on a regular basis. In the event exceedance of vibration criteria or alarms occur, downloading of the logger 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 exceedance in the vibration criteria reported as detailed in this report.

8.1.2.2 Vibration Monitoring Reports

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

9 SPECIFIC NOISE CONTROLS

9.1 STATIC PLANT

If required, additional noise reduction can be achieved by erecting solid barriers around static plant such as diesel generators.

The use of electric powered tower crane means that enclosing of crane motors or fitting of exhaust mufflers is not required. Adopting quieter plant is effective in reducing the noise emitted from its operation.

9.2 ACOUSTIC BARRIERS

The placement of barriers at the source is generally only effective for static plant (i.e. diesel generators). 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.

Screens around work areas will provide no material benefit for multi storey receivers as these will overlook screening.

For internal works, where activities occur within a building adjacent to occupied spaces, a temporary partition should be installed to isolate work areas. The rating of the partition would depend on the noise generated in the work area and the sensitivity if the adjacent space.

9.3 OTHER ACTIVITIES

In the event of complaint, noise management techniques identified in this report should be employed to minimise the level of noise impact if management levels are found to be exceeded. This may include additional community consultation and re-scheduling of loud construction processes.

Notwithstanding above, general management techniques and acoustic treatments are included in Section 9.6 which may be implemented on a case-by-case basis to reduce noise emissions to surrounding receivers.

9.4 GENERAL RECOMMENDATIONS

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

9.4.1 Treatment of Specific Equipment

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.

9.4.2 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).

9.4.3 Selection of Alternate Appliance or Process

Where a particular activity or construction appliance is found to generate excessive noise levels, it may be possible to select an alternative approach or appliance. For example; the use of a hydraulic hammer on certain areas of the site may potentially generate high levels of noise. By carrying out this activity by use of bulldozers ripping and/or milling machines lower levels of noise will result.

9.4.4 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.

9.4.5 Management Training

All site managers should be aware of noise and vibration limits, applicable control measures and methods. They should ensure that all agreed noise and vibration measures are carried out by employees and sub-contractors.

A copy of the Noise Management Plan is to be available to contractors, and site inductions should detail the site contact in the event of noise complaints.

9.4.6 Respite Periods

Kane Constructions has advised that noisy works will occur only during standard construction hours and for a maximum of 45 minutes followed by a minimum 15 minute break.

Respite periods would apply to very noisy works exceeding the highly noise affected management levels or as stipulated for the activities included in Condition C8. Of the activities proposed, jack hammering is the noisiest activity and should be carried out during the hours proposed in condition C8. It is noted that the majority of activities are generally low impact and that no activities have been predicted to exceed the HNML's.

9.4.7 Noise Monitoring

Noise monitoring is to be undertaken in the WIMR building as per the requirements outlined in the memo in Appendix A.

For other receivers, noise monitoring can be undertaken to determine the effectiveness of measures which are been implemented, whilst the results of monitoring can be used to devise further control measures.

Attended noise measurements can be undertaken at key stages when particularly noise generating activities are undertaken or specific items of plant are in operation.

Attended noise measurements are to be conducted in accordance with Australian Standard AS1055: 2018 *'Acoustics- Description and measurement of environmental noise'*, and should include the following:

- Type 1 or 2 sound meter (calibrated)
- Use of appropriate noise descriptor (in this case, $L_{eq(15min)}$).
- Detail of measurement position and proximity to reflecting surface if any (building or similar). Measurement positions will typically be a residential property boundary, or internally for other sensitive receiver types detailed in Section 2.

Monitoring should not be conducted under adverse weather conditions. The conditions applying at the time of the measurements should be indicated in the reporting.

9.4.8 Vibration Monitoring

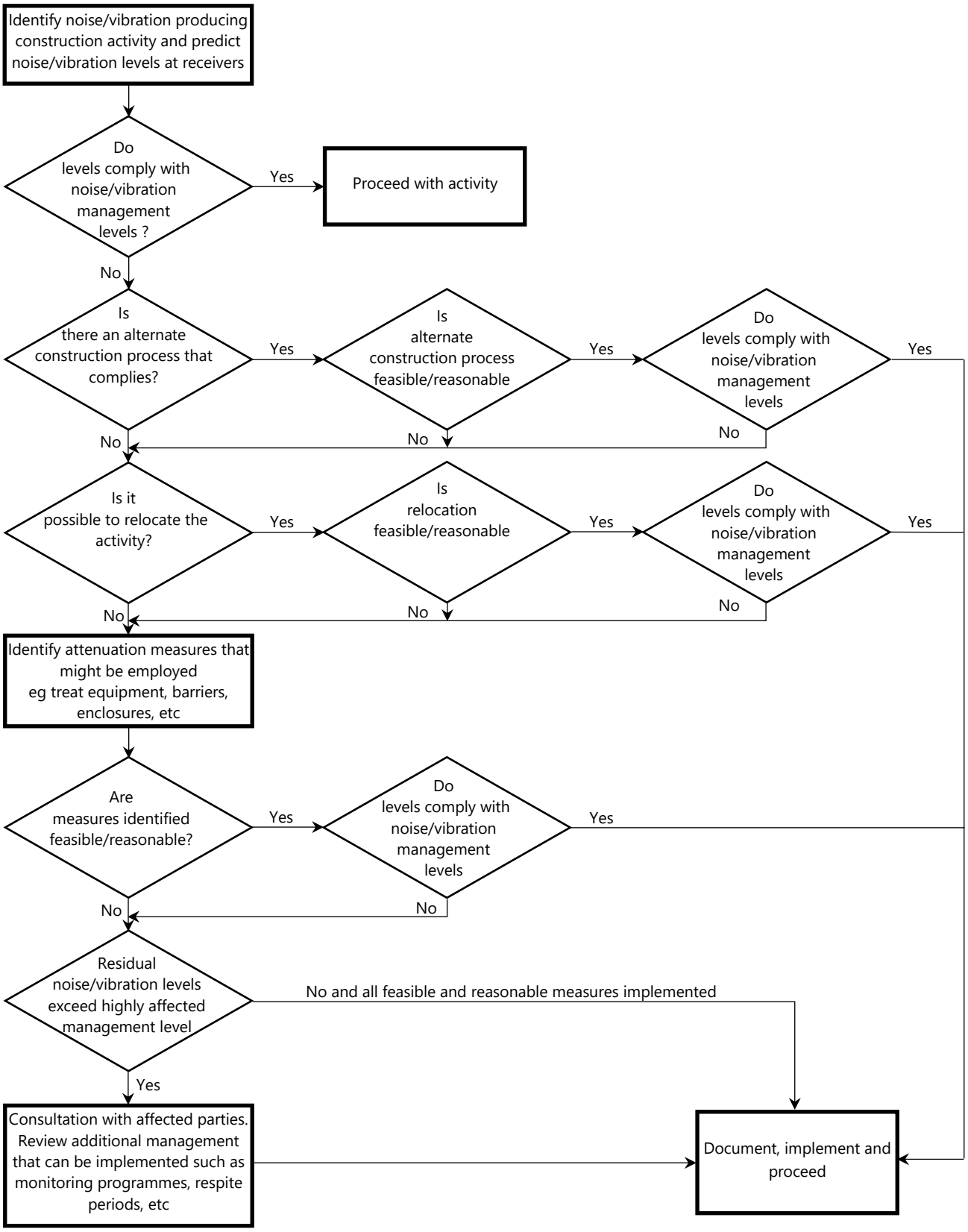
Vibration monitoring for Westmead Health Precinct receivers should be carried out as per the recommendations in section 8 of this report and the requirements outlined in the memos in Appendix A.

Where vibration monitoring is required for external residential receivers, the measurement location should be near the middle of the common boundary between the two properties, or as otherwise determined from time to time to best measure representative vibration levels. The monitor used should log the peak particle velocities and also transmit SMS warnings to the contractor and acoustic expert if a pre-determined threshold is exceeded. Regular reports should be provided (twice monthly) showing the vibration levels recorded and comparing these to the criteria.

Attended or unattended monitoring should also be undertaken at other locations in response to complaints, or as needed to confirm the use of additional plant/processes with the potential to exceed vibration criteria.

9.5 CONTROL OF CONSTRUCTION NOISE AND VIBRATION – PROCEDURAL STEPS

The flow chart presented below illustrates the process that should be followed in assessing construction activities.



9.6 DEALING WITH OFFENSIVE NOISE LEVELS

Should ongoing complaints of excessive noise occur, immediate measures shall be undertaken to investigate the complaint, the cause of noise exceedances and identify the required changes to work practices.

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.

All complaints or offensive noise 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 offensive noise 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.
- 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 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 COMMUNITY INTERACTION AND COMPLAINTS HANDLING

10.1 ESTABLISHMENT OF DIRECT COMMUNICATION WITH AFFECTED PARTIES

Consent Condition B17 states the following with respect to community interaction:

B17. The Construction Noise and Vibration Management Sub-Plan must address, but not be limited to, the following:

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

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

(c) describe aa reasonable and feasible mitigation measures to be implemented to manage high noise generating works such as piling, in close proximity to sensitive receivers;

(d) include strategies that have been developed with the community for managing high noise generating works;

(e) describe the community consultation undertaken to develop the strategies in condition B17(d);

(f) include a complaints management system that would be implemented for the duration of the construction; and

(g) include a program to monitor and report on the impacts and environmental performance of the development and the effectiveness of the implemented management measures in accordance with the requirements of condition B14.

Consultation Requirements under the SSDA Conditions

MSCP Condition B17 states that the Plan should be prepared in consultation with the relevant government organisations and surrounding stakeholders. These include:

- Children's Hospital Westmead (CHW).
- Central Acute Services Building (CASB).
- Kids Research Institute (KRI).
- Westmead Institute for Medical Research (WIMR).

We note that consultation has already commenced with the parties nominated above and that noise and vibration monitoring locations, criteria and procedures are being developed (See Appendix A).

Ongoing consultation

Ongoing consultation with key hospital stakeholders, particularly CASB and CHW and surrounding medical research facilities (KR and WIMR) containing noise and/or vibration sensitive equipment will continue throughout the construction of the project. This will be in the way of weekly interface and disruption notice meetings.

A complaint procedure will also be implemented where stakeholder complaints are tracked weekly and reported back to the principal during weekly contractor and interface meetings.

These complaints, whether it be from the community members or from hospital stakeholders, will be tracked in KANE's Community Contacts and Complaints Register.

Notification Process as required by REF item 12.3

The REF stipulates the following regarding notification to nearby development where noise objectives are expected to be exceeded.

> *For activities where acoustic controls and management techniques still cannot guarantee compliant noise levels, implement a notification process whereby nearby development is made aware of the time and duration of noise intensive construction processes.*

In light of the above, we recommend that a leaflet is distributed to affected external residential receivers prior to the commencement of noisy works, detailing time and duration of the works. This would in particular apply to residential receivers R3 before the commencement of external works. Notification to receivers R1 and R2 would not be required given that noise emissions to these receivers are expected to generally be below noise management levels.

For receivers within the Westmead Health precinct, notification should take place during weekly meetings discussed on previous page under the heading 'ongoing consultation'.

10.2 DEALING WITH COMPLAINTS

Should ongoing complaints of excessive noise or vibration 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 limits all work potentially producing vibration 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
- Setup vibration monitoring system at the location represents the nearest vibration receiver location 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.

11 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. Setup noise monitoring devices at locations represent nearest noise receivers and provide noise data for each complain time period. Analysis is required and determine suitable noise mitigation measures.

Complaints associated with noise and vibration generated by site activities shall be recorded on a Noise 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.

12 CONCLUSION

This document presents a noise and vibration management plan for construction activities associated with the redevelopment of The Children's Hospital, Westmead.

The principal issues which addressed in this report are:

- Specific activities that will be conducted and the associated noise/vibration sources;
- Identification of potentially affected noise/ vibration sensitive receivers;
- The development, hours of work and excavation period;
- The construction noise and vibration requirements specified in development conditions of consent.
- Noise/ vibration response procedures;
- Assessment of potential noise/ vibration from the proposed construction activities; and
- Contingency plans to be implemented in the event of non-compliances and/or noise complaints.

The assessment of noise and vibration indicates that construction actives associated with the project development may generate noise levels that will require some additional management. Adoption of the controls detailed in Section 9 of this report and adherence to the requirements of development consent will ensure that noise impacts will be minimised.

Vibration goals have also been set in this report to minimise structural damage risk for existing structures close to the project site and to protect human comfort in line with the requirements of the consent.

Noting the above, we find the construction noise and vibration management requirements of development consent B17 to be satisfied.

Please contact us should you have any further queries.

Yours faithfully,

Acoustic Logic Pty Ltd
Ross Ferraro

APPENDIX A – DOCUMENTS OUTLINING NOISE AND VIBRATION REQUIREMENTS AND CONSULTATION UNDERTAKEN WITH KEY STAKEHOLDERS

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Westmead Hospital N&V Monitoring

Attended Noise Measurements - VVMF Construction Activity

Arup have been engaged by PwC to evaluate the impact of construction activities conducted inside the Westmead Institute for Medical Research (WIMR) Biosciences Facility (BSF) to the adjacent Viral Vector Manufacturing Facility (VVMF). This letter presents the findings of a noise measurement exercise undertaken for trial construction works on 21 March 2023 using attended noise measurements, supplemented by ambient noise data collected from a permanent noise monitor located in WIMR Mice Holding Room I.1.20. It is expected that the measurements summarised within will contribute to the evaluation of construction noise. Supplementary analysis of construction activity to fixed logger position in WIMR is provided for April 6.

Construction noise measurements were undertaken within CASB with reference to the unattended logger location at WIMR being made to correlate measurement for assessment of noise in mice holding room WIMR I.1.20.

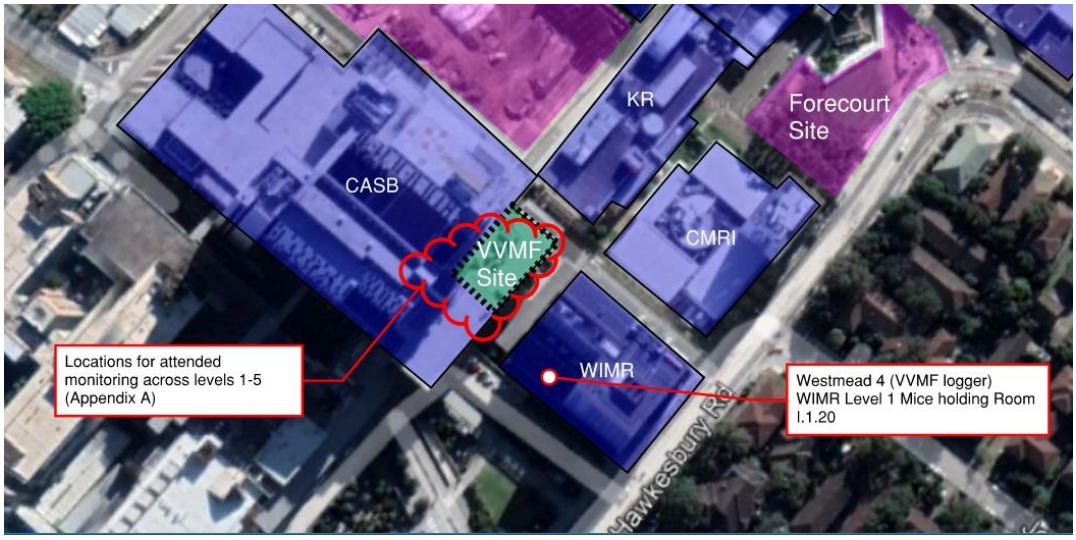


Figure 1: VVMF site location, vicinity of attended CASB monitoring and fixed WIMR noise logger position

1. CASB

1.1 Test procedure

Short duration noise measurements of 30 seconds to 1 minute were taken in a range of locations within CASB. Where possible, measurements were intended to characterise noise transfer during steady-state construction activity for areas where noise was noticeably louder than the measured background noise levels, or where complaints had been made (L3 innovation space). Testing followed the plan established by Kane Constructions. For reference, Table 1 below presents the equipment used and the time of measurement.

Table 1: Construction staging

Equipment	Start of equipment usage	End of equipment usage
Petrol demolition saw (on VVMF slab)	10:33 am	10:38 am
Petrol demolition saw (on VVMF primary beam)	10:43 am	10:49 am
Small jackhammer	10:55 am	11:04 am
Large jackhammer	11:10 am	11:15 am
1.5t excavator* with jackhammer	11:54 am	12:01 pm
Road saw	12:10 pm	12:17 pm
1.5t excavator* with jackhammer	12:25 am	12:27 pm
Cut Removal with Excavator & Skid Steer	12:34 pm	12:44 pm
Hammer drill (on L2 slab – VVMF roof)	14:12 pm	14:15 pm
Petrol demolition saw (on VVMF primary beam after construction of acoustic barrier)	14:22 pm	14:25 pm
Drilling – Starter bar	14:31 pm	14:34 pm
Angle grinder	14:39 pm	14:41 pm
*An original schedule and actual works were expected to use a 5t excavator. However, given the VVMF space is not currently accessible via a 5t excavator, pending widening of openings, a 1.5t excavator was used as a substitute.		

1.2 Instrumentation

Measurements were carried out using equipment as detailed in Table 2. The sound level meters and microphones are Type 1, conforming to BS EN 61672-1: 2003. The calibration of the sound level meters, pre-amplifier and microphone chains were checked before and after use, to confirm that there was no significant drift in meter response at the calibrator frequency and level. All Arup's sound level meters are regularly calibrated, and this calibration is traceable to international standards.

Table 2: Summary of measurement equipment

Instrument	Manufacturer	Type	Serial Number
Modular precision sound level analyser	Brüel and Kjær	2250 G4	3029878
Modular precision sound level analyser	Brüel and Kjær	4189	25053
Type 1 sound pressure level calibrator	Brüel and Kjær	4231	2445716

The equipment was calibrated prior and subsequent to the measurement period with no significant drift in calibration observed.

1.3 Results

Table 3 summarises the noise levels measured during attended measurements. Measurement locations and source IDs are presented to show the receiver locations in relation to placement of associated construction equipment. Table 3 is to be read in conjunction with the mark-up included within Appendix A that details measurement locations in relation to the noise source locations.

Table 3: CASB attended measurement results

ID	Measurement Location	Source	Source Location	dB L_{Aeq}	dB L_{AMax}	Note[1]
1	L1 Corridor (INVC.TE.011)	Background Noise	n/a	45	60	
1	L1 Corridor (INVC.TE.011)	Electric Demo Saw	S1. VVMF Slab	71	76	No acoustic barrier
1	L1 Corridor (INVC.TE.011)	Petrol Demo Saw	S2. VVMF Primary Beam	79	81	No acoustic barrier
1	L1 Corridor (INVC.TE.011)	Small Jackhammer	S2. VVMF Primary Beam	69	74	No acoustic barrier
1	L1 Corridor (INVC.TE.011)	Large Jackhammer	S2. VVMF Primary Beam	65	69	No acoustic barrier
1	L1 Corridor (INVC.TE.011)	Petrol Demo Saw	S2. VVMF Primary Beam	70	72	Acoustic barrier constructed
2	L1 ED Reception (CASB.EDU.243)	Background Noise	n/a	62	73	Jackhammer nearly inaudible during operation prior
3	L2 Exposition (INVC.INC.002)	Background Noise	n/a	37	46	
3	L2 Exposition (INVC.INC.002)	1.5T Excavator with Jackhammer	S2. VVMF Primary Beam	77	80	Structureborne
3	L2 Exposition (INVC.INC.002)	Hammer Drill	S3. VVMF Roof Slab	74	75	Structureborne
3	L2 Exposition (INVC.INC.002)	Drilling - Starter Bar Install	S4.	48	53	Airborne (via ductwork)
3	L2 Exposition (INVC.INC.002)	Angle Grinder	S4.	44	55	Airborne (via ductwork)
3	L2 Exposition (INVC.INC.002)	Cut Removal with Excavator & Skid Steer	S1. VVMF Slab	54	63	Airborne (via ductwork)

ID	Measurement Location	Source	Source Location	dB L_{Aeq}	dB L_{AMax}	Note[1]
3	L2 Exposition (INVC.INC.002)	Road Saw	S1. VVMF Slab	62	65	Airborne (via ductwork)
4	L3 Top of Stairs (CASB.ENG.890)	Background	n/a	44	46	
4	L3 Top of Stairs (CASB.ENG.890)	1.5T Excavator with Jackhammer	S2. VVMF Primary Beam	70	71	Structureborne
4	L3 Top of Stairs (CASB.ENG.890)	Hammer Drill	S3. VVMF Roof Slab	58	60	Structureborne
5	L4 Near Fire Stairs (INVC.INC.025)	1.5T Excavator with Jackhammer	S2. VVMF Primary Beam	69	70	Structureborne
5	L4 Near Fire Stairs (INVC.INC.025)	Road Saw	S1. VVMF Slab	49	55	Airborne
6	L5 USYD Open Space Inf Gr (USYD.INC.069)	Background	n/a	50	57	Conversations
6	L5 USYD Open Space Inf Gr (USYD.INC.069)	1.5T Excavator with Jackhammer	S2. VVMF Primary Beam	61	62	Structureborne
7	L3 Innovation Space Meeting Room 2 (INVC.INC.031)	Background Noise	n/a	33	49	Quiet office
7	L3 Innovation Space Meeting Room 2 (INVC.INC.031)	1.5T Excavator with Jackhammer	S2. VVMF Primary Beam	67	67	Structureborne
8	L3 Innovation Space Collab Zone (INVC.INC.103)	Background Noise	n/a	52	66	Conversations
8	L3 Innovation Space Collab Zone (INVC.INC.103)	1.5T Excavator with Jackhammer	S2. VVMF Primary Beam	76	77	Structureborne

1. Refer to Section 1.4.1 for discussion on structureborne/airborne

1.4 Discussion

1.4.1 Modes of Noise Transfer to L2-5

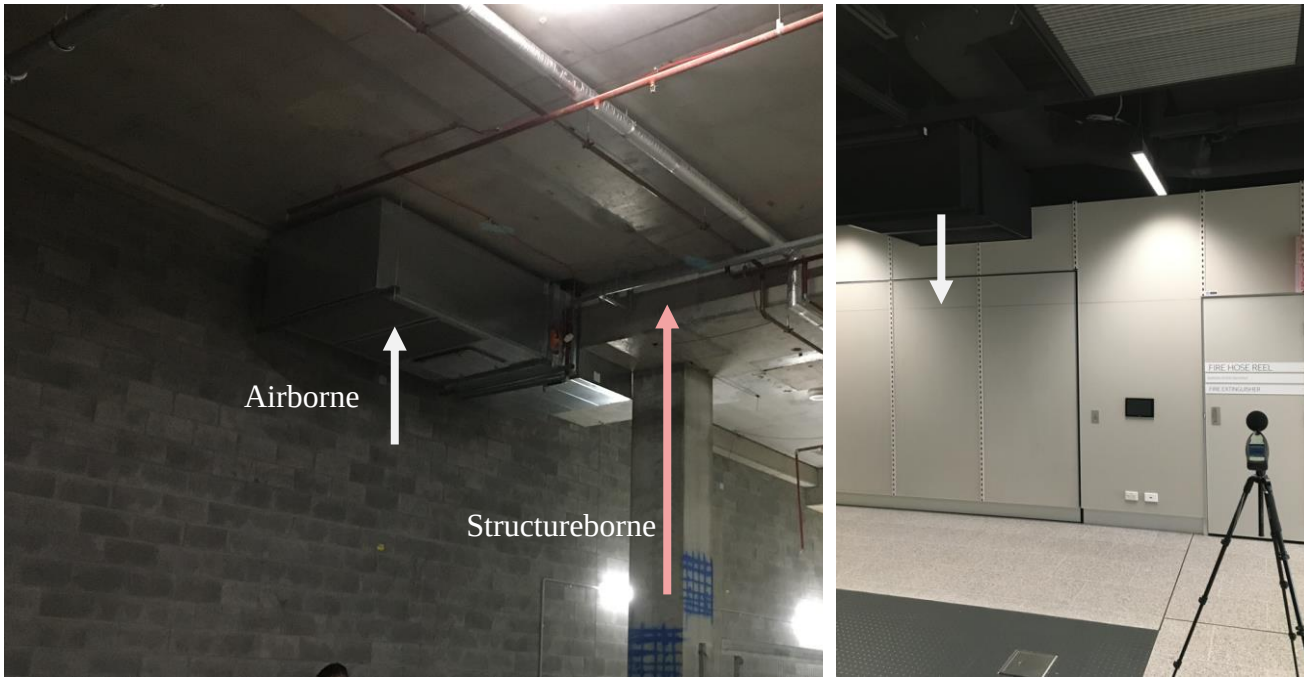


Figure 2: L1 and L2 airborne and structureborne noise transfer paths (Left: L1 VVMF site, Right: L2 Exposition)

Reradiated structureborne noise was noted across Levels 2-5 for construction options targeting the primary beam. Where structureborne noise was non-dominant, there was moderate noise intrusion into L2 exposition space INVC.INC.002 with an observed noise transfer path through exposed ductwork at the ceiling of the VVMF site. All ducts within this space would benefit from temporary covering during works.

1.4.2 Acoustic Barrier

A temporary construction hoarding packed with mineral wool insulation was built in front of the glazed sections of the partition between the VVMF site and the lift lobby/corridor on L1. Measurements indicate this provides an approximate 9dB improvement in measured noise levels within corridor INVC.TE.011. It is expected that this will translate to a beneficial reduction in airborne noise transfer within the ED reception, however this was not tested during the survey.

Figure 3: Temporary acoustic barrier - VVMF site

2. WIMR

2.1 Noise management levels

The following advice is provided regarding the Arup recommended noise management level trigger setting for I.1.20 Mice Holding Room within WIMR.

Based on a review of applicable research findings, Arup has proposed two different noise trigger limits:

- L_{Amax} 85 dB (for short duration high noise levels)
- $L_{Aeq(1minute)}$ 69 dB (for more continuous noise generation)

The noise management levels above were determined following both the review of current noise levels within the room when no construction was conducted, and research findings related to animal housing and breeding facilities[1].

The research indicates that noise and vibration from construction activities may have a negative impact on research animals. It is understood that it is the rapid increase in noise and vibration generated by construction activities that contributes to the adverse impacts. It is also understood that the initial adverse behaviours eventually subside as the animals become used to the environment.

The research indicates that typical day-to-day activities within animal housing labs generate noise significantly higher than the measured background noise levels (L_{max} 80-90 dBA). The day-to-day noise activities are typically short duration (few seconds), which lab animals are regularly exposed and accustomed to. The noise measurements conducted within WIMR were consistent with those noted in the research during the monitoring period with no construction (L_{max} 80-96 dBA). The research concluded that alert levels with a maximum level to not exceed of 85 dBL_{Amax} were deemed appropriate.

Accordingly, it is therefore proposed to adopt the trigger level to 85 dBL_{Amax} based on the maximum in the research paper, which would result in significantly less false triggers per day.

In addition, the research notes that animals may also be impacted by more continuous construction noises (such as core drilling or concrete drilling). While no alternative trigger metrics are recommended in the research paper, it is proposed to set an additional trigger based on an $L_{Aeq(1minute)}$, which corresponds to the average measured level over the time period. Based on the measured noise levels with no construction, an $L_{Aeq(1min)}$ of 69 dBA was exceeded approximately 1 time per day on average (28 times over the period identified above). It is proposed to adopt this level.

[1] Richard Finley and Chenzi Wu, 'Noise and vibration criteria and observations for construction works within animal research and breeding facilities' dated November 2022

2.2 Noise Impacts to Mice Holding Room I.1.20 (21 March)

Measured noise levels during trial construction works on 21 March 2023 are detailed in Table 4 below. Source positions are included in Appendix A.

Results are derived from one minute noise logging data from the ARL noise logger web portal, which is then correlated with timestamps from attended measurements. While noise levels during construction are raised above measured background levels for the holding room, fluctuations may also be caused by activity within the facility. Noise readings taken during construction show that all levels that can potentially be attributed to construction sources do not exceed the 69 dBL_{Aeq} and 85dBL_{Amax} triggers derived in Section 2.1.

Table 4 presents the noise logging results obtained via the ARL noise logger portal and correlated to the VVMF construction activity based on start time. dBC results are added so that low frequency noise contribution can be evaluated – these numbers do not directly correlate with dBA results. Triggers for dBC levels have not been established.

Table 4: Noise Impacts to Mice Holding Room

Equipment	Source Location ID	Start Time	Measured Level dB $L_{Aeq\ 1min}$	Measured Level dB $L_{Ceq\ 1min}$	Measured Level dB L_{Amax}	Measured Level dB L_{Cmax}
n/a (Background)	-	9.20am	49	59	51	72
Electric Concrete Saw	S1 – Slab	10:15am	50	64	59	82
Petrol Concrete Saw	S1 – Slab	10:34am	56	63	73	75
Petrol Concrete Saw	S2 – Primary Beam	10:45am	50	64	57	76
		14:24pm	59	71	79	93
Large Jackhammer	S2 – Primary Beam	11:09am	55	64	66	80
Excavator With Jackhammer Attachment	S2 – Primary Beam	11:56am	56	70	77	92
		12:26pm	54	73	76	94
Road Saw	S1 – Slab	12:12pm	55	62	77	77
Cut Removal with Excavator & Skid Steer	S1 – Slab	12:35pm	53	64	63	77
Hammer Drill	S3 - Ceiling	14:13pm	57	63	72	71
Drilling	S4	14:32pm	54	64	68	79

Equipment	Source Location ID	Start Time	Measured Level dB $L_{Aeq\ 1min}$	Measured Level dB $L_{Ceq\ 1min}$	Measured Level dB L_{Amax}	Measured Level dB L_{Cmax}
Angle Grinder	S4	14:39pm	55	63	77	78

2.3 Noise Impacts to Mice Holding Room I.1.20 (6 April)

A secondary construction stage was undertaken on April 6, supplementing initial data presented in Table 4 for Mice Holding Room. These findings are detailed below in Table 6.

Table 5: Construction staging

Equipment	Start of equipment usage	End of equipment usage
Drilling machine and 5.5t excavator	11:28am	11:38am
5.5t crusher and skid steer	12:22pm	12:39pm
	12:56pm	13:02pm
	13:04pm	13:14pm
Concrete Pump	14:38pm	14:49pm

Table 6: Noise impacts to Mice Holding Room

Equipment	Source Location ID	Start Time	Measured Level dB $L_{Aeq\ 1min}$	Measured Level dB $L_{Ceq\ 1min}$	Measured Level dB L_{Amax}	Measured Level dB L_{Cmax}
n/a (Background)	-	8:40am	49	60	52	64
Drilling machine and 5.5t excavator	S5 – Drilling Site	11:28am	56	68	74	89
5.5t crusher and skid steer	S6 – Primary Torsion Beam	12:22pm	66	76	83	98
		12:56pm	59	74	78	97
		13:04pm	56	71	78	94
Concrete Pump	S1 – Slab	14:38pm	58	71	77	93

ARUP

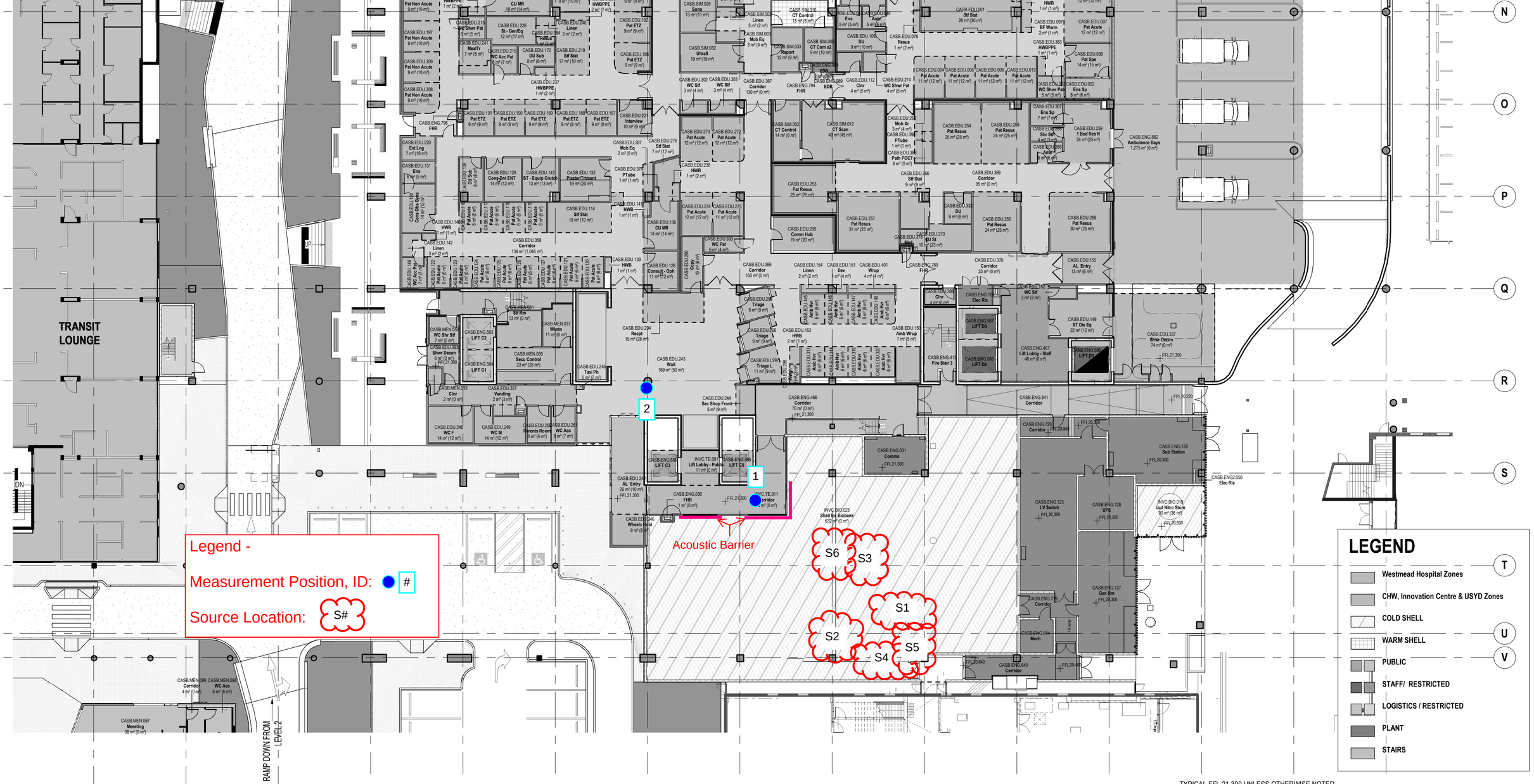
Our ref	283812-16
Date	21 April 2023

Regards,

Thomas Graham-Murdoch
Consultant

d +61293209034
m 0447443671
e thomas.graham-murdoch@arup.com

Appendix A – Measurement Locations and Construction Source Positions



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TRUE NORTH

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REV	DATE	DESCRIPTION	DWN	CHK
V	13/12/19	ROOMS RE TAGGED	JC	CM
W	10/01/20	FORTNIGHTLY ISSUE	JC	CM
X	07/02/20	FORTNIGHTLY ISSUE	JC	CM
Y	05/03/20	RISER ADDED	RSH	CM
Z	01/05/20	AS BUILT	JC	DJM
AA	04/05/20	AS BUILT UPDATE	JC	DJM
BB	08/07/20	AS BUILT - ROOM TAGS UPDATE	JC	DJM

PROJECT:
Westmead Hospital
DRAWING TITLE:
GENERAL ARRANGEMENT - LEVEL 01

PROJECT NUMBER:
232186
STATUS:
AS BUILT

DRAWING NUMBER:
CASB-HDR-AR-DG-820101

REVISION:
BB
SCALE:
1 : 250 @ A1

NSW GOVERNMENT Health Infrastructure

CLIENT:
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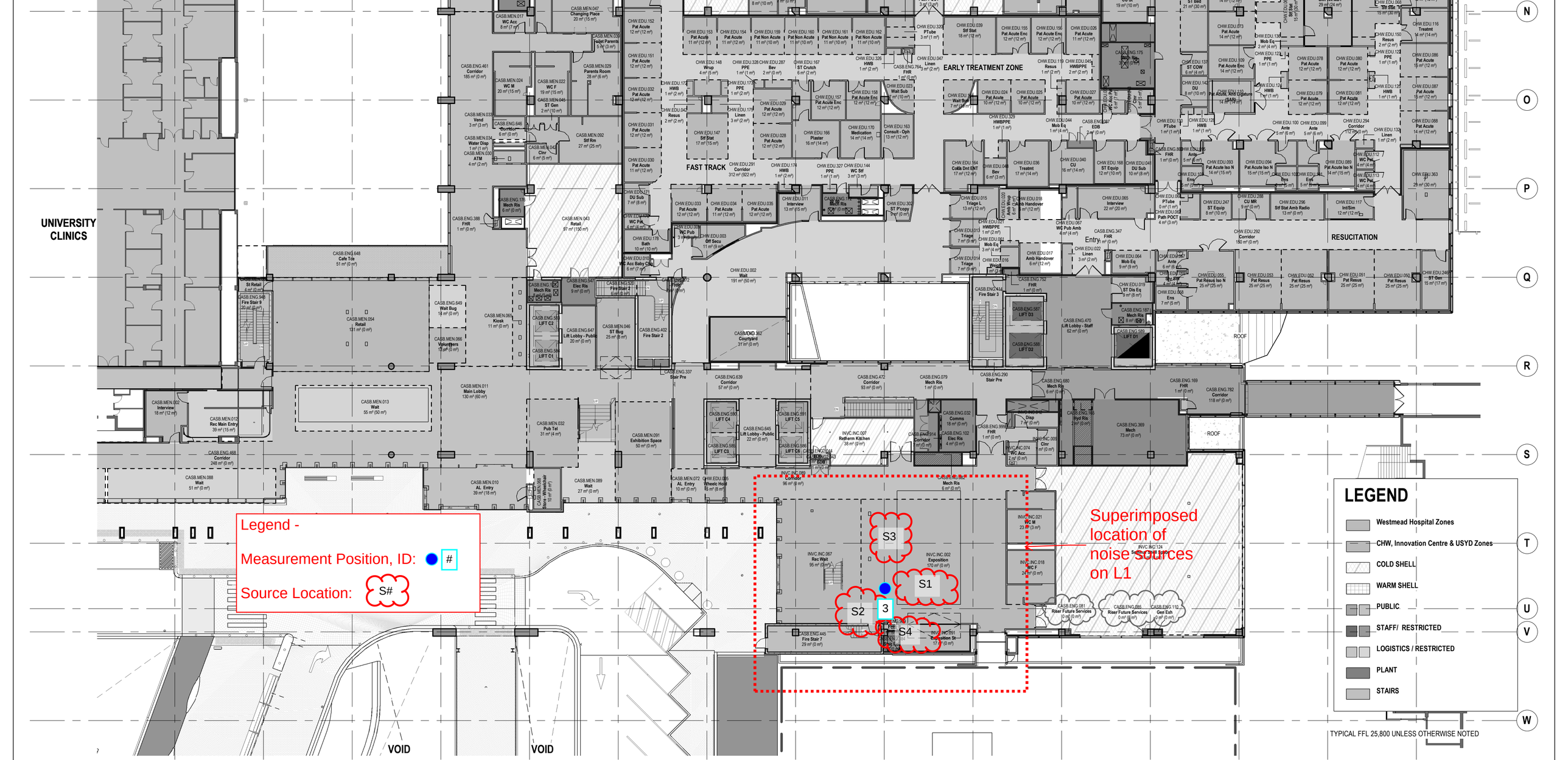
North Sydney NSW 2060

HDR
Level 5, 150 Walker Street, North Sydney NSW 2060, Australia
+61 2 9956 2666 | hdrinc.com.au
The Rice Daubney Group (NSW) Pty. Limited as trustee for
The Rice Daubney Trading Trust ABN 56 850 354 993 trading as HDR.

pwc

MULTIPLEX



8/07/2020 5:03:09 PM C:\rvt\2019\232186-A-CASB-INTERNAL_Jose.CruzUPGBK.rvt

TRUE NORTH

0 1250 5000 10000

1:250mm

REV	DATE	DESCRIPTION	DWN	CHK
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BB	07/02/20	FORTNIGHTLY ISSUE	JC	CM
CC	19/02/20	FORTNIGHTLY ISSUE	AW	CM
DD	02/03/20	ROOM REMOVED	HL	CL
EE	01/05/20	AS BUILT	JC	DJM
FF	04/05/20	AS BUILT UPDATE	JC	DJM
GG	08/07/20	AS BUILT - ROOM TAGS UPDATE	JC	DJM

PROJECT:
Westmead Hospital

DRAWING TITLE:
GENERAL ARRANGEMENT - LEVEL 02

PROJECT NUMBER:
232186

DRAWING NUMBER:
CASB-HDR-AR-DG-820201

REVISION:
GG

STATUS:
AS BUILT

SCALE:
1 : 250 @ A1

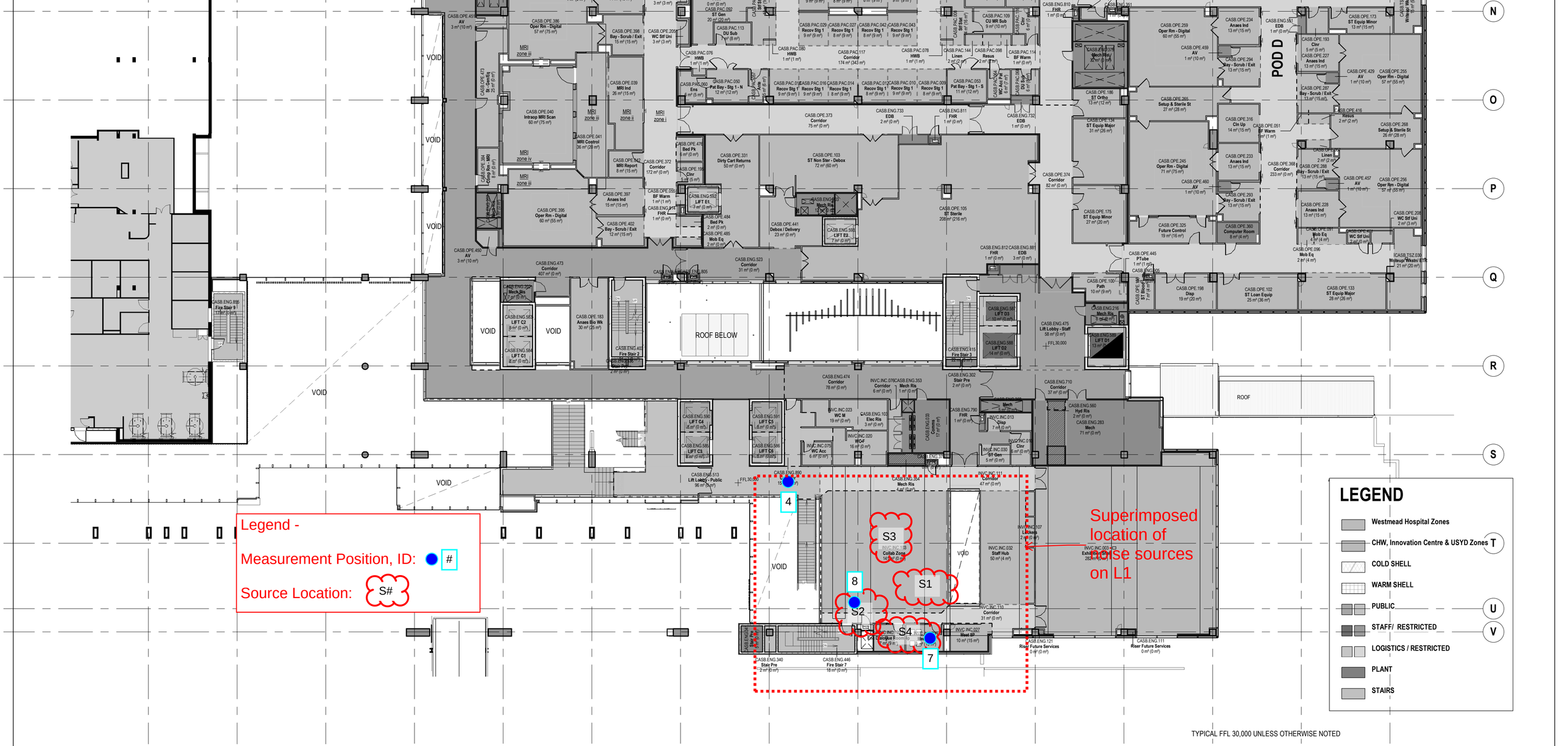
NSW GOVERNMENT Health Infrastructure

HDR

pwc

CLIENT:
Level 14, 77 Pacific Highway
North Sydney NSW 2060

MULTIPLEX



1/05/2020 4:29:27 PM C:\rvt\2019\232186-A-CASB-INTERNAL_Jose.CruzUPGBK.rvt

TRUE NORTH

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1:250mm

REV	DATE	DESCRIPTION	DWN	CHK
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S	09/08/19	FORTNIGHTLY ISSUE	JC	CM
T	27/09/19	FORTNIGHTLY ISSUE	JC	CM
U	25/10/19	FORTNIGHTLY ISSUE	JC	CM
V	06/12/19	FORTNIGHTLY ISSUE	JC	CM
W	07/02/20	FORTNIGHTLY ISSUE	JC	CM
X	01/05/20	AS BUILT	JC	DJM

PROJECT:
Westmead Hospital

DRAWING TITLE:
GENERAL ARRANGEMENT - LEVEL 03

PROJECT NUMBER:
232186

DRAWING NUMBER:
CASB-HDR-AR-DG-820301

REVISION:
X

STATUS:
AS BUILT

SCALE:
1 : 250 @ A1

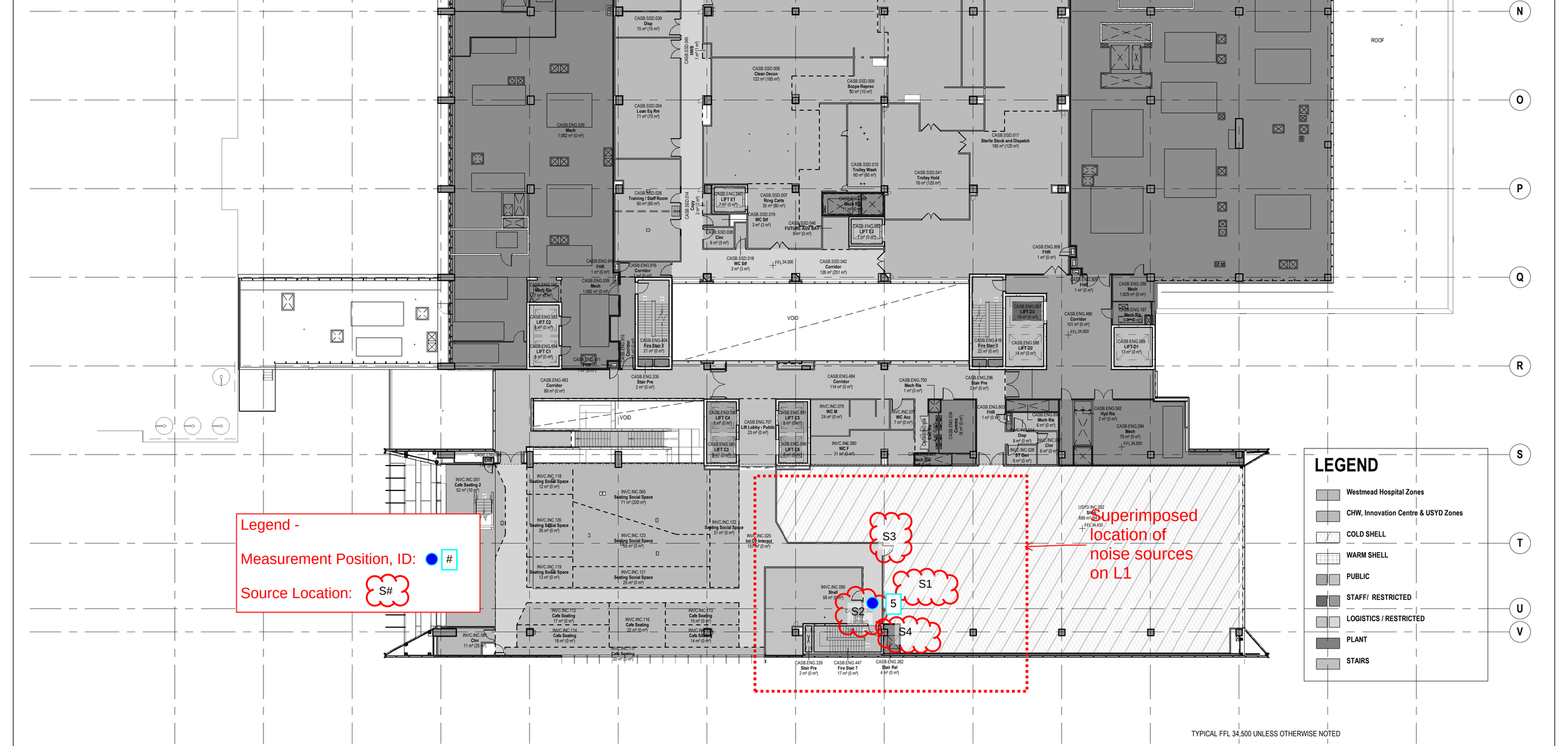
NSW GOVERNMENT Health Infrastructure

CLIENT:
Level 14, 77 Pacific Highway
North Sydney NSW 2060

HDR
Level 1, 150 Walker Street, North Sydney NSW 2060, Australia
+61 2 9956 2444 | hdrinc.com.au
The Rice Daudney Group (NSW) Pty. Limited as trustee for
The Rice Daudney Trading Trust ABN 56 850 354 993 trading as HDR.

pwc

MULTIPLEX



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TRUE NORTH

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1:250mm

REV	DATE	DESCRIPTION	DWN	CHK
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O	23/08/19	FORTNIGHTLY ISSUE	JC	CM
P	27/09/19	FORTNIGHTLY ISSUE	JC	CM
Q	11/10/19	FORTNIGHTLY ISSUE	JC	CM
R	25/10/19	FORTNIGHTLY ISSUE	JC	CM
S	07/02/20	FORTNIGHTLY ISSUE	JC	CM
T	01/05/20	AS BUILT	JC	DJM

PROJECT:
Westmead Hospital
DRAWING TITLE:
GENERAL ARRANGEMENT - LEVEL 04

PROJECT NUMBER:
232186
DRAWING NUMBER:
CASB-HDR-AR-DG-820401
REVISION:
T
STATUS:
AS BUILT
SCALE:
1 : 250 @ A1

NSW GOVERNMENT Health Infrastructure

CLIENT:
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North Sydney NSW 2060

HDR
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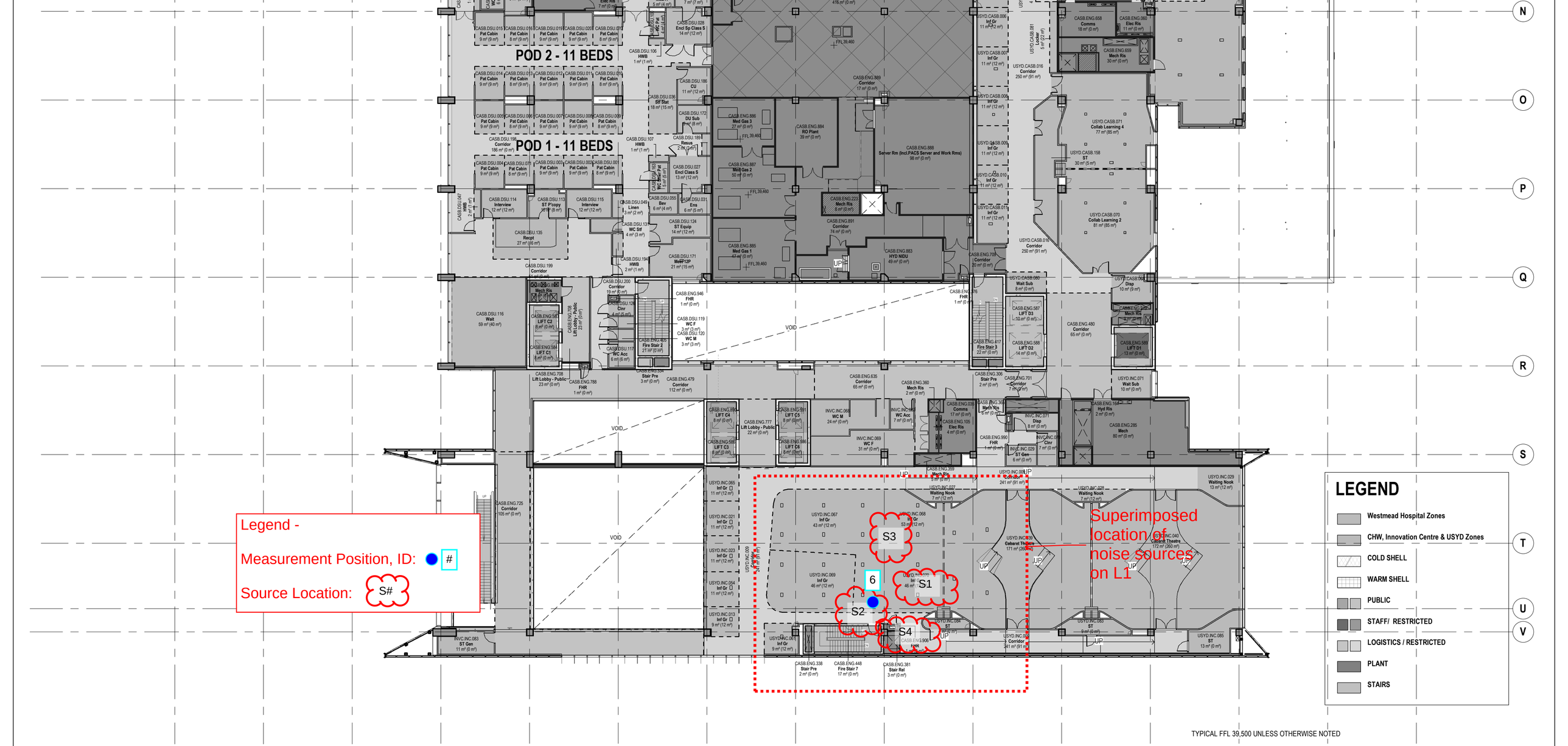
+61 2 9956 2666 | hdrinc.com.au
The Rice Daudney Group (NSW) Pty. Limited as trustee for The Rice Daudney Trading Trust ABN 56 850 204 993 trading as HDR.

pwc

MULTIPLEX



TYPICAL FFL 39,500 UNLESS OTHERWISE NOTED

1/05/2020 4:33:10 PM C:\rvt\2019\232186-A-CASB-INTERNAL_Jose.CruzUPGBK.rvt

TRUE NORTH

0 1250 5000 10000
1:250mm

REV	DATE	DESCRIPTION	DWN	CHK
U	23/08/19	FORTNIGHTLY ISSUE	JC	CM
V	27/09/19	FORTNIGHTLY ISSUE	JC	CM
W	25/10/19	FORTNIGHTLY ISSUE	JC	CM
X	22/11/19	FORTNIGHTLY ISSUE	JC	CM
Y	13/12/19	ROOMS RE TAGGED	JC	CM
Z	10/01/20	FORTNIGHTLY ISSUE	JC	CM
AA	01/05/20	AS BUILT	JC	DJM

PROJECT:
Westmead Hospital

DRAWING TITLE:
GENERAL ARRANGEMENT - LEVEL 05

PROJECT NUMBER:
232186

DRAWING NUMBER:
CASB-HDR-AR-DG-820501

REVISION:
AA

STATUS:
AS BUILT

SCALE:
1 : 250 @ A1

NSW GOVERNMENT Health Infrastructure

CLIENT:
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North Sydney NSW 2060

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Level 1, 910 Pacific Street, North Sydney NSW 2060, Australia
+61 2 9936 2444 | hdrinc.com.au
The Rice Daubney Group (NSW) Pty. Limited as trustee for The Rice Daubney Trading Trust ABN 56 850 354 993 trading as HDR.

pwc

MULTIPLEX

HOSPITAL ROAD

HAWKESBURY ROAD

BOUNDARY LINE 128° 30' 20"

BOUNDARY LINE 38° 22' 10"

EXTENT OF NEW PAVEMENT

FIRE STAIRS 1

FIRE STAIRS 2

ZONE OF BOLLARDS

SET BLOCK WALL 70mm BACK FROM THE OUTSIDE FACE OF THE COLUMNS TO ALLOW SUFFICIENT BOOM FOR THE CLADDING TOP RAILS AND ALUMINIUM CLADDING - FIXING HEIGHT

PROVIDE BOND BEAMS AT 2m CT'S (EVERY 10th COURSE) N16 FULLY GROUTED

EXTENT OF SAFETY PAINT MARKINGS TO LOADING DOCK AREA

FAIRFACED FINISH TO EXPOSED FACES OF BLOCKWORK WALLS. CORE-FILL UPTO 1 METRE. REINFORCE CORE FILLED 190 BLOCKWALL WITH N20 400 CENTRAL DRILL AND EPOXY FIX BARS.

PROVIDE BRICK STIFFENERS 89N6 or 100x100x5) SHS AS INDICATED

STUD WALL TO BE SUPPORTED FROM SHELF ANGLE FIXED TO SIDE OF STAIR - TO KEEP UP TO UNDERSIDE OF CONCRETE ROAM AT LEVEL 2

NOTE: FACE OF B1 WALL SETBACK 15MM FROM FACE OF BEAM OVER 3005 VOS

VERIFY ON SITE SETOUT OF WALLS & DOORS AROUND SPECIAL BUILT-IN EQUIPMENT

STEEL STAIR

BOXING FOR TRADE WASTE VENT

VERIFY ON SITE ACCESS DOOR LOCATION (TO BE ADJACENT HYDRAULIC CLEAR-OUTS)

PROVIDE MET-5 FROM CAPPING BEAM AT 400mm CENTRES.

PROVIDE MET-5 FROM CAPPING BEAM AT 400mm CENTRES.

VERIFY ON SITE ACCESS DOOR LOCATION (TO BE ADJACENT HYDRAULIC CLEAR-OUTS)

LOADBEARING BLOCKWALLS: FAIRFACED FINISH TO EXPOSED FACES ONLY. CORE-FILLED 190 BLOCKWALLS N16-800 CENTRAL

PROVIDE MET-5 FROM CAPPING BEAM AT 400mm CENTRES.

Westmead 4 (VVMF logger)
WIMR Level 1 Mice holding Room
I.1.20

NOTE:

1. PROVIDE HEAD RESTRAINTS AND WALL/COLUMN RESTRAINTS U.N.O.
HEAD RESTRAINT MET-4 AT 400mm CENTRES. WALL/COLUMN RESTRAINT MET-5 AT 400mm CENTRES U.N.O

2 PC3 AUTOCLAVE DETAIL
1 : 50

3 SAF AUTOCLAVE DETAIL
1 : 50

4 PC2 WASTE AUTOCLAVE DETAIL
1 : 50

5 GLASS WASH-UP AUTOCLAVE DETAIL
1 : 50

FIRE-RATING
60/60/60 FIRE-RATED WALL
90/90/90 FIRE-RATED WALL
120/120/120 FIRE-RATED WALL
SMOKE SEPARATION LINE

24/03/2014 1:48:00 PM

BVN
Donovan Hill

Telephone +61 2 8297 7200
Facsimile +61 2 8297 7299
www.bvn.com.au

ISSUE	DATE	FOR
1	23.02.2011	FOR INFORMATION
2	28.04.2011	FOR INFORMATION
3	24.05.2011	FOR INFORMATION
4	23.06.2011	FOR INFORMATION
5	15.08.2011	40% DESIGN DEVELOPMENT
6	18.08.2011	FOR INFORMATION
7	30.09.2011	70% DESIGN DEVELOPMENT
8	02.12.2011	90% DESIGN DEVELOPMENT
9	29.06.2012	ISSUED FOR TENDER
10	13.07.2012	FORMWORK TENDER
11	20.07.2012	FOR INFORMATION
12	26.07.2012	CONSTRUCTION CERTIFICATE
A	21.08.2012	FOR INFORMATION
AA	07.02.2014	FOR CONSTRUCTION
B	13.09.2012	FOR INFORMATION
BB	24.03.2014	AS BUILT
C	17.10.2012	FOR INFORMATION
D	26.10.2012	FOR BLOCKWORK TENDER
E	31.10.2012	FOR BLOCKWORK TENDER
F	16.11.2012	FOR DRYWALL TENDER
G	28.11.2012	REV. TENDER DRYWALL/GLAZED PTN.
H	21.12.2012	FOR INFORMATION
I	05.02.2013	FOR INFORMATION
J	08.02.2013	REV. TENDER DRYWALL/GLAZED PTN.
K	20.02.2013	REV. TENDER DRYWALL/GLAZED PTN.
L	27.02.2013	FLOOR FINISHES TENDER ONLY
M	21.03.2013	BLOCKWORK SETOUT/DRYWALL REV.
N	11.04.2013	BLOCKWORK/DRYWALL SETOUT
O	17.04.2013	COORDINATION ISSUE
P	24.04.2013	FOR INFORMATION
Q	30.04.2013	FOR CONSTRUCTION
R	28.05.2013	FOR CONSTRUCTION
S	06.06.2013	FOR CONSTRUCTION
T	07.06.2013	FOR CONSTRUCTION
U	17.06.2013	FOR CONSTRUCTION
V	12.07.2013	FOR CONSTRUCTION
W	22.07.2013	FOR CONSTRUCTION
X	06.08.2013	FOR CONSTRUCTION
Y	18.09.2013	FOR CONSTRUCTION
Z	05.02.2014	FOR CONSTRUCTION

CLIENT
Westmead Millennium Institute for Medical Research

PROJECT MANAGER
CAPITAL INSIGHT
Feasibility & Planning · Property Advisory · Project Strategy · Delivery

BUILDER
Abigroup Constructing Australia's Future · COCKRAM Construction since 1891

PROJECT
WESTMEAD MILLENNIUM INSTITUTE

BVN PROJECT NUMBER
S1012004

DRAWING KEY

TOP OF FLUE	RL 60.70
ROOF	RL 58.35
LEVEL 9	RL 56.00
PLANTROOM 8	RL 51.70
LEVEL 7	RL 47.40
LEVEL 6	RL 43.10
LEVEL 5	RL 38.80
LEVEL 4	RL 34.50
LEVEL 3	RL 30.20
LEVEL 2	RL 25.90
PLANTROOM 1	RL 23.20
LEVEL 1	RL 19.90
BASEMENT	RL 16.90

TRUE NORTH · PROJECT NORTH

GRAPHIC SCALE (m)
0 25 50

SCALE
1: 100 @ B1 DO NOT SCALE

STATUS
AS BUILT

DRAWING
FLOOR PLAN LEVEL L1
LOWER GROUND

DRAWING NUMBER	ISSUE
A-D-L1	BB

Memorandum

ARUP

To	CASB Facilities Manager	Date	22 November 2021
Copies	Mary Sakr; Hannah Urquhart	Reference number	
From	Matt Walden; Grant Cuthbert	File reference	
Subject	CHW Monitoring - CASB		

This memo outlines the proposed vibration monitoring locations and limits within CASB to help ensure disruption from the CHW development is minimised. The locations are preliminary and are to be discussed with CASB. At each of these locations, 240V power and an ethernet data connection is required. Ethernet connections are for outbound data only.

1 Level 2 – MRI Scanner

MRI scanners are considered the most sensitive piece of equipment within the CASB, and as such should be monitored. Figure 1 below shows the proposed location of the vibration monitor, while Table 1 outlines the proposed alert criteria. The proposed criteria is adopted from the Stantec Acoustic Report for the Paediatric Services Building, and from NSW Health Guidelines for vibration for new hospitals.

While there is a CT scanner on the Level 1 floor, this is marginally further away from the construction works, and is considered to be slightly less sensitive than the MRI scanner.

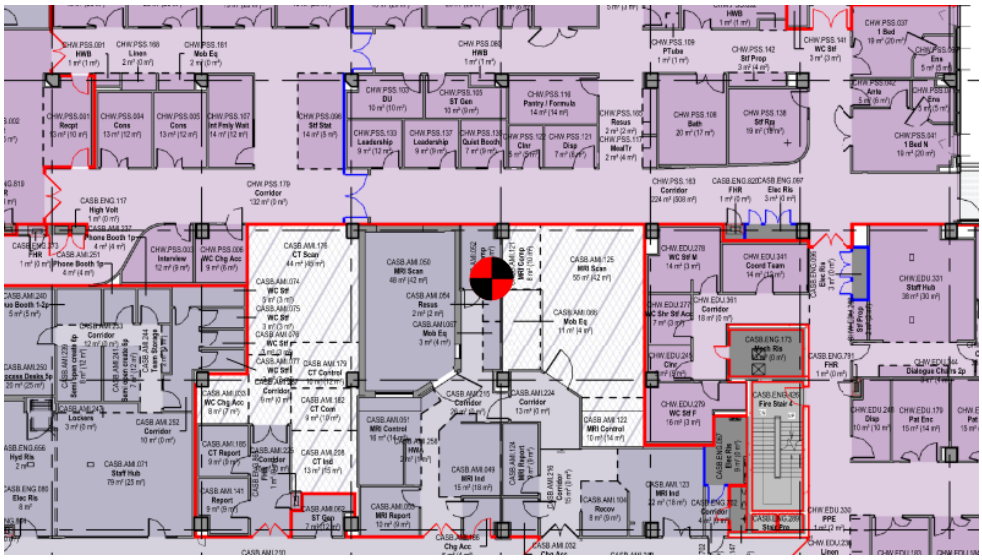

Figure 1: Level 2 MRI vibration monitor location

Table 1: Level 2 MRI vibration monitor criteria (NSW health guidelines for medical imaging)

PPV Criteria	RMS Velocity Criteria
Not applicable	Curve VC-A (1/3rd Octave band V_{RMS} to be below 0.051mm/s)

2 Level 3 – Surgical Suite

The surgical suites are of elevated risk and closest to the PSB site, and as such should be monitored. Figure 2 below shows the proposed location of the vibration monitor, while Table 2 outlines the proposed alert criteria. The proposed criteria is adopted from the Stantec Acoustic Report for the Paediatric Services Building, and from NSW Health Guidelines for vibration for new hospitals. Pod C is chosen and it is understood that Pod B is not yet in use.

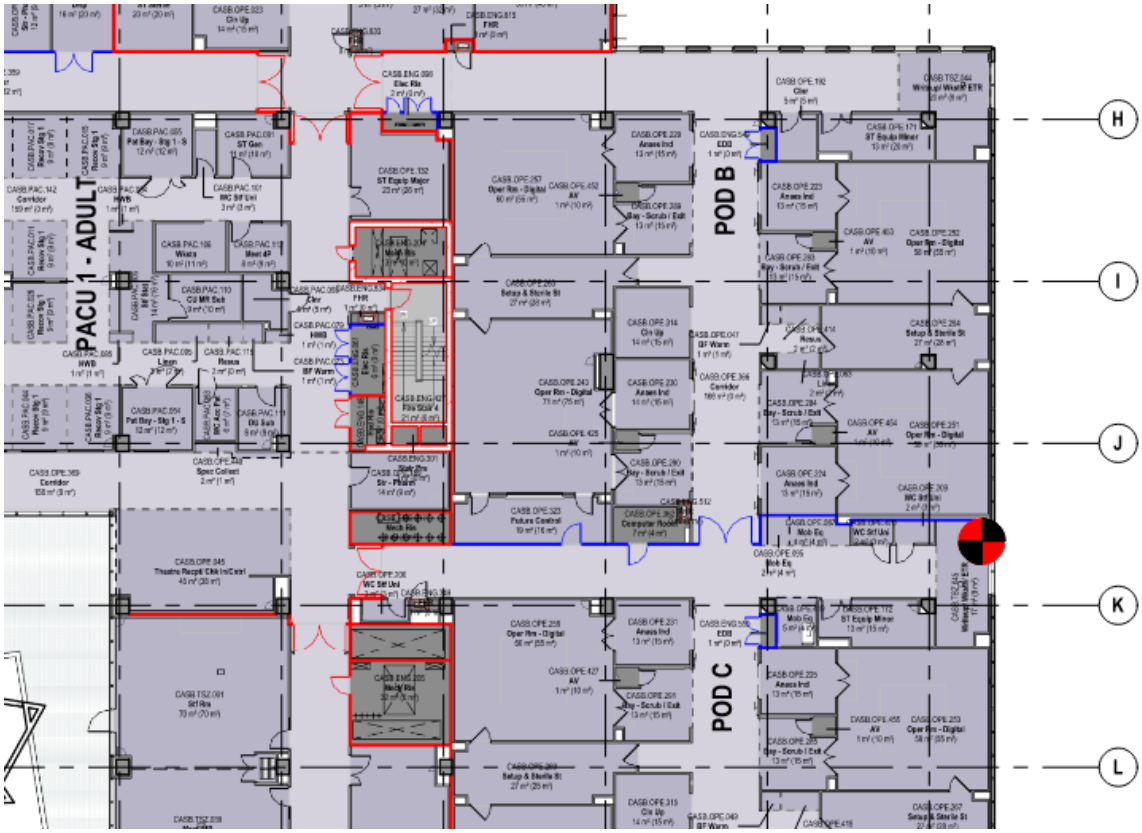

Figure 2: Level 3 surgical suite vibration monitor location

Table 2: Level 2 surgical suite vibration monitor criteria (NSW health guidelines for operating theatres)

PPV Criteria	RMS Velocity Criteria
Not applicable	Curve 1 Australian Standard AS2670.2 (1/3rd Octave band VRMS to be below 0.102mm/s)

3 Vibration Alert Management

The following diagram outlines the vibration alert management procedure. The first step is to confirm that the alert was not caused by someone in the vicinity of the monitor, as this is a common cause of false triggers. This could be accidental knocking of the device or dropping a large object nearby. If this was not the case, the rest of the escalation procedure below will be followed to investigate the source and the impact of vibrations and address as necessary.

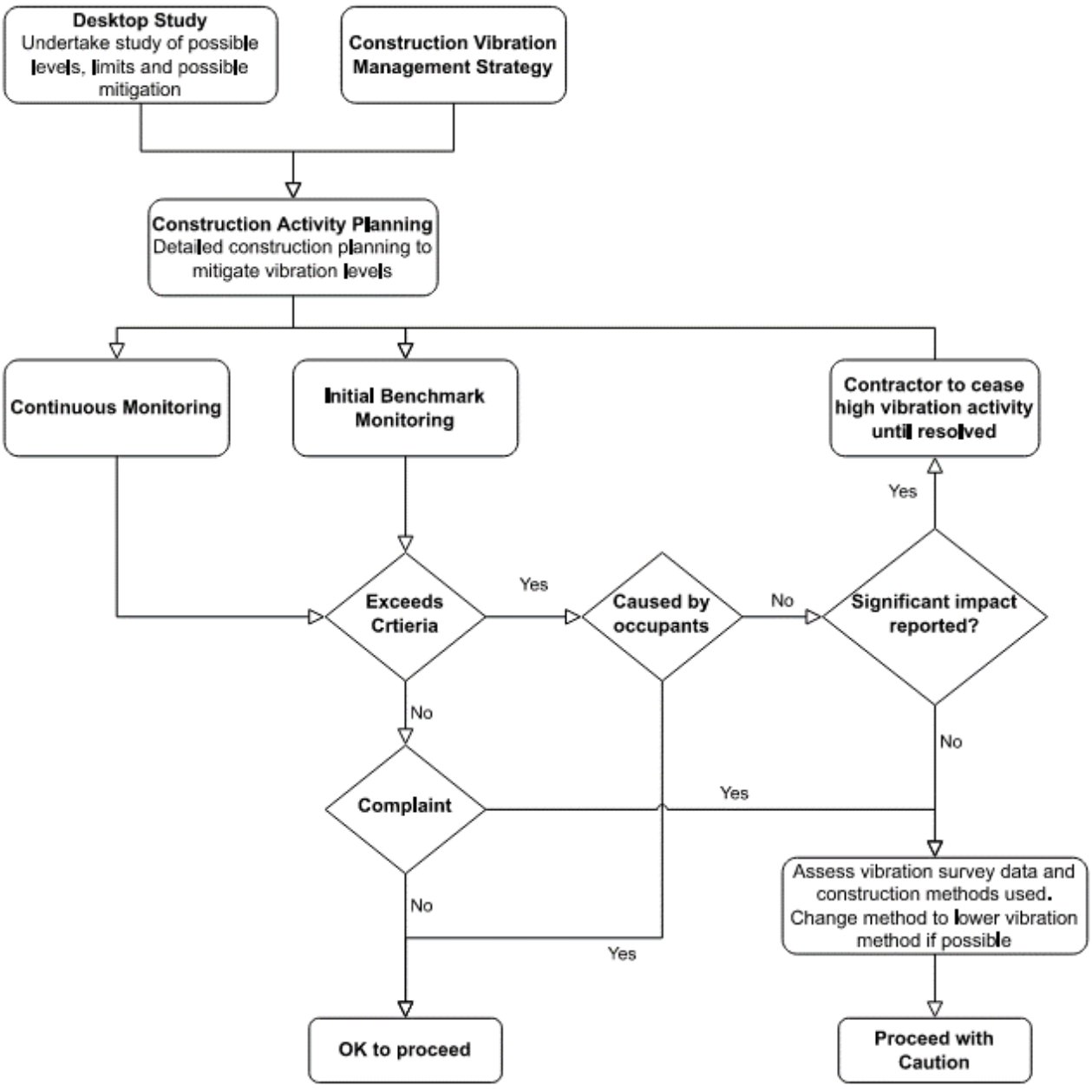

Figure 3: Vibration alert management procedure

Memorandum

ARUP

To	CHW Facilities Manager	Date	22 November 2021
Copies	Mary Sakr; Hannah Urquhart	Reference number	
From	Matt Walden; Grant Cuthbert	File reference	
Subject	CHW Monitoring - CHW		

This memo outlines the proposed vibration monitoring locations and limits within CHW to help ensure disruption from the PSB and MSCP development is minimised. The locations are preliminary and are to be discussed with CHW. At each of these locations, 240V power and an ethernet data connection is required. Ethernet connections are for outbound data only.

Figure 1 below shows the project site (red outline), and the scope area of this memo (yellow outline).

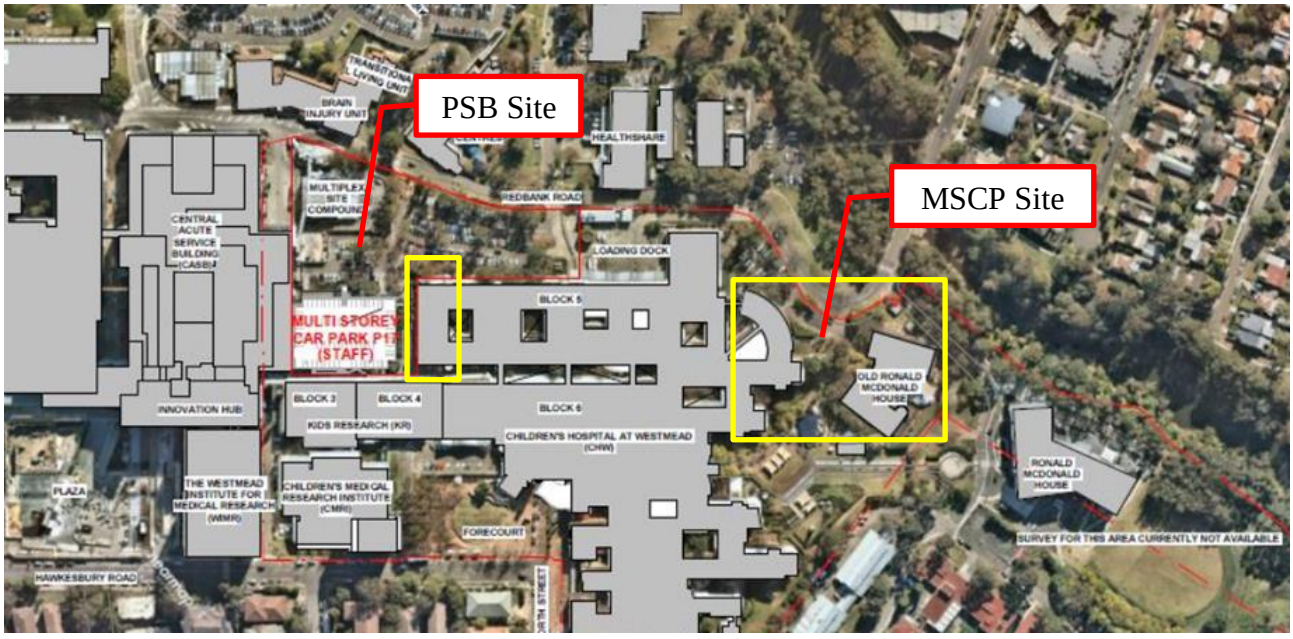

Figure 1 - Site map

1 Level 1 – Laboratories

The Level 1 endocrinology laboratory houses very sensitive and close to the PSB works, and as such should be monitored. This equipment includes:

- Immulite 1000 Analyser

- iSYS Analyser
- Wizard 2470 Gamma Counter
- TQ-S Tandem Mass Spectrometer
- TQ-XS Tandem Mass Spectrometer

Figure 2 below shows the proposed location of the vibration monitor, while Table 1 outlines the proposed alert criteria. The criteria adopted is based on the Stantec Acoustic Report for the Paediatric Services Building, which includes a table of the lab equipment and its specified vibration criteria.

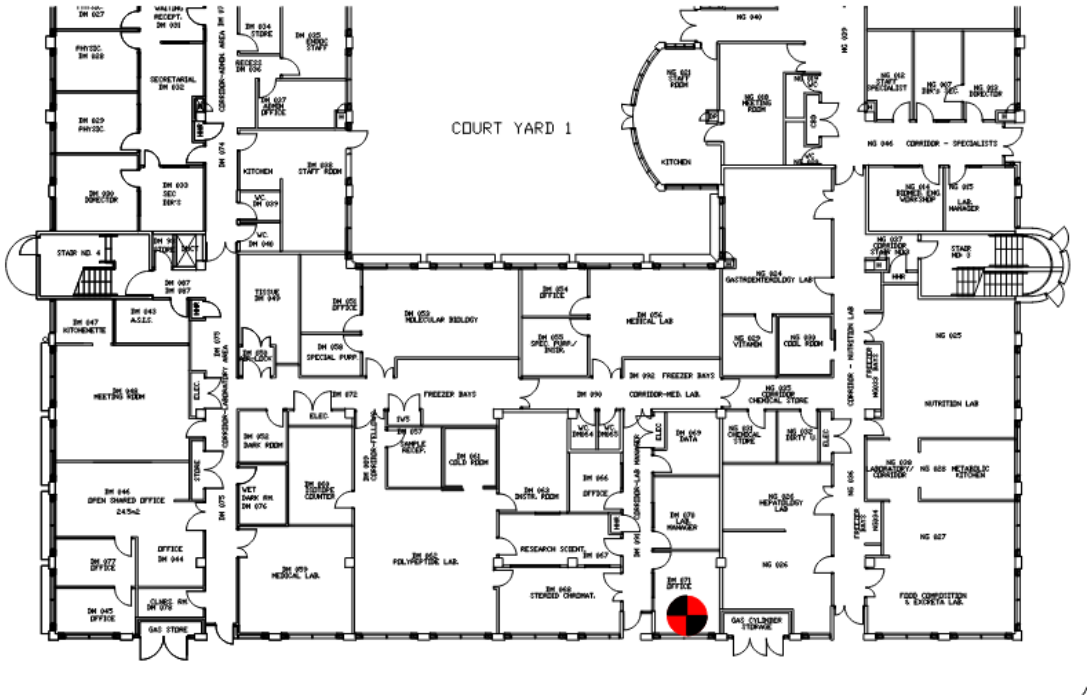

Figure 2: Level 1 Lab vibration monitor location

Table 1: Level 1 Lab vibration monitor criteria

PPV Criteria	RMS Velocity Criteria
Not applicable	Curve VC-C (1/3rd Octave band V_{RMS} to be below 0.0125mm/s), based on the two analysers

2 Level 1 – Mental Health Unit

As the facility closest to the MSCP site, the mental health unit should be monitored. Figure 3 below shows the proposed location of the vibration monitor, while Table 2 outlines the proposed alert criteria. This criteria is based on the Stantec Acoustic Report for the Multi-Storey Car Park and the NSW DEC Assessing Vibration: A Technical Guideline (2006), which prescribe maximum and preferred limits for residences in the daytime. As work is not expected at night time, the more stringent night time limit is not adopted.

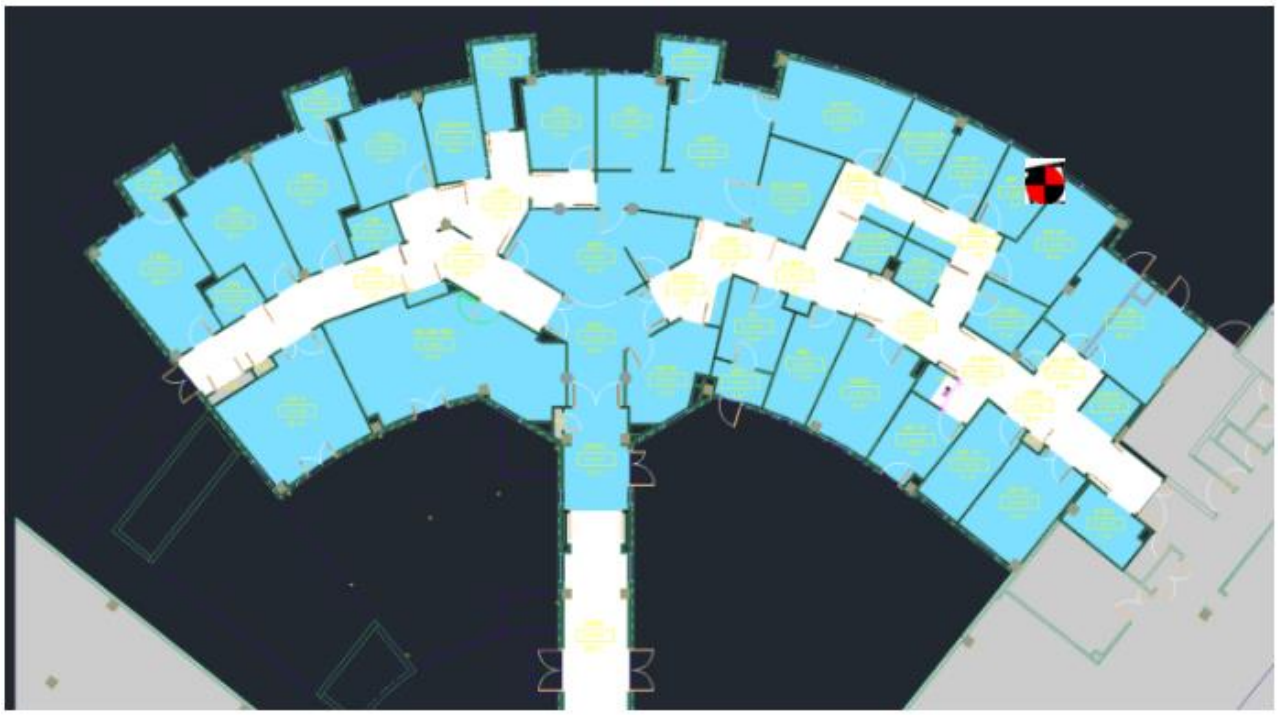

Figure 3: Level 1 mental health unit vibration monitor location

Table 2: Level 1 mental health unit vibration monitor criteria

PPV Criteria	RMS Velocity Criteria
Not applicable	Curve 2 Australian Standard AS2670.2 (1/3rd Octave band V_{RMS} to be below 0.204mm/s), based on daytime residence human comfort limit

3 Ronald McDonald House

Ronald McDonald House is also within the zone of influence of the Multi-Storey Car Park, it is further away from the site than the mental health unit above. It is also of similar usage, being residential housing for patient families. As such it is proposed that vibration levels at Ronald McDonald house are monitored by proxy with the vibration monitor in the mental health unit.

4 Vibration Alert Management

The following diagram outlines the vibration alert management procedure. The first step is to confirm that the alert was not caused by someone in the vicinity of the monitor, as this is a common cause of false triggers. This could be accidental knocking of the device or dropping a large object nearby. If this was not the case, the rest of the escalation procedure below will be followed to investigate the source and the impact of vibrations and address as necessary.

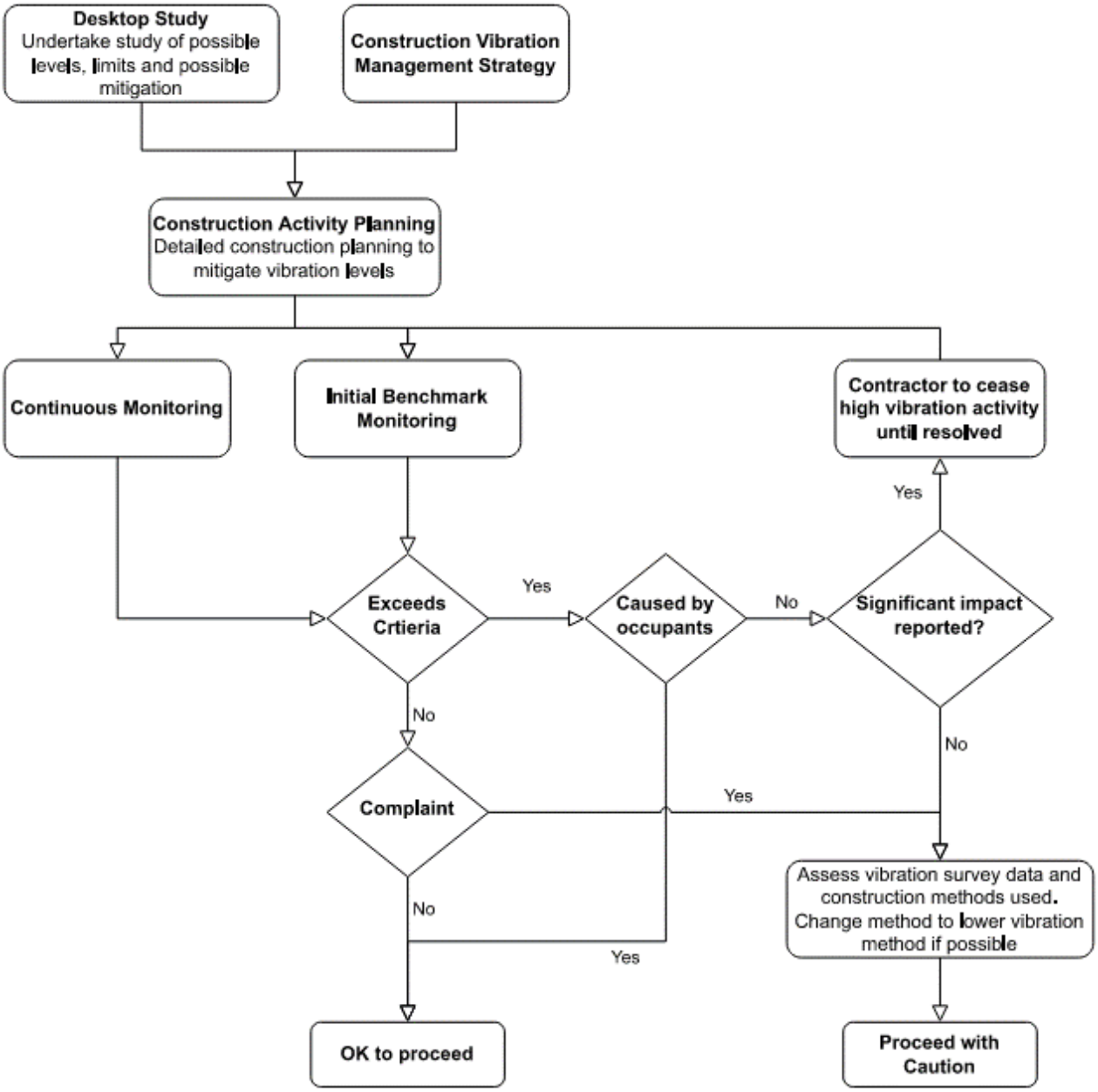

Figure 4: Vibration alert management procedure

Memorandum

ARUP

To	CASB Facilities Manager	Date	22 November 2021
Copies	Mary Sakr; Hannah Urquhart	Reference number	
From	Matt Walden; Grant Cuthbert	File reference	
Subject	CHW Monitoring - KR		

This memo outlines the proposed vibration monitoring locations and limits within KR to help ensure disruption from the CHW development is minimised. The locations are preliminary and are to be discussed with KR. At each of these locations, 240V power and an ethernet data connection is required. Ethernet connections are for outbound data only. 3G modems can be provided to locations where no ethernet is available (i.e. the corridor beside the animal house).

Figure 1 below shows the project site (red outline), and the scope area of this memo (yellow outline).

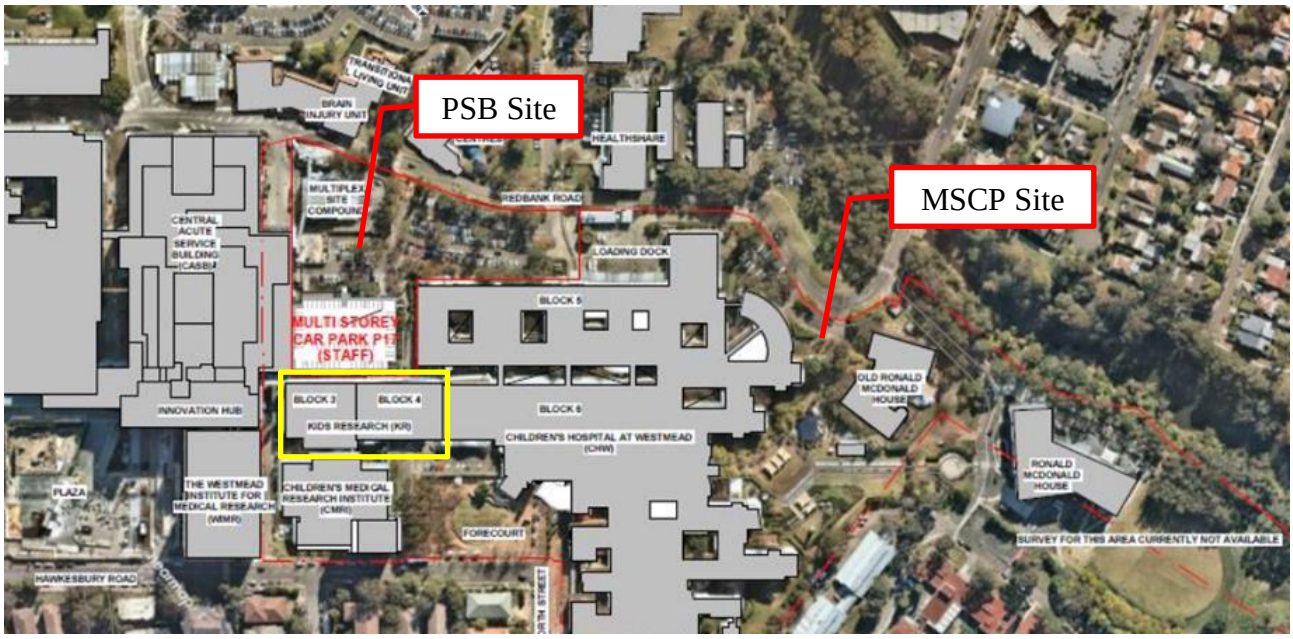

Figure 1 - Site map

Memorandum

1 Level 1 – Animal House

The animal house is considered highly important and is close to the construction site of the PSB, and as such should be monitored. Figure 2 below shows the proposed location of the vibration monitor, while Table 1 outlines the proposed alert criteria. The criteria adopted is based on the Stantec Acoustic Report for the Paediatric Services Building which includes a table outlining the required criteria for animal houses, and is in line with previous monitoring projects at KR.

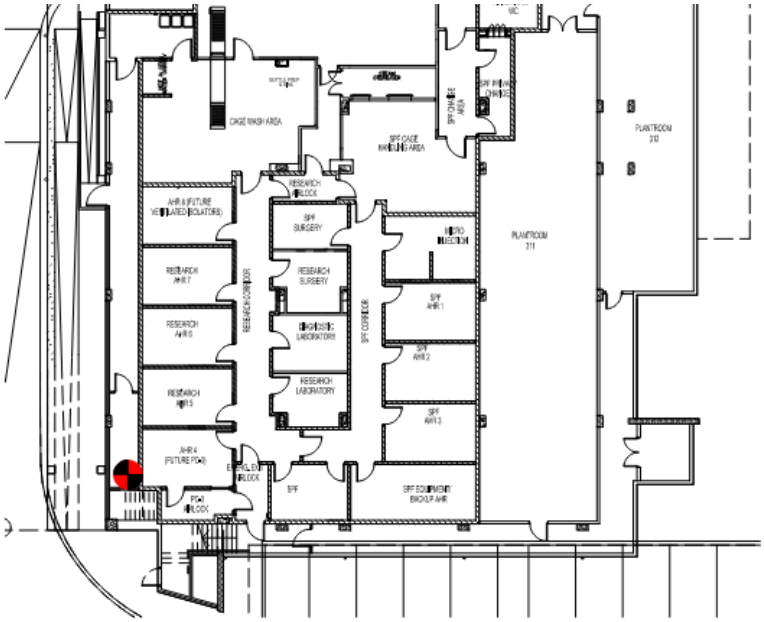

Figure 2: Level 1 Animal House vibration monitor location

Table 1: Level 1 Animal House vibration monitor criteria

PPV Criteria	RMS Velocity Criteria
1.0mm/s	Curve 1 Australian Standard AS2670.2 (1/3rd Octave band V_{RMS} to be below 0.102mm/s)

2 Level 2 – Offices

The offices on level 2 of KR are considered to be the least vibrationally sensitive spaces within KR. This space was monitored during the demolition of the P17 carpark. Data from this monitoring is presented in Figure 3. This shows that the measured levels were generally very low, below both the performance criteria of Curve 4, and below the average threshold of human perception (Curve 1).

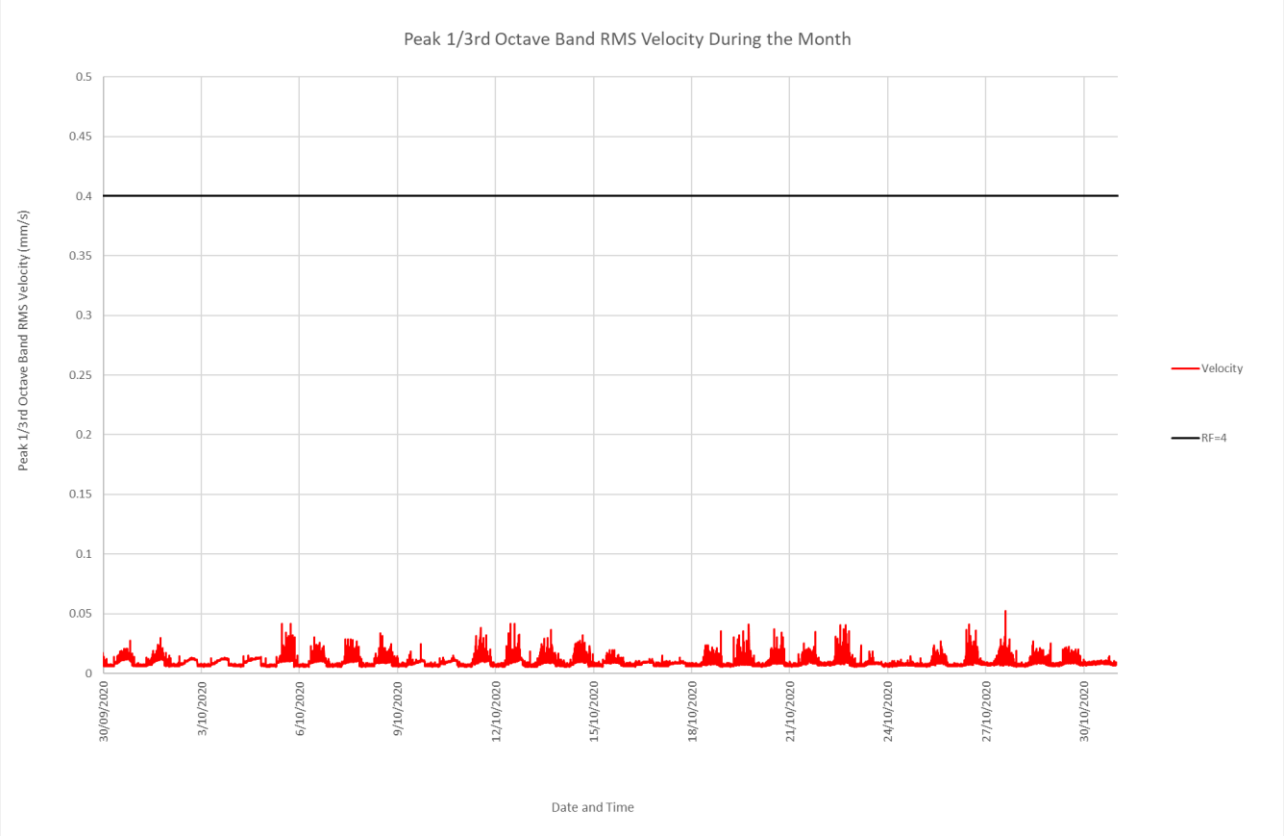

Figure 3: L2 office - P17 demolition monitored levels (1 month)

Based on the sensitivity of the space and historical recorded data, we do not believe that monitoring of this space is warranted.

3 Gait Lab

The gait lab is considered to be partially sensitive due to the equipment in the room. Previous monitoring in the facility (Figure 4) did show some exceedances, however these were not reflected in other monitors across KR and are therefore considered to have been locally generated.

Outside of these occasional exceedances, the recorded levels during the P17 demolition were generally well below the limit. As such, a monitor at this location is not deemed necessary.

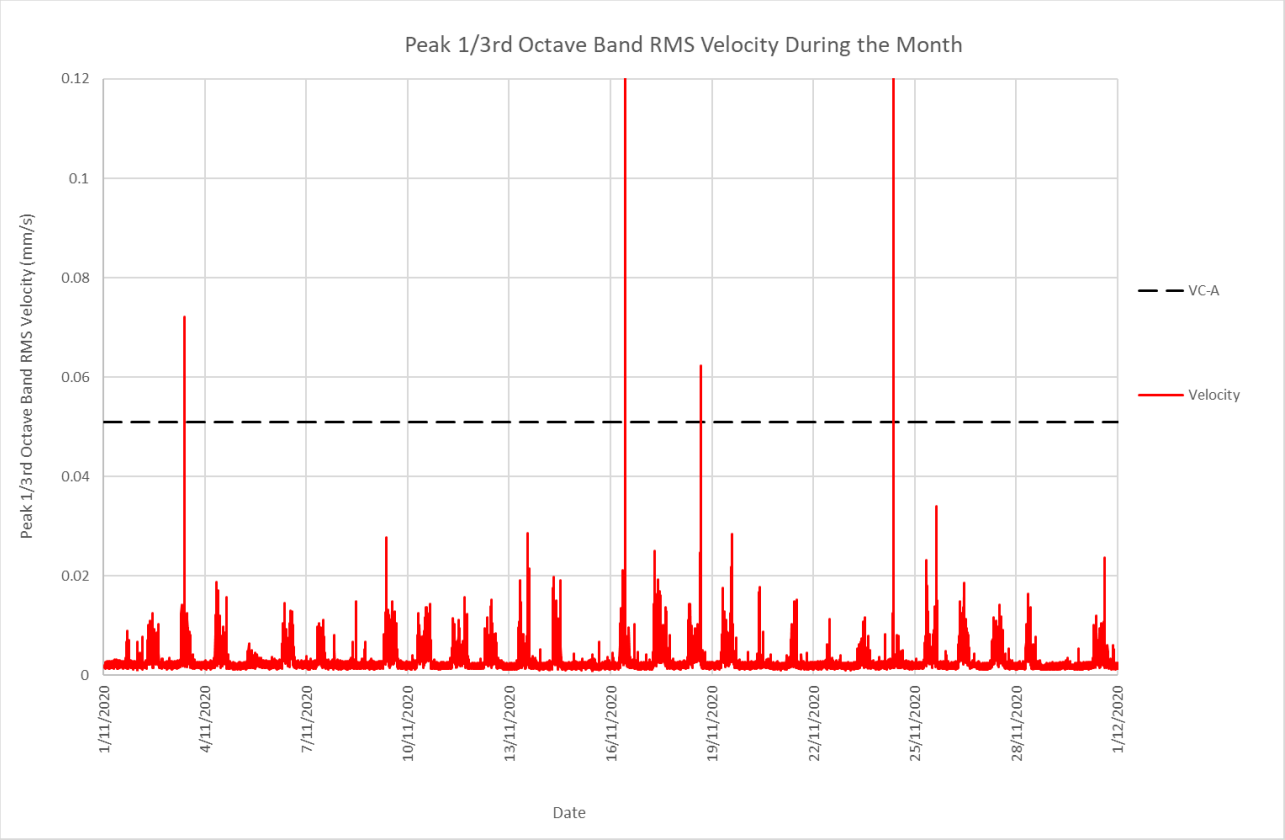

Figure 4: L2 gait lab - P17 demolition monitored levels (month 1)

4 Level 3 Laboratories

The level 3 labs are considered to be somewhat sensitive, and have been monitored as part of both CASB and the P17 demolition. This lab is considered less sensitive than Level 4 Lab 9, as the equipment in the L3 labs have higher vibration limits. This equipment is known to be:

- 3D printers
- Mecmesin torsional mechanical tester
- Faxitron
- Skyskan 1272/1174
- Piximus
- Incubators

Additionally, the recorded data from P17 demolition (Figure 5) shows that the recorded levels did not reach the triggering level.

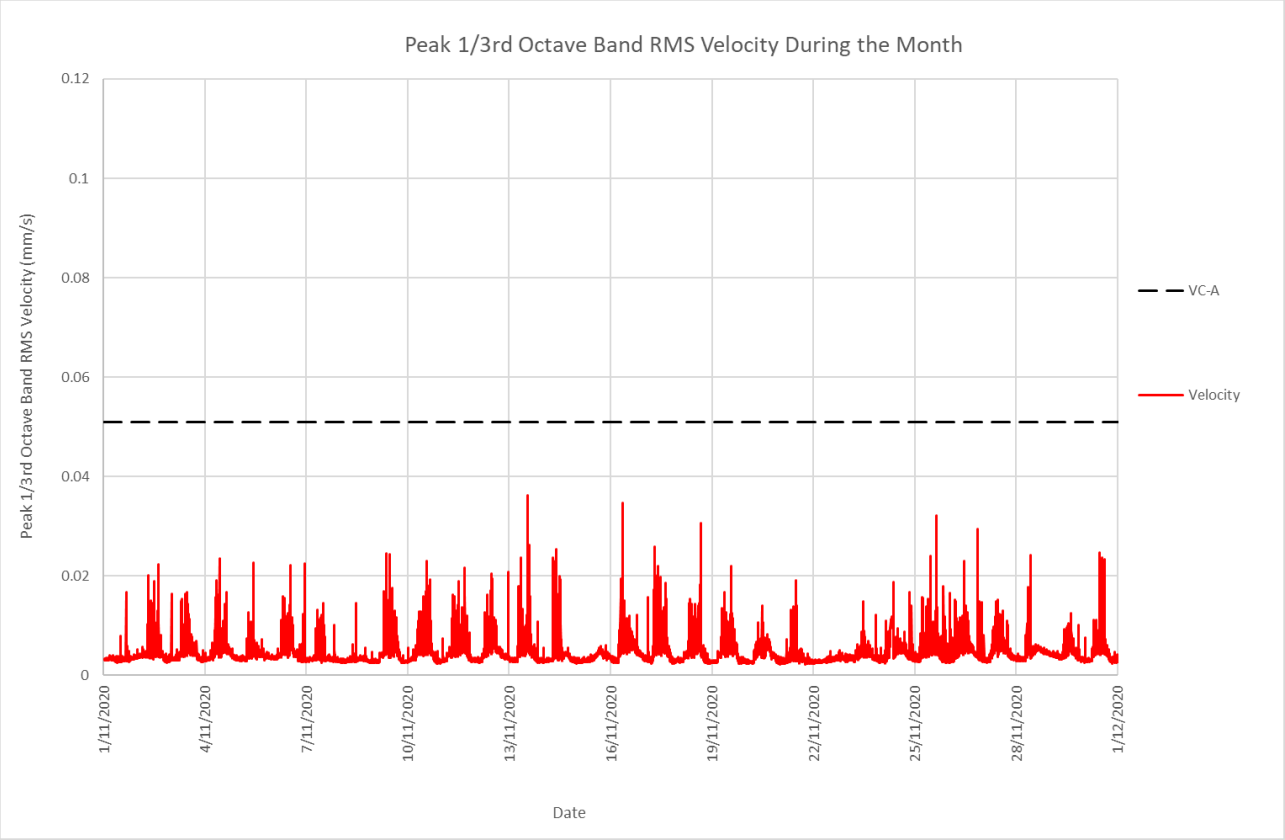

Figure 5: L3 laboratory - P17 demolition monitored levels (month 1)

Based on this lower sensitivity and historical measurement for construction on the PSB site, we do not recommend monitoring at this location.

5 Level 4 – Lab 9

Lab 9 was known to have the most sensitive equipment when works for the P17 demolition took place (VC-D), and as such should be monitored. In this location, actual monitoring prior to the P17 demolition indicated the floor was only able to meet a VC-B performance level. Figure 6 and Figure 7 below show the recorded data during the demolition works, which indicated that the floor is close to performing at VC-B level ordinarily, but the works did result in an increase in the vibration levels and resulted in exceedance.

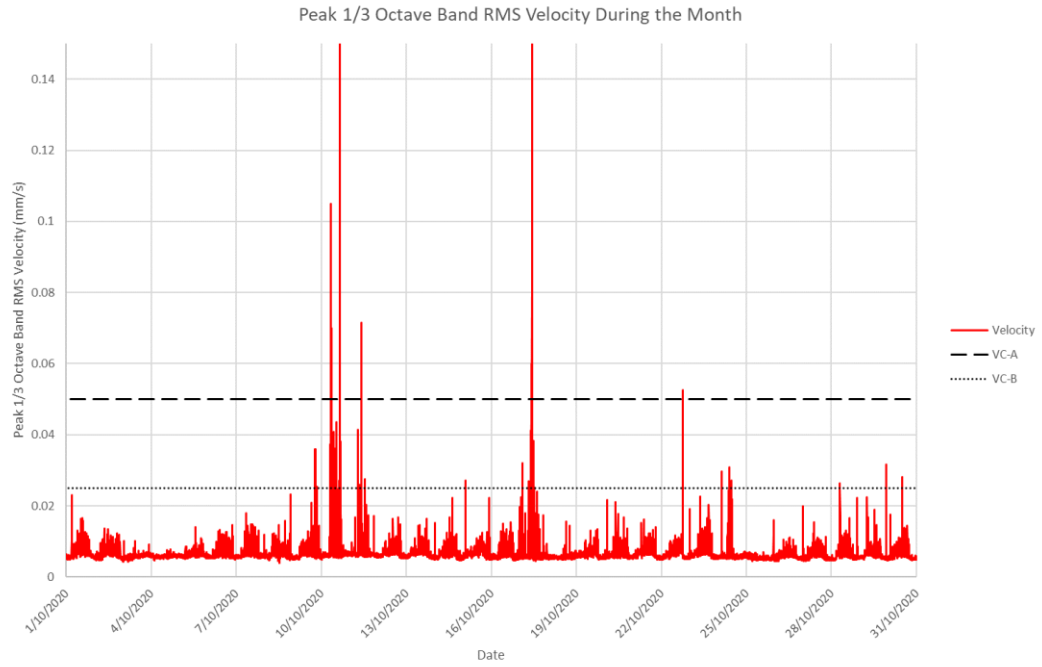

Figure 6: KR Lab 9 - P17 demolition (month 1)

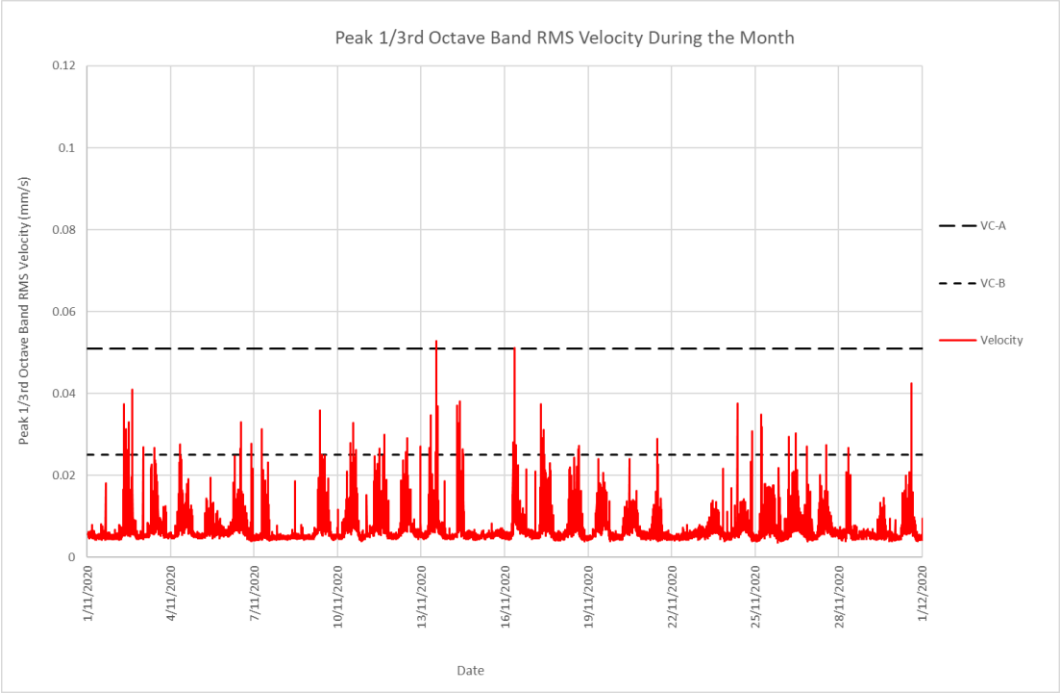

Figure 7: KR Lab 9 - P17 demolition (month 2)

Figure 8 below shows the proposed location of the vibration monitor. Note that we are not 100% sure that the room indicated is correct room, as this floor plan on file is not up to date. Table 2 outlines the proposed alert criteria, however it is anticipated that this location will require review and ongoing discussion regarding impact.

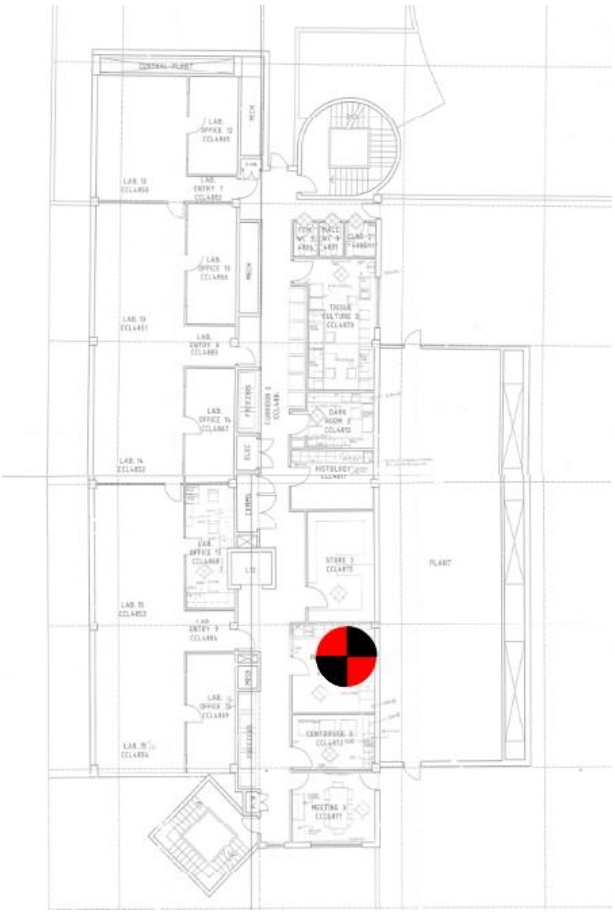

Figure 8: Level 4 Lab 9 vibration monitor location

Table 2: Level 4 Lab 9 vibration monitor criteria

PPV Criteria	RMS Velocity Criteria
Not applicable	Curve VC-B (1/3rd Octave band VRMS to be below 0.025mm/s)

6 Vibration Alert Management

The following diagram outlines the vibration alert management procedure. The first step is to confirm that the alert was not caused by someone in the vicinity of the monitor, as this is a common cause of false triggers. This could be accidental knocking of the device or dropping a large object nearby. If this was not the case, the rest of the escalation procedure below will be followed to investigate the source and the impact of vibrations and address as necessary.

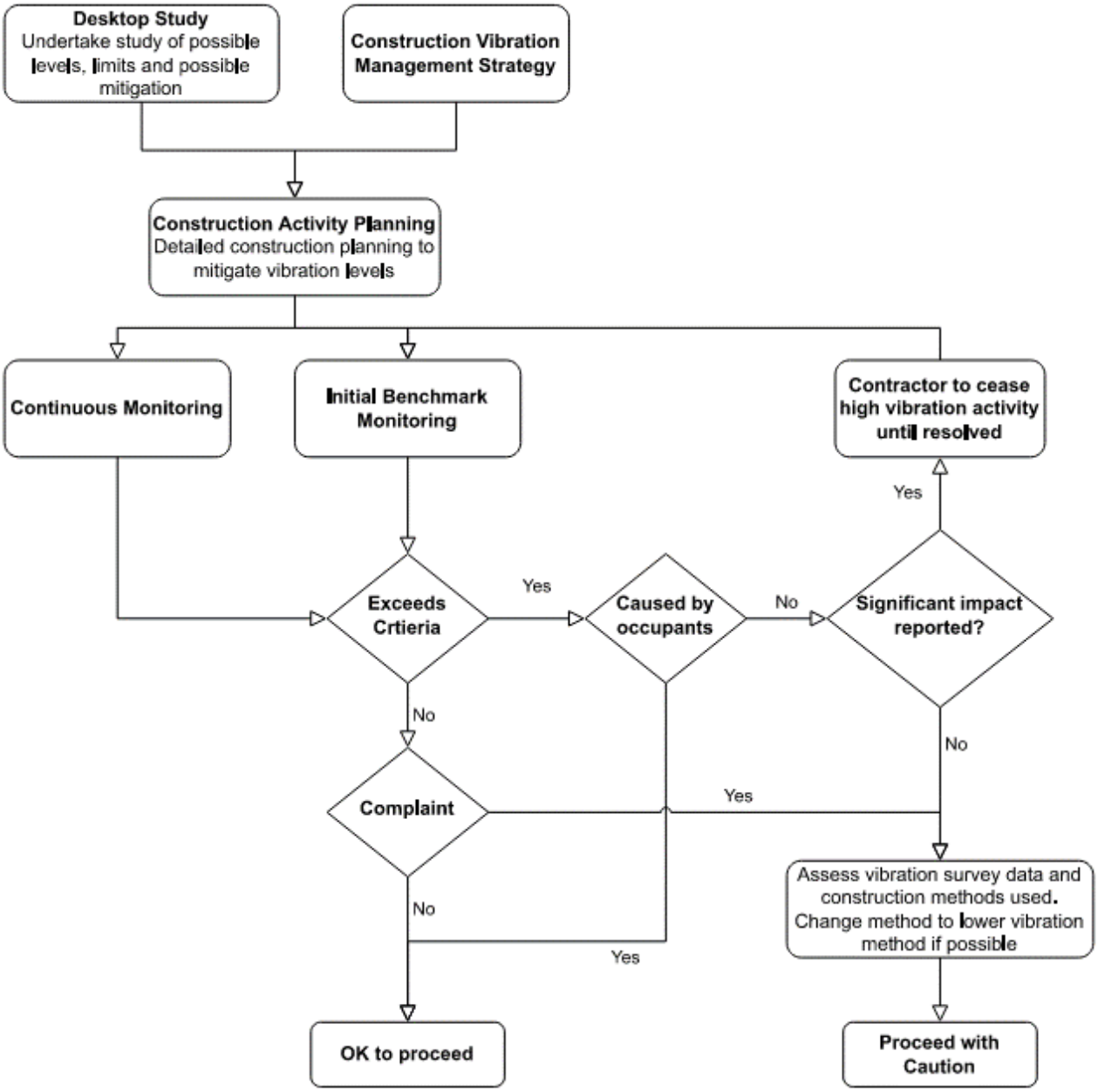

Figure 9: Vibration alert management procedure

ARUP

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By email
10 November 2022

Jesse Anil

Our ref 271985-00

Dear Jesse,

Westmead VVMF

Outcomes of WIMR site walk for VVMF impact and monitoring

This letter summarises the conversations held between Arup and the WIMR BSF representatives on 19 September 2022, regarding vibration and noise requirements for the VVMF works in an adjacent facility.

Key discussion points and conclusions are as follows:

1. While works are expected to continue for 6-9 months, the first two months of these works are likely to be of the largest impact from a vibration perspective – but still below human perception. These works are expected to be well below the levels seen in the CASB construction works and P17 carpark demolition. This is on the basis that:
    1. VVMF works to do not include bulk excavation;
    2. VVMF works do not include rock breaking or scraping;
    3. VVMF works do not include works where heavy objects can be expected to routinely fall from an appreciable height.
2. Arup have reviewed the technical specification of the x-ray and bioluminescence imaging machine for acceptable vibration levels. The vibration criteria are more stringent for the breeding animals, and therefore we do not expect vibration levels at this location to have a negative impact that won't also be observed at the animal cages. Both rolling 1s RMS and peak velocity vibration levels will be measured and set as trigger levels. With these considerations in mind, it is Arup's conclusion that one vibration and one noise logger in the WIMR BSF will be sufficient.
3. The criterion set for the animals will be $1/4^{th}$ of human perception for vibration as the facility now houses more sensitive breeding activities. The vibration loggers will be initially located in the cleaning room in the southwest corner. Vibrations are expected to dissipate from this point towards the animals, and therefore if not triggering at this location, should ensure acceptability for the experiments. If triggers are observed during a testing window, including if triggered by the machine wash unit, then we can move this vibration logger closer to the rooms that house the animals to be more representative. The noise logger will

be located closer to the animal housing facility to be representative. The trigger level for noise is expected to be set during baseline measurement.

4. Both monitoring equipment units (vibration and noise) will each require a power and ethernet point. The ethernet point will be required to allow outbound connections for the vibration logger, and an inbound and outbound connection for the noise logger – to enable data to be sent to Arup, and for Arup to perform updates remotely. If for any reason, inbound connections are not possible on the ethernet point, then any servicing and updates on the loggers will be done in person.
5. The program will require monitor set up and conduction of a baseline tests to ensure adequacy and validity of the monitored measurements. Following this baseline measurement period, that measures the ambient vibration in the space, the trial works including the use of various construction equipment items at a known period will be trialled to assess the vibration levels expected during the fit out works. Prior to testing the effect of the use of specific construction equipment, we propose that the wash machine is run to ensure the use of this equipment does not provide a false trigger if used. If so, the vibration equipment can be relocated closer to the animal housing rooms to be more representative of what the animals will be subjected to. Once these baseline levels are measured, and the effect of various construction equipment is tested, Arup will specify acceptable construction equipment for the fit-out teams to use, so as to limit vibration and noise levels to acceptable limits.

6. Construction equipment testing schedules should be shared with WIMR contacts for any internal experiments to be run during benchmarking.
7. If specific one-off periods of highly sensitive experimental or lab procedural works are required, then the period of these works should be shared by WIMR to Arup and PwC for coordinating the construction schedule to minimise impact of fit out works on WIMR's research works.

During the works, if criterion are triggered, contacts from WIMR, PwC and the construction teams will receive text and email alerts within 3 minutes of the criterion being exceeded. Work procedures following a trigger will be agreed upon by all parties prior to commencement of works to ensure that due care is given to the research works in the WIMR BSF.

Once acceptability of these plans are confirmed with all parties involved and our scope is approved, we will install the noise and vibration loggers to begin baseline measurement and equipment tests.

ARUP

Our ref	Job number
Date	18 October 2022

Yours sincerely,

Matthew Walden
Senior Engineer

d +61 2 9320 9565
e matthew.walden@arup.com

cc Pranav Rawal, Tom Morgan

HOSPITAL ROAD

BOUNDARY LINE 128° 30' 20"

BOUNDARY LINE 38° 22' 10"

HAWKESBURY ROAD

EXTENT OF NEW PAVEMENT

FIRE STAIRS 1

FIRE STAIRS 2

ZONE OF BOLLARDS

SET BLOCK WALL 70mm BACK FROM THE OUTSIDE FACE OF THE COLUMNS TO ALLOW SUFFICIENT BOOM FOR THE CLADDING TOP RAILS AND ALUMINIUM CLADDING - FIXING HEIGHT

PROVIDE BOND BEAMS AT 2m CT'S (EVERY 10th COURSE) N16 FULLY GROUTED

EXTENT OF SAFETY PAINT MARKINGS TO LOADING DOCK AREA

FAIRFACED FINISH TO EXPOSED FACES OF BLOCKWORK WALLS. CORE-FILL UPTO 1 METRE. REINFORCE CORE FILLED 190 BLOCKWALL WITH N20 400 CENTRAL DRILL AND EPOXY FIX BARS.

PROVIDE BRICK STIFFENERS 89N6 or 100x100x5) SHS AS INDICATED

STUD WALL TO BE SUPPORTED FROM SHELF ANGLE FIXED TO SIDE OF STAIR - TO KEEP UNDERSIDE OF CONCRETE ROAM AT LEVEL 2

NOTE: FACE OF B1 WALL SETBACK 15MM FROM FACE OF BOOM OVER 3025 VOS

VERIFY ON SITE SETOUT OF WALLS & DOORS AROUND SPECIAL BUILT-IN EQUIPMENT

PROPOSED LOCATION FOR NOISE MONITOR

PROPOSED LOCATION FOR VIBRATION MONITOR

BOXING FOR TRADE WASTE VENT

VERIFY ON SITE ACCESS DOOR LOCATION (TO BE ADJACENT HYDRAULIC CLEAR-OUTS)

PROVIDE MET-5 FROM CAPPING BEAM AT 400mm CENTRES.

PROVIDE MET-5 FROM CAPPING BEAM AT 400mm CENTRES.

VERIFY ON SITE ACCESS DOOR LOCATION (TO BE ADJACENT HYDRAULIC CLEAR-OUTS)

LOADBEARING BLOCKWALLS: FAIRFACED FINISH TO EXPOSED FACES ONLY. CORE-FILLED 190 BLOCKWALLS N16-800 CENTRAL

WIRE FENCING C/W ACCESS DOOR APPROX 2000mm HIGH

STEAM PLANT CONDENSATE PUMP ENCLOSURE

L3 ABOVE JOINERY PANELLING

PACK OUT 45 REQUIRED TO ALIGN

NOTE:

1. PROVIDE HEAD RESTRAINTS AND WALL/COLUMN RESTRAINTS U.N.O. HEAD RESTRAINT MET-4 AT 400mm CENTRES. WALL/COLUMN RESTRAINT MET-5 AT 400mm CENTRES U.N.O

2 PC3 AUTOCLAVE DETAIL
1 : 50

3 SAF AUTOCLAVE DETAIL
1 : 50

4 PC2 WASTE AUTOCLAVE DETAIL
1 : 50

5 GLASS WASH-UP AUTOCLAVE DETAIL
1 : 50

FIRE-RATING
60/60/60 FIRE-RATED WALL
90/90/90 FIRE-RATED WALL
120/120/120 FIRE-RATED WALL
SMOKE SEPARATION LINE

BVN
Donovan Hill

Telephone +61 2 8297 7200
Facsimile +61 2 8297 7299
www.bvn.com.au

ISSUE	DATE	FOR
1	23.02.2011	FOR INFORMATION
2	28.04.2011	FOR INFORMATION
3	24.05.2011	FOR INFORMATION
4	23.06.2011	FOR INFORMATION
5	15.08.2011	40% DESIGN DEVELOPMENT
6	18.08.2011	FOR INFORMATION
7	30.09.2011	70% DESIGN DEVELOPMENT
8	02.12.2011	90% DESIGN DEVELOPMENT
9	29.06.2012	ISSUED FOR TENDER
10	13.07.2012	FORMWORK TENDER
11	20.07.2012	FOR INFORMATION
12	26.07.2012	CONSTRUCTION CERTIFICATE
A	21.08.2012	FOR INFORMATION
AA	07.02.2014	FOR CONSTRUCTION
B	13.09.2012	FOR INFORMATION
BB	24.03.2014	AS BUILT
C	17.10.2012	FOR INFORMATION
D	26.10.2012	FOR BLOCKWORK TENDER
E	31.10.2012	FOR BLOCKWORK TENDER
F	16.11.2012	FOR DRYWALL TENDER
G	28.11.2012	REV. TENDER DRYWALL/GLAZED PTN.
H	21.12.2012	FOR INFORMATION
I	05.02.2013	FOR INFORMATION
J	08.02.2013	REV. TENDER DRYWALL/GLAZED PTN.
K	20.02.2013	REV. TENDER DRYWALL/GLAZED PTN.
L	27.02.2013	FLOOR FINISHES TENDER ONLY
M	21.03.2013	BLOCKWORK SETOUT/DRYWALL REV.
N	11.04.2013	BLOCKWORK/DRYWALL SETOUT
O	17.04.2013	COORDINATION ISSUE
P	24.04.2013	FOR INFORMATION
Q	30.04.2013	FOR CONSTRUCTION
R	28.05.2013	FOR CONSTRUCTION
S	06.06.2013	FOR CONSTRUCTION
T	07.06.2013	FOR CONSTRUCTION
U	17.06.2013	FOR CONSTRUCTION
V	12.07.2013	FOR CONSTRUCTION
W	22.07.2013	FOR CONSTRUCTION
X	06.08.2013	FOR CONSTRUCTION
Y	18.09.2013	FOR CONSTRUCTION
Z	05.02.2014	FOR CONSTRUCTION

CLIENT
Westmead Millennium Institute for Medical Research

PROJECT MANAGER
CAPITAL INSIGHT
Feasibility & Planning · Property Advisory · Project Strategy · Delivery

BUILDER
Abigroup Constructing Australia's Future
COCKRAM Construction since 1891

PROJECT
WESTMEAD MILLENNIUM INSTITUTE

BVN PROJECT NUMBER
S1012004

DRAWING KEY

TOP OF FLUE	RL 60.70
ROOF	RL 58.35
LEVEL 9	RL 56.00
PLANTROOM 8	RL 51.70
LEVEL 7	RL 47.40
LEVEL 6	RL 43.10
LEVEL 5	RL 38.80
LEVEL 4	RL 34.50
LEVEL 3	RL 30.20
LEVEL 2	RL 25.90
PLANTROOM 1	RL 23.20
LEVEL 1	RL 19.90
BASEMENT	RL 16.90

TRUE NORTH
PROJECT NORTH

GRAPHIC SCALE (m)
0 25 50

SCALE
1: 100 @ B1 DO NOT SCALE

STATUS
AS BUILT

DRAWING
FLOOR PLAN LEVEL L1
LOWER GROUND

DRAWING NUMBER
A-D-L1

ISSUE
BB

24/03/2014 1:48:00 PM

APPENDIX B – CURRICULUM VITAE

Qualifications

Master of Architectural Science (Audio & Acoustics), USYD 2020

Outline of Experience

Beginning at AL in 2020, Ross has developed experience in a variety of areas of noise and vibration measurement and assessment. Since working at AL, Ross has been involved in the investigation, design, construction, inspection and certification/compliance testing of acoustic impacts from environmental noise, building design, operational noise and mechanical noise. Ross has extensive experience in the usage and application of statutory codes and requirements of acoustic design in buildings and mechanical systems. Ross' areas of expertise include:

Spatial planning of development (room layouts, wall design etc)
Acoustic control of mechanical systems (ventilation systems, air-conditioning etc).
Acoustic design of reverberant noise in critical spaces (seminar rooms, theatres).
Environmental noise modelling and assessment as required for consent authorities.
Review of external noise impacts (traffic, rail).
Review of acoustic impact of helicopters/helipads.

Project Experience

A sample of projects Ross has been or is currently involved with as a Project Engineer include:

Residential/ Hotel/ Mixed-Use Projects

The Ribbon, Darling Harbour
77 Market Street, Sydney
Riverwood Estate SSD, Riverwood
Tallawong Station Precinct, Rouse Hill
5-7 Charles Street, Parramatta
26 Mann Street, Gosford
Scape Student Accommodation, Kengsington
Scape Student Accommodation, Kingsford
Carter Street, Lidcombe
128 Bunnerong Road, Pagewood

Commercial Projects

55 George Street, Sydney
One Eden Park Drive, North Ryde
Coles CFC, Horsely Business Park
Bondi Junction RSL
St Mary's Leagues Club
Toongabbie Sports Club
Castle Hill RSL

Healthcare, Research, Educational and Aged-Care Facilities

University of Sydney Biomedical Accelerator
University of Sydney Dubbo Medical Teaching Facility
Children's Medical Research Institute, Westmead
Westmead Hospital Central Acute Services Building
Westmead Innovation Centre
Westmead Innovation Quarter
Western Sydney University, Bankstown Campus
Hornsby Ku-Ring-Gai Hospital
Blacktown Hospital
Edmondson Park Public School
Millthorpe Public School, Orange
Bletchington Public School, Orange
Picton High School
Opal Aged Care, Toongabbie
Opal Aged Care, Carlingford

Qualifications

Bachelor of Mechanical Engineering (Hons, Class1) (1982)

Member of the Australian Acoustical Society (M.A.A.S)
Member of Institution of Engineers, Australia
Member of Australian Building Codes Board External Noise Project

1994 - Current	Director, Acoustic Logic Consultancy
1992 to 1994	Associate Director, Renzo Tonin and Associates
1989 to 1992	Project Engineer, Renzo Tonin and Associates
1981 to 1989	Engineer, NSW Public Works Department

Outline of Experience

Between 1981 and 1989 Victor was employed with the NSW Public Works Department as a professional engineer. His work involved the investigation, design and construction supervision of mechanical services (air conditioning, ventilation heating, solar design) for new and existing public buildings throughout the state as well as acoustics.

Victor joined Renzo Tonin and Associates, a Sydney-based acoustics and vibration consultancy, in 1989 as a project engineer, and was made an associate director of the firm in 1992. In 1994 he became a director of Acoustic Logic Consultancy.

Victor's areas of expertise include:

Building acoustics and building services noise control
Environmental noise modelling and assessment
Vibration isolation and structural dynamics
Traffic noise prediction
Helicopter & aircraft noise
Industrial Noise Control

Project Experience

Victor has undertaken a vast number of noise assessments and designs for a variety of projects. Some of these are listed below.

Star Event Centre and Hotel
Trinity Grammar Masterplan
Sydney Olympics
Eastern Distributor
710 George Street Residential Project
Canterbury, Liverpool, Campbelltown and Camden Hospitals
Mirvac Residential Developments Milsons Point and Rhodes
Shepherds Bay Residential precinct
AGL Site Mortlake redevelopment
Australand Residential Development Balmain, Waverton and Discovery Point