AW EDWARDS

Construction Monitoring Report October 2022 – March 2023

DOCUMENT INFORMATION

PROJECT	Sydney City & Southwest Metro – Crows Nest Station	**REVISION**	B
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CLIENT	Sydney Metro	**STATUS**	For Review

DOCUMENT APPROVAL

	PREPARED BY	REVIEWED BY	APPROVED BY
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Project Role	Senior Environment & Sustainability Coordinator	Planning & Environment Manager	Project Director
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Date	02/08/2023	02/08/2023	02/08/2023

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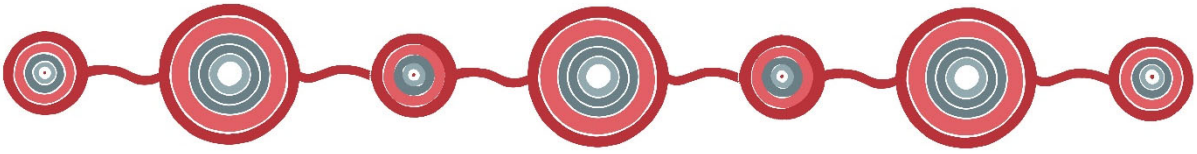
REVISION

REVISION	DATE	STATUS	AUTHOR	APPROVED BY	COMMENTS
A	29-Jun-2023	For review	[redacted]	[redacted]	Initial version for review
B	02-Aug-2023	For review	[redacted]	[redacted]	Addressing comments from ER and AA



AW EDWARDS acknowledges the Traditional Owners of Country throughout Australia and recognises the continuing connection to lands, waters and communities.
We pay our respect to Aboriginal and Torres Strait Islander people and culture, and to their Elders past and present.

"COMMUNITY"
Artwork by Raechel Saunders

CONTACTS

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Sydney Metro Senior Communications Manager	[redacted]	[redacted]
Independent Environmental Representative	[redacted]	[redacted]
Acoustic Advisor	[redacted]	[redacted]
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ISA Coordinator	[redacted]	[redacted]
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North Sydney Council		(02) 9936 8100
EPA pollution hotline		131 555
SafeWork NSW		131 050
NSW Health		(02) 9391 9939 (office hours) or 0491 227 423 (after hours)
Fire and Rescue NSW		1300 729 579 (or 000 if an emergency)
WIRES Wildlife Rescue		1300 094 737

APPROVAL
CITY & SOUTHWEST ACOUSTICS ADVISOR

Review of:	Sydney City & Southwest Metro – Crows Nest Station, Construction Monitoring Report October 2022 – March 2023	**Document reference:**	SMCSWSCN-AWE-SCN-EM-REP-003385 Rev B AW Edwards 2 August 2023
Prepared by:	Daniel Weston Acoustics Advisor		
Date of issue:	3 August 2023		

As approved Acoustics Advisor for the Sydney Metro City & Southwest project, I have reviewed and provided comment on the sections relating to noise and vibration in the Construction Monitoring Report October 2022 – March 2023 for the Crows Nest Integrated Station Development (CNISD), as required under A27 (d) of the project approval conditions.

This report is to be submitted to the NSW Department of Planning and Environment in accordance with Condition of Approval C16 and the CNISD Construction Noise and Vibration Management Plan (CNVMP).

I have reviewed the report and am satisfied that my comments have been adequately addressed and that it meets the requirements of the CNISD CNVMP. I endorse the report.

Daniel Weston, City & Southwest Acoustics Advisor

CONTENTS

1 INTRODUCTION

1.1 SYDNEY METRO

The New South Wales (NSW) Government through the Sydney Metro Statutory Authority is implementing Sydney's Rail Future, a plan to transform and modernise Sydney's rail network so that it can grow with the city's population and meet the needs of commuters and customers in the future. Sydney Metro is a new standalone rail network identified in Sydney's Rail Future. The Sydney Metro network consists of Sydney Metro Northwest (previously known as the North West Rail Link), Sydney Metro City & Southwest and Sydney Metro West.

The Sydney Metro City & Southwest is a 30-kilometre metro rail between Chatswood and Bankstown, including; 17 kilometres of new tunnel from Chatswood, under the harbour to Sydenham connecting seven new underground stations at Crows Nest, Victoria Cross (North Sydney), Barangaroo, Pitt Street, Martin Place, Central and Waterloo. Upgrading 13 kilometres of the Bankstown line, including 11 existing stations; Sydenham, Marrickville, Dulwich Hill, Hurlstone Park, Canterbury, Campsie, Belmore, Lakemba, Wiley Park, Punchbowl and Bankstown plus southern service facilities.

Several separate environmental impact assessments of the project were progressed by Transport for NSW (TfNSW). In May 2016, an environmental impact statement (EIS) for the Chatswood to Sydenham section of the project (the EIS) was placed on public exhibition for 48 days. A preferred infrastructure report on the Chatswood to Sydenham component (the PIR) was prepared and publicly released in October 2016. The project was approved on 9 January 2017 (SSI 15_7400) (planning approval). Following approval, eight modifications have been approved by NSW Department of Planning and Environment (DPE) and a ninth modification was approved by DPE on 30 June 2022 to extend hours of work on Saturdays until 6pm (from 1pm as originally approved).

A W Edwards was awarded the tender to construct Crows Nest Integrated Station Development (the project).

1.2 CROWS NEST INTEGRATED STATION DEVELOPMENT

The project is bounded by the Pacific Highway on the west, Oxley Street to the north and Clarke Lane on the east (refer Figure 1) and is strategically located south of the existing rail station at St Leonards and close to the leisure and retail strip along Willoughby Road.

The project will support the St Leonards specialised centre as a southern gateway to commercial and mixed-use activities. The station will also improve access to the restaurants and specialist shops in the Crows Nest village.

Crows Nest Station will:

- Create a new transport focus on the southern side of the St Leonards specialised centre.
- Maximise legibility and connectivity with the local urban structure.
- Integrate the station with local improvement plans and make a positive contribution to the sense of place.

1.3 CONSTRUCTION MONITORING REPORTING PERIOD

The six-month reporting period of the Construction Monitoring Report is from 1 October 2022 to 31 March 2023 and aligns with Sydney Metro's six-monthly reporting period.

Figure 1 Project site and monitoring locations

2 CONSTRUCTION UPDATE FOR PAST 6 MONTHS

Since the previous Construction Monitoring Report (April 2022 to September 2022), the following key activities have been undertaken:

- Waterproofing walls and floors in sites A, B and C;
- Concrete delivery, pumping, pouring and finishing;
- Services, finishes and fitout in below ground levels;
- Steel fixing;
- Preparation and placing of formwork;
- Delivery of materials to site via the logistics lane;
- Completion of delivery and install of oversize, overmass, precast girders;
- Tree root investigation along Clarke Street;
- Commenced removal of capping beam around Site A;
- Service investigations and realignment of services in public domain;
- Pouring of blinding layer and commencement of Site C building;
- External paving started on Oxley St.

Working hours during the reporting period were standard construction hours as indicated in Modification 9 of SSI 7400 dated 30 June 2022, this approved standard working hours on Saturdays until 6pm.

Therefore, the standard construction hours for the reporting period have been:

- 7:00 am to 6:00 pm Mondays to Fridays;
- 8:00 am to 6:00 pm on Saturdays; and
- No time on Sundays or public holidays.

3 METEORLOGICAL CONDITIONS

Meteorological data during the reporting period has been sourced from the Bureau of Meteorology (BoM) weather station situated at Observatory Hill, Sydney, (4.7km from site).

3.1 RAINFALL

Based on long-term climate statistics, the months January to June are the wetter months of the year averaging over 120 millimetres (mm) of rainfall per month, with June historically being the wettest month at 133 mm. July to December are the drier months of the year averaging 80 mm of rainfall per month, with September being the driest month of the year at 68 mm. The annual average rainfall calculated from 162 years of data is 1211 mm, during this reporting period alone, 853 mm of rainfall was recorded compared to a typical 599 mm.

October, January and February were above the historical average, with October being significantly higher (295 mm recorded compared to a historical average of 78 mm). This is likely due to the La Nina system which has resulted in persistent periods of extended rainfall throughout the reporting period. The reporting period amounts to 182 calendar days, of which 89 days (49%) recorded rainfall. These high levels of rainfall led to widespread flooding on the east coast of Australia.

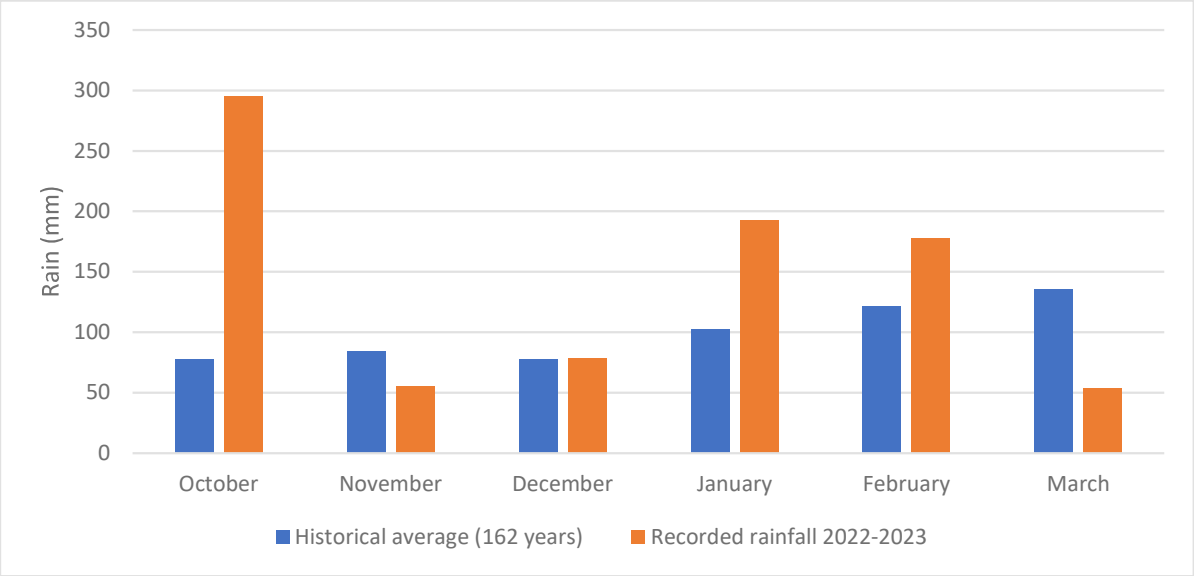


Figure 2 Monthly rainfall during the reporting period

3.2 TEMPERATURE

Based on long-term climate statistics, December to March are the warmest months of the year with maximum temperatures averaging around 25 degrees Celsius.

Based on the results recorded during the reporting period, temperatures followed the trend from the long-term statistics, but most months were slightly warmer than the statistical average.

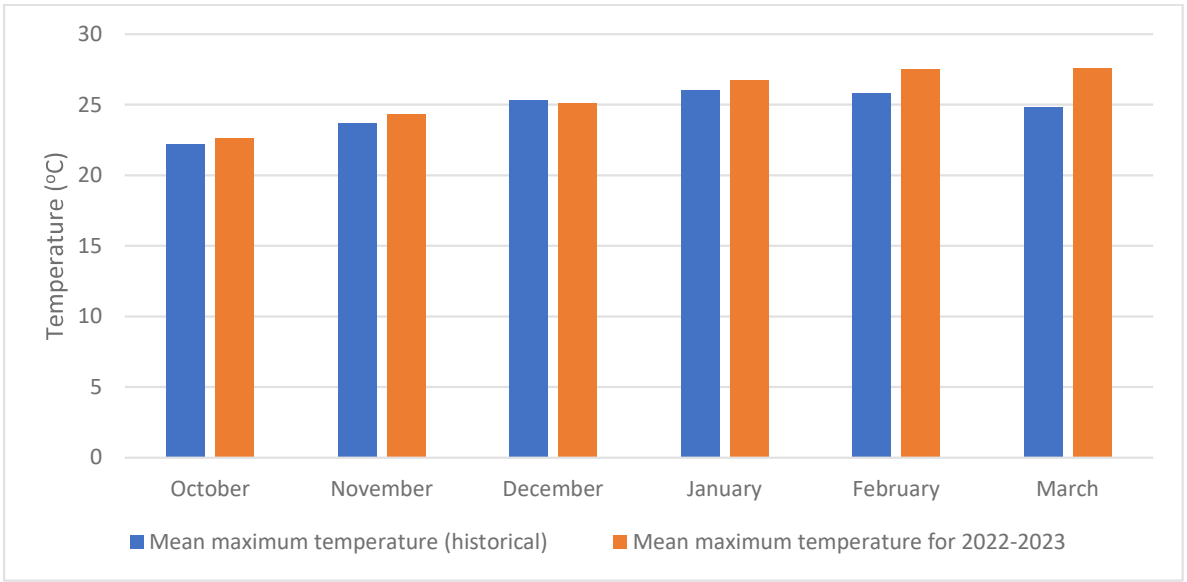


Figure 3 Monthly maximum temperatures during the reporting period

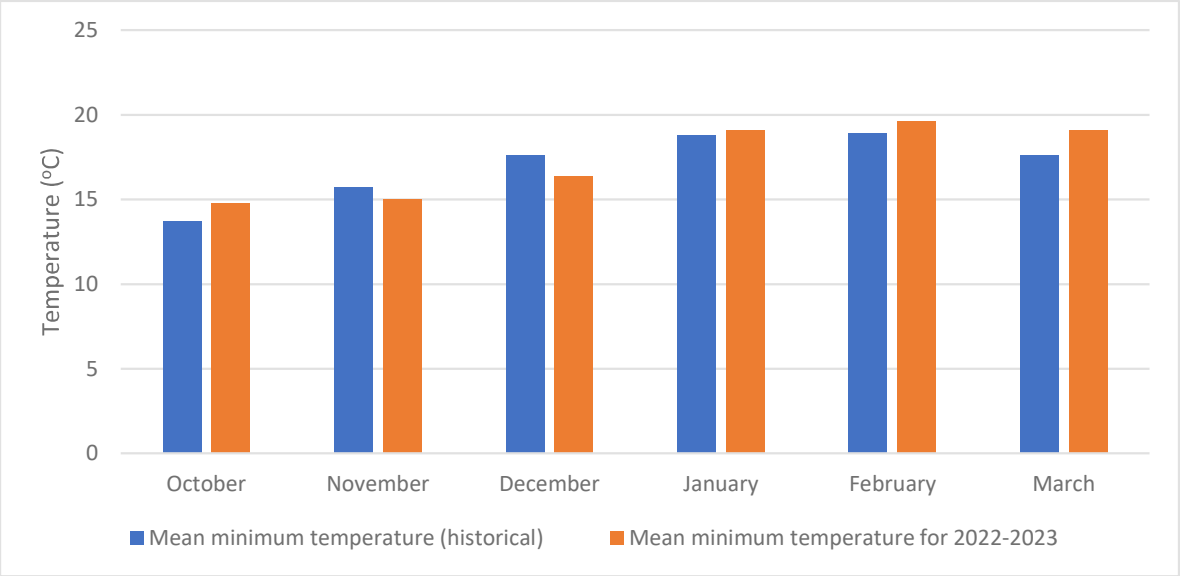


Figure 4 Monthly minimum temperatures during the reporting period

3.3 WIND

A review of the 9am wind direction during the reporting period demonstrates that the dominant wind direction has been from a westerly direction.

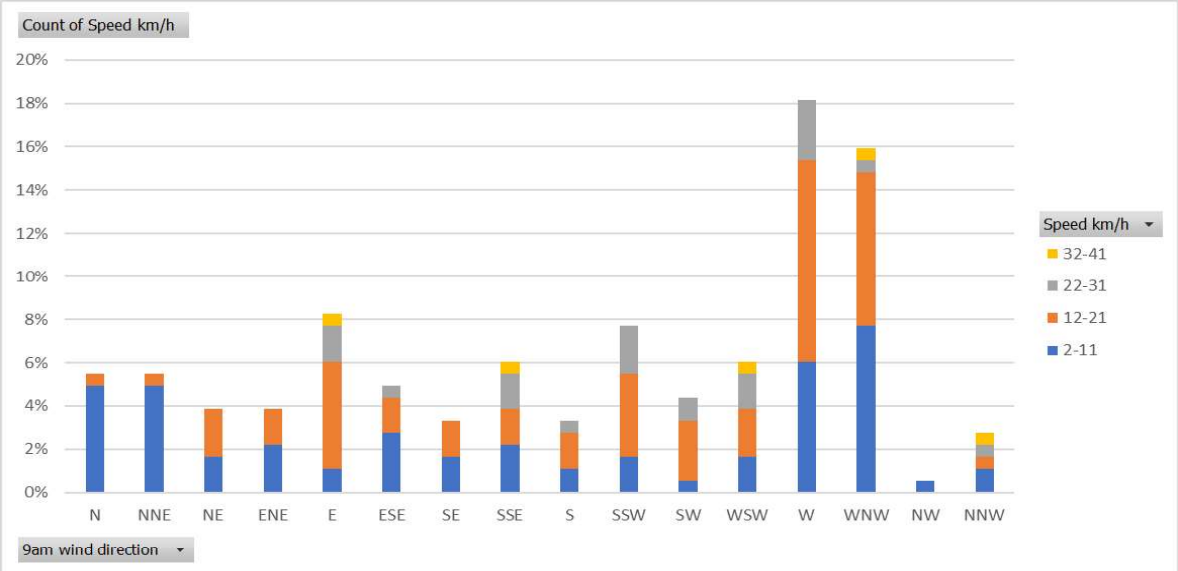


Figure 5 Wind direction during the reporting period

A review of the 9am wind speed during the reporting period demonstrates that wind has been predominantly travelling at between 12– 21 km/hr (gentle breeze) from the west and west north west.

4 CONSTRUCTION EQUIPMENT

Table 1 identifies the plant that has been inducted to site during the reporting period.

Table 1 Plant inducted to site during the reporting period

DATE	Description	Make / Model
30/03/2023	Boom Lift (Under 11 Metres)	Genie Z34/ 22
27/03/2023	Scissor Lift	Haulotte 8AC
27/03/2023	Excavator / Earthmoving Equipment	Hitachi ZX48U-5A
27/03/2023	Boom Lift (Under 11 Metres)	Haulotte Star 10
23/03/2023	Scissor Lift	2017 star 6 AC E
17/03/2023	Boom Lift (Under 11 Metres)	JLG T10E
16/03/2023	Concrete Line Pump	Transcrete
15/03/2023	Boom Lift (Under 11 Metres)	Haulotte Star 10
15/03/2023	Boom Lift (Under 11 Metres)	Haulotte Star 10
15/03/2023	Scissor Lift	Haulotte Star 10
15/03/2023	Mobile Crane	Kato CR200RF
14/03/2023	Excavator / Earthmoving Equipment	Bobcat E50R
14/03/2023	Scissor Lift	Skyjack SJ3219
14/03/2023	Vertical Lift	Haulotte Star 8 s
13/03/2023	Scissor Lift	Skyjack SJ1113219
13/03/2023	Excavator / Earthmoving Equipment	Hitachi ZX48U-5A
10/03/2023	Vertical Lift	Genie GR-20 M-20FT-E
9/03/2023	Air Compressors	Atlas Copco XAS 185
9/03/2023	Air Compressors	Atlas Copco XAS185
6/03/2023	Scissor Lift	Haulotte Optimum 8AC
6/03/2023	Scissor Lift	Haulotte Star 6AC
6/03/2023	Mobile Crane	Liebherr LTM1055-3.2
6/03/2023	Scissor Lift	Haulotte 32 foot Compact 12
4/03/2023	Forklift	Sumi Conda Viper 2.0
3/03/2023	Scissor Lift	Gene GS3232
3/03/2023	Boom Lift (Over 11 Metres)	Nifty HR21

DATE	Description	Make / Model
3/03/2023	Scissor Lift	Skyjack SJ-3226
1/03/2023	Electric pallet truck	Caterpillar NPP20N
1/03/2023	Excavator / Earthmoving Equipment	Kubota U55-4
1/03/2023	Mobile Crane	MAEDA LC785-6 BF
28/02/2023	Truck - Non Destructive Digger (Vac Truck)	DAF CF7585A
28/02/2023	Air Compressors	Atlas Copco XAS 185
28/02/2023	Concrete Placing Boom	Putzmeister BSF 47-5
25/02/2023	Air Compressors	Sullair 185
24/02/2023	Vertical Lift	Genie GR20
22/02/2023	Excavator / Earthmoving Equipment	Kubota U55-4
21/02/2023	Mobile Crane	Jekko JF-545
21/02/2023	Forklift	Toyota 8FBE18
19/02/2023	Mobile Crane	Sennebpgen 613
17/02/2023	Excavator / Earthmoving Equipment	KOBELCO SK135SR
17/02/2023	Boom Lift (Under 11 Metres)	Genie 230E
17/02/2023	Scissor Lift	Snorkel S4732E
16/02/2023	Heavy Vehicle	Isuzu NQR498A
16/02/2023	Truck - Non Destructive Digger (Vac Truck)	Isuzu FYH
15/02/2023	Truck - Non Destructive Digger (Vac Truck)	Isuzu FYH
15/02/2023	Truck - Non Destructive Digger (Vac Truck)	Isuzu FHFXZ
14/02/2023	Scissor Lift	Genie 230E
14/02/2023	Heavy Vehicle	Hino FG8J
14/02/2023	Piling Rig / Drill Rig	Hanjin D&B-8D
13/02/2023	Scissor Lift	Haulotte Compact 10
13/02/2023	Scissor Lift	Haulotte Compact 10
13/02/2023	Vertical Lift	Genie GR15
10/02/2023	Personnel Hoist	RX2740HF RX2740HF mid Speed Elec

DATE	Description	Make / Model
9/02/2023	Excavator / Earthmoving Equipment	Case CX60C
9/02/2023	Vertical Lift	JLG Toucan 10E
9/02/2023	Scissor Lift	Genie 1932
8/02/2023	Boom Lift (Over 11 Metres)	Nifty HR21
8/02/2023	Truck - Non Destructive Digger (Vac Truck)	Isuzu FXZ1500
3/02/2023	Vertical Lift	Genie GR-20 M-20FT-E
1/02/2023	Crane Truck	Palfinger PK2350
31/01/2023	Crane Truck	HMF 2620
30/01/2023	Concrete Placing Boom	Putzmeister BSF 56-5
25/01/2023	Scissor Lift	Haulotte Optimum 8AC
25/01/2023	Scissor Lift	Haulotte Optimum 8AC
25/01/2023	Scissor Lift	Haulotte Optimum 8AC
25/01/2023	Scissor Lift	Haulotte Optimum 8AC
23/01/2023	Excavator / Earthmoving Equipment	Yanmar VIO45-6B
18/01/2023	Concrete Placing Boom	FUSO
16/01/2023	Scissor Lift	Skyjack Sjllll3219
16/01/2023	Scissor Lift	Haulotte Optimum 8
9/01/2023	Forklift	FORKFORCE ENFORCER
4/01/2023	Scissor Lift	Genie 19ft Electric Scissorlift
21/12/2022	Concrete Line Pump	Nissan UD MK6
19/12/2022	Scissor Lift	JLG 1330L
19/12/2022	Piling Rig / Drill Rig	Soilmec SR35
16/12/2022	Excavator / Earthmoving Equipment	Komatsu PC138
15/12/2022	Boom Lift (Under 11 Metres)	Haulotte HA12CJ+
7/12/2022	Excavator / Earthmoving Equipment	Kubota KX080-3
6/12/2022	Piling Rig / Drill Rig	Christie Engineering CE 180
30/11/2022	Boom Lift (Over 11 Metres)	Nifty HR21Hybrid

DATE	Description	Make / Model
30/11/2022	Scissor Lift	Genie GR20
30/11/2022	Scissor Lift	Haulotte Optimum 8AC
30/11/2022	Scissor Lift	Genie GR-20
30/11/2022	Excavator / Earthmoving Equipment	Hitachi zx200-3
29/11/2022	Forklift	Sumi Conda Viper
28/11/2022	Concrete Line Pump	Mitsu FK65FLZ
28/11/2022	Boom Lift (Over 11 Metres)	Nifty HR210648
25/11/2022	Excavator / Earthmoving Equipment	Kubota KX057-4
24/11/2022	Mobile Crane	Grove GMK6400
23/11/2022	Excavator / Earthmoving Equipment	Caterpillar 301.7D CR
22/11/2022	Scissor Lift	Genie GS1932 AU2
22/11/2022	Boom Lift (Under 11 Metres)	JLG E300AJP
22/11/2022	Scissor Lift	Haulotte Optimum 8AC
21/11/2022	Scissor Lift	Haulotte Optimum 8AC
21/11/2022	Scissor Lift	Haulotte Star 8s
21/11/2022	Scissor Lift	Haulotte Star 8s
21/11/2022	Scissor Lift	Snorkel S3219E
16/11/2022	Excavator / Earthmoving Equipment	Komatsu PC138US-11
14/11/2022	Scissor Lift	Skyjack SJ3219
14/11/2022	Scissor Lift	Skyjack SJ3219
14/11/2022	Truck - Non Destructive Digger (Vac Truck)	Isuzu FVZ193A
11/11/2022	Piling Rig / Drill Rig	Christie Engineering CE 180
9/11/2022	Scissor Lift	Snorkel S4732E Snorkel S4732E
8/11/2022	Electric pallet truck	Enforcer walkie Stacker - WSBPRE16
3/11/2022	Scissor Lift	Genie 19ft Electric
28/10/2022	Truck - Non Destructive Digger (Vac Truck)	Hino 500 Series
27/10/2022	Scissor Lift	Genie GS1932XH

DATE	Description	Make / Model
27/10/2022	Scissor Lift	Genie GS1932XH
27/10/2022	Excavator / Earthmoving Equipment	Kubota U35-4
26/10/2022	Mobile Crane	Liebherr LTM1040-2.1
26/10/2022	Scissor Lift	HAULOTTE OPTIMUM 8 AC
26/10/2022	Scissor Lift	HAULOTTE OPTIMUM 8 AC
21/10/2022	Tower Crane	Favco M440D
20/10/2022	Forklift	MANITOU MC - X25-5
19/10/2022	Truck - Non Destructive Digger (Vac Truck)	Isuzu fyj300
18/10/2022	Excavator / Earthmoving Equipment	Yanmar VI055-6BP
18/10/2022	Truck - Tipper	Isuzu FR500
18/10/2022	Excavator / Earthmoving Equipment	Bobcat E20
18/10/2022	Mobile Crane	Grove GMK5150L
17/10/2022	Scissor Lift	Snorkel S3370RT35
17/10/2022	Mobile Crane	Franna AT20
13/10/2022	Scissor Lift	Anthea 850 Bi-leveling Scissor 850BL
13/10/2022	Scissor Lift	Athena 850
12/10/2022	Air Compressors	Atlas Copco XAS88
11/10/2022	Heavy Vehicle	Isuzu Hydrovac Truck FVY1400MY14
11/10/2022	Truck - Non Destructive Digger (Vac Truck)	Hino BL60SC
11/10/2022	Scissor Lift	Skyjack SJIII3219
10/10/2022	Truck - Tipper	Hino FE500
10/10/2022	Excavator / Earthmoving Equipment	Bobcat E35
10/10/2022	Truck - Tipper	Isuzu NLR
10/10/2022	Excavator / Earthmoving Equipment	Bobcat E35
5/10/2022	Scissor Lift	HAULOTTE OPTIMUM 8 AC
5/10/2022	Scissor Lift	HAULOTTE OPTIMUM 8 AC

5 CONSTRUCTION MONITORING PROGRAM

Condition C9 requires A W Edwards to prepare and implement construction monitoring programs for:

- Noise and Vibration; and
- Groundwater.

The construction monitoring programs listed above were incorporated into the relevant sub-plan and consultation with the relevant government agency was undertaken at the time of preparing the plans.

The Construction Environmental Management Plan (CEMP) and sub-plans, which included the relevant Construction Monitoring Programs, were deemed adequate to have met the relevant conditions of approval and approved on 24 February 2021. Monitoring of noise, vibration and groundwater has been implemented continuously since construction commenced on 26 February 2021.

6 NOISE AND VIBRATION MONITORING

The noise and vibration monitoring criteria have been approved in the Crows Nest Construction Noise and Vibration Management Plan (CNVMP).

6.1 REQUIREMENTS OF NOISE AND VIBRATION MONITORING REPORT

The content requirements for the noise and vibration monitoring report are stated in Section 7.4 of the CNVMP. Table 2 cross references where these requirements have been met.

Table 2 Requirements of noise and vibration monitoring report

REQUIREMENT	CROSS REFERENCE
Details of the type of monitoring completed and a brief statement of the measurement method.	Section 6.5
Relevant noise and vibration planning approval conditions and management objectives.	Section 6.2
Monitoring equipment specifications and locations.	Monitoring equipment: Section 6.6 Locations: Figure 1
Description of works, construction equipment, meteorological conditions and nearest affected sensitive receivers.	Description of works: Section 2 Meteorological conditions: Section 3 Construction equipment: Section 4 Nearest sensitive receivers: Figure 1
Any unattended monitoring results.	Section 6.7
Any attended monitoring results.	Section 6.7
Statements of compliances and non-compliances against noise and vibration planning approval conditions and management objectives, including reasons for any identified non-compliance's and strategies for minimising further occurrence of identified non-compliances.	Section 6.7 Table *5* Section 8

6.2 NOISE AND VIBRATION MANAGEMENT OBJECTIVES

Noise and vibration management objectives from Section 9.1 of the Sydney Metro Construction Environment Management Framework (CEMF) have been applied to the project and A W Edwards compliance with these objectives is stated in Table 3.

Table 3 Noise and vibration management objectives

MANAGEMENT OBJECTIVE	STATEMENT OF COMPLIANCE
Minimise unreasonable noise and vibration impacts on surrounding residents and businesses.	The project has been compliant with the noise and vibration criteria and has complied with the out of hours work approval process. An NCR was raised on 16 February for the use of a forklift on 2 February during the evening that was not in accordance with OOHW 25. A non-compliance was also raised on 22 February 2023 because a mitigation measure to conduct attended noise monitoring during January 2023 to confirm noise levels in OOHW 25 was not undertaken until 2 February 2023.
Undertake active community consultation.	A W Edwards proactively consults with the surrounding community on a regular basis. A W Edwards communicates the forth coming weeks work on a weekly basis via email, to a database of over 3,000 interested and affected parties. A W Edwards distributes a monthly newsletter to letterboxes in the surrounding community. Any out of hours work which hasn't been communicated in the monthly newsletter are notified via letterbox drops, specific notifications, phone calls or briefings at least seven days prior to the works commencing.
Avoid structural damage to buildings or heritage items from construction vibration.	No structural damage to buildings or heritage items has been recorded during the reporting period.
Maintain positive cooperative relationships with schools, childcare centres, local residents, and building owners.	A W Edwards has a positive relationship with a significant majority of the surrounding land users. There have been several instances where A W Edwards has received positive feedback for its community consultation.

6.3 NOISE MONITORING CRITERIA

Between the hours 7am and 8pm, the following internal noise control limits apply:

- $L_{Aeq(15minute)} \geq 60$ dBA for no longer than 6.5 hours.
- $L_{Aeq(15minute)} < 55$ dBA for at least 3.25 hours.
- The above are inclusive of a 5 dB penalty if rock breaking or any other annoying activity likely to result in ground-borne noise or a perceptible level of vibration.

6.4 VIBRATION MONITORING CRITERIA

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, the project set a conservative vibration damage screening level per receiver type as stated below:

- Reinforced or framed structures: 25.0 mm/s
- Unreinforced or light framed structures: 7.5 mm/s

6.5 MONITORING TYPES

During the reporting period A W Edwards has completed the following types of noise and vibration monitoring:

- Spot checks of plant and equipment sound power levels;
- Attended airborne noise monitoring in the community; and
- Real-time noise and vibration monitoring.

The procedure for monitoring each of the above listed types is detailed in Appendix C of the Construction Noise and Vibration Management Plan (CNVMP).

6.6 MONITORING EQUIPMENT

Monitoring equipment used during the reporting periods detailed in Table *4*. Attended monitors were field calibrated before and after each field measurement.

Table 4 Monitoring equipment used during the reporting period

MONITORING TYPE	MANUFACTURER	MODEL	SERIAL NO.	CALIBRATION DUE
Attended noise	B & K Type 1 sound level meter	2250	3028219	15-Mar-2025
Attended noise / spot checks	RION Type 1 sound level meter	NL-52	00219948	1-May-2025
Real-time noise	Sonitus Systems Type 1 sound level meter and data logger	EM2010 Type 1	00502	18-Nov-2023
Real-time vibration	AvaTrace	M80	1301	12-Oct-2024

6.7 MONITORING RESULTS

6.7.1 Attended airborne noise monitoring in the community

Attended noise monitoring was undertaken at representative locations around the project. The demolition of retaining walls / capping beam and piles to commence work at Site C presented the highest impact to surrounding receivers during the reporting period.

Table *5* summarises the attended monitoring that has been completed during the reporting period. Sound pressure levels reported in Table *5* were measured for 15-minute periods or sometimes for 3-minute periods for plant verification. All monitoring events have taken place during favourable weather conditions. All measured sound levels during the reporting period have been consistent with the predicted noise levels in the Crows Nest Construction Noise and Vibration Impact Statement (CNVIS).

Additional details, such as weather conditions, monitoring duration etc are recorded on the monitoring sheets, which can be provided on request. On request, attended monitoring records for out of hours work are forwarded on to Sydney Metro and the independent Acoustic Advisor and Environmental Representative.

Table 5 Attended noise monitoring completed during the reporting period

Date / Time	NCA	Address	Receiver type	Activities	Predicted Activity Noise ($L_{Aeq(15\ min)}$)	Total Noise Measured ($L_{Aeq(15\ min)}$)	Compliant (Y/N)	Comment
14/11/2022 4:00 PM	A	473 Pacific Highway	Residential	Tower Crane 3 Operation	78	67	Y	Tower Crane 3 at full throttle and turning and lifting. Concrete pour, Pacific Highway traffic and other general activities also audible.
14/12/2022	C	20 Clarke St	Commercial	Excavator Demolition	75	63	Y	Measurements of 5 minutes duration undertaken in corner office closest to works The highest predicted n ise level for t is rec iver for the ac i ity 'Demolish ground retention walls – excavator hammer' was 95 dB(A). Assuming a 20 dB(A) reduction from external to internal, predicted internal levels were in the order of 75 dB(A). Measured Leq values ranged between 63 to 73 dB(A) which is below the predicted levels and indicates that current mitigation measures are appropriate
14/12/2022	C	20 Clarke St	Commercial	Excavator Demolition	75	66	Y	Measurements of 5 minutes duration undertaken in the middle of the office space facing Clarke St. The highest predicted noise level for this receiver for the ac i ity 'Demolish ground reten ion walls – excavator hammer' was 95 dB(A ing a 20 dB(A) reduction from external to internal, predicted internal levels were in the order of 75 dB(A). Measured Leq values ranged between 63 to 73 dB(A) which is below the predicted levels and indicates that current mitigation measures are appropriate
14/12/2022	C	20 Clarke St	Commercial	Excavator Demolition	75	66	Y	Measurements of 5 minutes duration undertaken inThe highest predicted noise level for this receiver for the ac i ity 'Demolish ground reten ion walls – excavator hammer' was 95 dB(A ing a 20 dB(A) reduction from external to internal, predicted internal levels were in the order of 75 dB(A). Measured Leq values ranged between 63 to 73 dB(A) which is below the predicted levels and indicates that current mitigation measures are appropriate the middle of the office space facing Clarke St.
14/12/2022	C	20 Clarke St	Commercial	Excavator Demolition	75	72	Y	Measurements of 5 minutes duration undertaken in the central reception area. The highest predicted

Date / Time	NCA	Address	Receiver type	Activities	Predicted Activity Noise ($L_{Aeq(15\ min)}$)	Total Noise Measured ($L_{Aeq(15\ min)}$)	Compliant (Y/N)	Comment
								n ise level for t is rec iver for the ac i ity 'Demolish ground retention walls – excavator hammer' was 95 dB(A). Assuming a 20 dB(A) reduction from external to internal, predicted internal levels were in the order of 75 dB(A). Measured Leq values ranged between 63 to 73 dB(A) which is below the predicted levels and indicates that current mitigation measures are appropriate
2/02/2023 8:57 PM	A	420 Pacific Highway	Residential	Girder delivery and crane lift	70	70	Y	Traffic dominant noise source (75-83 dBA), motorbike at 87 dBA and construction 69-76.
2/02/2022 9:16 PM	B	545 Pacific Highway	Residential	Structure Construction	60	56	Y	Construction activities are not clearly audible above traffic noise at up to 80 dBA.
2/02/2022 9:34 PM	C	22-26 Clarke Street	Residential	Structure Construction	60	52	Y	Traffic is dominant with distant crane noise and non construction noise sources present.
2/02/2023 10:00 PM	A	420 Pacific Highway	Residential	Oversize girder delivery	63	63-64	Y	Acoustic consultant noted that work was generally aligned with predictions and made recommendations to reduce noise levels that exceeded predictions for short durations. Crane lifts, demobilisation and traffic at equivalent noise levels (75-80 dBA).
2/02/2023 10:16 PM	A	420 Pacific Highway	Residential	Oversize girder delivery	63	63-64	Y	Continued crane lifts, steady traffic. Refer to above not from Acoustic consultants.
2/02/2023 10:36 PM	A	420 Pacific Highway	Residential	Oversize girder delivery	63	58	Y	Background measurement whilst waiting for next girder delivery, heavy vehicles and occasional buses noted on Pacific Highway
2/02/2023 11:43 PM	A	420 Pacific Highway	Residential	Oversize girder delivery	63	64	Y	Constant traffic with heavy vehicles up to 80 dBA and crane noise in the 60-80 dBA range
2/02/2023 12:00 AM	A	420 Pacific Highway	Residential	Oversize girder delivery	63	64	Y	Traffic noises including bus at 84 dBA and horn at 86 from a passing motorist. Crane noises 60-70 dBA.
2/02/2023 12:16 AM	A	420 Pacific Highway	Residential	Oversize girder delivery	63	63	Y	Girder delivery was in line with predictions, jinker trucker movements at 68 dB.
2/02/2023 12:37 AM	A	420 Pacific Highway	Residential	Oversize girder delivery	63	63	Y	Crane lowering girder slowly at 66-67 dBA, crane is at idle recording 58-59 dBA. Trucks and buses recorded at 80-87 dBA.
16/02/2023	A	471 Pacific Highway	Residential	Tower Crane 3 with shroud	N/A	65	N/A	Crane under load. Some pedestrian noise influenced result and other construction noise at up to 75 dBA

Date / Time	NCA	Address	Receiver type	Activities	Predicted Activity Noise ($L_{Aeq(15\ min)}$)	Total Noise Measured ($L_{Aeq(15\ min)}$)	Compliant (Y/N)	Comment
16/02/2023	A	471 Pacific Highway	Residential	Tower Crane 3 with shroud	N/A	67	N/A	Cleaner measurement of constant crane use.
16/02/2023	A	475 Pacific Highway	Residential	Tower Crane 3 with shroud	N/A	70	N/A	Typical operation at 67 dBA with heavy loads at 69 dBA
16/02/2023	A	475 Pacific Highway	Residential	Tower Crane 3 with shroud	N/A	66	N/A	Crane not lifting or moving, audible at 62 dBA
16/02/2023	A	Site B	Infrastructure	Tower Crane 3 with shroud	N/A	74	N/A	On scaffold at approximately 10m distance, crane motor at 71-72 dBA with load.
16/02/2023	A	Site B	Infrastructure	Tower Crane 3 with shroud	N/A	72	N/A	Slightly cleaner measurement than previous value at approximately 10m distance to crane motor.
6/03/2023 8:02 PM	A	420 Pacific Highway	Residential	General Construction	60	<60	Y	Ambient noise levels observed to be higher than from construction activities e.g. motorbike 80, 92 buses and constant traffic noise.
6/03/2023 8:24 PM	B	545 Pacific Highway	Residential	General Construction	60	<60	Y	Pacific highway traffic is steady and main contribution to noise level, occasional construction noise faintly audible but not above traffic noise.
6/03/2023 8:42 PM	C	22-26 Clarke St	Residential	General Construction	60	<60	Y	General construction work in largely inaudible, insect noise and infrequent local traffic noise from Clarke St.
6/03/2023 23:42 PM	A	420 Pacific Highway	Residential	General Construction	63	60	Y	Works to prepare for scheduled girder delivery did not occur, crane idle at 53, crane lifting into position 63 and lowering lifting attachment 65 dBA. Bus passing by at 80 dBA

6.7.2 Attended vibration monitoring

Attended vibration monitoring was undertaken during demolition activities at Site C on the dates and locations listed below:

- 21 November 2022
  - South Eastern Corner of first floor of 20 Clarke Street
- 14 December 2022
  - Corner office and central lobby area of 20 Clarke Street;

Results from the attended vibration monitoring on 21 November 2022 indicate construction activities (demolition at Site C) were below the limits for human comfort as well as the cosmetic or structural damage screen criteria

Results from the attended vibration monitoring on 14 December 2022 indicate construction activities (demolition at Site C) were below the limits for human comfort as well as the cosmetic or structural damage screen criteria.

6.7.3 Real-time noise monitoring

The planning approval requires internal noise levels at residential receivers to be less than 60 dB $L_{Aeq(15\ minute)}$ for at least 6.5 hours between 7am and 8pm, of which at least 3.25 hours must be below 55 dB $L_{Aeq(15\ minute)}$. Noise equal to or above 60 dB $L_{Aeq(15\ minutes)}$ is allowed for the remaining 6.5 hours between 7am and 8pm. This requirement implies that, based on a 15-minute monitoring period, 26 periods may be above 60 dB(A) internally and the remaining 26 periods must be below 60 dB(A) internally, with 13 of the remaining periods below 55 dB(A) internally.

A real-time noise monitor is located at 28 Clarke Street, approximately 10 metres (m) from Site A. This location serves as a reference point for the project. Concrete pouring has been identified as one dominant noise activity on site. The noise is generated from the operation of concrete agitators and concrete pumps which are located at Clarke Lane North, Clarke Lane South and the concrete pumping location at the north of logistics lane. Concrete pouring has occurred during the monitoring period to facilitate concrete slab pours and concrete wall pours at each of these locations. The tower cranes can also be a dominant and controlling noise source when used during the evening and night periods. Capping beam removal was also conducted near Oxley St (northern end of Site A) in mid-late March.

Based on data collected from the real-time noise monitor (refer Figure *6*), noise from constructing the structure has been relatively consistent. Peaks in noise can be attributed to construction activities which occurred nearest the continuous noise meter. The 3 peaks in Figure *6* occurred on 7 October, 1 November and 24 March. On these days, equipment associated with structure construction was operating, or deliveries to the minor ancillary facility was occurring, near the microphone of the real-time noise meter. On days when there was no vehicles or equipment operating near the microphone, real-time noise levels were more reflective of the total noise environment.

To comply with the construction noise criteria, the project must not exceed more than 26 monitoring periods (50%) above 60 dB(A) internally on any given day, between 7am and 8pm, and 13 of the remaining 26 monitoring periods must be below 55 dB(A) internally.

Figure *6* shows that internal noise levels, which have been calculated by subtracting the façade loss cited in the approved Crows Nest CNVIS from the measured noise level at the façade of the building, were below 55 dB(A) for 94% of the time during the reporting period.

Instances above 60 dB(A) internally accounted for less than 1% of the time during the reporting period. Noise levels between 55-60 dB(A) did not cause an exceedance of noise criteria and accounted for 5% of the time during the monitoring period.

Noise levels have therefore been less than $L_{Aeq(15\ minute)}$ 60dB(A) for at least 6.5 hours between 7am and 8pm each day, of which at least 3.25 hours have been below $L_{Aeq\ (15\ minute)}$ 55 dB(A).

6.7.4 Real-time vibration monitoring

A W Edwards installed a real-time vibration monitor on the concrete floor of 28 Clarke Street, which is a building with local heritage significance. The real-time monitor has been operational since commencement of construction and for the full duration of the reporting period. There have been no exceedances of the vibration monitoring criteria during the reporting period (refer Figure 7). The highest value was recorded on October 12 at 6PM, however, this value is still below the 25 mm/s trigger.

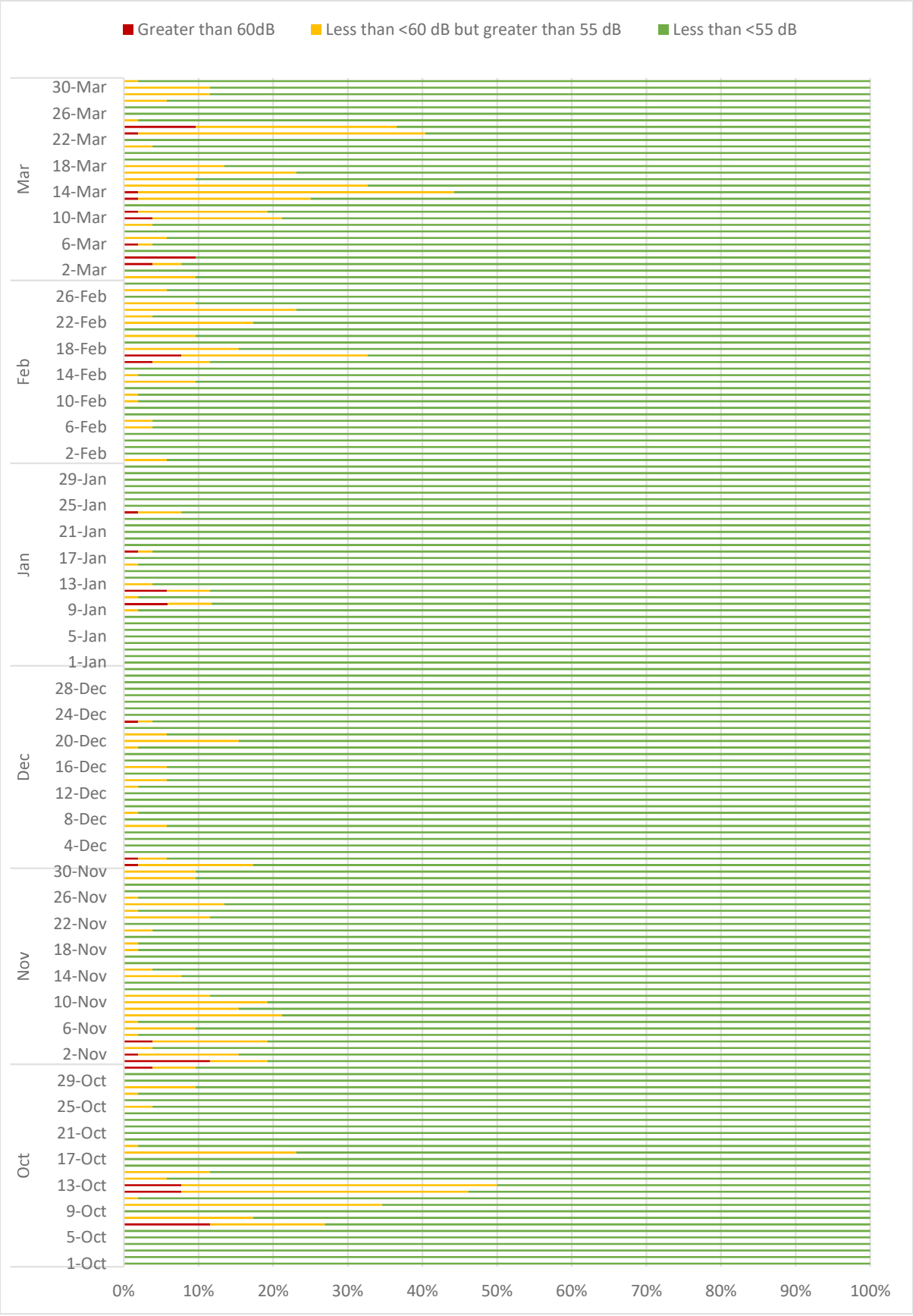


Figure 6 Estimated percentage of time where internals noise levels have been above or below 60 dBA

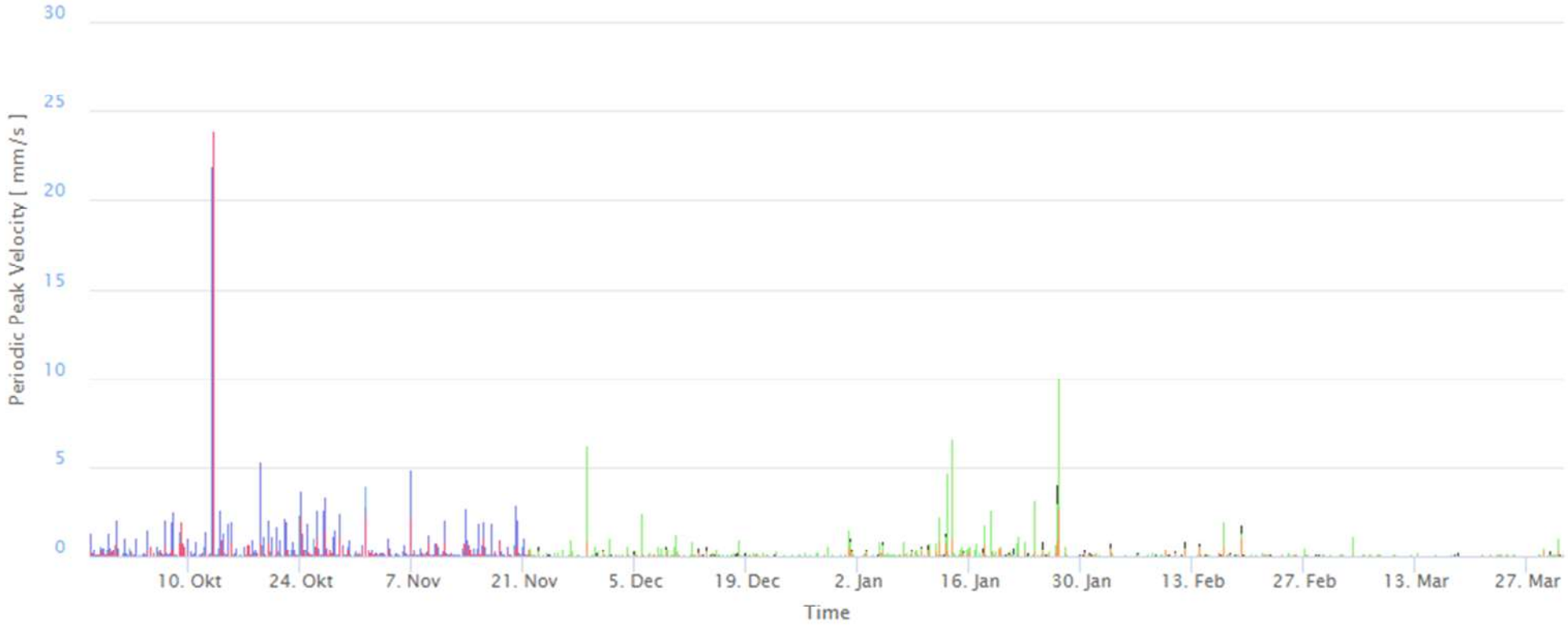


Figure 7 Maximum vibrations for real-time monitor at 28 Clarke Street

7 GROUNDWATER MONITORING

7.1.1 Criteria

No groundwater level criteria have been set for the construction phase.

7.1.2 Monitoring equipment

Dataloggers were previously installed in 2015 by Golder-Douglas in groundwater wells BH018 and BH019 (refer to Figure 1). BH018 is located near the intersection of Hume Street and Clarke Lane; BH019 is located on Oxley Street opposite Clarke Lane. The loggers were set to take a water level reading every two hours and have been recording since 2015. The logger installed at BH018 was replaced in February 2022

MONITORING WELL	SURFACE LEVEL (M, AHD)	WELL DEPTH (M)
BH018	90.75	25.3
BH019	84.43	7.2

7.1.3 Monitoring results

The data loggers were attempted to be retrieved on 31 May 2023 to download data for this reporting period, however, BH018 was not accessible at this time. Several attempts were made to access and retrieve this logger without success and a plan has been made to retrieve in the future monitoring round, with the logger currently underneath the corner of a scaffold installation.

The measured depth to groundwater in the monitoring wells on 31 May 2023, compared to previous periods was:

Monitoring Well	Measured Depth (m) to Groundwater in Monitoring Well 24 November 2021	Measured Depth (m) to Groundwater in Monitoring Well 22 March 2022	Measured Depth (m) to Groundwater in Monitoring Well 18 November 2022	Measured Depth (m) to Groundwater in Monitoring Well 31 May 2023
BH018	21.15	20.47	21.13	Not accessible
BH019	3.37	1.94	4.95	4.28

A review of groundwater levels during the reporting period indicates the following:

- Groundwater levels in BH018 have remained steady throughout the monitoring period as there's been no works that interact the groundwater, no significant change in the groundwater level is anticipated.
- Groundwater levels in BH019 have a strong relationship with rainfall events, with groundwater levels rising soon after rainfall and falling in the absence of rainfall.

Detailed results of the groundwater measurements are included in Appendix 1.

8 CONCLUSION

Observed noise and vibration levels are generally in accordance with, or below, the predicted impacts stated in the Construction Noise and Vibration Impact Statement.

Groundwater levels do not appear to be impacted by construction of the project.

Based on the monitoring results and site investigations, noise, vibration and groundwater impacts associated with construction works are compliant with the planning approval and project requirements during the monitoring period.

APPENDIX 1
GROUNDWATER MEASUREMENTS

Douglas Partners Pty Ltd
ABN 75 053 980 117
www.douglaspartners.com.au
96 Hermitage Road
West Ryde NSW 2114
PO Box 472
West Ryde NSW 1685
Phone (02) 9809 0666

Site Record

To	AW Edwards	Travis McCarthy	tmccarthy@awedwards.com.au
From	Joshua Bendit	**Date**	31 May 2023
Subject	Groundwater Monitoring to November 2022 Crows Nest Station	**Project No.** **Doc. No.**	200142.00 R.036.Rev0

This memorandum presents the results of long-term groundwater monitoring within standpipe piezometers SRT-BH018 and SRT-BH019 at Crows Nest Station.

Dataloggers were previously installed by Golder-Douglas in groundwater wells SRT-BH018 and SRT-BH019. The loggers were set up to take a water level reading every two hours and have been recording since 2015. The data logger installed in SRT-BH018 was removed on 24 November 2021 and was replaced with a new data logger on 16 February 2022 and set up to take a water level reading every two hours. The locations of these boreholes are shown on the attached plans and groundwater well logs for each well are also attached.

The data logger installed in SRT-BH019 was downloaded on 31 May 2023 and a manual measurement of the water level taken to calibrate the logger data. The groundwater well SRT-BH018 was inaccessible due to a scaffolding installation above it at the time of inspection.

A summary of the wells and manual readings is presented in Table 1.

Table 1: Summary of Manually Measured Groundwater in SRT-BH018 and SRT-BH019 (May 2023)

Borehole (Well)	Surface RL (m, AHD)	Well Depth (m)	Measured Depth (m) and RL (m, AHD) to Groundwater in Monitoring Well
			31 May 2023
SRT-BH018	90.75	25.3	Inaccessible at time of inspection
SRT-BH019	84.43	7.2	4.28 (RL 80.15)

The groundwater measurements obtained from the dataloggers within the reporting period specified by AW Edwards (1 January 2021 to 31 May 2023) are shown on the attached Figures 1 and 2, together with manual groundwater level measurements and a plot of daily rainfall records obtained from Observatory Hill, Sydney (Bureau of Meteorology Station 066214 from 1 January 2021 to 31 May 2023, http://www.bom.gov.au).

We trust that this meets your present requirements. Please contact the undersigned if you have any questions.

Douglas Partners Pty Ltd

Joshua Bendit
Geotechnical Engineer

Reviewed by

Luke James-Hall
Senior Associate

Attachments: Notes 'About This Report'
Figures 1 and 2
Well Location Plans and logs

About this Report

Douglas Partners

Introduction

These notes have been provided to amplify DP's report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

DP's reports are based on information gained from limited subsurface excavations and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

Copyright

Borehole and Test Pit Logs

The borehole and test pit logs presented in this report are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable or possible to justify on economic grounds. In any case the boreholes and test pits represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

Groundwater

Where groundwater levels are measured in boreholes there are several potential problems, namely:

- In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole is left open;
- A localised, perched water table may lead to an erroneous indication of the true water table;
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report; and
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water measurements are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, DP will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical and environmental aspects, and recommendations or suggestions for design and construction. However, DP cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

If these occur, DP will be pleased to assist with investigations or advice to resolve the matter.

About this Report

Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, DP requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

Information for Contractual Purposes

Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. DP would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Site Inspection

The company will always be pleased to provide engineering inspection services for geotechnical and environmental aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

Path: J:\geo\2016\1418746 SRT\GIS\1418746-001-P-Rev1-F033-F038-Detailed Investigation Locations.mxd

LEGEND

◆ BH

SCALE (at A3) 1:500

0 5 10 20 Metres

REFERENCE

1. AERIAL PHOTOGRAPHY SUPPLIED BY NEARMAP LTD, DATED JULY 2015.
2. OVERVIEW MAP: SOURCES: ESRI, DELORME, NAVTEQ, TOMTOM, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), SWISSTOPO, AND THE GIS USER COMMUNITY.

CLIENT
TRANSPORT FOR NSW

PROJECT
SYDNEY METRO CITY AND SOUTHWEST

TITLE
INVESTIGATION LOCATION PLAN - SRT BH018

CONSULTANT
Golder Associates
Douglas Partners Geotechnics | Environment | Groundwater

YYYY-MM-DD	2015-10-22
PREPARED	TWB
DESIGN	TWB
REVIEW	GS
APPROVED	GS

PROJECT No.	CONTROL	REVIEW	FIGURE
1418746	001	Rev0	21

STANDPIPE INSTALLATION: SRT BH018

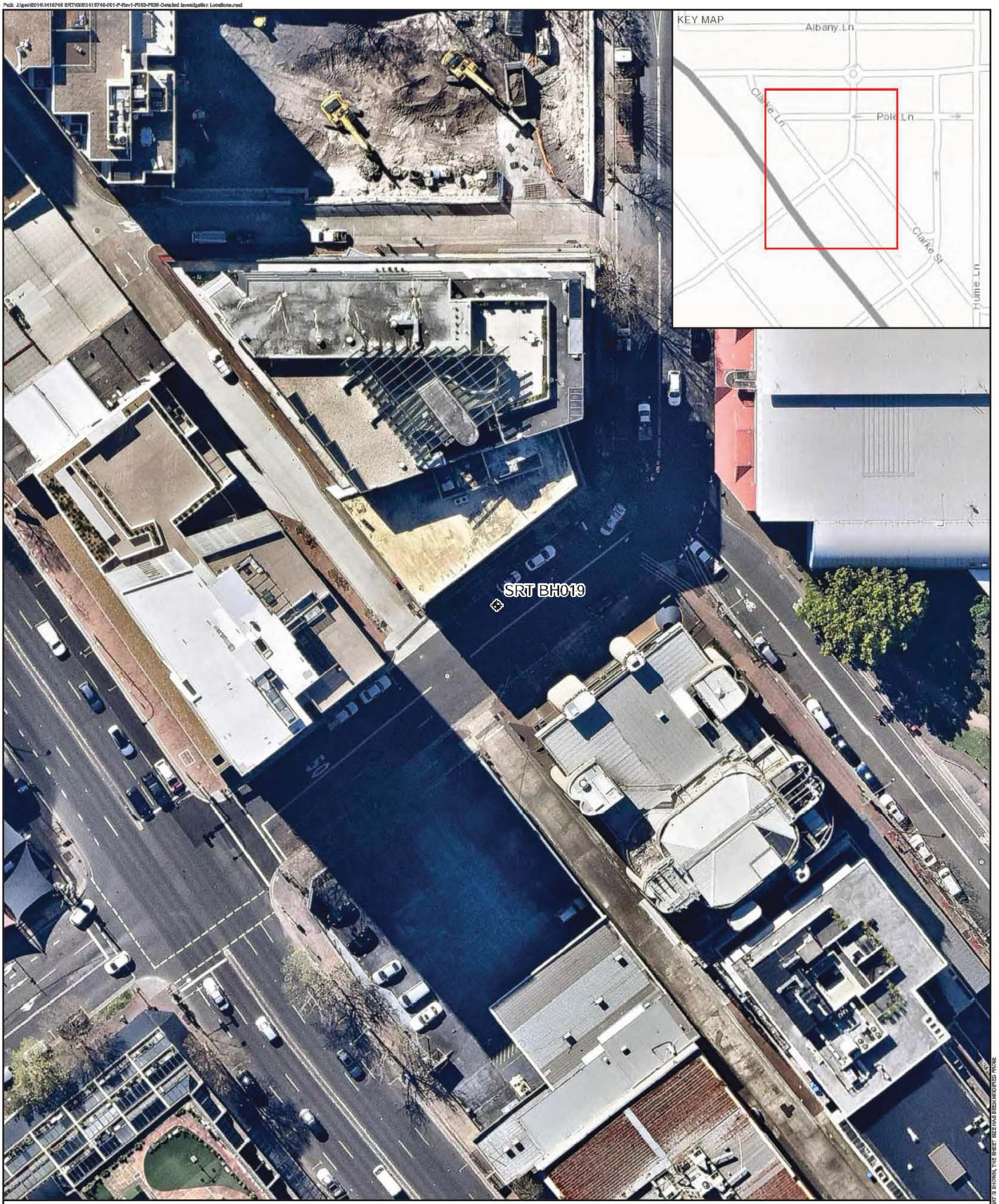
		SHEET: 1 OF 1	REV: D
CLIENT: Transport for New South Wales	COORDS: 333390.0 m E 6255706.0 m N MGA94 56	DRILL RIG: Scout 4	
PROJECT: SRT Geotechnical Investigation Services	SURFACE RL: 90.75 m DATUM: AHD	CONTRACTOR: Ground Test	
LOCATION: Hume St, Crows Nest	INCLINATION: -90°	LOGGED: AMS	START: 24/4/15
PROJECT No: PSC No.00013/10464	HOLE DEPTH: 46.53 m	CHECKED: DF/JCB	FINISH: 30/4/15

Drilling				Field Material Description		Instrumentation Details
METHOD	WATER	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	SOIL/ROCK MATERIAL DESCRIPTION	
NDD		0	90.75		NON-DESTRUCTIVE DIGGING	Gatic cover
			1.20			
ADT			2.10		CLAYEY GRAVEL	
			88.65		SILTY CLAY	
			4.00			
HQ3			86.75		SILTSTONE	
		5				
						Cement Bentonite Grout
		10				
			11.25			
			79.50		SANDSTONE	
		15				
			17.71			
			73.04		LAMINITE	18.30, RL72.45 Bentonite
						19.55, RL71.20 <5mm sand/gravel
		20	20.55			
			70.20		SANDSTONE	PVC slotted section with filter sock
		25				25.30, RL65.45 Bentonite
		30				
		35				Cement Bentonite Grout
		40	41.10			
			49.65		LAMINITE	
		45	46.77			
			46.53		SANDSTONE	46.53, RL44.22
			44.22		END OF BOREHOLE @ 46.53 m TARGET DEPTH STANDPIPE INSTALLED	

This report of standpipe installation must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

GAP gINT FN. F17 RL1

Path: J:\geo\2016\1418746 SRT\GIS\1418746-001-P-Rev1-F033-F038-Detailed Investigation Locations.mxd



LEGEND

◆ BH

SCALE (at A3) 1:500

0 5 10 20 Metres

REFERENCE

1. AERIAL PHOTOGRAPHY SUPPLIED BY NEARMAP LTD, DATED JULY 2015.
2. OVERVIEW MAP: SOURCES: ESRI, DELORME, NAVTEQ, TOMTOM, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), SWISSTOPO, AND THE GIS USER COMMUNITY.

CLIENT
TRANSPORT FOR NSW

PROJECT
SYDNEY METRO CITY AND SOUTHWEST

TITLE
INVESTIGATION LOCATION PLAN - SRT BH019

CONSULTANT

Golder Associates

Douglas Partners
Geotechnics | Environment | Groundwater

YYYY-MM-DD	2015-10-22
PREPARED	TWB
DESIGN	TWB
REVIEW	GS
APPROVED	GS

PROJECT No.	CONTROL	REVIEW	FIGURE
1418746	001	Rev0	22

STANDPIPE INSTALLATION: SRT BH019

		SHEET: 1 OF 1	REV: D
CLIENT: Transport for New South Wales	COORDS: 333306.0 m E 6255819.0 m N MGA94 56	DRILL RIG: Explora	
PROJECT: SRT Geotechnical Investigation Services	SURFACE RL: 84.43 m DATUM: AHD	CONTRACTOR:	
LOCATION: Oxley St, Crows Nest	INCLINATION: -90°	LOGGED: AP	START: 17/4/15
PROJECT No:PSC No.00013/10464	HOLE DEPTH: 36.10 m	CHECKED: DF/LM	FINISH: 24/4/15

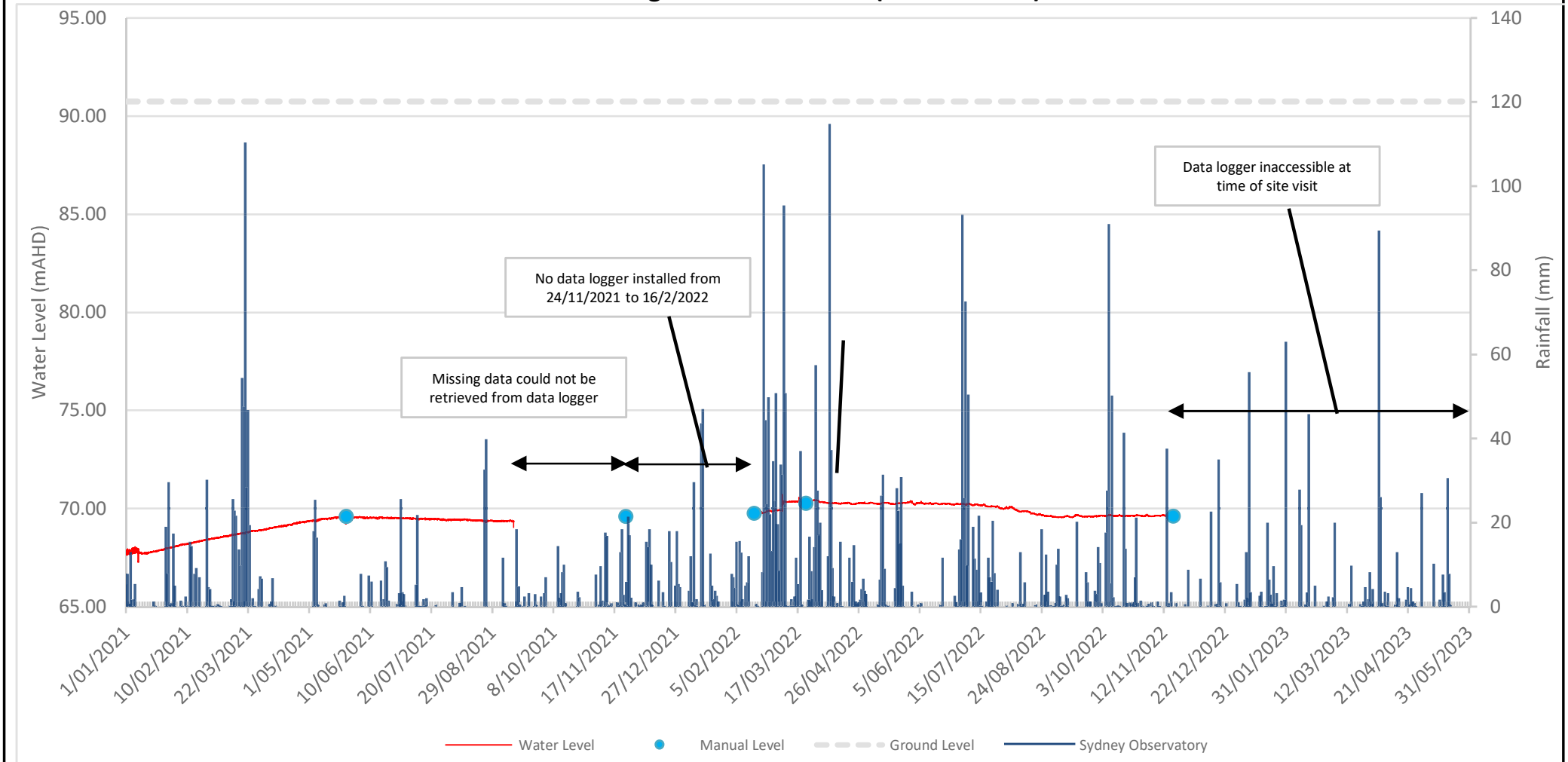
Drilling				Field Material Description		Instrumentation Details
METHOD	WATER	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	SOIL/ROCK MATERIAL DESCRIPTION	
NDD		0	84.05		ASPHALT	Gatic cover
					FILL	Cement Bentonite Grout
ADT					SILTY CLAY	
	24/04/15, 3.00m					2.80, RL81.63
	24/04/15, 10.00m					Bentonite
						3.75, RL80.68
						4.25, RL80.18
HQ3		5				<5mm sand/gravel
			6.20			
			78.23		SILTSTONE	PVC slotted
						7.20, RL77.23
			8.04			8.00, RL76.43
			76.39		SANDSTONE WITH SILTSTONE LAMINATIONS	Bentonite
		10				
			15.00			
		15	69.43		LAMINITE	
			18.01			
			66.39		SANDSTONE	
HQ3		20				
		25				Cement Bentonite Grout
		30				
		35				
			36.10			36.10, RL48.33
			48.33			

END OF BOREHOLE @ 36.10 m

This report of standpipe installation must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

GAP gINT FN. F17 RL1

Monitoring Well: SRT-BH018 (Hume Street)



Note: Reading Interval = 2 hour

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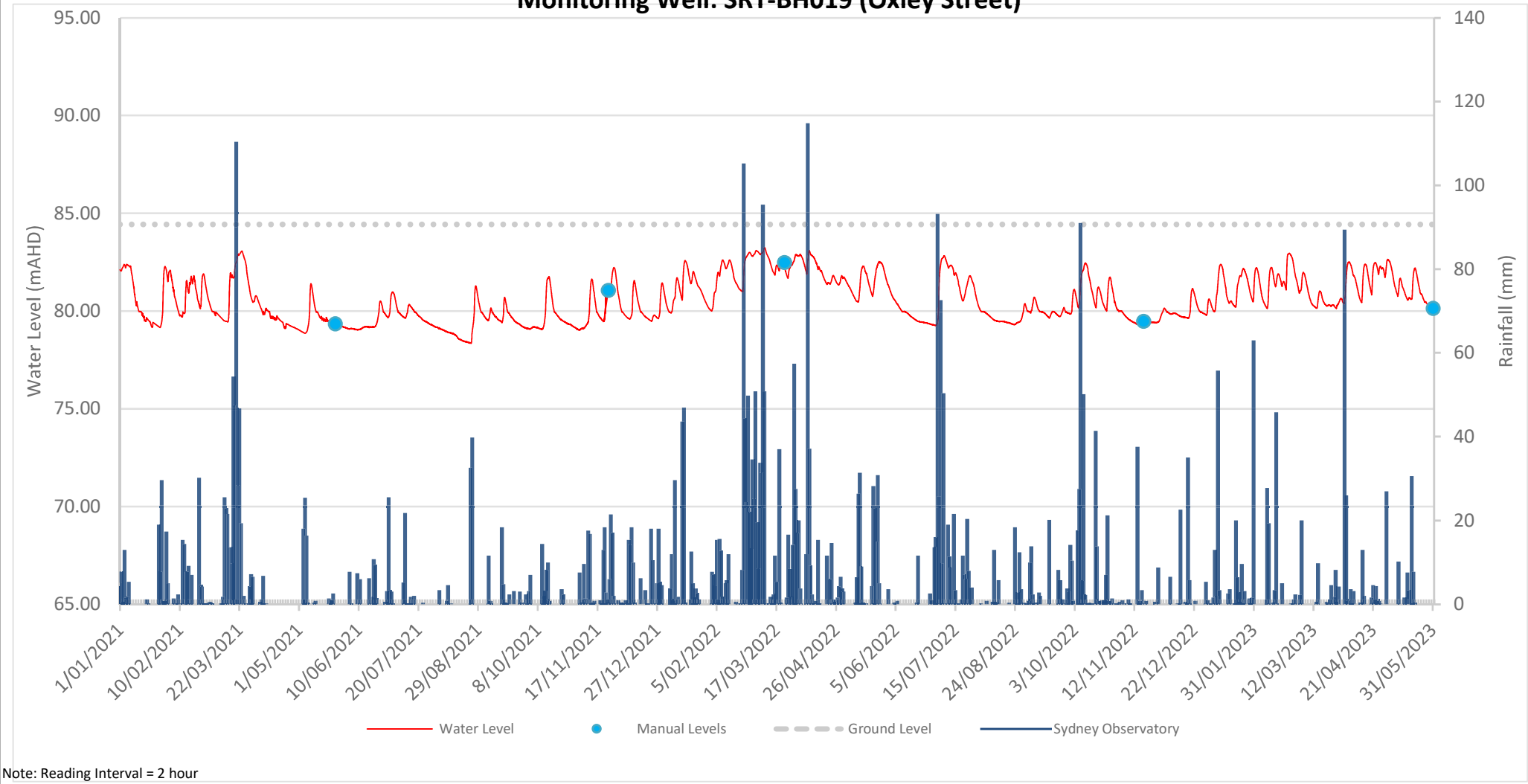
From	Drawn:
01-01-21	JDB
To	**Date:**
31-05-23	31-05-23

Monitoring Well: SRT-BH019 (Oxley Street)



Note: Reading Interval = 2 hour

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Geotechnics / Environment / Groundwater

From	Drawn:
01-01-21	JDB
To	**Date:**
31-05-23	31-05-23

APPENDIX 2
CALIBRATION CERTIFICATES

CERTIFICATE OF CALIBRATION

CERTIFICATE NO: G33974

EQUIPMENT TESTED : Geophone Sensitivity

Manufacturer: AvaTrace
Geophone Type: G3 WALL R1A **Serial No:** 1301

Owner: Resonate Consultants Pty Ltd
Level 4, 272 Pacific Highway
Crows Nest, NSW 2065

Tests Performed: Frequency Response, Linearity & Sensitivity at Selected Frequencies
Comments: Detailed overleaf.

CONDITION OF TEST:
Temperature 22 °C ±1° C
Relative Humidity 62 % ±5%

Date of Receipt : 10/10/2022
Date of Calibration : 11/10/2022
Date of Issue : 12/10/2022

Acu-Vib Test Procedure: AVP15 (Low Frequency Transducer, Geophone) based on AS2187.2 & DIN45669-1

CHECKED BY: ..... **AUTHORISED SIGNATURE:** .....
Hein Soe

Accredited for compliance with ISO/IEC 17025 - Calibration
Results of the tests, calibration and/or measurements included in this document are traceable to SI units through reference equipment that has been calibrated by the Australian National Measurement Institute or other NATA accredited laboratories demonstrating traceability.

This report applies only to the item identified in the report and may not be reproduced in part.

The uncertainties quoted are calculated in accordance with the methods of the ISO Guide to the Uncertainty of Measurement and quoted at a coverage factor of 2 with a confidence interval of approximately 95%.

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Acoustic and Vibration Measurements

Acu-Vib Electronics
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Head Office & Calibration Laboratory
Unit 14, 22 Hudson Ave. Castle Hill NSW 2154
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Frequency response and linearity characteristics for
AVA-Trace Triaxial Geophone **G3 Wall R1A** Serial No. **1301**
Constant velocity of 10 mm/sec Peak applied for response
(Except at 200.0 Hz where applied level limited to 1.0 mm/s peak)
For amplitude linearity applied level varied at 15.92 Hz
Terminating Resistor 100 kΩ Geophone Orientation.: Vertical

Frequency		Input Peak Level mm/s	Indicated Sensitivity mV/mms^{-1}			Expanded uncertainty
Hz	Radians/sec		Longitudinal Sensitivity	Transverse Sensitivity	Vertical Sensitivity	U_{95} %
3.00	18.85	10.0	6.26	5.94	6.37	1.00%
4.00	25.13	10.0	9.60	9.40	9.74	0.90%
6.00	37.70	10.0	13.40	13.56	13.84	0.90%
10.00	62.83	10.0	14.72	14.88	14.62	0.90%
15.00	94.25	10.0	14.92	14.99	14.65	0.90%
15.92	94.25	1.0	14.09	14.09	13.79	0.90%
15.92	94.25	5.0	14.07	13.79	13.80	0.90%
15.92	**94.25**	**10.0**	**14.07**	**14.12**	**13.80**	**0.90%**
15.92	94.25	50.0	14.08	13.79	13.77	0.90%
15.92	94.25	100	14.10	13.82	13.75	0.50%
30.00	188.50	10.0	15.94	16.10	14.58	0.50%
60.00	376.99	10.0	14.84	14.89	14.53	0.50%
120.00	753.98	10.0	15.99	16.06	14.64	0.50%
150.00	942.48	10.0	15.66	16.32	15.20	0.50%
Hz	Radians/sec	Input Peak Level mm/s	Longitudinal Sensitivity	Transverse Sensitivity	Vertical Sensitivity	U_{95} %

Note1:

The laboratory has accreditation under ISO/IEC 17025 from NATA for calibration to ISO 16063-21 at frequencies from 0.5 Hz. Measurements at all frequencies and levels shown in the table above are made using reference equipment traceably calibrated to Australian National Standards.

Note2: The uncertainties quoted are estimated at a confidence level of 95% and a coverage factor of k=2 applies unless otherwise stated.

End of Certificate

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Sound Level Meter
IEC 61672-3:2013
Calibration Certificate

Calibration Number C23259

Client Details	AW Edwards Pty Ltd 28 Clarke Street Crows Nest NSW 2065
Equipment Tested/ Model Number :	Rion NL-52
Instrument Serial Number :	00219948
Microphone Serial Number :	18911
Pre-amplifier Serial Number :	10464
Firmware Version :	2.0

Pre-Test Atmospheric Conditions		Post-Test Atmospheric Conditions	
Ambient Temperature :	20.8°C	**Ambient Temperature :**	21.5°C
Relative Humidity :	58.2%	**Relative Humidity :**	56%
Barometric Pressure :	100.45kPa	**Barometric Pressure :**	100.41kPa

Calibration Technician : Shaheen Boaz
Secondary Check: Dylan Selge
Calibration Date : 1 May 2023
Report Issue Date : 2 May 2023

Approved Signatory : Juan Aguero

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

The sound level meter submitted for testing has successfully completed the class 1 periodic tests of IEC 61672-3:2013, for the environmental conditions under which the tests were performed.

As public evidence was available, from an independent testing organisation responsible for approving the results of pattern evaluation test performed in accordance with IEC 61672-2:2013, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2013, the sound level meter submitted for testing conforms to the class 1 requirements of IEC 61672-1:2013.

Uncertainties of Measurement -

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

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

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

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

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

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

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

Calibration Number C23259

Client Details AW Edwards Pty Ltd
28 Clarke Street
Crows Nest NSW 2065

Equipment Tested/ Model Number : Rion NL-52
Instrument Serial Number : 00219948
Microphone Serial Number : 18911
Pre-amplifier Serial Number : 10464
Firmware Version : 2.0

Pre-Test Atmospheric Conditions		Post-Test Atmospheric Conditions	
Ambient Temperature :	20.8°C	**Ambient Temperature :**	21.5°C
Relative Humidity :	58.2%	**Relative Humidity :**	56%
Barometric Pressure :	100.45kPa	**Barometric Pressure :**	100.41kPa

Calibration Technician : Shaheen Boaz
Calibration Date : 1 May 2023
Secondary Check: Dylan Selge
Report Issue Date : 2 May 2023

Approved Signatory :  Juan Aguero

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

The sound level meter submitted for testing has successfully completed the class 1 periodic tests of IEC 61672-3:2013, for the environmental conditions under which the tests were performed.

As public evidence was available, from an independent testing organisation responsible for approving the results of pattern evaluation test performed in accordance with IEC 61672-2:2013, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2013, the sound level meter submitted for testing conforms to the class 1 requirements of IEC 61672-1:2013.

Uncertainties of Measurement -

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

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

1. OVERVIEW

This report presents the calibration test results of a Rion NL-52 Sound Level Meter, and associated equipment. Calibration is carried out in accordance with *IEC 61672-3.2013, Electroacoustics - Sound Level Meters - Part 3: Periodic Tests*.

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

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

1.1 UNCERTAINTIES

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

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

1.2 DOCUMENT CONVENTIONS

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

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

2. GENERAL

2.1 ENVIRONMENTAL CONDITIONS DURING TEST

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

2.2 CALIBRATION TESTS

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

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

2.3 TEST EQUIPMENT USED

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

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

2.3.1 Multi-function Acoustic Calibrator

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

2.3.2 Microphone Electrical Equivalent Circuit

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

A 13pF capacitance dummy microphone was used during testing.

2.3.3 Adjustable Attenuator

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

2.3.4 Arbitrary Function Generator

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

2.3.5 Environmental Monitoring

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

3. CALIBRATION TEST RESULTS

3.1 INDICATION AT THE CALIBRATION CHECK FREQUENCY

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

Stated reference conditions as found in manual are

Reference Level : 94.0 dB

Reference Frequency : 1000.0 Hz

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

Table 1 - Check Frequency Calibration Results

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

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

3.2 SELF GENERATED NOISE

3.2.1 Microphone Installed

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

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

Random Readings dB(A)

14.20	14.20	14.10	13.90	13.80
13.90	13.80	14.50	14.30	14.20

Acoustic Noise Floor : 14.1 dB(A)

3.2.2 Electrical Input Signal Device

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

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

Random Readings dB(A)

7.70	7.80	7.80	7.80	7.80
7.80	7.80	7.80	7.70	7.80

Random Readings dB(C)

7.10	7.10	7.10	7.10	7.10
7.10	7.10	7.10	7.10	7.10

Random Readings dB(Z)

12.6	12.7	13.1	13.0	13.1
12.7	12.6	13.1	12.9	13.0

	dB(A)	dB(C)	dB(Z)
Electric Noise Floor :	7.8	7.1	12.9

3.3 ACOUSTICAL SIGNAL TESTS OF A FREQUENCY WEIGHTING

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

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

Table 2 - Frequency Weighting C Response

Freq Hz	Reading 1	Reading 2	Reading 3	U95
125	94.0	94.0	94.0	0.13
1 000	94.1	94.1	94.1	0.13
8 000	88.4	88.4	88.4	0.14

Actual Freq Hz	B&K 4226 Corrections	Corrected Response dB(C)		Uexp
		Actual	re 1kHz	
125.90	-0.06	93.94	-0.08	0.13
1005.10	-0.08	94.02	0.00	0.13
7915.10	0.00	88.40	-5.62	0.14

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

Table 3 - Correction Data

Actual Freq Hz	FreeField Corrections	U95	BodyEffects Corrections	U95	Windscreen Corrections	U95
125.90	0.00	0.25	0.00	0.25	0.000	0.200
1005.10	0.00	0.25	0.00	0.25	-0.100	0.200
7915.10	3.00	0.35	0.30	0.35	0.000	0.300

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

Table 4 - Acoustic C Response

Actual Freq (Hz)	Corrected Response dB(C)		Expected Response dB(C)		Deviation	P/F	Uexp
	Actual	re 1kHz	re 1kHz	Tolerance			
125.90	93.94	0.02	-0.2	±1.0	0.22	P	0.43
1005.10	93.92	0.00	0.0	±0.7	0.00	P	0.43
7915.10	91.70	-2.22	-3.0	+1.5 / -2.5	0.78	P	0.60

3.4 ELECTRICAL SIGNAL TESTS OF FREQUENCY WEIGHTINGS

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

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

Table 5 - Measured Electrical Frequency Response

Freq Hz	A Weighting (dB)	C Weighting (dB)	Z Weighting (dB)	U95
63	92.9	92.9	93.0	0.13
125	92.9	93.0	93.0	0.11
250	92.9	93.0	93.0	0.10
500	92.9	93.0	93.0	0.10
1 000	93.0	93.0	93.0	0.10
2 000	93.0	93.0	93.0	0.10
4 000	93.0	93.0	93.0	0.10
8 000	93.0	93.0	93.0	0.10
15 850	91.8	91.8	93.0	0.13

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

Table 6 - Correction Data

Freq Hz	Ufreq	U95	Body Effects	U95	WS Effects	U95
63	0.100	0.250	0.000	0.250	0.000	0.200
125	0.100	0.250	0.000	0.250	0.000	0.200
250	0.100	0.250	0.000	0.250	0.000	0.200
500	0.000	0.250	-0.100	0.250	-0.100	0.200
1 000	0.000	0.250	0.000	0.250	-0.100	0.200
2 000	0.000	0.250	0.000	0.250	-0.300	0.200
4 000	0.100	0.250	0.300	0.250	-0.300	0.200
8 000	0.000	0.350	0.300	0.350	0.000	0.300
15 850	-0.800	0.450	0.400	0.350	0.700	0.300

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

Table 7 - A Weighted Electrical Response

Freq Hz	Response		Tolerance (dB)	P/F	Uexp
	Corrected	re 1kHz			
63	93.00	0.10	±1.0	P	0.43
125	93.00	0.10	±1.0	P	0.42
250	93.00	0.10	±1.0	P	0.42
500	92.70	-0.20	±1.0	P	0.42
1 000	92.90	0.00	±0.7	P	0.42
2 000	92.70	-0.20	±1.0	P	0.42
4 000	93.10	0.20	±1.0	P	0.42
8 000	93.30	0.40	+1.5 / -2.5	P	0.59
15 850	92.10	-0.80	+2.5 / –16	P	0.66

Table 8 - C Weighted Electrical Response

Freq Hz	Response		Tolerance (dB)	P/F	Uexp
	Corrected	re 1kHz			
63	93.00	0.10	±1.0	P	0.43
125	93.10	0.20	±1.0	P	0.42
250	93.10	0.20	±1.0	P	0.42
500	92.80	-0.10	±1.0	P	0.42
1 000	92.90	0.00	±0.7	P	0.42
2 000	92.70	-0.20	±1.0	P	0.42
4 000	93.10	0.20	±1.0	P	0.42
8 000	93.30	0.40	+1.5 / -2.5	P	0.59
15 850	92.10	-0.80	+2.5 / –16	P	0.66

Table 9 - Z Weighted Electrical Response

Freq Hz	Response		Tolerance (dB)	P/F	Uexp
	Corrected	re 1kHz			
63	93.10	0.20	±1.0	P	0.43
125	93.10	0.20	±1.0	P	0.42
250	93.10	0.20	±1.0	P	0.42
500	92.80	-0.10	±1.0	P	0.42
1 000	92.90	0.00	±0.7	P	0.42
2 000	92.70	-0.20	±1.0	P	0.42
4 000	93.10	0.20	±1.0	P	0.42
8 000	93.30	0.40	+1.5 / -2.5	P	0.59
15 850	93.30	0.40	+2.5 / –16	P	0.66

3.5 FREQUENCY AND TIME WEIGHTINGS AT 1KHZ

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

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

Table 10 - Frequency and Time Weighting Results

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

3.6 LONG-TERM STABILITY

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

Table 11 - Frequency and Time Weighting Results

Signal Level (mV)	Initial Response (dB)	Final Response (dB)	Deviation (dB)	P/F	Tolerance (dB)	U95
23.4	94	94.0	0.0	P	±0.1	0.10

3.7 LEVEL LINEARITY ON THE REFERENCE LEVEL RANGE

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

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

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

Table 12 - Level Linearity - Increasing

Ideal (dB)	Response (dB)	Deviation (dB)	Tolerance (dB)	P/F	U95
94.0	94.0	0.0	±0.8	P	0.1
99.0	99.0	0.0	±0.8	P	0.1
104.0	104.0	0.0	±0.8	P	0.1
109.0	109.0	0.0	±0.8	P	0.1
114.0	114.0	0.0	±0.8	P	0.1
119.0	119.0	0.0	±0.8	P	0.1
124.0	124.0	0.0	±0.8	P	0.1
129.0	129.0	0.0	±0.8	P	0.1
131.0	131.0	0.0	±0.8	P	0.1
132.0	132.0	0.0	±0.8	P	0.1
133.0	133.0	0.0	±0.8	P	0.1
134.0	134.0	0.0	±0.8	P	0.1
135.0	135.0	0.0	±0.8	P	0.1
136.0	136.0	0.0	±0.8	P	0.1
137.0	137.0	0.0	±0.8	P	0.1

Overload indication at 138.0dB.

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

Table 13 - Level Linearity - Decreasing

Ideal (dB)	Response (dB)	Deviation (dB)	Tolerance (dB)	P/F	U95
94.0	94.0	0.0	±0.8	P	0.1
89.0	89.0	0.0	±0.8	P	0.1
84.0	84.0	0.0	±0.8	P	0.1
79.0	79.0	0.0	±0.8	P	0.1
74.0	74.0	0.0	±0.8	P	0.1
69.0	69.0	0.0	±0.8	P	0.1
64.0	64.0	0.0	±0.8	P	0.1
59.0	59.0	0.0	±0.8	P	0.1
54.0	54.0	0.0	±0.8	P	0.1
49.0	49.0	0.0	±0.8	P	0.1
44.0	44.0	0.0	±0.8	P	0.1
39.0	39.0	0.0	±0.8	P	0.1
34.0	34.0	0.0	±0.8	P	0.1
30.0	30.0	0.0	±0.8	P	0.1
29.0	28.9	-0.1	±0.8	P	0.1
28.0	27.9	-0.1	±0.8	P	0.1
27.0	26.9	-0.1	±0.8	P	0.1
26.0	25.9	-0.1	±0.8	P	0.1
25.0	24.9	-0.1	±0.8	P	0.1

Under range indication at 24.0dB.

3.8 TONEBURST RESPONSE

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

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

Table 14 - FAST Weighted Response

Burst Length	Response dB(A)	Deviation (dB)	Tolerance (dB)	P/F	U95
200ms	134.0	0.0	±0.5	P	0.1
2ms	117.0	0.0	+1.0 / -1.5	P	0.1
0.25ms	107.9	-0.1	+1.0 / -3	P	0.1

Table 15 - SLOW Weighted Response

Burst Length	Response dB(A)	Deviation (dB)	Tolerance (dB)	P/F	U95
200ms	127.6	0.0	±0.5	P	0.1
2ms	108.0	0.0	+1.0 / -3	P	0.1

Table 16 - Sound Exposure Level Response

Burst Length	Response dB(A)	Deviation (dB)	Tolerance (dB)	P/F	U95
200ms	128.0	0.0	±0.5	P	0.1
2ms	108.0	0.0	+1.0 / -1.5	P	0.1
0.25ms	98.9	-0.1	+1.0 / -3	P	0.1

3.9 PEAK C RESPONSE

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

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

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

Table 17 - Single Cycle Response

Response Peak C	Deviation (dB)	Tolerance (dB)	P/F	U95	Overload Peak C
136.3	-0.1	±2.0	P	0.22	N

Table 18 - Half Cycle Response

Signal Orientation	Response Peak C	Deviation (dB)	Tolerance (dB)	P/F	U95
Positive	135.0	-0.4	±1.0	P	0.1
Negative	135.1	-0.3	±1.0	P	0.1

No overload was noted during Peak C testing.

3.10 OVERLOAD INDICATION

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

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

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

Table 19 - Overload Indication

Signal Orientation	Overload Response	Difference	Tolerance	P/F	Uncertainty
Positive	136.9	0.0	±1.5	P	0.1
Negative	136.1				

Overload indication was verified.

Overload latch indication was verified.

3.11 HIGH LEVEL STABILITY

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

Table 20 - FAST Weighted Response

Time Weighting	Initial Response (dB)	Final Response (dB)	Deviation (dB)	Tolerance (dB)	P/F	U95
Fast	137.0	137.0	0.0	±0.1	P	0.10
Slow	N/A	N/A	N/A	±0.1	N/A	0.10
Leq	137.0	137.0	0.0	±0.1	P	0.10

CERTIFICATE OF CALIBRATION

Certificate Number: 4797 **NATA Accreditation No: 20688**

Customer: **Resonate Systems**
Level 1, 23 Peel Street
Adelaide, SA 5000

Test Object:	Manufacturer:	Model:	Serial No:	ID:
Sound Level Meter	Sonitus Systems	EM2030	00879	4797
Microphone	PCB	377B02	312016	4797
Preamplifier	Included	Included	00879	4797
Calibrator	None	-	-	-
Connecting Cable	None	-	-	-

Information:

Test Configuration:	Microphone on Preamp
Instrument Manual:	Sonitus EM2030 Technical Manual
Firmware Version:	N/A
Class of Instrument:	Class 1
Source of Correction Data:	Sonitus and PCB

Environmental Conditions:	Pressure	Temperature	Relative Humidity
Reference Conditions:	101.325 kPa	23.0 °C	50.0 % RH
Conditions Before Measurement:	101.90 kPa	23.2 °C	57.2 % RH
Conditions After Measurement:	101.90 kPa	23.2 °C	57.2 % RH

The laboratory environmental conditions remained within the acceptable limits as defined in IEC 61672.3 and IEC 61260 throughout the calibration test.

The measurements are performed according to the *IEC 61672 Sound level meters – Part 3: Periodic tests (2013)*, and *DIN 45657 Sound Level Meters – Requirements for Special Applications (2015)*. Where applicable testing has also been completed in accordance with *IEC 61260 Electroacoustics – Octave-band and fractional-octave-band filters (2016)*.

The expanded uncertainty of measurement is reported at approximately 95% confidence level with a coverage factor k, of 2.

Accredited for compliance with ISO/IEC 17025 - Calibration.
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards. 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

Date of Calibration: 17/11/21
Date of Issue: 18/11/21
Authorised Signatory:

Claire Richardson

Certificate Number: 4797

NATA Accreditation No: 20688

Statement of Conformity

The sound level meter submitted for testing has successfully completed the Class 1 periodic tests of IEC 61672-3, 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 because evidence was not publicly available, from an independent testing organization responsible for pattern approvals, to demonstrate that the model of sound level meter fully conforms to the requirements of IEC 61672-1:2002, and because the periodic tests of IEC 61672-3 cover only a limited subset of the specifications in IEC 61672-1.

Uncertainty

For all tests, the expanded uncertainty of measurement is reported at approximately 95% confidence level with a coverage factor k, of 2. Except where noted otherwise, the results provided in this report are associated with the following expanded uncertainties:

Electrical Tests: 0.09 dB
Toneburst: 0.09 dB

Acoustic Tests:
0.13 dB for 31.5 Hz to below 2 kHz
0.14 dB for 2 kHz to below 8 kHz
0.16 dB for 8 kHz to below 12.5 kHz
0.10 dB at a reference frequency of 1 kHz

Bandpass Filters:
0.10 dB for attenuation less than 4 dB
0.15 dB for attenuation less above 4 dB to 18 dB
0.25 for attenuation 18 dB to 80 dB

Traceability

The measured values are traceable to the following laboratories:

Sound Pressure Level:	National Measurement Institute, Australia
Voltage:	TRVMS, Australia
Frequency:	TRVMS, Australia
Ambient Pressure:	Keysight, Australia
Temperature:	Keysight, Australia
Relative Humidity:	Keysight, Australia

Test Overview

Periodic tests were performed in accordance with procedures from IEC 61672-3 Ed. 2.0 (2013). In accordance with Clause 8.1 of IEC 61672-3, all design features that are required by IEC 61672-1 that are available on the instrument have been tested.

The verification measurements were performed using the calibration system Nor1504A with software type Nor1019. Most of the verification tests are electrical tests. Test signals are fed to the sound measuring device through an adapter that resembles the microphone signal. A special adapter with a suitable electrical characteristic is used.

Some measurements are acoustical tests. This is the acoustical part of the self noise test and the acoustical verification of the frequency response. Test was completed automatically, output signal was manually confirmed to match instrument display as per IEC61672-3 (2013, Clause 8.4)

Detailed measurement results are printed on the following pages. Each of the verification test points has a Result indication (P, U, or N) that tells the obtained result of the actual test.
P = the result is Passed
U = due to the Uncertainty of the measurement it is not possible to state if the result is passed or not
N = the result is Not passed
All verification tests must have a Passed indication in order to fulfill the requirements in the standard.

Acoustical levels are stated relative to 20 µPa. Other dB levels are relative values.
Version of Calibration Software Used: 6.1S-(CT 1.8.2)
Certificate Version: v8.5.4

Certificate Number: 4797

NATA Accreditation No: 20688

Measurement Results:

Indication at the Calibration Check Frequency - IEC61672-3 Ed.2 #10	**Passed**
Self-generated Noise - IEC 61672-3 Ed.2.0 #11	**Passed**
Frequency Weightings: A Network - IEC 61672-3 Ed.2.0 #13.3	**Passed**
Frequency Weightings: C Network - IEC 61672-3 Ed.2.0 #13.3	**Passed**
Frequency and Time Weightings at 1 kHz IEC 61672-3 Ed.2.0 #14	**Passed**
Level Linearity on the Reference Level Range - IEC 61672-3 Ed.2.0 #16	**Passed**
Toneburst Response - IEC 61672-3 Ed.2.0 #18	**Passed**
Overload Indication - IEC 61672-3 Ed.2.0 #20	**Passed**
High Level Stability Test - IEC 61672-3 Ed.2.0 #21	**Passed**
Long Term Stability Test - IEC 61672-3 Ed.2.0 #15	**Passed**
DIN 45657 (2013): Statistical Distribution Test #5.2	**Passed**
Acoustical signal tests of a frequency weighting - IEC 61673-3 Ed.2 #12	**Passed**

Certificate Number: 4797

NATA Accreditation No: 20688

Results

Indication at the Calibration Check Frequency - IEC61672-3 Ed.2 #10

Reference Calibrator: WSC3 - B&K4226_1k_94dB
Reference calibrator level: 94.08
Before calibration:
Environmental corrections:
Other corrections:
Notional level:
Calibrator level before adjustment: 94.1
After calibration:
Environmental corrections:
Other corrections:
Notional level:
Reference calibrator level after calibration: 94.1
Associated Calibrator: - -
Associated calibrator level: Not calibrated
Test Passed

Self-generated Noise - IEC 61672-3 Ed.2.0 #11

Network	Level (dB)	Max (dB)	Uncert. (dB)	Result	Comment
A	16.6	20.0	0.09	P	Microphone installed
A	20.0	22.0	0.09	P	Equivalent capacity
C	22.0	27.0	0.09	P	Equivalent capacity

Test Passed
Note: Compliance with this test is not a requirement of IEC61672.3-2013, these results are provided for reference only.

Frequency Weightings: A Network - IEC 61672-3 Ed.2.0 #13.3

Freq (Hz)	Ref. (dB)	Meas. (dB)	Tol. (dB)	Tol. (dB)	Uncert. (dB)	Dev. (dB)	Result
63.1	75.0	75.0	1.0	-1.0	0.09	0.0	P
125.9	75.0	75.0	1.0	-1.0	0.09	0.0	P
251.2	75.0	75.0	1.0	-1.0	0.09	0.0	P
501.2	75.0	75.0	1.0	-1.0	0.09	0.0	P
1000.0	75.0	75.0	0.7	-0.7	0.09	0.0	P
1995.3	75.0	75.0	1.0	-1.0	0.09	0.0	P
3981.1	75.0	75.0	1.0	-1.0	0.09	0.0	P
7943.3	75.0	75.0	1.5	-2.5	0.09	0.0	P
15848.9	75.0	75.0	2.5	-16.0	0.09	0.0	P

Test Passed

Frequency Weightings: C Network - IEC 61672-3 Ed.2.0 #13.3

Freq (Hz)	Ref. Level (dB)	Meas. Value (dB)	Tol. (dB)	Tol. (dB)	Uncert. (dB)	Dev. (dB)	Result
63.1	75.0	75.0	1.0	-1.0	0.09	0.0	P
125.9	75.0	75.0	1.0	-1.0	0.09	0.0	P

Certificate Number: 4797

251.2	75.0	75.0	1.0	-1.0	0.09	0.0	P
501.2	75.0	75.0	1.0	-1.0	0.09	0.0	P
1000.0	75.0	75.0	0.7	-0.7	0.09	0.0	P
1995.3	75.0	75.0	1.0	-1.0	0.09	0.0	P
3981.1	75.0	75.0	1.0	-1.0	0.09	0.0	P
7943.3	75.0	75.0	1.5	-2.5	0.09	0.0	P
15848.9	75.0	75.0	2.5	-16.0	0.09	0.0	P

Test Passed

Frequency and Time Weightings at 1 kHz IEC 61672-3 Ed.2.0 #14

Weightings		Ref.	Measured	Lim.		Uncert.	Dev.	Result
Time	Netw	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	
Fast	A	94.0	94.0	0.1	-0.1	0.09	0.0	P
Fast	C	94.0	94.0	0.1	-0.1	0.09	0.0	P
Slow	A	94.0	94.0	0.1	-0.1	0.09	0.0	P
Leq	A	94.0	94.0	0.1	-0.1	0.09	0.0	P

Test Passed

Level Linearity on the Reference Level Range - IEC 61672-3 Ed.2.0 #16

Ref. (dB)	Measured (dB)	Lim. (dB)	(dB)	Uncert. (dB)	Dev. (dB)	Result
Measurements are SPL measurements						
94.0	94.0	0.8	-0.8	0.09	0.0	P
99.0	99.0	0.8	-0.8	0.09	0.0	P
104.0	104.0	0.8	-0.8	0.09	0.0	P
109.0	109.0	0.8	-0.8	0.09	0.0	P
115.0	115.0	0.8	-0.8	0.09	0.0	P
116.0	116.0	0.8	-0.8	0.09	0.0	P
94.0	94.0	0.8	-0.8	0.09	0.0	P
89.0	89.0	0.8	-0.8	0.09	0.0	P
84.0	84.0	0.8	-0.8	0.09	0.0	P
79.0	79.0	0.8	-0.8	0.09	0.0	P
74.0	74.0	0.8	-0.8	0.09	0.0	P
69.0	69.0	0.8	-0.8	0.09	0.0	P
64.0	64.0	0.8	-0.8	0.09	0.0	P
59.0	59.0	0.8	-0.8	0.09	0.0	P
54.0	54.0	0.8	-0.8	0.09	0.0	P
49.0	49.0	0.8	-0.8	0.09	0.0	P
44.0	44.0	0.8	-0.8	0.09	0.0	P
39.0	39.0	0.8	-0.8	0.09	0.0	P
34.0	34.0	0.8	-0.8	0.09	0.0	P
29.0	29.0	0.8	-0.8	0.09	0.0	P
28.0	28.0	0.8	-0.8	0.09	0.0	P
27.0	27.0	0.8	-0.8	0.09	0.0	P
26.0	26.0	0.8	-0.8	0.09	0.0	P
25.0	25.0	0.8	-0.8	0.09	0.0	P

Test Passed
Full scale setting: 120dB
Measured at 8 kHz

Certificate Number: 4797

NATA Accreditation No: 20688

Toneburst Response - IEC 61672-3 Ed.2.0 #18

Burst type	Ref. (dB)	Measured (dB)	Lim. (dB)	Lim. (dB)	Uncert. (dB)	Dev. (dB)	Result
Fast 200 mSec	116.0	116.0	0.5	-0.5	0.09	0.0	P
Fast 2.0 mSec	99.0	98.9	1.0	-1.5	0.09	-0.1	P
Fast 0.25 mSec	90.0	89.8	1.0	-3.0	0.09	-0.2	P
Slow 200 mSec	109.6	109.6	0.5	-0.5	0.09	0.0	P
Slow 2.0 mSec	90.0	90.1	1.0	-3.0	0.09	0.1	P
Leq 200 mSec	100.0	100.0	0.5	-0.5	0.09	0.0	P
Leq 2.0 mSec	80.0	79.9	1.0	-1.5	0.09	-0.1	P
Leq 0.25 mSec	71.0	71.0	1.0	-3.0	0.09	0.0	P

Test Passed

Overload Indication - IEC 61672-3 Ed.2.0 #20

	Deviation (dB)	Lim. (+/-dB)	Uncert. (dB)	Result
Level difference of positive and negative pulses:	0.24	1.5	0.09	P

U
-

Positive 1/2 cycle 4 kHz. Overload occurred at: 124.4
Negative 1/2 cycle 4 kHz. Overload occurred at: 124.6
Test Passed

High Level Stability Test - IEC 61672-3 Ed.2.0 #21

Test signal: Sine wave at 1 kHz

Initial level (dB)	Final level (dB)	Diff. (dB)	Lim. value (dB)	Uncert. (dB)	Result
119.0	119.0	0.0	0.1	0.09	P

Test Passed

Long Term Stability Test - IEC 61672-3 Ed.2.0 #15

Test signal: Sine wave at 1 kHz

Time interval (mm:SS)	StartLevel (dB)	StopLevel (dB)	Difference (dB)	Tolerance (dB)	Result
27:01	94.2	94.1	-0.1	0.1	P

Test Passed

DIN 45657 (2013): Statistical Distribution Test #5.2

Ln %	Ref. Value (dB)	Measured Value (dB)	Tolerance Norm (dB)	Result Value (dB)	
1%	119.4	119.3	0.5	-0.1	P
5%	117.0	116.8	0.5	-0.2	P
50%	90.0	90.2	0.5	0.2	P
90%	66.0	66.0	0.5	0.0	P
95%	63.0	62.9	0.5	-0.1	P
99%	60.6	60.5	0.5	-0.1	P
LeqA	108.8	108.7	0.5	-0.1	P

Test Passed

Certificate Number: 4797

NATA Accreditation No: 20688

Acoustical signal tests of a frequency weighting - IEC 61673-3 Ed.2 #12

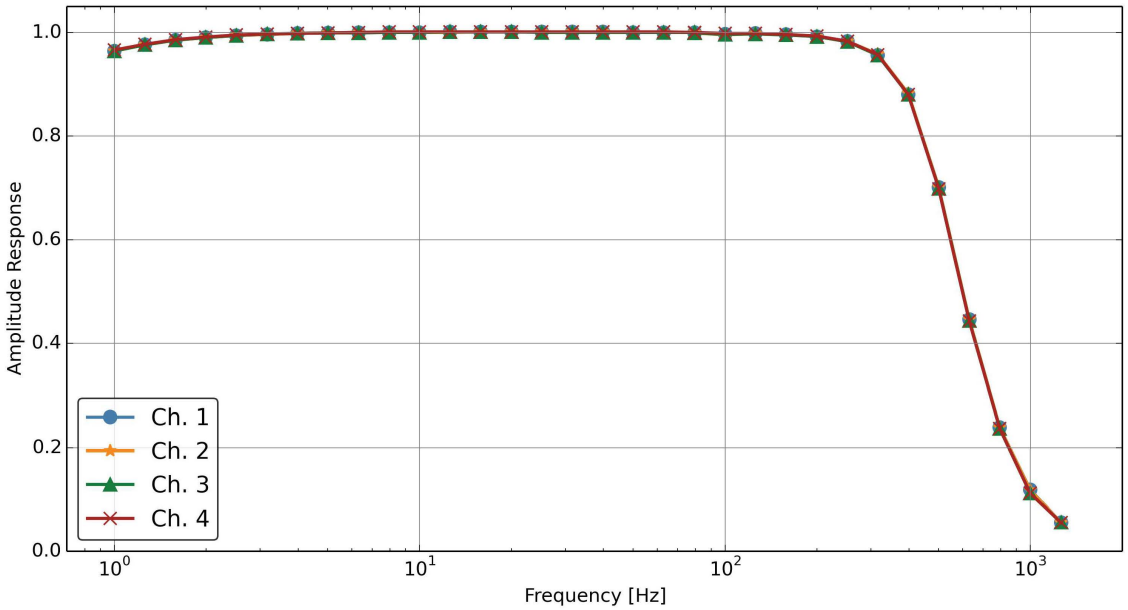
Freq.	Calibrator		Measurements					
	Level	U	1	2	3	Avg	SD	U
125Hz	94.08	0.07	93.90	93.80	93.80	93.83	0.06	0.10
1kHz	94.08	0.06	94.00	94.00	94.10	94.03	0.06	0.10
8kHz	94.05	0.09	85.40	85.50	85.60	85.50	0.10	0.10

Freq.		125Hz	1kHz	8kHz
SLM	Avg. Value	93.83	94.03	85.50
	Wgt. Corr	0.20	0.00	3.00
	U	0.10	0.10	0.10
Mic. Corr.	Level	0.00	0.05	3.68
	U	0.11	0.14	0.30
Case Corr.	Level	0.00	0.00	0.00
	U	0.00	0.00	0.00
WS Corr.	Level	0.00	0.00	0.00
	U	0.00	0.00	0.00
4226 Cal. Corr.	Level	-0.08	-0.08	-0.05
	U	0.07	0.07	0.09
Total Corr.	Level	0.12	-0.03	6.63
Results	Level	93.95	94.00	92.13
	Dev. Ref. 1kHz	-0.05	0.00	-1.87
	U	0.16	0.19	0.33
Tolerance		-1.0, 1.0	-0.7, 0.7	-2.5, 1.5
Pass		P	P	P

CALIBRATION CERTIFICATE

Resonate Systems Pty Ltd
Level 1, 23 Peel Street
ADELAIDE SA 5000
support@resonatesystems.com.au
(08) 7200 5700

Model	AvaTrace M80
Serial number	3110
Reference	RSPCC-2021-RC-AVA3110
Calibration date	Friday, 28 May 2021
Calibration equipment	NI-USB-6289 (SN: 1A04689)
Calibration result	All channels passed on all frequencies (see graph and table below for detail)
Calibration performed by	Peter Hüttenmeister
Certificate prepared by	Peter Hüttenmeister



Resonate Systems certifies that, at the time of test, the above product was calibrated in accordance with applicable AVA Monitoring AB procedure.

These procedures are designed to assure that the product meets AVA Monitoring's specifications.

The above product should be calibrated at least every second year or according to applicable regulations.

The standards used in this calibration are traceable to SP, NIST and/or other national measurement institutes.

RESONATE SYSTEMS

CALIBRATION CERTIFICATE

Resonate Systems Pty Ltd
Level 1, 23 Peel Street
ADELAIDE SA 5000
support@resonatesystems.com.au
(08) 7200 5700

	Freq (Hz)	Amplitude	V1	Pass/Fail	V2	Pass/Fail	V3	Pass/Fail	V4	Pass/Fail
0	1.0	3.0	0.964	PASS	0.964	PASS	0.964	PASS	0.966	PASS
1	1.259	3.0	0.976	PASS	0.976	PASS	0.976	PASS	0.977	PASS
2	1.585	3.0	0.985	PASS	0.985	PASS	0.985	PASS	0.986	PASS
3	1.995	3.0	0.99	PASS	0.99	PASS	0.99	PASS	0.991	PASS
4	2.512	3.0	0.994	PASS	0.994	PASS	0.994	PASS	0.995	PASS
5	3.162	3.0	0.996	PASS	0.996	PASS	0.997	PASS	0.997	PASS
6	3.981	3.0	0.998	PASS	0.998	PASS	0.998	PASS	0.998	PASS
7	5.012	3.0	0.999	PASS	0.999	PASS	0.999	PASS	0.999	PASS
8	6.31	3.0	1.0	PASS	1.0	PASS	0.999	PASS	1.0	PASS
9	7.943	3.0	1.0	PASS	1.0	PASS	1.0	PASS	1.001	PASS
10	10.0	3.0	1.0	PASS	1.0	PASS	1.0	PASS	1.001	PASS
11	12.589	3.0	1.001	PASS	1.0	PASS	1.001	PASS	1.001	PASS
12	15.849	3.0	1.001	PASS	1.001	PASS	1.001	PASS	1.001	PASS
13	19.953	3.0	1.001	PASS	1.001	PASS	1.001	PASS	1.001	PASS
14	25.119	3.0	1.001	PASS	1.001	PASS	1.0	PASS	1.001	PASS
15	31.623	3.0	1.001	PASS	1.001	PASS	1.0	PASS	1.001	PASS
16	39.811	3.0	1.001	PASS	1.001	PASS	1.0	PASS	1.001	PASS
17	50.119	3.0	1.0	PASS	1.0	PASS	1.0	PASS	1.001	PASS
18	63.096	3.0	1.0	PASS	1.0	PASS	1.0	PASS	1.001	PASS
19	79.433	3.0	1.0	PASS	1.0	PASS	1.0	PASS	1.0	PASS
20	79.433	2.0	0.999	PASS	1.0	PASS	1.0	PASS	1.0	PASS
21	79.433	2.5	0.999	PASS	0.999	PASS	0.999	PASS	1.0	PASS
22	100.0	3.0	0.997	PASS	0.995	PASS	0.996	PASS	0.998	PASS
23	125.893	3.0	0.998	PASS	0.998	PASS	0.997	PASS	0.998	PASS
24	158.489	3.0	0.996	PASS	0.996	PASS	0.995	PASS	0.996	PASS
25	199.526	3.0	0.992	PASS	0.992	PASS	0.992	PASS	0.993	PASS
26	251.189	3.0	0.983	PASS	0.983	PASS	0.982	PASS	0.983	PASS
27	316.228	3.0	0.956	PASS	0.958	PASS	0.956	PASS	0.957	PASS
28	398.107	3.0	0.88	PASS	0.882	PASS	0.88	PASS	0.88	PASS
29	501.187	3.0	0.701	PASS	0.701	PASS	0.699	PASS	0.698	PASS
30	630.957	3.0	0.446	PASS	0.446	PASS	0.444	PASS	0.443	PASS
31	794.328	3.0	0.239	PASS	0.239	PASS	0.237	PASS	0.237	PASS
32	1000.0	3.0	0.119	PASS	0.118	PASS	0.112	PASS	0.112	PASS
33	1258.925	3.0	0.056	PASS	0.056	PASS	0.056	PASS	0.056	PASS

RESONATE SYSTEMS