JOHN HOLLAND

Waterloo Integrated Station Development

Noise and Vibration Annual Monitoring Report

October 2022 to September 2023

DOCUMENT No: SMCSWSWL-JHG-SWL-EM-REP-000016

Document and Revision History

Document Details	
Title	Noise and Vibration Annual Monitoring Report – October 2022 - September 2023
Client	Sydney Metro City & Southwest

Revisions

Rev #	Date	Description	Prepared by	Reviewed by	Approved by
A	09/10/2023	Draft Report	T. Rodrigues	S. Reynolds	
0	17/10/2023	Final Report	T. Rodrigues	S. Reynolds	A. Knispel
01	28/11/2023	Update to address SM comments	T. Rodrigues		A. Knispel
02	12/12/2023	Updated to address AA comments	T. Rodrigues		A. Knispel 

Glossary

Term	Explanation
CEMP	Construction Environmental Management Plan
CNVIS	Construction Noise & Vibration Impact Statement
CNVMP	Construction Noise and Vibration Management Plan
CoA	Condition of Approval
CSSI	Critical State Significant Infrastructure
ICNG	Interim Construction Noise Guideline
ISD	Integrated Station Development
JH	John Holland
MQD	Metro Quarter Development
NML	Noise Management Level
OOHW	Out of Hours Work
OOHWA	Out of Hours Work Approval
OSD	Over-station Development
PNL	Predicted Noise Level
PPV	Peak Particle Velocity
RBL	Rating Background Level
VDV	Vibration Dose Value

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1. Introduction

1.2 Background

The Sydney Metro City & Southwest is a 30 kilometre metro rail between Chatswood and Bankstown, including; 17 kilometres of new tunnel from Chatswood, under the harbour to Sydenham connecting 7 new underground stations at Crows Nest, Victoria Cross (North Sydney), Barangaroo, Pitt Street, Martin Place, Central and **Waterloo**. Upgrading 13 kilometres of the Bankstown line, including 11 existing stations; Sydenham, Marrickville, Dulwich Hill, Hurlstone Park, Canterbury, Campsie, Belmore, Lakemba, Wiley Park, Punchbowl and Bankstown plus southern service facilities. The Waterloo Integrated Station Development (ISD) forms part of the Sydney Metro City & Southwest Project. The Waterloo ISD comprises of construction of the new station infrastructure to support customer movement and experience. The Waterloo Station works are undertaken by John Holland

The Waterloo ISD is located within Sydney's suburb of Waterloo, as shown in Figure 1, within the Metro Quarter. The Metro Quarter Development (MQD) comprises the land bounded by Botany Road, Raglan Street, Cope Street and Wellington Street, but excluding the Congregational Church located at 103 Botany Road. It is situated approximately 3km from the Sydney CBD and is surrounded by established residential and commercial land uses. The MQD incorporates the Waterloo ISD and the Over-station Development (OSD) however, the OSD component is not subject to the CSSI Project Planning Approval (SSI15_7400) and therefore does not form part of the scope of this report.

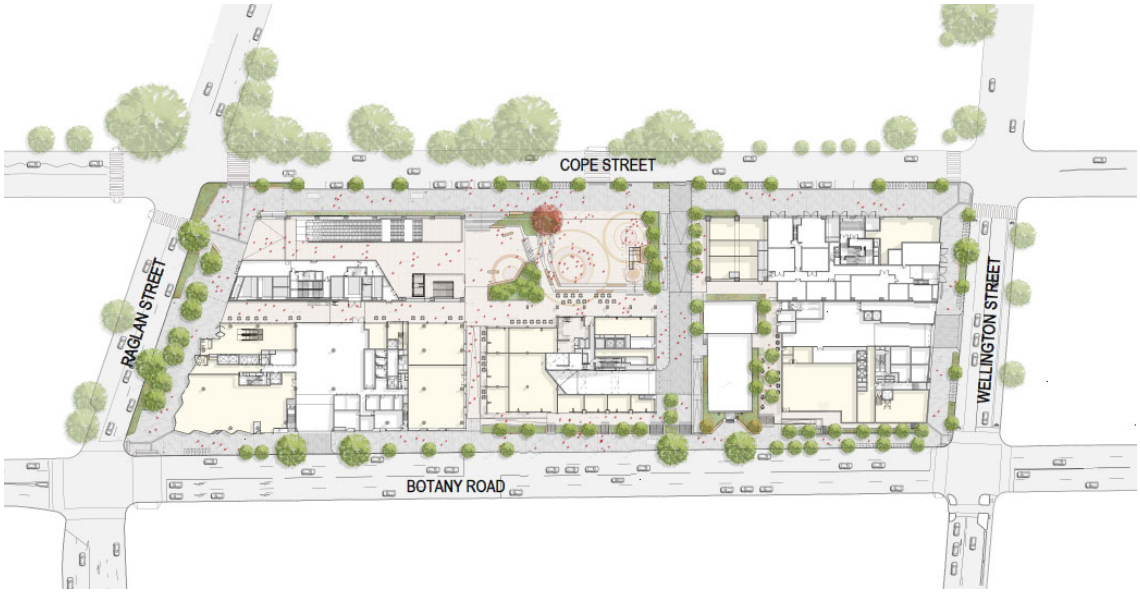

Figure 1 Location of the Waterloo ISD

1.3 Purpose

The Waterloo ISD annual noise and vibration monitoring report is a summary of all noise and vibration monitoring conducted over the 12 month period from commencement of Construction on 1st October 2022 to 30 September 2023.

The Construction Noise and Vibration Management Plan (Rev 4) (CNVMP) outlines the details of the monitoring program required by Condition of Approval (CoA) C10 and the frequency of reporting. The Construction Monitoring Program has been endorsed by the Acoustics Advisor and approved by the Secretary in accordance with CoA 13.

CoA C16 requires the results of the monitoring program to be provided to the Secretary for information at the frequency identified in the program. The approved monitoring program states the details of noise and vibration monitoring will be reported to Sydney Metro on an annual basis. The consolidated noise and vibration monitoring report will be submitted for information to the Secretary by Sydney Metro and relevant regulatory agencies and Council by Waterloo ISD.

Details of the compliance requirements are included in Table 1-1.

Table 1-1 Conditions of Approval relating to the Construction Monitoring Program

Condition	Requirement	Reference
C9	The following Construction Monitoring Programs must be prepared in consultation with the relevant government agencies identified for each Construction Monitoring Program to compare actual performance of construction of the CSSI against predicted performance. – Required Construction Monitoring Programs Relevant government agencies to be consulted for each Construction Monitoring Program – Noise and Vibration - EPA and Relevant Council(s) Blasting - EPA and Relevant Council(s) – Water Quality - EPA and Relevant Council(s) – Groundwater - DPI Water/NRAR	Noise and Vibration – refer to the Construction Noise and Vibration Management Plan Blasting – Not applicable Water Quality – Not applicable Groundwater - Not applicable
C16	The results of the Construction Monitoring Programs must be submitted to the Secretary for information, and relevant regulatory agencies, for information in the form of a Construction Monitoring Report at the frequency identified in the relevant Construction Monitoring Program	The results of the Construction Noise and Vibration Monitoring Program are discussed in Section 4. In accordance with CoA C16, this report will be submitted to the following agencies for information: – Department of Planning Industry and Environment – NSW Environment Protection Authority – City of Sydney Council

The Independent Acoustic Advisor will be provided with the report for endorsement prior to submission by Sydney Metro to the Secretary and submission to the relevant regulatory agencies by Waterloo ISD.

2. Monitoring Program Criteria

2.1 Noise criteria

The three primary noise metrics used to describe construction noise emissions are:

- LA1(1minute) - The typical 'maximum noise level for an event', used in the assessment of potential sleep disturbance during night-time periods. Alternatively, assessment may be conducted using the LAmax or maximum noise level.
- LAeq(15minute) - The "energy average noise level" evaluated over a 15-minute period. This parameter is used to assess the potential construction noise impacts.
- LA90 - The "background noise level" or "Rating Background Level" (RBL) in the absence of construction activities. This parameter represents the average minimum noise level during the daytime, evening and night-time periods respectively. The LAeq(15minute) construction noise management levels are based on the RBLs.
- The subscript "A" indicates that the noise levels are filtered to match normal hearing characteristics (A weighted).

The NSW EPA Interim Construction Noise Guideline (ICNG) requires project specific Noise Management Levels (NMLs) to be established for noise affected receivers. A site-specific Construction Noise and Vibration Impact Statement (CNVIS) (Rev 04) has been prepared in accordance with CoA E33 which predicts noise impacts to nearby sensitive receivers. In the event construction noise levels are predicted to be above the NMLs, all feasible and reasonable work practices are investigated to minimise noise emissions.

Having investigated all feasible and reasonable work practices, if construction noise levels are still predicted to exceed the NMLs then the potential noise impacts would be managed as per Section 12 of the CNVMP (Rev 4).

Site specific residential construction NMLs for Waterloo ISD have been nominated in the Sydney Metro Chatswood to Sydenham EIS Technical Paper 2: *Noise and Vibration* (EIS NIA, SLR Consulting Report 610.14718R8 dated 28 April 2016). These NMLs have been reproduced in Table 2-1.

Table 2-1 Residential Construction Noise Management Levels

Receiver Types	LAeq(15minute) Construction NMLs (dBA)			
	Daytime[1]	Daytime OOH[2]	Evening[3]	Night-time[4]
Residential[5]	64	59	52	44

Note 1: The Daytime period includes Monday to Friday 7.00 am to 6.00 pm and Saturdays 8.00 am to 6.00 pm, except for Public Holidays.

Note 2: The Daytime Out of Hours period includes Saturdays 7.00 am to 8.00 am, and Sundays and Public Holidays 7.00 am to 6.00 pm

Note 3: The Evening period includes 6.00 pm to 10.00 pm.

Note 4: The Night-time period includes 10.00 pm to 7.00 am.

Note 5: The EIS NIA determined the NML from noise logging conducted at Monitoring Location B.06 (122 Wellington Street, Waterloo) between 31 August and 14 September 2015. The EIS NIA adopted the NML from B.06 for both Waterloo Noise Catchment Areas (NCAs), NCA29 and NCA31.

The Project specific $L_{Aeq(15minute)}$ NMLs for non-residential noise sensitive receivers from the ICNG are provided in Table 2-2.

Table 2-2 Non-Residential Sensitive Receivers Noise Management Levels

Land Use	Area	NML $L_{Aeq(15minute)}$ Noise Levels	
		External	Internal
Hotel[1]	Bars and Lounges	70 dBA	50[2,3] (Daytime & Evening)
	Sleeping Areas: - Hotels near major roads	As per Table 6 for residential[4]	40[4] (Night-time)
Café[1]	Coffee bar	70 dBA[3]	50[2,3] (when in use)
Bar/Restaurant[1]	Bars and Lounges / Restaurant	70 dBA[3]	50[2,3](when in use)
Library[1]	Reading Areas	70 dBA	45[5](when in use)
Recording Studio[1]	Music Recording Studios	70 dBA	25[6](when in use)
Theatre/ Auditorium[1]	Drama Theatres	70 dBA	30[6](when in use)
Childcare Centres	Internal Play Area	65 dBA	55 dBA
	Sleeping Area	50 dBA (when in use)	40 dBA (when in use)
Classrooms at schools and other education institutions		55 dBA	45 dBA[7] (when in use)
Hospital wards and operating theatres		70 dBA	45 dBA
Places of Worship		70 dBA	45 dBA
Active recreation areas[8]		65 dBA	-
Passive recreation areas[9]		60 dBA	-
Community centres		Depends on the intended use of the centre. Refer to the recommended upper internal design sound levels in AS 2107 for specific uses.	
Commercial premises[10]	offices, retail outlets and small commercial premises	70 dBA (when in use)	45 dBA (when in use)
Industrial premises[10]		75 dBA (when in use)	-

Note 1: Design noise levels specified in AS 2107 internal noise levels.

Note 2: Where no external seating has been identified, fixed window glazing and air conditioning is assumed to mitigate high existing ambient noise levels and/or control internal noise break-out. A minimum outside-to-inside attenuation of 20 dB is assumed. The internal ICNG noise goal then corresponds to a façade level of 70 dBA.

Note 3: Where an open frontage or outdoor seating area has been identified, the external noise goal is taken as 60 dBA.

Note 4: Hotels (sleeping areas during the night-time) are assumed to have incorporated acoustic façade design in order to mitigate high existing ambient noise levels (refer to CNVMP Section 9.7) to achieve the internal design noise level of 40 dBA specified in AS 2107. Notwithstanding, the more conservative external NML corresponding to residential receivers (refer to CNVMP Table 6) has been applied to the sleeping areas of hotels.

Note 5: These receivers are typically well insulated from external noise break-in.

Note 6: These receivers are typically well insulated from external noise break-in, with significant acoustic mitigation included in the façade design.

Note 7: Assumed based on external noise levels being 10 dB higher than internal noise levels when windows are open.

Note 8: Characterised by sporting activities and activities which generate their own noise or focus for participants, making them less sensitive to external noise intrusion.

Note 9: Characterised by contemplative activities that generate little noise and where benefits are compromised by external noise intrusion (eg reading and meditation).

Note 10: Assess at the most affected occupied point on the premises.

2.2 Vibration Criteria

Vibration and its associated effects on people are usually classified as continuous, impulsive or intermittent as follows:

- Continuous vibration: machinery, steady road traffic, continuous construction activity such as underground drilling
- Impulsive vibration: infrequent activities that create up to three distinct vibration events in an assessment period, e.g. occasional dropping of heavy equipment, occasional loading and unloading
- Intermittent vibration: trains, nearby intermittent demolition activity, rock breakers and jack hammers.

Structural vibration in buildings can be detected by the occupants possibly affecting them in various ways including reducing working efficiency and quality of life. Complaint levels from occupants of the buildings subject to vibration depend on the use of the building and the time of day.

Based on the information contained in the CNVIS (Rev 04) and EIS, site specific vibration control criteria haven been nominated and are reproduced in Table 2-3.

Table 2-3 Nominated Site Vibration Control Criteria

Building type	Included Buildings	Site Control Criteria[1]	
		Operator warning level	Operator halt level
Reinforced frame structure	All surrounding commercial	20 mm/s PPV	25 mm/s PPV
Unreinforced or light framed structures	All surrounding Residential	5 mm/s PPV	7.5 mm/s PPV
Heritage (structurally sound)	Congregational Church	5 mm/s PPV	7.5 mm/s PPV
Buried Utilities	All	20 mm/s PPV	25 mm/s PPV
Human Response[2]	All	0.2 $m/s^{1.75}$ VDV	0.4 $m/s^{1.75}$ VDV
Vibration Sensitive Equipment[3]	Medical Centre, Hospital	0.013 mm/s PPV	0.018 mm/s PPV

Note 1: An exceedance of the operator warning level does not require activities to cease, but will alert the Project Manager and Foreman to proceed with caution at a reduced force or load.

Note 2: Based on information presented in DECCW's Assessing Vibration: a technical guideline.

Note 3: Based on the Generic Vibration Criteria for Vibration-Sensitive Equipment (SPIE 1991).

3. Methodology

The Construction Noise and Vibration Monitoring Program is designed to compare actual performance of construction of the CSSI against predicted performance and to assess the effectiveness of the mitigation measures applied during construction of the Project. The program has been executed in accordance with Section 13 of the CNVMP (Rev 04). The Construction Monitoring Program commenced 1 October 2020 at Construction commencement and will continue for the duration of the project.

3.1 Construction Activities

An indicative schedule of work is provided in Table 3-1. Note demolition work has been completed by the Sydney Metro TSE Contractor. No building demolition or blasting works have been identified as part of the Waterloo ISD project.

Table 3-1: Indicative schedule of construction phases for Waterloo ISD

Works	Description	Time
Station Works	The works for the new underground metro station include: • Detailed excavation and drilling required for sumps, track slab-invert, onsite detention tanks, drainage, services and foundations to support the structural works; • Waterproofing of the station box; • All primary and secondary structural works including for the entire station box, entrances, all services, utilities, systems, fit out elements, concourses, station platforms, over-track exhaust plenums and vertical transport; • Track invert slab including underline crossings, earthing mats and drainage; • Plant and equipment rooms; • Public and staff toilets; • All back of house areas; • Architectural fit-out; • Low-voltage electrical, fire, hydraulics, lighting and mechanical systems; • Building management control system; • Provisions for works by Interface Contractors; • Provisions for advertising and vending machines; • Lifts and escalators; • Signage and wayfinding; • External façade to the MQD Transfer Level including over street awnings; • Landscaping, kerbs and precinct activation works; • Bicycle parking facilities; • Public art (within the Station Lot); • Security measures.	October 2020 – early 2024
Local Area Works	Resurfacing or reconstruction of affected roads, footpaths, cycle ways or other public amenities, and signage, traffic control signals, street lighting, flood mitigation and traffic and transport management.	October 2020 – March 2024
Utility Service Works	Identification, protection, diversion, reconstruction or repair of affected utility	August 2021 – March 2024

Works	Description	Time
	services, new utility service connections and other general provisions.	
Property Works	Protection and adjustments to affected existing buildings and property.	2022
Retail Works	The works for the base build of the retail spaces in Waterloo Station and the station precinct, but excludes the retail spaces in the MQD Lot, including: - Shell of the retail space tenancy units (including storage areas); - Base building services including LV power, cold water supply, chilled water loops (for air conditioning), fire systems, sewage facilities; - Grease traps and ventilation exhausts (where appropriate); - Waste collection facility for the retail areas; - Telephone and data systems; - Glazed shopfront finishes.	Late 2023
MQD Enabling Works	The works to be performed for the areas of the MQD which are located within the footprint of the station box and below the MQD Transfer Level which are required for the integration of the MQD Works with the Station Works and to enable further construction of the MQD Works without disruption to the operating station. The MQD Enabling Works include: - Foundations and structures to support the MQD; and - Egress and any other Building Code of Australia compliance required to support the MQD Works.	Jan 2022 – late 2023

3.2 Sensitive Receivers

The Waterloo ISD Construction Noise and Vibration Impact Statement (CNVIS) (Rev 04) assessed the sensitive receivers potentially affected by construction noise. The receiver locations representing noise and vibration are shown in Figure 2 and Figure 3 .

In accordance with CoA E33, ongoing consultation with sensitive receivers is undertaken as the project progresses based on the scenarios identified in the CNVIS (Rev 04). The scenarios are reviewed and refined with the input of construction detail to determine the potential impact and appropriate mitigation. Consultation with potentially affected receivers is undertaken prior to the start of the relevant portion of works. Additional mitigation measures are then tailored based on the consultation feedback.

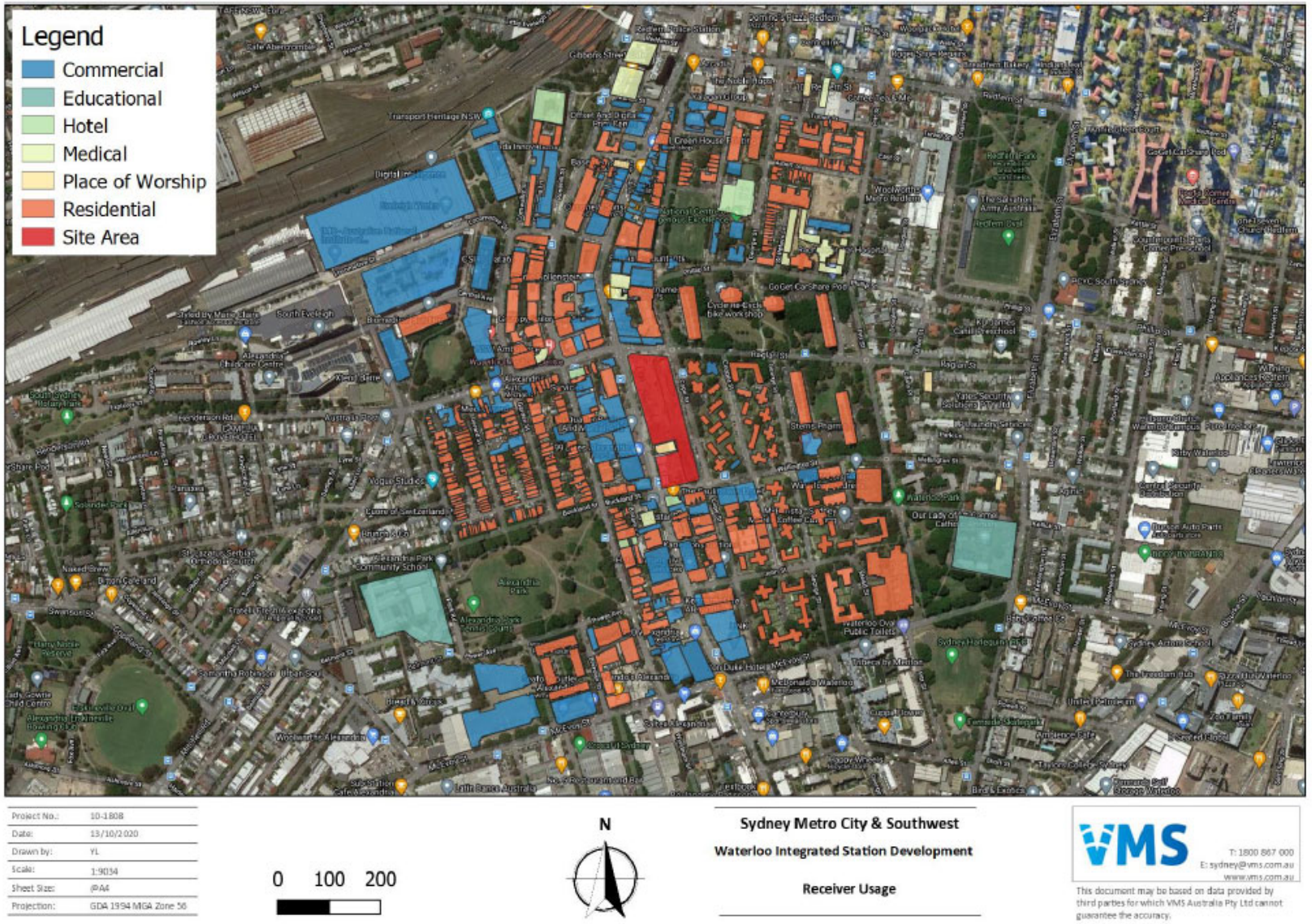

Figure 2 Noise Sensitive Receivers

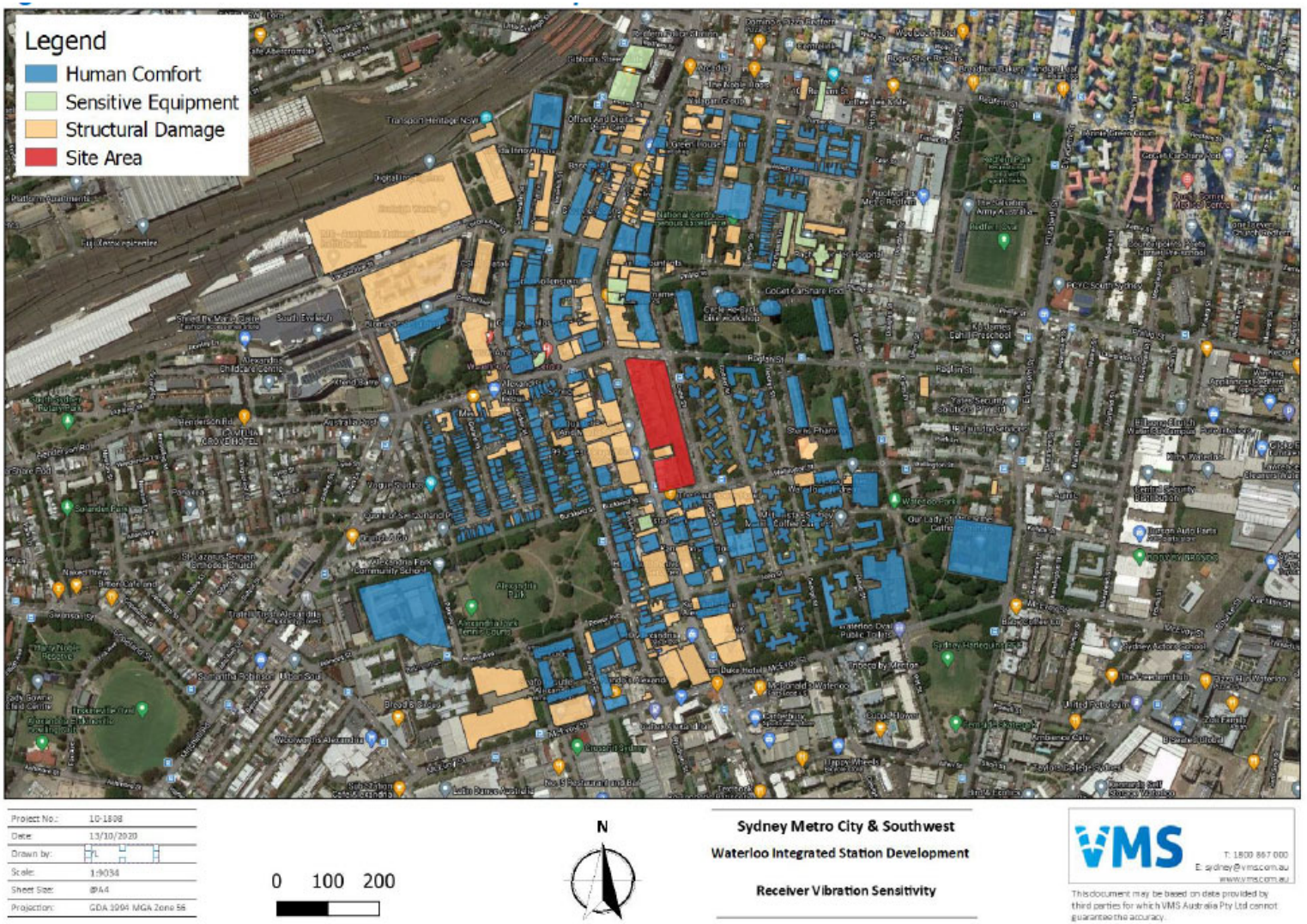

Figure 3 Vibration Sensitive Receivers

3.3 Monitoring

3.3.1 Attended noise monitoring

Noise monitoring has been undertaken by a suitably qualified person in accordance with the CNVMP (Rev 04). Attended measurements were undertaken from the commencement of each stage of construction in order to confirm that the noise and vibration levels in the adjacent community are consistent with the predictions in the CNVIS (Rev 04). Attended noise measurements would be repeated to ensure ongoing compliance.

The following key locations were identified in the CNVMP (Rev 04):

- Waterloo Congregational Church (noise and vibration)
- 104 Cope Street (noise)
- 219 Cope Street (noise)

Additional locations were monitored for noise impacts as the activities changed during the reporting period, this included noise monitoring outside 122-136 Wellington Street.

3.3.2 Unattended noise monitoring

Real time (unattended) noise or vibration monitoring will be undertaken to satisfy Project Planning Approval Condition C11. Real time monitoring will be deployed to manage impacts from ‘high risk’ activities, where the CNVIS predictions identify there is a high risk of annoyance from construction. The real-time noise monitors will be installed prior to commencement of the high risk activity. The monitor will be installed by an appropriately trained person in the measurement and assessment of construction noise and vibration, who is familiar with the requirements of the relevant standards and procedures. The real-time monitoring data will be available to Waterloo ISD, Sydney Metro, ER, AA, DPIE and EPA via a web based portal. Note no “high risk” activities were identified or conducted during the reporting period.

3.3.3 Noise monitoring parameters

Noise monitoring will be recorded over 15 minute sample intervals. Every 15 minutes, the data is to be processed statistically and stored in memory. The minimum noise metrics to be stored in memory and reported are the following A-weighted noise levels: L90, Leq and Lmax.

3.3.4 Vibration monitoring

Vibration monitoring was completed at the Congregational Church which is located adjacent to the construction site. A continuous vibration monitor was installed inside the church which records vibration. The monitor has been set up to provide an alert via SMS at trigger levels corresponding to “Warning Level” and “Halt Level”.

In response to vibration complaints additional monitoring may be undertaken to investigate and assess the extent and source of vibration exceedances and to apply mitigation measures preventing the complaint from reoccurring.

3.3.5 Attended Vibration Monitoring

During the reporting period, VMS were engaged to undertake attended vibration monitoring at the south-east corner of the Congregational Church during capping beam removal works. Attended monitoring was undertaken to quantify the site vibration emissions from the 5t excavator hammer operation and to assess against the nominated vibration criteria.

Refer to **Appendix B – Attended Vibration Monitoring Report**.

3.3.5 Vibration monitoring parameters

Vibration measurements will be undertaken in accordance with the procedures documented in the *OEH's Assessing Vibration - a technical guideline (2006), AS 2107.2 2006 Explosives – Storage and Use* and *DIN 4150:Part 3-1999 Structural Vibration - Effects of Vibration on Structures.*

Vibration monitoring will be recorded over a minimum 15 minute sample interval. For every sample, the data is to be processed statistically and stored in memory. The minimum vibration metrics to be stored in memory and reported are the following vibration levels: *Vibration Dose Value VDV, RMS, Peak Particle Velocity (PPV) and Frequency (Hz).*

If ongoing/continuous vibration monitoring is required, peak vibration levels are recorded and trigger an audible/visual alarm and/or SMS Alert corresponding to both "Operator Warning Level" and "Operator Halt Level" set according to nominated site vibration criteria levels presented in Table 2-3.

4. Results

The noise and vibration monitoring program includes details of the frequency of monitoring required to manage and control impacts associated with the construction activities. Refer to Section 13 Table 22 of the CNVMP (Rev 04).

Attended noise measurements will be undertaken within a period of 14 days from the commencement of each stage of construction in order to confirm that the noise and vibration levels in the adjacent community are consistent with the predictions in the CNVIS. Attended noise measurements would be repeated at a minimum interval of every month in order to ensure ongoing compliance.

The following are representative monitoring locations:

- Waterloo Congregational Church (noise and vibration)
- 104 Cope Street (noise)
- 219 Cope Street (noise)

Note, alternate monitoring locations were selected based on the location of work relative to sensitive receivers, e.g. 122 - 136 Wellington Street, Waterloo.

The results of the monitoring are communicated to relevant personnel when the noise or vibration goal is being approached so that work methodology or equipment being used can be altered, and / or additional management measures may be implemented where reasonable and feasible.

The CNVMP (Rev 04) requires real time noise monitoring to be deployed to manage impacts from 'high risk' activities, where the CNVIS predictions identify there is a high risk of annoyance from construction. During the reporting period, 'high risk' activities have not been identified.

4.1 Summary of activities

A summary of activities, including out of hours works, is provided in Table 4-1. The monitoring schedule is detailed in Table 4-2.

Table 4-1 Activities by Month

Month	Activity	Approved out of hours activities
October 2022	- Waterproofing Level 2 South - FRP and stripping works Level 2 - Paving on B5 - Blockwork to Service risers - Installation of permanent doors and monorail lifting devices - Stressing and grouting of tendons - Cable install - Cranage of materials using mobile/fixed cranes on surface - Deliveries	- Oversized deliveries - Concrete pour and finishing works - Crane usage for lifting within the station box (use of crane to install/move items safely and minimise number of workers within the lifting area - Station Fit out works - Utility investigative works

Month	Activity	Approved out of hours activities
November 2022	- Waterproofing works on North and South Structure Level 2 - FRP of Plaza area - Blockwork and fill across B3 and Level 1 - Capping Beam removal - Fit out of GRC panels on B3, Cladding on B5 - Deliveries - Services installation within the site	- Oversized deliveries - Concrete finishing works - Crane usage for lifting within the station box (use of crane to install/move items safely and minimise number of workers within the lifting area - Façade Installation - Station Fit out works - Utility investigative works - Watermain works on Wellington St and Botany Rd
December 2022	- FRP from surface to level 2 - Blockwork and fill across B3 and Level 1 - Services installation and fit out within the site - Capping Beam removal - Cranage of materials - Deliveries	- Oversized deliveries - Concrete finishing works - Crane usage for lifting within the station box (use of crane to install/move items safely and minimise number of workers within the lifting area - Façade Installation - Station Fit out works - Utility investigative works - Lighting Install along Botany Rd - Watermain works on Wellington St and Botany Rd
January 2023	- Redundant Cable removal Cope St - FRP Surface to Level 2 of North Structure - Blockwork and fill across B3 and Level 1 - Services installation and fit out within the site - Cranage of materials - Capping Beam removal - Demobilising Site Sheds - Deliveries	- Oversized deliveries - Concrete finishing works - Crane usage for lifting within the station box (use of crane to install/move items safely and minimise number of workers within the lifting area - Façade Installation - Station Fit out works - Utility investigative works - Lighting Install along Botany Rd - Watermain works on Botany Rd
February 2023	- FRP Surface to Level 2 of North Structure - Blockwork and fill across B2 and Level 1 - Services installation and fit out within the site - Cranage of materials - Capping Beam removal - Demobilising Site Sheds - Deliveries - Handover of Southern area to OSD team	- Oversized deliveries - Concrete finishing works - Crane usage for lifting within the station box (use of crane to install/move items safely and minimise number of workers within the lifting area - Façade Installation - Station Fit out works - Utility investigative works - Lighting Install along Botany Rd - Watermain works on Botany Rd

Month	Activity	Approved out of hours activities
March 2023	- FRP Surface to Level 2 of North Structure - Blockwork and fill across Surface – Level 2 - Services installation and fit out within the site - Electrical Cable Pulling - Cranage of materials - Capping Beam removal - Demobilising Site Sheds - Deliveries - Façade Installation - Civil works on Cope St	- Oversized deliveries - Concrete finishing works - Crane usage for lifting within the station box (use of crane to install/move items safely and minimise number of workers within the lifting area - Façade Installation - Station Fit out works - Utility investigative works - Lighting Install along Botany Rd - Watermain works on Botany Rd
April 2023	- Minor FRP to North Structure - Blockwork and fill across Surface – Level 2 - Services installation and fit out within the site - Lighting pole install on Botany Rd - Electrical Cable Pulling - Cranage of materials - Capping Beam removal - Demobilising Site Sheds - Deliveries - Façade Installation - Civil works on Cope St	- Oversized deliveries - Concrete finishing works - Crane usage for lifting within the station box (use of crane to install/move items safely and minimise number of workers within the lifting area - Façade Installation - Station Fit out works - Utility investigative works - Lighting Install along Botany Rd - Watermain works on Botany Rd
May 2023	- Minor FRP to North Structure - Blockwork and fill across Surface – Level 2 - Services installation and fit out within the site - Lighting pole install on Botany Rd - Electrical Cable Pulling - Cranage of materials - Capping Beam removal - Demobilising Site Sheds - Deliveries - Façade Installation - Civil works on Cope St	- Oversized deliveries - Concrete finishing works - Crane usage for lifting within the station box (use of crane to install/move items safely and minimise number of workers within the lifting area - Façade Installation - Station Fit out works - Utility investigative works - Ausgrid Outage for overhead removal and lighting install - Lighting Install along Botany Rd - Watermain works on Botany Rd
June 2023	- Minor FRP to North Structure - Blockwork and fill across Surface – Level 2 - Services installation and fit out within the site - Electrical Cable Pulling	- Oversized deliveries - Concrete finishing works - Crane usage for lifting within the station box (use of crane to install/move items safely and minimise number of workers within the lifting area

Month	Activity	Approved out of hours activities
	- Cranage of materials - Façade Installation - Capping Beam removal - Deliveries - Civil works on Cope St	- Façade Installation - Station Fit out works - Utility investigative works - Lighting Install along Botany Rd - Watermain works on Botany Rd
July 2023	- Minor FRP to North Structure - Blockwork and fill across Surface – Level 2 - Services installation and fit out within the site - Electrical Cable Pulling - Cranage of materials - Façade Installation - Capping Beam removal - Deliveries - Civil works on Cope St	- Oversized deliveries - Concrete finishing works - Crane usage for lifting within the station box (use of crane to install/move items safely and minimise number of workers within the lifting area - Façade Installation - Station Fit out works - Utility investigative works - Ausgrid Outage for removal of Kiosk on Raglan St - Lighting Install along Botany Rd - Watermain works on Botany Rd
August 2023	- Minor FRP to North Structure - Blockwork and fill across Surface – Level 2 - Services installation and fit out within the site - Electrical Cable Pulling - Cranage of materials - Façade Installation - Deliveries - Civil works on Cope St	- Oversized deliveries - Concrete finishing works - Crane usage for lifting within the station box (use of crane to install/move items safely and minimise number of workers within the lifting area - Façade Installation - Station Fit out works - Utility investigative works - Lighting Install along Botany Rd - Watermain works on Botany Rd
September 2023	- Minor FRP to North Structure - Services installation and fit out within the site - Cranage of materials - Façade Installation - Deliveries - Civil works on Cope St/Raglan St	- Oversized deliveries - Concrete finishing works - Crane usage for lifting within the station box (use of crane to install/move items safely and minimise number of workers within the lifting area - Façade Installation - Station Fit out works - Utility investigative works - Lighting Install along Botany Rd - Watermain works on Botany Rd

Table 4-2 Noise and Vibration Monitoring Schedule

	Monitoring Frequency		
Aspect	Continuous	Monthly (attended)	Other
Noise	In response to complaint / start of high-risk activity	X	Start of new works or OOHW or in response to a complaint
Vibration	X		If working within minimum working distances or in response to a complaint

4.2 Noise results

4.2.1 Attended noise monitoring

Noise monitoring was conducted to verify construction noise levels with Predicted Noise Level (PNL) outlined in the CNVIS and applicable OOHWA. During the reporting period a total of 58 events were conducted. Of these events, 20 monitored works during standard hours and 38 monitored out of hours works.

The construction noise level (LAeq 15min) was observed to be greater than the PNL for 8 events in total, with 7 of these events occurring out of hours. Generally, where the PNL was less than the actual noise during the monitoring event it was determined to be due to external factors such as traffic noise rather than specific construction activities.

A summary of noise monitoring results for the reporting period is outlined in **Table 4-3**.

4.2.2 Unattended real time noise monitoring

Unattended real time noise monitoring is only required at Waterloo ISD to manage impacts from ‘high risk’ activities, where the CNVIS predications identify there is a high risk of annoyance from construction.

During the reporting period no high risk activities were identified and therefore no real time noise monitoring was undertaken.

4.2.2 Plant and equipment monitoring

Plant and equipment monitoring is required to be completed in accordance with CNVMP (Rev 04). **Table** 4-3 **4-4** includes monitoring for the Concrete Agitator, Vacuum Truck, plate compactor and 5T Excavator. The monitoring was generally consistent with the sound pressure levels in the CNVMP (Rev 04). Obtaining the noise data is constrained due to the high number of activities also occurring at the same time in the same location.

Table 4-3: Noise monitoring results

Reporting Month	Reporting Quarter	Work Conducted by	OOHWA No.	Construction Activity	Date	Time	Location of Construction	Location of Monitoring	RBL	NML	PNL	LAeq	LAFmax	LAFmin	LAF90	Exceedance of RBL		Exceedance of NML		Exceedance of PNL		Exceedance construction related?	Onsite Observations	Offsite Observations
Oct-22	Q4 2022	John Holland	Day Work	Fit out B3	24/10/2022	12:50:00 PM	B3 South	130 Wellington St, Waterloo	54	64	63	**59.5**	76.2	48	52.9	Yes	5.5	No	-4.5	No	**-3.5**	No	Fit out of B3, Level 1 and 2 south structure works inaudible, EWP in use intermittently for 5 mins. In period of low to no traffic on wellington St and minimal traffic on Botany Rd, reading of 58dB was recorded for fit out works.	Truck and car traffic on wellington and Botany Rd most audible throughout monitoring. (58-62dB). Cars passing on Wellington St recorded ~62-65dB, Trucks passing on Wellington St recorded ~68dB.
Oct-22	Q4 2022	John Holland	Day Work	S12 General Crane Operations	27/10/2022	8:54:00 AM	Main site - Cope Street	213 Cope Street	54	64	75	**70**	79.8	64.8	68.1	Yes	16	Yes	6	No	**-5**	No	Operation of Yellow crane lifting on Cope St. Sitting idle with construction noise from South and north structure fit out works as dominant noise source. Reported a reading of 67dB	Intermittent pedestrian traffic
Oct-22	Q4 2022	John Holland	44	Utility Works	31/10/2022	9:30:00 PM	47 Botany Rd, Waterloo	62-72 Botany Rd, Alexandria	47	52	69	**67.6**	77.2	52.9	57.3	Yes	20.6	Yes	15.6	No	**-1.4**	No	Setting up works area on Botany Rd, works not audible	Traffic on Botany Rd consistent medium to light
Oct-22	Q4 2022	John Holland	44	Utility Works	31/10/2022	9:45:00 PM	47 Botany Rd, Waterloo	62-72 Botany Rd, Alexandria	47	52	69	**70.8**	95.3	58.7	63.4	Yes	23.8	Yes	18.8	Yes	**1.8**	No	Saw cut of concrete for 2mins, recorded at 73dB low traffic. Vac truck in use during low traffic period recoded at approximately 63-65dB. Vac truck with high traffic recorded at 70dB vac truck not main source of noise during this time.	Passing traffic more audible than works. Max reading of 95.3 attributed to passing fuel truck brakes screeching.
Oct-22	Q4 2022	John Holland	44	Utility Works	31/10/2022	10:00:00 PM	47 Botany Rd, Waterloo	62-72 Botany Rd, Alexandria	39	44	69	**71.5**	84.7	58.6	66	Yes	32.5	Yes	27.5	Yes	**2.5**	No	Saw cut of concrete for 2 mins recorded around 73dB, Vac truck in use for majority of recording period recorded at approximately 64dB with low to no traffic. Spot check of Raglan St (Res-4) during saw cutting, works inaudible noise recorded at 59dB	Passing traffic medium to low with intermittent bus and trucks passing.
Oct-22	Q4 2022	John Holland	Day Work	Utility Works	3/11/2022	12:25:00 PM	Wellington/Cope Intersection	136 Wellington St, Waterloo NSW 2017, Australia	54	64	75	**71.6**	87.6	63.1	67.3	Yes	17.6	Yes	7.6	No	**-3.4**	No	Vac truck on corner of Wellington & Cope St for watermain works. Internal fit out and scaffolding for Level 1 & 2 ongoing.	Passing cars and trucks on road, with intermittent pedestrian traffic.
Nov-22	Q4 2022	John Holland	45	S9 - Façade Works & Fit out	14/11/2022	6:00:00 PM	Main Site - Level 1 & 2 Wellington St	128 Wellington St, Waterloo NSW 2017	47	52	69	**59.8**	82.7	49.9	52.2	Yes	12.8	Yes	7.8	No	**-9.2**	No	Blockwork Level 1 and internal fit out of Mez area, Rattle gun use during internal fit out intermittent for 3 sec intervals measured at 63dB occurred for 30 sec total. Low to no construction work and low traffic for 50-52dB.	Traffic from botany Rd/Wellington St 55-60dB throughout majority of recording
Nov-22	Q4 2022	John Holland	45	S9 - Façade Works & Fit out	14/11/2022	6:15:00 PM	Main Site - Level 1 & 2 Wellington St	122 Wellington St, Waterloo NSW 2017	47	52	69	**59.7**	74	48.1	53	Yes	12.7	Yes	7.7	No	**-9.3**	No	Internal fit out works Mez and level 1 with blockwork. Saw cut metal/grinding recorded at 67dB on level 1 for 8 sec during recording. Crane on Cope St in operation for 5 mins not audible.	Passing traffic and pedestrians dominant noise source, 55-70dB with car revving engine 70dB,
Nov-22	Q4 2022	John Holland	45	S9 - Façade Works & Fit out	14/11/2022	6:30:00 PM	Main Site - Level 1 & 2 Wellington St	123 Wellington St	47	52	69	**59.3**	79.1	51.5	53.8	Yes	12.3	Yes	7.3	No	**-9.7**	No	Crane on Cope St in use throughout majority of recording 53-57 dB, blockwork level 1, internal fit out EWP in use recorded at 60dB for 2 mins	Passing traffic and pedestrians on Wellington/ Cope St most audible low traffic 55dB throughout majority of recording

Reporting Month	Reporting Quarter	Work Conducted by	OOHWA No.	Construction Activity	Date	Time	Location of Construction	Location of Monitoring	RBL	NML	PNL	LAeq	LAFmax	LAFmin	LAF90	Exceedance of RBL		Exceedance of NML		Exceedance of PNL		Exceedance construction related?	Onsite Observations	Offsite Observations
Nov-22	Q4 2022	John Holland	45	Concrete Finishing works	14/11/2022	9:45:00 PM	Main Site Level 2 North Structure	62-72 Botany Rd, Alexandria	47	52	61	**69.4**	83.8	50.2	57	Yes	22.4	Yes	17.4	Yes	**8.4**	No	Concrete finishing works/ scaffolding recorded at 60dB during periods of no traffic intermittent throughout recording. Alimac in operation with low traffic 62dB for 1 min during recording	Traffic on Botany Rd most audible and contributor to sound during recording period 72dB
Nov-22	Q4 2022	John Holland	45	S9 - Façade Works & Fit out	14/11/2022	10:05:00 PM	Main Site - Level 1 & 2 Wellington St	130 Wellington St	39	44	69	**56.5**	70.4	50.5	52.3	Yes	17.5	Yes	12.5	No	**-12.5**	No	Blockwork and internal fit out Mez area and scaffolding works intermittent recorded at 53-58dB throughout recording for approx. 8 mins. Traffic on Botany/Wellington St most audible throughout recording 55-64dB. No construction, low traffic measured at 53dB.	Traffic from botany Rd/wellington St 55-64dB throughout recording, main source of noise during recording
Nov-22	Q4 2022	John Holland	45	S9 - Façade Works & Fit out	14/11/2022	10:20:00 PM	Main Site - Level 1 & 2 Wellington St	122 Wellington St, Waterloo NSW 2017	39	44	69	**58.2**	74.1	51.1	52.5	Yes	19.2	Yes	14.2	No	**-10.8**	No	Blockwork and internal fit out Mez area and scaffolding works intermittent recorded at 53-58dB throughout recording for approx. 8 mins. Traffic on Botany/Wellington St most audible throughout recording 55-64dB. No construction, low traffic measured at 53dB.	Traffic from Botany Rd/Wellington St 55-64dB throughout recording, main source of noise during recording
Dec-22	Q4 2022	John Holland	Day Work	Utility Works	8/12/2022	1:00:00 PM	Cope St, South Compound	123 Wellington St	54	64	75	**75**	91.9	62	72	Yes	21	Yes	11	No	**0**	No	Vac truck works for excavating earthing pit	Minor pedestrian traffic with vehicle traffic of passing cars and motorcycles. LA Max attributed to passing motorcycle
Dec-22	Q4 2022	John Holland	Day Work	Utility Works	8/12/2022	2:30:00 PM	88 Botany Rd, Waterloo	62-72 Botany Rd, Alexandria	54	64	75	**69.2**	81.2	60.9	64.4	Yes	15.2	Yes	5.2	No	**-5.8**	No	Backfill and reinstate excavation on Botany Rd with plate compactor, in use for <1min. Plate compactor in use measured at 70dB with medium-low traffic. Traffic more audible	Traffic on Botany Rd most audible during recording.
Dec-22	Q4 2022	John Holland	Day Work	Level 1 & 2 Concrete Pours	16/12/2022	9:37:00 AM	Main Site Level 1 North Structure	62-72 Botany Rd, Alexandria	54	64	75	**70.4**	82.8	61.6	64.9	Yes	16.4	Yes	6.4	No	**-4.6**	No	Pump set up in Botany Rd Gate near North structure. Concrete pumping to level 1 blockwork. Slow rate of pour. Crane in use intermittently adjacent to concrete pump during monitoring, scaffolding works also occurring during monitoring period. Concrete pump with traffic idle and slight break 62dB	Medium traffic on Botany Rd most audible during recording period. Traffic moving with construction work recorded at 73dB. Traffic idle low cars with construction work 65dB. Traffic more audible that concrete construction works
Jan-23	Q1 2023	John Holland	Day Work	S9 - Façade Works & Fit out	11/01/2023	11:17:00 AM	Main Site - Level 1 & 2 Wellington St	128 Wellington St, Waterloo NSW 2017	54	64	75	**61.1**	78.6	51.7	54.6	Yes	7.1	No	-2.9	No	**-13.9**	No	Grinding and cutting of metal for fit out works for 5 seconds measured at 70dB. Scaffolding works south mez area and moving bins on Cope St, Low traffic with construction works measured at 55-60dB, with high traffic 67dB.	Traffic on Wellington St most audible with intermittent pedestrian noise. 65dB-78dB.
Jan-23	Q1 2023	John Holland	Day Work	S9 - Façade Works & Fit out	11/01/2023	11:33:00 AM	Main Site - Level 1 & 2 Wellington St	122 Wellington St	54	64	75	**60.2**	79.3	49.7	52.3	Yes	6.2	No	-3.8	No	**-14.8**	No	Grinding and cutting of metal for fit out works for 5 seconds measured at 70dB. Scaffolding works south mez area, Low traffic with construction works measured at 55-60dB, with high traffic 67dB.	Traffic on Wellington St most audible with intermittent pedestrian noise. 65dB-78dB.

Reporting Month	Reporting Quarter	Work Conducted by	OOHWA No.	Construction Activity	Date	Time	Location of Construction	Location of Monitoring	RBL	NML	PNL	LAeq	LAFmax	LAFmin	LAF90	Exceedance of RBL		Exceedance of NML		Exceedance of PNL		Exceedance construction related?	Onsite Observations	Offsite Observations
Feb-23	Q1 2023	John Holland	Day Work	S9 - Façade Works & Fit out	7/02/2023	12:55:00 PM	Main Site - Level 1 & 2 Wellington St	122 Wellington St	54	64	75	**64.4**	80.7	50	55.6	Yes	10.4	Yes	0.4	No	**-10.6**	No	Removal of loading deck south structure, scaffolding works,	intermittent pedestrian and traffic noise majority of noise contributed
Feb-23	Q1 2023	John Holland	Day Work	S9 - Façade Works & Fit out	28/02/2023	11:10:00 AM	Main Site Level 1 North Structure	62-72 Botany Rd, Alexandria	54	64	75	**77.5**	103.4	57.9	66.5	Yes	23.5	Yes	13.5	Yes	**2.5**	No	Removal of scaffold and core hole drilling north structure, OSD excavation works also contributing to noise levels however traffic was most audible throughout recording	consistent Medium to heavy traffic, sirens from ambulance passing 103.4 dB max reading. Traffic major contributor to noise levels
Mar-23	Q1 2023	John Holland	Day Work	Utility Works	2/03/2023	11:20:00 AM	Wellington St	136 Wellington St, Waterloo NSW 2017, Australia	54	64	75	**64.5**	84.6	59.9	61.5	Yes	10.5	Yes	0.5	No	**-10.5**	No	Removal of redundant watermain, excavator and tipper working,	intermittent traffic from botany Rd and wellington St throughout duration of monitoring
Mar-23	Q1 2023	John Holland	Day Work	S8 - Construction of Levels 1 & 2	7/03/2023	11:40:00 AM	Main Site Northwest Capping Beam	125-131 Raglan St, Waterloo	54	64	75	**67.6**	84.3	56.2	60.5	Yes	13.6	Yes	3.6	No	**-7.4**	No	Intermittent jack hammering northwest capping beam for approx. 5 mins (63dB), fit out works surface level	Consistent traffic on Raglan St with passing buses and pedestrians talking throughout recording
Mar-23	Q1 2023	John Holland	Day Work	Utility Works	7/03/2023	12:00:00 PM	Wellington St	136 Wellington St, Waterloo NSW 2017, Australia	54	64	75	**66.6**	79.9	60.9	63.1	Yes	12.6	Yes	2.6	No	**-8.4**	No	Compacting and loading of material from removal of redundant watermain on Wellington St footpath. Works recorded in traffic break at 63dB	Traffic on Botany Rd most audible over works, intermittent pedestrians and motorbikes passing
Mar-23	Q1 2023	John Holland	Day Work	S9 - Façade Works & Fit out	21/03/2023	5:10:00 AM	Main Site Level 1 South Structure	122 Wellington St, Waterloo NSW 2017	54	64	75	**62.1**	83.4	48.7	54.1	Yes	8.1	No	-1.9	No	**-12.9**	No	Duct work fit out on Level 1 south, grinder, Rattle gun and EWP intermittent use during recording, ~64dB, Crane on Cope St also working 60Db, Passing traffic more audible 65-70dB	Traffic on Botany Rd/Wellington St most audible over works, intermittent pedestrians and motorbikes passing
Mar-23	Q1 2023	John Holland	50	S9 - Façade Works & Fit out	21/03/2023	6:00:00 PM	Main Site Level 1 South Structure	126 Wellington Street, Waterloo NSW, 2017, Australia	47	52	69	**60**	79.1	46.9	52.7	Yes	13	Yes	8	Yes	**-9**	No	Duct work fit out on Level 1 south, grinder, Rattle gun and EWP intermittent use during recording, ~64dB, Crane on Cope St also working 60dB, Passing traffic more audible 65-70dB	Traffic on Botany Rd/Wellington St most audible over works, intermittent pedestrians and motorbikes passing
Mar-23	Q1 2023	John Holland	50	S9 - Façade Works & Fit out	21/03/2023	6:20:00 PM	Main Site Level 1 South Structure	130 Wellington St, Waterloo	47	52	69	**63.3**	84.7	48	53.3	Yes	16.3	Yes	11.3	Yes	**-5.7**	No	Duct work fit out on Level 1 south, grinder, Rattle gun and EWP intermittent use during recording, ~64dB, Crane on Cope St also working 60dB, Passing traffic more audible 65-70dB	Traffic on Botany Rd/Wellington St most audible over works, intermittent pedestrians and motorbikes passing
Mar-23	Q1 2023	John Holland	Day Work	Capping Beam Removal	24/03/2023	3:45:00 PM	Main site Southwest capping beam	130 Wellington St	54	64	75	**71.5**	85.2	59.5	62.4	Yes	17.5	Yes	7.5	No	**-3.5**	No	Hammering southwestern capping beam, (~70-72dB) intermittent use between moving concrete throughout recording, medium traffic throughout recording,	Medium traffic throughout recording
Mar-23	Q1 2023	John Holland	Day Work	Capping Beam Removal	31/03/2023	4:15:00 PM	Main site Southwest capping beam	136 Wellington St, Waterloo NSW 2017, Australia	54	64	75	**71.6**	87.3	57.4	62.7	Yes	17.6	Yes	7.6	No	**-3.4**	No	Hammering southwestern capping beam, (~70-72dB) intermittent use between moving concrete throughout recording, medium traffic throughout recording,	Medium traffic and pedestrians throughout recording
Apr-23	Q2 2023	John Holland	51	Utility works	20/04/2023	10:15:00 PM	47 Botany Rd, Waterloo	62-72 Botany Road	39	44	69	**67.6**	76.9	50.8	57.2	Yes	28.6	Yes	23.6	No	**-1.4**	No	Watermain investigation works Excavator with hammer for 5 sec during recording, hand tools and digging with excavator in use with bucket measured at 62-64dB for ~10 mins of recording	Medium-light traffic measured 68-75dB throughout recording, construction works not audible

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Apr-23	Q2 2023	John Holland	51	Utility works	20/04/2023	10:35:00 PM	47 Botany Rd, Waterloo	56-58 Botany Rd (Res-8)	39	44	65	**70**	83.7	55.3	64.5	Yes	31	Yes	26	Yes	**5**	No	Watermain investigation works vac truck in use measured at 65dB, consistent traffic at intersection throughout recording, traffic and pedestrians passing recorded at 65-70dB	medium consistent traffic throughout recording, measured at 65-70dB, trucks and buses passing
Apr-23	Q2 2023	John Holland	51	Utility works	20/04/2023	10:55:00 PM	47 Botany Rd, Waterloo	62-72 Botany Road	39	44	69	**69.5**	92.1	52.5	56.8	Yes	30.5	Yes	25.5	Yes	**0.5**	No	Watermain investigation works vac truck in use measured ~62dB-64dB, hand tools (drill) measured at 60-62dB	consistent traffic, revving cars and passing motorbikes throughout recording more audible than construction works.
May-23	Q2 2023	John Holland	51	Utility works	3/05/2023	7:55:00 PM	125-127 Raglan St, Waterloo	125-131 Raglan St, Waterloo	47	52	68	**64.8**	85.1	52.9	55.8	Yes	17.8	Yes	12.8	No	**-3.2**	No	Watermain Investigation works, excavating with excavator bucket and vac truck in use throughout recording. 64-66dB.	Pedestrians yelling and frequent cars passing throughout recording
May-23	Q2 2023	John Holland	51	Utility works	3/05/2023	8:20:00 PM	Wellington St	1-3 Buckland St	47	52	65	**60.9**	80.7	48.5	53	Yes	13.9	Yes	8.9	No	**-4.1**	No	Works on Wellington/botany Intersection investigation works, Excavator in asphalt used throughout recording ~60dB	Parked car running idle approx. 5m away from monitoring location ~57dB, pedestrians and cars along Botany Rd audible
May-23	Q2 2023	John Holland	53	S9 - Façade Works & Fit out	3/05/2023	8:45:00 PM	Main site Level 1 North Structure	62-72 Botany Rd, Alexandria	47	52	78	**68.4**	78.3	58.8	61.9	Yes	21.4	Yes	16.4	No	**-9.6**	No	Western façade of north structure install works, securing panels ~62dB no traffic.	Traffic throughout recording, 60-78dB
May-23	Q2 2023	John Holland	51	Utility works	3/05/2023	10:10:00 PM	125-127 Raglan St, Waterloo	47 Botany Rd	39	44	75	**67**	83.1	56.5	91.7	Yes	28	Yes	23	No	**-8**	No	Watermain investigation works, vac truck in use with hand tools.60-65dB in low traffic	Intermittent Medium-light traffic throughout recording
May-23	Q2 2023	John Holland	51	Utility works	3/05/2023	10:30:00 PM	Crn Wellington/Botany Rd	136 Wellington St, Waterloo NSW 2017, Australia	39	44	74	**64.9**	96.7	52.4	56	Yes	25.9	Yes	20.9	No	**-9.1**	No	Excavating works near watermain for investigation ~64dB, (10 mins of recording) 5 mins hand tools digging	low-no traffic throughout recording
May-23	Q2 2023	John Holland	51	Utility works	3/05/2023	10:45:00 PM	Crn Wellington/Botany Rd	1-3 Buckland St	39	44	65	**57.3**	75.8	45.2	49.7	Yes	18.3	Yes	13.3	No	**-7.7**	No	excavation and investigation work, hand tools and tracking excavator ~56dB	low traffic throughout recording, traffic on Botany Rd audible
May-23	Q2 2023	John Holland	53	S9 - Façade Works & Fit out	3/05/2023	11:00PM	Main site Level 1 North Structure	62-72 Botany Rd, Alexandria	39	44	78	**66.2**	76.8	48.3	56.2	Yes	27.2	Yes	22.2	No	**-11.8**	No	Western façade of north structure install works, securing panels ~62dB no traffic.	Low traffic throughout recording
May-23	Q2 2023	John Holland	49	Utility works	28/05/2023	11:38:00 PM	Crn Buckland St/ Botany Rd	1-3 Buckland St	39	44	65	**61.7**	83.5	57.2	58.9	Yes	22.7	Yes	17.7	No	**-3.3**	No	Working at the corner of Buckland and Botany Rd, using bucket truck. Bucket truck alarm throughout portion of recording (~64dB), removing overhead wires, truck idle dominant noise source	low traffic throughout recording, traffic on Botany Rd audible when cars pass
May-23	Q2 2023	John Holland	49	Utility works	28/05/2023	12:00:00 AM	Crn Buckland St/ Botany Rd	136 Wellington St, Waterloo NSW 2017, Australia	39	44	70	**63.6**	73.1	61.2	62.3	Yes	24.6	Yes	19.6	No	**-6.4**	No	Working on the corner of Wellington and Botany Rd, removing overhead wires, Bucket truck at intersection with 100kv generator dominant noise source throughout recoding. Rattle gun used intermittently for 2-5 seconds ~70dB)	low traffic throughout recording, traffic on Botany Rd audible when cars pass

Reporting Month	Reporting Quarter	Work Conducted by	OOHWA No.	Construction Activity	Date	Time	Location of Construction	Location of Monitoring	RBL	NML	PNL	LAeq	LAFmax	LAFmin	LAF90	Exceedance of RBL		Exceedance of NML		Exceedance of PNL		Exceedance construction related?	Onsite Observations	Offsite Observations
Jun-23	Q2 2023	John Holland	51	Utility works	15/06/2023	9:30:00 PM	Raglan St	125-131 Raglan St, Waterloo	47	52	68	**66.8**	79.9	46.8	51.5	Yes	19.8	Yes	14.8	No	**-1.2**	No	Saw cutting (~70dB for 5 mins). Use of excavator for surface removal (bucket, no hammering ~60-62 dB)	low traffic throughout recording, passing pedestrians and motorbike attributed to max reading.
Jun-23	Q2 2023	John Holland	51	Utility works	15/06/2023	10:00:00 PM	Raglan St	104 Raglan St	39	44	69	**61.3**	71.6	53.4	59.3	Yes	22.3	Yes	17.3	No	**-7.7**	No	Excavator in use with bucket attachment (~60dB) and hand tools	Passing traffic 65-68dB,
Jun-23	Q2 2023	John Holland	53	S9 - Façade Works & Fit out	30/06/2023	9:00:00 PM	Wellington St, Southern Facade	132 Wellington, Waterloo	39	44	75	**64.2**	77.8	54.9	57.2	Yes	25.2	Yes	20.2	No	**-10.8**	No	Installation of precast elements, façade, EWP working, Lighting towers consistent throughout monitoring. Hand tools in use intermittently.	Intermittent pedestrians walking past,
Jun-23	Q2 2023	John Holland	53	S9 - Façade Works & Fit out	30/06/2023	9:20:00 PM	Wellington St, Southern Facade	123 Wellington St	39	44	78	**59.2**	72.6	55.1	56.1	Yes	20.2	Yes	15.2	No	**-18.8**	No	Installation of precast elements, façade, EWP working, Lighting towers consistent throughout monitoring. Hand tools in use intermittently.	Intermittent pedestrians walking past,
Jun-23	Q2 2023	John Holland	53	S9 - Façade Works & Fit out	30/06/2023	10:00:00 PM	Cope St, Eastern Façade, North Structure	209 Cope St, Waterloo NSW 2017, Australia	39	44	78	**65.5**	78	61.2	62.8	Yes	26.5	Yes	21.5	No	**-12.5**	No	Installation of precast elements, façade, EWP working, Lighting towers consistent throughout monitoring. Hand tools in use intermittently.	Intermittent pedestrians walking past,
Jul-23	Q3	John Holland	Day Work	Capping Beam Removal	6/07/2023	12:45:00 PM	Capping Beam behind Church	136 Wellington St, Waterloo NSW 2017, Australia	54	64	75	**67.2**	78.2	58.9	60.9	Yes	13.2	Yes	3.2	No	**-7.8**	No	Jackhammering from capping beam removal not audible over other construction works or passing traffic	Medium -light traffic throughout recording
Jul-23	Q3	John Holland	Day Work	Capping Beam Removal	6/07/2023	1:00:00 PM	Capping Beam behind Church	213 Cope St, Waterloo	54	64	75	**62.5**	69.8	53.6	56.2	Yes	8.5	No	-1.5	No	**-12.5**	No	Jackhammering from capping beam removal not audible over other construction works on Cope St	Intermittent pedestrians walking past,
Jul-23	Q3	John Holland	Day Work	Capping Beam Removal	6/07/2023	1:20:00 PM	Capping Beam behind Church	62-72 Botany Rd, Alexandria	54	64	75	**70**	76.9	59.9	63.8	Yes	16	Yes	6	No	**-5**	No	Jackhammering from capping beam removal works not audible over passing traffic.	Medium traffic throughout recording
Jul-23	Q3	John Holland	51	Utility works	18/07/2023	9:45:00 PM	Raglan St	56-58 Botany Rd (Res-8)	39	44	75	**68.4**	82.9	60.1	63.7	Yes	29.4	Yes	24.4	No	**-6.6**	No	Raglan St watermain works, saw cutting 65-68dB, Vac truck in use with low traffic 64dB, Noise more audible from Redfern surf club music	Passing traffic ~67dB
Jul-23	Q3	John Holland	53	Utility works	18/07/2023	10:00:00 PM	Raglan St	125-131 Raglan St, Waterloo	39	44	68	**60.1**	67.6	54.8	56.7	Yes	21.1	Yes	16.1	No	**-7.9**	No	Raglan St watermain works, Vac truck in use with low traffic ~ 61dB, mostly inaudible	Low traffic intermittent during recording
Jul-23	Q3	John Holland	53	S9 - Façade Works & Fit out	18/07/2023	10:00:00 PM	Raglan St	125-131 Raglan St, Waterloo	39	44	78	**60.1**	67.6	54.8	56.7	Yes	21.1	Yes	16.1	No	**-17.9**	No	Façade works on Northeastern structure ~ 61dB, mostly inaudible	Low traffic intermittent during recording
Jul-23	Q3	John Holland	51	Utility works	18/07/2023	11:00:00 PM	Raglan St	47 Botany Rd	39	44	75	**65.9**	77.7	60.2	63	Yes	26.9	Yes	21.9	No	**-9.1**	No	Raglan St watermain works, Vac truck in use with low traffic 64dB, Noise from botany Rd traffic throughout recording	low traffic through recording

Reporting Month	Reporting Quarter	Work Conducted by	OOHWA No.	Construction Activity	Date	Time	Location of Construction	Location of Monitoring	RBL	NML	PNL	LAeq	LAFmax	LAFmin	LAF90	Exceedance of RBL		Exceedance of NML		Exceedance of PNL		Exceedance construction related?	Onsite Observations	Offsite Observations
Aug-23	Q3	John Holland	57	S9 - Façade Works & Fit out	10/08/2023	10:00:00 PM	Cope St, Eastern Façade, South Structure	130 Wellington St	39	44	78	**56.5**	76	48.4	51	Yes	17.5	Yes	12.5	No	**-21.5**	No	Installing façade on southeastern face of south structure. EWP in use ~58dB, passing cars ~60dB	low traffic throughout recording
Aug-23	Q3	John Holland	57	S9 - Façade Works & Fit out	10/08/2023	10:20:00 PM	Cope St, Eastern Façade, South Structure	123 Wellington St	39	44	75	**61.5**	76.6	54.3	59.6	Yes	22.5	Yes	17.5	No	**-13.5**	No	Installing façade on southeastern face of south structure. EWP ~64dB, hand tools and panel install ~67dB	low traffic throughout recording
Aug-23	Q3	John Holland	57	S9 - Façade Works & Fit out	10/08/2023	10:35:00 PM	Cope St, Eastern Façade, South Structure	213 Cope St, Waterloo	39	44	78	**62.5**	69.8	58.3	61	Yes	23.5	Yes	18.5	No	**-15.5**	No	Installing façade on southeastern face of south structure. EWP ~64dB, hand tools and panel install ~67dB	
Aug-23	Q3	John Holland	57	S9 - Façade Works & Fit out	10/08/2023	10:50:00 PM	Cope St, South and Eastern façade, North Structure	209 Cope St, Waterloo NSW 2017, Australia	39	44	78	**60.6**	70.4	56	56.8	Yes	21.6	Yes	16.6	No	**-17.4**	No	Installing façade on south face and eastern face of northern structure EWP in use 63-65dB. Lighting tower ~57dB throughout recording, hand tools and panel install ~67dB for 5 sec	
Aug-23	Q3	John Holland	57	S9 - Façade Works & Fit out	10/08/2023	11:05:00 PM	Cope St, South and Eastern façade, North Structure	104 Raglan St, Waterloo	39	44	65	**59.1**	77.7	45.8	51.3	Yes	20.1	Yes	15.1	No	**-5.9**	No	Installing façade on south face and eastern face of northern structure EWP in use 63-65dB. Lighting tower ~57dB throughout recording, hand tools and panel install ~67dB for 5 sec	Member of public screamed during recording contributed to max value
Aug-23	Q3	John Holland	57	S9 - Façade Works & Fit out	10/08/2023	11:15:00 PM	Cope St, North Structure	125-131 Raglan Street Waterloo NSW 2017	39	44	65	**59**	74.1	45.9	48.9	Yes	20	Yes	15	No	**-6**	No	Installing façade panels eastern face of north structure and internal fit out north structure ~54dB-58dB	Member of public screamed during recording contributed to max value, passing bus ~60dB
Sep-23	Q3 2023	John Holland	Day Work	S9 - Façade Works & Fit out	2023-09-12	10:30:00	Cope St, South and Eastern façade	128 Wellington St, Waterloo	54	64	75	**73.9**	99.8	53.1	57.2	Yes	19.9	Yes	9.9	No	**-1.1**	No	Installing façade on southeastern face of south structure. EWP ~64dB, hand tools and panel install ~67dB	Piling rig in use in Southern Precinct, bored piling ~67-80dB. Crawler Crane in operation, more audible than façade works

Table 4-4: Plant and equipment monitoring results (as per Section 13.5 of the CNVMP)

Standard or OOHW	Construction Activity	Date	Time	Construction location	Monitoring location	Maximum allowable construction plant sound levels - dBA		1-min SPL recorded	Exceedance of SPL at 7m		Construction activities	Comments/ observations during monitoring
						Sound Power Level	Sound Pressure Level (SPL) at 7m					
Standard	Tower Crane (electric)	27/10/2022	09:15:00 AM	Main Site – Electric Tower Crane	7m away from plant	105	80	64	No	-16	Electric Crane in operation lifting into station box. Works below PNL.	PNL of 80 dB sound pressure level at 7 meters taken from CNVIS 1-min sound pressure level measurement taken Sound Pressure Level below predicted
Standard	Plate Compactor	8/12/2023	2:28:00 PM	Main Site – Plate Compactor	7m away from plant	108	83	82	No	-1	Plate Compactor in use. Sound pressure level taken at 7m away from plant in use on Cope St..	1-min sound pressure level measurement taken Sound Pressure Level below predicted
Standard	Dry Vac Truck	21/06/2023	1:30:00 PM	Main Site – Dry Vac Truck	7m away from plant	110	85	78.3	No	-6.7	Dry Vac Truck in use. Sound pressure level taken at 7m away from plant in use on Cope St during excavation	1-min sound pressure level measurement taken Sound Pressure Level below predicted
Standard	Excavator (5T)	21/06/2023	1:35:00 PM	Main Site – Excavator	7m away from plant	100	75	64	No	-11	5T Excavator in use. Sound pressure level taken at 7m away from plant in use on Cope St during excavation	1-min sound pressure level measurement taken Sound Pressure Level below predicted

4.3 Vibration results

4.3.1 Attended Vibration Monitoring

Attended vibration monitoring was conducted at the beginning of capping beam removal works adjacent to the Congregational Church. Maximum reported vibration levels during the attended monitoring survey were reported to be 3.5mm/s which is compliant with the adopted operator warning level of 5mm/s and operator stop level of 7.5mm/s.

Attended vibration survey conducted at Waterloo ISD found that the vibration emissions generated by the 5t excavator hammering complied with the relevant Cosmetic damage vibration control criteria as nominated in Table 13 of the CNVMP (Rev 04) and would not cause structural damage to the existing Congregational Church structure. Based on these results works progressed with continuous vibration monitoring of the Congregational Church carried out.

4.3.2 Continuous Vibration Monitoring

Continuous vibration monitoring was conducted to verify construction vibration levels were not exceeding the nominated structural damage site vibration control criteria outlined in the CNVIS. During the reporting period vibration monitoring was conducted continuously at the Waterloo Congregational Church using Texcel Geophone (VM), serial number 7361.

A total of 1356 alerts were received, notifying that an event had occurred. Of these, 1349 were reported in the month of July. These alerts were reported to be exceedances of the operator warning level during capping beam removal works adjacent to the church, however no reported exceedances of the BS7385 Minimal Risk of Cosmetic Damage Level were reported. Capping beam removal methodology was reviewed and approved by both a structural engineer and Heritage consultant. Furthermore, the Congregational Church was inspected prior and post capping beam removal with no damage identified as a result of capping beam removal works. (Refer to **Appendix C**).

A summary of the peak monitoring results are provided in **Table 4-5** and the trigger events are outlined below:

Table 4-5: Continuous vibration monitoring results summary at Waterloo Congregational Church

	Highest recorded vibration (PPV)					Compliance CNVIS				
Monitoring month	Date & time of Event	vSum (mm/s)	X Peak (mm/s)	Y Peak (mm/s)	Z Peak (mm/s)	Operator warning (mm/s)	Operator halt (mm/s)	No. of Events above halt warning	Events above trigger as a result of construction	Comments
October 2022	17/10/2022 5:37	**1.02**	1	0.72	0.48	5	7.5	0	N/A	
November 2022	8/11/2022 10:23	**3.38**	0.86	3.21	0.73	5	7.5	0	N/A	
December 2022	1/12/202 7:08	**3.39**	3.37	0.39	0.59	5	7.5	0	N/A	
January 2023	8/01/2023 15:41	**1.23**	1.13	0.55	0.32	5	7.5	0	N/A	
February 2023	18/02/2023 11:34	**2.86**	2.75	0.61	0.7	5	7.5	0	N/A	
March 2023	27/02/2023 12:17	**50.28**	3.75	50.31	3.6	5	7.5	2	N/A	Adhesive for vibration monitor failed and monitor fell from wall. Not construction related. Second event related to moving monitor, not related to construction works
April 2023	3/04/2023 8:34	**3.76**	3.72	1.11	2.77	5	7.5	0	N/A	
May 2023	15/05/2023 12:16	**4.14**	4.13	1.11	0.7	5	7.5	0	N/A	
June 2023	19/06/2023 16:53	**26.05**	25.55	4.98	5.08	5	7.5	1	N/A	Monthly vibration validation monitoring, Exceedance related to testing notification system of monitor
July 2023	7/07/2023 12:57	**27.58**	23.2	15.15	4.25	5	7.5	1349	**Yes**	Monthly vibration validation monitoring. Of these exceedances 982 were reported below the operator halt level and 367 were reported above the operator halt level, however no reported exceedances of the BS7385 Minimal Risk of Cosmetic Damage Level*
August 2023	15/08/2023 8:32	**10.41**	10.18	4.63	2.3	5	7.5	4	**No**	Monthly vibration validation monitoring. Exceedance not related to ISD works. Reported compliant with cosmetic damage criteria.
September 2023	13/09/2023 16:06	**4.46**	4.04	1.79	3.48	5	7.5	0	**No**	

*- Refer to Appendix C for consultant advice on reported levels

5. Community Consultation

5.1 Management measures

Each month a project update which outlines the upcoming construction works was distributed to residents and businesses in the local area. Regular doorknocks and briefings and specific notifications were provided by the Waterloo Community Team to inform the stakeholders of proposed works and likely impacts.

Over the course of out of hours work that has been undertaken, the directly impacted community were provided with offers of respite vouchers and alternate accommodation when identified by the noise modelling to trigger this management measure. Works such as where high noise impacting construction activities were required to continue throughout the night period, for example, utility works requiring a road opening licence triggered these additional management measures to be implemented.

Prior to activities that would result in vibration, notifications were distributed to inform of the potential impacts, this included weekly and monthly notifications. (Refer to Appendix D)

5.2 Complaints summary

During the reporting period, a total of 28 complaints were received from the community related to noise and vibration, 5 complaints related to parking, worker behaviour and visual amenity. A breakdown of noise and vibration complaints are provided in Table 5-1.

- 28 complaints related to noise and vibration.
    - 10 complaints relating to noise and vibration during standard hours
    - 15 complaints related to noise and vibration during out of hours work
    - 3 complaints were unrelated to the project.
- 5 complaints related to parking, worker behaviour or visual amenity

All complaints were managed and reported to Sydney Metro as required by the Community Communication Strategy.

Table 5-1 Complaints breakdown

Month	Noise	Vibration	Monthly Total
October 2022	– 4*, 1#, 1^	– 0	– **6**
November 2022	– 1*, 1^	– 0	– **2**
December 2022	– 1#, 1^	– 0	– **2**
January 2023	– 0	– 0	– **0**
February 2023	– 0	– 0	– **0**
March 2023	– 1*, 4#	– 0	– **5**
April 2023	– 0	– 0	– **0**
May 2023	– 1#	– 0	– **1**
June 2023	– 3*, 3#	– 0	– **6**

Month	Noise	Vibration	Monthly Total
July 2023	– 2*	– 0	– **2**
August 2023	– 4*	– 0	– **4**
September 2023	– 0	– 0	– **0**
Total	– **28**	– **0**	– **28**

*Refers to OOHW complaint, # refers to standard hours, ^refers to nor related to the project

6. Conclusion

The requirements for the noise and vibration monitoring program are outlined in the CNVMP (Rev 4) Section 13. The program identified criteria, methodology and monitoring parameters. The program was endorsed by the Acoustic Advisor and approved in accordance with the Project Planning Condition C13.

A CNVIS (Rev 04) has been prepared for the project and outlines the predicted noise and vibration impacts as a result of construction works. Attended noise monitoring has been completed in accordance with the noise monitoring program to review actual noise levels with predicted noise. This data is used to determine if the noise management measures implemented are effective at minimising the impacts of construction on the surrounding community. The attended monitoring determined the exceedance of the PNL was generally due to external factors such as traffic on the surrounding streets rather than related to construction activities.

Plant and equipment monitoring was completed during the reporting period, refer to Table 4-4 for details.

Attended vibration monitoring was conducted at the beginning of capping beam removal works adjacent to the Congregational Church. Maximum reported vibration levels during the attended monitoring survey were reported to be 3.5mm/s which is compliant with the adopted operator warning level of 5mm/s and operator stop level of 7.5mm/s.

A continuous vibration monitor was installed in the Waterloo Congregational Church to measure any vibration impacts and to confirm compliance with the CNVIS (Rev 04). During the reporting period, a total of 1356 alerts were received, notifying that an event had occurred. Of these, 1349 were reported in the month of July. These alerts were reported to be exceedances of the operator warning level during capping beam removal works adjacent to the church, however no reported exceedances of the BS7385 Minimal Risk of Cosmetic Damage Level were reported.

Capping beam removal methodology was reviewed and approved by both a structural engineer and Heritage consultant. Furthermore, the Congregational Church was inspected prior and post capping beam removal with no damage identified as a result of capping beam removal works.

During the reporting period a total of 33 complaints were received, 5 of which were unrelated to noise and vibration. To manage the noise impacts during out of hours work, moulded ear plugs continued to be on offer by the Waterloo Community Team during the year. However, there was no new requests for ear moulds during the reporting period. Additionally, over the progress of out of hours work one receiver has been fitted with blackout blinds to help reduce the impact of noise.

Further mitigation measures offered as a result of out of hours work included, respite offers (e.g. vouchers) and alternative accommodation when triggered through the noise modelling process.

Appendix A – Calibration Certificates

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Sound Level Meter
IEC 61672-3:2013
Calibration Certificate

Calibration Number C22475

Client Details	Waterloo Integrated Station Development John Holland JV 84-88 Botany Road Waterloo NSW 2016
Equipment Tested/ Model Number :	Rion NL-42EX
Instrument Serial Number :	00409019
Microphone Serial Number :	185664
Pre-amplifier Serial Number :	90464

Pre-Test Atmospheric Conditions		**Post-Test Atmospheric Conditions**	
Ambient Temperature :	20.6°C	**Ambient Temperature :**	22.4°C
Relative Humidity :	43.2%	**Relative Humidity :**	39.7%
Barometric Pressure :	101.74kPa	**Barometric Pressure :**	101.72kPa

Calibration Technician : Lucky Jaiswal
Secondary Check: Shaheen Boaz
Calibration Date : 15 Jul 2022
Report Issue Date : 15 Jul 2022

Approved Signatory : Juan Aguero

Clause and Characteristic Tested	Result	Clause and Characteristic Tested	Result
12: Acoustical Sig. tests of a frequency weighting	*Pass*	17: Level linearity incl. the level range control	*N/A*
13: Electrical Sig. tests of frequency weightings	*Pass*	18: Toneburst response	*Pass*
14: Frequency and time weightings at 1 kHz	*Pass*	19: C Weighted Peak Sound Level	*Pass*
15: Long Term Stability	*Pass*	20: Overload Indication	*Pass*
16: Level linearity on the reference level range	*Pass*	21: High Level Stability	*Pass*

The sound level meter submitted for testing has successfully completed the class 2 periodic tests of IEC 61672-3:2013, for the environmental conditions under which the tests were performed.

However, no general statement or conclusion can be made about conformance of the sound level meter to the full requirements of IEC 61672-1:2013 because evidence was not publicly available, from an independent testing organisation responsible for pattern approvals, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2013 and because the periodic tests of IEC 61672-3:2013 cover only a limited subset of the specifications in IEC 61672-1:2013.

Uncertainties of Measurement -

Acoustic Tests		Environmental Conditions	
125Hz	*±0.13dB*	*Temperature*	*±0.1°C*
1kHz	*±0.13dB*	*Relative Humidity*	*±1.9%*
8kHz	*±0.14dB*	*Barometric Pressure*	*±0.014kPa*
Electrical Tests	*±0.13dB*		

All uncertainties are derived at the 95% confidence level with a coverage factor of 2.

This calibration certificate is to be read in conjunction with the calibration test report.

Acoustic Research Labs Pty Ltd is NATA Accredited Laboratory Number 14172.
Accredited for compliance with ISO/IEC 17025 - Calibration.

The results of the tests, calibrations and/or measurements included in this document are traceable to SI units.

NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration and inspection reports.

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Sound Level Meter
IEC 61672-3:2013
Calibration Test Report

Calibration Number C22475

Client Details Waterloo Integrated Station Development John Holland JV
84-88 Botany Road
Waterloo NSW 2016

Equipment Tested/ Model Number : Rion NL-42EX
Instrument Serial Number : 00409019
Microphone Serial Number : 185664
Pre-amplifier Serial Number : 90464

Pre-Test Atmospheric Conditions		Post-Test Atmospheric Conditions	
Ambient Temperature :	20.6°C	**Ambient Temperature :**	22.4°C
Relative Humidity :	43.2%	**Relative Humidity :**	39.7%
Barometric Pressure :	101.74kPa	**Barometric Pressure :**	101.72kPa

Calibration Technician : Lucky Jaiswal
Calibration Date : 15 Jul 2022
Secondary Check: Shaheen Boaz
Report Issue Date : 15 Jul 2022

Approved Signatory :  Juan Aguero

Clause and Characteristic Tested	Result	Clause and Characteristic Tested	Result
12: Acoustical Sig. tests of a frequency weighting	*Pass*	17: Level linearity incl. the level range control	*N/A*
13: Electrical Sig. tests of frequency weightings	*Pass*	18: Toneburst response	*Pass*
14: Frequency and time weightings at 1 kHz	*Pass*	19: C Weighted Peak Sound Level	*Pass*
15: Long Term Stability	*Pass*	20: Overload Indication	*Pass*
16: Level linearity on the reference level range	*Pass*	21: High Level Stability	*Pass*

The sound level meter submitted for testing has successfully completed the class 2 periodic tests of IEC 61672-3:2013, for the environmental conditions under which the tests were performed.

However, no general statement or conclusion can be made about conformance of the sound level meter to the full requirements of IEC 61672-1:2013 because evidence was not publicly available, from an independent testing organisation responsible for pattern approvals, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2013 and because the periodic tests of IEC 61672-3:2013 cover only a limited subset of the specifications in IEC 61672-1:2013.

Uncertainties of Measurement -

Acoustic Tests		Environmental Conditions	
125Hz	*±0.13dB*	*Temperature*	*±0.1°C*
1kHz	*±0.13dB*	*Relative Humidity*	*±1.9%*
8kHz	*±0.14dB*	*Barometric Pressure*	*±0.014 kPa*
Electrical Tests	*±0.13dB*		

All uncertainties are derived at the 95% confidence level with a coverage factor of 2.

1. OVERVIEW

This report presents the calibration test results of a Rion NL-42EX Sound Level Meter, and associated equipment. Calibration is carried out in accordance with *IEC 61672-3.2013, Electroacoustics - Sound Level Meters - Part 3: Periodic Tests*.

Relevant clauses from this standard have been used for periodic testing in conjunction with Acoustic Research Labs internal test methods described in Section 2 of the calibration work instruction manual.

1.1 UNCERTAINTIES

For each test performed, the associated measurement uncertainties are derived at the 95% confidence level and are given with a coverage factor of 2.

The uncertainty applies at the time of measurement only, and takes no account of any drift or other effects that may apply afterwards. When estimating uncertainty at any later time, other relevant information should also be considered, including, where possible, the history of the performance of the instrument and the manufacturer's specifications.

1.2 DOCUMENT CONVENTIONS

Test results which highlight non-conformances relative to the standard, and the sound level meter type specified by the manufacturer have been marked with an **F** in the respective tests.

Any tests that are not required, due to sound level meter configuration, are marked N/A.

2. GENERAL

2.1 ENVIRONMENTAL CONDITIONS DURING TEST

No corrections have been applied to any results obtained to compensate for the environmental conditions.

2.2 CALIBRATION TESTS

Where applicable the following tests were performed in accordance with the requirements of *IEC 61672-3.2013*. These clauses are used to define the periodic testing of Sound Level Meters.

Clause 10	Indication at the Calibration Check Frequency
Clause 11	Self Generated Noise
Clause 12	Acoustical Signal Tests of Frequency Weighting
Clause 13	Electrical Signal Tests of Frequency Weightings
Clause 14	Frequency and Time Weightings at 1kHz
Clause 15	Long Term Stability
Clause 16	Level Linearity on the Reference Level Range
Clause 17	Level Linearity including the level range control
Clause 18	Toneburst Response
Clause 19	Peak C Sound Level
Clause 20	Overload Indication
Clause 21	High Level Stability

2.3 TEST EQUIPMENT USED

All test equipment used during periodic testing are calibrated every 12months by an accredited laboratory, traceable to SI units.

The performance of all equipment during these calibrations and the effects of instrument stability are used to determine the measurement uncertainty of each reported result.

2.3.1 Multi-function Acoustic Calibrator

A Bruel & Kjaer 4226 Multi-function calibrator (S/N - 2985012) was used for frequency response testing of the entire instrument (including microphone). This instrument was used as a reference calibrator and for frequency response verification.

2.3.2 Microphone Electrical Equivalent Circuit

Calibration of most instrument parameters is carried out using electrical signals fed to the unit via a two-port electrical equivalent circuit of the microphone.

A 19pF capacitance dummy microphone was used during testing.

2.3.3 Adjustable Attenuator

A means for varying the attenuation of electrical signals via the dummy microphone was provided by a JFW Industries dual rotary attenuator (S/N - 792819 2132). The attenuator is switchable in 1dB steps between 0dB and 60dB.

2.3.4 Arbitrary Function Generator

A Hewlett Packard 33120A (S/N - US36047448) was used to generate the required electrical signals.

2.3.5 Environmental Monitoring

A MHB-382SD (S/N – AH.88227) was used for measuring environmental conditions during device calibration. It is capable of providing temperature, relative humidity and pressure measurements.

3. CALIBRATION TEST RESULTS

3.1 INDICATION AT THE CALIBRATION CHECK FREQUENCY

The indication of the sound level meter at the calibration check frequency was checked by application of an acoustic signal at the reference sound pressure level and frequency.

Stated reference conditions as found in manual are

Reference Level : 94.0 dB

Reference Frequency : 1000.0 Hz

Indications before and after adjustments were recorded and are shown in Table 1 (all measurements in dB) -

Table 1 - Check Frequency Calibration Results

Frequency Weighting	Initial Response	B&K 4226 Corrected	FreeField Corrected	Final Corrected Response
A	93.90	94.10	94.00	94.02
C	93.90	94.10	94.00	94.02
Z	93.90	94.10	94.00	94.02

Free field adjustment data as provided by the manufacturer. Windscreen correction factors applied.

3.2 SELF GENERATED NOISE

3.2.1 Microphone Installed

Self generated noise was measured with the microphone installed on the sound level meter, in the configuration submitted for periodic testing. The sound level meter was set to the most-sensitive level range and with frequency weighting A selected.

Ten (10) time weighted observations were made over a period of 60 seconds.

Random Readings dB(A)

14.60	14.70	14.70	14.60	14.60
14.60	14.60	14.70	14.60	14.60

Acoustic Noise Floor : 14.6 dB(A)

3.2.2 Electrical Input Signal Device

With the microphone replaced by the electrical input signal device and terminated as specified, the sound level meter was set to the most-sensitive level range and with frequency weightings Z, C and A selected as provided.

Ten (10) time weighted observations were made over a period of 60 seconds.

Random Readings dB(A)

7.80	7.80	7.80	7.80	7.80
7.80	7.80	7.80	7.80	7.80

Random Readings dB(C)

8.40	8.40	8.40	8.40	8.70
8.60	8.40	8.60	8.60	8.60

Random Readings dB(Z)

13.1	13.0	13.1	13.4	13.2
13.4	13.1	13.0	13.4	13.3

	dB(A)	dB(C)	dB(Z)
Electric Noise Floor :	7.8	8.5	13.2

3.3 ACOUSTICAL SIGNAL TESTS OF A FREQUENCY WEIGHTING

The sound level meter was set to measure frequency weighting C with a FAST response. The test was carried out using a multi-function acoustic calibrator set to pressure mode.

Three (3) readings were made at each test frequency. The average of the readings was then corrected to the multi-function acoustic calibrator.

Table 2 - Frequency Weighting C Response

Freq Hz	Reading 1	Reading 2	Reading 3	U95
125	94.3	94.3	94.3	0.13
1 000	94.0	94.0	94.0	0.13
8 000	87.8	87.8	87.8	0.14

Actual Freq Hz	B&K 4226 Corrections	Corrected Response dB(C)		Uexp
		Actual	re 1kHz	
125.90	-0.06	94.24	0.32	0.13
1005.10	-0.08	93.92	0.00	0.13
7915.10	0.00	87.80	-6.12	0.14

Adjustments were then applied to correct for free field and sound level meter body effects with data supplied by the manufacturer as per Table 3. Windscreen correction factors applied.

Table 3 - Correction Data

Actual Freq Hz	FreeField Corrections	U95	BodyEffects Corrections	U95	Windscreen Corrections	U95
125.90	0.00	0.25	0.00	0.25	0.000	0.200
1005.10	0.10	0.25	0.00	0.25	-0.100	0.200
7915.10	3.20	0.35	0.30	0.35	0.000	0.300

Finally, the corrected responses are normalised to the response at 1kHz and compared to the tolerances stated in Table 2 of IEC 61672.1-2013.

Table 4 - Acoustic C Response

Actual Freq (Hz)	Corrected Response dB(C)		Expected Response dB(C)		Deviation	P/F	Uexp
	Actual	re 1kHz	re 1kHz	Tolerance			
125.90	94.24	0.32	-0.2	±1.5	0.52	P	0.43
1005.10	93.92	0.00	0.0	±1.0	0.00	P	0.43
7915.10	91.30	-2.62	-3.0	±5.0	0.38	P	0.60

3.4 ELECTRICAL SIGNAL TESTS OF FREQUENCY WEIGHTINGS

Frequency weighting responses for Z, C and A were determined relative to the response at 1kHz using steady sinusoidal electrical input signals.

On the reference level range, and for each frequency weighting under test, the level of a 1kHz input signal was adjusted to yield 93dB. At test frequencies other than 1kHz, the input signal level was adjusted to compensate for the design goal attenuations as specified in Table 2 of IEC 61672.1-2013.

Table 5 - Measured Electrical Frequency Response

Freq Hz	A Weighting (dB)	C Weighting (dB)	Z Weighting (dB)	U95
63	92.9	93.0	92.9	0.13
125	92.8	93.0	93.0	0.11
250	92.9	93.0	93.0	0.10
500	92.9	93.0	93.0	0.10
1 000	93.0	93.0	93.0	0.10
2 000	93.0	93.0	93.0	0.10
4 000	93.0	93.0	93.0	0.10
8 000	93.0	93.0	93.0	0.10
15 850	N/A	N/A	N/A	0.14

Adjustments were then applied to correct for a uniform free field response and sound level meter body effects with data supplied by the manufacturer as per Table 6. Windscreen correction factors applied.

Table 6 - Correction Data

Freq Hz	Ufreq	U95	Body Effects	U95	WS Effects	U95
63	0.000	0.250	0.000	0.250	0.000	0.200
125	0.000	0.250	0.000	0.250	0.000	0.200
250	0.000	0.250	0.000	0.250	0.000	0.200
500	0.000	0.250	-0.100	0.250	-0.100	0.200
1 000	0.000	0.250	0.000	0.250	-0.100	0.200
2 000	0.200	0.250	0.000	0.250	-0.300	0.200
4 000	0.400	0.250	0.300	0.250	-0.300	0.200
8 000	-0.500	0.350	0.300	0.350	0.000	0.300
15 850	0.000	0.000	0.400	0.350	0.700	0.300

Finally, the corrected responses were referenced to the response at 1kHz and compared to the tolerances stated in Table 2 of IEC 61672.1-2013.

Table 7 - A Weighted Electrical Response

Freq Hz	Response		Tolerance (dB)	P/F	Uexp
	Corrected	re 1kHz			
63	92.90	0.00	+1.0 / -2	P	0.43
125	92.80	-0.10	±1.5	P	0.42
250	92.90	0.00	±1.5	P	0.42
500	92.70	-0.20	±1.5	P	0.42
1 000	92.90	0.00	±1.0	P	0.42
2 000	92.90	0.00	±2.0	P	0.42
4 000	93.40	0.50	±3.0	P	0.42
8 000	92.80	-0.10	±5.0	P	0.59
15 850	N/A	N/A	+5.0 / −∞	N/A	0.49

Table 8 - C Weighted Electrical Response

Freq Hz	Response		Tolerance (dB)	P/F	Uexp
	Corrected	re 1kHz			
63	93.00	0.10	+1.0 / -2	P	0.43
125	93.00	0.10	±1.5	P	0.42
250	93.00	0.10	±1.5	P	0.42
500	92.80	-0.10	±1.5	P	0.42
1 000	92.90	0.00	±1.0	P	0.42
2 000	92.90	0.00	±2.0	P	0.42
4 000	93.40	0.50	±3.0	P	0.42
8 000	92.80	-0.10	±5.0	P	0.59
15 850	N/A	N/A	+5.0 / −∞	N/A	0.49

Table 9 - Z Weighted Electrical Response

Freq Hz	Response		Tolerance (dB)	P/F	Uexp
	Corrected	re 1kHz			
63	92.90	0.00	+1.0 / -2	P	0.43
125	93.00	0.10	±1.5	P	0.42
250	93.00	0.10	±1.5	P	0.42
500	92.80	-0.10	±1.5	P	0.42
1 000	92.90	0.00	±1.0	P	0.42
2 000	92.90	0.00	±2.0	P	0.42
4 000	93.40	0.50	±3.0	P	0.42
8 000	92.80	-0.10	±5.0	P	0.59
15 850	N/A	N/A	+5.0 / −∞	N/A	0.49

3.5 FREQUENCY AND TIME WEIGHTINGS AT 1KHZ

A steady sinusoidal electrical input signal of 1kHz at the reference sound pressure level was applied to the reference level range.

The deviations of the indicated level of C and Z frequency weightings were recorded, along with the deviations of the indication of A weighted time averaged, and SLOW weighted response.

Table 10 - Frequency and Time Weighting Results

Frequency Weighting	Time Weighting	Response (dB)	Deviation (dB)	P/F	Tolerance (dB)	U95
A	Fast	94.0	0.0	P	±0.2	0.10
	Leq	94.0	0.0	P	±0.2	0.10
	Slow	94.0	0.0	P	±0.2	0.10
C	Fast	94.0	0.0	P	±0.2	0.10
Z	Fast	94.0	0.0	P	±0.2	0.10

3.6 LONG-TERM STABILITY

Long-term stability was tested by comparing a steady sinusoidal electrical signal applied at the start, and at the end of testing. The applied signal level was set to the reference level and frequency and was maintained constant. The difference between the indicated levels was recorded.

Table 11 - Frequency and Time Weighting Results

Signal Level (mV)	Initial Response (dB)	Final Response (dB)	Deviation (dB)	P/F	Tolerance (dB)	U95
68.4	94	94.0	0.0	P	±0.3	0.10

3.7 LEVEL LINEARITY ON THE REFERENCE LEVEL RANGE

Level linearity was tested with a steady sinusoidal electrical signal at a frequency of 8kHz, with the meter set to display frequency weighted A, FAST response.

The starting point for level linearity testing was set to 94.0dB as stated in the instruction manual.

Level linearity was measured in 5dB steps of increasing input signal level from the starting point up to within 5dB of the stated upper limit, then at 1dB steps up to (but not including) the first indication of overload.

Table 12 - Level Linearity - Increasing

Ideal (dB)	Response (dB)	Deviation (dB)	Tolerance (dB)	P/F	U95
94.0	94.0	0.0	±1.1	P	0.1
99.0	99.0	0.0	±1.1	P	0.1
104.0	104.0	0.0	±1.1	P	0.1
109.0	109.0	0.0	±1.1	P	0.1
114.0	114.0	0.0	±1.1	P	0.1
119.0	119.0	0.0	±1.1	P	0.1
124.0	124.0	0.0	±1.1	P	0.1
129.0	129.0	0.0	±1.1	P	0.1
131.0	131.0	0.0	±1.1	P	0.1
132.0	132.0	0.0	±1.1	P	0.1
133.0	133.0	0.0	±1.1	P	0.1
134.0	134.0	0.0	±1.1	P	0.1
135.0	135.0	0.0	±1.1	P	0.1
136.0	136.0	0.0	±1.1	P	0.1
137.0	137.0	0.0	±1.1	P	0.1

Overload indication at 138.0dB.

Level linearity test was the continued in 5dB steps of decreasing input signal level from the starting point up to within 5dB of the stated lower limit, then at 1dB steps up to (but not including) the first indication of under range.

Table 13 - Level Linearity - Decreasing

Ideal (dB)	Response (dB)	Deviation (dB)	Tolerance (dB)	P/F	U95
94.0	94.0	0.0	±1.1	P	0.1
89.0	89.0	0.0	±1.1	P	0.1
84.0	84.0	0.0	±1.1	P	0.1
79.0	79.0	0.0	±1.1	P	0.1
74.0	74.0	0.0	±1.1	P	0.1
69.0	69.0	0.0	±1.1	P	0.1
64.0	64.0	0.0	±1.1	P	0.1
59.0	59.0	0.0	±1.1	P	0.1
54.0	54.0	0.0	±1.1	P	0.1
49.0	49.0	0.0	±1.1	P	0.1
44.0	44.0	0.0	±1.1	P	0.1
39.0	39.0	0.0	±1.1	P	0.1
34.0	34.0	0.0	±1.1	P	0.1
30.0	29.9	-0.1	±1.1	P	0.1
29.0	28.9	-0.1	±1.1	P	0.1
28.0	27.9	-0.1	±1.1	P	0.1
27.0	26.8	-0.2	±1.1	P	0.1
26.0	25.8	-0.2	±1.1	P	0.1
25.0	24.7	-0.3	±1.1	P	0.1

Under range indication at 24.0dB.

3.8 TONEBURST RESPONSE

The response of the sound level meter to short-duration signals was tested on the reference range with 4kHz tone bursts.

The tone bursts were generated from a steady sinusoidal signal at a level of 135.0dB.

Table 14 - FAST Weighted Response

Burst Length	Response dB(A)	Deviation (dB)	Tolerance (dB)	P/F	U95
200ms	134.0	0.0	±1.0	P	0.1
2ms	117.0	0.0	+1.0 / -2.5	P	0.1
0.25ms	107.9	-0.1	+1.5 / -5	P	0.1

Table 15 - SLOW Weighted Response

Burst Length	Response dB(A)	Deviation (dB)	Tolerance (dB)	P/F	U95
200ms	127.6	0.0	±1.0	P	0.1
2ms	108.0	0.0	+1.0 / -5	P	0.1

Table 16 - Sound Exposure Level Response

Burst Length	Response dB(A)	Deviation (dB)	Tolerance (dB)	P/F	U95
200ms	128.1	0.1	±1.0	P	0.1
2ms	108.5	0.5	+1.0 / -2.5	P	0.1
0.25ms	98.9	-0.1	+1.5 / -5	P	0.1

3.9 PEAK C RESPONSE

Indication of Peak C sound level was tested on the least sensitive level range. Test signals used were -

- A single complete cycle of an 8kHz sinusoid, starting and stopping at zero crossings
- Positive and negative half cycles of a 500Hz sinusoid, starting and stopping at zero crossings.

The level of the steady 8kHz sinusoid was adjusted to display 133.0dB(C).

Table 17 - Single Cycle Response

Response Peak C	Deviation (dB)	Tolerance (dB)	P/F	U95	Overload Peak C
136.4	0.0	±3.0	P	0.22	N

Table 18 - Half Cycle Response

Signal Orientation	Response Peak C	Deviation (dB)	Tolerance (dB)	P/F	U95
Positive	134.4	-1.0	±2.0	P	0.1
Negative	134.4	-1.0	±2.0	P	0.1

No overload was noted during Peak C testing.

3.10 OVERLOAD INDICATION

The overload indication was tested on the least sensitive level range, with the sound level meter set to display frequency weighted A, time averaged values.

Positive and negative half cycle sinusoidal electrical signals at 4kHz were used. The test began at an indicated time averaged level of137.0dB(A).

Using the positive half cycle signal, the signal level was increased in steps of 0.5dB up to, but not including, the first indication of overload. The level of the input signal was then increased in steps of 0.1dB until the first indication of overload. These steps were repeated using the negative half cycle signal.

Table 19 - Overload Indication

Signal Orientation	Overload Response	Difference	Tolerance	P/F	Uncertainty
Positive	136.6	0.0	±1.5	P	0.1
Negative	136.6				

Overload indication was verified.

Overload latch indication was verified.

3.11 HIGH LEVEL STABILITY

High level stability was tested by measuring the response of the meter to high signal levels. The result was evaluated as the difference between the A-Weighted indicated levels in response to a steady 1kHz signal applied over 5 minutes.

Table 20 - FAST Weighted Response

Time Weighting	Initial Response (dB)	Final Response (dB)	Deviation (dB)	Tolerance (dB)	P/F	U95
Fast	137.0	137.0	0.0	±0.3	P	0.10
Slow	N/A	N/A	N/A	±0.3	N/A	0.10
Leq	137.0	137.0	0.0	±0.3	P	0.10

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Sound Level Meter
IEC 61672-3:2013
Calibration Certificate

Calibration Number C23448

Client Details	John Holland Pty Ltd Level 3, 65 Pirrama Road Pyrmont NSW 2009
Equipment Tested/ Model Number :	Rion NL-42EX
Instrument Serial Number :	00409019
Microphone Serial Number :	185664
Pre-amplifier Serial Number :	90464
Firmware Version :	2.0

Pre-Test Atmospheric Conditions		**Post-Test Atmospheric Conditions**	
Ambient Temperature :	21.7 °C	**Ambient Temperature :**	23.7 °C
Relative Humidity :	41.6 %	**Relative Humidity :**	40.1 %
Barometric Pressure :	101.8 kPa	**Barometric Pressure :**	101.62 kPa

Calibration Technician : Shaheen Boaz
Secondary Check: Steve Woodhead
Calibration Date : 3 Jul 2023
Report Issue Date : 5 Jul 2023

Approved Signatory : Juan Aguero

Clause and Characteristic Tested	Result	Clause and Characteristic Tested	Result
12: Acoustical Sig. tests of a frequency weighting	*Pass*	17: Level linearity incl. the level range control	*N/A*
13: Electrical Sig. tests of frequency weightings	*Pass*	18: Toneburst response	*Pass*
14: Frequency and time weightings at 1 kHz	*Pass*	19: C Weighted Peak Sound Level	*Pass*
15: Long Term Stability	*Pass*	20: Overload Indication	*Pass*
16: Level linearity on the reference level range	*Pass*	21: High Level Stability	*Pass*

The sound level meter submitted for testing has successfully completed the class 2 periodic tests of IEC 61672-3:2013, for the environmental conditions under which the tests were performed.

However, no general statement or conclusion can be made about conformance of the sound level meter to the full requirements of IEC 61672-1:2013 because evidence was not publicly available, from an independent testing organisation responsible for pattern approvals, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2013 and because the periodic tests of IEC 61672-3:2013 cover only a limited subset of the specifications in IEC 61672-1:2013.

Uncertainties of Measurement -

Acoustic Tests		Environmental Conditions	
125Hz	*±0.13 dB*	*Temperature*	*±0.1 °C*
1kHz	*±0.13 dB*	*Relative Humidity*	*±1.9 %*
8kHz	*±0.14 dB*	*Barometric Pressure*	*±0.014 kPa*
Electrical Tests	*±0.13 dB*		

All uncertainties are derived at the 95% confidence level with a coverage factor of 2.

This calibration certificate is to be read in conjunction with the calibration test report.

Acoustic Research Labs Pty Ltd is NATA Accredited Laboratory Number 14172.
Accredited for compliance with ISO/IEC 17025 - Calibration.

The results of the tests, calibrations and/or measurements included in this document are traceable to SI units.

NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration and inspection reports.

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Sound Level Meter
IEC 61672-3:2013
Calibration Test Report

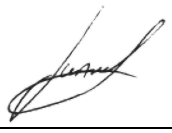
Calibration Number C23448

Client Details John Holland Pty Ltd
Level 3, 65 Pirrama Road
Pyrmont NSW 2009

Equipment Tested/ Model Number : Rion NL-42EX
Instrument Serial Number : 00409019
Microphone Serial Number : 185664
Pre-amplifier Serial Number : 90464
Firmware Version : 2.0

Pre-Test Atmospheric Conditions		Post-Test Atmospheric Conditions	
Ambient Temperature :	21.7 °C	**Ambient Temperature :**	23.7 °C
Relative Humidity :	41.6 %	**Relative Humidity :**	40.1 %
Barometric Pressure :	101.8 kPa	**Barometric Pressure :**	101.62 kPa

Calibration Technician : Shaheen Boaz
Calibration Date : 3 Jul 2023
Secondary Check: Steve Woodhead
Report Issue Date : 5 Jul 2023

Approved Signatory :  Juan Aguero

Clause and Characteristic Tested	Result	Clause and Characteristic Tested	Result
12: Acoustical Sig. tests of a frequency weighting	*Pass*	17: Level linearity incl. the level range control	*N/A*
13: Electrical Sig. tests of frequency weightings	*Pass*	18: Toneburst response	*Pass*
14: Frequency and time weightings at 1 kHz	*Pass*	19: C Weighted Peak Sound Level	*Pass*
15: Long Term Stability	*Pass*	20: Overload Indication	*Pass*
16: Level linearity on the reference level range	*Pass*	21: High Level Stability	*Pass*

The sound level meter submitted for testing has successfully completed the class 2 periodic tests of IEC 61672-3:2013, for the environmental conditions under which the tests were performed.

However, no general statement or conclusion can be made about conformance of the sound level meter to the full requirements of IEC 61672-1:2013 because evidence was not publicly available, from an independent testing organisation responsible for pattern approvals, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2013 and because the periodic tests of IEC 61672-3:2013 cover only a limited subset of the specifications in IEC 61672-1:2013.

Uncertainties of Measurement -

Acoustic Tests		Environmental Conditions	
125Hz	*±0.13 dB*	*Temperature*	*±0.1 °C*
1kHz	*±0.13 dB*	*Relative Humidity*	*±1.9 %*
8kHz	*±0.14 dB*	*Barometric Pressure*	*±0.014 kPa*
Electrical Tests	*±0.13 dB*		

All uncertainties are derived at the 95% confidence level with a coverage factor of 2.

1. OVERVIEW

This report presents the calibration test results of a Rion NL-42EX Sound Level Meter, and associated equipment. Calibration is carried out in accordance with *IEC 61672-3.2013, Electroacoustics - Sound Level Meters - Part 3: Periodic Tests*.

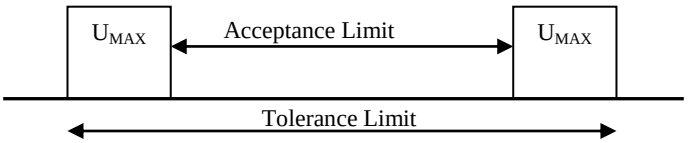
Relevant clauses from this standard have been used for periodic testing in conjunction with Acoustic Research Labs internal test methods described in Section 1 of the calibration work instruction manual.

Where required, reference is made to manual version N/A as provided by the manufacturer.

1.1 UNCERTAINTIES

For each test performed, the associated measurement uncertainties are derived at the 95% confidence level and are given with a coverage factor of 2.

The uncertainty applies at the time of measurement only, and takes no account of any drift or other effects that may apply afterwards. When estimating uncertainty at any later time, other relevant information should also be considered, including, where possible, the history of the performance of the instrument and the manufacturer's specifications.



Where deviations from the design goals are provided to determine conformance to performance specifications, each measurement is reported with:

- The measured deviation from the design goal
- Associated acceptance limits for the test
- Maximum allowable uncertainty of measurement for the test
- Actual expanded uncertainty for each measurement

1.2 DOCUMENT CONVENTIONS

Test results which highlight non-conformances relative to the standard, and the sound level meter type specified by the manufacturer have been marked with an **F** in the respective tests.

Any tests that are not required, due to sound level meter configuration, are marked N/A.

2. GENERAL

2.1 ENVIRONMENTAL CONDITIONS DURING TEST

No corrections have been applied to any results obtained to compensate for the environmental conditions.

2.2 CALIBRATION TESTS

Where applicable the following tests were performed in accordance with the requirements of *IEC 61672-3.2013*. These clauses are used to define the periodic testing of Sound Level Meters.

Clause 10	Indication at the Calibration Check Frequency
Clause 11	Self Generated Noise
Clause 12	Acoustical Signal Tests of Frequency Weighting
Clause 13	Electrical Signal Tests of Frequency Weightings
Clause 14	Frequency and Time Weightings at 1kHz
Clause 15	Long Term Stability
Clause 16	Level Linearity on the Reference Level Range
Clause 17	Level Linearity including the level range control
Clause 18	Toneburst Response
Clause 19	Peak C Sound Level
Clause 20	Overload Indication
Clause 21	High Level Stability

2.3 TEST EQUIPMENT USED

All test equipment used during periodic testing are calibrated every 12months by an accredited laboratory, traceable to SI units.

The performance of all equipment during these calibrations and the effects of instrument stability are used to determine the measurement uncertainty of each reported result.

2.3.1 Multi-function Acoustic Calibrator

A Bruel & Kjaer 4226 Multi-function calibrator (S/N - 2985012) was used for frequency response testing of the entire instrument (including microphone). This instrument was used as a reference calibrator and for frequency response verification.

2.3.2 Microphone Electrical Equivalent Circuit

Calibration of most instrument parameters is carried out using electrical signals fed to the unit via a two-port electrical equivalent circuit of the microphone.

A 12pF capacitance dummy microphone was used during testing.

2.3.3 Adjustable Attenuator

A means for varying the attenuation of electrical signals via the dummy microphone was provided by a JFW Industries dual rotary attenuator (S/N - 792819 2132). The attenuator is switchable in 1dB steps between 0dB and 60dB.

2.3.4 Arbitrary Function Generator

A Keysight 33511B (S/N – MY58001621) was used to generate the required electrical signals.

2.3.5 Environmental Monitoring

A MHB-382SD (S/N – AG.44204) was used for measuring environmental conditions during device calibration. It is capable of providing temperature, relative humidity and pressure measurements.

3. CALIBRATION TEST RESULTS

3.1 INDICATION AT THE CALIBRATION CHECK FREQUENCY

The indication of the sound level meter at the calibration check frequency was checked by application of an acoustic signal at the reference sound pressure level and frequency.

Stated reference conditions as found in manual are

Reference Level : 94.0 dB

Reference Frequency : 1000.0 Hz

Indications before and after adjustments were recorded and are shown in Table 1 (all measurements in dB) -

Table 1 - Check Frequency Calibration Results

Frequency Weighting	Initial Response	B&K 4226 Corrected	FreeField Corrected	Final Corrected Response
A	94.00	94.10	94.00	94.02
C	94.00	94.10	94.00	94.02
Z	94.00	94.10	94.00	94.02

Free field adjustment data as provided by the manufacturer. Windscreen correction factors applied.

3.2 SELF GENERATED NOISE

3.2.1 Microphone Installed

Self generated noise was measured with the microphone installed on the sound level meter, in the configuration submitted for periodic testing. The sound level meter was set to the most-sensitive level range and with frequency weighting A selected.

Ten (10) time weighted observations were made over a period of 60 seconds.

Random Readings dB(A)

14.60	14.60	14.60	14.60	14.70
14.60	14.60	14.60	14.60	14.60

Acoustic Noise Floor : 14.6 dB(A)

3.2.2 Electrical Input Signal Device

With the microphone replaced by the electrical input signal device and terminated as specified, the sound level meter was set to the most-sensitive level range and with frequency weightings Z, C and A selected as provided.

Ten (10) time weighted observations were made over a period of 60 seconds.

Random Readings dB(A)

7.10	7.10	7.10	7.10	7.10
7.10	7.10	7.10	7.10	7.10

Random Readings dB(C)

8.70	8.70	8.70	8.70	8.70
8.70	8.70	8.70	8.70	8.70

Random Readings dB(Z)

13.1	13.2	13.6	13.5	13.6
13.4	13.1	13.2	13.3	13.3

	dB(A)	dB(C)	dB(Z)
Electric Noise Floor :	7.1	8.7	13.3

3.3 ACOUSTICAL SIGNAL TESTS OF A FREQUENCY WEIGHTING

The sound level meter was set to measure frequency weighting C with a FAST response. The test was carried out using a multi-function acoustic calibrator set to pressure mode.

Three (3) readings were made at each test frequency. The average of the readings was then corrected to the multi-function acoustic calibrator.

Table 2 - Frequency Weighting C Response

Freq Hz	Reading 1	Reading 2	Reading 3	Uncertainty (dB)
125	94.2	94.2	94.2	0.13
1 000	94.0	94.0	94.0	0.13
8 000	87.7	87.7	87.7	0.14

Actual Freq Hz	B&K 4226 Corrections	Corrected Response dB(C)		Uncertainty (dB)
		Actual	re 1kHz	
125.90	-0.06	94.14	0.22	0.13
1005.10	-0.08	93.92	0.00	0.13
7915.10	0.00	87.70	-6.22	0.14

Adjustments were then applied to correct for free field and sound level meter body effects with data supplied by the manufacturer as per Table 3. Windscreen correction factors applied.

Table 3 - Correction Data

Actual Freq (Hz)	Pressure to Freefield (dB)	Uncertainty (dB)	Body Effects (dB)	Uncertainty (dB)	WS Effects (dB)	Uncertainty (dB)
125.90	0.00	0.25	0.00	0.25	0.00	0.20
1005.10	0.10	0.25	0.00	0.25	-0.10	0.20
7915.10	3.20	0.35	0.30	0.35	0.00	0.30

Finally, the corrected responses are normalised to the response at 1kHz and compared to the tolerance limits stated in Table 2 of IEC 61672.1-2013.

Table 4 - Acoustic C Response

Actual Freq (Hz)	Corrected Response dB(C)		Expected Response dB(C)		Deviation (dB)	P/F	Uncertainty (dB)	Maximum Permitted Uncertainty (dB)
	Actual	re 1kHz	re 1kHz	Tolerance Limit				
125.90	94.14	0.22	-0.2	±1.5	0.42	P	0.43	0.60
1005.10	93.92	0.00	0.0	±1.0	0.00	P	0.43	0.60
7915.10	91.20	-2.72	-3.0	±5.0	0.28	P	0.60	0.70

3.4 ELECTRICAL SIGNAL TESTS OF FREQUENCY WEIGHTINGS

Frequency weighting responses for Z, C and A were determined relative to the response at 1kHz using steady sinusoidal electrical input signals.

On the reference level range, and for each frequency weighting under test, the level of a 1kHz input signal was adjusted to yield 93dB. At test frequencies other than 1kHz, the input signal level was adjusted to compensate for the design goal attenuations as specified in Table 2 of IEC 61672.1-2013.

Table 5 - Measured Electrical Frequency Response

Freq (Hz)	A Weighting (dB)	C Weighting (dB)	Z Weighting (dB)	Uncertainty (dB)
63	92.9	92.9	93.0	0.13
125	92.9	93.0	93.0	0.11
250	92.9	93.0	93.0	0.10
500	93.0	93.0	93.0	0.10
1 000	93.0	93.0	93.0	0.10
2 000	93.0	93.1	93.0	0.10
4 000	93.0	93.0	93.0	0.10
8 000	93.1	93.0	93.0	0.10
15 850	N/A	N/A	N/A	0.13

Adjustments were then applied to correct for a uniform free field response and sound level meter body effects with data supplied by the manufacturer as per Table 6. Windscreen correction factors applied.

Table 6 - Correction Data

Freq (Hz)	Ufreq (dB)	Uncertainty (dB)	Body Effects (dB)	Uncertainty (dB)	WS Effects (dB)	Uncertainty (dB)
63	0.00	0.25	0.00	0.25	0.00	0.20
125	0.00	0.25	0.00	0.25	0.00	0.20
250	0.00	0.25	0.00	0.25	0.00	0.20
500	0.00	0.25	-0.10	0.25	-0.10	0.20
1 000	0.00	0.25	0.00	0.25	-0.10	0.20
2 000	0.20	0.25	0.00	0.25	-0.30	0.20
4 000	0.40	0.25	0.30	0.25	-0.30	0.20
8 000	-0.50	0.35	0.30	0.35	0.00	0.30
15 850	0.00	0.00	0.00	0.00	0.00	0.00

Finally, the corrected responses were referenced to the response at 1kHz and compared to the tolerance limits stated in Table 2 of IEC 61672.1-2013.

Table 7 - A Weighted Electrical Response

Freq (Hz)	Response (dB)		Tolerance Limit (dB)	P/F	Uncertainty (dB)	Maximum Permitted Uncertainty (dB)
	Corrected	re 1kHz				
63	92.90	0.00	+1.0 / -2	P	0.43	0.60
125	92.90	0.00	±1.5	P	0.42	0.60
250	92.90	0.00	±1.5	P	0.42	0.60
500	92.80	-0.10	±1.5	P	0.42	0.60
1 000	92.90	0.00	±1.0	P	0.42	0.60
2 000	92.90	0.00	±2.0	P	0.42	0.60
4 000	93.40	0.50	±3.0	P	0.42	0.60
8 000	92.90	0.00	±5.0	P	0.59	0.70
15 850	N/A	N/A	+5.0 / −∞	N/A	0.13	1.00

Table 8 - C Weighted Electrical Response

Freq (Hz)	Response (dB)		Tolerance Limit (dB)	P/F	Uncertainty (dB)	Maximum Permitted Uncertainty (dB)
	Corrected	re 1kHz				
63	92.90	0.00	+1.0 / -2	P	0.43	0.60
125	93.00	0.10	±1.5	P	0.42	0.60
250	93.00	0.10	±1.5	P	0.42	0.60
500	92.80	-0.10	±1.5	P	0.42	0.60
1 000	92.90	0.00	±1.0	P	0.42	0.60
2 000	93.00	0.10	±2.0	P	0.42	0.60
4 000	93.40	0.50	±3.0	P	0.42	0.60
8 000	92.80	-0.10	±5.0	P	0.59	0.70
15 850	N/A	N/A	+5.0 / −∞	N/A	0.13	1.00

Table 9 - Z Weighted Electrical Response

Freq (Hz)	Response (dB)		Tolerance Limit (dB)	P/F	Uncertainty (dB)	Maximum Permitted Uncertainty (dB)
	Corrected	re 1kHz				
63	93.00	0.10	+1.0 / -2	P	0.43	0.60
125	93.00	0.10	±1.5	P	0.42	0.60
250	93.00	0.10	±1.5	P	0.42	0.60
500	92.80	-0.10	±1.5	P	0.42	0.60
1 000	92.90	0.00	±1.0	P	0.42	0.60
2 000	92.90	0.00	±2.0	P	0.42	0.60
4 000	93.40	0.50	±3.0	P	0.42	0.60
8 000	92.80	-0.10	±5.0	P	0.59	0.70
15 850	N/A	N/A	+5.0 / −∞	N/A	0.13	1.00

3.5 FREQUENCY AND TIME WEIGHTINGS AT 1KHZ

A steady sinusoidal electrical input signal of 1kHz at the reference sound pressure level was applied to the reference level range.

The deviations of the indicated level of C and Z frequency weightings were recorded, along with the deviations of the indication of A weighted time averaged, and SLOW weighted response.

Table 10 - Frequency and Time Weighting Results

Frequency Weighting	Time Weighting	Response (dB)	Deviation (dB)	P/F	Tolerance Limit (dB)	Uncertainty (dB)	Maximum Permitted Uncertainty (dB)
A	Fast	94.0	0.0	P	±0.2	0.10	0.20
	Leq	94.0	0.0	P	±0.2	0.10	0.20
	Slow	94.0	0.0	P	±0.2	0.10	0.20
C	Fast	94.0	0.0	P	±0.2	0.10	0.20
Z	Fast	94.0	0.0	P	±0.2	0.10	0.20

3.6 LONG-TERM STABILITY

Long-term stability was tested by comparing a steady sinusoidal electrical signal applied at the start, and at the end of testing. The applied signal level was set to the reference level and frequency and was maintained constant. The difference between the indicated levels was recorded.

Table 11 - Frequency and Time Weighting Results

Signal Level (mV)	Initial Response (dB)	Final Response (dB)	Deviation (dB)	P/F	Tolerance Limit (dB)	Uncertainty (dB)	Maximum Permitted Uncertainty (dB)
21.9	94	94.0	0.0	P	±0.3	0.10	0.10

3.7 LEVEL LINEARITY ON THE REFERENCE LEVEL RANGE

Level linearity was tested with a steady sinusoidal electrical signal at a frequency of 8kHz, with the meter set to display frequency weighted A, FAST response.

The starting point for level linearity testing was set to 94.0dB as stated in the instruction manual.

Level linearity was measured in 5dB steps of increasing input signal level from the starting point up to within 5dB of the stated upper limit, then at 1dB steps up to (but not including) the first indication of overload.

Table 12 - Level Linearity - Increasing

Ideal (dB)	Response (dB)	Deviation (dB)	Tolerance Limit (dB)	P/F	Uncertainty (dB)	Maximum Permitted Uncertainty (dB)
94.0	94.0	0.0	±1.1	P	0.1	0.3
99.0	99.0	0.0	±1.1	P	0.1	0.3
104.0	104.0	0.0	±1.1	P	0.1	0.3
109.0	108.9	-0.1	±1.1	P	0.1	0.3
114.0	114.0	0.0	±1.1	P	0.1	0.3
119.0	119.0	0.0	±1.1	P	0.1	0.3
124.0	124.0	0.0	±1.1	P	0.1	0.3
129.0	128.9	-0.1	±1.1	P	0.1	0.3
131.0	131.0	0.0	±1.1	P	0.1	0.3
132.0	132.0	0.0	±1.1	P	0.1	0.3
133.0	132.9	-0.1	±1.1	P	0.1	0.3
134.0	134.0	0.0	±1.1	P	0.1	0.3
135.0	135.0	0.0	±1.1	P	0.1	0.3
136.0	135.9	-0.1	±1.1	P	0.1	0.3
137.0	136.9	-0.1	±1.1	P	0.1	0.3

Overload indication at 138.0dB.

Level linearity test was the continued in 5dB steps of decreasing input signal level from the starting point up to within 5dB of the stated lower limit, then at 1dB steps up to (but not including) the first indication of under range.

Table 13 - Level Linearity - Decreasing

Ideal (dB)	Response (dB)	Deviation (dB)	Tolerance Limit (dB)	P/F	Uncertainty (dB)	Maximum Permitted Uncertainty (dB)
94.0	94.0	0.0	±1.1	P	0.1	0.3
89.0	89.0	0.0	±1.1	P	0.1	0.3
84.0	84.0	0.0	±1.1	P	0.1	0.3
79.0	79.0	0.0	±1.1	P	0.1	0.3
74.0	74.0	0.0	±1.1	P	0.1	0.3
69.0	69.0	0.0	±1.1	P	0.1	0.3
64.0	64.0	0.0	±1.1	P	0.1	0.3
59.0	59.0	0.0	±1.1	P	0.1	0.3
54.0	54.0	0.0	±1.1	P	0.1	0.3
49.0	49.0	0.0	±1.1	P	0.1	0.3
44.0	44.0	0.0	±1.1	P	0.1	0.3
39.0	39.0	0.0	±1.1	P	0.1	0.3
34.0	34.0	0.0	±1.1	P	0.1	0.3
30.0	29.9	-0.1	±1.1	P	0.1	0.3
29.0	28.9	-0.1	±1.1	P	0.1	0.3
28.0	27.9	-0.1	±1.1	P	0.1	0.3
27.0	26.8	-0.2	±1.1	P	0.1	0.3
26.0	25.8	-0.2	±1.1	P	0.1	0.3
25.0	24.7	-0.3	±1.1	P	0.1	0.3

Under range indication at 24.0dB.

3.8 TONEBURST RESPONSE

The response of the sound level meter to short-duration signals was tested on the reference range with 4kHz tone bursts.

The tone bursts were generated from a steady sinusoidal signal at a level of 135.0dB.

Table 14 - FAST Weighted Response

Burst Length	Response dB(A)	Deviation (dB)	Tolerance Limit (dB)	P/F	Uncertainty (dB)	Maximum Permitted Uncertainty (dB)
200ms	134.0	0.0	±1.0	P	0.1	0.3
2ms	117.0	0.0	+1.0 / -2.5	P	0.1	0.3
0.25ms	107.9	-0.1	+1.5 / -5	P	0.1	0.3

Table 15 - SLOW Weighted Response

Burst Length	Response dB(A)	Deviation (dB)	Tolerance Limit (dB)	P/F	Uncertainty (dB)	Maximum Permitted Uncertainty (dB)
200ms	127.6	0.0	±1.0	P	0.1	0.3
2ms	108.0	0.0	+1.0 / -5	P	0.1	0.3

Table 16 - Sound Exposure Level Response

Burst Length	Response dB(A)	Deviation (dB)	Tolerance Limit (dB)	P/F	Uncertainty (dB)	Maximum Permitted Uncertainty (dB)
200ms	128.0	0.0	±1.0	P	0.1	0.3
2ms	108.0	0.0	+1.0 / -2.5	P	0.1	0.3
0.25ms	98.9	-0.1	+1.5 / -5	P	0.1	0.3

3.9 PEAK C RESPONSE

Indication of Peak C sound level was tested on the least sensitive level range. Test signals used were -

- A single complete cycle of an 8kHz sinusoid, starting and stopping at zero crossings
- Positive and negative half cycles of a 500Hz sinusoid, starting and stopping at zero crossings.

The level of the steady 8kHz sinusoid was adjusted to display 133.0dB(C).

Table 17 - Single Cycle Response

Response Peak C	Deviation (dB)	Tolerance Limit (dB)	P/F	Uncertainty (dB)	Overload Peak C	Maximum Permitted Uncertainty (dB)
135.7	-0.7	±3.0	P	0.22	N	0.35

Table 18 - Half Cycle Response

Signal Orientation	Response Peak C (dB)	Deviation (dB)	Tolerance Limit (dB)	P/F	Uncertainty (dB)	Maximum Permitted Uncertainty (dB)
Positive	134.9	-0.5	±2.0	P	0.1	0.35
Negative	135.0	-0.4	±2.0	P	0.1	0.35

No overload was noted during Peak C testing.

3.10 OVERLOAD INDICATION

The overload indication was tested on the least sensitive level range, with the sound level meter set to display frequency weighted A, time averaged values.

Positive and negative half cycle sinusoidal electrical signals at 4kHz were used. The test began at an indicated time averaged level of137.0dB(A).

Using the positive half cycle signal, the signal level was increased in steps of 0.5dB up to, but not including, the first indication of overload. The level of the input signal was then increased in steps of 0.1dB until the first indication of overload. These steps were repeated using the negative half cycle signal.

Table 19 - Overload Indication

Signal Orientation	Overload Response (dB)	Difference (dB)	Tolerance Limit (dB)	P/F	Uncertainty (dB)	Maximum Permitted Uncertainty (dB)
Positive	135.4	0.0	±1.5	P	0.10	0.25
Negative	135.4					

Overload indication was verified.

Overload latch indication was verified.

3.11 HIGH LEVEL STABILITY

High level stability was tested by measuring the response of the meter to high signal levels. The result was evaluated as the difference between the A-Weighted indicated levels in response to a steady 1kHz signal applied over 5 minutes.

Table 20 - FAST Weighted Response

Time Weighting	Initial Response (dB)	Final Response (dB)	Deviation (dB)	Tolerance Limit (dB)	P/F	Uncertainty (dB)	Maximum Permitted Uncertainty (dB)
Fast	137.0	137.0	0.0	±0.3	P	0.10	0.10
Slow	N/A	N/A	N/A	±0.3	N/A	0.10	0.10
Leq	137.0	137.0	0.0	±0.3	P	0.10	0.10

Appendix B – Attended Vibration Monitoring Report

18 May 2023

10-1808 Vibration Trial (YL) 20230518.docx

John Holland Pty Ltd
Level 10, 54 Park Street
SYDNEY NSW 2000

Attention: **Mr Omar Deeb**

Dear Omar

Operator-attended Vibration Monitoring Trial
5t Excavator Hammer
Sydney Metro Waterloo Integrated Station Development

1 Introduction

VMS Australia Pty Ltd (VMS) was engaged by John Holland Pty Ltd (JHPL) to conduct operator-attended vibration trial in relation to the capping beam demolition works taking place at the Sydney Metro Waterloo Integrated Station Development (Waterloo ISD) (the Project Site). This report presents the operator-attended vibration monitoring results for the operation of the 5t excavator hammer conducted on Tuesday 16 May 2023.

As required in Section 7.1.6 of Syndey Metro – City & Southwest – Construction Noise and Vibration Strategy, "*Attended vibration measurements are required at the commencement of vibration generating activities to confirm that vibration levels satisfy the criteria for that vibration generating activity. Where there is potential for exceedances of the criteria further vibration site law investigations would be undertaken to determine the site-specific safe working distances for that vibration generating activity*".

Operator-attended vibration monitoring was conducted at the south-east corner of the Congregational Church in order to quantify the site vibration emissions from the 5t excavator hammer operation and to assess against the nominated vibration criteria.

2 Monitoring Location

The Project Site layout and operator-attended vibration monitoring location is shown in **Figure 1**.

Figure 1 Operator-attended Vibration Monitoring Location

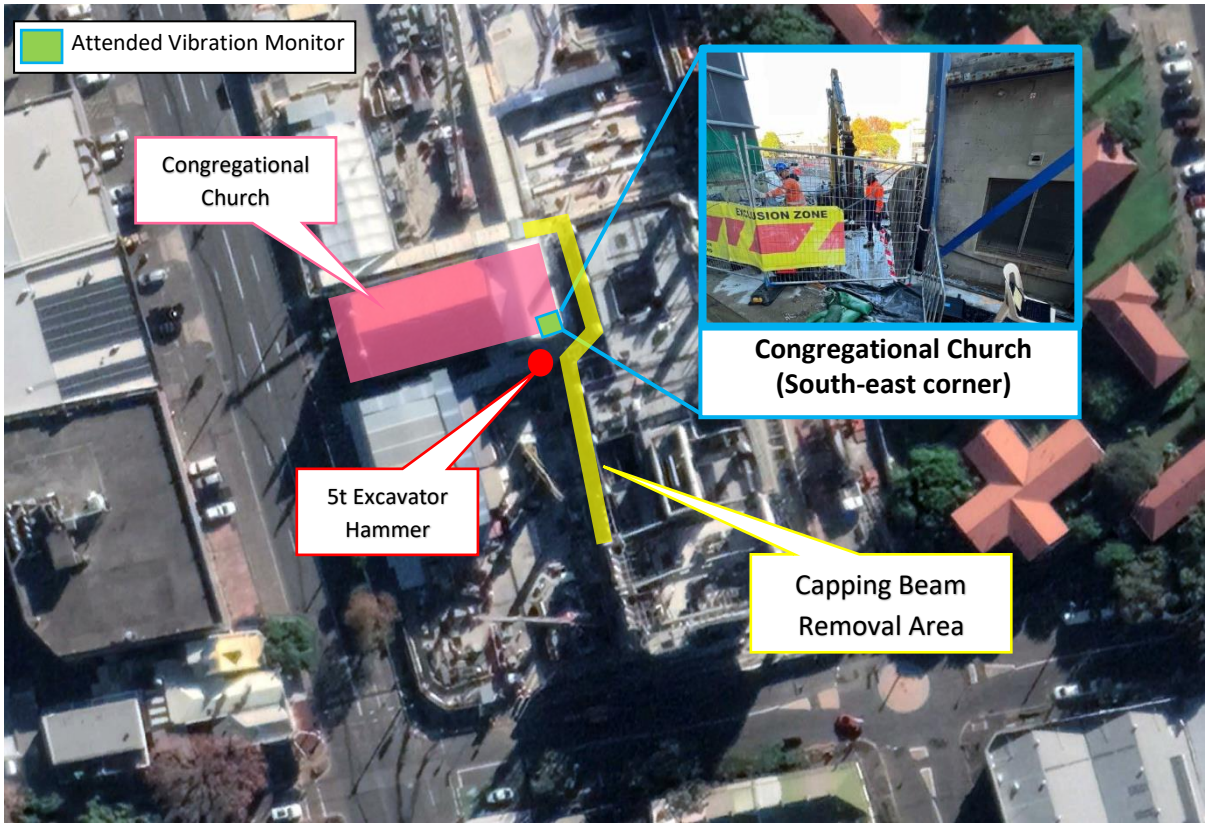


Image courtesy by Google Earth

3 Construction Vibration Criteria

Structural vibration criteria are defined in term of levels of vibration emission from the works that will minimise the risk of damage to buildings and other structures.

The project site specific construction vibration control criteria for the Congregational Church were nominated in Section 10.3 of the "Construction Noise and Vibration Management Plan" (CNVMP) (document number: SMCSWSWL-JHG-SWL-EM-PLN-000005) dated 20 May 2021 and are reproduced in **Table 1**.

Table 1 Project Site Specific Construction Vibration Criteria

Building Type	Include Buildings	Site Control Criteria[1]	
		Operating Warning Level	Operator halt level
Heritage (Structurally sound)	Congregational Church	5.0 mm/s PPV	7.5 mm/s PPV

Note 1: An exceedance of the operator warning level does not require activities to cease, but will alert the Project Manager and Foreman to proceed with caution at a reduced force or load.

4 Vibration Measurements

Capping beam demolition activity was conducted by using a 5t excavator hammer at the Project site. Operator-attended vibration survey were undertaken at the south-west corner of the Congregational Church. The highest vibration levels from the hammering activities were recorded.

5 Operator-attended Vibration Monitoring Results

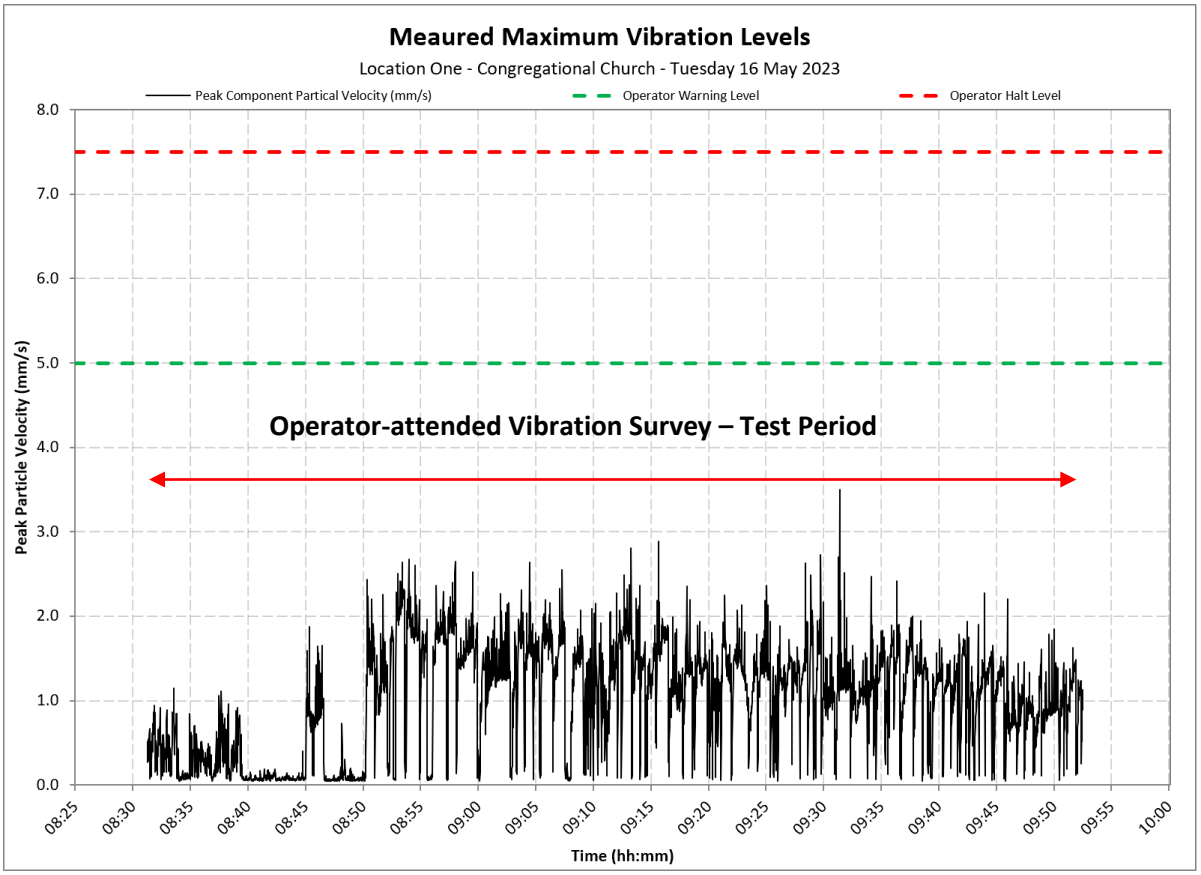
Table 2 presents a summary of the measured maximum vibration levels (in any orthogonal direction) at the monitoring location from the operations of the 5t excavator hammer. The histogram of the measured peak vibration levels at the monitoring location is also presented graphically in **Figure 2**.

Table 2 Summary of Maximum Vibration Levels

Plant/Equipment	Operating Mode	Measurement Location	Measured Maximum Vibration Level	Frequency	Vibration Criteria[1]	Vibration Assessment
5t Excavator Hammer	Hammering	Congregational Church (south-east corner)	3.5 mm/s	>100 Hz	5.0 mm/s 7.5 mm/s	Complies Complies

Note 1: Refer to **Table 1**. Operator warning level of 5.0mm/s and operator halt level of 7.5 mm/s in accordance with the CNVMP.

Figure 2 Measured Peak Vibration Levels



The measured vibration levels from the operator-attended vibration survey complied with the nominated project site specific vibration control criteria nominated in **Table 1**.

6 Conclusion

Operator-attended vibration survey conducted at Waterloo ISD found that the vibration emissions generated by the 5t excavator hammering complied with the relevant structural damage vibration control criteria as nominated in the CNVMP and would not cause structural damage to the existing Congregational Church structure.

I trust that the above report meets your current requirements. Should you have any questions or require any additional information, please contact me on 0412 888 423.

Regards,

YANG LIU
Principal - Construction Vibration

Appendix C – Structural Engineer and Heritage Consultant Advice

Tristan Rodrigues-JHG

From: Jennie Lindbergh <jenniel@ambs.com.au>
Sent: Tuesday, 18 July 2023 3:35 PM
To: Tristan Rodrigues-JHG
Cc: Sally Reynolds-ETP; Savannah Hodge-JHG; Lian Ramage
Subject: Re: Waterloo Capping Beam removal works

Hi Tristan,
Having inspected the church hall today, I am satisfied that no damage has been done dto the church hall as a result of the removal of the capping beam.
Thank you for escorting me.
Regards,

Jennie Lindbergh
Director Historic Heritage
M.Herit.Cons. M ICOMOS

Please note that I no longer work on Friday

ambs ecology & heritage
Gadigal Country Unit 14, 1 Hordern Place Camperdown NSW 2050 - http://ambs.com.au
jenniel@ambs.consulting - 02 9518 4489

AMBS acknowledges and respects the traditional custodians and ancestors of the lands on which we work

On Thu, 13 Jul 2023 at 15:32, Tristan Rodrigues-JHG <Tristan.Rodrigues@jhg.com.au> wrote:

> Hi Jennie,
>
> Capping beam removal works have been completed,
>
> Please let me know when you are planning to inspect and I can organise access
>
> Kind Regards
>
> **Tristan Rodrigues**
>
> Environment Advisor, Waterloo Station

Gadigal Country

84-88 Botany Road

Waterloo NSW 2016
M 0460 844 512

E tristan.rodrigues@jhg.com.au

W johnholland.com.au

From: Jennie Lindbergh <jenniel@ambs.com.au>
Sent: Tuesday, June 6, 2023 2:55 PM
To: Tristan Rodrigues-JHG <Tristan.Rodrigues@jhg.com.au>
Cc: Lian Ramage <lian@ambs.com.au>; Sally Reynolds-ETP <sally.reynolds@jcgjv.com.au>
Subject: Re: Waterloo Capping Beam removal works

Thanks Tristan,

I'll probably drop in next week to check the church hall.

Regards,

Jennie Lindbergh

Director Historic Heritage
M.Herit.Cons. M ICOMOS

Please note that I no longer work on Friday

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jenniel@ambs.consulting - 02 9518 4489

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On Tue, 6 Jun 2023 at 13:27, Tristan Rodrigues-JHG <Tristan.Rodrigues@jhg.com.au> wrote:

Hi Jennie,

It looks like stitch coring is scheduled for tomorrow 7/6/2023, with hammering to begin on Thursday at this stage.

Kind Regards

Tristan Rodrigues

Environment Advisor, Waterloo Station

Waterloo Integrated Station Development
A Joint Venture Project
JOHN HOLLAND
mirvac

Gadigal Country

84-88 Botany Road

Waterloo NSW 2016
M 0460 844 512

E tristan.rodrigues@jhg.com.au

W johnholland.com.au

I support **LGBTI+** Inclusion

Make flexibility work – if you receive an email from me outside of normal business hours, it's because I'm sending it at a time that suits me. I'm not expecting you to read it or reply until normal business hours.

From: Jennie Lindbergh <jenniel@ambs.com.au>
Sent: Wednesday, May 31, 2023 10:46 AM
To: Tristan Rodrigues-JHG <Tristan.Rodrigues@jhg.com.au>
Cc: Lian Ramage <lian@ambs.com.au>; Sally Reynolds-ETP <sally.reynolds@jcgjv.com.au>
Subject: Re: Waterloo Capping Beam removal works

Hi Tristan,

I've heard that the removal of the capping beam has been delayed. Could you let me know when it will be happening. As indicated I will inspect following removal,

Cheers,

Jennie Lindbergh

Director Historic Heritage
M.Herit.Cons. M ICOMOS

Please note that I no longer work on Friday

ambs ecology & heritage
Gadigal Country Unit 14, 1 Hordern Place Camperdown NSW 2050 - http://ambs.com.au
jenniel@ambs.consulting - 02 9518 4489

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On Sun, 28 May 2023 at 17:12, Jennie Lindbergh <jenniel@ambs.com.au> wrote:

> Hi Tristan,
>
> I have reviewed the methodology and agree that it is appropriate for removing the capping beam adjacent to the east elevation of the church hall. I note that the methodology and the Dilapidation Report refer to the building as the Church, rather than the church hall, which is the building attached to the east elevation of the Church.
>
> In particular, I note the following:
>
> - removal of the plywood and structural steel abutting the east wall of the church hall to leave an air gap of c.300mm between the capping beam and the wall.
> - a stitch core to be carried out at the approximate mid-point of the capping beam.

- that vibration levels are set at 3mm/s with Halt levels set at 5mm/s as a conservative measure. The vibration STOP level is 7.5mm/s. These levels are within the acceptable vibration levels of 3mm/s-8mm/s for a heritage structure'
- that matting will be placed against the wall to protect it from inadvertent damage from concrete debris.

All these actions together with monitoring of the vibration monitor will ensure against damage to the church hall during the removal of the capping beam.

Identification of the HALT and STOP levels of vibration, indicates that the process wi;; be monitored, which will ensure that any problems can be identified quickly.

If possible, I will inspect at completion of the removal.

Regards

Jennie Lindbergh

Director Historic Heritage
M.Herit.Cons. M ICOMOS

Please note that I no longer work on Friday

ambs ecology & heritage
Gadigal Country Unit 14, 1 Hordern Place Camperdown NSW 2050 - http://ambs.com.au
jenniel@ambs.consulting - 02 9518 4489

AMBS acknowledges and respects the traditional custodians and ancestors of the lands on which we work

On Fri, 26 May 2023 at 10:17, Tristan Rodrigues-JHG <Tristan.Rodrigues@jhg.com.au> wrote:

> Thanks Jennie,
>
> Please also see below more detailed methodology for the capping beam removal works as discussed on-site.
>
> - 5t Excavator with Hammer attachment is to be used for demolition of the concrete capping beam

- Prior to hammering all structural steel remains from previous walkway structure including plywood will be stripped, to limit the transmission of vibration through adjacent structures.
- Stitch core to be carried, approximately at the midway point, along the width of the capping (1000mm). Base of the cores to be approx. 200mm below the proposed cut level, to limit the transmission of vibration.
- At completion, a survey baseline will be carried of the Church Eastern Wall Face , including the structures corner for position and form the basis of our survey monitoring plan.
  We will continuously monitoring at 2 day Intervals, or when the project seems necessary, after halt level is reached.
  This survey monitoring will be provided to the Responsible Project Engineer for review
- Separation is noted between the Capping Beam and the Church Structure approx. 300mm (air gap)
- Approval has been provided from the Structure Permanent Works Designer , for loading the Station Structure, as the 5t Excavator will be positioned on the slab, limiting the vibration exerted by the excavator tracks during demolition.
- A requirement of “Crack Monitoring” was noted in an inspection, which will be carried out by installing,” Tell-Tale” Crack Monitors at certain identified cracks within the church, that shall monitor the cracks. Note as part of JHG OSD Works, some cracks are already set up.
- Demolition will commence from the Southern end of the zone and work towards the Stitch Core Location, once completed.
  Another stitch core at the most Northern end of the demolition zone will be cored through.
- Matting on the face of the church will be installed, where the strike zone of concrete debris would be. This will be a min of 1500mm from the top of the Capping Beam,
  This will be the same for strike zone towards the Station and the installed glazing
- The project currently has one vibration monitor installed within the Church and has been continuously monitoring vibration during Waterloo construction activities.
- The vibration monitor is installed on the East Face inside the Church
- Operator warning levels are set at 3mm/s with Halt levels set at 5mm/s as a conservative measure. The vibration STOP level is 7.5mm/s. The Environment Advisor, General Superintendent and Environmental Manager, Project Manager, will receive a text message alert at 3mm/s and 5mm/s. Following receipt of the alert, a review of the activities will be done to determine if any impact has occurred and if an alternate work method is required.

Kind Regards

Tristan Rodrigues

Environment Advisor, Waterloo Station

Waterloo Integrated Station Development
A Joint Venture Project
JOHN HOLLAND mirvac

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W johnholland.com.au

I support **LGBTI+** Inclusion

Make flexibility work – if you receive an email from me outside of normal business hours, it's because I'm sending it at a time that suits me. I'm not expecting you to read it or reply until normal business hours.

From: Jennie Lindbergh <jenniel@ambs.com.au>
Sent: Friday, May 26, 2023 9:00 AM
To: Tristan Rodrigues-JHG <Tristan.Rodrigues@jhg.com.au>
Cc: Lian Ramage <lian@ambs.com.au>; Sally Reynolds-ETP <sally.reynolds@jcgjv.com.au>
Subject: Re: Waterloo Capping Beam removal works

Hi Tristan

Thank you. I will review over the weekend and get back to you on Monday morning, latest. We are at all-day seminars today.

Cheers, Jennie

On Thu, 25 May 2023, 17:23 Tristan Rodrigues-JHG, <Tristan.Rodrigues@jhg.com.au> wrote:

> Hi Jennie/Lian,
>
> Nice to meet you on-site today,
>
> As discussed, please see attached survey report and advice from structural engineers around capping beam removal works.
>
> These works are planned to begin next week Tuesday 30th May with stitch coring, Hammering will then commence once stitch coring is completed which is expected to begin on Wednesday 31st May

Please review and provide any advice on these works.

Let me know if you require anything further

Kind Regards

Tristan Rodrigues

Environment Advisor, Waterloo Station

Gadigal Country

84-88 Botany Road

Waterloo NSW 2016
M 0460 844 512

E tristan.rodrigues@jhg.com.au

W johnholland.com.au

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MAIL TYPE	MAIL NUMBER	REFERENCE NUMBER
General Correspondence	RBG-GCOR-001672	JH-GCOR-033151

Re: Capping Beam Removal

From	Jody Cradock - Robert Bird Group
To	David Banjac - John Holland Pty Ltd
Cc (7)	Janet Marsh - John Holland Pty Ltd
	Mr Anthony Dodds - John Holland Pty Ltd
	Ms Maddelon Holt-Smith - John Holland Pty Ltd
	Mr Andrew Knispel - John Holland Pty Ltd
	Sally Reynolds - John Holland Pty Ltd
	Mr Anthony Coleman - John Holland Pty Ltd
	Mr Tristan Rodrigues - John Holland Pty Ltd
Sent	Friday, 12 May 2023

DETAILS

Discipline	Structural Engineering
Design Package	000 - Project Wide/Multiple
Phase	CP Construction Phase

MESSAGE

Hi David

We have reviewed the proposed methodology for the demolition of the capping beam and based on the previous monitoring and work completed we believe this methodology is appropriate.

The vibration monitoring should be maintained at the proposed warning levels of 3mm/sec and in accordance with the BS 7385 for sensitive structures. Additional survey monitoring should be completed of the church as works progress and in accordance with the current monitoring requirements.

Furthermore if the vibration monitoring and survey have not been exceeded during the demolition works, highlighted in yellow below, then it is reasonable to assume that future works which are no closer to the church will have a similar effect.

Regards

Jody

From: D Banjac
Sent: 10/05/2023 4:55:37 PM AEST (GMT +10:00)
To: David Banjac, Jody Cradock
Cc: Anthony Coleman, Anthony Dodds, Maddelon Holt-Smith, Andrew Knispel, Janet Marsh, Sally Reynolds, Tristan Rodrigues
Mail Number: JH-GCOR-033151
Subject: Capping Beam Removal

Discipline:	Structural Engineering
Design Package:	000 - Project Wide/Multiple
Phase:	CP Construction Phase

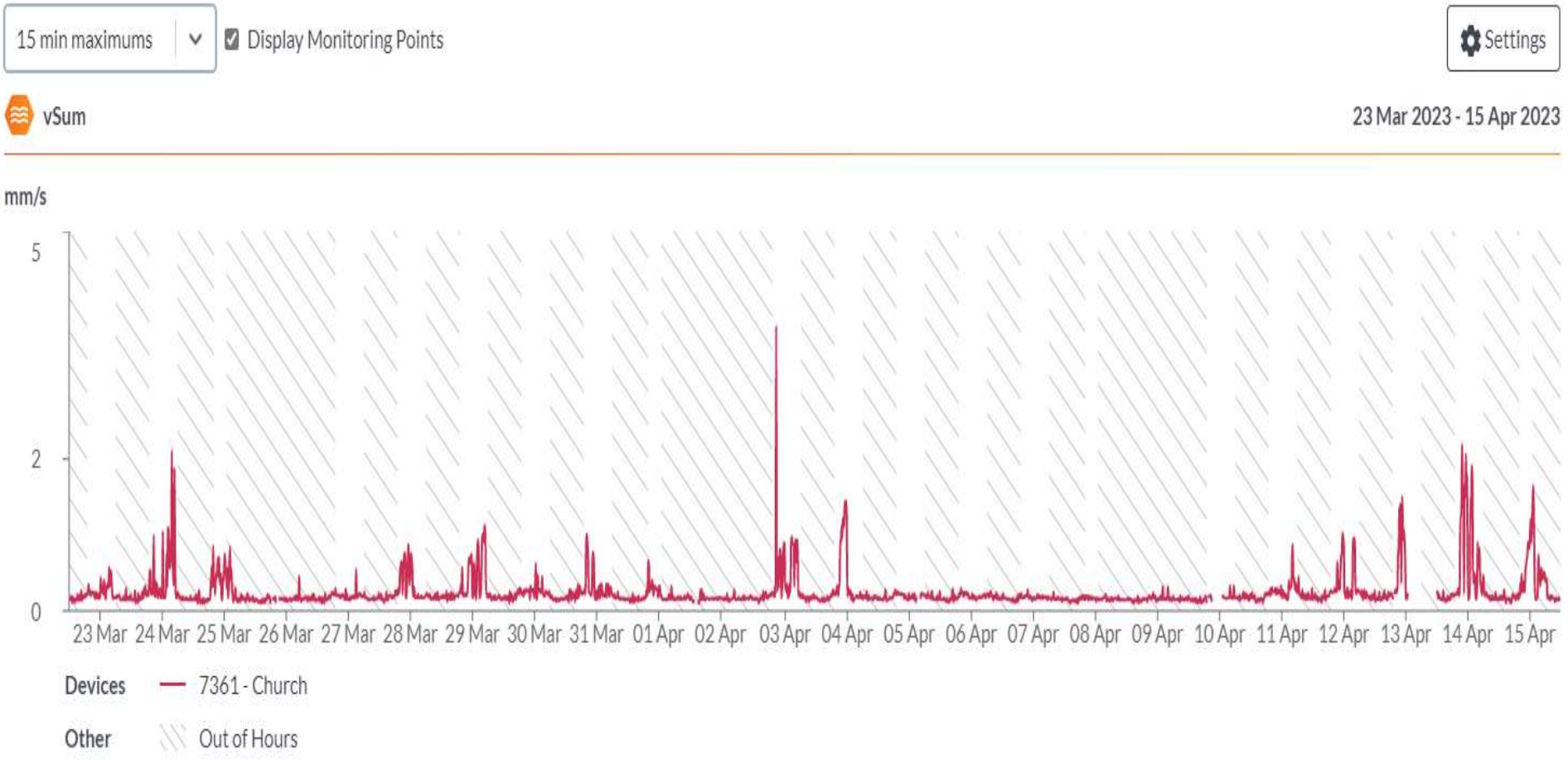
Hi Jody,

Please see below proposed methodology for demolition of the capping beam in vicinity of the heritage object, Waterloo Church, and advise if proposed is suitable:

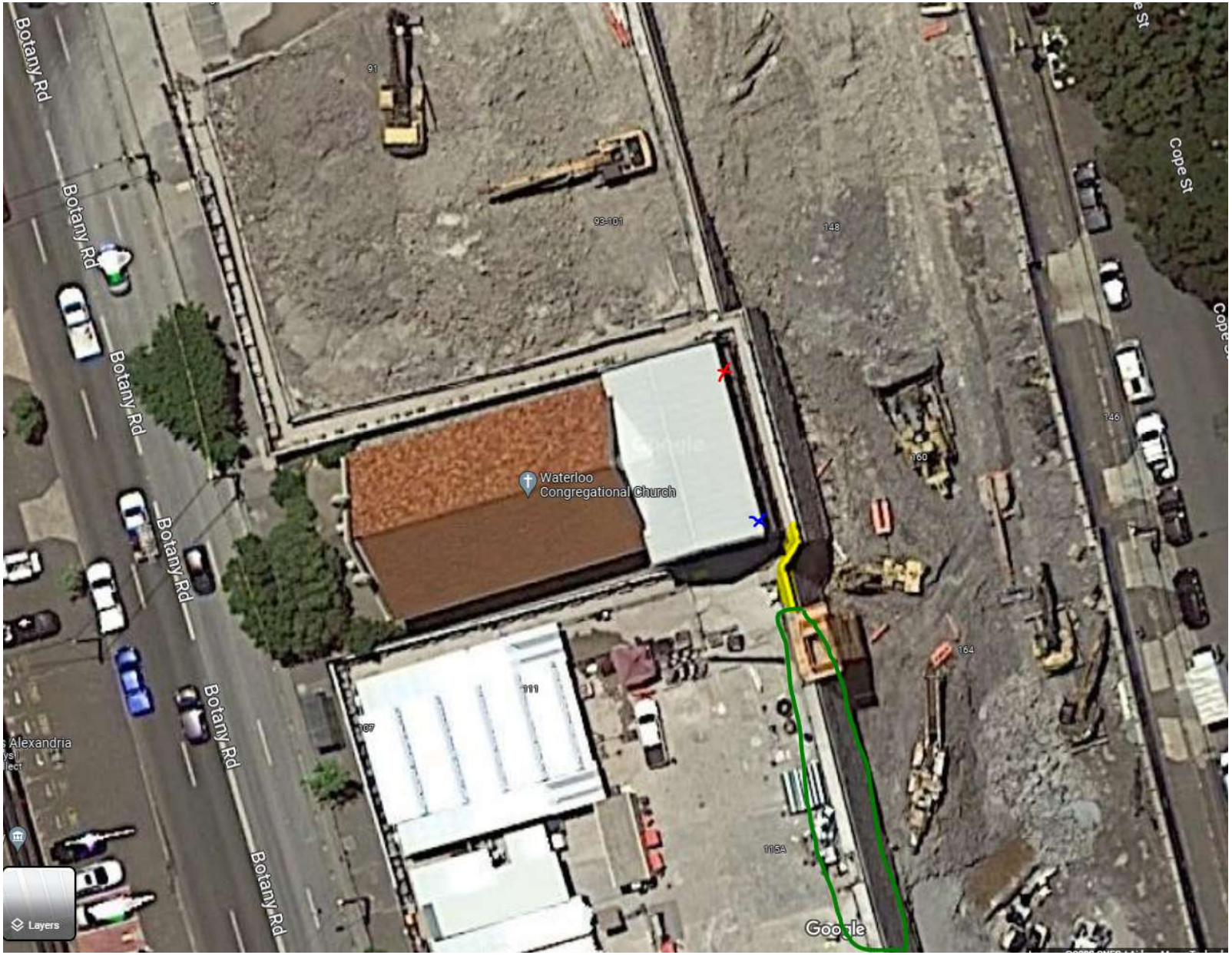
- 5t Excavator with Hammer attachment is to be used for demolition of the concrete capping;
- Prior to hammering, stitch coring will be completed on the Northern Extent of the immediate demolition.

- Stitch core to be carried out on Northern Extent and will go down approx. 1500mm below the Capping Beam, approx. 300mm below the proposed Cut level, to limit vibration extent
- There is also a small separation between the Capping Beam and the Church Structure, approx. 100-300mm
- Matting on the face of the church will be installed, where the strike zone of concrete debris would be. This will be a min of 1500mm from the top of the Capping Beam
- The project currently has one vibration monitor installed within the Church, and has been continuously monitoring vibration during Waterloo construction activities.
- The vibration monitor is installed on the Eastern Face inside the Church.
- Operator warning levels are set at 3mm/s with Halt levels set at 5mm/s as a conservative measure. The vibration STOP level is 7.5mm/s. The Environment Advisor, General Superintendent and Environmental Manager, Project Manager, will receive a text message alert at 3mm/s and 5mm/s. Following receipt of the alert, a review of the activities will be done to determine if any impact has occurred and if an alternate work method is required.

Note when we were removing the capping beam further south (Circled green) with a 14T excavator and hammer (23rd March-15th April) we did not report any exceedances of the criteria. Please see below monitoring data for reference.



Location of vibration monitor (marked red “x”), location of proposed capping beam demolition with 5T excavator (highlighted), proposed new location of vibration monitor for works (marked blue “x”). Completed capping beam demolition with 14T excavator with hammer.



Please send me your VO proposal for above scope but also include second stage demolition which will start in next 2 months. For the second stage, which is full length demolition behid the Church, we need assessment based on the results obtained during first stage works with instructions to proceed with minimum rist to the heritage object.

If there is anything else you need please let me know.

Regards,

David Banjac

Tristan Rodrigues-JHG

From: Mark Blake <mblake@vms.com.au>
Sent: Tuesday, 4 July 2023 3:56 PM
To: Tristan Rodrigues-JHG
Cc: Sally Reynolds-ETP; Mark Blake; Yang Liu; VMS Accounts
Subject: RE: Vibration monitoring church (10-1808)

Follow Up Flag: Follow up
Flag Status: Completed

Hi Tristan,

Further to our discussion and the information provided below and the additional raw data files, I note the following:

- For the Church, the approved CNVMP nominates a Warning level of 5mm/s PPV and a Halt level of 7.5mm/s PPV based on the Cosmetic Damage Vibration Criteria in accordance with British Standard (BS) 7385-Part 2:1993 *Evaluation and Measurement for Vibration in Buildings*, where PPV (Peak Particle Velocity) is equivalent to Peak Component Particle Velocity (PCPV) vibration parameter nominated in BS7385.
- When assessing the measured vibration levels against the CNVMP, the following parameters are to be assessed from the Texcel monitoring system at the site:
    - Radial PPV
    - Transverse PPV
    - Vertical PPV
- The Peak Vector Sum Velocity (PVS) level is not the assessable parameter.
- Where the Warning and Halt levels are exceeded, it is appropriate to review the PPV levels and corresponding Zero Crossing Frequency (labelled as Frequency (ZC at Peak) on the Texcel report) against the frequency dependent criteria curve in BS7385 (refer to Table 12 in the CNMVP for dwellings). If the recorded vibration level is below the BS7385 criteria curve, then there is negligible risk of vibration induced cosmetic damage and the works may proceed without modification. If it is above, the works methodology will have be revised to reduce the vibration emissions.
- I have reviewed the supplied vibration data from yesterday and summarise the findings as follows:
    - Maximum PCPV was 7.87mm/s (though this is not the assessable parameter)
    - Maximum PPV (or PCPV) was 6.47mm/s at 20Hz
    - The maximum PPV is below the Halt level of 7.5mm/s
    - The maximum PPV is below the BS7385 Minimal Risk of Cosmetic Damage Level at 20Hz of 13mm/s for continuous vibration
    - All other recorded PPV/ZC were also below the corresponding BS7385 Minimal Risk of Cosmetic Damage Levels
- On the basis of the above the works may proceed with caution.
- Additional controls to consider include:
    - Use smaller hammers (hand held)
    - Change direction/angle hammering
    - Use low vibration generating excavation alternative (e.g. high pressure water (hydro) excavation)
    - Create an isolation cut (air gap) in the ground/slab between the capping beam and the church foundation

I trust the above meets your current requirements.

Regards,

Mark Blake
Managing Director
VMS Australia Pty Ltd
Acoustics · Noise · Vibration · Blasting

Email: mblake@vms.com.au
Phone: 1800 867 000
Mobile: 0439 006 867
Web: www.vms.com.au

From: Tristan Rodrigues-JHG <Tristan.Rodrigues@jhg.com.au>
Sent: Tuesday, July 4, 2023 2:02 PM
To: Mark Blake <mblake@vms.com.au>
Cc: Sally Reynolds-ETP <sally.reynolds@jcgjv.com.au>
Subject: FW: Vibration monitoring church

Hi Mark,

Yang advised he was on leave,

Please see below

Kind Regards

Tristan Rodrigues
Environment Advisor, Waterloo Station

Waterloo Integrated Station Development
A Joint Venture Project
JOHN HOLLAND
mirvac

Gadigal Country
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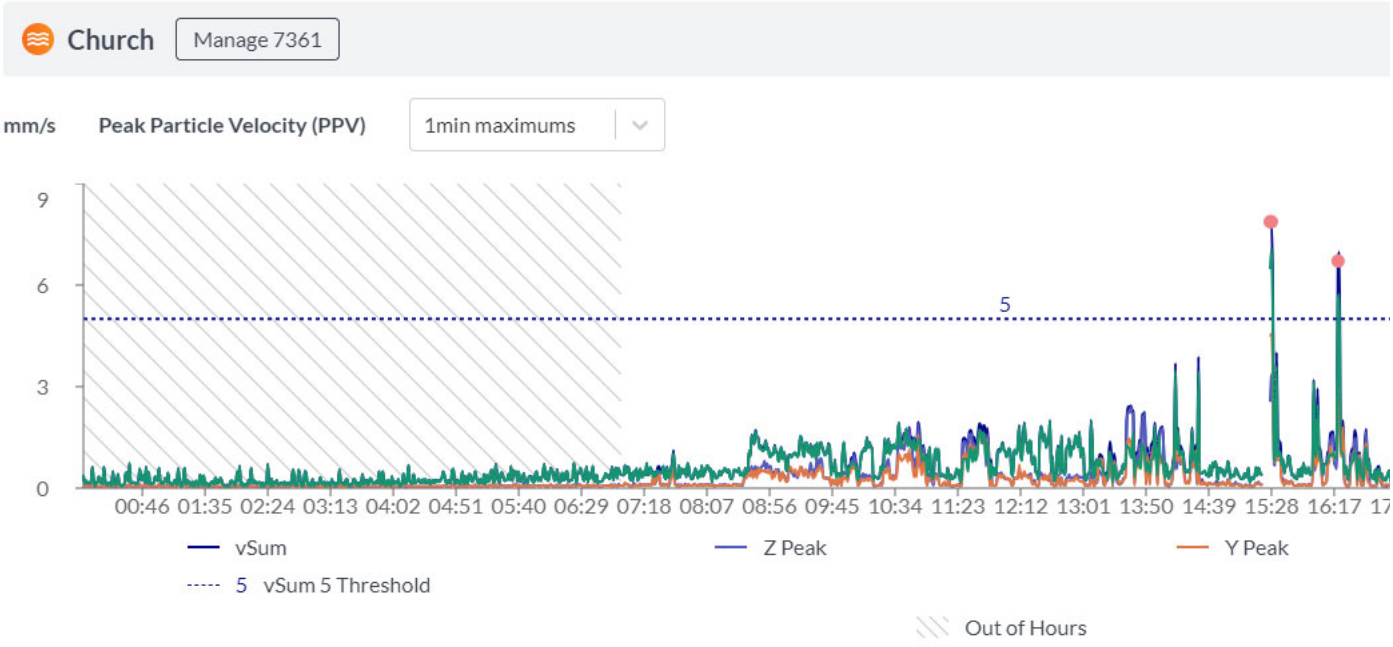
From: Tristan Rodrigues-JHG
Sent: Tuesday, July 4, 2023 1:55 PM
To: Yang Liu <yliu@vms.com.au>
Cc: Sally Reynolds-ETP <sally.reynolds@jcgjv.com.au>
Subject: Vibration monitoring church

Hi Yang,

We reported the following vibration exceedances whilst completing the capping beam demolition behind the church.
See below results.
Could you please give me a call to talk through results and advise.



Kind Regards

Tristan Rodrigues
Environment Advisor, Waterloo Station

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Appendix D – Community Notification

Project Update

July 2023

Sydney Metro is Australia's biggest public transport project.

Services started in May 2019 in the city's North West with a train every four minutes in the peak. Metro rail will be extended into the CBD and beyond to Bankstown, with new CBD metro railway stations at Martin Place, Pitt Street and Barangaroo and new metro platforms at Central. By 2030, Sydney will have a network of four metro lines, 46 stations, and 113km of new metro rail.

The new Waterloo integrated station development includes construction of the new Waterloo metro station by John Holland, while a joint venture between John Holland and Mirvac will deliver the Waterloo Metro Quarter, including buildings above and next to the station.

Systems Connect (an unincorporated joint venture between CPB Contractors and UGL Limited) is delivering line-wide work including installing metro rail track, power systems and infrastructure to turn the excavated tunnels into a working railway between Chatswood and Sydenham. Line-wide work also includes the permanent systems, services and buildings required for Sydney Metro operations between Chatswood and Bankstown.

Upcoming work in July around Waterloo Station

Construction activity at Waterloo Station is taking place 24 hours a day, seven days a week, including fit-out work within the tunnels. An indicative work schedule for July is listed below.

Standard construction hours are Monday to Friday, 7am to 6pm and Saturday, 8am to 6pm

Waterloo Station:

- Vehicle movements of plant, equipment, and materials including concrete truck deliveries.
- Excavation, waterproofing, formwork, steel and reinforcement installation, welding, concrete pouring, blockwork, removal of the capping beam, saw cutting, wire sawing, hammering, stripping activities, installation of internal architectural cladding, and acoustic screens.
- Delivering and removing equipment, machinery, and materials.
- Crane lifts of equipment and materials around the site.
- Installation of building façade including use of cranes and elevated work platform (EWP).
- Testing and commissioning

Wellington, Buckland, Cope and Raglan streets and Botany Road:

- Utility work on Cope, Raglan and Wellington streets and Botany Road.

- Civil work including new kerbs, drainage, garden beds, removal of roundabouts, footpath upgrades and new dwarf wall on the corner of Raglan and Cope Street.
- These activities will include traffic control, pedestrian diversions, potholing, road sawing, excavation, pipe and conduit installation, cable installation, removal of redundant services and reinstatement of the area.
- Concrete pouring and crane lifts from within the Cope Street work area.
- Installation of building façade including use of cranes and EWP.

Waterloo over station development:

- Utility work on Wellington Street and Botany Road including upgrading Telstra conduits and pits, Sydney Water main and Ausgrid high voltage work.
- Delivering and removing equipment, large machinery, and materials.
- Archaeological investigations within site boundary.
- Crane establishment on South Station Box
- Wellington Street and Botany Road driveway access changes
- B-class hoarding installation on Botany Road
- Kiosk removal on Raglan Street
- Piling preparation works in the northern and southern precincts, including oversized deliveries and use of heavy vehicles

Work taking place outside standard construction hours (OOHW)

Waterloo Station:

- Concrete finishing work within the site.
- Deliveries (including loading and unloading), removing equipment, machinery, and materials.
- Steel fixing, formwork, waterproofing, blockwork, scaffolding, welding, core-holing, removal of the capping beam, structural steel installation and station fit-out, services installation, stripping activities, installation of internal architectural cladding, and acoustic screens.
- Crane lifts of equipment and materials will take place around the site.
- Prefabricated elements will be delivered to either Botany Road, Cope or Wellington streets, then lifted from the vehicle on to site.
- Installation of building façade including use of cranes and EWP.

Wellington, Cope, Buckland and Raglan streets, Botany and Henderson roads

- Utility work on Cope, Raglan, Buckland and Wellington streets and Botany and Henderson roads.
- Civil work including new kerbs, drainage, garden beds, removal of roundabouts and footpath upgrades.

- These activities will include traffic control, pedestrian diversions, potholing, road sawing, excavation, conduit and cable installation, concrete pouring, removal and installation of light footings and reinstatement of the area.
- To complete some utility work, power or water outages may be required. These will be carried out at the direction of the utility company and any impacted residents will be notified.
- Delivering and removing equipment, machinery and materials.
- Vehicle movements of plant, equipment and materials including oversized deliveries.
- Use of site cranes within the site and along Cope Street.
- Installation of building façade which includes use of cranes and EWP.
- Installing overhead gantry protection along Wellington Street and Botany Road
- Crane establishment on South Station Box.

Map of Waterloo Station work activities

What to expect

- Equipment used will include, but is not limited to, hand-held and electric tools, jack-hammers, welders, power drills, excavators, compaction equipment, elevated work platforms, concrete trucks, concrete mixers and pumps, sweeper, cranes, light and heavy vehicles, pavement cutters, vacuum trucks, asphalt compactors, piling rig and vibratory roller. A mechanical hoist and fans operate inside the station box.

- Due to the nature of the work, nearby residents may be able to hear noise and feel vibration from some of the work. The project team will limit these impacts wherever possible. A range of mitigation measures are in place to meet the project's approval conditions and reduce noise, including turning off equipment when not in use and, where possible, equipping machinery with non-tonal movement alarms and using acoustic sheeting. Respite from high impact work such as hammering is also provided. This includes three hours of work, followed by one hour respite.
- Temporary traffic changes will be in place for the safety of workers and the community during this work, including reduced speed limits, footpath, removal of parking and lane closures. The Cope Street closure (between Raglan and Wellington streets) is ongoing.
- Updates about out-of-hours work will be distributed via email rather than letterbox drop. To ensure you receive these updates, sign up to our email distribution list.

Systems Connect and MTR Australia work at Waterloo Station

Systems Connect will be accessing the tunnels through the Waterloo Station site to undertake tunnel fit-out activities 24 hours, seven days a week. Systems Connect will also be installing station room equipment within the station box. Installation of TVS and drainage equipment, cables and terminations throughout the station. Ongoing testing and commissioning activities of electrical services, including power, communications and signalling equipment and systems, ventilation systems and dynamic train testing in the tunnels.

MTR Australia is delivering the installation of platform screen doors at Waterloo Station and the communications and signalling systems across the City & Southwest project. In July, installation of cables, communications and signalling equipment will continue as well as testing and commissioning of trains, platform screen doors, and communications equipment.

July Community Events at Waterloo

Archaeological Open Day: Friday 7 July from 12pm to 2pm at 78-82 Wyndham Street, Alexandria, NSW, 2015 for a peek into Waterloo's past with a presentation and display of artefacts discovered during excavations at Waterloo Metro Quarter presented by AMBS Ecology & Heritage archaeologists on behalf of John Holland and Mirvac. Presentations will be held at 12:15pm and 1:15pm

Community Connect: Thursday 20 July from 1:30pm to 3pm at Café Japanon, 129 Raglan Street, Waterloo, NSW, 2017. Please drop in for a coffee and cake with members of our project team who will be ready to answer any questions about the Waterloo Station project and the over-station development. Construction activity at Waterloo Station is taking place 24 hours a day, seven days a week, including fit-out work within the tunnels. An indicative work schedule for July is listed in the table below.

Contact us

If you have any questions about the Waterloo integrated station development or Waterloo Metro Quarter, please contact Savannah Hodge on **1800 171 386** or email waterloometro@transport.nsw.gov.au

For questions about the tunnel fit-out work by Systems Connect please contact Hubavina Barbolova on **1800 171 386** or email linewidemetro@transport.nsw.gov.au

Have your say

If you have any questions or would like more information please contact our project team:

1800 171 386 Community information line
open 24 hours

sydneymetro@transport.nsw.gov.au

Sydney Metro City & Southwest,
PO Box K659, Haymarket NSW 1240

Translating and interpreting service

If you need help understanding this information, please contact the Translating and Interpreting Service on **131 450** and ask them to call us on **1800 171 386**