

Technical Acoustic Memorandum

Omāroro Reservoir Project

Title	Omāroro Reservoir Project (RC) Environmental Noise Review Report	Status	WCC Final
Client	WCC Compliance Report	Discipline	Acoustics (Noise)
Date	7 May 2021	Issue	Bob Barber Compliance Team Leader
Authors	Lindsay Hannah		
Reviewer	Whitney Cocking		

1 Introduction

Wellington City Council (the Council) has received a complaint regarding construction noise emissions emanating from the Omāroro Reservoir Project as received at an adjoining residential site in Rolleston Street. Wellington City Councils Team Leader of Compliance has requested Councils Acoustic Engineer (the author of this report) undertake an independent assessment of the acoustic methodology and measurements undertaken by HEB Construction, the Consent Holder (Wellington Water) Principal Contractor.

The review concludes

1. It is the authors opinion that there are technical deficiencies with the HEB noise measurements, sampling and reporting methods.
 - a. Recommendations have been made to remedy these deficiencies immediately
2. Although deficiencies have been noted, based on the measurement information and data provided the activity appears to be complying with the relevant conditions of consent for noise and permitted noise limits set out in **NZS 6803:1999 Acoustics Construction Noise Limits**.

2 Background

This report is a high level review and does not set out to repeat the detailed background to this project however it is noted that the Notice of Requirement (NoR) to build the reservoir was granted by Wellington City Council in 2017. The report focuses on deficiencies that should be addressed immediately. The Resource Consent conditions required a Construction Noise and Vibration Management Plan (CNVMP) be prepared. The HEB CNVMP is incorporated within a series of other Environmental Management Plans, to manage the environmental risks for the construction of the reservoir. The CNVMP specifically states it's been prepared to address 'the potential to generate noise'. The HEB CNVMP has been reviewed as part of the analysis as have the measurement results. A site visit by the author and reviewer has also been undertaken as part of the review. This review includes a walk around the site and review of adjacent residential sites, including in Rolleston Street near the entrance to the site.

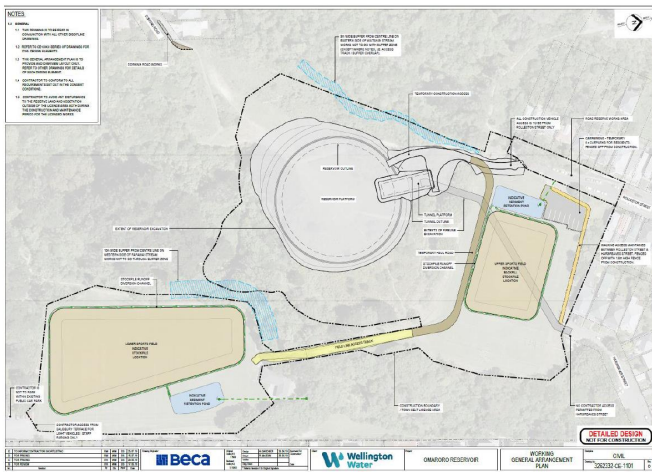
3 The Project

The Omāroro Reservoir Project is the construction of a buried concrete reservoir, with a capacity of 35,000m³ in the Town Belt, immediately southwest of the Upper Park of the Prince of Wales Park in Mount Cook, Wellington. There are five key stages to the project these are described as (a) Separable Portion 1: Works to Achieve an Operational Reservoir (b) Separable Portion 2: Planting and Landscaping (c) Separable Portion 3: Reinstatement of the Playing Fields (d) Separable Portion 4: New and Reinstated Walking Tracks (e) Separable Portion 5: All Other Works.

4 The Site and Receiving Environs

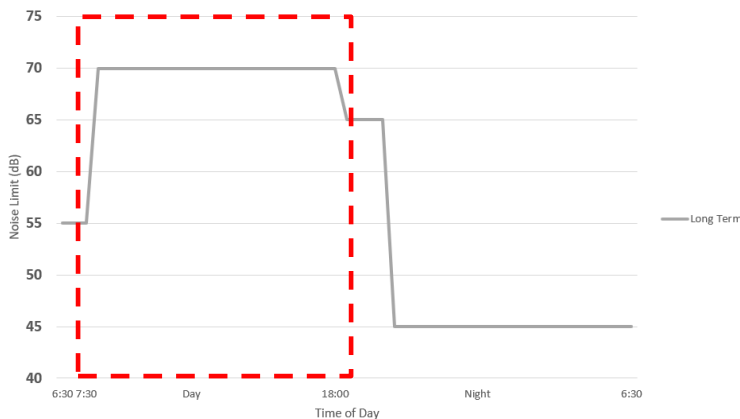
The Omāroro Reservoir site is located on a spur within the Prince of Wales Park. The Prince of Wales Park is located within the Wellington Town Belt in the Brooklyn Hills, Wellington. Properties along Dorking Road, approx. 160 metres south-west look onto the site (as the crow flies). Site to the north in Rolleston Street are approx 45m (as the crow flies) to the main reservoir parking area. The main reservoir is located at a further distance. It is noted that Rolleston Street forms the primary access route to the site. Rolleston Street also lies adjacent to the sites parking and set down area and in this regard is affected from construction vehicles (include numbers 73, and 86 to 102 Rolleston Street). **Appendix A** attached contains an aerial photo of the site relative to noise sensitive sites (residential areas surrounding the site).

The following is a schematic of the projects layout to provide an oversight of the nature and scale of the development. See **Appendix D** for enlarged project map.



5 Applicable Noise Limits

The project is 'long term' duration being greater than 20 weeks. **DC.17(i)** states for on-site construction activities the hours of operation are 7:30am to 6.00pm Monday to Saturday (excluding public holidays). The HEB CNVMP under **Section 3.0** sets out the full long term duration limits between the operating hours of 7:30am to 6.00pm Monday to Saturday. The limits between 7:30am to 6.00pm Monday to Saturday are **70 dB LAeq / 85 dB LAfmax**. The following is a summary graph of the LAeq noise limits vs time of day that apply:



6 Applicable Vibration Limits

Section 3.2 of the HEB CNVMP discussed vibration limits and notes **DIN 4150-3:1999 "Structural Vibration – Effects of Vibration on Structures"**. The relevant criteria from **DIN 4150-3:1999** is summarised as follows:

Building Type	Short-term vibration			PPV (horizontal plane) of highest floor (mm/s)	Long-term vibration	
	PPV at the foundation at:					PPV (horizontal plane) of highest floor (mm/s)
	1-10Hz (mm/s)	10-50 Hz (mm/s)	50-100 Hz (mm/s)			
Commercial	20	20 – 40	40 – 50	40	10	
Dwellings	5	5 – 15	15 – 20	15	5	

7 Assessment Overview

The following areas of assessment have been reviewed

- CNVMP methodology;
- Measurement results; and
- Mitigation measures, engagement and compliants.

8 Review

8.1 Monitoring Method - Duration /Sample Time

New Zealand Acoustic Standard **NZS6803:1999 Acoustics Construction Noise (Section 6.3)** states sample measurements should not exceed 60 minutes. The standard notes that measurements should be '**representative of the duration and characteristic**'. What this means in lay terms is a complex activity with many noise sources (including high impact noise activities) can have measurement periods up to 60 minutes to take account of representative characteristic of the site. This means that if such high impact activities are present when a measurement is conducted over 60 minutes it would most likely comply with the permitted noise limits. The HEB CNVMP however states '**Measurements will be taken as 15-minute readings**'. The measurement resulted presented do not all present 15-minute samples.

8.2 Monitoring Method – Background Sound and Adjustments

New Zealand Acoustic Standard **NZS6803:1999 Acoustics Construction Noise (Section 6.4)** states sample measurements should not be adjusted for Special Audible Characteristics (SAC) however the levels shall be adjusted for significant background (L_{A90}) sound levels. Based on the authors knowledge of the site and surrounds the area does not have significant background sound levels. However if required measurements should be adjusted for background sound and the adjustment noted. The HEB results do not discuss backgrounds sound levels or present any data.

8.3 Monitoring Equipment – Sound Level Meter

The HEB CNVMP states that monitoring will be undertaken using a 'Pro Sound Level Meter with calibrator which conforms to IEC 61672-1 Class 2 for sound level meters'. It is understood this sound level meter has been adopted as per the HEB CNVMP requirements. As per **NZS 6801: 2008 Acoustics Measurement of Environmental Sound (Section 5.2.2)** a sound level meter shall be required to be calibrated at least every 2 years (by an independent accredited lab).

8.4 Monitoring Equipment – Sound Level Meter Calibration

A sound level meter should be calibrated before and after each measurement with a handheld calibrator or pistonphone and results presented on the monitoring sheets. No information on calibration results or equipment has been provided in the measurement sheets. As per **NZS 6801: 2008 Acoustics Measurement of Environmental Sound (Section 5.2.2)** the calibrator shall conform with IEC 60942.

8.5 Monitoring Descriptors

The HEB CNMVP states measurements will be '**capturing the L_{Aeq} and L_{Amax} sound pressure level descriptors**'. It is noted that measurement results have been presented as 'average', 'min' and 'max'. It is unclear if these results are actually true L_{Aeq} and L_{Amax} . An integrating sound level meter would be required to capture true L_{Aeq} results.

8.6 Weather Conditions

The HEB CNVMP requires that weather conditions be reported. This HEB reporting does provide review of basic weather. It is also noted in some cases rainfall is noted on the monitoring sheets for example '**Wet weather today so minimal works occurring in terms of earthworks**'. Measurements should generally not be conducted with precipitation as this can increase sound levels. In a real life situation however including major projects of this nature monitoring may be required with the presence of precipitation. If the results are compliant with the presence of precipitation this will not alter the overall compliance of the activity with the noise limits.

8.7 Breach of Applicable Limits Set under CNVMP

The HEB CNVMP states that '**If noise monitoring indicates that Project noise criteria are being exceeded, and that was not anticipated then the management of the area will be reviewed. If breaches of the noise standards continue, then a site-specific Noise Management Plan will be prepared and implemented. A copy of the plan shall be provided to the CMO**'. No actual compliance statements are provided with each measurement result or sign off that the compliance levels are achieved.

8.8 Measurement Location

The HEB CNVMP Section 5 has made reference to ‘Sensitive Receivers’. *NZS6803:1999 Acoustics Construction Noise ‘Measurement Locations’ (Section 6.2)* notes that all measurements should be conducted 1m from the wall of the most exposed façade and 1.2m to 1.5m above ground or floor level. A number of the measurement results have been conducted within close proximity to dwellings while we are also advised by HEB that monitoring has also been conducted adjacent residential sites (but not 1m from the most exposed façade as per *NZS6803:1999 Acoustics Construction Noise*). It is however understood that these measurements were not 1m from the façade but close to the site boundary, this was in order to avoid going onto private property.

There are many examples in the HEB measurement results where measurements are conducted next to reflecting hard surfaces and not 1.2 to 1.5m above ground as required by *NZS6803:1999 Acoustics Construction Noise*. The following photo set below illustrates this where the sound level meter was located on the hood of a ute or car ~ 300mm from the reflecting surface.



8.9 Measurement Time Stamp

In some cases there are notes on the HEB measurement sheets that the incorrect time is shown.

8.10 Distance to Source

The HEB measurement sheets contain information on distances, including ‘distance from main activity’ and ‘distance from site boundary’. There is a third set of information on the measure sheet ‘distance from activity (m)’. The following illustrates this from a sample sheet:

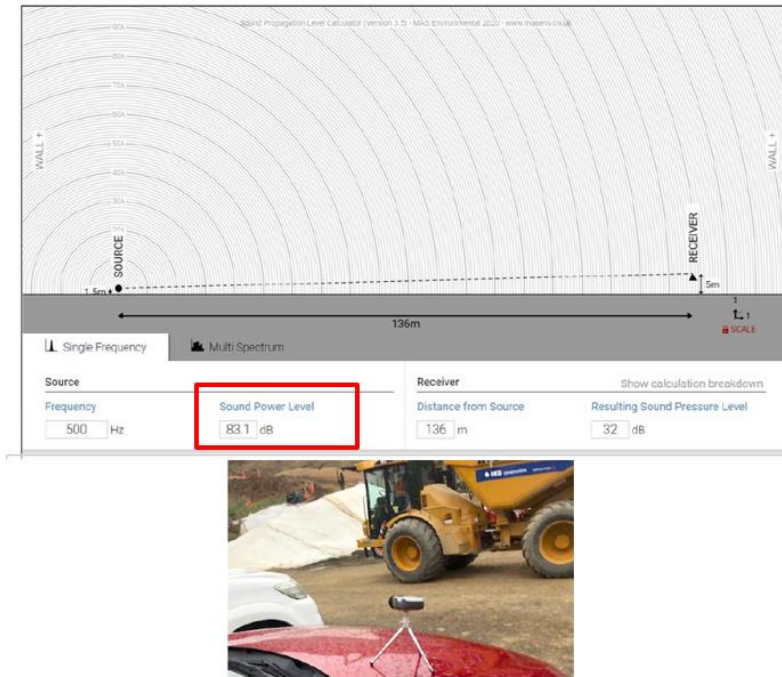
Other Comments:	Max dB is 83.1dB. 136m from site boundary.	Distances from Main Activity:	10-15m
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MEASUREMENTS	
Time	Distance from Activity (m)
<i>The measurement sam</i>	

It is unclear what the actual distance is to the sound source(s), is this the ‘main activity’? It is critical to include this for compliance purposes as it allows review of the level at source which can be used to calculate the level at other receiver locations to check compliance.

8.11 Sound Propagation Calculator

The HEB measurement sheets sometimes contain the use of a sound propagation calculator, the following is a sample of this from one of the sheets



The operator is **incorrectly** applying the data into the calculator as they are applying a measured sound pressure level at distance and not the sound power level as required by the calculator.

8.12 Operational Noise Monitoring Sheet HEB ER13

The CNVMP Appendix 3 sets out the HEB Monitoring Sheet. This sheet has been adopted by HEB when presenting its results, however in some cases the sheets are not fully completed with all required information. The following is a sample of one of the HEB measurement sheets where no levels are provided and the sheet not filled out. In many cases the HEB results just reproduce a graph.

MEASUREMENTS				
Time	Distance from Activity (m)	Noise reading (dB - average)	Noise Level (dB Max)	Comments
<i>The measurement sample time should not exceed one hour, 15 minutes for constant sound will often be adequate Refer to NZS 6803:1999 Acoustics - Construction Noise</i>				
COMMENTS				

8.13 Experience and Qualifications of Operator

The person undertaking any monitoring should be suitably qualified and experienced in acoustics and have an understanding of the required New Zealand Acoustic Standards including but (NZS6801/02/03).

9 Mitigation Measures, Engagement and Complaint

The HEB CNVMP presents a host of mitigation measures for both noise and vibration. With respect to community engagement HEB has advised that they provide regular updates to residents around the project including informing residents regularly. It is recommended the HEB continue to follow the CNVMP and that all noise and or vibration complaints are dealt with in accordance with the methodology specified within **'Complaint Initial Action'** and **'Follow Up Actions'**, Section 9. Stakeholder Engagement & Complaints. We do not see any issue with the community engagement or complaints process undertaken by HEB to date.

10 Measurement Results

A high level review of measurement results has been undertaken based on measurement results presented by HEB. The following results are based on a closest receiver location to the entrance to the site at Rolleston Street. As noted in the results the activity complies with the permitted levels, however this is based on the current methods and data presented to Council. A larger, more readable, copy of this results summary is provided as Appendix F.

Activity Summary	Sources ID	HEB Measured Sound		Distance to Source (m)	Sound Power Level LAeq dB	Sound Pressure Level at Receiver Location LAeq dB	NZS6803 Limit LAeq?	Comply with LAeq NZS6803?	Sound Pressure Level at Reiver Location LAmax dB	NZS6803 Limit LAmax?	Comply with LAmax NZS6803?
		Pressure Level LAeq dB	Pressure Level LAmax dB								
Tree Chipping	Excavator, hand tools. Power tools and tree chipper	65	94	10	96	50	70 dB	Yes	79	85 dB	Yes
Vegetation clearance	Mulcher and excavator	66	85	20	103	58	70 dB	Yes	77	85 dB	Yes
Concrete Cutting	Concrete saw and Jack Hammering	50	66	50	96	51	70 dB	Yes	67	85 dB	Yes
Mixed	Roller, excavator, Utes, moxy, trucks and people	61	75	15	96	50	70 dB	Yes	64	85 dB	Yes
Mixed	4xmoxxy, 2x roller, trucks and people	59	69	10	90	44	70 dB	Yes	54	85 dB	Yes
Mixed	Concrete cutting and jack hammering	59		50	105	60	70 dB	Yes		85 dB	Yes
Mixed	Diggers and rollers	65	73	10	96	50	70 dB	Yes	56	85 dB	Yes
Single Event (b-train)	B train (WCC Prediction)	85	85	7.5	113	67	70 dB	Yes	73	85 dB	Yes
Chain Saw	2x Combustion Chainsaw (WCC prediction)				112	67	70 dB	Yes	72	85 dB	Yes
Worse Case theoretical	Total Sound Power of 115 dB LAeq and 125 dB Lmax (WCC Prediction)				115	70	70 dB	Yes	75	85 dB	Yes

10.1 Single Event Measurement Results (Vehicles Entering and Exiting the Site from Rolleston Street)

The HEB CNVMP **Section 4.1.3** has made reference to '**Vehicle Movements**'. The project will require movements for a host of reasons including concrete delivery through to removal of excavated material. Vehicles on a public road are exempt under the Resource Management Act. However with respect to a heavy vehicle traversing Rolleston Street onto a level of approx LAeq 75 dB to 85 dB would be expected at source this would result in a level of less than LAeq 75 dB at the closest dwellings. When averaged in accordance with **NZS 6803:1999 Acoustics Construction Noise** levels would be predicted at below LAeq 70 dB.

10.2 Combustion Engine Chain sawing, Mulching and Concrete Cutting (High Impact Noise Activities)

The review above includes assessment of chainsaw noise, mulching and concrete cutting. The assessment indicates based on previous measurements conducted by the author that chain saw noise (2 combustion chainsaws operating) would generate a level of up to LAeq 67 dB at the closest dwelling in Rolleston Street. In theory two more chain saws (total of 4) could operate and remain within the LAeq 70 dB limit at the closest dwelling. Mulching resulted in levels of less than LAeq 60 dB at the closest dwelling in Rolleston Street. The review above also includes assessment of concrete cutting. The assessment indicates based on HEB data a level of no more than LAeq 60 dB at the closest dwelling in Rolleston Street would occur. In summary when assessed in accordance with the data set provided from HEB and the permitted limits set out in **NZS 6803:1999 Acoustics Construction Noise** noise levels are below LAeq 70 dB.

10.3 Worst Case Operating Scenario

The review above includes a predicted worst case operating assessment utilising a sound power level (level at source) of LAeq 115 dB and LAmax 125 dB. Sound power levels would not be expected to reach these worst case levels for a project of this nature and scale. Regardless if levels at source did reach levels of LAeq 115 dB and LAmax 125 dB the results indicate compliance with the permitted limits set out in **NZS 6803:1999 Acoustics Construction Noise** at the closest dwelling in Rolleston Street.

11 Vibration

The HEB CNVMP states when it is not practical to achieve the criteria set out in Section 3.2 of the CNVMP. It is understood that vibration has been raised as an issue on certain occasions. It is noted that vibration may be perceptible at times but this does not mean that vibration limits are not compliant. **CNVMP states under Section 8.2 'As specified above, it is not envisioned the vibration limits as set out in Section 3.2 to be exceeded, based on the proposed activities'**. The CNVMP notes that 'HEB construction during consultation will inform residents that the vibration criteria in section 3.2 are the limits to avoid structural damage to buildings and that they may however be able to 'feel' vibration at lower levels than these criteria'. No results from vibration monitoring have been supplied for review and thus no comment can be made.

12 Recommendations

The following recommendations are made for review by WCC Compliance team leader to discuss with the Contractor:

1. All monitoring shall be conducted by suitably qualified and experienced person(s). It's expected, with the adoption of the recommendations contained herein, that site personnel (who are best placed to respond quickly to any noise related issues that may arise) will enhance and improve their noise monitoring processes;
2. As per the HEB CNVMP all measurements shall be 15-minute sample readings (if there are any diversions sufficient information should be provided as to why);
3. If adjustment is required for background sound this should be applied (and adjustment levels noted in results).
4. The sound level meter should be calibrated with a handheld calibrator before and after each measurement set and calibration results presented on the monitoring sheet;
5. The hand held calibrator used to calibrate the sound level meter before and after each measurement shall conform with IEC 60942. The details on the handheld calibrator used for the measurements shall be presented on the monitoring sheet;
6. The sound level meter calibration certificate should be included with the measurement results (this can be forwarded once to WCC to be placed on file – see **Appendix E** for an example of the certification required);
7. The HEB monitoring sheet should report results as $L_{Aeq(15min)}$ and L_{Amax} sound pressure level descriptors (not min, max, avg);
8. HEB shall ensure monitoring is undertaken at 1m from the wall of the most exposed façade (or the most exposed site boundary if access to the property is an issue – if boundary measurement occurs measurements adjustments shall be applied and reported);
9. HEB shall ensure monitoring should be conducted on a tripod 1.2 to 1.5m above ground;
10. The HEB monitoring sheet should report the sample start and finish time accurately (without comment on amended time stamps i.e. the operator should check the correct time on the meter before starting the measurements);
11. The HEB monitoring sheet should include a single distance to sound source(s) from sound level meter;
12. The HEB monitoring sheet should include a compliance statement indicating the permitted levels have been complied with;
13. Vibration monitoring should be conducted and resulted report to WCC. All vibration monitoring shall follow the requirements set out in the HEB CNVMP as well as DIN 4150-3:1999 "Structural Vibration – Effects of Vibration on Structures".
14. The CNVMP Appendix 3 HEB Monitoring Sheet should be updated to take account of all the requirements set out above This sheet and required monitoring techniques shall be adopted by HEB when presenting any future results.

Lindsay Hannah.

Lindsay Hannah

Acoustic Engineer MASNZ (1202HL) MIEH MWAA NZPI (Assoc)

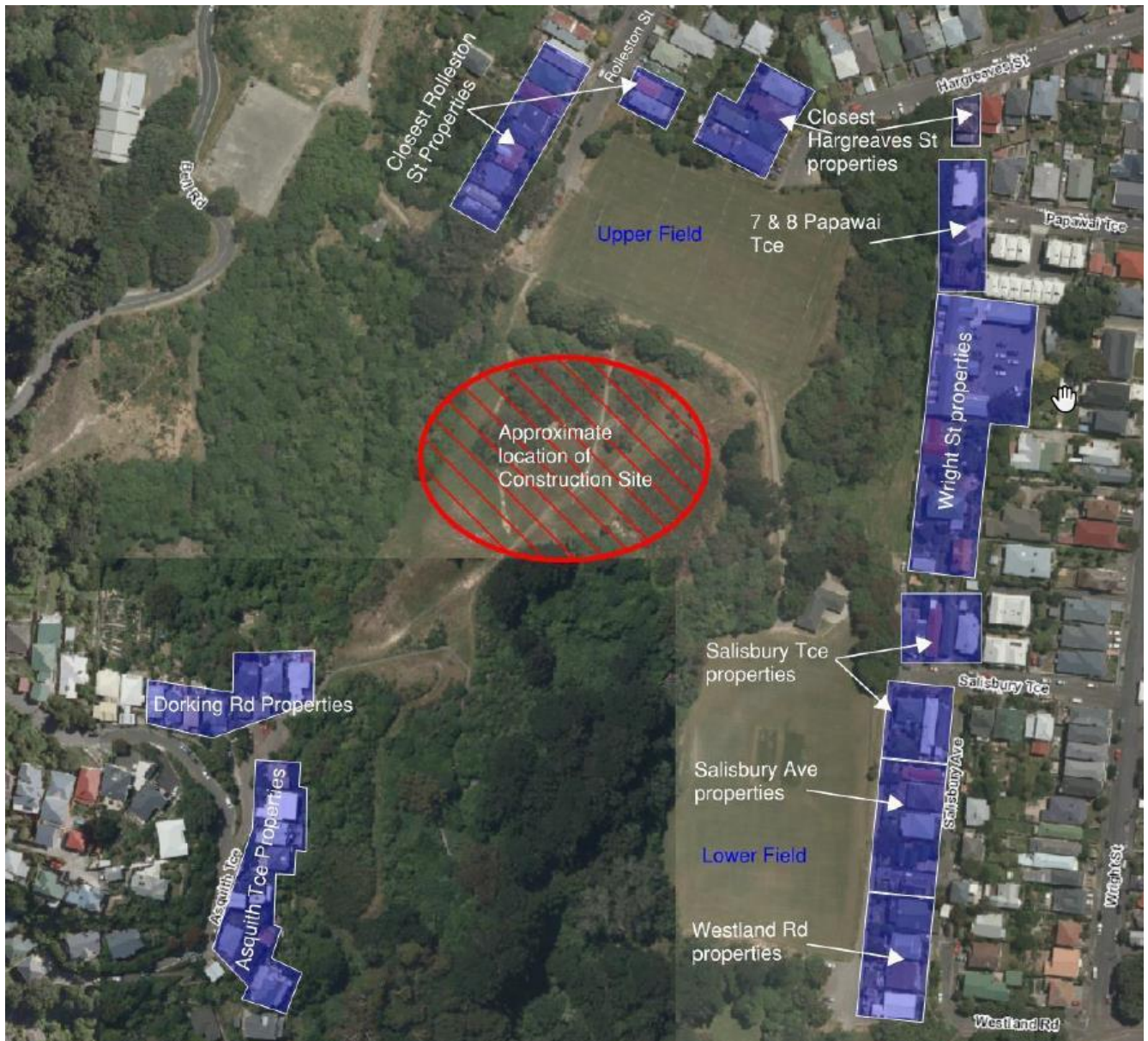
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Acoustic Engineer. City Consenting and Compliance Wellington City Council

Attachments

- **Appendix A:** Closest Noise Sensitive Sites (Surrounding Area)
- **Appendix B:** Wellington City Council Planning Map
- **Appendix C:** Aerial Maps of Surrounds and Project
- **Appendix D:** Project Map
- **Appendix E:** Sample IANZ Calibration Certificate for Sound Level Meter
- **Appendix F:** Summary of Measurement Results

Appendix A: Closest Noise Sensitive Sites (Surrounding Area).



Appendix B: Wellington City Council Planning Map



Appendix C: Aerial Maps of Surrounds and Project




Appendix E: Sample IANZ Calibration Certificate for Sound Level Meter

 (IANZ Accredited laboratory)
Calibration, Sales & Service of Audiological and Acoustical Equipment



SUMMARY CALIBRATION CERTIFICATE FOR A SOUND LEVEL METER

Job Number: SO014219-3028727

Date of report: 

Measurement Procedure: The above instrument was tested using Diatec procedure ECSP10 and to the requirements of IEC 61672-3:2013 Electroacoustics - Sound Level Meters - Part 3: Periodic Tests. The laboratory is accredited for compliance to ISO/IEC 17025. All tests and measurements reported here are traceable to New Zealand and Australian National Standards.

Item tested:

Sound Level Meter:	Bruel & Kjaer	2250	
Designation:	Class: 1		
Firmware version:	HW v4.0, BZ7222 v4.7.5		
Microphone:	B&K	4189	Serial No: 
Applied Data:	Body - B&K, 2250. Windscreen - Default, Flat		
Notes:	-		
Date of test:	19 January, 2021		
Tested by:	RJ		

Ambient conditions at the time of tests:

Temperature: 23.5 °C Humidity: 52.9 %RH Atmospheric pressure: 1003.3hPa

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

Result: Passed all tests.

Statement of Compliance: 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 organisation 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 1 requirements of IEC61672-1:2013. A full technical report is available if required.

Authorised IANZ Signatory

Report checked



Appendix F: Sample Results Summary

Activity Summary	Sources ID	HEB Measured		HEB Measured		Sound Pressure Level at Receiver Location LAeq dB	Sound Pressure Level at Receiver Location LAeq dB	Distance to Source (m)	Sound Power Level LAeq dB	Comply with NZS6803 Limit LAeq?	Comply with NZS6803 LAmax?
		Sound Pressure Level LAeq dB	Sound Pressure Level LAmax dB	Sound Pressure Level LAeq dB	Sound Pressure Level LAmax dB						
Tree Chipping	Excavator, hand tools. Power tools and tree chipper	65	94	10	96	50	79	70 dB	Yes	85 dB	Yes
Vegetation clearance	Mulcher and excavator	66	85	20	103	58	77	70 dB	Yes	85 dB	Yes
Concrete Cutting	Concrete saw and Jack Hammering	50	66	50	96	51	67	70 dB	Yes	85 dB	Yes
Mixed	Roller, excavator, Utes, mogy, trucks and people	61	75	15	96	50	64	70 dB	Yes	85 dB	Yes
Mixed	2x Excavator, 10x Utes, 4xmogy, 2x roller, trucks and people	59	69	10	90	44	54	70 dB	Yes	85 dB	Yes
Mixed	Concrete cutting and Jack hammering	59	73	50	105	60	56	70 dB	Yes	85 dB	Yes
Single Event (b-train)	Diggers and rollers	65	85	10	96	50	73	70 dB	Yes	85 dB	Yes
Chain Saw	B train (WCC Prediction) 2x Combustion Chainsaw (WCC prediction)	85	112	7.5	113	67	72	70 dB	Yes	85 dB	Yes
Worse Case theoretical	Total Sound Power of 115 dB LAeq and 125 dB Lmax (WCC Prediction)		115			70	75	70 dB	Yes	85 dB	Yes