Operational and Construction Noise and Vibration Assessment

Appin Road and St Johns Road Intersection Upgrade
Bradbury, NSW

Prepared for: bd infrastructure Pty Ltd
February 2025
MAC231792-01RP1V3

Muller Acoustic Consulting

Document Information

Operational and Construction Noise and Vibration Assessment

Appin Road and St Johns Road Intersection Upgrade

Bradbury, NSW

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1 Introduction

Muller Acoustic Consulting Pty Ltd (MAC) has been commissioned by bd infrastructure Pty Ltd (bd infrastructure), on behalf of Transport for NSW (TfNSW) to complete an Operational and Construction Noise and Vibration Assessment (OCNVA) for the upgrade to the intersection of Appin Road and St Johns Road, Bradbury, NSW (the proposal).

This report presents the results, findings and recommendations of the OCNVA and has been prepared to accompany the Review of Environmental Factors (REF) being prepared by bd infrastructure. The assessment has been completed in general accordance with the following standards and guidelines:

- Transport for NSW, Noise and Vibration Assessment Procedure (for road traffic and construction) February 2023;
- Transport for NSW, Construction Noise and Vibration Guideline (for road and maritime works) June 2022;
- Transport for NSW (2022), Road Noise Criteria Guideline (RNCG);
- Transport for NSW (2022), Road Noise Mitigation Guideline (RNMG);
- Transport for NSW (2022), Road Noise Validation Guideline (RNVG);
- Department of Environment and Climate Change (2009), Interim Construction Noise Guideline (ICNG);
- Department of Environment and Conservation (2006), Assessing Vibration: A Technical Guideline;
- NSW Environment Protection Authority (2017), Noise Policy for Industry (NPI);
- NSW Environment Protection Authority (EPA's), Approved Methods for the measurement and analysis of environmental noise in NSW, 2022;
- Standards Australia – AS 2436-2010 (R2016) Guide to Noise Control on Construction, Maintenance and Demolition Sites;
- Standards Australia AS IEC 61672.1-2019 Electroacoustics – Sound level meters – Specifications;
- Standards Australia – AS 1055:2018 Acoustics- Description and measurement of environmental noise;
- British Standard BS 7385: Part 2-1993 "Evaluation and measurement for vibration in buildings Part 2"; and
- German Institute for Standardisation – DIN 4150 (1999-02) Part 3 (DIN4150-3) – Structural Vibration - Effects of Vibration on Structures.

A glossary of terms, definitions and abbreviations used in this report is provided in **Appendix A**.

1.1 Assessment Objectives

The OCNVA quantifies potential construction noise and vibration impacts and operational road traffic noise intrusion to residential receivers along the proposal alignment.

Primary considerations in this assessment report include:

- provide a technical document that can support the Construction Environmental Management Plan (CEMP) for the proposal;
- identification of sensitive receivers;
- quantifying potential operational road traffic noise based on the proposal concept design and concept design report;
- quantifying construction noise and vibration impacts from the proposal based on the proposal brief information; and
- review reasonable and feasible control measures to mitigate noise and vibration emissions with the aim of meeting Noise Management Levels (NMLs) and relevant vibration criteria.

The structure and format of this report has been prepared in accordance with the Transport for NSW (formerly Roads and Maritime Services) document Preparing an Operational Traffic and Construction Noise and Vibration Assessment Report (Roads and Maritime, 2016), with consideration to the Editorial Style Guide (Roads and Maritime, 2019).

2 Project Description

2.1 Proposal Area

The proposal area is at the intersection of Appin Road (B69) and St Johns Road, Bradbury, a suburb in the southwest of Sydney, NSW. The study area for the proposal is illustrated in **Figure 1**.

Within the proposal area Appin Road is a north / south road with dual carriageway in each direction and a wide centre median. The pavement is generally in good condition with a combination of V-shaped drains and soft edges along the extent of the proposal area. Appin Road travels from Campbelltown in the north to Appin in the south, and has a sign posted speed limit of 80km/h.

St Johns Road is a collector road providing access from Appin Road to the residential subdivision of Bradbury and Airds. The intersection of St Johns Road with Appin Road is a signalised intersection with left in and left out slip lanes.

Construction site compound and/or stockpile facilities are proposed to be established at up to five locations, including Flynns Reserve and St Helens Park off Woodlands Road, Bradbury, two locations off Copperfield Drive, Rosemeadow, and one location off Dickens Road, Ambervale, NSW. The compound/stockpile sites will remain in use for the duration of the construction period, with up to four of the sites in use at any one time.

2.2 Proposal Details

The proposal would include the following scope of works;

- the widening of Appin Road at St Johns Road to upgrade the existing northbound and southbound carriageway from two lanes to three lanes in each direction, with a right turn lane on the northern approach to St Johns Road;
- high entry angle left turn from Appin Road southbound into St Johns Road;
- widening of St Johns Road into the median to provide two right turn lanes from St Johns Road into Appin Road northbound and a separate left turn lane with a high entry angle left turn into Appin Road southbound;
- provision for cyclists in the north bound and south bound direction on Appin Road;
- regrading of vertical alignment along Appin Road to mitigate impacts to the existing pavement;
- provision of a flat area around the base of proposed street lighting posts to allow for maintenance access;
- regrading of proposed cut batters on the southern tie in to allow for planting and improved maintenance considerations;
- inclusion of road furniture, street lighting, stormwater drainage infrastructure, landscaping, line marking, Traffic Signal Adjustments and signage and adjustments / relocation / new utility services; and
- construction Site Compound Facilities for the duration of the construction period.

The works would primarily be undertaken during standard working hours. However, it is noted that night works would be necessary as required during the course of the project.

The key noise generating activities associated with the proposal include:

- mobilisation and site establishment;
- demolition of existing road structures and removal of roadside vegetation;
- adjustment of utilities, services and property access;
- road widening works, including bulk earthworks;
- installation of drainage infrastructure;
- paving and asphalting works;
- installation of traffic signals, road furniture and line marking; and
- operation of the ancillary site.

The Concept Design for the proposal is presented in **Appendix B**.

2.3 Identification of Sensitive Receivers

The noise environment surrounding the proposal site is typical of suburban environment with low to medium density residential housing, green space corridors / parks, active recreation facilities, local commercial centres, schools and Campbelltown Hospital. The dominant noise sources in the locality include road traffic noise, domestic noise and environmental noise (birds).

A review of aerial imagery identifies that the study area in the vicinity of the proposal site comprises predominantly residential properties. A summary of the type and number of sensitive receivers within approximately 800m of the proposal site is presented in **Table 1**. The locality plan identifying the position of the sensitive receivers is provided in **Figure 2.**

Table 1 Type and Number of Noise Sensitive Receivers

Receiver Type	Number of Buildings
Residential	~4,000
Commercial	~35
Educational	6
Place of Worship	4
Hospital	1
Childcare Centre	2
Active Recreation Area (including Parks)	6

The level of affectation for each receiver is influenced by the activity that is being undertaken and the distance and exposure of each receiver to the proposal site. It is noted that the area of affectation is the distance from the proposal where receivers may experience noise levels above the relevant Noise Management Levels.

FIGURE 1

Proposal Site

MAC231792-01

Appin Road Intersection

KEY

Proposal Site

Compound Site

0 100 200 300 400 m

N

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FIGURE 2
Receiver Map
MAC231792-01
Appin Road Intersection
KEY
Proposal Site
Compound Site
Logger Location
Sensitive Receivers
Residential
Residential Region
Education Institution
Childcare Centre
Hospital
Place of Worship
Active Recreation
Commercial
0
120
240
360
480 m
N
L1
L2
APPIN ROAD
GLEDSWOOD PLACE
ENGLORIE PARK DRIVE
CLENNAM AVENUE
HOLBORN STREET
CODLIN STREET
JINIWIN PLACE
THROSBY WAY
WOODHOUSE DRIVE
LAVINIA PLACE
JARNDYCE AVENUE
MANTALINI STREET
LIGHTWOOD STREET
CLERKENWELL STREET
TIPPING PLACE
TROTWOOD AVENUE
BOYTHORN AVENUE
TWINGLETON AVENUE
HARTHOUSE ROAD
ORLICK STREET
CRISPSPARKLE DRIVE
WOODCOURT STREET
CLEOPATRA DRIVE
TAMORA STREET
MACBETH WAY
JULIUS ROAD
CASSIO WAY
VIOLENTA WAY
OCTAVIA AVENUE
ANTHONY DRIVE
BALTHASAR CLOSE
ROMEO CRESCENT
FITZGIBBON LANE
KELLERMAN DRIVE
COPPERFIELD DRIVE
WHITECHAPEL CLOSE
DICKENS ROAD
PEGGOTTY AVENUE
PINE AVENUE
CAMPBELLFIELD AVENUE
GREENOAKS AVENUE
COACHWOOD CRESCENT
JACARANDA AVENUE
JARRAH AVENUE
CALEY ROAD
KABLE ROAD
MACLEAY STREET
ST JOHNS ROAD
BANGALLA AVENUE
DEWRANG AVENUE
WANOOKA CRESCENT
AKUNA AVENUE
BIMBADEEN AVENUE
KAPALA AVENUE
WARRINA ROAD
NARDANGO ROAD
TANDARA AVENUE
PINAROO CRESCENT
BALOOK CRESCENT
THE PARKWAY
AMINYA CRESCENT
WOODLAND ROAD
WINTAROO CRESCENT
KARRABUL ROAD
KEANY CLOSE
IRONSIDE AVENUE
ST HELENS PARK DRIVE
PARMA CRESCENT
PADMELON AVENUE
WEDDERBURN ROAD
OMAC
Muller Acoustic Consulting

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3 Existing Environment

The community's reaction to noise from construction may be influenced by the time of day that work is carried out. Residents are potentially more affected by work that occurs during OOH periods (ie evening or night periods). Therefore, it is important to understand the existing noise environment surrounding the proposal to manage and minimise potential noise impact on the environment and local community.

A review of the project locality identified that the area surrounding the proposal site is a suburban environment. Hence, a detailed background noise assessment was undertaken to determine the RBLs and subsequent NMLs.

3.1 Unattended Noise Monitoring

The unattended noise survey was conducted in general accordance with the procedures described in Standards Australia AS 1055:2018, "Acoustics - Description and Measurement of Environmental Noise". The selected monitoring location is shown in **Figure 2**. The noise monitoring charts for the background monitoring assessment are provided in **Appendix C.**

The measurements were carried out at two monitoring locations, in the vicinity of the intersection at St Johns Road (L1) and in the vicinity of the ancillary site off Woodland Road (L2) using Svantek Type 1, Svan 977 noise monitors from Thursday 25 May 2023 to Tuesday 6 June 2023. Observations on-site identified that road traffic noise was the dominant noise source at each of the monitoring locations.

All acoustic instrumentation used carries appropriate and current NATA (or manufacturer) calibration certificates with records of all calibrations maintained by MAC as per Approved Methods for the measurement and analysis of environmental noise in NSW (EPA, 2022) and complies with AS/NZS IEC 61672.1-2019-Electroacoustics - Sound level meters - Specifications. Calibration of all instrumentation was checked prior to and following measurements. Drift in calibration did not exceed ±0.5dBA.

The results of the long-term unattended noise monitoring were used to determine the Rating Background Level (RBL) for the assessment during the day, evening and night periods in accordance with the NPI, as required by the ICNG. Data affected by adverse meteorological conditions, including wind speeds above 5m/s at microphone height and rain have been excluded from the calculation of the RBLs in accordance with methodologies provided in Fact Sheet A4 of the NPI. The results of long-term unattended noise monitoring are provided in **Table 2**.

Table 2 Summary of Existing Background Noise Levels

Location	Measured RBL, dB L_{A90}			Measured dB L_{Aeq}			Road Noise Levels, dB $L_{Aeq,period}$	
	Day[1]	Evening[2]	Night[3]	Day[1]	Evening[2]	Night[3]	Day[4]	Night[5]
L1	52	49	36	64	62	59	64	59
L2	43	43	28 (30)	54	52	52	54	52

Note: Excludes periods of wind or rain affected data, meteorological data obtained from the Bureau of Meteorology Campbelltown (Mount Annan) (34.1°S 150.8°E 112m AMSL).

Note 1: Day period for RBLs 7am to 6pm.

Note 2: Evening period for RBLs 6pm to 10pm.

Note 3: Night period for RBLs 10pm to 7am.

Note 4: Day period for road noise levels from 7am to 10pm.

Note 5: Night period for road noise levels from 10pm to 7am.

4 Construction Noise Impact Assessment

The assessment and management of noise from construction work is completed with reference to the Construction Noise and Vibration Guideline (CNVG). This guideline outlines the approach Transport for NSW takes when assessing and mitigating construction noise. The guideline provides the detail required to identify feasible and reasonable noise mitigation measures for construction, minor work and maintenance projects and needs to be considered for all Transport for NSW managed projects.

Construction noise impacts and mitigation measures need to be evaluated at various stages of a project to inform the concept design, environmental impact assessment, detail design and construction process.

The guideline describes the principles to be applied when reviewing and assessing construction noise, vibration and construction traffic. It also describes procedures to assist in reviewing noise and vibration mitigation.

The intention in all situations is to meet the following principles:

1. Good engagement with the community will be maintained to facilitate effective project delivery with balanced community impact.
2. Construction noise and vibration levels at sensitive receivers will be minimised where feasible and reasonable.
3. Feasible and reasonable mitigation will reflect the time of day, and/or the degree and duration of the impact.
4. The community will be informed of the dates for the intended work, sequencing and timing of noisy events. Where possible this will include an indicative schedule over a 24 hour period.
5. Minimising construction noise and vibration will be viewed as a continuous improvement exercise that is inclusive of stakeholders where no idea is too small to be considered.
6. Staff and community will be informed of the effort and methods undertaken to reduce noise and vibration for the work.
7. Any operational noise and vibration improvements resulting from the work will be promoted to the community.

4.1 Policies and Guidelines

4.1.1 Construction Noise and Vibration Guideline – Construction Hours

Table 3 summaries the CNVG recommended standard and out of hours periods for construction. Note, although not mandatory, strong justification is required to work outside of normal construction hours.

Table 3 Recommended Hours for Construction

Hour Commencing	12 AM	1 AM	2 AM	3 AM	4 AM	5 AM	6 AM	7 AM	8 AM	9 AM	10 AM	11 AM	12 PM	1 PM	2 PM	3 PM	4 PM	5 PM	6 PM	7 PM	8 PM	9 PM	10 PM	11 PM
Monday	OOH Period 2							Standard Hours											OOH Period 1 (Evening)					
Tuesday																								
Wednesday																								
Thursday																								
Friday																								
Saturday													OOH Period 1 (Day)											
Sunday																					OOH Period 2			
Public Holiday																								

Out of Hours (OOH) work is divided into two periods of sensitivity and cover the hours listed below:

- **OOH Period 1 (day/low risk period):** Saturdays – 7am to 8am & 1pm to 6pm, Sundays/Public Holidays – 8am to 6pm;
- **OOH Period 1 (evening/low risk period):** Monday to Friday – 6pm to 10pm; and
- **OOH Period 2 (night/medium to high-risk period):** Monday to Friday – 10pm to 7am, Saturdays/Sundays/Public Holidays – 6pm to 7am (8am on Sunday mornings and Public Holidays).

4.1.2 Interim Construction Noise Guideline

In accordance with the CNVG, construction Noise Management Levels are established with reference to the NSW Interim Construction Noise Guideline (ICNG). The ICNG is specifically aimed at managing noise from construction work regulated by the EPA and is used to help in setting statutory conditions in licences or other regulatory instruments. The types of construction regulated by the Environment Protection Authority (EPA) under the Protection of the Environment Operations Act 1997 (POEO Act), include construction, maintenance and renewal activities carried out by a public authority, such as road upgrades as described in Schedule 1 of the POEO Act.

The ICNG sets out procedures to identify and address the impact of construction noise on residences and other sensitive land uses. This section provides a summary of noise objectives that are applicable to the assessment. The ICNG provides two methodologies for the assessment of construction noise emissions:

- quantitative, which is suited to major construction proposals with typical durations of more than three weeks; and
- qualitative, which is suited to short term infrastructure maintenance (for proposals with a typical duration of less than three weeks).

The methodology for a quantitative assessment requires a more complex approach, involving noise emission predictions from construction activities to the relevant assessment locations, whilst the qualitative assessment methodology is a more simplified approach that relies more on noise management strategies.

This report has adopted a quantitative assessment approach. The assessment includes identification of potentially affected assessment locations, description of activities involved in the proposal, derivation of the construction noise criteria for standard and out of hours (OOH) periods, quantification of potential noise impacts at receivers and, provides management and mitigation recommendations.

Table 4 reproduces the ICNG management levels for residential receivers. The construction Noise Management Level (NML) is the sum of the management level and relevant Rating Background Level (RBL) for each specific assessment period. Table 5 reproduces the ICNG management levels for other receiver types.

Table 4 ICNG Residential Management Levels		
Time of Day	Management Level $LA_{eq(15min)}$[1]	How to Apply
Recommended standard hours: Monday to Friday 7am to 6pm Saturday 8am to 1pm No work on Sundays or public holidays.	Noise affected RBL + 10dB.	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured LAeq(15min) is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75dBA.	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: ▪ times identified by the community when they are less sensitive to noise such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences; and ▪ if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours.	Noise affected RBL + 5dB.	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5dBA above the noise affected level, the proponent should negotiate with the community. For guidance on negotiating agreements see section 7.2.2.

Note 1: The Rating Background Level (RBL) is an overall single figure background level representing each assessment period over the whole monitoring period. The RBL is used to determine the construction NML for noise assessment purposes and is the median of the ABL's.

Table 5 Noise Management Levels for Other Noise Sensitive Receivers		
Land use	Where objective applies	Management Level $LA_{eq(15min)}$[1]
Classrooms at schools and other educational institutions	Internal noise level	45dB
Hospital wards and operating theatres	Internal noise level	45dB
Places of worship	Internal noise level	45dB
Active recreation areas	External noise level	65dB
Passive recreation areas	External noise level	60dB
Commercial premises	External noise level	70dB
Industrial premises	External noise level	75dB

Note 1: Noise Management Levels apply when receiver areas are in use only.

Where the predicted or measured $LA_{eq(15min)}$ noise level is greater than the NML, the proponent should apply all feasible and reasonable work practices to meet the relevant NML. Following the implementation of standard mitigation measures, where residual noise impacts occur, additional mitigation measures (AMMs) should be implemented.

4.1.3 Construction Noise Management Levels (Criteria)

The NMLs for standard and out of hours work periods are summarised in **Table 6** for residential receivers. Location L1 is representative of residential receivers immediately adjacent to Appin Road, while L2 is representative of all other residential receivers, partially shielded from Appin Road. It is noted that the NML for standard construction hours is equal to the standard hours RBL + 10dB, while the OOH NMLs are equal to the OOH RBLs + 5dB.

Upon review of background monitoring data, it was determined that the measured RBLs for the OOH Period 1 day and evening periods were similar. Hence, the OOH Period 1 NML represents both the OOH day and OOH evening periods for urban residential receivers.

Table 6 Construction NMLs – Residential Receivers				
Location	Assessment Period	RBL, dBA	NML dB $LA_{eq(15min)}$	Highly noise affected NML[1] dB $LA_{eq(15min)}$
L1 – First Row of Houses Appin Rd	Standard Hours	52	62	75
	OOH Period 1	49	54	75
	OOH Period 2	36	41	75
L2 – All other Residential Receivers	Standard Hours	43	53	75
	OOH Period 1	43	48	75
	OOH Period 2	30[2]	35	75

Note 1: The highly noise affected NML is a hypothetical level that is adopted to ensure the avoidance of strong community reaction. Should this level be exceeded the construction methodology is to be reviewed to reduce the impact on surrounding sensitive receivers.

Note 2: Where the measured RBL is less than the minimum default RBLs, the minimum default RBL is adopted.

The NMLs for standard and out of hours work periods are summarised in **Table 7** for applicable non-residential receivers.

Table 7 Construction NMLs – Non-Residential Receivers

Location	Assessment Period	Where NML Applies	NML dB $L_{Aeq(15min)}$
Hospital Wards and Operating Theatres	When in use	Internal noise level	45
Education Institution	When in use	Internal noise level	45
Place of Worship	When in use	Internal noise level	45
Childcare Centres[1]	When in use	Internal sleeping areas	35
		External play areas	55
Active Recreation	When in use	External noise level	65
Commercial Receivers	When in use	External noise level	70

Note 1: As per AAAS guideline for Child Care Centre Acoustic Assessment v3.0.

4.2 Maximum Noise Level Assessment

The maximum noise level assessment (sleep disturbance) criterion of 65dB L_{Amax} is referred to in Section 2.1.5 of the Noise and Vibration Assessment Procedure (for road traffic and construction) (Transport for NSW, 2023) and Appendix E of the Construction Noise and Vibration Guideline (for road and maritime works) (Transport for NSW, 2022).

The maximum noise level assessment criterion relates to both operational phase and construction phase sleep disturbance impacts and has been adopted as the relevant assessment criterion for this assessment.

4.3 Noise Assessment Methodology

A computer model was developed to quantify project noise emissions to neighbouring receivers using DGMR (iNoise, Version 2023.2) noise modelling software. iNoise is an intuitive and quality assured software for industrial noise calculations in the environment. 3D noise modelling is considered industry best practice for assessing noise emissions from projects.

The model incorporated a three-dimensional digital terrain map giving all relevant topographic information used in the modelling process. Additionally, the model uses relevant noise source data, ground type, attenuation from barrier or buildings and atmospheric information to predict noise levels at the nearest potentially affected receivers. Where relevant, modifying factors in accordance with Fact Sheet C of the NPI have been applied to calculations.

The model calculation method used to predict noise levels was in accordance with ISO 9613-1 'Acoustics - Attenuation of sound during propagation outdoors. Part 1: Calculation of the absorption of sound by the atmosphere' and ISO 9613-2 'Acoustics - Attenuation of sound during propagation outdoors. Part 2: General method of calculation' including corrections for meteorological conditions using CONCAWE[1]. The ISO 9613 standard from 1996 is the most used noise prediction method worldwide. Many countries refer to ISO 9613 in their noise legislation. However, the ISO 9613 standard does not contain guidelines for quality assured software implementation, which leads to differences between applications in calculated results. In 2015 this changed with the release of ISO/TR 17534-3. This quality standard gives clear recommendations for interpreting the ISO 9613 method. iNoise fully supports these recommendations. The models and results for the 19 test cases are included in the software.

[1] Report no. 4/18, "the propagation of noise from petroleum and petrochemical complexes to neighbouring communities", Prepared by C.J. Manning, M.Sc., M.I.O.A. Acoustic Technology Limited (Ref.AT 931), CONCAWE, Den Haag May 1981

4.4 Proposed Works and Construction Scenarios

Construction activities considered to have the greatest potential for noise impact on nearby receivers were determined in consultation with TfNSW. The construction scenarios included in this assessment are described in **Table 8** and the typical plant and equipment, along with the fleet Sound Power Level (SWL) and maximum noise levels (L_{Amax}) for each of the construction activities are provided in **Table 9**. The fleet Sound Power Levels, and maximum noise levels were sourced from the TfNSW Construction and Maintenance Noise Estimator tool.

The precise locations and types of equipment used for construction are not known in detail at the concept design phase of the proposal. Hence, the construction fleet for each activity was modelled across the potential extent of each work area, with all plant and equipment operating simultaneously and at maximum capacity for the duration of the assessment period. It is noted that typical construction plant and equipment are unlikely to operate simultaneously but may be used sequentially across each part of the construction area. On that basis, this assessment provides a broad assessment of the likely worst-case impacts from each stage of the construction works.

Table 8 Proposed Construction Scenarios

Scenarios	Description
S1 – Site establishment	▪ Installation of boundary fences and traffic control measures
S2 – Corridor Clearing	▪ Removal or trimming trees to provide a clear corridor
S3 – Utility adjustment	▪ Relocation of services
S4 – Road widening works	▪ Excavation and formation of road alignment ▪ Placement and compaction of sublayers
S5 – Drainage structures	▪ Excavation of trenches and pits ▪ Delivery and placement of pipes and pits ▪ Compacting
S6 – Pavement works	▪ Laying of new pavement
S7 – Road furniture installation / line marking	▪ Signposting ▪ New line markings
S8 – Ancillary Site	▪ Operation of ancillary site

Table 9 Construction Scenarios & Fleet Sound Power Levels dB $L_{Aeq(15min)}$ – Construction Phase									
Item	SWLs	Construction Scenarios							
		S1 Site Establishment	S2 Corridor Clearing	S3 Utility Adjustment	S4 Road Widening	S5 Drainage Works	S6 Paving Works	S7 Line Marking	S8 Ancillary Site
Light Vehicles	88								✓
Truck (Medium)	103	✓		✓					
Road Truck / Tipper	108	✓	✓		✓	✓	✓	✓	✓
EWP	98	✓						✓	
Franna	98	✓						✓	
Excavators	110		✓	✓	✓	✓			
Concrete Saw	118			✓			✓		
Vacuum Truck	109			✓					
Backhoe	104			✓	✓	✓			
Skid Steer	91								✓
Compressor	109								✓
Chainsaw	114		✓						
Tub Grinder	116		✓						
Pneumatic Hammer	113			✓					
Concrete Truck	109					✓	✓		
Generator / Lighting	98			✓					✓
Truck Compressor	75					✓			
Pavement Layer	114						✓		
Asphalt Truck	106						✓		
Rollers (Steel Drum/Multi-tire)	107				✓	✓	✓		
Compactor	106				✓				
Line Marking	108							✓	
Water Cart	107				✓				
Total Fleet SWL[1]		110	118	115	116	115	117	109	109
Maximum Noise Level Assessment (L_{Amax}), Night-time periods (10pm to 7am)									
Fleet L_{Amax}		116	122	116	128	116	130	116	116

Note 1: Includes an adjustment for duration.

4.5 Construction Noise Levels

Construction noise levels have been predicted for sensitive receiver locations for each of the construction scenarios described in **Section 4.4**. A summary of the predicted $LA_{eq(15min)}$ noise emissions is presented for the most affected receiver location for each receiver type in **Table 10**. Predicted levels exceeding the NMLs are displayed **BOLD** text. For detailed mapping of the affected areas, noise contours for each modelled scenario are presented in **Appendix D**.

It is noted that at the concept design phase of the proposal, detailed schedules and construction hours have not yet been determined. Hence, the assessment has considered the potential noise impacts for each construction activity during standard and OOH work periods.

Table 10 Summary of Noise Assessment Results – Most Affected Receivers

Receiver Type	Period	NML (dB LA_{eq})	Highest Predicted dB LA_{eq} Per Scenario[1]							
			S1	S2	S3	S4	S5	S6	S7	S8
NCA 1 Fronting Appin Road	Standard	62	**64**	**76**	**78**	**80**	**67**	**78**	**69**	n/a
	OOH P1	54	**64**	**76**	**78**	**80**	**67**	**78**	**69**	n/a
	OOH P2	41	**64**	**76**	**78**	**80**	**67**	**78**	**69**	n/a
NCA 2 All other Residential	Standard	53	**62**	**62**	**62**	**63**	**62**	**63**	**62**	**62**
	OOH P1	48	**62**	**62**	**62**	**63**	**62**	**63**	**62**	**62**
	OOH P2	35	**62**	**62**	**62**	**63**	**62**	**63**	**62**	**62**
Hospital Wards	When in use	70[2]	32	35	40	41	39	42	39	n/a
Education	When in use	70[2]	48	48	48	48	48	48	48	48
Childcare Centre	When in use	60[2]	**64**	**64**	**64**	**64**	**64**	**64**	**64**	**64**
Place of Worship	When in use	70[2]	46	46	46	46	46	46	46	46
Active Recreation	When in use	65	59	59	59	59	59	59	59	59
Commercial	When in use	70	62	62	62	62	62	62	62	62

Note 1: Exceedance of relevant NMLs highlighted and shown in **BOLD**.

Note 2: External noise criteria derived using 25dBA façade attenuation for masonry building type with single glazed windows (closed) as per Table 4.2 of ENMM.

The results of the assessment demonstrate that $LA_{eq(15min)}$ noise emissions would be above the relevant NMLs for residential receivers for all construction scenarios during standard and OOH work periods. The highest $LA_{eq(15min)}$ noise levels are predicted at up to 80dB at 263 St Johns Road, Bradbury during road widening works (S4). Furthermore, construction noise levels are predicted to exceed the highly affected NML of 75dB $LA_{eq(15min)}$ at nearby residential receivers during corridor clearing (S2), utility adjustment (S3), road widening (S4) and paving works (S6).

The construction noise emissions are predicted to exceed the NMLs at one non-residential receiver, identified as the Open Arms Early Education Centre, adjacent to the compound site at Copperfield Drive.

4.5.1 Scenario 1 – Site Establishment

Table 10 demonstrates that $LA_{eq(15min)}$ noise emissions are predicted to be above the relevant NMLs for nearby residential receivers during standard and OOH work periods during site establishment works, with the highest predicted noise levels of up to 64dB at 263 St Johns Road, Bradbury. The affected distances and number of residential receivers within the affected area are provided in Table 11.

Table 11 Affected Distances – Site Establishment

Receiver Type	Assessment Period	NML dB $LA_{eq(15min)}$	Affected Distance (m)	Number of Receivers Affected
Residential – Fronting Appin Road and/or St Johns Road	Standard Hours	62	~25	2
	OOH P1	54	~45	~20
	OOH P2	41	~150	~100
	Highly Affected	75	n/a	0
Residential – All other Residential	Standard Hours	53	~65	~40
	OOH P1	48	~140	~110
	OOH P2	35	~330	~800
	Highly Affected	75	n/a	0

The results of the assessment demonstrate that during site establishment works, two residential receivers fronting Appin Road, and up to 40 residential receivers set back from Appin Road (within approximately 50m) would experience noise levels above the standard hours NMLs. During OOH P1 (day and evening) and OOH P2, residential receivers within 140m and 330m of the proposal respectively are anticipated to experience noise levels above the relevant NMLs. Noise levels are not expected to exceed the highly affected NML at any sensitive receiver locations.

One non-residential receiver, identified as the Open Arms Early Education Centre, adjacent to the compound site at Copperfield Drive, is predicted to experience noise levels above the relevant NMLs.

4.5.2 Scenario 2 – Corridor Clearing

Table 10 demonstrates that $LA_{eq(15min)}$ noise emissions are predicted to be above the relevant NMLs for nearby residential receivers during standard and OOH work periods during corridor works, with the highest predicted noise levels of up to 76dB at 318 St Johns Road, Bradbury. The affected distances and number of residential receivers within the affected area are provided in Table 12.

Table 12 Affected Distances – Corridor Clearing

Receiver Type	Assessment Period	NML dB $LA_{eq(15min)}$	Affected Distance (m)	Number of Receivers Affected
Residential – Fronting Appin Road and/or St Johns Road	Standard Hours	62	~25	~25
	OOH P1	54	~60	~55
	OOH P2	41	~150	~120
	Highly Affected	75	<10	1
Residential – All other Residential	Standard Hours	53	~130	~60
	OOH P1	48	~240	~170
	OOH P2	35	~950	~2,000
	Highly Affected	75	<10	0

The results of the assessment demonstrate that during corridor clearing / removal of roadside vegetation, up to 25 residential receivers fronting Appin Road, and up to 60 residential receivers set back from Appin Road (within approximately 130m) would experience noise levels above the standard hours NMLs. During OOH P1 (day and evening) and OOH P2, residential receivers within 240m and 950m of the proposal respectively are anticipated to experience noise levels above the relevant NMLs. Noise levels are not expected to exceed the highly affected NML at any sensitive receiver locations.

One non-residential receiver, identified as the Open Arms Early Education Centre, adjacent to the compound site at Copperfield Drive, is predicted to experience noise levels above the relevant NMLs. Additionally, one residential receiver, identified as 318 St Johns Road, is predicted to exceed the highly noise affected NML of 75dB $LA_{eq(15min)}$.

4.5.3 Scenario 3 – Utility Adjustment

As shown in **Table 10**, $LA_{eq(15min)}$ noise emissions are predicted to be above the NMLs for standard hours and OOH work periods for nearby residential receivers during utility adjustment works, with noise levels predicted to 78dBA at 263 St Johns Road. The affected distances and number of receivers within the affected areas are provided in **Table 13**.

Table 13 Affected Distances – Utility Adjustment

Receiver Type	Assessment Period	NML dB $LA_{eq(15min)}$	Affected Distance (m)	Number of Receivers Affected
Residential – Fronting Appin Road and/or St Johns Road	Standard Hours	62	~25	~45
	OOH P1	54	~65	~85
	OOH P2	41	~200	~150
	Highly Affected	75	<10	1
Residential – All other Residential	Standard Hours	53	~80	~70
	OOH P1	48	~260	~310
	OOH P2	35	~950	~1,750
	Highly Affected	75	<10	0

The results of the assessment demonstrate that during utility adjustment works, up to 45 residential receivers fronting Appin Road, and up to an additional 70 residential receivers set back from Appin Road (within approximately 80m) would experience noise levels above the standard hours NMLs. During OOH P1 (day and evening) and OOH P2, residential receivers within 260m and 950m of the proposal respectively are anticipated to experience noise levels above the relevant NMLs.

One non-residential receiver, identified as the Open Arms Early Education Centre, adjacent to the compound site at Copperfield Drive, is predicted to experience noise levels above the relevant NMLs. Additionally, one residential receiver, identified as 263 St Johns Road, is predicted to exceed the highly noise affected NML of 75dB $LA_{eq(15min)}$.

4.5.4 Scenario 4 – Road Widening

As shown in **Table 10**, $LA_{eq(15min)}$ noise emissions are predicted to be above the NMLs for standard hours and OOH work periods for nearby residential receivers during drainage works, with noise levels predicted to 80dBA at 263 St Johns Road. The affected distances and number of receivers within the affected area are provided in **Table 14**.

Table 14 Affected Distances – Road Widening Works

Receiver Type	Assessment Period	NML dB $LA_{eq(15min)}$	Affected Distance (m)	Number of Receivers Affected
Residential – Fronting Appin Road and/or St Johns Road	Standard Hours	62	~30	~40
	OOH P1	54	~95	~75
	OOH P2	41	~230	~150
	Highly Affected	75	<10	2
Residential – All other Residential	Standard Hours	53	~100	~70
	OOH P1	48	~390	~290
	OOH P2	35	~1,100	>2,500
	Highly Affected	75	<10	0

The results of the assessment demonstrate that during road widening works, up to 40 residential receivers fronting Appin Road, and up to an additional 70 residential receivers set back from Appin Road (within approximately 80m) would experience noise levels above the standard hours NMLs. During OOH P1 (day and evening) and OOH P2, residential receivers within 390m and 1,100m of the proposal respectively are anticipated to experience noise levels above the relevant NMLs.

One non-residential receiver, identified as the Open Arms Early Education Centre, adjacent to the compound site at Copperfield Drive, is predicted to experience noise levels above the relevant NMLs. Noise levels are also expected to exceed the highly affected NML at two residential receivers adjacent to Appin Road, identified as 263 St Johns Road and 318 St Johns Road.

4.5.5 Scenario 5 – Drainage Structures

As shown in **Table 10**, $LA_{eq(15min)}$ noise emissions are predicted to be above the NMLs for standard hours and OOH work periods for nearby residential receivers during the installation of drainage structures, with noise levels predicted to 67dBA at 29 Poplar Street. The affected distances and number of receivers within the affected area are provided in **Table 15**.

Table 15 Affected Distances – Installation of Drainage Structures

Receiver Type	Assessment Period	NML dB $LA_{eq(15min)}$	Affected Distance (m)	Number of Receivers Affected
Residential – Fronting Appin Road and/or St Johns Road	Standard Hours	62	~30	~30
	OOH P1	54	~95	~75
	OOH P2	41	~230	~150
	Highly Affected	75	n/a	0
Residential – All other Residential	Standard Hours	53	~135	~65
	OOH P1	48	~250	~235
	OOH P2	35	~950	~1,750
	Highly Affected	75	n/a	0

The results of the assessment demonstrate that during drainage works, up to 30 residential receivers fronting Appin Road, and up to an additional 65 residential receivers set back from Appin Road (within approximately 135m) would experience noise levels above the standard hours NMLs. During OOH P1 (day and evening) and OOH P2, residential receivers within 250m and 950m of the proposal respectively are anticipated to experience noise levels above the relevant NMLs.

One non-residential receiver, identified as the Open Arms Early Education Centre, adjacent to the compound site at Copperfield Drive, is predicted to experience noise levels above the relevant NMLs.

4.5.6 Scenario 6 – Pavement Works

As shown in **Table 10**, $LA_{eq(15min)}$ noise emissions are predicted to be above the NMLs for standard hours and OOH work periods for nearby residential receivers during pavement works, with noise levels predicted to 78dBA at 263 St Johns Road. The affected distances and number of receivers within the affected area are provided in **Table 16**.

Table 16 Affected Distances – Pavement Works

Receiver Type	Assessment Period	NML dB $LA_{eq(15min)}$	Affected Distance (m)	Number of Receivers Affected
Residential – Fronting Appin Road and/or St Johns Road	Standard Hours	62	~60	~50
	OOH P1	54	~150	~100
	OOH P2	41	~500	~160
	Highly Affected	75	<10m	1
Residential – All other Residential	Standard Hours	53	~215	~135
	OOH P1	48	~420	~440
	OOH P2	35	~1,250	>2,500
	Highly Affected	75	n/a	0

The results of the assessment demonstrate that during drainage works, up to 50 residential receivers fronting Appin Road, and up to an additional 135 residential receivers set back from Appin Road (within approximately 215m) would experience noise levels above the standard hours NMLs. During OOH P1 (day and evening) and OOH P2, residential receivers within 420m and 1,250m of the proposal respectively are anticipated to experience noise levels above the relevant NMLs.

One non-residential receiver, identified as the Open Arms Early Education Centre, adjacent to the compound site at Copperfield Drive, is predicted to experience noise levels above the relevant NMLs. Additionally, one residential receiver, identified as 263 St Johns Road, is predicted to exceed the highly noise affected NML of 75dB $LA_{eq(15min)}$.

4.5.7 Scenario 7 – Line Marking / Road Furniture Installation

As shown in **Table 10**, $LA_{eq(15min)}$ noise emissions are predicted to be above the NMLs for standard hours and OOH work periods for nearby residential receivers during line marking works, with noise levels predicted to 69dBA at 263 St Johns Road. The affected distances and number of receivers within the affected area are provided in **Table 17**.

Table 17 Affected Distances – Line Marking

Receiver Type	Assessment Period	NML dB $LA_{eq(15min)}$	Affected Distance (m)	Number of Receivers Affected
Residential – Fronting Appin Road and/or St Johns Road	Standard Hours	62	~30	~15
	OOH P1	54	~100	~95
	OOH P2	41	~250	~145
	Highly Affected	75	n/a	0
Residential – All other Residential	Standard Hours	53	~100	~65
	OOH P1	48	~250	~230
	OOH P2	35	~675	~1,350
	Highly Affected	75	n/a	0

The results of the assessment demonstrate that during line marking and installation of road furniture, up to 15 residential receivers fronting Appin Road, and up to an additional 65 residential receivers set back from Appin Road (within approximately 100m) would experience noise levels above the standard hours NMLs. During OOH P1 (day and evening) and OOH P2, residential receivers within 250m and 675m of the proposal respectively are anticipated to experience noise levels above the relevant NMLs.

One non-residential receiver, identified as the Open Arms Early Education Centre, adjacent to the compound site at Copperfield Drive, is predicted to experience noise levels above the relevant NMLs.

4.5.8 Scenario 8 – Operation of Compound Sites

As shown in **Table 10**, $LA_{eq(15min)}$ noise emissions are predicted to be above the NMLs for standard hours and OOH work periods for nearby residential receivers during operation of the compound site in isolation of other works, with noise levels predicted to 62dBA at 20 MacDuff Way. The affected distances and number of receivers within the affected area are provided in **Table 18**.

Table 18 Affected Distances – Compound Sites

Receiver Type	Assessment Period	NML dB $LA_{eq(15min)}$	Affected Distance (m)	Number of Receivers Affected
Residential – Fronting Appin Road and/or St Johns Road	Standard Hours	62	n/a	0
	OOH P1	54	n/a	3
	OOH P2	41	~215	~45
	Highly Affected	75	n/a	0
Residential – All other Residential	Standard Hours	53	~95	~50
	OOH P1	48	~150	~125
	OOH P2	35	~560	~1,100
	Highly Affected	75	n/a	0

The results of the assessment demonstrate that during operation of the compound sites, up to 50 residential receivers set back from Appin Road (within approximately 95m) would experience noise levels above the standard hours NMLs. During OOH P1 (day and evening) and OOH P2, residential receivers within 150m and 560m of the proposal respectively are anticipated to experience noise levels above the relevant NMLs.

One non-residential receiver, identified as the Open Arms Early Education Centre, adjacent to the compound site at Copperfield Drive, is predicted to experience noise levels above the relevant NMLs.

4.5.9 Maximum Noise Level Assessment Results

Out of hours construction activities occurring during the night-time have the potential to generate noise emissions that may cause sleep disturbance at receivers in proximity to the proposal site.

Maximum night-time noise level events have been predicted for sensitive receiver locations for each of the construction scenarios described in **Section 4.4**. Maximum noise levels were sourced from the TfNSW Construction and Maintenance Noise Estimator to represent emissions from transient sources during each of the construction activities.

A summary of the predicted L_{Amax} noise emissions is presented for the most affected receiver location for residential receivers and accommodation services in **Table 19**. Predicted levels exceeding the maximum noise criterion are displayed **BOLD** text.

Table 19 Summary of Maximum Noise Levels – Most Affected Receivers

Receiver Type	Period	NML	Highest Predicted dB L_{Aeq} Per Scenario							
		(dB L_{Amax})	S1	S2	S3	S4	S5	S6	S7	S8
Residential	OOH P2	65	**85**	**92**	**83**	**96**	**78**	**96**	**82**	**70**

The results of the assessment demonstrate that maximum noise levels are predicted to exceed the maximum noise criterion of 65dB L_{Amax} at nearby residential receivers during all construction scenarios. It is understood that all works would potentially be undertaken during OOH work periods except for site establishment works (S1) and corridor clearing (S2). Additionally, it is noted that in accordance with the CNVG, road widening works (bulk earthworks) are not recommended for OOH work periods.

Further assessment of maximum noise levels was undertaken for the activity with the greatest potential for sleep disturbance effects, identified as paving works (S6) utilising a concrete saw. The results of the modelling identified that approximately 385 residential receivers within about 400m, including residences within approximately 65m of the compound sites, are predicted to experience noise levels above the maximum noise criterion during paving works along Appin Road (see **Figure 3**). Therefore, it is recommended that the proposal proactively manages night-time noise emissions and implement reasonable and feasible noise control strategies to minimise the occurrence of sleep disturbance within the surrounding locality. It is also recommended that particularly noisy activities, such as concrete sawing should be avoided during OOH work where possible.

FIGURE 3

Maximum Noise Levels

Paving Works (S6)

MAC231792-01

Appin Road Intersection

KEY

- Proposal Site
- Compound Site
- MNLA Noise Affected Area

0 90 180 270 360 m

N

MAC
Muller Acoustic Consulting

4.5.10 Construction Road Traffic Noise

Construction traffic will generate noise over a relatively wide area and beyond the construction site itself. It would be expected that traffic noise would be greatest where there is a concentration of vehicle movements, such as the compound sites and specific locations where construction is occurring.

The proposal is anticipated to generate approximately 60 heavy vehicle movements and 40 light construction vehicle movements per day at the peak of construction activity. These movements will include approximately 25 light vehicles and 37 heavy vehicles during standard construction hours, and 15 light vehicles and 23 heavy vehicles during out of hours work periods. Existing traffic flows were sourced from the Appin Road and St Johns Road Intersection Upgrade 100% Detailed Design Report (AECOM, 2022, Ref: P0056856), which projected annual average daily traffic (AADT) volumes for Appin Road to 2024. AADT volumes for Fitzgibbon Lane and Copperfield Drive (access to compound sites) were determined from measured 2016 AM peak volumes provided in the Detailed Design Report (AECOM, 2022), projected to 2024 using a 2% annual growth rate. The AM peak volume was multiplied by 10 to determine the AADT volume, with a 90%/10% day and night split applied.

Existing traffic volumes were not available for Dickens Road, therefore, AADT volumes were determined by multiplying the number of residences (~200) directly accessed from Dickens Road by 10.7 daily vehicle trips, as per the TfNSW (2013) Guide to Traffic Generating Developments, with 50% of vehicles using the southern portion of Dickens Road to access Copperfield Drive. Day period and night period traffic volumes were determined using a 90%/10% split.

An analysis of the increase in road traffic noise levels from construction traffic is presented in **Table 20**. The results of the analysis demonstrate that due to high existing road traffic noise levels in the locality, construction road noise levels would be negligible, with increases in noise levels anticipated to remain below the 2dB $LA_{eq(period)}$ increase criterion.

Table 20 Construction Road Traffic Noise					
Road Segment	Period	Existing Traffic	Construction Vehicles[1,2]	Increase in Traffic	Increase in Traffic Noise, dB LAeq,period
Appin Road	Day	28,310	62	0.2%	<0.1
	Night	7,078	38	0.5%	<0.1
Fitzgibbon Lane	Day	6,053	31	0.5%	<0.1
	Night	673	19	2.8%	<0.2
Copperfield Drive	Day	2,489	31	1.2%	<0.1
	Night	277	19	6.9%	<0.3
Dickens Road	Day	963	31	3.2%	<0.2
	Night	107	19	17.8%	~0.7

Note 1: Construction vehicles per period.

Note 2: Assumes a reduced rate (50%) of construction vehicles travelling to compound sites off Copperfield Drive and Dickens Road.

4.6 Construction Noise Mitigation Measures

4.6.1 Standard Mitigation Measures

The TfNSW CNVG outlines noise management and mitigation measures to minimise the noise and vibration impacts from construction activities on nearby sensitive receivers. Adopting the standard mitigation measures may result in an attenuation of up to 10dBA where space requirements place limitations on the attenuation options, and up to 20dBA in situations where noise source noise mitigation measures (silencers, mufflers etc) can be combined with noise barriers and other management techniques. The standard mitigation measures as per the CNVG are reproduced in **Table 21**.

Table 21 Standard Mitigation Measures

Action Required	Details
Management Measures	
Implementation of any project specific mitigation measures required	Implementation of any project specific mitigation measures required.
Implement community consultation or notification measures	Notification detailing work activities, dates and hours, impacts and mitigation measures, indication of work schedule over the night-time period, any operational noise benefits from the works (where applicable) and contact telephone number. Notification should be a minimum of 7 calendar days prior to the start of works. For projects other than maintenance works more advanced consultation or notification may be required. Please contact Roads and Maritime Communication and Stakeholder Engagement for guidance. ▪ Website (If required); ▪ Contact telephone number for community; ▪ Email distribution list (if required); and ▪ Community drop in session (if required by approval conditions).
Site inductions	All employees, contractors and subcontractors are to receive an environmental induction. The induction must at least include: ▪ all relevant project specific and standard noise and vibration mitigation measures; ▪ relevant licence and approval conditions; ▪ permissible hours of work; ▪ any limitations on noise generating activities; ▪ location of nearest sensitive receivers; ▪ construction employee parking areas; ▪ designated loading/unloading areas and procedures; ▪ site opening/closing times (including deliveries); and

Table 21 Standard Mitigation Measures	
Action Required	**Details**
	▪ environmental incident procedures.
Behavioural practices	No swearing or unnecessary shouting or loud stereos/radios on site. No dropping of materials from height, throwing of metal items and slamming of doors.
Verification	Where specified under Appendix C a noise verification program is to be carried out for the duration of the works in accordance with the Construction Noise and Vibration Management Plan and any approval and licence conditions.
Attended vibration measurements	Where required attended vibration measurements should be undertaken at the commencement of vibration generating activities to confirm that vibration levels are within the acceptable range to prevent cosmetic building damage.
Update Construction Environmental Management Plan	The CEMP must be regularly updated to account for changes in noise and vibration management issues and strategies.
Building condition surveys	Undertake building dilapidation surveys on all buildings located within the buffer zone prior to commencement of activities with the potential to cause property damage (refer to Section 4.10 for Vibration Assessment).
Source Controls	
Construction hours and scheduling	Where feasible and reasonable, construction should be carried out during the standard daytime working hours. Work generating high noise and/or vibration levels should be scheduled during less sensitive time periods
Construction respite period during normal hours and out-of-hours work	Please refer to Appendix C of the CNVG for more details on the following respite measures: ▪ Respite Offers (RO); ▪ Respite Period 1 (R1); ▪ Respite Period 2 (R2); and ▪ Duration Respite (DR)
Equipment selection	Use quieter and less vibration emitting construction methods where feasible and reasonable. For example, when piling is required, bored piles rather than impact-driven piles will minimise noise and vibration impacts. Similarly, diaphragm wall construction techniques, in lieu of sheet piling, will have significant noise and vibration benefits. Ensure plant including the silencer is well maintained.
Plant noise levels	The noise levels of plant and equipment must have operating Sound Power or Sound Pressure Levels compliant with the criteria in Appendix H of the CNVG. Implement a noise monitoring audit program to ensure equipment remains within the more stringent of the manufacturer's specifications or Appendix H of the CNVG.
Rental plant and equipment	The noise levels of plant and equipment items are to be considered in rental decisions and in any case cannot be used on site unless compliant with the criteria in Table 2 of the CNVG.

Table 21 Standard Mitigation Measures	
Action Required	**Details**
Use and siting of plant	The offset distance between noisy plant and adjacent sensitive receivers is to be maximised. Plant used intermittently to be throttled down or shut down. Noise-emitting plant to be directed away from sensitive receivers. Only have necessary equipment on site.
Plan worksites and activities to minimise noise and vibration.	Locate compounds away from sensitive receivers and discourage access from local roads. Plan traffic flow, parking and loading/unloading areas to minimise reversing movements within the site. Where additional activities or plant may only result in a marginal noise increase and speed up works, consider limiting duration of impact by concentrating noisy activities at one location and move to another as quickly as possible. Very noise activities should be scheduled for normal working hours. If the work cannot be undertaken during the day, it should be completed before 11:00pm. Where practicable, work should be scheduled to avoid major student examination periods when students are studying for examinations such as before or during Higher School Certificate and at the end of higher education semesters. If programmed night work is postponed the work should be re-programmed and the approaches in this guideline apply again.
Reduce equipment power	Use only the necessary size and power.
Non-tonal reversing alarms	Non-tonal reversing beepers (or an equivalent mechanism) must be fitted and used on all construction vehicles and mobile plant regularly used on site and for any out of hours work. Consider the use of ambient sensitive alarms that adjust output relative to the ambient noise level.
Minimise disturbance arising from delivery of goods to construction sites	Loading and unloading of materials/deliveries is to occur as far as possible from sensitive receivers. Select site access points and roads as far as possible away from sensitive receivers. Dedicated loading/unloading areas to be shielded if close to sensitive receivers. Delivery vehicles to be fitted with straps rather than chains for unloading, wherever possible. Avoid or minimise these out of hours movements where possible.
Engine compression brakes	Limit the use of engine compression brakes at night and in residential areas.

Table 21 Standard Mitigation Measures	
Action Required	**Details**
	Ensure vehicles are fitted with a maintained original equipment manufacturer exhaust silencer or a silencer that complies with the National Transport Commission's 'In-service test procedure' and standard.
Path Controls	
Shield stationary noise sources such as pumps, compressors, fans etc	Stationary noise sources should be enclosed or shielded whilst ensuring that the occupational health and safety of workers is maintained. Appendix D of AS2436:2010 lists materials suitable for shielding
Shield sensitive receivers from noise activities	Use structures to shield residential receivers from noise such as site shed placement; earth bunds; fencing; erection of operational stage noise barriers (where practicable) and consideration of site topography when situating plant.
Receptor Controls	
Structural surveys and vibration monitoring	Pre-construction surveys of the structural integrity of vibration sensitive buildings may be warranted. At locations where there are high-risk receptors, vibration monitoring should be conducted during the activities causing vibration.
See Appendix C of the CNVG for additional measures	In some instances, additional mitigation measures may be required.

4.6.2 Additional Mitigation Measures

Standard noise mitigation and management measures in accordance with the ICNG would be implemented for the proposal where practicable.

The CNVG (Roads and Maritime, 2015) outlines a range of mitigation measures which are recommended in order to manage the potential impact. The CNVG additional measures reproduced in **Table 22** will be considered by Transport for NSW or the construction contractor following incorporation of feasible and reasonable mitigation measures for the proposal. **Appendix E** provides a definition of each additional mitigation measure listed below.

Table 22 CNVG Triggers for Additional Mitigation Measures - Airborne Noise

Perception	Predicted airborne $LA_{eq(15min)}$ noise level at receiver		Additional mitigation measures Type	Mitigation Levels
	dB(A) above RBL	dB(A) above NML		
All hours				
75dBA or greater			N, V, PC, RO	HA
Standard Hours: Mon - Fri (7am – 6pm), Sat (8am – 1pm), Sun/Pub Holidays (Nil)				
Noticeable	5 to 10	0	-	NML
Clearly Audible	10 to 20	< 10	-	NML
Moderately intrusive	20 to 30	10 to 20	N, V	NML+10
Highly intrusive	> 30	> 20	N, V	NML+20
OOH Period 1: Mon – Fri (6pm – 10pm), Sat (7am – 8am & 1pm – 10pm), Sun/Pub Hol (8am – 6pm)				
Noticeable	5 to 10	< 5	-	NML
Clearly Audible	10 to 20	5 to 15	N, R1, DR	NML+5
Moderately intrusive	20 to 30	15 to 25	V, N, R1, DR	NML+15
Highly intrusive	> 30	> 25	V, IB, N, R1, DR, PC, SN	NML+25
OOH Period 2: Mon – Fri (10pm – 7am), Sat (10pm – 8am), Sun/Pub Holidays (6pm – 7am)				
Noticeable	5 to 10	< 5	N	NML
Clearly Audible	10 to 20	5 to 15	V, N, R2, DR	NML+5
Moderately intrusive	20 to 30	15 to 25	V, IB, N, PC, SN, R2, DR	NML+15
Highly intrusive	> 30	> 25	AA, V, IB, N, PC, SN, R2, DR	NML+25

Notes: AA = Alternative accommodation, R1 = Respite Period 1, V = Validation of predicted noise levels (not required for projects less than 3 weeks), PC = Phone calls, IB = Individual briefings (not required for projects less than 3 weeks), SN = Specific notifications, N = Notification, R2 = Respite Period 2, DR = Duration Respite, Perception = relates to level above RBL, NML = Noise Management Level (see Appendix C), HA = Highly Affected (> 75 dB(A) - applies to residences only).

It is understood that although construction works would typically be undertaken during standard construction hours, all proposed works, apart from site establishment (S1) and corridor clearing (S2), may occur during OOH work periods. OOH works would typically involve removal of existing line marking and placement of temporary line marking and concrete barriers, and intersection works (including removal of existing concrete structures, construction of new pavement, and construction of new concrete islands).

The assessment of AMM affected distances has considered the scenario with highest potential for noise impacts on surrounding receivers, identified as paving works (S6). Where other construction activities with a lower potential impact are undertaken during OOH work periods, the affected distances for each impact category are expected to be less than those presented in the section below. It is reiterated that in accordance with the CNVG, road widening works (bulk earthworks) are not recommended for OOH work periods.

The affected distances and the number of potentially affected receivers for each AMM category are presented in Table 23. It is noted that the derivation of affected distances has allowed for a conservative 5dB reduction to account for noise attenuation from the implementation of standard mitigation measures as per Section 4.6.1.

A visual representation of the affected distances is presented in Figure 4 to Figure 6 for paving works, and Appendix F for all other construction scenarios. It is noted that there are no applicable additional mitigation measures required beyond standard mitigation measures for the 'noticeable' category (standard hours and OOH period 1), or the 'clearly audible' category (standard hours).

Table 23 – Additional Mitigation Measures – Affected Distances – Paving Works (Scenario 6)										
Assessment Period	Noticeable		Clearly Audible		Moderately Intrusive		Highly Intrusive		Highly Affected	
	Distance	Receivers	Distance	Receivers	Distance	Receivers	Distance	Receivers	Distance	Receivers
Receivers Fronting Appin Rd										
Standard Hours	~35m	11[1]	~35m	11[1]	~10m	1	<10m	0	<10m	0
OOH1	~90m	75[1]	~45m	26	~15m	2	<10m	0	<10m	0
OOH2	~200m	155	~100m	127	~50m	51	~25m	4	<10m	0
Receivers Set Back from Appin Rd										
Standard Hours	~50m	10[1]	~50m	10[1]	~25m	0	<10m	0	<10m	0
OOH1	~175m	107[1]	~100m	10	~35m	0	<10m	0	<10m	0
OOH2	~800m	~950	~550m	~475	~175m	17	~60m	0	<10m	0

Note 1: No additional mitigation measures are applicable.

Note 2: A conservative 5dBA reduction has been applied to noise level predictions to account for noise reduction from implementation of standard mitigation measures.

FIGURE 4

Additional Mitigation Measures

Standard Hours

Paving Works

MAC231792-01

Appin Road Intersection

KEY

- Proposal Site
- Compound Site

AMM Affected Areas

- Noticeable / Clearly Audible
- Moderately Intrusive
- Highly Intrusive

Receivers - Fronting Proposal

- Noticeable / Clearly Audible
- Moderately Intrusive

0 100 200 300 400 m

N

MAC
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FIGURE 5
Additional Mitigation Measures
OOH Period 1
Paving Works
MAC231792-01
Appin Road Intersection
KEY
Proposal Site
Compound Site
AMM Affected Areas
Noticeable
Clearly Audible
Moderately Intrusive
Highly Intrusive
Receivers - Fronting Proposal
Noticeable
Clearly Audible
Moderately Intrusive
0
100
200
300
400 m
N
MAC
Muller Acoustic Consulting
CLENNAM AVENUE
CODLIN STREET
JINWIN PLACE
HOLBORN STREET
GRIMWIG CRESCENT
THROSBY WAY
WOODHOUSE DRIVE
FERN AVENUE
LAVINIA PLACE
CLARISSA PLACE
PINE AVENUE
CAMPBELLFIELD AVENUE
GREENOAKS AVENUE
JACARANDA AVENUE
COACHWOOD CRESCENT
JARRAH AVENUE
MACLEAY STREET
JARNDYCE AVENUE
ATHEL TREE CRESCENT
ST JOHNS ROAD
CLERKENWELL STREET
TIPPING PLACE
TROTWOOD AVENUE
BOYTHORN AVENUE
MARTHA WAY
PEGGOTTY AVENUE
APPIN ROAD
WANDARRA CRESCENT
DEWRANG AVENUE
MANOOKA CRESCENT
BANGALLA AVENUE
AKUNA AVENUE
TWINGLETON AVENUE
HARTHOUSE ROAD
ORLICK STREET
WHITECHAPEL CLOSE
DICKENS ROAD
BALOOK CRESCENT
WARRINA ROAD
NARDANGO ROAD
TANDARA AVENUE
PINAROO CRESCENT
AMINYA CRESCENT
KAPALA AVENUE
ELGATA CRESCENT
THE PARKWAY
BIMBADEEN AVENUE
COPPERFIELD DRIVE
CLEOPATRA DRIVE
MACBETH WAY
TAMORA STREET
WOODLAND ROAD
ST HELENS PARK DRIVE
KENNY CLOSE
MONCRIEFF CLOSE
CUSACK CLOSE
IRONSIDE AVENUE
PARMA CRESCENT
PADEMELON AVENUE
JULIUS ROAD
CASSIO WAY
VIOLENTIA WAY

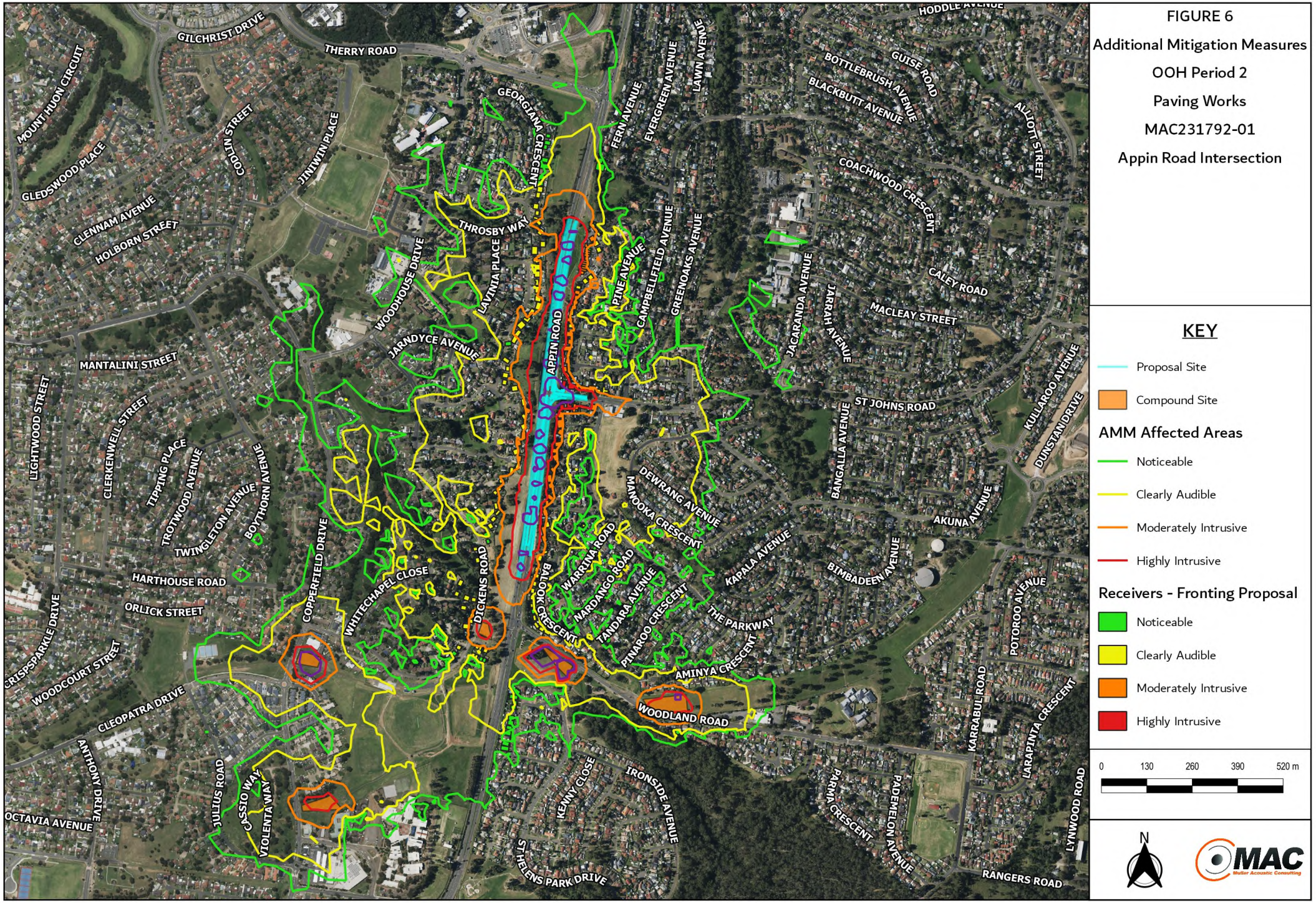
FIGURE 6
Additional Mitigation Measures
OOH Period 2
Paving Works
MAC231792-01
Appin Road Intersection
KEY
Proposal Site
Compound Site
AMM Affected Areas
Noticeable
Clearly Audible
Moderately Intrusive
Highly Intrusive
Receivers - Fronting Proposal
Noticeable
Clearly Audible
Moderately Intrusive
Highly Intrusive
0
130
260
390
520 m
N
MAC
Muller Acoustic Consulting
GILCHRIST DRIVE
THERRY ROAD
MOUNT HUON CIRCUIT
GLEDSWOOD PLACE
GLENNAM AVENUE
HOLBORN STREET
COOLIN STREET
JINIWIN PLACE
GEORGIANA CRESCENT
THROSBY WAY
WOODHOUSE DRIVE
LAVINIA PLACE
JARNDYCE AVENUE
APPIN ROAD
FERN AVENUE
EVERGREEN AVENUE
LAWN AVENUE
PINE AVENUE
CAMPBELLFIELD AVENUE
GREENOAKS AVENUE
HODDLE AVENUE
GUISE ROAD
BOTTLEBRUSH AVENUE
BLACKBUTT AVENUE
ALLOTT STREET
COACHWOOD CRESCENT
CALEY ROAD
MACLEAY STREET
JACARANDA AVENUE
JARRAH AVENUE
MANTALINI STREET
LIGHTWOOD STREET
CLERKENWELL STREET
TIPPING PLACE
TROTWOOD AVENUE
TWINGLETON AVENUE
BOYTHORN AVENUE
ST JOHNS ROAD
KULLAROO AVENUE
DUNSTAN DRIVE
BANGALLA AVENUE
DEWRANG AVENUE
MANOOKA CRESCENT
AKUNA AVENUE
KAPALA AVENUE
BIMBADEEN AVENUE
POTOROO AVENUE
HARTHOUSE ROAD
ORLICK STREET
COPPERFIELD DRIVE
WHITECHAPEL CLOSE
DICKENS ROAD
BALOOK CRESCENT
WARRINA ROAD
NARDANGO ROAD
TANDARA AVENUE
PINAROO CRESCENT
THE PARKWAY
AMINYA CRESCENT
CRISPSPARKLE DRIVE
WOODCOURT STREET
CLEOPATRA DRIVE
WOODLAND ROAD
KARRABUL ROAD
LARAPINTA CRESCENT
ANTHONY DRIVE
OCTAVIA AVENUE
JULIUS ROAD
CASSIO WAY
VIOLENTA WAY
KENNY CLOSE
IRONSIDE AVENUE
PARNA CRESCENT
PADEMELON AVENUE
LYNWOOD ROAD
ST HELENS PARK DRIVE
RANGERS ROAD

4.7 Construction Vibration Criteria

British Standard BS 7385:Part 2-1993 “Evaluation and measurement for vibration in buildings Part 2”, gives guidance on the levels of vibration which building structures could be damaged. BS7385 also takes into consideration the frequency of the vibration which is critical when assessing the likelihood of building damage.

Guide values are set for building vibration based on the lowest vibration levels above which damage has been credibly demonstrated. These levels are judged to result in a minimum risk of vibration-induced damage, where minimal risk for a named effect is usually taken as a 95% probability of no effect.

The recommended limits (guide values) for transient vibration to ensure minimal risk of cosmetic damage to residential and heavy commercial/industrial buildings are presented in **Table 24**. Where sources of continuous vibration may give rise to dynamic magnification due to resonance, the values provided in **Table 24** should be reduced by 50%, this is especially the case with respect to Peak Particle Velocity (PPV) at lower frequencies.

Table 24 Transient Vibration Guide Values - Minimal Risk of Cosmetic Damage

Line	Type of Building	Peak Component Particle Velocity in Frequency Range of Predominant Pulse	
		4 Hz to 15 Hz	15 Hz and above
1	Reinforced or framed structures Industrial and heavy commercial buildings	50 mm/s at 4 Hz and above	
2	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

4.8 Heritage Items

It is noted that the CNVG and BS7385 do not specify recommended vibration limits or minimum working distances for heritage items or other sensitive structures. BS7385 indicates that heritage buildings and structures should not be assumed to be more sensitive to vibration unless they are found to be structurally unsound. If a heritage building or structure is structurally unsound (following inspection) a more conservative cosmetic damage objective as per DIN 4150 would be applicable.

German Standard DIN 4150 - Part 3: 1999 provides guideline values for vibration velocity to be used with evaluating the effects of short-term vibration on structures, including for sensitive structures such as heritage items. The DIN 4150 values are summarised in **Table 25.**

Table 25 Structural Damage Guideline – DIN4150

Type of Structure	Vibration Velocity in mm/s			
	Less than 10Hz	10Hz to 50 Hz	50Hz to 100Hz	… at horizontal plane of highest floor (all frequencies)
Buildings used for commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40
Dwellings and buildings of similar design and/or use	5	5 to 15	15 to 20	15
Structures that because of their particular sensitivity to vibration do not correspond to those above and have intrinsic value (e.g. heritage buildings)	3	3 to 8	8 to 10	8

Table 25 demonstrates that for sensitive buildings such as heritage structures, the guideline vibration values for effects on structures are typically half of those for dwellings. Therefore, based on the DIN 4150 structural damage guidelines, the minimum working distance for heritage structures that are found to be structurally unsound would be approximately equal to twice the minimum working distance for other building types.

4.9 Human Comfort – Assessing Vibration a Technical Guideline

Humans are far more sensitive to vibration than is commonly realised and may detect vibration levels which are well below levels that may cause damage to buildings or structures. Assessing vibration: a technical guideline was published in February of 2006 by the DECC and is based on guidelines contained in BS 6472 – 1992, Evaluation of human exposure to vibration in buildings (1-80 Hz) and provides guidance on assessing vibration against human comfort.

The guideline presents preferred and maximum vibration values for use in assessing human responses to vibration and provides recommendations for measurement and evaluation techniques. At vibration values below the preferred values, there is a low probability of adverse comment or disturbance to building occupants. Where all feasible and reasonable mitigation measures have been applied and vibration values are still beyond the maximum value, it is recommended the operator negotiate directly with the affected community.

The guideline defines three vibration types and provides direction for assessing and evaluating the applicable criteria. Table 2.1 of the guideline provides examples of the three vibration types and has been reproduced in **Table 26**.

Table 26 Examples of types of vibration (from Table 2.1 of the guideline)

Continuous Vibration	Impulsive Vibration	Intermittent Vibration
Machinery, steady road traffic, continuous construction activity (such as tunnel boring machinery)	Infrequent: Activities that create up to three distinct vibration events in an assessment period, e.g. occasional dropping of heavy equipment, occasional loading and unloading. Blasting is assessed using ANZECC (1990)	Trains, intermittent nearby construction activity, passing heavy vehicles, forging machines, impact pile driving, jack hammers. Where the number of vibration events in an assessment period is three or fewer these would be assessed against impulsive vibration criteria.

4.9.1 Continuous Vibration

Appendix C of the guideline outlines acceptable criteria for human exposure to continuous vibration (1-80 Hz), the criteria are dependent on both the time of activity (usually daytime or night-time) and the occupied place being assessed. **Table 27** reproduces the preferred and maximum criteria relating to measured peak velocity.

Table 27 Criteria for Exposure to Continuous Vibration

Place	Time[1]	Peak Velocity (mm/s)	
		Preferred	Maximum
Critical working Areas (e.g. hospital operating theatres, precision laboratories)	Day or Night	0.14	0.28
Residences	Day	0.28	0.56
	Night	0.20	0.40
Offices	Day or Night	0.56	1.1
Workshops	Day or Night	1.1	2.2

Note: rms velocity (mm/s) and vibration velocity value (dB re 10^{-9} mm/s) values given for most critical frequency >8Hz assuming sinusoidal motion.

Note 1: Daytime is 7am to 10pm and Night-time is 10pm to 7am.

4.9.2 Impulsive Vibration

Appendix C of the guideline outlines acceptable criteria for human exposure to impulsive vibration (1-80 Hz), these criteria are dependent on both the time of activity (usually daytime or night-time) and the occupied place being assessed. Impulsive vibration (as defined in Section 2.1 of the guideline) is generally associated with infrequent activities that create up to three (3) distinct vibration events in an assessment period e.g. occasional dropping of heavy equipment, occasional loading and unloading. **Table 28** reproduces the preferred and maximum criteria relating to measured peak velocity.

Table 28 Criteria for Exposure to Impulsive Vibration

Place	Time[1]	Assessment Criteria	
		Peak Velocity (mm/s)	
		Preferred	Maximum
Critical working Areas (e.g. hospital operating theatres, precision laboratories)	Day or Night-time	0.14	0.28
Residences	Daytime	8.6	17.0
	Night-time	2.8	5.6
Offices	Day or Night-time	18.0	36.0
Workshops	Day or Night-time	18.0	36.0

Note 1: Daytime is 7am to 10pm and Night-time is 10pm to 7am.

4.9.3 Intermittent Vibration

Intermittent vibration (as defined in Section 2.1 of the guideline) is assessed using the vibration dose concept which relates to vibration magnitude and exposure time.

Intermittent vibration is representative of activities such as impact hammering, rolling or general excavation work (such as an excavator tracking).

Section 2.4 of the Guideline provides acceptable values for intermittent vibration in terms of vibration dose values (VDV) which requires the measurement of the overall weighted RMS (root mean square) acceleration levels over the frequency range 1-80 Hz. To calculate VDV the following formula (refer section 2.4.1 of the guideline) was used:

$$VDV = \left[\int_0^T a^4(t)dt \right]^{0.25}$$

Where VDV is the vibration dose value in $m/s^{1.75}$, a (t) is the frequency-weighted RMS of acceleration in m/s^2 and T is the total period of the day (in seconds) during which vibration may occur.

The Acceptable Vibration Dose Values (VDV) for Intermittent Vibration is reproduced in **Table 29**.

Table 29 Acceptable Vibration Dose Values (VDV) for Intermittent Vibration

Location	Daytime		Night-time	
	Preferred Value $m/s^{1.75}$	Maximum Value $m/s^{1.75}$	Preferred Value $m/s^{1.75}$	Maximum Value $m/s^{1.75}$
Critical Areas	0.10	0.20	0.10	0.20
Residences	0.20	0.40	0.13	0.26
Offices, schools, educational institutions and places of worship	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60

Note: Daytime is 7am to 10pm and Night-time is 10pm to 7am.

Note: These criteria are indicative only, and there may be a need to assess intermittent values against continuous or impulsive criteria for critical areas.

There is a low probability of adverse comment or disturbance to building occupants at vibration values below the preferred values. Adverse comment or complaints may be expected if vibration values approach the maximum values. The guideline states that activities should be designed to meet the preferred values where an area is not already exposed to vibration.

4.10 Vibration Assessment

For road construction projects, items of plant with the greatest potential for vibration typically include hydraulic hammers and vibratory rollers. It is understood that pneumatic hammers (jackhammers) would be used for the demolition of existing concrete structures and vibratory rollers would be used along the alignment prior to road resurfacing. Peak levels of vibration from rolling typically occurs as the roller stops to change direction and a resonance is created as the roller (and vibrator) is stationary.

Table 30 provides the minimum working distances for the use of various vibration intensive sources to nearby receivers to meet cosmetic damage and human response criteria. It is important to note that the minimum working distances are indicative and will vary depending on the particular item of plant and local geotechnical conditions.

Table 30 Minimum Working Distances or Vibratory Plant (m)

Plant item	Rating / Description	Minimum working distance		
		Cosmetic damage (BS 7385)	Heritage Item (DIN 4150)	Human response (OH&E)
Vibratory Roller	< 50 kN (Typically 1-2 tonnes)	5m	10m	15m to 20m
	< 100 kN (Typically 2-4 tonnes)	6m	12m	20m
	< 200 kN (Typically 4-6 tonnes)	12m	24m	40m
	< 300 kN (Typically 7-13 tonnes)	15m	30m	100m
	> 300 kN (Typically 13-18 tonnes)	20m	40m	100m
	> 300 kN (> 18 tonnes)	25m	50m	100m
Small Hydraulic Hammer	(300 kg - 5 to 12t excavator)	2m	4m	7m
Medium Hydraulic Hammer	(900 kg – 12 to 18t excavator)	7m	14m	23m
Large Hydraulic Hammer	(1600 kg – 18 to 34t excavator)	22m	44m	73m
Vibratory Pile Driver	Sheet piles	2m to 20m	up to 40m	20m
Pile Boring	≤ 800 mm	2m (nominal)	4m	4m
Jackhammer	Hand held	1m (nominal)	2m	2m

Note: Source, CNVG (Roads and Maritime, 2016).

Precise details on the equipment to be used to construct the proposal has not been determined at the concept design stage. Hence, assessment of potential vibration impacts is based on the worst-case scenario, which is a large vibratory roller (>18t). Based on the minimum working distances presented in **Table 30**, receivers within approximately 25m of the proposal site may experience vibration levels above the cosmetic damage criterion, and receivers within approximately 100m of the proposal site may experience vibration levels above the human comfort criterion, during the use of the vibratory roller.

A review of aerial photography identifies that the nearest receiver, on the corner of St Johns Road and Appin Road (263 St Johns Road), is located within approximately 10m of the proposal site. Receivers adjacent to Appin Road are typically located 15m to 25m from the proposal site. The potential vibration affected areas are presented in **Figure 7**.

Following final selection of plant, where works are undertaken within the potential vibration affected areas, dilapidation surveys should be considered for potentially affected receivers, and the additional mitigation measures in **Table 31** should be implemented where feasible and reasonable. **Appendix E** provides a definition of each additional mitigation measure listed below.

Table 31 Triggers for Additional Mitigation Measures - Vibration

Construction Period	Additional Mitigation Measures	
	Type	Apply to
Standard Hours	V, N, RP	All affected receivers
OOH1	V, IB, N, RO, PC, RP, SN	
OOH2	AA, V, IB, N, PC, RP, SN	

Notes: AA = Alternative accommodation, V = Validation of predicted levels, PC = Phone calls, IB = Individual briefings, SN = Specific notifications, N = Notification, RO = Project respite offer.

A review of the Campbelltown Local Environment Plan 2015 (LEP) identifies one (1) heritage item adjacent to the proposal site, listed as the “Silos” on Appin Road between Parkway and St Johns Road, Bradbury. The Silos are described as corrugated iron silos on road reserve. It is noted that the safe working distances for heritage items assume that the buildings are particularly sensitive to vibration or may be structurally unsound. Given the construction type and materials of the Silos, which generally fall outside of the definition of a structurally unsound or particularly sensitive structure, it is recommended that further advice is sought by a structural engineer to determine the susceptibility of the silos to vibration, and to determine appropriate safe working distances.

Where vibration intensive work is planned to occur close to the Silos, any safe working distances should be reviewed following selection of final plant. In the event that the Silos are within the appropriate safe working distance, and there is a risk of exceedance of the cosmetic damage objective, a different construction method with lower source vibration levels must be used where feasible and reasonable, or, vibration monitoring should be undertaken at the commencement and throughout the works. Additionally, a dilapidation survey should be completed for the Silos to document the baseline structural condition of the structure.

FIGURE 7

Vibration Affected Areas

MAC231792-01

Appin Road Intersection

KEY

Proposal Site

Vibration Affected Areas

Cosmetic Damage

Heritage Items

0 65 130 195 260 m

N

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4.11 Construction Noise and Vibration Monitoring and Management

Where additional mitigation measures require the spot check verification of noise levels, attended measurements are to be undertaken within a period of 14 days from the commencement of construction activities. The purpose of these measurements is to confirm that:

- noise and vibration levels from construction in the adjacent community are consistent with the predictions in the noise assessment, approval and/or licence conditions; and
- mitigation is appropriate for the range of background noise levels at receivers affected by the works. Where the background noise levels differ from those assumed in the noise assessment then refinement of mitigation measures may be required, and the CEMP amended.

The attended measurements must be undertaken at:

- the potentially most exposed receivers; and
- locations further from the works and existing noise sources which may have lower background noise levels.

Where measured noise levels are found to exceed the predicted worst-case, the source of excessive noise generations will be identified, and any additional feasible and reasonable measures available will be implemented to either reduce noise emissions or reduce the impacts on receivers. At a minimum, the noise mitigation measures detailed in Table 21 and AMMs identified in Section 4.6.2 will be applied.

Noise measurements shall be undertaken consistent with the procedures documented in AS1055.1-2018 Acoustics – Description and Measurement of Environmental Noise – General Procedures. Vibration measurements shall be undertaken in accordance with the procedures documented in the OEH's Assessing Vibration – a technical guideline (2006) and BS7385 Part 2-1993 Evaluation and measurement for vibration in buildings.

For projects with a duration of less than three months, or where out of hours works are required, the attended measurements must be undertaken at the time intervals described in the assessment, out of hours assessment, approval and/or licence conditions.

When required, the operator shall quantify and characterise the maximum (L_{Amax}) and the energy equivalent (L_{Aeq}) intrusive noise level from construction over a 15-minute measurement period. In addition, the operator shall quantify and characterise the overall levels of ambient noise over the 15-minute measurement interval. It is recommended that instrumentation used during the monitoring is to be equivalent to a Type 1 meter with 1/3 octave band analysis and have audio recording functionality for post processing source identification. It is noted that 1/3 octave band analysis is required to establish whether modification factors in accordance with the NPI are to be applied.

All acoustic instrumentation used as part of the attended monitoring program must been designed to comply with the requirements of AS IEC 61672.1-2019, Electroacoustics – Sound level meters - Specifications and shall have current calibration certificates. All instrumentation shall be programmed to record statistical noise level indices in 15-minute intervals including L_{Amax}, L_{Amin} and L_{Aeq}.

Instrument calibration shall be checked before and after each measurement survey, with the variation in calibrated levels not exceeding ±0.5 dBA. The measurement position(s) should be selected considering:

- weather conditions such as rain and wind, insect noise;
- the location and direction of any noise source/s;
- the most sensitive position at the affected receiver; and
- the need to avoid reflecting surfaces (where possible).

Where vibration intensive activities are required, vibration monitoring will be carried out within the established buffer distances, or where there is considered to be a risk that levels may exceed the relevant structural damage goals. Where vibration is found to exceed the safe levels, impacts will be avoided by changing the work method and/or equipment. In the event that a complaint relating to property damage is received, an inspection of the property would be undertaken and an interim building condition survey prepared.

Attended vibration monitoring will be undertaken when checking the safe working distances from construction plant or in response to a complaint. The testing method includes:

- transducer to be affixed to ground or building in general accordance with AS 2775- 2004;
- monitoring to be conducted for at least three distances from the plant, where possible, including a representative distance for the nearest sensitive structures and/or receivers; and
- the testing will be conducted at each location to obtain a suitable representation of the range of vibration levels that would occur from the tested plant.

Peak (PPV) vibration levels and the dominant frequency of the vibration will be recorded for assessment against the structural and cosmetic damage criteria. In situations in which human comfort is also of concern then the rms vibration level should also be recorded

Longer-term unattended noise and/or vibration monitoring may be conducted throughout the construction period in situations where noise and/or vibration levels are predicted to exceed the NMLs for the majority of works or for extended periods of time, or where vibration intensive works would occur within safe working distances and there is a reasonable risk of exceeding the vibration criteria. These monitors would have the capability to send automated alerts or include audible or visual alarms, which would inform the need for further noise and/or vibration management.

5 Assessment of Road Traffic Noise Impacts

5.1 Operational Road Traffic Noise Criteria

In accordance with Section 4 of the Road Noise Criteria Guideline (RNCG) (Transport for NSW, 2022), the operational road traffic criteria for sensitive receivers are determined on a basis of the road's functional class and whether the road project constitutes a new road, redevelopment of a road or minor works.

A new road project is one where the road is constructed in an undeveloped corridor, the project changes the function class of the road, or the project extends beyond the existing road corridor. A road is redeveloped if the purpose or outcome of the upgrade will result in an increase in the traffic carrying capacity of the overall road or increases the number of heavy vehicles by 50 per cent or more. A minor works project is one that does not increase the carrying capacity of the overall road or significantly increase heavy vehicle traffic, and typically includes minor straightening of curves, installing traffic control devices, intersection widening and turning bay extensions or making minor road alignments.

In accordance with Section 4.5 of the RNCG, the proposal is deemed to be a minor works project, as the intent is to improve the function and safety of the intersection through minor road widening works to facilitate adjustment and/or realignment of turning lanes.

Section 5.6 of the RNCG outlines that the existing road criteria applies where the minor work increases noise levels by more than 2dBA relative to the existing noise levels at the worst affected receiver.

5.2 Existing Traffic Flows

Annual average daily traffic data (AADT) was sourced from the Appin Road and St Johns Road Intersection Upgrade 100% Detailed Design Report (AECOM, 2022, Ref: P0056856), which projected AADT volumes for Appin Road and St Johns Road to 2024. To determine day period (7am to 10pm) and night period (10pm to 7am) traffic volumes, an 80% to 20% split was applied. A summary of the traffic data used for this assessment are presented in **Table 32.**

Table 32 Existing Traffic Flows

Road	Total Traffic Volume	Day (07:00 to 22:00)			Night (22:00 to 07:00)		
		Volume Total Vehicles	% Heavy Vehicles	Speed Limit	Volume Total Vehicles	% Heavy Vehicles	Speed Limit
Appin Road	35,388	28,310	10	80	7,078	10	80
St Johns Road	10,787	8,630	2.2	60	2,157	2.2	60

5.3 Operational Noise Assessment

The operational road traffic assessment has been completed utilising Predictor (v11.10) noise modelling software, incorporating the Calculation of Road Traffic Noise (CoRTN) algorithm. The calculation method, developed by the United Kingdom Department of Environment, is widely accepted in Australia and is the preferred method for assessing operational road traffic emissions by the NSW Environmental Protection Agency (EPA) and Transport for NSW.

The modeled noise levels were calibrated using the results of the unattended noise monitoring undertaken adjacent to 263 St Johns Road from Thursday 25 May 2023 to Tuesday 6 June 2023. Table 33 summarises the results of the calibration model, outlining the traffic noise levels for existing conditions compared to the measured traffic noise levels at monitoring location. Noise calculations demonstrate a consistency of ±<2dB tolerance when compared against measured levels and are therefore within industry accepted tolerances.

Table 33 Road Traffic Noise Model Calibration

Location	dB $LA_{eq(15hr)}$ Daytime Noise Level			dB $LA_{eq(9hr)}$ Night-time Noise Level		
	Measured Level	Predicted Level	Variance dB	Measured Level	Predicted Level	Variance dB
263 St Johns Road	63.6	63.8	0.2	58.9	59.2	0.3

5.3.1 Comparison of Existing and Future Road Traffic Noise Levels

In accordance with the Procedure for Preparing an Operational Traffic and Construction Noise and Vibration Assessment Report (Roads and Maritime, 2016), an assessment of road traffic noise has been carried out for the existing and future road alignment.

The primary aim of the proposal is to improve traffic flows through lane adjustments and intersection upgrades at Appin Road and St Johns Road. It is understood that the proposal would not result in a change to daily traffic volumes or vehicle speeds, which are the primary determinants for road traffic noise.

A review of modelled noise levels for the existing and proposed road alignments identified that road traffic noise levels at existing receiver locations along Appin Road and St Johns Road would experience an increase in road traffic noise level of up to 1.4dB $LA_{eq(15hr)}$ for the day period and up to 1.3dB $LA_{eq(9hr)}$ for the night period. The noise level changes are therefore within the 2dBA increase criteria and ameliorative measures are not required.

5.3.2 Maximum Noise Level Assessment

Under Section 3.1.5 of the Environmental Impact Assessment Procedure: Preparing an Operational Traffic and Construction Noise and Vibration Assessment Report (Roads and Maritime, 2016) and Practice Note iii of the Environmental Noise Management Manual (ENMM) (Roads and Traffic Authority, 2001) a maximum noise level assessment should be undertaken where noise impacts (potential sleep disturbance) from road traffic noise at night are expected to occur.

A review of unattended monitoring data from the nearest residential receivers on St Johns Road indicates that the $LA_{eq(1hr)}$ noise levels for the night period, with a +2.5dB correction for façade reflection (66dBA) exceeds the maximum noise level assessment criterion of 65dB LA_{max}. Furthermore, $LA_{eq(9hr)}$ noise levels were measured on the order of 71dB with a +2.5dB correction for façade reflection. It is therefore considered that existing vehicle passby events typically exceed the maximum noise level criterion, and minor lane adjustments, including slip lanes at the intersection at St Johns Road are unlikely to significantly alter the nature of maximum noise level events.

5.3.3 Operational Noise Attenuation Measures

As demonstrated in **Section 5.3.1**, changes in road traffic noise levels are not predicted to increase by more than the 2dBA increase criteria. It is therefore considered that operational noise attenuation measures are not required for receivers near to the proposal site, and an *Operational Noise Attenuation Measures Report* is not applicable.

5.4 Signalised Crossing Noise Assessment

The upgrade of the intersection of Appin Road and St Johns Road would involve the relocation of the signalised intersection with pedestrian access across St Johns Road. The pedestrian crossing areas would maintain audible alarms similar to the existing signalised pedestrian crossing. The audible alarms have two different working modes:

- audible locating signal; and
- audible crossing signal ('walk' phase).

Audible Locating Signal

The audio-tactile locating signal assists vision-impaired persons to locate the push-button assembly to activate the crossing signal. The locating signal is characterised by a short burst of 25ms duration at approximately 1000 Hz, with a periodicity of approximately two (2) seconds. The noise level of the locating signal is set approximately 15dBA lower than the crossing signal.

Audible Crossing Signal

The audible crossing signal sounds when activated to alert vision-impaired persons that it is safe to commence using the crossing. The crossing signal is a rapid tonal pulse, operating at a frequency of approximately 500Hz.

In accordance with the TfNSW *management framework for assessing noise levels from the traffic control signal audio-tactile pedestrian push buttons* (the 'management framework'), the loudest producible noise level during the walk phase is a sound pressure level of 85dBA at a distance of 1m from the push button device, which corresponds to a Sound Power Level of 93dBA. To account for the tonal component at the start of the walk phase, a 5dBA correction is applied to the noise source level in accordance with the NSW Noise Policy for Industry. Hence, the maximum assessed Sound Power Level for the walk phase signal is 98dBA.

It is noted that to achieve a balance between ensuring the safety needs of vision impaired persons and amenity needs of nearby noise sensitive receivers, the audio-tactile pedestrian push button devices are designed to produce an audio signal with a built-in volume control that is automatically adjusted relative to the ambient noise level. Additionally, the devices are fitted with a three-setting volume switch that can allow a volume adjustment potential of 6dBA, where required. For the purpose of this assessment however, the maximum Sound Power Levels for the locating and crossing signals have been assumed.

5.4.1 Prediction of Signalised Crossing Noise

The TfNSW management framework provides details on the applicable noise goals to minimise noise impacts associated with the operation of the audio-tactile pedestrian push button devices. The management framework indicates that as the audio-tactile push buttons produce short duration high noise levels, a maximum noise goal of 15dBA over the assumed internal sleeping accommodation noise level of 35dBA should be applied. Furthermore, as most houses will achieve a 10dBA noise level reduction through the building façade with windows open for ventilation, the external noise goal for evaluating environmental noise associated with new traffic signal installations is 60dB L_{Amax} outside an affected bedroom window of a dwelling during the night period.

In addition to the sleep disturbance criterion described above, the management framework states that noise management strategies are required to be investigated where the L_{Amax} walk phase audio signal noise level exceeds the L_{A90} background noise level by greater than 15dBA during any noise assessment period.

Based on the RBLs for each period as presented in **Table 2**, the applicable compliance noise goals for nearby residential receivers are presented in **Table 34**.

Table 34 Compliance Noise Goals, dB LAmax

Receiver	Period[1]	RBL dB LA90	Compliance Noise Goal dB LAmax[2]
All residential	Day	52	67
	Evening	43	58
	Night	36	51

Note 1: Day - the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays; Evening - the period from 6pm to 10pm; Night - the remaining periods

Note 2: Compliance noise goal calculated as the RBL + 15dBA.

Noise predictions were undertaken for the nearest residential receivers to the intersection of St Johns Road with Appin Road. For a conservative assessment, noise levels were predicted to the façade nearest to the signalised crossing.

As stated above, the audio-tactile pedestrian push button devices are fitted with a three-setting volume switch that can allow a volume adjustment potential of up to 6dBA. Therefore, the assessment has considered the 'high', 'normal' and 'low' volume settings with a 3dBA sound level reduction for each volume adjustment setting. The predicted noise levels from the walk phase signal at the nearest residential receiver locations are presented in **Table 35**.

Table 35 Operational Noise Levels – Signalised Crossing Alarms

Receiver	Period[1]	Noise Goal dB LAmax[2]	Predicted Noise Level dB LAmax		
			High	Medium	Low
263 St Johns Road	Day	67	54	51	48
	Evening	58	54	51	48
	Night	51	54	51	48
320 St Johns Road	Day	67	**57**	**54**	**51**
	Evening	58	**57**	**54**	**51**
	Night	51	**57**	**54**	**51**

Note 1: Day - the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays; Evening - the period from 6pm to 10pm; Night - the remaining periods.

Note 2: Assessment criteria determined on the basis of the RBL + 15dBA.

Note 3: Bold font represents exceedance of the day, evening and/or night-time compliance noise goals.

The results of the assessment indicate that noise emissions from the operation of the audio-tactile pedestrian push button devices would comply with the maximum noise goal of 60dB LAmax, above which sleep disturbance impacts are possible, on each of the volume settings.

In assessment of noise emissions against the compliance noise goals, noise levels are predicted to exceed the compliance noise goals for the night period when set to the high or medium volume settings, however, noise levels are predicted to comply with the compliance noise goals when set to the low volume setting. Therefore, where the low volume setting is applied, no further mitigation is required, however, where the medium or high volume setting is preferred, the following mitigation strategies should be considered.

5.4.2 Noise Mitigation Strategies

Automatic Gain Control

The audio-tactile pedestrian push button device incorporates an automatic gain control (AGC), which is a built-in volume control that is automatically adjusted relative to the instantaneous ambient noise level immediately prior to the walk phase signal being activated. The maximum output of the push button device (i.e. 85dBA at 1m from the face plate), occurs when the ambient noise level immediately prior to the walk phase signal is greater than 73dB(Lin) (70dBA).

In the absence of a car passby event, the AGC will track longer term ambient noise levels, reducing the maximum output of the walk phase signal by up to 26dBA when the ambient noise level is 44dBA or lower. By assuming a source reduction of 1dBA for each 1dBA reduction in ambient noise levels below the threshold, **Table 36** presents predicted noise levels with the implementation of the AGC, based on the monitored ambient noise levels presented in **Table 2**.

Table 36 Operational Noise Levels – Signalised Crossing Alarms with AGC

Receiver	Period[1]	Noise Goal dB LA_{max}[2]	Ambient Noise Level, LA_{eq}	Noise Reduction from AGC	Predicted Noise Level dB $LA_{eq(15min)}$		
					High	Normal	Low
320 St Johns Road	Day	67	64	6	51	48	45
	Evening	58	62	8	**49**	**46**	43
	Night	51	59	11	**46**	**43**	40

Note 1: Day - the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays; Evening - the period from 6pm to 10pm; Night - the remaining periods.

Note 2: Assessment criteria determined on the basis of the RBL + 15dBA.

The results of the assessment demonstrate where the AGC is implemented, it is anticipated that there would be no noise impacts associated with the operation of the signalised pedestrian crossings or any of the volume settings.

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6 Discussion and Conclusion

An Operational and Construction Noise and Vibration Assessment has been prepared in accordance with Transport for NSW requirements to quantify potential noise and vibration impacts from the upgrade at the intersection of Appin Road with St Johns Road, Bradbury, NSW.

The construction noise assessment demonstrates that noise from the construction works are anticipated to exceed the Noise Management Levels at residential receivers adjacent to the proposal site during each of the construction activities during standard and out of hours work periods.

During paving works along the proposal alignment, considered to be the construction activity with the greatest potential for noise impacts, up to 185 residential receivers are predicted to experience noise levels above the standard hours NML. During OOH Period 1 (OOH Day and OOH evening) up to 540 residential receivers are predicted to experience noise levels above the NML, while more than 2,600 residential receivers are predicted to experience noise levels above the OOH Period 2 (night) NML. Furthermore, one receiver (263 St Johns Road) is predicted to experience noise levels above the highly affected NML of 75dB $LA_{eq(15min)}$.

Following implementation of standard mitigation measures, it is predicted that one residential receiver (263 St Johns Road) would experience noise levels above the trigger levels for the implementation of AMMs during standard hours. It is noted that a further 20 residential receivers would experience noise levels in the noticeable and clearly audible range, however, AMMs do not apply to those categories during standard hours. During out of hours period one (out of hours day and evening), up to 36 residential receivers are anticipated to experience noise levels above the relevant AMM trigger levels, while during out of hours period two (night), up to 1,100 residential receivers are anticipated to experience noise levels above the relevant AMM trigger levels.

Predictive noise modelling identifies that the maximum noise trigger level for sleep disturbance has the potential to be exceeded at up to 385 residential receivers within 400m of the proposal site during pavement works. Hence, it is recommended that the proposal proactively manages night-time noise emissions to minimise the occurrence of sleep disturbance impacts on nearby residential receivers.

An analysis of construction road traffic noise levels demonstrated that due to high existing road traffic noise levels on the local road network, noise emissions from construction vehicles would not result in an increase in road traffic noise levels at the nearest residential receivers.

A review of safe working distances for vibration intensive plant indicates that construction vibration levels would potentially exceed the criteria for cosmetic damage to buildings and human comfort for receivers 25m and 100m from the proposal site respectively. Hence, additional mitigation measures should be implemented for highly vibration intensive activities in close proximity to residential receivers.

A review of the Campbelltown Local Environment Plan 2015 identified one item of heritage significance (Silos on Appin Road between Parkway and St Johns Road) within the minimum working distance of 50m for heritage structures. It is recommended that further advice is sought by a structural engineer to determine the structural integrity of the silos, and susceptibility to vibration, prior to determining appropriate safe working distances.

The results of the operational road traffic noise assessment demonstrates that the nearest residential receivers located adjacent to Appin Road are anticipated to experience an increase in road traffic noise levels of up to 1.4dBA $LA_{eq(period)}$ due to a reduction in the minimum offset between the road alignment and the dwellings. The changes in noise levels are therefore demonstrated to remain below 2dBA, which is be the level above which the increase in noise levels would be discernible. Hence, it is considered that there would be no additional impact from road traffic noise resulting from the development.

An analysis of noise emissions from the operation of the proposed signalised crossing at the intersection of Appin Road and St Johns Road was undertaken to assess the potential impact of the audible alarms to the nearest residential receivers. The analysis demonstrated the operation of the signalised crossing would achieve the maximum noise goal and compliance noise goals at the nearest residential receivers, where the push button device is operated at the low volume setting. Where the medium or high-volume setting is preferred, the device should incorporates an automatic gain control (AGC) to automatically adjust the built-in volume control relatively to the instantaneous ambient noise level immediately prior to the walk phase signal being activated.

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Appendix A – Glossary of Terms

A number of technical terms have been used in this report and are explained in **Table A1**.

Table A1 Glossary of Acoustical Terms

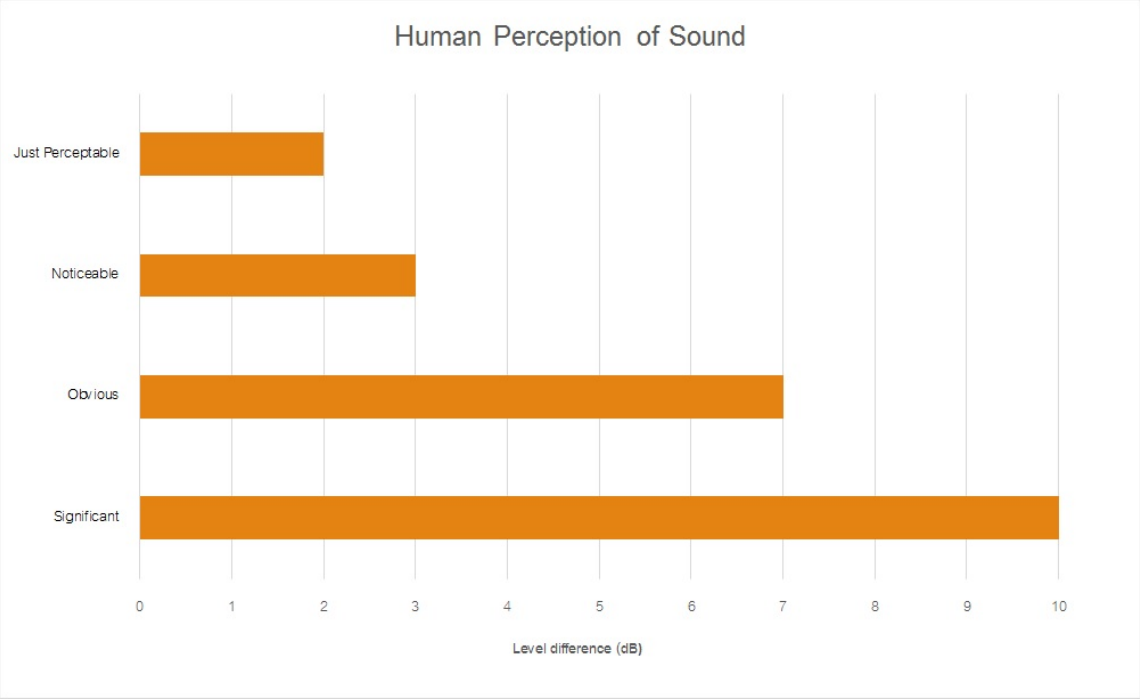
Term	Description
1/3 Octave	Single octave bands divided into three parts
Octave	A division of the frequency range into bands, the upper frequency limit of each band being twice the lower frequency limit.
ABL	Assessment Background Level (ABL) is defined in the NPI as a single figure background level for each assessment period (day, evening and night). It is the tenth percentile of the measured L90 statistical noise levels.
Ambient Noise	The total noise associated with a given environment. Typically, a composite of sounds from all sources located both near and far where no particular sound is dominant.
A Weighting	A standard weighting of the audible frequencies designed to reflect the response of the human ear to sound.
Background Noise	The underlying level of noise present in the ambient noise, excluding the noise source under investigation, when extraneous noise is removed. This is usually represented by the LA90 descriptor
dBA	Noise is measured in units called decibels (dB). There are several scales for describing noise, the most common being the 'A-weighted' scale. This attempts to closely approximate the frequency response of the human ear.
dB(Z), dB(L)	Decibels Z-weighted or decibels Linear (unweighted).
Extraneous Noise	Sound resulting from activities that are not typical of the area.
Hertz (Hz)	The measure of frequency of sound wave oscillations per second - 1 oscillation per second equals 1 hertz.
LA10	A sound level which is exceeded 10% of the time.
LA90	Commonly referred to as the background noise, this is the level exceeded 90% of the time.
LAeq	Represents the average noise energy or equivalent sound pressure level over a given period.
LAmax	The maximum sound pressure level received at the microphone during a measuring interval.
Masking	The phenomenon of one sound interfering with the perception of another sound. For example, the interference of traffic noise with use of a public telephone on a busy street.
RBL	The Rating Background Level (RBL) as defined in the NPI, is an overall single figure representing the background level for each assessment period over the whole monitoring period. The RBL, as defined is the median of ABL values over the whole monitoring period.
Sound Power Level (Lw or SWL)	This is a measure of the total power radiated by a source in the form of sound and is given by 10.log10 (W/Wo). Where W is the sound power in watts to the reference level of 10^{-12} watts.
Sound pressure level (Lp or SPL)	the level of sound pressure; as measured at a distance by a standard sound level meter. This differs from Lw in that it is the sound level at a receiver position as opposed to the sound 'intensity' of the source.

Table A2 provides a list of common noise sources and their typical sound level.

Table A2 Common Noise Sources and Their Typical Sound Pressure Levels (SPL), dBA

Source	Typical Sound Pressure Level
Threshold of pain	140
Jet engine	130
Hydraulic hammer	120
Chainsaw	110
Industrial workshop	100
Lawn-mower (operator position)	90
Heavy traffic (footpath)	80
Elevated speech	70
Typical conversation	60
Ambient suburban environment	40
Ambient rural environment	30
Bedroom (night with windows closed)	20
Threshold of hearing	0

Figure A1 – Human Perception of Sound



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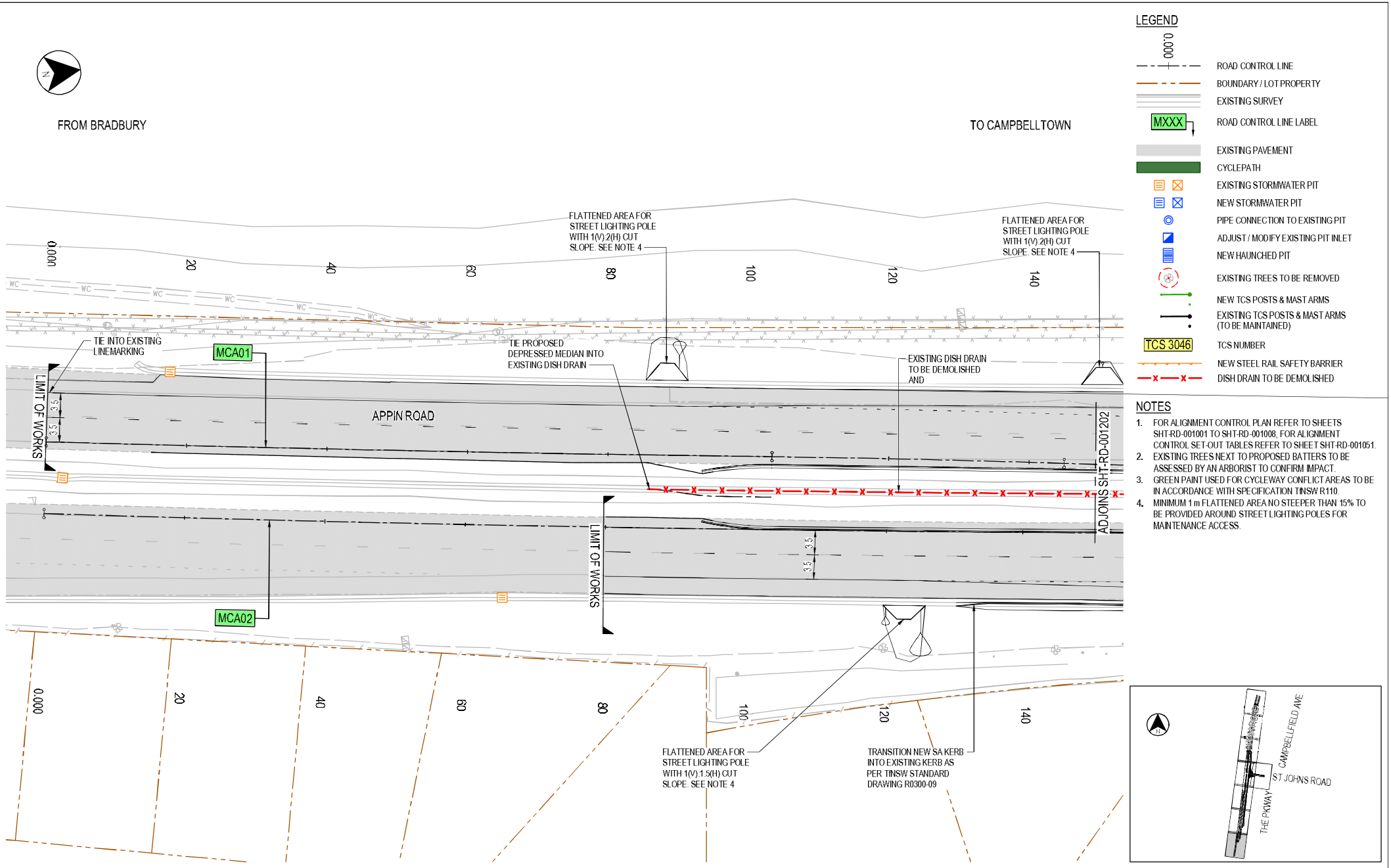
Appendix B – Concept Design



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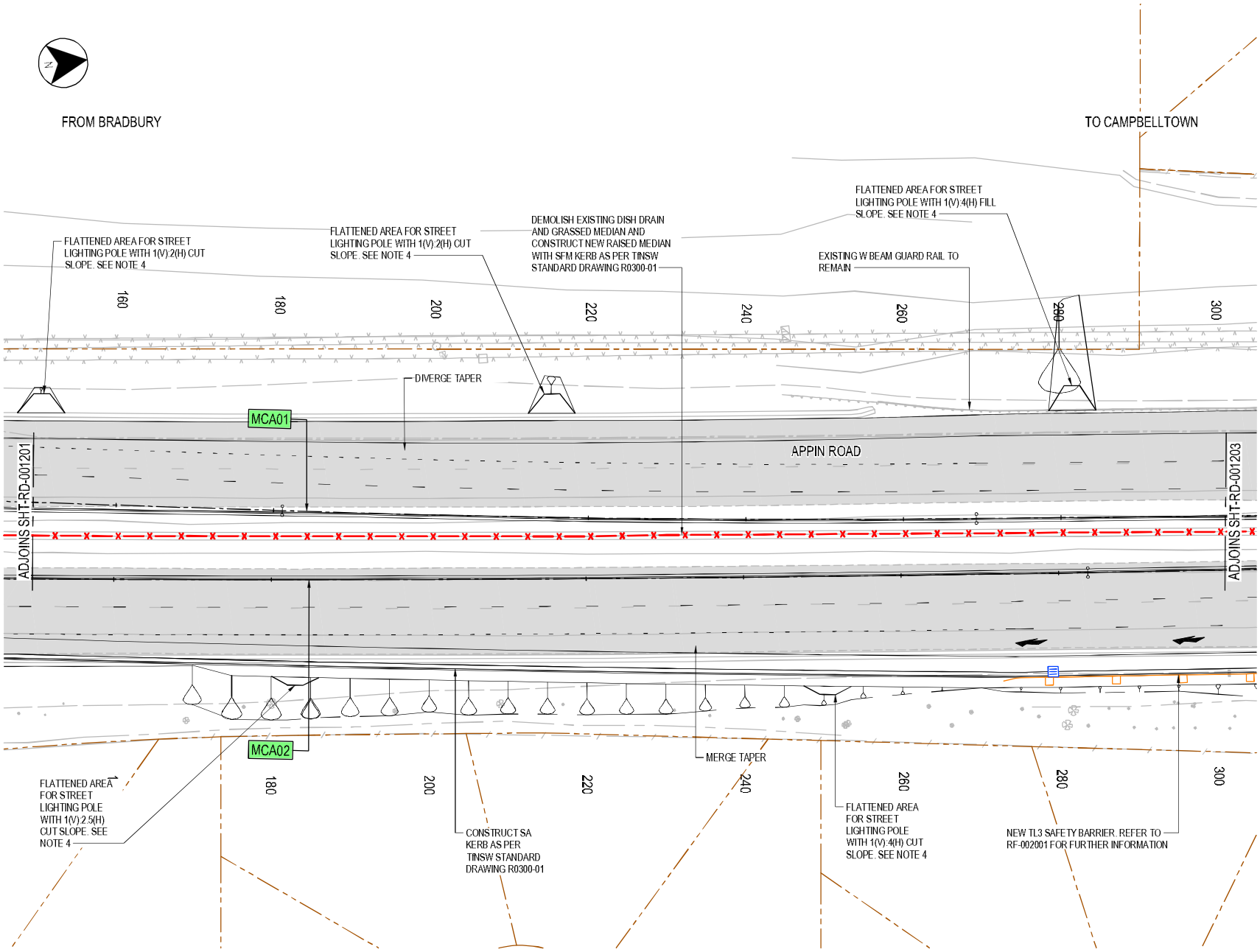

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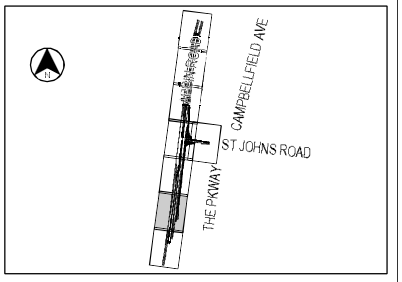

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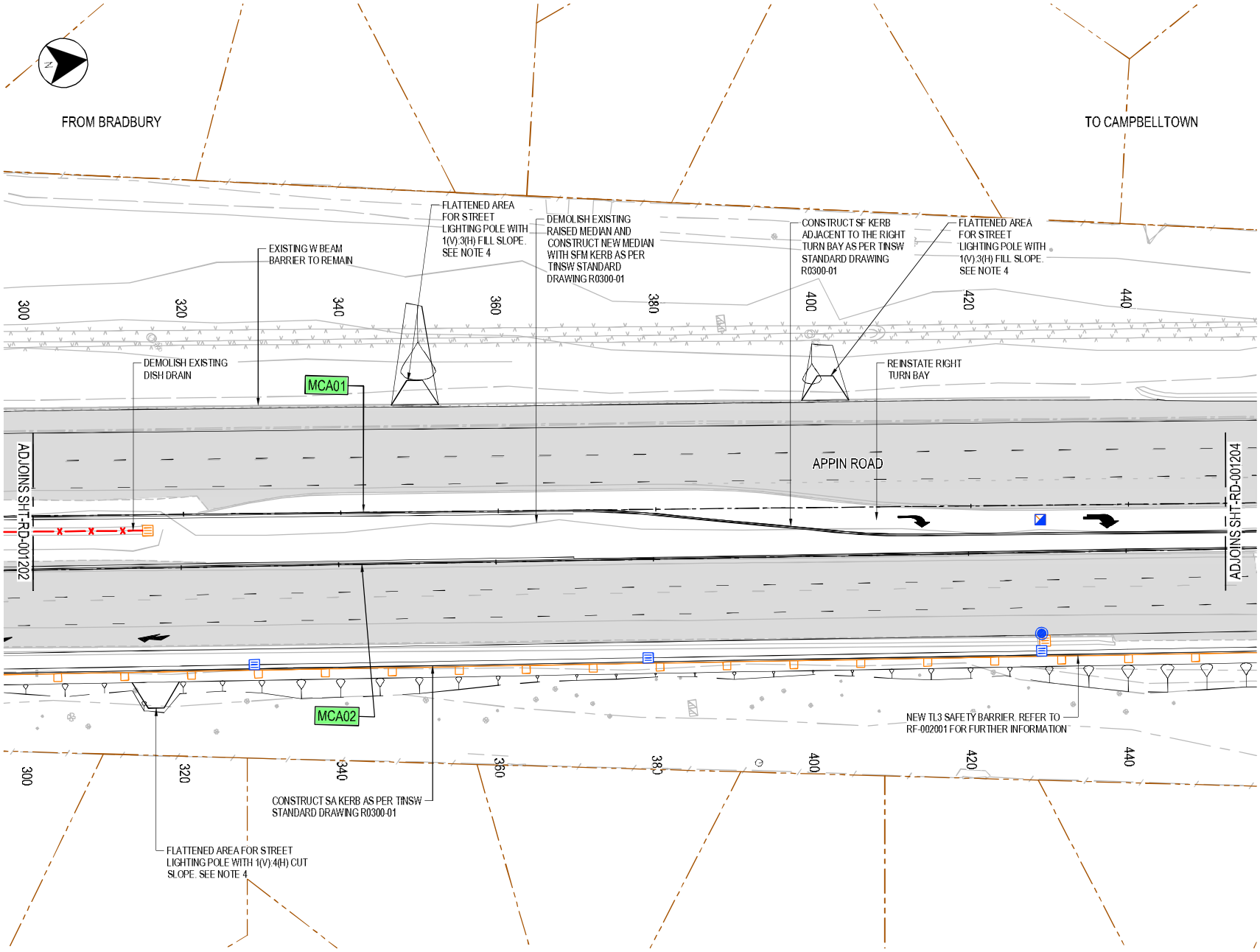

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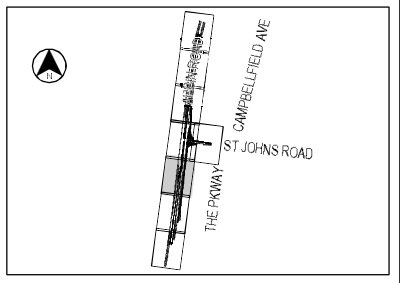

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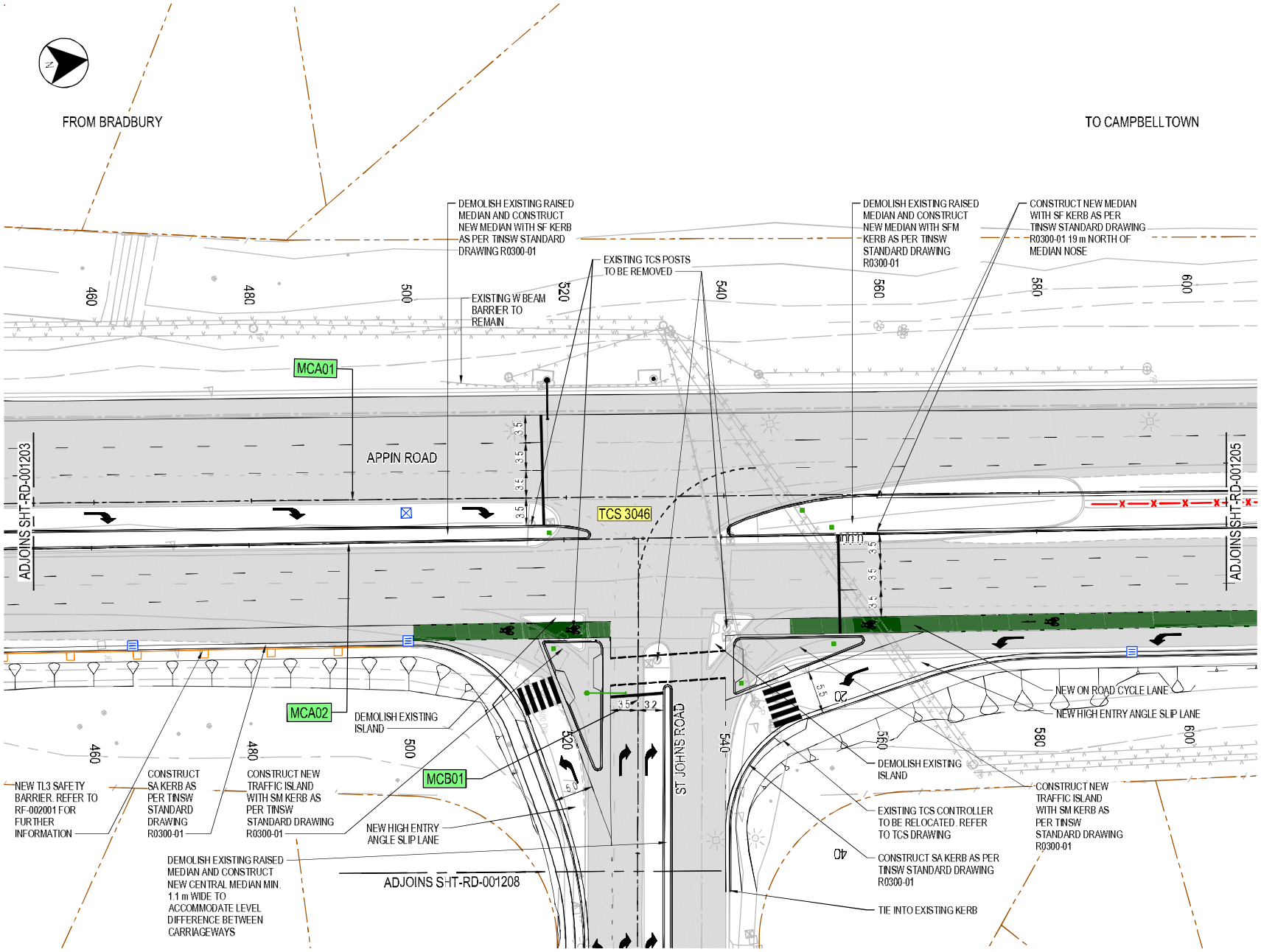

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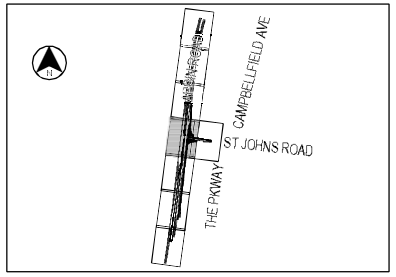

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DRAWINGS / DESIGN PREPARED BY: AECOM
AECOM Australia Pty Ltd A.B.N. 20 093 846 925
-

CHECK PRINT — PRELIM / FINAL — INITIAL / DATE

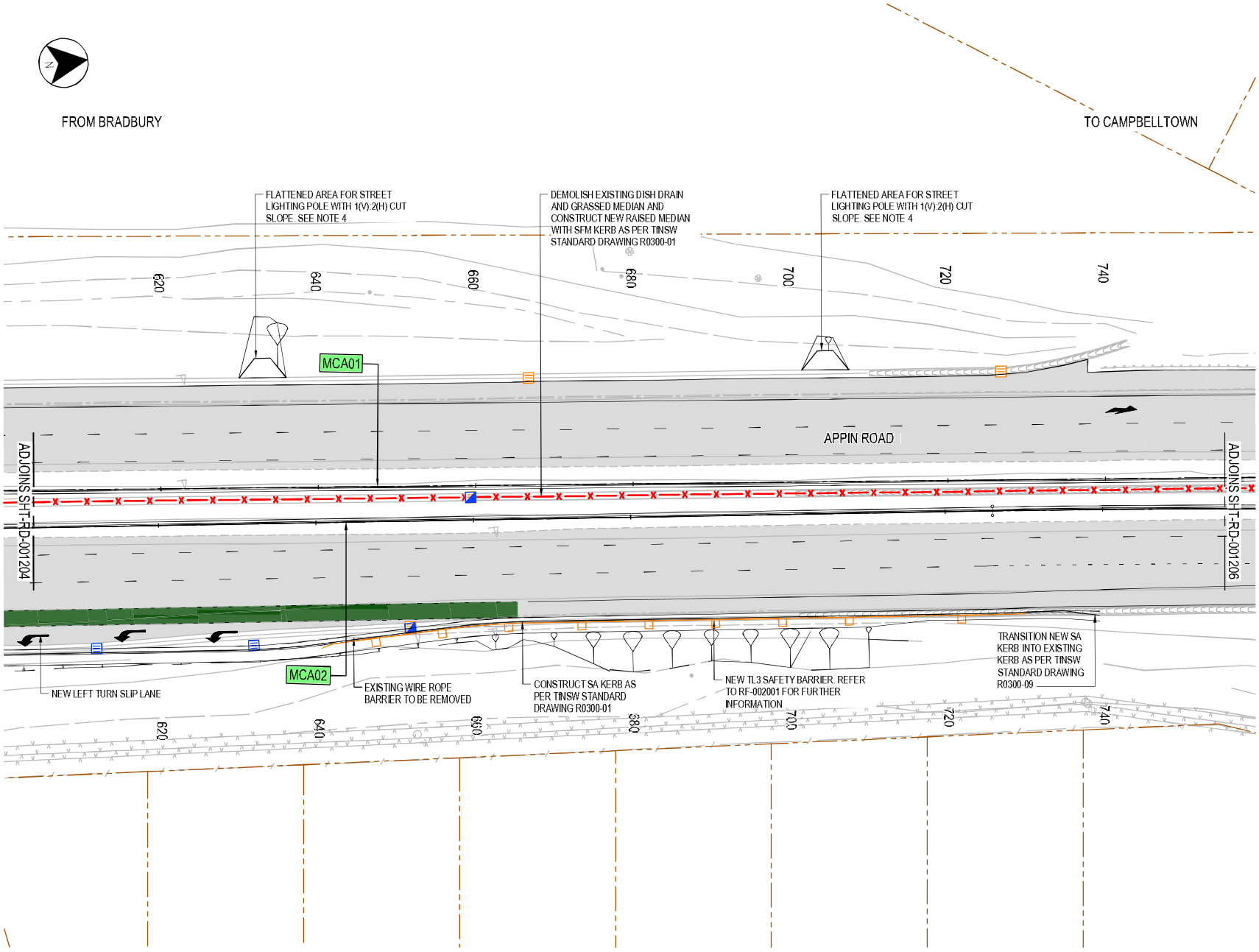
DISCIPLINE		
DISCIPLINE		
DISCIPLINE		
DISCIPLINE		
BACKDRAFTED/CORRECTED		
CONFIRMED		

CLIENT: NSW GOVERNMENT Transport for NSW
PREPARED FOR: INFRASTRUCTURE & PLACE DELIVERY, STRATEGY AND IMPROVEMENT PINCH POINTS

CAMPBELLTOWN CITY COUNCIL
MR177 APPIN ROAD
APPIN ROAD UPGRADE AT INTERSECTION WITH ST JOHNS ROAD
GENERAL ARRANGEMENT PLAN
SHEET 4 OF 8

A3

TINSW REGISTRATION No: DS2021/0000706
PART: 1
ISSUE STATUS: 50% DETAILED DESIGN
EDMS No.: -
SHEET No.: SHT-RD-001204
ISSUE: 0



LEGEND

- ROAD CONTROL LINE
- BOUNDARY / LOT PROPERTY
- EXISTING SURVEY
- MXXX — ROAD CONTROL LINE LABEL
- EXISTING PAVEMENT
- CYCLEPATH
- EXISTING STORMWATER PIT
- NEW STORMWATER PIT
- PIPE CONNECTION TO EXISTING PIT
- ADJUST / MODIFY EXISTING PIT INLET
- NEW HAUNCHED PIT
- EXISTING TREES TO BE REMOVED
- NEW TCS POSTS & MAST ARMS
- EXISTING TCS POSTS & MAST ARMS (TO BE MAINTAINED)
- TCS 3046 — TCS NUMBER
- NEW STEEL RAIL SAFETY BARRIER
- DISH DRAIN TO BE DEMOLISHED

NOTES

1. FOR ALIGNMENT CONTROL PLAN REFER TO SHEETS SHT-RD-001001 TO SHT-RD-001008, FOR ALIGNMENT CONTROL SET-OUT TABLES REFER TO SHEET SHT-RD-001051.
2. EXISTING TREES NEXT TO PROPOSED BATTERS TO BE ASSESSED BY AN ARBORIST TO CONFIRM IMPACT.
3. GREEN PAINT USED FOR CYCLEWAY CONFLICT AREAS TO BE IN ACCORDANCE WITH SPECIFICATION TINSW R110.
4. MINIMUM 1 m FLATTENED AREA NO STEEPER THAN 15% TO BE PROVIDED AROUND STREET LIGHTING POLES FOR MAINTENANCE ACCESS.

CHECK PRINT

Last saved by: JEFFLANG.YAN(2023-02-03) Last Plotted: 2023-02-03

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0 5 10 15 20 25 30 35 40 45 150mm ON A3 SIZE ORIGINAL

DRAWING FILE LOCATION / NAME: PW:/P0056856-SHT-RD-001205.DWG
EXTERNAL REFERENCE FILES:

REV	DATE	AMENDMENT / REVISION DESCRIPTION
0	17.12.2021	DRAFT ISSUE (DETAILED)
1	26.08.2022	100% DETAILED DESIGN

REVISION IN PROGRESS

DESIGN LOT CODE: WVR No. | APPROVAL: J. CROSSLEY, A. MASSOUD

DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING: -
SCALES ON A3 SIZE DRAWING: 2.5 0 2.5 5 7.5m — 1 : 500 FULL SIZE A3
CO-ORDINATE SYSTEM: MGA ZONE 56 | HEIGHT DATUM: AHD

DRAWINGS / DESIGN PREPARED BY: AECOM
AECOM Australia Pty Ltd A.B.N. 20 093 846 925
-

PLOT DATE / TIME: 3-Feb-23 / 11:02 AM | PLOT BY: JEFFLANG.YAN

CHECK PRINT	PRELIM	FINAL
	INITIAL	DATE
DISCIPLINE		
DISCIPLINE		
DISCIPLINE		
DISCIPLINE		
BACKDRAFTED/CORRECTED		
CONFIRMED		

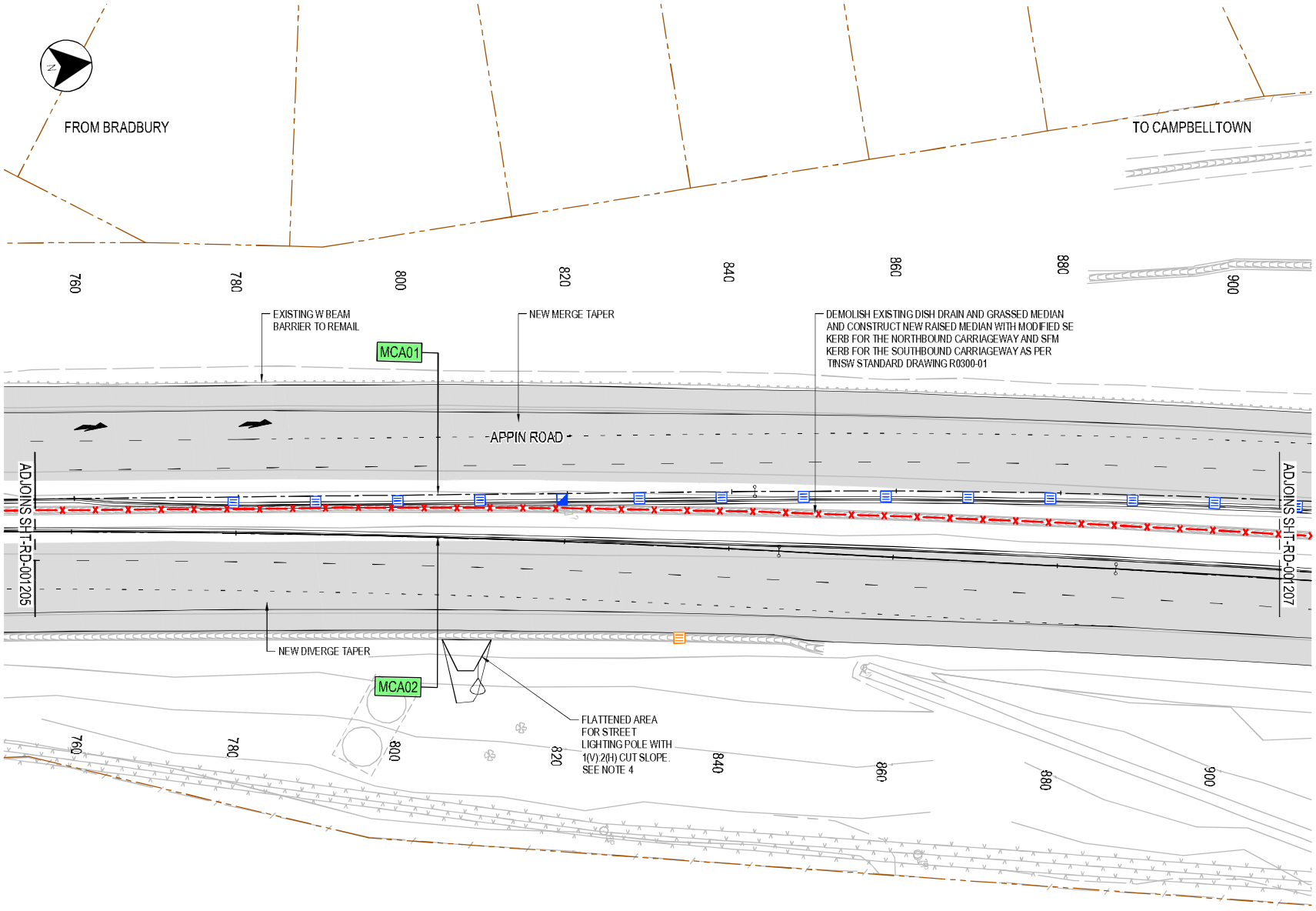
CLIENT: NSW GOVERNMENT Transport for NSW

PREPARED FOR: INFRASTRUCTURE & PLACE DELIVERY, STRATEGY AND IMPROVEMENT PINCH POINTS

CAMPBELLTOWN CITY COUNCIL
MR177 APPIN ROAD
APPIN ROAD UPGRADE AT INTERSECTION WITH ST JOHNS ROAD GENERAL ARRANGEMENT PLAN

A3
SHEET 5 OF 8

TINSW REGISTRATION No: DS2021/0000706 | PART: 1
ISSUE STATUS: 100% DETAILED DESIGN | EDMS No.: - | SHEET No.: SHT-RD-001205 | ISSUE: 1



LEGEND

0.000

- ROAD CONTROL LINE
- BOUNDARY / LOT PROPERTY
- EXISTING SURVEY
- MXXX — ROAD CONTROL LINE LABEL
- EXISTING PAVEMENT
- CYCLEPATH
- EXISTING STORMWATER PIT
- NEW STORMWATER PIT
- PIPE CONNECTION TO EXISTING PIT
- ADJUST / MODIFY EXISTING PIT INLET
- NEW HAUNCHED PIT
- EXISTING TREES TO BE REMOVED
- NEW TCS POSTS & MAST ARMS
- EXISTING TCS POSTS & MAST ARMS (TO BE MAINTAINED)
- TCS 3046 — TCS NUMBER
- NEW STEEL RAIL SAFETY BARRIER
- DISH DRAIN TO BE DEMOLISHED

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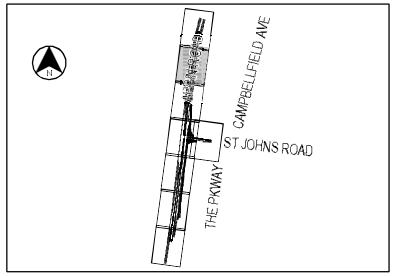
4. MINIMUM 1 m FLATTENED AREA NO STEEPER THAN 15% TO BE PROVIDED AROUND STREET LIGHTING POLES FOR MAINTENANCE ACCESS.



NOT FOR CONSTRUCTION

Last saved by: WANGD11 (2022-09-28) Last Plotted: 2023-02-03

THIS DRAWING MAY BE PREPARED IN COLOUR AND MAY BE INCOMPLETE IF COPIED

150mm ON A3 SIZE ORIGINAL

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DESIGN LOT CODE	-
WVR No.	
APPROVAL	J. CROSSLEY, A. MASSOUD
DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING	-
SCALES ON A3 SIZE DRAWING	2.5 0 2.5 5 7.5m; 1 : 500 FULL SIZE A3
CO-ORDINATE SYSTEM	MGA ZONE 56
HEIGHT DATUM	AHD
DRAWINGS / DESIGN PREPARED BY	AECOM Australia Pty Ltd A.B.N. 20 093 846 925
PLOT DATE / TIME	3-Feb-23 / 1.2:12:19 PM
PLOT BY	WANGD11
CLIENT	NSW GOVERNMENT Transport for NSW
PREPARED FOR	INFRASTRUCTURE & PLACE DELIVERY, STRATEGY AND IMPROVEMENT PINCH POINTS

REV	DATE	AMENDMENT / REVISION DESCRIPTION
0	17.12.2021	DRAFT ISSUE (DETAILED)
1	26.08.2022	100% DETAILED DESIGN

	NAME	DATE
TITLE		
DRAWN	G. ACUNA	28.09.2022
DRG CHECK	J. WANG	28.09.2022
DESIGN	S. SOORIYAKUMARAN	28.09.2022
DESIGN CHECK	S. QUANG	28.09.2022
VERIFIER	J. CALDERON	28.09.2022
PROJECT MNGR	A. MASSOUD	28.09.2022

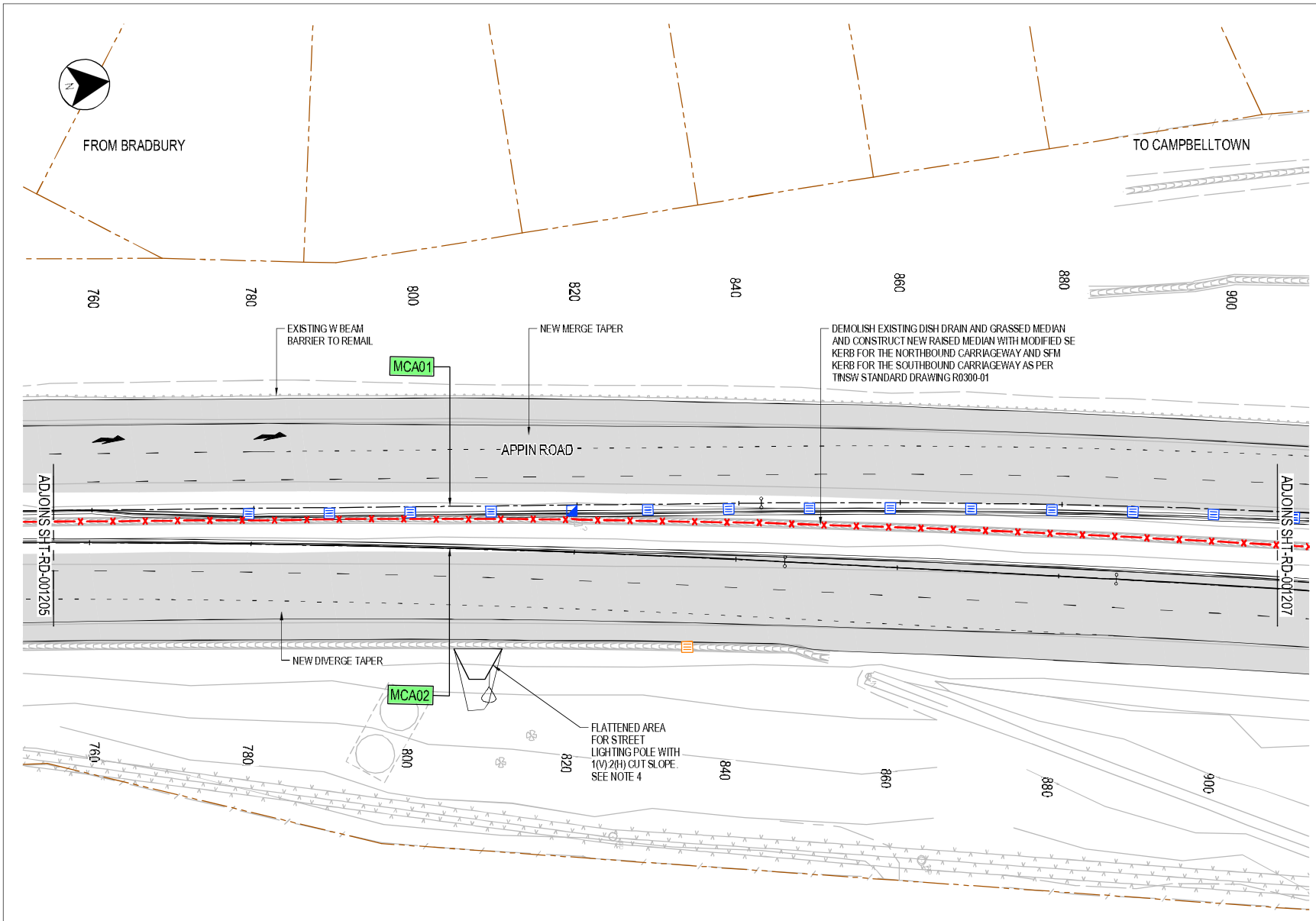
A3

CAMPBELLTOWN CITY COUNCIL
MR177 APPIN ROAD

APPIN ROAD UPGRADE AT INTERSECTION WITH ST JOHNS ROAD GENERAL ARRANGEMENT PLAN

SHEET 6 OF 8

TINSW REGISTRATION No.	DS2021/0000706	PART	1
ISSUE STATUS	100% DETAILED DESIGN	EDMS No.	-
SHEET No.	SHT-RD-001206	ISSUE	1



LEGEND

- ROAD CONTROL LINE
- BOUNDARY / LOT PROPERTY
- EXISTING SURVEY
- MXXX — ROAD CONTROL LINE LABEL
- EXISTING PAVEMENT
- CYCLEPATH
- EXISTING STORMWATER PIT
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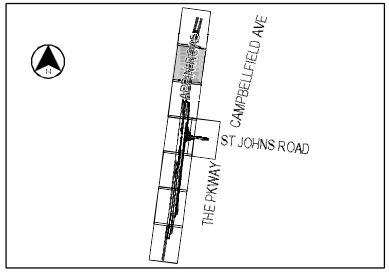

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Last saved by: JEFFLANG.YAN(2023-02-03) Last Plotted: 2023-02-03

THIS DRAWING MAY BE PREPARED IN COLOUR AND MAY BE INCOMPLETE IF COPIED
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DRAWING FILE LOCATION / NAME: PATH_LOCATION				DESIGN LOT CODE: -	DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING: -	PLOT DATE / TIME: 3-Feb-23/ 1 2:25:7 PM	PLOT BY: JEFFLANG.YAN
EXTERNAL REFERENCE FILES	REV	DATE	AMENDMENT / REVISION DESCRIPTION	WVR No.	APPROVAL	SCALES ON A3 SIZE DRAWING: 2.5 0 2.5 5 7.5m; 1 : 500 FULL SIZE A3	DRAWINGS / DESIGN PREPARED BY: AECOM Australia Pty Ltd A.B.N. 20 093 846 925; TSNSWREGNO
			REVISION IN PROGRESS			CO-ORDINATE SYSTEM: MGA ZONE 56; HEIGHT DATUM: AHD	

CHECK PRINT — PREL INITIAL / FINAL DATE

DISCIPLINE		
DISCIPLINE		
DISCIPLINE		
DISCIPLINE		
BACKDRAFTED/CORRECTED		
CONFIRMED		

CLIENT: NSW GOVERNMENT Transport for NSW

PREPARED FOR: BRANCH_NAME; SECTION NAME; DEPARTMENT NAME

COUNCIL_AREA_NAME
ROAD_NUMBER_ROAD_NAME
PROJ_DESC_LINE1
PROJ_DESC_LINE2
SHEET_TYPE
SHEET_DETAILS_RANGE

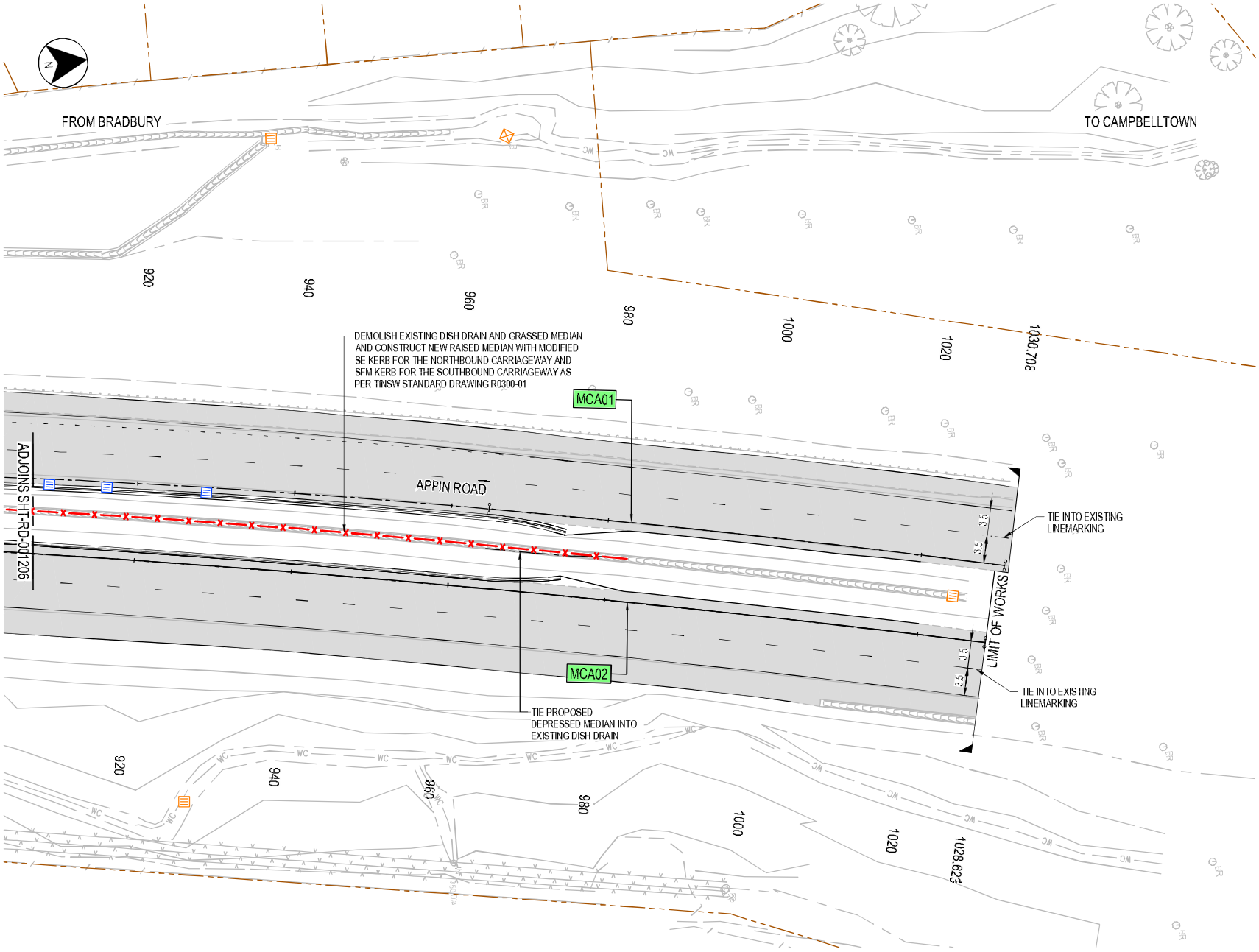
A3

SHEET XX OF XX

TINSW REGISTRATION No: REG_NO

PART: PART

ISSUE STATUS: DESIGN_STAGE | EDMS No.: EDMS_NO | SHEET No.: SHEET_NO | ISSUE: ISSUE



LEGEND

- ROAD CONTROL LINE
- BOUNDARY / LOT PROPERTY
- EXISTING SURVEY
- MXXX — ROAD CONTROL LINE LABEL
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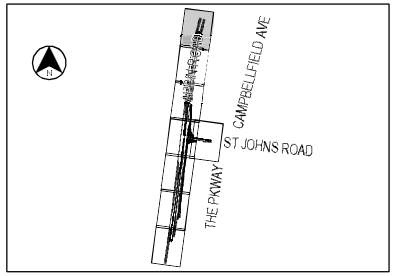

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Last saved by: JEFFLANG.YAN(2023-02-03) Last Plotted: 2023-02-03

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150mm ON A3 SIZE ORIGINAL

DRAWING FILE LOCATION / NAME: PW:/P0056856-SHT-RD-001207.DWG
EXTERNAL REFERENCE FILES:

REV	DATE	AMENDMENT / REVISION DESCRIPTION
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1	26.08.2022	100% DETAILED DESIGN

REVISION IN PROGRESS

DESIGN LOT CODE: WVR No. | APPROVAL: J. CROSSLEY, A. MASSOUD

DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING: -
SCALES ON A3 SIZE DRAWING: 2.5 0 2.5 5 7.5m — 1 : 500 FULL SIZE A3
CO-ORDINATE SYSTEM: MGA ZONE 56 | HEIGHT DATUM: AHD

DRAWINGS / DESIGN PREPARED BY: AECOM Australia Pty Ltd A.B.N. 20 093 846 925 -

PLOT DATE / TIME: 3-Feb-23 / 11:04:40 AM | PLOT BY: JEFFLANG.YAN

CHECK PRINT — PRELIM ☐ FINAL ☐

		INITIAL	DATE
DISCIPLINE	G. ACUNA		28.09.2022
DISCIPLINE	J. WANG		28.09.2022
DISCIPLINE	S. SOORIYAKUMARAN		28.09.2022
DISCIPLINE	S. QUANG		28.09.2022
BACKDRAFTED/CORRECTED	J. CALDERON		28.09.2022
CONFIRMED	A. MASSOUD		28.09.2022

CLIENT: NSW GOVERNMENT Transport for NSW

PREPARED FOR: INFRASTRUCTURE & PLACE DELIVERY, STRATEGY AND IMPROVEMENT PINCH POINTS

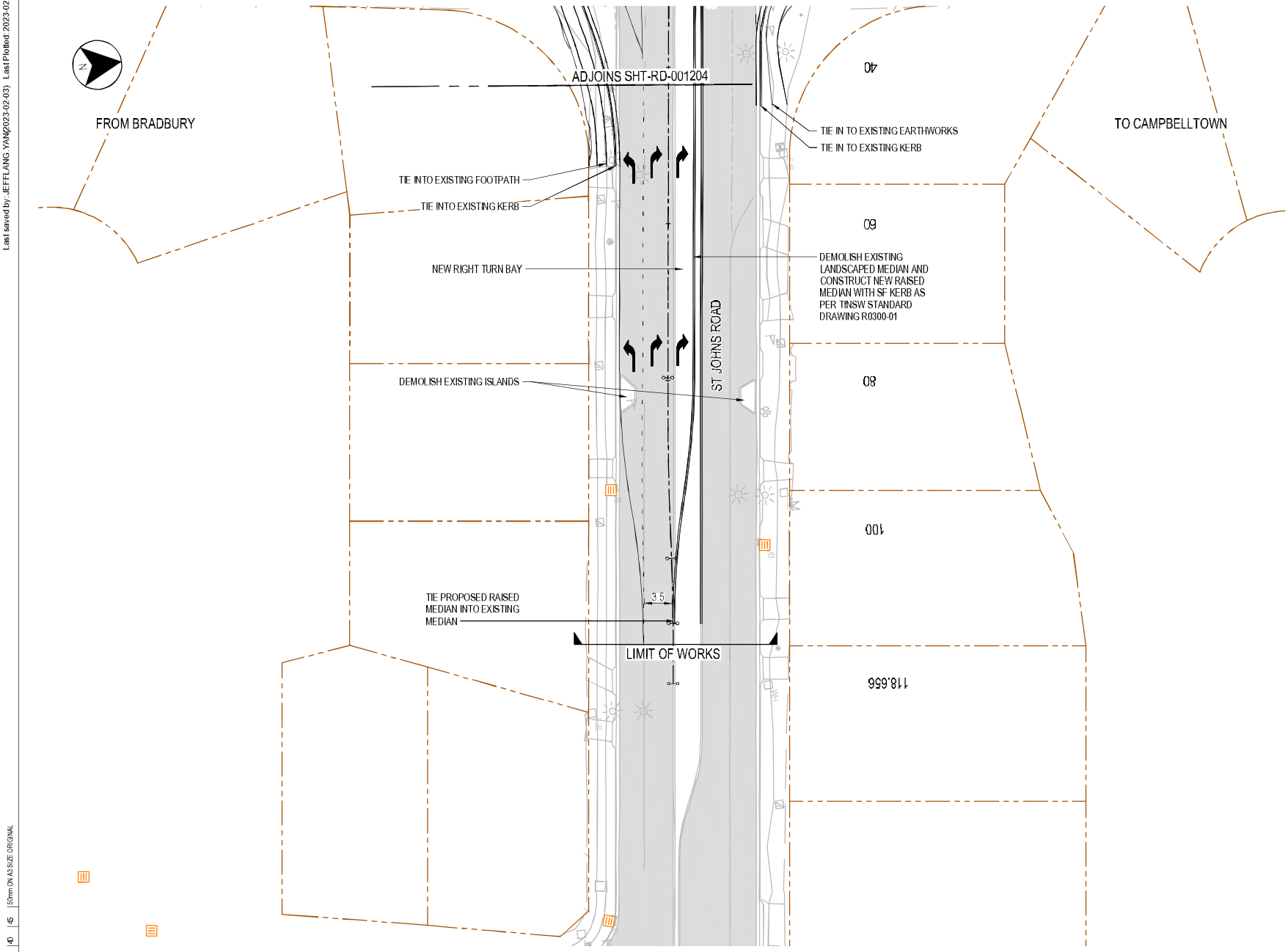
CAMPBELLTOWN CITY COUNCIL
MR177 APPIN ROAD
APPIN ROAD UPGRADE AT INTERSECTION WITH ST JOHNS ROAD GENERAL ARRANGEMENT PLAN

A3

SHEET 1 OF 8

TINSW REGISTRATION No: DS2021/0000706 | PART: 1

ISSUE STATUS: 100% DETAILED DESIGN | EDMS No.: - | SHEET No.: SHT-RD-001207 | ISSUE: 1



LEGEND

- 0.000 — ROAD CONTROL LINE
- BOUNDARY / LOT PROPERTY
- EXISTING SURVEY
- MXXX — ROAD CONTROL LINE LABEL
- EXISTING PAVEMENT
- CYCLEPATH
- EXISTING STORMWATER PIT
- NEW STORMWATER PIT
- PIPE CONNECTION TO EXISTING PIT
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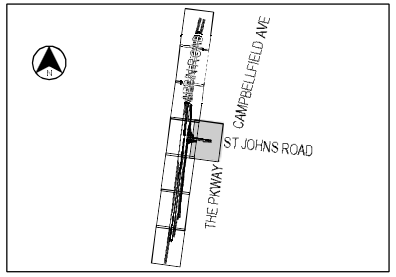

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Last saved by: JEFFLANG.YAN(2023-02-03) Last Plotted: 2023-02-03

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150mm ON A3 SIZE ORIGINAL

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DESIGN LOT CODE: -

DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING: -

PLOT DATE / TIME: 3-Feb-23 / 11:0:19 AM

PLOT BY: JEFFLANG.YAN

EXTERNAL REFERENCE FILES	REV	DATE	AMENDMENT / REVISION DESCRIPTION	WVR No.	APPROVAL
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	1	26.08.2022	100% DETAILED DESIGN		A. MASSOUD

REVISION IN PROGRESS

SCALES ON A3 SIZE DRAWING: 2.5 0 2.5 5 7.5m — 1 : 500 FULL SIZE A3

CO-ORDINATE SYSTEM: MGA ZONE 56

HEIGHT DATUM: AHD

DRAWINGS / DESIGN PREPARED BY: AECOM Australia Pty Ltd A.B.N. 20 093 846 925

-

CHECK PRINT — PRELIM / FINAL — INITIAL / DATE

DISCIPLINE		
DISCIPLINE		
DISCIPLINE		
DISCIPLINE		
BACKDRAFTED/CORRECTED		
CONFIRMED		

CLIENT: NSW GOVERNMENT Transport for NSW

PREPARED FOR: INFRASTRUCTURE & PLACE DELIVERY, STRATEGY AND IMPROVEMENT PINCH POINTS

CAMPBELLTOWN CITY COUNCIL

MR177 APPIN ROAD

APPIN ROAD UPGRADE AT INTERSECTION WITH ST JOHNS ROAD GENERAL ARRANGEMENT PLAN

A3

SHEET 8 OF 8

TINSW REGISTRATION No: DS2021/0000706 — PART 1

ISSUE STATUS: 100% DETAILED DESIGN

EDMS No.: -

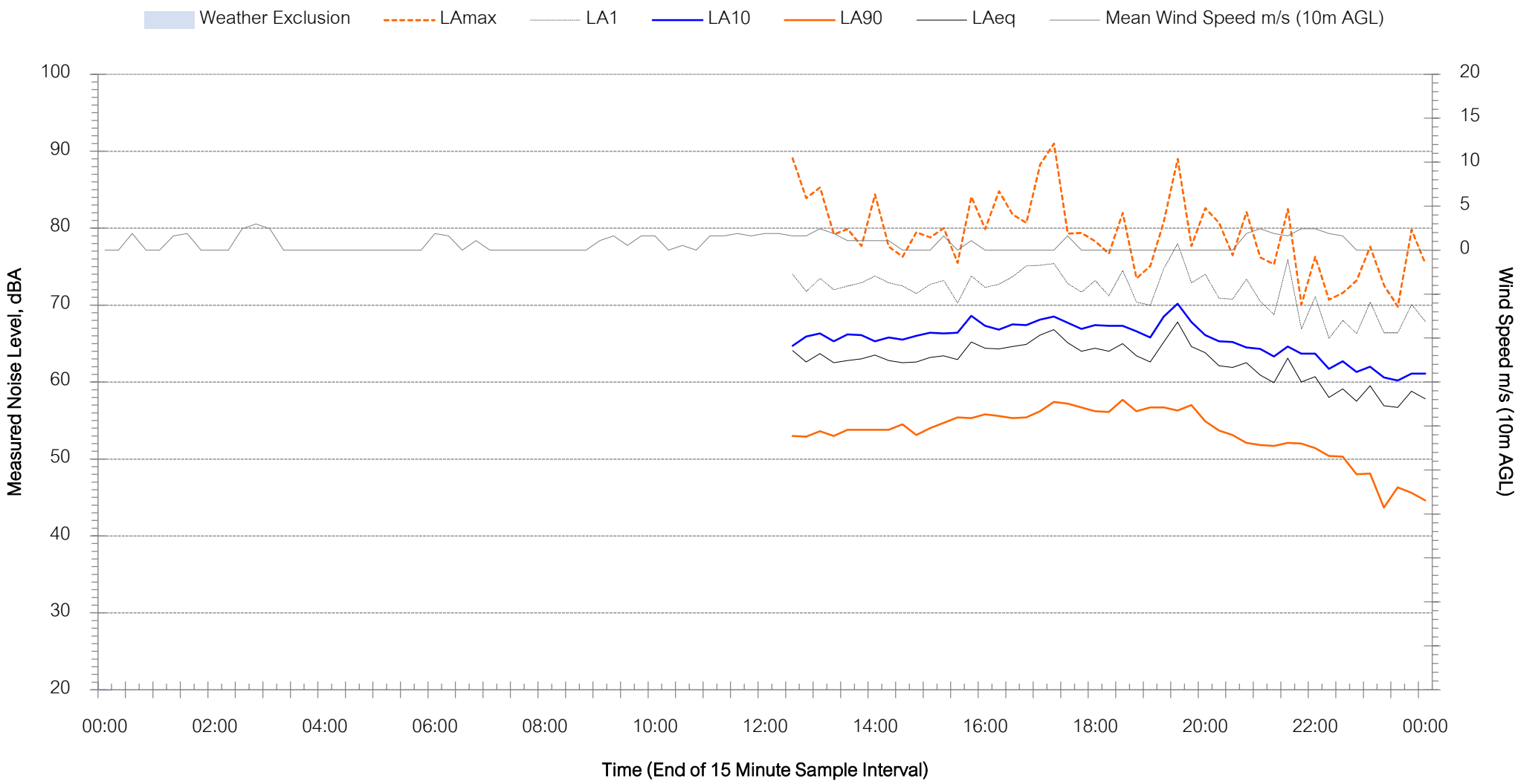
SHEET No.: SHT-RD-001208

ISSUE: 1

Appendix C – Background Monitoring Charts

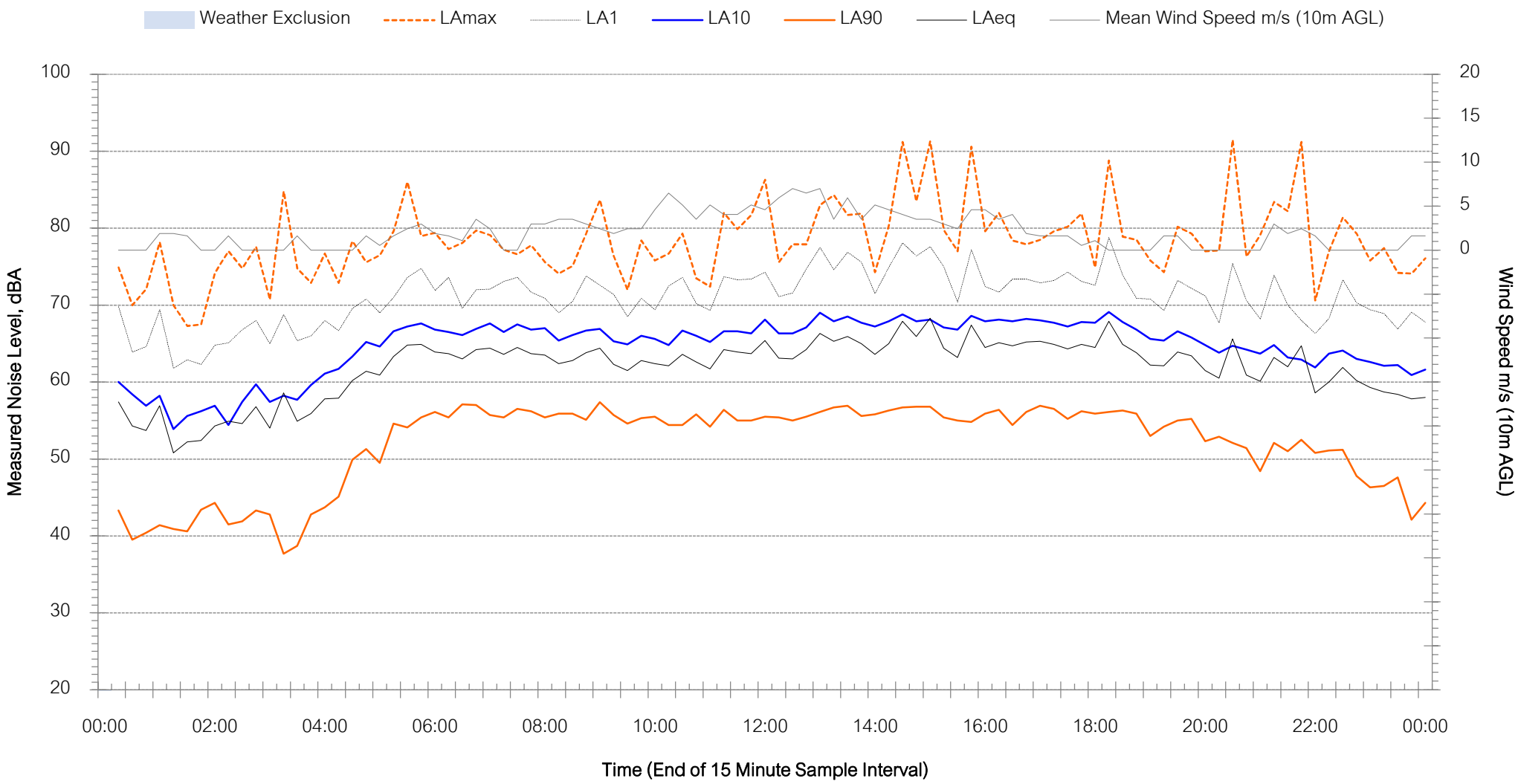
Background Noise Levels

Appin Road and St Johns Road Intersection - Thursday 25 May 2023



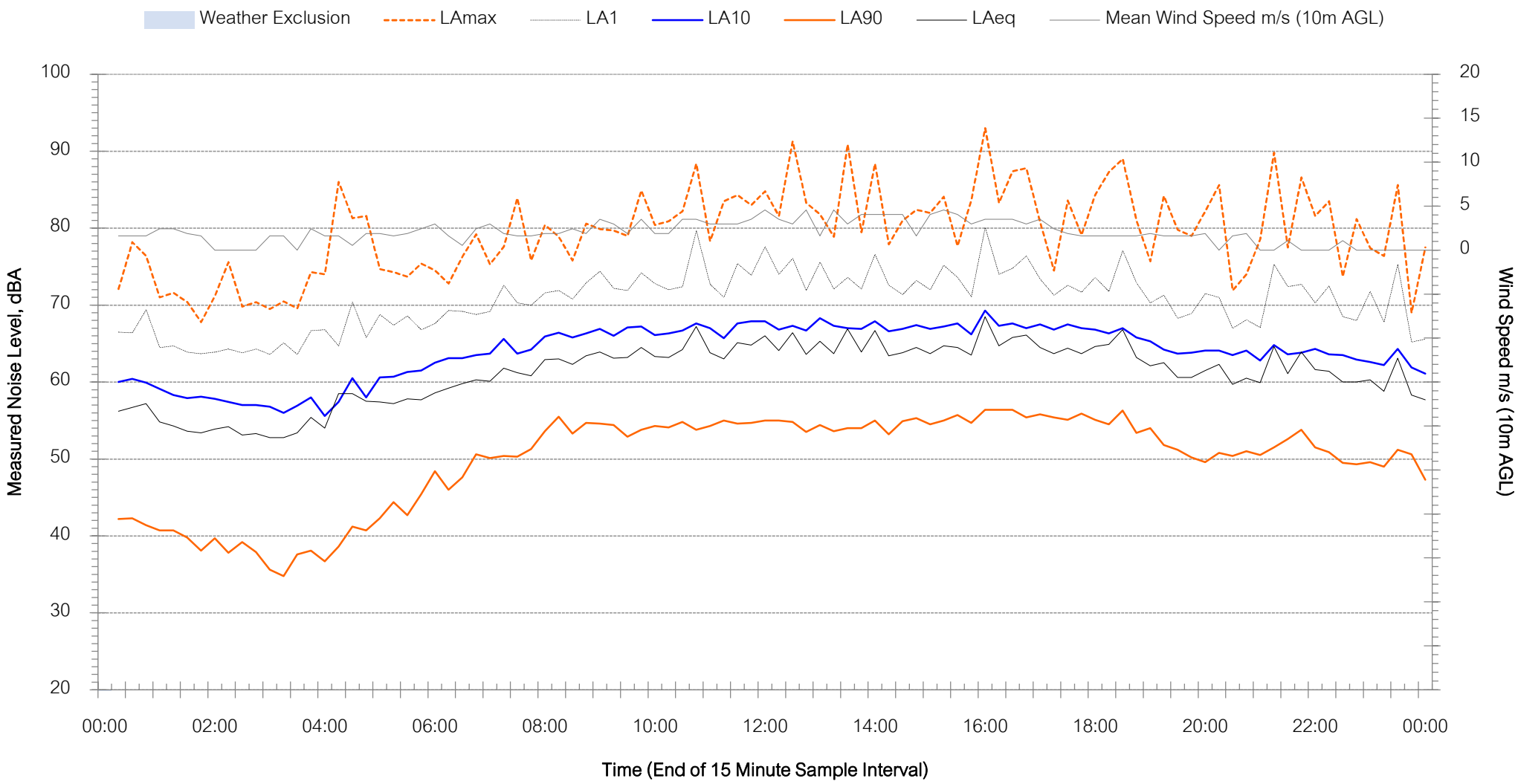
Background Noise Levels

Appin Road and St Johns Road Intersection - Friday 26 May 2023



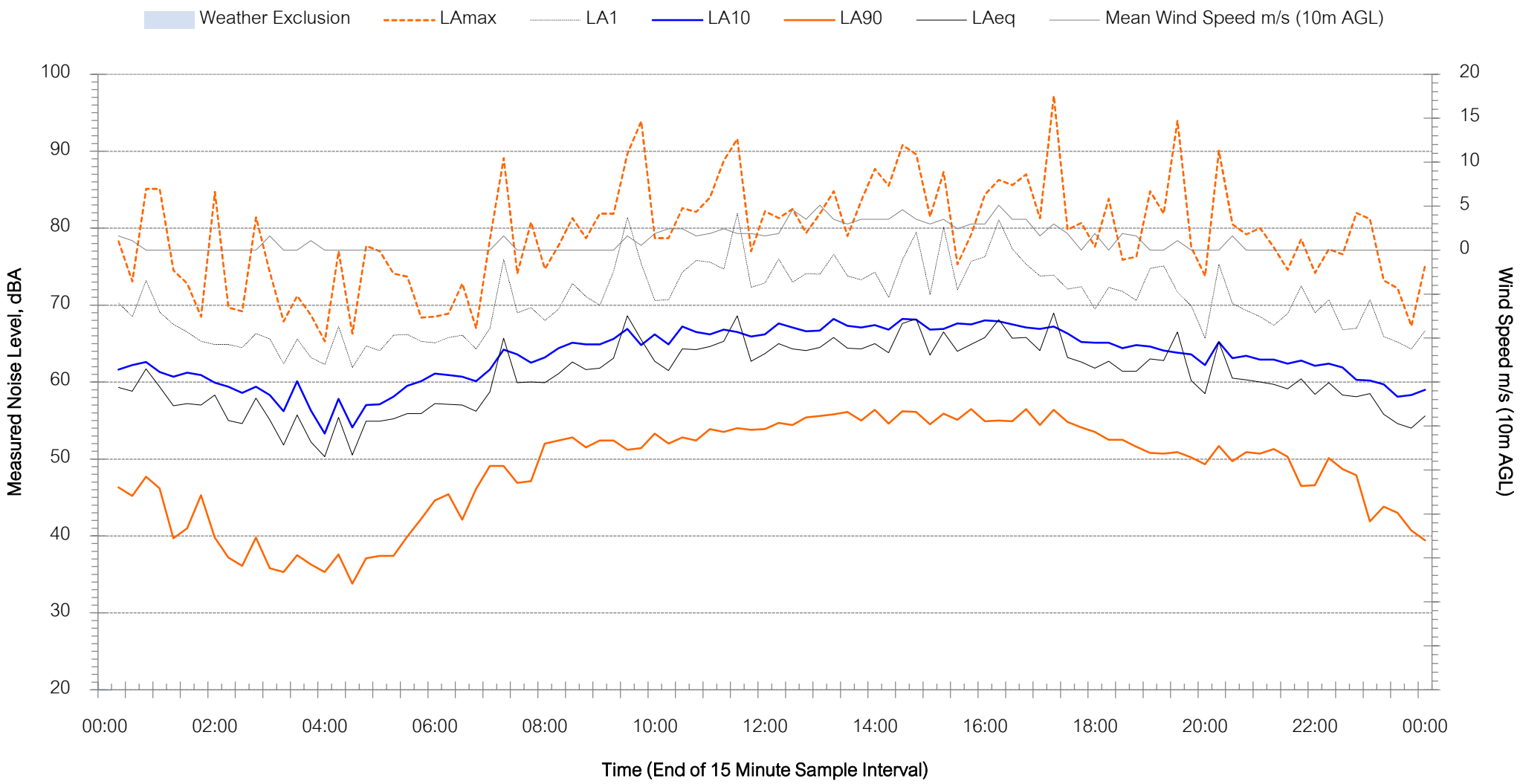
Background Noise Levels

Appin Road and St Johns Road Intersection - Saturday 27 May 2023



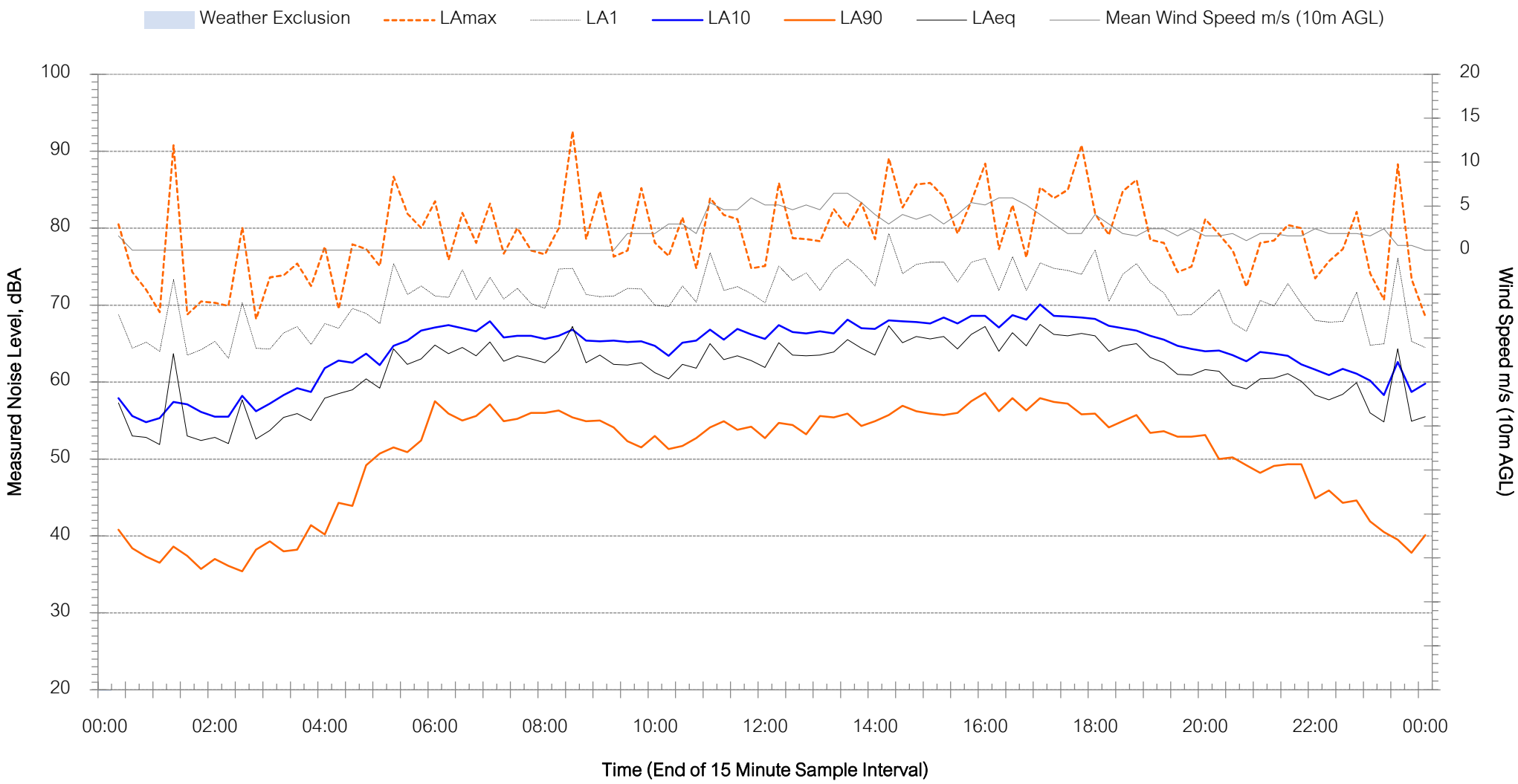
Background Noise Levels

Appin Road and St Johns Road Intersection - Sunday 28 May 2023



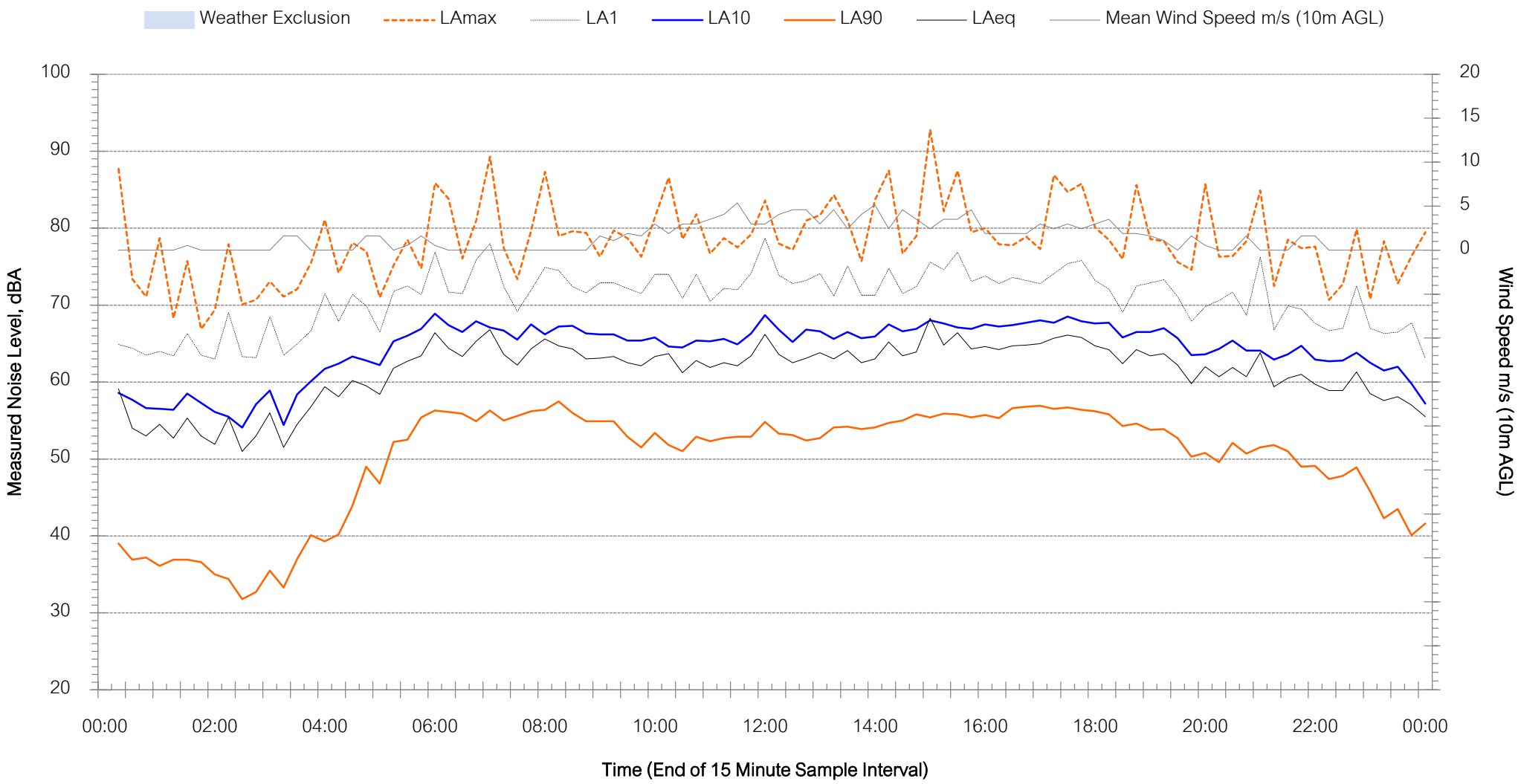
Background Noise Levels

Appin Road and St Johns Road Intersection - Monday 29 May 2023



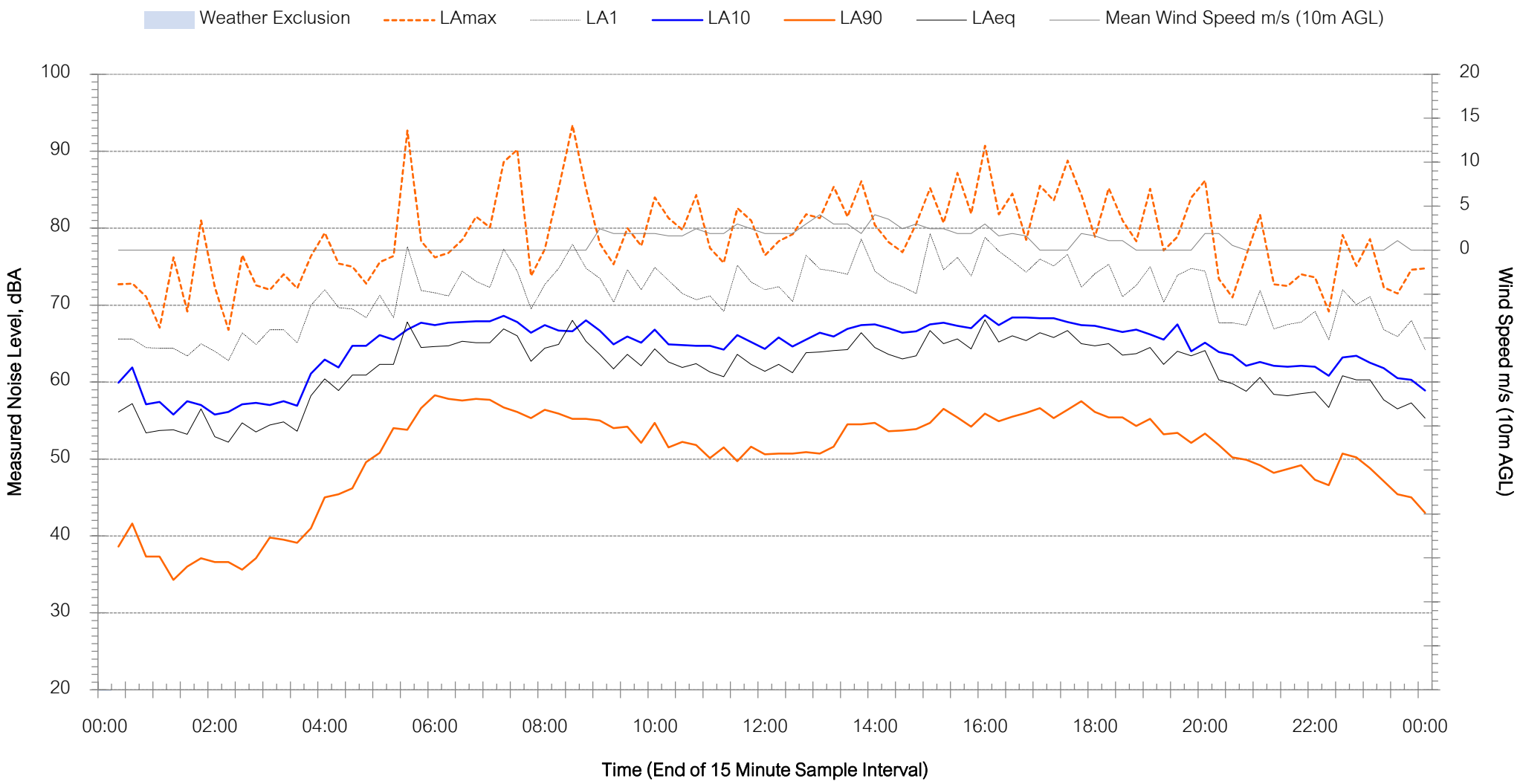
Background Noise Levels

Appin Road and St Johns Road Intersection - Tuesday 30 May 2023



Background Noise Levels

Appin Road and St Johns Road Intersection - Wednesday 31 May 2023

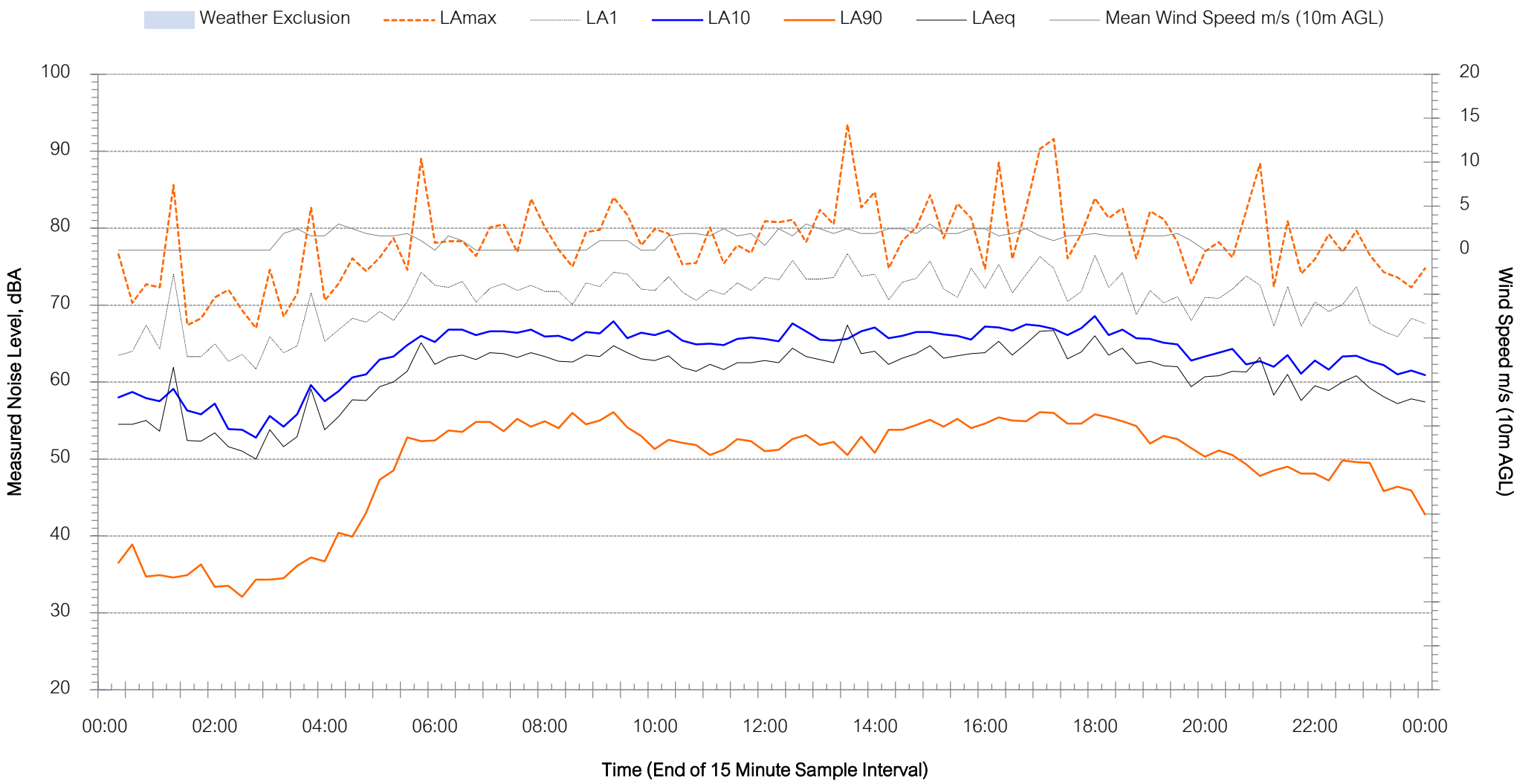


Background Noise Levels

Appin Road and St Johns Road Intersection - Thursday 1 June 2023

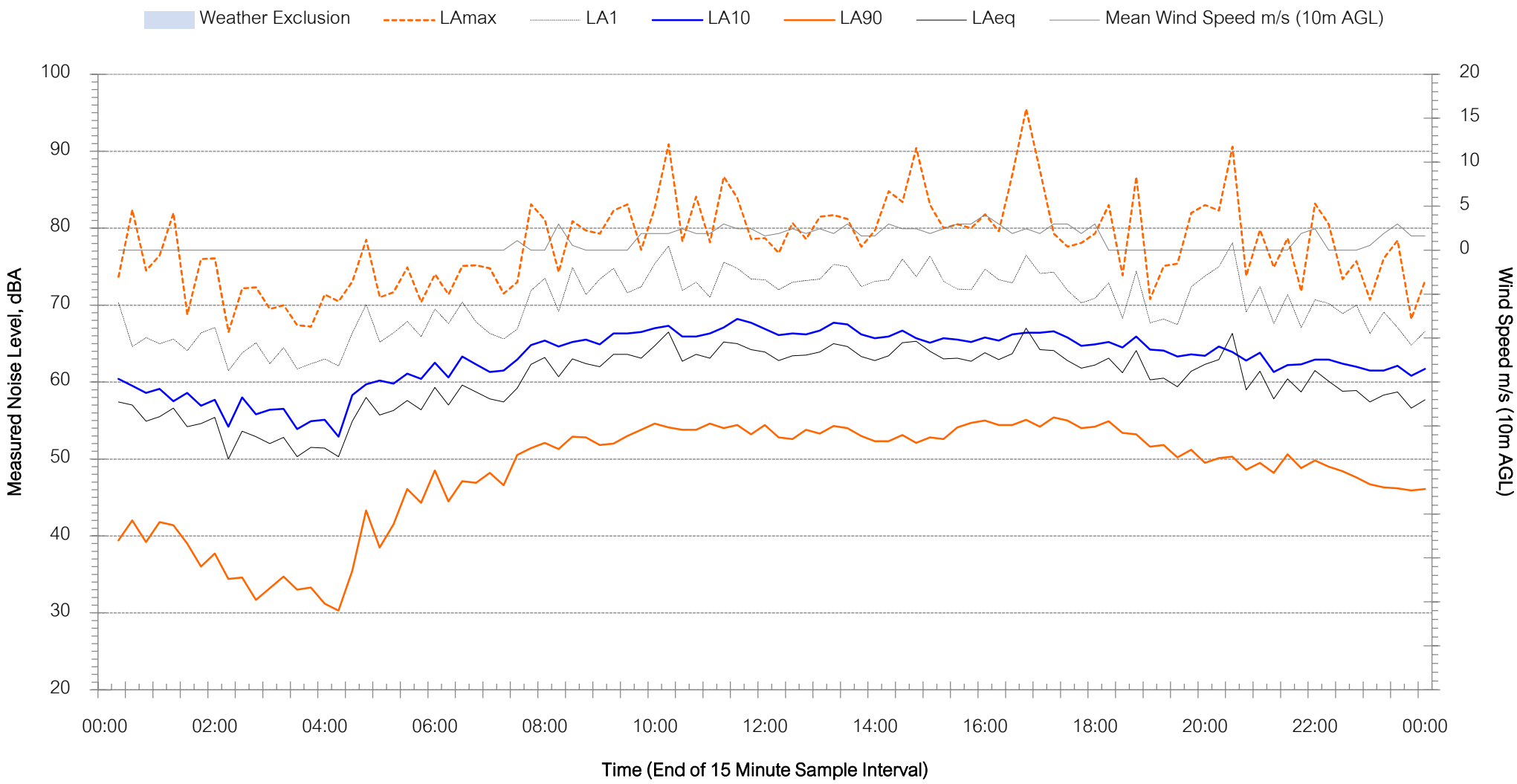
Background Noise Levels

Appin Road and St Johns Road Intersection - Friday 2 June 2023



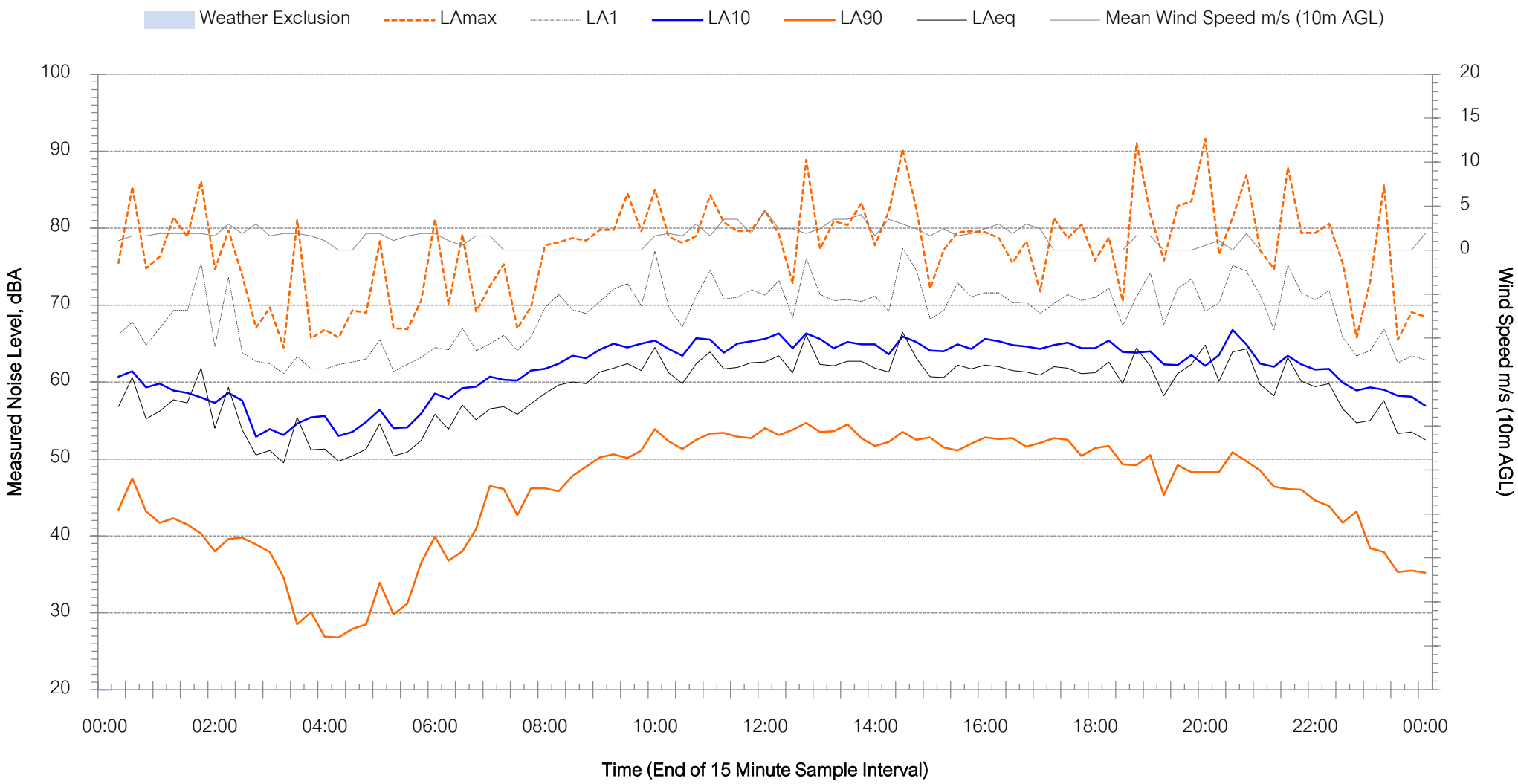
Background Noise Levels

Appin Road and St Johns Road Intersection - Saturday 3 June 2023



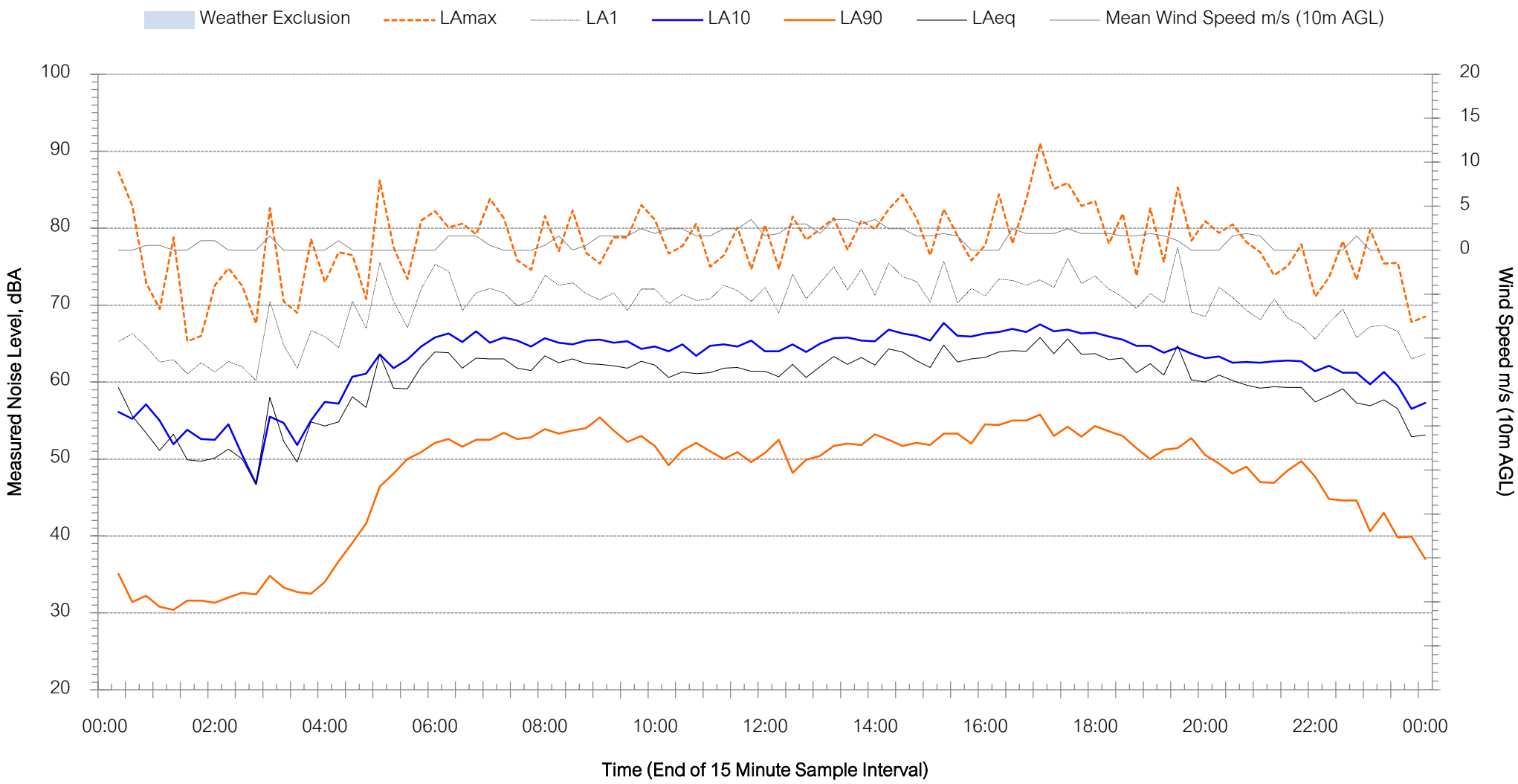
Background Noise Levels

Appin Road and St Johns Road Intersection - Sunday 4 June 2023



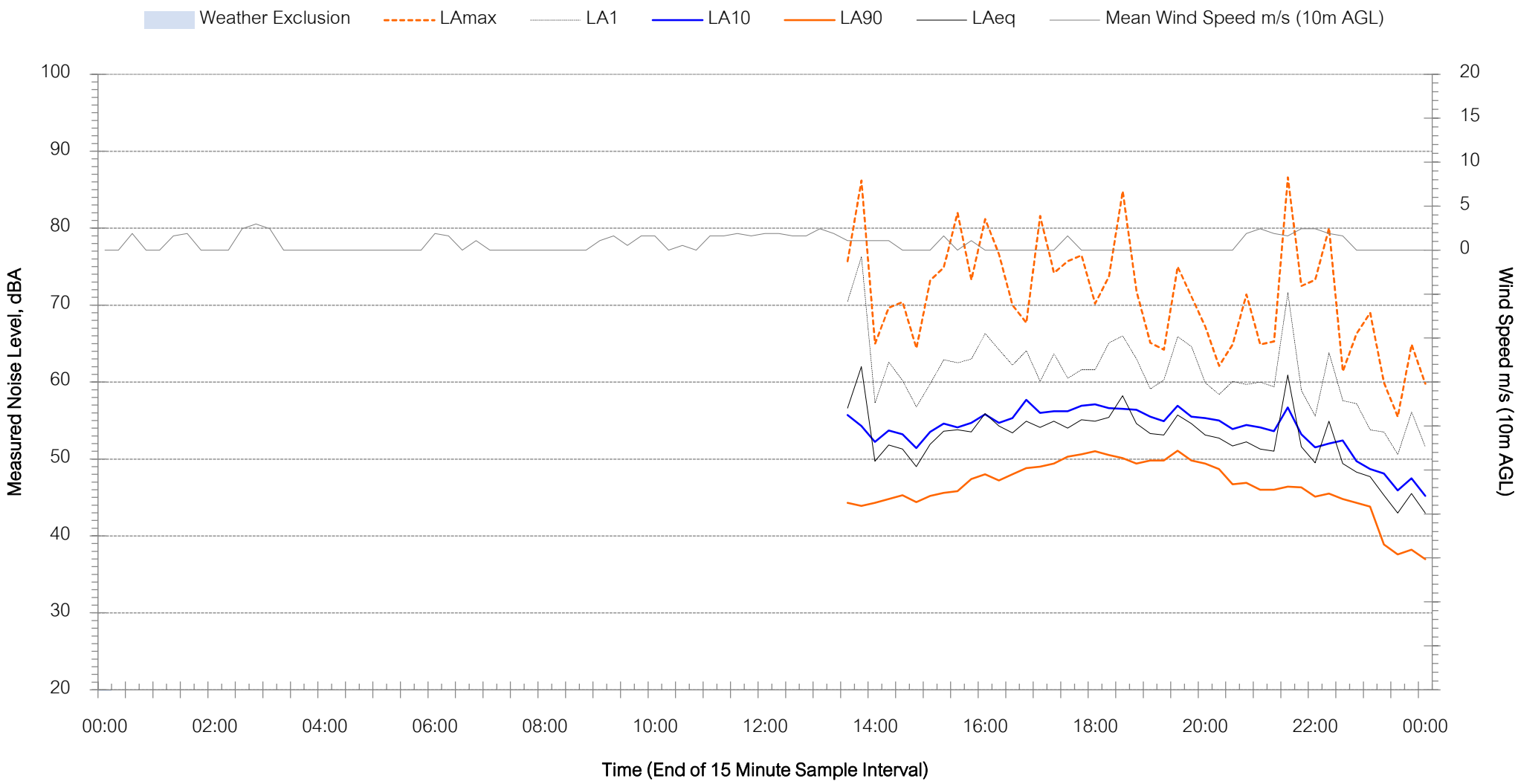
Background Noise Levels

Appin Road and St Johns Road Intersection - Monday 5 June 2023



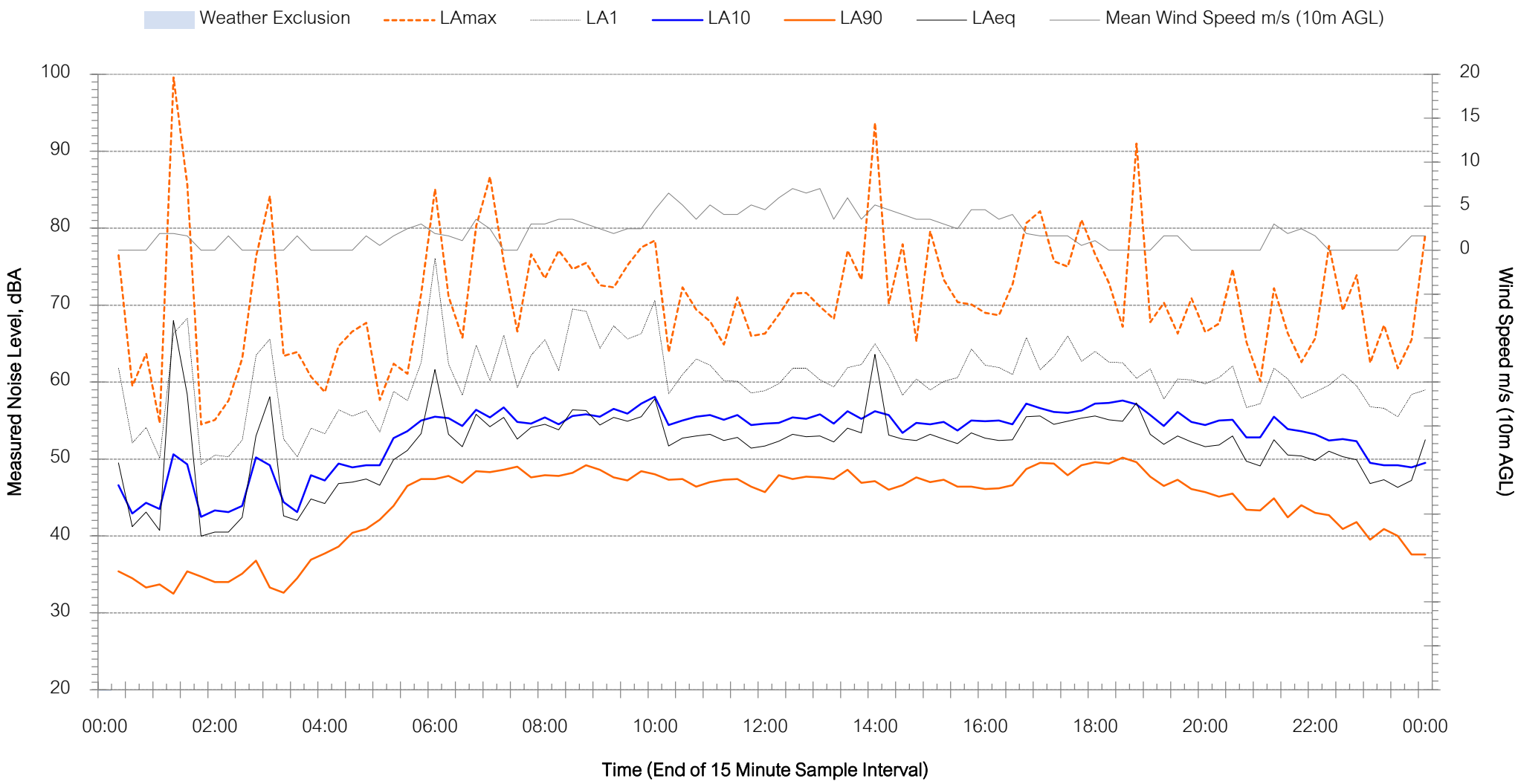
Background Noise Levels

Pinaroo Reserve, St Helens Park - Thursday 25 May 2023



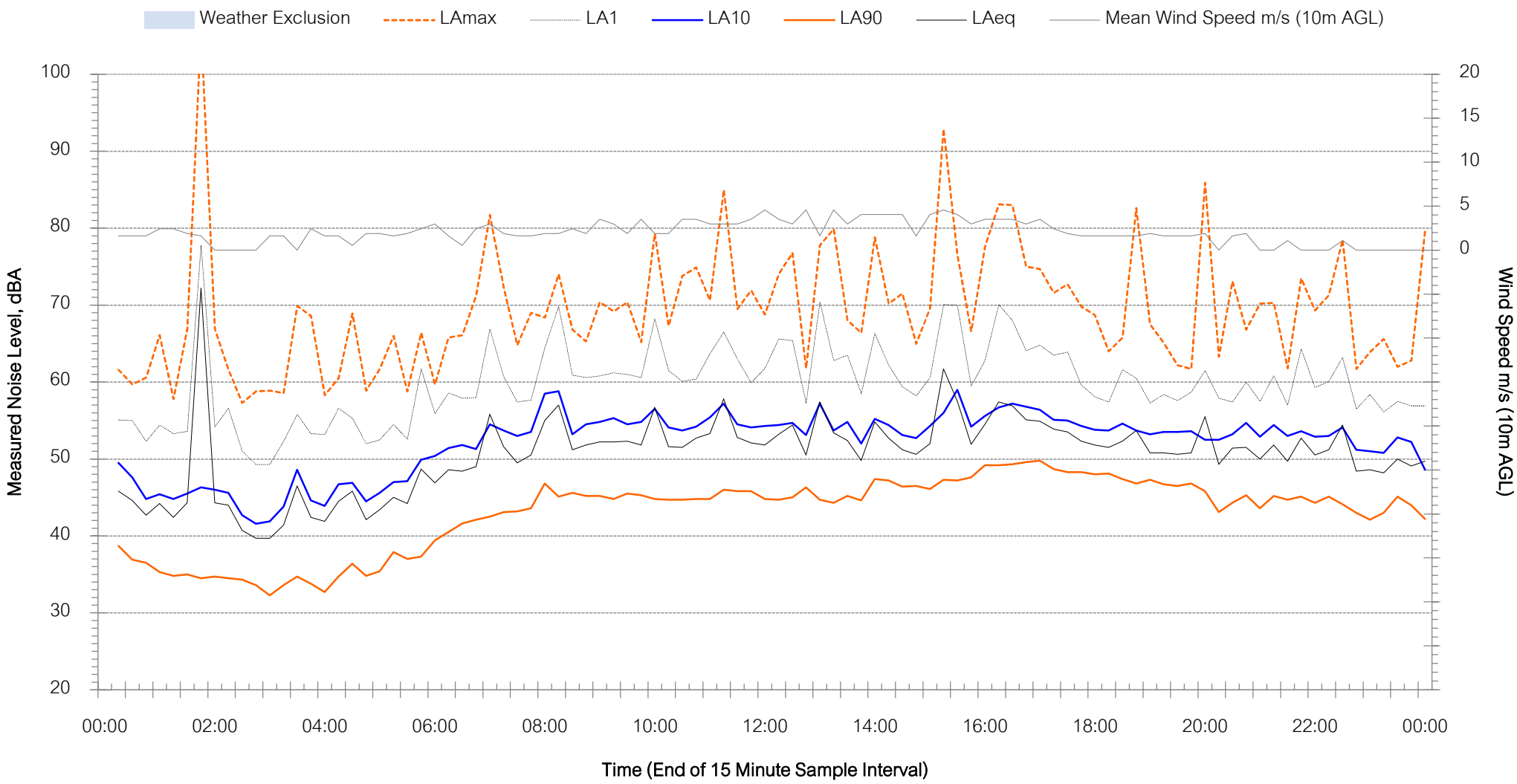
Background Noise Levels

Pinaroo Reserve, St Helens Park - Friday 26 May 2023



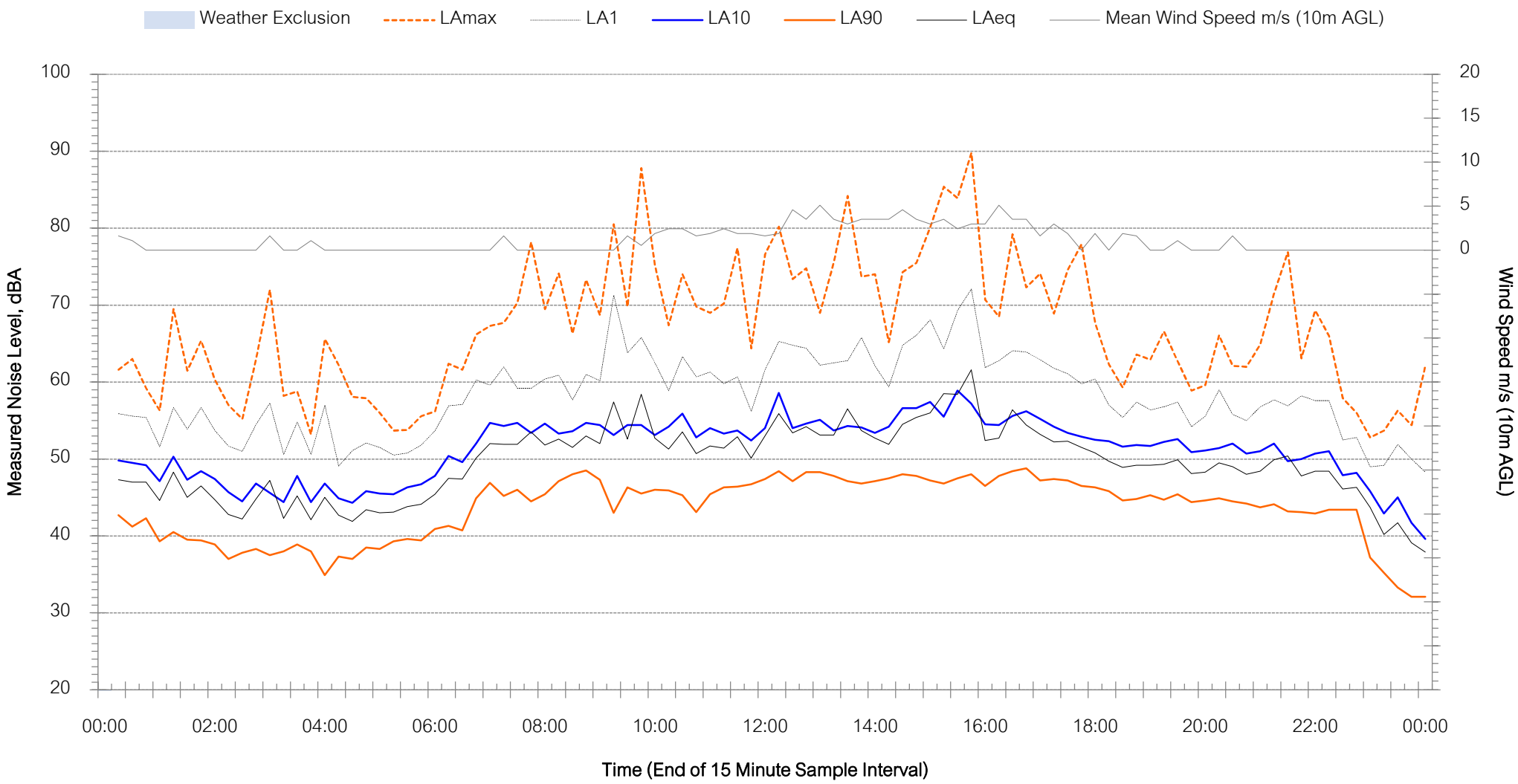
Background Noise Levels

Pinaroo Reserve, St Helens Park - Saturday 27 May 2023



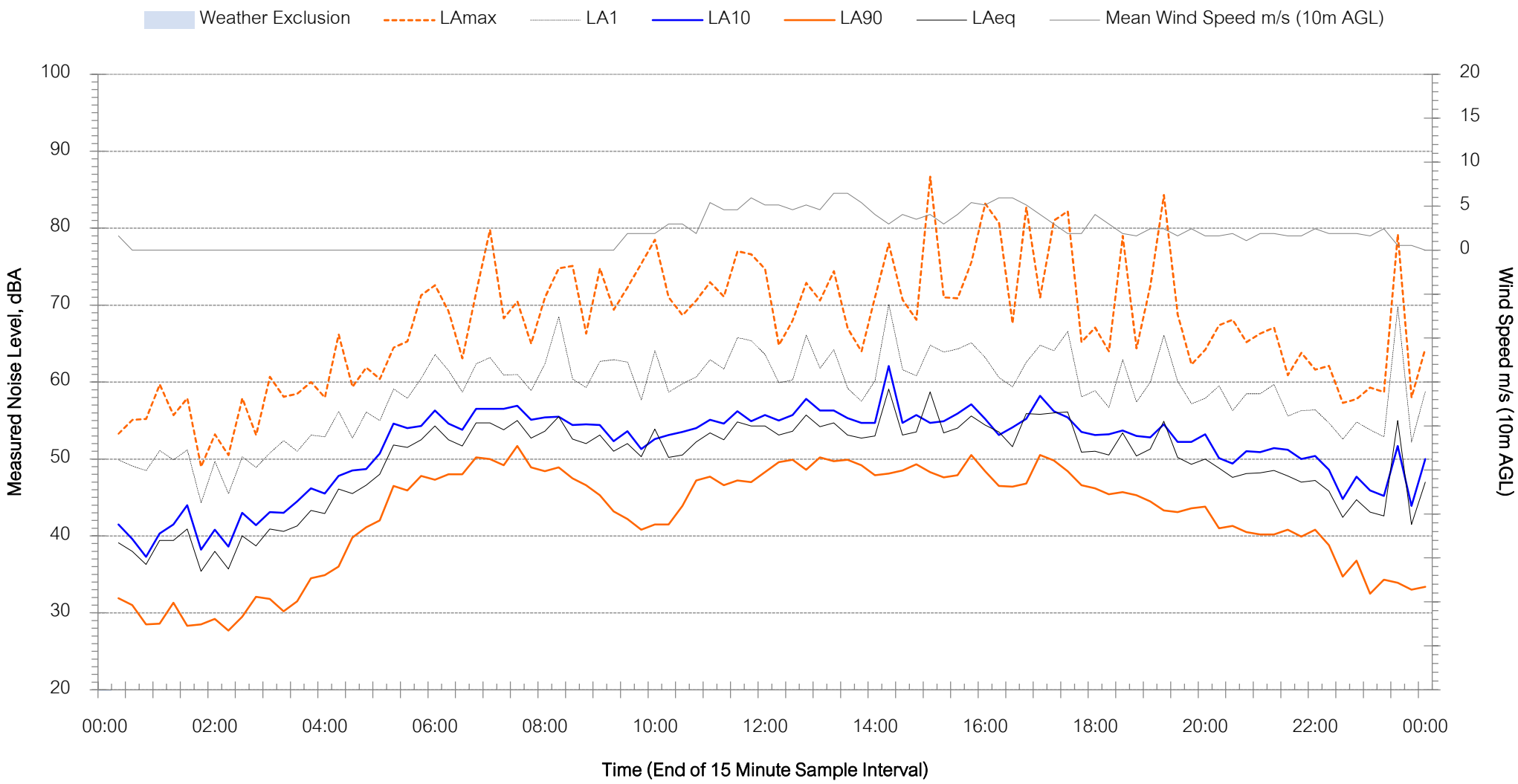
Background Noise Levels

Pinaroo Reserve, St Helens Park - Sunday 28 May 2023



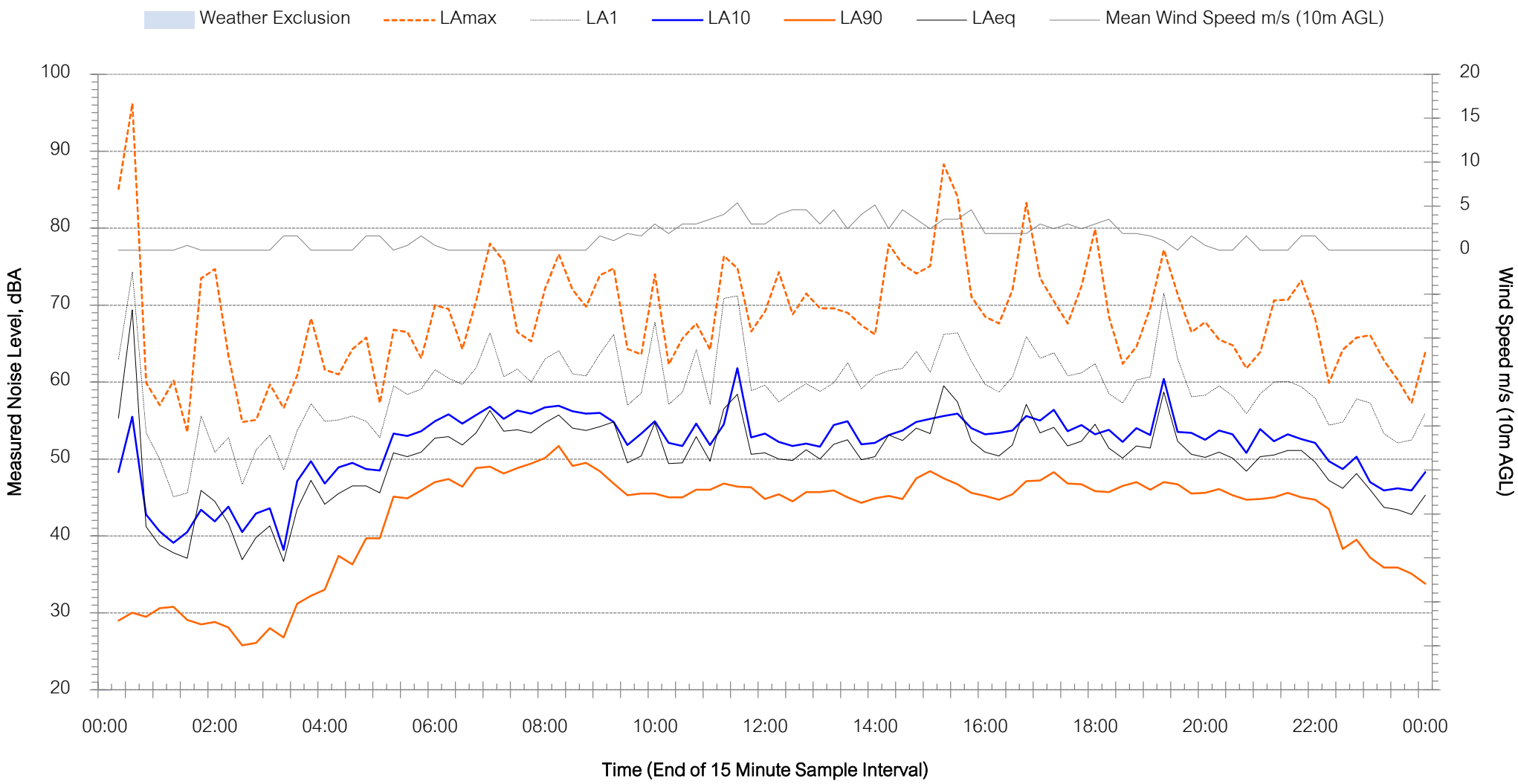
Background Noise Levels

Pinaroo Reserve, St Helens Park - Monday 29 May 2023



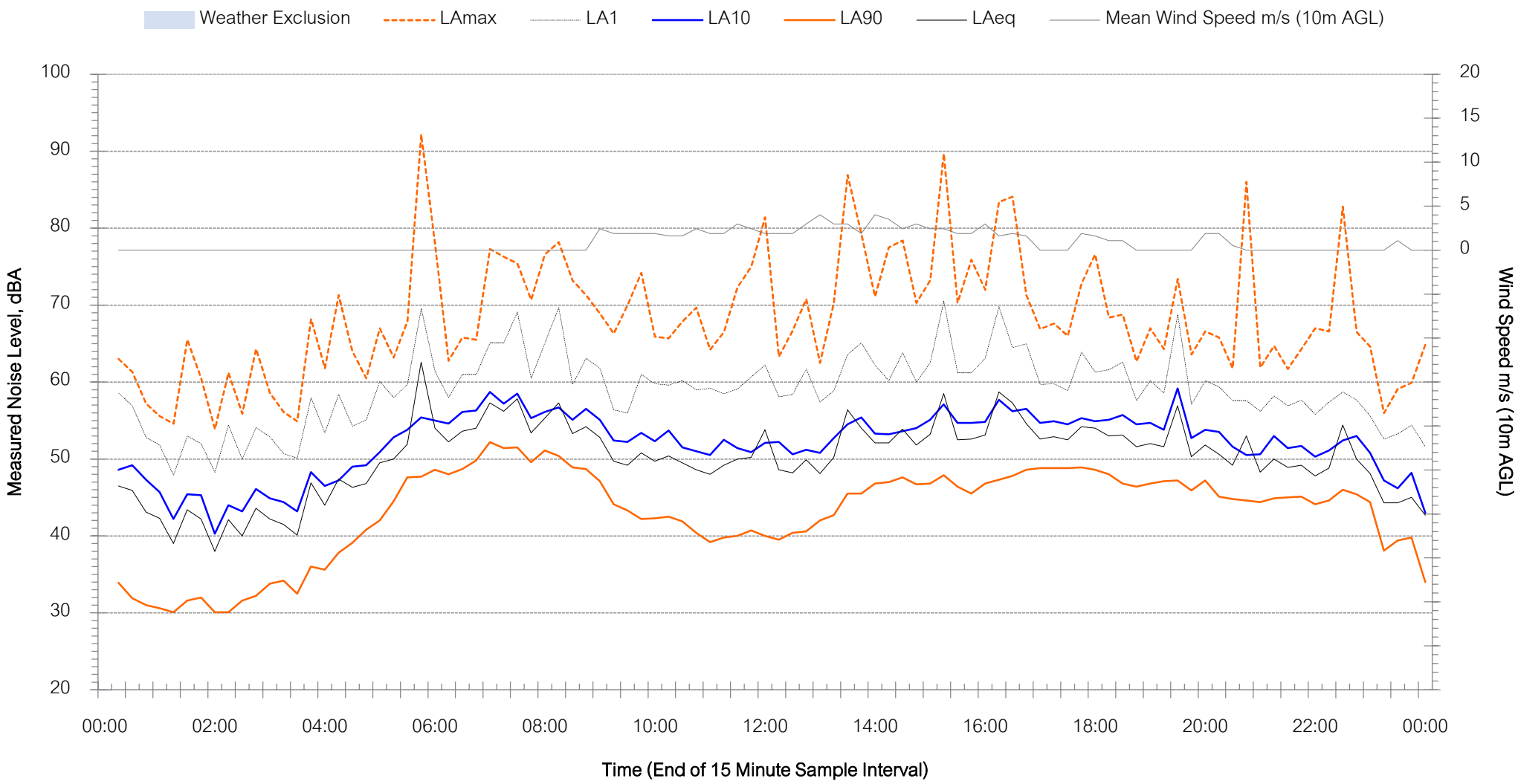
Background Noise Levels

Pinaroo Reserve, St Helens Park - Tuesday 30 May 2023



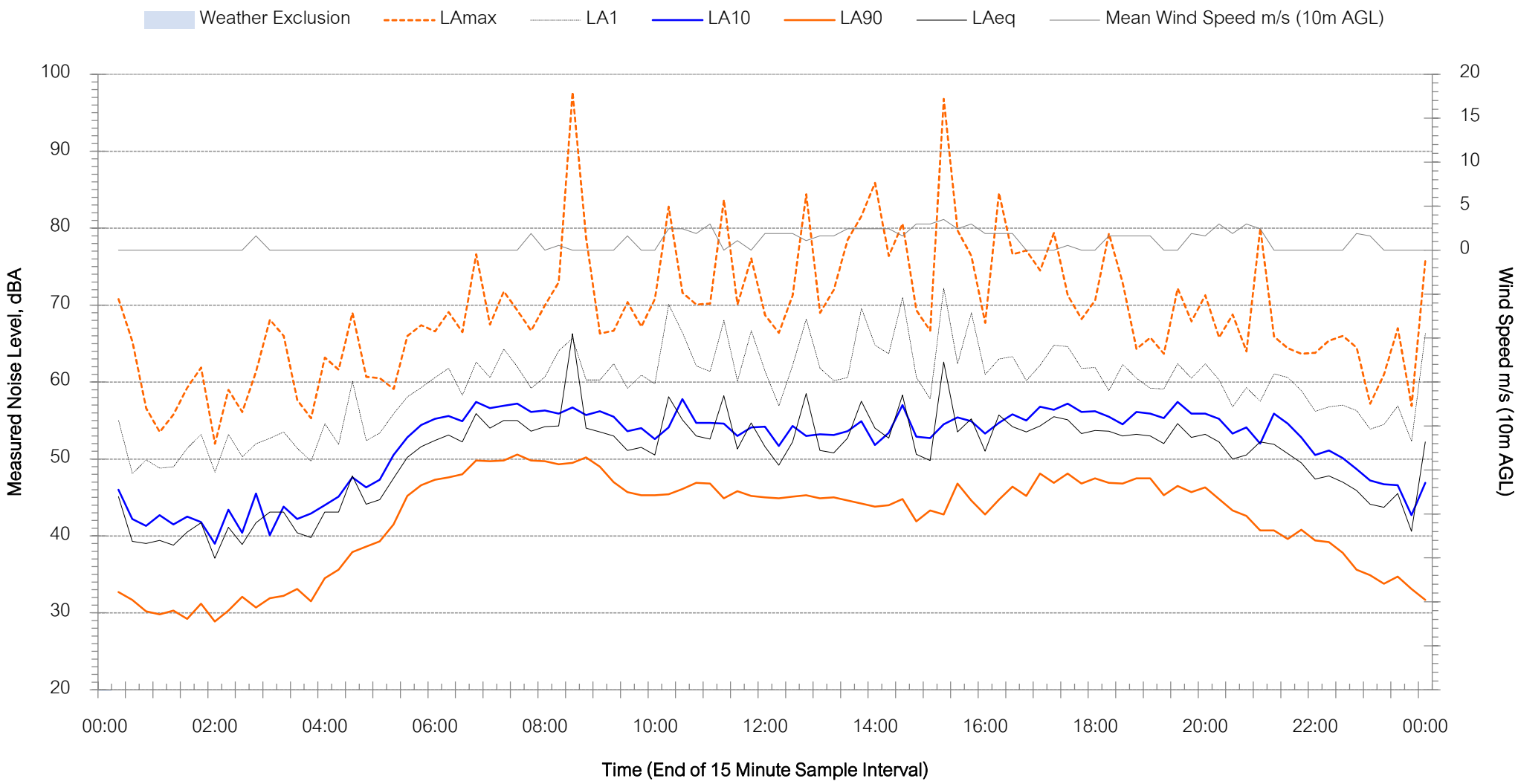
Background Noise Levels

Pinaroo Reserve, St Helens Park - Wednesday 31 May 2023



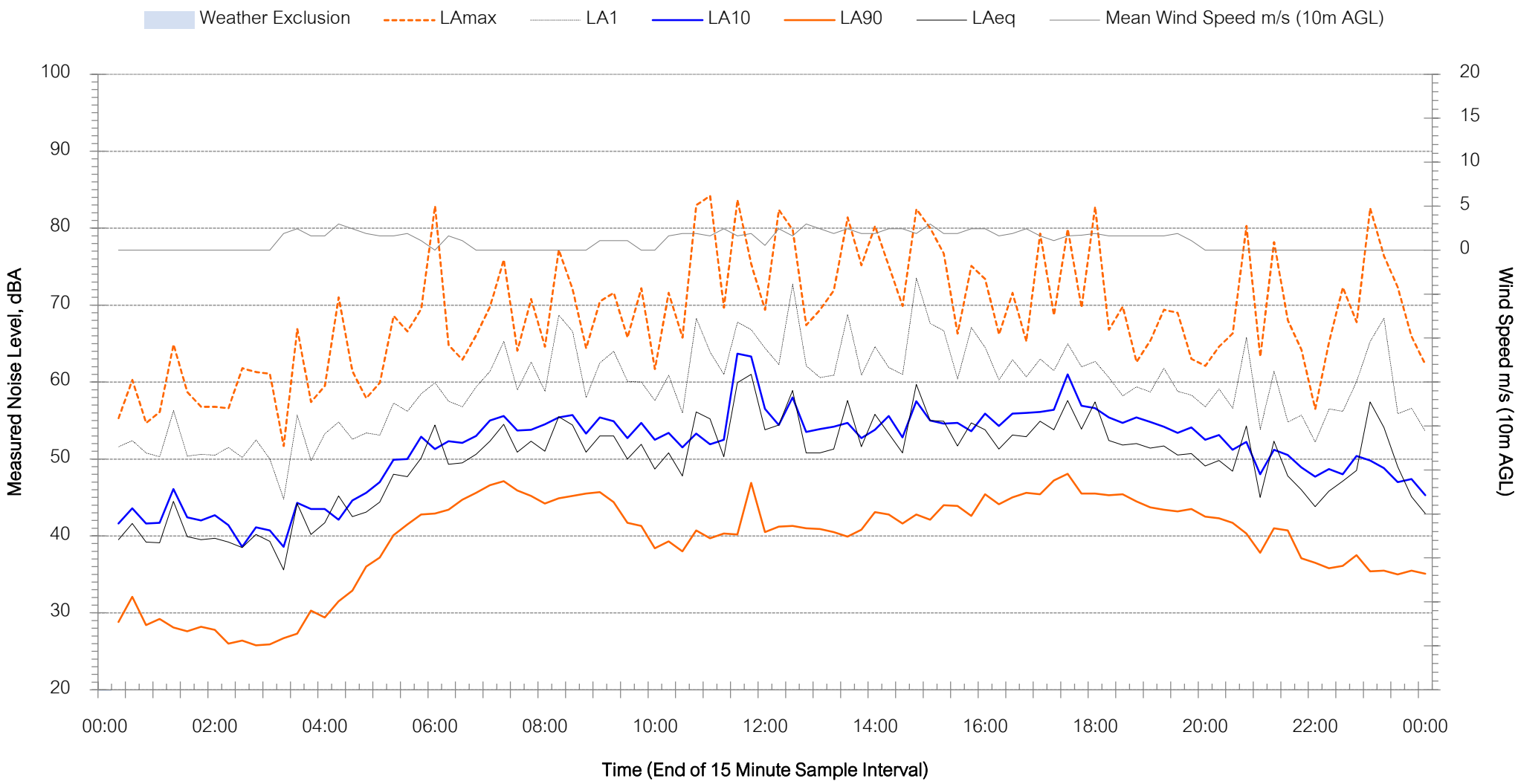
Background Noise Levels

Pinaroo Reserve, St Helens Park - Thursday 1 June 2023



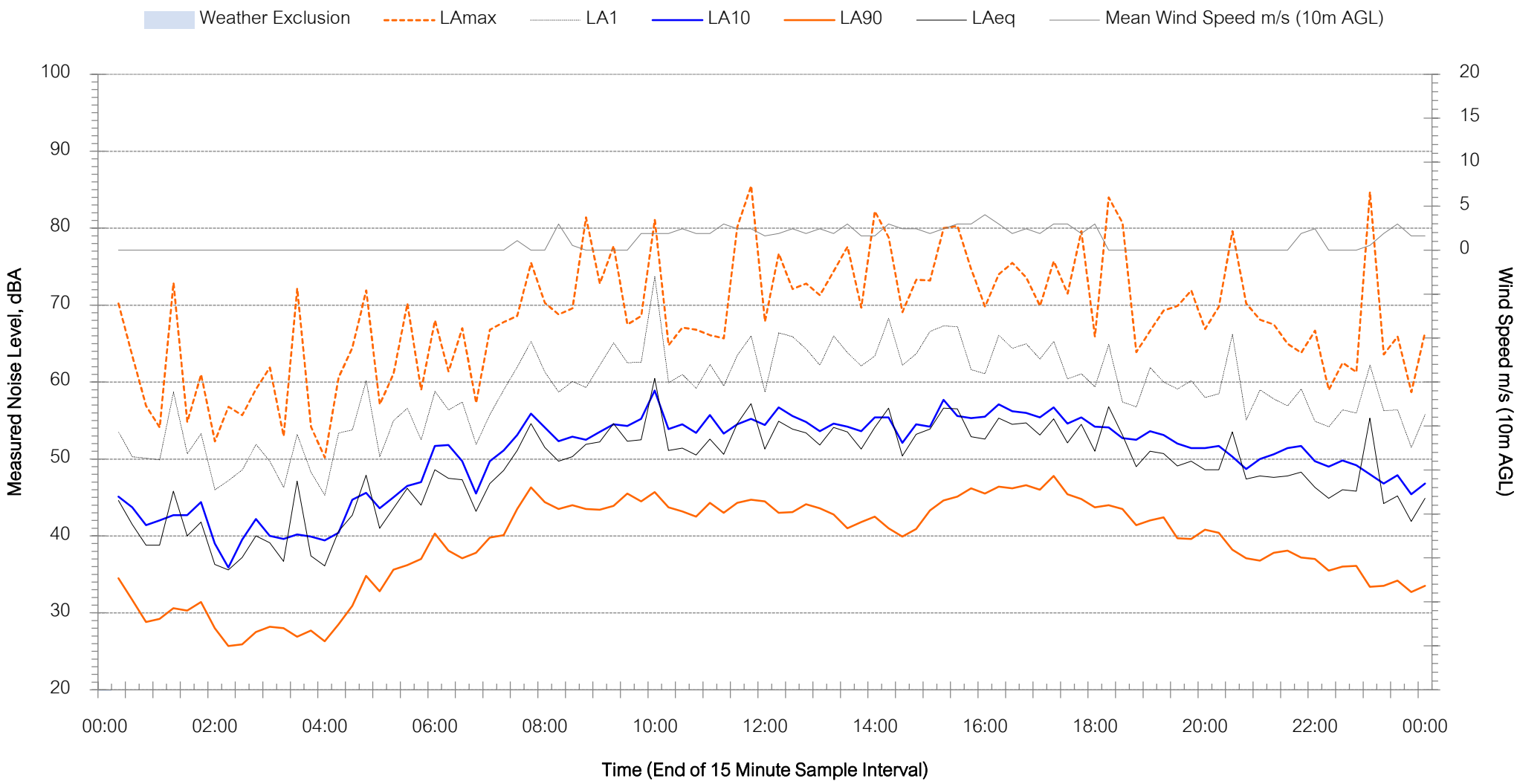
Background Noise Levels

Pinaroo Reserve, St Helens Park - Friday 2 June 2023



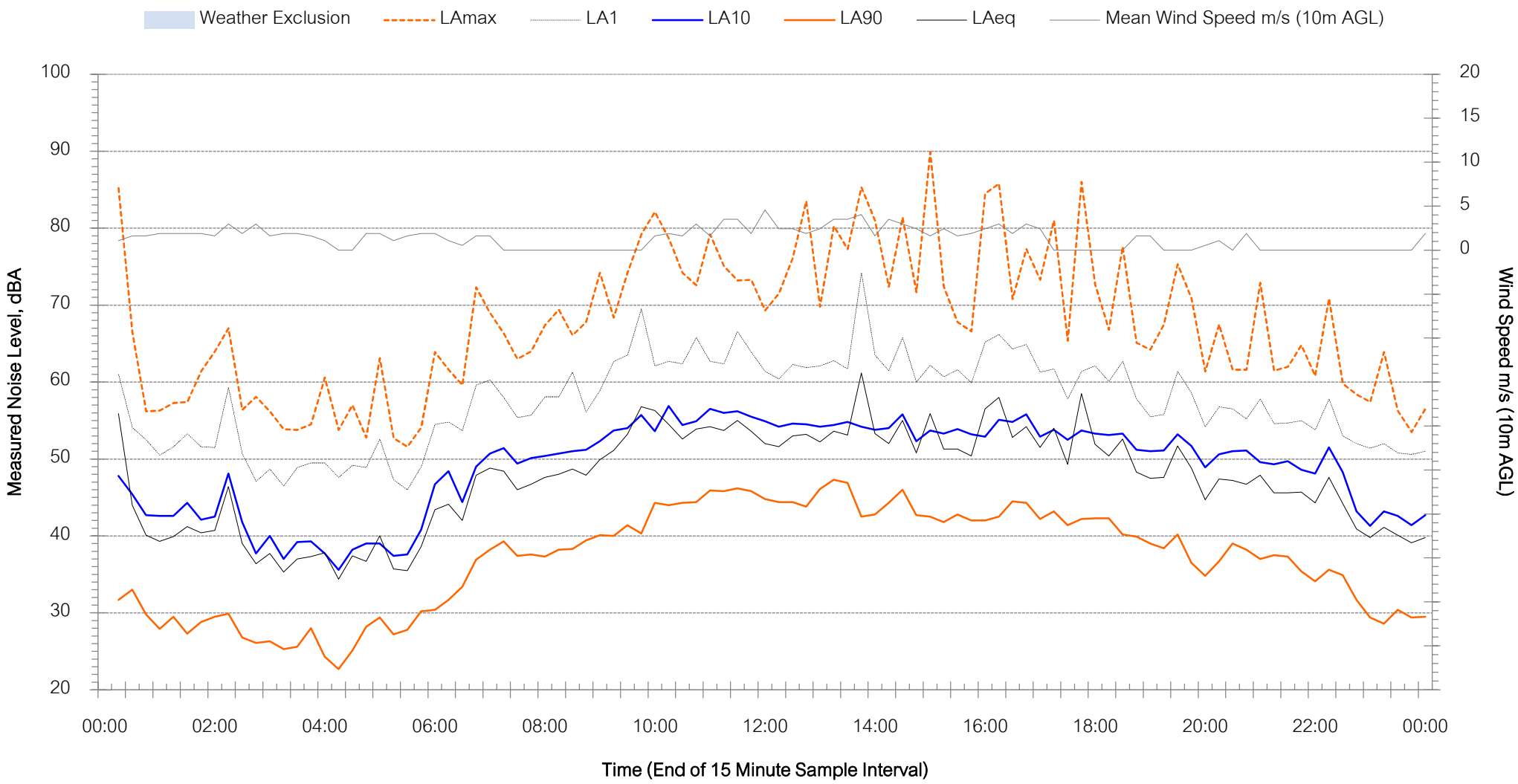
Background Noise Levels

Pinaroo Reserve, St Helens Park - Saturday 3 June 2023



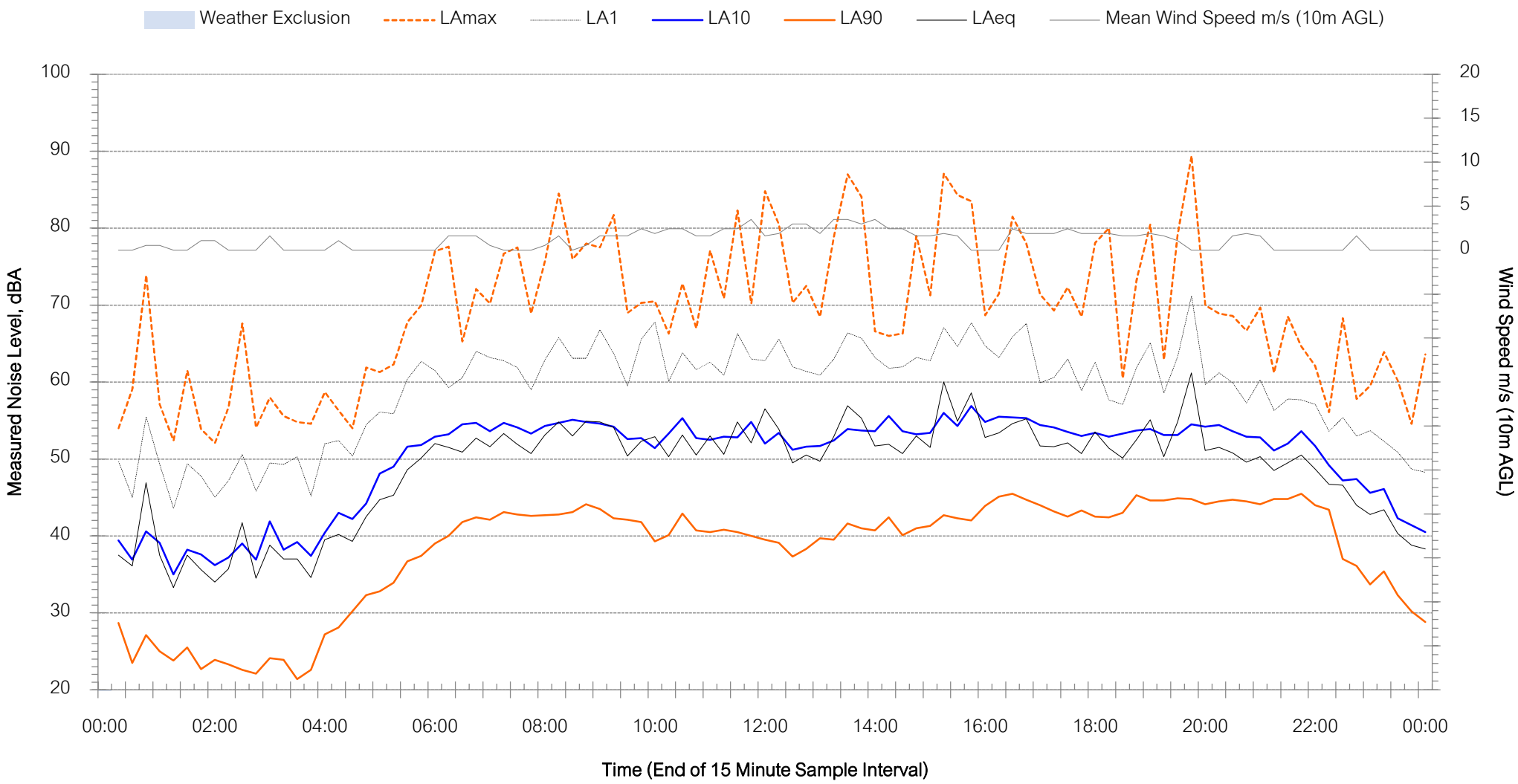
Background Noise Levels

Pinaroo Reserve, St Helens Park - Sunday 4 June 2023



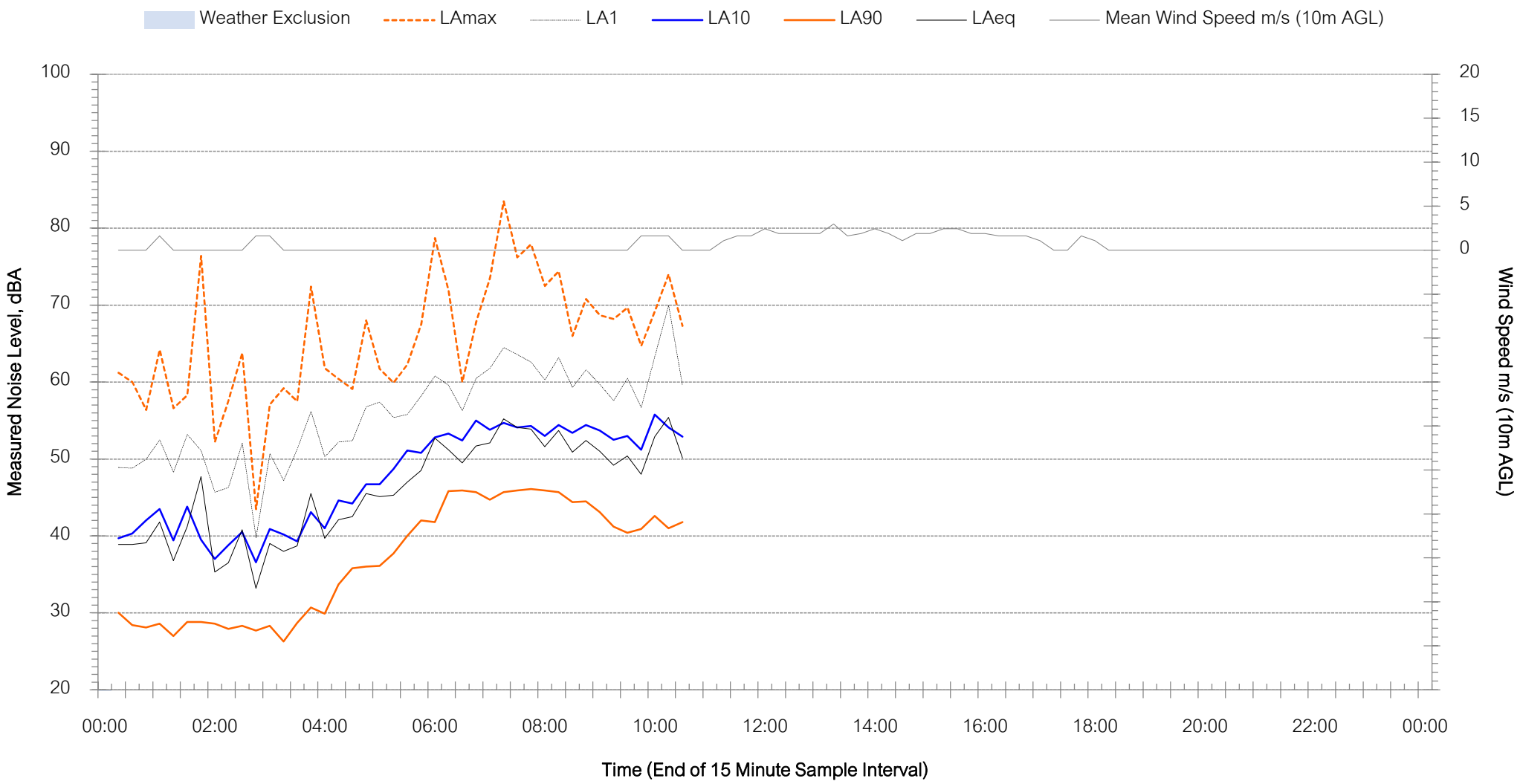
Background Noise Levels

Pinaroo Reserve, St Helens Park - Monday 5 June 2023



Background Noise Levels

Pinaroo Reserve, St Helens Park - Tuesday 6 June 2023



Appendix D – Construction Noise Contours

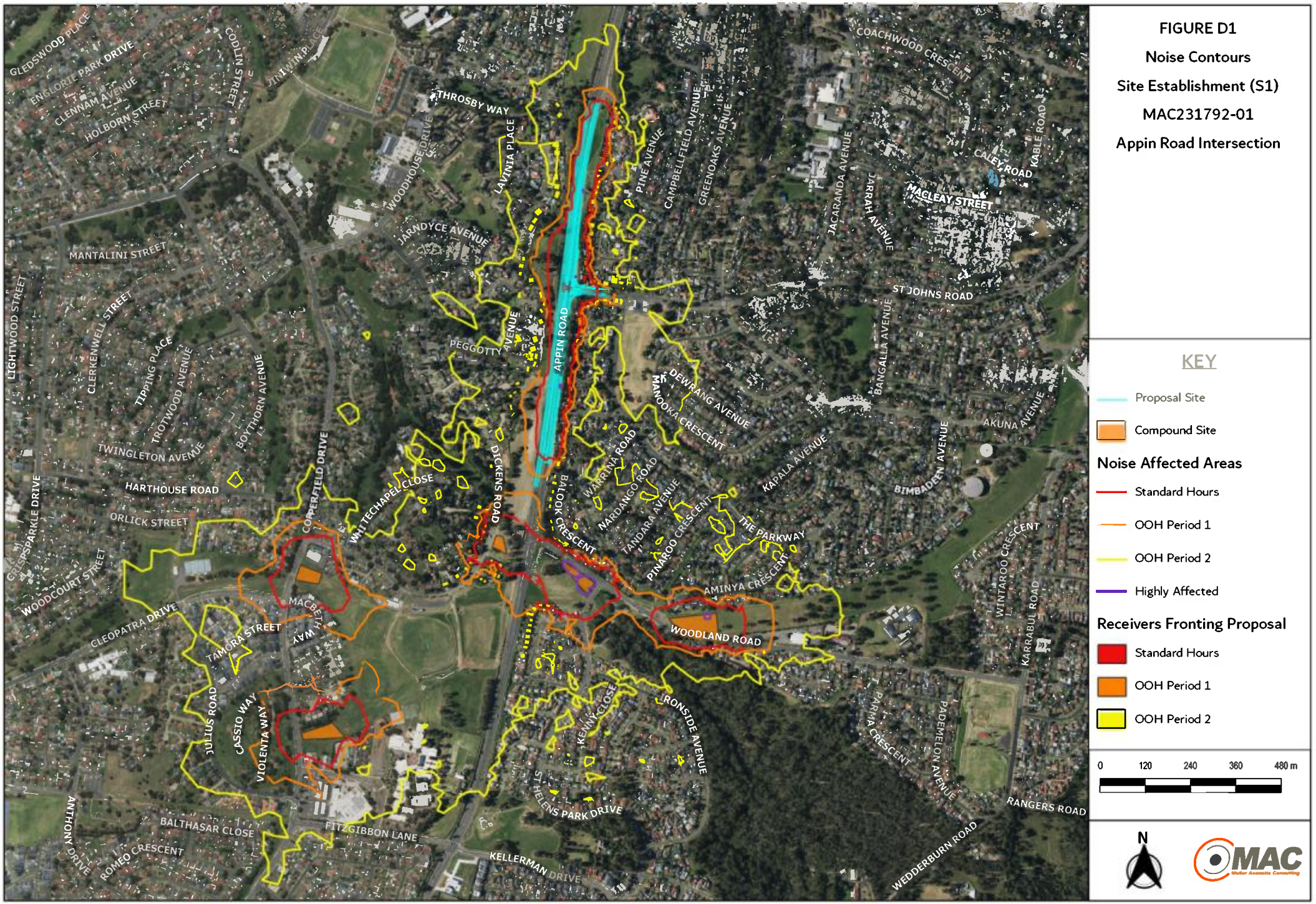


FIGURE D1
Noise Contours
Site Establishment (S1)
MAC231792-01
Appin Road Intersection
KEY
Proposal Site
Compound Site
Noise Affected Areas
Standard Hours
OOH Period 1
OOH Period 2
Highly Affected
Receivers Fronting Proposal
Standard Hours
OOH Period 1
OOH Period 2
0
120
240
360
480 m
N
MAC
GLEDSWOOD PLACE
ENGLORIE PARK DRIVE
CLENNAM AVENUE
HOLBORN STREET
CODLIN STREET
JINIWIN PLACE
THROSBY WAY
WOODHOUSE DRIVE
LAVINIA PLACE
JARNDYCE AVENUE
PINE AVENUE
CAMPBELLFIELD AVENUE
GREENOAKS AVENUE
COACHWOOD CRESCENT
JACARANDA AVENUE
JARRAH AVENUE
CALEY ROAD
KABLE ROAD
MACLEAY STREET
ST JOHNS ROAD
MANTALINI STREET
LIGHTWOOD STREET
CLERKENWELL STREET
TIPPING PLACE
TROTWOOD AVENUE
BOYTHORN AVENUE
PEGGOTTY AVENUE
APPIN ROAD
DEWRANG AVENUE
YANOOKA CRESCENT
BANGALLA AVENUE
AKUNA AVENUE
TWINGLETON AVENUE
HARTHOUSE ROAD
ORLICK STREET
CRISPSPARKLE DRIVE
WOODCOURT STREET
COPPERFIELD DRIVE
WHITECHAPEL CLOSE
DICKENS ROAD
BAYLOOK CRESCENT
WARRINA ROAD
NARDANGO ROAD
TANDARA AVENUE
PINAROO CRESCENT
KAPALA AVENUE
BIMBADEEN AVENUE
THE PARKWAY
AMINYA CRESCENT
WINTAROO CRESCENT
KARRABUL ROAD
CLEOPATRA DRIVE
TAMORA STREET
MACBETH WAY
WOODLAND ROAD
JULIUS ROAD
CASSIO WAY
VIOLENTA WAY
KENNY CLOSE
IRONSIDE AVENUE
PARMA CRESCENT
PADMELON AVENUE
RANGERS ROAD
ANTHONY DRIVE
BALTHASAR CLOSE
ROMEO CRESCENT
FITZGIBBON LANE
ST HELENS PARK DRIVE
KELLERMAN DRIVE
WEDDERBURN ROAD


FIGURE D2
Noise Contours
Corridor Clearing (S2)
MAC231792-01
Appin Road Intersection
KEY
Proposal Site
Compound Site
Noise Affected Areas
Standard Hours
OOH Period 1
OOH Period 2
Highly Affected
Receivers Fronting Proposal
Standard Hours
OOH Period 1
OOH Period 2
Highly Affected
0
150
300
450
600 m
N
MAC
APPIN ROAD
THE PARKWAY
WOODLAND ROAD
GILCHRIST DRIVE
THERRY ROAD
HODDLE AVENUE
GUISE ROAD
BOTTLEBRUSH AVENUE
BLACKBUTT AVENUE
ALLOTT STREET
GLEN ALPINE DRIVE
GLEDSWOOD PLACE
ENGLORIE PARK DRIVE
CLENNAM AVENUE
HOLBORN STREET
COOLIN STREET
JINTWIN PLACE
GEORGIANA CRESCENT
FERN AVENUE
EVERGREEN AVENUE
LANN AVENUE
COACHWOOD CRESCENT
CALEY ROAD
MACLEAY STREET
JACARANDA AVENUE
CAMPBELLFIELD AVENUE
GREENOAKS AVENUE
THROSBY WAY
WOODHOUSE DRIVE
LIGHTWOOD STREET
CLERKENWELL STREET
TIPPING PLACE
TROTWOOD AVENUE
BOYTHORN AVENUE
COPPERFIELD DRIVE
TWINGLETON AVENUE
HARTHOUSE ROAD
ORLICK STREET
CLAYPOLE STREET
CRISPSPARKLE DRIVE
WOODCOURT STREET
CLEOPATRA DRIVE
OCTAVIA AVENUE
DEMETRIUS ROAD
ANTHONY DRIVE
ROMEO CRESCENT
JUBILEE CIRCUIT
JULIUS ROAD
VIOLENTA WAY
FITZGIBBON LANE
ST HELENS PARK DRIVE
KELLERMAN DRIVE
IRONSIDE AVENUE
DICKENS ROAD
PUNARO CRESCENT
TANDARA AVENUE
DEWRANG AVENUE
MAMOOKA CRESCENT
KAPALA AVENUE
AMINYA CRESCENT
BANGALLA AVENUE
ST JOHNS ROAD
KULLAROO AVENUE
DUNSTAN DRIVE
AKUNA AVENUE
BIMBADEEN AVENUE
GREENGATE ROAD
POTOROO AVENUE
KARRABUL ROAD
LARAPINTA CRESCENT
LYNWOOD ROAD
PADEMELON AVENUE
PARRA CRESCENT
RANGERS ROAD
WEDDERBURN ROAD
CNE LANE

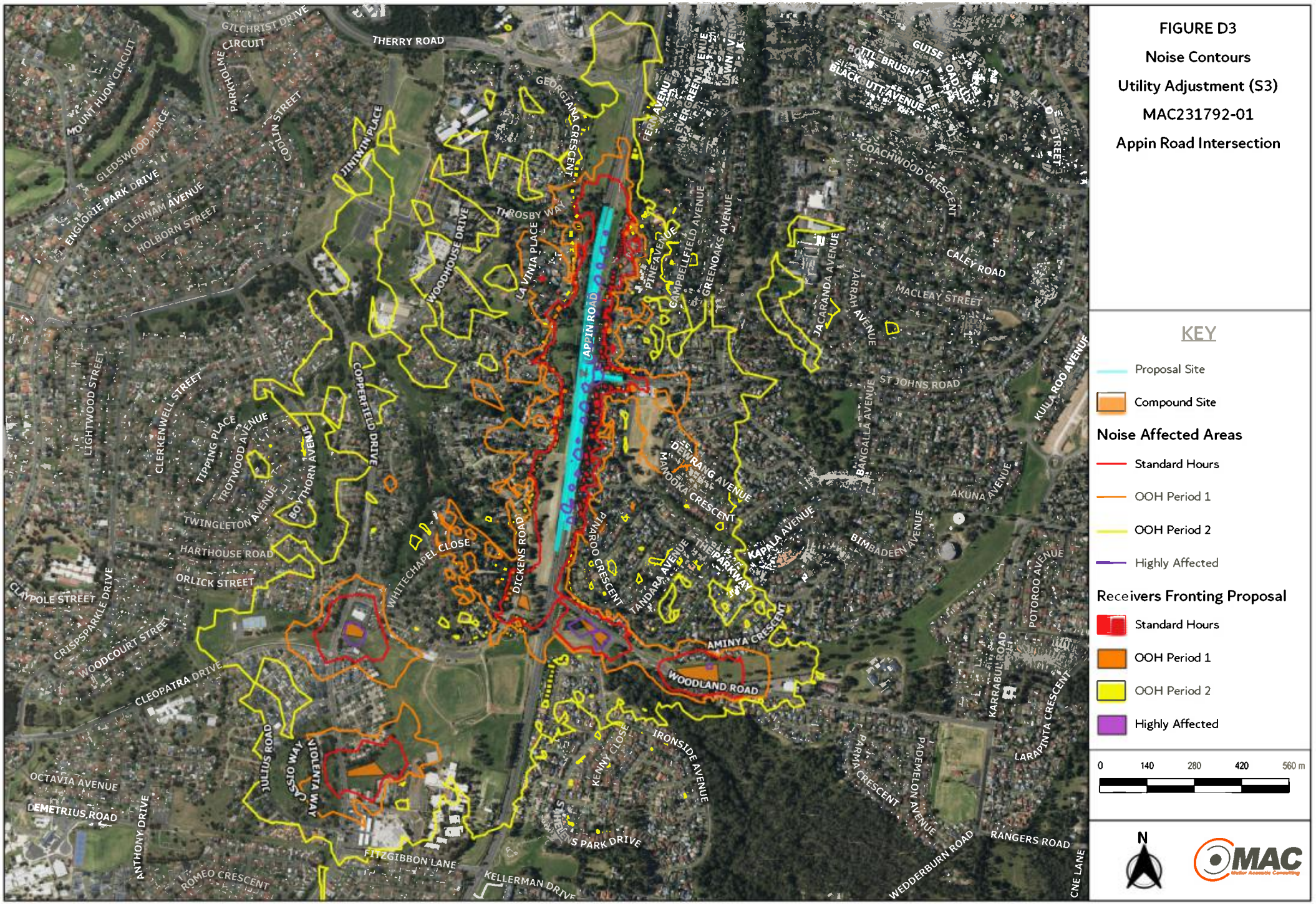


FIGURE D3

Noise Contours

Utility Adjustment (S3)

MAC231792-01

Appin Road Intersection

KEY

Proposal Site

Compound Site

Noise Affected Areas

Standard Hours

OOH Period 1

OOH Period 2

Highly Affected

Receivers Fronting Proposal

Standard Hours

OOH Period 1

OOH Period 2

Highly Affected

0 140 280 420 560 m

N

MAC

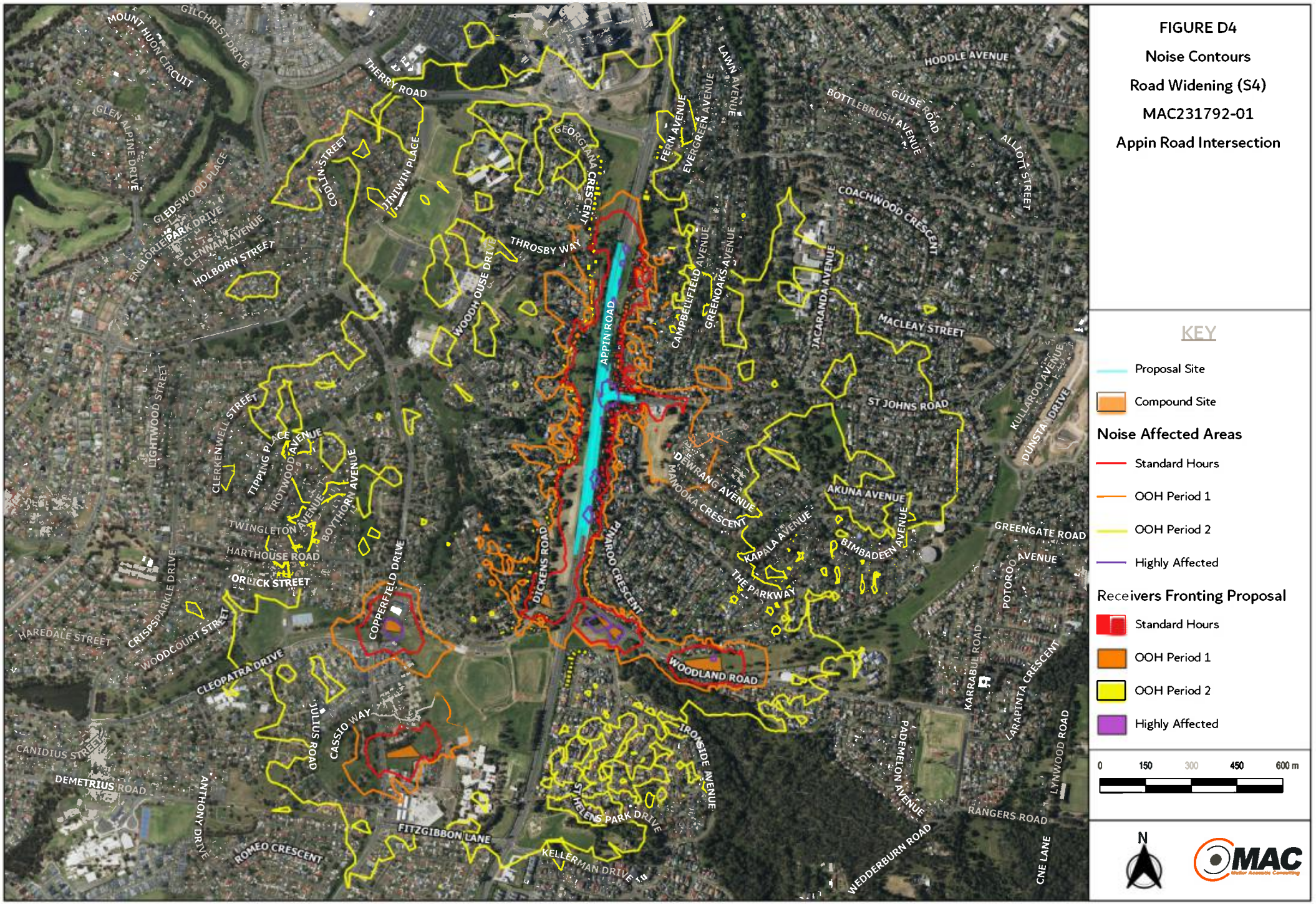


FIGURE D4

Noise Contours

Road Widening (S4)

MAC231792-01

Appin Road Intersection

KEY

Proposal Site

Compound Site

Noise Affected Areas

Standard Hours

OOH Period 1

OOH Period 2

Highly Affected

Receivers Fronting Proposal

Standard Hours

OOH Period 1

OOH Period 2

Highly Affected

0 150 300 450 600 m

N

MAC

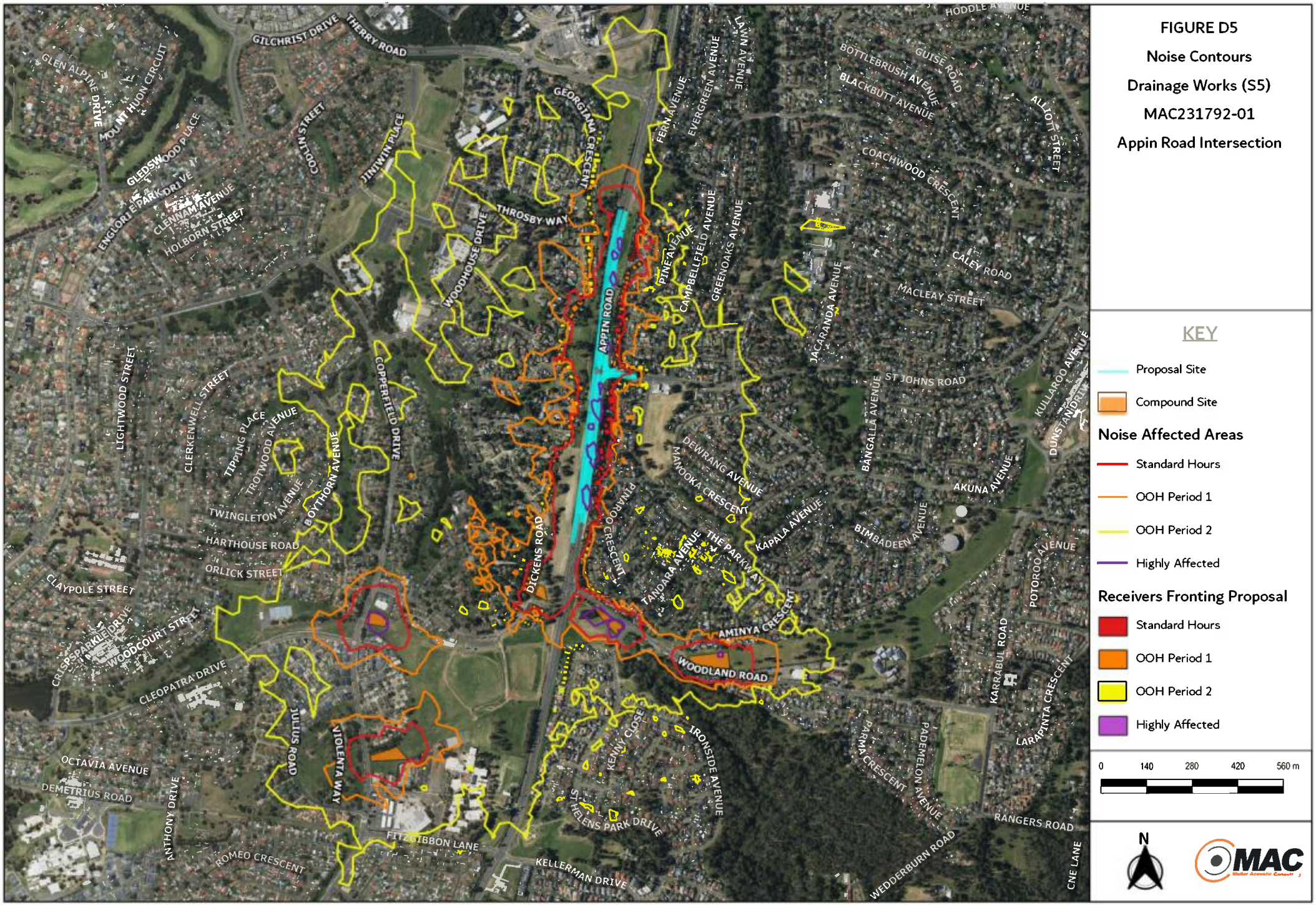


FIGURE D5
Noise Contours
Drainage Works (S5)
MAC231792-01
Appin Road Intersection
KEY
Proposal Site
Compound Site
Noise Affected Areas
Standard Hours
OOH Period 1
OOH Period 2
Highly Affected
Receivers Fronting Proposal
Standard Hours
OOH Period 1
OOH Period 2
Highly Affected
0 140 280 420 560 m
N
MAC
GILCHRIST DRIVE
THERRY ROAD
GLEN ALPINE DRIVE
MOUNT HUON CIRCUIT
GLEDSWOOD PLACE
ENGLORIE PARK DRIVE
CLENNAM AVENUE
HOLBORN STREET
COOLUM STREET
JINIWIN PLACE
GEORGIANA CRESCENT
THROSBY WAY
WOODHOUSE DRIVE
APPIN ROAD
FERN AVENUE
EVERGREEN AVENUE
LAWN AVENUE
HODDLE AVENUE
GUISE ROAD
BOTTLEBRUSH AVENUE
BLACKBUTT AVENUE
ALLIOTT STREET
COACHWOOD CRESCENT
PINE AVENUE
CAMPBELLFIELD AVENUE
GREENOAKS AVENUE
CALEY ROAD
MACLEAY STREET
JACARANDA AVENUE
ST JOHNS ROAD
BANGALLA AVENUE
KULLAROO AVENUE
DUNSTAN DRIVE
LIGHTWOOD STREET
CLERKENWELL STREET
TIPPING PLACE
TROTWOOD AVENUE
BOYTHORN AVENUE
COPPERFIELD DRIVE
TWINGLETON AVENUE
HARTHOUSE ROAD
ORLICK STREET
CLAYPOLE STREET
CRISPSPARKLE DRIVE
WOODCOURT STREET
CLEOPATRA DRIVE
DEWRANG AVENUE
MAMOOKA CRESCENT
PINAROO CRESCENT
DICKENS ROAD
KAPALA AVENUE
AKUNA AVENUE
BIMBADEEN AVENUE
THE PARKWAY
TANDARA AVENUE
AMINYA CRESCENT
WOODLAND ROAD
POTOROO AVENUE
KARRABUL ROAD
LARAPINTA CRESCENT
JULIUS ROAD
VIOLENTA WAY
KENNY CLOSE
IRONSIDE AVENUE
PADEMELON AVENUE
PARMA CRESCENT
OCTAVIA AVENUE
DEMETRIUS ROAD
ANTHONY DRIVE
ROMEO CRESCENT
FITZGIBBON LANE
ST HELENS PARK DRIVE
KELLERMAN DRIVE
RANGERS ROAD
WEDDERBURN ROAD
CNE LANE

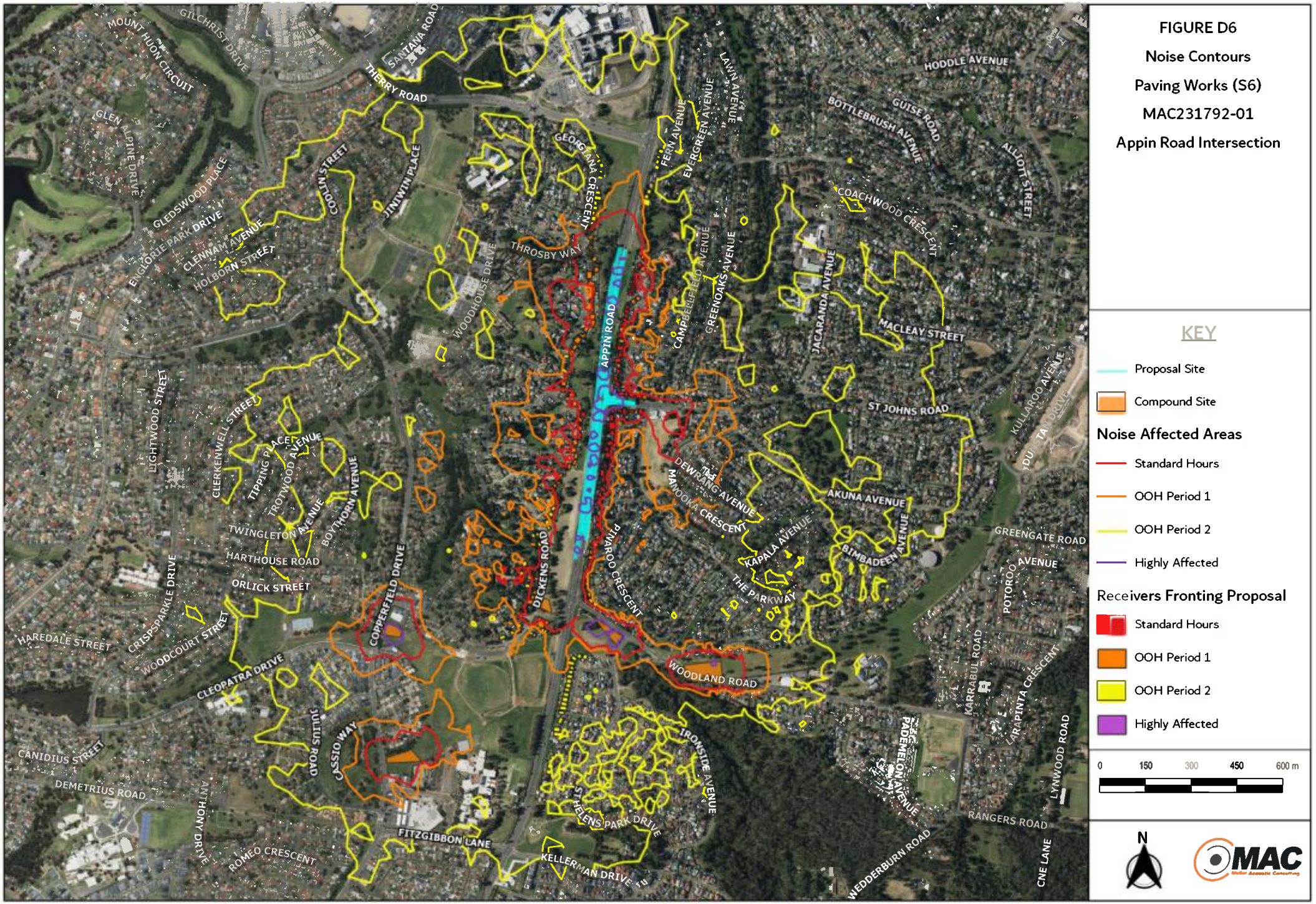


FIGURE D6
Noise Contours
Paving Works (S6)
MAC231792-01
Appin Road Intersection
KEY
Proposal Site
Compound Site
Noise Affected Areas
Standard Hours
OOH Period 1
OOH Period 2
Highly Affected
Receivers Fronting Proposal
Standard Hours
OOH Period 1
OOH Period 2
Highly Affected
0 150 300 450 600 m
N
MAC
MOUNT HUON CIRCUIT
GILCHRIST DRIVE
SANTANA ROAD
THERRY ROAD
GLEN ALPINE DRIVE
GLEDSWOOD PLACE
ENGLORIE PARK DRIVE
CLENNAM AVENUE
HOLBORN STREET
COLTON STREET
JINTWIN PLACE
GEORGIANA CRESCENT
WOODHOUSE DRIVE
THROSBY WAY
FERN AVENUE
EVERGREEN AVENUE
LAWN AVENUE
HODDLE AVENUE
BOTTLEBRUSH AVENUE
GUISE ROAD
ALLOTT STREET
COACHWOOD CRESCENT
APPIN ROAD
CAMPBELLFIELD AVENUE
GREENOAKS AVENUE
JACARANDA AVENUE
MACLEAY STREET
ST JOHNS ROAD
KULLAROO AVENUE
DUNTA DRIVE
LIGHTWOOD STREET
CLERKENWELL STREET
TIPPING PLACE
TROTWOOD AVENUE
BOYTHORN AVENUE
TWINGLETON AVENUE
HARTHOUSE ROAD
ORLICK STREET
DEWRANG AVENUE
WANOOKA CRESCENT
AKUNA AVENUE
KAPALA AVENUE
BIMBADEEN AVENUE
GREENGATE ROAD
POTOROO AVENUE
THE PARKWAY
DICKENS ROAD
PINAROO CRESCENT
COPPERFIELD DRIVE
CRISPSPARKLE DRIVE
HAREDALE STREET
WOODCOURT STREET
CLEOPATRA DRIVE
WOODLAND ROAD
KARRABUL ROAD
LARAPINTA CRESCENT
LYNWOOD ROAD
CANIDIUS STREET
DEMETRIUS ROAD
ANTHONY DRIVE
JULIUS ROAD
CASSIO WAY
IRONSIDE AVENUE
ST HELENS PARK DRIVE
PADEMELON AVENUE
RANGERS ROAD
FITZGIBBON LANE
ROMEO CRESCENT
KELLERMAN DRIVE
WEDDERBURN ROAD
CNE LANE

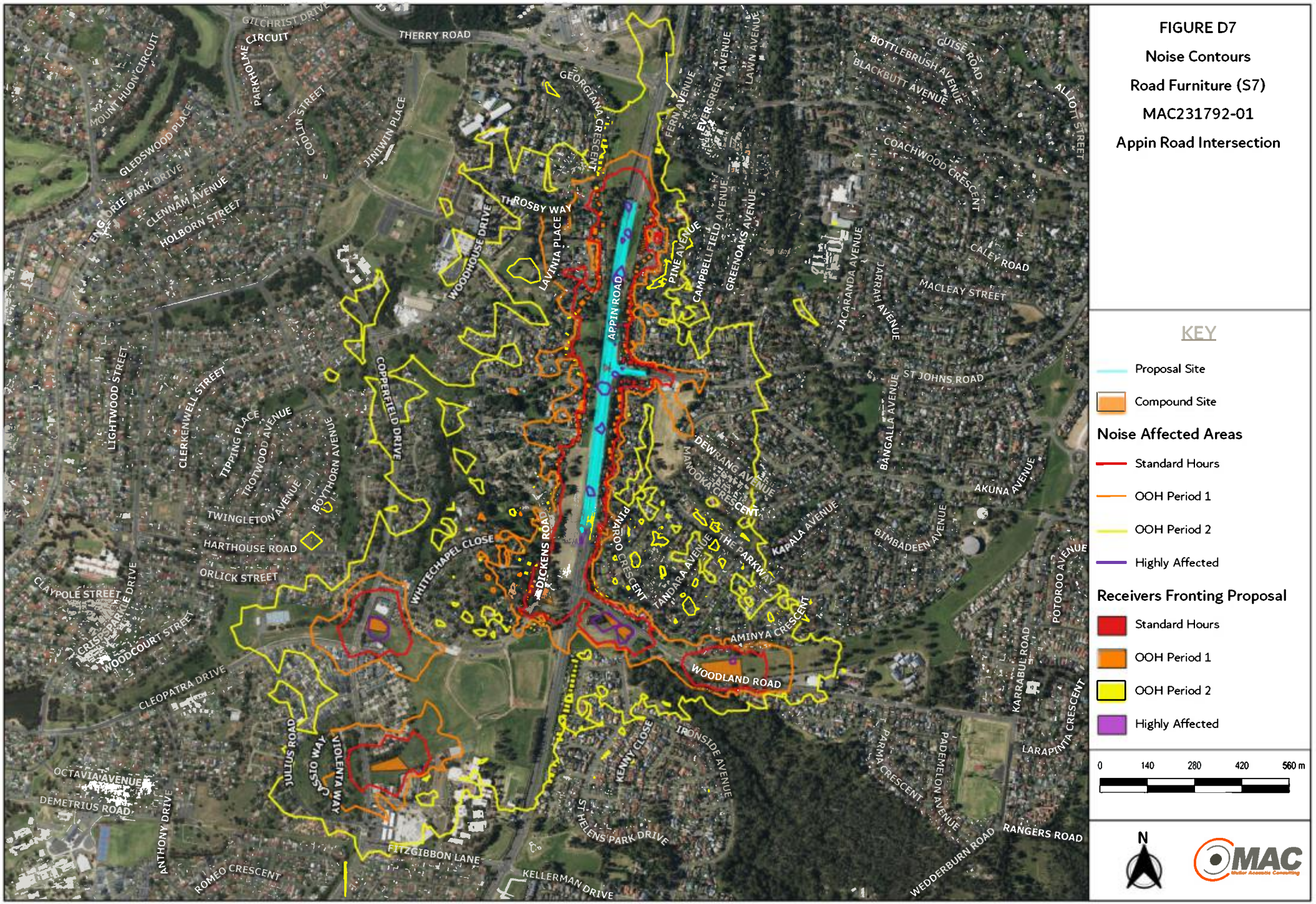


FIGURE D7

Noise Contours

Road Furniture (S7)

MAC231792-01

Appin Road Intersection

KEY

Proposal Site

Compound Site

Noise Affected Areas

Standard Hours

OOH Period 1

OOH Period 2

Highly Affected

Receivers Fronting Proposal

Standard Hours

OOH Period 1

OOH Period 2

Highly Affected

0 140 280 420 560 m

N

MAC

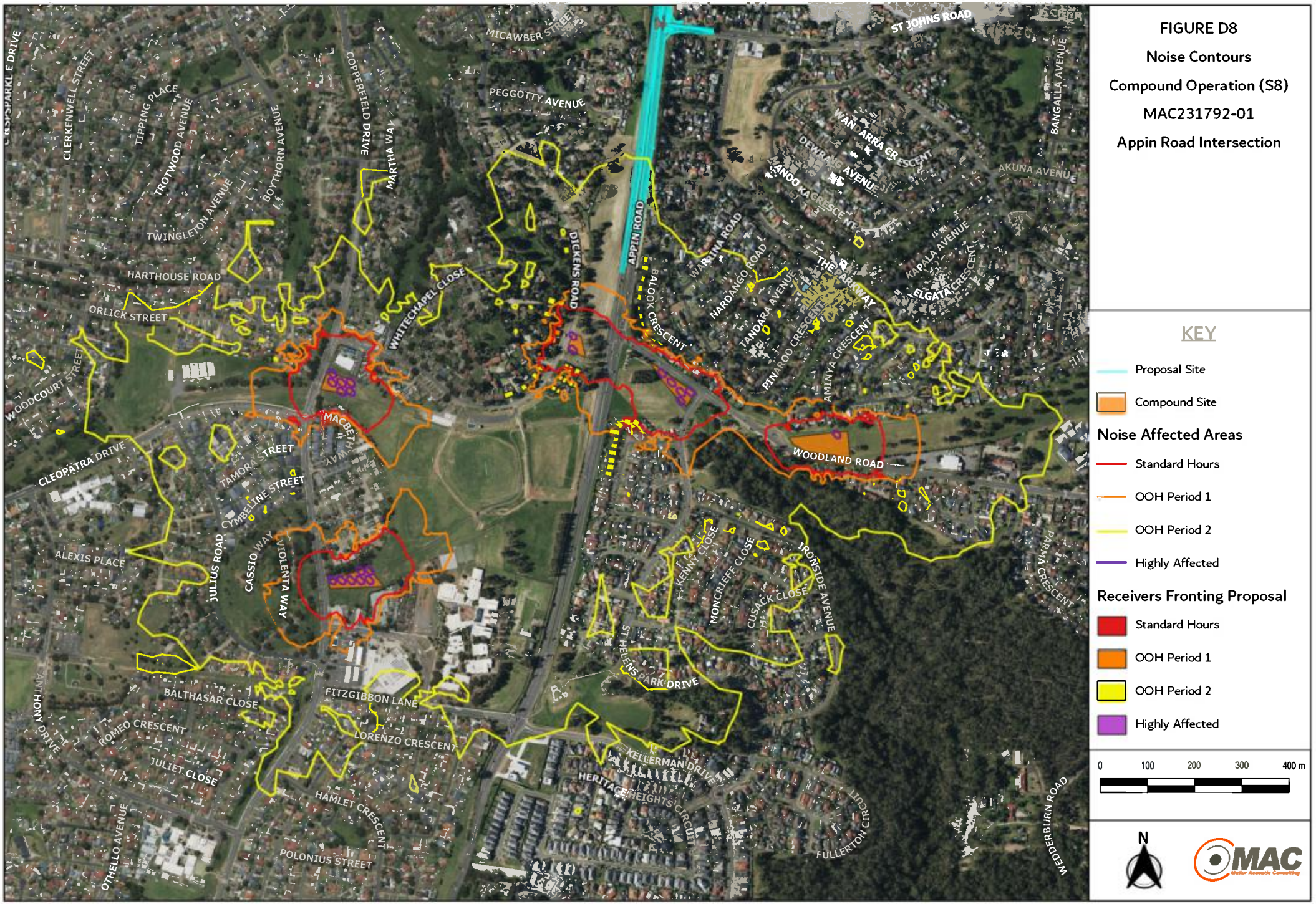


FIGURE D8
Noise Contours
Compound Operation (S8)
MAC231792-01
Appin Road Intersection
KEY
Proposal Site
Compound Site
Noise Affected Areas
Standard Hours
OOH Period 1
OOH Period 2
Highly Affected
Receivers Fronting Proposal
Standard Hours
OOH Period 1
OOH Period 2
Highly Affected
0
100
200
300
400 m
N
MAC
Noise Acoustic Consulting
APPIN ROAD
WOODLAND ROAD
MACBETH WAY
DICKENS ROAD
WHITECHAPEL CLOSE
HARTHOUSE ROAD
ORLICK STREET
WOODCOURT STREET
CLEOPATRA DRIVE
TAMORA STREET
CYMBELINE STREET
ALEXIS PLACE
JULIUS ROAD
CASSIO WAY
VIOLENTA WAY
BALTHASAR CLOSE
ROMEO CRESCENT
JULIET CLOSE
OTHELLO AVENUE
HAMLET CRESCENT
POLONIUS STREET
FITZGIBBON LANE
LORENZO CRESCENT
ANTHONY DRIVE
CLERKENWELL STREET
TIPPING PLACE
TROTWOOD AVENUE
TWINGLETON AVENUE
BOYTHORN AVENUE
COPPERFIELD DRIVE
MARTHA WAY
MICAWBER STREET
PEGGOTTY AVENUE
BALOOK CRESCENT
WARRINA ROAD
NARDANGO ROAD
TANDARA AVENUE
PINAROO CRESCENT
AMINYA CRESCENT
THE BROADWAY
KENNY CLOSE
MONCRIEFF CLOSE
CUSACK CLOSE
IRONSIDE AVENUE
ST HELENS PARK DRIVE
KELLERMAN DRIVE
HERITAGE HEIGHTS CIRCUIT
FULLERTON CIRCUIT
WEDDERBURN ROAD
PARMA CRESCENT
ST JOHNS ROAD
WAN ARRA CRESCENT
DEWRANG AVENUE
KANOO KA CRESCENT
AKUNA AVENUE
BANGALLA AVENUE
KAPALA AVENUE
ELGATA CRESCENT

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Appendix E – Additional Mitigation Measures

Additional mitigation measures as outlined in Section 11.2.2 of the CNVG (Roads and Maritime, 2015) are summarised below. Many of these measures require communication with the community.

Notifications (letterbox drop or equivalent) (N)

Advance warning of works and potential disruptions can assist in reducing the impact on the community. The notification may consist of a letterbox drop (or equivalent) detailing work activities, time periods over which these will occur, impacts and mitigation measures. Notification should be a minimum of 5 working days prior to the start of works. The approval conditions for projects may also specify requirements for notification to the community about works that may impact on them.

Specific notifications (SN)

Specific notifications are letterbox dropped or hand distributed to identified stakeholders no later than seven days ahead of construction activities that are likely to exceed the noise objectives. The exact conditions under which specific notifications would proceed are defined in the relevant Additional Mitigation Measures (Tables C1 to C3). This form of communication is used to support periodic notifications, or to advertise unscheduled work.

Phone calls (PC)

Phone calls detailing relevant information would be made to identified/affected stakeholders within seven days of proposed work. Phone calls provide affected stakeholders with personalised contact and tailored advice, with the opportunity to provide comments on the proposed work and specific needs etc.

Individual briefings (IB)

Individual briefings are used to inform stakeholders about the impacts of high noise activities and mitigation measures that will be implemented. Communications representatives from the contractor would visit identified stakeholders at least 48 hours ahead of potentially disturbing construction activities. Individual briefings provide affected stakeholders with personalised contact and tailored advice, with the opportunity to comment on the proposal.

Respite Offer (RO)

Respite Offers should be made where there are high noise and vibration generating activities near receivers. As a guide work should be carried out in continuous blocks that do not exceed 3 hours each, with a minimum respite period of one hour between each block. The actual duration of each block of work and respite should be flexible to accommodate the usage of and amenity at nearby receivers.

Respite Period 1 (R1)

Out of hours construction noise in out of hours period 1 shall be limited to no more than three consecutive evenings per week except where there is a Negotiated Respite. For night work these periods of work should be separated by not less than one week and no more than 6 evenings per month

Respite Period 2 (R2)

Night time construction noise in out of hours period 2 shall be limited to two consecutive nights except for where there is a Negotiated Respite. For night work these periods of work should be separated by not less than one week and 6 nights per month.

Duration Respite (DR)

Respite periods 1 and 2 may be counterproductive in reducing the impact on the community for longer duration proposals. In this instance and where it can be strongly justified it may be beneficial to increase the number of evenings or nights worked through Negotiated Respite so that the proposal can be completed more quickly.

Pre-purchased movie tickets or a similar offer may also provide respite for the community while providing provision for additional out of hours work. This measure is determined on a proposal-by-proposal basis, and may not be applicable to all RMS proposals.

The receivers that should be liaised with to gain community support for Negotiated Respite include those where out of hours work exceed the NML.

Where there are few receivers above the NML each of these receivers should be visited to discuss the proposal to gain support for Negotiated Respite.

In instances where there are many receivers above the NML it may not be practical discuss the proposal with every receiver. Instead the community should be proactively engaged so they have an incentive to participate in discussion supporting Negotiated Respite. Support may be demonstrated from surveys, online feedback, contact phone numbers and community events.

Alternative accommodation (AA)

Alternative accommodation options should be provided to residents living in close proximity to construction work that are likely to incur noise levels significantly above the applicable level (Tables C1-C3). The specifics of the offer will be determined on a proposal-by-proposal basis.

Verification

Appendix F of the CNVG provides details about verification of Noise and Vibration levels following complaints and as part of routine checks of noise levels.

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Appendix F – Additional Mitigation Measures Noise Contours

FIGURE F1

Additional Mitigation Measures

Standard Hours

Site Establishment

MAC231792-01

Appin Road Intersection

KEY

Proposal Site

Compound Site

AMM Affected Areas

Noticeable / Clearly Audible

Moderately Intrusive

Highly Intrusive

0 100 200 300 400 m

N

MAC
Muller Acoustic Consulting

FIGURE F2

Additional Mitigation Measures

OOH Period 1

Site Establishment

MAC231792-01

Appin Road Intersection

KEY

- Proposal Site
- Compound Site

AMM Affected Areas

- Noticeable
- Clearly Audible
- Moderately Intrusive
- Highly Intrusive

0 100 200 300 400 m

N

MAC
Muller Acoustic Consulting

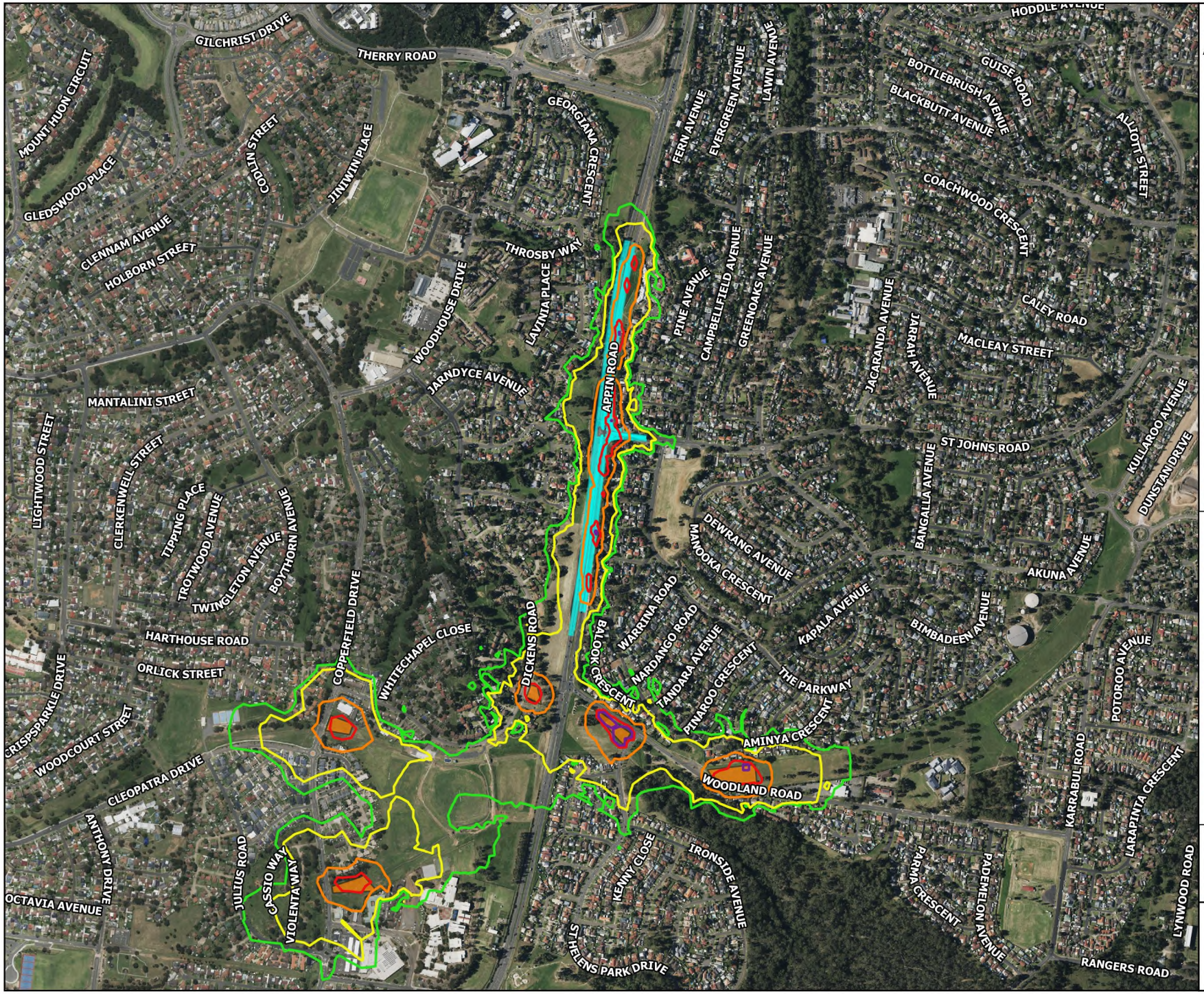

FIGURE F3

Additional Mitigation Measures

OOH Period 2

Site Establishment

MAC231792-01

Appin Road Intersection

KEY

- Proposal Site
- Compound Site

AMM Affected Areas

- Noticeable
- Clearly Audible
- Moderately Intrusive
- Highly Intrusive

0 130 260 390 520 m

N

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FIGURE F4

Additional Mitigation Measures

Standard Hours

Corridor Clearing

MAC231792-01

Appin Road Intersection

KEY

- Proposal Site
- Compound Site

AMM Affected Areas

- Noticeable / Clearly Audible
- Moderately Intrusive
- Highly Intrusive

0 100 200 300 400 m

N

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FIGURE F5

Additional Mitigation Measures

OOH Period 1

Corridor Clearing

MAC231792-01

Appin Road Intersection

KEY

- Proposal Site
- Compound Site

AMM Affected Areas

- Noticeable
- Clearly Audible
- Moderately Intrusive
- Highly Intrusive

0 100 200 300 400 m

N

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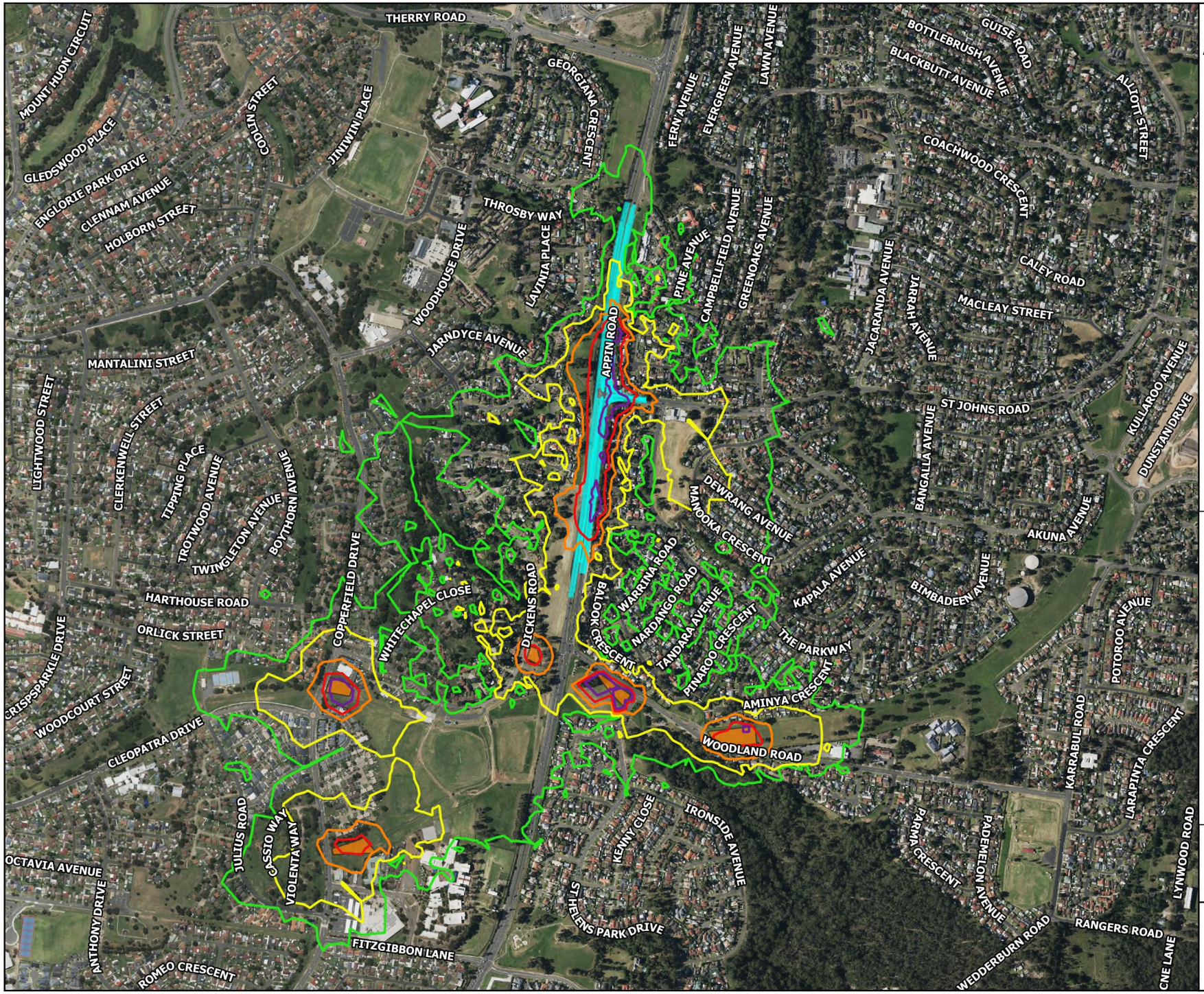

FIGURE F6

Additional Mitigation Measures

OOH Period 2

Corridor Clearing

MAC231792-01

Appin Road Intersection

KEY

- Proposal Site
- Compound Site

AMM Affected Areas

- Noticeable
- Clearly Audible
- Moderately Intrusive
- Highly Intrusive

0 130 260 390 520 m

N

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FIGURE F7

Additional Mitigation Measures

Standard Hours

Utility Adjustment

MAC231792-01

Appin Road Intersection

KEY

Proposal Site

Compound Site

AMM Affected Areas

Noticeable / Clearly Audible

Moderately Intrusive

Highly Intrusive

0 100 200 300 400 m

N

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FIGURE F8

Additional Mitigation Measures

OOH Period 1

Utility Adjustment

MAC231792-01

Appin Road Intersection

KEY

- Proposal Site
- Compound Site

AMM Affected Areas

- Noticeable
- Clearly Audible
- Moderately Intrusive
- Highly Intrusive

0 100 200 300 400 m

N

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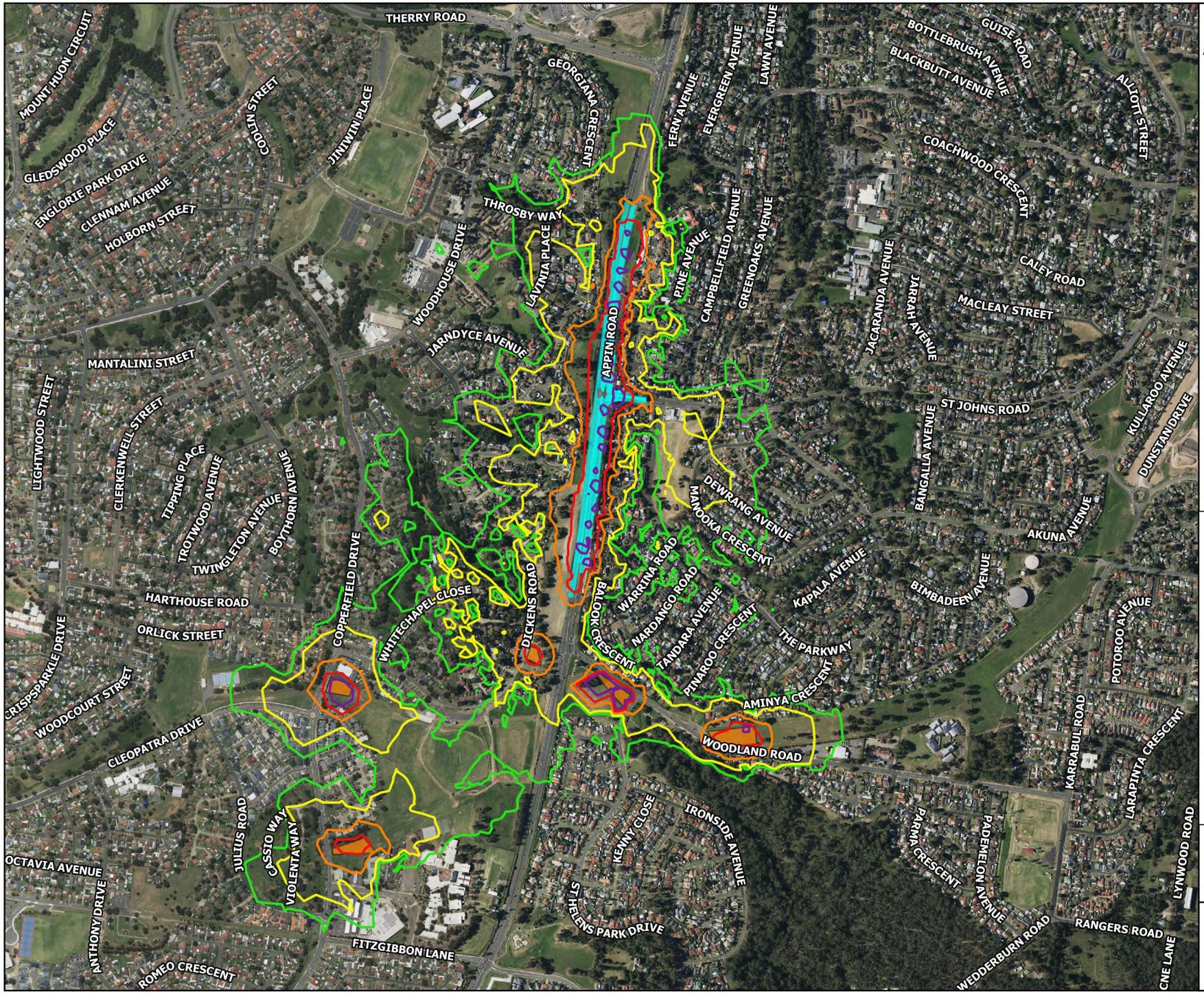

FIGURE F9

Additional Mitigation Measures

OOH Period 2

Utility Adjustment

MAC231792-01

Appin Road Intersection

KEY

- Proposal Site
- Compound Site

AMM Affected Areas

- Noticeable
- Clearly Audible
- Moderately Intrusive
- Highly Intrusive

0 130 260 390 520 m

N

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FIGURE F10

Additional Mitigation Measures

Standard Hours

Road Widening

MAC231792-01

Appin Road Intersection

KEY

- Proposal Site
- Compound Site

AMM Affected Areas

- Noticeable / Clearly Audible
- Moderately Intrusive
- Highly Intrusive

0 100 200 300 400 m

N

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FIGURE F11

Additional Mitigation Measures

OOH Period 1

Road Widening

MAC231792-01

Appin Road Intersection

KEY

- Proposal Site
- Compound Site

AMM Affected Areas

- Noticeable
- Clearly Audible
- Moderately Intrusive
- Highly Intrusive

0 100 200 300 400 m

N

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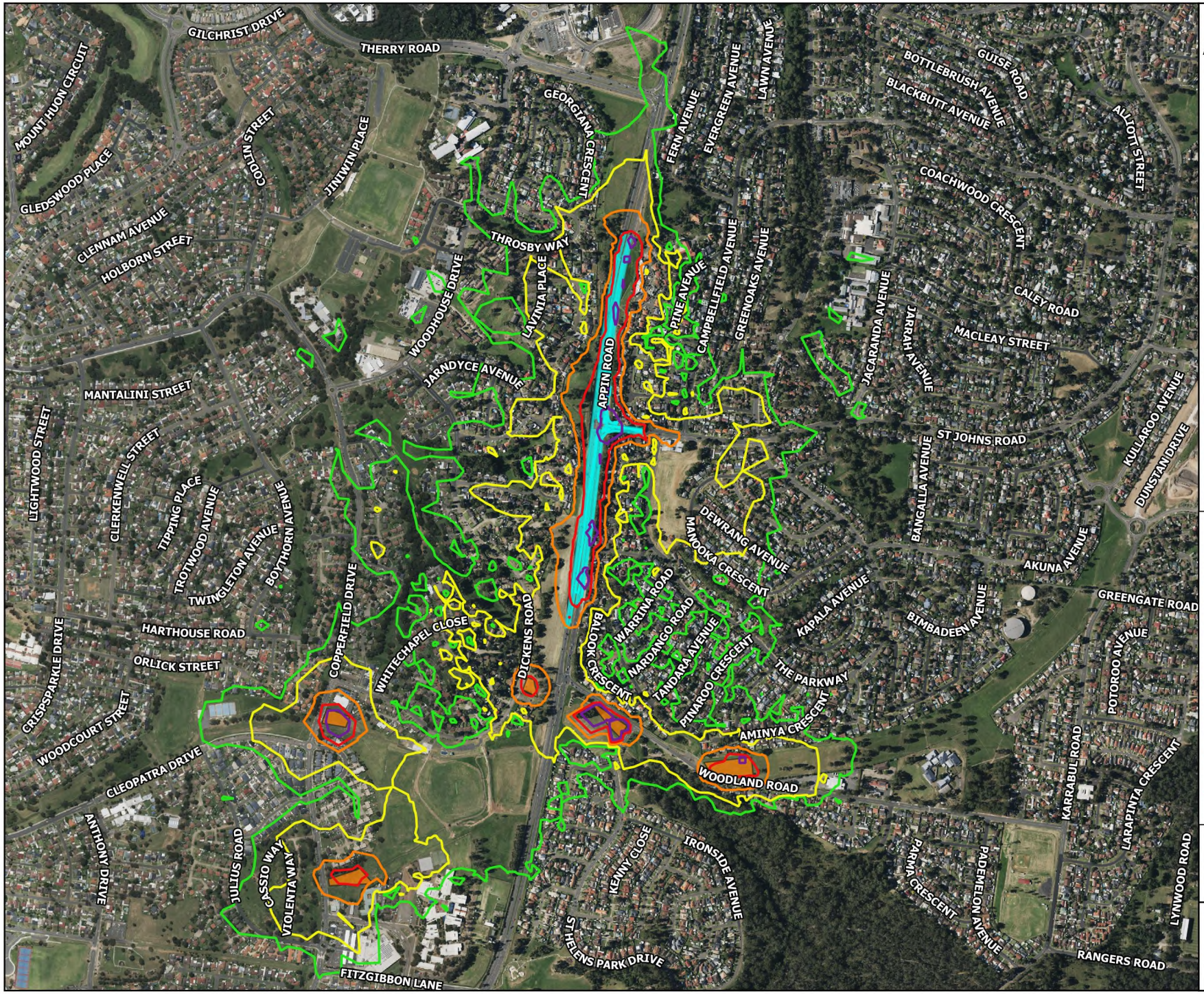

FIGURE F12

Additional Mitigation Measures

OOH Period 2

Road Widening

MAC231792-01

Appin Road Intersection

KEY

- Proposal Site
- Compound Site

AMM Affected Areas

- Noticeable
- Clearly Audible
- Moderately Intrusive
- Highly Intrusive

0 130 260 390 520 m

N

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FIGURE F13

Additional Mitigation Measures

Standard Hours

Drainage Works

MAC231792-01

Appin Road Intersection

KEY

- Proposal Site
- Compound Site

AMM Affected Areas

- Noticeable / Clearly Audible
- Moderately Intrusive
- Highly Intrusive

0 100 200 300 400 m

N

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FIGURE F14

Additional Mitigation Measures

OOH Period 1

Drainage Works

MAC231792-01

Appin Road Intersection

KEY

- Proposal Site
- Compound Site

AMM Affected Areas

- Noticeable
- Clearly Audible
- Moderately Intrusive
- Highly Intrusive

0 100 200 300 400 m

N

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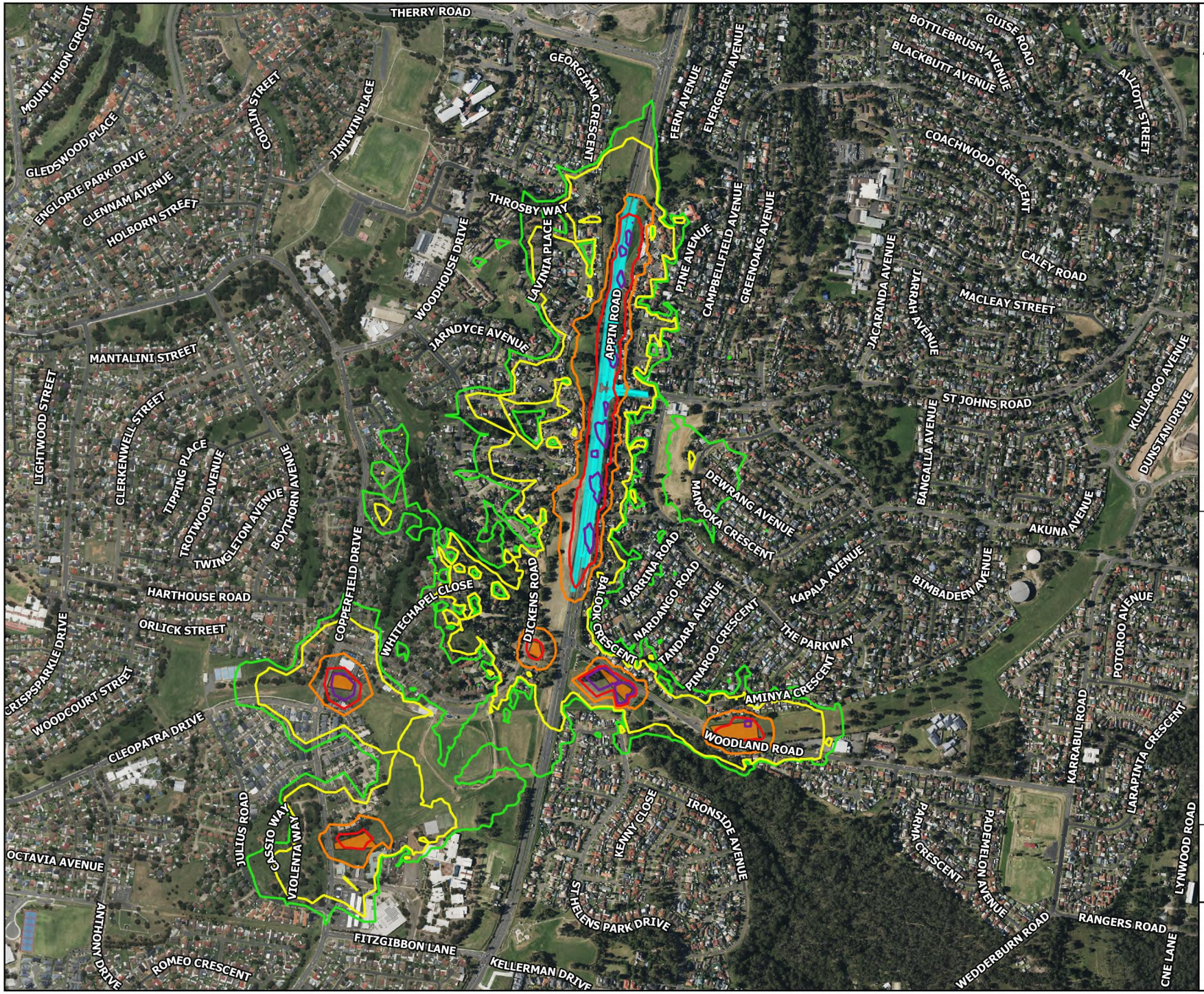

FIGURE F15

Additional Mitigation Measures

OOH Period 2

Drainage Works

MAC231792-01

Appin Road Intersection

KEY

- Proposal Site
- Compound Site

AMM Affected Areas

- Noticeable
- Clearly Audible
- Moderately Intrusive
- Highly Intrusive

0 130 260 390 520 m

N

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FIGURE F16

Additional Mitigation Measures

Standard Hours

Line Marking

MAC231792-01

Appin Road Intersection

KEY

Proposal Site

Compound Site

AMM Affected Areas

Noticeable / Clearly Audible

Moderately Intrusive

Highly Intrusive

0 100 200 300 400 m

N

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FIGURE F17

Additional Mitigation Measures

OOH Period 1

Line Marking

MAC231792-01

Appin Road Intersection

KEY

- Proposal Site
- Compound Site

AMM Affected Areas

- Noticeable
- Clearly Audible
- Moderately Intrusive
- Highly Intrusive

0 100 200 300 400 m

N

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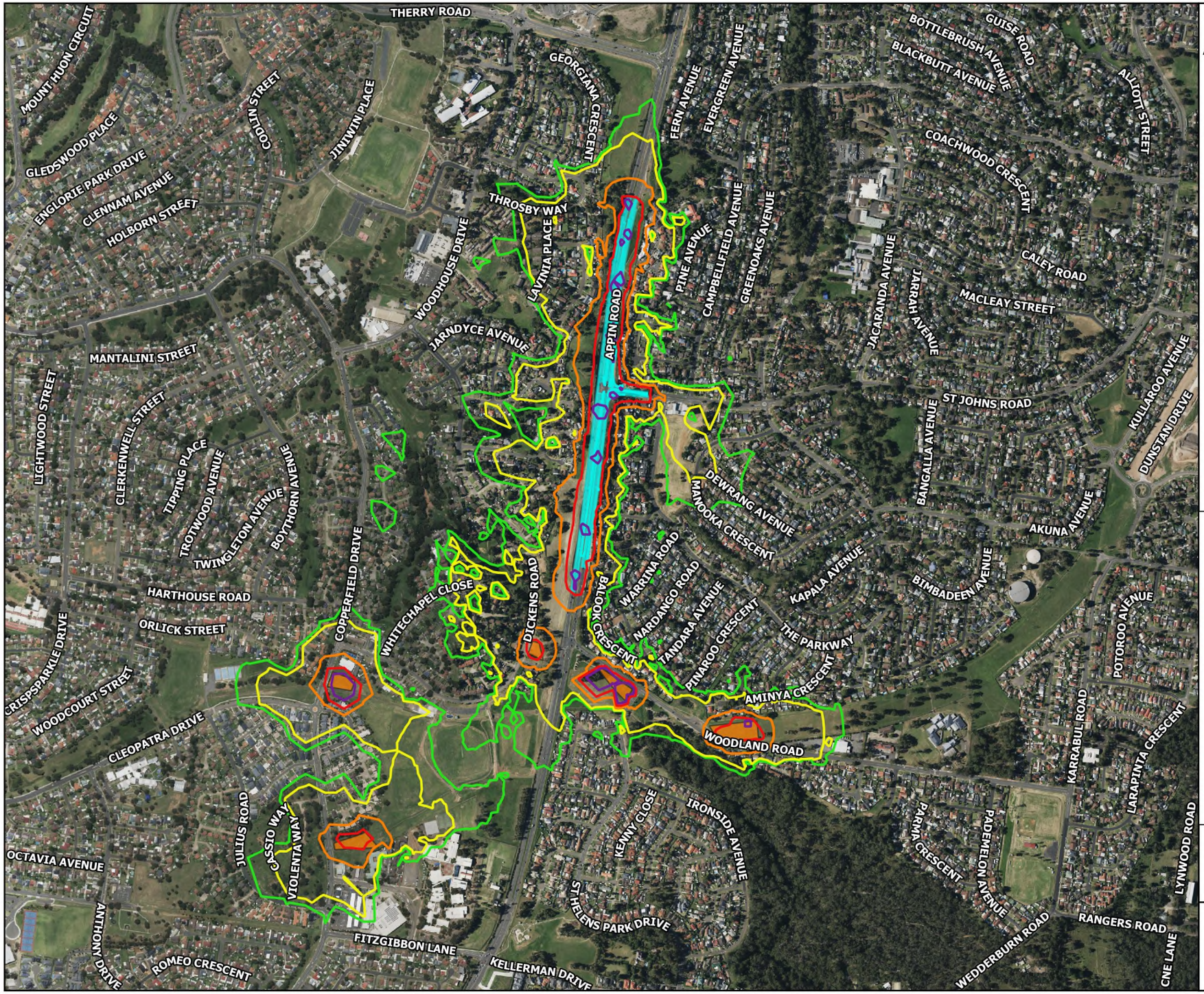

FIGURE F18

Additional Mitigation Measures

OOH Period 2

Line Marking

MAC231792-01

Appin Road Intersection

KEY

- Proposal Site
- Compound Site

AMM Affected Areas

- Noticeable
- Clearly Audible
- Moderately Intrusive
- Highly Intrusive

0 130 260 390 520 m

N

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