Construction Monitoring Report September 2023 – February 2024

Sydney Metro City & Southwest – Line-wide Works

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Document Approval

Rev.	Date	Prepared by	Reviewed by	Remarks
0	21/03/2024	N. Nasser	T McCormick	
1	30/04/2024	N. Nasser	T McCormick	
2	9/05/2024	N. Nasser	T McCormick	
Signature:				

Revision Details

Revision	Details
0	For Information
1	Addressing reviewer comments
2	Addressing reviewer comments

Contents

1. Introduction

1.1 Project Summary

The Sydney Metro City & Southwest (SMCSW) is the second portion of the new standalone rail network known as the Sydney Metro, which is Australia's largest public transport infrastructure project and a priority rail project for the NSW Government. The project will extend Sydney Metro Northwest to the CBD and beyond to Bankstown. The project is being delivered through a suite of contracts for the tunnels, stations, Line-wide infrastructure and systems. Line-wide is a key component of the SMCSW, with works taking place over the full length of the project as shown in Figure 1 below:

Figure 1: Line-wide Locations

1.2 Planning Approval Requirements

The Sydney Metro Authority received planning approval to construct the project from the Department of Planning and Environment. The Conditions of Approval CSSI 7400 cover the works from Chatswood to Sydenham and the Conditions of Approval CSSI 8256 cover the works from Marrickville to Bankstown.

A Construction Environmental Management Plan and sub-plans were developed for the project to address all environmental aspects, including construction monitoring. Approval of the plans enabled commencement of construction on 4 March 2020. The plans for the Line-wide works were developed to address the requirements of both planning approvals in each plan or sub-plan. Construction monitoring requirements are detailed in the Soil, Water and Groundwater Management Sub-Plan C2B and the Construction Noise and Vibration Management Plan – C2B. The plans can be accessed at the CPB Sydney Metro City & Southwest Line-wide Works Project website:

https://www.cpbcon.com.au/en/our-projects/2018/sydney-metro-line-wide-works

The objectives for this report are to provide construction monitoring results for the six (6) months of works on the Line-wide Project, from the start of September 2023 to the end of February 2024. This construction monitoring report is the eighth issue since Line-wide construction works commenced in 2020. This report is provided for information to the Department of Planning and Environment. It is intended to address the requirements of Conditions C16 of CSSI 7400 and C14 of CSSI 8256.

2. Water Quality Monitoring

The Soil, Water and Groundwater Management Sub-Plan C2B requires that water quality monitoring will be undertaken for controlled discharges offsite to watercourses and stormwater drainage to ensure compliance with discharge criteria. The discharge criteria are shown in the Table 1 below:

Table 1: Surface Water Quality Criteria for discharging off premises

Parameter	Measurement and Assessment			Discharge Criteria
	Percentile Concentration Limit	**Sample Method & Frequency**	**Units**	
pH	100	Probe/ grab sample Prior to discharge	pH	6.5-8.5
Total Suspended Solids	100	Probe/ grab sample Prior to discharge	mg/L	<50
Oil and Grease	Not visible	Visual Prior to discharge	mg/L	Not visible

In August 2023, the EPA issued a licence variation, which introduced new discharge concentration limits for the Marrickville water treatment plant discharge point 3 and requested results be reported monthly. As shown in Table 2 below.

Table 2: Marrickville Water Treatment Plant Discharge Criteria (Point 3)

Parameter	Measurement and Assessment			Discharge Criteria
	Percentile Concentration Limit	**Sample Method & Frequency**	**Units**	
pH	100	Probe/ grab sample Prior to discharge	pH	7-8.5
Turbidity	100	Probe/ grab sample Prior to discharge	NTU	25
Oil and Grease	Not visible	Visual Prior to discharge	mg/L	Not visible
Nickel	100	Grab sample	mg/L	0.007
Copper (dissolved)	100	Grab sample	mg/L	0.008
Zinc	100	Grab sample	mg/L	0.021
Iron	100	Grab sample	mg/L	0.3
Ammonia	100	Grab sample	mg/L	2.4
Nitrate	100	Grab sample	mg/L	10.6

To comply with EPL condition 21423 M3.3, sampling is undertaken at the source (influent/input) and the discharge point (effluent/output) at the Marrickville water treatment plant.

There were no exceedances at Discharge Point 3 between September 2023 and February 2024 (refer to Appendix B). Monthly results were reported to the EPA within two weeks of the sampling event, as required.

2.1 Permit to Dewater

Systems Connect have an internal Permit to Dewater system, which ensures compliance with discharge criteria at all times. Monitoring is done prior to each dewatering event. The Systems Connect Permit to Dewater and Water Quality Monitoring Register is provided in Appendix A. This demonstrates that discharge criteria were met for all discharges.

2.2 Water Treatment Plant

On 1 August 2020, Systems Connect took possession of a portion of the Chatswood Dive site from the Tunneling and Station Excavation Contractor. The portion contained the Chatswood Water Treatment Plant (WTP), which was operated by Systems Connect in the reporting period. The WTP processed and treated surface water from the Chatswood Dive site, and tunnel water between Barangaroo and the Chatswood Dive. The Chatswood Water Treatment Plant was decommissioned on the 28th of June 2023.

From November 2021, the construction WTP at Marrickville became operational. This WTP takes water from the tunnels between Barangaroo and the Marrickville Dive. From 28th June 2023 the Marrickville WTP began processing water from the tunnels between the Chatswood Dive and the Marrickville Dive. On the 3rd of August 2023, discharge point 3 was added to EPL #21423 for the operational WTP. The switch from the construction WTP to operational WTP was made in September 2023.

A WTP Checklist is completed by the WTP operator daily (working days), where a range of WTP observations, parameters and chemical levels are noted. This includes water discharge parameters required for regulatory compliance. The compliance results from the checklists completed during the reporting period are described in Table 4 below:

Table 4: WTP Compliance Results

WTP	Date	pH	Turbidity (NTU)	Oil and Grease
Marrickville	1/09/2023 to 29/02/2024	7.1 – 7.9	0.2 – 1.7	None visible

At the Marrickville water treatment plant under Systems Connect control, the discharge parameters pH, TSS and NTU are to be sampled monthly. Results demonstrating compliance are provided in Appendix B. As part of the August 2023 EPL licence variation, additional monthly discharge water monitoring requirements were introduced for the Marrickville WTP. These monthly discharge water monitoring results are also provided in Appendix B.

2.3 Receiving Water Monitoring

The Soil, Water and Groundwater Management Sub-Plan C2B requires that monitoring of receiving waters will occur quarterly, while WTPs are active and in SC control. Monitoring parameters are provided in Table 5 below:

Table 5: Surface Water Quality Parameters

Parameter	Sample Method	Analytical method	ANZECC[1, 2] Criteria (freshwater)	ANZECC [1, 3] Criteria (marine water)[7]	Trigger Values	Action
Temperature (ºC)	Probe	Field Analysis	>80%ile[4] <20%ile[4]		Results are > than the baseline 80th percentile	Environment Coordinators to re-test to confirm results. Environment Coordinator is to undertake an inspection of the Works and propose actions where required Note: There is a delay in receiving the results from grab samples. Environment Coordinator to obtain further grab samples for testing to confirm results. Environment Coordinator to undertake an inspection once results received and establish what activities had been undertaken prior to the tests being undertaken and propose actions where required.
Dissolved Oxygen (%Sat)	Probe	Field Analysis	Lower Limit: 85 Upper Limit: 110	Lower Limit: 90 Upper Limit: 110		
Turbidity (NTU)	Probe	Field Analysis	6-50	0.5-10		
Oil and Grease	Visual analysis, then grab sample if required	Visual Assessment Lab Analysis	-	-	Visible oil and grease	
Conductivity (µS/cm)[6]	Grab Sample and Probe	Field Analysis Lab Analysis	125 – 2200	-	Results are > than the baseline 80th percentile	
Total Suspended Solids (TSS: mg/L)	Grab Sample	Lab Analysis	-	-		
Iron (mg/L)			0.3[5]	-		
Manganese(mg/L)			1.7	0.8		
pH	Grab Sample and Probe	Field Analysis Lab Analysis	Lower Limit: 6.5 Upper Limit: 8.0	Lower Limit: 8.0 Upper Limit: 8.4		

Notes:

[1] 95% protection level – most commonly applied to ecosystems that could be classified as slightly to moderately disturbed.

[2] ANZECC (2000) guidelines for the protection of freshwater aquatic ecosystems

[3] ANZECC (2000) guidelines for the protection of marine aquatic ecosystems

[4] Default trigger value for each ecosystem-type

[5] There is insufficient data at this stage to derive a reliable value for iron. The current Canadian guideline has been used.

[6] Conductivity will not be tested at monitoring points at estuarine/marine catchments.

[7] Applicable to monitoring location SW-AC-01

- No data available

Only the receiving waters downstream of the Marrickville WTP was applicable for monitoring during this period. The sampling point downstream of the Marrickville WTP is in the Alexandra Canal. Sampling points are described in Table 6 below:

Table 6: Sampling Point Information

Site ID	Site interaction	Relative location	Catchment	Sampling address	Easting	Northing	Type
SW-AC-01	Receiving waters from Marrickville WTP discharges. Monitoring location active while the Marrickville WTP is active and in SC control.	Downstream	Alexandra Canal	Access via bicycle track from the end of Coward Street, Mascot	331342	6244783	Marine

The results of the receiving water monitoring are provided in Appendix C.

3. Noise and Vibration

The Construction Noise and Vibration Management Plan – C2B includes the Construction Noise and Vibration Monitoring Program. This program requires that the results of construction noise and vibration monitoring be reported every six months. The results for this monitoring period are included in this report.

3.1 Noise Monitoring

Section 8.1.4 of the CNVMP states that: “Attended monitoring of construction noise levels will be undertaken as follows:

- At the first opportunity following the commencement of construction activity to confirm the effectiveness of actions and measures determined in CNVIS process
- Repeated as described in the CNVIS, as part of the audit cycle to ensure that noise and vibration levels in the adjacent community remain consistent with the predicted levels in the CNVIS
- Where appropriate in response to a noise related complaint(s) (determined on a case-by-case basis)
- During sensitive periods (i.e. night works)
- As directed by an authorised officer of the EPA.

Monitoring would be undertaken at the potentially most exposed receivers in proximity to construction activities. Noise monitoring locations should be consistent with the distances/ locations identified in the CNVIS and will consider factors including:

- The location of previous monitoring sites
- The proximity of the receiver to a worksite
- The sensitivity of the receiver to noise
- Background noise levels
- The expected duration of the impact.”

As the project nears its conclusion and moves closer towards operations, the work activities subject to noise monitoring outside of standard construction hours within the reporting period was predominantly for substation energisation. Other construction activities monitored included the erection of hoarding and fencing works within the rail corridor.

Summary results of attended noise monitoring conducted by Systems Connect in the reporting period are provided in Appendix D (Systems Connect Noise Monitoring Register), including the above extract from the management plan. All noise monitoring demonstrated compliance within the reporting period with the exception of four receiver locations in Marrickville following the energisation of the Dulwich Hill traction substation.

One rectifier transformer is required to operate continuously to enable the testing and commissioning of the Dulwich Hill traction substation and the connected Sydney Metro City and Southwest high voltage power supply network. As such, the corrective action was to obtain an approved out of hours works permit that will remain in place until permanent noise mitigating enclosures are constructed around the two rectifier transformers. Noise blankets have been temporarily installed around the operating rectifier transformer to mitigate noise in the interim.

Noise monitoring equipment details, including make, model, serial number, last calibration date and NATA testing facility, are provided in Appendix E.

Further details are collected for each field reading, including time, duration, meteorological conditions and extraneous noise sources during reading. Samples of Noise Monitoring Record Sheets are provided in Appendix F. Others are available on request.

3.2 Vibration Monitoring

The Construction Noise and Vibration Management Plan – C2B explains that: “the requirement for real time vibration monitoring will be determined on a site-by-site basis and identified in the CNVIS for LW worksites between Chatswood and Sydenham. Real time vibration monitoring will be deployed to

manage vibration impacts from ‘high risk’ sites, where the CNVIS vibration predictions identify there is a high risk of annoyance (or potential building damage) from construction vibration.”

During the reporting period, there were three work campaigns where vibration monitoring was undertaken. On two occasions, vibration monitoring was required for hammering works within the minimum working distance to the Sydney Dental Hospital located on Randle Lane, Surry Hills. Vibration monitoring was also required for demolition works adjacent to the heritage listed Mowbray House, located within the Chatswood Dive site. All vibration monitoring campaigns demonstrated compliance and construction activities were measured below their specific screening criterion. Summary results demonstrating compliance with vibration criteria are included in Appendix G (Systems Connect Vibration Monitoring Register).

The Vibration Monitoring Reports are provided in Appendix I and vibration monitoring equipment details, including make, model, serial number, last calibration date and NATA testing facility, are provided in Appendix H.

Appendix A: Systems Connect Permit to Dewater and Water Quality Monitoring Register

Systems Connect LWW Permit to Dewater and Water Quality Monitoring Register

Permit to Dewater	Date	Location	Detailed Monitoring Location	Single or Continuous	Reason	Discharge Point	Water Quality Analyser	pH	Turbidity NTU	Oil & Grease
Permit to Dewater LWW-256	4/09/2023 - 4/10/2023	Marrickville WTP	N/A	Continuous	For discharge approval	Marrickville WTP Discharge Point 3	NA	NA	NA	NA
Permit to Dewater LWW-257	4/10/2023 - 4/11/2023	Marrickville WTP	N/A	Continuous	For discharge approval	Marrickville WTP Discharge Point 3	NA	NA	NA	NA
Permit to Dewater LWW-258	4/11/2023 - 4/12/2023	Marrickville WTP	N/A	Continuous	For discharge approval	Marrickville WTP Discharge Point 3	NA	NA	NA	NA
Permit to Dewater LWW-259	4/12/2023 - 4/01/2024	Marrickville WTP	N/A	Continuous	For discharge approval	Marrickville WTP Discharge Point 3	NA	NA	NA	NA
Permit to Dewater LWW-260	4/01/2024 - 4/02/2024	Marrickville WTP	N/A	Continuous	For discharge approval	Marrickville WTP Discharge Point 3	NA	NA	NA	NA
Permit to Dewater LWW-261	4/02/2024 - 4/03/2024	Marrickville WTP	N/A	Continuous	For discharge approval	Marrickville WTP Discharge Point 3	NA	NA	NA	NA

Appendix B: Monthly WTP Sampling

Monthly Water Quality Monitoring - Marrickville WTP

MKV-O Discharge point

Date	Time	Sample ID	pH	Turbidity (NTU)	Oil & Grease (visible/none visbile)	Ni	Cr	Cu	Zn	Fe	Ammonia	Nitrate	Nitrogen	Phosphorous
18/09/2023	9:00:00 AM	MKV-O	7.82	0.9	None Visible	0.002	<0.001	0.002	<0.005	<0.05	0.09	2.33	3.3	0.01
16/10/2023	10:00:00 AM	MKV-O	7.82	0.8	None Visible	0.001	<0.001	<0.001	<0.005	<0.05	0.15	3.8	5.4	0.01
13/11/2023	8:30:00 AM	MKV-O	7.84	0.7	None Visible	0.001	<0.001	<0.001	<0.005	<0.05	0.05	2.94	4.7	0.02
18/12/2023	8:00:00 AM	MKV-O	7.93	0.8	None Visible	<0.001	<0.001	0.002	<0.005	<0.05	0.02	2.98	3.8	0.04
22/01/2024	9:00:00 AM	MKV-O	7.45	1.3	None Visible	0.002	0.002	0.002	<0.005	<0.05	0.02	3.49	4.7	1.3
19/02/2024	8:00:00 AM	MKV-O	7.81	0.8	None Visible	<0.001	0.002	<0.001	<0.005	<0.05	0.11	4.11	5.2	0.03

Appendix C: Receiving Water Monitoring Results

Quarterly Downstream Surface Water Quality Monitoring - Marrickville

			Field Results						Lab Results			
Date	Time	Sample ID	Temperature (C)	Dissolved Oxygen (%)	Turbidity (NTU)	Conductivity (µS/cm)	pH	Oil & Grease (Y/N)	Total Suspended Solids (mg/L)	pH	Manganese (mg/L)	Iron
24/10/2023	10:53:00 AM	SW-AC-01	22.5	146.6	21.2	38700	8.32	N	8	7.42	<0.01	<0.10
24/01/2024	7:30:00 AM	SW-AC-01	23.6	52.2	8.5	43100	7.63	N	2	7.54	<0.01	<0.10

Appendix D: Systems Connect Noise Monitoring Register

Systems Connect LWW Noise Monitoring Register

Date	Location	Detailed Monitoring Location	NCA	Predicted Noise Level $L_{Aeq, 15min}$	Measured $L_{Aeq, 15min}$	Comments
7/09/2023	Dulwich Hill TSS	20 Randall Street, Marrickville	S2B_02	38	40	One rectifer transformer is reqired to operate continuously in order to enable the required testing and commssioning of the Dulwich Hill traction substation and the connected Sydeny Metro City & Southwest high voltage power supply network. The operating transformer measured 2dB above predicted. Review of works, assessment and monitoring has been completed. Noise modelling revised and the measured data included into the OOHW permit, triggering letterbox notification. Corrective action to ensure noise compliance is to construct enclosures around the rectifer transformers.
7/09/2023	Dulwich Hill TSS	17 Abermarle Street, Marrickville	S2B_02	38	37	Below predicted, LW works compliant.
7/09/2023	Dulwich Hill TSS	19 Abermarle Street, Marrickville	S2B_02	38	47	One rectifer transformer is required to operate continuously in order to enable the required testing and commssioning of the Dulwich Hill traction substation and the connected Sydeny Metro City & Southwest high voltage power supply network. The operating transformer measured 9dB above predicted. The measurement location was at the property boundary of the residence, located approximately 8m from the closest facade. Adjusting for this distance offset, it is likely that the measured LAeq would be reduced by 4 dB(A). Noise modelling revised and the measured data included into the OOHW permit, triggering letterbox notification. Corrective action to ensure noise compliance is to construct enclosures around the rectifer transformers.
7/09/2023	Dulwich Hill TSS	23 Abermarle Street, Marrickville	S2B_02	38	49	One rectifer transformer is required to operate continuously in order to enable the required testing and commssioning of the Dulwich Hill traction substation and the connected Sydeny Metro City & Southwest high voltage power supply network. The operating transformer measured 11dB above predicted. The measurement location was at the property boundary of the residence, located approximately 11m from the closest facade. Adjusting for this distance offset, it is likely that the measured LAeq would be reduced by 6 dB(A). Noise modelling revised and the measured data included into the OOHW permit, triggering letterbox notification and monitoring. Corrective action to ensure noise compliance is to construct enclosures around the rectifer transformers.
7/09/2023	Dulwich Hill TSS	7 Randall Street, Marrickville	S2B_02	38	33	Below predicted, LW works compliant.
7/09/2023	Dulwich Hill TSS	Challis Avenue, Dulwich Hill	S2B_02	38	40	One rectifer transformer is required to operate continuously in order to enable the required testing and commssioning of the Dulwich Hill traction substation and the connected Sydeny Metro City & Southwest high voltage power supply network. The operating transformer measured 2dB above predicted. Review of works, assessment and monitoring has been completed. Noise modelling revised and the measured data included into the OOHW permit, triggering letterbox notification. Corrective action to ensure noise compliance is to construct enclosures around the rectifer transformers.
7/09/2023	Campsie TSS	54 Lillian Street, Campsie	S2B_06	45	43	Below predicted, LW works compliant.
7/09/2023	Campsie TSS	60 Lillian Street, Campsie	S2B_06	45	37	Below predicted, LW works compliant.
7/09/2023	Campsie TSS	52 Wilfred Avenue, Campsie	S2B_06	45	40	Below predicted, LW works compliant.
28/09/2023	Canterbury TSS	6 Hutton Street, Hurlstone Park	S2B_03	39	40	Traffic noise dominant, LW works compliant
28/09/2023	Canterbury TSS	2 Hutton Street, Hurlstone Park	S2B_03	39	42	Traffic noise dominant, LW works compliant
28/09/2023	Canterbury TSS	27 Hurlstone Avenue, Hurlstone Park	S2B_03	39	40	Traffic noise dominant, LW works compliant
28/09/2023	Canterbury TSS	63 Melford Street, Hurlstone Park	S2B_03	39	40	Traffic noise dominant, LW works compliant
28/09/2023	Canterbury TSS	124 Melford Street, Hurlstone Park	S2B_04	40	36	Below predicted, LW works compliant
28/09/2023	Canterbury TSS	2 Canberra Street, Hurlstone Park	S2B_04	40	38	Below predicted, LW works compliant
26/10/2023	Lakemba Station	54 Railway Parade, Lakemba	SBB_08	45	37	Traffic noise dominant, LW works compliant
9/11/2023	Chatswood	17 Nelson Street	CDS_03	48	54	Traffic noise dominant, LW works compliant
9/11/2023	Chatswood	552 - 554 Pacific Highway	CDS_02	67	72	Traffic noise dominant, LW works compliant
30/11/2023	Canterbury TSS	3 Canberra Street, Hurlstone Park	S2B_04	40	39	Below predicted, LW works compliant

3/12/2023	Northern Connection	1-3 Gordon Avenue, Chatswood	CDS_03	68	55	Below predicted, LW works compliant
15/12/2023	Canterbury TSS	6 Hutton Street, Hurlstone Park	S2B_03	39	49	Traffic noise dominant, LW works compliant
15/12/2023	Canterbury TSS	2 Hutton Street, Hurlstone Park	S2B_03	39	44	Traffic noise dominant, LW works compliant
15/12/2023	Canterbury TSS	27 Hurlstone Avenue, Hurlstone Park	S2B_03	39	53	Traffic noise dominant, LW works compliant
15/12/2023	Canterbury TSS	63 Melford Street, Hurlstone Park	S2B_03	39	51	Traffic noise dominant, LW works compliant
15/12/2023	Canterbury TSS	124 Melford Street, Hurlstone Park	S2B_04	40	50	Traffic noise dominant, LW works compliant
15/12/2023	Canterbury TSS	2 Canberra Street, Hurlstone Park	S2B_04	40	60	Traffic noise dominant, LW works compliant

Appendix E: Noise Monitoring Equipment Details

Noise Monitor Tracking and Calibration Records

Bag No.	Make	Model	Device Serial Number	Previous Calibration Date	External Calibration Due Date	Place of Calibration
1	RION	NL-42	00509242	5/09/2022	5/09/2024	Acoustic Research Lab
		NC-75 - Portable Calibrator	34202225	21/09/2023	22/09/2024	Acoustic Research Lab
2	RION	NL-42	01000278	23/03/2022	23/03/2024	Acoustic Research Lab
		NC-75 - Portable Calibrator	34212953	13/04/2023	13/04/2024	Acoustic Research Lab
3	RION	NL-42	00269685	7/07/2022	7/07/2024	Acoustic Research Lab
		NC-75 - Portable Calibrator	00970021	14/08/2023	14/08/2024	Acoustic Research Lab
4	RION	NL-42	00469907	18/08/2022	18/08/2024	Acoustic Research Lab
		NC-75 - Portable Calibrator	34502426	21/09/2023	21/09/2024	Acoustic Research Lab
5	RION	NL-21	00877037	29/09/2022	29/09/2024	Acoustic Research Lab
	Pulsar	Model 105	98618	Calibrator purchased 10/11/2022	Due 10/11/2023*	Acoustic Research Lab
6	Nti Audio	XL2	A2A-20889-EO	26/10/2023	26/10/2024	NATacoustic
	Bruel & Kjaer	Type 4231	2677710	11/01/2023	11/01/2025	NATacoustic

*RION #5 has been decommissioned as project nears completion.
Note that calibration of the noise monitors are due every two years, while the calibration of the calibrators are due yearly.

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Sound Calibrator

IEC 60942:2017

Calibration Certificate

Calibration Number C23600

Client Details Systems Connect Line-wide JV
L3 116 Miller Street
North Sydney NSW 2060

Equipment Tested/ Model Number : NC-75
Instrument Serial Number : 00970021

Atmospheric Conditions

Ambient Temperature : 20.3 °C
Relative Humidity : 51.9 %
Barometric Pressure : 100.61 kPa

Calibration Technician : Ken Williams
Secondary Check: Steven Woodhead
Calibration Date : 14 Aug 2023
Report Issue Date : 14 Aug 2023

Approved Signatory : Ken Williams

Characteristic Tested	Result
Generated Sound Pressure Level	*Pass*
Frequency Generated	*Pass*
Total Distortion	*Pass*

Nominal Level	Nominal Frequency	Measured Level	Measured Frequency
94	1000	94.24	1000.00

The sound calibrator has been shown to conform to the class 1 requirements for periodic testing, described in Annex B of IEC 60942:2017 for the sound pressure level(s) and frequency(ies) stated, for the environmental conditions under which the tests were performed..

Uncertainties of Measurement -

Specific Tests		Environmental Conditions	
Generated SPL	*±0.10 dB*	*Temperature*	*±0.1 °C*
Frequency	*±0.07 %*	*Relative Humidity*	*±1.9 %*
Distortion	*±0.20 %*	*Barometric Pressure*	*±0.014 kPa*

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 Certificate

Calibration Number C22458

Client Details	Systems Connect Line-wide Level 1, 116 Miller Street North Sydney NSW 2060
Equipment Tested/ Model Number :	Rion NL-42EX
Instrument Serial Number :	00269685
Microphone Serial Number :	162015
Pre-amplifier Serial Number :	50072

Pre-Test Atmospheric Conditions		**Post-Test Atmospheric Conditions**	
Ambient Temperature :	25.8°C	**Ambient Temperature :**	25.1°C
Relative Humidity :	48.5%	**Relative Humidity :**	51%
Barometric Pressure :	99.82kPa	**Barometric Pressure :**	99.8kPa

Calibration Technician : Lucky Jaiswal
Secondary Check: Dhanush Bonu
Calibration Date : 7 Jul 2022
Report Issue Date : 11 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.

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Accredited for compliance with ISO/IEC 17025 - Calibration.

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Sound Level Meter
IEC 61672-3:2013
Calibration Certificate

Calibration Number C22543

Client Details	Systems Connect Line-Wide Level 1, 116 Miller Street North Sydney NSW 2060
Equipment Tested/ Model Number :	Rion NL-42EX
Instrument Serial Number :	00469907
Microphone Serial Number :	162461
Pre-amplifier Serial Number :	60212
Firmware Version :	1.7

Pre-Test Atmospheric Conditions		Post-Test Atmospheric Conditions	
Ambient Temperature :	22.4°C	**Ambient Temperature :**	24°C
Relative Humidity :	42.9%	**Relative Humidity :**	41%
Barometric Pressure :	100.53kPa	**Barometric Pressure :**	100.49kPa

Calibration Technician :	Lucky Jaiswal	**Secondary Check:**	Rhys Gravelle
Calibration Date :	18 Aug 2022	**Report Issue Date :**	19 Aug 2022

Approved Signatory : Ken Williams

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.

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Sound Level Meter
IEC 61672-3:2013
Calibration Certificate

Calibration Number C22577

Client Details	Systems Connect Line-wide JV Level 1, 116 Miller Street North Sydney NSW 2060
Equipment Tested/ Model Number :	Rion NL-42
Instrument Serial Number :	00509242
Microphone Serial Number :	186793
Pre-amplifier Serial Number :	00867
Firmware Version :	2.0

Pre-Test Atmospheric Conditions		Post-Test Atmospheric Conditions	
Ambient Temperature :	21°C	**Ambient Temperature :**	22.3°C
Relative Humidity :	51.4%	**Relative Humidity :**	50.1%
Barometric Pressure :	101.3kPa	**Barometric Pressure :**	101.26kPa

Calibration Technician :	Lucky Jaiswal	**Secondary Check:**	Shaheen Boaz
Calibration Date :	5 Sep 2022	**Report Issue Date :**	5 Sep 2022

Approved Signatory : Ken Williams

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.

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

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Sound Level Meter
IEC 61672-3:2013
Calibration Certificate

Calibration Number C22626

Client Details	Systems Connect Line-Wide Level 1, 116 Miller Street North Sydney NSW 2060
Equipment Tested/ Model Number :	Rion NL-21
Instrument Serial Number :	00877037
Microphone Serial Number :	116410
Pre-amplifier Serial Number :	24434
Firmware Version :	N/A

Pre-Test Atmospheric Conditions		Post-Test Atmospheric Conditions	
Ambient Temperature :	25.5°C	**Ambient Temperature :**	24.8°C
Relative Humidity :	50.5%	**Relative Humidity :**	51.5%
Barometric Pressure :	100.62kPa	**Barometric Pressure :**	100.63kPa

Calibration Technician : Lucky Jaiswal
Secondary Check: Dylan Selge
Calibration Date : 29 Sep 2022
Report Issue Date : 30 Sep 2022

Approved Signatory : Ken Williams

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	*Pass*
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.

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Sound Calibrator

IEC 60942:2017

Calibration Certificate

Calibration Number C22727

Client Details Systems Connect
Level 3, 116 Miller Street
North Sydney NSW 2060

Equipment Tested/ Model Number : Pulsar Model 105
Instrument Serial Number : 98618

Atmospheric Conditions
Ambient Temperature : 23.4°C
Relative Humidity : 51%
Barometric Pressure : 100.99kPa

Calibration Technician : Lucky Jaiswal
Secondary Check: Dhanush Bonu
Calibration Date : 10 Nov 2022
Report Issue Date : 10 Nov 2022

Approved Signatory : Ken Williams

Characteristic Tested	Result
Generated Sound Pressure Level	*Pass*
Frequency Generated	*Pass*
Total Distortion	*Pass*

Nominal Level	Nominal Frequency	Measured Level	Measured Frequency
94	1000	93.98	1000.30

The sound calibrator has been shown to conform to the class 1 requirements for periodic testing, described in Annex B of IEC 60942:2017 for the sound pressure level(s) and frequency(ies) stated, for the environmental conditions under which the tests were performed..

Uncertainties of Measurement -

Specific Tests		Environmental Conditions	
Generated SPL	*±0.10dB*	*Temperature*	*±0.1°C*
Frequency	*±0.13%*	*Relative Humidity*	*±1.9%*
Distortion	*±0.20%*	*Barometric Pressure*	*±0.014kPa*

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

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Sound Calibrator

IEC 60942:2017

Calibration Certificate

Calibration Number C23192

Client Details CPB Contractors
Level 17-18, 177 Pacific Highway
North Sydney NSW 2060

Equipment Tested/ Model Number : Rion NC-75
Instrument Serial Number : 34212953

Atmospheric Conditions
Ambient Temperature : 22.4°C
Relative Humidity : 49.9%
Barometric Pressure : 99.87kPa

Calibration Technician : Shaheen Boaz
Calibration Date : 13 Apr 2023
Secondary Check: Dhanush Bonu
Report Issue Date : 2 May 2023

Approved Signatory : Juan Aguero

Characteristic Tested	Result
Generated Sound Pressure Level	*Pass*
Frequency Generated	*Pass*
Total Distortion	*Pass*

Nominal Level	Nominal Frequency	Measured Level	Measured Frequency
94	1000	94.14	1000.00

The sound calibrator has been shown to conform to the class 1 requirements for periodic testing, described in Annex B of IEC 60942:2017 for the sound pressure level(s) and frequency(ies) stated, for the environmental conditions under which the tests were performed..

Uncertainties of Measurement -

Specific Tests		Environmental Conditions	
Generated SPL	*±0.10dB*	*Temperature*	*±0.1°C*
Frequency	*±0.07%*	*Relative Humidity*	*±1.9%*
Distortion	*±0.20%*	*Barometric Pressure*	*±0.014kPa*

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.
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Sound Calibrator

IEC 60942:2017

Calibration Certificate

Calibration Number C23716

Client Details CPB Contractors
Level 18, 177 Pacific Highway
North Sydney NSW 2060

Equipment Tested/ Model Number : NC-75
Instrument Serial Number : 34202225

Atmospheric Conditions

Ambient Temperature : 23.9 °C
Relative Humidity : 38.5 %
Barometric Pressure : 100.64 kPa

Calibration Technician : Max Moore
Calibration Date : 21 Sep 2023
Secondary Check: Dhanush Bonu
Report Issue Date : 22 Sep 2023
Approved Signatory : Ken Williams

Characteristic Tested	Result
Generated Sound Pressure Level	*Pass*
Frequency Generated	*Pass*
Total Distortion	*Pass*

Nominal Level	Nominal Frequency	Measured Level	Measured Frequency
94	1000	94.13	1000.00

The sound calibrator has been shown to conform to the class 1 requirements for periodic testing, described in Annex B of IEC 60942:2017 for the sound pressure level(s) and frequency(ies) stated, for the environmental conditions under which the tests were performed..

Uncertainties of Measurement -

Specific Tests		Environmental Conditions	
Generated SPL	*±0.10 dB*	*Temperature*	*±0.1 °C*
Frequency	*±0.07 %*	*Relative Humidity*	*±1.9 %*
Distortion	*±0.20 %*	*Barometric Pressure*	*±0.014 kPa*

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.

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Sound Calibrator

IEC 60942:2017

Calibration Certificate

Calibration Number C23717

Client Details CPB Contractors
Level 18, 177 Pacific Highway
North Sydney NSW 2060

Equipment Tested/ Model Number : NC-75
Instrument Serial Number : 34502426

Atmospheric Conditions

Ambient Temperature : 23.8 °C
Relative Humidity : 38.1 %
Barometric Pressure : 100.65 kPa

Calibration Technician : Max Moore
Calibration Date : 21 Sep 2023
Secondary Check: Dhanush Bonu
Report Issue Date : 22 Sep 2023
Approved Signatory : Ken Williams

Characteristic Tested	Result
Generated Sound Pressure Level	*Pass*
Frequency Generated	*Pass*
Total Distortion	*Pass*

Nominal Level	Nominal Frequency	Measured Level	Measured Frequency
94	1000	94.04	1000.00

The sound calibrator has been shown to conform to the class 1 requirements for periodic testing, described in Annex B of IEC 60942:2017 for the sound pressure level(s) and frequency(ies) stated, for the environmental conditions under which the tests were performed..

Uncertainties of Measurement -

Specific Tests		Environmental Conditions	
Generated SPL	*±0.10 dB*	*Temperature*	*±0.1 °C*
Frequency	*±0.07 %*	*Relative Humidity*	*±1.9 %*
Distortion	*±0.20 %*	*Barometric Pressure*	*±0.014 kPa*

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.

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Sound Level Meter
IEC 61672-3:2013
Calibration Certificate

Calibration Number C22181

Client Details	Systems Connect Line-wide Level 1, 116 Miller Street North Sydney NSW 2060
Equipment Tested/ Model Number :	Rion NL-42
Instrument Serial Number :	01000278
Microphone Serial Number :	189006
Pre-amplifier Serial Number :	01941

Pre-Test Atmospheric Conditions		**Post-Test Atmospheric Conditions**	
Ambient Temperature :	25°C	**Ambient Temperature :**	24.5°C
Relative Humidity :	52%	**Relative Humidity :**	43.7%
Barometric Pressure :	99.9kPa	**Barometric Pressure :**	99.91kPa

Calibration Technician :	Lucky Jaiswal	**Secondary Check:**	Max Moore
Calibration Date :	23 Mar 2022	**Report Issue Date :**	23 Mar 2022

Approved Signatory : Ken Williams

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	*±0.10dB*		

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

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

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Ph: (02) 8218 0570 email: service@natacoustic.com.au website: www.natacoustic.com.au
A division of Renzo Tonin & Associates (NSW) Pty Ltd ABN 29 117 462 861

Certificate of Calibration
Sound Level Calibrator

Calibration Date	11/01/2023	**Job No**	RC035	**Operator**	AM EF
Client Name	RENZO TONIN & ASSOCIATES (NSW) PTY LTD				
Client Address	LEVEL 1 418A ELIZABETH ST SURRY HILLS 2010				

Test Item

Calibrator Make	B&K	**Model**	4231	**Serial No**	2677710
Accessories	N/A				

Class (1 or 2)	1

Environmental Conditions	Measured	
	Start	End
Temperature (degC)	23.4	23.4
Rel. Humidity (%)	52.2	53
Air Pressure (kPa)	100.8	100.7

Applicable Standards:
IEC 60942:2017 "Electroacoustics - Sound calibrators"

Applicable Work Instruction:
RWi-08 SLM & Calibrator Verification

Laboratory Equipment :
GRAS Power Module type 12AK SN 1551616
GRAS 1/2" Pressure Microphone 40AD SN 252620 and preamplifier SN 292045
B&K4226 Multifunction Acoustic Calibrator SN 2288472
Agilent Digital Multimeter Model 34401A SN MY41004386
Audio Tester AUDT30 v3.0 software
Behringer UCA222 USB Audio Interface U-Control

Traceability:
The results of the tests and measurements included in this document are traceable via the test methods described under each test, and by the use of the above equipment, which has been calibrated by NATA accredited calibration facilities.

Scope:
This certificate is issued on the basis that the instrument complies with the manufacturer's specification.
See "Sound Level Calibrator Verification - Summary of Tests" page for an itemised list of results for each test.

Uncertainty:

Calibration Statement:
The sound calibrator has been shown to conform to the class 1 requirements for periodic testing, described in Annex B of IEC 60942:2017 for the sound pressure level(s) and frequency(ies) stated, for the environmental conditions under which the tests were performed. However, as public evidence was not available, from a testing organization responsible for pattern approval, to demonstrate that the model of sound calibrator conformed to the requirements for pattern evaluation described in Annex A of IEC 60942:2017, no general statement or conclusion can be made about conformance of the sound calibrator to the requirements of IEC 60942:2017.

NATA
WORLD RECOGNISED ACCREDITATION

NATA Accredited Laboratory Number 14966

Accredited for compliance with ISO/IEC 17025 - Calibration

Authorized Signatory:

Print Name: Ariel Michael Date: 11/01/2023

Template Document Name: RQT-03 (rev 70) Calibrator Verification

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Level 1, 418A Elizabeth Street., Surry Hills NSW 2010 AUSTRALIA
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A division of Renzo Tonin & Associates (NSW) Pty Ltd ABN 29 117 462 861

Certificate of Calibration
Sound Level Meter

Calibration Date	26/10/2023	**Job No**	RD032	**Operator**	KW
Client Name	RENZO TONIN & ASSOCIATES (NSW) PTY LTD				
Client Address	LEVEL 1 418A ELIZABETH ST SURRY HILLS 2010				

Test Item

Instrument Make	NTi	**Model**	XL2	**Serial No**	#A2A-20889-E0 #XL2-A
Microphone Make	NTi	**Model**	MC230A	**Serial No**	#A23418
Preamplifier Make	NTi	**Model**	MA220	**Serial No**	#7230
Ext'n Cable Make	Nil	**Model**	N/A	**Serial No**	N/A
Accessories	Nil			**Firmware**	V4.82

SLM Class	1
Filters Class	1

Environmental Conditions	**Measured**	
	Start	**End**
Air Temp. (°C)	24.0	24.7
Rel. Humidity (%)	49.4	46.3
Air Pressure (kPa)	101.8	101.7

Applicable Standards:
Periodic tests were performed in accordance with procedures from IEC 61672-3 :2013 and IEC 61260-3 :2016

Applicable Work Instruction:
RWi-08 SLM & Calibrator Verification

Laboratory Equipment :
B&K4226 Multifunction Acoustic Calibrator SN 2288472
Agilent Function Generator Model 33511B SN MY59001831
Agilent Digital Multimeter Model 34401A SN MY41004386

Traceability:
The results of the tests and measurements included in this document are traceable via the test methods described under each test,
and by the use of the above equipment, which through an unbroken chain of calibrations, is ultimately traceable to the International System of Units (SI).

Scope:
This certificate is issued on the basis that the instrument complies with the manufacturer's specification.
See "Sound Level Meter Verification - Summary of Tests" page for an itemised list of results for each test.

Uncertainty:
The uncertainty is stated at a confidence level of 95% using a k factor of 2.04.

Calibration Statement:
The sound level meter submitted for testing has successfully completed the periodic tests of IEC 61672-3:2013 and IEC 61260-3:2016, 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 specifications of IEC 61672-1:2013 and IEC 61260-1:2014 because (a) evidence was not publicly available, from an independent testing organization responsible for pattern approvals, to demonstrate that the model of sound level meter fully conformed to the class 1 specifications in IEC 61672-1:2013 and IEC 61260-1:2014 or correction data for acoustical test of frequency weighting were not provided in the Instruction Manual and (b) because the periodic tests of IEC 61672-3:2013 and IEC 61260-3:2016 cover only a limited subset of the specifications in IEC 61672-1:2013 and IEC 61260-1:2014.

NATA
WORLD RECOGNISED ACCREDITATION

NATA Accredited Laboratory Number 14966

Accredited for compliance with ISO/IEC 17025 - Calibration

Authorized Signatory:

Print Name: Ariel Michael Date: 26/10/2023

Template Document Name: RQT-05 SLM IEC61672 Verification (r88)

Appendix F: Noise Monitoring Record Sheet Samples

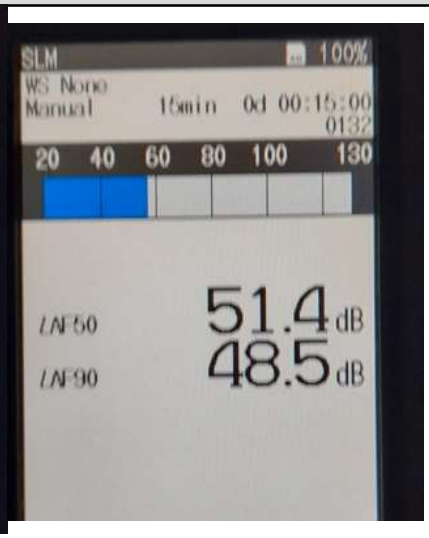
Noise Monitoring Record Sheet

DATE:	26-October-2023	**MAIN ACTIVITY**	Generator operating
CONDUCTED BY:	Tristan McCormick	**LOCATION OF WORKS:**	Lakemba Station
METEROLOGICAL CONDITIONS:		Light winds, partly cloudy	
DAY, EVENING OR NIGHT PERIOD?		Night	
MAKE / MODEL:	Rion NL-42	**SERIAL NUMBER:**	00509242
TIME WEIGHTING:	FAST / ~~SLOW~~	**FREQUENCY WEIGHTING:**	A / ~~C / FLAT~~
FIELD CALIBRATION:	94 dB	**POST CALIBRATION CHECK:**	94dB
COMMUNITY NOTIFICATIONS GONE OUT FOR THE WORKS?		YES / ~~NO~~	
LIGHT SPILL into residences?		No	
Are noise mitigation measures installed?		Noise mats installed correctly around generator	

MONITORING LOCATION 1				
LOCATION:	54 Railway Parade, Lakemba NSW			
ACTIVITIES:	Generator operation to power padmount transformer			
PLANT:	Generator			
START TIME	**END TIME**	**RBL (dBA)**	**NML (dBA)**	**NCA**
22:07	22:22	41	46	S2B_08
L_{aeq}	**L_{max}**	**L_{min}**	**L_{A10}**	**L_{A90}**
54.8	75.1	44.8	57.1	48.5
PREDICTED NOISE LEVEL (dBA):		45		
Laeq ABOVE PREDICTED NOISE LEVEL:		-2		
Measured noise level with no construction activity (if applicable)				
MONITORING COMMENTS	Dominant noise source was traffic passing on Railway Pde (55 to 75 dB) Generator audible as a constant hum (42 to 43 dB) Distant traffic / ambient noise (40 to 45dB) Occassional trains and plane (45 to 60 dB) Cars passing (regularly) on Railway Parade was the dominant noise source. During breaks in traffic (Railway Pde traffic) the generatror hum was audible along with ambient / background traffic noise and was measured between 44 and 46 dB. Trains passing occasionally and one plane also influenced the measurement.			

DIAGRAMS AND PHOTOS

Insert:
- Photo of works being monitored
- Map showing monitoring location or Screenshot of GPS Location



Noise Monitoring Record Sheet

DATE:	09-November-2023	**MAIN ACTIVITY**	Installation of hoarding	
CONDUCTED BY:	Charlotte Carter	**LOCATION OF WORKS:**	Chatswood Dive Site	
METEROLOGICAL CONDITIONS:		17.6 degrees celcius, light rain, wind 6km/h		
DAY, EVENING OR NIGHT PERIOD?		Night		
MAKE / MODEL:	Rion NL-42	**SERIAL NUMBER:**	01000278	
TIME WEIGHTING:	FAST / ~~SLOW~~	**FREQUENCY WEIGHTING:**		A / ~~C / FLAT~~
FIELD CALIBRATION:	94dBA	**POST CALIBRATION CHECK:**		94dBA
COMMUNITY NOTIFICATIONS GONE OUT FOR THE WORKS?		YES / ~~NO~~		
LIGHT SPILL into residences?		N/A		
Are noise mitigation measures installed?		Reversing squawkers on all plant		

MONITORING LOCATION 1				
LOCATION:	17 Nelson Street, Chatswood			
ACTIVITIES:	Installation of hoarding			
PLANT:	Forklift, hand tools			
START TIME	**END TIME**	**RBL (dBA)**	**NML (dBA)**	**NCA**
22:45	23:00	39	44	CDS_03
L_{aeq}	**L_{max}**	**L_{min}**	**L_{A10}**	**L_{A90}**
53.6	70.9	40.1	56.1	45.6
PREDICTED NOISE LEVEL (dBA):		48		
Laeq ABOVE PREDICTED NOISE LEVEL:		-3		
Measured noise level with no construction activity (if applicable)				
MONITORING COMMENTS	Noise monitor was set up 10m in front of property façade due to access restrictions. Constant traffic on Pacific Highway was the dominant source of noise throughout the reading Nearby passing train: 61dBA Passing bus on Pacific Highway: 64dBA Passing truck on Pacific Highway (not SC): 70dBA Cars passing on Pacific Hwy: 49 to 60dBA Handtools and forklift (cumulative with traffic on Pacific Highway): maximum reading of 51dBA Handtools and forklift (reduced traffic on Pac Hwy): 45dBA During breaks (or reduced traffic) the construction noise was measured no higher than 45 dBA and therefore determined to be below predicted. Pacific Highway traffic contributed to maximum noise source.			

MONITORING LOCATION 2				
LOCATION:	552 - 554 Pacific Highway, Chatswood			
ACTIVITIES:	Installation of hoarding			
PLANT:	Forklift, hand tools			
START TIME	**END TIME**	**RBL (dBA)**	**NML (dBA)**	**NCA**
23:08	23:23	42	47	CDS_02
L_{aeq}	**L_{max}**	**L_{min}**	**L_{A10}**	**L_{A90}**
71.8	85.8	49.8	76.2	58.0
PREDICTED NOISE LEVEL (dBA):		67		
Laeq ABOVE PREDICTED NOISE LEVEL:		-6		
Measured noise level with no construction activity (if applicable)				
MONITORING COMMENTS	Constant traffic on Pacific Highway was the dominant source of noise throughout the reading Three buses passed the noise monitoring location during the reading, noise levels reached up to around 80dBA Passing motorbike on pacific highway: 85dBA Passing truck on Pacific Highway (not SC): 80dBA Constant cars passing on Pacific Hwy: 67 to 81 dBA Door slammed near noise monitoring location: 75dBA People talking loudly passing noise monitoring location: 63dBA Handtools and forklift (cumulative with traffic on Pacific Highway): maximum reading of 66dBA Handtools and forklift (reduced traffic on Pac Hwy): 52 to 61dBA During breaks (or reduced traffic) the construction noise was measured no higher than 61 dBA and is therefore determined to be below predicted. Pacific Highway traffic contributed to maximum noise source			

DIAGRAMS AND PHOTOS

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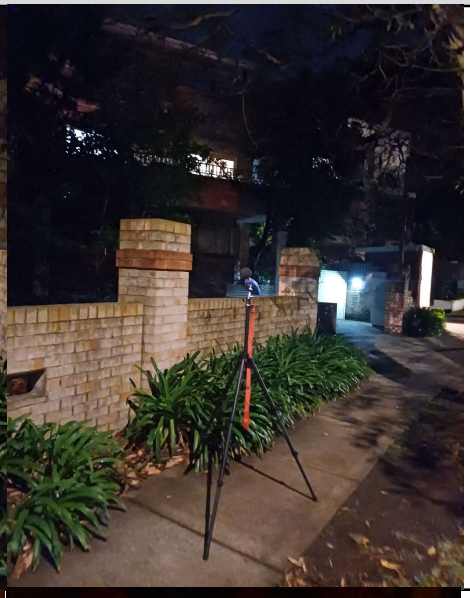

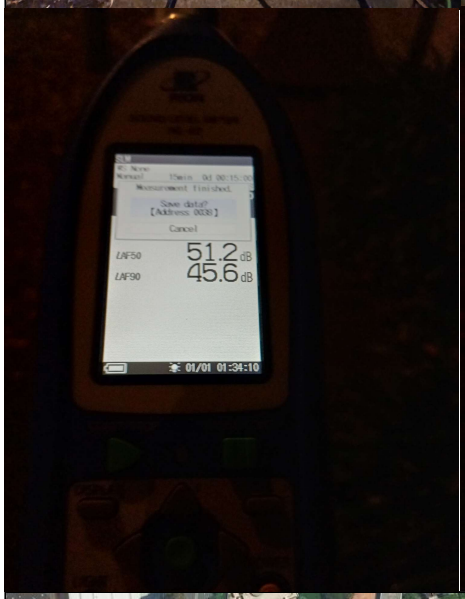

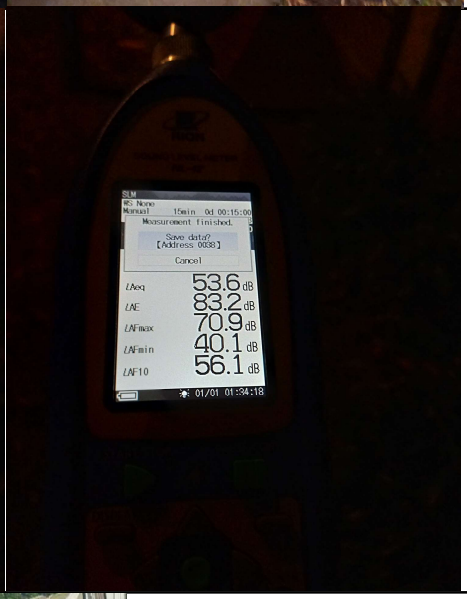

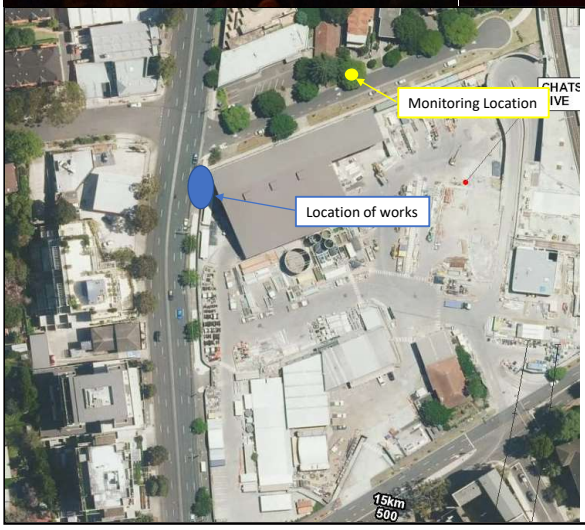

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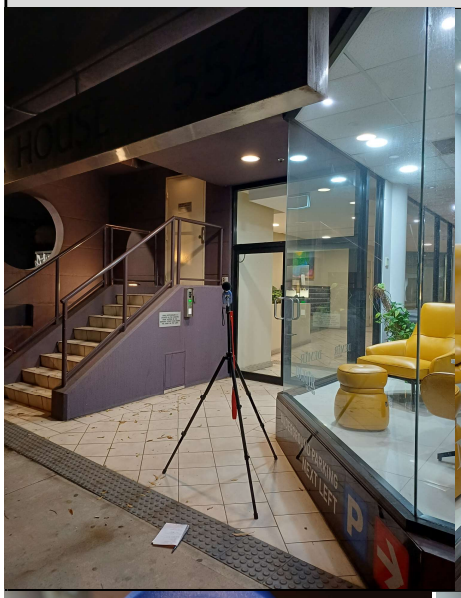
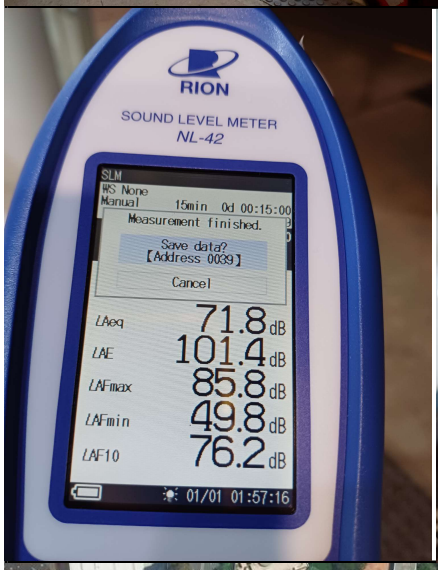
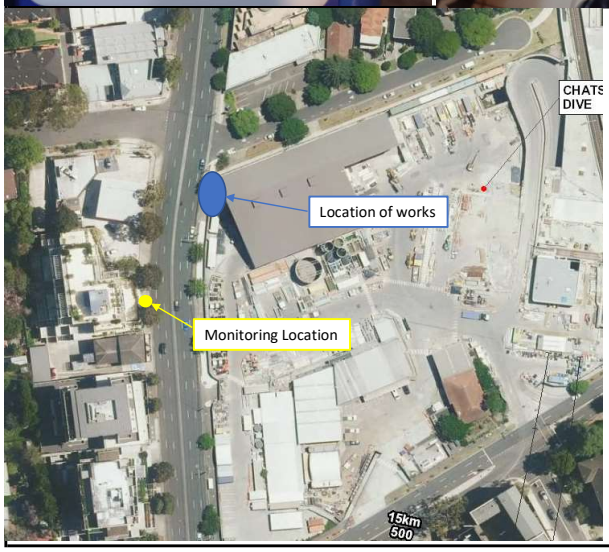






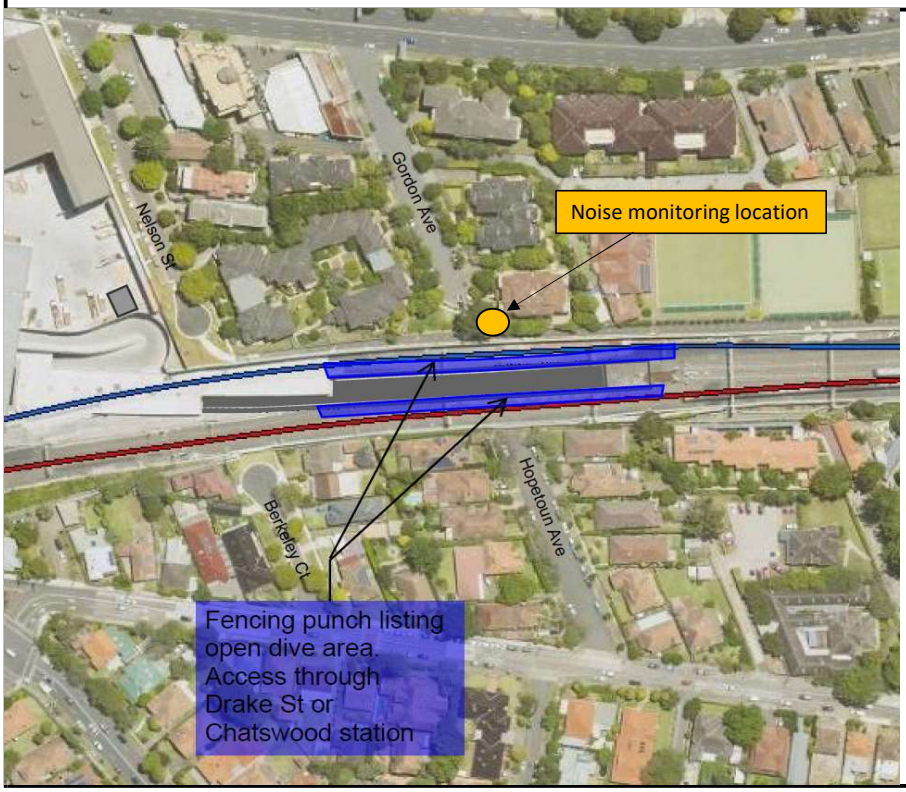
Noise Monitoring Record Sheet

DATE:	03-December-2023	**MAIN ACTIVITY**	Fencing Works	
CONDUCTED BY:	Charlotte Carter	**LOCATION OF WORKS:**	Northern Connection	
METEROLOGICAL CONDITIONS:		24.5 Degrees Celcius, Wind 33km/h, 63% humidity, Sunny		
DAY, EVENING OR NIGHT PERIOD?		Day		
MAKE / MODEL:	Rion NL-42	**SERIAL NUMBER:**	01000278	
TIME WEIGHTING:	FAST / ~~SLOW~~	**FREQUENCY WEIGHTING:**		A / ~~C / FLAT~~
FIELD CALIBRATION:	94dBA	**POST CALIBRATION CHECK:**		94dBA
COMMUNITY NOTIFICATIONS GONE OUT FOR THE WORKS?		YES ~~/ NO~~		
LIGHT SPILL into residences?		N/A		
Are noise mitigation measures installed?		Reversing squawkers in place on all plant and equipment		

MONITORING LOCATION 1				
LOCATION:	1-3 Gordon Avenue, Chastwood			
ACTIVITIES:	Fencing Works			
PLANT:	Power Tools			
START TIME	**END TIME**	**RBL (dBA)**	**NML (dBA)**	**NCA**
16:25	16:40	50	55	CDS_03
L_{aeq}	**L_{max}**	**L_{min}**	**L_{A10}**	**L_{A90}**
54.9	79.8	44.1	57.2	49.1
PREDICTED NOISE LEVEL (dBA):		68dBA		
Laeq ABOVE PREDICTED NOISE LEVEL:		-23		
MONITORING COMMENTS	Construction noise was barely audible throughout the reading. Power tools were confirmed to be in use throughout the noise monitoring. Noise of construction when traffic noise was minimal: approx. 40 - 45dBA Traffic noise on Pacific Highway was dominant and constant throughout the reading: 50 to 65dBA Passing Ambulance on Pacific Highway: 60dBA Plane passing nearby: 58dBA Loud running group passing noise monitoring location: 63dBA Slamming of car door near noise monitoring location: 79dBA (maximum source of noise, not construction related) Summary: Traffic noise dominant, measured noise level below predicted.			

DIAGRAMS AND PHOTOS

Insert:
- Photo of works being monitored
- Map showing monitoring location or Screenshot of GPS Location



RENZO TONIN & ASSOCIATES
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Acoustics
Vibration
Structural Dynamics

SYDNEY METRO CITY & SOUTHWEST: LINE-WIDE WORKS

Canterbury Substation Round 2 Noise Monitoring Report

19 December 2023

Systems Connect

TK685-67F06 TCR Round 2 noise monitoring report (r1)

40 YEARS 1982-2022 ACOUSTIC ENGINEERING EXCELLENCE

Sydney Melbourne Brisbane Gold Coast Kuwait Singapore
Renzo Tonin & Associates ABN 29 117 462 861
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Document details

Detail	Reference
Doc reference:	TK685-67F06 TCR Round 2 noise monitoring report (r1)
Prepared for:	Systems Connect
Address:	Level 1 116 Miller Street North Sydney NSW 2060
Attention:	Tristan McCormick

Document control

Date	Revision history	Non-issued revision	Issued revision	Prepared	Instructed	Reviewed / Authorised
19.12.2023	Issued	0	1	C. Chan	-	M. Gange

File Path: \\192.168.168.249\data\AssocSydProjects\TK651-TK700\TK685 PK SMCSW Linewide Works (CPB UGL)\1 Docs\25 TDH & TCS Substation\TK685-67F06 TCR Round 2 noise monitoring report (r1).docx

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1 Introduction

Renzo Tonin & Associates was engaged by Systems Connect to monitor noise emission from the Canterbury Substation (TCR).

Noise monitoring has previously been undertaken during the initial energisation of the Canterbury Substation (TCR), on the night of Thursday 28 September 2023. The noise monitoring found noise emission from the TCR to be compliant with the relevant noise objectives.

Systems Connect has requested a second round of noise monitoring to confirm that the operation of the TCR still complies with the noise objectives. This report presents the results and findings of the TCR Round 2 noise testing which occurred on the night of Friday 15 December, 2023 and continued into the early hours of the following day.

The work documented in this report was carried out in accordance with the Renzo Tonin & Associates Quality Assurance System, which is based on Australian Standard / NZS ISO 9001. Appendix A contains a glossary of acoustic terms used in this report.

2 Noise objectives

The noise design objectives are sourced from the following documents:

- NSW Department of Planning & Environment, Sydney Metro Sydenham to Bankstown – Approval, 12 December 2018
- Sydney Metro City & Southwest – Line-wide Works – Schedule C1 Scope of Works and Technical Criteria – Appendix B8 – Noise and Vibration
- NSW Noise Policy for Industry (NPfI) (EPA, 2017)
- Renzo Tonin & Associates – Line-Wide Works – Design Package 1015 – Southwest Corridor Substation Noise & Vibration Design Report – Stage 3 – Revision 3 dated 3 December 2021 (henceforth in this document is referred to as 'the Design Report').

Table 2-1 reproduces the project noise trigger levels (determined in accordance with the NPfI) for the Canterbury Substation from the Design Report.

Table 2-1: Project noise trigger levels

Receiver type	$L_{Aeq,15min}$ project noise trigger levels, dB(A)		
	Day[1]	Evening[2]	Night[3]
Canterbury Substation (TCR)			
Residential	45	45	40
Passive recreation area	53[4]	53[4]	53[4]

Notes:
1. Day is 07:00-18:00 Monday to Saturday and 08:00-18:00 Sunday & public holidays
2. Evening is 18:00-22:00 Monday to Sunday & public holidays
3. Night is 22:00-07:00 Monday to Saturday and 22:00-08:00 Sunday & public holidays
4. When in use

3 Details of monitoring

3.1 Measurement details

Noise monitoring was undertaken on the night of Friday 15 December, 2023. The monitoring commenced at 10:47pm to minimise the influence of the distant road traffic noise on the measurement results and continued to 1:05am on the following day.

Noise measurements were conducted at the boundary of nearby residences and receiver points identified in the Design Report to confirm compliance with the noise objectives.

The monitoring locations are outlined in Table 3-1 and shown in Figure 1.

Table 3-1: TCR noise monitoring locations

ID	Address	Description
L1	6 Hutton Street, Hurlstone Park	Two-storey dwelling to the south of the Canterbury Substation. Due to the topography at this residential premises, the first-floor level of the dwelling is at a similar elevation to the natural ground level at the northern (Hutton Street) boundary. The monitoring was conducted in a free-field location, on the footpath adjacent to the northern) boundary of the residential premises.
L2	2 Hutton Street, Hurlstone Park	Single storey dwelling to the south-east of the Canterbury Substation. The monitoring was conducted in a free-field location, on the footpath adjacent to the northern boundary of the residential premises.
L3	27 Hurlstone Avenue, Hurlstone Park	Two-storey dwelling to the east of the Canterbury Substation. The dwelling has first-floor level windows on the western facade which are the critical receiver locations for this residential premises as they overlook the substation site. The monitoring was conducted in a free-field location, on the footpath adjacent to the western boundary of the residential premises. An extension pole was used at this monitoring location to position the microphone at a first-floor level elevation and obtain measurement results representative of the critical receiver locations.
L4	63 Melford Street, Hurlstone Park	Single storey dwelling to the north-east of the Canterbury Substation. The monitoring was conducted in a free-field location, on the footpath adjacent to the western boundary of the residential premises.
L5	124 Melford Street, Hurlstone Park	Single storey dwelling located in the north-western corner of the intersection of Melford Street and Canberra Street (to the north of the Canterbury Substation). The monitoring was conducted in a free-field location, on the nature strip adjacent to the southern (Canberra Street) boundary of the residential premises.
L6	2 Canberra Street, Hurlstone Park	Single storey dwelling to the north-west of the Canterbury Substation. The monitoring was conducted in a free-field location, on the nature strip adjacent to the northern boundary of the residential premises. The monitor had a direct line-of-sight across the yard of the residential premises to the Canterbury Substation.
L7	Boat Harbour	Passive recreation area to the south-west of the Canterbury Substation. The monitoring was conducted in a free-field location on the footpath that runs along the banks of Cooks River.

Figure 1: TCR noise monitoring locations

3.2 Monitoring methodology

The noise measurement equipment consisted of an NTi Audio XL2 precision sound level analyser which is a Class 1 instrument having accuracy suitable for field and laboratory use. The calibration of the equipment was checked prior to and after measurements using a Bruel & Kjaer Type 4231 calibrator. No significant drift in the calibration was observed. All instrumentation complies with IEC 61672 (parts 1-3) '*Electroacoustics – Sound Level Meters*' and IEC 60942 '*Electroacoustics – Sound calibrators*' and carries current NATA certification (or manufacturers certification if less than two years old).

Table 3-2 lists the noise measurement equipment.

Table 3-2: Noise measurement equipment

Instrument	Make	Model	Serial number	Last calibrated
Class 1 sound level meter	NTi Audio	XL2	A2A-20889-E0	26 October 2023
Class 1 sound level calibrator	Bruel & Kjaer	Type 4231	2677710	11 January 2023

3.3 Environmental conditions

Environmental conditions recorded during the measurement are provided in Table 3-3. Environmental conditions were suitable for measuring noise levels under typical calm conditions.

Table 3-3: Environmental conditions

Site	Date / Time	Environmental conditions
Canterbury substation (TCR)	22:47 15.12.2023 – 01:05 16.12.2023	Clear skies, air temperature 21-22°C, calm wind conditions, relative humidity 77-82%

4 Noise monitoring results

4.1 Measured noise levels

The results of the noise monitoring are presented and discussed below.

The measured $L_{Aeq,15min}$ levels at the receiver locations were generally affected by intermittent noise sources such as aircraft overflights, train passbys and individual vehicle movements along the surrounding local roads. Therefore, the measured $L_{A90,15min}$ levels have been used to assess noise emission from the substation. As the operation of the two rectifier transformers at the substation emit a continuous noise that does not fluctuate in level, the L_{A90} and L_{Aeq} noise emission levels of the substation are effectively the same.

Table 4-1 identifies measured $L_{A90,15min}$ levels of less than 40dB(A) at the residential receiver locations. The measured $L_{A90,15min}$ levels were observed to be a mixture of distant road traffic noise and transformer noise from the TCR with a slight contribution from crickets. Therefore, the noise contribution of the TCR alone is less than the measured $L_{A90,15min}$ levels and satisfies the 40dB(A) night-time project trigger noise level at the nearest residential receivers surrounding the site.

With respect to Location L7 (Boat Harbour), noise emission from the TCR was barely audible due to the acoustic environment being dominated by the noise of crickets. Therefore, the noise contribution of the TCR is expected to be well below the measured $L_{A90,15min}$ level of 44dB(A) and easily satisfies the project trigger noise level of 53dB(A) for passive recreation areas.

While the transformer noise from the TCR was observed to have a slight tonal characteristic at some receiver locations, an analysis of the one-third octave band measurement data reveals no significant peaks in the frequency spectrum that would result in the application of a tonal noise penalty (in accordance with the corrections for annoying noise characteristics set out in Fact Sheet C of the NPfI). The analysis of the measured noise spectrums in accordance with Fact Sheet C of the NPfI also found no requirement for a low-frequency noise penalty to be applied to the noise contribution of the substation.

Table 4-1: Noise monitoring results

Location / time	Measured noise level, dBA(A)		Night-time project trigger noise level, dB(A)	Compliance?
	$L_{Aeq,15min}$	$L_{A90,15min}$		
L1 – 6 Hutton Street 00:50 – 01:05	49	38	40	Yes
L2 – 2 Hutton Street 00:35 – 00:50	44	39	40	Yes
L3 – 27 Hurlstone Avenue 00:19 – 00:34	53	40	40	Yes
L4 – 63 Melford Street 22:47 – 23:02	51	37	40	Yes
L5 - 124 Melford Street 23:05 – 23:20	50	34	40	Yes

Location / time	Measured noise level, dBA(A)		Night-time project trigger noise level, dB(A)	Compliance?
	$L_{Aeq,15min}$	$L_{A90,15min}$		
L6 – 2 Canberra Street 23:21 – 23:36	60	36	40	Yes
L7 – Boat Harbour 23:45-00:00	47	44	53	Yes

Further observation details at each monitoring location are discussed below to further qualify the acoustic environment experienced by the surrounding receivers.

4.2 Discussion

Location L1 – 6 Hutton Street, Hurlstone Park

At the time of the measurement (12:50am to 01:05am), the volume of road traffic in the surrounding area had generally subsided. As a result, the measured $L_{A90,15min}$ level of 38dB(A) was predominantly from the rectifier transformers at the substation, with a slight contribution from distant road traffic.

During the 15-minute measurement period, mechanical plant servicing the substation was observed to operate briefly (ie. for approximately one minute) at 12:53am and 1:01am. However, the noise emission of the mechanical plant was barely audible and did not give rise to any significant increase to the overall A-weighted noise level.

The ambient $L_{Aeq,15min}$ noise level of 49dB(A) is the result of two passenger trains and one freight train passing the measurement location. The passenger trains gave rise to maximum noise levels of 49 – 56dB(A) while the freight train gave rise to a maximum noise level of 68dB(A).

Location L2 – 2 Hutton Street, Hurlstone Park

The measured $L_{A90,15min}$ level of 39dB(A) at this location was controlled by noise emission from the rectifier transformers at the substation with a slight contribution from distant road traffic. Mechanical plant noise from the substation was briefly detected at 12:44am but was barely audible and did not result in any significant increase to the overall A-weighted noise level.

The ambient $L_{Aeq,15min}$ noise level of 44dB(A) measured at this location was the result of intermittent noise from three vehicles passing the measurement location on Hurlstone Avenue which gave rise to maximum noise levels of 50 – 57dB(A), and two passenger train passbys with maximum noise levels of 55 – 57dB(A).

Location L3 – 27 Hurlstone Avenue, Hurlstone Park

As set out in Section 3.1, the monitoring was conducted at a first-floor level elevation for this residential premises to represent the worst-case receiver locations on the first-floor level of the dwelling (western facade windows) which overlook the substation site. The ground floor level of this residential premises

would experience lower noise emission levels from the substation due to acoustic shielding from the concrete barriers surrounding the substation.

The elevated monitoring location is also more exposed to the ambient background noise of distant traffic and as a result, the measured $L_{A90,15min}$ level of 40dB(A) was a mixture of distant road traffic noise and noise from the rectifier transformers of the substation. Therefore, determination of the noise contribution from the substation alone required waiting for lulls in the traffic noise. Noise levels of 37dB(A) were observed during lulls in traffic noise, which is conservatively determined to be the substation noise contribution. The actual contribution is expected to be less than 37dB(A) if all traffic noise contribution was removed.

The ambient $L_{Aeq,15min}$ level of 53dB(A) was the result of three vehicles passing the measurement location on Hurlstone Avenue which gave rise to maximum noise level of 63 – 68dB(A), two passenger train passbys with maximum noise levels of 52 – 54dB(A) and a helicopter overflight that had a maximum noise level of 69dB(A).

Location L4 – 63 Melford Street, Hurlstone Park

Noise emission from the rectifier transformers at the substation could be detected during the 15-minute measurement (from 10:47pm to 11:02pm). However, the substation noise was generally masked by the distant road traffic on Canterbury Road (to the north-west of the monitoring location) which was observed to be the primary noise source contributing to the measured $L_{A90,15min}$ level of 37dB(A).

The ambient $L_{Aeq,15min}$ noise level of 51dB(A) was controlled by the interment noise of four vehicles passing the monitoring location on Melford Street and three passenger train passbys. The vehicle passbys gave rise to maximum noise levels of 64 – 69dB(A), while the train passbys had maximum noise levels of 59 – 68 dB(A).

Location L5 – 124 Melford Street, Hurlstone Park

Substation noise could be detected at this measurement location as a constant hum from the rectifier transformers. The measured $L_{A90,15min}$ level of 34dB(A) was controlled by noise emission from the rectifier transformers with a slight contribution from distant road traffic.

During the 15-minute measurement period, the intermittent noise from five individual vehicle movements along the surrounding local roads (Melford Street and Canberra Street), two train passbys and a pedestrian were observed to control the ambient $L_{Aeq,15min}$ noise level of 50dB(A). The vehicle movements on the surrounding roads gave rise to maximum noise levels of 51 – 65dB(A) and the train passbys had maximum noise levels of 62 – 71dB(A). The pedestrian was talking on the phone while walking past the measurement location on Canberra Street which resulted in a maximum noise level of 53dB(A).

Location L6 – 2 Canberra Street, Hurlstone Park

Substation noise could be detected at this measurement location as a constant hum from the rectifier transformers. The measured $L_{A90,15min}$ level of 36dB(A) was controlled by noise emission from the rectifier transformers with a slight contribution from distant road traffic.

The ambient $L_{Aeq,15min}$ level of 60dB(A) was the result of one vehicle passing the measurement location on Canberra Street which gave rise to a maximum noise level of 69dB(A), two passenger train passbys with maximum noise levels of 64 – 67dB(A) and a freight train passby that had a maximum noise level of 80dB(A).

Location L7 – Boat Harbour

Noise emission from the substation was barely audible and could not be measured at this monitoring location due to the noise of crickets which dominated the prevailing acoustic environment. Therefore, the noise contribution of the substation is expected to be well below the measured $L_{A90,15min}$ noise level of 44dB(A).

5 Conclusion

Noise monitoring of the Canterbury Substation (TCR) was conducted on the night of Friday 15 December, 2023 and continued into the early hours of the following day.

The noise emission of the substation could generally be detected at the nearest surrounding receiver locations as a constant hum from the rectifier transformers, but was somewhat masked by the ambient noise of distant road traffic.

If the measured $L_{A90,15min}$ noise levels were conservatively assigned as the noise contribution of the substation, the results reveal compliance with the night-time project trigger noise levels of 40dB(A) at all surrounding residential receivers, and 53dB(A) for the Boat Harbour passive recreation area. However, it is noted that the actual noise emission of the substation would be less than the measured $L_{A90,15min}$ noise levels if the contribution of the distant road traffic and crickets were removed.

As the noise monitoring of the Canterbury Station at the nearest surrounding receivers revealed compliance with the noise objectives during the critical night-time period, noise emission from the operation of Canterbury Substation will also be compliant during the other time periods of the day which are subject to less stringent project trigger noise levels, and at other receiver locations which would be subject to further distant attenuation and/or shielding by intervening buildings.

APPENDIX A Glossary of terminology

The following is a brief description of the technical terms used to describe noise to assist in understanding the technical issues presented.

Adverse weather	Weather effects that enhance noise (that is, wind and temperature inversions) that occur at a site for a significant period of time (that is, wind occurring more than 30% of the time in any assessment period in any season and/or temperature inversions occurring more than 30% of the nights in winter).
Ambient noise	The all-encompassing noise associated within a given environment at a given time, usually composed of sound from all sources near and far.
Assessment period	The period in a day over which assessments are made.
Assessment point	A point at which noise measurements are taken or estimated. A point at which noise measurements are taken or estimated.
Background noise	Background noise is the term used to describe the underlying level of noise present in the ambient noise, measured in the absence of the noise under investigation, when extraneous noise is removed. It is described as the average of the minimum noise levels measured on a sound level meter and is measured statistically as the A-weighted noise level exceeded for ninety percent of a sample period. This is represented as the L90 noise level (see below).
Decibel [dB]	The units that sound is measured in. The following are examples of the decibel readings of every day sounds: 0dB The faintest sound we can hear 30dB A quiet library or in a quiet location in the country 45dB Typical office space. Ambience in the city at night 60dB CBD mall at lunch time 70dB The sound of a car passing on the street 80dB Loud music played at home 90dB The sound of a truck passing on the street 100dB The sound of a rock band 115dB Limit of sound permitted in industry 120dB Deafening
dB(A)	A-weighted decibels. The A- weighting noise filter simulates the response of the human ear at relatively low levels, where the ear is not as effective in hearing low frequency sounds as it is in hearing high frequency sounds. That is, low frequency sounds of the same dB level are not heard as loud as high frequency sounds. The sound level meter replicates the human response of the ear by using an electronic filter which is called the "A" filter. A sound level measured with this filter switched on is denoted as dB(A). Practically all noise is measured using the A filter.
dB(C)	C-weighted decibels. The C-weighting noise filter simulates the response of the human ear at relatively high levels, where the human ear is nearly equally effective at hearing from mid-low frequency (63Hz) to mid-high frequency (4kHz), but is less effective outside these frequencies.
Frequency	Frequency is synonymous to pitch. Sounds have a pitch which is peculiar to the nature of the sound generator. For example, the sound of a tiny bell has a high pitch and the sound of a bass drum has a low pitch. Frequency or pitch can be measured on a scale in units of Hertz or Hz.
Impulsive noise	Having a high peak of short duration or a sequence of such peaks. A sequence of impulses in rapid succession is termed repetitive impulsive noise.
Intermittent noise	The level suddenly drops to that of the background noise several times during the period of observation. The time during which the noise remains at levels different from that of the ambient is one second or more.
L_{Max}	The maximum sound pressure level measured over a given period.
L_{Min}	The minimum sound pressure level measured over a given period.

L_1	The sound pressure level that is exceeded for 1% of the time for which the given sound is measured.
L_{10}	The sound pressure level that is exceeded for 10% of the time for which the given sound is measured.
L_{90}	The level of noise exceeded for 90% of the time. The bottom 10% of the sample is the L90 noise level expressed in units of dB(A).
L_{eq}	The "equivalent noise level" is the summation of noise events and integrated over a selected period of time.
Reflection	Sound wave changed in direction of propagation due to a solid object obscuring its path.
SEL	Sound Exposure Level (SEL) is the constant sound level which, if maintained for a period of 1 second would have the same acoustic energy as the measured noise event. SEL noise measurements are useful as they can be converted to obtain Leq sound levels over any period of time and can be used for predicting noise at various locations.
Sound	A fluctuation of air pressure which is propagated as a wave through air.
Sound absorption	The ability of a material to absorb sound energy through its conversion into thermal energy.
Sound level meter	An instrument consisting of a microphone, amplifier and indicating device, having a declared performance and designed to measure sound pressure levels.
Sound pressure level	The level of noise, usually expressed in decibels, as measured by a standard sound level meter with a microphone.
Sound power level	Ten times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power.
Tonal noise	Containing a prominent frequency and characterised by a definite pitch.

Appendix G: Systems Connect Vibration Monitoring Register

Systems Connect Vibration Monitoring Register

Start Date	End Date	Conducted By	Location	Detailed Monitoring Location	Attended or Continuous	Type of Works	Reason for Vibration Monitoring	Type of Structures	Vibration Criteria mm/s	Compliant with Vibration Criteria or Monitorong Protocol Y/N	Comments
23/09/2023	25/09/2023	Renzo Tonin Wayne Moloney	BPS Surry Hills	Randall Lane, Surry Hills (Dental Hospital address location is 2-18 Chalmers St, Surry Hills)	Attended	BPS cable joint excavation	Works close to and within MWD of building	Reinforced structure (commercial building)	25	Y	No vibration exceedances due to operation of vibratory equipment
25/09/2023	4/10/2023	Renzo Tonin	Chatswood	Mowbray Road House, Chatswood	Attended	Demolition works	Works close to MWD for heritage structure, however not within MWD.	Heritage structures (structurally sound and structurally unsound)	2.5	Y	No vibration exceedances resulted due to construction demolition works.
9/10/2023	11/10/2023	Renzo Tonin	BPS Surry Hills	Surry Hills Dental hospital, Randle Lane, Surry Hills	Attended	Hammering works	Works close to and within MWD of building	Reinforced structure (commercial building)	25	Y	No vibration exceedances due to operation of vibratory equipment

Appendix H: Vibration Monitoring Equipment Details

Vibration Monitor Calibration Records

No.	Make	Model	Device Serial Number	Calibration Date	Place of Calibration
1	Sigicom	Infra C12	70190	18/12/2023	NATacoustic
2	Sigicom	Infra C13	102478	30/03/2023	NATacoustic

Note: calibration of vibration monitors is managed by Renzo Tonin & Associates

Note: caliabration of vibration monitors are due every two years

NATacoustic
Acoustic Calibration & Testing Laboratory
Level 1, 418A Elizabeth Street., Surry Hills NSW 2010 AUSTRALIA
Ph: (02) 8218 0570 email: service@natacoustic.com.au website: www.natacoustic.com.au
A division of Renzo Tonin & Associates (NSW) Pty Ltd ABN 29 117 462 861

Certificate of Calibration
Accelerometer / Vibration Monitor

Calibration Date 30/03/2023 **Operator** EF
Client Name RENZO TONIN & ASSOCIATES (NSW) PTY LTD
Client Address LEVEL 1 418A ELIZABETH ST SURRY HILLS 2010

Test Item

Manufacturer Sigicom **Serial No** #102478
Instrument Model Infra c22

Applicable Work Instruction:
WiTC-100 Sigicom Calibration

Reference Standards:
International Standard ISO8041:2005 Human response to vibration -Measuring instrumentation
International Standard ISO 16063-1:1998 Methods for the calibration of vibration and shock transducers - Part 1: Basic concepts
International Standard ISO 16063-21:2003 Methods for the calibration of vibration and shock transducers - Part 21: Vibration calibration by comparison to a reference transducer

Laboratory Equipment :
Electrodynamic shaker - Ground Zero GZNW 18XSPL
Power Amplifier – Behringer Model NU3000DSP
Signal generator
DT 9837A 4-channel data acquisition card
SpectraPLUS software
Reference accelerometer

Traceability:
The results of the tests and measurements included in this document are traceable via the test methods described in the applicable work instruction which references the listed international standards.
And by the use of the above lab equipment, which has been calibrated where required using reference equipment calibrated by NATA accredited calibration facilities.
This document shall not be reproduced, except in full.

Scope:
This certificate is issued on the basis that the instrument complies with the manufacturer's specification.

Calibration Notes:
Sensitivity of reference accelerometer and measurement chain was verified using a BK 4294 field accelerometer. The measured rms vibration level was within 0.1 dB of the reference level at 1000 rad/s.

Calibration Checked and Approved:

Print Name: Ariel Michael Date: 5/04/2023

NATacoustic
Acoustic Calibration & Testing Laboratory
Level 1, 418A Elizabeth Street., Surry Hills NSW 2010 AUSTRALIA
Ph: (02) 8218 0570 email: service@natacoustic.com.au website: www.natacoustic.com.au
A division of Renzo Tonin & Associates (NSW) Pty Ltd ABN 29 117 462 861

Certificate of Calibration
Accelerometer / Vibration Monitor

Calibration Date 18/12/2023 **Operator** AM / KW
Client Name RENZO TONIN & ASSOCIATES (NSW) PTY LTD
Client Address LEVEL 1 418A ELIZABETH ST SURRY HILLS 2010

Test Item

Manufacturer Sigicom **Serial No** #70190
Instrument Model Infra C12

Applicable Work Instruction:
WiTC-100 Sigicom Calibration

Reference Standards:
International Standard ISO8041:2005 Human response to vibration -Measuring instrumentation
International Standard ISO 16063-1:1998 Methods for the calibration of vibration and shock transducers - Part 1: Basic concepts
International Standard ISO 16063-21:2003 Methods for the calibration of vibration and shock transducers - Part 21: Vibration calibration by comparison to a reference transducer

Laboratory Equipment :
Electrodynamic shaker - Ground Zero GZNW 18XSPL
Power Amplifier – Behringer Model NU3000DSP
Signal generator
DT 9837A 4-channel data acquisition card
SpectraPLUS software
Reference accelerometer

Traceability:
The results of the tests and measurements included in this document are traceable via the test methods described in the applicable work instruction which references the listed international standards.
And by the use of the above lab equipment, which has been calibrated where required using reference equipment calibrated by NATA accredited calibration facilities.

Scope:
This certificate is issued on the basis that the instrument complies with the manufacturer's specification.

Calibration Notes:
Sensitivity of reference accelerometer and measurement chain was verified using a BK 4294 field accelerometer. The measured rms vibration level was within 0.1 dB of the reference level at 1000 rad/s.

Calibration Checked and Approved:

Print Name: Ariel Michael Date: 19/12/2023

Appendix I: Vibration Monitoring Report Samples

28 September 2023
TK685-03-05F05 Dental Hospital Vibration Monitoring Report (r1)

Systems Connect
Level 3, 116 Miller Street
North Sydney NSW 2060

Sydney Metro Line Wide Works - Surry Hills - Randle Lane Excavation - Vibration Monitoring Report

1 Introduction

Renzo Tonin and Associates was engaged by Systems Connect to conduct vibration monitoring at Sydney Dental Hospital during the excavation works on Randle Lane, Surry Hills. Vibration monitoring was undertaken to minimise and manage the potential vibration impacts to the nearby Sydney Dental Hospital building.

The work documented in this report was carried out in accordance with the Renzo Tonin & Associates Quality Assurance System, which is based on Australian Standard / NZS ISO 9001.

2 Details of monitoring

The vibration monitoring details are shown in Table 2.1.

Table 2.1: Vibration monitoring details

Measurement ID	Assessment Point	Date and Time	Measured plant	Approx. distance to measured plant
M1	Sydney Dental Hospital building, Randle Lane, Surry Hills (Figure 2.1 and Figure 2.2)	23.09.2023 – 25.09.2023 08:07am – 12:04pm	5t excavator with hammer attachment	3m – 10m

The instrumentation used for the vibration measurement is summarised Table 2.2. The monitoring location is shown in Figure 2.1 and instrumentation set up is shown in Figure 2.2.

Table 2.2: Instrumentation

Type	Make / Model
Triaxial Transducers	Sigicom C22 (SN: 102478)

The triaxial transducers used in the measurements have current calibration certificates.

Figure 2.1: Monitoring location

Figure 2.2: Instrumentation set up

3 Vibration criteria

The established vibration criteria in the *Sydney Metro – City and Southwest – Construction Noise and Vibration Management Plan* are given below:

3.1 Cosmetic damage to buildings

BS7385 suggests levels at which 'cosmetic', 'minor' and 'major' categories of damage might occur. The 'cosmetic' damage levels set by BS 7385 are considered 'safe limits' up to which no damage due to vibration effects has been observed for particular building types. Damage comprises minor non-structural effects such as hairline cracks on drywall surfaces, hairline cracks in mortar joints and cement render, enlargement of existing cracks and separation of partitions or intermediate walls from load bearing walls. 'Minor' damage is considered possible at vibration magnitudes which are twice those given and 'major' damage to a building structure may occur at levels greater than four times those values.

Table 3.1 sets out the recommended limits from BS7385 for transient vibration to ensure minimal risk of cosmetic damage to residential, commercial and industrial buildings.

These limits relate predominantly to transient vibration which does not give rise to resonant responses in structures, and to low-rise buildings. Where the dynamic loading caused by continuous vibration is such as to give rise to dynamic magnification due to resonance, especially at the lower frequencies where lower guide values apply, then the guide values in Table 3.1 may need to be reduced by up to 50 for Residential Buildings.

Note: rock breaking/hammering and sheet piling activities are considered to have the potential to cause dynamic loading in some structures (e.g. residences) and it may be appropriate to reduce the transient values by 50%. In addition, for most construction activities involving intermittent vibration sources such as rock breakers, piling rigs, vibratory rollers, excavators and the like, the predominant vibration energy occurs at frequencies greater than 4 Hz (and usually in the 10 Hz to 100 Hz range). Furthermore, a Structural Condition and Trench Impact Assessment of the heritage building (Robert Bird Group December 2020, reference: 20309-RBG-ZZ-XX-RP-CE-C1005) found that the building was sound. On this basis, consistent with the SM-CNVS a conservative vibration damage screening level for the Sydney Dental Hospital building is given below:

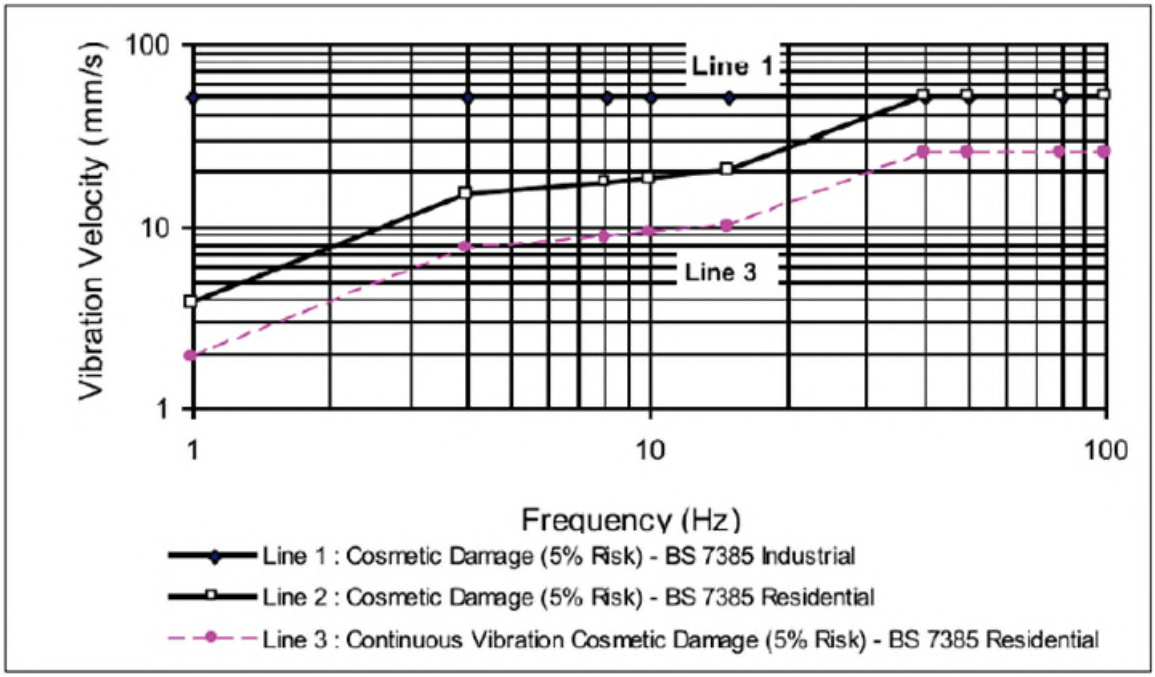
- Reinforced or framed structures (Line 1): 25.0 mm/s

At locations where the predicted and/or measured vibration levels are greater than shown above (peak component particle velocity), a more detailed analysis of the building structure, vibration source, dominant frequencies and dynamic characteristics of the structure would be required to determine the applicable safe vibration level. The analysis would take into consideration the transient vibration guide values for minimal risk of cosmetic damage set out in Table 3.1 and Figure 3.1 following.

Table 3.1: Transient vibration guide values – minimal risk of cosmetic damage (BS 7385) – peak component particle velocity

Line	Type of structure	Frequency range 4 to 15 Hz	Frequency range 15 to 40 Hz	Frequency range 40 Hz and above
1	Reinforced or framed structures Industrial and heavy commercial buildings	50 mm/s	50 mm/s	50 mm/s
2	Unreinforced or light framed structures Residential or light commercial type buildings	15 mm/s at 4Hz, increasing to 20 mm/s at 15Hz	20 mm/s at 15Hz, increasing to 50 mm/s at 40Hz	50 mm/s

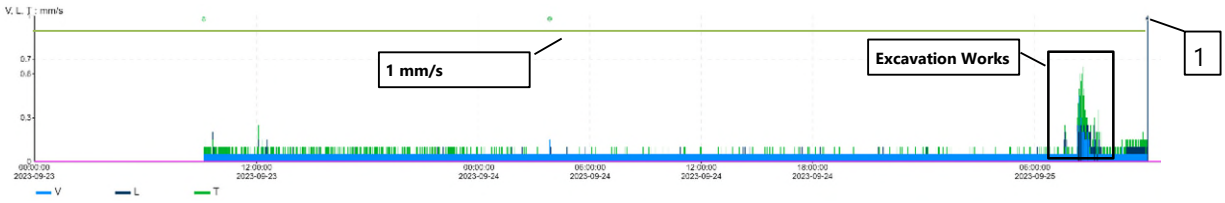
Figure 3.1: Graph of Transient Peak Component Particle Velocity Vibration Guide Values for Cosmetic Damage



4 Vibration monitoring results

The results of the unattended vibration monitoring are presented in Figure 4.1.

Figure 4.1: Unattended vibration monitoring results



The discussion of the unattended vibration monitoring is summarised in Table 4.1.

Table 4.1: Unattended vibration monitoring summary

Exceedance ID	Date and Time	Cause of exceedance
1	25.09.2023 12:04pm	At this time, the site engineer removed the vibration monitor from the monitoring location. This exceedance was not construction related.

It can be seen in Figure 4.1 that the vibration levels produced from the measured hammering works were below 1 mm/s. Given that the screening criterion is 25 mm/s, the risk of cosmetic damage from the hammering works is considered low. Note that there was an event that resulted in instantaneous vibration levels of above 25 mm/s. The cause of the exceedance has been justified in Table 4.1.

5 Conclusion

Renzo Tonin and Associates was engaged by Systems Connect to conduct vibration monitoring at Sydney Dental Hospital during the excavation works on Randle Lane, Surry Hills. Vibration monitoring was undertaken to minimise and manage the potential vibration impacts to the nearby Sydney Dental Hospital building.

The vibration monitoring results show that the vibration levels produced from the hammering works were below 1 mm/s. Given that the screening criterion is 25 mm/s, the risk of cosmetic damage from the hammering works is considered low.

Document control

Date	Revision history	Non-issued revision	Issued revision	Prepared	Instructed	Reviewed / Authorised
28.09.2023	First Issue	0	1	A. Hannelly	R. Zhafranata	R. Zhafranata

File Path: R:\AssocSydProjects\TK651-TK700\TK685 PK SMCSW Linewide Works (CPB UGL)\1 Docs\100 CONSTRUCTION\3-05 CNVIS C2S_P3 BPS Surry Hills\TK685-03-05F05 Dental Hospital Vibration Monitoring Report (r1).docx

11 October 2023
TK685-03-05F06 Dental Hospital Vibration Monitoring Report (r1)

Systems Connect
Level 3, 116 Miller Street
North Sydney NSW 2060

Sydney Metro Line Wide Works - Surry Hills - Randle Lane Excavation - Vibration Monitoring Report

1 Introduction

Renzo Tonin and Associates was engaged by Systems Connect to conduct vibration monitoring at Sydney Dental Hospital during the excavation works on Randle Lane, Surry Hills. Vibration monitoring was undertaken to minimise and manage the potential vibration impacts to the nearby Sydney Dental Hospital building.

The work documented in this report was carried out in accordance with the Renzo Tonin & Associates Quality Assurance System, which is based on Australian Standard / NZS ISO 9001.

2 Details of monitoring

The vibration monitoring details are shown in Table 2.1.

Table 2.1: Vibration monitoring details

Measurement ID	Assessment Point	Date and Time	Measured plant	Approx. distance to measured plant
M1	Sydney Dental Hospital building, Randle Lane, Surry Hills (Figure 2.1 and Figure 2.2)	09.10.2023 – 11.10.2023 07:26am – 09:15am	5t excavator with hammer attachment	2m – 8m

The instrumentation used for the vibration measurement is summarised Table 2.2. The monitoring location is shown in Figure 2.1 and instrumentation set up is shown in Figure 2.2.

Table 2.2: Instrumentation

Type	Make / Model
Triaxial Transducers	Sigicom C12 (SN: 70190)

The triaxial transducers used in the measurements have current calibration certificates.

Figure 2.1: Monitoring location

Figure 2.2: Instrumentation set up

3 Vibration criteria

The established vibration criteria in the *Sydney Metro – City and Southwest – Construction Noise and Vibration Management Plan* are given below:

3.1 Cosmetic damage to buildings

BS7385 suggests levels at which 'cosmetic', 'minor' and 'major' categories of damage might occur. The 'cosmetic' damage levels set by BS 7385 are considered 'safe limits' up to which no damage due to vibration effects has been observed for particular building types. Damage comprises minor non-structural effects such as hairline cracks on drywall surfaces, hairline cracks in mortar joints and cement render, enlargement of existing cracks and separation of partitions or intermediate walls from load bearing walls. 'Minor' damage is considered possible at vibration magnitudes which are twice those given and 'major' damage to a building structure may occur at levels greater than four times those values.

Table 3.1 sets out the recommended limits from BS7385 for transient vibration to ensure minimal risk of cosmetic damage to residential, commercial and industrial buildings.

These limits relate predominantly to transient vibration which does not give rise to resonant responses in structures, and to low-rise buildings. Where the dynamic loading caused by continuous vibration is such as to give rise to dynamic magnification due to resonance, especially at the lower frequencies where lower guide values apply, then the guide values in Table 3.1 may need to be reduced by up to 50 for Residential Buildings.

Note: rock breaking/hammering and sheet piling activities are considered to have the potential to cause dynamic loading in some structures (e.g. residences) and it may be appropriate to reduce the transient values by 50%. In addition, for most construction activities involving intermittent vibration sources such as rock breakers, piling rigs, vibratory rollers, excavators and the like, the predominant vibration energy occurs at frequencies greater than 4 Hz (and usually in the 10 Hz to 100 Hz range). Furthermore, a Structural Condition and Trench Impact Assessment of the heritage building (Robert Bird Group December 2020, reference: 20309-RBG-ZZ-XX-RP-CE-C1005) found that the building was sound. On this basis, consistent with the SM-CNVS a conservative vibration damage screening level for the Sydney Dental Hospital building is given below:

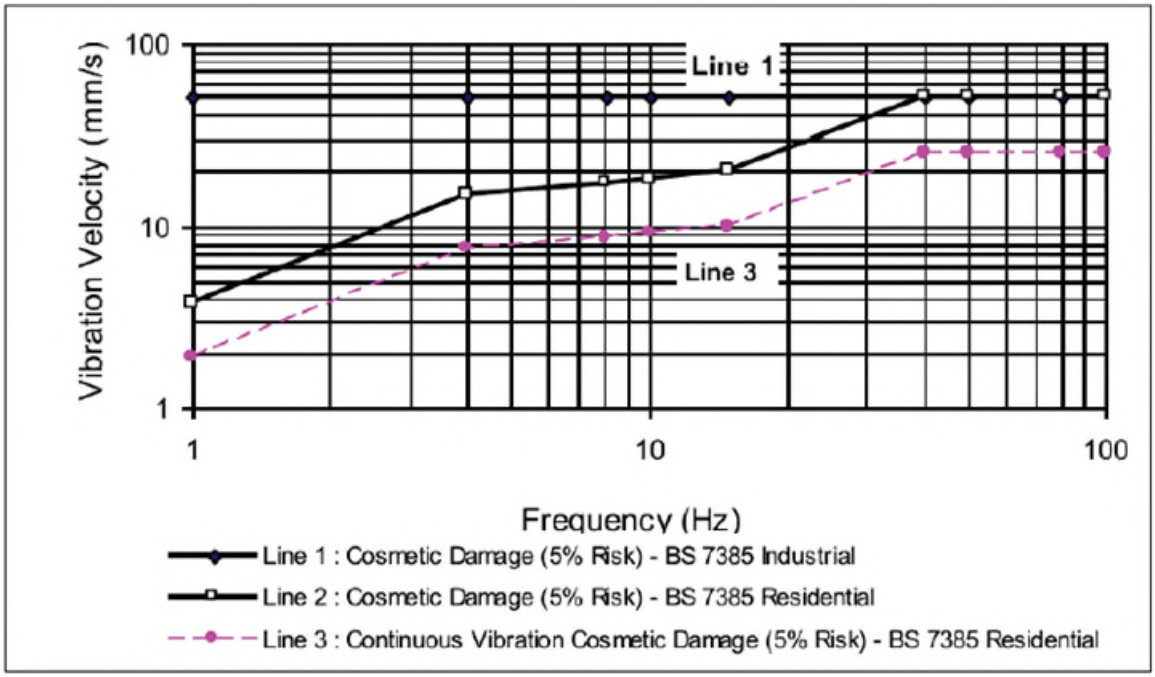
- Reinforced or framed structures (Line 1): 25.0 mm/s

At locations where the predicted and/or measured vibration levels are greater than shown above (peak component particle velocity), a more detailed analysis of the building structure, vibration source, dominant frequencies and dynamic characteristics of the structure would be required to determine the applicable safe vibration level. The analysis would take into consideration the transient vibration guide values for minimal risk of cosmetic damage set out in Table 3.1 and Figure 3.1 following.

Table 3.1: Transient vibration guide values – minimal risk of cosmetic damage (BS 7385) – peak component particle velocity

Line	Type of structure	Frequency range 4 to 15 Hz	Frequency range 15 to 40 Hz	Frequency range 40 Hz and above
1	Reinforced or framed structures Industrial and heavy commercial buildings	50 mm/s	50 mm/s	50 mm/s
2	Unreinforced or light framed structures Residential or light commercial type buildings	15 mm/s at 4Hz, increasing to 20 mm/s at 15Hz	20 mm/s at 15Hz, increasing to 50 mm/s at 40Hz	50 mm/s

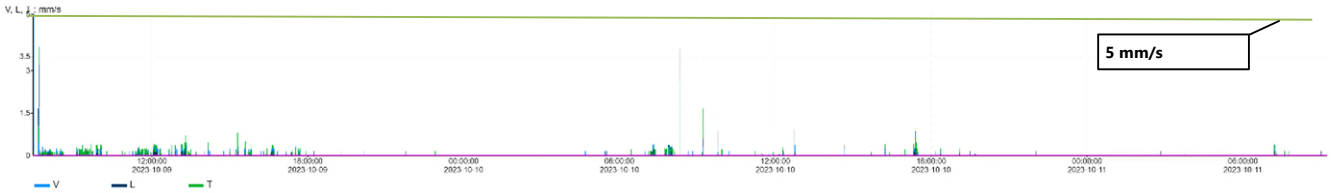
Figure 3.1: Graph of Transient Peak Component Particle Velocity Vibration Guide Values for Cosmetic Damage



4 Vibration monitoring results

The results of the unattended vibration monitoring are presented in Figure 4.1.

Figure 4.1: Unattended vibration monitoring results



It can be seen in Figure 4.1 that the vibration levels produced from the measured hammering works were generally below 1 mm/s. Given that the screening criterion is 25 mm/s, the risk of cosmetic damage from the hammering works is considered low.

5 Conclusion

Renzo Tonin and Associates was engaged by Systems Connect to conduct vibration monitoring at Sydney Dental Hospital during the excavation works on Randle Lane, Surry Hills. Vibration monitoring was undertaken to minimise and manage the potential vibration impacts to the nearby Sydney Dental Hospital building.

The vibration monitoring results show that the vibration levels produced from the hammering works were generally below 1 mm/s. Given that the screening criterion is 25 mm/s, the risk of cosmetic damage from the hammering works is considered low.

Document control

Date	Revision history	Non-issued revision	Issued revision	Prepared	Instructed	Reviewed / Authorised
11.10.2023	First Issue	0	1	A. Hannelly	R. Zhafranata	R. Zhafranata

File Path: R:\AssocSydProjects\TK651-TK700\TK685 PK SMCSW Linewide Works (CPB UGL)\1 Docs\100 CONSTRUCTION\3-05 CNVIS C2S_P3 BPS Surry Hills\TK685-03-05F06 Dental Hospital Vibration Monitoring Report (r1).docx

12 October 2023
TK685-3-02F09 Mowbray Rd House Vibration Monitoring Report (r1)

Systems Connect
Level 3, 116 Miller Street
North Sydney NSW 2060

Sydney Metro Line Wide Works – Mowbray Road House Vibration Monitoring Report

1 Introduction

Renzo Tonin & Associates was engaged by Systems Connect to conduct vibration monitoring at the Chatswood Dive site. The vibration monitoring was undertaken to monitor the heritage listed structure Mowbray Road House during demolition works. This report provides a summary of the monitoring results.

The work documented in this report was carried out in accordance with the Renzo Tonin & Associates Quality Assurance System, which is based on Australian Standard / NZS ISO 9001.

2 Details of monitoring

Unattended vibration monitoring was undertaken at the Mowbray Road House within the Chatswood Dive site between 07:15am 25th September 2023 and 11:31am 4th October 2023.

2.1 Monitoring location

The monitoring location is listed in Table 2.1 and shown in Figure 2.1.

Table 2.1: Monitoring details

Measurement ID	Assessment Point	Date and time	Measured plant	Monitoring type	Approx. distance to measured plant
M1	Mowbray Road House, Chatswood	07:15am 25.09.2023 – 11:31am 04.10.2023	24t & 35t excavator (with grapple, crusher and ripper boot attachments), dump truck, skid steer, EWP and delivery trucks	Vibration	10-75m

Figure 2.1: Vibration monitoring location

2.2 Monitoring methodology

The vibration monitor was installed as close as possible to the foundation of Mowbray Road House. For monitoring on hard surfaces, in accordance with AS 2775-2004[1], the surface was brushed to displace any loose dirt and the monitor was attached to the surface using double sided adhesive tape. The vibration monitoring setup is shown in APPENDIX A.

The instrumentation used for the vibration monitoring are summarised in Table 2.2. The transducer used in the measurements have current calibration certificates.

Table 2.2: Summary of vibration instrumentation

Type	Make / Model
Triaxial Transducer	Sigicom C12 (SN: #70190)

3 Vibration criteria

The established vibration criteria in the *Sydney Metro – City and Southwest – Construction Noise and Vibration Management Plan* are given below:

[1] Australia Standard 2775-2004 Mechanical vibration and shock – Mechanical mounting of accelerometers

3.1 Cosmetic damage to buildings

BS7385 suggests levels at which 'cosmetic', 'minor' and 'major' categories of damage might occur. The 'cosmetic' damage levels set by BS 7385 are considered 'safe limits' up to which no damage due to vibration effects has been observed for particular building types. Damage comprises minor non-structural effects such as hairline cracks on drywall surfaces, hairline cracks in mortar joints and cement render, enlargement of existing cracks and separation of partitions or intermediate walls from load bearing walls. 'Minor' damage is considered possible at vibration magnitudes which are twice those given and 'major' damage to a building structure may occur at levels greater than four times those values.

Table 3.1 sets out the recommended limits from BS7385 for transient vibration to ensure minimal risk of cosmetic damage to residential, commercial and industrial buildings.

These limits relate predominantly to transient vibration which does not give rise to resonant responses in structures, and to low-rise buildings. Where the dynamic loading caused by continuous vibration is such as to give rise to dynamic magnification due to resonance, especially at the lower frequencies where lower guide values apply, then the guide values in Table 3.1 may need to be reduced by up to 50 for Residential Buildings.

Note: rock breaking/hammering and sheet piling activities are considered to have the potential to cause dynamic loading in some structures (e.g. residences) and it may be appropriate to reduce the transient values by 50%. In addition, for most construction activities involving intermittent vibration sources such as rock breakers, piling rigs, vibratory rollers, excavators and the like, the predominant vibration energy occurs at frequencies greater than 4 Hz (and usually in the 10 Hz to 100 Hz range). On this basis, consistent with the SM-CNVS a conservative vibration damage screening level for Mowbray Road House is given below:

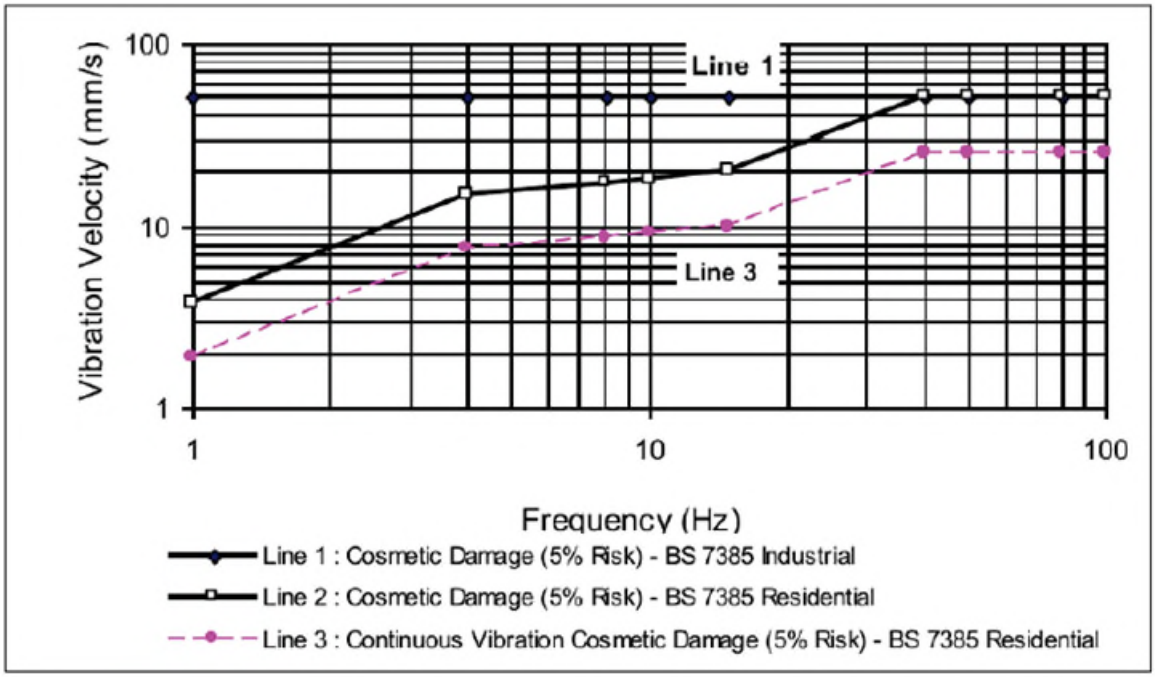
- Heritage structures (structurally sound): 7.5 mm/s
- Heritage structures (structurally unsound): 2.5 mm/s

At locations where the predicted and/or measured vibration levels are greater than shown above (peak component particle velocity), a more detailed analysis of the building structure, vibration source, dominant frequencies and dynamic characteristics of the structure would be required to determine the applicable safe vibration level. The analysis would take into consideration the transient vibration guide values for minimal risk of cosmetic damage set out in Table 3.1 and Figure 3.1 following.

Table 3.1: Transient vibration guide values – minimal risk of cosmetic damage (BS 7385) – peak component particle velocity

Line	Type of structure	Frequency range 4 to 15 Hz	Frequency range 15 to 40 Hz	Frequency range 40 Hz and above
1	Reinforced or framed structures Industrial and heavy commercial buildings	50 mm/s	50 mm/s	50 mm/s
2	Unreinforced or light framed structures Residential or light commercial type buildings	15 mm/s at 4Hz, increasing to 20 mm/s at 15Hz	20 mm/s at 15Hz, increasing to 50 mm/s at 40Hz	50 mm/s

Figure 3.1: Graph of Transient Peak Component Particle Velocity Vibration Guide Values for Cosmetic Damage



4 Vibration Monitoring results

The results of the unattended vibration monitoring are shown in Figure 4.1 and Figure 4.2.

Figure 4.1: Vibration monitoring results

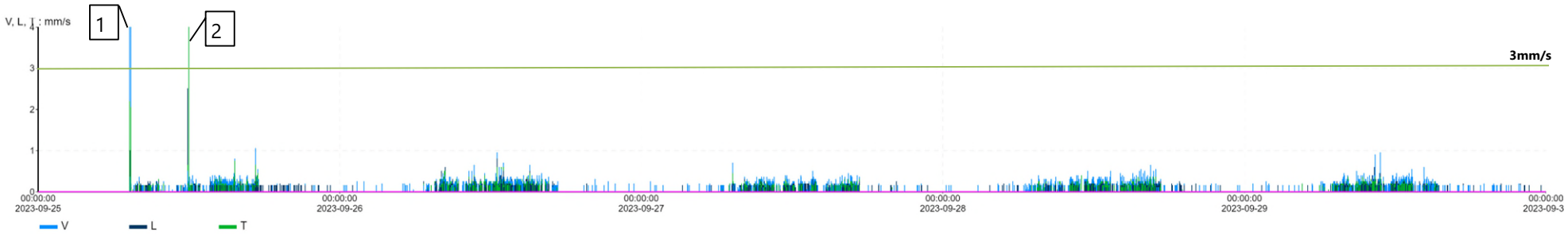
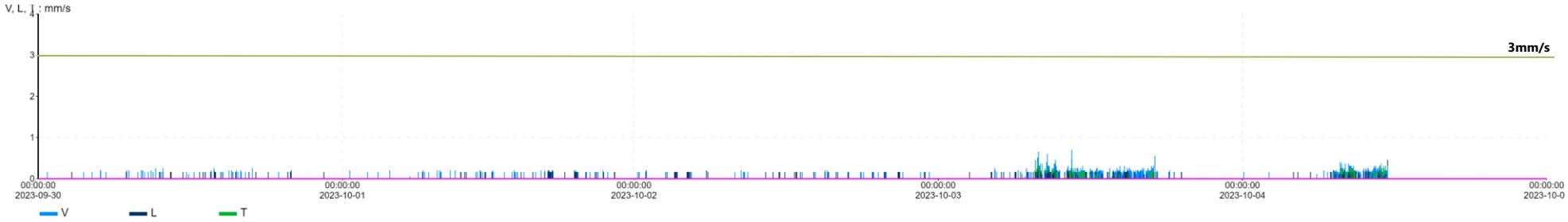


Figure 4.2: Vibration monitoring results



The discussion of the vibration monitoring results is summarised in Table 4.1.

Table 4.1: Vibration monitoring summary

Exceedance ID	Date and Time	Cause of exceedance
1	07:15pm 25.09.2023	At this time, the vibration monitor was mounted on the ground by a Renzo Tonin site engineer. Therefore, the exceedance was not construction related.
2	11:56am 25.09.2023	At this time, it was confirmed by the project team that a construction worker inadvertently bumped the monitor. Therefore, the exceedance was deemed not construction related.

It can be seen in Figure 4.1 and Figure 4.2 that the vibration levels produced from the demolition works were typically below 1 mm/s, which is below the established screening criteria for structurally sound and unsound heritage structures. Therefore, the risk of cosmetic damage from the measured demolition works is considered low. Note that there were events that resulted in an instantaneous vibration level of above 2.5 mm/s which have been deemed not construction related.

5 Conclusion

Renzo Tonin and Associates was engaged by Systems Connect to conduct vibration monitoring at the Chatswood Dive Site. The vibration monitoring was undertaken to monitor the heritage listed structure Mowbray Road House during demolition works.

The vibration monitoring results show that the vibration levels produced from the demolition works were typically below 1 mm/s, which is below the established screening criteria for structurally sound and unsound heritage structures. Therefore, the risk of cosmetic damage from the measured demolition works is considered low.

Document control

Date	Revision history	Non-issued revision	Issued revision	Prepared	Instructed	Reviewed / Authorised
12.10.2023	First issue	0	1	A. Hannelly	R. Zhafranata	R. Zhafranata

File Path: R:\AssocSydProjects\TK651-TK700\TK685 PK SMCSW Linewide Works (CPB UGL)\1 Docs\100 CONSTRUCTION\3-02 CNVIS C2B_P3 Northern Connection\TK685-3-02F09 Mowbray Rd House Vibration Monitoring Report (r1).docx

APPENDIX A Monitoring location

A.1 Vibration monitor setup

APPROVAL
CITY & SOUTHWEST ACOUSTICS ADVISOR

Review of	**Construction Monitoring Report September 2023 to February 2024 Sydney Metro City & Southwest - Line Wide West**	**Document reference:**	**Construction Monitoring Report September 2023 to February 2024 Line Wide Works Development Prepared by CPB.** *Document number: SMCSWLWC-SYC-CSW-EM-REP-023196* *Team Binder: SMCSWLWC-SYC-CSW-EM-REP-023196.02.RVW.02.01* *Revision date: 9/05/2024* *Revision: 2*
Prepared by:	Carl Fokkema Alternate Acoustics Advisor		
Date of issue:	13 May 2024		

As approved Alternate Acoustics Advisor for the Sydney Metro City & Southwest project, I have reviewed and provided comment on the Construction Monitoring Report (CMR) for the Sydney Metro City & Southwest – Liw-wide Works, as required under A27 (d) of the project approval conditions (SSI 15-7400).

I reviewed and commented on previous revision's (Rev 0 and 1) of the CMR September 2023 to February 2024. This revision 2 includes minor amendments that required updating or were of an administrative or minor nature and are consistent with the terms of approval and the document approved by the Secretary.

I am satisfied that such amendments are necessary, approve revision 2 of the CMR September 2023 to February 2024 (dated 9 May 2024), and consider that the document is appropriate for submission to the Secretary for information.

Carl Fokkema, City & Southwest Alternate Acoustics Advisor