AW EDWARDS

Construction Monitoring Report Feb 2021 – Sep 2021

DOCUMENT INFORMATION

PROJECT	Sydney City & Southwest Metro – Crows Nest Station	**REVISION**	C
DOCUMENT NUMBER	SMCSWSCN-AWE-SCN-EM-REP-003385	**DATE**	17.01.2022
CLIENT	Sydney Metro	**STATUS**	For Approval

DOCUMENT APPROVAL

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Project Role	Planning & Environment Manager	Environmental Coordinator	Project Director
Signature			
Date	17/01/2022	17/01/2022	17/01/2022

REVISION

REVISION	DATE	STATUS	AUTHOR	APPROVED BY	COMMENTS
A	11-Nov-2021	For review	Darren Green	Colin Danby	Initial version for review
B	8-Dec-2021	For approval	Darren Green	Colin Danby	Updated in response to Sydney Metro comments.
C	17-Jan-2022	For approval	Darren Green	Colin Danby	Updated in response to Sydney Metro comments.

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

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(or 000 if an emergency)		
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1 INTRODUCTION

1.1 SYDNEY METRO

The New South Wales (NSW) Government through Transport for NSW (TfNSW) 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, Infrastructure and Environment (DPIE).

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 for this Construction Monitoring Report is from the commencement of construction, 26 February 2021, to 26 August 2021.Sydney Metro's six-monthly reporting period was from 1 April 2021 to 30 September 2021. A W Edwards has

therefore elected to report from 26 February 2021 to 30 September 2021 to align with Sydney Metro's reporting frequency.

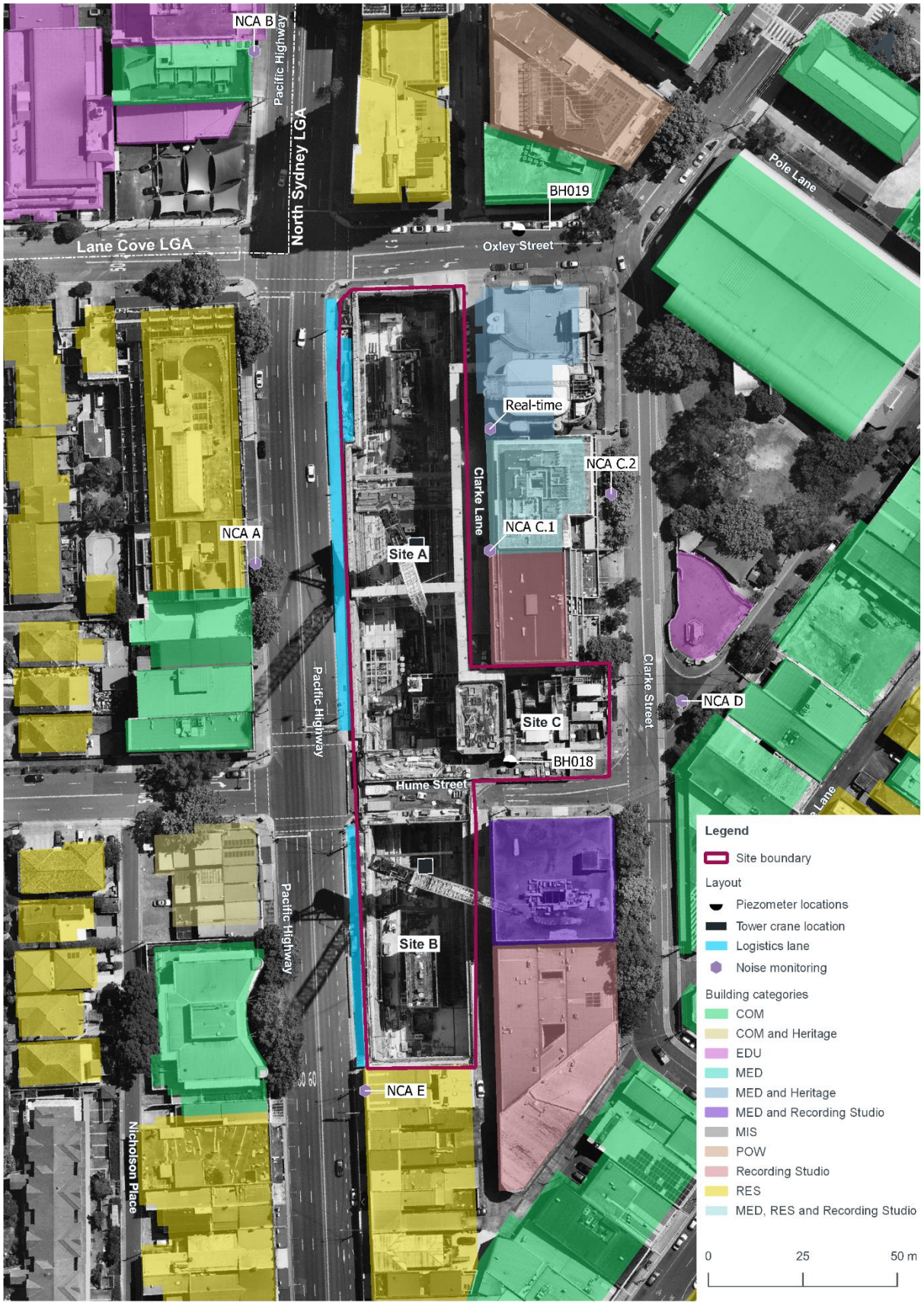

Figure 1 Project site and monitoring locations

2 CONSTRUCTION UPDATE FOR PAST 6 MONTHS

Since construction commenced on 26 February 2021 the following activities have been undertaken:

- Site establishment, including:
  - Installation and erection of tower cranes;
  - Site C amenities;
  - Hume Street utility relocations;
  - Installation of covered walkway;
  - Replacement of perimeter hoarding;
  - Installation of temporary man and material hoist; and
  - Concrete line testing and removal.
- Detailed excavation of Site A and B
- Inground services, including
  - Inground drainage;
  - Waterproofing walls and floors;
  - Concrete delivery, pumping, pouring and finishing; and
  - Steel fixing.
- Below ground structure (B6 under platform slab and B6 to B3 walls)
  - Preparation and placing of formwork;
  - Concrete delivery, pumping, pouring and finishing;
  - Steel fixing;
  - Riggin work; and
  - Installation of structural steel and pre-cast concrete for over track exhaust (OTE).
- Delivery of materials

Working hours during the reporting period have been in accordance with allowances of the planning approval, as amended by the Environmental Planning and Assessment (COVID-19 Development – Infrastructure Construction Work Days No.1 and No.2) Order 2020 (the 'Order').

The Order provides for the following:

1. The carrying out of any building work or work, or the demolition of a building or work on a Saturday, Sunday or public holiday is development specified for the Order.
2. The conditions specified for the development are that the development must:
   2.1. be the subject of a development consent;
   2.2. comply with all conditions of the consent other than any condition that restricts the hours of work or operation on a Saturday, Sunday or public holiday; and
   2.3. for work or operation on a Saturday, Sunday or public holiday:
      2.3.1. comply with the conditions of the consent that restrict the hours of work or operation on any other day as if the conditions applied to work or operation on a Saturday, Sunday or public holiday;
      2.3.2. not involve the carrying out of rock breaking, rock hammering, sheet piling, pile driving or similar activities during the hours of work or operation that would not be permitted but for this Order; and
      2.3.3. take all feasible and reasonable measures to minimise noise.

In consideration of the Order, the standard construction hours for the reporting period have been:

- 7:00 am to 6:00 pm, Mondays to Fridays; and
- 7:00 am to 6:00 pm on Saturdays and Sundays, or public holidays (with limited construction activities permitted i.e. no rock breaking, rock hammering, sheet piling, pile driving or similar activities).

3 METEORLOGICAL CONDITIONS

Meteorological data during the reporting period has been sourced from the Bureau of Meteorology (BoM) weather station (No. 066214) at Observatory Hill, Sydney, approximately 3.5 kilometres south from the project. Most weather observations are from Observatory Hill, but wind observations are from Fort Denison (No. 066022) and pressure, cloud, evaporation and sunshine observations are from Sydney Airport (No. 066037).

Long-term climate statistics have been sourced from the retired station at Observatory Hill (No. 066062) which was in operation from 1858 to 31 August 2020.

3.1 RAINFALL

Based on long-term climate statistics from station 066062, the months January to June represent the wetter months of the year averaging over 100 millimetres (mm) of rainfall per month, with June historically being the wettest month. July through to December are the drier months, with September being the driest month of the year.

Based on the results recorded during the reporting period, March 2021 was above the statistical average and was due to an extreme rainfall event on the east coast of Australia which began on 18 March 2021, leading to widespread flooding in New South Wales.

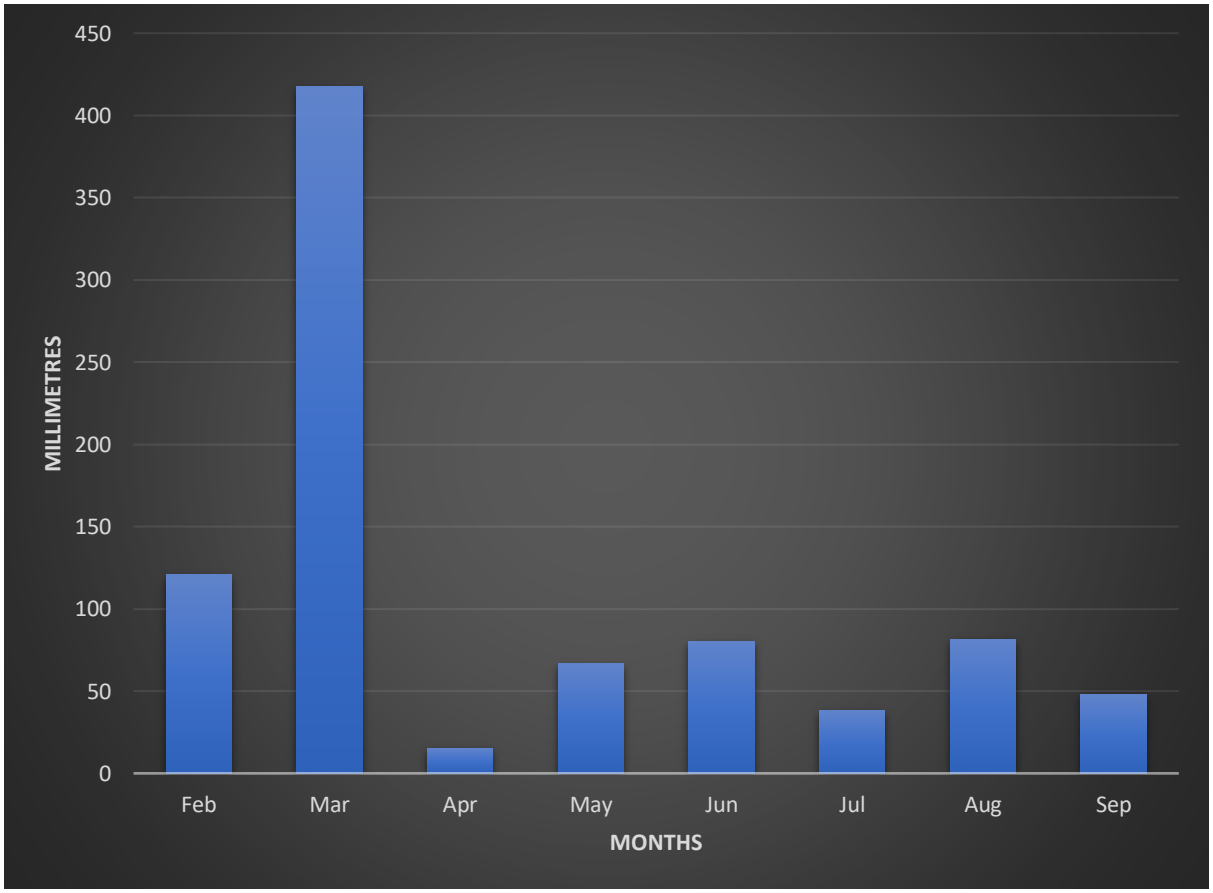

Figure 2 Monthly rainfall during the reporting period

3.2 TEMPERATURE

Based on long-term climate statistics from station 066062, December to March is the hottest period of the year, with June to August being the coldest period of the year.

Based on the results recorded during the reporting period, temperatures followed the trend from the long-term statistics

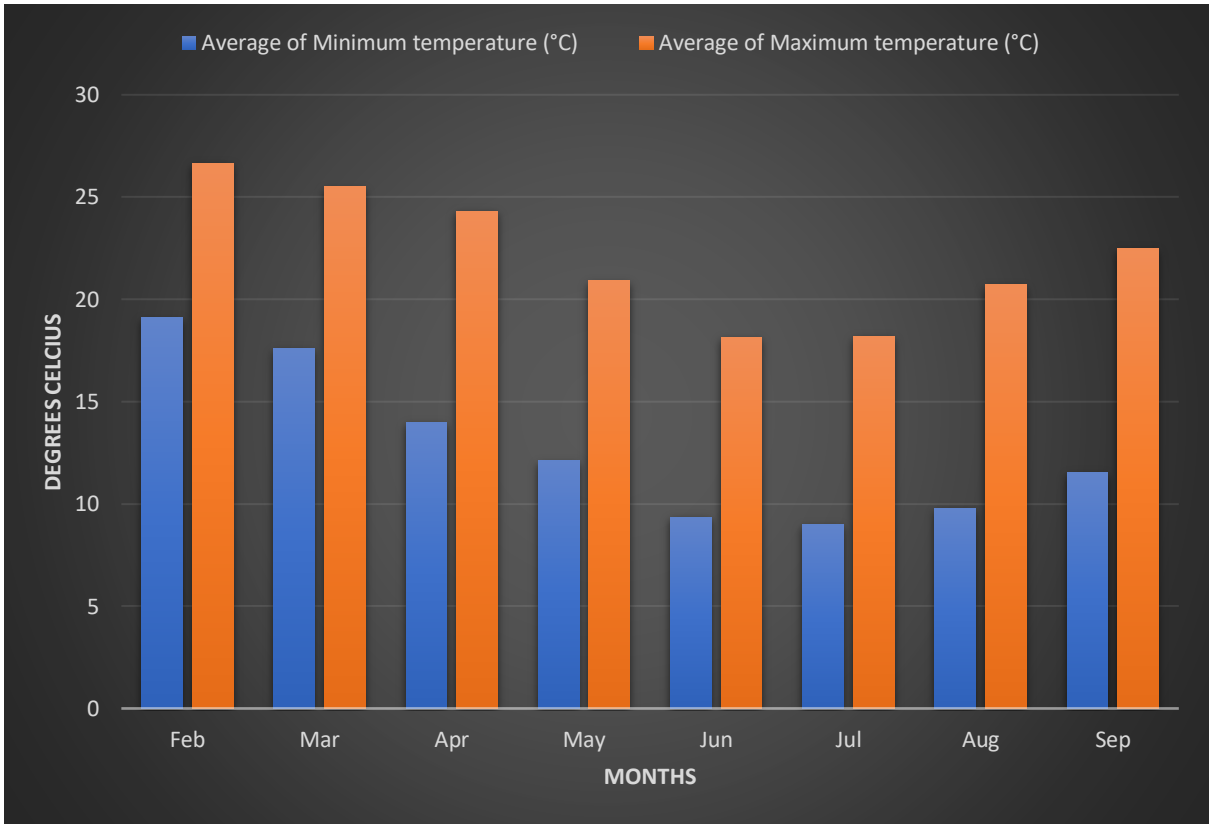

Figure 3 Monthly minimum and maximum temperatures during the reporting period

3.3 WIND

The dominant wind direction during the reporting period has been from a westerly direction.

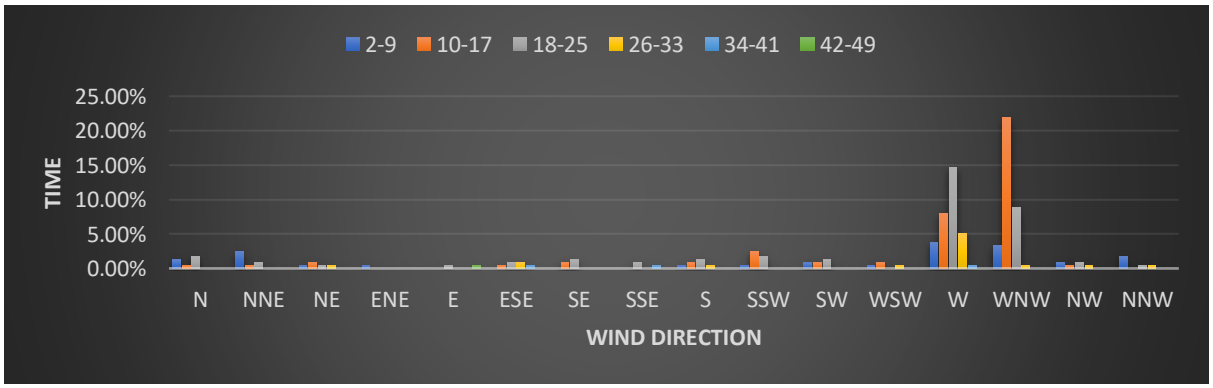

Figure 4 Wind speed and direction during the reporting period

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	NAME	MAKE & MODEL	DATE NEXT SERVICE
9/04/2021	Boom Lift (Over 11 Metres)	GENIE Z-135/70AU	8/06/2021
16/04/2021	Forklift	TCM FD30	14/07/2021
17/04/2021	Boom Lift (Over 11 Metres)	SKYJACK SJ85AJ	15/07/2021
27/04/2021	Scissor Lift	HAULOTTE COMPACT 12	27/07/2021
29/04/2021	Boom Lift (Over 11 Metres)	GENIE Z-135/70AU	11/05/2021
11/05/2021	Excavator / Earthmoving Equipment	Kubota U55-4G	16/01/2022
12/05/2021	Boom Lift (Over 11 Metres)	JLG 860SJ	11/08/2021
12/05/2021	Boom Lift (Under 11 Metres)	HAULOTTE HA16RTJ PRO	23/07/2021
13/05/2021	Scissor Lift	Skyjack SJIII 4740	5/11/2021
13/05/2021	Boom Lift (Over 11 Metres)	Haulotte KB45RTD	26/07/2021
18/05/2021	Scissor Lift	HAULOTTE COMPACT 14	17/08/2021
26/05/2021	Crane Truck	Unic URW376E	1/10/2021
27/05/2021	Front End Loader	Volvo L90F	23/08/2021
27/05/2021	Skid Steer Loader (Bobcat)	Bobcat T320	4/08/2021
28/05/2021	Skid Steer Loader (Bobcat)	Bobcat T590	20/07/2021
28/05/2021	Skid Steer Loader (Bobcat)	Kubota SVL75-2	6/07/2021
28/05/2021	Skid Steer Loader (Bobcat)	Terex RT7S	8/07/2021
28/05/2021	Skid Steer Loader (Bobcat)	Kubota SVL75-2	6/11/2021
28/05/2021	Boom Lift (Over 11 Metres)	MANITOU 160ATJP	30/07/2021
28/05/2021	Excavator / Earthmoving Equipment	Kubota U55-4GA	
29/05/2021	Skid Steer Loader (Bobcat)	Bobcat T770	31/08/2021
1/06/2021	Boom Lift (Under 11 Metres)	NIFTY HR12	12/06/2021
8/06/2021	Excavator / Earthmoving Equipment	Kubota KX080-3	28/06/2021
8/06/2021	Scissor Lift	JLG 2646ES JLG 2646ES	14/09/2021
8/06/2021	Scissor Lift	JLG 2646ES JLG 2646ES	
9/06/2021	Scissor Lift	JLG 2646ES JLG 2646	2/10/2021
15/06/2021	Mobile Crane	Liebherr LTC1045	6/08/2021
23/06/2021	Scissor Lift	SKYJACK SJ6832RT	6/08/2021
23/06/2021	Scissor Lift	SKYJACK SJ6832RT	27/08/2021
25/06/2021	Mobile Crane	Senebogen 653R	2/08/2021
28/06/2021	Materials Hoist / Alimak	Men and Material Hoist 2 (Twin) PH 650	
28/06/2021	Scissor Lift	SKYJACK 4740	12/08/2021
3/07/2021	Concrete Placing Boom	PUTZMEISTER BSF 42-5.16H	15/12/2021
6/07/2021	Excavator / Earthmoving Equipment	Kubota U55-4	15/09/2021

DATE	NAME	MAKE & MODEL	DATE NEXT SERVICE
8/07/2021	Boom Lift (Under 11 Metres)	GENIE Z34/22IC	8/10/2021
9/07/2021	Boom Lift (Over 11 Metres)	GENIE ZX-135/70AU	17/09/2021
12/07/2021	Scissor Lift	SKYJACK SJ6832RT	12/10/2021
26/07/2021	Tower Crane	Favelle Favco M2480D	27/07/2021
2/08/2021	Excavator / Earthmoving Equipment	Hitachi ZX60USB	15/08/2021
10/08/2021	Scissor Lift	ELECTRIC SCISSOR LIFT SKYJACK SJ3219	30/10/2021
13/08/2021	Boom Lift (Over 11 Metres)	JLG 600AJ	23/09/2021
16/08/2021	Scissor Lift	SKYJACK SJ3219	16/11/2021
16/08/2021	Scissor Lift	SKYJACK SJ4626	9/11/2021
16/08/2021	Scissor Lift	Haulotte Optimum 8AC	22/10/2021
17/08/2021	Scissor Lift	SKYJACK SJ6832RT	15/01/2022
19/08/2021	Boom Lift (Over 11 Metres)	GENIE Z-135/70	19/11/2021
20/08/2021	Scissor Lift	SKYJACK SJ4740	17/11/2021
20/08/2021	Scissor Lift	SKYJACK SJ4632	11/10/2021
30/08/2021	Excavator / Earthmoving Equipment	Kubota U55-4GA	27/09/2021
31/08/2021	Excavator / Earthmoving Equipment	Komatsu KX033-4	21/09/2021
31/08/2021	Scissor Lift	Haulotte COMPACT 12DX	30/11/2021
31/08/2021	Scissor Lift	SKYJACK SJ6832RT	30/11/2021
2/09/2021	Boom Lift (Over 11 Metres)	JLG M450AJ	7/10/2021
10/09/2021	Scissor Lift	SKYJACK SJIII3219	2/12/2021
10/09/2021	Scissor Lift	Haulotte Optimum 8AC	6/11/2021
21/09/2021	Boom Lift (Over 11 Metres)	660SJ SB66RTD	30/10/2021
21/09/2021	Boom Lift (Over 11 Metres)	JLG 600AJ	14/12/2021
23/09/2021	Scissor Lift	Haulotte Optimum 8 AC	10/11/2021
23/09/2021	Scissor Lift	Haulotte Optimum 8 AC	28/10/2021
23/09/2021	Boom Lift (Over 11 Metres)	JLG800AJ 800AJ	11/11/2021
29/09/2021	Mobile Crane	Liebherr LTM1060	14/01/2022

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 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 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 for all works required outside standard construction hours.
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 2,000 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.

MANAGEMENT OBJECTIVE	STATEMENT OF COMPLIANCE
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:

- $L_{Aeq(15minute)}$ ≥ 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 26 February 2021 to 30 September 2021, 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;
- Attended ground-borne noise and vibration monitoring in nearby structures; 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	NTI Audio Type 1 sound level meter	XL2-TA	9477	30 Nov 2022
Attended noise / spot checks	RION Type 1 sound level meter	NL-52	00219948	23 April 2023
Attended noise	RION Type 1 sound level meter	NL-31	772983	10 Dec 2021
Real-time noise	Sonitus Systems	EM2010 Type 1	00502	8 Jan 2022

MONITORING TYPE	MANUFACTURER	MODEL	SERIAL NO.	CALIBRATION DUE
	Type 1 sound level meter and data logger			
Real-time vibration	AvaTrace	M80	4470	18 Sep 2022

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. Detailed excavation utilising hydraulic hammering was the highest impact to surrounding receivers during the reporting period. Once detailed excavation was completed, potential impacts from construction noise were reduced to the equipment associated with structural works.

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 during favourable weather conditions, as required in the CNVMP. The “Dominant Activity” column identifies the scenario modelled in the Crows Nest Construction Noise and Vibration Impact Statement (CNVIS). The “Predicted Level (at façade) (dBA)” is the total noise level predicted at the façade of the identified receiver, according to the modelled scenario. The column “Compliant” is the determination of A W Edwards of the measured works in comparison to the predicted noise level; compliance has also been determined where traffic from the Pacific Highway has been dominant and construction noise has been inaudible at the monitoring location.

Additional record details, such as weather conditions, monitoring duration etc are recorded on the individual record sheet which can be provided on request. All attended monitoring records for out of hours work are forwarded on to Sydney Metro and the independent Acoustic Advisor within 48 hours of the monitoring being completed.

Table 5 Attended noise monitoring completed during the reporting period

DATE & TIME	NCA	LOCATION/ ADDRESS	RECEIVER	DOMINANT ACTIVITY	PREDICTED LEVEL (AT FAÇADE) (DBA)	MEASURED LEVEL (DBA)	COMPLIANT (Y/N)	REASON	COMMENT
2/03/2021 9:02 AM	D	Suite 202, 10-12 Clarke Street	Commercial	Detailed Excavation	88	56 (internal)	Y	Responding to complaint.	Respite hours provided.
2/03/2021 9:31 AM	D	Apartment 206, 8-10 Clarke Street	Commercial	Detailed Excavation	89	63 (internal)	Y	Responding to complaint.	Office vacant. Respite hours provided
10/03/2021 1:15 PM	C	Kelly's Place, 35 Clarke St. (internal)	Childcare	Detailed Excavation	67	60 (internal)	Y	Responding to feedback. A W Edwards work was not audible internally or externally. Carried out noise monitoring to determine noise caused by construction work at 47 Hume Street.	Lloyds carrying out demolition work at 47 Hume Street.
10/03/2021 1:30 PM	D	Adjacent to 47 Hume Street on sidewalk (external)	Childcare	Detailed Excavation	N/A Noise level from other construction works	69	Y	Responding to feedback from Kelly's Place. A W Edwards work not audible. Carried out noise monitoring to determine noise caused by construction work at 47 Hume Street.	Lloyds carrying out demolition work at 47 Hume Street.
10/03/2021 11:07 AM	A	7m from excavator on Site A Pacific Highway	Commercial	Detailed Excavation	N/A Plant spot check	82	-	Verification of 24T excavator with telescopic arm removing spoil from station box	Excavator noise could not be completely isolated due to passing traffic. Calculated SWL consistent with noise model SWL.
10/03/2021 11:29 AM	A	420 Pacific Highway	Residential	Detailed Excavation	81	74	Y	Verification of total noise at NCA-A for Spoil Removal, Detailed Excavation, Waterproofing	Traffic noise dominant, construction noise was audible between traffic changes.
10/03/2021 11:53 AM	E	473 Pacific Highway	Commercial	Detailed Excavation	88	73	Y	Verification of total noise at NCA-E for Spoil Removal, Detailed Excavation, Waterproofing	Construction noise was not audible, noise caused by traffic on Pacific Highway.

THIS DOCUMENT IS UNCONTROLLED WHEN PRINTED

DATE & TIME	NCA	LOCATION/ ADDRESS	RECEIVER	DOMINANT ACTIVITY	PREDICTED LEVEL (AT FAÇADE) (DBA)	MEASURED LEVEL (DBA)	COMPLIANT (Y/N)	REASON	COMMENT
25/03/2021 10:00 AM	C	22-26 Clarke Street	Residential	Detailed Excavation	91	65	Y	Verification for Crane Idling	
25/03/2021 10:20 AM	C	22-26 Clarke Street	Residential	Detailed Excavation	91	71	Y	Verification for Crane Lift	
30/03/2021 10:34 AM	C/D	35 Hume Street, Clarke Street	Commercial	Detailed Excavation	73	68	Y	Catchment monitoring at NCA D	
30/03/2021 2:30 PM	C/D	Clarke Lane/ Hume Street Intersection	Commercial	Detailed Excavation	88	68	Y	Verification of core drilling activity	
13/04/2021 11:15 AM	A	420 Pacific Highway	Residential	Detailed Excavation	81	75	Y	Verification of saw cutting and tower crane lifts	Traffic noise dominant, construction noise was audible between traffic changes.
20/04/2021 2:20 PM	A	420 Pacific Highway	Residential	Detailed Excavation	81	75	Y	Verification of spoil loadout, excavation	Traffic noise dominant, construction noise was audible between traffic changes.
20/04/2021 2:40 PM	B	454-456 Pacific Highway	Commercial	Detailed Excavation	75	74	Y	Verification of spoil loadout, excavation	Traffic noise dominant, construction was not audible.
20/04/2021 3:05 PM	C/D	Clarke Street/ Hume Street Intersection	Commercial	Detailed Excavation	73	66	Y	Verification of respite hour, crane lifting	Respite from high noise activities honoured. Crane lift was audible.
21/04/2021 10:20 AM	A	25 Nicholson Street	Residential	Tower Crane rotating and lifting	61	59	Y	Responding to noise complaint relating to sound of tower crane operation	Tower crane 1 was audible.
27/04/2021 9:30 AM	E	473 Pacific Highway	Residential	Site Shed Establishment Clarke Lane	N/A	74	Y	Validation monitoring at NCA E	Construction noise was not audible, noise caused by traffic on Pacific Highway.
27/04/2021 9:50 AM	A	25 Nicholson Lane	Residential	Site Shed Establishment Clarke Lane	N/A	59	Y	Validation monitoring at NCA A	Tower crane 1 was audible.
27/04/2021 10:15 AM	B	454-456 Pacific Highway	Commercial	Site Shed Establishment Clarke Lane	N/A	71	Y	Validation monitoring at NCA B	Traffic noise dominant, construction was not audible.

DATE & TIME	NCA	LOCATION/ ADDRESS	RECEIVER	DOMINANT ACTIVITY	PREDICTED LEVEL (AT FAÇADE) (DBA)	MEASURED LEVEL (DBA)	COMPLIANT (Y/N)	REASON	COMMENT
27/04/2021 10:45 AM	C/D	22-26 Clarke Street	Residential	Site shed Establishment Clarke Lane	N/A	73	Y	Validation monitoring at NCA C	Construction and Tower Crane 2 audible
28/04/2021 1:50 PM	D	10-12 Clarke Street, Clarke Lane	Commercial	Below ground structure	78	67	Y	Validation monitoring at NCA D for Tower Crane operation and steel fixing in station box.	Tower crane audible, steel fixing was not audible.
28/04/2021 2:10 PM	C/D	35 Hume Street, Clarke Street	Commercial	Below ground structure	71	69	Y	Validation monitoring at NCA C/D for Tower Crane operation and steel fixing in station box.	Tower crane audible, steel fixing was not audible.
4/05/2021 10:15 AM	C/D	35 Hume Street, Clarke Street	Commercial	Detailed Excavation	73	66	Y	Validation monitoring at NCA C/D	Tower crane audible
17/05/2021 12:30 PM	A	420 Pacific Highway	Residential	Crane Lift, Inground Services, Formwork	65	73	Y	Validation monitoring at NCA A	Traffic noise dominant, construction was not audible.
12/05/2021 3:15 PM	C/D	35 Hume Street, Clarke Street	Commercial	Detailed Excavation	73	62	Y	Verification of total noise at NCA-C for Spoil Removal, Detailed Excavation, Waterproofing	
27/05/2021 6:00 PM	C	22-26 Clarke Street (on Clarke Lane) by hoarding gate	Residential	Concrete Pour	75	67	Y	Validation of OOH Concrete pour	
1/06/2021 11:45 AM	A	390 Pacific Hwy	Commercial	Below ground structure	67	73	Y	Validation monitoring at NCA A Tower Crane Operation, Sleeper deliveries for Linewide and 5t excavator lifting steel panel on Hume St.	Traffic noise dominant, construction was not audible.
1/06/2021 12:25 PM	C/D	35 Hume Street, Clarke Street	Commercial	Below ground structure	71	67	Y	Validation monitoring at NCA C/D Winching cable and tower crane operation	Tower crane audible, below ground structure works not audible.
2/06/2021 10:25 AM	A	390 Pacific Hwy	Commercial	Below ground structure	67	75	Y	Validation monitoring at NCA A Tower Crane Operation	Traffic noise dominant, construction was not audible.

DATE & TIME	NCA	LOCATION/ ADDRESS	RECEIVER	DOMINANT ACTIVITY	PREDICTED LEVEL (AT FAÇADE) (DBA)	MEASURED LEVEL (DBA)	COMPLIANT (Y/N)	REASON	COMMENT
2/06/2021 10:55 AM	-	Station Box	-	Diesel Generator	N/A Plant spot check	78	-	Validation of diesel generator at 3m distance	Calculated SWL consistent with noise model SWL.
2/06/2021 10:50 AM	-	Station Box	-	Borger Crane (Mobile Crane)	N/A Plant spot check	73	-	Validation of Borger crane while idling at 3m distance	Diesel generator running nearby, EWP operating nearby, intermittent hammering nearby
2/06/2021 11:00 AM	-	Station Box	-	EWP Operation	N/A Plant spot check	77	-	Validation of EWP operating at 3m distance	Movement and elevation of EWP
2/06/2021 11:15 AM	-	Station Box	-	Hilti Saw Operation	N/A Plant spot check	82	-	Validation of Hilti saw operating at 3m distance	Saw cutting reo bar
2/06/2021 11:30 AM	-	Station Box	-	Drill (Handheld)	N/A Plant spot check	77	-	Validation of handheld drill operation at 3m distance	
2/06/2021 11:35 AM	-	Station Box	-	Rattle Gun operation	N/A Plant spot check	79	-	Validation of Rattle gun operating at 8m distance	
2/06/2021 11:45 AM	-	Station box	-	Demolition Hammer Drill Operation	N/A Plant spot check	85	-	Validation of Demolition Hammer Drill 2m	
11/06/2021 9:55 AM	A	390 Pacific Hwy	Commercial	Below ground structure	67	72	Y	Validation monitoring at NCA A Tower Crane operation	Truck idling and beeping near to monitor (not related to station work), Pac Hwy noise dominant, construction inaudible
16/06/2021 1:45 PM	A	420 Pacific Hwy	Residential	Below ground structure	65	74	Y	Validation monitoring at NCA A Pac Hwy Deliveries and Tower Crane Operation	Tower Crane operation, Borger crane idling on Pac Hwy, Pac Hwy traffic dominant, construction audible intermittently.
16/06/2021 2:07 PM	B	454-456 Pacific Highway	Commercial	Below ground structure	60	72	Y	Validation monitoring at NCA B Pac Hwy deliveries and tower crane operation	Traffic on Pac Hwy dominant, construction only occasionally audible
16/06/2021 2:35 PM	C/D	35 Hume Street, Clarke Street	Commercial	Below ground structure	71	65	Y	Validation monitoring at NCA C/D	Construction on Hume St (not related

DATE & TIME	NCA	LOCATION/ ADDRESS	RECEIVER	DOMINANT ACTIVITY	PREDICTED LEVEL (AT FAÇADE) (DBA)	MEASURED LEVEL (DBA)	COMPLIANT (Y/N)	REASON	COMMENT
									to A W Edwards work) dominant, passing cars, construction on site only sometimes audible
16/06/2021 3:10 PM	E	473 Pacific Highway	Residential	Below ground structure	73	78	Y	Validation monitoring at NCA E Tower crane operation	Construction inaudible, traffic dominant noise, fire engine with siren passed by noise monitor and passing cars beeping all along Pac Highway
16/06/2021 7:45 PM	C	22-26 Clarke Street	Residential	OOHW 10	75	58	Y	Evening validation monitoring for OOH 10 Steel Fixing	Traffic dominant, construction only occasionally audible
22/06/2021 3:15 PM	A	420 Pacific Hwy	Residential	Below ground structure	65	77	Y	Crane lifting, Steel Fixing, Waterproofing	Traffic noise dominant, crane noise occasionally audible. Ambulance siren passed nearby monitor. Concrete agitator (not project related) idling on Pacific Highway.
24/06/2021 10:10 PM	E	473 Pacific Highway	Residential	OSOM Delivery	68	64	Y	Verification of OOH Work	Traffic dominant noise.

DATE & TIME	NCA	LOCATION/ ADDRESS	RECEIVER	DOMINANT ACTIVITY	PREDICTED LEVEL (AT FAÇADE) (DBA)	MEASURED LEVEL (DBA)	COMPLIANT (Y/N)	REASON	COMMENT
03/08/2021 1:45 PM	C/D	Clarke Street/ Hume Street Intersection	Commercial	Below ground structure	71	65	Y	Verification of NCA Tower Crane Operation & Waterproofing	Unrelated council work occurring on Hume Street. Traffic noise dominant.
03/08/2021 2:10 PM	B	454-456 Pacific Highway	Commercial	Below ground structure	60	72	Y	Verification of NCA Tower Crane Operation & Waterproofing	Pacific Highway dominant. Tower Crane audible during dip in traffic. Truck beeping (unrelated to CN ISD) while passing monitor.
03/08/2021 2:30 PM	A	388 Pacific Highway	Commercial	Below ground structure	68	74	Y	Verification of NCA Crane Lift, Deliveries via Pacific Hwy and Hoist Operation	Pacific Highway traffic dominant. Tower Crane prominent when traffic reduces.
03/08/2021 2:55 PM	E	473-475 Pacific Highway	Residential	Below ground structure	73	72	Y	Verification of NCA Tower Crane Operation & Waterproofing	Pacific Highway traffic dominant. Construction is not audible.
18/08/2021 2:45 PM	E	473-475 Pacific Highway	Residential	Below ground structure	73	73	Y	Verification of NCA Crane lifting. Waterproofing. Steel fixing	Traffic on Pacific Hwy dominant. Site work is not audible.
18/08/2021 2:25 PM	A	388 Pacific Highway	Commercial	Below ground structure	68	75	Y	Verification of NCA Crane lifting. Waterproofing. Steel fixing	Pacific Hwy noise dominant. Tower crane is audible during dip in traffic.

DATE & TIME	NCA	LOCATION/ ADDRESS	RECEIVER	DOMINANT ACTIVITY	PREDICTED LEVEL (AT FAÇADE) (DBA)	MEASURED LEVEL (DBA)	COMPLIANT (Y/N)	REASON	COMMENT
18/08/2021 2:05 PM	B	454-456 Pacific Highway	Commercial	Below ground structure	60	75	Y	Verification of NCA Crane lifting. Saw cutting. Waterproofing.	Pacific Hwy noise dominant. Saw cutting occasionally audible during dip in traffic. Police siren passed near monitor during recording.
18/08/2021 11:00 AM	C/D	Clarke Street/ Hume Street Intersection	Commercial	Below ground structure	71	62	Y	Verification of NCA Crane lifting. Waterproofing. Steel fixing.	Traffic on Clarke Street dominant. Hum from tower crane audible.
2/09/2021 10:40 PM	A	420 Pacific Highway	Residential	OOH pre-cast girder delivery	69	66	Y	Verification of pre-cast girder delivery.	Pacific Hwy dominant. No construction taking place.
3/09/2021 12:30 AM	A	420 Pacific Highway	Residential	OOH pre-cast girder delivery	69	67	Y	Girder delivery and tower crane lift.	Tower crane clearly audible. Regular passing vehicles on Pacific Hwy. Chain dropped at 00:35. Loud placing of tools on water filled barrier. Clattering noise when truck brace removed.
3/09/2021 12:45 AM	A	420 Pacific Highway	Residential	OOH pre-cast girder delivery	69	65	Y	Girder lift.	Crane idling audible. Regular passing vehicles on Pac Hwy. Boom moving into place and being rigged throughout the duration of this measurement.

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DATE & TIME	NCA	LOCATION/ ADDRESS	RECEIVER	DOMINANT ACTIVITY	PREDICTED LEVEL (AT FAÇADE) (DBA)	MEASURED LEVEL (DBA)	COMPLIANT (Y/N)	REASON	COMMENT
3/09/2021 1:20 AM	A	420 Pacific Highway	Residential	OOH pre-cast girder delivery	69	71	Y	Measured level within 3 dB of the predicted level.	Crane lift dominant. Pedestrians talking loudly near noise meter. Hoist operation during tower crane lift is not audible. Infrequent passing cars and bus. 2nd girder arrived halfway through measurement. Revving of crane engine during initial lift.
9/09/202 10:05 PM	A	420 Pacific Highway	Residential	OOHW 10 Night	64	67	Y	Traffic noise dominant.	Linewide working too. Pacific Hwy traffic dominant. Hoist audible during dip in traffic, site activities faintly audible.
9/09/2021 10:25 PM	E	473-475 Pacific Highway	Residential	OOHW 10 Night	75	66	Y	Traffic noise dominant.	Linewide working too. Pacific Hwy traffic dominant. Metallic clang heard faintly during dip in traffic.
9/09/2021 10:45 PM	B	454-456 Pacific Highway	Commercial	OOHW 10 Night	61	66	Y	Traffic noise dominant and site activities are not audible.	Linewide working too. Pacific Hwy traffic dominant. Site activities are not audible. Humming noise from 563 Pacific Hwy for duration of measurement.
16/09/2021 9:45 PM	A	420 Pacific Highway	Residential	OOHW 10 Evening	80	73	Y	Verification of NCA.	Pacific Hwy noise dominant. Tower crane audible only during infrequent dips in traffic. Steel fixing works inaudible.

DATE & TIME	NCA	LOCATION/ ADDRESS	RECEIVER	DOMINANT ACTIVITY	PREDICTED LEVEL (AT FAÇADE) (DBA)	MEASURED LEVEL (DBA)	COMPLIANT (Y/N)	REASON	COMMENT
16/09/2021 10:05 PM	A	420 Pacific Highway	Residential	OOHW Night	64	69	Y	Traffic noise dominant.	Traffic noise on Pacific Highway dominant. Steel fixing inaudible. Hoist audible once during dip in traffic.
16/09/2021 10:25 PM	E	473-475 Pacific Highway	Residential	OOHW 10 Night	75	68	Y	Traffic noise dominant.	Pacific Highway dominant noise. Site activities not audible. Noise levels representative of traffic noise during this period.
16/09/2021 10:45 PM	B	454-456 Pacific Highway	Commercial	OOHW 10 Night	61	68	Y	Traffic noise dominant and site activities are not audible.	Pacific Hwy dominant. No noise audible from site. Construction activities ceased prior to monitoring period. Noise levels representative of Pac Highway noise during this period.
20/09/2021 9:45 PM	A	420 Pacific Highway	Residential	OOHW 10 Evening	80	67	Y	Traffic noise dominant.	Traffic highway noise dominant. Steel fixing and hoist operation inaudible during measurement due to traffic noise.
20/09/2021 10:05 PM	A	420 Pacific Highway	Residential	OOHW Night	64	68	Y	Traffic noise dominant.	Pacific Hwy traffic noise dominant. Steel fixing inaudible during period due to traffic noise.
20/09/2021 10:21 PM	B	454-456 Pacific Highway	Commercial	OOHW 10 Night	61	67	Y	Traffic noise dominant and site activities are not audible.	Pacific Highway traffic noise dominant. Steel fixing inaudible. Humming noise from 545 Pacific

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DATE & TIME	NCA	LOCATION/ ADDRESS	RECEIVER	DOMINANT ACTIVITY	PREDICTED LEVEL (AT FAÇADE) (DBA)	MEASURED LEVEL (DBA)	COMPLIANT (Y/N)	REASON	COMMENT
									Highway throughout duration of measurement.
23/09/2021 9:30 PM	A	420 Pacific Highway	Residential	OOHW 10 Evening	80	68	Y	Traffic noise dominant.	Pacific Hwy noise dominant. Hoist audible during low traffic periods. Steel fixing works inaudible. Crane operation audible during last 2 minutes of monitoring period.
23/09/2021 9:50 PM	C	22-26 Clarke Street (street level)	Residential	OOHW 10 Evening	71	68	Y	Traffic noise dominant.	Steel work audible during recording. Crane operational for duration of monitoring period.
23/09/2021 10:15 PM	B	454-456 Pacific Highway	Commercial	OOHW 10 Night	61	67	Y	Traffic noise dominant.	Works in station box inaudible. TC2 operating in preparation for girder delivery. TC2 slightly perceptible during dip in traffic. Pacific Hwy noise dominant.
23/09/2021 10:30 PM	A	420 Pacific Highway	Residential	OOH pre-cast girder delivery	69	68	Y	Traffic noise dominant.	Pacific Hwy noise dominant. Crane audible but not dominant noise. Steel fixing inaudible due to traffic noise. Crane positioning for upcoming girder delivery and under load for duration of measurement. Noise level at monitoring location did not change

DATE & TIME	NCA	LOCATION/ ADDRESS	RECEIVER	DOMINANT ACTIVITY	PREDICTED LEVEL (AT FAÇADE) (DBA)	MEASURED LEVEL (DBA)	COMPLIANT (Y/N)	REASON	COMMENT
									from when crane was not operating.
23/09/2021 11:00 PM	A	420 Pacific Highway	Residential	OOH pre-cast girder delivery	69	67	Y	Traffic noise dominant.	Traffic noise on Pac Hwy. Tower crane idling in position while spreader bar rigged to girder.
23/09/2021 11:30 PM	A	420 Pacific Highway	Residential	OOH pre-cast girder delivery	69	68	Y	Crane noise on a par with traffic noise.	Jinker engine noise audible but only operated for 1 minute. Regular passing vehicles on Pac Hwy. Crane noise is audible as a hum throughout period.

6.7.2 Attended ground-borne noise and vibration monitoring

Attended vibration monitoring was undertaken within an IVF clinic located in the basement level of 28-34 Clarke Street on 22 April 2021. The IVF clinic was a new tenant in the building that was commencing operations in end-May, after detailed excavation activities would be completed.

Measurements were taken at three locations within the clinic using a Brüel & Kjær 2250 sound level meter (serial number 3001238) with a Wilcoxon 731A accelerometer (serial number 971). Results from the monitoring demonstrates that, while works in the station box were being undertaken, vibration levels did not exceed 8 µm/s, which is below the screening criterion of 25 µm/s (VC-B criterion) for eye surgery procedures and 100 µm/s for other surgery procedures.

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

A W Edwards followed-up with the IVF clinic in June 2021 and offered another round of attended vibration monitoring, which was accepted but as no vibration generating equipment was being used at the time or in the near-future, the offer was left open.

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. 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 the Site A and approximately 34 m from the engine of the nearest tower crane. This location serves as a reference point for the project. During detailed excavation the dominant and controlling noise was generated by the excavators with hammer attachments located at the bottom of the station excavation. Detailed excavation was completed in mid-May 2021. Thereafter the tower crane became the dominant and controlling noise source associated with construction.

Based on data collected from the real-time noise monitor (refer Figure 5), mid-April saw a peak in noise levels during a peak in detailed excavation. Noise from constructing the below ground structure has been relatively consistent, with noticeably lower levels being recorded during the construction shutdown in July and re-commencement of works in August.

To comply with the construction noise criteria, the project must not exceed more than 26 monitoring periods 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.

Table 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 most monitoring periods during the reporting period, with a peak in April above 60 dBA (internally). The 15 monitoring periods in April that peaked above 60 dBA occurred over 4 working days and there was no exceedance of the noise criteria.

Table 6 Monthly summary of monitoring periods per noise monitoring criteria

MONTH	NO. OF 15-MIN PERIODS ABOVE 60 DB(A)	NO. OF 15-MIN PERIODS BELOW 55 DB(A)
Feb	0	129
Mar	0	1354
Apr	15	1278
May	1	1363
Jun	0	1319
Jul	0	1364
Aug	0	1364
Sep	0	1102

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 for the full duration of the reporting period. There have been no exceedances of the vibration monitoring criteria; there were however two instances where vibrations levels were noticeably elevated above the typical average (refer Figure 6). In the first instance, 7 May 2021, a team member was inspecting the area where the vibration monitor is located resulting in an above average reading. In the second instance, 5 August 2021, the battery for the vibration meter was changed and validation testing was necessary.

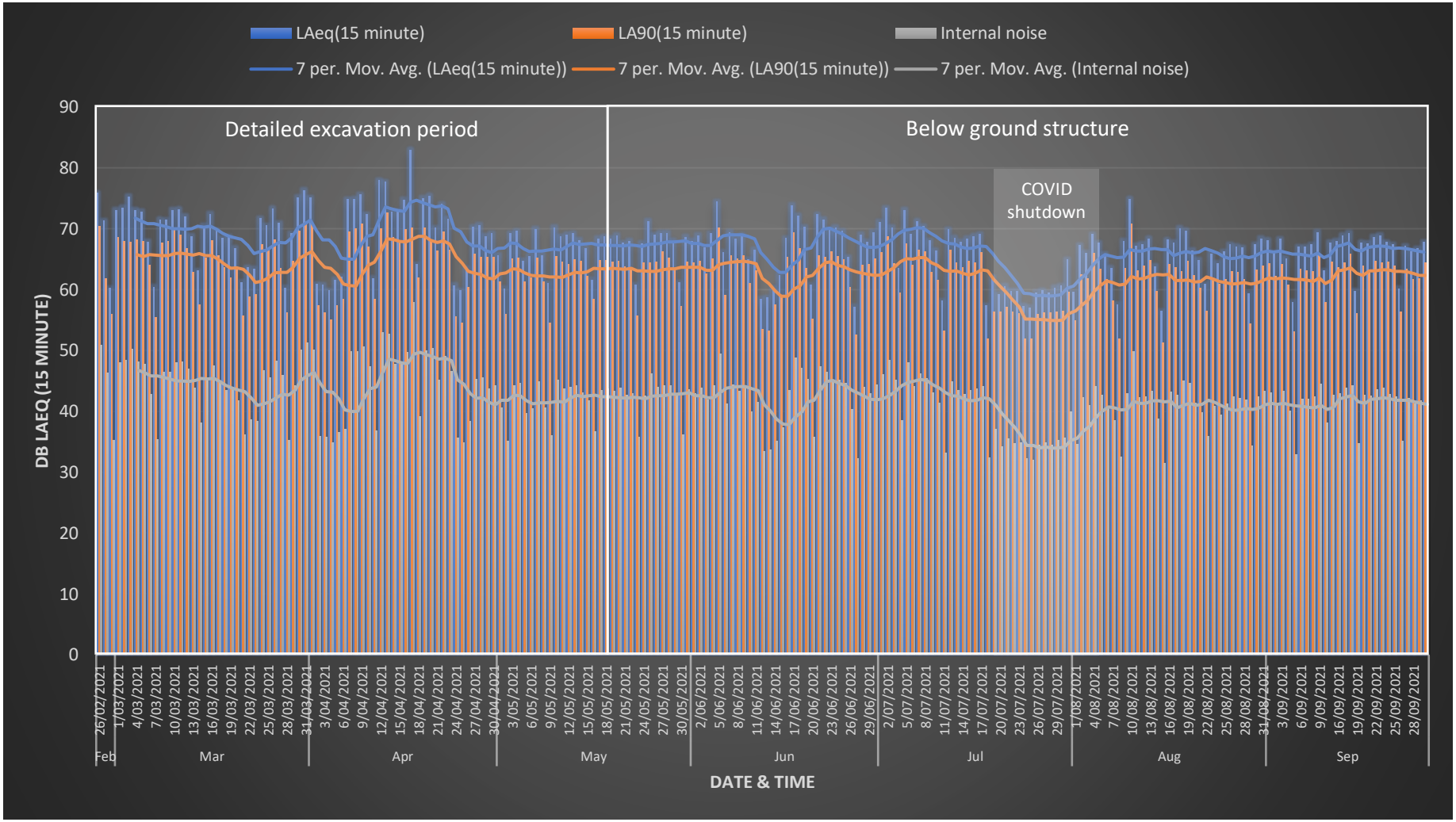


Figure 5 Real-time noise monitoring at 28 Clarke Street between 7am and 8pm

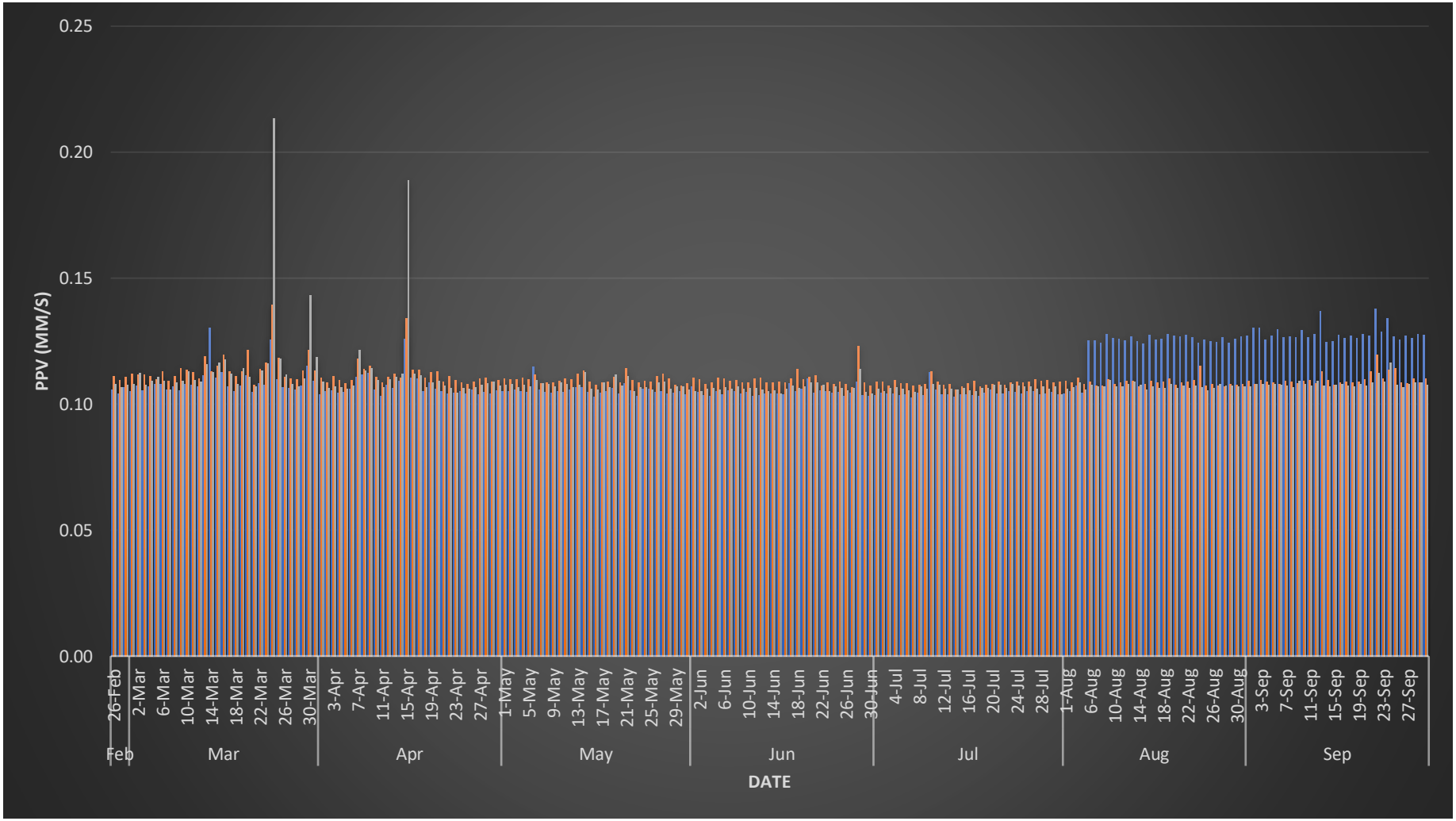


Figure 6 Maximum vibrations for real-time monitor at 28 Clarke Street

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.

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 retrieved on 25 May 2021 and a manual measurement of the water level taken to calibrate the logger data.

The measured depth to groundwater in the monitoring wells were:

- BH018 – 21.15m; and
- BH019 – 5.10m.

A review of groundwater levels during the period 1 January 2021 to 21 May 2021 indicates the following:

- Groundwater levels in BH018 are steadily rising;
- 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 2.

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
IVF CLINIC ATTENDED VIBRATION MEASUREMENTS

Wednesday, 19 May 2021

Project number: S200740
Reference: S200740LT2

Darren Green
Element Environment
PO Box 1563,
Warriewood NSW 2102

Dear Darren,

Sydney Metro Crows Nest Station Construction Noise and Vibration
Vibration Measurement Results Summary

1 Introduction

Resonate Consultants Pty Ltd (Resonate) was engaged to undertake floor vibration measurements within the IVF clinic located in the basement level of 28-34 Clarke Street, Crows Nest. The building is located directly adjacent to the Crows Nest Station site. It is understood that the IVF clinic is a new tenancy within the building that commenced operation subsequent to commencement of construction.

The vibration measurements were conducted in the absence of concrete sawing and rock hammering activities. It is understood that these activities would generally not be required from when the IVF clinic commences operations.

The report presents the methodology and results for the vibration survey.

2 Generic Vibration Criteria

A number of general vibration criteria have been developed over the years for sensitive equipment. The vibration criteria developed by Colin Gordon and Associates is one of the most commonly used classes of vibration criteria for sensitive equipment.

The VC criteria are defined as velocity spectra in one-third octave frequency bands, arriving at a 'curve' of allowable levels for each one-third octave band. VC criteria are described as curves, named alphabetically and sequentially from VC-A to VC-G in order of increasing sensitivity.

Applications of the generic criteria (as derived from Colin Gordon and Associates[1]) to different spaces are outlined in Figure 1.

[1] Amick, Hal & Gendreau, Michael & Busch, Todd & Gordon, Colin. (2005). Evolving criteria for research facilities: vibration. 10.1117/12.617970.

Criterion Curve	Amplitude[1] μm/s (μin/s)	Detail size[2] μm	Description of use
Workshop (ISO)	800 (32 000)	N/A	Distinctly perceptible vibration. Appropriate to workshops and nonsensitive areas.
Office (ISO)	400 (16 000)	N/A	Perceptible vibration. Appropriate to offices and nonsensitive areas.
Residential day (ISO)	200 (8 000)	75	Barely perceptible vibration. Appropriate to sleep areas in most instances. Usually adequate for computer equipment, hospital recovery rooms, semiconductor probe test equipment, and microscopes less than 40x.
Operating theatre (ISO)	100 (4 000)	25	Vibration not perceptible. Suitable in most instances for surgical suites, microscopes to 100x and for other equipment of low sensitivity.
VC-A	50 (2 000)	8	Adequate in most instances for optical microscopes to 400x, microbalances, optical balances, proximity and projection aligners, etc.
VC-B	25 (1 000)	3	Appropriate for inspection and lithography equipment (including steppers) to 3 μm line widths.
VC-C	12.5 (500)	1 – 3	Appropriate standard for optical microscopes to 1000x, lithography and inspection equipment (including moderately sensitive electron microscopes) to 1 μm detail size, TFT-LCD stepper/scanner processes.
VC-D	6.25 (250)	0.1 – 0.3	Suitable in most instances for demanding equipment, including many electron microscopes (SEMs and TEMs) and E-Beam systems.
VC-E	3.12 (125)	< 0.1	A challenging criterion to achieve. Assumed to be adequate for the most demanding of sensitive systems including long path, laser-based, small target systems, E-Beam lithography systems working at nanometer scales, and other systems requiring extraordinary dynamic stability.
VC-F	1.56 (62.5)	N/A	Appropriate for extremely quiet research spaces; generally difficult to achieve in most instances, especially cleanrooms. Not recommended for use as a design criterion, only for evaluation.
VC-G	0.78 (31.3)	N/A	Appropriate for extremely quiet research spaces; generally difficult to achieve in most instances, especially cleanrooms. Not recommended for use as a design criterion, only for evaluation.

[1]As measured in one-third octave bands of frequency over the frequency range 8 to 80 Hz (VC-A and VC-B) or 1 to 80 Hz (VC-C through VC-G).

[2]The detail size refers to line width in the case of microelectronics fabrication, the particle (cell) size in the case of medical and pharmaceutical research, etc. It is not relevant to imaging associated with probe technologies, AFMs, and nanotechnology.

The information given in this table is for guidance only. In most instances, it is recommended that the advice of someone knowledgeable about applications and vibration requirements of the equipment and processes be sought.

Figure 1 Application and interpretation of the generic vibration criterion (VC) curves

The planning approval and Construction Noise and Vibration Management Plan (CNVMP) for the site identified a number of sensitive medical usages adjacent to the site. These included the Crows Nest Day Surgery (22 Clarke Street), which is used for dental and eye surgery. A draft property assessment commissioned by Transport for NSW adopted a screening criterion of 25 μm/s (VC-B criterion) for eye surgery procedures and 100 μm/s for other surgery procedures.

A specific vibration criterion has not been established for the IVF clinic, however as a benchmark, the measured vibration levels will be compared to the aforementioned requirements.

3 Vibration measurement results

3.1 Measurement locations

Resonate attended site on 22 April 2021 to conduct attended vibration measurements. Measurements were conducted at three locations within the IVF clinic as shown in Figure 2 and described below.

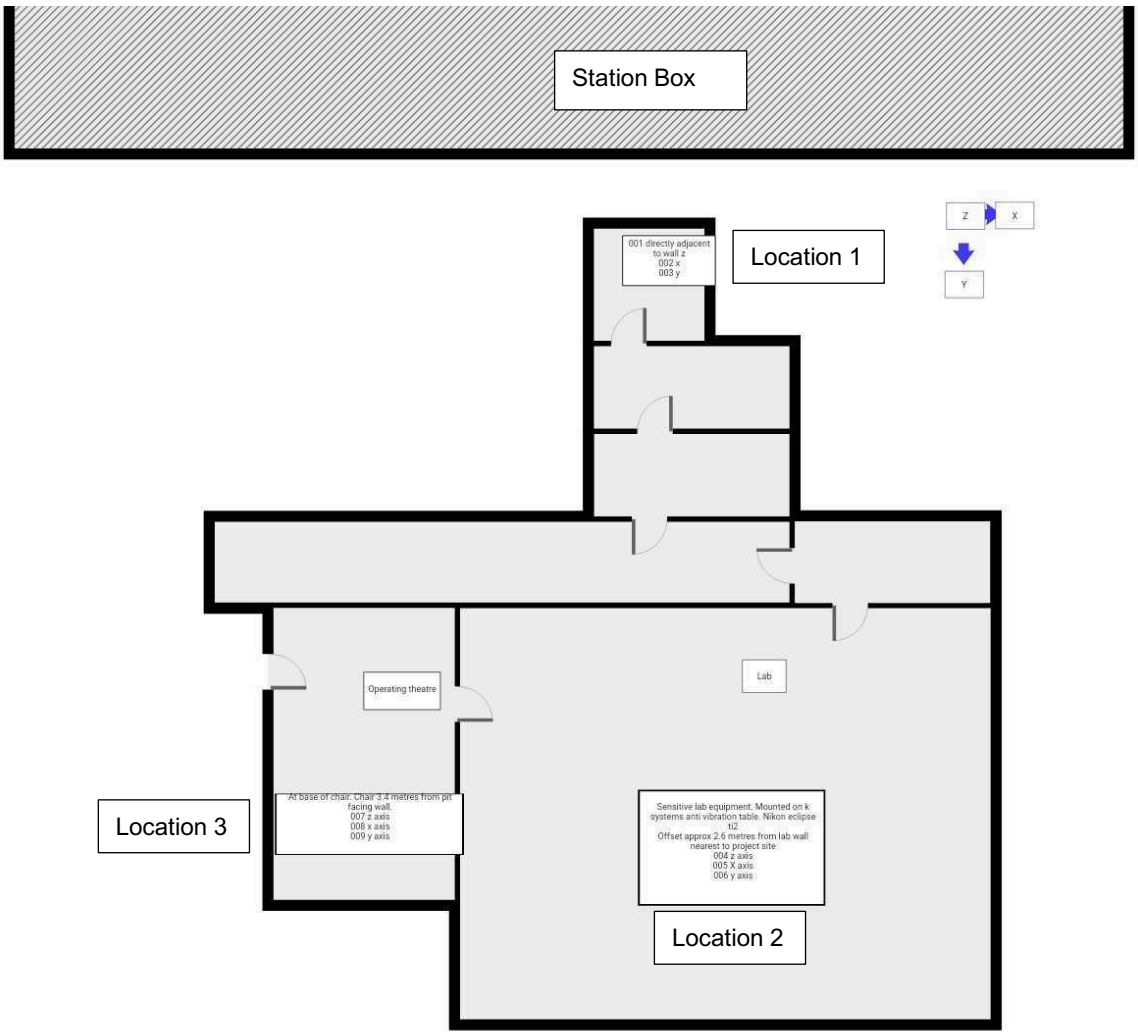


Figure 2 Measurement Locations

The measurement locations are described as follows:

- Location 1: Room in closest proximity to the station box.
- Location 2: Laboratory space that included a microscope on a vibration isolation table.
- Location 3: Operating theatre.

3.2 Instrumentation

Vibration measurements were conducted using a Brüel & Kjær 2250 sound level meter (serial number 3001238) with a Wilcoxon 731A accelerometer (serial number 971). The instrumentation carries current calibration certification from a NATA accredited laboratory.

3.3 Procedure

Vibration measurements were undertaken in accordance with the following:

- The accelerometer was affixed to a mounting block in three orthogonal directions.
  - Z – Vertical.
  - X – Transverse.
  - Y – Lateral
- The mounting block was attached to the floor with beeswax. Vibration levels in the vertical direction were measured.
- The measurement results are presented as maximum, one third octave vibration velocity spectra with a one second time constant.

3.4 Results

Figure 3 presents the maximum ambient vibration levels measured during the survey. The VC-B, VC-C and VC-D vibration criteria are overlaid on Figure 3 for reference.

It was observed that vibration levels did not exceed 8 μm/s during the survey.

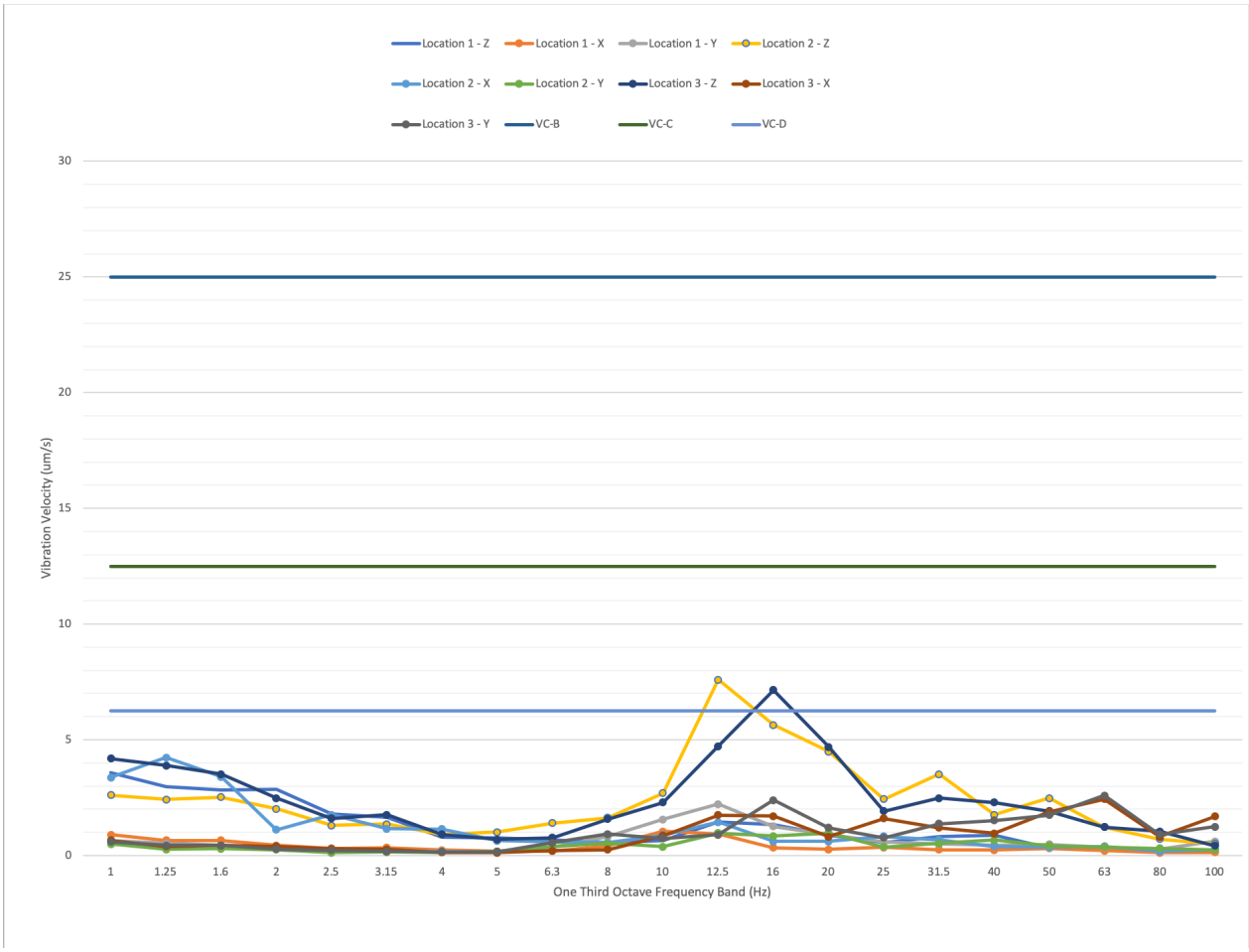


Figure 3 Graph of vibration velocity vs frequency

3.5 Discussion

The following observations can be made with respect to the generic vibration design targets provided in Section 2.

- The maximum one second one-third octave band vibration level in the absence of concrete sawing, rock hammering and walkers was approximately 7.5 μm/s RMS. This level is less than VC-C criterion.
- The maximum one second one-third octave band vibration levels during the survey were less than the established criterion of VC-B for the Crows Nest Day Surgery by way of comparison.

Please let me know if you have any queries or wish to discuss the above.

Yours sincerely,

Andrew Parker
Technical Director
+61 2 8355 4888
+61 432 602 803
andrew.parker@resonate-consultants.com

APPENDIX 2
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	Darragh O'Brien	dobrien@awedwards.com.au	
		Cameron Edwards	cedwards@awedwards.com.au	
From	Nick Burrows		**Date**	07 Jun 2021
Subject	Groundwater Monitoring 25 May 2021 Crows Nest Station		**Project No.** **Doc. No.**	200412.00 R.011

This memorandum presents the results of long-term groundwater monitoring within standpipe piezometers SRT-BH018 and SRT-BH019 at Crow 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 locations of these boreholes are shown on the attached plans and groundwater well logs for each well are also attached.

The data loggers were retrieved on 25 May 2021 and a manual measurement of the water level taken to calibrate the logger data. A summary of the wells and manual readings are presented in Table 1.

Table 1: Summary of Manually Measured Groundwater in SRT-BH018 and SRT-BH019

Borehole (Well)	Surface RL (m, AHD)	Well Depth (m)	Measured Depth (m) and RL (m, AHD) to Groundwater in Monitoring Well
			25 May 2021
SRT-BH018	90.75	25.3	21.15 (RL69.35)
SRT-BH019	84.43	7.2	5.10 (RL.79.33)

The groundwater measurements obtained from the dataloggers within the reporting period specified by AW Edwards (1 January 2021 to 25 May 2021) 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 25 May 2021, http://www.bom.gov.au).

Douglas Partners Pty Ltd

for **Nick Burrows**
Engineering Geologist

Reviewed by

Scott Easton
Principal

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

This report is the property of Douglas Partners Pty Ltd. The report may only be used for the purpose for which it was commissioned and in accordance with the Conditions of Engagement for the commission supplied at the time of proposal. Unauthorised use of this report in any form whatsoever is prohibited.

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.

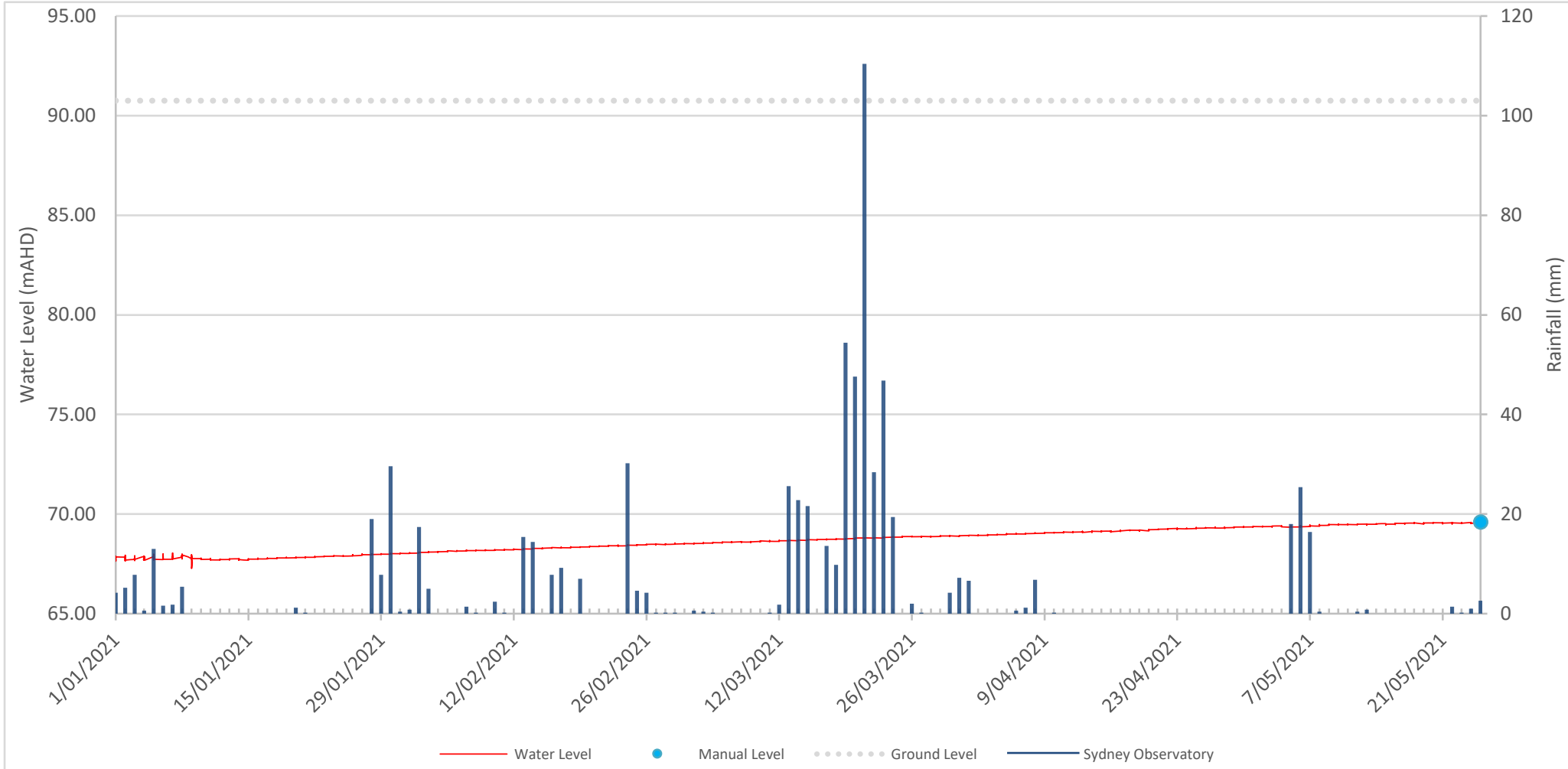
Information for Contractual Purposes

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.

Monitoring Well: SRT-BH018 (Hume Street)

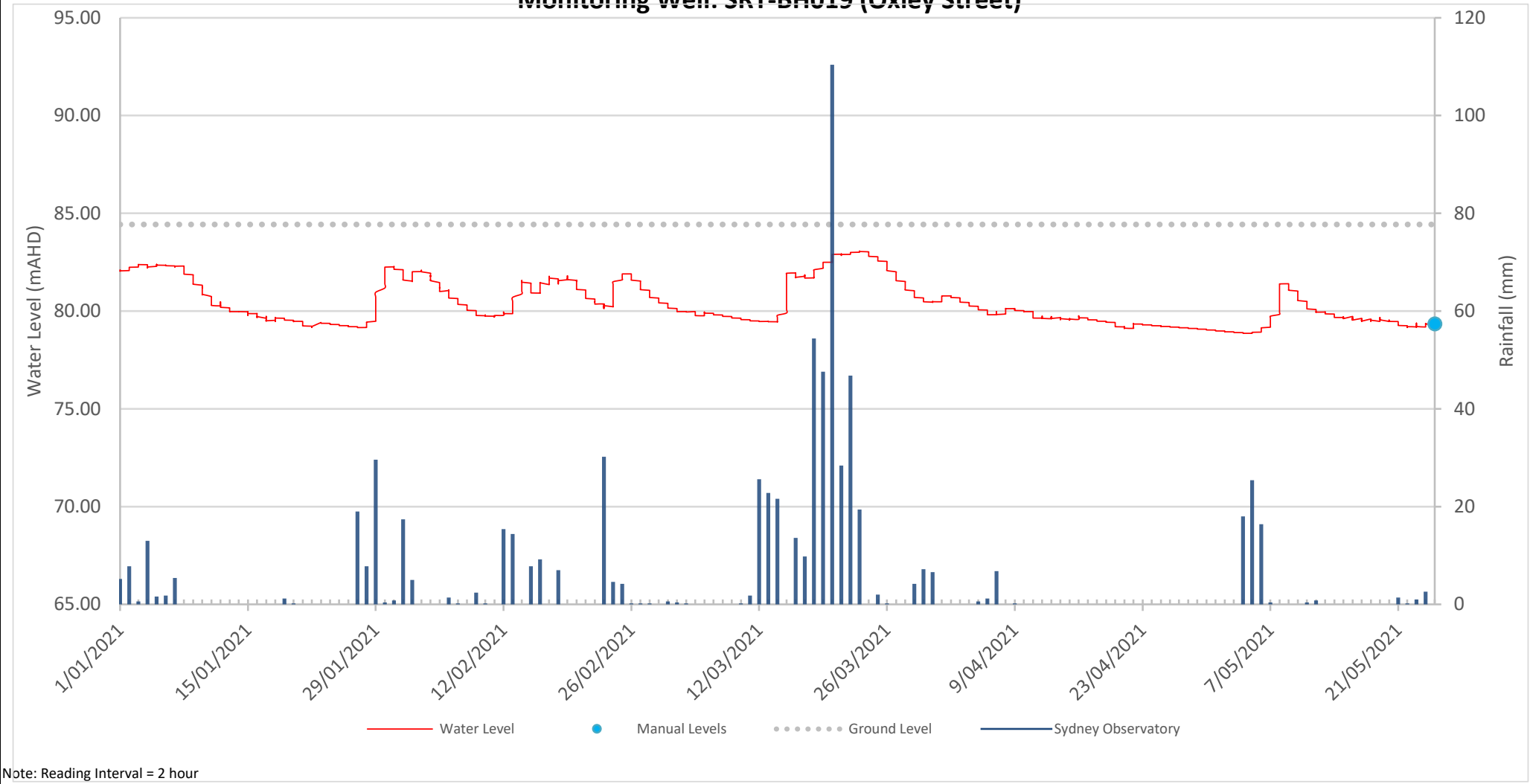


Note: Reading Interval = 2 hour

Douglas Partners
Geotechnics / Environment / Groundwater

From	Drawn:
1/01/2021	NB
To	**Date:**
25/05/2021	4/06/2021

Monitoring Well: SRT-BH019 (Oxley Street)



Note: Reading Interval = 2 hour

Douglas Partners
Geotechnics / Environment / Groundwater

From	Drawn:
1/01/2021	NB
To	**Date:**
25/05/2021	4/06/2021

Path: J:\geo\2014\1418746 SRT\GIS\1418746-001-F-Rev1-F003-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

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM A3

STANDPIPE INSTALLATION: SRT BH018

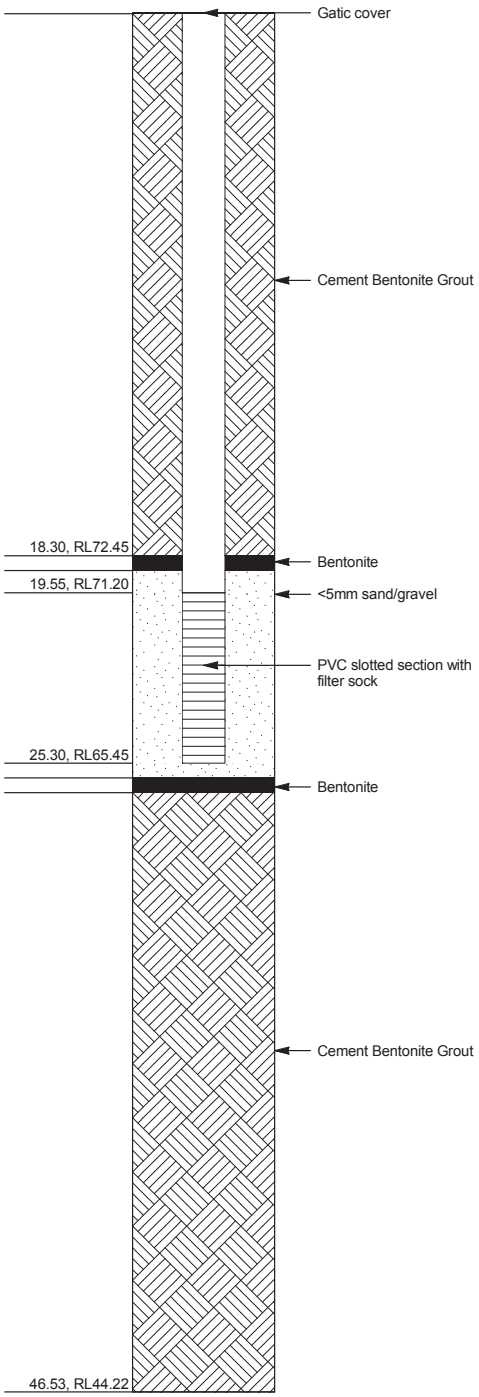
SHEET: 1 OF 1 REV: D

CLIENT: Transport for New South Wales
PROJECT: SRT Geotechnical Investigation Services
LOCATION: Hume St, Crows Nest
PROJECT No PSC No.00013/10464

COORDS: 333390.0 m E 6255706.0 m N MGA94 56
SURFACE RL: 90.75 m DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 46.53 m

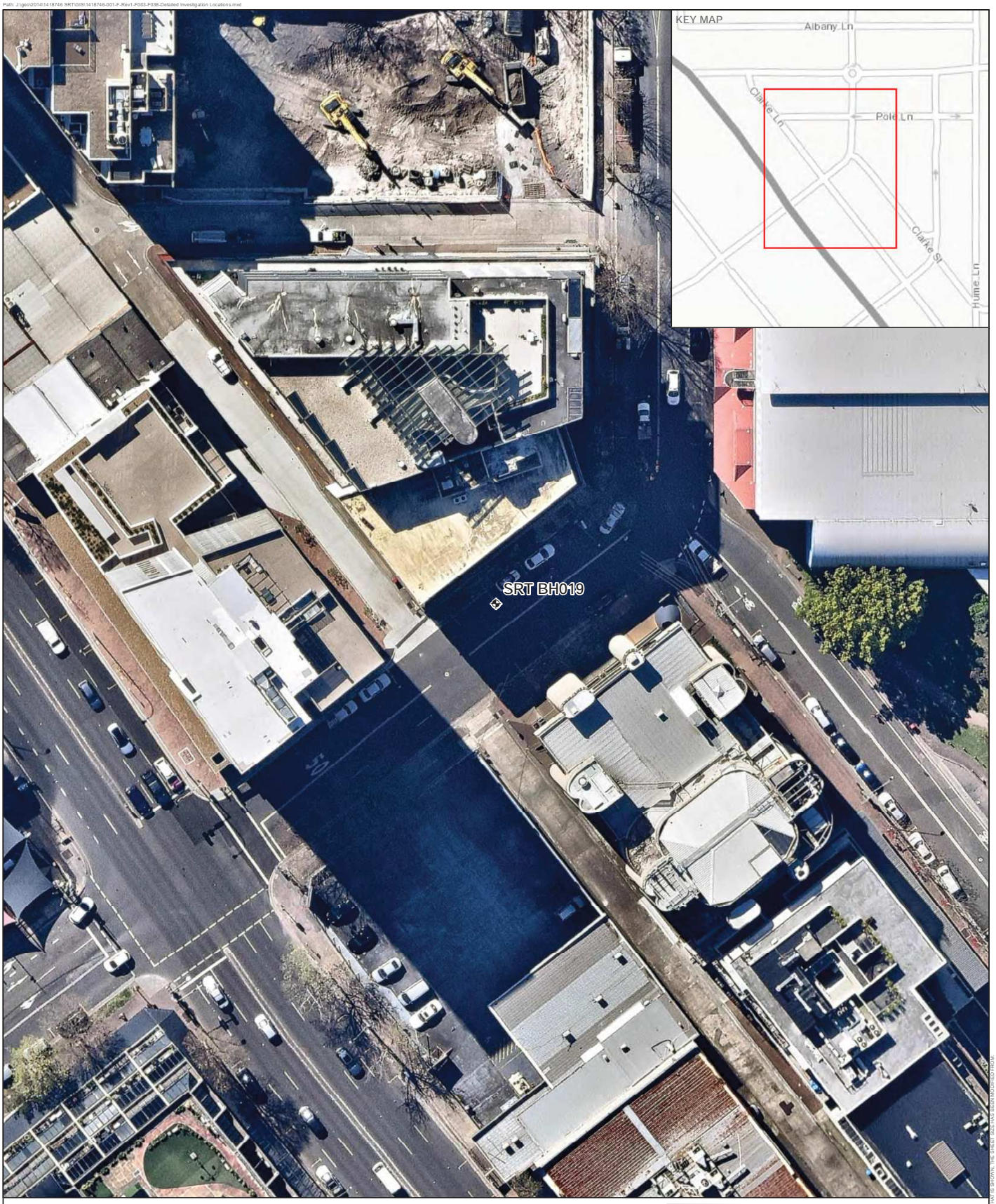
DRILL RIG: Scout 4
CONTRACTOR: Ground Test
LOGGED: AMS START: 24/4/15
CHECKED: DF/JCB FINISH: 30/4/15

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	
			1.20			
ADT			*2.10*		CLAYEY GRAVEL	
			88.65		SILTY CLAY	
			4.00			
			86.75		SILTSTONE	
		5				
		10				
			11.25			
			79.50		SANDSTONE	
		15				
			17.71			
			73.04		LAMINITE	
		20	*20.55*			
			70.20		SANDSTONE	
HQ3		25				
		30				
		35				
		40	*41.10*			
			49.65		LAMINITE	
		45	*45.77*			
			46.53		SANDSTONE	
			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.

Path: J:\geo\2014\1418746 SRT\GIS\1418746-001-F-Rev1-F003-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

0 20mm

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM

STANDPIPE INSTALLATION: SRT BH019

		SHEET: 1 OF 1	REV: D
CLIENT: Transport for New South Wales	COORDS: 333308.0 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, 10.00am					2.80, RL81.63
HQ3	24/04/15, 3.00pm					Bentonite
						3.75, RL80.68
						4.25, RL80.18
		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	
			18.04			
			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

APPENDIX 3
CALIBRATION CERTIFICATES

Resonate systems
Level 1, 23 Peel Street, ADELAIDE SA 5000, Australia
Tel: +61 8 7200 5700

CERTIFICATE

Model: AvaTrace M80

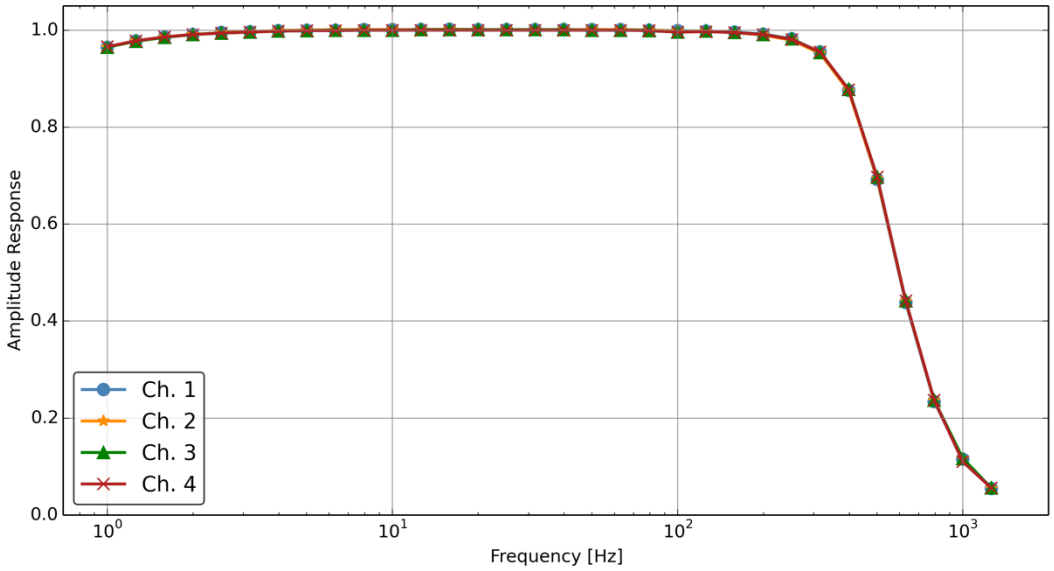
Serial Number: 4470

Calibration Certificate: AvaTrace Certificate of Calibration **Ref. #** 648

Calibration Date: 18/09/2020

Calibration Equipment: NI USB-6289 (SN: 1A04689)

Calibration Result: All channels passed on all frequencies (see graph and table below for detail)



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.

Calibration performed by Peter Hüttenmeister

Certificate prepared by Peter Hüttenmeister

© 2019 Resonate Systems

Resonate systems

CERTIFICATE

	Freq (Hz)	Amplitude	V1	Pass/Fail	V2	Pass/Fail	V3	Pass/Fail	V4	Pass/Fail
0	1.0	3.0	0.965	PASS	0.965	PASS	0.965	PASS	0.966	PASS
1	1.259	3.0	0.978	PASS	0.978	PASS	0.977	PASS	0.978	PASS
2	1.585	3.0	0.986	PASS	0.986	PASS	0.985	PASS	0.986	PASS
3	1.995	3.0	0.991	PASS	0.991	PASS	0.991	PASS	0.991	PASS
4	2.512	3.0	0.995	PASS	0.995	PASS	0.994	PASS	0.994	PASS
5	3.162	3.0	0.997	PASS	0.997	PASS	0.996	PASS	0.996	PASS
6	3.981	3.0	0.999	PASS	0.999	PASS	0.998	PASS	0.998	PASS
7	5.012	3.0	1.0	PASS	1.0	PASS	0.999	PASS	0.999	PASS
8	6.31	3.0	1.0	PASS	1.001	PASS	1.0	PASS	0.999	PASS
9	7.943	3.0	1.001	PASS	1.001	PASS	1.0	PASS	1.0	PASS
10	10.0	3.0	1.001	PASS	1.001	PASS	1.0	PASS	1.0	PASS
11	12.589	3.0	1.001	PASS	1.001	PASS	1.001	PASS	1.0	PASS
12	15.849	3.0	1.002	PASS	1.002	PASS	1.001	PASS	1.0	PASS
13	19.953	3.0	1.001	PASS	1.001	PASS	1.001	PASS	1.0	PASS
14	25.119	3.0	1.001	PASS	1.001	PASS	1.001	PASS	1.0	PASS
15	31.623	3.0	1.001	PASS	1.001	PASS	1.001	PASS	1.0	PASS
16	39.811	3.0	1.001	PASS	1.001	PASS	1.001	PASS	1.0	PASS
17	50.119	3.0	1.001	PASS	1.001	PASS	1.0	PASS	1.0	PASS
18	63.096	3.0	1.001	PASS	1.001	PASS	1.0	PASS	1.0	PASS
19	79.433	3.0	1.0	PASS	1.0	PASS	1.0	PASS	0.999	PASS
20	79.433	2.0	1.0	PASS	1.0	PASS	1.0	PASS	0.999	PASS
21	79.433	2.5	1.0	PASS	1.0	PASS	0.999	PASS	0.999	PASS
22	100.0	3.0	0.999	PASS	0.998	PASS	0.996	PASS	0.996	PASS
23	125.893	3.0	0.998	PASS	0.998	PASS	0.998	PASS	0.997	PASS
24	158.489	3.0	0.996	PASS	0.995	PASS	0.995	PASS	0.995	PASS
25	199.526	3.0	0.992	PASS	0.99	PASS	0.991	PASS	0.991	PASS
26	251.189	3.0	0.982	PASS	0.979	PASS	0.982	PASS	0.981	PASS
27	316.228	3.0	0.955	PASS	0.952	PASS	0.954	PASS	0.955	PASS
28	398.107	3.0	0.876	PASS	0.874	PASS	0.878	PASS	0.877	PASS
29	501.187	3.0	0.692	PASS	0.694	PASS	0.697	PASS	0.697	PASS
30	630.957	3.0	0.438	PASS	0.441	PASS	0.442	PASS	0.442	PASS
31	794.328	3.0	0.234	PASS	0.236	PASS	0.237	PASS	0.237	PASS
32	1000.0	3.0	0.115	PASS	0.117	PASS	0.117	PASS	0.11	PASS
33	1258.925	3.0	0.055	PASS	0.055	PASS	0.056	PASS	0.056	PASS

© 2019 Resonate Systems

CERTIFICATE OF CALIBRATION

Certificate Number: 3014

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	Sinitus Systems	EM2010	00502	3014
Microphone:	PCB	377B02	179435	3014
Preamplifier	PCB	Included	00502	3014
Calibrator	None	-	-	-
Connecting Cable	None	-	-	-

Information:

Test Configuration:	Microphone on preamp
Instrument Manual:	Em2010 User Guide
Firmware Version:	0.0.13
Class of Instrument:	Class 1
Source of Correction Data:	Sonitus Systems

Environmental Conditions:	Pressure:	Temperature:	Relative Humidity:
Reference Conditions:	101.325 kPa	23.0 °C	50.0 % RH
Conditions Before Measurement:	101.33 kPa	22.6 °C	0 % RH
Conditions After Measurement:	101.31 kPa	22.3 °C	54.3 % 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: 09/01/20
Date of Issue: 09/01/20
Authorised Signatory:

Beau Weyers

Certificate Number: 3014

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 31.5Hz <= f < 2kHz
0.14 dB for 2kHz <= f < 8kHz
0.16 dB for 8kHz <= f < 12.6kHz
0.10 dB for 1kHz
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).

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.

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 20µPa. Other dB levels are relative values.

Version of Calibration Software Used: 6.1 TestS-(ANE 1.7)

Certificate Number: 3014

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**
Peak C Sound Level - IEC 61672-3 Ed.2.0 #19	**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: 3014

Results

Indication At The Calibration Check Frequency - IEC61672-3 Ed.2 #10

Reference Calibrator: WSC3 - B&K4226_1k_94dB
Reference calibrator level: 94.26
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	19.3	20.0	0.09	P	Microphone installed
A	18.5	22.0	0.09	P	Equivalent capacity
C	18.9	27.0	0.09	P	Equivalent capacity
Z	20.3	28.0	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

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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

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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

Peak C Sound Level - IEC 61672-3 Ed.2.0 #19

Pulse Type	Pulse Freq. (Hz)	Ref. RMS (dB)	Ref. Peak (dB)	Measured Value (dB)	Lim. (+/-dB)	Uncert. (dB)	Dev. (dB)	Result
1 cycle	8k	129.0	132.4	131.9	2.0	0.09	-0.5	P
Pos 1/2 cycle	500	132.0	134.4	134.2	1.0	0.09	-0.2	P
Neg 1/2 cycle	500	132.0	134.4	134.3	1.0	0.09	-0.1	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

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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

Certificate Number: 3014

DIN 45657 (2013): Statistical Distribution Test #5.2

Ln %	Ref. Value (dB)	Measured Value (dB)	Tolerance Norm (dB)	Result Value (dB)	
1%	119.4	119.4	0.5	0.0	P
5%	117.0	117.0	0.5	0.0	P
10%	114.0	114.0	0.5	0.0	P
50%	90.0	90.0	0.5	0.0	P
90%	66.0	66.0	0.5	0.0	P
95%	63.0	63.0	0.5	0.0	P
99%	60.6	60.6	0.5	0.0	P
LeqA	108.8	108.7	0.5	-0.1	P

Test Passed

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

Freq.	Calibrator Level	U	Measurements 1	2	3	Avg	SD	U
125Hz	94.24	0.07	93.90	93.80	93.80	93.83	0.06	0.10
1kHz	94.26	0.06	94.00	94.00	94.10	94.03	0.06	0.10
8kHz	94.24	0.09	85.50	85.50	85.60	85.53	0.06	0.10

Freq.		125Hz	1kHz	8kHz
	Avg. Value	93.83	94.03	85.53
SLM	Wgt. Corr	0.20	0.00	3.00
	U	0.10	0.10	0.10
Mic. Corr.	Level	0.00	0.10	3.20
	U	0.00	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	-0.24	-0.26	-0.24
	U	0.07	0.07	0.09
Total Corr.	Level	-0.04	-0.16	5.96
Results	Level	93.79	93.87	91.50
	Dev. Ref. 1kHz	-0.08	0.00	-2.37
	U	0.12	0.19	0.33
Tolerance		-1.0, 1.0	-0.7, 0.7	-2.5, 1.5
Pass		P	P	P

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Manufacturer Calibration Certificate

The sound level meter submitted for testing successfully completed the periodic tests of IEC 61672-3. All tests are traceable in accordance with ISO/IEC 17025.

This model of sound level meter submitted for periodic testing successfully completed the applicable pattern-evaluation tests given in IEC 61672-2. The pattern approval certificate is available at www.nti-audio.com/XL2.

Sound Level Meter

Manufacturer	NTi Audio		
Type	XL2-TA	S/N	A2A-18354-E0
Firmware	V4.21		
Reference Level Range	mid		
Microphone Model	M2230		
Preamplifier	MA220	S/N	9477
Microphone Capsule	MC230A	S/N	A19435
Performance class	Class 1		
Customer Inventory Nr.			

Customer

Date 01 December 2020

Certificate FL-20-103

Results **PASSED**
(for detailed report see next pages)

Operator

Markus Frick

Measurement equipment

Test System

Model	NTi Audio FX100, S/No. 11094
Last Calibration	16 July 2020
Cal Certificate	NTI Cal #3393
Next Calibration	16 July 2021

Reference Microphone

Model	MTG MV203 S/N #630, Mic Capsule MK221 S/No. #16502
Last Calibration	18 December 2019
Cal Certificate	METAS #259-18522
Next Calibration	17 December 2021

Sound Calibrator

Model	Norsonic 1251 S/No. #30930
Reference Level	114 dB
Calibration Frequency	1000 Hz
Last Calibration	06 December 2018
Cal Certificate	METAS #259-17305
Next Calibration	05 December 2020

Environmental conditions

Temperature	22.2 °C
Humidity	26 %
Pressure	964 hPa

Notes

- This calibration certificate documents the traceability to national standards, which realize the units of measurement according to the international Systems of Units (SI).
- The user is obliged to have the object recalibrated at appropriate intervals.
- This calibration certificate may not be reproduced other than in full except with the permission of the issuing laboratory. Calibration certificates without signature are not valid.
- All limits listed in this report are acceptance limits in accordance with IEC61672.
- The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k=2, providing a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with the regulations of the GUM.

NTi AUDIO

1. Indication at the calibration check frequency

The indication of the sound level meter at the calibration check frequency is checked by application of the sound calibrator and adjusted, if necessary, to indicate the required sound level for the environmental conditions under which the tests are performed. All levels in [dB].

Sensitivity before calibration	Sensitivity after calibration	Meas level	Limit -	Limit +	Uncert.	Status
43.2 mV/Pa	44.1 mV/Pa	114.2	113	115	0.2	Passed

2. Self-generated noise

2.1 Microphone cartridge installed

The self-generated noise is measured in the most-sensitive level range as a time-averaged sound pressure level with frequency-weighting A and an averaging time of 30 seconds. All levels in [dB].

Weighting	Meas level	Limit +	Uncert.	Status
A	15.6	18.0	0.1	Passed

2.2 Microphone cartridge replaced by the capsule replacement NTI-K65-15

The self-generated noise is measured in the most-sensitive level range as a time-averaged sound pressure level for all frequency-weightings and an averaging time of 30 seconds. All levels in [dB] referenced to S = 42 mV/Pa.

Weighting	Meas level	Limit +	Uncert.	Status
A	8.5	13.0	0.1	Passed
C	12.4	16.0	0.1	Passed
Z	18.6	24.0	0.1	Passed

3. Acoustic signal tests of a frequency weighting

The frequency weighting is tested for frequency-weighting A, using an acoustic test facility. The sound level meter is set to a fast time-weighted sound level in the reference level range. All levels in [dB].

Freq. [Hz]	Gen. level	Meas level	Dev	Limit -	Limit +	Uncert.	Status
125	70.0	70.7	0.7	-1.0	1.0	0.4	Passed
250	77.1	77.1	0.0	-1.0	1.0	0.4	Passed
500	82.7	82.9	0.2	-1.0	1.0	0.4	Passed
1000	86.0	86.2	0.2	-0.7	0.7	0.4	Passed
2000	87.2	87.6	0.4	-1.0	1.0	0.4	Passed
4000	87.0	87.3	0.3	-1.0	1.0	0.4	Passed
8000	84.8	85.7	0.9	-2.5	1.5	0.4	Passed

NTi AUDIO

4. Electric signal tests of frequency weightings

Frequency weightings are determined relative to the response at 1 kHz using steady sinusoidal electrical input signals. The sound level meter is set to display F-time-weighted sound level in the reference level range. All available frequency weightings provided in the sound level meter are verified. All levels in [dB].

4.1 A-Weighting

Freq. [Hz]	Gen. level	Meas level	Dev	Limit -	Limit +	Uncert.	Status
1000	80.0	80.1	0.1	-0.7	0.7	0.1	Passed
63	106.2	80.0	0.0	-1.0	1.0	0.1	Passed
125	96.1	79.9	-0.1	-1.0	1.0	0.1	Passed
250	88.6	80.0	0.0	-1.0	1.0	0.1	Passed
500	83.2	80.0	0.0	-1.0	1.0	0.1	Passed
2000	78.8	80.1	0.1	-1.0	1.0	0.1	Passed
4000	79.0	80.0	0.0	-1.0	1.0	0.1	Passed
8000	81.1	80.0	0.0	-2.5	1.5	0.1	Passed
12500	84.3	80.0	0.0	-2.5	1.5	0.1	Passed
16000	86.6	79.9	-0.1	-2.5	1.5	0.1	Passed

4.2 C-Weighting

Freq. [Hz]	Gen. level	Meas level	Dev	Limit -	Limit +	Uncert.	Status
1000	80.0	80.0	0.0	-0.7	0.7	0.1	Passed
63	80.8	80.0	0.0	-1.0	1.0	0.1	Passed
125	80.2	80.1	0.1	-1.0	1.0	0.1	Passed
250	80.0	80.0	0.0	-1.0	1.0	0.1	Passed
500	80.0	80.1	0.1	-1.0	1.0	0.1	Passed
2000	80.2	80.1	0.1	-1.0	1.0	0.1	Passed
4000	80.8	80.0	0.0	-1.0	1.0	0.1	Passed
8000	83.0	80.0	0.0	-2.5	1.5	0.1	Passed
12500	86.2	79.9	-0.1	-2.5	1.5	0.1	Passed
16000	88.5	79.9	-0.1	-2.5	1.5	0.1	Passed

4.3 Z-Weighting

Freq. [Hz]	Gen. level	Meas level	Dev	Limit -	Limit +	Uncert.	Status
1000	80.0	80.0	0.0	-0.7	0.7	0.1	Passed
63	80.0	80.1	0.1	-1.0	1.0	0.1	Passed
125	80.0	80.0	0.0	-1.0	1.0	0.1	Passed
250	80.0	80.0	0.0	-1.0	1.0	0.1	Passed
500	80.0	80.0	0.0	-1.0	1.0	0.1	Passed
2000	80.0	80.0	0.0	-1.0	1.0	0.1	Passed
4000	80.0	80.0	0.0	-1.0	1.0	0.1	Passed
8000	80.0	80.0	0.0	-2.5	1.5	0.1	Passed
12500	80.0	80.0	0.0	-2.5	1.5	0.1	Passed
16000	80.0	80.1	0.1	-2.5	1.5	0.1	Passed

5. Frequency and time weightings at 1kHz

While injecting a constant steady signal at the reference frequency of 1 kHz the F-time-weighted sound level, S-time-weighted sound level and time-averaged sound level are verified with frequency weighting A. Additionally the F-time-weighted sound level for frequency weightings C and Z is measured. The first measurement serves as reference and differences in the reading with respect to this first one are determined. All levels in [dB].

Level	Exp level	Meas level	Dev	Limit -	Limit +	Uncert.	Status
LAF	114.0	114.0	0.0	-0.7	0.7	0.1	Passed
LAS	114.0	113.8	-0.2	-0.7	0.7	0.1	Passed
LAeq	114.0	114.0	0.0	-0.7	0.7	0.1	Passed
LCF	114.0	114.0	0.0	-0.7	0.7	0.1	Passed
LCeq	114.0	114.0	0.0	-0.7	0.7	0.1	Passed
LZF	114.0	114.0	0.0	-0.7	0.7	0.1	Passed
LZeq	114.0	114.0	0.0	-0.7	0.7	0.1	Passed

6. Level linearity on the reference level range

The level linearity on the reference level range is determined by applying steady sinusoidal electrical signals at a frequency of 8 kHz with the sound level meter set for frequency-weighting A and fast time-weighting. All levels in [dB].

Exp abs level	Meas. level	Abs dev	Abs Limit -	Abs Limit +	Exp rel level	Rel dev	Rel Limit -	Rel Limit +	Uncert.	Status
114.0	114.0	0.0	-0.8	0.8	0.0	0.0	-0.3	0.3	0.1	Passed
119.0	119.0	0.0	-0.8	0.8	119.0	0.0	-0.3	0.3	0.1	Passed
124.0	124.0	0.0	-0.8	0.8	124.0	0.0	-0.3	0.3	0.1	Passed
114.0	114.0	0.0	-0.8	0.8	0.0	0.0	-0.3	0.3	0.1	Passed
109.0	109.0	0.0	-0.8	0.8	109.0	0.0	-0.3	0.3	0.1	Passed
104.0	104.0	0.0	-0.8	0.8	104.0	0.0	-0.3	0.3	0.1	Passed
99.0	99.0	0.0	-0.8	0.8	99.0	0.0	-0.3	0.3	0.1	Passed
94.0	94.0	0.0	-0.8	0.8	94.0	0.0	-0.3	0.3	0.1	Passed
89.0	89.0	0.0	-0.8	0.8	89.0	0.0	-0.3	0.3	0.1	Passed
84.0	84.0	0.0	-0.8	0.8	84.0	0.0	-0.3	0.3	0.1	Passed
79.0	79.0	0.0	-0.8	0.8	79.0	0.0	-0.3	0.3	0.1	Passed
74.0	74.0	0.0	-0.8	0.8	74.0	0.0	-0.3	0.3	0.1	Passed
69.0	69.0	0.0	-0.8	0.8	69.0	0.0	-0.3	0.3	0.1	Passed
64.0	64.0	0.0	-0.8	0.8	64.0	0.0	-0.3	0.3	0.1	Passed
59.0	59.0	0.0	-0.8	0.8	59.0	0.0	-0.3	0.3	0.1	Passed
54.0	54.0	0.0	-0.8	0.8	54.0	0.0	-0.3	0.3	0.1	Passed
49.0	49.0	0.0	-0.8	0.8	49.0	0.0	-0.3	0.3	0.1	Passed
44.0	44.0	0.0	-0.8	0.8	44.0	0.0	-0.3	0.3	0.1	Passed
39.0	39.1	0.1	-0.8	0.8	39.0	0.1	-0.3	0.3	0.1	Passed
34.0	34.2	0.2	-0.8	0.8	34.1	0.1	-0.3	0.3	0.1	Passed
33.0	33.2	0.2	-0.8	0.8	33.2	0.0	-0.3	0.3	0.1	Passed
32.0	32.2	0.2	-0.8	0.8	32.2	0.0	-0.3	0.3	0.1	Passed
31.0	31.2	0.2	-0.8	0.8	31.2	0.0	-0.3	0.3	0.1	Passed
30.0	30.3	0.3	-0.8	0.8	30.2	0.1	-0.3	0.3	0.1	Passed

7. Level linearity including the level range control

The test is performed with steady sinusoidal electrical input signals at a frequency of 1 kHz and with the sound level meter set for frequency weighting A and fast time weighting. With the input signal level kept constant, the indicated signal level is recorded for all level ranges where the applied signal level is displayed. All levels in [dB].

		Low Range		Mid Range		High Range			
Starting Range	Source level	Dev	Limit +/-	Dev	Limit +/-	Dev	Limit +/-	Uncert.	Status
Low	94	0.0	0.40	0.0	0.15	0.0	0.15	0.1	Passed
Mid	114			0.0	0.30	0.0	0.55	0.1	Passed
High	134					0.0	0.30	0.1	Passed
Low	29	0.1	0.30					0.1	Passed
Mid	36			0.1	0.30			0.1	Passed
High	58					0.1	0.30	0.1	Passed

8. Toneburst response

The response of the sound level meter to short-duration signals is tested on the reference level range with 4 kHz tonebursts that start and stop at zero crossings and are extracted from steady 4 kHz sinusoidal electrical input signals. The sound level meter is set for frequency weighting A. All levels in [dB].

The continuous signal level is 123 dB.

Burst signal	Burst duration [ms]	Exp level	Meas level	Dev	Limit -	Limit +	Uncert.	Status
LAF	200	122.0	121.9	-0.1	-0.5	0.5	0.2	Passed
LAF	2	105.0	104.9	-0.1	-1.5	1.0	0.2	Passed
LAF	0.25	96.0	95.8	-0.2	-3.0	1.0	0.2	Passed
LAS	200	115.6	115.5	-0.1	-0.5	0.5	0.2	Passed
LAS	2	96.0	95.9	-0.1	-3.0	1.0	0.2	Passed
LAeq10s	200	106.0	105.9	-0.1	-0.5	0.5	0.2	Passed
LAeq10s	2	86.0	85.9	-0.1	-0.5	0.5	0.2	Passed
LAeq10s	0.25	77.0	76.8	-0.2	-0.5	0.5	0.2	Passed

9. C-weighted peak sound level

The sound level meter is tested on the least-sensitive level range with fast time weighting and C frequency weighting. The test signals are a single complete cycle of an 8 kHz sinusoid starting and stopping at zero crossings and positive and negative half cycles of a 500 Hz sinusoid that also start and stop at zero crossings. All levels in [dB].

Burst signal	Source level	Exp LCp-LCF	Meas LCp-LCF	Dev	Limit -	Limit +	Uncert.	Status
8kHz	129.0	3.4	3.1	-0.3	-2.0	2.0	0.2	Passed
500Hz +	132.0	2.4	2.2	-0.2	-1.0	1.0	0.2	Passed
500Hz -	132.0	2.4	2.2	-0.2	-1.0	1.0	0.2	Passed

10. Overload Indication

Overload indication is tested on the least-sensitive level range with the sound level meter set to A-weighted, time-averaged sound level. Positive and negative one-half-cycle sinusoidal electrical signals at a frequency of 4 kHz are used. All levels in [dB].

Start level	OV +	OV -	Dev	Limit -	Limit +	Uncert.	Status
136.6	138.8	138.8	0.0	-1.5	1.5	0.3	Passed

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Sound Level Meter
IEC 61672-3.2013
Calibration Certificate

Calibration Number C21268

Client Details	A W Edwards Pty Ltd Level 1, 131 Sailors Bay Road Northbridge NSW 2063
Equipment Tested/ Model Number :	Rion NL-52
Instrument Serial Number :	00219948
Microphone Serial Number :	18911
Pre-amplifier Serial Number :	10464

Pre-Test Atmospheric Conditions		**Post-Test Atmospheric Conditions**	
Ambient Temperature :	23.4°C	**Ambient Temperature :**	23.4°C
Relative Humidity :	39.9%	**Relative Humidity :**	39.6%
Barometric Pressure :	100.6kPa	**Barometric Pressure :**	100.6kPa

Calibration Technician : Lucky Jaiswal
Calibration Date : 23 Apr 2021

Secondary Check: Max Moore
Report Issue Date : 23 Apr 2021

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 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.

Least Uncertainties of Measurement -

		Environmental Conditions	
Acoustic Tests		*Temperature*	*±0.2°C*
125Hz	*±0.12dB*	*Relative Humidity*	*±2.4%*
1kHz	*±0.11dB*	*Barometric Pressure*	*±0.015kPa*
8kHz	*±0.13dB*		
Electrical Tests	*±0.10dB*		

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

NATA
WORLD RECOGNISED ACCREDITATION

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 Calibrator
IEC 60942-2017
Calibration Certificate

Calibration Number C21269

Client Details A W Edwards Pty Ltd
Level 1, 131 Sailors Bay Road
Northbridge NSW 2063

Equipment Tested/ Model Number : Rion NC-75
Instrument Serial Number : 34212952

Atmospheric Conditions
Ambient Temperature : 23.4°C
Relative Humidity : 39.9%
Barometric Pressure : 100.6kPa

Calibration Technician : Lucky Jaiswal
Secondary Check: Max Moore
Calibration Date : 23 Apr 2021
Report Issue Date : 23 Apr 2021

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	94.02	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..

Least Uncertainties of Measurement -

Specific Tests		Environmental Conditions	
Generated SPL	*±0.14dB*	*Temperature*	*±0.2°C*
Frequency	*±0.09%*	*Relative Humidity*	*±2.4%*
Distortion	*±0.09%*	*Barometric Pressure*	*±0.015kPa*

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

* The tests <1000 kHz are not covered by Acoustic Research Labs Pty Ltd NATA accreditation.

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CERTIFICATE OF CALIBRATION

CERTIFICATE NO.: SLM 26012A

Equipment Description:	Sound Level Meter		
Manufacturer:	Rion		
Model No:	NL-31	**Serial No:**	772983
Microphone Type:	SV22	**Serial No:**	4013109
Preamplifier Type:	NH-21	**Serial No:**	20938
Comments:	All tests passed for class 2. (See over for details)		
Owner:	Resonate Consultants Pty Ltd Level 1, 23 Peel Street Adelaide SA 5000		
Ambient Pressure:	991 hPa ±1.5 hPa		
Temperature:	25 °C ±2° C	**Relative Humidity:**	30 % ±5%
Date of Calibration:	03/12/2019	**Issue Date:**	09/12/2019

Acu-Vib Test Procedure: AVP10 (SLM)

CHECKED BY: ..... **AUTHORISED SIGNATURE:** .....

Hein Soe

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

NATA
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Accredited Lab. No. 9262
Acoustic and Vibration Measurements

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Mobile: 0413 809806
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CERTIFICATE NO.: SLM 26012A

The performance characteristics listed below were tested. The tests are based on the relevant clauses of IEC 61672-3:2013

Tests Performed:	Clause	Result
Absolute Calibration	10	Pass
Acoustical Frequency Weighting	12	Pass
Self Generated Noise	11.1	Entered
Electrical Noise	11.2	Entered
Long Term Stability	15	Pass
Electrical Frequency Weightings	13	Pass
Frequency and Time Weightings	14	Pass
Reference Level Linearity	16	Pass
Range Level Linearity	17	Pass
Toneburst	18	Pass
Peak C Sound Level	19	Pass
Overload Indicator	20	Pass
High Level Stability	21	Pass

Statement of Compliance: The sound level meter submitted for testing has successfully completed the 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 organization responsible for approving the results of pattern evaluation tests 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 2 requirements of IEC 61672-1:-2013.
A full technical report is available if required.

Date of Calibration: 03/12/2019 **Issue Date:** 09/12/2019

Checked by: .....

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

NATA
WORLD RECOGNISED ACCREDITATION

Accredited Lab. No. 9262
Acoustic and Vibration Measurements

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