Prepared for
Major Projects Canberra
ABN: 66 676 633 401

Noise and Vibration Impact Assessment

03-Feb-2023
Light Rail City to Commonwealth Park
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Noise and Vibration Impact Assessment

Client: Major Projects Canberra

ABN: 66 676 633 401

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1.0 Introduction

Major Projects Canberra (MPC) proposes to extend the Canberra Light Rail (CLR) network from its current southern terminus at Alinga Street, Canberra City, to Woden (Light Rail City to Woden). Light Rail Stage 2 City to Woden is being progressed in two, self-contained stages for a faster project delivery: Stage 2A City to Commonwealth Park (the Project, the subject of this Assessment), and Stage 2B Commonwealth Park to Woden..

The Project is needed as part of a coordinated and holistic delivery of a series of major projects in Canberra City and surrounds, to realise the strategic planning and development for Canberra City presented in the Territory Plan, the Transport for Canberra Plan and the National Capital Plan (NCP). The Project also supports the ACT Government's vision for a compact and efficient city and reaching net zero by 2045. Furthermore, the Project is a specific directive identified as a key strategy for developing and delivering an efficient, compact and sustainable Canberra City within the Moving Canberra Plan, The Light Rail Network Plan and The ACT Planning Strategy.

AECOM Australia Pty Ltd (AECOM) has been commissioned to undertake a noise and vibration impact assessment for the proposed works associated with Canberra Light Rail (CLR) Stage 2A.

This technical report provides a noise and vibration impact assessment of the Project and has been prepared to support the Environmental Assessment (EA). The construction and operational phases of the report have been assessed using the applicable noise and vibration guidelines.

2.0 Project description

The Project would involve extending the light rail network from the current southern terminus at Alinga Street to a proposed stop at Commonwealth Park. A full project description for the Project is provided in Chapter 3.0 of the Environmental Assessment.

The Project would include the following key elements:

- An extension of approximately 1.7 km of track, extending southbound via the western side of London Circuit before continuing on Commonwealth Avenue
- A new bridge across Parkes Way
- Three stops are proposed to be located at key points along the alignment to provide access to the light rail where there is expected to be high demand: Edinburgh Avenue Stop, City South Stop and Commonwealth Park Stop.
- One scissor crossover (crossover of railway tracks) to allow LRVs to reverse direction
- Utility, stormwater drainage and streetlighting adjustments, relocations and provisions
- Landscaping features sympathetic with Canberra's design as envisioned by the Griffins' along with requirements set out in other Territory and Australian Government policy
- 'Green tracks' running along Commonwealth Avenue and Northbourne Place that involve planting grass or shrubs between and besides the alignment
- Intersection layout, traffic signal phasing and road traffic speed changes along the alignment, including new intersections and modifications to existing intersections
- Pedestrian footpaths and crossing modifications
- Road widening and verge and kerb line changes.

The completed Project, including its key features and elements, is shown on **Figure 1**.

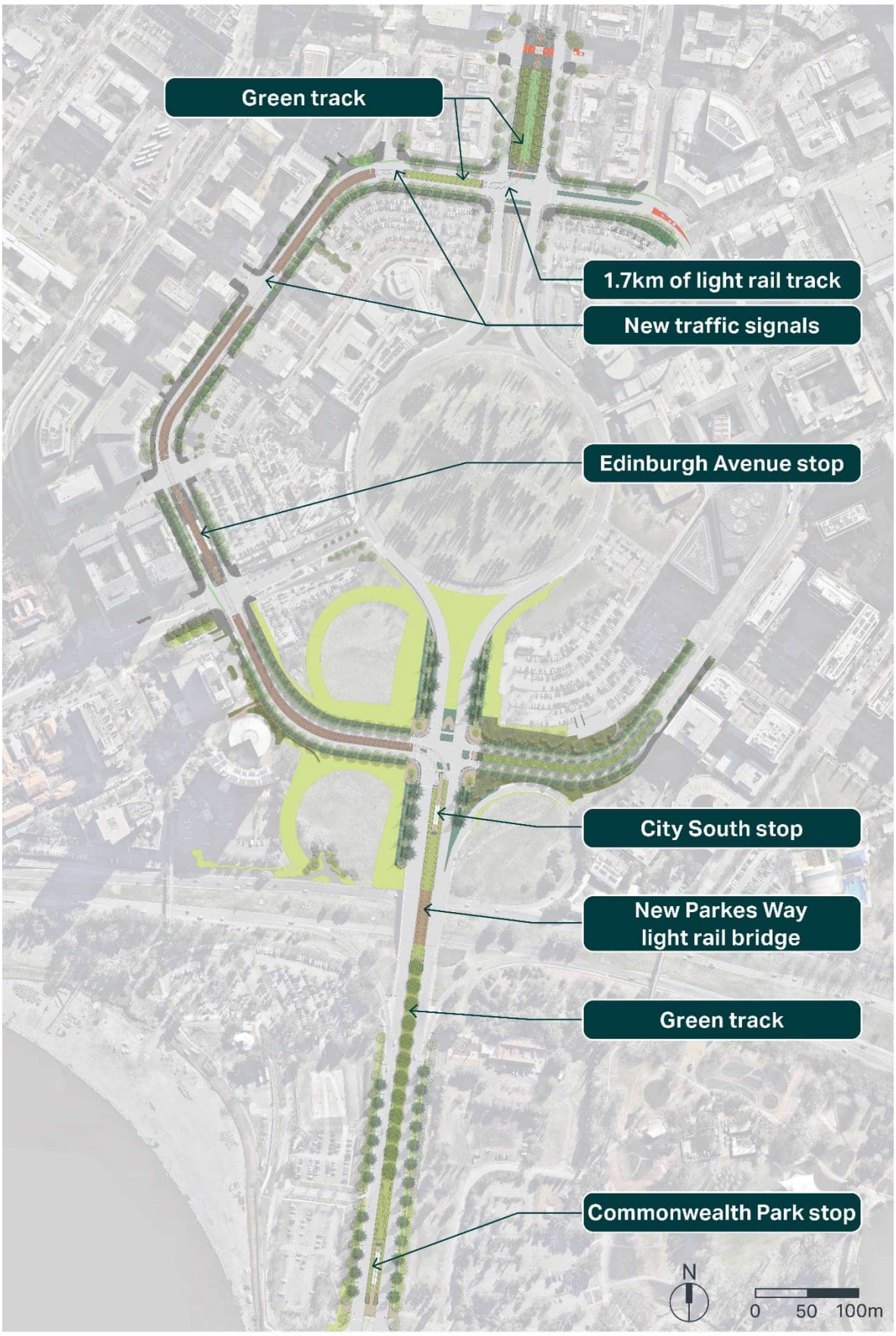


Figure 1 The Project and its key features

2.1 Construction

Construction activities associated with the Project would occur within a footprint referred to as the 'delivery phase area' (**Figure 2**). The operation of the Project would occur within a subset of the delivery phase area. The delivery phase area includes both Designated Land and Territory land. This Assessment addresses the Project in its entirety to allow for consideration of the Project as a whole.

Construction of the Project is anticipated to commence in 2024 with completion of construction planned in 2026. However, the duration of the construction would be dependent on final construction methodology and staging selected by the delivery contractor, as well as any efficiencies identified during the program. Testing and commissioning would commence in the latter stages of construction and continue for a period of up to nine months following the conclusion of main works. Successful completion of the testing and commissioning programme would allow the Project Contractor to obtain accreditation from the Office of the National Rail Safety Regulator (ONRSR). Once complete, the system would be ready to be handed over for operation.

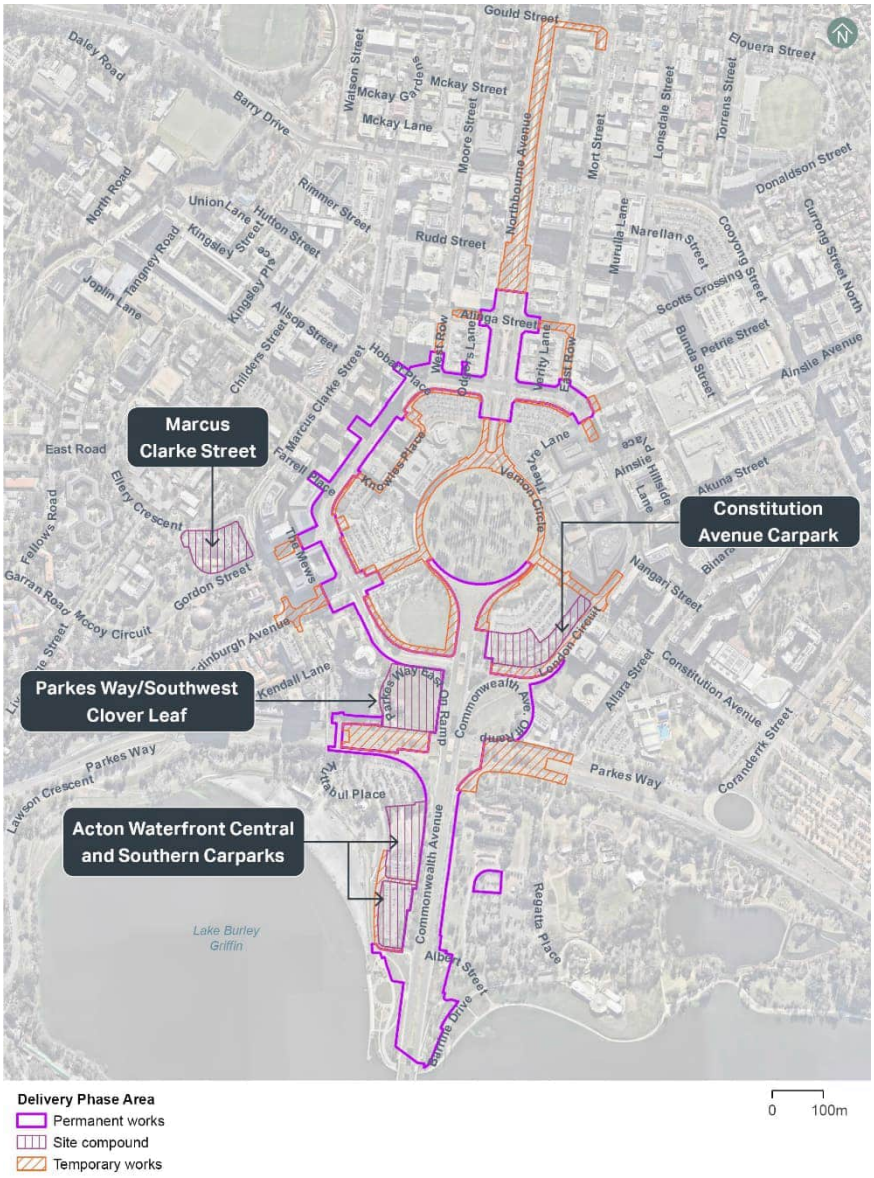


Figure 2 Delivery phase area

2.1.1 Site establishment and preparatory works

There would be four major compound sites, as shown on **Figure 2**. Several temporary construction compounds, stockpile sites and laydown areas would also be required as part of the Project. Upon completion of the works all established site compounds would be reinstated prior to handing back to the respective land owners.

There are utilities within the delivery phase area which are affected to various degrees by the Project. Most protection, decommissioning and removal of utilities would be completed early in the Project construction period, but may also be staged during the construction period depending on construction planning requirements.

Traffic management arrangements would include full and partial road closures and would introduce necessary traffic detours to direct the travelling public around work sites and construction access and egress points. Notification of these closures would be advertised in advance and sufficient time to deliver written notice would be required for the local businesses and residents. All temporary traffic management arrangements and diversionary routes would be agreed and approved by TCCS (RoadsACT) prior to implementation.

2.1.2 Construction strategy

The construction strategy of the Project has been divided by construction zones, major intersections and the Parkes Way Bridge.

Table 1 Construction staging locations

Location	Description
Block closures	These are construction areas between major intersections. Block closures would be used to close off entire sections of the road network, typically between blocks to allow the Project contractor full access to the worksite and the best opportunity to complete the Project most efficiently. Stops would be constructed upon the occupation of the block section where it is located. Blocks include: • Northbourne Avenue (between Alinga Street and London Circuit) • London Circuit (between Northbourne Avenue and Petrie Plaza) • London Circuit (between Northbourne Avenue and West Row) • London Circuit (West Row to Knowles Place North) • London Circuit (between Knowles Place North and Gordon Street) • London Circuit (between Gordon Street and Edinburgh Avenue) • London Circuit (between Edinburgh Avenue and Commonwealth Avenue) • Commonwealth Avenue (between London Circuit and Parkes Way) • Commonwealth Avenue (between Parkes Way and Lake Burley Griffin).
Major intersections	The major intersections include Northbourne Avenue and Alinga Street, Northbourne Avenue and London Circuit, London Circuit and Edinburgh Avenue, London Circuit and Gordon Street and Commonwealth Avenue and London Circuit. For works within major intersections, wherever possible the construction of the intersection would be carried out during normal working hours, within the confines of a protected worksite. Closures, where required, are expected to be carried out over several weekends (typically from Friday 10pm to Monday 6am) for a maximum of 56 hours at a time, except during construction of track slab where a continuous 80 hours would be required to facilitate concrete curing and ensure adequate concrete strength is achieved prior to intersection reopening and eventual trafficking. The Commonwealth Avenue and London Circuit intersection would not require full closure, and would be subject to a contraflow arrangement for several weeks.

Location	Description
Parkes Way bridge	A new bridge would be built between the two road bridges on Commonwealth Avenue over Parkes Way. In appearance, the gap would be infilled to create a single surface. The new rail bridge would be supported on 8 concrete piles (four piles for each bridge abutment) and concrete-walled abutments. The construction of temporary roads allows for the continued movement of traffic during bridge construction activities, with the location of temporary roads selected by the contractor in line with the Roads ACT requirements.

2.2 Operation

The Project would be an extension of the City to Gungahlin service and would therefore have the same frequency. It would take approximately six to nine minutes to travel between Alinga Street and Commonwealth Park.

A minimum of five LRVs would be required for the expansion of the CLR network. The new LRVs would be similar in appearance, size and performance to those that operate on the current CLR network. These LRVs and modifications to the stabling yard at the Mitchell Depot would be complete prior to the operation of this Project.

A wire free track is proposed for the Project alignment with LRVs operating using onboard battery power supply between the current Alinga Street southern terminus and the proposed Commonwealth Park terminus. Battery storage capacity for additional and existing LRVs has been proposed to minimise visual impact in landscape and visual sensitive zones, such as Commonwealth Avenue.

Two track forms, a permanent form of rail infrastructure that provides a surface for rail vehicles to move, are required for the Project. One trackform would operate northbound and the other southbound, with a crossover installed on Commonwealth Avenue to allow LRVs to change direction. Green track would also be included as part of the Project, in three locations: Northbourne Place, London Circuit between Northbourne Avenue and West Row, and Commonwealth Avenue between London Circuit and Albert Street. Non-potable water would be used for the irrigation of the Commonwealth Avenue green track.

2.2.1 Changes to the road network

The proposed light rail track would run within a median between opposing vehicular traffic flows for the entire length of the proposed alignment. The median would be between 80-150 mm high between intersections to minimise the possibility of road vehicles straying into the rail corridor. The median height would transition to be at grade just before each signalised intersection. This would facilitate vehicular and pedestrian movement across the track.

Road network changes required to accommodate the Project's median light rail alignment and associated stops are provided in Table 2.

Table 2 Lane configuration

Road	Proposed lane configuration
London Circuit	• The lane arrangement on London Circuit between Edinburgh Avenue and Commonwealth Avenue would remain unchanged • Two 3.3m wide traffic lanes in each direction along London Circuit between Northbourne Avenue and West Row, including a dedicated westbound right turn lane to West Row • A single 3.7m wide traffic lane in each direction along London Circuit between West Row and Edinburgh Avenue, except on the southbound approach to Gordon Street which would have a dedicated right turn lane. • The posted speed limit along London Circuit would remain 40km/h except in the vicinity of the Edinburgh Avenue stop where the speed would be reduced to 20km/h because of the high pedestrian activity expected at the stop • All on street parking and loading along London Circuit would be removed.

Road	Proposed lane configuration
	• Two new signalised intersections on London Circuit to facilitate right turns across the Project's alignment at West Row and University Avenue. The remaining unsignalised intersections along London Circuit would be converted to left-in/left-out out[1].
Alinga Street	One lane in each direction on Alinga Street within the median on Northbourne Avenue. These lanes would be for buses only.
Commonwealth Avenue	No change
Northbourne Avenue	No change

2.2.2 Active transport infrastructure

The Project includes walking and cycling facilities or upgrades that aim to improve pedestrian and cyclist safety, connectivity and amenity within the study area, and in particular along London Circuit West and Commonwealth Avenue. Active transport infrastructure includes dedicated and separate pedestrian and cycling paths.

[1] Right turn out from Knowles Place south permitted by emergency vehicles under signals

3.0 Legislation and strategic context

3.1 Relevant guidelines and policies

The following acts and regulations are relevant for this assessment:

- ACT Government *Environment Protection Act* 1997 (EP Act)
- ACT Government *Environment Protection Regulation* 2005 (EPR or the Regulation)

The following guidelines and/or standards have been used for the noise and vibration assessment:

- General:
  - *Noise Measurement Manual* (ACT EPA, 2009)
  - *Environment Protection (Noise) Environment Protection Policy* 2012 (ACT EPA, 2012).
  - *Infrastructure Sustainability (IS) Rating Scheme* (ISCA) (Infrastructure Sustainability Council, 2018)
  - AS 1055.1-1997*Acoustics - Description and Measurement of Environmental Noise - General Procedures*
  - AS/NZS 2107:2000 *Recommended Design Sound Levels and Reverberation Times for Building Interiors*, Standards Australia, 2000
- Construction noise:
  - *Environment Protection Regulation* (ACT Government, 2005)
  - *Interim Construction Noise Guideline* (Department of Environment and Climate Change (DECC, 2009)
  - *Construction Noise and Vibration Guideline (for Road and Maritime Works) (Transport for NSW, 2022)*
- Construction vibration:
  - *Assessing Vibration: a technical guideline* (NSW Department of Environment and Conservation (DEC), 2006a)
  - DIN 4150:Part 3-1999 Structural vibration – Effects of vibration on structures (*Deutsches Institut für Normung,* 1999)
  - Evaluation and Measurement for Vibration in Buildings Part 2, (British Standard (BS) 7385:Part 2-1993) (BS 7385).
- Sleep disturbance during construction:
  - NSW *Road Noise Policy* (RNP) (DECCW, 2011)
  - *Noise Policy for Industry* (NPfI) (NSW Environment Protection Authority (NSW EPA), 2017)
- Operational noise – Light rail noise
  - *Noise Management Guideline* (Roads ACT, 2018)
  - *Rail Infrastructure Noise Guideline* (RING) (NSW Environment Protection Authority (NSW EPA), 2013)
- Operational noise – Road traffic noise
  - *Roads ACT Noise Management Guideline* (Transport Canberra and City Services, 2018)

The above policies and guidelines are detailed further in the following Sections, including how they have been employed for the purposes of this assessment.

3.1.1 Infrastructure Sustainability rating scheme

The Infrastructure Sustainability Council (ISC) Infrastructure Sustainability (IS) rating scheme is Australia's only comprehensive rating scheme for evaluating sustainability for infrastructure. The Project is seeking an As-Built IS rating. As part of this process, alignment with the Env-1 (noise) and Env-3 (vibration) credits is required. This report seeks to align with the IS criteria and additional guidance where relevant to the scope of the assessment. As summarised in **Appendix** A, this report responds to the noise and vibration benchmarks provided by the ISC.

4.0 Existing environment

The noise environment is typically urban in nature, with existing road traffic and urban 'hum' dominant throughout the Project area.

4.1 Noise sensitive receivers

Land use in the area immediately surrounding the construction footprint is characterised by a CBD setting, transitioning to residential dwellings further to the north, and recreational areas to the south. Noise sensitive receivers within the study area were identified using aerial photography. The uses of all buildings within the study area were determined through a ground-truthing site survey exercise. This, in conjunction with cadastral information, was used to determine the classification of residential, commercial, recreational and other uses within the Project noise assessment study area.

MPC with further observations from AECOM have determined a list of notable noise and vibration sensitive receivers adjoining the site. They are listed below in **Table 4-1**.. Sensitive receivers are presented visually in **Appendix C**.

Table 4-1 Notable sensitive receivers within the operational and construction noise assessment study areas

Receiver	Address	Receiver Type
Sydney Building	101-103 London Circuit, Canberra	Commercial
Melbourne Building	59-81 London Circuit, Canberra	Commercial
Metropolitan	1-3 Gordon Street, Canberra	Residential
Reserve Bank of Australia	20-22 London Circuit, Canberra	Commercial (alarms are noise and vibration sensitive)
Canberra City Police Station	16-18 London Circuit, Canberra	Commercial
7 London Circuit	7 London Circuit, Canberra	Commercial
Law Courts and Justices Precinct	4-6 Knowles Place, Canberra	Commercial
Corrective Services	249 London Circuit, Canberra	Commercial
Canberra Theatre Centre	Civic Square, London Circuit, Canberra	Community Centre
Archbishop residence	1 Regatta Place, Canberra	Residential
QT Tower	1 London Circuit, Canberra	Residential
BreakFree Capital Tower	2 Marcus Clarke Street, Canberra	Residential
Australian Medical Council	4 Marcus Clarke Street, Canberra	Commercial
Zoo Bar	17 London Circuit, Canberra	Commercial
The Cupping Room	1-13 University Avenue, Canberra	Commercial
ANU School of Music – Building 100	William Herbert Place, Canberra ACT 2601	Education
ANU School of Music – Peter Karmel Building	4 Childers Street, Canberra	Education
Llewellyn Hall	Building 100, William Herbert Place, Canberra ACT 2601	Community Centre
KU Canberra City AMEP Child Care Centre	34 East Row, Canberra	Childcare
AK Education	Within 1-13 University Avenue, Canberra	Education
Pilgrim House	69 Northbourne Avenue, Canberra	Place of Worship
Church of Scientology	Within Sydney Building	Place of Worship
Divergent Church	Within Sydney Building	Place of Worship
Canberra Museum and Gallery	180 London Circuit, Canberra	Community Centre
City Hill Park	City Hill Park, Canberra	Passive Recreation
Henry Rolland Park	Barrine Drive, Parkes	Passive Recreation
Acton Waterfront	5 Kuttabul Place, Acton	Passive Recreation
Metropol Apartments	81 Cooyong Street, Reid	Residential
The Avenue Apartments	20 Moore Street, Turner	Residential

This noise and vibration impact assessment specifically relates to the above sensitive receivers. Noise contours are provided in this report for other structures that exist within the project area.

4.2 Heritage items

There are a number of heritage listed places located in the vicinity of the Project (Table 4-2). These heritage items are assessed in the Heritage Impact Assessment (HIA) prepared by GML Heritage Pty Ltd in November 2022.

Table 4-2 Listed historic heritage places

Place name	Register (and status/ID)
Lake Burley Griffin and Adjacent Lands	Listed: CHL (Listed: 105230)
Australian Academy of Science Building	NHL (Listed/105741)
Parliament House Vista	CHL (Listed/105466)
Reserve Bank of Australia	CHL (Listed/105396)
City Hill	ACT Heritage Register (Registered/20002)
Sydney and Melbourne Buildings	ACT Heritage Register (Registered/20032)
ANZ Bank Building (former ES&A Bank)	ACT Heritage Register (Registered/20150)
The Civic Square Precinct	ACT Heritage Register (Registered)
Law Courts Precinct	ACT Heritage Register (Nominated)
Hotel Acton (Acton House)	ACT Heritage Register (Registered)
Ian Potter House (Beauchamp House)	ACT Heritage Register (Registered/20091)

4.3 Noise monitoring

4.3.1 Instrumentation

Details of the sound level meters (noise loggers) used for unattended long-term noise monitoring are presented in **Table 4-3**. The noise monitoring locations are shown in **Figure 4-1**. These noise monitoring locations were selected in consultation with MPC and relevant stakeholders in order to determine the nature of the local noise environment throughout the study area.

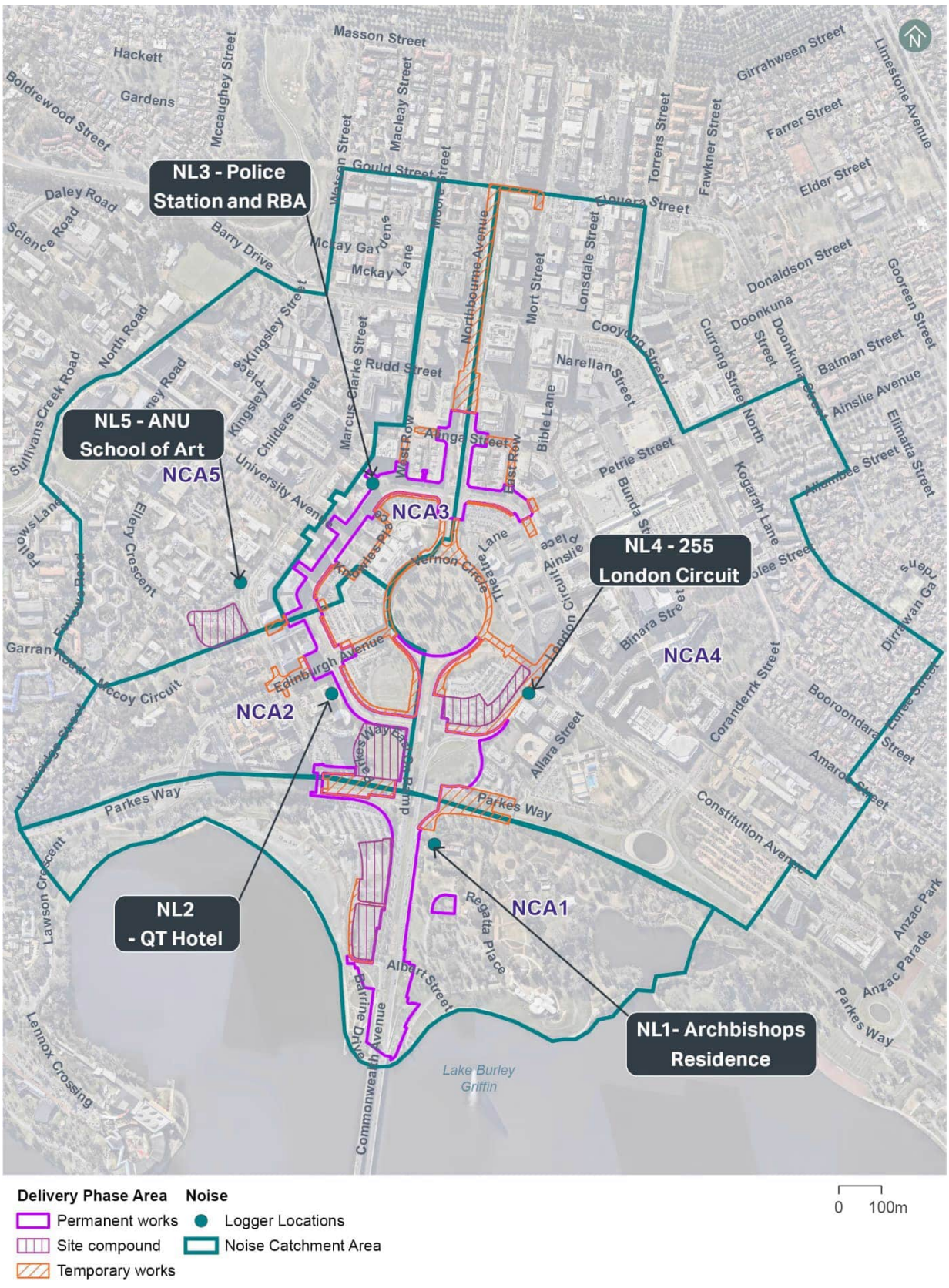


Figure 4-1 Noise logger locations and noise catchment areas

Table 4-3 Noise logging locations, measurement periods and instrumentation

ID	Address	Logger type/ Serial number	Measurement period	Days of data retrieved
NL1	Archbishops House, Parkes	Rion NL-52 S/N: 00175537	26/07/2021 – 09/08/2021	14
NL2	QT Hotel, 1 London Circuit, Canberra	Rion NL-52 S/N: 00164393	26/07/2021 – 09/08/2021	14
NL3	Police Station and RBA, Canberra	Rion NL-52 S/N: 00164394	26/07/2021 – 09/08/2021	14
NL4[1]	255 London Circuit, Canberra	Rion NL-52 S/N: 00164394	10/08/2021 – 24/08/2021	14
NL5[1]	ANU School of Art, 61 Marcus Clarke Street, Canberra	Rion NL-52 S/N: 00164396	5/08/2021 – 19/08/2021	14

Notes:
1. *A portion of the noise monitoring period for these locations occurred during 2021 Covid-19 lockdown, therefore measured background noise levels are likely to be lower than usual and therefore considered conservative.*

All acoustic instrumentation used in for the assessment comply with the requirements of *Australian Standard (AS) IEC 61672.1-2004 Electroacoustics – Sound level meters*, Specifications and were calibrated before and after monitoring sessions with a drift in calibration not exceeding plus or minus (±) 0.5 decibel (dB).

All instruments used were within their current National Association of Testing Authorities, Australia (NATA) certified in-calibration period (i.e. calibration in the last two years).

4.3.2 Unattended background noise monitoring

Ambient noise monitoring was undertaken at the five locations listed in **Table 4-3** between 26 July and 24 August 2021. The locations for the unattended noise loggers were determined through examination of aerial photography and site inspections. Final locations were selected in consultation with MPC and relevant stakeholders in order to determine the local noise environment throughout the study area.

A noise logger measures the noise level over a 15-minute sample period and then determines L_{A1}, L_{A10}, L_{A90}, L_{Amax} and L_{Aeq} levels of the noise environment. The L_{A1}, L_{A10} and L_{A90} levels are the levels exceeded for 1 %, 10 % and 90 % of the sample period respectively. The L_{Amax} level is the maximum noise level due to individual noise events. The L_{A90} level is taken as the background noise level. The L_{Aeq} level is the energy averaged noise level over the 15-minute period.

In accordance with the EPA's NSW *Noise Policy for Industry*, noise monitoring affected by adverse weather conditions or extraneous noise events was excluded from the monitoring data. The *Noise Policy for Industry* advises that data may be affected where adverse weather, such as wind speeds higher than 5 m/s or rain, occurs. Weather data recorded during the noise monitoring survey periods were obtained from the Bureau of Meteorology weather station, located at Canberra Airport (ID: 070351). Periods which were affected by noise from extraneous wind and rain were omitted from the results, as indicated in **Appendix B**.

The noise logging locations are shown in **Figure 4-1**. Photos of the noise loggers and the noise logging results are provided in **Appendix B**, and are summarised in **Table 4-4** below.

Table 4-4 Unattended background noise monitoring results

ID	Rating background level (L_{A90}), dB(A)			Ambient noise level (L_{Aeq}), dB(A)		
	Day[1]	Evening[1]	Night[1]	Day[1]	Evening[1]	Night[1]
NL1	57	54	39	63	61	56
NL2	53	50	45	61	58	54
NL3	52	49	44	57	55	54
NL4	43	40	34	58	55	53
NL5	48	48	43	57	54	50

Notes:

dB(A) represents A-weighted decibels, the relative frequency response used in sound measuring instruments.

1. In accordance with the NPfI, time of day is defined as follows:
Day – the period from 7 am to 6 pm Monday to Saturday or 8 am to 6 pm on Sundays and public holidays.
Evening – the period from 6 pm to 10 pm.
Night – the remaining periods.

4.3.3 Existing long-term noise impacts

Existing noise impacts at each receiver are detailed on the summary pages of **Appendix B**. In general, the background noise at each receiver location is dominated by traffic noise from London Circuit and the on/off ramps to Commonwealth Avenue. Music from licensed premises was audible at noise measurement location NL3. It is not likely that these existing sources of noise are significantly impacting the health and amenity of noise sensitive receivers within each noise logging area.

4.3.4 Noise catchment areas

Noise catchment areas (NCAs) have been defined based on the above unattended noise monitoring locations. Background noise levels defined by each noise monitoring location are considered representative for the entire NCA (**Figure 4-1**).

5.0 Methodology

5.1 General assessment methodology

This section details the general methodology for this noise and vibration impact assessment. Specific methodologies pertaining to construction noise and operational noise are detailed in **Sections 6.1, 7.1** and **8.1**. General methodology is as follows:

1. Identify sensitive receivers near the Project that are likely to be impacted by construction and operational noise and vibration
2. Conduct noise monitoring and attended noise measurements to determine relevant noise criteria, where applicable
3. Assess noise and vibration impacts to nearby sensitive receivers using relevant guidelines and policies, and compare against relevant criteria
4. Provide indicative noise management measures, mitigation options or treatments where applicable.

5.2 Construction noise and vibration assessment levels

5.2.1 Construction noise

Section 29 of the ACT Environment Protection Regulation (2005) states that:

> *"Under section 25 (1), noise is not taken to cause environmental harm in an affected place if it is noise mentioned in schedule 2, table 2.3, column 2 and the conditions (if any) mentioned in* column 3 for the noise are met."

Clause 16 of Table 2.3 of the Regulation then places no conditions on the "Noise emitted in the course of constructing or maintaining a major road, a dedicated bus way, a railway or a light rail". This is the clause under which light rail construction does not require noise assessment in the ACT.

Section 9.11 of the Environment Protection (Noise) Environment Protection Policy 2012 provides the following reasoning for the exemption of roadworks:

> *"9.11 Roadworks*
>
> *The construction and maintenance of roads is central to the economic and social well-being of the community. The Regulation restricts the times at which roadworks can take place to limit noise nuisance while not unduly affecting traffic.*
>
> *No time restrictions are placed on the construction and maintenance of major roads to enable work to take place during periods of low traffic flows."*

The same principle is applied to the construction of light rail. Accordingly, construction noise generated by the Project is not required to be assessed against specific numerical noise limits. Notwithstanding, as part of the Project's contract documents, the construction contractor is required to prepare and demonstrate compliance with a best-practice Construction Noise and Vibration Management Plan (CNVMP), subject to statutory authorities' approvals. As such, the noise and vibration controls governed by the NSW DECC *Interim Construction Noise Guideline* are typically adopted in the absence of Territory specific quantifiable criteria.

The *Interim Construction Noise Guideline* is a NSW Government document that sets out ways to deal with the impacts of construction noise on residences and other sensitive land uses. It presents assessment approaches tailored to the scale of the construction project and identifies practices to minimise noise impacts. As the proposed works are expected to continue for a period of more than three weeks and are within relatively close proximity to noise sensitive receivers, a quantitative assessment, based on the worst-case construction scenario, has been carried out for construction works. Noise assessment levels have been developed for the Project based on the *Interim Construction Noise Guideline* noise management levels. While an assessment of construction noise generated by the Project is not required to be assessed against specific numerical noise limits, the derived assessment levels used in this NVIA provide an indication of potential noise impacts to assist in the identification of appropriate mitigation and management measures.

Noise levels resulting from construction activities that are predicted at nearby noise sensitive receivers (e.g. residences, schools, hospitals, places of worship, passive and active recreation areas) are compared to the assessment levels derived from the *Interim Construction Noise Guideline*. Where an exceedance of the levels is predicted, the *Interim Construction Noise Guideline* advises that receivers can be considered 'noise affected' and the proponent should apply all feasible and reasonable work practices to minimise the noise impact. The proponent should also inform all potentially affected residents of the nature of the works to be carried out, the expected noise level and duration, as well as contact details should they wish to make a complaint.

Where construction noise levels at the receiver reach 75 dB(A) residential receivers are considered to be 'highly noise affected' and the proponent should, in consultation with the community, consider restrictions to the hours of construction to provide respite periods.

The construction noise assessment levels (NAL) for the residential and other sensitive land uses are detailed in **Table 5-1**, **Table 5-2** and **Table 5-3**. These noise assessment levels will be used to guide the management of construction noise throughout construction.

Table 5-1 ***Interim Construction Noise Guideline*** **derived residential noise assessment levels**

Time of day	NAL, $L_{Aeq,15min}$, dB(A)[1]	How to apply
Standard hours: Monday to Friday 7 am to 6 pm Saturday 7am to 1 pm No work on Sundays or public holidays	Noise affected RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. • Where the predicted or measured $L_{Aeq\ (15\ min)}$ 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 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. • Where noise is above this level, MPC may give consideration to restricting the hours that the very noisy activities can occur, taking into account: 1. 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 2. 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 + 5 dB	• A strong justification would 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 5 dB(A) above the noise affected level, the proponent should engage with the community. • For guidance on negotiating agreements see section 7.2.2 of the *Interim Construction Noise Guideline*.

Notes:

1. *Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5 m above ground level. If the property boundary is more than 30 m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30 m of the residence. Noise levels may be higher at upper floors of the noise affected residence.*

The *Interim Construction Noise Guideline* defines what is considered to be feasible and reasonable as follows:

- *"Feasible*

  A work practice or abatement measure is feasible if it is capable of being put into practice or of being engineered and is practical to build given project constraints such as safety and maintenance requirements.

- *Reasonable*

  Selecting reasonable measures from those that are feasible involves making a judgment to determine whether the overall noise benefits outweigh the overall adverse social, economic and environmental effects, including the cost of the measure."

Table 5-2 presents the NALs applied to residential receivers nearby to this development for this assessment.

Table 5-2 Construction noise assessment levels – Residential receivers L_{Aeq}

Noise catchment Area	Noise Assessment Level (NAL) $L_{Aeq,15min}$, dB(A)			
	Standard hours (RBL + 10)	Outside standard hours (RBL + 5)		Highly noise affected level
	Day	Evening	Night	
NCA1	67	59	44	75
NCA2	63	55	50	
NCA3	62	54	49	
NCA4	53	45	39	
NCA5	58	53	48	

Table 5-3 presents the NALs applied to other noise sensitive receivers such as educational facilities and places of worship and to commercial receivers for this assessment.

Table 5-3 Construction noise assessment levels – Other receivers

Land use	Noise assessment level, dB(A)
Places of worship	55 dB(A)[1]
Classrooms at schools and other educational institutions	55 dB(A)[1]
Passive recreation	60 dB(A)
Active recreation	65 dB(A)
Commercial premises (including offices, retail outlets)	70 dB(A)
Industrial premises	75 dB(A)
Community centres	Depends on the intended use of the centre[2]

Notes:

1. *These external assessment levels are based upon a 45 dB(A) internal noise assessment level and a 10 dB reduction from outside to inside through an open window.*)
2. *Based on recommended 'maximum' internal levels in AS2107:2016. In this case, "Art galleries" and "Concert and recital halls" were utilised.*

The *Construction Noise and Vibration Guideline* (Transport, 2016) sets out community perceptions of construction noise dependent upon the level of exceedance of the rating background level and noise assessment levels. These, as applied for this assessment, are presented in Table 5-4.

Table 5-4 Community perception of construction noise

Perception	dB(A) above rating background level	dB(A) above noise assessment level – Standard hours	dB(A) above noise assessment level – Out of hours
Noticeable	5-10	0	0-5
Clearly audible	11-20	0-10	6-15
Moderately intrusive	21-30	11-20	16-25
Highly intrusive	>30	>20	>25

5.2.1.1 Sleep disturbance

The *Interim Construction Noise Guideline* requires a sleep disturbance assessment to be carried out where construction work is planned to extend over more than two consecutive nights. The *Interim Construction Noise Guideline* makes reference to the NSW *Environment Criteria for Road Traffic Noise*, now superseded by the NSW *Road Noise Policy*, for assessment of sleep disturbance. The NSW *Road Noise Policy* references the recommendations in the *Environment Criteria for Road Traffic Noise* as providing the most appropriate assessment guidance.

The guidance provided in the *Road Noise Policy* for assessing the potential for sleep disturbance recommends that to minimise the risk of sleep disturbance during the night-time period (10pm to 7am), the $L_{A1(1\ min)}$ noise level outside a bedroom window should not exceed the $L_{A90(15\ min)}$ background noise level by more than 15 dB(A). The EPA considers it appropriate to use this metric as a screening criterion to assess the likelihood of sleep disturbance. If this screening criterion is found to be exceeded then a more detailed analysis must be carried out that should include the extent that the maximum noise level exceeds the background noise level and the number of times this is likely to happen during the night-time period.

The *Road Noise Policy* contains a review of research into sleep disturbance which represents NSW EPA advice on the subject of sleep disturbance due to noise events. It concludes that 'Maximum internal noise levels below 50-55 dB(A) are unlikely to cause awakening reactions'. Therefore, given that an open window provides about 10 dB(A) in noise attenuation from outside to inside, external noise levels of 60-65 dB(A) are unlikely to result in awakening reactions.

Table 5-5 presents the sleep disturbance screening and sleep disturbance awakening reaction criteria.

Table 5-5 Construction noise sleep disturbance criteria

NCA	Night-time rating background level, dB(A)	Sleep disturbance screening $L_{A1(1min)}$ criteria, dB(A)	Sleep disturbance awakening reaction $L_{A1(1min)}$ criteria, dB(A)
NCA1	39	54	65
NCA2	45	60	65
NCA3	44	59	65
NCA4	34	49	65
NCA5	43	58	65

5.2.2 Construction vibration

The relevant standards/guidelines for the assessment of construction vibration are summarised in **Table 5-6**.

Table 5-6 Standards/guidelines used for assessing construction vibration

Item	Standard/guideline
Structural damage	Heritage structures – German Standard DIN 4150 – Part 3 – *Structural Vibration in Buildings – Effects on Structures* (DIN 4150) Non-heritage structures – *Evaluation and Measurement for Vibration in Buildings* Part 2, (British Standard (BS) 7385:Part 2-1993) (BS 7385)
Human comfort (tactile vibration)	*Assessing Vibration: A Technical Guideline* (AVATG) [1]
Human comfort (ground-borne noise)	*Interim Construction Noise Guideline* (ICNG)

Notes:

1 This document is based upon the guidelines contained in British Standard 6472:1992, "Evaluation of human exposure to vibration in buildings (1-80 Hz)". This British Standard was superseded in 2008 with BS 6472-1:2008 "Guide to evaluation of human exposure to vibration in buildings – Part 1: Vibration sources other than blasting" and the 1992 version of the Standard

was withdrawn. Although a new version of BS 6472 has been published, the Environment Protection Authority still requires vibration to be assessed in accordance with the 1992 version of the Standard at this point in time.

Vibration and its associated effects are usually classified as follows:

- Continuous vibration continues uninterrupted for a defined period and includes sources such as machinery and continuous construction activities for example, a vibratory roller
- Impulsive vibration is a rapid build up to a peak followed by a damped decay. It may consist of several cycles at around the same amplitude, with a duration of typically less than two seconds and no more than three occurrences in an assessment period. This may include occasional dropping of heavy equipment or loading activities
- Intermittent vibration occurs where there are interrupted periods of continuous vibration, repeated periods of impulsive vibration or continuous vibration that varies significantly in magnitude. This may include intermittent construction activity, impact pile driving, jack hammers.

5.2.2.1 Structural damage

At present, no Australian Standards exist for the assessment of building damage caused by vibration. DIN 4150 and BS 7385-2 provide recommended maximum levels of vibration that reduce the likelihood of building damage caused by vibration and are presented in **Table 5-7** and **Table 5-8**. DIN 4150 states that buildings exposed to higher levels of vibration than recommended limits would not necessarily result in damage. Structural damage criteria for heritage items have been taken from DIN 4150, whilst criteria for commercial/residential items have been taken from BS 7385.

Table 5-7 DIN 4150: Structural damage safe limits for building vibration

Group	Type of structure	Vibration velocity in mm/s			
		At foundation at a frequency of:			Vibration at the horizontal plane of the highest floor
		Less than 10 Hz	10 Hz to 50 Hz	50 Hz to 100 Hz	All frequencies
1	Buildings used for commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40
2	Dwellings and buildings of similar design and/or use	5	5 to 15	15 to 20	15
3	Structures that because of their particular sensitivity to vibration, do not correspond to those listed in Group 1 or 2 and have intrinsic value (e.g. Reserve Bank of Australia Building, Parkes Way bridge)	3	3 to 8	8 to 10	8

Table 5-8 BS 7385-2: Transient vibration guide values for cosmetic damage

Group	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	50 mm/s at 4 Hz and above	

Group	Type of building	Peak component particle velocity in frequency range of predominant pulse	
		4 Hz to 15 Hz	15 Hz and above
	Industrial and heavy commercial buildings		
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

5.2.2.2 Human comfort

Humans are sensitive to vibration such that they can detect vibration levels well below those required to cause any risk of damage to a building or its contents. Criteria to avoid annoyance are therefore more stringent than those to prevent structural damage.

5.2.2.2.1 Intermittent vibration

The assessment of intermittent vibration outlined in AVATG is based on Vibration Dose Values (VDVs). The VDV accumulates the vibration energy received over the daytime and night-time periods.

Maximum and preferred VDVs for intermittent vibration arising from construction activities are listed in **Table 5-9**. The VDV criteria are based on the likelihood that a person would be annoyed by the level of vibration over the entire assessment period.

Table 5-9 Preferred and maximum vibration dose values for intermittent vibration ($m/s^{1.75}$)

Location	Day time		Night-time	
	Preferred	Max	Preferred	Max
Critical areas[1]	0.10	0.20	0.10	0.20
Residences[2]	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

Notes:

1 *Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. These may be cases where sensitive equipment or delicate tasks require more stringent criteria than the human comfort criteria.*

2 *Criteria for residences are lower than schools as people expect to be able to relax/sleep in their homes without annoyance and are generally more concerned about structural damage than would be the case within schools and offices.*

5.2.2.2.2 Continuous and impulsive vibration

Acceptable levels of human exposure to continuous and impulsive vibration are dependent on the time of day and the activity taking place in the occupied space. AVATG provides the preferred values for continuous and impulsive vibration. These are presented in **Table 5-10**.

There is low probability of adverse comment or disturbance to building occupants at vibration values below the preferred values in **Table 5-10**. Situations exist where vibration above the preferred values can be acceptable, particularly for temporary disturbances and infrequent events of short duration. Vibration levels above those indicated in **Table 5-10** may be dealt with through negotiation with the regulator of the affected community. The following axes are defined in relation to the human body:

- x – back to chest
- y – right side to left side
- z – foot to head.

Table 5-10 Peak particle velocity for continuous and impulsive vibration (mm/s) z-axis

Location	Assessment period	Preferred	Maximum
Continuous vibration			
Critical areas[1]	When in use	0.14	0.28
Residences[2]	Day Night	0.28 0.20	0.56 0.40
Offices, schools, educational institutions and places of worship	When in use	0.56	1.10
Impulsive vibration			
Critical areas[1]	When in use	0.14	0.28
Residences[2]	Day Night	8.60 2.80	17.0 5.60
Offices, schools, educational institutions and places of worship	When in use	18.0	36.0

Notes:

1 Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. These may be cases where sensitive equipment or delicate tasks require more stringent criteria than the human comfort criteria.

2 Criteria for residences are lower than schools as people expect to be able to relax/sleep in their homes without annoyance and are generally more concerned about structural damage than would be the case within schools and offices.

Vibration

5.3 Operational noise criteria – Light rail noise

5.3.1 Airborne noise criteria

The ACT does not have relevant light rail specific noise guidelines. In the absence of these guidelines and in accordance with the Project Scope and Performance Requirements (SPR), this noise assessment has been undertaken in accordance with the NSW EPA Rail Infrastructure Noise Guideline (RING) and the Roads ACT Management Guideline (2018).

The RING provides the applicable noise trigger levels for the assessment of airborne noise of light rail developments. These trigger levels are considered non mandatory and represent a point at which reasonable and feasible noise mitigation should be considered.

Table 5-11 presents a summary of the RING trigger levels for light rail developments.

Table 5-11 Airborne heavy rail noise trigger levels for residential land uses

Type of development	Noise trigger levels dB(A) (External)	
	Day (7am to 10pm)	Night (10pm to 7am)
All light rail line developments	60 $L_{Aeq(15hour)}$ or 80 L_{AFmax}	50 $L_{Aeq(9hour)}$ or 80 L_{AFmax}

In accordance with the RING, sensitive land uses other than residential (e.g. hospitals, schools) have their own specific noise trigger levels for rail redevelopments, applicable when the facility or space is in use. These applicable criteria are shown in **Table 5-12**.

Table 5-12 Airborne rail noise trigger levels applicable to heavy and light rail developments for sensitive land uses other than residential

Other sensitive land use	New rail line development
	Resulting rail noise levels exceed:
Schools, educational institutions and child care centres	40 $L_{Aeq(1hr)}$ (internal)

Other sensitive land use	New rail line development
Places of worship	40 $L_{Aeq(1hr)}$ (internal)
Open space – Passive use	60 $L_{Aeq(15hr)}$ (external)

5.3.2 Ground-borne noise criteria

In the absence of specific ACT light rail specific noise guidelines, the RING provides the applicable noise trigger levels for the assessment of ground-borne noise. As per the RING, ground-borne noise level values are relevant only where they are higher than the airborne noise from railways (such as in the case of an underground railway) and where the ground-borne noise levels are expected to be, or are, audible within habitable rooms. The NSW RING internal noise trigger levels for ground-borne noise are presented in **Table 5-13**.

Table 5-13 Ground-borne noise trigger levels for heavy or light rail projects

Land use	Time of Day	Internal Noise Trigger Levels (dB(A))
		Development increases existing rail noise levels by 3 dB(A) or more **and** resulting rail noise levels exceed
Residential	Day (7am to 10pm)	40 L_{ASmax}
	Night (10pm to 7am)	35 L_{ASmax}
Schools, educational institutions and child care centres	When in use	40-45 L_{ASmax}

5.4 Operational noise criteria – Road traffic noise

5.4.1 Roads ACT Noise Management Guideline

The operational road traffic noise assessment criteria used in this assessment has been taken from the Roads ACT *Noise Management Guideline* (2018) (NMG). The criteria apply at 1 m from the building façade, approximately 1.2-1.5 m above ground level.

Road traffic noise criteria applicable to upgrading roads in existing areas is provided in **Table 5-14** below.

Table 5-14 Traffic noise levels resulting from upgraded road in existing areas of noise sensitive land use (ground level)

Existing traffic noise level at adjacent buildings, $L_{Aeq,15hr}$	Traffic noise level at adjacent buildings after road works completed
> 60 dB(A)	Equal to existing level (not greater than 65 dB(A))
55 – 60 dB(A)	60 dB(A)
< 55 dB(A)	Not more than 5 dB(A) above existing level

The NMG also identified noise sensitive receivers that should be included in an assessment of road traffic impacts, these are defined in **Table 5-15** below. The table also outlines how these have been addressed in this assessment.

Table 5-15 Noise sensitive receivers

Building use	Corresponding receiver type in assessment
Apartment Attached house Boarding house Caravan park/camping ground Detached house Guest house Retirement complex Special care establishment Special care hostel	Residential
Childcare centre	Child Care
Community activity centre (except community halls)	Passive Recreation and Community Theatre
Educational establishment	Education
Health facility/hospital	None
Special dwelling	Place of Worship

6.0 Construction noise and vibration assessment

6.1 Noise assessment methodology

Noise levels due to construction activities have been assessed quantitatively, taking into consideration the following factors:

- Construction equipment
- Location of works in relation to sensitive receivers
- Duration of activities.

General mitigation measures for construction noise have been provided in **Section 9.0**.

6.2 Construction scenarios

The following works would be undertaken within the project area:

- Mobilisation and establishment of construction compound sites
- Decommissioning and treatment of utilities
- Construction of trackform
- Construction of stops
- Construction of Parkes Way Bridge.

Description of activities and work hours for the five construction phases are shown in Table 6-1.

Table 6-1 Assessed construction scenarios

Construction scenario	Activities	Work hours
Mobilisation and establishment of construction compound sites	Several temporary construction compounds, stockpile sites and laydown areas would be required as part of the Project. Additional offsite locations would also be required to store equipment and machinery. The location of proposed construction compound sites are listed below and shown in **Figure 6-1**. • Site Compound A – Constitution Avenue Carpark, RLC compound, occupying part of the carpark currently in City Block 1, Section 116 • Site compound B – Marcus Clarke Street Carpark, RLC compound, occupying the carpark currently in City Block 2 and City Block 3, Section 20 • Site Compound C – Acton Waterfront Central and Southern Carparks - RLC compound, occupying the carpark currently in Acton Block 24 Section 33 - New compound, occupying the carpark currently in Acton Block 1 Section 95 • Site Compound D – Parkes Way/Southwest Clover Leaf, new compound, occupying the former south west cloverleaf disturbed by RLC.	Standard construction hours

Construction scenario	Activities	Work hours
Decommissioning and treatment of utilities	Utilities within the Project delivery phase area that may be affected by construction works would be relocated prior to the commencement of construction. Utilities infrastructure that remains within and around the Project delivery phase area would be subject to one or more of the following, depending on agreement with the relevant utility owner/operator: • Protected for the duration of construction works • Disconnected, decommissioned and removed • Disconnected, decommissioned and left in-situ. Most protection, decommissioning and removal of utilities would be completed early in the Project construction period, but may also be staged during the construction period depending on construction planning requirements.	Standard construction hours and OOHW
Construction of trackform	Trackform construction would entail the following methodology: • Establishing a safe work area with fencing, environmental controls, and traffic control to allow safe entry and exit of construction traffic. Signs and traffic control devices would be delivered on light trucks and access to work sites would be controlled • The use of concrete or water filled traffic barriers • Stripping topsoil where applicable and would be transported off site for disposal • Signed diversions where construction crosses the intersections. The road surface would be saw cut before excavating and the kerb and gutter demolished • The combined services route (CSR) pit and pipe to be constructed in advance of the track slab typically located between or offset to the proposed tracks. Trench to be suitably backfilled and compacted using small compaction plant. CSR provision for line wide systems and stops to be considered • Complete installation of any trackside drainage to allow track drainage connections • Completing excavation to formation level. Unsuitable material would be removed and replaced • Prior to backfill and placement of lean mix concrete, complete drainage connections extending beyond the track slab footprint • Any unsuitable formation to be replaced with select fill. Select fill would be imported by truck, spread with a grader and compacted in layers using a vibrating roller. Water would be added to achieve the optimum moisture content as well as to supress dust • Placing a lean mix layer before the track slab is constructed • Welding 20 m lengths of rail on site into 120 m strings. A flash butt welder could be used • The Project Contractor may adopt a Trelleborg Top-Down or similar system for track construction, embedding rail in a synthetic boot mounted on jigs	Standard construction hours and OOHW

Construction scenario	Activities	Work hours
	every 2 m and cast into a conventional concrete slab for track construction. Track drainage, conduits (required for embedded systems) would be installed as required before the concrete is poured • Where paving, asphalt or alternative finishes is required, the concrete would be left below the rail head and pavers installed as a follow up activity. For exposed aggregate finish the newly laid surface would be sprayed with a suitable retarder and then washed. The slurry would be collected and disposed of appropriately • Rail would be bonded as detailed in the design • Surface finishing as detailed in the urban design with pavers laid by hand on a bedding layer • Hand over to allow installation of the rail systems.	
Construction of stops	Stops will be constructed during concurrent works in each construction zone: • Edinburgh Avenue stop – Zone 9 • City South stop – Zone 13 • Commonwealth Park stop – Zone 15. Structural slabs, copings and kerbs will be installed followed by canopies, platform equipment furniture and paving. Final commissioning of equipment and systems may take place towards the completion of construction.	Standard construction hours
Construction of Parkes Way Bridge	The construction of Parkes Way Bridge will entail the following methodology and activities: • Enabling works, including removal of trees, temporary removal of street lighting and construction of temporary roads • Piling works to install 8 piles (four piles for each bridge abutment and four for bridge piers). It is likely a bore piling methodology would be used • Structural works, including the construction of pile caps, footings, abutment walls and piers • Demolition of the top 2.5 m of existing Parkes Way Bridges abutment walls and backfilling • Installation of steel box girders with cranes • Construction of deck and track slab, including CSR conduits, irrigation mains and trench drains installation.	Standard construction hours

Construction is scheduled to be undertaken primarily during standard hours. Some trackform construction and utilities works will require night works for safety reasons and to minimise effects on traffic. Any out of hours work would require justification, assessment and more detailed management.

6.3 Construction equipment

Construction equipment and associated sound power levels typically used for these construction scenarios are identified in **Table 6-2**. The listed sound power levels are typical values taken from data provided in:

- *Construction Noise and Vibration Guideline (Transport for NSW, 2022)*

- Australian Standard AS 2436-2010, *Guide to noise control on construction, demolition and maintenance sites*
- British Standard BS 5228: Part 1 2009 *Code of Practice for Noise and Vibration Control on Construction and Open Sites Part 1: Noise.*

It has been assumed that all equipment is modern and in good working order. Noise measurements undertaken by AECOM and data provided in BS 5228 indicate that L_{A1} sound power levels are typically up to 8 dB(A) above L_{Aeq} sound power levels for construction works.

During the ongoing design development, local site conditions and changes in work practices may cause some variation in the equipment used. While the equipment may vary, other major infrastructure projects have shown that due to the conservative approach to noise predictions, actual noise levels are unlikely to be appreciably higher than those predicted in this assessment.

This approach is used at this point in the assessment to ensure that identified impacts are not under-predicted and adequate noise management and mitigation measures are considered early in the project.

Table 6-2 Indicative construction plant/equipment and associated sound power levels

Activity	Indicative plant/equipment	L_{Aeq}, SWL	Activity total L_{Aeq} SWL, dB(A)	Activity total L_{A1} SWL, dB(A)
Mobilisation and site establishment	Chainsaw 4-5 hp	114	125	130
	Excavator (tracker) 35t + hydraulic hammer	122		
	Mobile crane 500t	107		
	Front end loader	112		
	Excavator (tracked) 35t	110		
	Grader	113		
	Vibratory roller	109		
	Concrete truck	109		
	Dump truck	110		
	Water cart	107		
	Concrete vibrator	113		
	Concrete pump	109		
	Power generator	103		
	Light vehicles (eg 4WD)	103		
Decommissioning and treatment of utilities	Excavator (tracked) 35t	110	124	130
	Rigid trucks and dog trailers	103		
	Franna crane 20t	98		
	Excavator (tracker) 35t + hydraulic hammer	122		
	Concrete saw	118		
	Vacuum truck	109		
	Backhoe	111		
	Power generator	103		

Activity	Indicative plant/equipment	L_{Aeq}, SWL	Activity total L_{Aeq} SWL, dB(A)	Activity total L_{A1} SWL, dB(A)
Construction of trackform	Scraper 615	110	124	130
	Excavator (tracked) 35t	110		
	Excavator (tracker) 35t + hydraulic hammer	122		
	Grader	113		
	Rigid trucks and dog trailers	103		
	Compactor	106		
	Roller (large pad foot)	109		
	Concrete truck	109		
	Concrete vibrator	113		
	Concrete pump	109		
	Welding equipment	105		
	Water cart	107		
Construction of stops	Backhoe	110	119	121
	Franna crane 20t	98		
	Excavator (tracked) 35t	110		
	Concrete truck	109		
	Truck compressor	75		
	Vibratory roller	109		
	Road truck	108		
	Power generator	103		
	Mobile crane 500t	107		
	Concrete vibrator	113		
	Concrete pump	109		

Activity	Indicative plant/equipment	L_{Aeq}, SWL	Activity total L_{Aeq} SWL, dB(A)	Activity total L_{A1} SWL, dB(A)
Construction of Parkes Way Bridge	Franna crane 20t	98	127	130
	Crusher	118		
	Excavator (tracker) 35t + hydraulic hammer	122		
	Mobile crane 500t	107		
	Piling rig – driven	116		
	Piling rig – bored	112		
	Power generator	100		
	Concrete pump	102		
	Concrete truck	109		
	Air Compressor	109		
	Excavator (tracked) 35t + hydraulic hammer	122		
	Welding equipment	105		

Notes

1. *Overall L_{A1} sound power level represented by the highest plant L_{Aeq} sound power levels in that activity plus 8 dB(A) above L_{Aeq} sound power levels*

The overall footprint for each construction scenario is shown in **Figure 6-1** to **Figure 6-5**.

Figure 6-1 Construction Footprint - Mobilisation and site establishment

Figure 6-2 Construction Footprint – Decommissioning and treatment of utilities

Figure 6-3 Construction Footprint – Construction of trackform

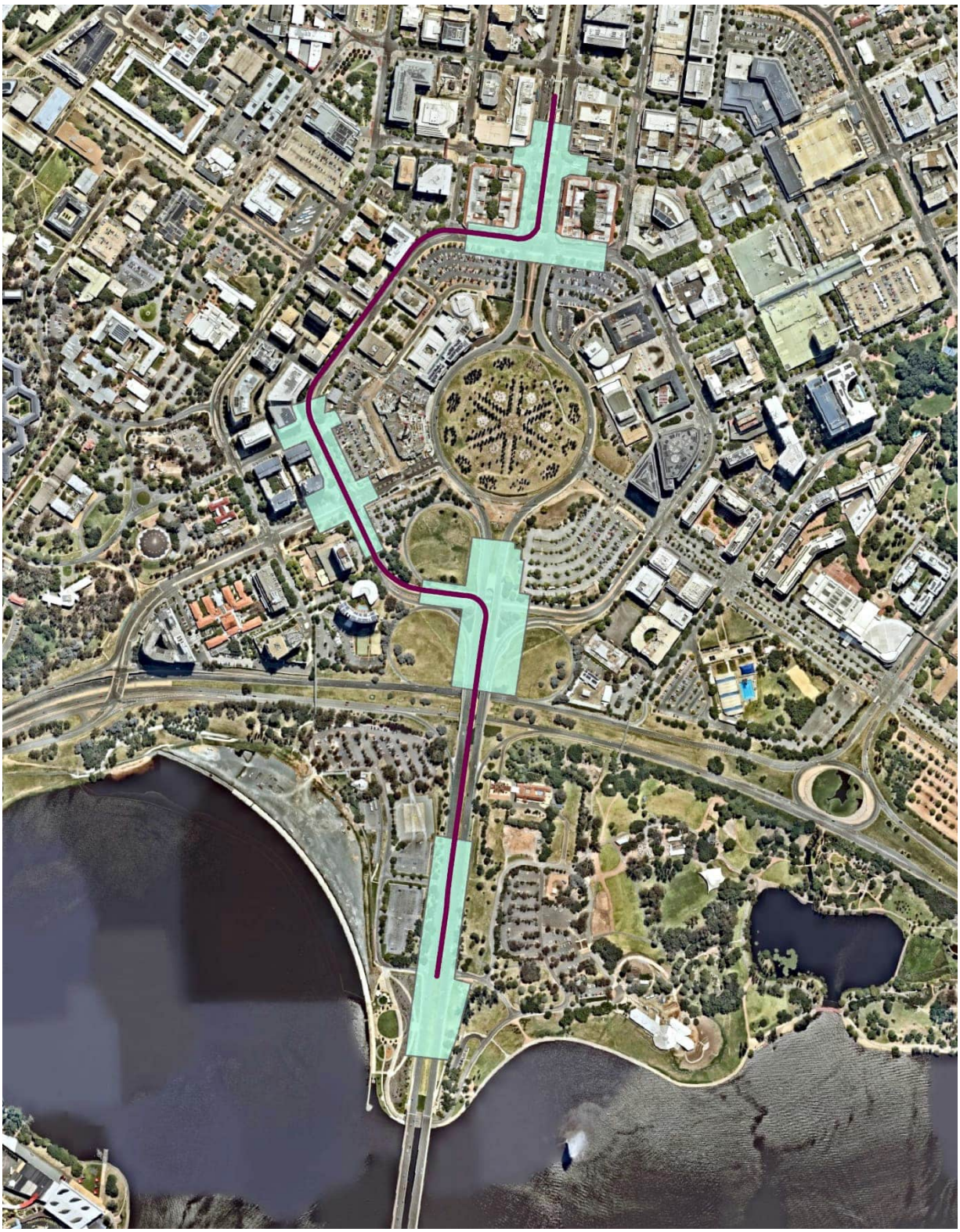


Figure 6-4 Construction Footprint – Construction of stops

Figure 6-5 Construction Footprint – Construction of Parkes Way Bridge

6.4 Construction hours

Construction would largely be carried out during standard construction work hours:

- Monday to Friday: 7am to 6pm
- Saturday: 7am to 1pm
- Sundays and public holidays: no work.

To minimise disruption to daily traffic and disturbance to surrounding landowners and businesses, it would be necessary to carry out some work outside of standard construction work hours. This includes some trackform construction works and utilities works.

Any out of hours work would require justification, assessment and more detailed management. This would be completed in accordance with the Construction Noise and Vibration Management Plan (CNVMP) developed for the project during detailed design.

6.5 Construction schedule

Construction of the Project is expected to start in 2024 and be completed by 2027, with works being carried out in stages and packages to minimise disruption to residents, businesses and existing transport operations in the local vicinity. The indicative construction program for the Project is shown in **Table 6-3**:

Table 6-3 Indicative construction program

Zone no.	Works location	Construction type	Indicative construction program								
			2024	2025				2026			
			Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
11	London Circuit between Edinburgh Avenue and Commonwealth Avenue	Block									
2	Northbourne Avenue between Alinga Street and London Circuit	Block									
9	London Circuit between Gordon Street and Edinburgh Avenue	Block									
7	London Circuit between Knowles Place North and Gordon Street	Block									
14	Parkes Way Bridge	Bridge									
12	Commonwealth Avenue and London Circuit intersection	Intersection									
10	London Circuit and Edinburgh Avenue intersection	Intersection									
1	Northbourne Avenue and Alinga Street intersection	Intersection									
4	Northbourne Avenue and London Circuit intersection	Intersection									
8	London Circuit and Gordon Street intersection	Intersection									
6	London Circuit between West Row and Knowles Place North	Block									
13	Commonwealth Avenue between London Circuit and Parkes Way Bridge	Block									
15	Commonwealth Avenue between Parkes Way Bridge and Albert Street	Block									
5	London Circuit between Northbourne Avenue and West Row	Block									
3	London Circuit between Petrie Plaza and Northbourne Avenue	Block									

6.6 Construction noise modelling and prediction

Modelling of the proposed construction scenarios was completed using SoundPLAN version 8.2 noise modelling software. Standard weather conditions were applied. The modelling used the CONCAWE algorithm and included ground topography, buildings and structures and representative construction noise sources. Free field point receivers at 1.5 metres high were assumed, source heights are dependent on the equipment.

It can be expected that there may be differences between predicted and measured noise levels due to variations in instantaneous operating conditions, plant in operation during the measurement and also the location of the plant equipment. The acoustic shielding calculated in the model due to localised fixed building structures would also vary as the construction equipment moves around the construction footprint.

6.6.1 Receiver noise levels

Table 6-4, Table 6-5, Table 6-6, Table 6-7 and **Table 6-8** present the construction noise modelling results for noise sensitive properties and indicate at which properties the derived noise assessment levels are likely to be exceeded during the daytime and night-time. The tables also present which residential receivers are predicted to be exposed to noise levels over the highly affected level (75 dB(A)).

It is important to consider that this assessment is representative of the worst case 15-minute period of construction activity, while the construction equipment is at the nearest location to each sensitive

receiver location. The assessed scenario does not represent the ongoing day to day noise impact at noise sensitive receivers for an extended period of time.

Particularly noisy activities, such as rock hammering and use of concrete saws, are likely to persist for only a fraction of the overall construction period. In addition, the predictions use the shortest separation distance to each sensitive receiver, however in reality separation distances would vary between plant and sensitive receivers. For linear works (works that move along the light rail alignment, rather than works located at a construction compound) noise exposure at each receiver would reduce due to increases in distance loss as the works progress along the alignment. Typical noise levels could be 5 to 10 dB(A) lower dependent on the site and nature of works.

The *Interim Construction Noise Guideline* states that where a construction noise impact level of greater than 75 dB(A) is predicted, a residential receiver is considered to be 'highly noise affected' and afforded additional consideration for mitigation. The receivers where noise levels exceed 75 dB(A) can be identified on the noise contours provided in **Appendix D**. The potential for highly noise affected receivers would be confirmed during detailed construction planning. These receivers would receive additional consultation with regards to specific timing and impacts of construction works. Respite periods would also be considered for these receivers in accordance with the *Interim Construction Noise Guideline.*

Feasible and reasonable mitigation measures would be detailed in the Construction Noise and Vibration Management Plan (refer to **Section 9.0**).

Mobilisation and establishment of construction compounds

Mobilisation and establishment of construction compound site works are likely to be completed before any other construction stages begin.

Receivers near to the site establishment and enabling works would experience elevated noise levels during these works. Approximately 15 receivers during works in standard construction hours may experience noise levels above the noise assessment levels. One residential receiver is expected to be highly noise affected.

Noise levels would be considered moderately intrusive at up to five receivers and highly intrusive at up to three receivers across the project area in the daytime.

Table 6-4 Mobilisation and establishment of construction compound sites – Predicated construction noise levels

Noise catchment area and receiver	Standard hours		Outside of standard construction hours (night-time)		Highly affected > 75 dB(A)[1]
	Noise assessment level, dB(A)	Predicted noise level, dB(A)	Noise assessment level, dB(A)	Predicted noise level, dB(A)	
NCA1					
Acton Waterfront	60	**81**	-	-	N/A
Archbishops Residence	67	**71**	-	-	No
Henry Rolland Park	60	**76**	-	-	N/A
NCA2					
Australian Medical Council	70	**85**	-	-	N/A
BreakFree Capital Tower	63	**94**	-	-	Yes
QT Tower	63	**72**	-	-	No
The Metropolitan East	70	69	-	-	N/A
The Metropolitan West	70	**77**	-	-	N/A
NCA3					
7 London Circuit	70	**73**	-	-	N/A
Canberra City Police Station	70	58	-	-	N/A
Law Courts and Justices Precinct	70	62	-	-	N/A
Melbourne Building East	70	54	-	-	N/A
Melbourne Building West	70	53	-	-	N/A
Pilgrim House	55	52	-	-	N/A
Reserve Bank Australia	70	53	-	-	N/A
The Avenue Apartments	62	47	-	-	No
The Cupping Room	70	55	-	-	N/A
Zoo Bar	70	53	-	-	N/A

Noise catchment area and receiver	Standard hours		Outside of standard construction hours (night-time)		Highly affected > 75 dB(A)[1]
	Noise assessment level, dB(A)	Predicted noise level, dB(A)	Noise assessment level, dB(A)	Predicted noise level, dB(A)	
NCA4					
Canberra Museum and Gallery	55	50	-	-	N/A
Canberra Theatre Centre	50	**66**	-	-	N/A
City Hill Park	60	**67**	-	-	N/A
Corrective Services	70	**81**	-	-	N/A
KU Canberra City AMEP Child Care Centre	55	52	-	-	N/A
Metropol Apartment Building 1	53	32	-	-	No
Metropol Apartment Building 2	53	45	-	-	No
Metropol Apartment Building 3	53	35	-	-	No
Sydney Building East	70	52	-	-	N/A
Sydney Building West	70	56	-	-	N/A
NCA5					
ANU School of Music	55	**71**	-	-	N/A
Llewellyn Hall	50	**71**	-	-	N/A
ANU Peter Karmel Building	55	**64**	-	-	N/A

Notes:

1. Highly affected applies to residential premises only

Utilities

Receivers near to the utility works would experience elevated noise levels during these works. Approximately 28 receivers during works in standard construction hours and 12 receivers during works outside of standard construction hours across the project area may experience noise levels above the associated noise assessment levels. Three residential receivers may be highly noise affected.

Noise levels would be considered moderately intrusive at up to 25 receivers across the project area in the daytime. Night-time mitigation measures would be required for approximately 12 receivers with perceptions ranging from ‘clearly audible’ to ‘highly intrusive’. Approximately 12 receivers would require notification of night-time works, at these receivers construction noise may be ‘noticeable’.

Table 6-5 Decommissioning and treatment of utilities – Predicted construction noise levels

Noise catchment area and receiver	Standard hours		Outside of standard construction hours (night-time)		Highly affected > 75 dB(A)[1]
	Noise assessment level, dB(A)	Predicted noise level, dB(A)	Noise assessment level, dB(A)	Predicted noise level, dB(A)	
NCA1					
Acton Waterfront	60	**68**	-	-	N/A
Archbishops Residence	67	**85**	44	**85**	Yes
Henry Rolland Park	60	**>95**	-	-	N/A
NCA2					
Australian Medical Council	70	**>95**	-	-	N/A
BreakFree Capital Tower	63	**92**	50	**92**	Yes
QT Tower	63	**94**	50	**94**	Yes
The Metropolitan East	70	**>95**	70	**>95**	N/A
The Metropolitan West	70	**>95**	70	**>95**	N/A
NCA3					
7 London Circuit	70	**>95**	-	-	N/A
Canberra City Police Station	70	**>95**	70	**>95**	N/A
Law Courts and Justices Precinct	70	**78**	-	-	N/A
Melbourne Building East	70	**>95**	-	-	N/A
Melbourne Building West	70	**>95**	-	-	N/A
Pilgrim House	55	**91**	-	-	N/A
Reserve Bank Australia	70	**>95**	-	-	N/A
The Avenue Apartments	62	**65**	49	65	No
The Cupping Room	70	**>95**	-	-	N/A
Zoo Bar	70	**>95**	70	**>95**	N/A

NCA4					
Canberra Museum and Gallery	55	**>95**	-	-	N/A
Canberra Theatre Centre	50	**82**	50	82	N/A
City Hill Park	60	**77**	-	-	N/A
Corrective Services	70	**>95**	-	-	N/A
KU Canberra City AMEP Child Care Centre	55	**>95**	-	-	N/A
Metropol Apartment Building 1	53	45	39	45	No
Metropol Apartment Building 2	53	50	39	50	No
Metropol Apartment Building 3	53	46	39	46	No
Sydney Building East	70	**>95**	-	-	N/A
Sydney Building West	70	**>95**	-	-	N/A
NCA5					
ANU School of Music	55	**75**	-	-	N/A
Llewellyn Hall	50	**75**	-	-	N/A
ANU Peter Karmel Building	55	**73**	-	-	N/A

Notes:

1. Highly affected applies to residential premises only

Construction of trackform

Approximately 26 receivers during works in standard construction hours and 12 receivers during works outside of standard construction hours across the project area may experience noise levels above the noise assessment levels. Three residential receivers may be highly noise affected.

Noise levels would be considered moderately intrusive at up to 22 receivers across the project area during standard construction hours. Night-time mitigation measures would be required for approximately 11 receivers with perceptions ranging from ‘clearly audible’ to ‘highly intrusive’. Approximately 12 receivers would require notification of night-time works, at these receivers construction noise may be ‘noticeable’. As trackform construction is expected to be staged and therefore the actual number of affected receivers would be limited at any single point in time.

Table 6-6 Construction of trackform – Predicted construction noise levels

Noise catchment area and receiver	Standard hours		Outside of standard construction hours (night-time)		Highly affected > 75 dB(A)[1]
	Noise assessment level, dB(A)	Predicted noise level, dB(A)	Noise assessment level, dB(A)	Predicted noise level, dB(A)	
NCA1					
Acton Waterfront	60	**68**	-	-	N/A
Archbishops Residence	67	**75**	44	75	Yes
Henry Rolland Park	60	**>95**	-	-	N/A
NCA2					
Australian Medical Council	70	**>95**	-	-	N/A
BreakFree Capital Tower	63	**82**	50	**82**	Yes
QT Tower	63	**95**	50	**95**	Yes
The Metropolitan East	70	**>95**	70	105	N/A
The Metropolitan West	70	**91**	70	91	N/A
NCA3					
7 London Circuit	70	**>95**	-	-	N/A
Canberra City Police Station	70	**>95**	70	**>95**	N/A
Law Courts and Justices Precinct	70	**81**	-	-	N/A
Melbourne Building East	70	**>95**	-	-	N/A
Melbourne Building West	70	**>95**	-	-	N/A
Pilgrim House	55	**73**	-	-	N/A
Reserve Bank Australia	70	**>95**	-	-	N/A
The Avenue Apartments	62	61	49	61	No
The Cupping Room	70	**>95**	-	-	N/A
Zoo Bar	70	**>95**	70	**>95**	N/A

Noise catchment area and receiver	Standard hours		Outside of standard construction hours (night-time)		Highly affected > 75 dB(A)[1]
	Noise assessment level, dB(A)	Predicted noise level, dB(A)	Noise assessment level, dB(A)	Predicted noise level, dB(A)	
NCA4					
Canberra Museum and Gallery	55	**72**	-	-	N/A
Canberra Theatre Centre	50	**71**	50	71	N/A
City Hill Park	60	**65**	-	-	N/A
Corrective Services	70	**67**	-	-	N/A
KU Canberra City AMEP Child Care Centre	55	**75**	-	-	N/A
Metropol Apartment Building 1	53	41	39	41	No
Metropol Apartment Building 2	53	48	39	48	No
Metropol Apartment Building 3	53	46	39	46	No
Sydney Building East	70	**89**	-	-	N/A
Sydney Building West	70	**>95**	-	-	N/A
NCA5					
ANU School of Music	55	**75**	-	-	N/A
Llewellyn Hall	50	**75**	-	-	N/A
ANU Peter Karmel Building	55	**74**	-	-	N/A

Notes:

1. Highly affected applies to residential premises only

Construction of stops

Approximately 20 receivers during works in standard construction hours across the project area may experience noise levels above the noise assessment levels. One receiver is expected to be highly noise affected.

Noise levels would be considered moderately intrusive at up to 13 receivers and highly intrusive at up to nine receivers across the project area in the daytime.

Table 6-7 Construction of stops – Predicted construction noise levels

Noise catchment area and receiver	Standard hours		Outside of standard construction hours (night-time)		Highly affected > 75 dB(A)[1]
	Noise assessment level, dB(A)	Predicted noise level, dB(A)	Noise assessment level, dB(A)	Predicted noise level, dB(A)	
NCA1					
Acton Waterfront	60	**63**	-	-	N/A
Archbishops Residence	67	62	-	-	No
Henry Rolland Park	60	**87**	-	-	N/A
NCA2					
Australian Medical Council	70	**77**	-	-	N/A
BreakFree Capital Tower	63	**70**	-	-	No
QT Tower	63	**91**	-	-	Yes
The Metropolitan East	70	**>95**	-	-	N/A
The Metropolitan West	70	**87**	-	-	N/A
NCA3					
7 London Circuit	70	**>95**	-	-	N/A
Canberra City Police Station	70	67	-	-	N/A
Law Courts and Justices Precinct	70	**71**	-	-	N/A
Melbourne Building East	70	**>95**	-	-	N/A
Melbourne Building West	70	**>95**	-	-	N/A
Pilgrim House	55	**67**	-	-	N/A
Reserve Bank Australia	70	66	-	-	N/A
The Avenue Apartments	62	56	-	-	No
The Cupping Room	70	62	-	-	N/A
Zoo Bar	70	63	-	-	N/A

Noise catchment area and receiver	Standard hours		Outside of standard construction hours (night-time)		Highly affected > 75 dB(A)[1]
	Noise assessment level, dB(A)	Predicted noise level, dB(A)	Noise assessment level, dB(A)	Predicted noise level, dB(A)	
NCA4					
Canberra Museum and Gallery	55	**72**	-	-	N/A
Canberra Theatre Centre	50	**68**	-	-	N/A
City Hill Park	60	**61**	-	-	N/A
Corrective Services	70	61	-	-	N/A
KU Canberra City AMEP Child Care Centre	55	**80**	-	-	N/A
Metropol Apartment Building 1	53	33	-	-	No
Metropol Apartment Building 2	53	43	-	-	No
Metropol Apartment Building 3	53	40	-	-	No
Sydney Building East	70	**>95**	-	-	N/A
Sydney Building West	70	**>95**	-	-	N/A
NCA5					
ANU School of Music	55	**58**	-	-	N/A
Llewellyn Hall	50	**58**	-	-	N/A
ANU Peter Karmel Building	55	48	-	-	N/A

Notes:

1. Highly affected applies to residential premises only

Construction of Parkes Way Bridge

Approximately ten receivers during works in standard construction hours across the project area may experience noise levels above the noise assessment levels. Three residential receivers may be highly noise affected.

Noise levels would be considered moderately intrusive at up to 3 receivers and highly intrusive at up to 2 receivers across the project area in the daytime.

Table 6-8 Construction of Parkes Way Bridge – Predicted construction noise levels

Noise catchment area and receiver	Standard hours		Outside of standard construction hours (night-time)		Highly affected > 75 dB(A)
	Noise assessment level, dB(A)	Predicted noise level, dB(A)	Noise assessment level, dB(A)	Predicted noise level, dB(A)	
NCA1					
Acton Waterfront	60	**69**	-	-	N/A
Archbishops Residence	67	**88**	-	-	Yes
Henry Rolland Park	60	60	-	-	N/A
NCA2					

Noise catchment area and receiver	Standard hours		Outside of standard construction hours (night-time)		Highly affected > 75 dB(A)
	Noise assessment level, dB(A)	Predicted noise level, dB(A)	Noise assessment level, dB(A)	Predicted noise level, dB(A)	
Australian Medical Council	70	**87**	-	-	N/A
BreakFree Capital Tower	63	**95**	-	-	Yes
QT Tower	63	**76**	-	-	Yes
The Metropolitan East	70	68	-	-	N/A
The Metropolitan West	70	65	-	-	N/A
NCA3					
7 London Circuit	70	64	-	-	N/A
Canberra City Police Station	70	58	-	-	N/A
Law Courts and Justices Precinct	70	63	-	-	N/A
Melbourne Building East	70	56	-	-	N/A
Melbourne Building West	70	56	-	-	N/A
Pilgrim House	55	53	-	-	N/A
Reserve Bank Australia	70	56	-	-	N/A
The Avenue Apartments	62	49	-	-	No
The Cupping Room	70	59	-	-	N/A
Zoo Bar	70	56	-	-	N/A

Noise catchment area and receiver	Standard hours		Outside of standard construction hours (night-time)		Highly affected > 75 dB(A)
	Noise assessment level, dB(A)	Predicted noise level, dB(A)	Noise assessment level, dB(A)	Predicted noise level, dB(A)	
NCA4					
Canberra Museum and Gallery	55	51	-	-	N/A
Canberra Theatre Centre	50	**64**	-	-	N/A
City Hill Park	60	**65**	-		N/A
Corrective Services	70	70	-	-	N/A
KU Canberra City AMEP Child Care Centre	55	53	-	-	N/A
Metropol Apartment Building 1	53	40	-	-	No
Metropol Apartment Building 2	53	49	-	-	No
Metropol Apartment Building 3	53	39	-	-	No
Sydney Building East	70	57	-	-	N/A
Sydney Building West	70	57	-	-	N/A
NCA5					
ANU School of Music	55	53	-	-	N/A
Llewellyn Hall	50	**53**	-	-	N/A
ANU Peter Karmel Building	55	52	-	-	N/A

Notes:

1. Highly affected applies to residential premises only

6.6.2 Overlapping construction activities

While most construction activities are expected to occur at distinct scheduled times and at different locations, it is possible that noisy construction activities for the Project may occur at the same time in close proximity to each other. In these cases, it is possible that an increase of up to 3 dB(A) of the highest noise level predicted for any construction stage may occur (assuming that at any one location equal noise levels from two stages of works are experienced).

Noise from use of the construction compound sites may also contribute to construction noise at receivers, however it is likely that the other construction stages would dominate cumulative noise levels, and any increase in the overall noise level from the Project would be less than 3 dB(A).

Overlapping construction stages and identification of any receivers subject to increased noise levels would be determined during detailed design. Any additional mitigation measures subsequently required would also be identified during detailed design.

6.7 Sleep disturbance assessment

To ensure worker safety and to minimise traffic disruptions, some works would be required to be undertaken outside of standard construction hours. The *Interim Construction Noise Guideline* states that public infrastructure works are one of the five categories of works that may need to be carried out outside the recommended standard hours.

Sleep disturbance is assessed using an $L_{A1(1\ min)}$ parameter, which is considered to be the maximum noise level excluding extraneous noise events. A sleep disturbance assessment has been undertaken for the proposed night works with the construction information available to date. The noise modelling results are provided in **Table 6-9** with the number of residential buildings where noise levels are

predicted to exceed the sleep disturbance screening criteria and the awakening reaction criteria. Sleep disturbance noise contours are presented visually in **Appendix E**.

A number of exceedances of the sleep disturbance screening criteria have been predicted due to the night-time construction works associated with the Project. In addition, noise associated with all of the works would exceed the awakening reaction screening criterion at some receivers. The exceedances are attributed to the close proximity of the construction site to some residences, and the length of the Project. It is difficult to predict the number of times the sleep awakening reaction criterion would be exceeded, however the impacts are considered to be consistent with other similar projects and indicate the need for effective noise mitigation and management planning.

It should be noted that the works would generally be progressive so that not all receivers would be affected at any one time, or for the whole duration of the works.

Table 6-9 Residential buildings in assessment scope where noise levels may exceed sleep disturbance screening criteria for night works

Scenario	Decommissioning and treatment of utilities		Construction of trackform	
	Sleep disturbance screening level $L_{A1(1\ minute)}$, dB(A)	Awakening reaction level $L_{A1(1\ minute)}$, dB(A)	Sleep disturbance screening level $L_{A1(1\ minute)}$, dB(A)	Awakening reaction level $L_{A1(1\ minute)}$, dB(A)
Archbishops residence	Yes	Yes	Yes	Yes
The Avenue apartments	Yes	Yes	Yes	Yes
BreakFree Capital Tower	Yes	Yes	Yes	Yes
QT Tower	Yes	Yes	Yes	Yes
Metropol apartment building 1	Yes	No	No	No
Metropol apartment building 2	Yes	No	Yes	No
Metropol apartment building 3	Yes	No	Yes	No

Decommissioning and treatment of utilities

Noise levels at all seven residential buildings in the assessment scope are predicted to exceed the sleep disturbance screening level for the decommissioning and treatment of utilities works. Awakening reactions may occur at the Archbishop's residence, BreakFree Capital Tower, QT Tower and the Avenue apartments. As the works are expected to be staged, the number of affected residential receivers at any one time would be limited. The highest impacts are expected during hammering activities which may be limited during the night-time period.

Construction of trackform

Noise levels at six residential receivers in the assessment scope are predicted to exceed the sleep disturbance screening level for the trackform construction works during the construction period. Awakening reactions may be expected at the Archbishop's residence, BreakFree Capital Tower, QT Tower and the Avenue apartments. As the works are expected to be staged, the number of affected residential receivers at any one time would be limited. The highest impacts are expected during hammering activities which may be limited during the night-time period.

Night-time works, are only proposed to occur when deemed unavoidable and will require strict approval from the Territory.

6.8 Construction vibration

6.8.1 Minimum working distances

Construction vibration may be generated due to the vibration intensive equipment proposed to be used during some stages of work. The minimum working distances for these items of equipment from off-site receivers are shown in **Table 6-10**.

Table 6-10 Recommended minimum working distances for vibration intensive plant

Plant item	Rating/Description	Minimum working distance		
		Cosmetic damage (BS 7385) Light-framed structures	Cosmetic damage (DIN 4150) Heritage and other sensitive structures	Human response (EPA's Vibration guideline)
Vibratory Roller	< 50 kN (Typically 1-2 t)	5 m	14 m	15 m to 20 m
	< 100 kN (Typically 2-4 t)	6 m	16 m	20 m
	< 200 kN (Typically 4-6 t)	12 m	33	40 m
	< 300 kN (Typically 7-13 t)	15 m	41	100 m
	> 300 kN (Typically 13-18 t)	20 m	54 m	100 m
	> 300 kN (> 18 t)	25 m	68 m	100 m
Small Hydraulic Hammer	(300 kg - 5 to 12 t excavator)	2 m	5 m	7 m
Medium Hydraulic Hammer	(900 kg – 12 to 18 t excavator)	7 m	19 m	23 m
Large Hydraulic Hammer	(1,600 kg – 18 to 34 t excavator)	22 m	60 m	73 m
Vibratory Pile Driver	Sheet piles	20 m	50 m	100 m
Pile Boring	≤ 800 mm	2 m (nominal)	4 m	4 m
Jackhammer	Hand held	1 m (nominal)	2 m	2 m

This is based on recommendations of the *Construction Noise and Vibration Guideline* and AECOM's previous project experience. If these minimum working distances are complied with, no adverse impacts from vibration intensive works are likely in terms of human response or cosmetic damage. Equipment size would be selected by the construction contractor and would take into account the minimum working distances and the distance between the area of construction and the nearest receiver. If vibration intensive works are required within these minimum working distances, mitigation measures to control excessive vibration would be implemented as outlined in **Section 9.0.**

6.8.2 Human comfort

Works undertaken within the human comfort minimum working distances may cause some people to experience annoyance and concern for cosmetic damage. Receivers located within the minimum distances for human comfort would be notified of the potential impacts as part of the notification of highly noise affected receivers.

6.8.3 Cosmetic damage

Table 6-10 presents minimum working distances to minimise the likelihood of cosmetic damage on buildings and structures, including heritage items. The Heritage assessment prepared for the Project does not identify any heritage items that are likely to be impacted by construction vibration.

Works undertaken within minimum working distances for cosmetic damage may cause damage to buildings. However, damage to heritage and other buildings is unlikely to occur when the management

measures have been implemented appropriately. These measures include undertaking attended vibration measurements at the work site when work commences, to determine site specific minimum working distances. These measurements would be made progressively at distances outside the minimum working distances to ensure no structure damage occurs and would provide detailed information regarding the transmission of vibration to allow site specific safe working distances to be determined.

6.8.4 Sensitive vibration receivers

The Reserve Bank of Australia (RBA) contains intricate and highly sensitive noise and vibration alarms around its vault, which may be affected by vibration intensive construction activities. A detailed assessment based on the vault's alarm sensitivity will be required at the detailed design stage. At this stage however, the RBA will be treated as standard commercial premises. A specific vibration management plan should be provided at the detailed design stage in consultation with the Reserve Bank of Australia.

6.9 Construction road traffic noise

6.9.1 Site access and traffic movements

Construction traffic would be distributed across the construction compound facilities, via Northbourne Avenue to the north, and Commonwealth Avenue to the south. Heavy vehicle movements, which are likely to have the largest impact, would mainly be related to earthworks or spoil movement, but would also include other movements such as materials delivery and plant delivery.

During peak construction periods, it is expected that approximately 10 heavy vehicle movements per hour would be generated by construction works along the Project. Broken down across each haulage route, on average there would be an additional 2 heavy vehicle movements per route per hour in both directions. Conservatively it is estimated that an additional 20 light vehicles may be generated per hour.

For the purposes of the construction road traffic noise assessment, the following assumptions have been made:

- All construction compound facilities would be operational at the same time
- All construction vehicles would be on the road network at the same time (presenting a worst-case cumulative impact)
- Hourly construction vehicle movements would be evenly distributed across all construction routes
- Existing traffic volumes have been determined based on the morning peak hour, and afternoon peak hour (Monday to Friday) hourly traffic movements
- The existing traffic flows were based on traffic count data modelled for the 2026 base case model.

Figure 6-6 and Figure 6-7 present the planned haulage routes during the construction stages.

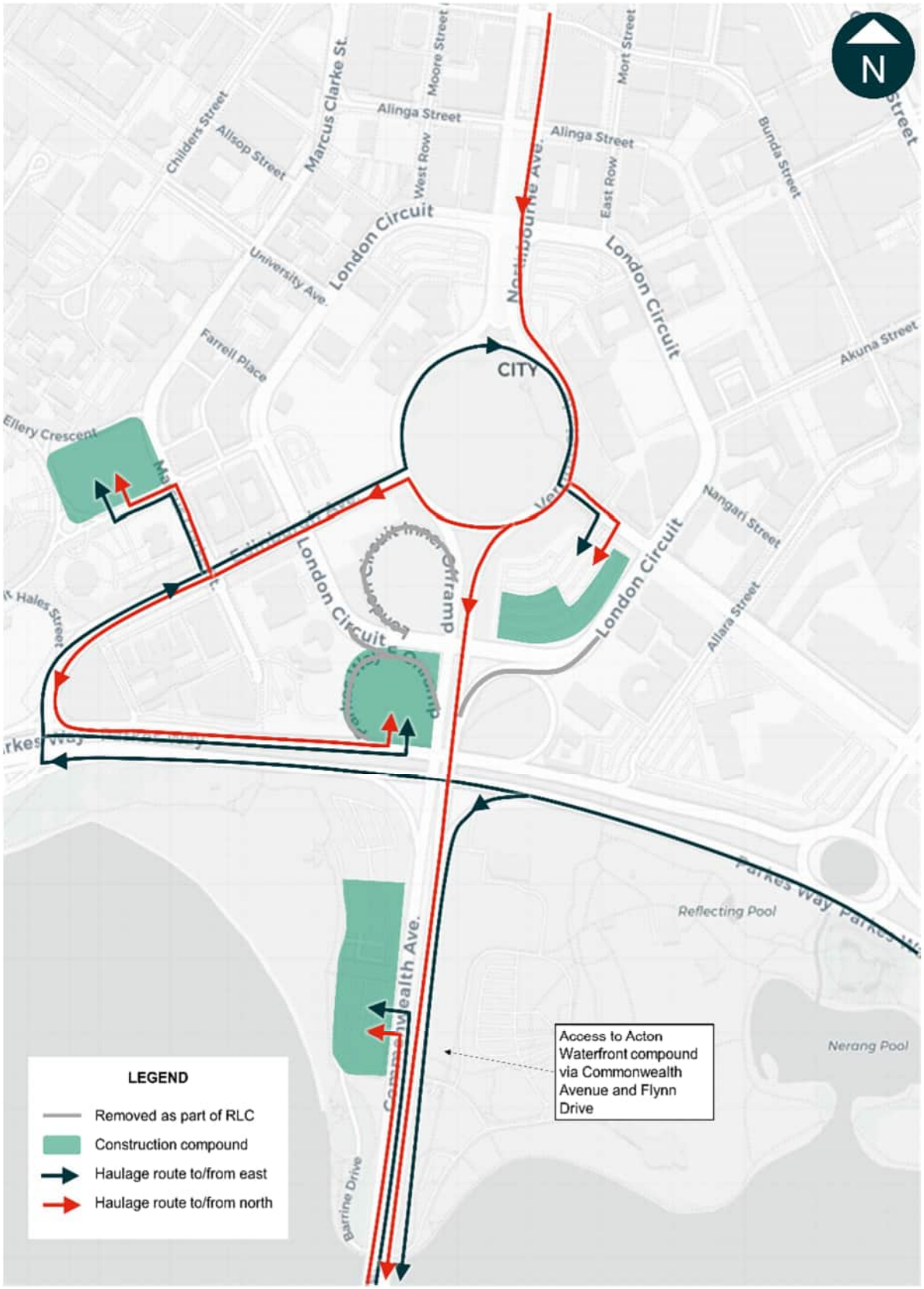


Figure 6-6 Inbound haulage routes

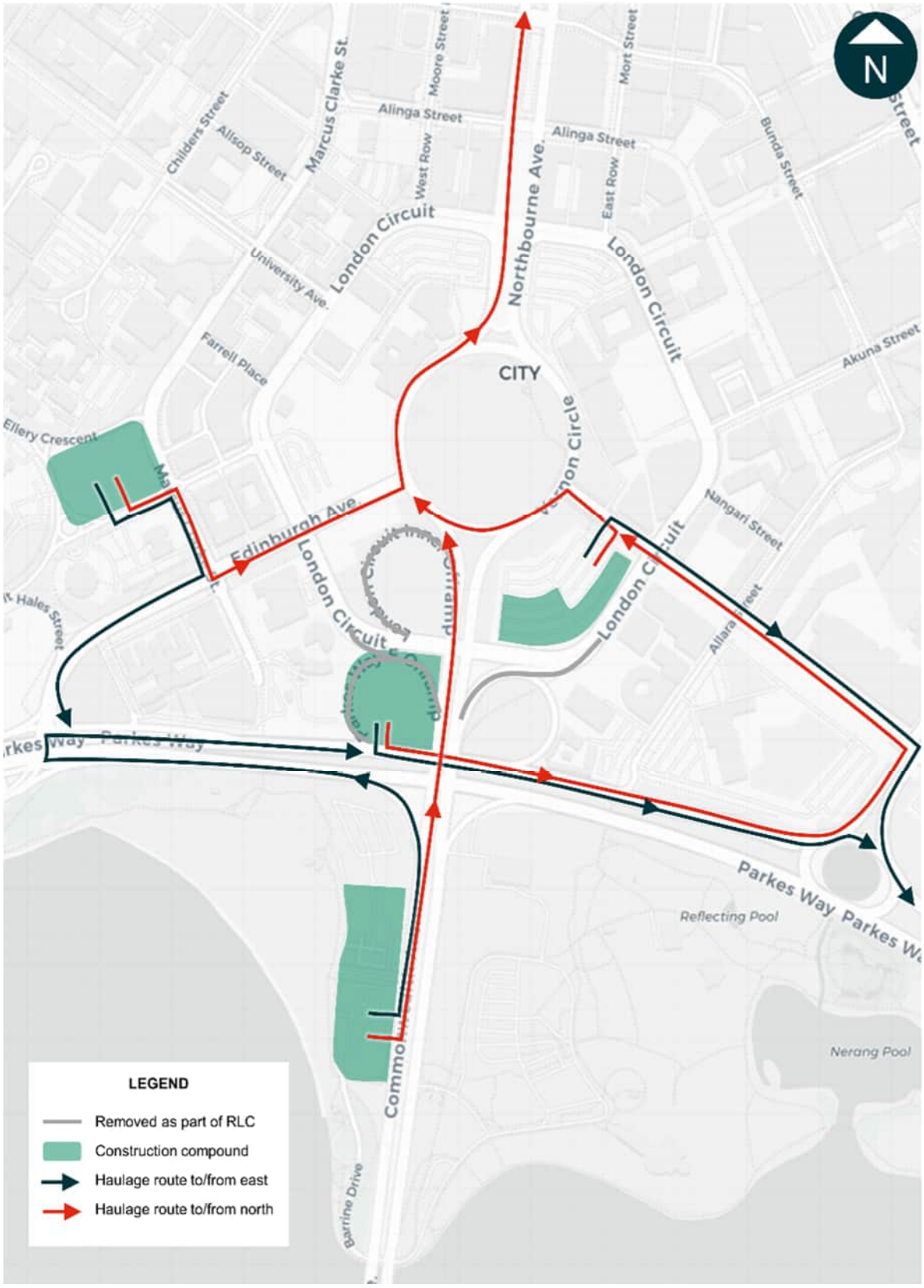


Figure 6-7 Outbound haulage routes

6.9.2 AM peak hour movements

Table 6-11 presents a summary of the existing, forecasted additional traffic flow and the resultant noise increases for the AM peak hour. At this stage, only peak existing and approximate additional traffic levels are provided per hour, therefore these have been considered at this stage. The most affected hour and therefore greatest predicted relative increase in traffic noise levels should be assessed at the detailed design stage.

Table 6-11 Construction road traffic noise peak hourly traffic counts – AM peak hour

Route	Direction	Existing traffic (hourly)		Approximate additional traffic (hourly)		Relative increase, dB(A)
		Light	Heavy[1]	Light	Heavy	
Northbourne Avenue between London Circuit and Alinga Street	Northbound	991	26	2	1	0.0
	Southbound	1,428	9	2	1	0.0
Parkes Way between Commonwealth Avenue and Edinburgh Avenue	Eastbound	3,621	83	2	1	0.0
	Westbound	2,485	86	2	1	0.0
Commonwealth Avenue between Parkes Way and Albert Street	Northbound	2,768	56	2	1	0.0
	Southbound	3,405	73	2	1	0.0
Edinburgh Avenue between London Circuit and Vernon Circle	Eastbound	282	10	2	1	0.1
	Westbound	30	0	2	1	1.6
Constitution Avenue between London Circuit and Allura Street	Eastbound	257	7	2	1	0.2
	Westbound	169	16	2	1	0.2

Notes:

1. Existing heavy vehicle movements conservatively include bus movements

No increases in road traffic noise of greater than 2 dB(A) have been identified along any of the proposed haulage routes during the AM peak hour.

6.9.3 PM peak hour movements

Table 6-12 presents a summary of the existing, forecasted additional traffic flow and the resultant noise increases for the PM peak hour. At this stage, only peak existing and approximate additional traffic levels are provided per hour, therefore these have been considered at this stage. The most affected hour and therefore greatest predicted relative increase in traffic noise levels should be assessed at the detailed design stage.

Table 6-12 Construction road traffic noise peak hourly traffic counts – PM peak hour

Route	Direction	Existing traffic (hourly)		Approximate additional traffic (hourly)		Relative increase, dB(A)
		Light	Heavy[1]	Light	Heavy	
Northbourne Avenue between London Circuit and Alinga Street	Northbound	970	4	2	1	0.1
	Southbound	978	4	2	1	0.1
Parkes Way between Commonwealth Avenue and Edinburgh Avenue	Eastbound	2,210	57	2	1	0.0
	Westbound	3,706	46	2	1	0.0
Commonwealth Avenue between Parkes Way and Albert Street	Northbound	2,746	45	2	1	0.0
	Southbound	2,335	67	2	1	0.0
Edinburgh Avenue between London Circuit and Vernon Circle	Eastbound	180	10	2	1	0.2
	Westbound	14	0	2	1	2.9
Constitution Avenue between London Circuit and Allura Street	Eastbound	306	17	2	1	0.1
	Westbound	156	5	2	1	0.3

Notes:

1. Existing heavy vehicle movements conservatively include bus movements

No increases in road traffic noise of greater than 2 dB(A) have been identified along the proposed haulage routes except for eastbound along Edinburgh Avenue. This section of Edinburgh Avenue directly adjoins commercial premises and recreational areas only, therefore the increase of 2.9 dB(A) is not predicted to negatively impact any noise sensitive receivers during the PM peak hour and is therefore deemed acceptable.

Truck movements would occur at any time throughout the work shift, but would not be continuous, i.e. there would be times when no trucks are travelling to or from work sites.

7.0 Operational noise assessment – Light rail noise

The assessment of road traffic noise has been completed in accordance with Roads ACT Noise Management Guideline (2018) (NMG). To assess the potential impact of the Project on noise sensitive receivers, future road traffic noise levels have been modelled for the Design Year build scenario. This scenario incorporates the ultimate design with the projected number of rail movements. All turnouts, posted design speeds and track features have been included in the design noise model.

7.1 Noise modelling methodology

Railway noise levels have been calculated using SoundPLAN v8.2 software, incorporating the Nordic Prediction Method (Kilde Report 130) algorithm. This algorithm predicts both $L_{Aeq(period)}$ and L_{Amax} noise levels. With suitable corrections, this method has been shown to give accurate predictions of railway noise under Australian conditions.

Noise levels for LRVs utilised in this assessment were previously measured by AECOM as presented in the final completion report for CLR 1 – *60513616-RPNV-02_C_Final_Completion_NV.*

The parameters which are included in the model are detailed in **Table 7-1**.

Table 7-1 Modelling noise parameters

Parameter	Comment
Ground Topographical contours	Terrain data and the Project alignment were obtained from the design team in CAD format for use in the noise predictions, including elevation lines and cadastre 1-metre grid terrain contour within the study area was used, and 3-D rail track design string based on the following CAD files: • S200-ACM-MOD-CIV-RW-ROAD_SURVEY_CONTOURS_3D.DXF • S210-ACM-MOD-CIV-TR-RAIL STRINGS.DXF dated 29 April 2022
Assessed buildings	All buildings have been assessed within 100 metres of the alignment. Each building has been given an identification number. The identification number is made up of: • Project chainage • Side of track • Distance from track centreline to building centroid
Traffic volumes	The number of LRVs using the railway during each period • Daytime (7 am to 10 pm) – 222 movements • Night-time (10 pm to 7 am) – 18 movements • Hourly maximum – 12 movements in each direction
Traffic speeds	The source speeds for the Project were modelled based on the design speeds shown in the track design drawings presented in: CLR POSTED LINE SPEEDS (CIN C082)_REV A. The majority of speed limits along Stage 2A are between 15-40 km/h, with a maximum speed of 60 km/h between London Circuit and Commonwealth Park Station.
Source levels	The source level defines the noise generated by the LRVs. Provided below is a summary of these source levels, measured at 60 km/h and 7.5 metres from the track centreline on CLR 1. $L_{Aeq,Tp}$ – 74 dB(A) L_{AFmax} - 81 dB(A)

Parameter	Comment
Rail surface discontinuities	Discontinuities such as track joins can create impact noise events, resulting in a localised increase in noise from the system. Embedded rail constitutes continuously welded rail, resulting in joints. The embedded track would be maintained to ensure that the rail surface is generally smooth plus free from corrugations and other surface discontinuities.
Curving and flanging noise	Curving and flanging noise can be generated on small radii curves (less than 200 metres for a light rail system) where a stick-slip motion is generated, resulting in either wheel-squeal or flanging noise. The LRV fleet will incorporate flange lubrication to minimise all flanging and wheel squeal noise generated by tight curves. This system will deploy lubrication on approach to the curve, ensuring that wheel-squeal and flanging noise is minimised. However the curve at the intersection of Northbourne Avenue and London Circuit is considerably tight (40 metre radius). Noise source data from tight turns on CLR 1 were used to model at this curve. The above noise source levels do not include any consideration of localised noise events such as wheel squeal and flanging. The following were applied to both the dBL_{Aeq} and dBL_{Amax} source levels to account for these events: Turnouts and crossing (10m on either sides of a turnout or crossing track discontinuity) (+ 6 dB(A)) Radii where noise from wheel squeal and flanging could occur (+3 dB(A) where R>300m<500m, and +8 where R<300m).
Railway source height	A single source has been modelled 0.5 m above the embedded track.
Length of train	33 m
Ground absorption	Railway noise levels reduce with increasing distance from the noise source along the ground. Ground absorption factors of 0.5 throughout the Project have been applied.
Buildings	The height of receiver buildings in the study area affects the noise exposure and it can also affect the amount of acoustic shielding provided to other nearby buildings. The height of all buildings within the study area was determined through a ground-truthing exercise and the heights were then included in the road traffic noise model.
Noise barriers	Existing noise barriers have not been identified within the Project area.
Facade	A correction of 2.5 dB(A) was added to all railway noise levels to take account of façade reflection effects in accordance with the NSW EPA RING. Noise levels have been calculated and assessed at each façade of each sensitive receiver location. Only the most affected façade for each receiver is presented in this report.
Noise from warning bells	Warning bells will be used only in emergencies. As such they have not been included in the assessment of the Project.

7.2 Noise sensitive receivers

Land use in the area immediately surrounding the project area is characterised by a CBD setting, transitioning to residential dwellings further to the north. Noise sensitive receivers within the study area were identified using aerial photography. The uses of all buildings within the study area were

determined through a ground-truthing site survey exercise. This, in conjunction with cadastral information, was used to determine the classification of residential, commercial, recreational and other uses within the Project noise assessment study area.

7.3 Airborne noise assessment

The detailed noise contours are provided in **Appendix F**. The closest residential receivers are located approximately 20 m from the alignment on London Circuit. With a maximum speed of 40 km/h in this section, the maximum noise level would be complied with at all locations. A maximum speed of 60 km/h is expected for Stage 2A.

The design has incorporated two curve radii of approximately 25 m at the corner of Northbourne Avenue and London Circuit, as well as the corner of London Circuit and Commonwealth Avenue. At these locations wheel squeal can be expected. In addition, wheel squeal may also occur at the three 70 m curve radii along London Circuit itself. There are currently no effective solutions to eliminate wheel squeal for tight radius curves that would meet the project constraints (for example steerable bogeys are likely to reduce the wheel squeal, which would not be feasible to incorporate in the design). Designing a resilient trackform has been proven to reduce the effect of wheel squeal, so the inclusion of the embedded track in the design is certainly an advantage. Adding too much resilience to the trackform, leads to an increase in corrugations, so a more resilient embedded track could cause more long term problems than it solves. Lubrication is also recommended to mitigate the occurrence of wheel squeal.

These improvements should minimise any curve squeal generated. Curve squeal is likely to still occur on occasion, however the SPR requires the consideration of all feasible and reasonable noise mitigation to address any noise issues. The above inclusions will meet these requirements.

It is noted however, that given the current modelling inputs the operation of LRVs along Stage 2A would be compliant at all sensitive receiver locations.

7.3.1 Mitigation recommendations

At this preliminary design stage, there are no sensitive receivers where noise levels would exceed the nominated daytime, night-time or maximum noise level criteria in SPR 2.2.2. However, as curve squeal may occur on occasion lubrication is recommended. Architectural treatments would not be required.

7.4 Ground-borne noise assessment

7.4.1 Ground-borne noise and vibration modelling

Detailed ground-borne noise and vibration calculations have been undertaken using AECOM's vibration calculation software. This software is an 'ISO14837-1: Mechanical vibration – Ground-borne noise and vibration arising from rail systems' compliant calculation tool used to calculate the emission and three-dimensional propagation of vibration. The software provides detailed information about the vibration in terms of tactile vibration, vibration dose values and the ground-borne noise generated by a project.

The software calculates the ground-borne noise and vibration impact at each sensitive receiver location within the project and presents the results as both impact contours and maximum results for each building.

7.4.2 Source vibration levels

Vibration measurements were completed during the commissioning phase of Stage 1 at Northbourne Avenue, 100 m south of the Greenway Street intersection on 17 December 2019 and can be found in AECOM's document *60513616-RPNV-02_C_Final_Completion_NV.* A summary of these results standardised to 60 km/h and to a distance of 1 m is presented in **Table 7-2**. Testing was undertaken in general accordance with ISO3095:2013.

Table 7-2 Measured Source Vibration Levels, dB ref 10^{-9} mm/s

Item	Frequency, Hz																		
	6.3	8	10	12.5	16	20	25	31.5	40	50	63	80	100	125	160	200	250	315	400
Vibration emission values	69	67	64	63	58	60	66	77	83	95	101	102	96	88	83	79	74	68	68

7.4.3 Slab coupling loss

The slab to ground coupling losses were previously determined during the design of CLR1 and considered to be suitable for use during this stage also. These losses are presented in **Table 7-3**.

Table 7-3 Slab coupling loss, dB

Item	Frequency, Hz																		
	6.3	8	10	12.5	16	20	25	31.5	40	50	63	80	100	125	160	200	250	315	400
Vibration coupling loss	0	0	0	0	0	-1	-2	-2	-5	-7	-10	-15	-12	-8	-1	2	2	-2	-13

7.4.4 Vibration ground loss

The transmission characteristics of the ground surrounding the CLR1 alignment were also previously determined and considered to be suitable for use during this stage also. The vibration attenuation through the ground is summarised in **Table 7-4** below.

Table 7-4 Measured vibration attenuation, dB per decade

Item	Frequency, Hz																		
	6.3	8	10	12.5	16	20	25	31.5	40	50	63	80	100	125	160	200	250	315	400
Measured vibration attenuation	-	13	11	10	10	16	19	18	23	27	31	45	50	43	51	62	57	80	87

7.4.5 Building coupling loss

The building coupling losses to be adopted for this assessment are summarised below in **Table 7-5**. These coupling losses are from the Transportation Noise Reference Book.

Table 7-5 Building coupling loss, dB

Item	Building type	Frequency, Hz																	
		6.3	8	10	12.5	16	20	25	31.5	40	50	63	80	100	125	160	200	250	315	400
Vibration coupling loss	Residential	-3	-4	-4	-5	-5	-6	-6	-6	-6	-6	-6	-6	-5	-5	-5	-4	-4	-4	-4
	Commercial	-5	-5	-6	-7	-8	-8	-9	-9	-9	-9	-9	-9	-8	-8	-8	-7	-6	-5	-5
	Commercial 2-4 storey masonry on spread footings	-6	-6	-7	-9	-11	-11	-12	-13	-13	-13	-13	-13	-12	-12	-11	-10	-9	-8	-8

Based on the measured vibration conducted during the commissioning phase of Stage 1 at Northbourne Avenue, the ground-borne noise exposure has been modelled for the Stage 2A alignment.

It should be noted that the modelled speed at this preliminary stage has been set to 60 km/h along the alignment. It is likely that the LRVs would be operating at a slower speed than this therefore the modelling is considered conservative. The majority of speed limits along Stage 2A are between 15-40 km/h, with a maximum speed of 60 km/h between London Circuit and Commonwealth Park Station.

The closest residential receivers are located approximately 20 m from the alignment at 5 London Circuit. Ground-borne noise levels and vibration dose values are predicted to meet with the SPR criteria at all receivers. The detailed noise contours are provided in **Appendix G**.

7.4.6 Mitigation recommendations

At this preliminary design stage, there are no sensitive receivers where noise levels or vibration would exceed the nominated criteria in SPR 2.2.1. As a result, no additional treatment would be required. It should be noted that at this stage it is not known if any particularly sensitive equipment is located in buildings adjacent to the proposed route. The operation of LRVs along Stage 2A would be compliant at all sensitive receiver locations.

8.0 Operational noise assessment – Road traffic noise

The assessment of road traffic noise has been completed in accordance with Roads ACT Noise Management Guideline (2018) (NMG). To assess the potential impact of the Project on noise sensitive receivers, future road traffic noise levels have been modelled for the 'no build' (without the Project) and 'build' scenarios for the year of opening (2026) and design year (2036). This is discussed further in **Section 8.2** and results are presented in **Section 8.3**.

8.1 Noise modelling methodology

Road traffic noise levels were calculated using SoundPLAN v8.2 software, which implements the Calculation of Road Traffic Noise (CoRTN) algorithm. The UK Department of Transport devised the CoRTN algorithm and with suitable corrections, this method has been shown to give accurate predictions of road traffic noise under Australian conditions.

The modelling parameters which are included in the model are detailed below in **Table 8-1.**

Table 8-1 Modelling noise parameters

Parameter	Comment
Traffic volumes and mix	The number of vehicles using the road and the percentage of heavy vehicles. A higher percentage of heavy vehicles would increase the road traffic noise levels. The mix of heavy vehicles i.e. double or triple axles would also affect the road traffic noise levels. Predicted traffic volumes for the year of opening (2026) and for the design year (2036) for the 'no build' and 'build' scenarios were sourced from traffic modelling (refer to the Traffic and Transport Impact Assessment prepared by AECOM).
Traffic speeds	An increase in speed generally causes an increase in road traffic noise. Traffic speeds have been based on current posted road speeds for all modelled scenarios
Roadway gradient	Road traffic noise levels vary dependent on the gradient of the roadway compared with a flat roadway. CoRTN calculates this variation, however it does not take into account noise from heavy vehicle engine braking. According to literature, similar A-weighted noise levels would be generated when heavy vehicles, with appropriately fitted OEM mufflers, use engine brakes as when under full throttle conditions. However, engine braking noise emitted from heavy vehicles without appropriate mufflers would be significantly higher than A-weighted levels emitted under full throttle conditions. Given that all heavy vehicles should be fitted with OEM mufflers (Transport estimate 95% of trucks are) the noise levels predicted by CoRTN are considered to adequately represent typical road traffic noise levels.
Road surface	Road surface characteristics would determine the level of road/tyre interfacial noise created. Dense graded asphalt (DGA) surfaces were modelled for all road surfaces. A correction (0 dB(A) for DGA) was applied to the road traffic noise model to account for the existing road surfaces
Ground absorption	Road traffic noise levels reduce with increasing distance from the noise source along the ground. A ground absorption factor of 0.6 was applied.
Terrain	Natural topographical features such as hills and valleys can shield sensitive receivers from road traffic noise. These effects are taken account of in the model which incorporates one metre terrain contours.

Parameter	Comment
Buildings	The height of receiver buildings in the operational study area affects the road traffic noise exposure. It can also affect the amount of acoustic shielding provided to other nearby buildings. The height of all buildings within the operational study area was determined through a ground-truthing exercise and the heights were then included in the road traffic noise model.
Noise barriers	No existing noise barriers were identified for this Project.
Facade	A correction of 2.5 dB(A) was added to all road traffic noise levels to take account of façade reflection effects. Noise levels have been calculated and assessed at each façade of each sensitive receiver location. Only the noise level at the most affected façade for each receiver is presented in this report.
Road network	All existing major roads were included in the noise model. Noise levels at the noise logger locations used for the model validation were predominantly controlled by the traffic on London Circuit, Commonwealth Avenue and Parkes Way. This was verified during site activities.
Standard corrections	CoRTN provides L_{A10} road traffic noise levels. The industry standard correction of -3 dB(A) was applied to convert the L_{A10} levels to L_{Aeq} road traffic noise levels to allow assessment of the results against the *Road Noise Policy* and *Noise Criteria Guideline* criteria. The Australian Road Research Board Australian conditions correction (Saunders et al, 1983) of -1.7 dB(A) was applied.

8.2 Modelled scenarios

To determine the noise impacts for sensitive receivers located close to the development two scenarios have been modelled. These are:

- Year 2026 'No build' scenario
- Year 2036 'Build' scenario.

8.3 Predicted operational road traffic noise impacts

Noise levels have been predicted for each scenario across the extent of the Project. Road traffic noise levels are predicted to exceed the $L_{Aeq(15hr)}$ noise criteria at a total of five noise sensitive receivers:

- Exceedance of the noise criterion at these receivers is predominantly caused by existing road traffic on Parkes Way
- Road traffic noise levels are not anticipated to increase by a significant amount due to the Project at these receivers.

As a result, no further consideration of operational road traffic noise mitigation is required. A summary of the aforementioned exceedances is provided in **Table 8-2** below. All assessed receiver locations and their predicted road traffic noise levels are presented in **Appendix H** and **Appendix I**.

Table 8-2 Road traffic noise assessment

ID	Address	Road traffic noise level, $L_{Aeq,15hr}$, dB(A)				Notes
		Criterion	Predicted noise level, 2026 'No Build'	Predicted noise level, 2036 'Build'	Change	
8	2 Marcus Clarke Street, Canberra	65	68	67	-0.7	No noise increase due to Project
12	19 Marcus Clarke, Street, Canberra (Low-rise)	65	68	68	0	No noise increase due to Project
14	19 Marcus Clarke, Street, Canberra (High-rise)	65	67	66	-0.1	No noise increase due to Project
19	2 Edinburgh Avenue, Canberra	65	66	66	0.4	Insignificant increase due to Project
94	12 Marcus Clarke Street, Canberra	64	64	65	1.2	Insignificant increase due to Project
95	3 Gordon Street, Canberra	63	63	64	1.2	Insignificant increase due to Project
20	1-3 Gordon Street, Canberra	65	66	66	0.2	Insignificant increase due to Project

9.0 Mitigation measures

9.1 Construction noise and vibration

The quantitative construction noise and vibration assessment presented in Section 6.0 noted the likelihood of 'highly intrusive' noise impacts. As a result of this, noise and vibration safeguards have been identified in Table 9-1 below.

Table 9-1 Noise and vibration safeguards

Impact	Environmental safeguards	Timing
Construction noise and vibration	Implement controls on construction equipment and activities in accordance with Australian Standards and manufacturer specifications. Regularly inspect, test and maintain all stationary and mobile plant equipment to ensure that emission levels do not deteriorate over the life of the Project.	During construction
Construction noise and vibration	Orientate noisy/vibration generating equipment as far as possible from receivers, and implement a 'no-idling' policy by shutting down construction equipment and vehicles when not in use	During construction
Construction noise and vibration	As part of monthly construction updates, receivers that could be highly noise affected by upcoming works would be notified, prior to the commencement of those works. The notification would include details of: • The construction activities likely to have noise or vibration impact • Construction period and construction hours • Any proposed mitigation measures for noise and vibration • Contact information for the project, including out of hours contact • Complaint, corrective action, and incident procedures and how to obtain further information	During construction
Construction noise and vibration	As necessary, undertake condition surveys on buildings and structures within the potential radius of effect, prior to commencement of demolition and heavy earthworks activities.	During construction
Construction noise and vibration	Construction activities for the Project would be undertaken between the hours of 7.00 am and 6.00 pm Monday to Friday and 7am to 1pm Saturdays (normal hours), with no work on Sundays and Public Holidays unless otherwise approved through an Out of Hours Works Plan request.	During construction
Construction noise	Construction works proposed to take place outside 'normal' construction hours would require individual assessment and approval on a case-by-case basis. In general, this process would include: • Identification of the duration, location, type of activities construction equipment involved • Assessment of the potential noise and vibration impact associated with the proposed construction activities and determination of the number and type of sensitive receivers potentially impacted	During construction

Impact	Environmental safeguards	Timing
	• Identification of any reasonable and feasible mitigation measures to be implemented • Consultation with the potentially impacted receivers to inform them of the proposed out of hours works, and providing an opportunity for impacted receivers to provide feedback • Minimising out of hours works as much as practicable (e.g., deliveries of equipment and materials could be made, or disposal of construction waste may be delayed until on the following day) • Inclusion of scheduled respite for the community for extended periods of night work	
Construction noise	A **Construction Noise and Vibration Management Plan** (CNVMP) would be developed to identify: • Potentially major noise and vibration generating activities associated with the Project, including delivery activities • Noise and vibration sensitive receivers • Measures to be implemented during construction to minimise noise and vibration impacts. • A monitoring program that obtains noise data that is representative of construction activities, and in response to complaints will be developed to assess performance against relevant noise and vibration criteria and will be used to inform continuous improvement to the CNVMP. • Methods for assessment and review of impacts associated with Out of Hours Works as part of continuous improvement	Pre-construction and during construction
Construction noise	When establishing work areas, site compounds and laydowns consideration would be given to arranging the site to limit the need for reversing associated with regular/repeatable movements, where safe and space permits.	During construction
Construction noise and vibration	Vibration generating activities would be managed, and construction equipment would be selected, to avoid working within the structural damage minimum working distances. The use of less vibration intensive methods of construction or equipment would be considered where feasible and reasonable.	During construction

9.2 Future noise monitoring locations

It is proposed that noise monitoring be conducted during the construction and pre-operation stages to verify noise emissions from the project to nearby sensitive receivers. The purpose of monitoring would be to verify the operational noise generated by the light rail systems at multiple locations, accounting for different track types, speed limits, and alignment. Additionally, construction noise would be monitored in order to verify the noise predictions provided in this report and determine if any further noise mitigation measures are required.

It is recommended that noise monitoring be conducted at two locations representative of the most noise impacted NCAs surrounding the development footprint. An additional noise monitoring location should be utilised outside “The Avenue Apartments” (Location 5) which is representative of the nearest residential receiver to the northern end of the site. Noise monitoring locations are shown visually in Figure 9-1.

Proposed future noise monitoring locations are at this stage preliminary and should be reconsidered as design development continues.

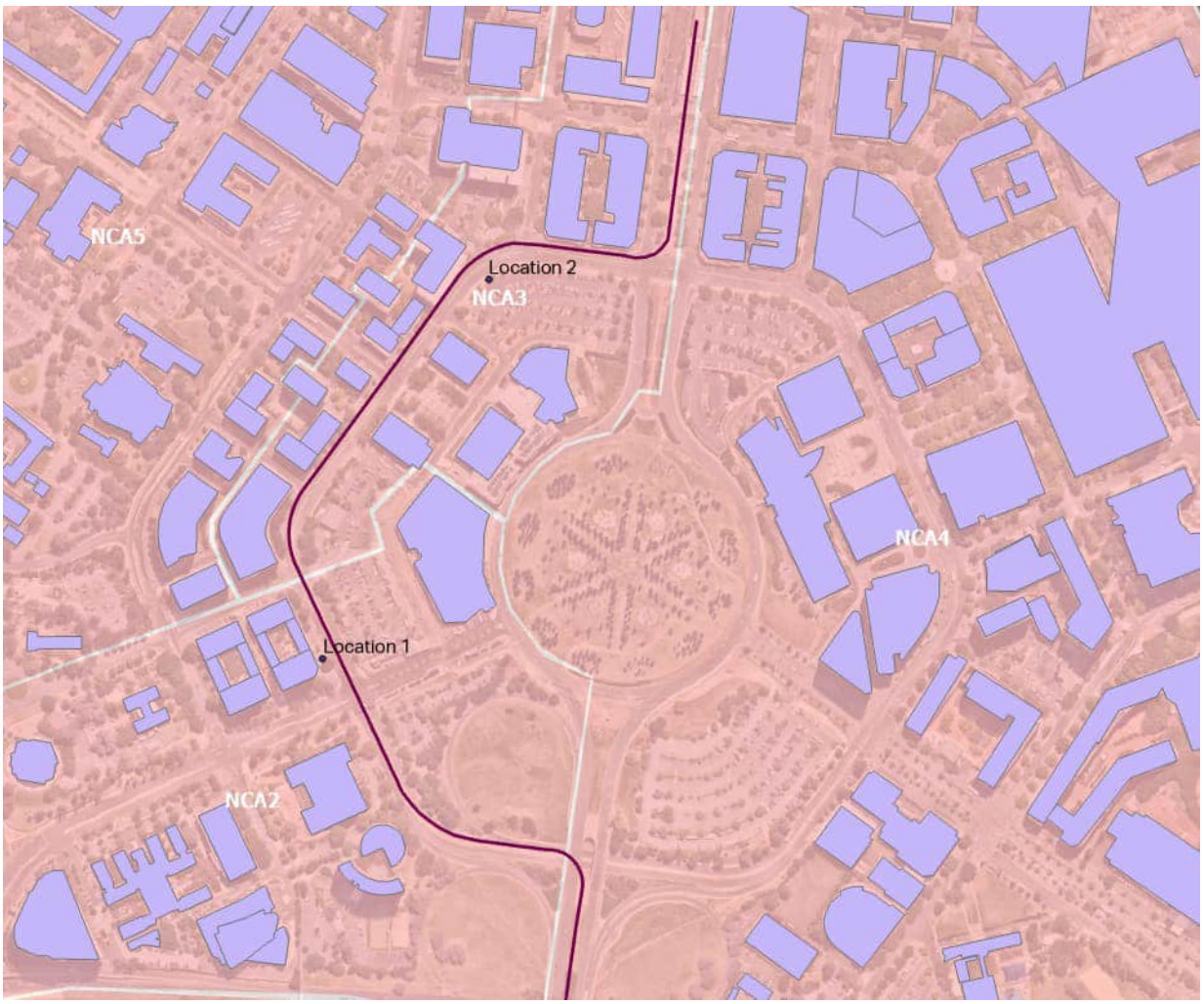


Figure 9-1 Proposed future noise monitoring locations

10.0 Conclusion

Major Projects Canberra (MPC) proposes to extend the existing Canberra Light Rail 1.7 kilometres from the Alinga Street stop to Commonwealth Park as a part of CLR Stage 2A. The project would include the construction of new light rail trackform and augmentation of some local roads to facilitate the extended alignment.

10.1 Construction impacts

A quantitative assessment of construction noise impacts due to the Project has been undertaken.

Some activities are required to be conducted during the night-time period, the most noise and vibration sensitive period for residential receivers.

Due to the proximity of works to the receivers (in some cases 5-10 metres from a building's façade), and the noisy nature of the works, noise impacts at the worst affected receivers are predicted to be 'highly intrusive' at times, that is noise levels up to 20 dB above the daytime noise assessment levels and 25 dB above the night-time noise assessment levels. Although the worst noise impacts would not continue over the entire duration of the main works since activities would move along the alignment as construction progresses, several weeks or months of 'highly intrusive' noise levels may be experienced by noise sensitive receivers during the daytime period.

Impacted receivers are primarily non-residential in nature, but the nearest residents to the site may also be impacted by elevated noise levels during construction. These premises are located on average 100-200 metres from the proposed alignment of the light rail.

Noise mitigation measures, both activity specific and general, have been provided, with a focus on scheduling noisiest works outside of the night-time period, noise reduction measures, community consultation, and good work practices on site.

Vibration impacts should be managed by adhering to minimum working distances to buildings, and mitigation measures have been provided should works be required within these distances. A specific vibration plan of management should be implemented to address the vibration sensitive alarms located at the Reserve Bank of Australia.

Based on the assessments detailed above, construction noise emissions are expected to generate some disturbance to the community, primarily during the night-time periods during the noisiest construction activities. These activities are temporary in nature, however they would require implementation of mitigation and management measures typical of major infrastructure projects.

10.2 Operational impacts

Operational airborne and ground borne noise levels have been predicted from the Light Rail Vehicles to nearby sensitive receivers.

There are no sensitive receivers where noise levels or vibration would exceed the nominated criteria LRV operational criteria. As a result, no additional treatment would be required. It should be noted that at this stage it is not known if any particularly sensitive equipment is located in buildings adjacent to the proposed route. The operation of LRVs along Stage 2A would be compliant at all sensitive receiver locations.

An operational road traffic noise assessment has been conducted in accordance with the *Roads ACT Noise Management Guideline*.

Noise levels have been predicted at sensitive receiver locations throughout the Project area during the daytime for the 'Year of Opening' 2026, and the 'Design Year' 2036.

Exceedances of the applicable noise criteria have been identified for five receivers. However, it should be noted that predicted noise levels at these receivers are primarily due to road traffic noise from Parkes Way, and not roads in the Project area. In addition, road traffic noise levels are not predicted to significantly increase at other receivers as a result of the Project. Therefore, no further consideration of noise mitigation is required.

Appendix A

ISC Env-2 & Env-3 noise and vibration benchmarks

Appendix A ISC Env-2 & Env-3 noise and vibration benchmarks

Table A-1: ISC Env-2 requirements

ISC requirement	Section addressed
DL1.1 Baseline studies of the existing noise environment have been carried out for the project.	Unattended noise logging surveys were conducted to determine the existing environment as addressed in **Section 0**.
DL1.2 Modelling and/or predictions for noise have been developed for construction and operation phases of the project.	Modelling and noise predictions were conducted for construction (**Section 6.0**) and operational noise (**Sections 7.0** and **8.0**). SoundPLAN v8.2 was utilised for the modelling with utilisation of the CONCAWE algorithm for construction noise, the Nordic Prediction Method (Kilde Report 130) algorithm for operational light rail noise. Predictions for noise are given in these sections and presented visually in **Appendix D**, **Appendix E**, **Appendix F** and **Appendix G**. The CoRTN algorithm for operational road traffic noise, the predicted road traffic noise levels are presented in **Appendix H**.
DL1.3 Noise goals are identified for the project.	Noise assessment levels are identified in **Section 5.0** of the report as based on local relevant guidelines and policies. Noise goals will be defined in the Construction Noise and Vibration Management Plan to be developed by the contractor.
DL1.4 Measures to mitigate noise during construction and operation have been identified and implemented to meet the goals developed in DL1.3.	Construction noise mitigation measures are presented in **Section 9.0** of the report based on what is reasonable and feasible for the project. No noise mitigation is required for the operational aspects of the project.
DL1.5 Monitoring requirements of noise impacts are included in relevant management plans (i.e. during high-impact activities)	Construction noise monitoring requirements should be included in the Construction Noise and Vibration Management Plan as per **Section 9.0**. A mitigation measure for the CNVMP to include “a monitoring program to assess performance against relevant noise and vibration criteria” has been included in **Section 9.0**.
If the scope and/or footprint has changed, then the baseline studies undertaken as part of a Planning rating must be reviewed and updated where necessary by a suitably qualified professional.	The noise assessment has been conducted based on the latest available information regarding the project footprint and scope. Any updates to the scope may require a variation to this report.
Baseline studies must be undertaken by a suitably qualified professional to identifying the pre-exiting noise environment prior to any potential project impacts (for example, prior to demolition works or breaking ground in construction).	Baseline noise studies were undertaken and presented in this report prior to demolition or site establishment works. Baseline studies were conducted by the AECOM NSW and ACT acoustics team, all of whom possess the grade of Member with the Australian Acoustical Society.

ISC requirement	Section addressed
These studies must consider representative sampling and links to activities in the area likely to affect the baseline.	Noise logging was conducted at representative locations surrounding the project area that suitably represent several noise catchment areas. Attended noise measurements were undertaken to verify the characteristics of the existing environment, with all weather and other extraneous noise removed from the survey. This is presented in **Section 4.3**.
The baseline assessment must identify the relevant environmental parameters and the minimum time and location monitoring requirements to suitably demonstrate change in environmental impacts throughout the duration of the construction and operational phases.	Noise logging was conducted at five representative locations around the project footprint for a period of 14 days. Noise logging was conducted in the third quarter of 2021. Differences in baseline noise levels are not expected, therefore it is not expected that this will impact on the noise assessment. Noise logging results are presented in **Section 4.3**.
The following must be included in the assessment: • Peak and average measurements of monitoring parameters, • Seasonal and/or time of day variations (whichever is most appropriate for accurate baselines to be established), • Specific local variations, representative sampling and links to activities likely to affect the baseline (such as nearby construction works or rail transport services), and • The measurement criteria/indicators/factors used in the assessments and associated justification of how these link to goals and targets.	All of the referenced information has been captured in noise monitoring result summary pages in **Appendix B**. All noise monitoring was conducted in accordance with the NSW EPA's Noise Policy for Industry which possesses consistent requirements to this condition.
A baseline for background noise levels must be determined using the assessment methodology for the type of works and operation for the asset development.	Background noise level measurements were conducted in accordance with the NSW EPA's Noise Policy for Industry. Any extraneous data or adverse weather events were omitted as per these guidelines. Details are presented in **Section 4.3.2** and **Appendix B**.
The measurements must be taken in locations that can be/are likely to be accessible throughout the construction and operational phases of the asset development.	Access was provided previously for properties where background noise measurements to be undertaken. These sites, (ANU School of Art, Archbishops House, RBA), are likely to be accessible for further measurements if required during construction and operational phases of the project.
Where measurement locations are temporary or are likely to change this must be clearly identified with appropriate justification,	Measurement locations are permanent.
The baseline assessment must consider existing long-term noise impacts that may be affecting human health and detail the noise source, time measured and associated peak and average noise levels.	Existing long-term noise impacts (such as traffic noise and commercial noise) are addressed in **Section 4.3.3**.
Baseline studies must consider the location of sensitive receivers.	Sensitive receivers have been considered and are presented in **Section 4.1**.

ISC requirement	Section addressed
Noise predictions must be established for the construction and operation phases of the project, and consider a comparison against the baseline data as established in DL1.1.	Predictions of noise levels for construction and operation of the project have been presented and compared to the criteria derived in this report in **Sections 6.6**, **6.7**, **7.3**, **7.4**, and **8.3**.
Predictions must be developed by a suitably qualified professional and incorporate all equipment proposed to be used through the construction and operation of the project that could result in noise impacts.	Noise impact from all proposed construction and operational noise sources have been addressed. Noise sources considered for construction noise impacts are summarised in **Table 6-2**. Operational impacts have been addressed as per **Section 7.1** and **8.1**. Modelling has been conducted by Suitably Qualified Professionals..
Predictions must factor in sensitive receivers and the increased impact that noise may have on them. Impacts can vary greatly depending on the distance to each sensitive receiver, as well as any intervening topography or buildings.	All appropriately noise sensitive receivers have been considered for the project. Noise criteria has been derived for each receiver based on the land use of the property. Distance to receivers, intervening topography, and buildings have all been included in the noise model.
Predictions must be incorporated and influence noise goals established in DL1.3.	Noise goals have been established considering the baseline data and predictions.
If noise goals have been established and verified as part of a Planning rating, then those goals must be incorporated into the project's management plan or similar.	Not applicable
If the scope and/or footprint of the project has changed, then the goals established as part of a Planning rating must be reviewed and updated where necessary by a suitably qualified professional.	Not applicable
Noise goals must be established for the project considering the baseline data (DL1.1) and predictions (DL1.2). The goals must be SMART (specific, measurable, achievable, relevant and time-bound) and must align with a no net impact outcome.	Noise goals have been established based on DL1.1 and DL1.2. The goals are SMART, and align with the criteria defined by other relevant acoustical planning guidelines.
The evidence for this criterion must include: • Any assumptions made, with relevant calculations, • The methodology used to develop the goals, • Background information demonstrating how the goals align with the intended outcome/s, and • How the baseline assessment has been incorporated.	Details of noise criteria and assessment methodology is referenced in **Section 5.0**. Derivation of noise criteria is based on relevant planning guidelines and baseline noise measurements, with the ultimate goal to minimise noise impact to sensitive receivers.
Baseline studies and noise predictions must be used to inform the management process and measures.	Baseline studies and noise predictions were conducted as per **Section 4.0**, **5.2** and **5.3**. Management process and measures are provided in **Section 9.0** and are based on the above noise predictions.
Measures to meet the goals identified in DL1.3 must be identified for construction and operation and must be included in the project's Environmental Management, Construction and Operational Environmental Management Plans, specific Noise Management Plans or similar.	Noise mitigation measures are provided in **Section 9.0** of the report. These measures would be properly implemented by the construction contractor for the project specific Noise Management Plan.

ISC requirement	Section addressed
The measures implemented/adopted to meet the goals identified in DL1.2 must be detailed for construction and operation.	Noise mitigation measures required are presented in **Section 9.0** for construction, and **Section 7.3.1**, **7.4.6**, and **8.3** for operational noise.
The measures identified for construction and operational phases must be implemented.	To be addressed by Contractor.
Where works are deemed unavoidable or essential, suitable control measures must be used to ensure that the impact is minimised as much as is feasible and reasonable.	Suitable control measures as are standard for construction noise mitigation are detailed in **Section 9.1**.
A schedule for all planned works with appropriate approvals process and identified control measures must be provided as evidence during the design phase.	Construction schedule is outlined in **Section 6.5**.
Monitoring requirements of noise must be included in relevant management plans for construction and operation & maintenance manuals for the operational phase (where required).	Monitoring requirements for construction noise are outlined in **Table 9-1**. These would be finalised by the construction contractor in the Construction Noise and Vibration Management Plan (CNVMP). No noise monitoring is required for the operational phase of the project.
These must include the frequency, duration and locations of monitoring, any relevant triggers (e.g. high-risk activities like night works) and the parameters to be monitored.	Monitoring requirements for construction noise are outlined in **Table 9-1**. These would be finalised by the construction contractor in the Construction Noise and Vibration Management Plan (CNVMP). Details of frequency, duration, and locations of monitoring should be specified at the detailed design stage.
Justification of the frequency and duration of monitoring during the construction phase must be included and be sufficient to appropriately review the efficacy of control measures implemented.	Monitoring requirements for construction noise are outlined in **Table 9-1**. These would be finalised by the construction contractor in the Construction Noise and Vibration Management Plan (CNVMP). Details of frequency, duration, and locations of monitoring should be specified at the detailed design stage.
DL2.1 Modelling and/or predictions demonstrate no recurring or major exceedances of the noise goals set in DL1.3.	Exceedances are noted for construction noise goals identified in DL1.3. It is noted however that major infrastructure projects in the ACT are not required to comply with the recommended noise goals presented in **Section 5.2**. No recurring or major exceedances are expected as a consequence of the operation of the project.
Modelling and/or predictions must demonstrate no recurring or major exceedances of the noise goals set in DL1.3.	As above.
Where exceedances are predicted, these must be clearly identified with the appropriate control measures to limit the scale of the impact.	Exceedances of the noise goals are provided in **Section 6.6.** Reasonable and feasible noise mitigation measures to manage these exceedances are proposed and provided in **Section 9.0**.
In addition, a report developed by a suitable qualified professional must be provided, providing justification and interpretation of the results with any recommended controls.	Justification of any exceedances are provided in Sections **6.6.2**. Recommended controls are provided in this report in Section **9.0**. Reporting has been conducted by a Suitably Qualified Professional.

ISC requirement	Section addressed
DL3.1 Modelling demonstrates no exceedances of the noise goals.	Exceedances of the noise goals are provided in Section 6.6.1.
Modelling and/or predictions must demonstrate no exceedances of the noise goals set in DL1.3.	As above

Table A-2: ISC Env-3 requirements

ISC requirement	Section addressed
DL1.1 Baseline studies of the existing vibration environment and dilapidation surveys have been undertaken for properties potentially impacted by vibration.	No high vibration generating sources currently exist within the project area. It is of the opinion of the Suitably Qualified Professional that the existing vibration environment is null. Dilapidation surveys would be conducted by the contractor where necessary. Mitigation measures in **Section 6.8** detail that where the use of vibration intensive equipment within the relevant minimum working distances cannot be avoided, a detailed inspection would be carried out and a written and photographic report prepared to document the condition of buildings and structures within the minimum working distances. Vibration modelling has been conducted by Suitably Qualified Professionals.
DL1.2 Modelling and/or predictions for vibration have been developed for construction and operation phases of the project.	Predictions for construction and operational vibration have been provided in **Section 6.8** and **Section 7.4**. Minimum working distances for vibration intensive construction works are provided in **Section 6.8.1**.
DL1.3 Vibration goals are identified for the project.	Vibration goals are outlined in **Section 5.2.2**.
DL1.4 Measures to mitigate vibration during construction and operation have been identified and implemented to meet the goals developed in DL1.3.	Construction vibration mitigation measures are provided in **Section 6.8**. If vibration mitigation measures are properly implemented, vibration goals will be met. No operational vibration mitigation measures are required.
DL1.5 Monitoring requirements of vibration impacts are included in relevant management plans (i.e. during high-impact activities)	Vibration monitoring would only be required if high vibration activities are to occur within the minimum working distances outlined in **Section 6.8.1**.
If the scope and/or footprint has changed, then the baseline studies undertaken as part of a Planning rating must be reviewed and updated where necessary by a suitably qualified professional.	Not applicable
Baseline studies must be undertaken by a suitably qualified professional to identify the pre-existing vibration environment ideally prior to the procurement phase of the project commencing.	No high vibration generating sources currently exist within the project area, therefore the existing vibration environment is expected to be null. It is the opinion of the Suitably Qualified Professional that baseline studies are not required for vibration.

ISC requirement	Section addressed
Dilapidation surveys must be undertaken for properties potentially impacted by vibration if they exist	Dilapidation surveys would be conducted by the contractor where necessary. Mitigation measures in **Section 6.8** detail that where the use of vibration intensive equipment within the relevant minimum working distances cannot be avoided, a detailed inspection would be carried out and a written and photographic report prepared to document the condition of buildings and structures within the minimum working distances.
If heritage buildings and sensitive environments do exist on or near the project site, and baseline studies are not required, then justification must be provided by a suitably qualified professional outlining why baseline studies are not needed.	Baseline studies are not required as heritage buildings and sensitive environment are not located within the minimum working distances outlined in **Table 6-10**.
Vibration predictions must be established for the construction and operation phases of the project, considering the baseline data established in DL1.1.	Vibration predictions for construction phases of the project are based on the adherence to minimum working distances outlined in **Table 6-10**. Predictions for ground-borne noise generated by the operation of the project are provided in **Section 7.4**.
Predictions must be developed by a suitably qualified professional and incorporate all equipment proposed to be used through the construction and operation of the project that could result in vibratory impacts.	Vibration impact from all proposed construction and operational vibration sources have been addressed. Sources considered for construction vibration impacts are summarised in **Table 6-10**. Operational vibration impact is addressed in **Section 7.4**.
Predictions must factor in sensitive receivers and the increased impact that vibration may have on them.	All receivers surrounding the site that may be impacted by high vibration activities are considered in the vibration assessment.
Predictions must be incorporated and influence vibration goals established in DL1.3.	Vibration goals have been established considering proposed vibration sources and distances to receivers.
Suitable evidence to demonstrate that the risk of vibration is insignificant must be provided for verification.	Evidence that risk of vibration is insignificant is based on minimum working distances which is provided in **Table 6-10**.
If vibration goals have been established and verified as part of a Planning rating, then those goals must be incorporated into the project's management plan or similar.	Not applicable
If the scope and/or footprint of the project has changed, then the goals established as part of a Planning rating must be reviewed and updated where necessary by a suitably qualified professional.	Not applicable
Vibration goals must be established for the project considering the baseline data and predictions.	Vibration goals are based on relevant vibration criteria. The baseline is conservative in assuming that the existing vibration levels are null.
The goals must be SMART (specific, measurable, achievable, relevant and time-bound) and must align with a no net impact outcome.	The vibration related goals are SMART, and align with the criteria defined by other relevant vibration planning guidelines.

ISC requirement	Section addressed
The evidence for this criterion must include: • Any assumptions made, with relevant calculations, • The methodology used to develop the goals, • Background information demonstrating how the goals align with the intended outcome/s, and • How the baseline assessment has been incorporated.	Details of vibration criteria are referenced in **Section 5.0**. Derivation of criteria is based on relevant planning guidelines, with the ultimate goal to minimise vibration impact to sensitive receivers.
The measures implemented/adopted to meet the goals identified in DL1.3 must be detailed for construction and operation.	Vibration mitigation measures required are presented in **Section 9.0** for construction, and **Section 7.4.6** for operational noise. Where construction vibration mitigation measures are properly implemented, the goals set out in this report are expected to be met.
The measures identified for construction and operational phases must be implemented. During the design phase, this means measures implemented into the design to mitigate impacts in operation and for construction, controls required to mitigate impacts in the construction phase.	Vibration mitigation strategies are outlined in **Section 9.0**. To be addressed by the Contractor.
Monitoring requirements of vibration must be included in relevant management plans for construction and operation & maintenance manuals for the operational phase (where required).	Monitoring requirements for construction vibration is outlined in **Table 9-1**. The Construction Noise and Vibration Management Plan would include “a monitoring program to assess performance against relevant noise and vibration criteria”. No vibration monitoring is required for the operational phase of the project.
These must include the frequency, duration and locations of monitoring, any relevant triggers (e.g. high-risk activities) and the parameters to be monitored.	General monitoring requirements for construction vibration is outlined in **Table 9-1**. The Construction Noise and Vibration Management Plan would include “a monitoring program to assess performance against relevant noise and vibration criteria”. Details of frequency, duration, and locations of monitoring should be specified at the detailed design stage.
Justification of the frequency and duration of monitoring during the construction phase must be included and be sufficient to appropriately review the efficacy of control measures implemented.	Monitoring requirements for construction vibration is outlined in **Table 9-1**. The Construction Noise and Vibration Management Plan would include “a monitoring program to assess performance against relevant noise and vibration criteria”.
DL2.1 Modelling demonstrates no exceedances of vibration goals for structural damage to buildings and structures.	Modelling shows that during construction possible exceedances of vibration goals are based on that of the minimum working distances to vibration sensitive buildings and structures. Vibration monitoring is to be undertaken where it is not possible to adhere to the minimum working distances outlined in **Section 6.8.1**. No exceedances in operational vibration goals are predicted as per **Section 7.4.6**.
DL2.2 For operation, modelling demonstrates no recurring or major exceedances of vibration goals for human comfort criteria.	No major exceedances of vibration goals for human comfort are expected as per **Section 7.4.6**.

ISC requirement	Section addressed
Modelling must demonstrate there are no exceedances of vibration goals for structural damage to buildings and structures.	No major exceedances of vibration goals for structural damage are expected as per **Section 7.4.6**.
Where exceedances are predicted, these must be identified with the appropriate control measures to limit the scale of the impact.	No controls required.
The controls identified for construction and operational phases must be implemented. During the design phase, this means controls implemented into the design to mitigate impacts in operation and controls required in the construction phase that must be incorporated into management plans or similar.	Vibration mitigation strategies are outlined in **Section 9.0**. Suitable vibration controls are to be included in the Construction Noise and Vibration Management Plan to be provided at the detailed design stage.
The suitable control measures identified must be communicated to the relevant stakeholders for implementation in construction and include the methods that will be used to communicate the controls required (e.g. toolbox talk agendas/outlines).	Suitable vibration controls are to be included in the Construction Noise and Vibration Management Plan to be provided at the detailed design stage.
Modelling must demonstrate there are no recurring or major exceedances of vibration goals for human comfort criteria for operation.	No major exceedances of operational vibration goals for human comfort are expected as per **Section 7.4.6**.
Where exceedances are modelled/predicted, these must be identified with the appropriate control measures to limit the scale of the impact.	No major exceedances of vibration goals for structural damage are expected as per **Section 7.4.6**. Vibration mitigation strategies are outlined in **Section 9.0**.
The measures identified for construction and operational phases must be implemented. During the design phase, this means measures implemented into the design to mitigate impacts in operation and for construction, controls required to mitigate impacts in the construction phase.	Vibration mitigation strategies are outlined in **Section 9.0**. Suitable vibration controls are to be included in the Construction Noise and Vibration Management Plan to be provided at the detailed design stage.
Suitable evidence to demonstrate that the risk of vibration is insignificant must be provided for verification.	Evidence demonstrating insignificant vibration risk is provided in **Sections 6.8** and **7.4**.
DL3.1 For operation, modelling demonstrates no exceedances of vibration goals for human comfort criteria.	No exceedances of vibration goals for human comfort criteria are expected as per **Section 7.4.6**.
Modelling must demonstrate there are no exceedances of vibration goals for human comfort criteria.	No exceedances of vibration goals for human comfort criteria are expected as per **Section 7.4.6**. Construction will not lead to exceedances in human comfort criteria provided the minimum working distances provided in **Section 6.8.1** are adhered to.
Where exceedances are predicted, these must be identified with the appropriate control measures to limit the scale of the impact.	No exceedances of vibration goals for human comfort criteria are expected as per **Section 7.4.6**. Construction will not lead to exceedances in human comfort criteria provided the minimum working distances provided in **Section 6.8.1** are adhered to.

ISC requirement	Section addressed
The measures identified for construction and operational phases must be implemented.	To be addressed by Contractor.
Suitable evidence to demonstrate that the risk of vibration is insignificant must be provided for verification.	No exceedances of vibration goals for human comfort criteria are expected as per **Section 7.4.6**. Construction will not lead to exceedances in human comfort criteria provided the minimum working distances provided in **Section 6.8.1** are adhered to.

Appendix B

Noise logger reports

Noise Logger Report

Archbishops House, Parkes

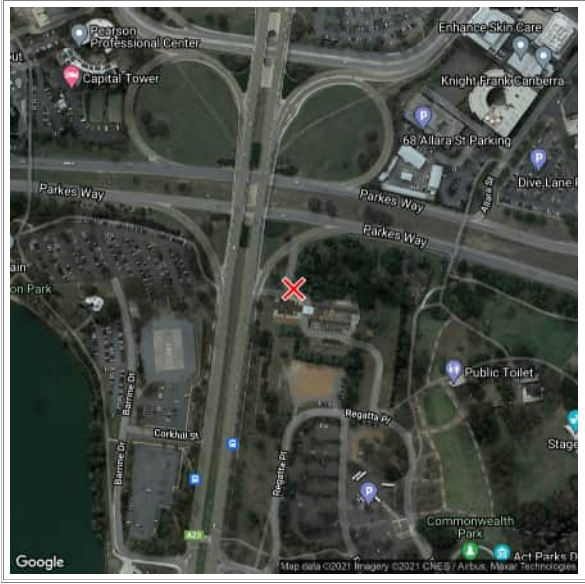
Item	Information
Logger Type	NL-52
Serial number	175537
Address	Archbishops House, Parkes
Location	Archbishops House, Parkes
Facade / Free Field	Free field
Environment	Noise environement dominated by road noise from on-ramp to Commonwealth Avenue. Cockatoos present

Measured noise levels

Logging Date	$L_{Aeq,day}$ 7am-6pm	$L_{Aeq,evening}$ 6pm-10pm	$L_{Aeq,night}$ 10pm-7am	ABL Day 7am-6pm	ABL Eve 6pm-10pm	ABL Night 10pm-7am	$L_{Aeq,15hr}$ 7am-10pm	$L_{Aeq,9hr}$ 10pm-7am
Mon Jul 26 2021	64	61	54	-	-	-	62	54
Tue Jul 27 2021	64	60	57	-	53	-	63	57
Wed Jul 28 2021	65	60	54	-	-	-	64	54
Thu Jul 29 2021	63	61	57	-	54	38	62	57
Fri Jul 30 2021	62	61	56	56	53	37	62	56
Sat Jul 31 2021	61	60	56	53	55	39	61	56
Sun Aug 1 2021	61	58	55	-	49	40	60	55
Mon Aug 2 2021	61	59	54	54	50	34	61	54
Tue Aug 3 2021	64	61	58	-	-	-	63	58
Wed Aug 4 2021	65	61	58	-	55	-	63	58
Thu Aug 5 2021	64	61	58	-	54	-	63	58
Fri Aug 6 2021	62	62	57	-	55	41	62	57
Sat Aug 7 2021	61	59	55	-	50	39	60	55
Sun Aug 8 2021	59	57	54	49	47	40	58	54
Mon Aug 9 2021	61	-	55	-	-	-	61	55
Summary	**63**	**60**	**56**	**54**	**53**	**39**	**62**	**56**

Note: Results denoted with '-' do not contain enough valid data for a value to be calculated. The data has been excluded either manually or automatically as a result of adverse weather conditions.

Logger Location



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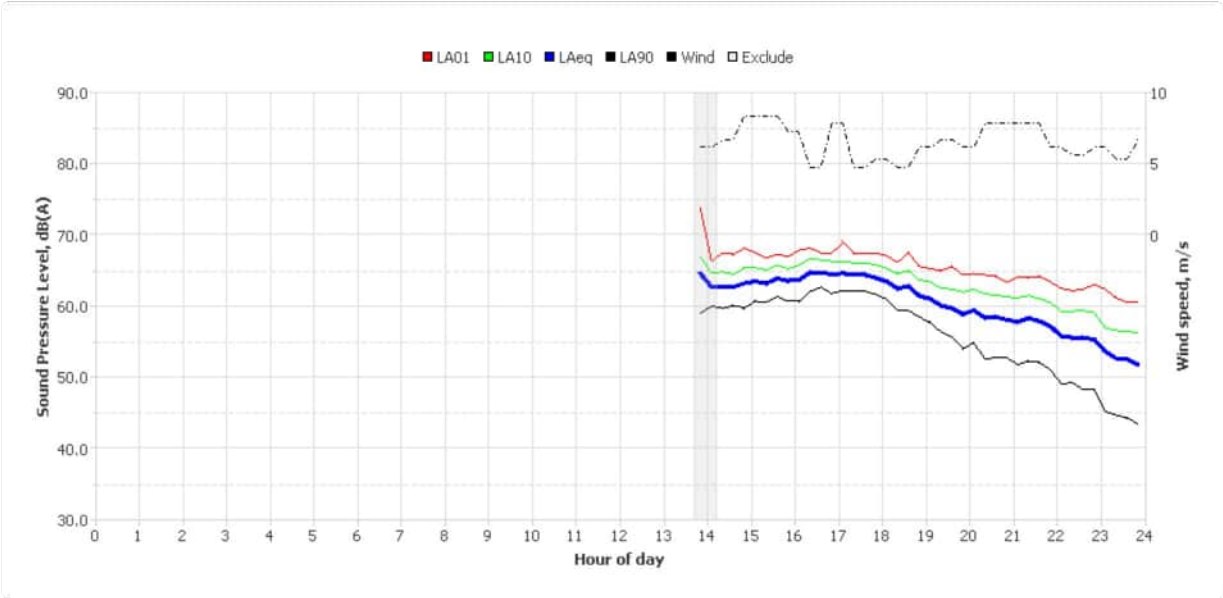

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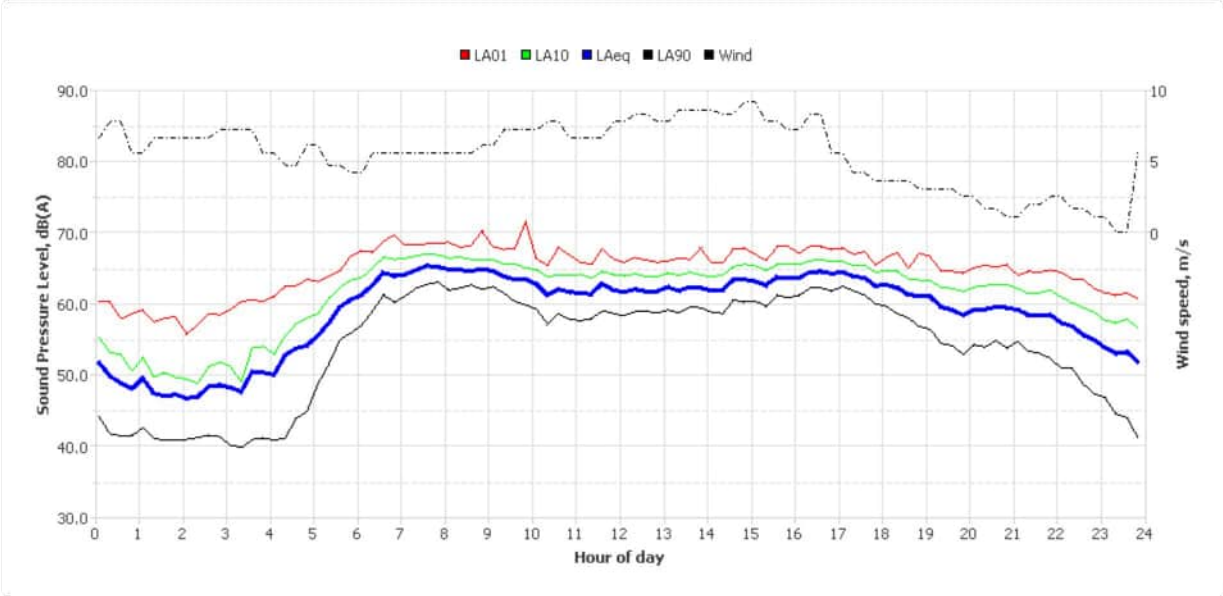

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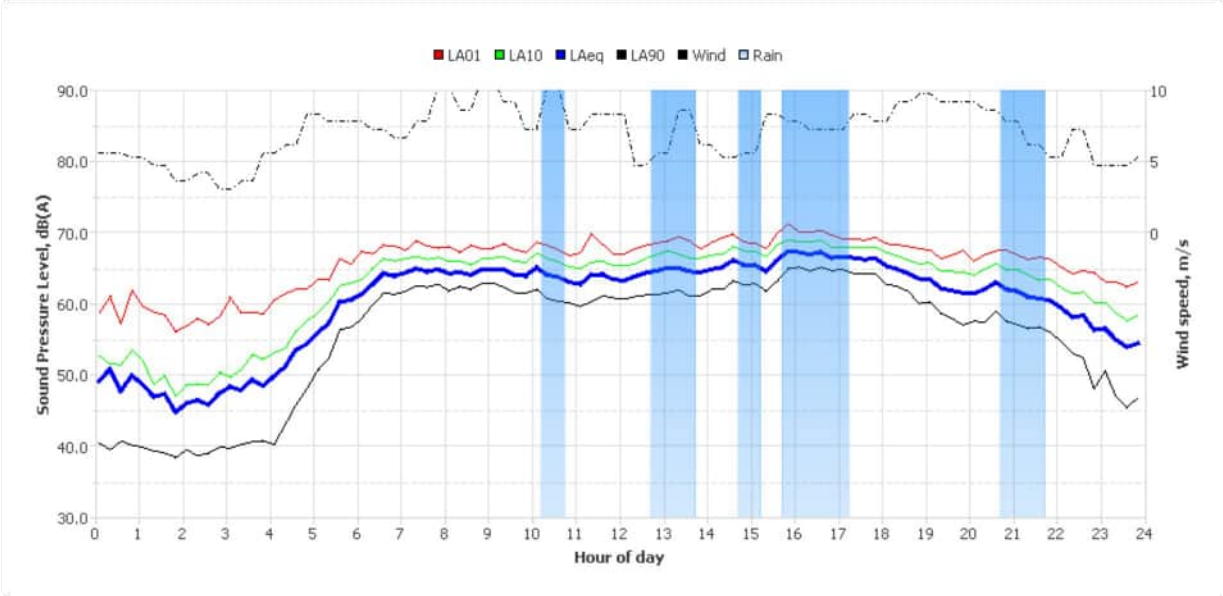

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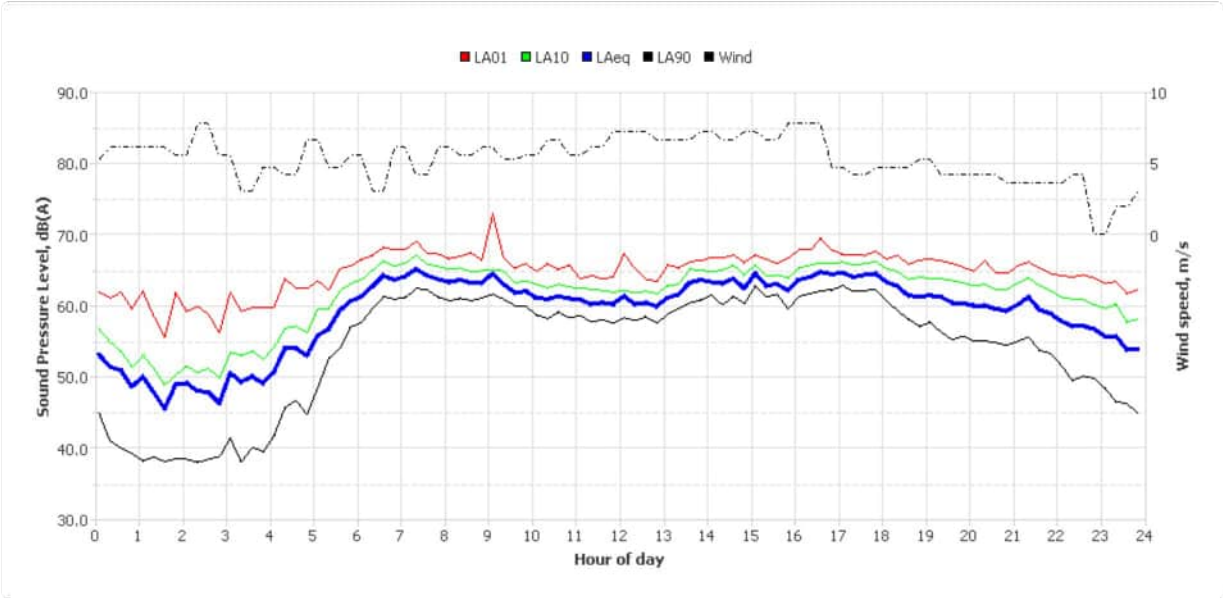

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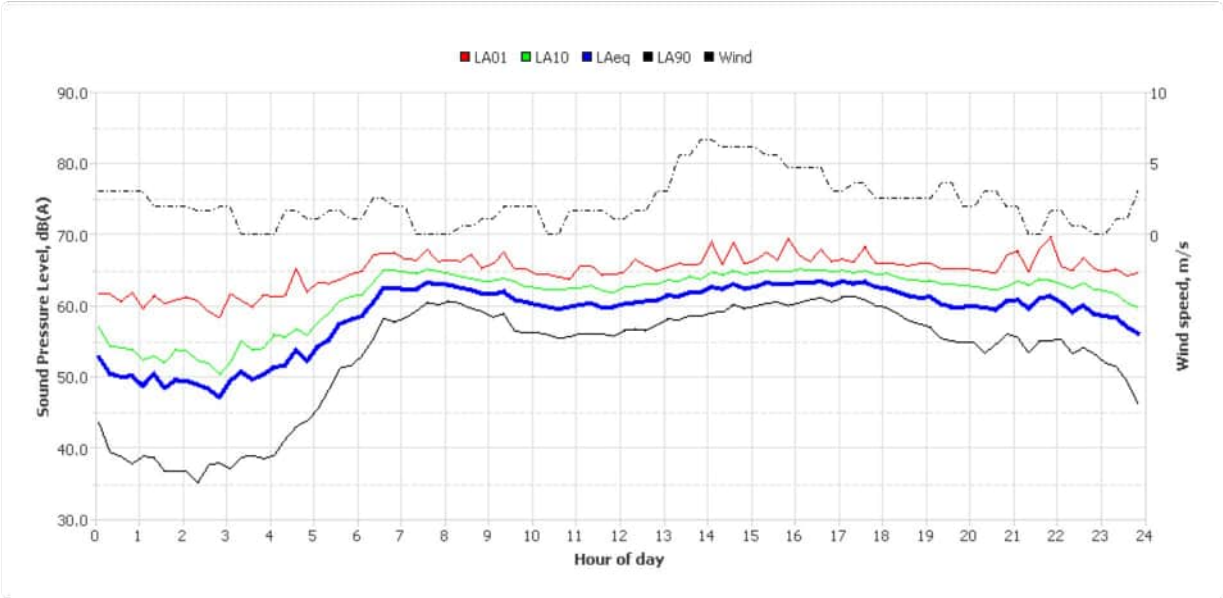

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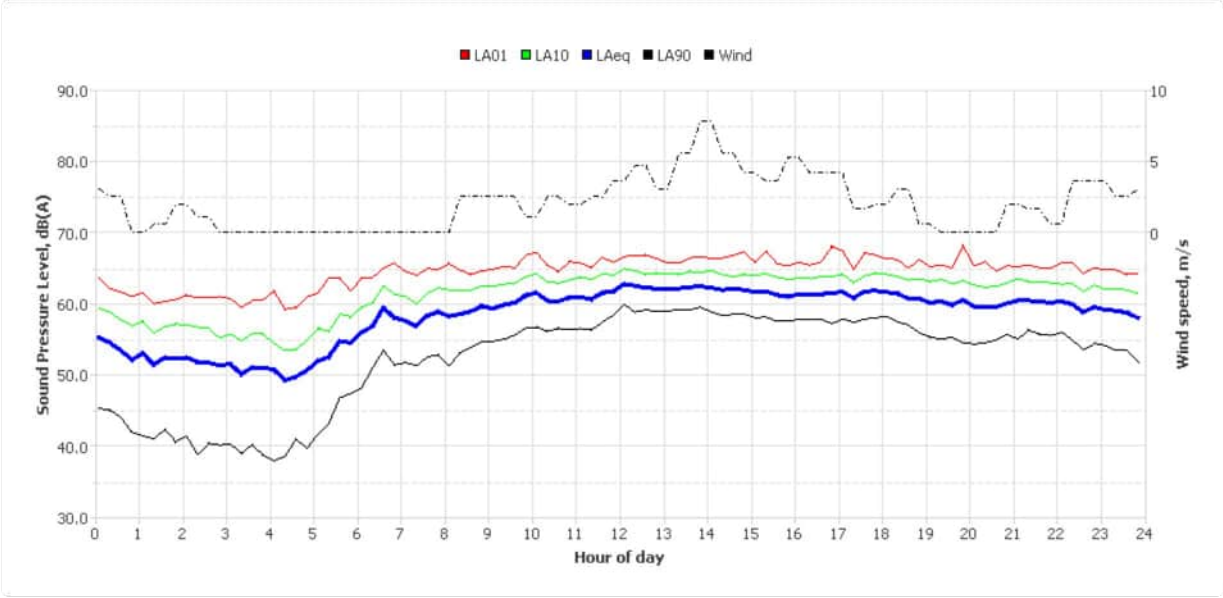

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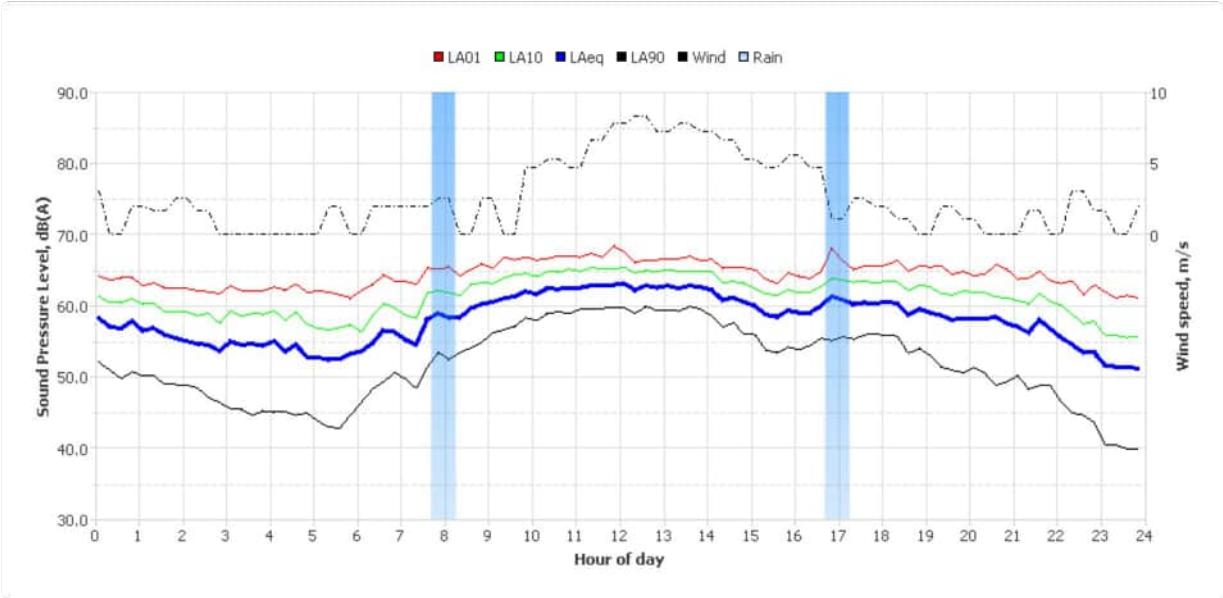

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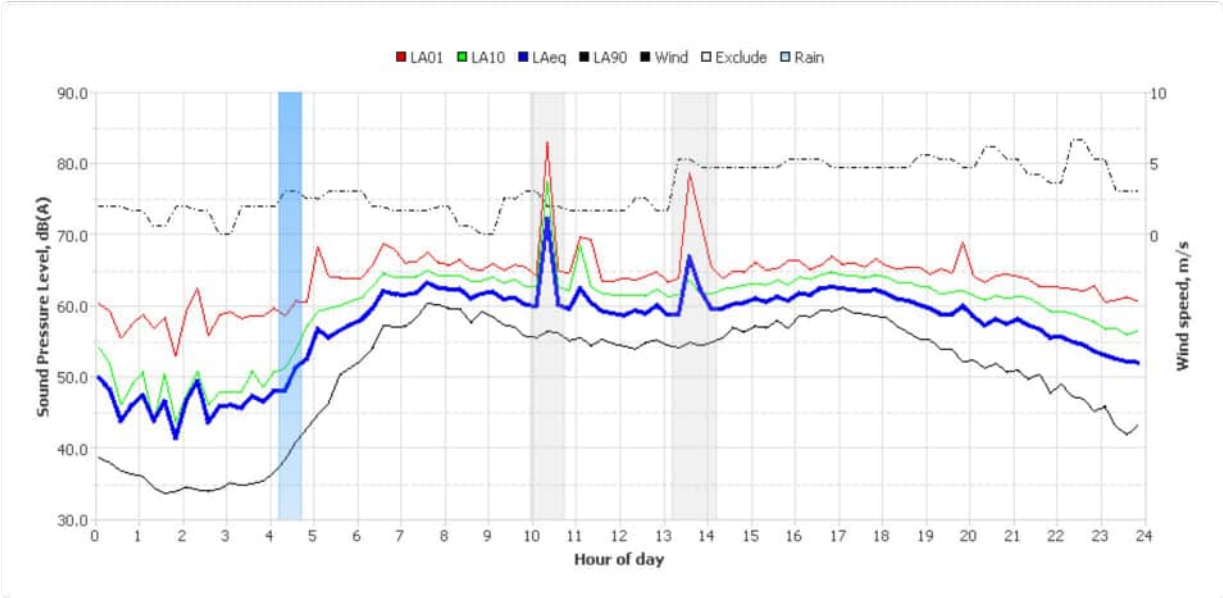

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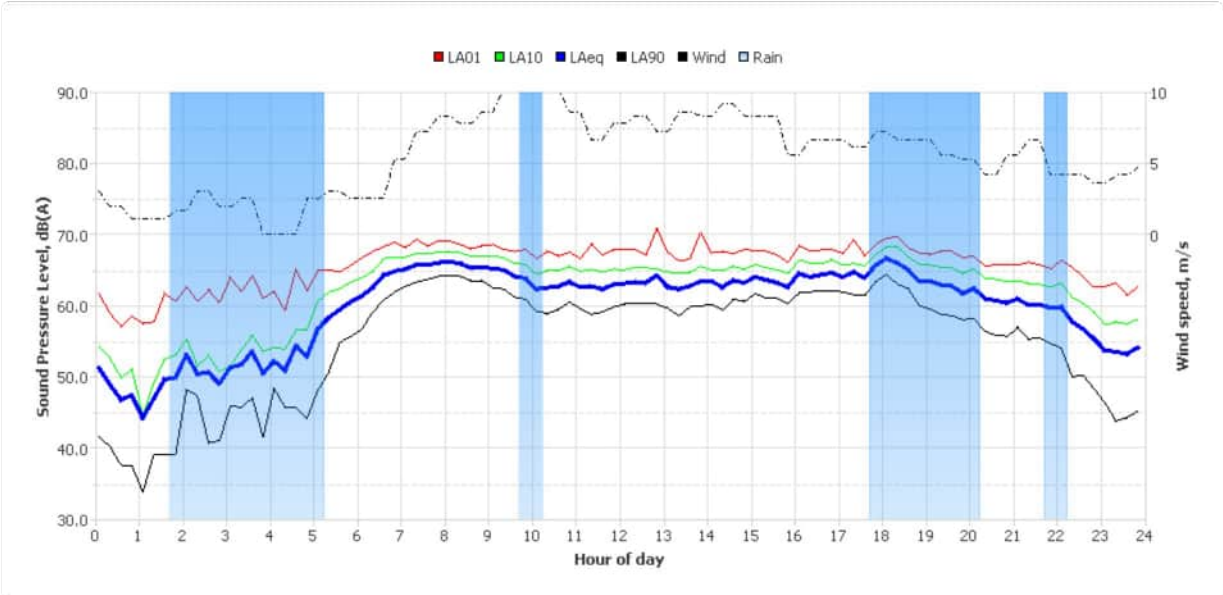

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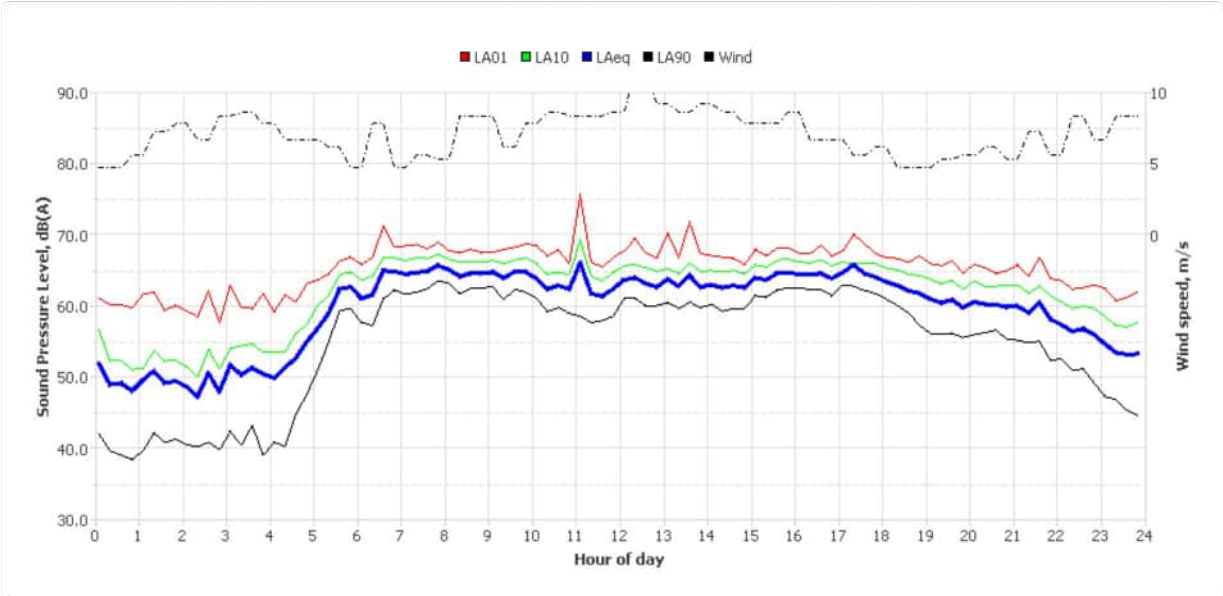

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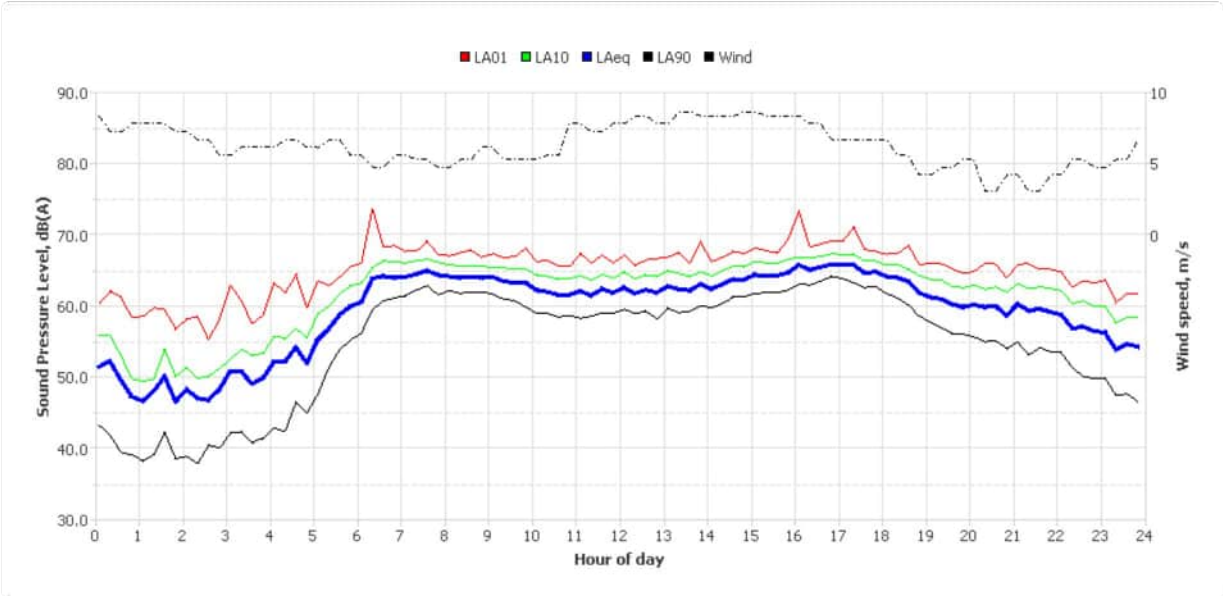

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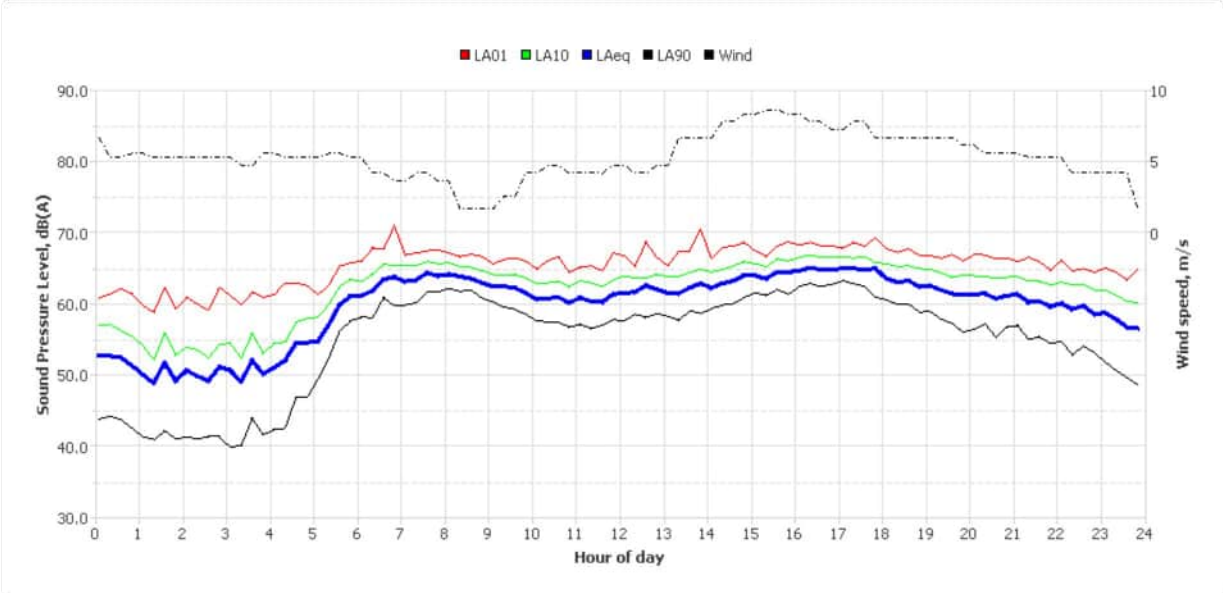

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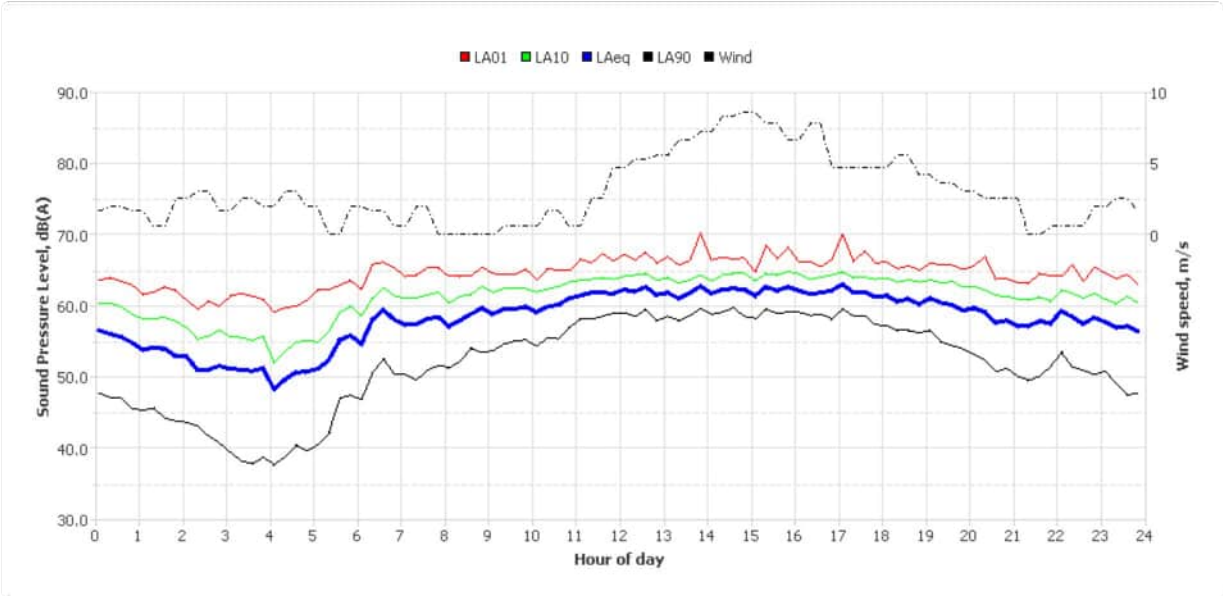

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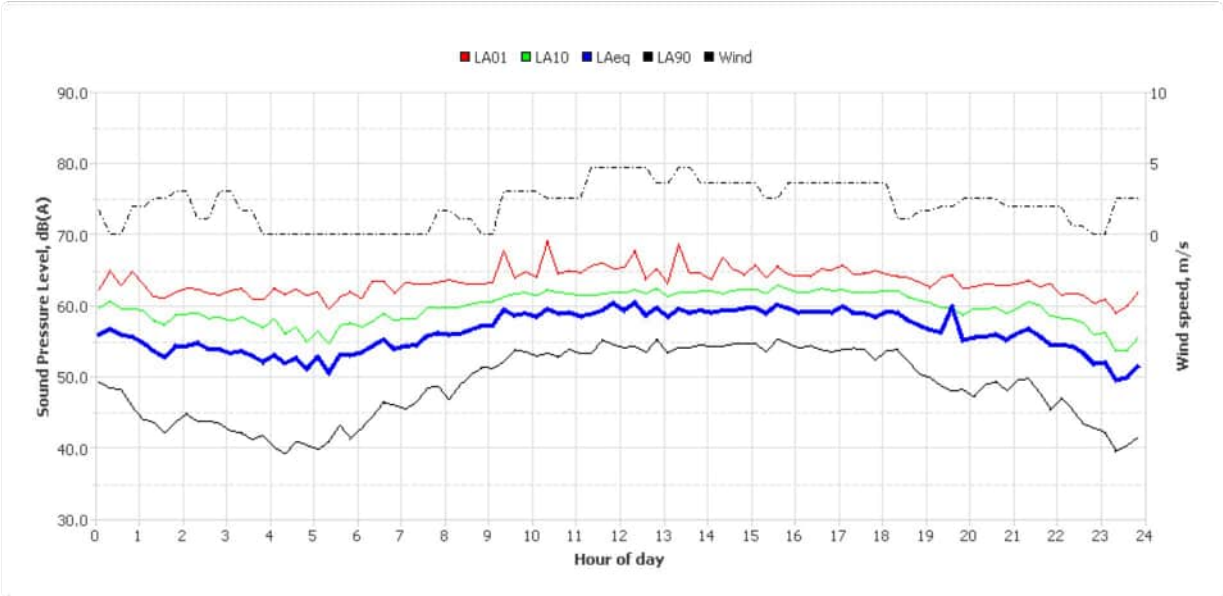

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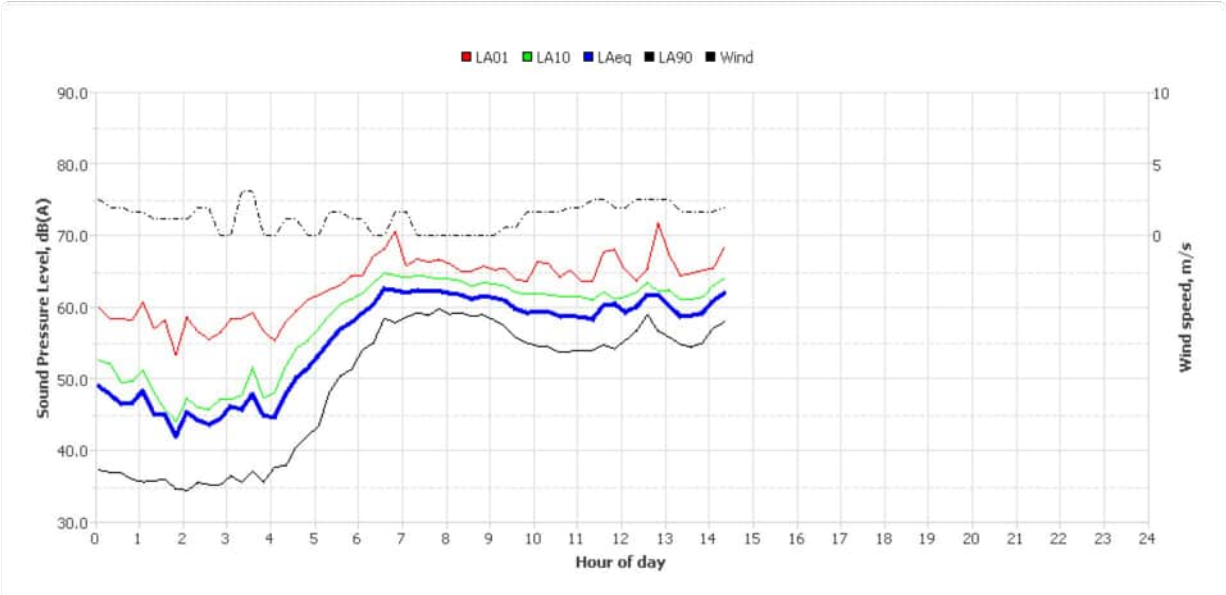

Noise Logger Report

1 London Circuit, Canberra

Item	Information
Logger Type	NL-52
Serial number	164393
Address	1 London Circuit, Canberra
Location	1 London Circuit, Canberra
Facade / Free Field	Free field
Environment	Noise nvironment dominated by road traffic noise on London Circuit. Some bird noise.

Measured noise levels

Logging Date	$L_{Aeq,day}$ 7am-6pm	$L_{Aeq,evening}$ 6pm-10pm	$L_{Aeq,night}$ 10pm-7am	ABL Day 7am-6pm	ABL Eve 6pm-10pm	ABL Night 10pm-7am	$L_{Aeq,15hr}$ 7am-10pm	$L_{Aeq,9hr}$ 10pm-7am
Mon Jul 26 2021	62	59	53	-	-	-	60	53
Tue Jul 27 2021	62	57	54	-	48	-	61	54
Wed Jul 28 2021	63	60	52	-	-	-	63	52
Thu Jul 29 2021	62	58	54	-	49	-	61	54
Fri Jul 30 2021	62	59	55	53	50	45	61	55
Sat Jul 31 2021	58	58	54	50	51	-	58	54
Sun Aug 1 2021	58	57	54	-	48	46	58	54
Mon Aug 2 2021	62	57	53	52	50	44	61	53
Tue Aug 3 2021	62	57	55	-	-	-	61	55
Wed Aug 4 2021	62	58	53	-	49	-	61	53
Thu Aug 5 2021	63	58	55	-	49	-	61	55
Fri Aug 6 2021	62	59	55	-	51	45	61	55
Sat Aug 7 2021	59	59	55	-	51	-	59	55
Sun Aug 8 2021	58	56	54	49	47	47	58	54
Mon Aug 9 2021	61	-	54	-	-	-	61	54
Summary	**61**	**58**	**54**	**51**	**49**	**45**	**60**	**54**

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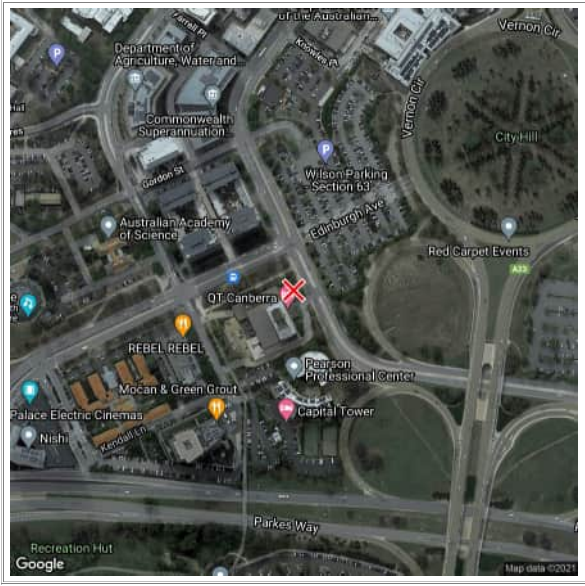	

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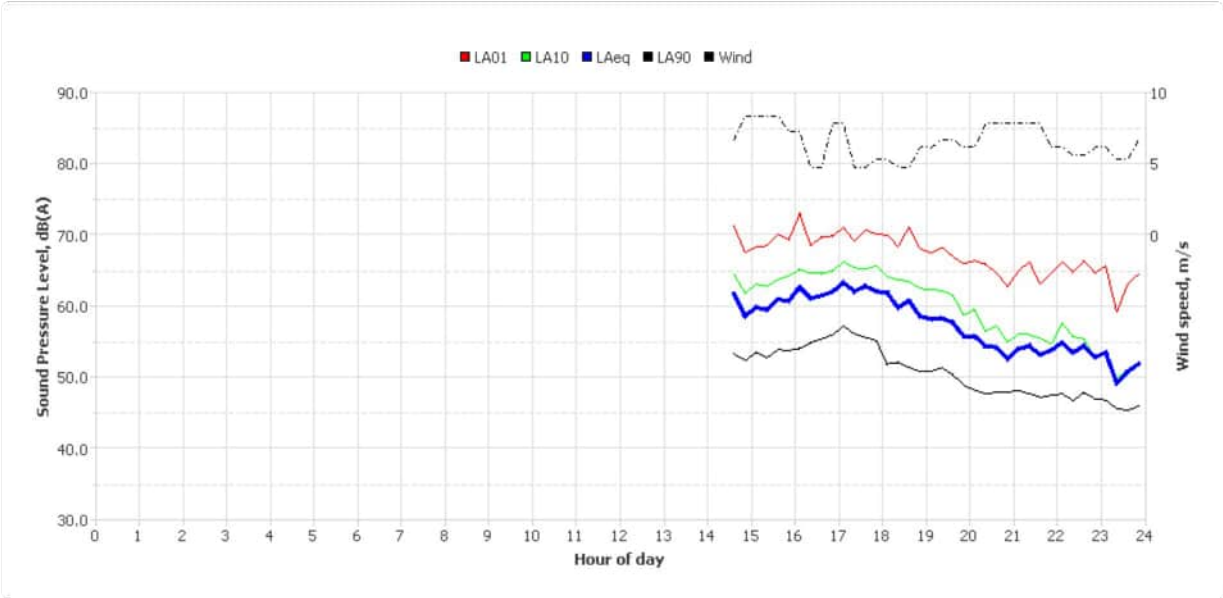

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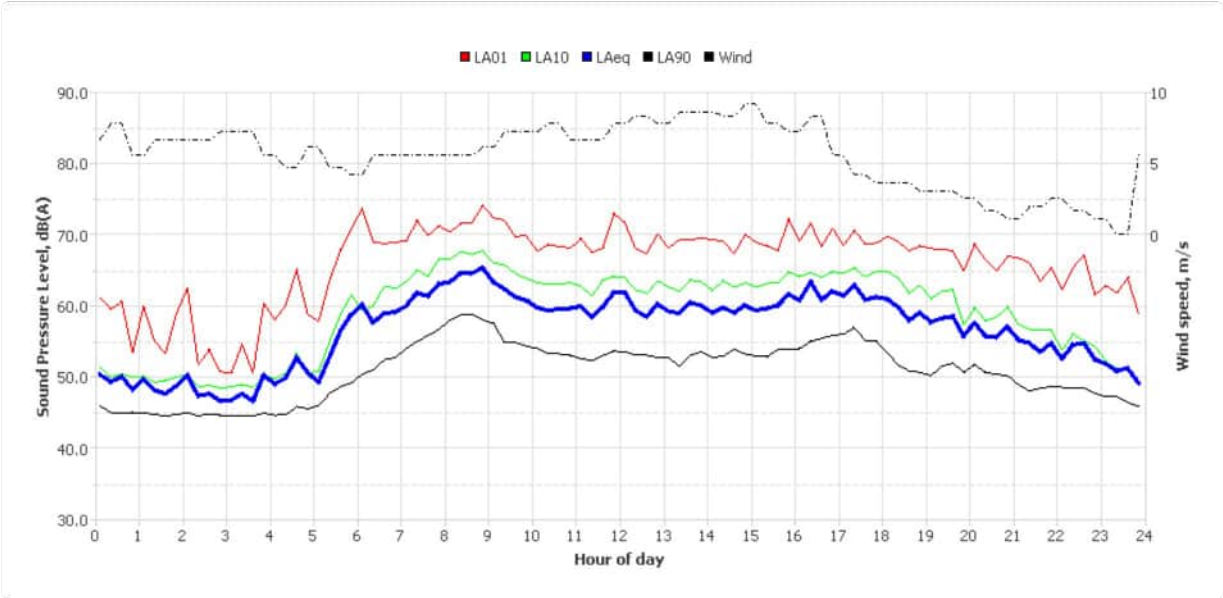

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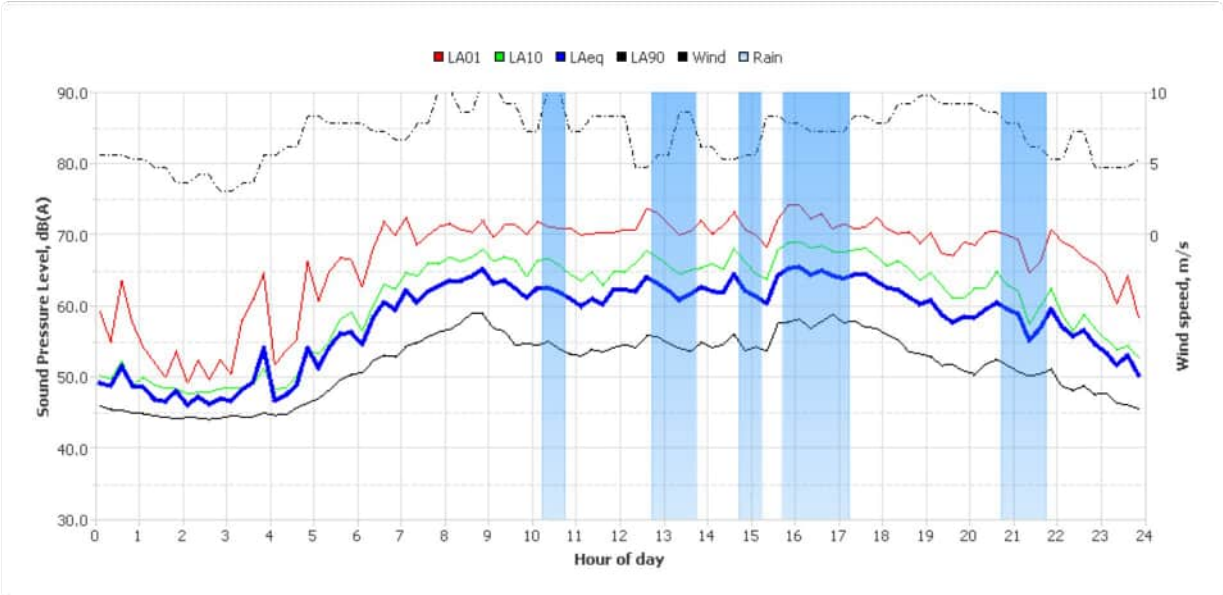

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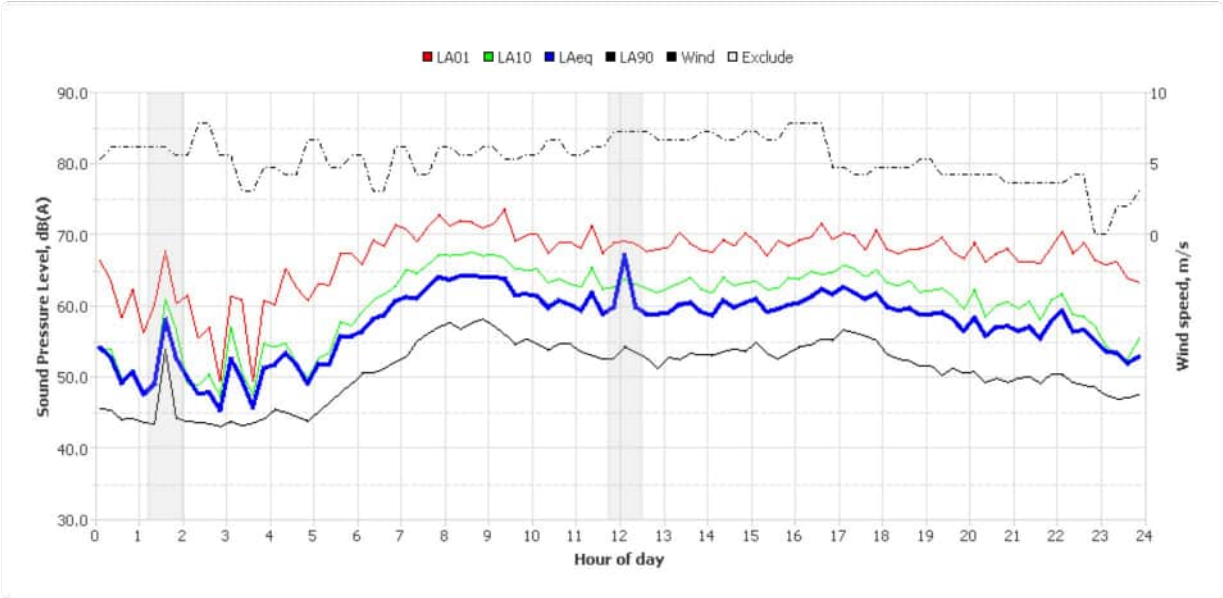

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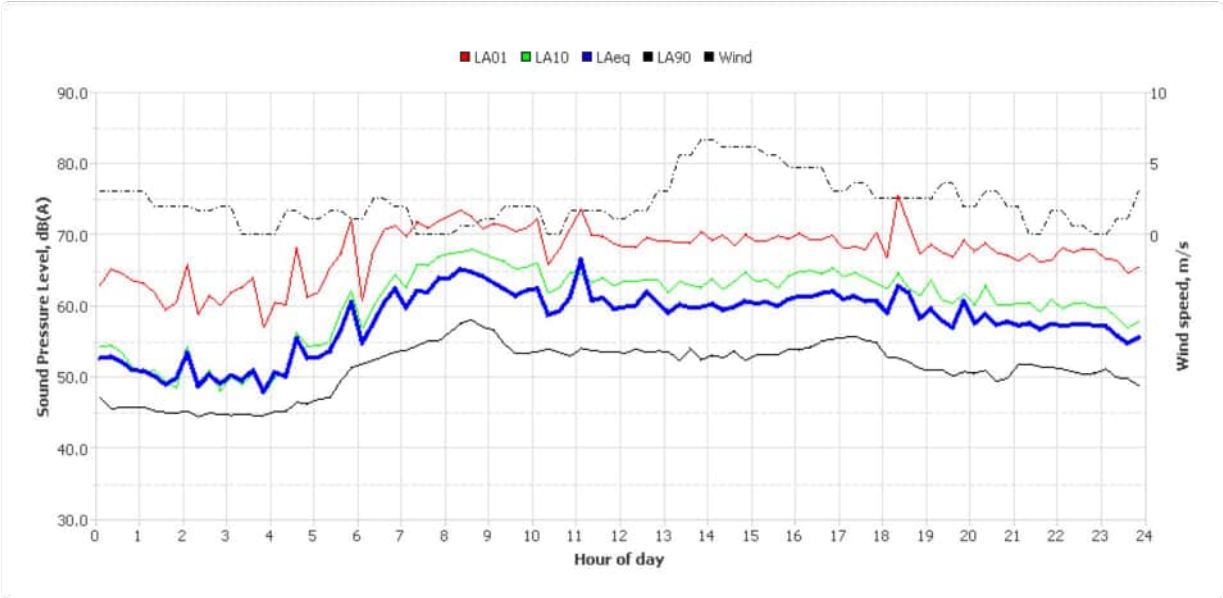

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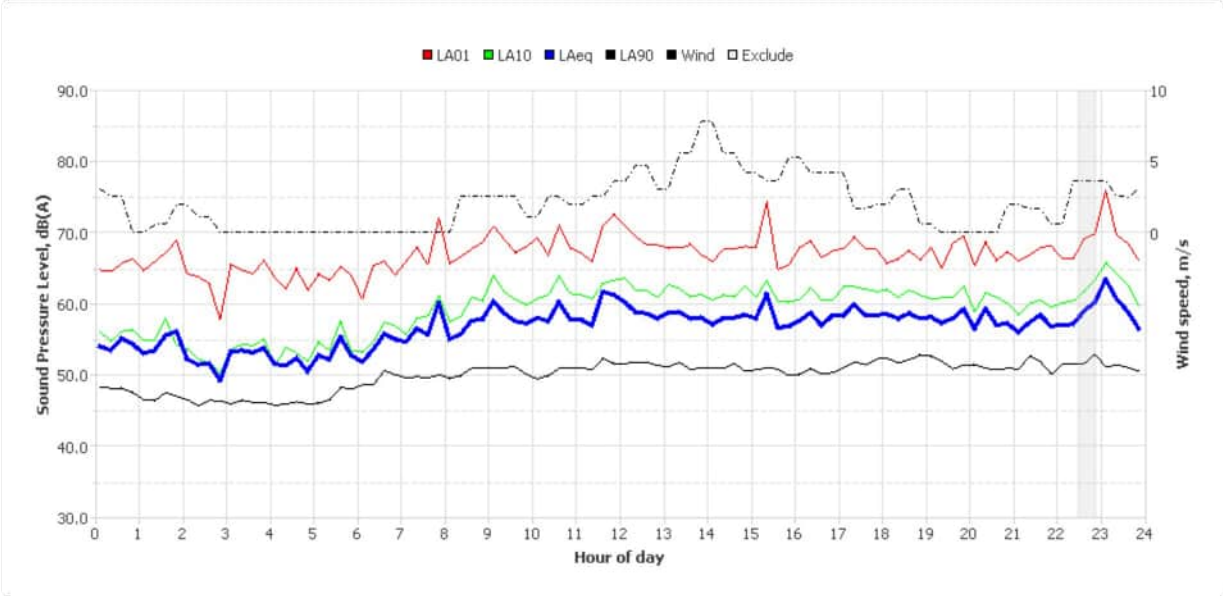

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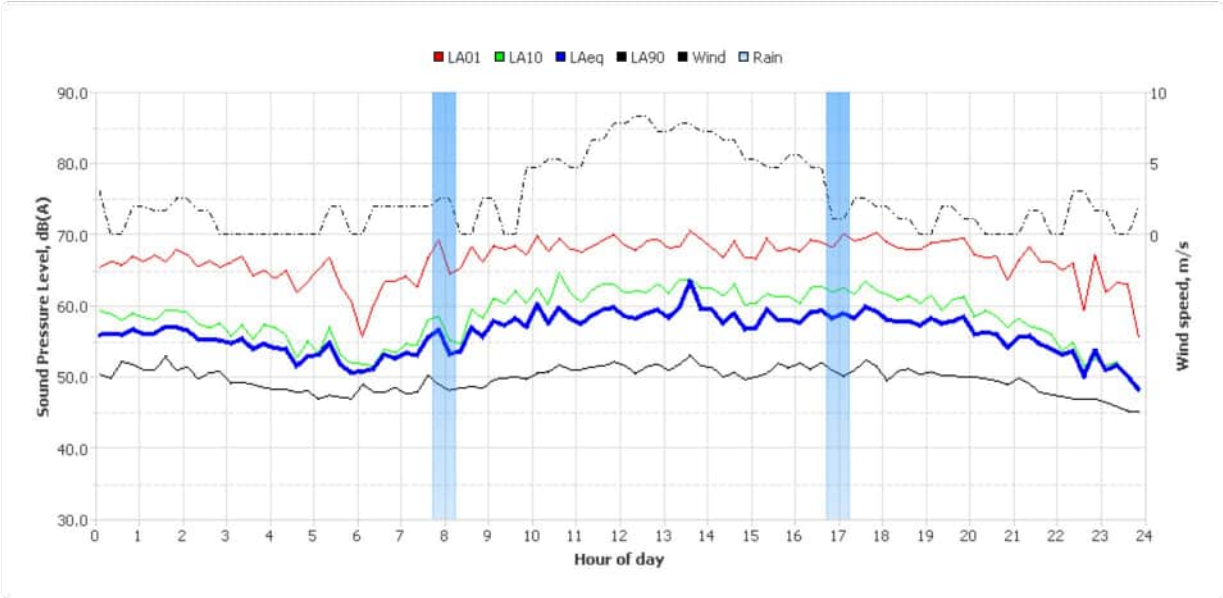

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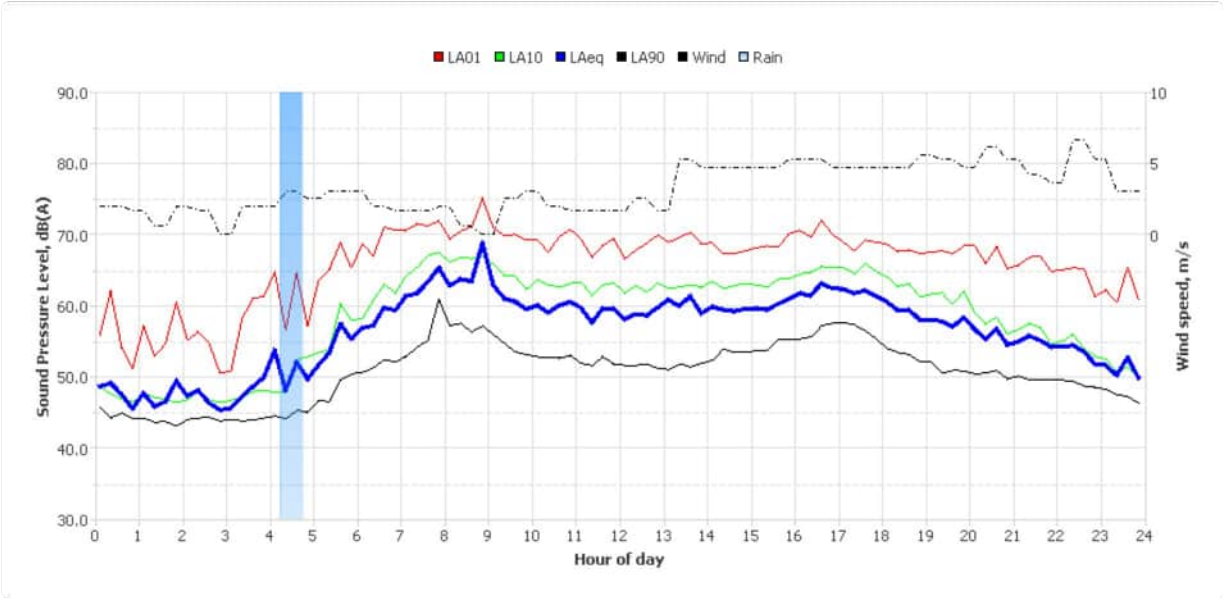

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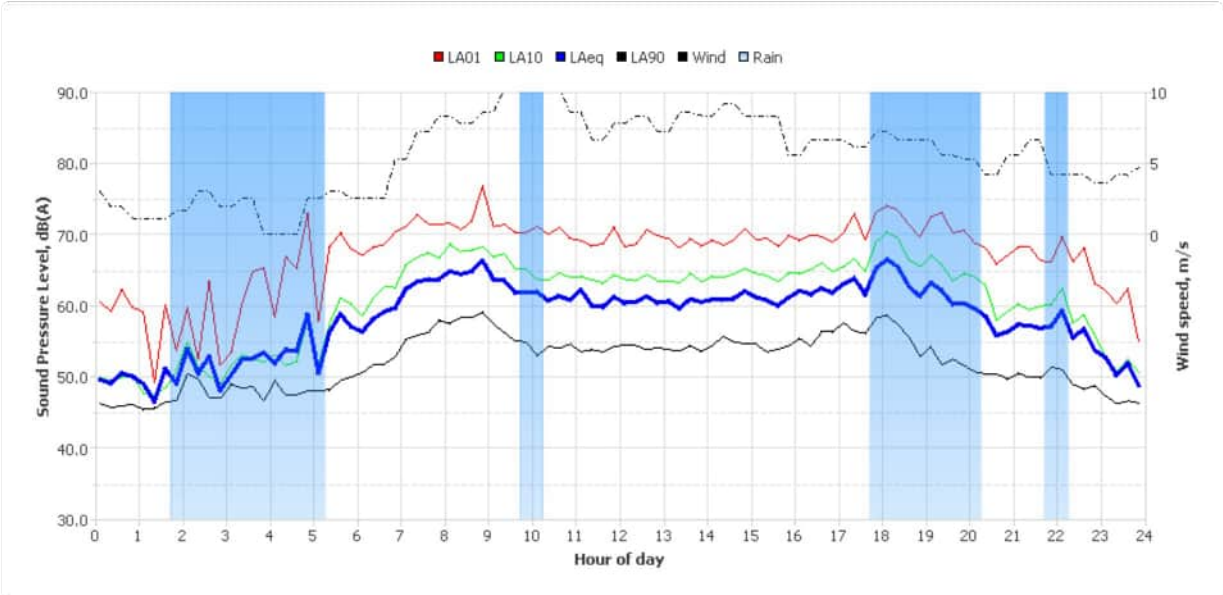
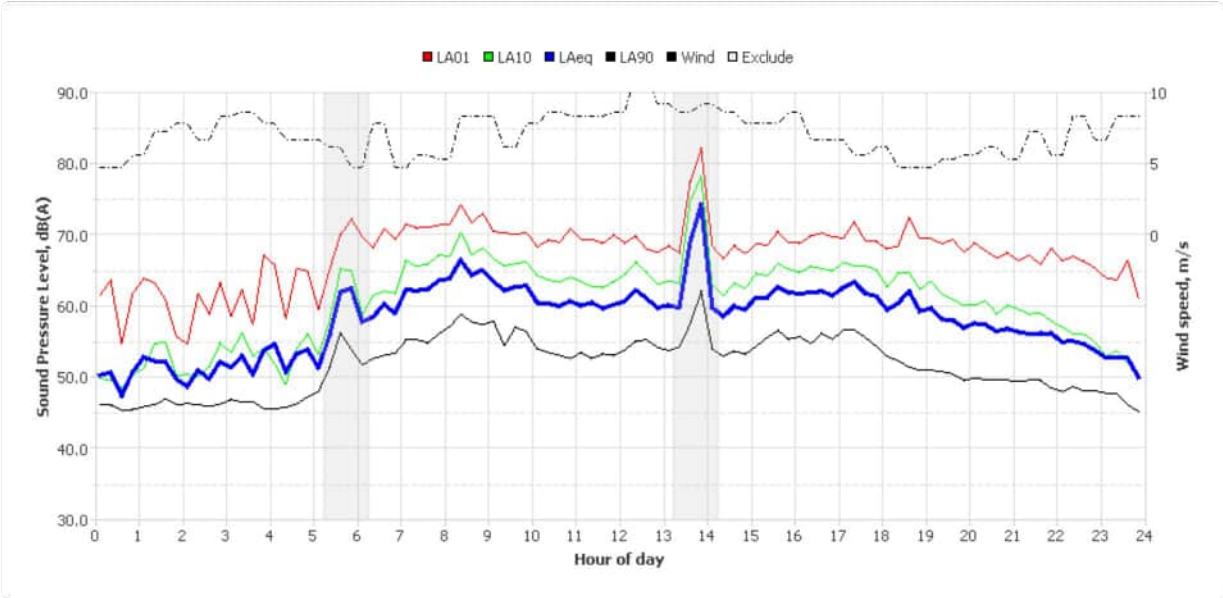
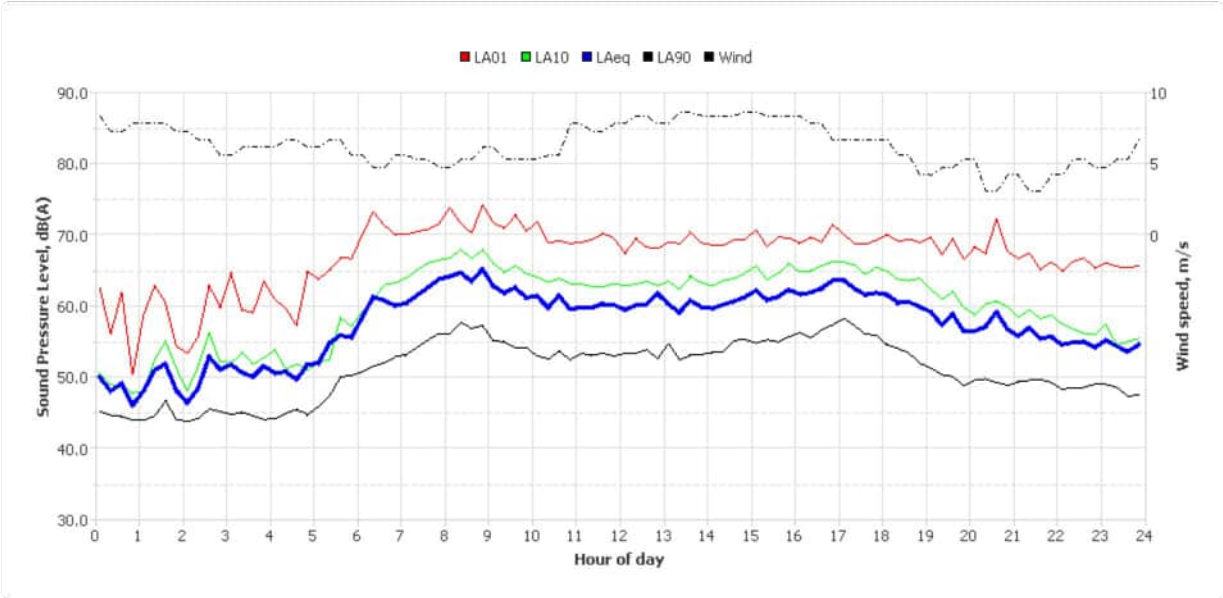


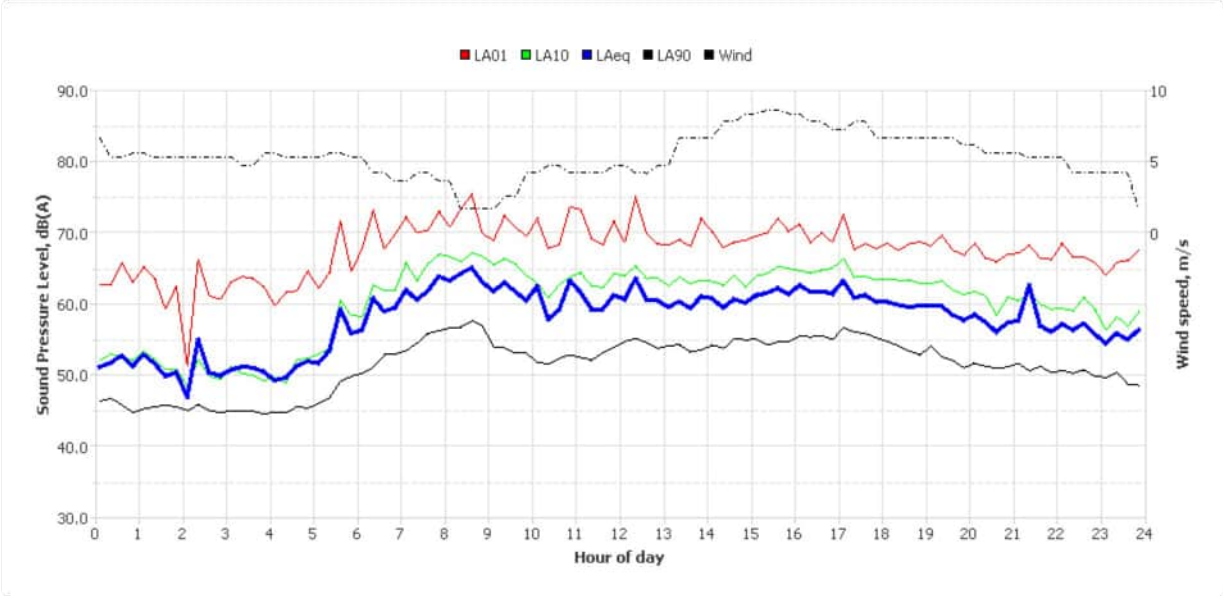
Wednesday, 04 Aug 2021



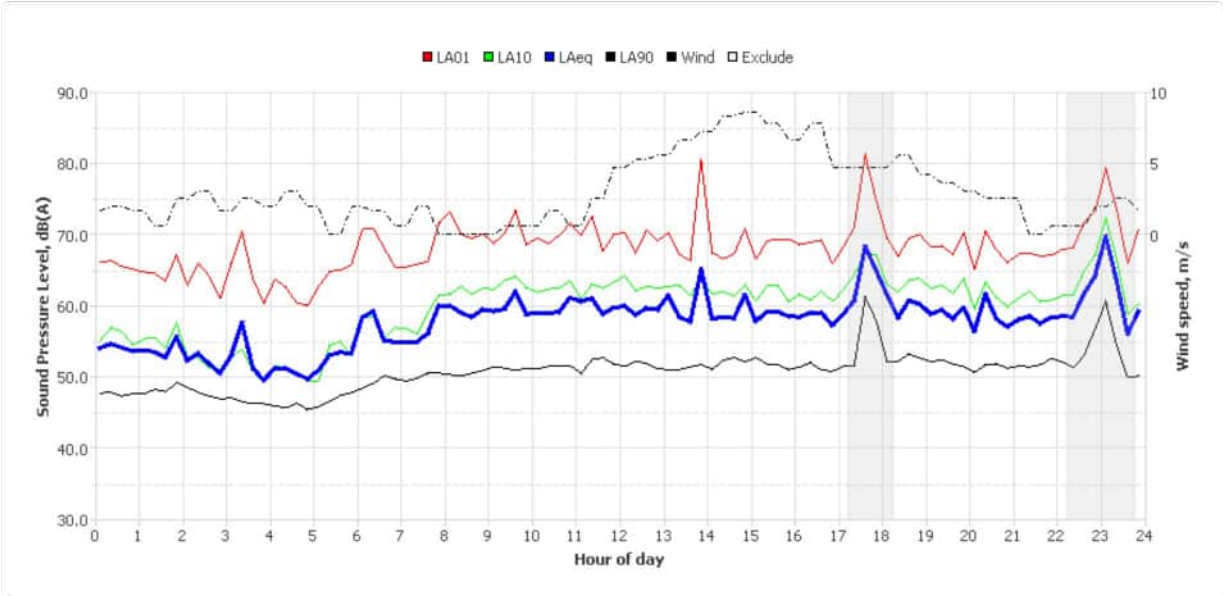
Thursday, 05 Aug 2021



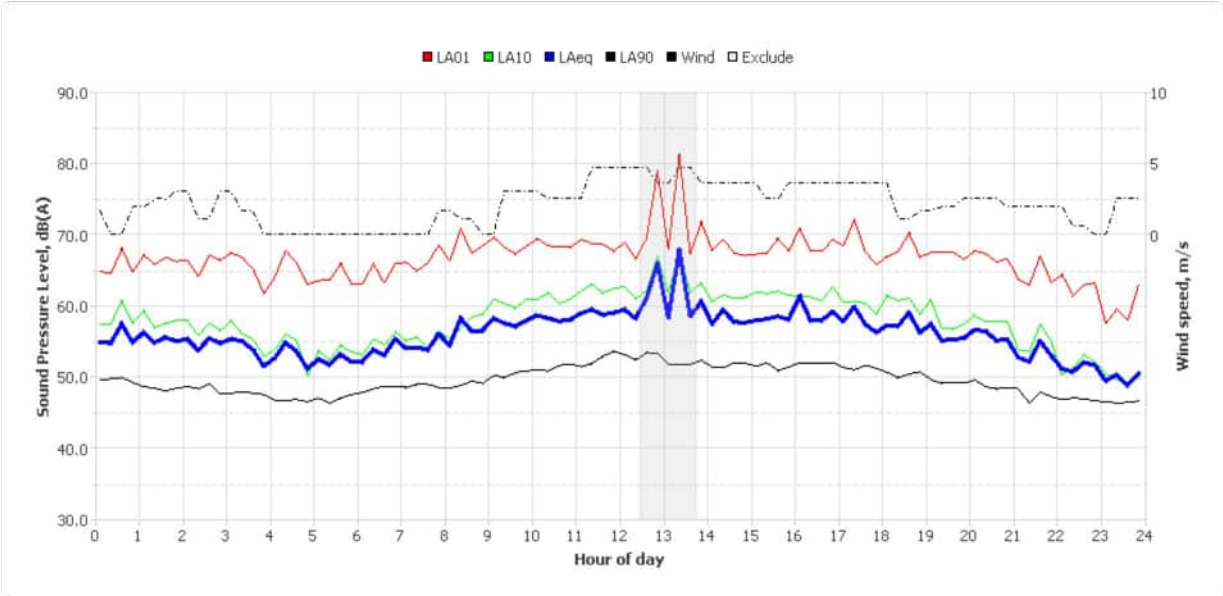
Friday, 06 Aug 2021



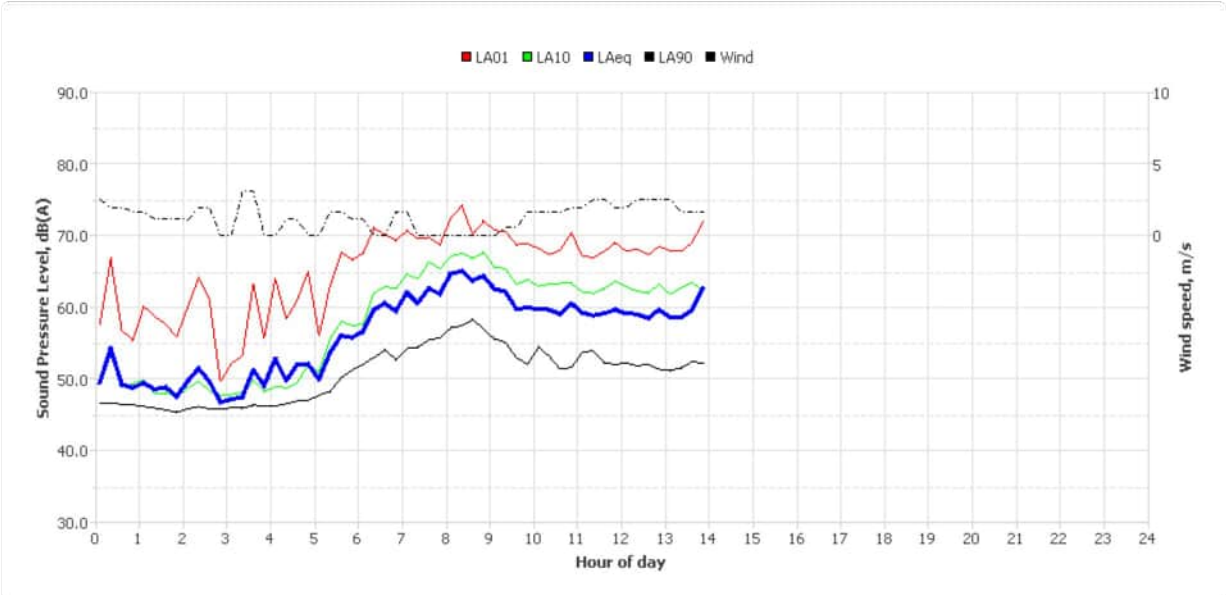
Saturday, 07 Aug 2021



Sunday, 08 Aug 2021



Monday, 09 Aug 2021



Noise Logger Report

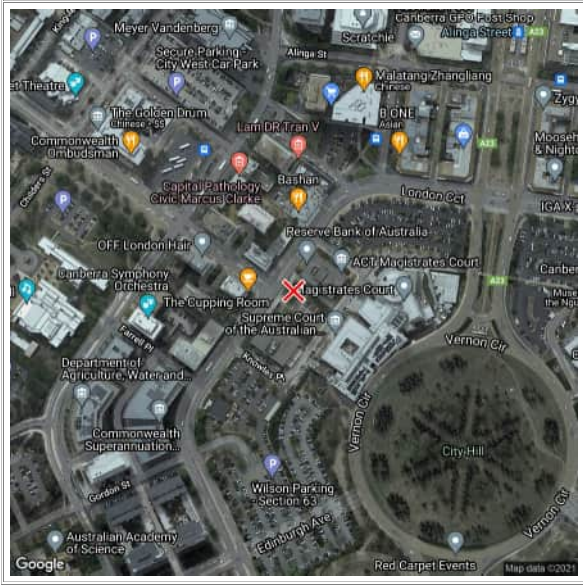
Police Station and RBA, Canberra

Item	Information
Logger Type	NL-52
Serial number	164394
Address	Police Station and RBA, Canberra
Location	Police Station and RBA, Canberra
Facade / Free Field	Free field
Environment	Noise environment dominated by road traffic noise from London Circuit. Music from bar across street audible

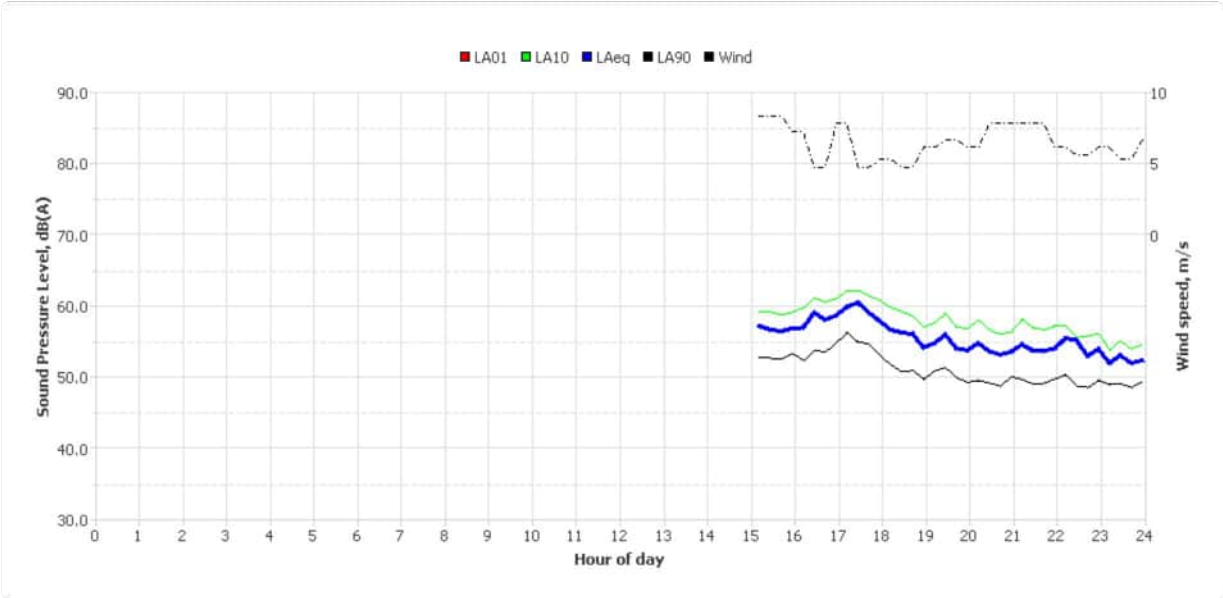
Measured noise levels

Logging Date	$L_{Aeq,day}$ 7am-6pm	$L_{Aeq,evening}$ 6pm-10pm	$L_{Aeq,night}$ 10pm-7am	ABL Day 7am-6pm	ABL Eve 6pm-10pm	ABL Night 10pm-7am	$L_{Aeq,15hr}$ 7am-10pm	$L_{Aeq,9hr}$ 10pm-7am
Mon Jul 26 2021	59	55	53	-	-	-	57	53
Tue Jul 27 2021	59	54	52	-	47	-	57	52
Wed Jul 28 2021	60	55	51	-	-	-	59	51
Thu Jul 29 2021	59	55	52	-	48	-	58	52
Fri Jul 30 2021	58	56	55	52	51	45	58	55
Sat Jul 31 2021	54	56	57	48	51	46	55	57
Sun Aug 1 2021	54	54	56	-	47	46	54	56
Mon Aug 2 2021	58	54	51	52	47	44	58	51
Tue Aug 3 2021	59	55	53	-	-	-	58	53
Wed Aug 4 2021	58	54	53	-	48	-	56	53
Thu Aug 5 2021	58	56	54	-	49	-	57	54
Fri Aug 6 2021	57	55	53	-	50	43	57	53
Sat Aug 7 2021	55	56	55	-	51	46	55	55
Sun Aug 8 2021	53	52	55	47	46	46	53	55
Mon Aug 9 2021	57	-	52	-	-	-	57	52
Summary	**58**	**55**	**54**	**50**	**48**	**46**	**57**	**54**

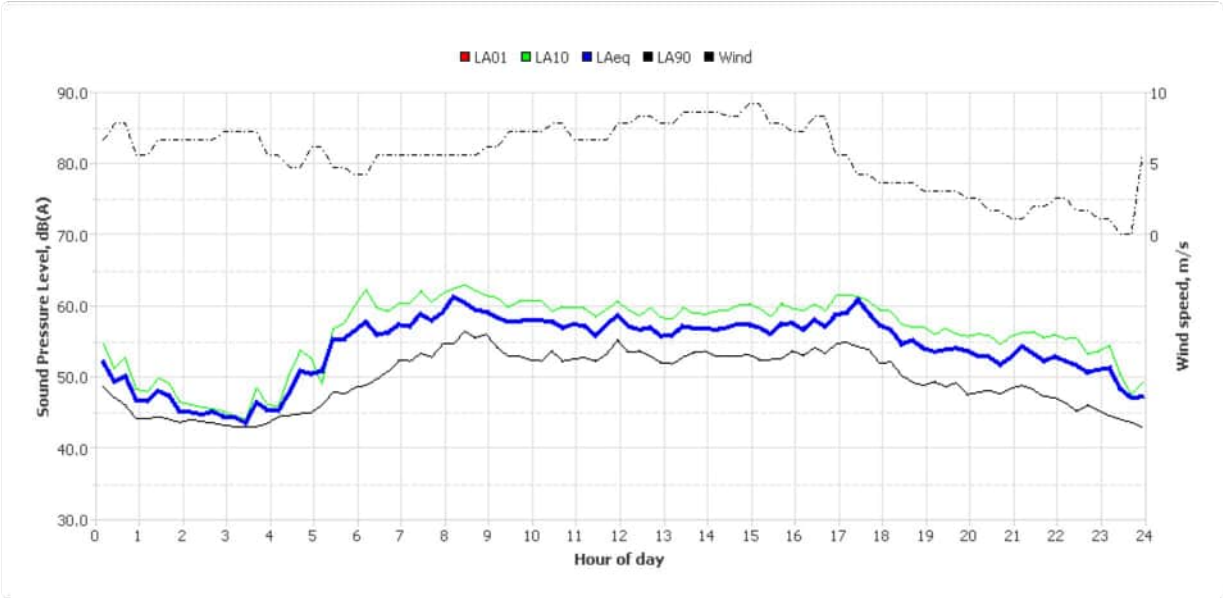
Note: Results denoted with '-' do not contain enough valid data for a value to be calculated. The data has been excluded either manually or automatically as a result of adverse weather conditions.

Logger Location	Logger Deployment Photo
	

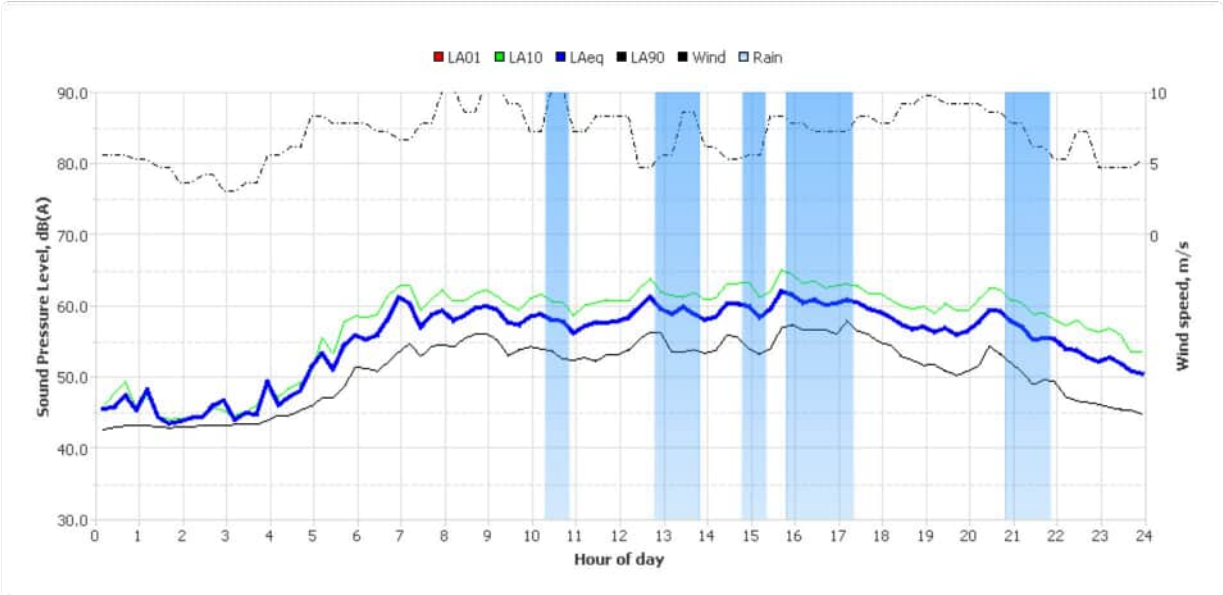
Monday, 26 Jul 2021



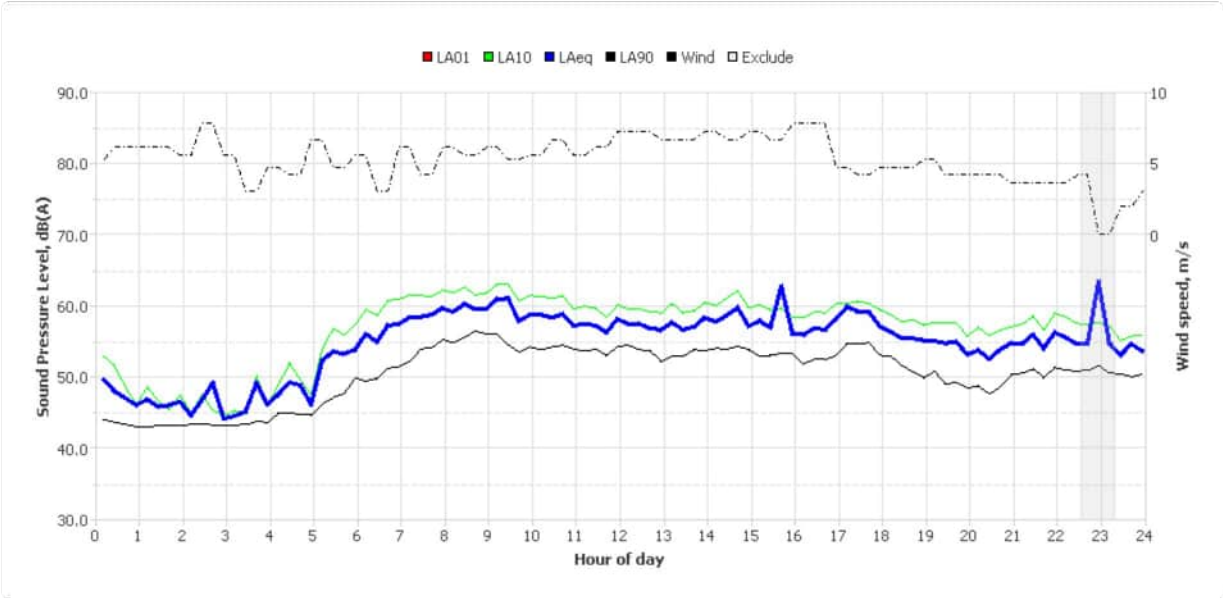
Tuesday, 27 Jul 2021



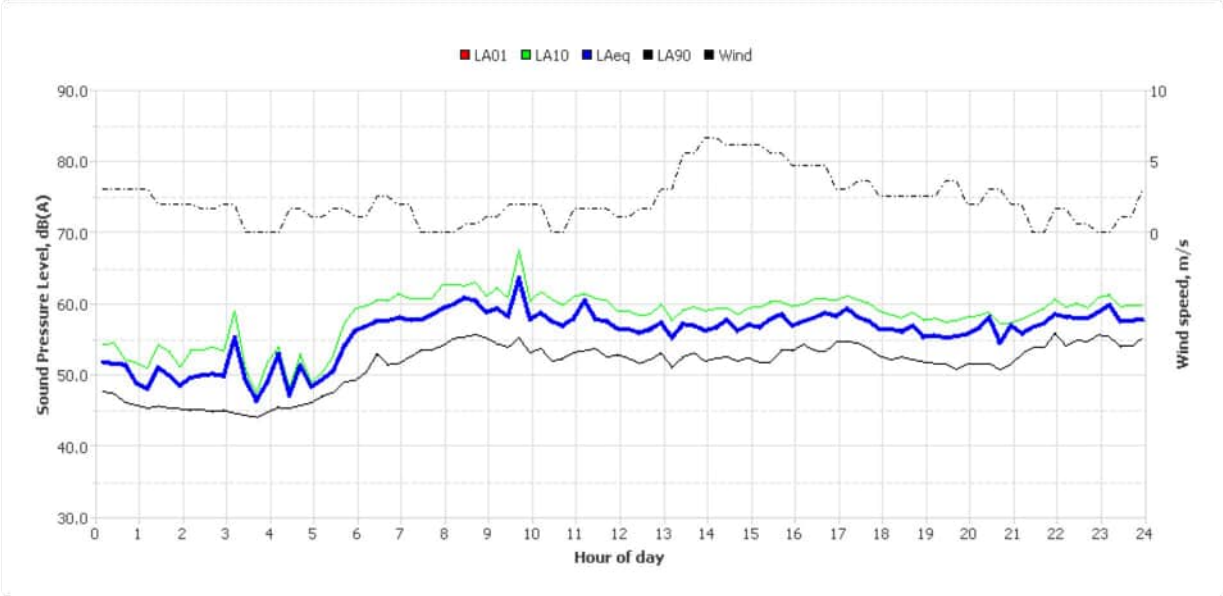
Wednesday, 28 Jul 2021



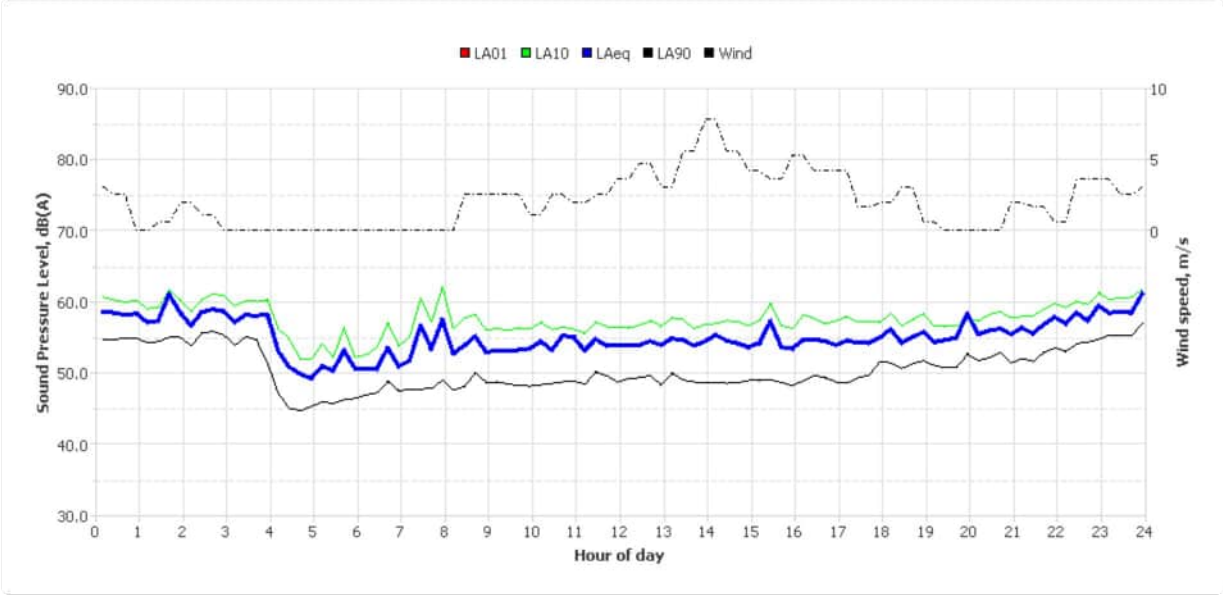
Thursday, 29 Jul 2021



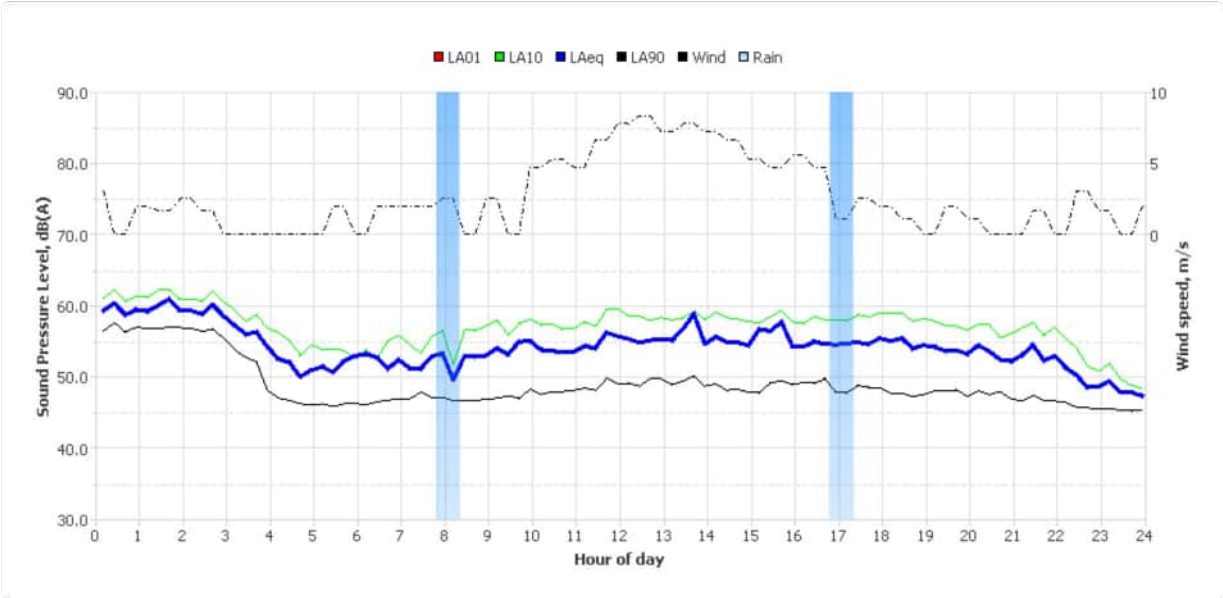
Friday, 30 Jul 2021



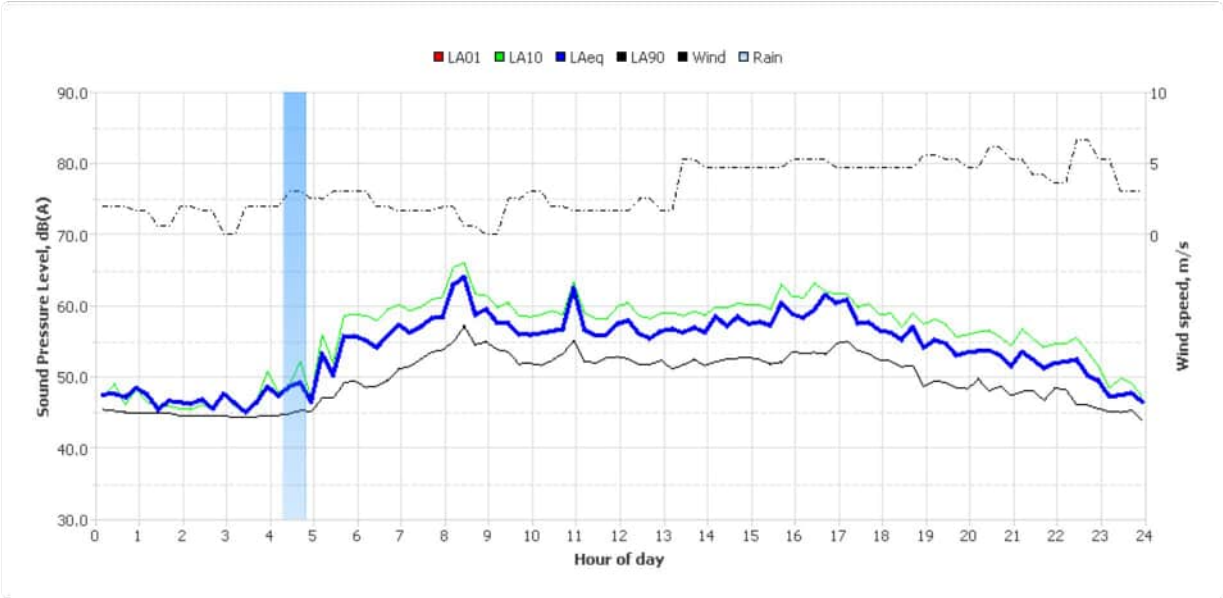
Saturday, 31 Jul 2021



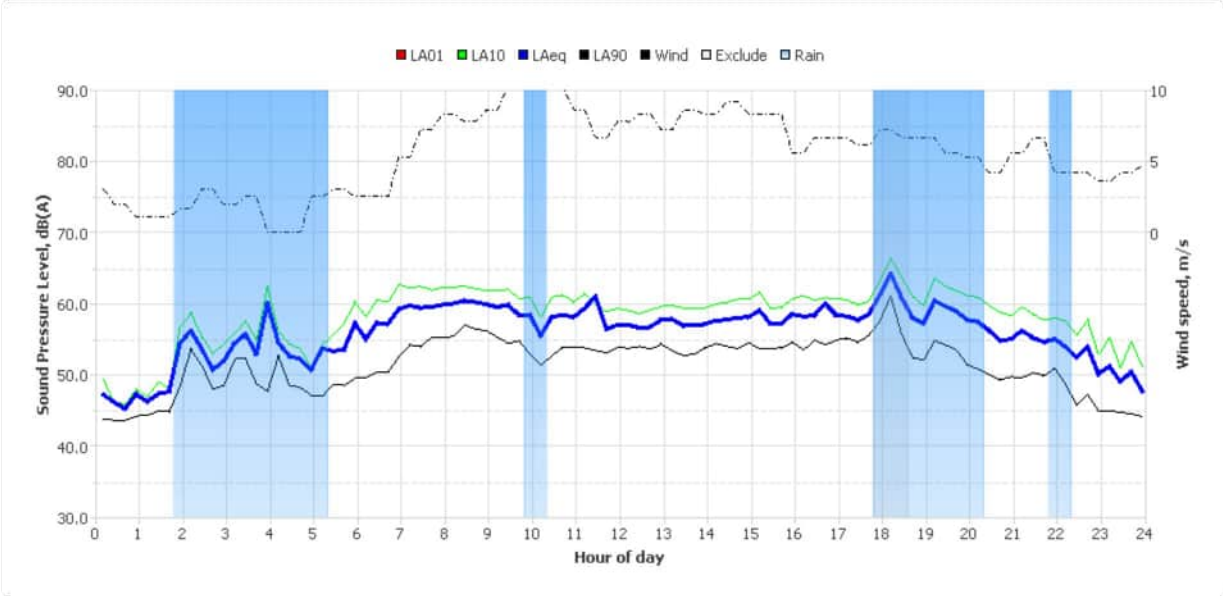
Sunday, 01 Aug 2021



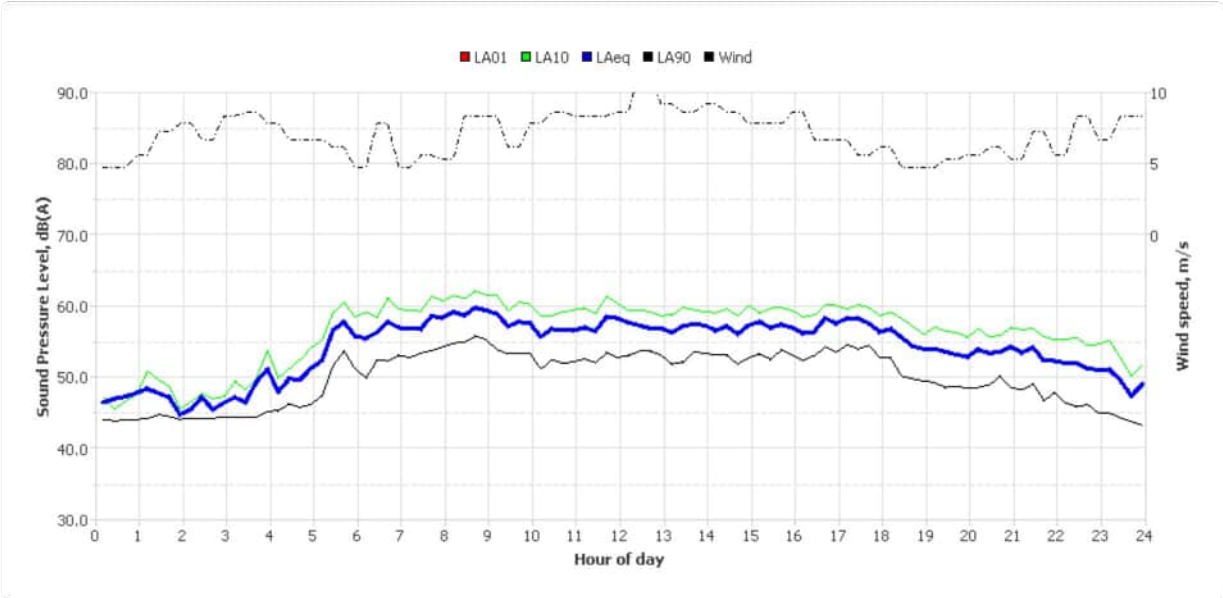
Monday, 02 Aug 2021



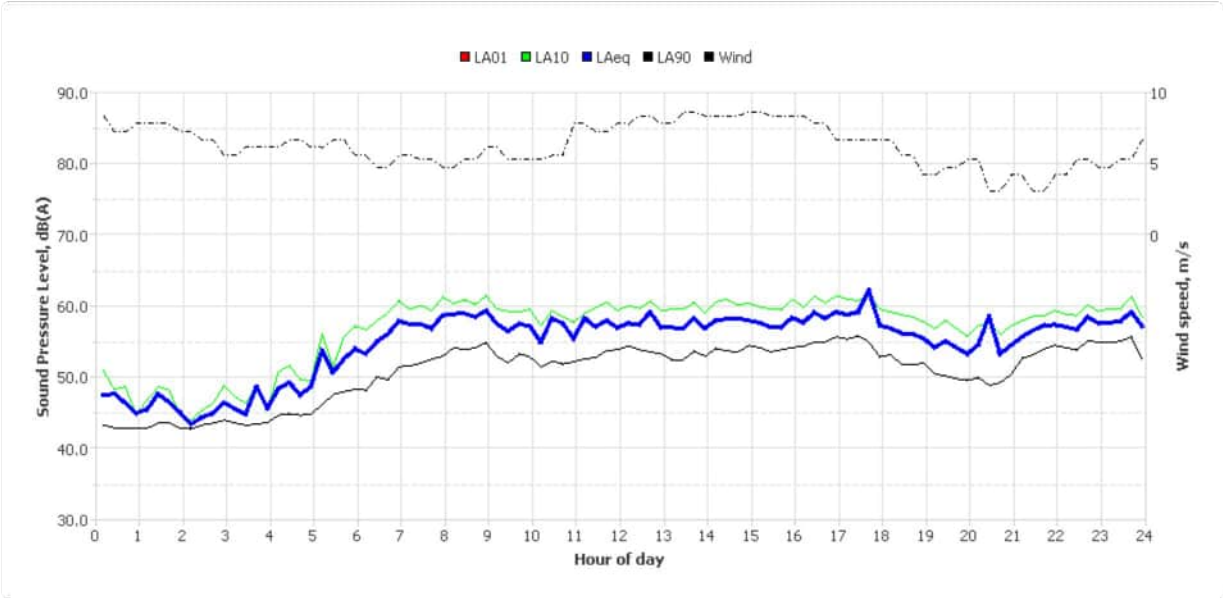
Tuesday, 03 Aug 2021



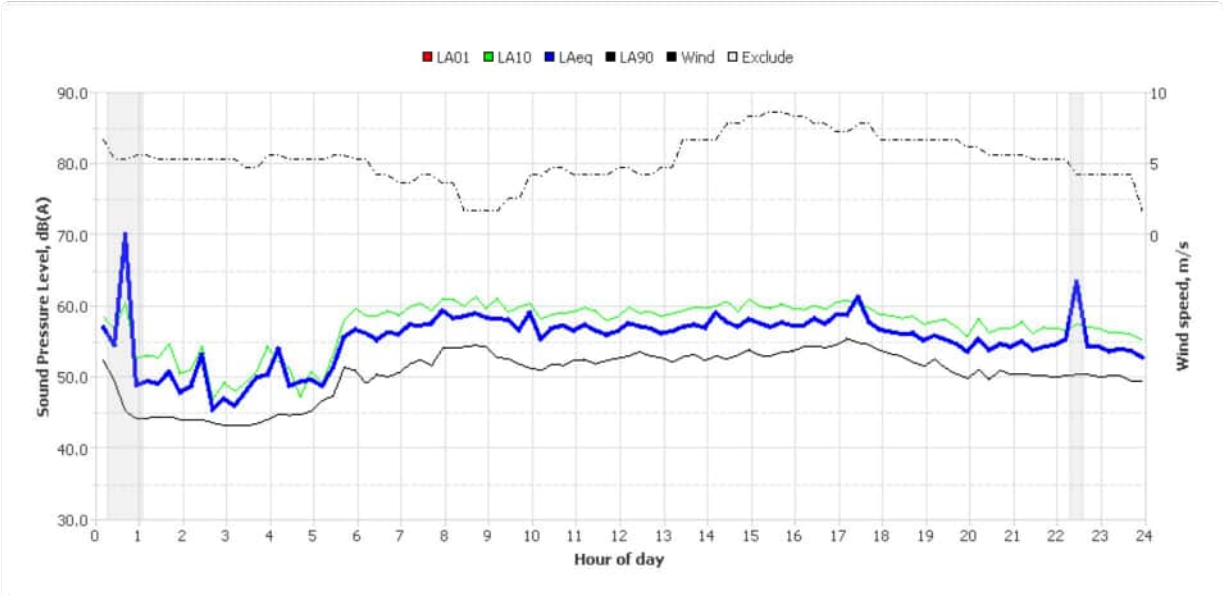
Wednesday, 04 Aug 2021



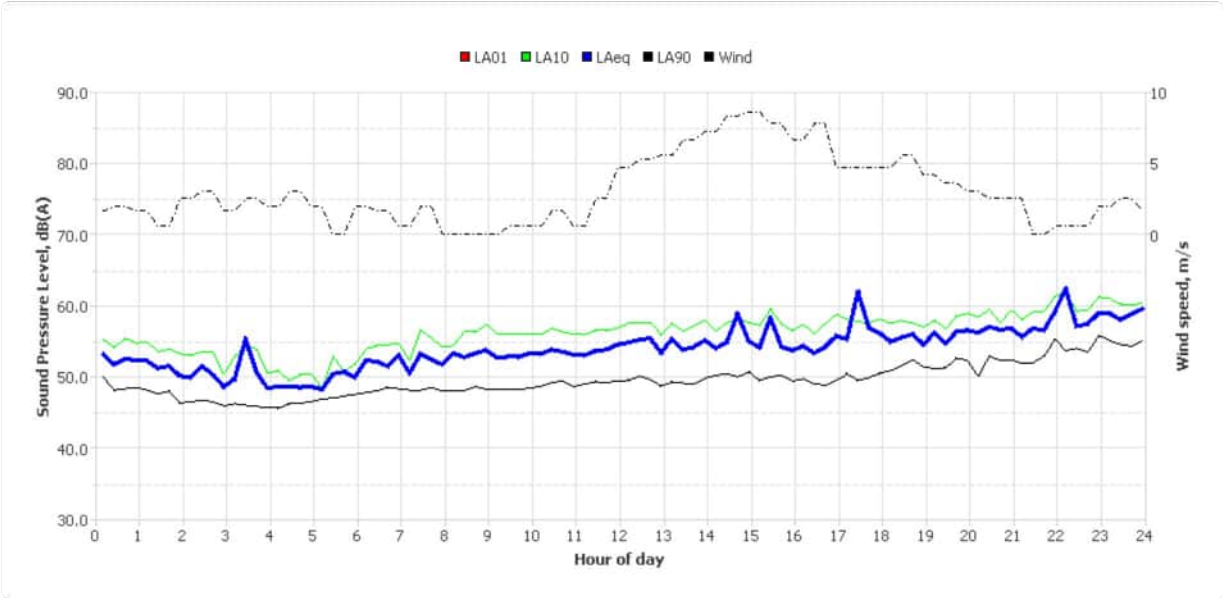
Thursday, 05 Aug 2021



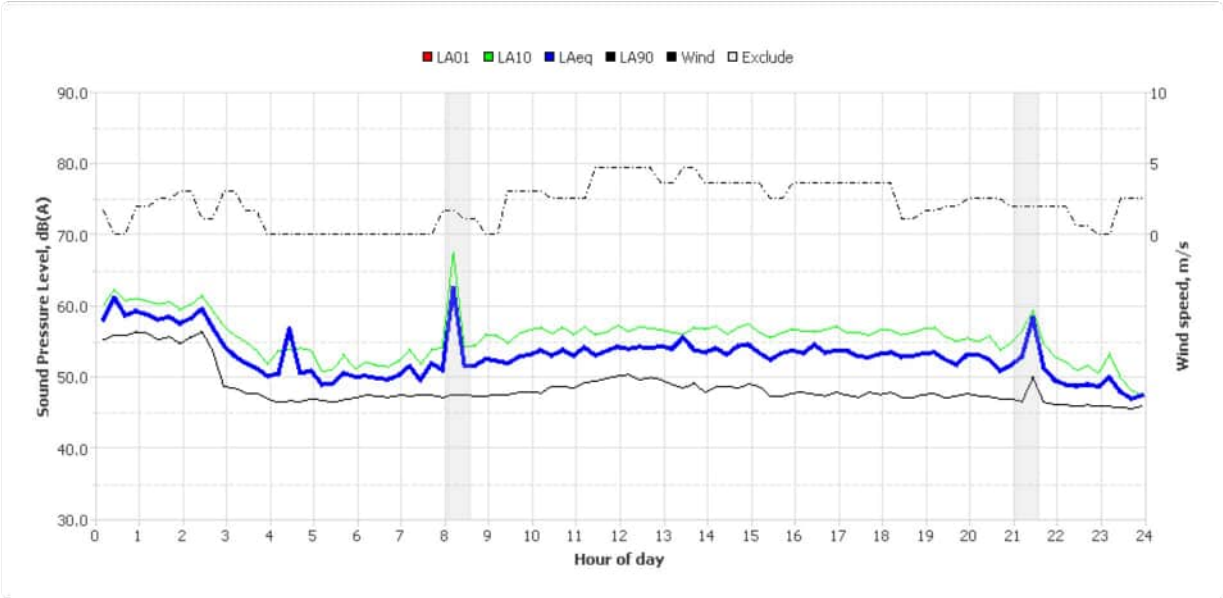
Friday, 06 Aug 2021



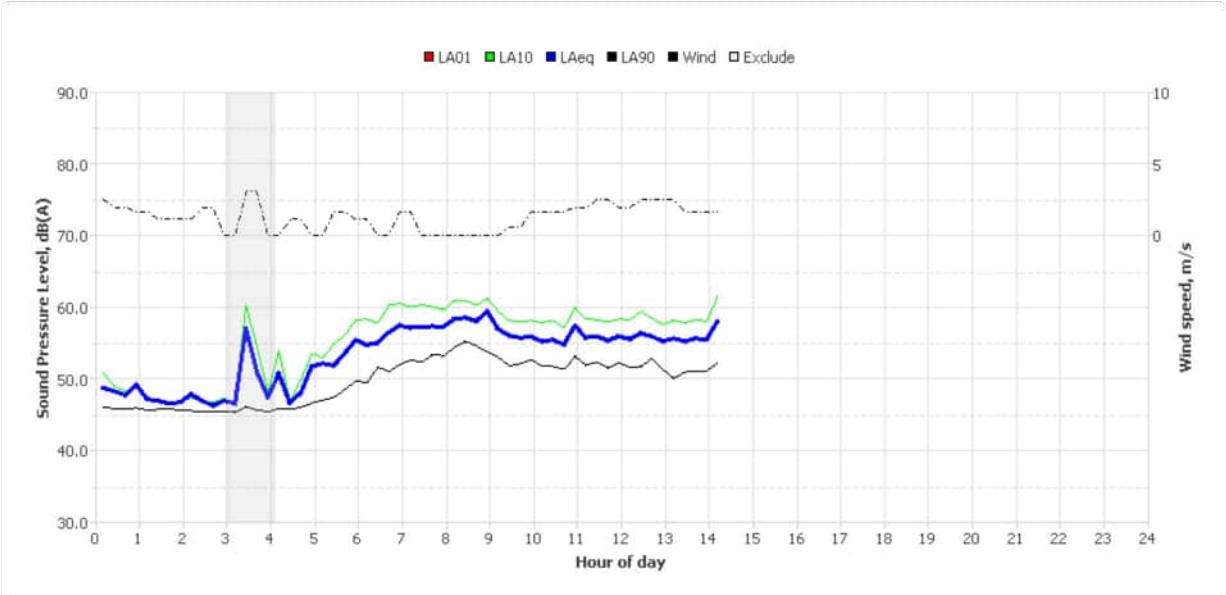
Saturday, 07 Aug 2021



Sunday, 08 Aug 2021



Monday, 09 Aug 2021



Noise Logger Report

DFAT, Canberra

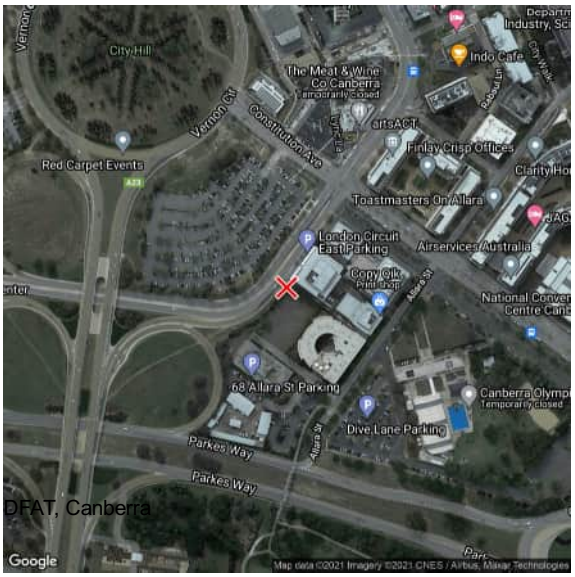
Item	Information
Logger Type	NL-52
Serial number	164394
Address	DFAT, Canberra
Location	DFAT, Canberra
Facade / Free Field	Free field
Environment	

Measured noise levels

Logging Date	$L_{Aeq,day}$ 7am-6pm	$L_{Aeq,evening}$ 6pm-10pm	$L_{Aeq,night}$ 10pm-7am	ABL Day 7am-6pm	ABL Eve 6pm-10pm	ABL Night 10pm-7am	$L_{Aeq,15hr}$ 7am-10pm	$L_{Aeq,9hr}$ 10pm-7am
Tue Aug 10 2021	62	57	53	-	44	-	58	53
Wed Aug 11 2021	62	-	53	-	-	-	62	53
Thu Aug 12 2021	61	54	53	-	41	-	59	53
Fri Aug 13 2021	58	54	49	45	40	33	57	49
Sat Aug 14 2021	53	52	47	40	40	33	53	47
Sun Aug 15 2021	52	53	43	-	-	-	52	43
Mon Aug 16 2021	57	54	46	-	41	-	55	46
Tue Aug 17 2021	56	53	50	43	39	37	55	50
Wed Aug 18 2021	56	54	49	43	40	34	55	49
Thu Aug 19 2021	56	54	49	44	40	34	55	49
Fri Aug 20 2021	56	55	49	-	41	34	56	49
Sat Aug 21 2021	53	52	46	-	40	-	53	46
Sun Aug 22 2021	52	51	42	-	41	34	52	42
Mon Aug 23 2021	59	57	50	-	-	-	58	50
Tue Aug 24 2021	58	58	53	-	-	-	58	53
Summary	**58**	**55**	**50**	**43**	**40**	**34**	**57**	**50**

Note: Results denoted with '-' do not contain enough valid data for a value to be calculated. The data has been excluded either manually or automatically as a result of adverse weather conditions.

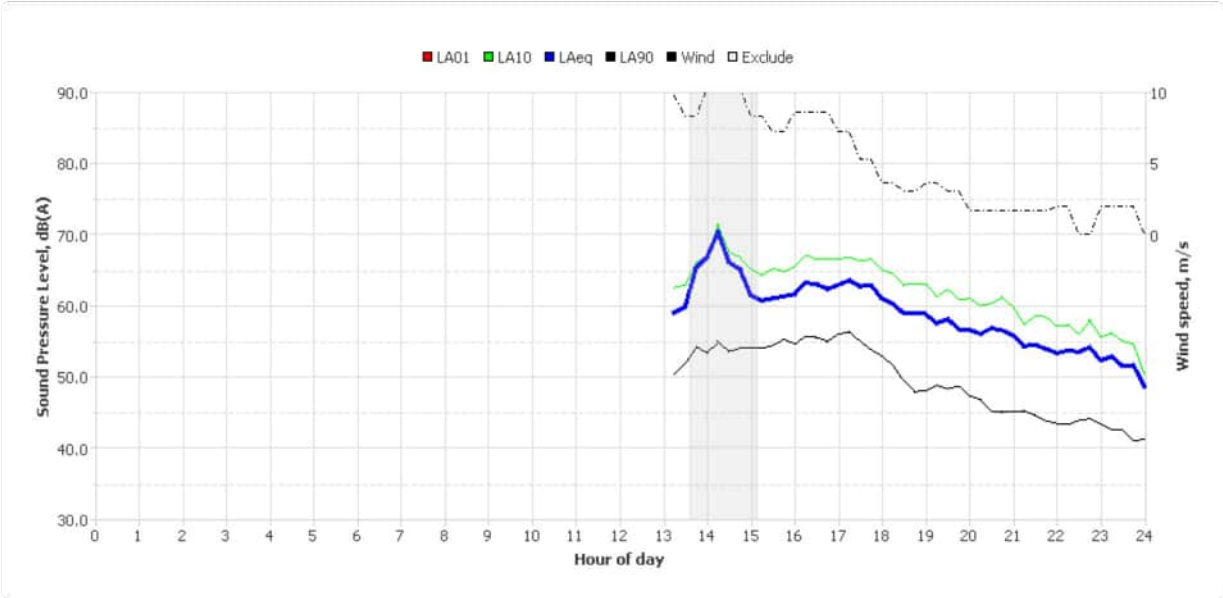
Logger Location



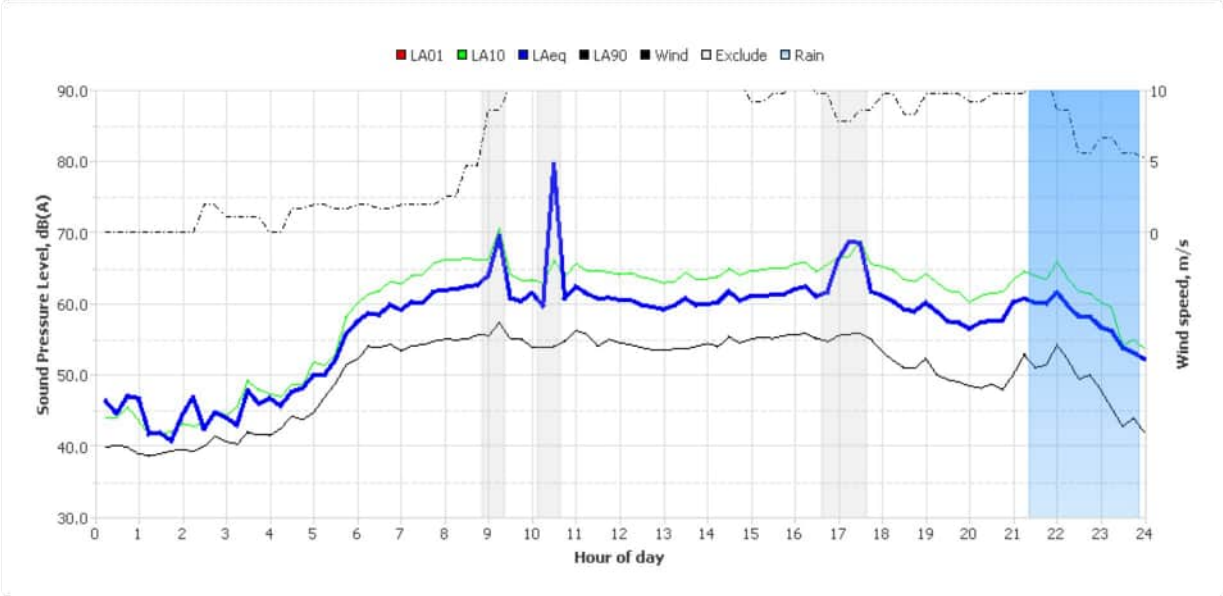
DFAT, Canberra

Logger Deployment Photo

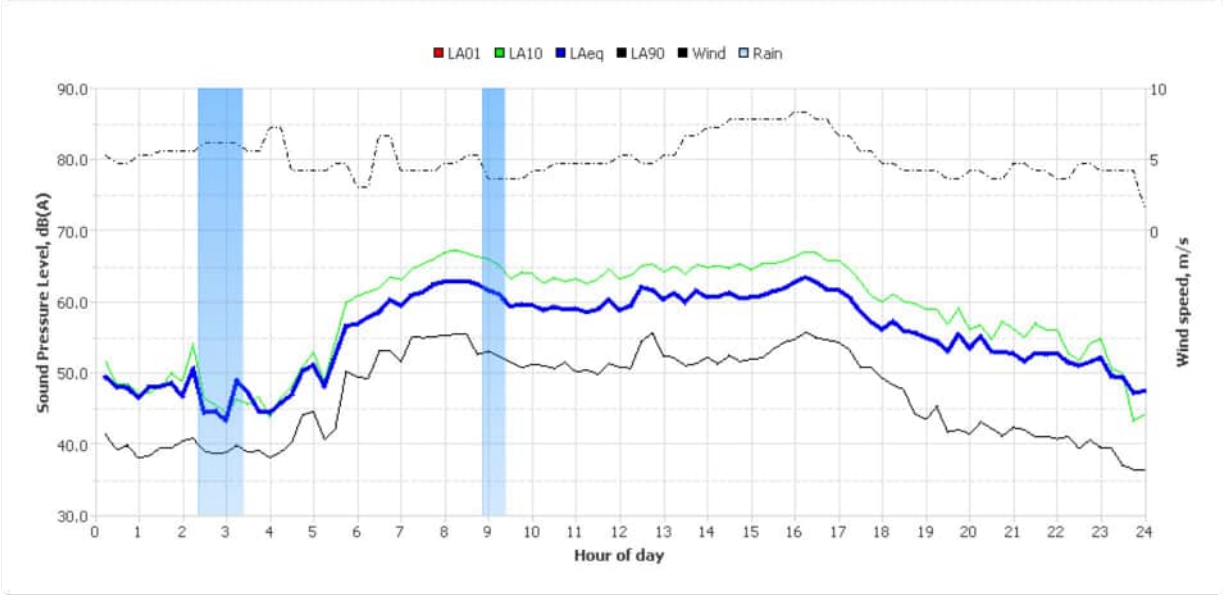
Tuesday, 10 Aug 2021



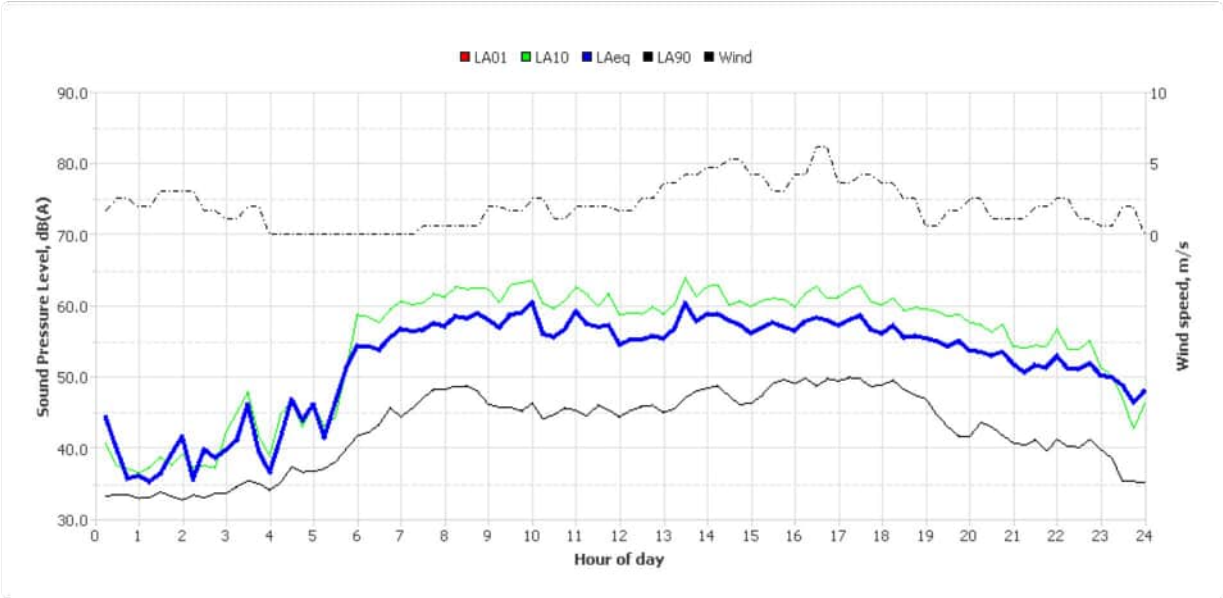
Wednesday, 11 Aug 2021



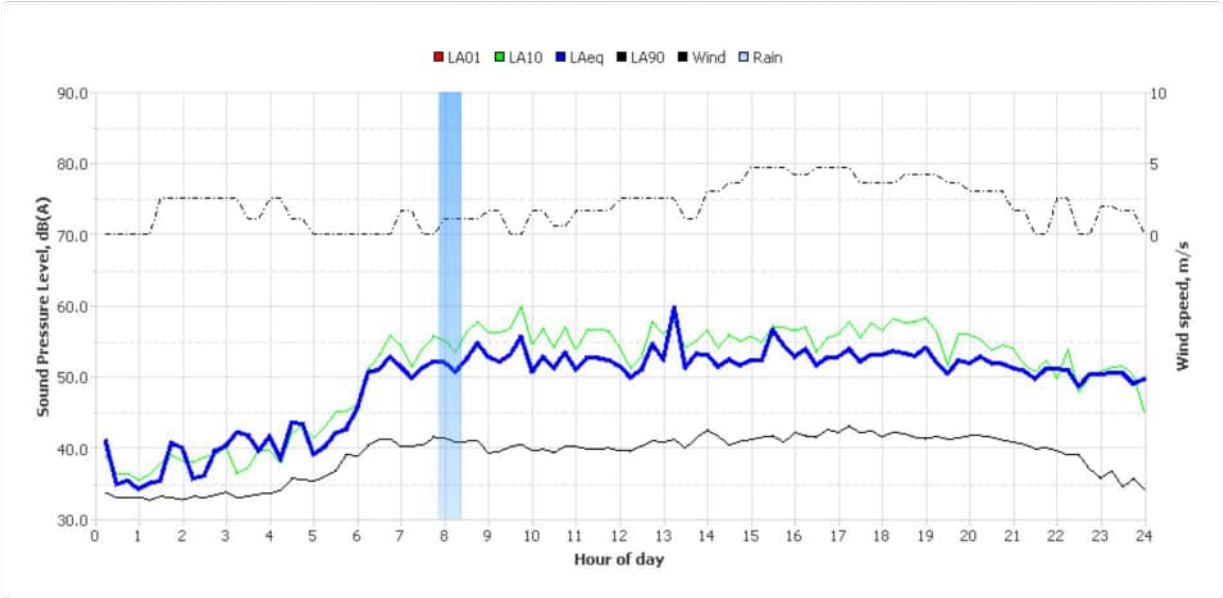
Thursday, 12 Aug 2021



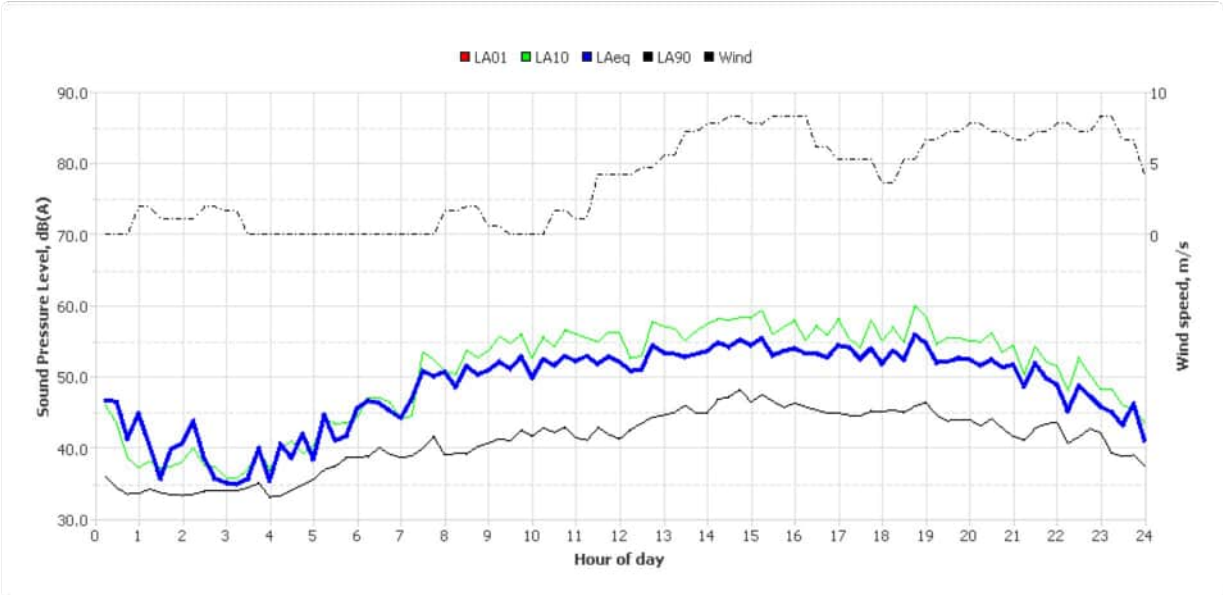
Friday, 13 Aug 2021



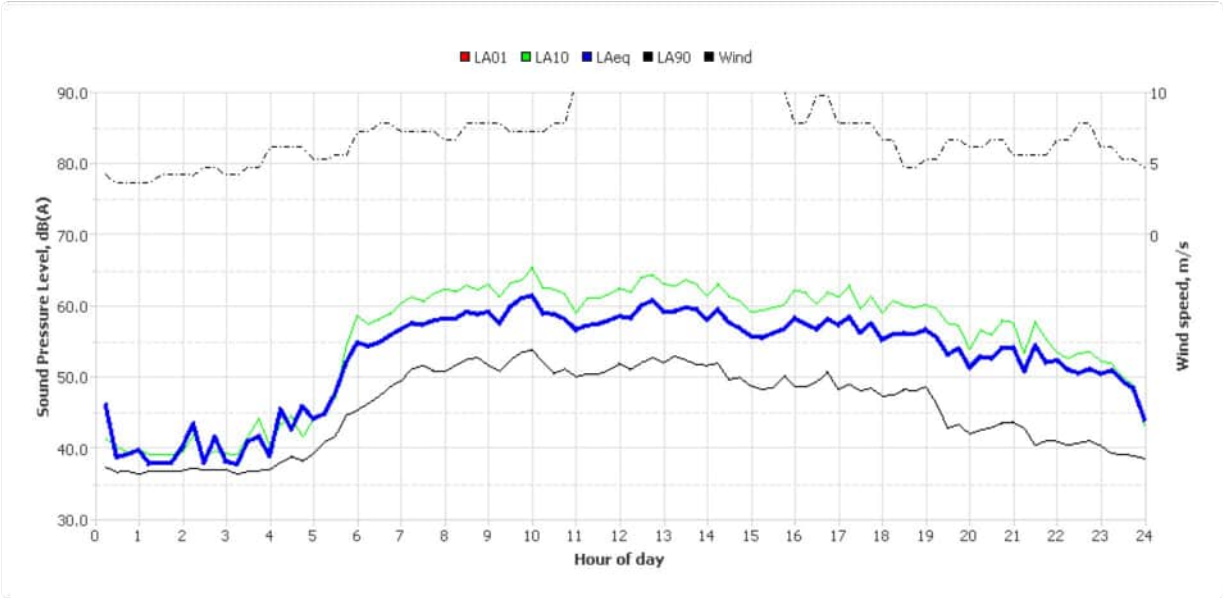
Saturday, 14 Aug 2021



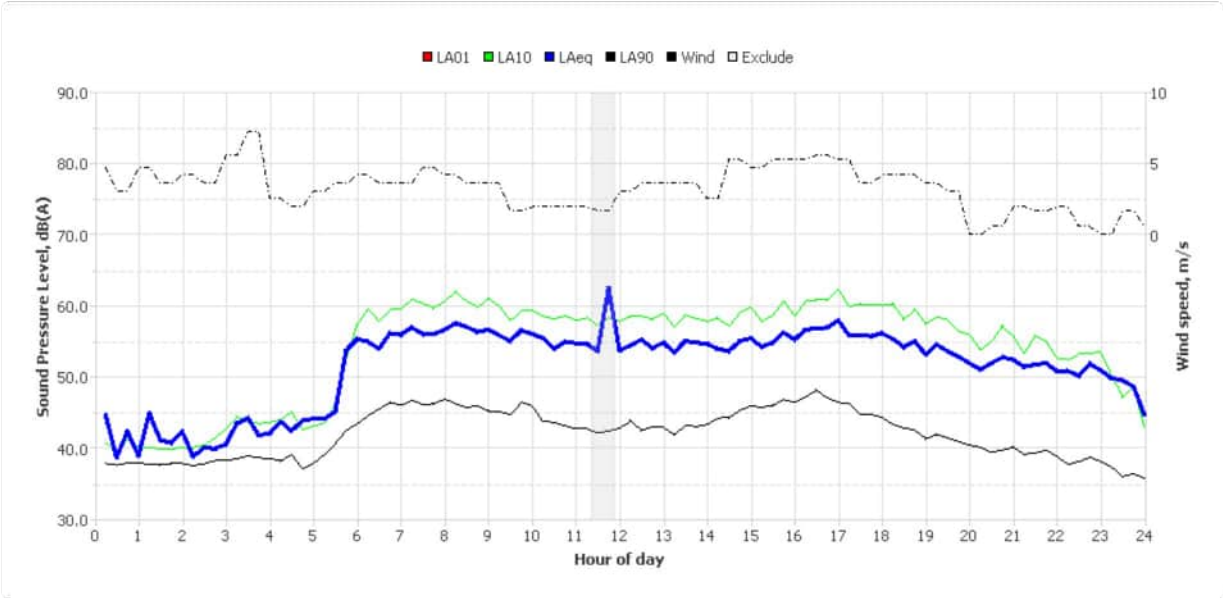
Sunday, 15 Aug 2021



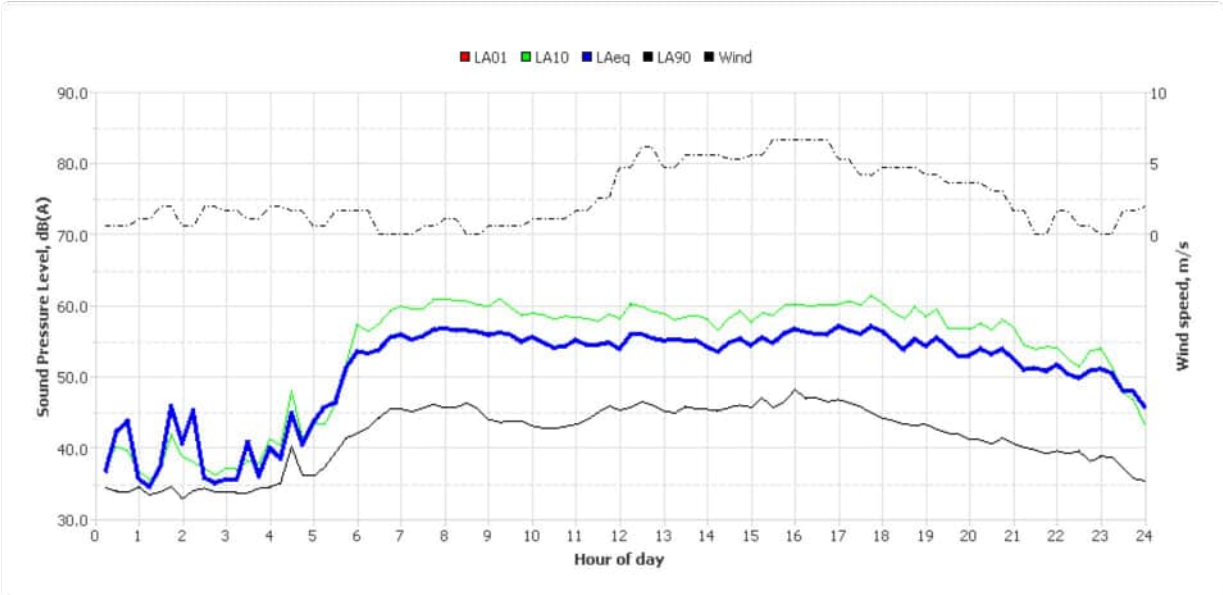
Monday, 16 Aug 2021



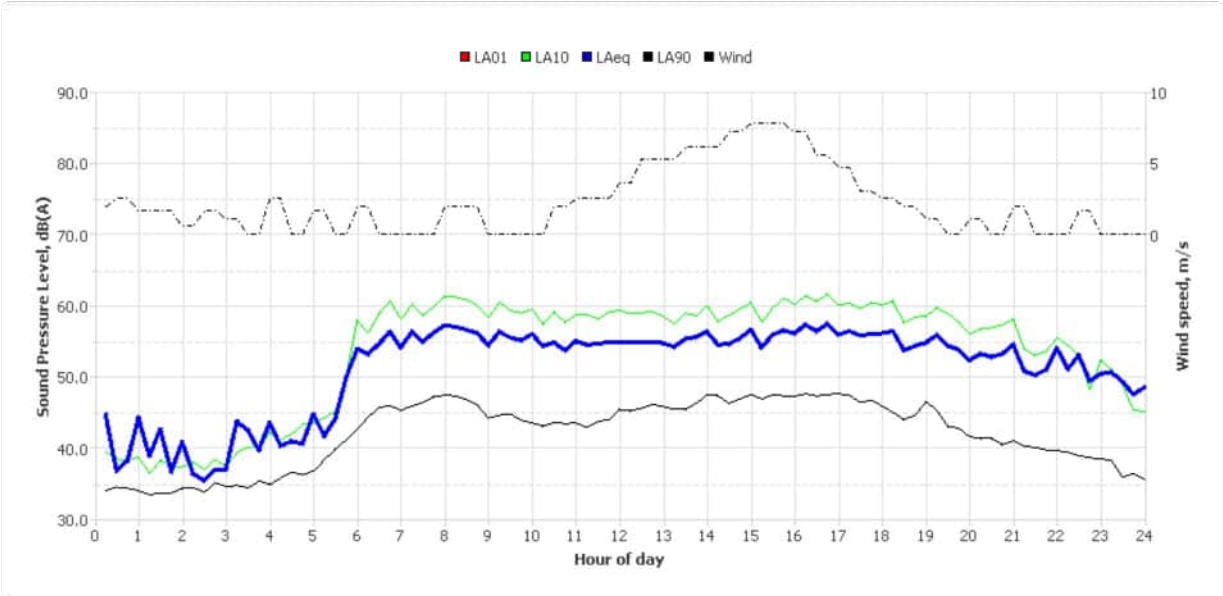
Tuesday, 17 Aug 2021



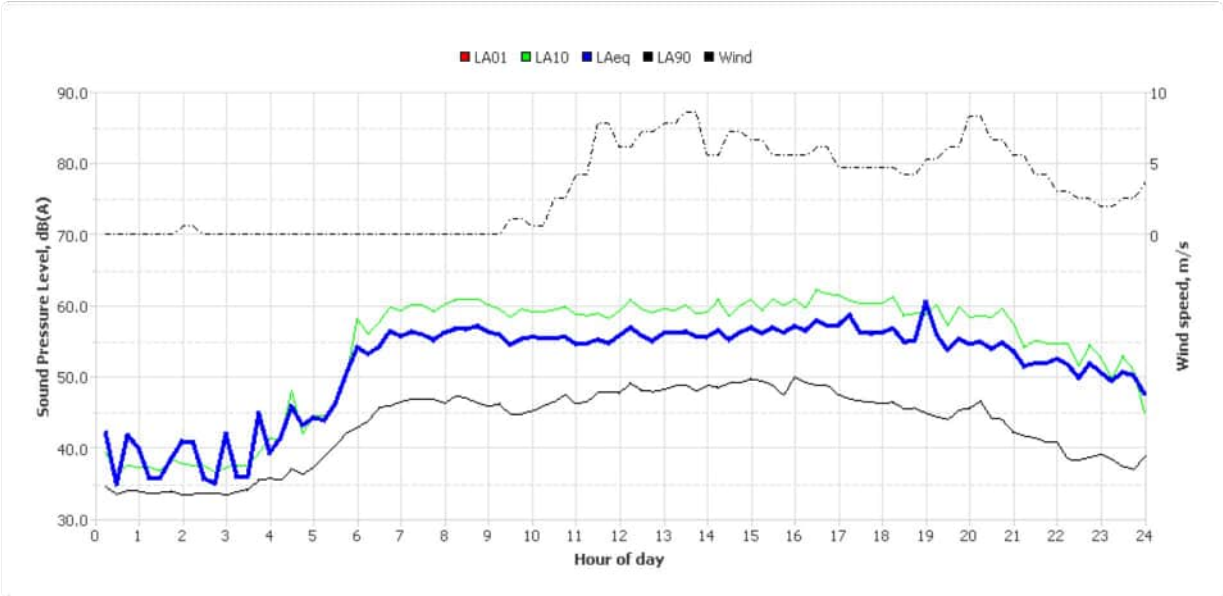
Wednesday, 18 Aug 2021



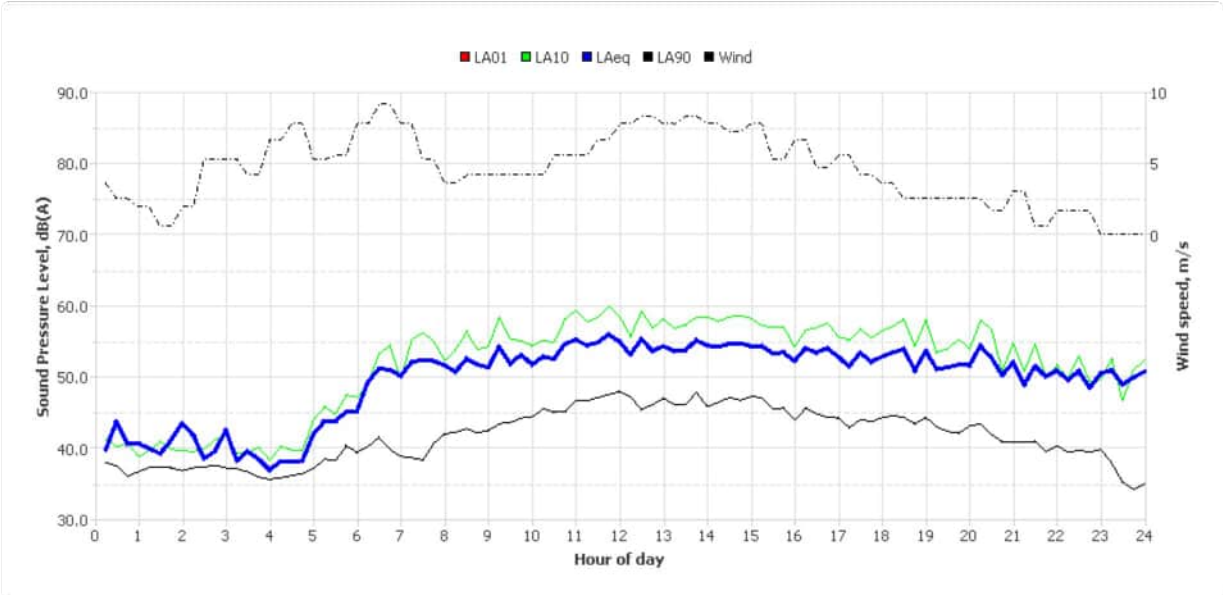
Thursday, 19 Aug 2021



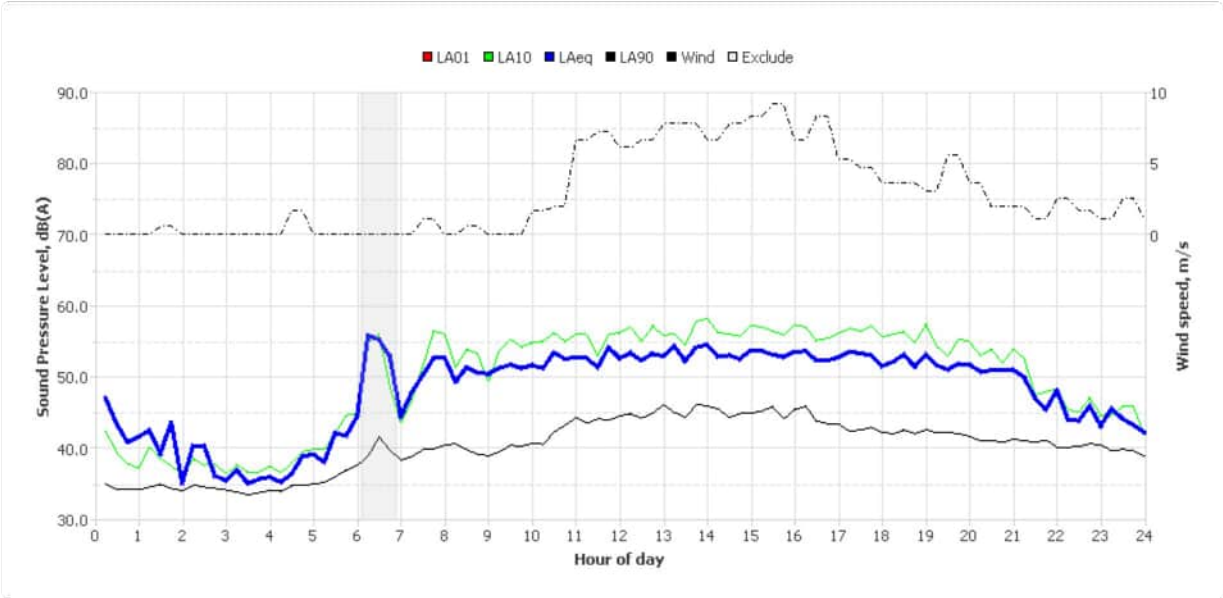
Friday, 20 Aug 2021



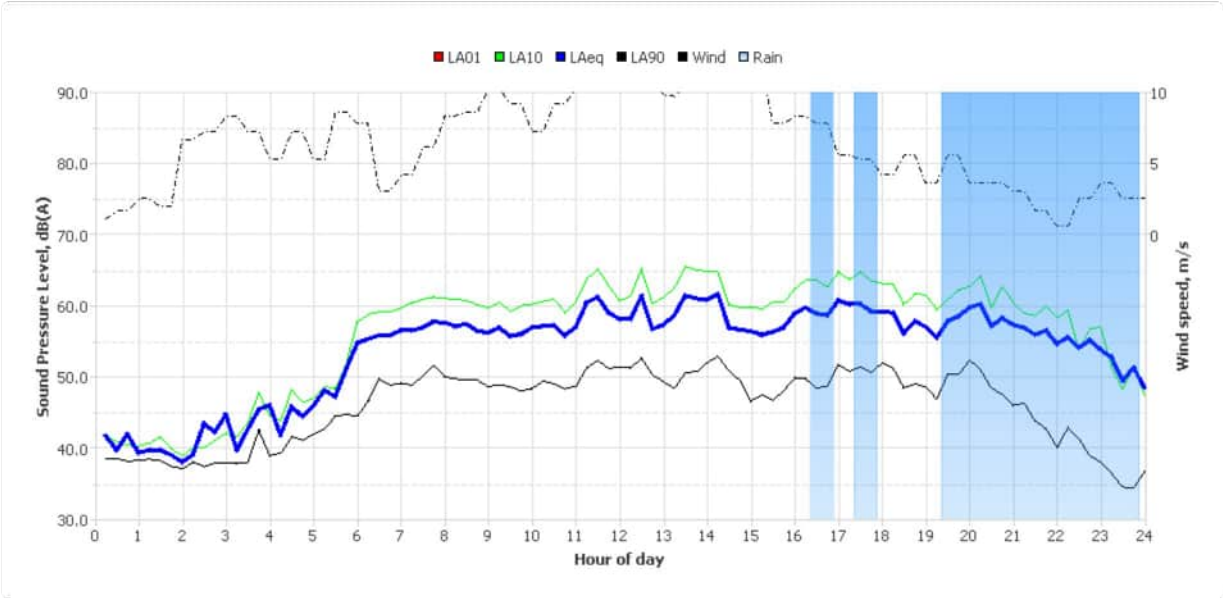
Saturday, 21 Aug 2021



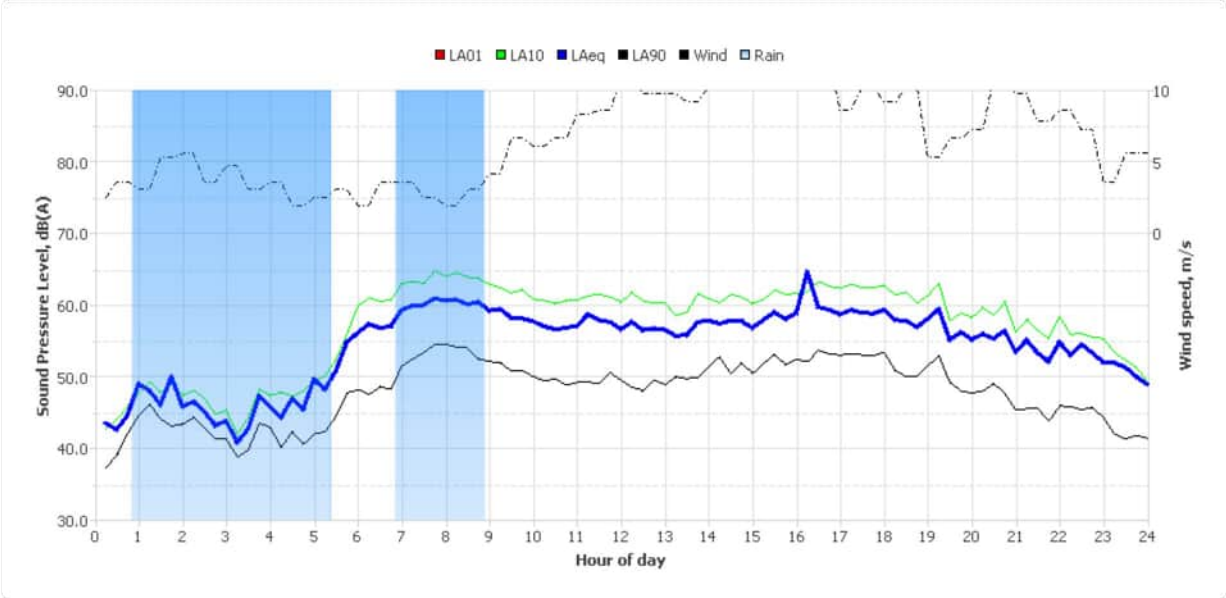
Sunday, 22 Aug 2021



Monday, 23 Aug 2021



Tuesday, 24 Aug 2021



Noise Logger Report

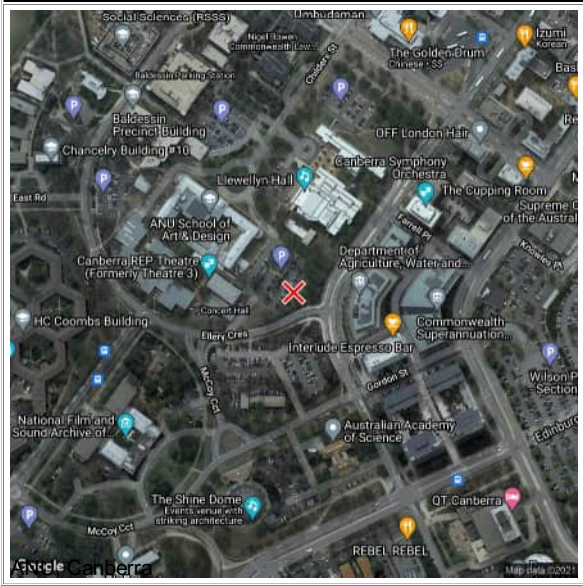
ANU, Canberra

Item	Information
Logger Type	NL-52
Serial number	164396
Address	ANU, Canberra
Location	ANU, Canberra
Facade / Free Field	Free field
Environment	

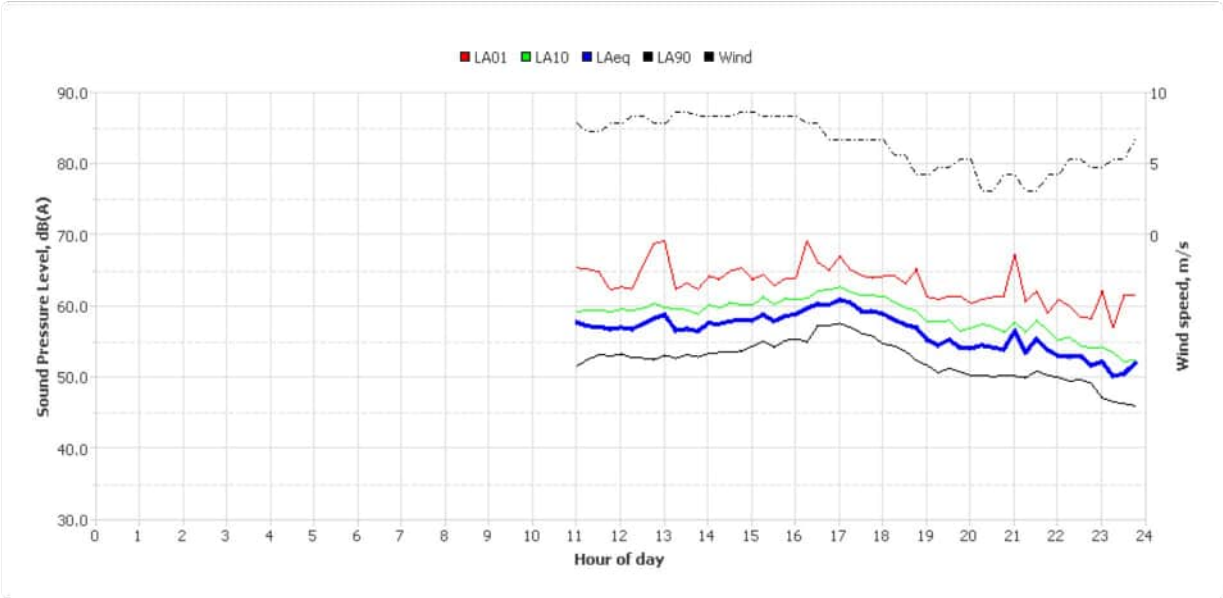
Measured noise levels

Logging Date	$L_{Aeq,day}$ 7am-6pm	$L_{Aeq,evening}$ 6pm-10pm	$L_{Aeq,night}$ 10pm-7am	ABL Day 7am-6pm	ABL Eve 6pm-10pm	ABL Night 10pm-7am	$L_{Aeq,15hr}$ 7am-10pm	$L_{Aeq,9hr}$ 10pm-7am
Thu Aug 5 2021	60	56	52	-	50	-	57	52
Fri Aug 6 2021	58	56	52	-	50	45	57	52
Sat Aug 7 2021	55	54	50	-	49	44	55	50
Sun Aug 8 2021	53	53	48	48	47	44	53	48
Mon Aug 9 2021	58	54	52	51	49	43	57	52
Tue Aug 10 2021	59	55	52	-	49	44	58	52
Wed Aug 11 2021	60	-	52	-	-	-	60	52
Thu Aug 12 2021	60	52	53	-	48	-	58	53
Fri Aug 13 2021	54	51	51	49	48	44	54	51
Sat Aug 14 2021	52	50	46	47	48	43	51	46
Sun Aug 15 2021	50	55	45	-	-	-	52	45
Mon Aug 16 2021	55	56	49	-	48	-	56	49
Tue Aug 17 2021	54	50	48	48	47	43	53	48
Wed Aug 18 2021	56	51	48	49	47	43	55	48
Thu Aug 19 2021	54	50	47	48	47	43	54	47
Summary	**57**	**54**	**50**	**48**	**48**	**43**	**56**	**50**

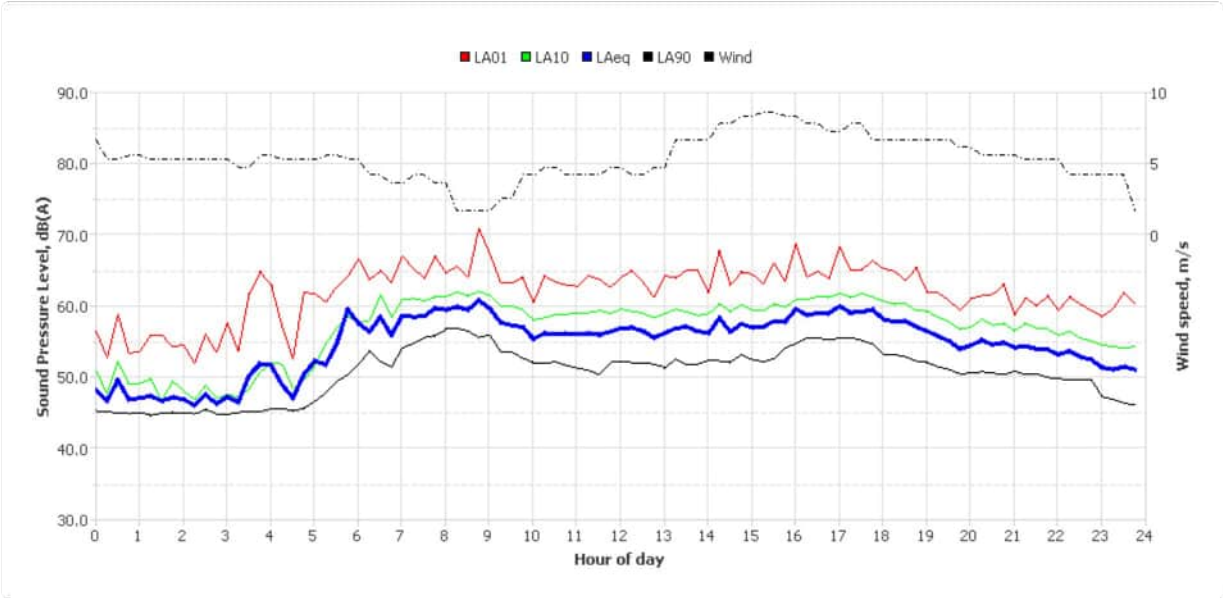
Note: Results denoted with '-' do not contain enough valid data for a value to be calculated. The data has been excluded either manually or automatically as a result of adverse weather conditions.

Logger Location	Logger Deployment Photo
	

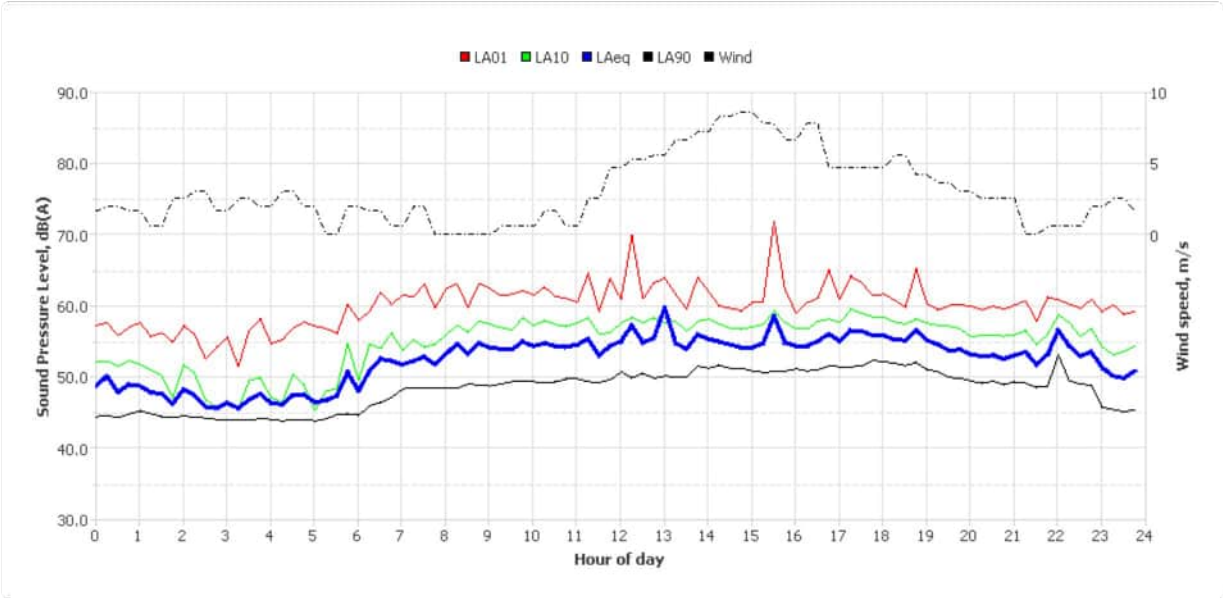
Thursday, 05 Aug 2021



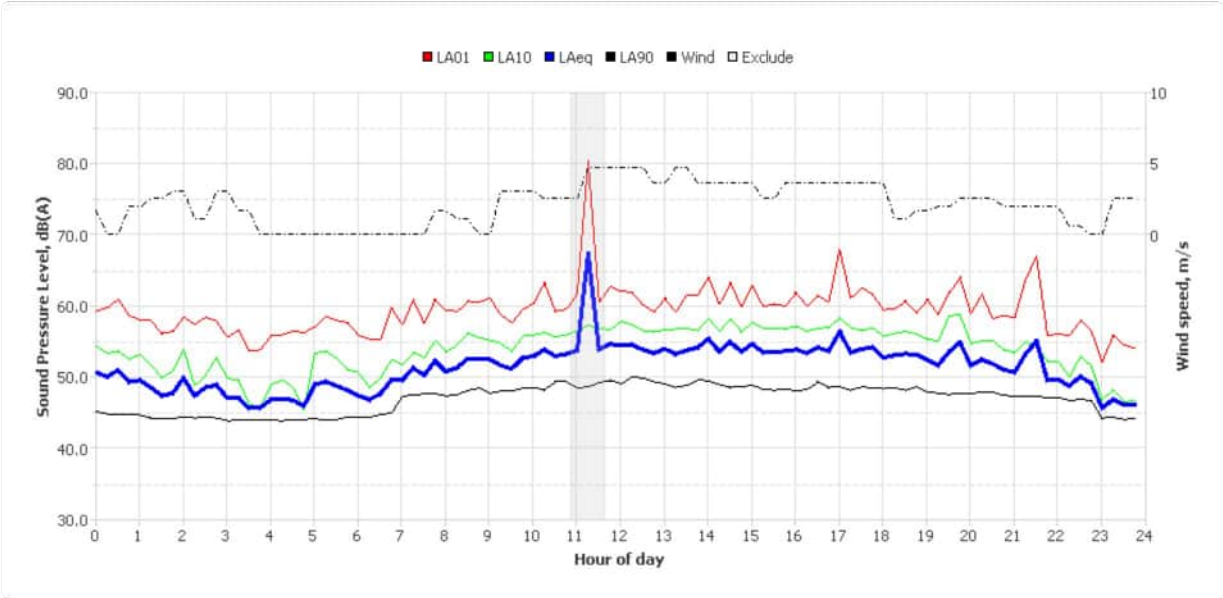
Friday, 06 Aug 2021



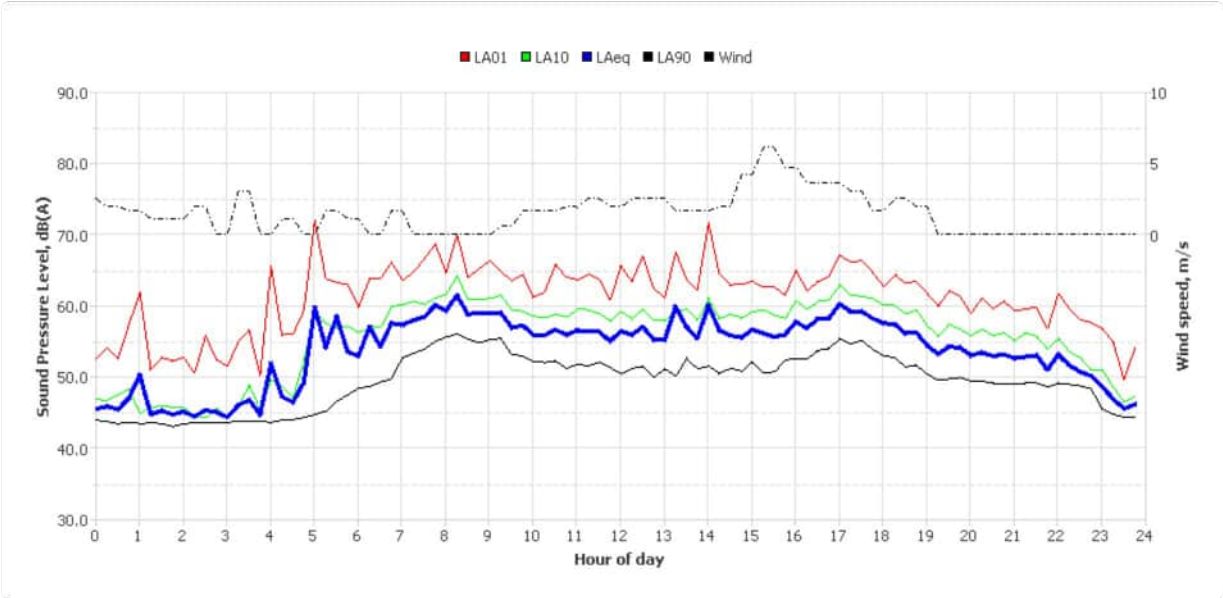
Saturday, 07 Aug 2021



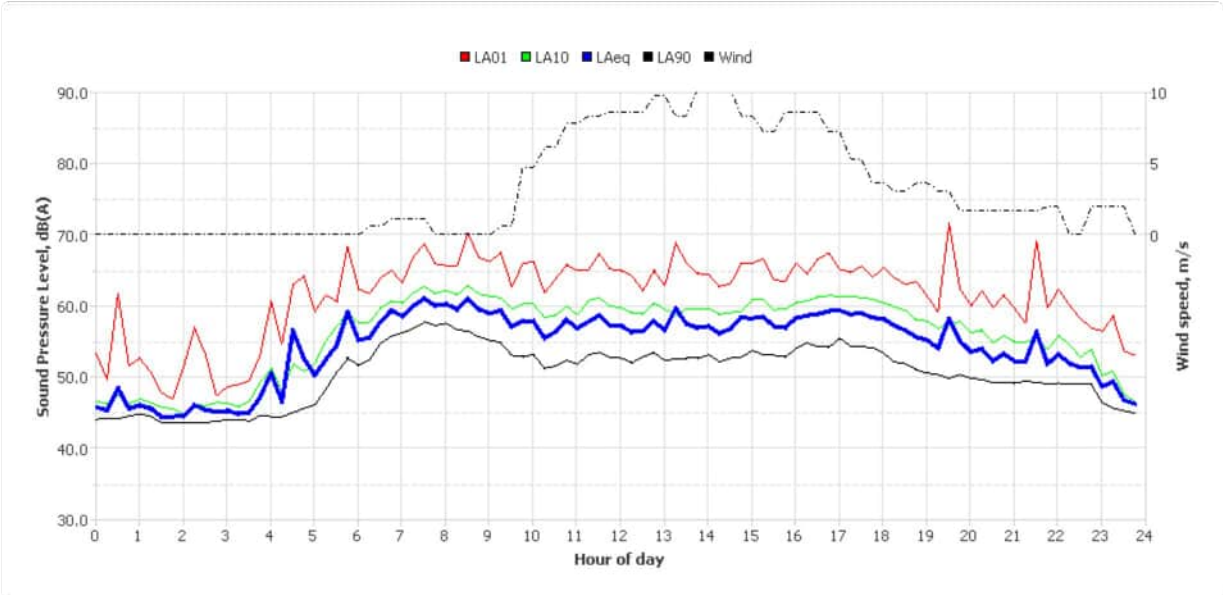
Sunday, 08 Aug 2021



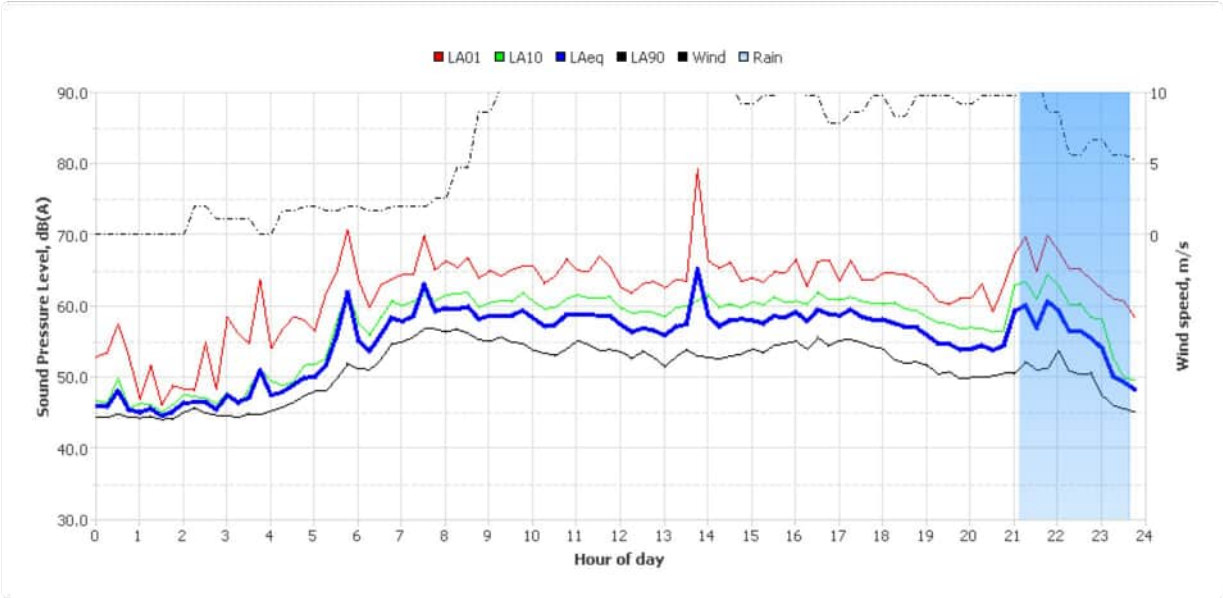
Monday, 09 Aug 2021



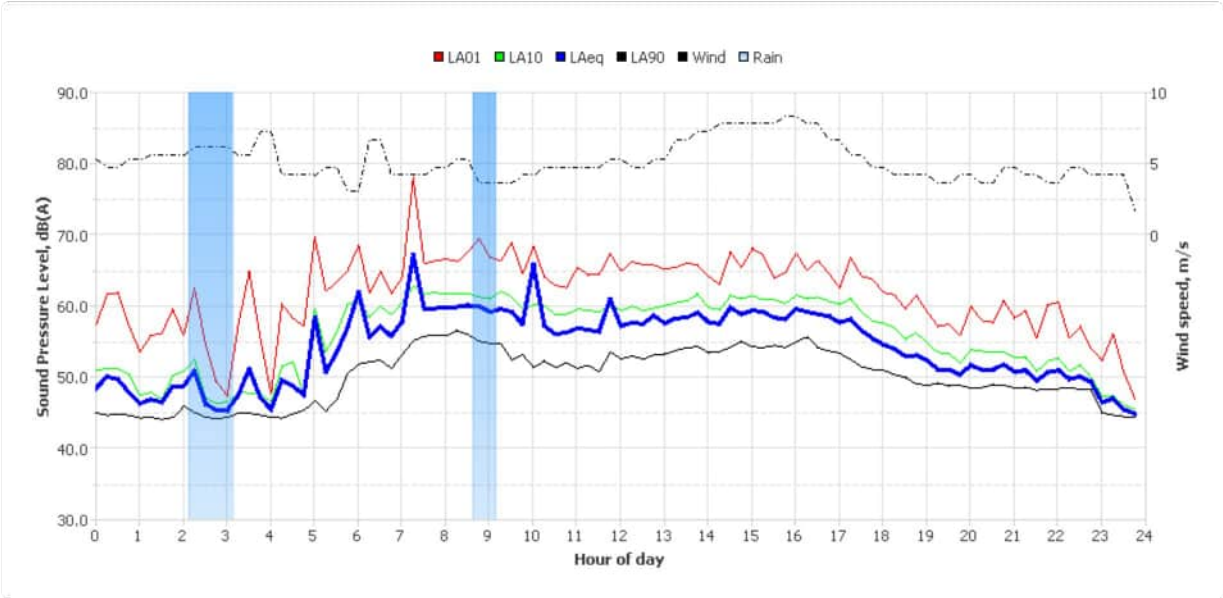
Tuesday, 10 Aug 2021



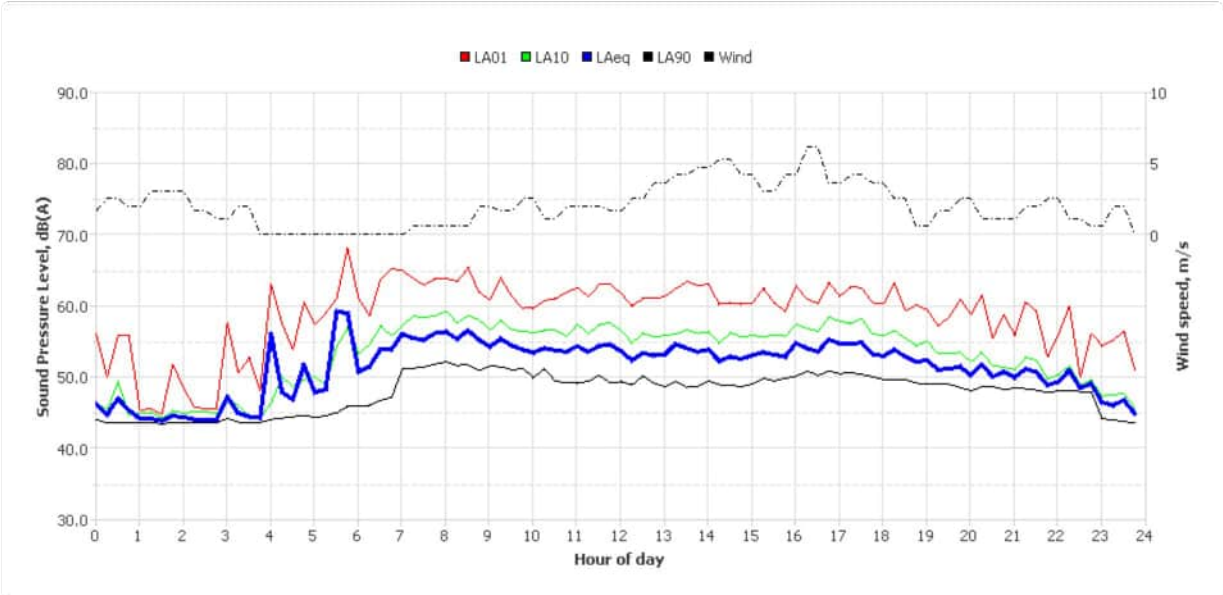
Wednesday, 11 Aug 2021



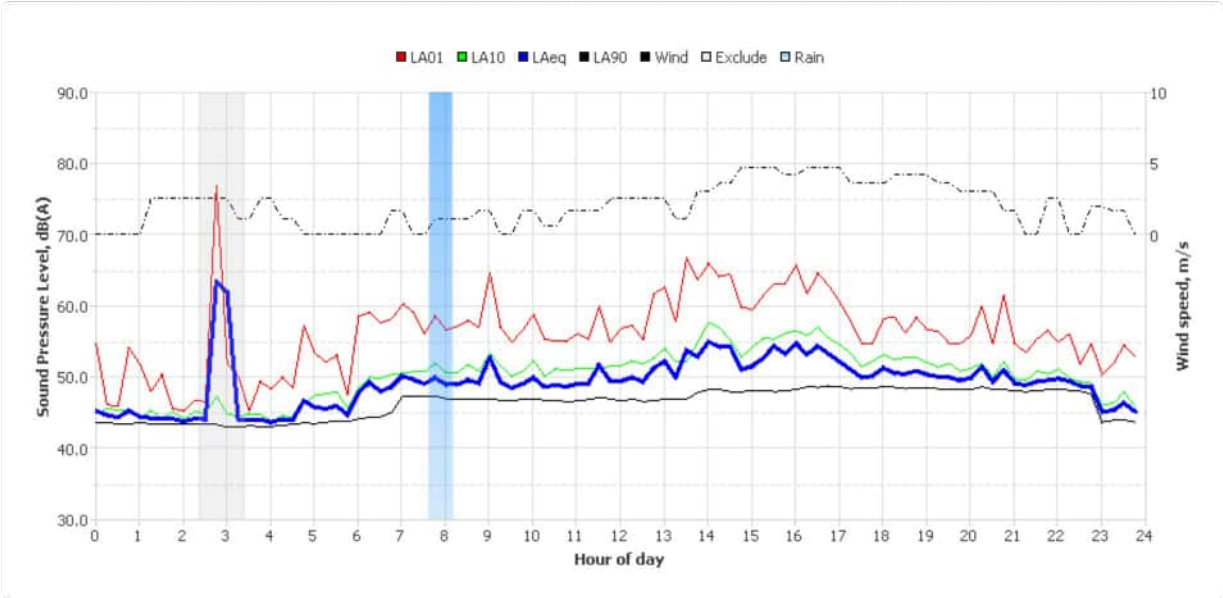
Thursday, 12 Aug 2021



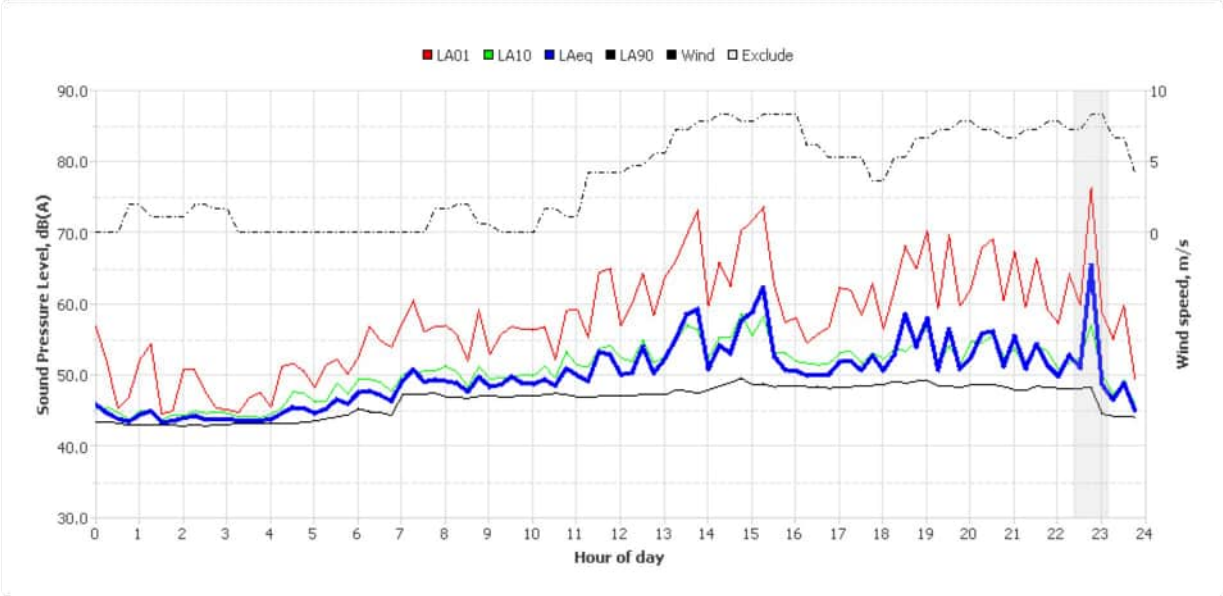
Friday, 13 Aug 2021



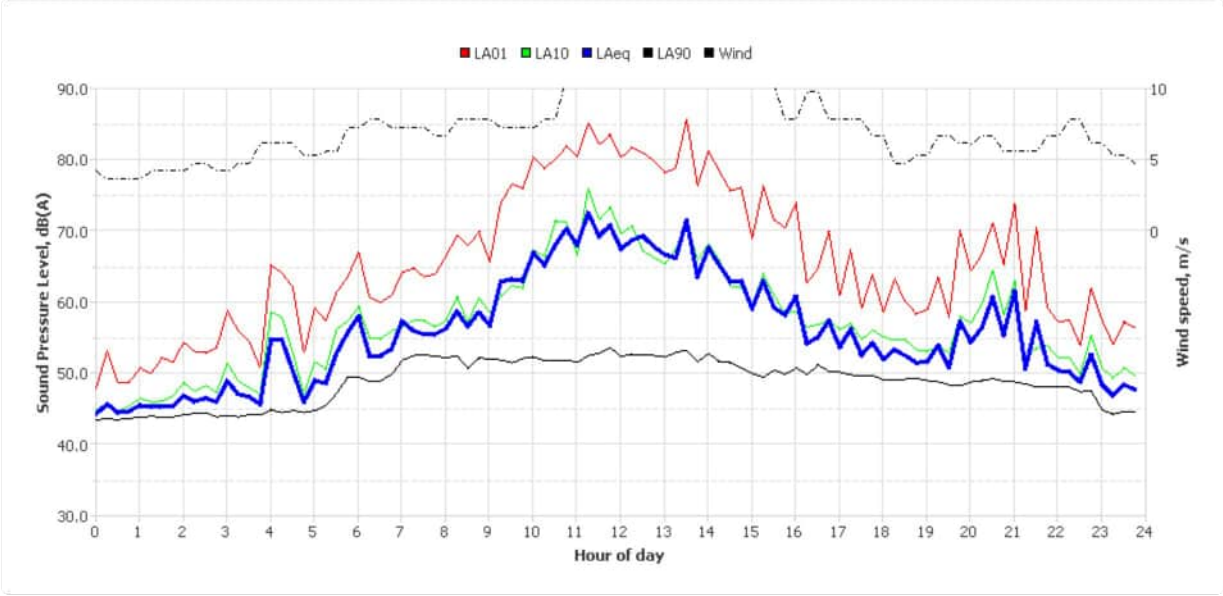
Saturday, 14 Aug 2021



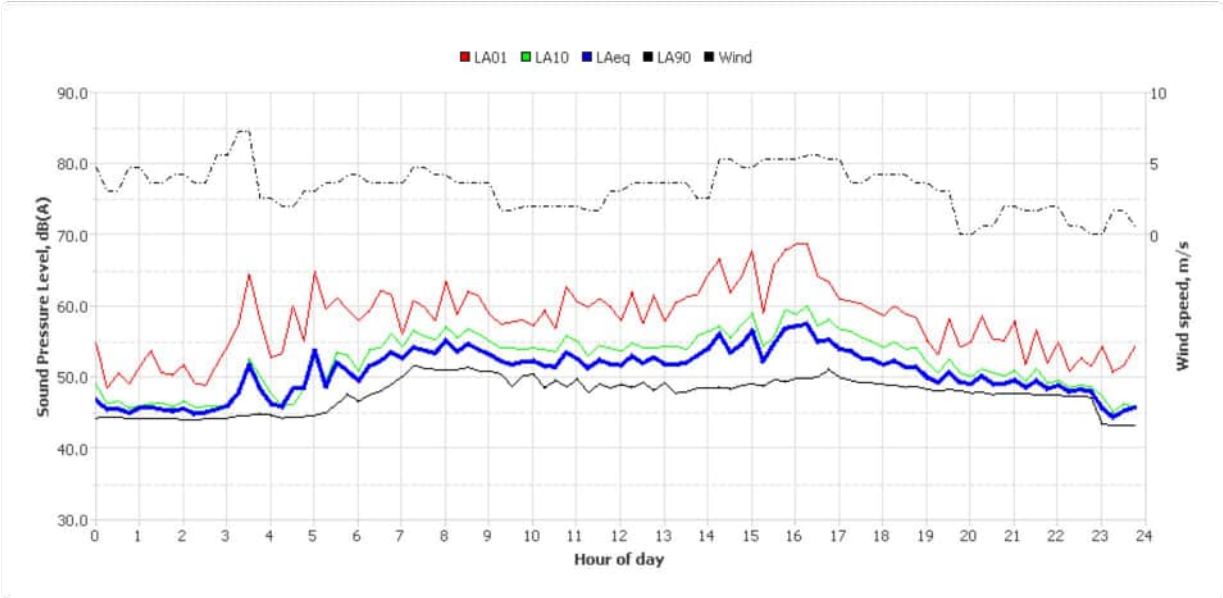
Sunday, 15 Aug 2021



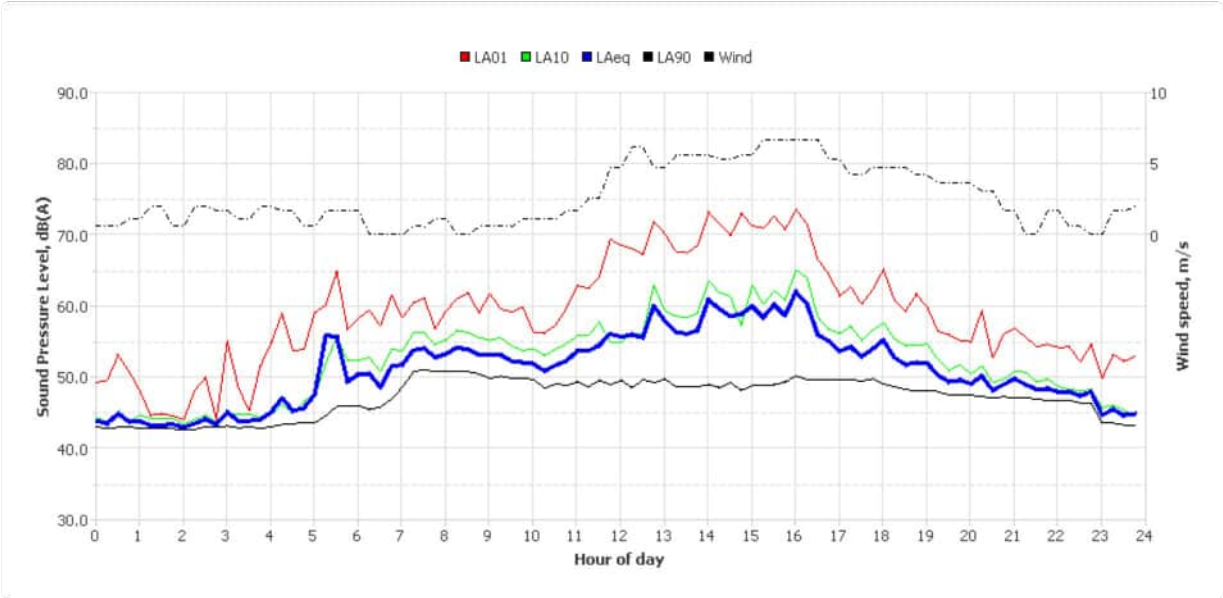
Monday, 16 Aug 2021



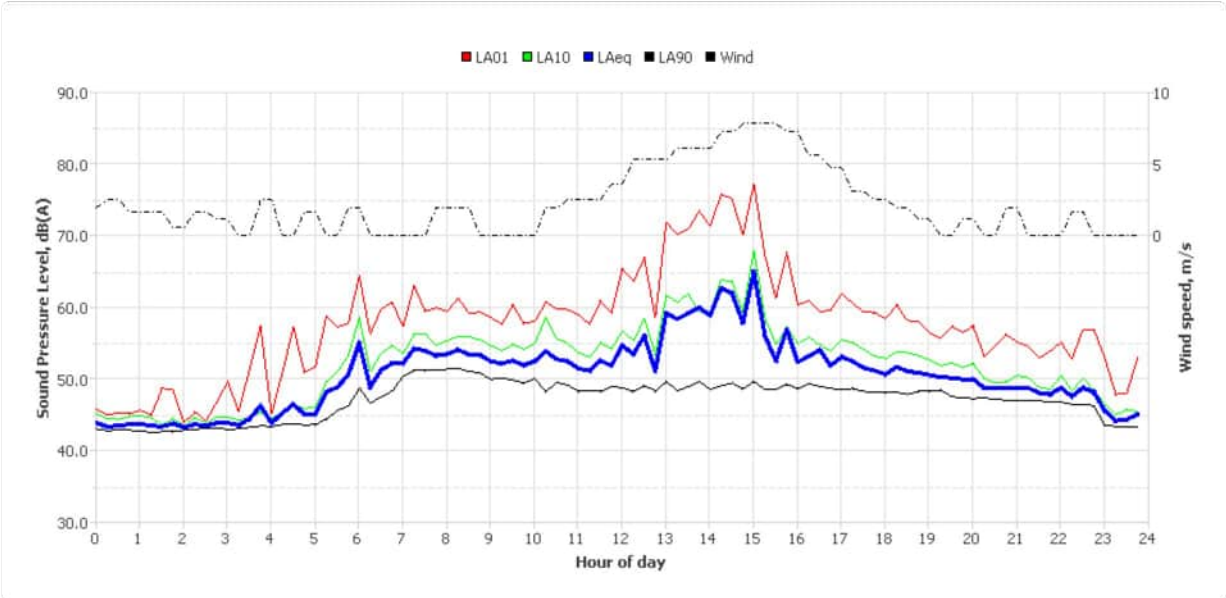
Tuesday, 17 Aug 2021



Wednesday, 18 Aug 2021



Thursday, 19 Aug 2021



Appendix C

Identified sensitive receivers

CLR2A - Sensitive Receiver Locations

Light Rail Alignment

Sensitive Receivers (Identified by MPC)

Sensitive Receivers (Identified by AECOM)

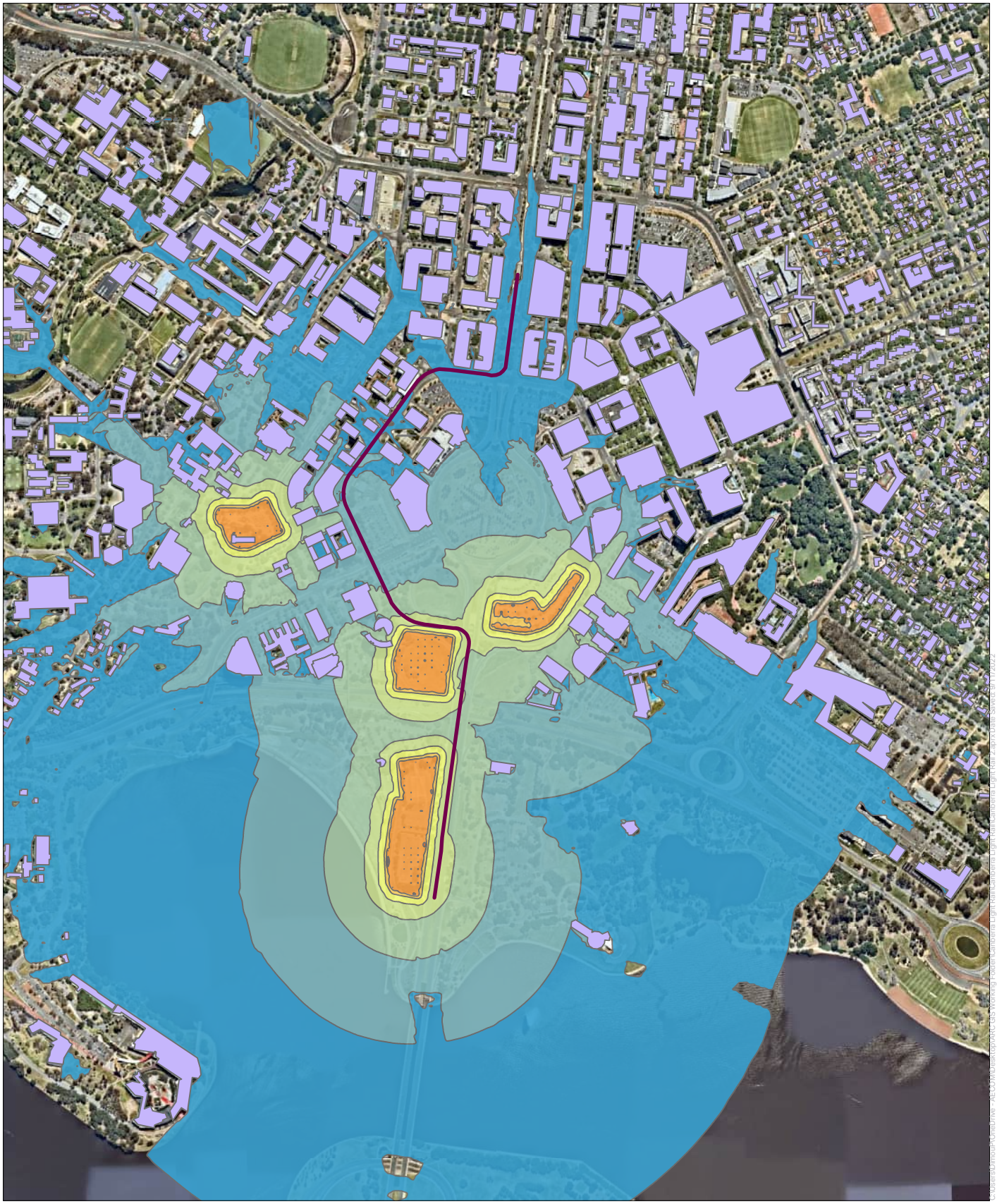
N

0 150 300 Meters

AECOM

Appendix D

Construction airborne L_{Aeq} contour maps



CLR2A - Construction Noise

Mobilisation and establishment of construction compound sites

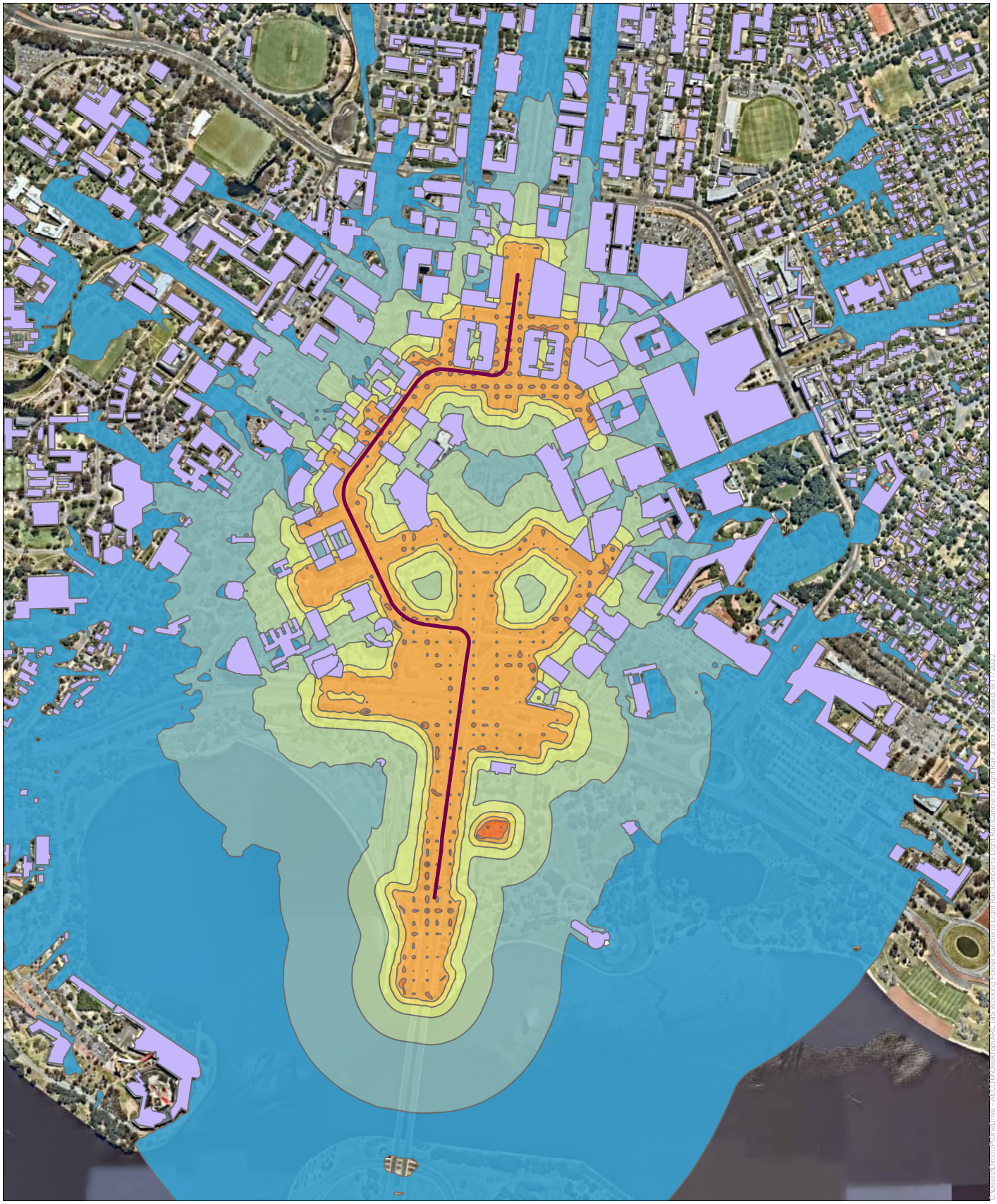
Construction noise L_{Aeq} dB

50	60	70	80	90	100	110	120	130

N

0 150 300 Meters

AECOM



CLR2A - Construction Noise

Decommissioning and treatment of utilities

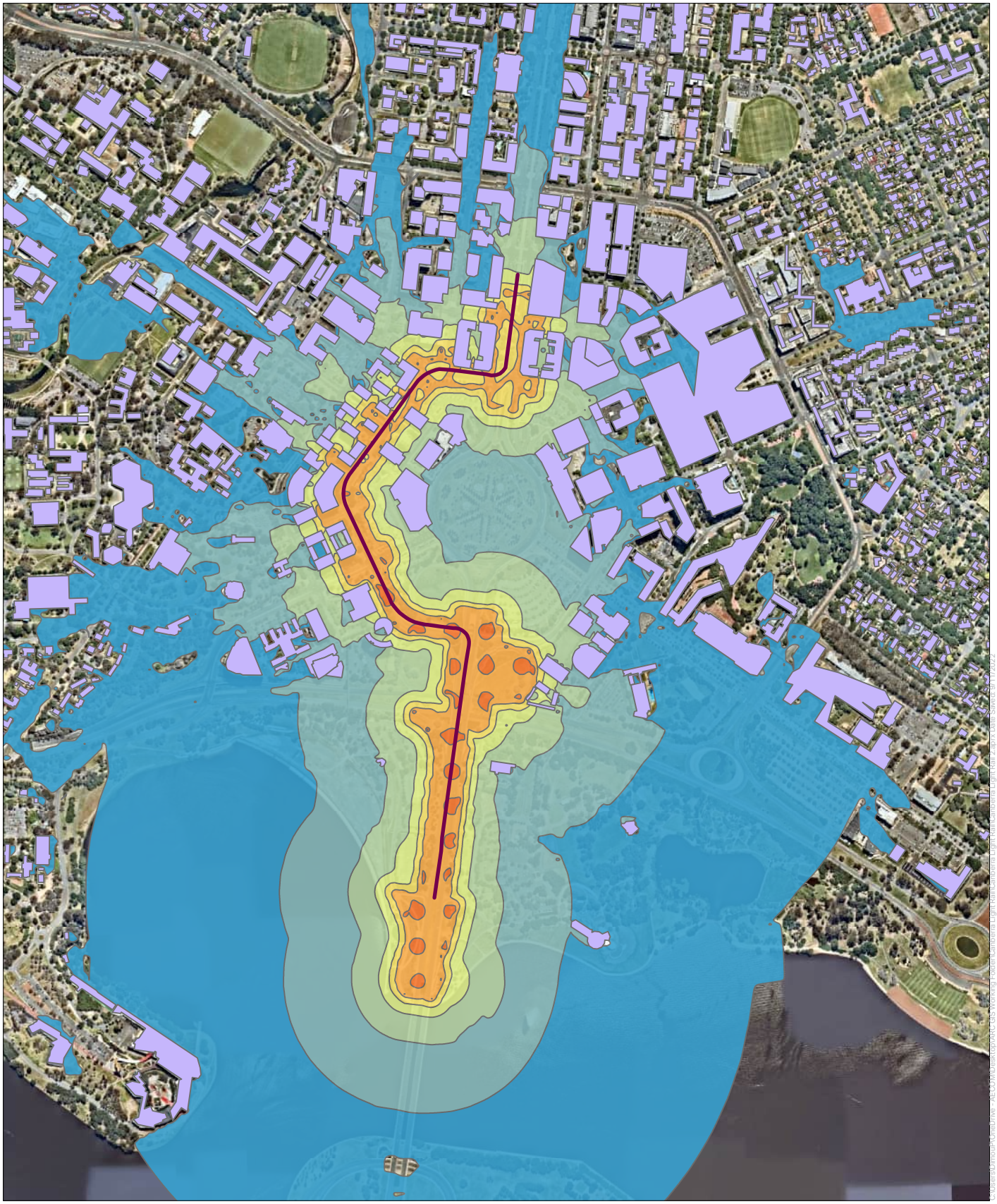
Construction noise L_{Aeq} dB

50	60	70	80	90	100	110	120

N

0 150 300 Meters

AECOM



CLR2A - Construction Noise

Construction of trackform

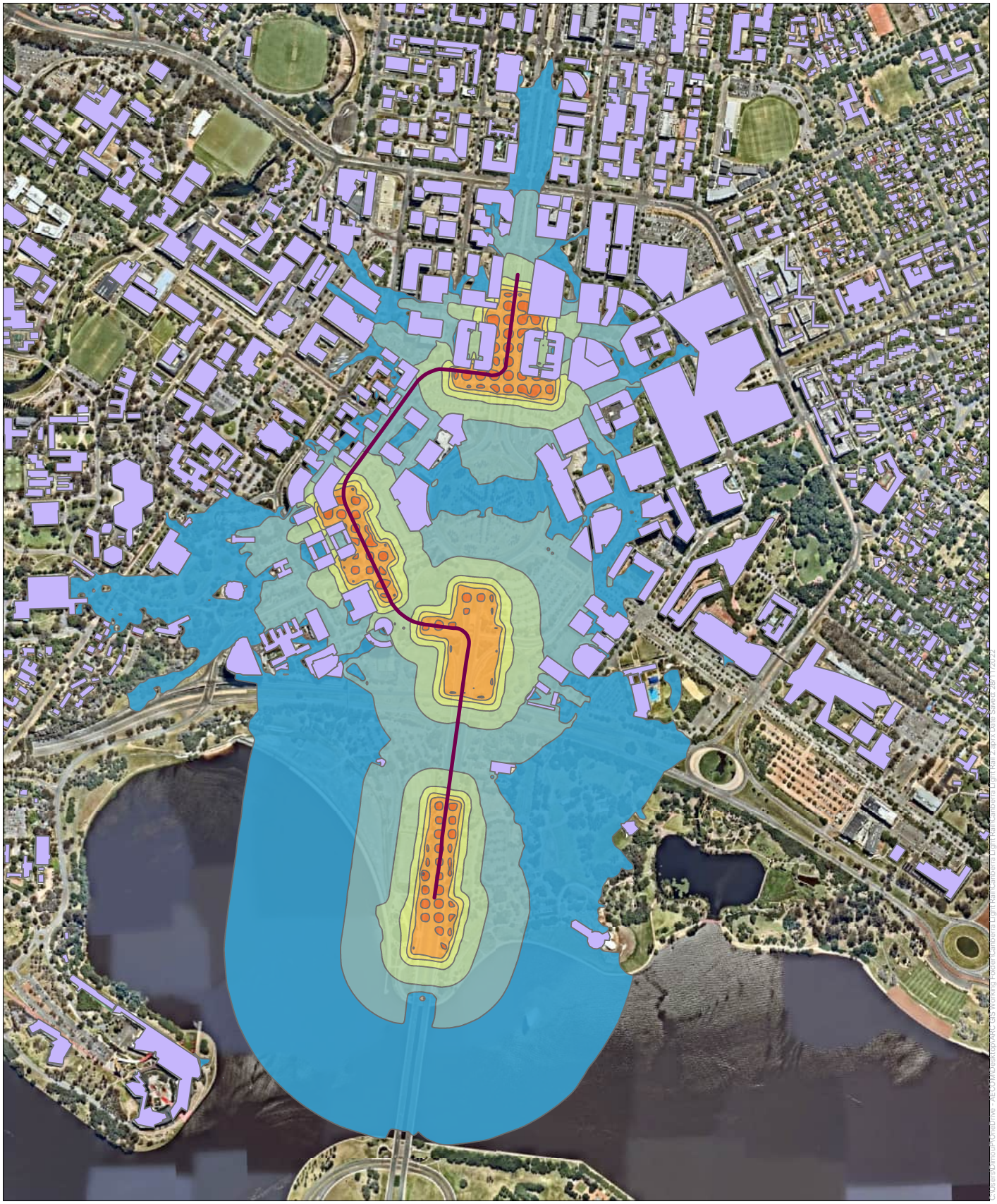
Construction noise L_{Aeq} dB

50	60	70	80	90	100	110	120

N

0 150 300 Meters

AECOM



CLR2A - Construction Noise

Construction of stops

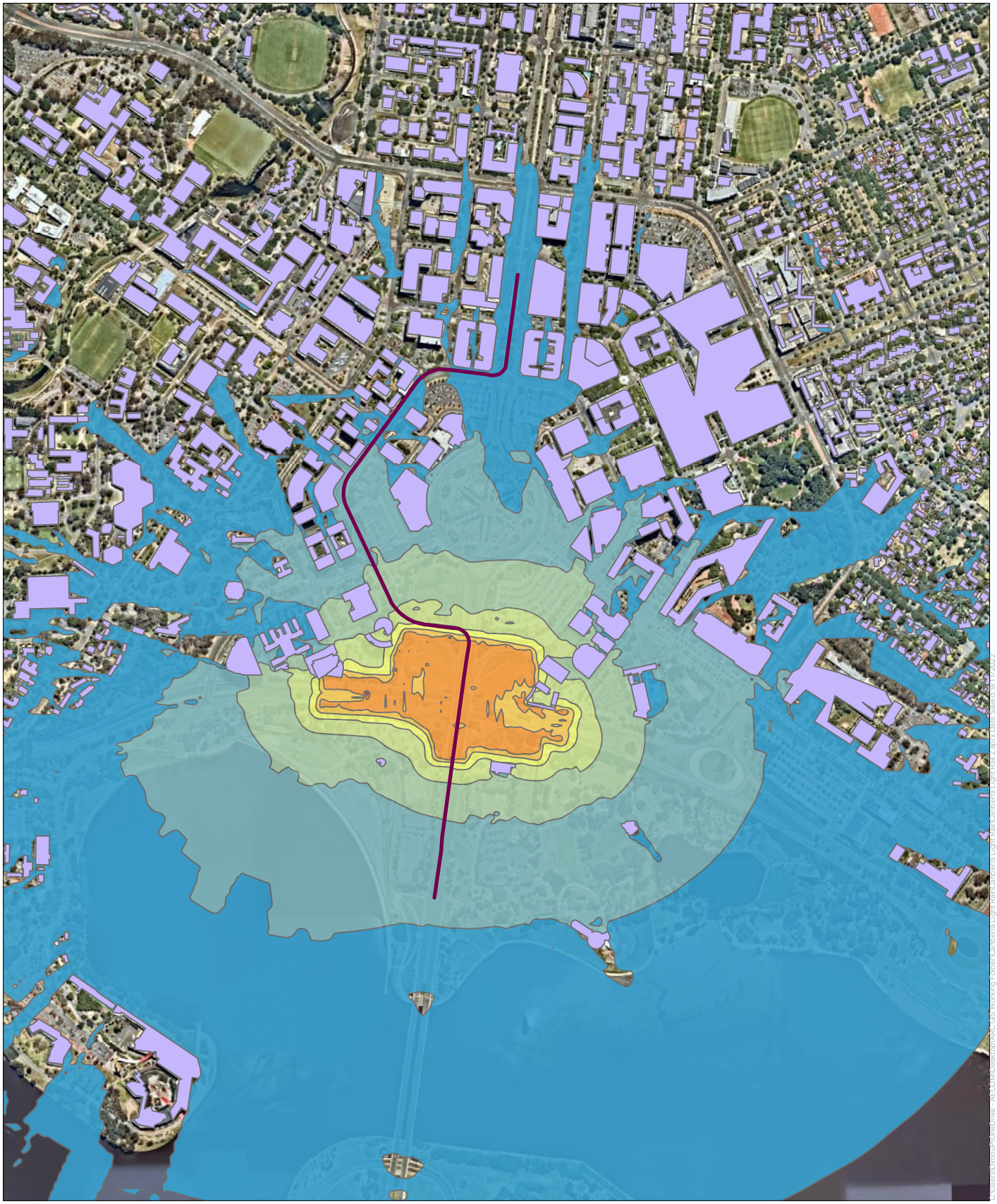
Construction noise L_{Aeq} dB

50	60	70	80	90	100	110	120

N

0 150 300 Meters

AECOM



CLR2A - Construction Noise

Construction of Parkes Way Bridge

Construction noise L_{Aeq} dB

50	60	70	80	90	100	110	120	130

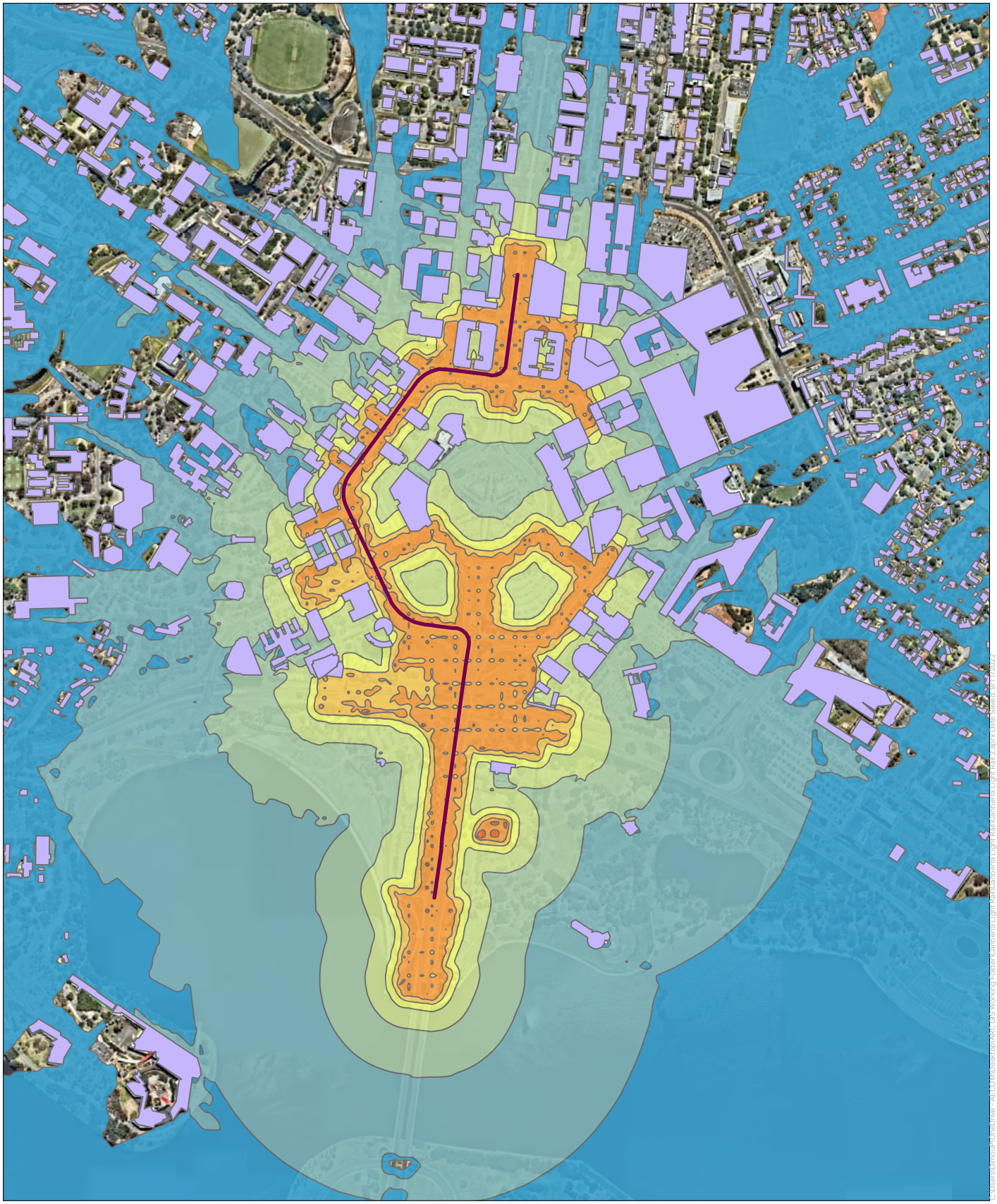
N

0 150 300 Meters

AECOM

Appendix E

Construction airborne sleep disturbance contour maps



CLR2A - Construction Noise

Decommissioning and treatment of utilities
Sleep Disturbance

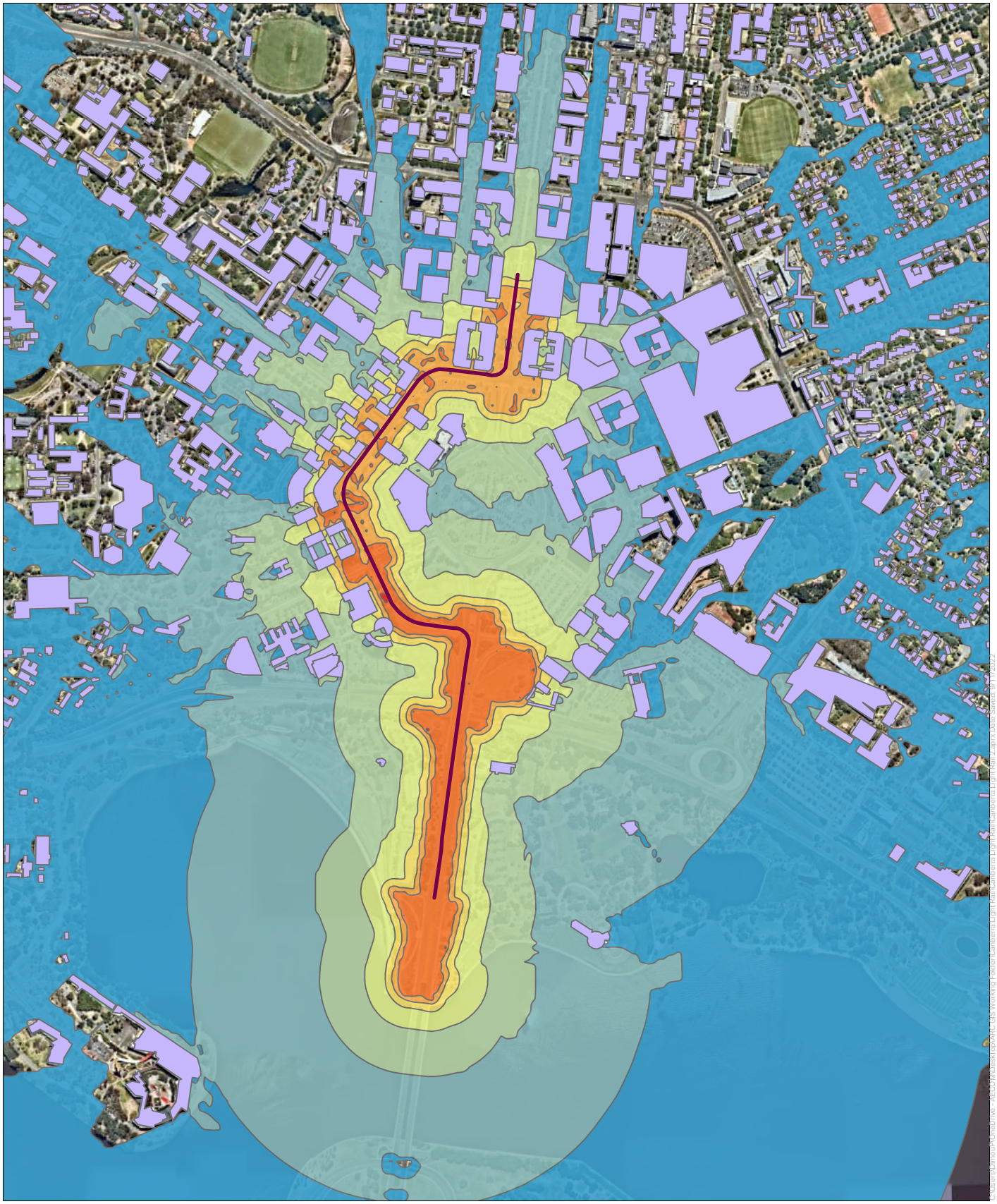
Construction noise $L_{A1,1min}$ dB

50	60	70	80	90	100	110	120	130

N

0 150 300 Meters

AECOM



CLR2A - Construction Noise

Construction of trackform
Sleep Disturbance

Construction noise $L_{A1,1min}$ dB

50	60	70	80	90	100	110	120

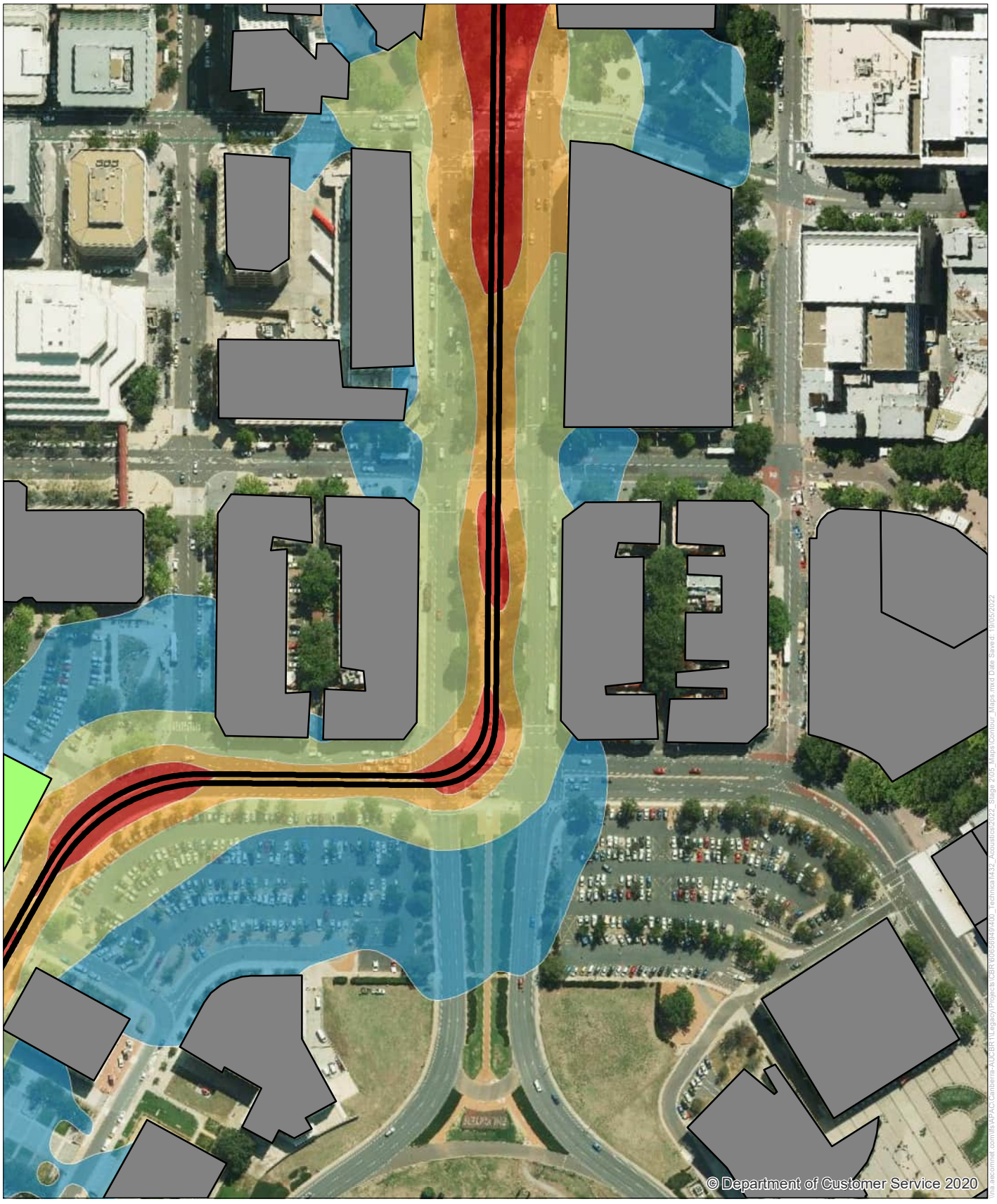
N

0 150 300 Meters

AECOM

Appendix F

Operational light rail airborne L_{Aeq} contour maps



Canberra Light Rail - Stage 2A

Daytime $L_{Aeq,15hr}$ Noise Levels

N

0 30 60 Meters

AECOM

Legend

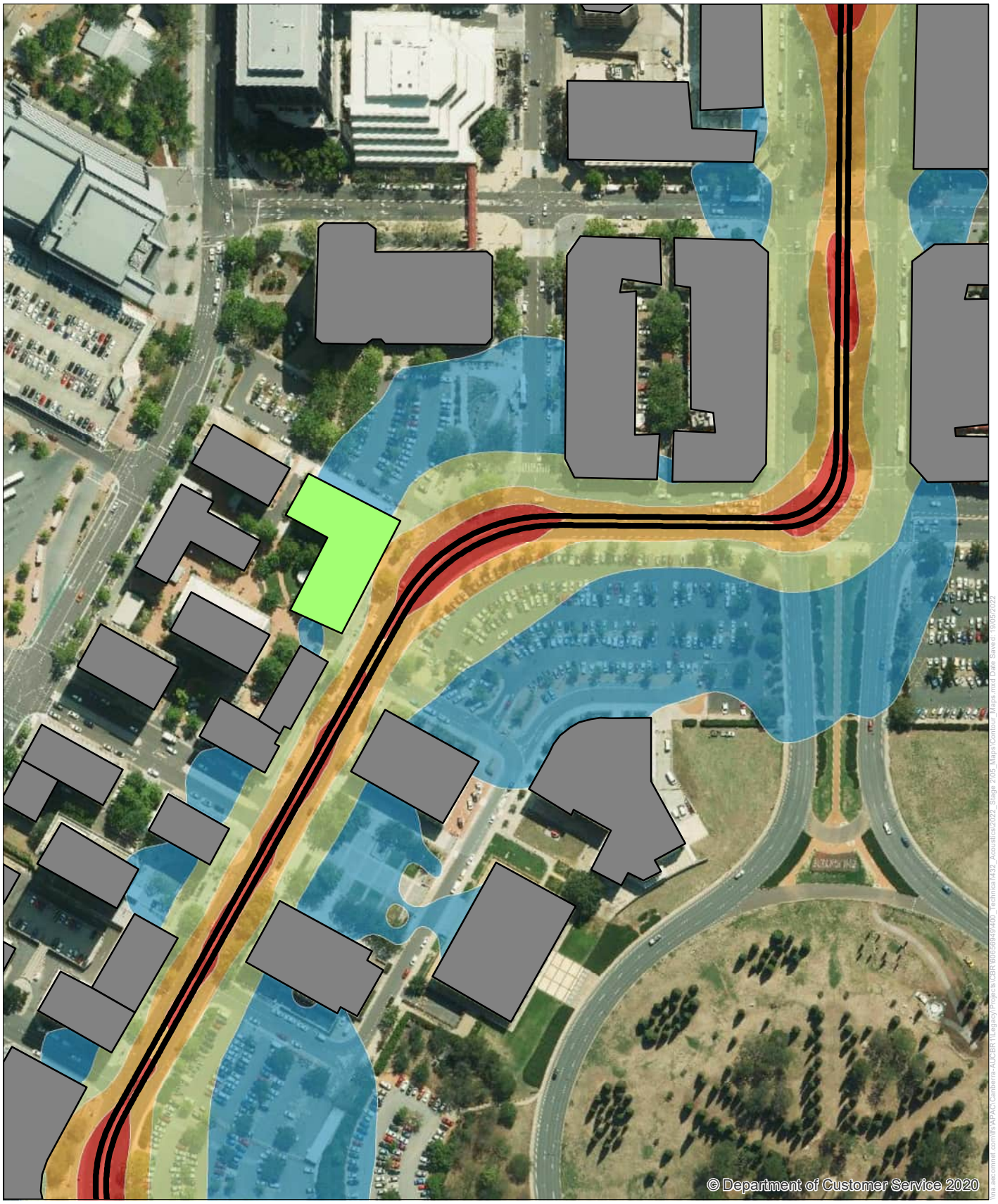
Non-residential Receiver

Residential

Commercial/Other

Sound Pressure Level, $L_{Aeq,15hr}$, dB(A)

45 50 55 60



Canberra Light Rail - Stage 2A

Daytime $L_{Aeq,15hr}$ Noise Levels

N

0 30 60 Meters

AECOM

Legend

Non-residential Receiver

Residential

Commercial/Other

Sound Pressure Level, $L_{Aeq,15hr}$, dB(A)

45 50 55 60

Canberra Light Rail - Stage 2A

Daytime $L_{Aeq,15hr}$ Noise Levels

N

0 30 60 Meters

AECOM

Legend

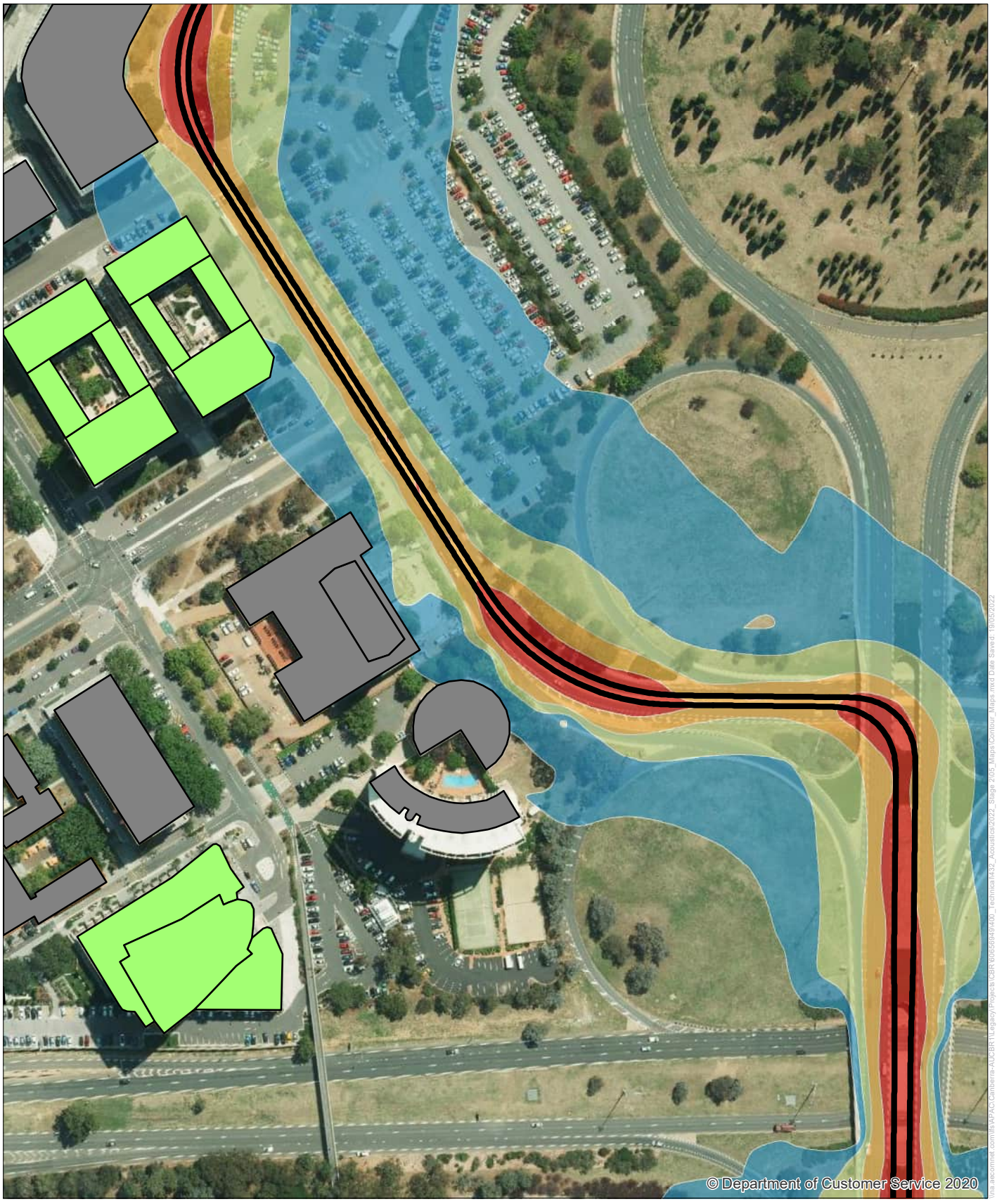
Non-residential Receiver

Residential

Commercial/Other

Sound Pressure Level, $L_{Aeq,15hr}$, dB(A)

45 50 55 60



Canberra Light Rail - Stage 2A

Daytime $L_{Aeq,15hr}$ Noise Levels

N

0 30 60 Meters

AECOM

Legend

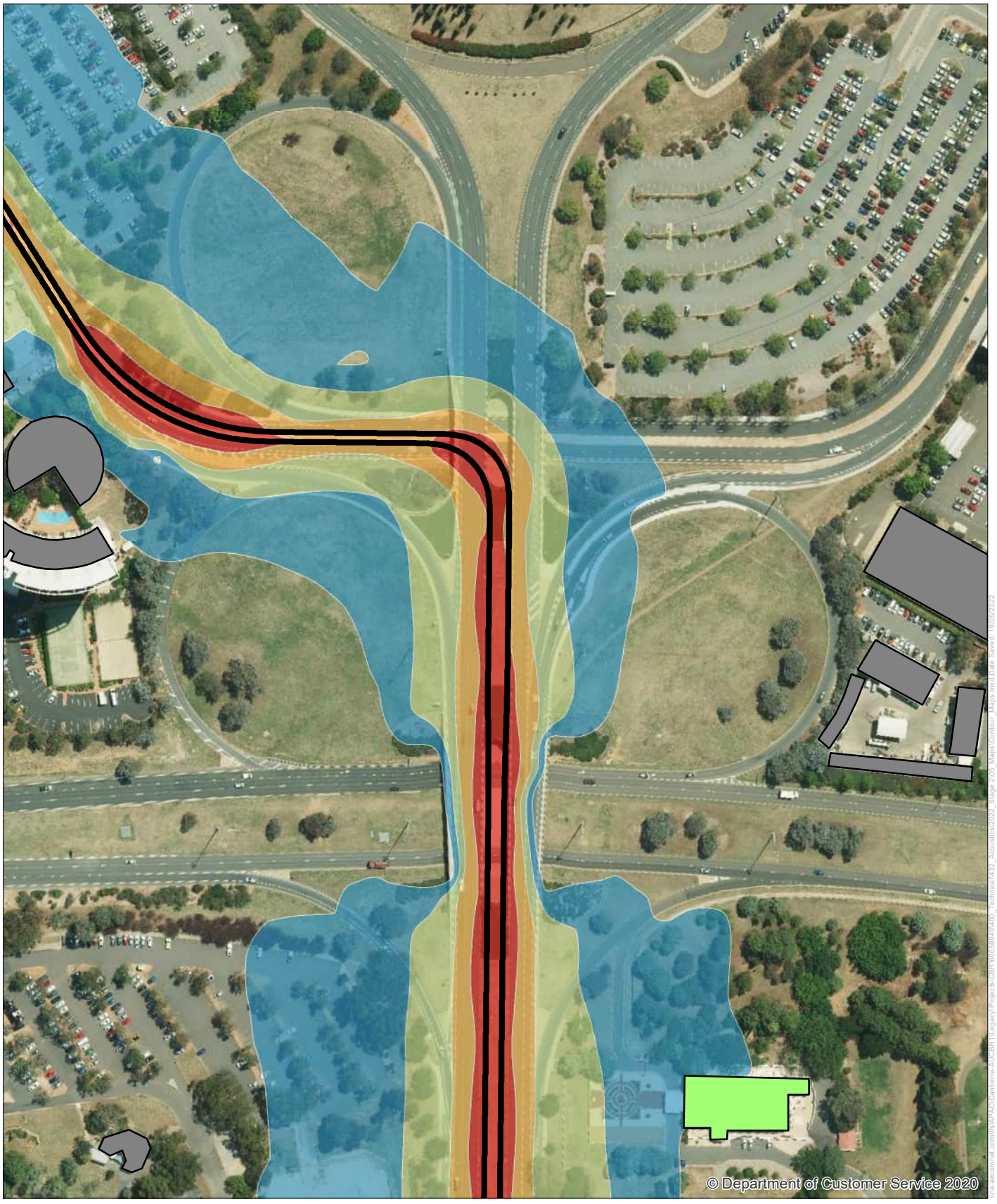
Non-residential Receiver

Residential

Commercial/Other

Sound Pressure Level, $L_{Aeq,15hr}$, dB(A)

45 50 55 60



Canberra Light Rail - Stage 2A

Daytime $L_{Aeq,15hr}$ Noise Levels

N

0 30 60 Meters

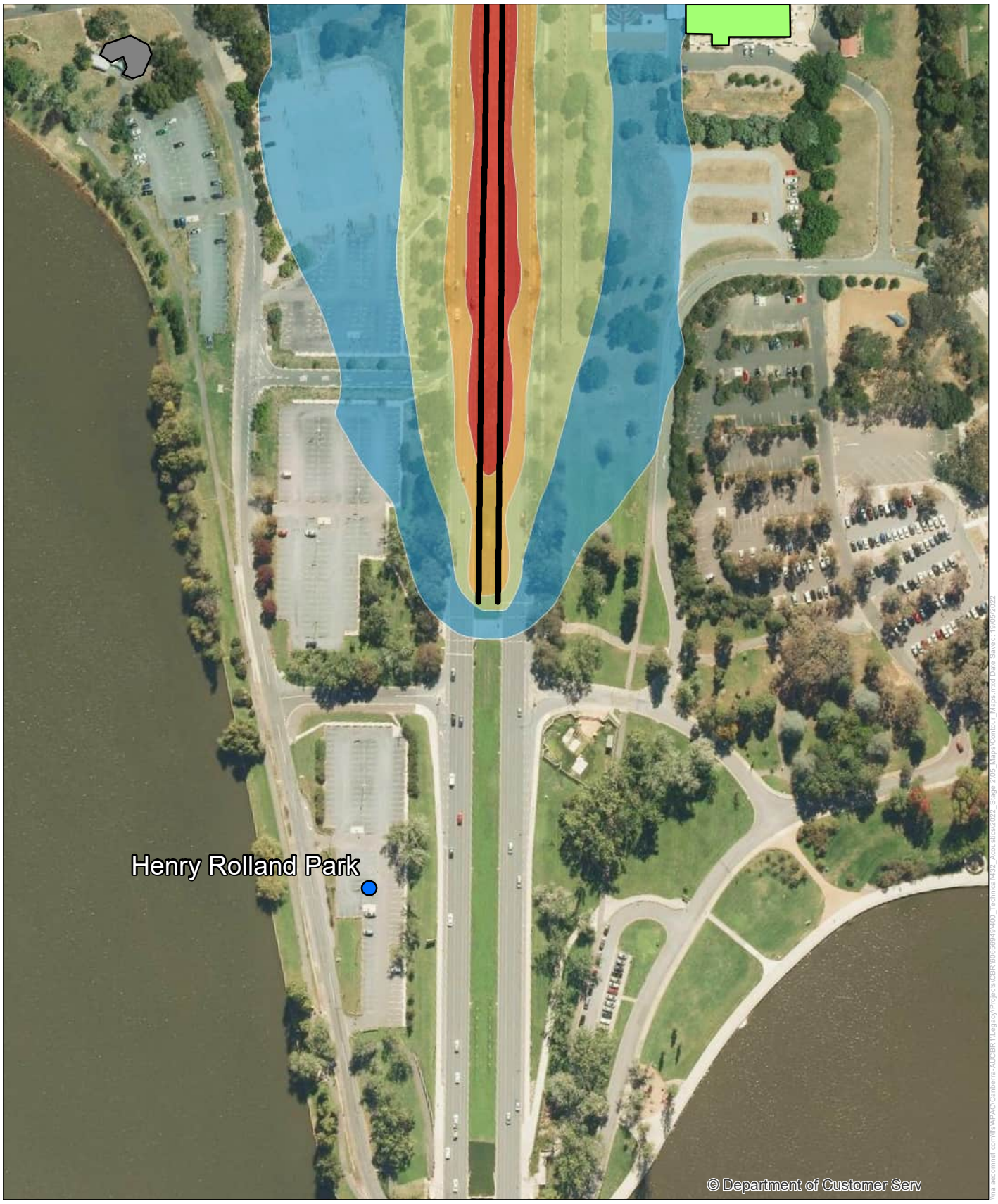
AECOM

Legend

- Non-residential Receiver
- Residential
- Commercial/Other

Sound Pressure Level, $L_{Aeq,15hr}$, dB(A)

45 50 55 60



Canberra Light Rail - Stage 2A

Daytime $L_{Aeq,15hr}$ Noise Levels

N

0 30 60 Meters

AECOM

Legend

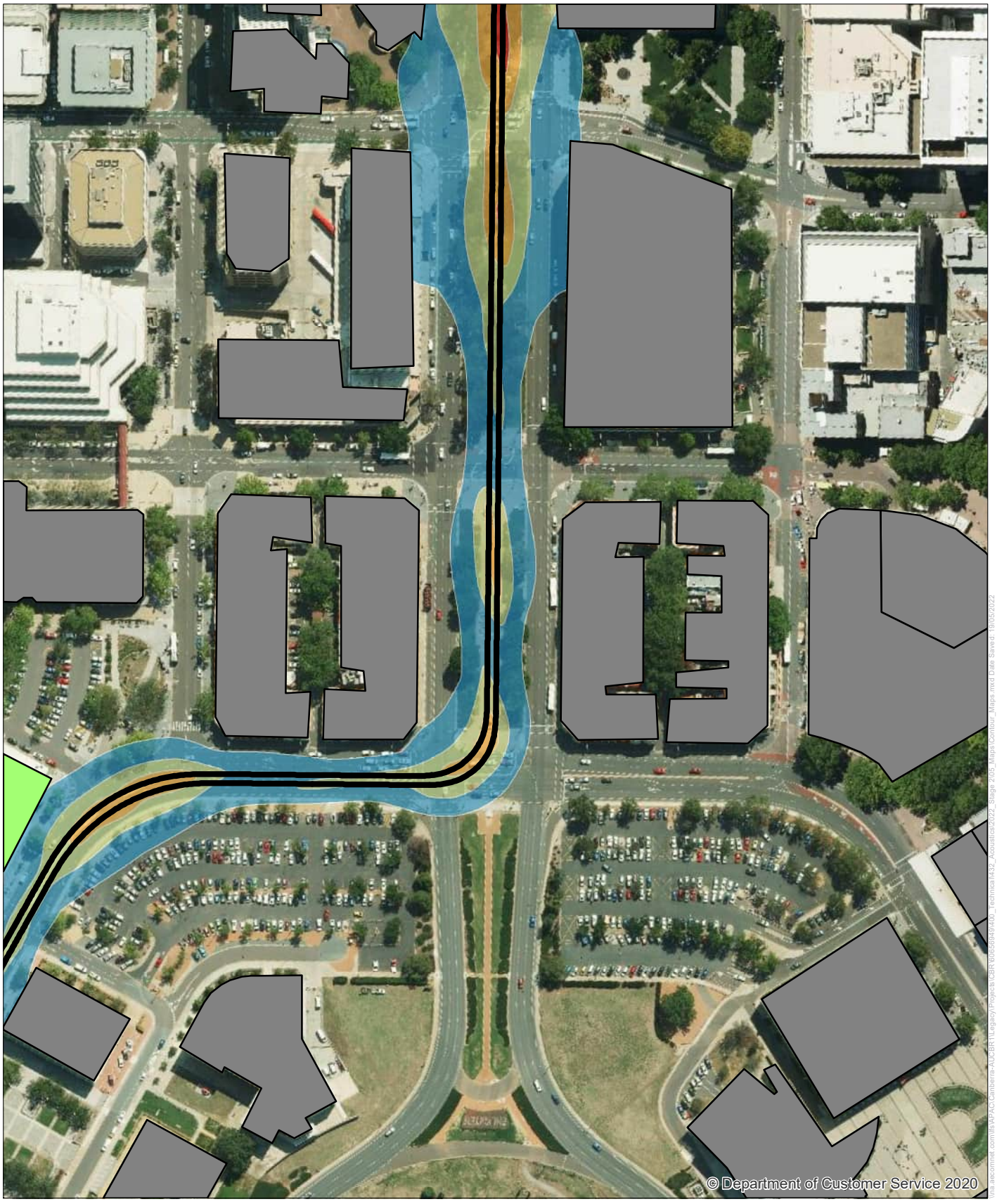
Non-residential Receiver

Residential

Commercial/Other

Sound Pressure Level, $L_{Aeq,15hr}$, dB(A)

45 50 55 60



Canberra Light Rail - Stage 2A

Night-time $L_{Aeq,9hr}$ Noise Levels

N

0 30 60 Meters

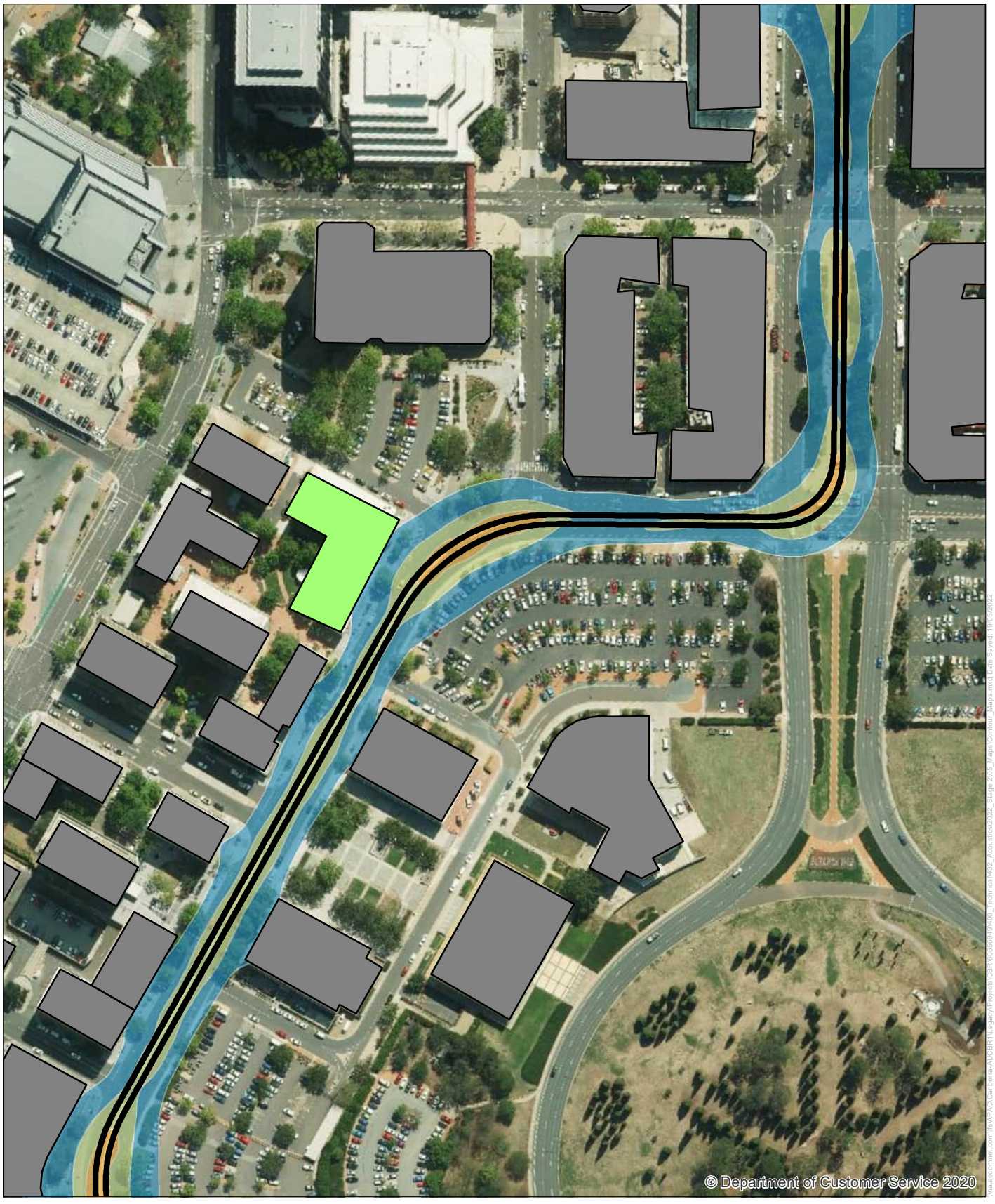
AECOM

Legend

- Non-residential Receiver
- Residential
- Commercial/Other

Sound Pressure Level, $L_{Aeq,9hr}$, dB(A)

45 50 55 60



Canberra Light Rail - Stage 2A

Night-time $L_{Aeq,9hr}$ Noise Levels

N

0 30 60 Meters

AECOM

Legend

- Non-residential Receiver
- Residential
- Commercial/Other

Sound Pressure Level, $L_{Aeq,9hr}$, dB(A)

45 50 55

Canberra Light Rail - Stage 2A

Night-time $L_{Aeq,9hr}$ Noise Levels

N

0 30 60 Meters

AECOM

Legend

- Non-residential Receiver
- Residential
- Commercial/Other

Sound Pressure Level, $L_{Aeq,9hr}$, dB(A)

45 50 55

Canberra Light Rail - Stage 2A

Night-time $L_{Aeq,9hr}$ Noise Levels

N

0 30 60 Meters

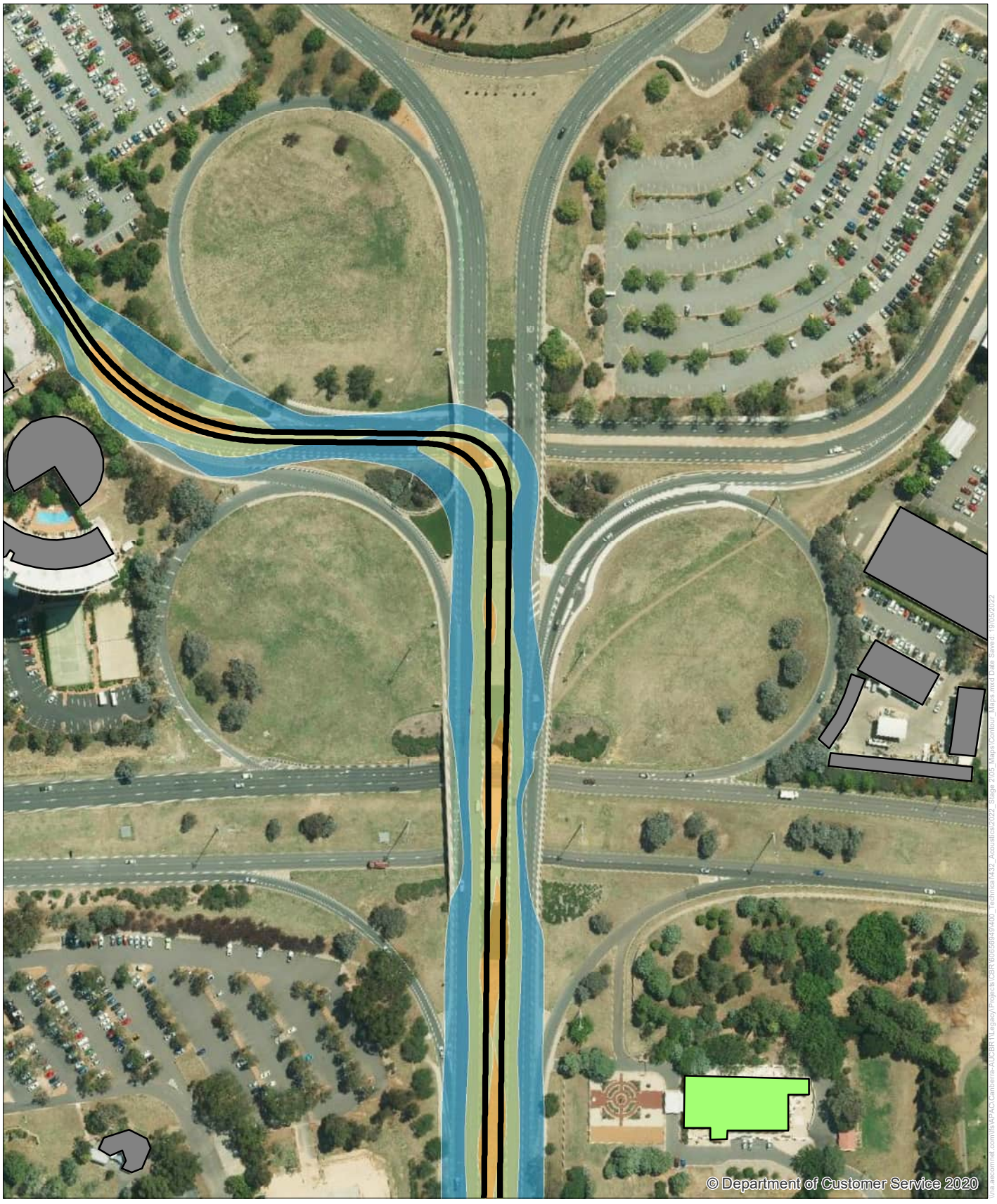
AECOM

Legend

- Non-residential Receiver
- Residential
- Commercial/Other

Sound Pressure Level, $L_{Aeq,9hr}$, dB(A)

45 50 55



Canberra Light Rail - Stage 2A

Night-time $L_{Aeq,9hr}$ Noise Levels

N

0 30 60 Meters

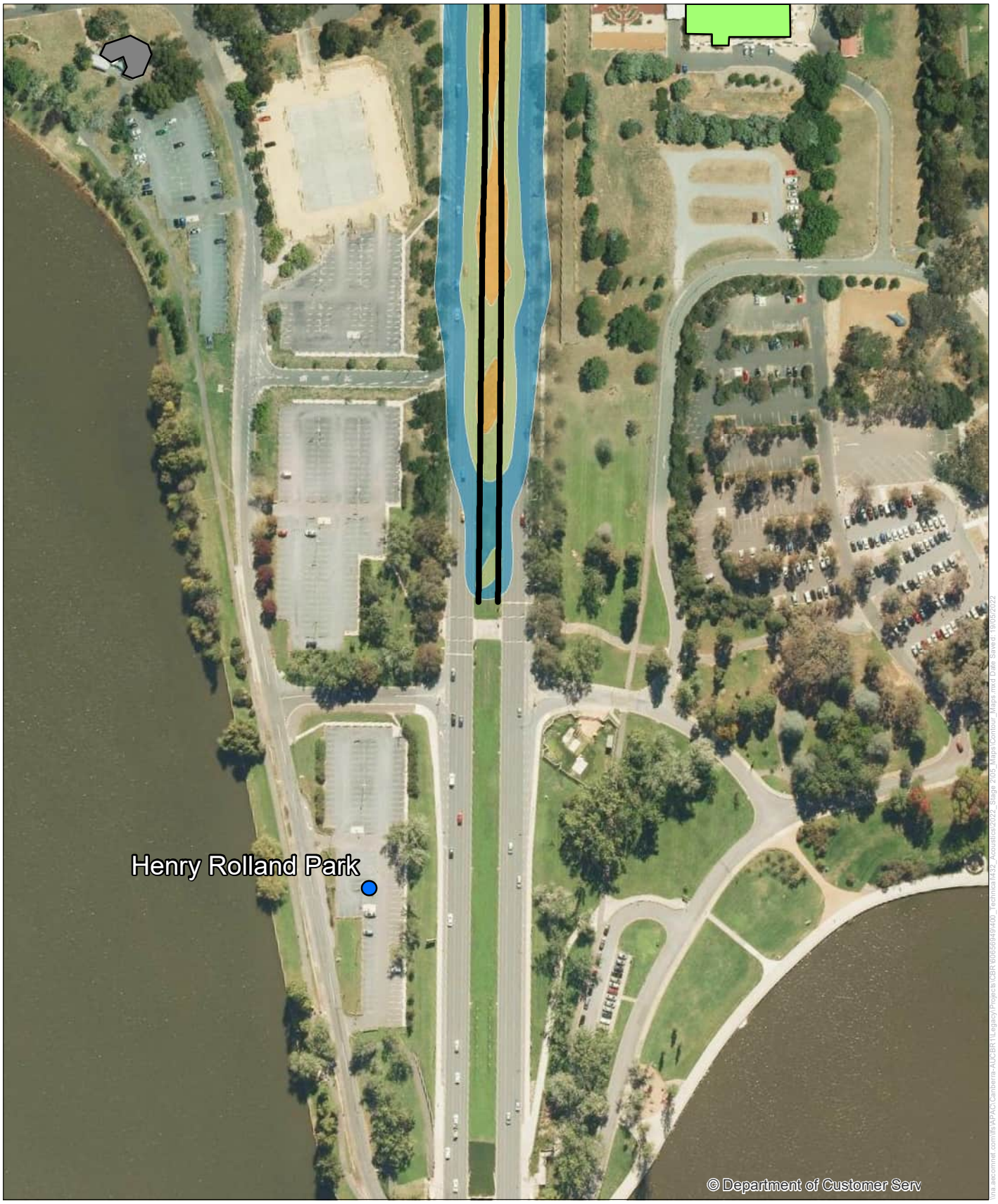
AECOM

Legend

- Non-residential Receiver
- Residential
- Commercial/Other

Sound Pressure Level, $L_{Aeq,9hr}$, dB(A)

45 50 55



Canberra Light Rail - Stage 2A

Night-time $L_{Aeq,9hr}$ Noise Levels

N

0 30 60 Meters

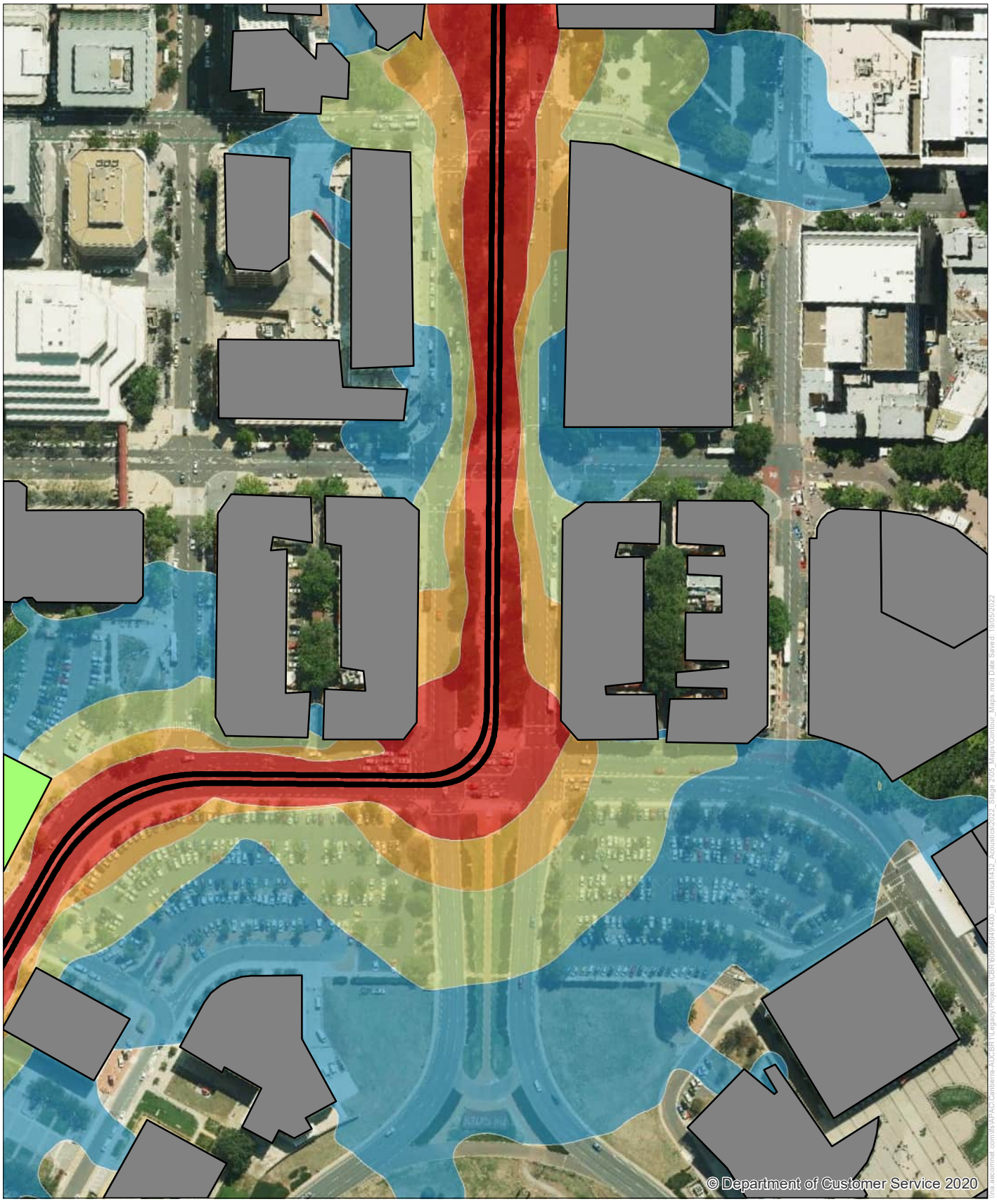
AECOM

Legend

- Non-residential Receiver
- Residential
- Commercial/Other

Sound Pressure Level, $L_{Aeq,9hr}$, dB(A)

45 50 55



Canberra Light Rail - Stage 2A

L_{Amax} Noise Levels

N

0 30 60 Meters

AECOM

Legend

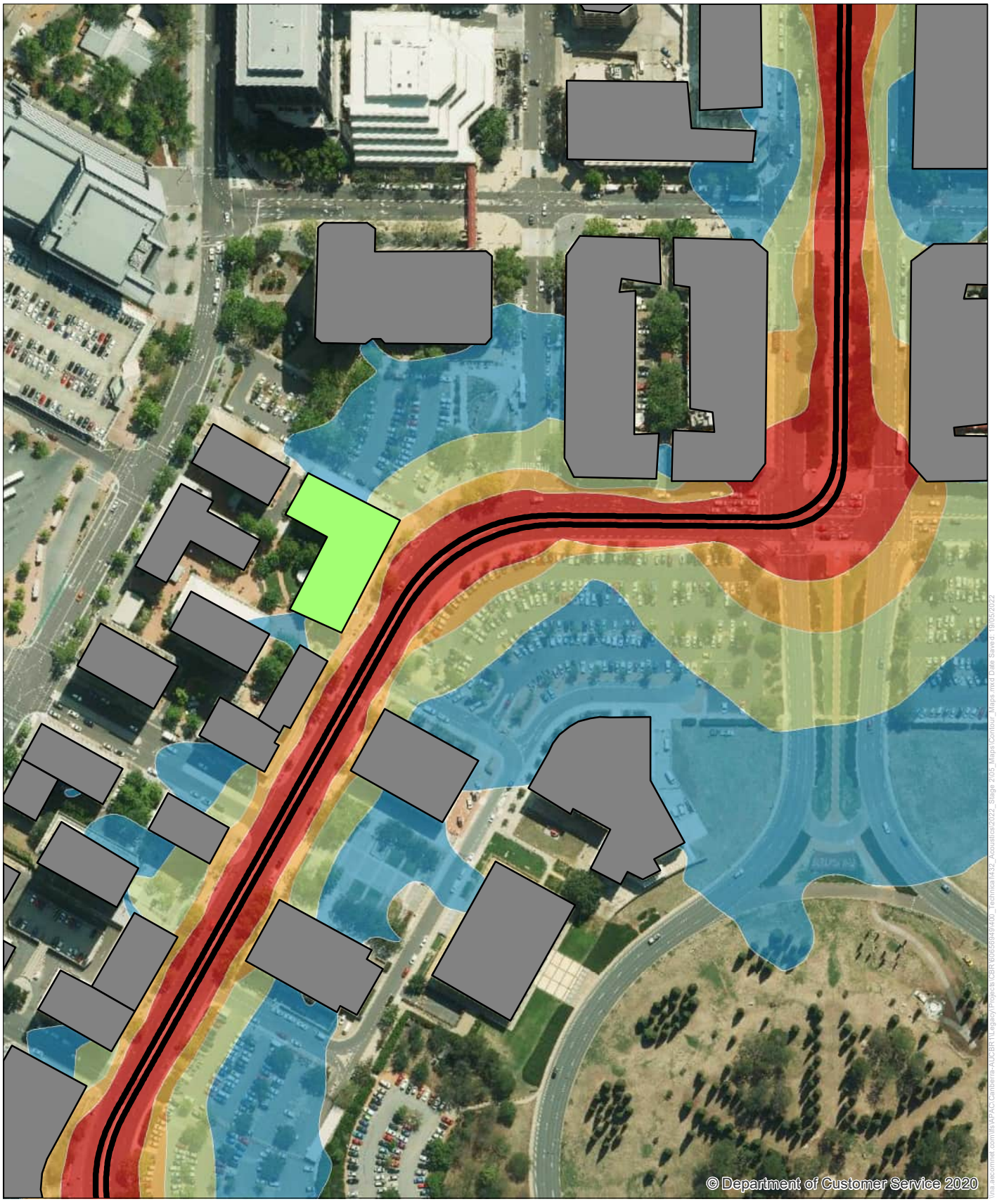
Non-residential Receiver

Residential

Commercial/Other

Sound Pressure Level, L_{Amax}, dB(A)

65 70 75 80



Canberra Light Rail - Stage 2A

L_{Amax} Noise Levels

N

0 30 60 Meters

AECOM

Legend

- Non-residential Receiver
- Residential
- Commercial/Other

Sound Pressure Level, L_{Amax}, dB(A)

65 70 75 80

Canberra Light Rail - Stage 2A

L_{Amax} Noise Levels

N

0 30 60 Meters

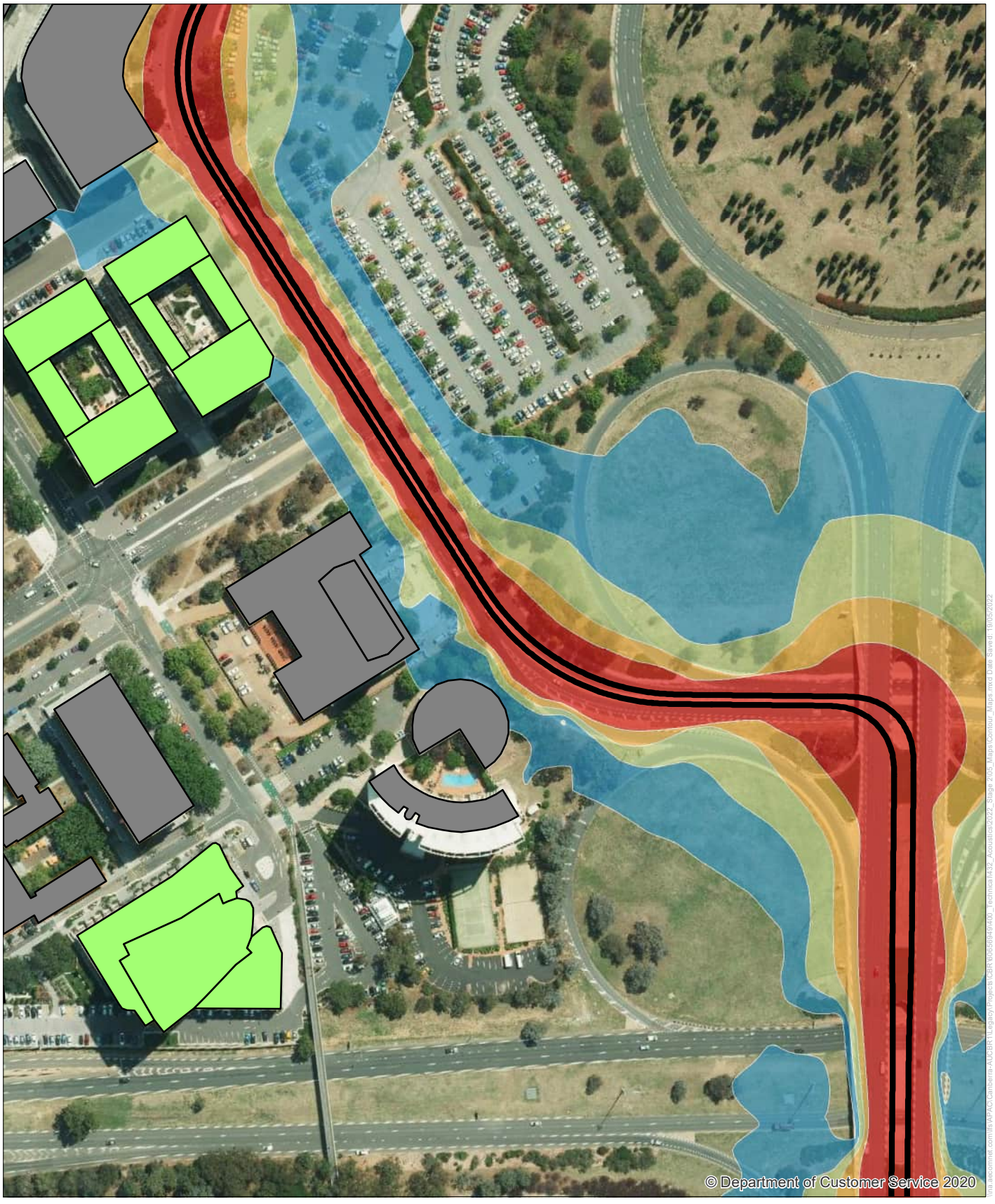
AECOM

Legend

- Non-residential Receiver
- Residential
- Commercial/Other

Sound Pressure Level, L_{Amax}, dB(A)

65 70 75 80



Canberra Light Rail - Stage 2A

L_{Amax} Noise Levels

N

0 30 60 Meters

AECOM

Legend

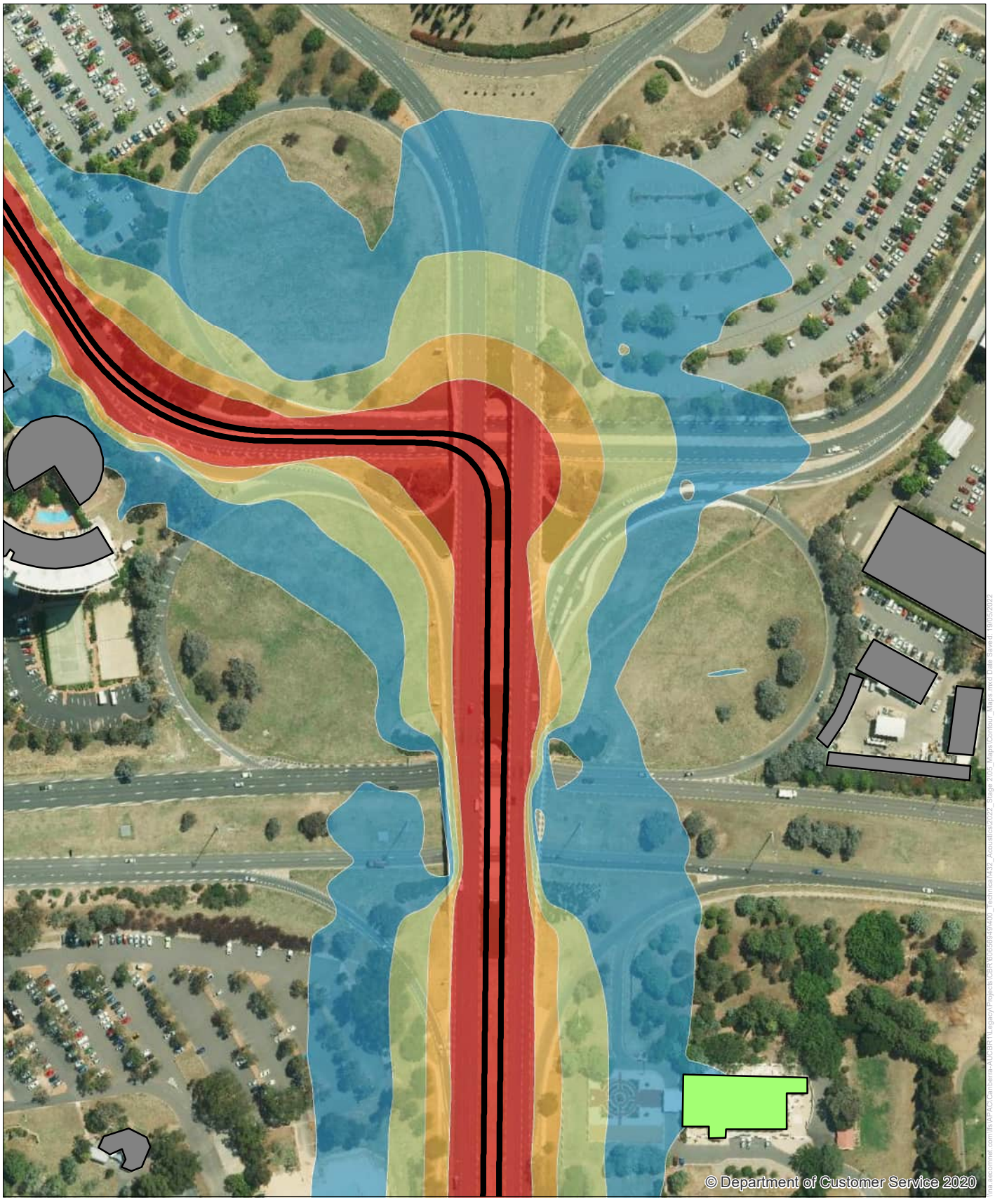
Non-residential Receiver

Residential

Commercial/Other

Sound Pressure Level, L_{Amax}, dB(A)

65 70 75 80



Canberra Light Rail - Stage 2A

L_{Amax} Noise Levels

N

0 30 60 Meters

AECOM

Legend

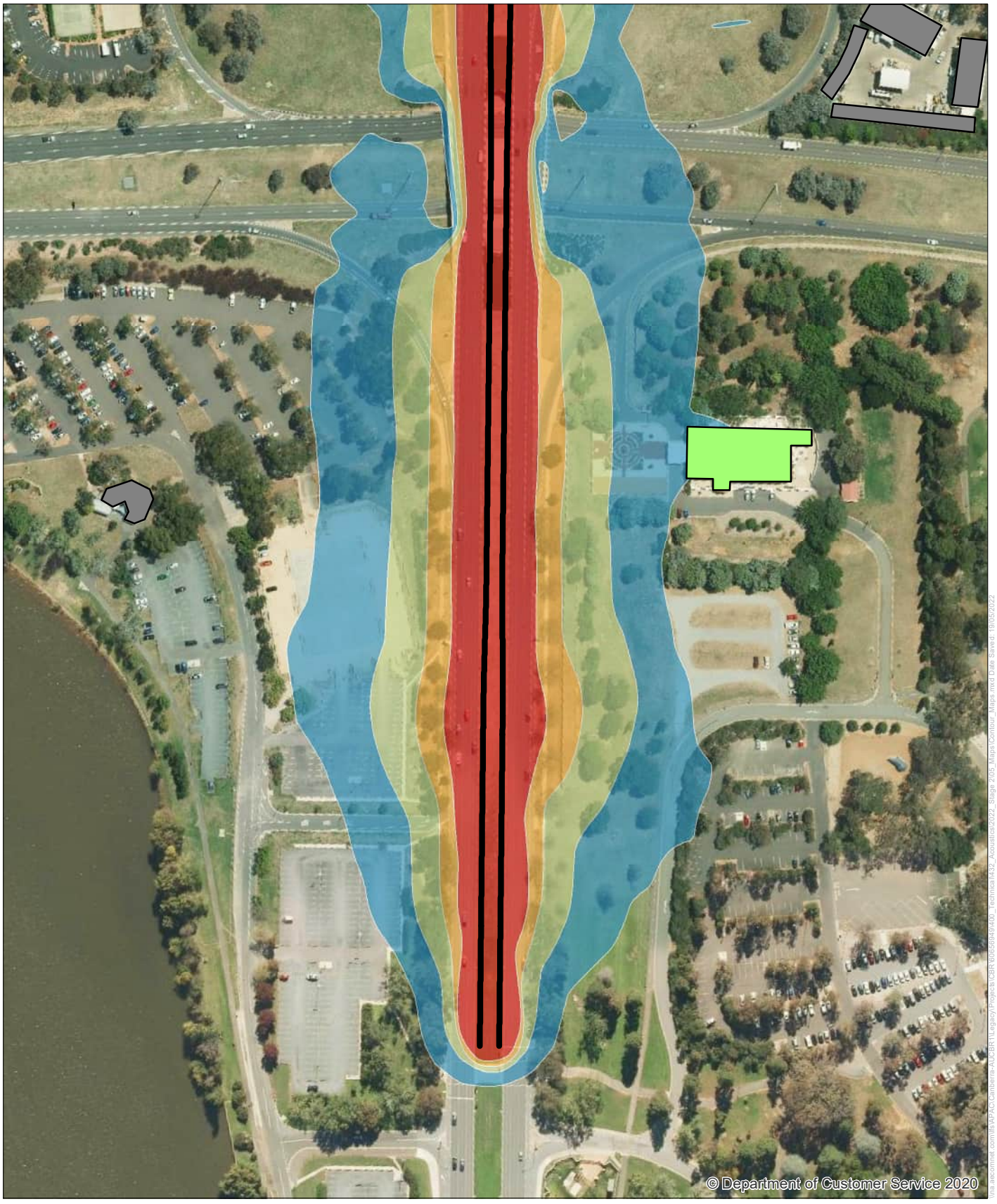
Non-residential Receiver

Residential

Commercial/Other

Sound Pressure Level, L_{Amax}, dB(A)

65 70 75 80



Canberra Light Rail - Stage 2A

L_{Amax} Noise Levels

N

0 30 60 Meters

AECOM

Legend

Non-residential Receiver

Residential

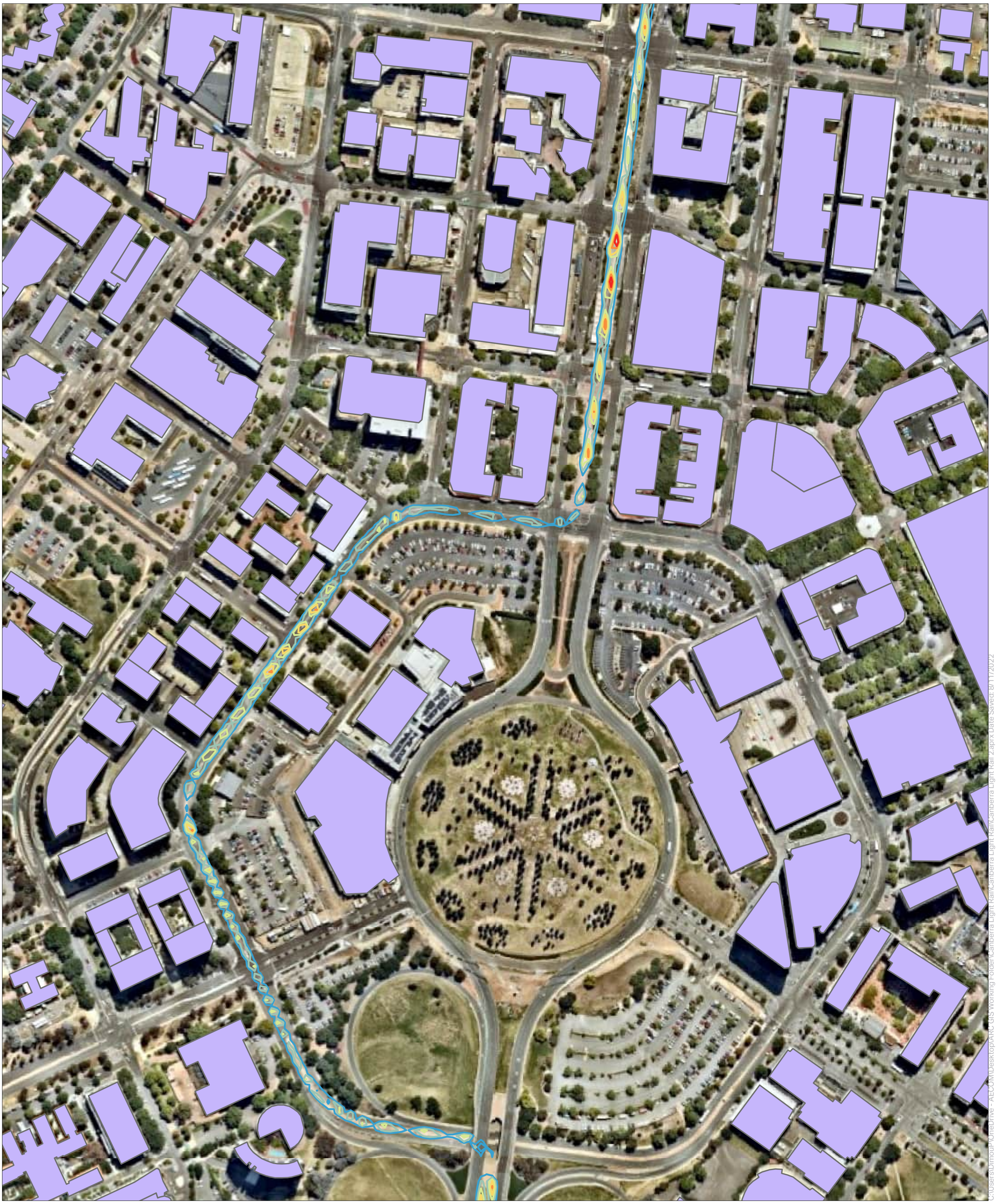
Commercial/Other

Sound Pressure Level, L_{Amax}, dB(A)

65 70 75 80

Appendix G

Operational light rail ground-borne L_{Aeq} contour maps



CLR2A - Operational Ground-borne Noise

N

0 60 120 Meters

Ground-borne noise L_{Aeq} dB

20 25 30 35 40 45

CLR2A - Operational Ground-borne Noise

Ground-borne noise L_{Aeq} dB

20 25 30 35 40 45

N

0 60 120 Meters

AECOM

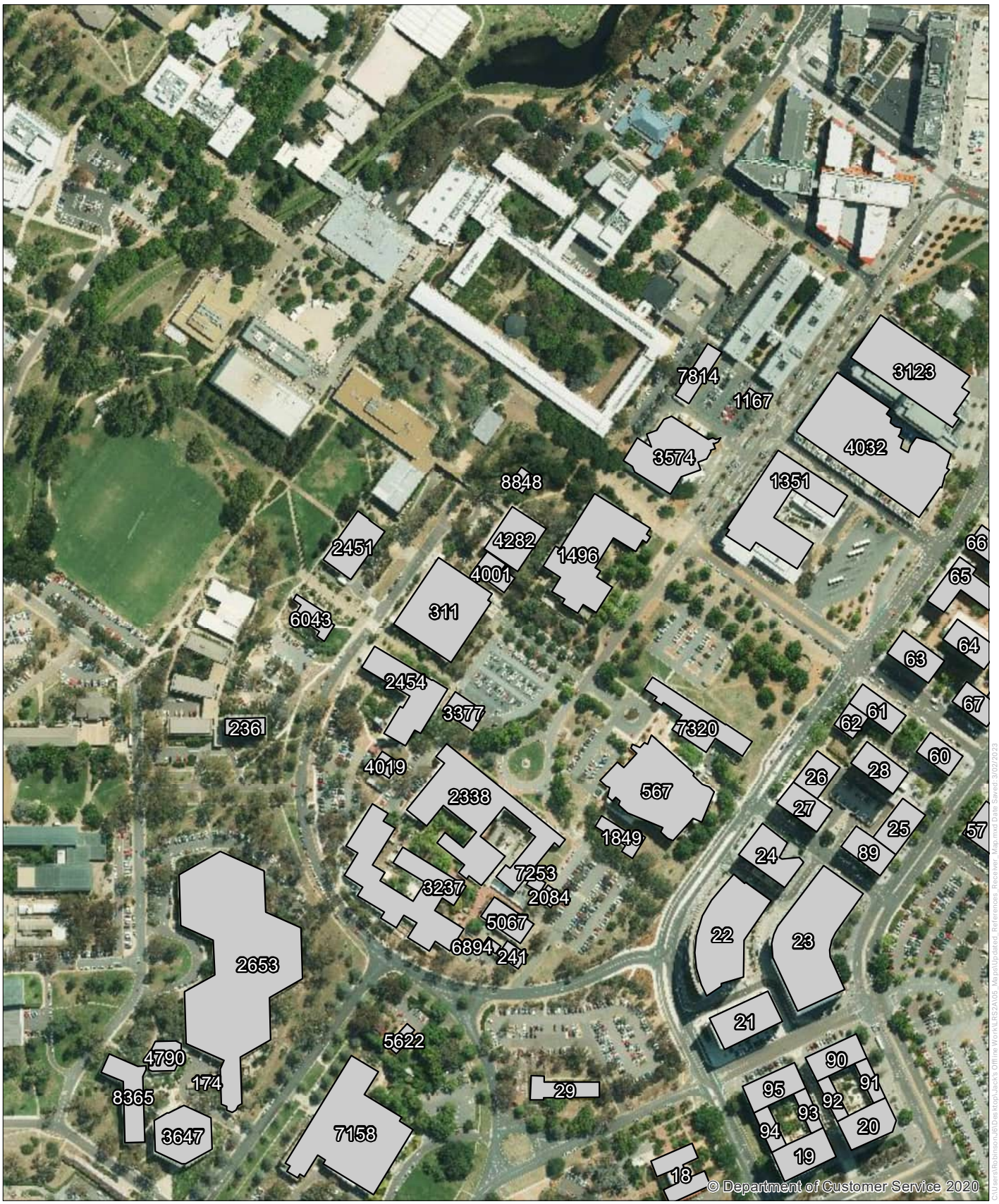
Appendix H

Operational traffic predicted noise levels

ID	Use	Worst affected façade	Criterion	Predicted Noise Levels LAeq(period) dB(A) - Design Year (2036)			Exceeds Criterion?
				2026 'No Build'	2036 'Build'	Change	
8	Residential	S	65	68	67	-0.7	Yes
9	Residential	NE	64	64	63	-0.8	No
12	Residential	E	65	68	68	0	Yes
13	Residential	NE	63	63	63	-0.1	No
14	Residential	SE	65	66	66	-0.1	Yes
19	Residential	SE	65	66	66	0.4	Yes
20	Residential	SE	65	66	66	0.2	Yes
77	Residential	W	62	62	62	-0.6	No
86	Residential	SW	60	58	58	-0.3	No
90	Residential	NE	64	64	64	-0.6	No
91	Residential	NE	64	64	64	-0.6	No
92	Residential	SW	58	53	53	0.3	No
93	Residential	NE	56	51	52	0.5	No
94	Residential	SW	64	64	65	1.2	Yes
95	Residential	SW	64	64	65	1.2	Yes
985	Residential	SW	38	33	33	-0.3	No
989	Residential	SE	56	51	52	0.2	No
2191	Residential	SW	55	50	50	-0.2	No
2389	Residential	SW	44	39	39	-0.1	No
3088	Residential	S	55	50	50	-0.1	No
3562	Residential	SW	41	36	35	-0.2	No
3719	Residential	S	40	35	34	-0.2	No
4409	Residential	NE	49	44	44	0	No
4529	Residential	SE	51	46	46	0	No
5055	Residential	SW	41	36	35	-0.2	No
5348	Residential	SE	58	53	53	0	No
5743	Residential	SW	39	34	34	-0.4	No
6207	Residential	SW	56	51	51	0	No
6656	Residential	NE	38	33	33	-0.4	No
6786	Residential	E	55	50	50	0	No
6932	Residential	NW	38	33	33	-0.4	No
7473	Residential	SE	51	46	46	-0.1	No
7867	Residential	E	51	46	46	0	No
8484	Residential	SW	38	33	33	-0.3	No
8494	Residential	SW	45	40	40	-0.1	No
8790	Residential	S	61	61	60	-0.1	No
9198	Residential	SE	52	47	47	-0.1	No

Appendix I

Operational traffic receiver locations map

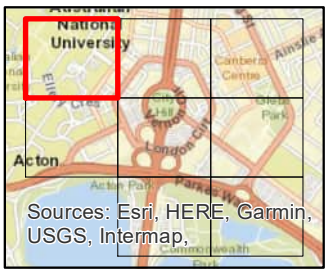


CLR Stage 2A - Assessed Noise Receivers

N

0 0.06 0.12 km

AECOM



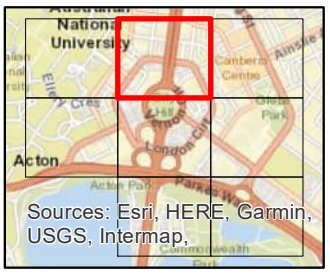
Assessed Receiver

CLR Stage 2A - Assessed Noise Receivers

N

0 0.06 0.12 km

AECOM



Assessed Receiver

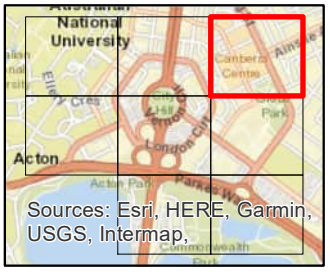
C:\Users\RobinsonJ6\Desktop\Jacks Offline Work\LRS2A\05_Maps\Updated_References_Receiver_Map.mxd Date Saved: 3/02/2023

CLR Stage 2A - Assessed Noise Receivers

N

0 0.06 0.12 km

AECOM



Assessed Receiver

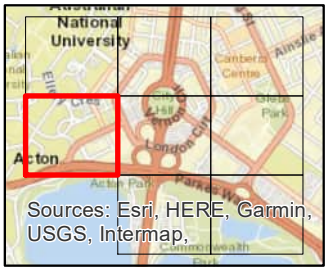
C:\Users\RobinsonJ6\Desktop\Jacks Offline Work\ULRS2A\05_Maps\Updated_References_Receiver_Map.mxd Date Saved: 3/02/2023

CLR Stage 2A - Assessed Noise Receivers

N

0 0.06 0.12 km

AECOM



Assessed Receiver

CLR Stage 2A - Assessed Noise Receivers

N

0 0.06 0.12 km

AECOM

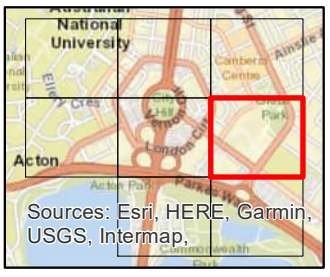
Assessed Receiver

CLR Stage 2A - Assessed Noise Receivers

N

0 0.06 0.12 km

AECOM



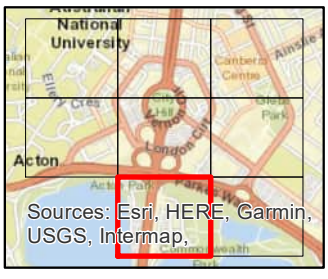
Assessed Receiver

CLR Stage 2A - Assessed Noise Receivers

N

0 0.06 0.12 km

AECOM



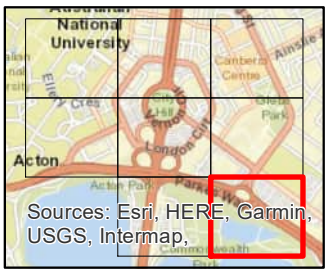
Assessed Receiver

CLR Stage 2A - Assessed Noise Receivers

N

0 0.06 0.12 km

AECOM



Assessed Receiver

C:\Users\RobinsonJ6\Desktop\Jacks Offline Work\LRS2A\05_Maps\Updated_References_Receiver_Map.mxd Date Saved: 3/02/2023

Appendix J

Out of Hours Works Plan

Out of Hours Works Plan #0001

Key Contacts (name, position, mobile number and email)

Supervisor	
Engineering	
Environment	
Communications	

Scope of Out of Hours Works

Location (Map at Appendix A)	
Justification for OoHW	
Activities to be Undertaken	
Construction Equipment	
Relevant TTMP/s	
Dates, Times and expected Duration	

Qualitative Noise and Vibration Assessment

Sensitive Receivers

Identified sensitive receivers[1] (Map at Appendix A)	

Pre-mitigation noise impacts

Noise source (Plant or equipment including size)	**Will be used during works?**		**Noise heard at sensitive receivers**		
		Is the noise loud, in absolute terms, or relative to other noises in the area?	Does the noise include tones or impulses? *(Tonal noise commonly has a prominent frequency and single pitch e.g. reversing beepers, alarms, grinding metal, screeching of mechanical plant. Impulse noises are short sharp discrete noise events such as bangs, clicks or thumps.)*	Sound Pressure Level, dB(A) at approximately 10m.	Does the noise occur at times that interfere with sleep or comfort?
Commonly used plant/equipment on the project:					
Vac Truck	☐				
Road Saw	☐				
Telehandler	☐				
Lighting Towers	☐				
Light Vehicles	☐				
MR Trucks	☐				
Excavator	☐				
HR Trucks	☐				
Compaction Equipment	☐				
Roller	☐				
Asphalt paver	☐				
Line marking truck	☐				
Tipper truck	☐				
Concrete Pumps	☐				
Concrete Vibrators	☐				
OTHER [please insert below]					
	☐				
	☐				
	☐				
	☐				

[1] Sensitive receivers include residential (including hotels and motels etc.), education institutions (schools, child-care centres etc.), places of worship, outdoor recreation areas). Commercial and industrial receivers are not considered sensitive to airborne noise impacts.

Mitigation measures

	No	Yes
Part C - Are the proposed OoHW with implementation of mitigation measures likely exceed the applicable noise goals?	☐	☐

Contingencies

In certain circumstances, alternative work methodologies may require consideration during the course of out of hours works. Where alternative work methodologies do not materially change the nature of the impacts (noise, light spill, access etc), and at the discretion of the Site Supervisor, these alternative work methodologies may be used, provided they are documented below:

Alternative work method	Reason	Site Supervisor Sign-off

Other Information

If the works were requested to be conducted out of normal woring hours by MPC or another ACT Government dept please provide details of that request below.

Date Received	Nature of the Request	Response

Consultation with Affected Receivers and Stakeholders (SPR31 5.2.2)

Please include detail of the communications activities proposed to be undertaken and include a draft copy of the notification at Appendix B:

Comments:

In addition please answer the following questions:

	No	Yes
Part D - Are the proposed works complex or potentially contentious or work that includes major road closures, disruptions to major events, removal of trees or pollution?	☐	☐
Part E – Has the Territory directed that an issues-specific Communications Action Plan be developed?	☐	☐

Traffic Management

	No	Yes
Part F – Do the works require any temporary traffic management arrangements?	☐	☐
Part G – (If yes to Part F): Have the works been through the Traffic and Transport Liaison Group (TTLG) submission process?	☐	☐
Part H – (If yes to Part G): Are required Temporary Traffic Management Plans (TTMPs) approved by Roads ACT?	☐	☐
Part I – do the works require major diversions or lane closures that may affect action buses or other ACT stakeholders	☐	☐
Comments:		

Out of Hours Works Approval

	Approved	Signature	Name	Approval Date
(Contractor) Environment Manager (or delegate)	☐			
(Contractor) Communications and Stakeholder Manager (or delegate)	☐			
(Contractor) Deputy Project Director (or delegate)	☐			
Territory Representative (or delegate)	☐			

Conditions for Out of Hours Works Approval

1.

Appendix A

Out of Hours Works location and potentially affected sensitive receivers

Appendix B

Community and Stakeholder Notifications and Information