Noise & Vibration Monitor Installation Report

Barangaroo Cutaway Cultural Facility
Installation Report - 3847

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1 Introduction

FDC Construction and Fitouts are undertaking a large-scale construction project for the transformation of the concrete shell cutaway space in Barangaroo, New South Wales, Australia (henceforth referred to as the Cutaway project). The Cutaway project involves the transformation of a large concrete shell space into a new cultural facility. This significant development project includes extensive construction activities such as demolition, excavation, structural alterations, and the installation of new amenities. These activities are expected to generate substantial noise and vibration levels that could potentially impact the surrounding environment and nearby residential & commercial properties.

In response to these concerns, NoiseNet has been engaged to implement a comprehensive unattended noise and vibration monitoring system throughout the construction period. This monitoring system is designed to ensure compliance with relevant noise and vibration standards, mitigate potential impacts on the community, and provide real-time data for effective management and control of construction activities.

NoiseNet has deployed airborne noise & vibration sensors for unattended monitoring of the construction activities of the Cutaway project. This report aims to detail the sensor specifications, installation locations, and data capture & reporting practices adopted by NoiseNet to identify possible high-emission construction works.

2 Site Context and Installation Locations

Noise and vibration monitors were installed around the project site on Thursday 13th June 2024. Figure 1 shows the installation locations of three smart noise monitors (Serial Numbers 5007, 5037, and 5039) and four vibration monitors (Serial Numbers 1000V, 1001V, 1002V, and 10004V). An additional noise monitor (Serial Number 5038) is expected to be installed at the location indicated.

Noise and vibration monitoring locations were chosen to facilitate long term monitoring of the site, and provide data representative of impacts to residential and commercial receivers in the nearby area. Specifically, sensors 1000v are installed in the skylight opening at the northern end of Merriman Street, 5007 and 1001v in the skylight opening in the middle of Merriman Street, and 5037 and 1002v in the skylight opening towards the southern end of Merriman Street. The position inside the skylight opening is approximately 0.5m below the concrete lip of the skylight, at ground level.

Vibration monitor 1004v was installed at the site ground floor level, at the base of a concrete column and noise monitor 5039 was installed at on the norther façade of Munn Street commercial offices, approximately 1m above ground level. All eight installed sensors are directly powered through the mains power supply to ensure an uninterrupted power supply during the monitoring period. Figure 3(a)-(d) shows the exact location of the installed sensors on the Cutaway project site.

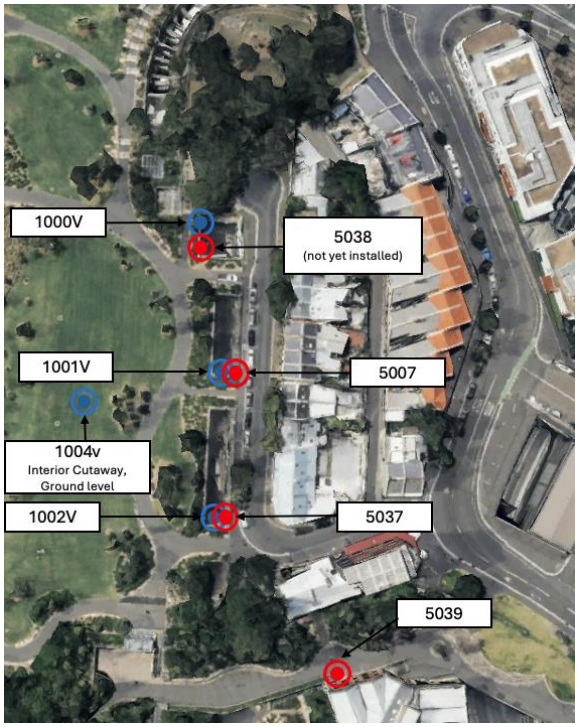


Figure 1: Install location of NoiseNet smart noise monitors and vibration sensors on the Cutaway project construction site.

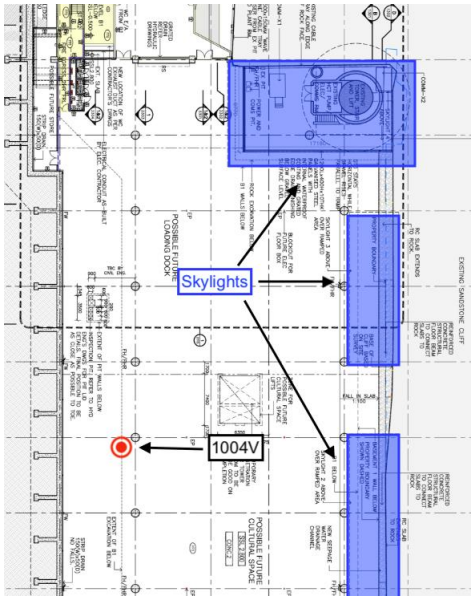


Figure 2: Install location of NoiseNet vibration monitor 1004v

Figure 3: Shows the installed sensors on the Cutaway project site: (a) 5007 & 1001V, (b) 5037 & 1002V, (c) 1004V, and (d) 5039.

3 Receiver Noise Level Adjustments

Due to the positioning of the noise monitors in the skylights, an adjustment is required to reflect noise levels as experienced by residential receivers along Merriman Street. This adjustment is calculated using the methodology described in *ISO9613-2 Attenuation of sound during outdoor propagation,* with further adjustments to be made at the next opportunity for onsite measurement and verification. Noise levels at the sensitive receivers along Merriman Street will be lower than those measured by monitors at the skylights, due to screening effects from site layout, separation distance, and contributions from reflections to the measured level. Adjustments are summarised in Table 1, with additional details available in Section 6.

Effect	Receiver Adjustment (dB)
Screening	-11
Separation Distance	-5
Reflections at measurement position	-2
Total	-18

Table 1: Adjustment from measured levels at skylight monitoring locations, to worst case levels at receiver positions along Merriman Street.

4 Reporting

4.1 Monthly Reporting

Reports summarising noise and vibration results will be issued on or before the 25th of each month, for the duration of the project.

4.2 Dashboard

An Eagle.io workspace has been set up for real-time monitoring of noise and vibration data, with key data summarised in a dashboard overview.

The dashboard is available at the following link:
https://noisenet.eagle.io/ui/nois56/X-FDC_Barangaroo_Cutaway/Barangaroo_Noise_and_Vibration

The workspace, which gives access to all sensor parameters is provided at the following link:
https://noisenet.eagle.io/ui/nois56/X-FDC_Barangaroo_Cutaway

It is recommended that the dashboard (Figure 4) is used view noise or vibration levels as required. Currently displayed parameters are peak velocity (mm/s) for vibration, and $LA_{EQ.10min}$ for noise (including adjustments per Section 3). Additional parameters of interest can be added to the dashboard upon request (described in Table 2, and generally available in the workspace).

Figure 4: Noise and vibration summary dashboard.

Sensor Type	Parameter	Definition	Intuition
Noise	dB slow current	Current A weighted SPL (dB) reading using a slow time-weighting	The instantaneous noise level at the time of the logging statement. Good for comparing a calibration signal or known noise source.
	LEQ-10	Equivalent A weighted continuous sound level averaged over a 10-minute period.	It provides a measure of the average energy of the sound over the specified period. Good to use as the value for general construction noise.
	LA-MAX-10	Maximum A-weighted sound level over a 10-minute period.	Provides a measurement of the loudest observed noise in the last 10 minutes. Good for establishing the impact from short duration impulsive noises.
	L-90-10	A-weighted sound level that is exceeded 90% of the time over a 10-minute measurement period.	Provides a good measurement for the background noise level, and a baseline for comparing other noise levels to.
Vibration	Average (axes)	The average particle velocity in mm/s in the direction of the specified axes, x/y/z.	Estimate of the average vibration velocity in the direction of a particular axes.
	Max (axes)	The maximum particle velocity in mm/s in the direction of the specified axes, x/y/z.	Estimate of worst case vibration velocity in the direction of a particular axes.
	Average	The vector magnitude of average particle velocity in mm/s for all axes	Estimate of the average vibration velocity.
	Peak	The vector magnitude of maximum particle velocity in mm/s for all axes	Estimate of worst case vibration velocity.

Table 2: Noise parameters as reported in the dashboards of the live reporting tool.

4.3 Alerts & Alarms

SMS and email alerting is set up for both noise and vibration. Alarm thresholds and notification settings will be monitored and adjusted in the initial phases of construction to ensure reasonable responsiveness is achieved, while minimising false positive alerts. Current thresholds are as follows.

Sensor Type	Threshold	Level	Action Required
Noise	75dB on LEQ-10	Warning – High Noise Emission	Managers aware that current activities have the potential to be considered as High Emission. Respite periods may have to be observed.
	76dB on LEQ-10, for 60minutes	Alarm – High Noise Emission	Managers aware that current activities are likely to be considered as High Emission. Respite periods will very likely have to be observed. NoiseNet analysts to review and advise.
Vibration	2mm/s (1000v, 1001v, 1002v)	Warning - Vibration	Monitor the situation and liaise with plant operators to advise that the alarm level is being approached. Understand the cause of vibration and mitigate where practical.
	3mm/s (1000v, 1001v, 1002v)	Alarm - Vibration	Stop work. Contact NoiseNet to review. Prepare for inspection of structures for signs of damage.
	5mm/s (1004v)	Warning – Site Vibration	Monitor the situation, particularly vibration levels at other vibration sensors.

Table 3: Noise and vibration alerting and alarming thresholds and actions.

5 Equipment Details

The NoiseNet devices are strategically placed around the construction site to capture accurate noise and vibration levels, ensuring that any exceedances are promptly identified and addressed. The choice of the installation location is based on the construction noise and vibration management sub-plan (CNVMP). Figure 1 shows the installation location of the smart noise monitors and vibration sensors.

5.1 Airborne Noise Monitoring

Figure 5: NoiseNet smart noise monitor

The NoiseNet smart noise monitor is installed at three fixed locations to monitor and capture airborne noise levels (dB) and audio data. Figure 1 shows the installation location of the smart noise monitor at the Cutaway project site (with a blue marker). These devices provide Class 1 noise level readings and have NATA-certified calibrations available. Moreover, these devices have a noise floor and can be adjusted for the surveillance of desired frequency ranges and, therefore, captures all air-transmitted noise.

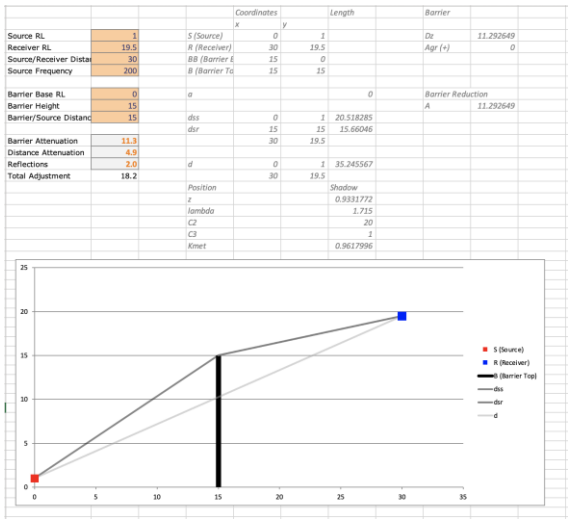
5.2 Vibration Sensing

Figure 6: VSE mk2 8g vibration sensor

NoiseNet is using a combination of VSE mk2 8g and VSE mk4 8g (Convergence Instruments, Sherbrooke, Canada) vibration meter to monitor the vibrations generated as a result of construction activities. It can record accelerations, vibrations, velocities and inclinations.

Depending on the settings it can record acceleration or velocity signals and/or RMS levels for months. Its small size allows for an easy installation.

6 Noise Level Adjustment Calculation



			Coordinates		Length		Barrier	
			x	y				
Source RL	1	S (Source)	0	1			Dz	11.292649
Receiver RL	19.5	R (Receiver)	30	19.5			Agr (+)	0
Source/Receiver Distar	30	BB (Barrier E	15	0				
Source Frequency	200	B (Barrier To	15	15				
Barrier Base RL	0	a			0		Barrier Reduction	
Barrier Height	15						A	11.292649
Barrier/Source Distanc	15	dss	0	1	20.518285			
		dsr	15	15	15.66046			
Barrier Attenuation	11.3		30	19.5				
Distance Attenuation	4.9							
Reflections	2.0	d	0	1	35.245567			
Total Adjustment	18.2		30	19.5				
		Position			Shadow			
		z			0.9331772			
		lambda			1.715			
		C2			20			
		C3			1			
		Kmet			0.9617996			

Figure 7: ISO9613 Screening Calculations for adjustment to receiver level. Worst case conditions are assumed.

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