



CABRAMATTA LOOP PROJECT

AUSTRALIAN RAIL TRACK CORPORATION

CONSTRUCTION MONITORING REPORT

May 2023 to October 2023

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1. Introduction

Australian Rail Track Corporation (ARTC) is constructing a passing loop for up to 1,300m length trains on the Southern Sydney Freight Line (SSFL), which will allow freight trains travelling in opposite directions to pass and provide additional rail freight capacity along the SSFL. The project is referred to as the Cabramatta Loop Project. The project has been assessed under Division 5.2 (State significant infrastructure) of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). The project is State Significant Infrastructure (SSI #9186) and was declared Critical State Significant Infrastructure (CSSI) on 15 May 2020. The Minister for Planning and Public Spaces granted approval of the CSSI on 28 July 2020.

ARTC has contracted Fulton Hogan to construct the Cabramatta Loop Project. The construction works commenced in November 2021 and are being performed under the provisions of the Ministers Conditions of Approval and Environment Protection Licence 3142. In accordance with Condition of Approval C13, the following report details all required monitoring to be undertaken during the reporting period.

C13 The results of the Construction Monitoring Programs must be made publicly available in the form of a Construction Monitoring Report at the frequency identified in the relevant Construction Monitoring Program.

Note: Where a relevant CEMP Sub-Plan exists, the relevant Construction Monitoring Program may be incorporated into that CEMP Sub-Plan.

2. Site Activities and Rainfall

Weather conditions were generally favourable in May, with only 2 days where more than 1mm of rain fell. The BoM recorded 13mm from 6 rain days, which is well below the 63.4mm average for May. This meant that momentum of works in key areas continued without disruption -- particularly around the closed Sussex Street area, FRP/Capping beam continuation and noise panel relocation along Broomfield St. Considerable progression was also made in JOR, with commencement of rail embankment/foundation-related earthworks largely uninterrupted by weather.

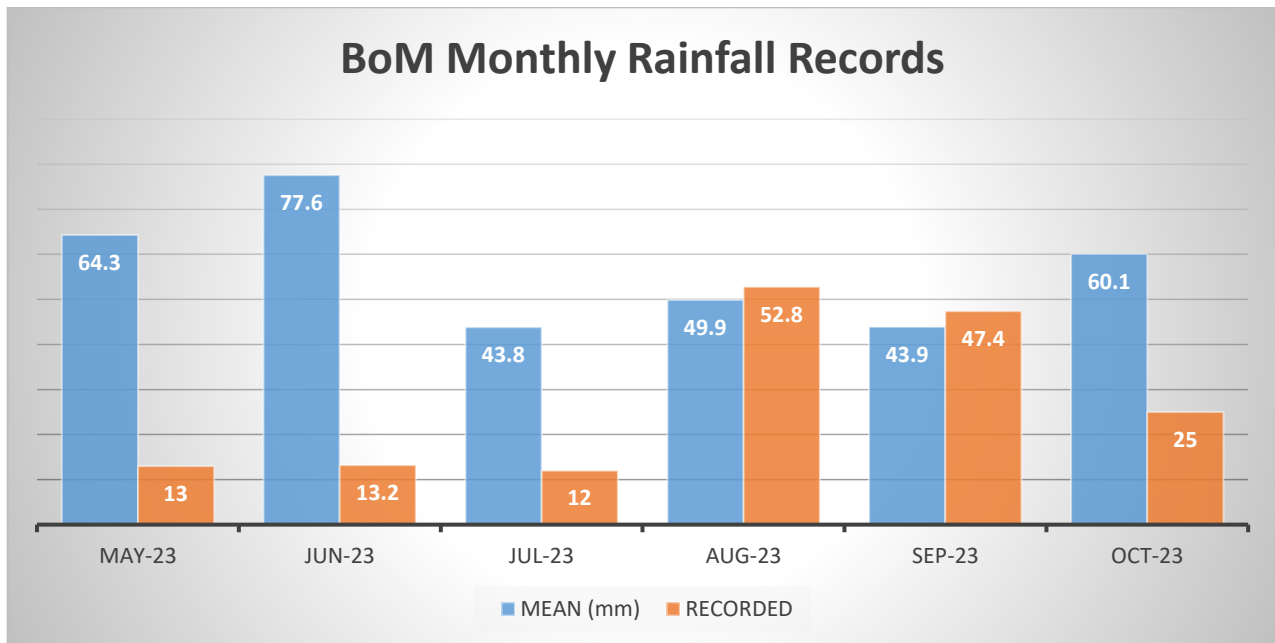
Weather conditions were generally favourable in June, with only 3 days where more than 1mm of rain fell. The BoM recorded 13mm from 6 rain days, which is well below the 77.6mm average for June. This meant that momentum of works in key areas continued without disruption -- particularly around the JOR rail embankment works, FRP/Capping beam continuation and noise panel relocation along Broomfield Street. Considerable progression was also made on finishing works along Broomfield Street where the new shared path and kerb were poured to Junction Street, which demonstrates the shift into the completion stages of the project in focussing on reducing construction footprint and environmental impacts.

Dry weather conditions were again experienced on the project in July, a total of 12mm was recorded was recorded at the closest BoM weather station. This enabled construction works to progress significantly which included planned works around Cabramatta Creek where taking advantage of the low flow conditions helped in reducing the construction footprint and risk. Considerable progression was also made on finishing works along Broomfield Street where pavement waterproofing and landscaping were completed during the month.

Minor rainfall events fell weekly in August which provided a consistent weather pattern for the month. A total of 53mm was recorded at the closest weather station. The experienced weather made dynamic shifts in environmental management. Captured site water was able to be re-used as dust suppression and wet weather aided in enhancing the newly landscaped areas around the project.

Average rainfall was received during September with a monthly total of 47mm. This consistent rain continued the fast establishment of landscaping on the project. The installation of noise wall panels continued, along with successful formation and pour of concrete kerbs, gutters and shared pathways along the western side of Broomfield Street. The reduction in construction footprint through turf installation within Jacqui Osmond Reserve was completed successfully, with rainfall conditions complimentary to the early watering requirements. Conditions were also favourable for the September WE09 possession, during which 100% of the scope was achieved.

Below average rainfall was received during October with a monthly total of 25mm has allowed for a good progression in construction activity on the project. Relocation of the noise wall panels reached above 90% completion and final drainage works proceeded uninterrupted along Broomfield Street. Meanwhile, the rail team took advantage of the dry conditions by completing most of the track formation works, including ballast and sleeper placement in preparation for the November possession.



Above: Rainfall data from the nearest Bureau of Meteorology station at Bankstown Airport vs statistical mean records (May 2023 to October 2023)



Above: Excavations holding water following a minor rainfall event in May 2023



Above: Upstream of ephemeral drain connected to Cabramatta Creek following a minor rainfall event in June 2023



Above: Upstream Cabramatta Creek following a ~14mm rainfall event in August 2023.



Above: Downstream Cabramatta Creek following a minor rainfall event in October 2023



Above: Upstream Cabramatta Creek following a major rainfall event (~35mm) in October 2023.

3. Cabramatta Creek Water Quality Monitoring

The purpose of water quality monitoring during the construction phase is to determine impacts resulting from construction of the project only (i.e. road/ rail construction) and not other unrelated sources, such as upstream urban development, agricultural operations, sewage overflows, or runoff of nutrient rich fertilisers from nearby landscaped parks/ recreational areas such as playing fields or golf courses. Sampling parameters have been assessed for consistency with the following NSW Water Quality Objective Criteria:

Turbidity - Lowland Rivers: 6-50 NTU

pH - Lowland Rivers: 6.5 – 8.5

Oil and Grease: No visual evidence

The GHD study titled Australian Rail Track Corporation – Cabramatta Loop Water Quality Monitoring Report (September 2020), provides the following insights to the two In situ tested physico-chemical indicators and significance :

Turbidity: *“High turbidity is typical of disturbed catchments and during high flow events. Not toxic, but can affect ecosystems and biota”*...*“Turbidity, directly measured in situ by the water quality probe, provides readings which express how light is scattered by suspended particulate material in the water. These results, given in Nephelometric Turbidity Units (NTU), generally provide a good correlation with the concentration of particles in the water that affect water clarity and phytoplankton productivity. Although high turbidity is often a sign of poor water quality and land management, crystal clear water does not always guarantee healthy water. Extremely clear water can signify very acidic conditions, or*

high levels of salinity. The ANZECC (2000) Freshwater Guidelines give a trigger value of 6-50 NTU for turbidity in lowland rivers”.

pH: “Extremes of pH can be directly toxic to biota, and can modify the effect of other stressors (eg release metals)”.... “Most of the adverse effects of pH in water are associated with low pH values (acidic), effectively when pH of less than 6.5 is recorded. ANZECC (2000) states that almost all water quality guidelines around the world recommend that pH should be maintained in the range 6.5 to 9.0 to protect freshwater aquatic organisms. The ANZECC (2000) Guidelines for pH are 6.5 - 8.0 for freshwater lakes and reservoirs, and 6.5 – 8.5 for NSW lowland rivers.”

During the reporting period, surface water quality in Cabramatta Creek has been monitored immediately upstream and downstream of the bridge works at Cabramatta Creek so that any impacts directly related to construction activities can be identified and addressed.

The two construction water quality monitoring locations are indicated below as SW1 (Upstream) and SW2 (Downstream). The sampling sites were moved from those recommended by GHD in advance of construction occurring based on the following assessments:

SW1 (Upstream) was identified as the safest access immediately west of the existing rail bridge over Cabramatta Creek. This is downstream of GHD’s recommended location and picks up additional major urban inflows from a box culvert draining from the west adjacent Cabramatta Sports Grounds containing runoff from parts of Sussex Street (west), Jasmine Crescent and Begonia Avenue and two pipe culverts draining to a headwall just west of the rail bridge crossing, draining parts of Sussex Street (west), Church Street and Railway Parade. Without relocating this upstream monitoring location, any pollutants associated with urban runoff may have been thought attributable to the construction phase of the project.

SW2 (Downstream) was identified as the safest access immediately east of the existing shared user culvert crossing over Cabramatta Creek. Firstly, the site nominated by GHD as Downstream (Broomfield Street cycleway) did not adequately capture potential runoff that could drain into Cabramatta Creek from the piling and crane pads associated with construction of the Cabramatta Creek rail bridge or the potential runoff from the laydown area adjoining Jacqui Osmond Reserve. During a previous reporting period, the project identified a potential new downstream location that took advantage of a previously cleared section of embankment associated with a pumping station to provide safe access to the waterway where potential hazards such as steep embankment, rock and woody debris trips and snakes can be easily identified without impacts to riparian flora. Following a major flooding event, along with antisocial behaviour of a vagrant living at the pumping station, it was determined unsafe to continue monitoring at this location and a contingency location was identified further downstream for times when safety of monitoring staff could not be guaranteed. See Figure 1 and below images for details.



Figure 1 – Indicative water quality monitoring locations



Above:
 Upstream Surface Water Sampling Point SW1
 Latitude: -33.90260 °
 Longitude: 150.93804
 November 2021



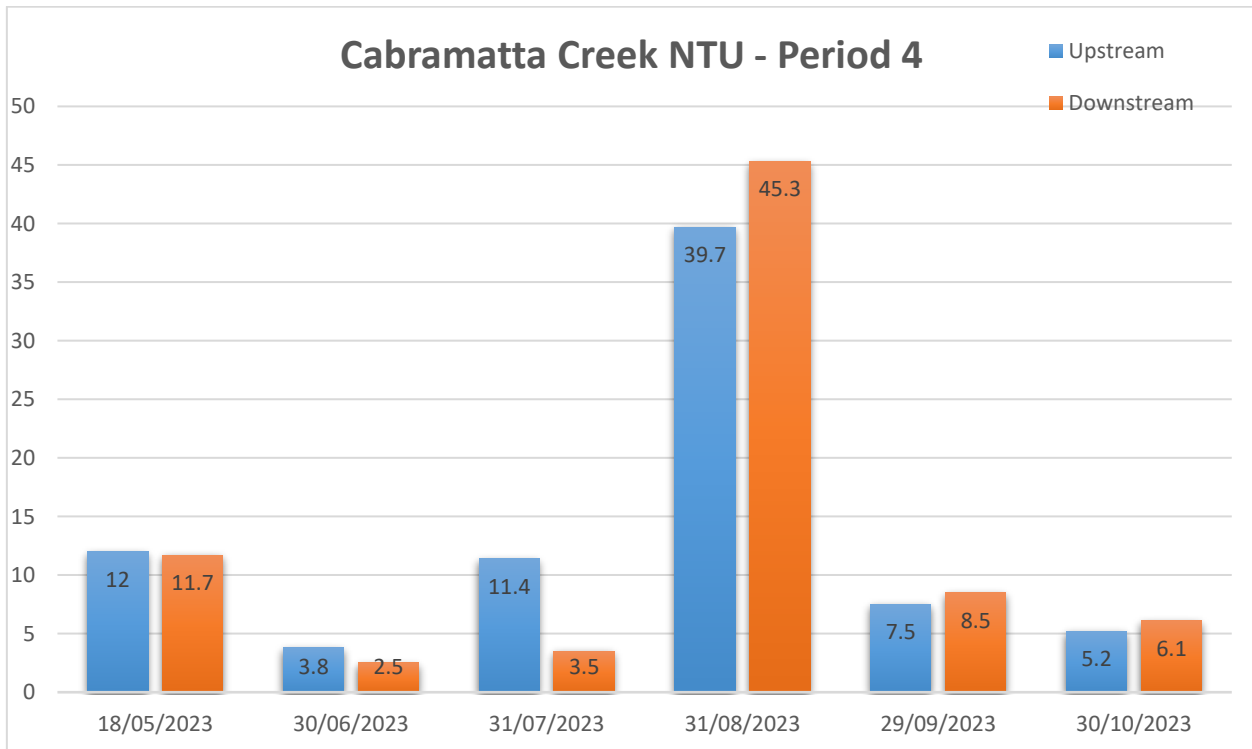
Above:
 Downstream Surface Water Sampling Point SW2
 Latitude: - 33.541814°
 Longitude: 150.562122°
 May 2022

Monitoring sites were sampled opportunistically on a monthly basis. At each site, grab samples were collected for field analysis. In addition, relevant site descriptions and notes were taken for each site and visual observations made. Visual observations included: Visual oil and grease; Stream flows; Water clarity; Water colour, odour and any other notable observations. Photos of each water quality sample site were taken to record the visual appearance of the site at the time of sampling. Where appropriate, photos of stream banks were taken providing a digital record of bank stability, geomorphology and riparian vegetation condition.

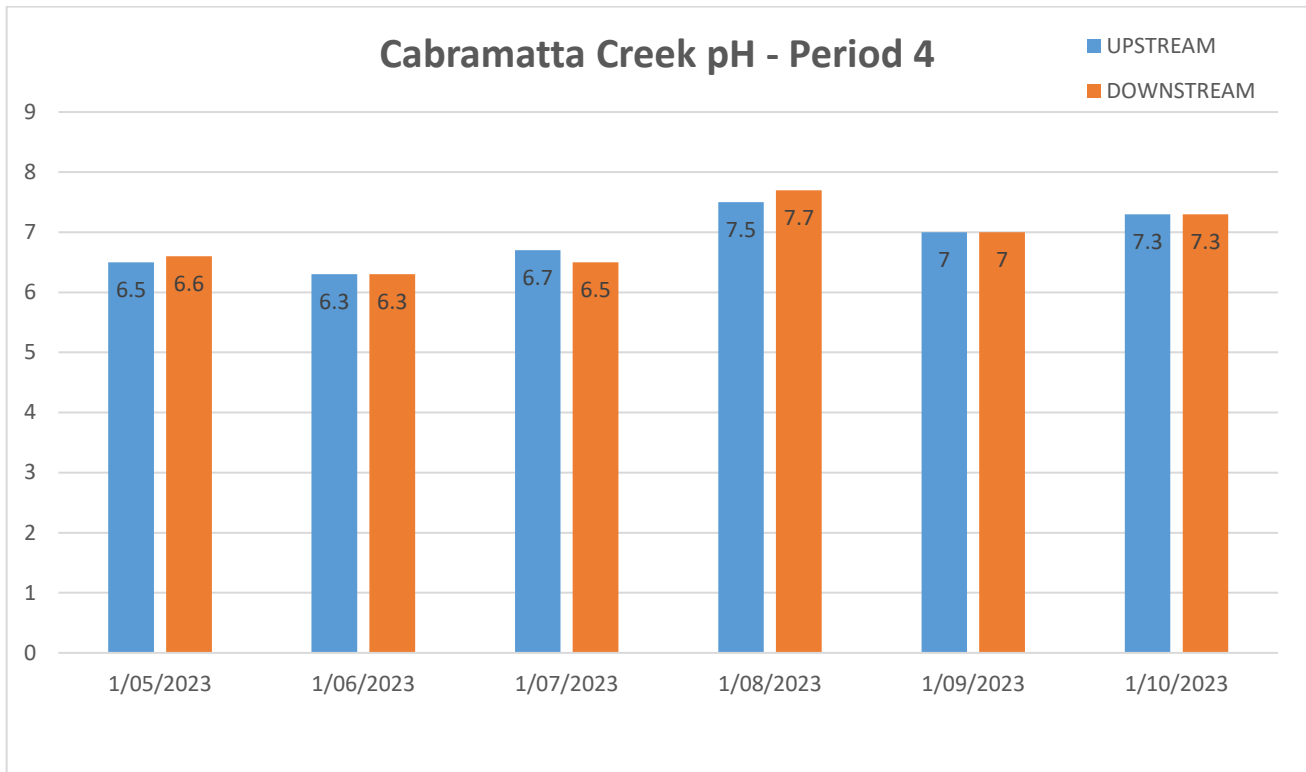
Water quality sampling was performed in accordance with Australian Standard AS/NZS 5667-1998 “Water Quality – Sampling” and “Approved methods for the sampling and analysis of water pollutants in NSW” (EPA, 2022) only when safe for personnel to get close enough to the live waterway. Therefore the data is not reflective of peak worst case water quality conditions, but is representative of general flow parameters at the time of sampling. This data is provided in Table 1 and monthly trends may be interpreted in the following graphs.

Table 1. Water quality monitoring results – May 2023 – October 2023

Date	Location	Co-ordinates	pH	NTU (Field)	Oil & Grease
18/05/2023	Cabramatta Creek Upstream	-33.90260° 150.93804°	6.5	12	Not visible
18/05/2023	Cabramatta Creek Downstream	-33.90531° 150.93942°	6.6	11.7	Not visible
30/06/2023	Cabramatta Creek Upstream	-33.90260° 150.93804°	6.3	3.8	Not visible
30/06/2023	Cabramatta Creek Downstream	-33.90531° 150.93942°	6.3	2.5	Not visible
31/07/2023	Cabramatta Creek Upstream	-33.90260° 150.93804°	6.7	11.4	Not visible
31/07/2023	Cabramatta Creek Downstream	-33.90531° 150.93942°	6.5	3.5	Not visible
31/08/2023	Cabramatta Creek Upstream	-33.90260° 150.93804°	7.5	39.7	Not visible
31/08/2023	Cabramatta Creek Downstream	-33.90531° 150.93942°	7.7	45.3	Not visible
29/09/2023	Cabramatta Creek Upstream	-33.90260° 150.93804°	7	7.5	Not visible
29/09/2023	Cabramatta Creek Downstream	-33.90531° 150.93942°	7	8.5	Not visible
30/10/2023	Cabramatta Creek Upstream	-33.90260° 150.93804°	7.3	5.2	Not visible
30/10/2023	Cabramatta Creek Downstream	-33.90531° 150.93942°	7.3	6.1	Not visible



Above: Turbidity data from Table 1 graphed to demonstrate monthly trends



Above: pH data from Table 1 graphed to demonstrate monthly trends

Prior to construction GHD was engaged by ARTC to prepare the baseline water quality monitoring program for the project titled 'Australian Rail Track Corporation Cabramatta Loop: Water Quality Monitoring Report' dated September 2020. This baseline monitoring of surface water quality commenced in May 2019 at various sites upstream and downstream from the project and monitored baseline conditions for twelve months between May 2019 and April 2020.

In March of 2023, Bureau of Meteorology modelling declared that the La Nina period was over and ENSO-neutral conditions were likely to continue. This announcement marked the end of ~3 back-to-back years of intense rainfall and accompanied flooding around NSW. Broadly, the water quality samples obtained within the May – October 2023 monitoring period were comparable to GHDs baseline parameters, which may be attributed to the significant reduction in rainfall conditions within the catchment.

During the period May 2023 – October 2023 the following observations have been made:

- No oil or grease was observed as visible during any sampling event.
- In all months, the turbidity recorded at both the upstream and downstream sites was below the 50 NTU NSW Water Quality Objective Criteria. In June, July, September and October, turbidity was recorded below or close to the lower guideline of 6 NTU. Extremely clear water can signify very acidic conditions or high levels of salinity however these results are consistent with baseline monitoring data where GHD previously reported "A number of samples at all sites were below the lower guideline, this was attributed to the salinity of the sites as recorded in the EC present. Whilst these samples are regarded as outside the guideline range, the low turbidity can be expected due to natural processes present at the sites." In relation to levels ranging from 2.5 to 45.3 NTU, these

values are consistent with baseline maximums where GHD has commented “*these results are as expected in wet weather flows through areas where urbanisation through the catchment has occurred, as it has in much of the Cabramatta Creek catchment.*” Because of these findings the elevated turbidity levels recorded in the construction monitoring program represent background conditions and do not provide any attributable factors related to construction activities.

- In all months besides June, pH recordings were always within the ANZECC guideline range, with a lower end of 6.3pH and a high end of 7.7pH . June samples indicated a pH of 6.3pH upstream and 6.3pH downstream, which is slightly below the guideline range for lowland rivers. However, June’s sample echoes the results observed by GHD during baseline monitoring. The highest pH readings came from the month of August, indicating a pH of 7.5pH upstream and 7.7pH downstream. These samples are within the guideline range and consistent with the 20th and 80th percentile ranges observed during GHDs baseline monitoring.
- Based on the available data and field observations, the construction phase environmental controls and management measures implemented during the six month period have been effective in meeting the project’s water quality objectives and minimising impacts to the Cabramatta Creek and Georges River ecosystems.



Above: Downstream sampling of Cabramatta Creek during July.

4. Noise Monitoring Results

Chapter 9 of the EIS assessed the potential extent and magnitude of noise impacts generated from construction of the project. This included a detailed assessment documented in EIS Volume 2 – Technical Report 2 – Cabramatta Loop Project: Noise and Vibration Impact Assessment (GHD, August 2019). As a result of this study, the area of potential noise sensitive receivers has been divided into four noise catchment areas (NCAs). These NCAs are based on ambient noise characteristics with respect to major roads and rail corridors in the project area as described and represented in Figure 2 below:

- NCA 1: The area to the North of Jacqui Osmond Reserve and west of the rail corridor. The area comprises of commercial and residential land uses. Rail noise, road traffic noise from Railway Parade and noise from commercial premises along Railway Parade dominate the noise environment in NCA01.
- NCA 2: The area to the North of Jacqui Osmond Reserve and east of the rail corridor. The area comprises of residential land uses. Road traffic noise from Broomfield Street and local roads in the area dominate the noise environment with Hume Highway operations contributing to background noise levels. An existing noise wall along Broomfield Street attenuates rail noise.
- NCA 3: The area to the South of Jacqui Osmond Reserve and West of the rail corridor. The area comprises of primarily residential land uses. Rail noise and traffic along the Hume Highway and local roads dominate the noise environment in NCA03.
- NCA 4: The area to the South of Jacqui Osmond Reserve and East of the rail corridor. The area comprises of primarily industrial and commercial land uses. Rail noise and industrial activities dominate the noise environment in NCA04.

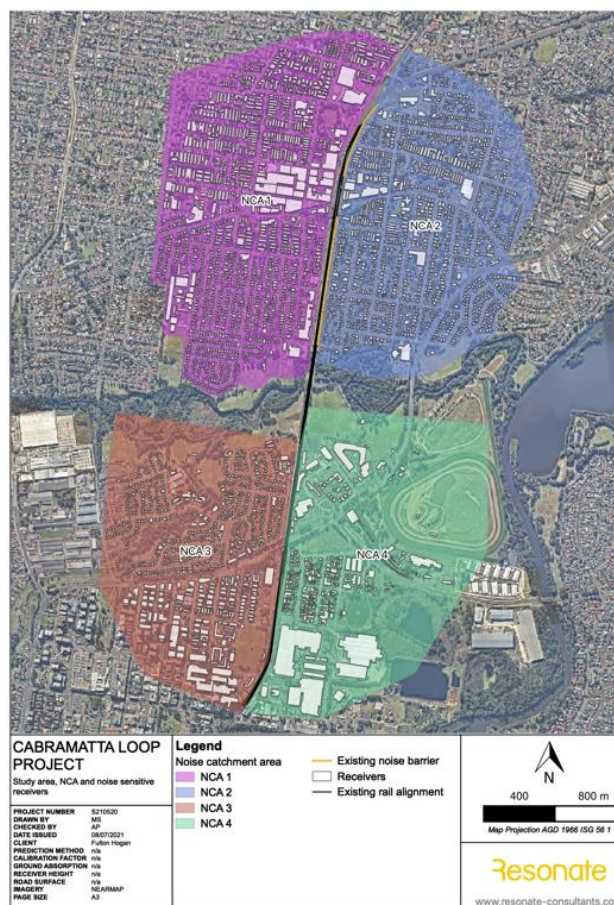


Figure 2: Noise Catchment Areas

The nominated monthly attended noise monitoring locations are shown in Figure 3 and listed below:

- Location 1: 225 Railway Parade, Cabramatta
- Location 2: 150 Broomfield Street, Cabramatta
- Location 3: Corner of Station Street and Lawrence Hargrave Road
- Location 4: In railway corridor north of Warwick Farm Station

The monitoring locations were selected to cover each NCA and proximity to key construction zones and most potentially affected sensitive receivers.

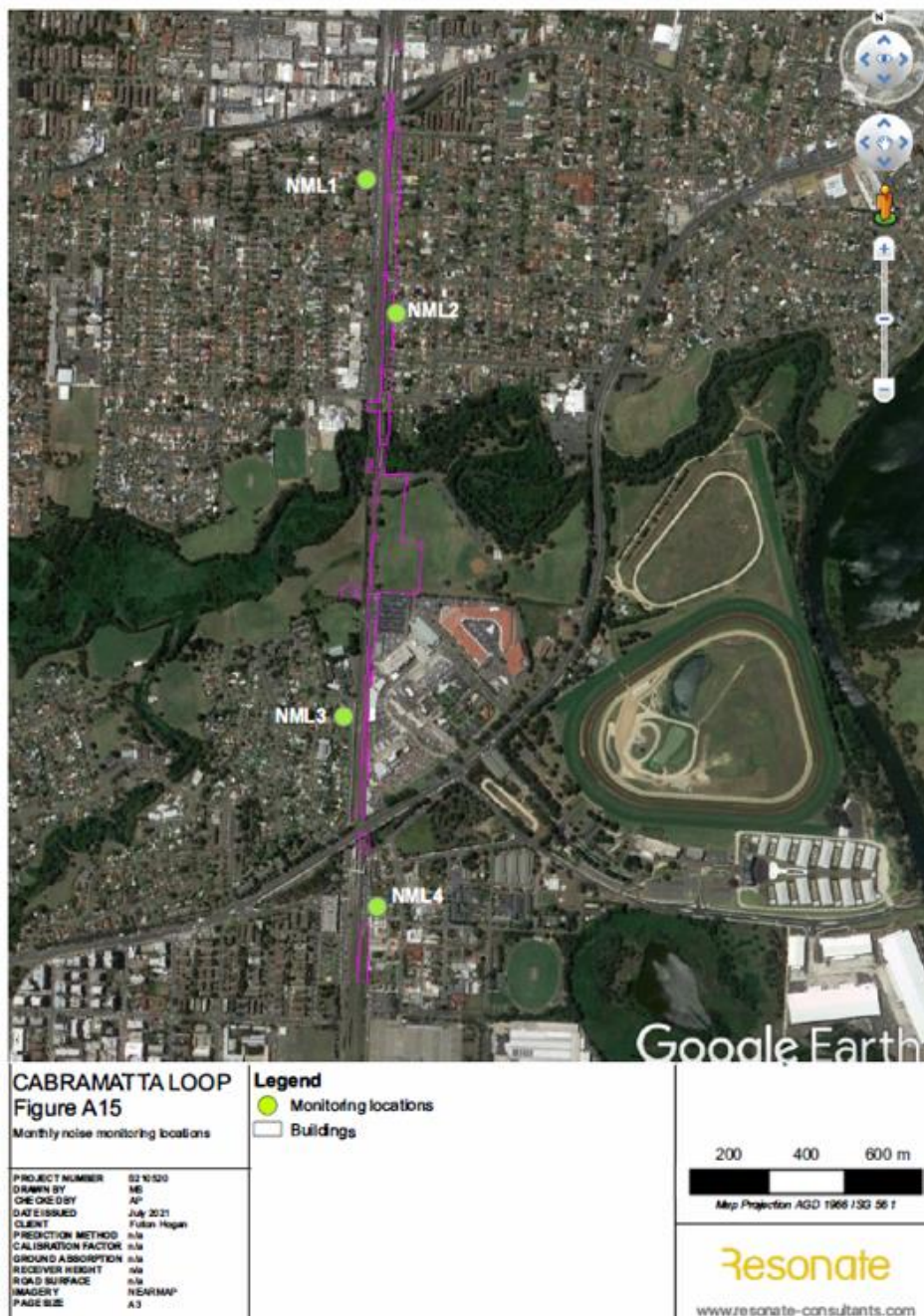


Figure 3 – Indicative noise monitoring locations

A summary of the baseline noise monitoring including a description of the ambient noise environment at each location is provided in the table below.

Table 2. Summary of Baseline Noise Monitoring

NCA	Address	Free-field or façade	Rating background level (RBL)			Ambient noise levels, $L_{Aeq}(\text{period})$					Ambient noise observations
			Day	Evening	Night	Day	Evening	Night	Day (15 hour)	Night (9 hour)	
-	In rail corridor (North of Warwick Farm Station)	Free field	-	-	-	65	64	63	65	63	Rail noise dominant
-	In rail corridor (South of Cabramatta Station)	Free field	43	41	33	68	68	66	68	66	Rail noise dominant
01	225 Railway Parade, Cabramatta	Free field	45	44	33	61	61	59	61	59	Rail noise dominant, road traffic noise along Railway Parade
02	150 Broomfield Street, Cabramatta	Façade	39	38	31	56	56	52	56	52	Rail noise dominant, road traffic noise along Broomfield Street, construction works at residence along Broomfield Street
02	46a National Street, Cabramatta	Free field	38	37	31	53	48	46	51	46	Rail noise faintly audible, road traffic noise along National Street
01	41 Church Street, Cabramatta	Free field	38	39	30	55	53	50	54	50	Road traffic noise along Church Street, rail passbys in background
03	25 Lawrence Hargrave Road, Warwick Farm	Free field	37	38	32	52	50	47	50	47	Rail noise dominant, car passbys and bird noise

As a result of this baseline monitoring, the below noise management levels were determined and are used to ensure that impacts to noise and vibration are minimised and within the scope permitted by the project approval through the employment of reasonable and feasible attenuation and management measures:

Table 3. Summary of residential noise management levels

NCA	Standard hours, $L_{Aeq,16\text{min}}$	OOHW Period 1, $L_{Aeq,16\text{min}}$		OOHW Period 2, $L_{Aeq,16\text{min}}$	Sleep disturbance, $L_{AF\text{max}}$
		Day	Evening	Night	Night
NCA01	48	43	42	36	52
NCA02	48	43	43	35	52
NCA03	47	42	42	37	52
NCA04	47	42	42	37	52

The following noise monitoring has been performed:

- Monthly noise monitoring at sensitive receiver locations identified as Noise Monitoring Locations 1 to 4 from May 2023 to November 2023;
- Where Out of Hours Works have been performed, monitoring has also been undertaken at the closest receivers and at random locations for the purpose of verification within the catchment.

This has occurred during weekend track closures known as “possessions”. Such activities are permitted by ARTC’s Environmental Protection Licence to provide a safe working environment and the works are assessed in accordance with the OOHW Protocol approved by the Department of Planning and Environment.

- During this reporting period the following possessions have taken place:
 - WE09 – 26th – 22nd of August 2023
 - WE13 – 22nd – 24th of September 2023

Three (3) complaints were received in relation to acoustic impacts within the four noise catchments during the reporting period.

Attended measurements were conducted using the following instrumentation:

- Sound Level Meter - Rion NA-28 sound level meter serial number: 01270688
- Sound Calibrator – Pulsar Model 106 serial number 83428

The sound level meter holds a current calibration certification. The Rion NA-28 was manufactured before 2019 and complies with Australian Standard IEC 61672.1:2013. The Pulsar 106 complies with the requirements set out in IEC 60942:2017 Electroacoustics: sound calibrators. The attended measurement events were guided by the methods described in Australian Standard 1055:2018 Acoustics: description and measurement of environmental noise and Approved methods for the measurement and analysis of environmental noise in NSW (EPA, 2022).

Field calibration of the sound level meter was checked both prior and post measurement and no noise level drift was observed. All monitoring locations have been established to ensure outdoor free-field noise level measurements where the influence of reflecting structures (other than the ground) is minimised i.e., measurements have been undertaken at least 3.5m from any reflecting structure and at a height of 1.2m above ground level mounted on a tripod. There were no instances where the nearest residence was more than 30m away from the monitoring location.

Although the project formally entered “construction commencement” 30 days after approval of the Construction Environmental Management Plan, minimal enabling work activities beyond compound establishment in Jacqui Osmond Reserve occurred in November 2021, hence the attended monitoring data for November (as reported in Period 1 report) is very useful in terms of context and comparison against the baseline established in 2018/19 during the EIS planning phase. No construction impacts were audible during this time at any of the noise monitoring locations and on each occasion, the recorded minimums were above the rated background levels for each catchment. This has been a trend throughout the construction period, indicating some change in ambient acoustics has likely occurred during the past few years. Frequent monitoring in noise catchments 3 and 4 also provide insights to current ambient conditions with minimal project work occurring outside of possession weekends.

During this monitoring period, with the exception of possession weekends, almost always ambient acoustics are dominated by background noise in all catchments except for NCA 2 where Broomfield Street enabling work such as utility diversions and street realignment civil works are the primary noise source. Significant contributions to background levels are attributed to common noise sources including passenger and freight trains within the rail corridor, light and heavy vehicles on local roads and the Hume Highway bridge over the rail corridor at Warwick Farm (to the South for NCAs 3 and 4) and Cabramatta Road bridge over the rail at Cabramatta (to the North for NCAs 1 and 2), overhead

aircraft including jet and propeller thrust aircraft as well as helicopters departing and approaching Bankstown Airport.

Each month of attended monitoring data and observations are represented in Tables 4 to 9.

NB: OOHW monitoring was undertaken by an acoustic consultant (Resonate) on Sunday 13 November 2022 (WE22 Possession). Results are presented in the tables below.



Acoustics • EMF • Structural Dynamics • Vibration



Acoustics • EMF • Structural Dynamics • Vibration

Table 1 Noise Measurement Locations

ID	Location	Description of Works
AM01	1-109 Stage 4 of 4 Riverpark Drive, Liverpool	Concrete pour via mini-pump truck and concrete agitator
AM02	Footpath outside of 2 Lawrence Hargrave Road, Warwick Farm	WF18 Signal installations Warwick Farm Station (north) B. Stockpile operations Warwick Farm Station (South) C. Trench & Install CSR trench and conduits (33.890 to 33.920km) D. Track Formation widening works (33.630 to 33.800km) E. Inter track Drainage Works (33.432 to 33.630km) F. Track Underbore & pit installations (33.900km) G. Main compound logistical activities and stockpile operations in Jacqui Osmond Reserve
AM03	Footpath outside of 13 Station Street, Warwick Farm	WF18 Signal installations Warwick Farm Station (north) B. Stockpile operations Warwick Farm Station (South) C. Trench & Install CSR trench and conduits (33.890 to 33.920km) D. Track Formation widening works (33.630 to 33.800km) E. Inter track Drainage Works (33.432 to 33.630km) F. Track Underbore & pit installations (33.900km) G. Main compound logistical activities and stockpile operations in Jacqui Osmond Reserve
AM04	Western end of walkway between Warwick Street and Manning Street, Warwick Farm	WF18 Signal installations Warwick Farm Station (north) Stockpile operations Warwick Farm Station (South) Trench & Install CSR trench and conduits (33.890 to 33.920km) Track Formation widening works (33.630 to 33.800km) Inter track Drainage Works (33.432 to 33.630km) Track Underbore & pit installations (33.900km) Main compound logistical activities and stockpile operations in Jacqui Osmond Reserve
AM05	Footpath outside of 100 Broomfield Street, Cabramatta	Backfill around Loc & pathway, hand mix concrete, install ballast on trackside of LOC slab, clean up
AM06	Footpath outside of 225 Railway Parade, Cabramatta	Backfill around Loc & pathway, hand mix concrete, install ballast on trackside of LOC slab, clean up

3 Noise Measurement Results

The measured noise levels and discussion of key observations is presented in Table 2.

Table 2 Noise Measurement Results

ID/Meas no.	Time	Duration (minutes)	Predicted L _{Aeq} (15 minute) dB(A)	Estimated (Measured) L _{Aeq} (15 minute) dB(A) Construction Noise	Measured L _{Aeq} (15 minute) dB(A) Total Noise	Measured L _{A90} dB(A) Total Noise	Comment
AM01 1 (60)	10:36	15	66	49	52	47	<ul style="list-style-type: none"> Works were typically around 47 dB(A) discernible over ambient. Road traffic on main Newbridge Road was audible. Non-tonal reversing alarms 49 dB(A). Impact noise at times 50 – 52 dB(A). Airplane flyover. Infrequent local traffic.
AM01 2 (61)	10:55	15	66	49	50	47	<ul style="list-style-type: none"> Works were discernible over ambient, typically 49 dB(A). Occasional impact noises 54 dB(A). Metal on metal 61 dB(A) Road traffic on main Newbridge Road was audible. Infrequent local traffic.
AM02 (62)	11:29	15	57	47	49	43	<ul style="list-style-type: none"> Light rain. Idling plant 44 – 46 dB(A). Non-tonal reversing alarms 50 - 52 dB(A). Amplified music from residence was audible at times 44 dB(A).

ID/Meas no.	Time	Duration (minutes)	Predicted L _{Aeq} (15 minute) dB(A)	Estimated (Measured) L _{Aeq} (15 minute) dB(A) Construction Noise	Measured L _{Aeq} (15 minute) dB(A) Total Noise	Measured L _{A90} dB(A) Total Noise	Comment
AM03 (63)	11:49	15	59	53	54	50	<ul style="list-style-type: none"> • Heavier rain at times during this measurement period. • Non-tonal reversing alarms and road traffic from overpass clearly audible. • Excavator 57 – 59 while under load. • Local road traffic not contributing to period L_{eq}. • Excavator reversing alarm 64 dB(A) when directly opposite measurement location.
AM04 (64)	12:17	15	52	Not directly measurable	51	47	<ul style="list-style-type: none"> • Works were not visible or audible during measurement period.
AM05 (65)	12:49	15	60	53	58	51	<ul style="list-style-type: none"> • Contribution from local traffic and on overpass. • Amplified music from residence. • Conversation from residences 54 dB(A). • Works audible infrequently however not the dominant noise source. • Light aircraft flyover 65 dB(A). • 61 dB(A) typical local car pass by. • Infrequent grinding/pneumatic equipment at times 60 dB(A).

ID/Meas no.	Time	Duration (minutes)	Predicted L _{Aeq} (15 minute) dB(A)	Estimated (Measured) L _{Aeq} (15 minute) dB(A) Construction Noise	Measured L _{Aeq} (15 minute) dB(A) Total Noise	Measured L _{A90} dB(A) Total Noise	Comment
AM06 1 (66)	13:15	15	48	Not directly measurable	64	52	<ul style="list-style-type: none"> • Noise environment dominated by train replacement buses and local traffic.
AM06 2 (67)	13:32	15	48	Not directly measurable	65	52	<ul style="list-style-type: none"> • Noise environment dominated by train replacement buses and local traffic.

4 Summary and General Observations

Noise levels were below those predicted of for the works. The noise measurements confirmed that the noise mitigation implemented in accordance with the Construction Noise and Vibration Management Plan was appropriate. Whilst the use of a mini-pump and concrete agitator was required for the Liverpool Station works, the noise levels were not of sufficient magnitude to require additional mitigation measures over and above that which was implemented at any of the measurement locations.

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

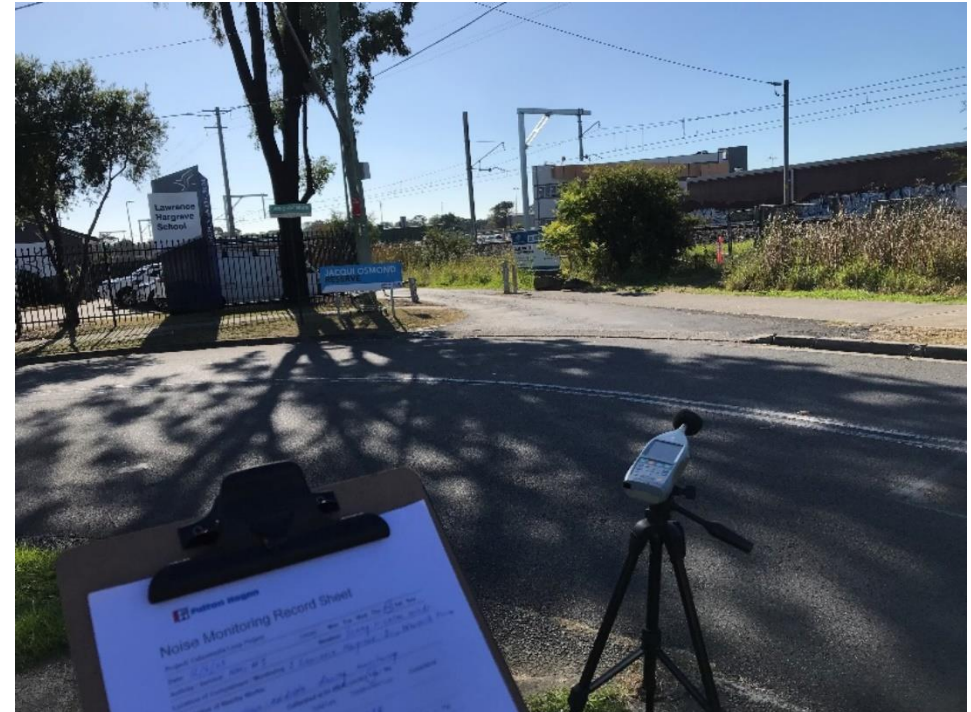
Yours sincerely,



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Above: Attended monitoring at 150 Broomfield St (NML2) during noise panel relocation works in May 2023.



Above: Attended monitoring at 2 Lawrence Hargrave Dr (NML3) during May 2023.

Table 4. Attended noise monitoring results – May 2023

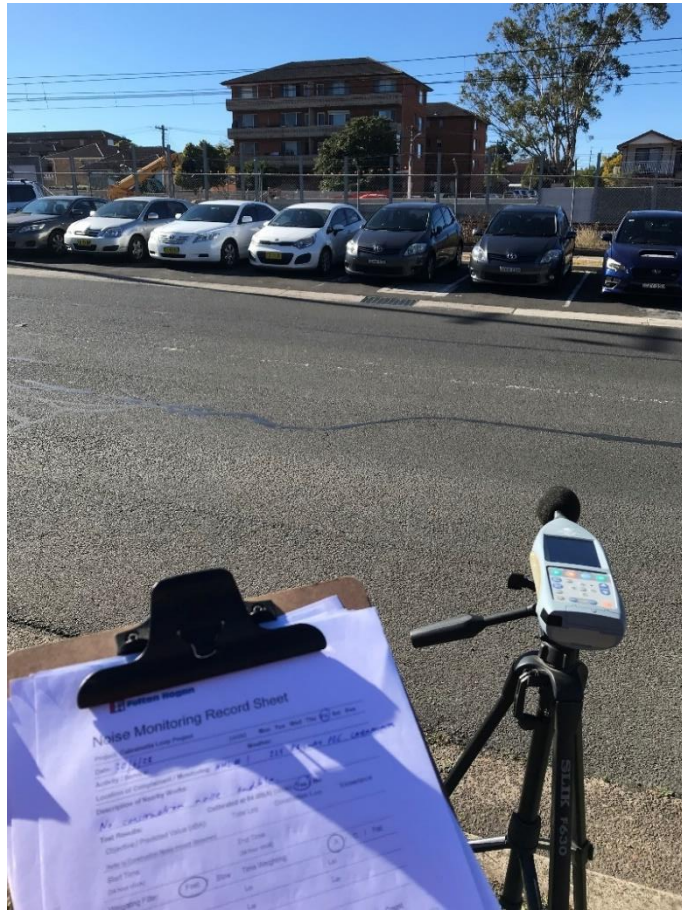
ID# / NCA	Location	Reason for monitoring	Date/Time	RBL dB(A)	L(A) _{eq(15min)} dB(A)	Comments					
						L(A) _{eq(15min)}	L(A) _{max}	L(A) _{10(15min)}	L(A) _{90(15min)}	L(A) _{min}	
NML1 NCA1	Location 1 – 225 Railway Parade, Cabramatta	Monthly Monitoring - Assessment of potential noise impacts	26/5/2023	45	67	67	81	71	52	45	<p>Passing LVs and buses dominated the acoustics. CLP construction not audible during monitoring.</p> <ul style="list-style-type: none"> - >300 LVs @50-72dB for 3-5 secs. - 8 x Passing HVs (mainly buses) @53-78dB for 3-5 secs. - 2 x overhead aircraft @50-60dB for 20-30 secs. - 5 x Syd Trains @52-68dB for 7-10 secs. - 1 x Freight Train @50-80dB for ~2 min. - Cabramatta Rd constantly audible in background @46-49dB aside from very brief moments. - >20 x pedestrians (mainly school kids) chatting @48-55dB for 5-7 secs.

ID# / NCA	Location	Reason for monitoring	Date/Time	RBL dB(A)	L(A) _{eq(15min)} dB(A)	Comments				
						L(A) _{eq(15min)}	L(A) _{max}	L(A) _{10(15min)}	L(A) _{90(15min)}	L(A) _{min}
NML2 NCA2	Location 2 – 150 Broomfield Street, Cabramatta	Monthly Monitoring - Assessment of potential noise impacts	30/5/2023	39	64	64	73	67	54	48
<p>Monitoring occurred during works associated with noise panel relocation south of the NML and capping wall formwork directly opposite. Acoustics were generally dominated by these works during standard hours.</p> <ul style="list-style-type: none"> - 1 x passing HV @58-66dB for 5-7 secs. - 4 x overhead aircraft @58-67dB for 15-30 secs. - 5 x Syd Trains @50-60dB for 5-7 secs. - Generator @60dB for 90 secs. - EWP engine + tracking back and forth @62-66dB for 90 secs. - Franna engine/quacker @60-72dB for 90 secs. - Rattling chains on noise panels @53-55dB for 60 secs. - >20 x Dogs barking @48-50dB for 3-5 secs. - Grinder at pit installation @50-52dB for 30 secs. - Truck loading out behind wall @48-50dB for 5-7 secs. 										

ID# / NCA	Location	Reason for monitoring	Date/Time	RBL dB(A)	L(A) _{eq(15min)} dB(A)	Comments										
NML3 NCA3	Location 3 - Corner of Station Street and Lawrence Hargrave Road, Warwick Farm	Monthly Monitoring - Assessment of potential noise impacts	12/5/2023	37	62	<table border="1"> <thead> <tr> <th>L(A)_{eq(15min)}</th> <th>L(A)_{max}</th> <th>L(A)_{10(15min)}</th> <th>L(A)_{90(15min)}</th> <th>L(A)_{min}</th> </tr> </thead> <tbody> <tr> <td>62</td> <td>80</td> <td>62</td> <td>43</td> <td>41</td> </tr> </tbody> </table> <p>No construction noise audible during monitoring. Catchment dominated by aircraft and Sydney Trains.</p> <ul style="list-style-type: none"> - 8 x overhead aircraft @48-61dB for 20-30 secs. - 5 x Syd trains passing @47-75dB for 8-12 secs. - 1 x freight train @49-77dB for 30 secs. - Hume Hwy constantly audible @44-47dB. - Music/singing at Lawrence Hargrave School @46-47dB for ~3 mins. - >50 horns at Peter Warren @47-49dB for 1-2 secs. 	L(A) _{eq(15min)}	L(A) _{max}	L(A) _{10(15min)}	L(A) _{90(15min)}	L(A) _{min}	62	80	62	43	41
L(A) _{eq(15min)}	L(A) _{max}	L(A) _{10(15min)}	L(A) _{90(15min)}	L(A) _{min}												
62	80	62	43	41												
NML4 NCA4	Location 4 - Warwick Farm Station Car Park	Monthly Monitoring - Assessment of potential noise impacts	26/5/2023	37	62	<table border="1"> <thead> <tr> <th>L(A)_{eq(15min)}</th> <th>L(A)_{max}</th> <th>L(A)_{10(15min)}</th> <th>L(A)_{90(15min)}</th> <th>L(A)_{min}</th> </tr> </thead> <tbody> <tr> <td>62</td> <td>85</td> <td>57</td> <td>51</td> <td>47</td> </tr> </tbody> </table> <p>No construction noise audible during monitoring. Catchment dominated by Syd Trains.</p> <ul style="list-style-type: none"> - 2 x passing LVs (commuters) @53-64dB for 3-5 secs. - 2 x overhead aircraft @50-58dB for 15-20 secs. - 6 x Syd Trains @53-62dB for 5-7 secs (all 6 stopped). - 1 x small freight train @52-84dB for 20 secs. - Hume Hwy constant @47-53dB. - Small birds chirping in nearby trees and cockatoos overhead sporadic @50-60dB. - Lawn mower in distance @53dB for 3 mins. 	L(A) _{eq(15min)}	L(A) _{max}	L(A) _{10(15min)}	L(A) _{90(15min)}	L(A) _{min}	62	85	57	51	47
L(A) _{eq(15min)}	L(A) _{max}	L(A) _{10(15min)}	L(A) _{90(15min)}	L(A) _{min}												
62	85	57	51	47												

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ID# / NCA	Location	Reason for monitoring	Date/Time	RBL dB(A)	L(A) _{eq(15min)} dB(A)	Comments					
						L(A) _{eq(15min)}	L(A) _{max}	L(A) _{10(15min)}	L(A) _{90(15min)}	L(A) _{min}	
Spot test	3/247 Railway Pde, Cabramatta	Test monitoring of existing retaining wall demolition (hammering)	29/5/2023	-	65	65	81	69	46	41	<p>Catchment generally dominated by passing light vehicles and Sydney Trains. Hammering of existing retaining wall ~20 metres away was audible at times.</p> <ul style="list-style-type: none"> - >100 x LVs @51-75dB for 3-5 secs - 1 x Overhead aircraft @50-75dB for 15-20 secs - 7 x Syd Trains @52-80dB for 7-10 secs - 1 x freight train @48-81dB for ~30 secs - Hammering of retaining wall @56-61dB for ~10 mins - 4 x Birds squawking overhead @60-65dB for 2-3 secs - 6 x Angle grinder from nearby commercial area for ~2 mins



Above: Monitoring at 225 Railway Pde (NML1) during June 2023.



Above: Calibrating the machine at 94 dB(A) before monitoring in June 2023.

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Table 5. Attended noise monitoring results – June 2023

ID# / NCA	Location	Reason for monitoring	Date/Time	RBL dB(A)	L(A) _{eq(15min)} dB(A)	Comments					
						L(A) _{eq(15min)}	L(A) _{max}	L(A) _{10(15min)}	L(A) _{90(15min)}	L(A) _{min}	
NML1 NCA1	Location 1 – 225 Railway Parade, Cabramatta	Monthly Monitoring - Assessment of potential noise impacts	30/06/2023	45	65	65	79	69	52	46	<p>No construction noise audible during monitoring. Catchment dominated by LVs and HVs as per usual. Very busy road.</p> <ul style="list-style-type: none"> - >300 LVs (some speeding) @51-80dB for 4-6 secs. - 4 x buses turning at Boundary Ln @50-65dB for 5-7 secs. - 2 x Syd trains @52-72dB for 10-12 secs. - 1 x freight train @52-76dB for 30-40 secs. - Cabramatta Rd constant @48-50dB. - Pedestrians nearby walking/chatting @53-55dB for 5-7 secs.

ID# / NCA	Location	Reason for monitoring	Date/Time	RBL dB(A)	L(A) _{eq(15min)} dB(A)	Comments					
						L(A) _{eq(15min)}	L(A) _{max}	L(A) _{10(15min)}	L(A) _{90(15min)}	L(A) _{min}	
NML2 NCA2	Location 2 – 150 Broomfield Street, Cabramatta	Monthly Monitoring - Assessment of potential noise impacts	30/06/2023	39	61	61	80	64	50	46	<p>Monitoring took place during minor excavation and tidy up works near the Junction St gate access.</p> <ul style="list-style-type: none"> - 1 x LV (hybrid) @50-54dB for 3-5 secs. - 2 x overhead aircraft @54-68dB for 20-30 secs. - 3 x Syd trains @53-70dB for 5-7 secs. - 4 x excavator tracking @53-61dB for 5-7 secs. - 5 x excavator bucket clanging/dumping @58-63dB for 2-3 secs. - 1 x wacker packer @52-54dB for 5 mins. - 20 x birds chirping @54-57dB for 1-2 secs. - Second excavator clanging bucket/tracking @65-75dB for 2 mins.
NML3 NCA3	Location 3 - Corner of Station Street and Lawrence Hargrave Road, Warwick Farm	Monthly Monitoring - Assessment of potential noise impacts	30/06/2023	37	62	62	80	63	49	46	<p>No construction noise audible.</p> <ul style="list-style-type: none"> - 3 x passing LVs @50-63dB for 4-6 secs. - 2 x overhead aircraft @51-60dB for 20-30 secs. - 7 x Syd trains @52-76dB

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ID# / NCA	Location	Reason for monitoring	Date/Time	RBL dB(A)	L(A) _{eq(15min)} dB(A)	Comments					
						L(A) _{eq(15min)}	L(A) _{max}	L(A) _{10(15min)}	L(A) _{90(15min)}	L(A) _{min}	
NML4 NCA4	Location 4 - Warwick Farm Station Car Park	Monthly Monitoring - Assessment of potential noise impacts	30/06/2023	37	60	60	75	56	50	46	No construction noise audible during monitoring. Catchment dominated by Syd Trains. - 6 x passing LVs (commuters) @53-64dB for 3-5 secs. - 4 x overhead aircraft @50-58dB for 15-20 secs. - 6 x Syd Trains @53-62dB for 5-7 secs (all 6 stopped). - Hume Hwy constant @46-53dB. - Small birds chirping in nearby trees @50-60dB.



Above: Monitoring at Warwick Farm Station (NML4) during July 2023.



Above: Monitoring at 150 Broomfield St (NML2) during July 2023.

Table 6. Attended noise monitoring results – July 2023

ID# / NCA	Location	Reason for monitoring	Date/Time	RBL dB(A)	L(A) _{eq(15min)} dB(A)	Comments					
						L(A) _{eq(15min)}	L(A) _{max}	L(A) _{10(15min)}	L(A) _{90(15min)}	L(A) _{min}	
NML1 NCA1	Location 1 – 225 Railway Parade, Cabramatta	Monthly Monitoring - Assessment of potential noise impacts	31/07/2023	45	65	65	93	69	51	45	<p>Construction noise barely discernible during monitoring. Works on opposite side of track involved removal and relocation of noise panels. Catchment dominated by light vehicle traffic and regular Sydney Trains.</p> <ul style="list-style-type: none"> - >250 x LVs @51-75dB for 3-5 secs (almost constant). - 1 x HV @60-78dB for 5-7 secs. - 2 x overhead aircraft @58-62dB for 20-30 secs (difficult to discern). - 5 x Syd Trains @52-80dB for 7-10 secs. - Cumberland Hwy (overpass) constant @48-49dB background. - 2 x Anric excavator tracking @58-60dB for 2-5 secs. - Horn of passing electric bike (max) @92dB for 1 secs.

ID# / NCA	Location	Reason for monitoring	Date/Time	RBL dB(A)	L(A) _{eq(15min)} dB(A)	Comments										
NML2 NCA2	Location 2 – 150 Broomfield Street, Cabramatta	Monthly Monitoring - Assessment of potential noise impacts	31/07/2023	39	59	<table border="1"> <thead> <tr> <th>L(A)_{eq(15min)}</th> <th>L(A)_{max}</th> <th>L(A)_{10(15min)}</th> <th>L(A)_{90(15min)}</th> <th>L(A)_{min}</th> </tr> </thead> <tbody> <tr> <td>59</td> <td>77</td> <td>62</td> <td>53</td> <td>50</td> </tr> </tbody> </table>	L(A) _{eq(15min)}	L(A) _{max}	L(A) _{10(15min)}	L(A) _{90(15min)}	L(A) _{min}	59	77	62	53	50
						L(A) _{eq(15min)}	L(A) _{max}	L(A) _{10(15min)}	L(A) _{90(15min)}	L(A) _{min}						
59	77	62	53	50												
<p>Monitoring took place during drainage cutover works at nearby Junction St intersection. Retaining wall demolition works were also audible. Catchment was dominated by diesel generator situated approximately 30-40 metres from monitoring location.</p> <ul style="list-style-type: none"> - 5 x LVs @52-74dB for 4-6 secs - 2 x overhead aircraft @52-67dB for 30-40 secs. - 1 x Syd Trains @54-64dB for 7-10 secs. - Hume/Cumberland Hwys not audible. - Frequent hammering behind capping beam @60-62dB for 5-10 sec bursts. - Generator running constantly during monitoring @50-51dB. - Excavator engine revving in constant bursts at @53-63dB. - Conversation with construction worker @55-60dB for 30 secs - Clanging of nearby scaffold/ATF gate @65-70dB for 5 secs 																

ID# / NCA	Location	Reason for monitoring	Date/Time	RBL dB(A)	L(A) _{eq(15min)} dB(A)	Comments										
NML3 NCA3	Location 3 - Corner of Station Street and Lawrence Hargrave Road, Warwick Farm	Monthly Monitoring - Assessment of potential noise impacts	31/07/2023	37	59	<table border="1"> <thead> <tr> <th>L(A)_{eq(15min)}</th> <th>L(A)_{max}</th> <th>L(A)_{10(15min)}</th> <th>L(A)_{90(15min)}</th> <th>L(A)_{min}</th> </tr> </thead> <tbody> <tr> <td>59</td> <td>86</td> <td>53</td> <td>41</td> <td>39</td> </tr> </tbody> </table>	L(A) _{eq(15min)}	L(A) _{max}	L(A) _{10(15min)}	L(A) _{90(15min)}	L(A) _{min}	59	86	53	41	39
						L(A) _{eq(15min)}	L(A) _{max}	L(A) _{10(15min)}	L(A) _{90(15min)}	L(A) _{min}						
59	86	53	41	39												
<p>No construction noise audible during monitoring.</p> <ul style="list-style-type: none"> - 2 x passing LVs @51-63dB for 5-7 secs. - 1 x passing HV @50-85dB for 5-7 secs. - 2 x overhead aircraft @52-60dB for 20-30 secs. - 3 x Syd Trains @48-75dB for 8-10 secs. - Hume Hwy constant @43-45dB. - Birds chirping in constant bursts @44-48dB. - >50 horns @50-52dB for 1-2 secs. - Pedestrian passing by with stroller @46-48dB for 5-7 secs. 																
NML4 NCA4	Location 4 - Warwick Farm Station Car Park	Monthly Monitoring - Assessment of potential noise impacts	31/07/2023	37	58	<table border="1"> <thead> <tr> <th>L(A)_{eq(15min)}</th> <th>L(A)_{max}</th> <th>L(A)_{10(15min)}</th> <th>L(A)_{90(15min)}</th> <th>L(A)_{min}</th> </tr> </thead> <tbody> <tr> <td>58</td> <td>73</td> <td>55</td> <td>49</td> <td>43</td> </tr> </tbody> </table>	L(A) _{eq(15min)}	L(A) _{max}	L(A) _{10(15min)}	L(A) _{90(15min)}	L(A) _{min}	58	73	55	49	43
						L(A) _{eq(15min)}	L(A) _{max}	L(A) _{10(15min)}	L(A) _{90(15min)}	L(A) _{min}						
58	73	55	49	43												
<p>No construction noise audible during monitoring. Catchment dominated by Syd Trains.</p> <ul style="list-style-type: none"> - 6 x passing LVs (commuters) @53-64dB for 3-5 secs. - 4 x overhead aircraft @50-58dB for 15-20 secs. - 6 x Syd Trains @53-62dB for 5-7 secs (all 6 stopped). - Hume Hwy constant @46-53dB. 																



Above: Monitoring at Warwick Farm Station(NML#4) during August



Above: Monitoring at 225 Railway Pde, Cabramatta (NML#1) during August

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Table 7. Attended noise monitoring results – August 2023

ID# / NCA	Location	Reason for monitoring	Date/Time	RBL dB(A)	L(A) _{eq(15min)} dB(A)	Comments					
						L(A) _{eq(15min)}	L(A) _{max}	L(A) _{10(15min)}	L(A) _{90(15min)}	L(A) _{min}	
NML1 NCA1	Location 1 – 225 Railway Parade, Cabramatta	Monthly Monitoring - Assessment of potential noise impacts	31/8/2023	45	67	67	87	71	54	48	<p>Works on opposite side of track involved removal and relocation of noise panels and preparation works at the northern turnout area. Catchment generally dominated by light/heavy vehicle traffic -- and regular Sydney Trains as per usual.</p> <ul style="list-style-type: none"> - >200 x LVs @50-75dB for 3-5 secs (almost constant). - 15 x HVs (all buses) @60-86dB for 4-6 secs. - 1 x overhead aircraft @~60dB for 60 secs (difficult to discern between traffic). - 3 x Syd Trains @62-75dB for 7-10 secs. - Cabramatta Rd (overpass) constant @46-48dB background. - 2 x excavator engines revving @50-52dB constant. - 10 x ratchet drill @52dB for 2-3 secs. - 10 x squealing noise from excavator tracking @65dB for 2-3 secs.

ID# / NCA	Location	Reason for monitoring	Date/Time	RBL dB(A)	L(A) _{eq(15min)} dB(A)	Comments				
						L(A) _{eq(15min)}	L(A) _{max}	L(A) _{10(15min)}	L(A) _{90(15min)}	L(A) _{min}
NML2 NCA2	Location 2 – 150 Broomfield Street, Cabramatta	Monthly Monitoring - Assessment of potential noise impacts	31/8/2023	39	58	58	78	61	51	46
<p>Monitoring took place during Broomfield West drainage works. Predominantly 1 x excavator working, with labourers using hand tools.</p> <ul style="list-style-type: none"> - 6 x LVs @53-70dB for 5-7 secs. - 2 x Syd Trains @54-64dB for 5-7 secs. - ~50 x excavator tracking @58-65dB for 3-10 secs - ~50 x excavator shaking bucket @55-76dB for 3-5 secs. - ~50 x movement quacker @58-60 for 3-10 secs. - 1 x postman on bike @57-65dB for 10 secs. - 1 x wacker packer @51-53dB for 7 mins. - 1 x angle grinder @52-53dB for 60 secs. - 5 x workers yelling @53-57dB for 3-5 secs. - Mechanic/workshop at 150 Broomfield St audible @50-53dB for ~30 secs. 										

ID# / NCA	Location	Reason for monitoring	Date/Time	RBL dB(A)	L(A) _{eq(15min)} dB(A)	Comments										
NML3 NCA3	Location 3 - Corner of Station Street and Lawrence Hargrave Road, Warwick Farm	Monthly Monitoring - Assessment of potential noise impacts	31/8/2023	37	59	<table border="1"> <thead> <tr> <th>L(A)_{eq(15min)}</th> <th>L(A)_{max}</th> <th>L(A)_{10(15min)}</th> <th>L(A)_{90(15min)}</th> <th>L(A)_{min}</th> </tr> </thead> <tbody> <tr> <td>59</td> <td>79</td> <td>59</td> <td>45</td> <td>42</td> </tr> </tbody> </table>	L(A) _{eq(15min)}	L(A) _{max}	L(A) _{10(15min)}	L(A) _{90(15min)}	L(A) _{min}	59	79	59	45	42
						L(A) _{eq(15min)}	L(A) _{max}	L(A) _{10(15min)}	L(A) _{90(15min)}	L(A) _{min}						
59	79	59	45	42												
<p>No construction noise audible during monitoring.</p> <ul style="list-style-type: none"> - 5 x passing LVs @50-64dB for 4-6 secs. - 6 x overhead aircraft @47-62dB for 20-30 secs. - 4 x Syd Trains @49-78dB for 7-10 secs. - Hume Hwy constant @45-47, with 1 x truck braking @55dB for 2-3 secs. - Birds chirping in constant bursts @44-56dB. - >50 horns @50-52dB for 1-2 secs. - Cyclist passing by @50-52dB for 3-4 secs. - Frogs/crickets constant @46-48dB. - Power tools at Peter Warren constant 2-3 sec bursts @47-49dB. - 2 x ambulance sirens from Hume Hwy @60-62dB for ~5 secs. 																
NML4 NCA4	Location 4 - Warwick Farm Station Car Park	Monthly Monitoring - Assessment of potential noise impacts	31/8/2023	37	61	<table border="1"> <thead> <tr> <th>L(A)_{eq(15min)}</th> <th>L(A)_{max}</th> <th>L(A)_{10(15min)}</th> <th>L(A)_{90(15min)}</th> <th>L(A)_{min}</th> </tr> </thead> <tbody> <tr> <td>61</td> <td>80</td> <td>59</td> <td>47</td> <td>43</td> </tr> </tbody> </table>	L(A) _{eq(15min)}	L(A) _{max}	L(A) _{10(15min)}	L(A) _{90(15min)}	L(A) _{min}	61	80	59	47	43
						L(A) _{eq(15min)}	L(A) _{max}	L(A) _{10(15min)}	L(A) _{90(15min)}	L(A) _{min}						
61	80	59	47	43												
<p>No construction noise audible during monitoring. Catchment dominated by Syd Trains.</p> <ul style="list-style-type: none"> - 5 x passing LVs (commuters) @50-60dB for 3-5 secs. - 2 x overhead aircraft @53-58dB for 30-40 secs. - 6 x Syd Trains @52-72dB for 5-7 secs of movement (all 6 stopped). - Hume Hwy constant @47-59dB (motorbike loudest). - Birds chirping nearby @50-68dB constant. 																

ID# / NCA	Location	Reason for monitoring	Date/Time	RBL dB(A)	L(A) _{eq(15min)} dB(A)	Comments				
						L(A) _{eq(15min)}	L(A) _{max}	L(A) _{10(15min)}	L(A) _{90(15min)}	L(A) _{min}
WE09 Possession NCA2	106 Broomfield St	Verification monitoring	26/8/2023	-	61	61	79	63	52	49
						<p>Monitoring during demolition of redundant concrete piles and cess drain.</p> <ul style="list-style-type: none"> - 3 x passing LVs @58dB for 3 secs - 3 x overhead aircraft @60-72dB for 10 secs - 4 x Syd Trains @63dB for 10 secs - 1 x freight train @~62dB for 5 secs - Cabramatta Rd constant @51-55dB - 8 x Hammering of piles (20t excavator) @62-68dB for ~5 sec bursts - 2 x LV reverse quacker @60dB for 20 secs - Local resident chatting nearby @~56dB for 2 mins - 11 x hammering of cess drain (8t excavator) @60-62dB for ~10 sec bursts - 3 x Pedestrians chatting nearby @~60-66dB for 5 secs - 2 x EWP quacker @54dB for 30 secs 				

ID# / NCA	Location	Reason for monitoring	Date/Time	RBL dB(A)	L(A) _{eq(15min)} dB(A)	Comments				
						L(A) _{eq(15min)}	L(A) _{max}	L(A) _{10(15min)}	L(A) _{90(15min)}	L(A) _{min}
WE09 Possession NCA2	106 Broomfield St	Verification monitoring	27/8/2023	-	64	64	69	66	62	61
						<p>Monitoring took place opposite concrete loadout and subsoil excavation works. The dominant construction noise came from the vac truck, which was in operation for the full duration of monitoring. Background noise from the nearby Cabramatta Rd also contributed significantly to the Leq.</p> <ul style="list-style-type: none"> - 2 x Syd trains @60-67dB for 3-5 secs - Cabramatta Rd constant @55-62dB background - ~20 x Loading out of concrete into bogie using excavator (banging against tub + excavator engine noise) @60-65dB for 3-5 secs - 3 x Groups of pedestrians passing (chatting) @64dB for 5-7 secs - 3 x Excavator quacker @70dB for 10 secs - Birds chirping constantly @~65dB bursts - Vac truck operating @63dB consistently 				



Monitoring at 2 Lawrence Hargrave Dr, Warwick Farm during Possession WE13 in September 2023.



Monitoring at 110 Broomfield St, Cabramatta during Possession WE13 in September 2023.

Table 8. Attended noise monitoring results – September 2023

ID# / NCA	Location	Reason for monitoring	Date/Time	RBL dB(A)	L(A) _{eq(15min)} dB(A)	Comments					
						L(A) _{eq(15min)}	L(A) _{max}	L(A) _{10(15min)}	L(A) _{90(15min)}	L(A) _{min}	
NML1 NCA1	Location 1 – 225 Railway Parade, Cabramatta	Monthly Monitoring - Assessment of potential noise impacts	23/9/2023	45	61	61	78	64	44	42	Construction noise was barely discernible during monitoring. Nearby works involved cable pulling by the signalling team. Passing LVs and HVs (buses) dominated the acoustics.

ID# / NCA	Location	Reason for monitoring	Date/Time	RBL dB(A)	L(A) _{eq(15min)} dB(A)	Comments										
						<ul style="list-style-type: none"> - >100 LVs @50-70 for 3-5 secs. - 9 x passing HVs @53-78dB for 3-5 secs. - 4 x Overhead aircraft @48-55dB for 20-30 secs. - Cabramatta Rd constant @45-46dB. - Family walking past monitor and chatting @48-60dB for 5-7 secs. - Birds (Cockatoos) overhead @55-65dB (screeching) for 3-5 secs. - 5 x squeaking sound from UGL cable reel @60-63dB for 2-3 secs. 										
NML2 NCA2	Location 2 – 150 Broomfield Street, Cabramatta	Monthly Monitoring - Assessment of potential noise impacts	23/9/2023	39	56	<table border="1"> <thead> <tr> <th>L(A)_{eq(15min)}</th> <th>L(A)_{max}</th> <th>L(A)_{10(15min)}</th> <th>L(A)_{90(15min)}</th> <th>L(A)_{min}</th> </tr> </thead> <tbody> <tr> <td>56</td> <td>74</td> <td>57</td> <td>46</td> <td>41</td> </tr> </tbody> </table> <p>UGL cable pulling happening approx 70 metres north of monitoring. No noise wall in that location. Construction noise barely audible. Only handwork utilised for unwinding of cable. No plant operating at time of monitoring.</p> <ul style="list-style-type: none"> - 7 x passing LVs @50-65dB for 4-6 secs. - 3 x overhead aircraft @48-74dB for 30-40 sccs. - 7 x pedestrian groups walking past monitor chatting @46-67dB for 3-5 secs. - 5 x Buses/HVs on railway pde @ 48-50dB for 5-7 secs. - 1 x Pedestrian with wobbly trolley @48-67dB for 8-10 secs. - Cabramatta Rd constant @45-46dB background. - UGL unwinding cable (squeaking wheel) @48-50dB for 12-15 secs. 	L(A) _{eq(15min)}	L(A) _{max}	L(A) _{10(15min)}	L(A) _{90(15min)}	L(A) _{min}	56	74	57	46	41
L(A) _{eq(15min)}	L(A) _{max}	L(A) _{10(15min)}	L(A) _{90(15min)}	L(A) _{min}												
56	74	57	46	41												
NML3 NCA3	Location 3 - Corner of Station Street and Lawrence Hargrave Road, Warwick Farm	Monthly Monitoring - Assessment of potential noise impacts	23/9/2023	37	64	<table border="1"> <thead> <tr> <th>L(A)_{eq(15min)}</th> <th>L(A)_{max}</th> <th>L(A)_{10(15min)}</th> <th>L(A)_{90(15min)}</th> <th>L(A)_{min}</th> </tr> </thead> <tbody> <tr> <td>64</td> <td>81</td> <td>66</td> <td>56</td> <td>51</td> </tr> </tbody> </table> <p>Monitoring taken place during intertrack drainage works at Peter Warren area. Plant included 2 x hi-rail excavators, 2 x Hydremas, 1 x 8-10T excavator, 1 x bogie and multiple trackwork crew. Sydney Trains</p>	L(A) _{eq(15min)}	L(A) _{max}	L(A) _{10(15min)}	L(A) _{90(15min)}	L(A) _{min}	64	81	66	56	51
L(A) _{eq(15min)}	L(A) _{max}	L(A) _{10(15min)}	L(A) _{90(15min)}	L(A) _{min}												
64	81	66	56	51												

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ID# / NCA	Location	Reason for monitoring	Date/Time	RBL dB(A)	L(A) _{eq(15min)} dB(A)	Comments										
						<p>were also present to complete maintenance on their asset. The most audible noise from construction was the shaking of the excavator bucket after loading the Hydremas with material (typically ballast).</p> <ul style="list-style-type: none"> - 3 x LVs @58-68dB for 3-5 secs - 1 x HV @60-80dB for 5-7 secs - 4 x Excavator loading hydrema (engine whirring) 55-57dB for 2 mins - >50 x Excavator bucket shaking @60-75dB for 2-5 secs - Plant quackers constant in north and south @56-58dB - Nearby bogie revving (Syd Trains?) @58-60dB for 5-7 secs - >50 x Slew alarm on hi-rail Hitachi @62-65dB for 3-5 secs - 3 x workers shouting @60-62dB for 2-3 secs - >20 x Hi-rail excavators tracking back and forth @58-60dB for 5-7 secs. 										
NML4 NCA4	Location 4 - Warwick Farm Station Car Park	Monthly Monitoring - Assessment of potential noise impacts	23/9/2023	37	55	<table border="1"> <thead> <tr> <th>L(A)_{eq(15min)}</th> <th>L(A)_{max}</th> <th>L(A)_{10(15min)}</th> <th>L(A)_{90(15min)}</th> <th>L(A)_{min}</th> </tr> </thead> <tbody> <tr> <td>55</td> <td>71</td> <td>58</td> <td>47</td> <td>43</td> </tr> </tbody> </table> <p>Monitoring took place during signalling works approx 100m away to the south. 1 small excavator and a hi-rail hydrema were in operation. Overhead aircraft and the Hume Hwy generally dominated the acoustics.</p> <ul style="list-style-type: none"> - 5 x overhead aircraft @50-70dB for 20-30 secs - 3 x Hydrema tracking past (with quacker) @50-64dB for 10-12 secs - Hume Hwy constant @47-56dB - Nearby birds chirping constant @50-52dB 	L(A) _{eq(15min)}	L(A) _{max}	L(A) _{10(15min)}	L(A) _{90(15min)}	L(A) _{min}	55	71	58	47	43
L(A) _{eq(15min)}	L(A) _{max}	L(A) _{10(15min)}	L(A) _{90(15min)}	L(A) _{min}												
55	71	58	47	43												
WE13 Possession	6 Nicholls St, Warwick Farm	Verification monitoring	23/9/2023	-	59	<table border="1"> <thead> <tr> <th>L(A)_{eq(15min)}</th> <th>L(A)_{max}</th> <th>L(A)_{10(15min)}</th> <th>L(A)_{90(15min)}</th> <th>L(A)_{min}</th> </tr> </thead> <tbody> <tr> <td>59</td> <td>85</td> <td>60</td> <td>49</td> <td>45</td> </tr> </tbody> </table> <p>Monitoring of Peter Warren work area incl intertrack drainage and turnout preparation. Shaking of</p>	L(A) _{eq(15min)}	L(A) _{max}	L(A) _{10(15min)}	L(A) _{90(15min)}	L(A) _{min}	59	85	60	49	45
L(A) _{eq(15min)}	L(A) _{max}	L(A) _{10(15min)}	L(A) _{90(15min)}	L(A) _{min}												
59	85	60	49	45												

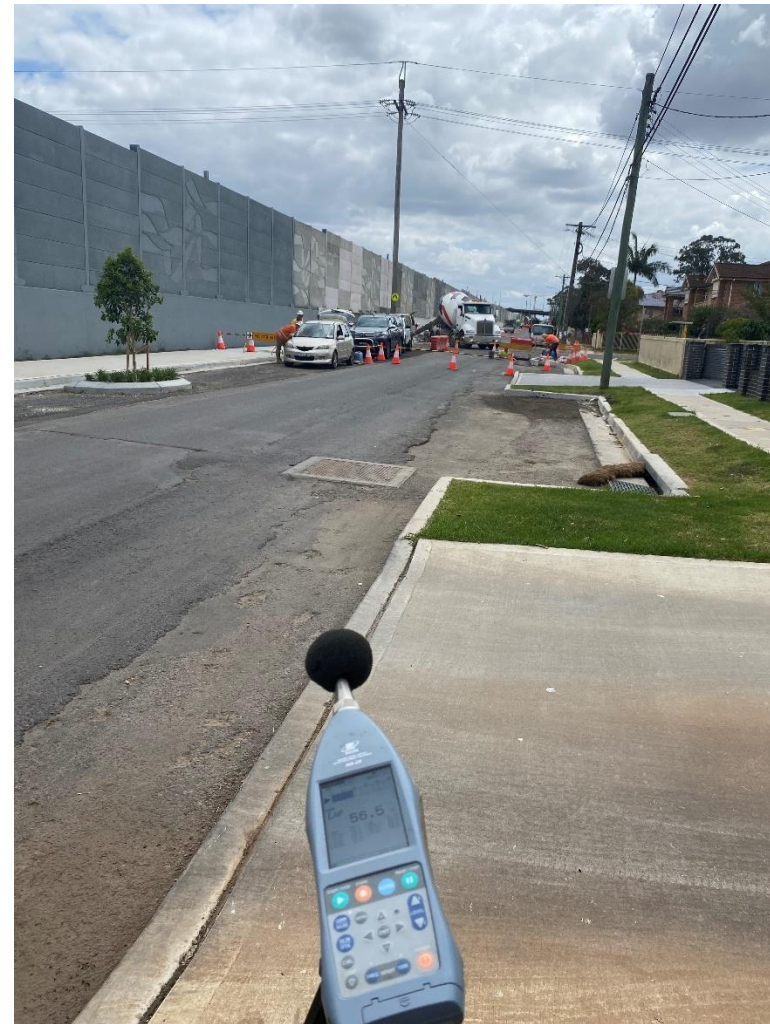
ID# / NCA	Location	Reason for monitoring	Date/Time	RBL dB(A)	L(A) _{eq(15min)} dB(A)	Comments										
						<p>buckets and quackers dominant construction noise. Overhead aircraft and birds dominant background noise.</p> <ul style="list-style-type: none"> - 4 x passing LVs @50-68dB for 5-7 secs - 2 x passing HVs @53-74dB for 7-10 secs - 5 x overhead aircraft @48-58dB for 20-30 secs - ~30 x Excavator shaking bucket @56-68dB for 2-3 secs - Birds chirping nearby constantly @46-68dB - Quackers from multiple plant/vehicles @48-52dB for ~8mins - 1 x Horn from excavator @70dB for 2 secs - 30 x dog barks @48-52dB for 3-5 secs - 3 x excavator loading ballast @53-58dB for 2-3 secs - 1 x Bogie tipping fresh ballast @54-57dB for 6-7 secs - 1 x Tailgate slamming on bogie @84dB for 1 sec 										
						<table border="1"> <thead> <tr> <th>L(A)_{eq(15min)}</th> <th>L(A)_{max}</th> <th>L(A)_{10(15min)}</th> <th>L(A)_{90(15min)}</th> <th>L(A)_{min}</th> </tr> </thead> <tbody> <tr> <td>62</td> <td>88</td> <td>64</td> <td>52</td> <td>46</td> </tr> </tbody> </table> <p>Monitoring approximately 200m south of turnout works at Peter Warren. Mild construction noise audible.</p> <ul style="list-style-type: none"> - 1 x passing LVs @55-64dB for 3-5 secs - 10 x hydrema tracking (incl quacker) @61-63dB for 10-12 secs - Hume Hwy constant @50-56db (+ 1 x 66dB compression brake @66dB) - 1 x resident vehicle idling nearby @60-63dB for ~10 mins - 1 x residents chatting @58-60dB for 10 secs - 20 x excavator bucket shaking @55-58dB for 2-3 secs - 1 x hydrema idling opposite @52-54dB for 1 min - 1 x sneeze from operator of noise monitoring device @88dB for 1-2 secs 	L(A) _{eq(15min)}	L(A) _{max}	L(A) _{10(15min)}	L(A) _{90(15min)}	L(A) _{min}	62	88	64	52	46
L(A) _{eq(15min)}	L(A) _{max}	L(A) _{10(15min)}	L(A) _{90(15min)}	L(A) _{min}												
62	88	64	52	46												
WE13 Possession	23 Station St, Warwick Farm	Verification monitoring	23/9/2023		62											

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ID# / NCA	Location	Reason for monitoring	Date/Time	RBL dB(A)	L(A) _{eq(15min)} dB(A)	Comments				
						L(A) _{eq(15min)}	L(A) _{max}	L(A) _{10(15min)}	L(A) _{90(15min)}	L(A) _{min}
WE13 Possession	7 Station St, Warwick Farm	Verification monitoring	23/9/2023		58	58	76	61	50	47
						<p>Monitoring of southern turnout and intertrack drainage works. Quackers and shaking of excavator bucket dominant construction noise.</p> <ul style="list-style-type: none"> - 2 x passing LVs @54-72dB for 3-5 secs - 1 x overhead aircraft @52-60dB for 30 secs - 1 x idling and occasional revving truck owned by resident @56-65 for 2 mins - Quackers from multiple plant @50-62dB constant - 10 x tipping of ballast from loader @56-64dB for 2-3 secs - Hume Hwy constant in background @46-48dB 				



Above: Monitoring at NML#1 during October 2023



Above: Monitoring at NML#2 during October 2023

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Table 9. Attended noise monitoring results – October 2023

ID# / NCA	Location	Reason for monitoring	Date/Time	RBL dB(A)	L(A) _{eq(15min)} dB(A)	Comments				
						L(A) _{eq(15min)}	L(A) _{max}	L(A) _{10(15min)}	L(A) _{90(15min)}	L(A) _{min}
NML1 NCA1	Location 1 – 225 Railway Parade, Cabramatta	Monthly Monitoring - Assessment of potential noise impacts	30/10/2023	45	63	63	84	66	45	41
						<p>Construction noise:</p> <ul style="list-style-type: none"> - 5 x Bang of tool on Broomfield St @62dB(A) for 1sec - 1 x Engine idle (not visible) @43-44dB for 20sec <p>Background noise:</p> <ul style="list-style-type: none"> - 47 x Passing LVs @58-73dB for 2sec - 5 x Passing HVs @70-78dB for 3sec - 10 x Overhead aircraft @53-68dB for 20sec - 4 x Sydney trains @68-76 for 10sec - 1 x Freight trains @61-65dB for 30sec - 5 x Nearby residential construction works (grinding, sanding etc) @48-52dB for 30sec - 3 x Nearby residential construction works (banging) @62-68dB for 1sec - 3 x Distant birds chirping @44-50dB for 10sec 				
NML2 NCA2	Location 2 – 150 Broomfield Street, Cabramatta	Monthly Monitoring - Assessment of potential noise impacts	30/10/2023	39	57	57	70	61	46	42
						<p>Construction noise:</p> <ul style="list-style-type: none"> - 1 x Moving water filled barrier @67-68dB for 5sec - 1 x Concrete truck packing down chutes @68-70dB for 2sec 				

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ID# / NCA	Location	Reason for monitoring	Date/Time	RBL dB(A)	L(A) _{eq(15min)} dB(A)	Comments										
						<ul style="list-style-type: none"> - 1 x Concrete truck idle during pour @54-55dB for 8min - 5 x Concrete truck pumping concrete @55-61dB for 5sec - 5 x Pit defects works (grout stirring with drill) @54-57 x 10sec - 2 x Workers talking @50-52dB for 10sec - 1 x Work ute starting and idling @58dB (start) + idling @56-57dB for 30sec - Workers radio @45-47dB constant <p>Background noise:</p> <ul style="list-style-type: none"> - 8 x Overhead aircraft @55-59dB for 15sec - 1 x Sydney trains @60-63dB for 10sec - 5 x Birds chirping @57-64dB for 5sec 										
NML3 NCA3	Location 3 - Corner of Station Street and Lawrence Hargrave Road, Warwick Farm	Monthly Monitoring - Assessment of potential noise impacts	30/10/2023	37	64	<table border="1"> <thead> <tr> <th>L(A)_{eq(15min)}</th> <th>L(A)_{max}</th> <th>L(A)_{10(15min)}</th> <th>L(A)_{90(15min)}</th> <th>L(A)_{min}</th> </tr> </thead> <tbody> <tr> <td>64</td> <td>81</td> <td>62</td> <td>42</td> <td>37</td> </tr> </tbody> </table> <p>Construction noise:</p> <ul style="list-style-type: none"> - 1 x Excavator loading tipper/digging @43-45dB for 2sec - 5 x Reverse alarm (quacker) @43-44dB for 3sec <p>Background noise:</p> <ul style="list-style-type: none"> - 1 x Passing LV @49-68dB for 10sec - 6 x Overhead aircraft @44-67dB for 30sec - 5 x Sydney trains @68-78dB for 5sec - 1 x freight trains @72-81 for 30sec - Peter Warren car yard – 3 x Grinding @46-53dB for 10sec, 5 x Rattle gun @41-50dB for 3sec, ~30 x EWP(beeper) @49-50 count for 2sec 	L(A) _{eq(15min)}	L(A) _{max}	L(A) _{10(15min)}	L(A) _{90(15min)}	L(A) _{min}	64	81	62	42	37
L(A) _{eq(15min)}	L(A) _{max}	L(A) _{10(15min)}	L(A) _{90(15min)}	L(A) _{min}												
64	81	62	42	37												

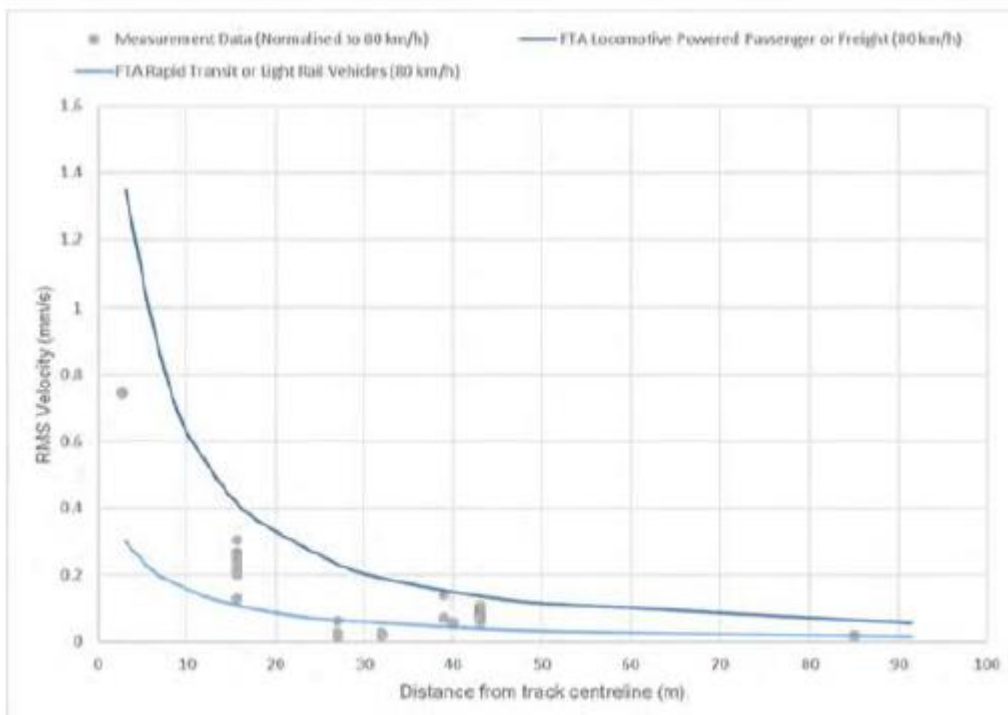
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ID# / NCA	Location	Reason for monitoring	Date/Time	RBL dB(A)	L(A) _{eq(15min)} dB(A)	Comments										
						<ul style="list-style-type: none"> - Hume HWY40-42dB constant - Birds chirping 58-65dB count 15@1sec - Ambo siren 43-46 count 2@30sec 										
NML4 NCA4	Location 4 - Warwick Farm Station Car Park	Monthly Monitoring - Assessment of potential noise impacts	30/10/2023	37	57	<table border="1"> <thead> <tr> <th>L(A)_{eq(15min)}</th> <th>L(A)_{max}</th> <th>L(A)_{10(15min)}</th> <th>L(A)_{90(15min)}</th> <th>L(A)_{min}</th> </tr> </thead> <tbody> <tr> <td>57</td> <td>76</td> <td>61</td> <td>46</td> <td>40</td> </tr> </tbody> </table> <p>No construction noise audible during monitoring. All noise attributed to non-construction activity such as passing trains, chirping birds and the busy Hume Hwy.</p>	L(A) _{eq(15min)}	L(A) _{max}	L(A) _{10(15min)}	L(A) _{90(15min)}	L(A) _{min}	57	76	61	46	40
L(A) _{eq(15min)}	L(A) _{max}	L(A) _{10(15min)}	L(A) _{90(15min)}	L(A) _{min}												
57	76	61	46	40												

5. Vibration Monitoring Results

Baseline Vibration Monitoring

During the EIS assessment in 2018, attended and unattended vibration monitoring was undertaken within and outside the rail corridor. The results of the monitoring indicated 4-5 mm/s peak vibration levels 6 metres from the railway tracks and levels between 0.1 mm/s and 0.3 mm/s at the residence (150 Broomfield Street, 31 metres from the SSFL). The vibration environment was dominated by road traffic noise and intermittent rail passbys. The measured vibration levels from train passbys as presented in the EIS is shown in Figure 2. The Construction Noise and Vibration Plan commits to monitoring to confirm that works occur outside of the minimum working distances and to ensure consistency with the approved level of anticipated impacts.



Above: Excerpt from EIS - Figure 2: Baseline Vibration Monitoring Data

Vibration Management

Construction vibration criteria are detailed in the approved Construction Noise and Vibration Management Plan (CNVMP) and have been adopted from the following sources, consistent with the EIS:

- Cosmetic and structural damage to heritage buildings: German Standard DIN 4150-31
- Human comfort: British Standard BS 6472-12 and BS 6472-23
- Human comfort: Assessing Vibration – a technical guideline (the Guideline).
- Ground-borne noise, that is ground vibration re-radiated as noise internally within a building, has also been assessed against the requirements of the ICNG.

The project aims to achieve compliance with the following accepted parameters and well established construction vibration criteria:

■ for structural damage to heritage structures, the vibration limits set out in the German Standard DIN 4150-3: Structural Vibration - effects of vibration on structures:

Type of Structure	Peak Particle Velocity (PPV) mm/s			
	Vibration at the foundation at a frequency of:			Vibration of horizontal plane of highest floor at all frequencies
	1 to 10 Hz	10 to 50 Hz	50 to 100 Hz ¹	
Structures that are particularly sensitive to vibration, e.g. heritage-listed structures.	3	3 to 8	8 to 10	8

(1) For frequencies above 100 Hz, the maximum values specified in this column shall be applied.
Values referred to are at the base of the building

Above: Excerpt from CNVMP Table 12: Structural Damage Criteria – Heritage Structures

■ for damage to other buildings and/or structures, the vibration limits set out in the British Standard BS 7385-2:1993 - Evaluation and measurement for vibration in buildings - Guide for measurement of vibration and evaluation of their effects on buildings (and referenced in Australian Standard 2187.2 – 2006 Explosives –Storage and use – Use of explosives).

Line (see Figure 3)	Type of Building	Peak component particle velocity in frequency range of predominant pulse	
		4 to 15 Hz	15 Hz and above
1	Unreinforced or light framed structures. Residential or light commercial type buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above
2	Reinforced or framed structures. Industrial and heavy commercial buildings	50 mm/s at 4 Hz and above	

Notes 1. Values referred to are at the base of the building
2. For line 1, at frequencies below 4 Hz, a maximum displacement of 0.6 mm (zero to peak) should not be exceeded.

Above: Excerpt from CNVMP Table 13: Transient Vibration Guide Values for Cosmetic Damage

■ for human exposure, the acceptable vibration values set out in Environmental Noise Management Assessing Vibration: A Technical Guideline (Department of Environment and Conservation, 2006).

Building type	Preferred VDV (m/s ^{1.75})	Maximum VDV (m/s ^{1.75})
Residential daytime (7am-10pm)	0.20	0.40
Residential night-time (10pm-7am)	0.13	0.26
Offices, schools, educational institutions and places of worship (day and night-time)	0.40	0.80

Above: Excerpt from CNVMP Table 14: Acceptable Vibration Dose Values for Intermittent Vibration

All plant selection during construction has been guided by the safe working distances established detailed in Table 25 of the CNVMP below:

Plant item	Rating / Description	Safe working distance, m					
		Cosmetic damage			Human response		
		Heritage structure	Residential structure	Commercial / Industrial	Residence – night	Residence – day	Educational
Vibratory roller	<50 kN (typically 1-2t)	7	5	2	25	15	10
	<50 kN (typically 2-4t)	9	6	2	35	20	13
	<50 kN (typically 4-6t)	22	12	5	65	40	25
	<50 kN (typically 7-13t)	27	15	6	140	110	65
	<50 kN (typically 13-18t)	36	20	8	170	140	70
	<50 kN (typically >18t)	45	25	10	170	140	75
Handheld compactor	Up to 300 kg	7	5	2	30	20	12
Small hydraulic hammer	300 kg – 18-34t excavator	3	2	–	10	7	5
Medium hydraulic hammer	1600 kg – 5-12t excavator	12	7	3	35	23	15
Large hydraulic hammer	1600 kg – 12-18t excavator	30	22	9	100	73	45
Bored piling	< 800 mm	3	2	–	7	4	2
Excavation works	12-18t excavator	3	2	–	15	10	7
Jackhammer	Handheld	2	1	–	5	–*	–*

Above: Excerpt from CNVMP Table 25: Vibration Safe Working Distances

Construction Monitoring:

No vibration complaints regarding property damage or human exposure were received during the reporting period. Naturally, the risk of vibration exceedance was extremely unlikely during this reporting period with construction moving even further away from residents and construction activity transitioned into finishing works where vibration intensive plant was no longer required.

This reporting period contrasted previous periods (May 22 -- Oct 22 and Nov 22 – Apr 23), during which piling proceeded close to heritage bridges, heavy drainage works taking place on the eastern side of Broomfield St, and vibratory compaction rolling occurring at Sussex St -- in some cases within 10 metres of residential property.